U. S. Geological Survey
U. S. Bureau of Mines

MINERAL COMMODITY SUMMARIES 1996

ALUMINUM	FLUORSPAR	MANUFACTURED ABRASIVES	SELENIUM
ANTIMONY	GALLIUM	MERCURY	SILICON
ARSENIC	GARNET	MICA	SILVER
ASBESTOS	GEMSTONES	MOLYBDENUM	SODA ASH
BARITE	GERMANIUM	NICKEL	SODIUM SULFATE
BAUXITE	GOLD	NITROGEN	STONE
BERYLLIUM	GRAPHITE	PEAT	STRONTIUM
BISMUTH	GYPSUM	PERLITE	SULFUR
BORON	HAFNIUM	PHOSPHATE ROCK	TALC
BROMINE	HELIUM	PLATINUM	TANTALUM
CADMIUM	ILMENITE	POTASH	TELLURIUM
CEMENT	INDIUM	PUMICE	THALLIUM
CESIUM	IODINE	QUARTZ CRYSTAL	THORIUM
CHROMIUM	IRON ORE	RARE EARTHS	TIN
CLAYS	IRON AND STEEL	RHENIUM	TITANIUM
COBALT	KYANITE	RUBIDIUM	TUNGSTEN
COLUMBIUM	LEAD	RUTILE	VANADIUM
COPPER	LIME	SALT	VERMICULITE
DIAMOND	LITHIUM	SAND AND GRAVEL	YTTRIUM
DIATOMITE	MAGNESIUM	SCANDIUM	ZINC
FELDSPAR	MANGANESE		ZIRCONIUM

This report is the earliest Government publication to furnish estimates covering 1995 nonfuel mineral industry data. Most of the estimates are based on at least 6 months data. These data sheets contain information on the domestic industry structure, Government programs, tariffs, and 5-year salient statistics for over 90 individual minerals and materials. Most data are rounded to no more than 3 significant figures.

January 1996

Although the U.S. Bureau of Mines has been abolished, the Minerals Information functions, which prepared this report, are being transferred to the U.S. Geological Survey, Reston, Virginia.

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General:

Commodities:

INSTANT INFORMATION

In an effort to facilitate the rapid dissemination of information and publications on minerals and materials, two electronic document dissemination systems are now available for use. One, MINES FaxBack, is a simple-to-operate automated fax response system that operates 24 hours a day, seven days a week. A user needs access to a fax machine with a touch-tone telephone. After calling MINES FaxBack, the requester is guided by a series of voice messages to assist in ordering the desired documents. Information on approximately 90 commodities, 50 States, and 180 countries is now available on MINES FaxBack. MINES FaxBack can be accessed by calling (703) 648-4999, using the touch-tone telephone attached to the user's fax machine.

The second system, MINES-DATA, is a computer bulletin board system that makes Mineral Industry Surveys reports available in electronic form, as computer files. A user needs access to a personal computer with a modem and standard communications software. Information on 33 commodities is now available on MINES-DATA. MINES-DATA can be accessed by calling (703) 648-7796. Further information on how to use MINES-DATA may be obtained from the system operator by calling (703) 648-4750.

KEY PUBLICATIONS

Minerals Yearbook—Annual publications that review the mineral industry of the United States and foreign countries. Contains statistical data on materials and minerals and includes information on economic and technical trends and developments. The Yearbook is published in three volumes: Volume I, Metals and Minerals; Volume II, Area Reports, Domestic; and Volume III, Area Reports, International.

Mineral Industry Surveys—Periodic statistical and economic reports 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, depending on the need for current data. (See Annual Reviews below.)

Annual Reviews—Yearly Mineral Industry Surveys covering the individual commodities, states, and countries appearing in the *Minerals Yearbook*.

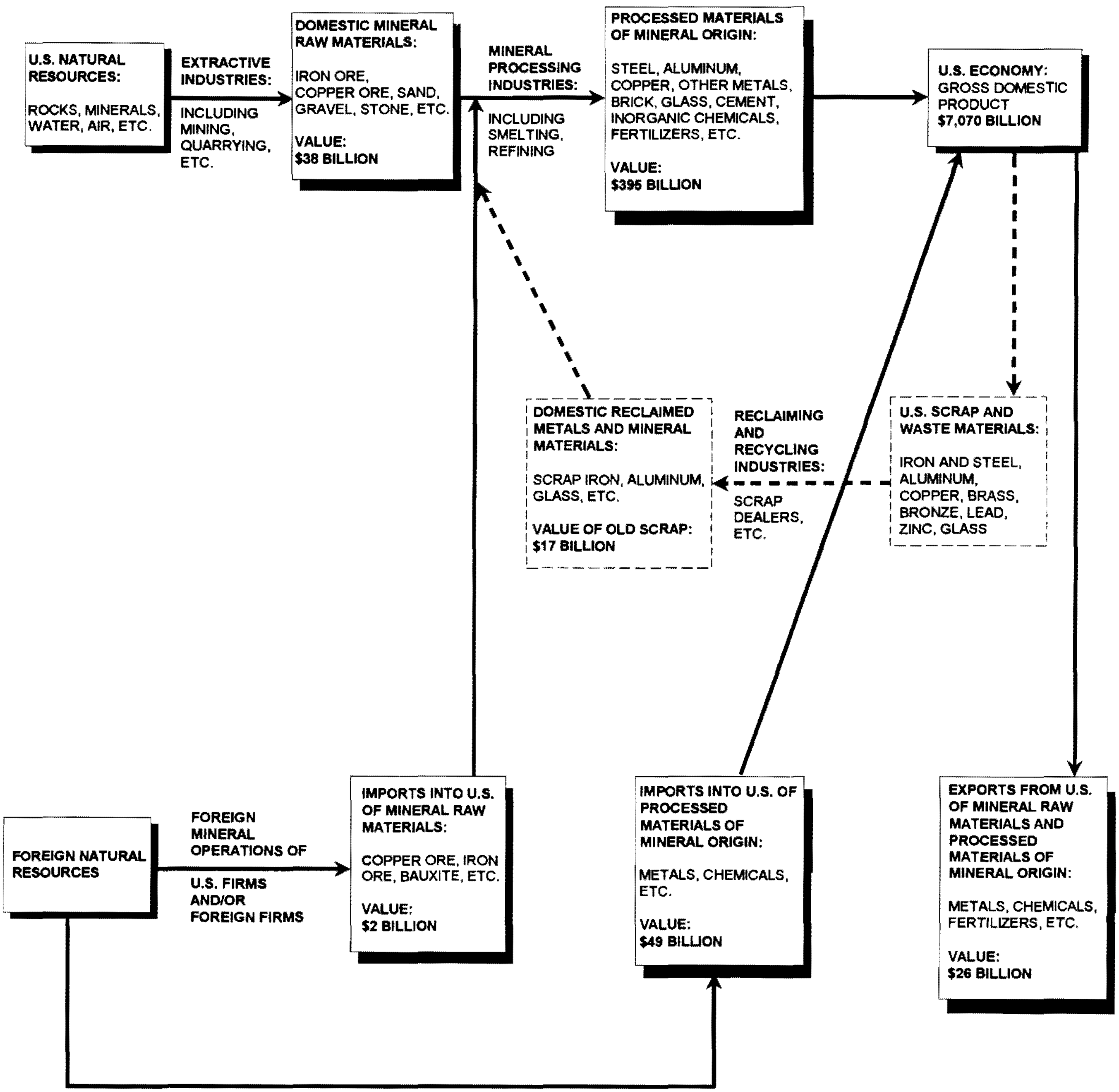
Mineral Perspectives—Reports that present timely data on mineral developments in foreign geographic areas.

WHERE TO OBTAIN PUBLICATIONS

- *Mineral Industry Surveys* can be obtained free of charge by calling (412) 892-4412.
- Special studies such as *Mineral Commodity Summaries* and *Mineral Perspectives* are sold by the U.S. Government Printing Office, Washington, D.C.

THE ROLE OF NONFUEL MINERALS IN THE U.S. ECONOMY

(ESTIMATED VALUES IN 1995)



1995 U.S. NET IMPORT RELIANCE FOR SELECTED NONFUEL MINERAL MATERIALS

COMMODITY	PERCENT	MAJOR SOURCES (1991-94)
ARSENIC	100	China, Chile, Mexico
COLUMBIUM (niobium)	100	Brazil, Canada, Germany
GRAPHITE (natural)	100	Mexico, Canada, China, Madagascar, Brazil
MANGANESE	100	South Africa, Gabon, France, Brazil
MICA, sheet (natural)	100	India, Brazil, Finland, China
STRONTIUM (celestite)	100	Mexico, Germany
THALLIUM	100	Belgium, Canada, United Kingdom
YTTRIUM	100	China, United Kingdom, Hong Kong, Japan, France
BAUXITE and ALUMINA	99	Australia, Jamaica, Guinea, Brazil
GEMSTONES	98	Israel, India, Belgium, United Kingdom
FLUORSPAR	92	China, South Africa, Mexico
TUNGSTEN	87	China, Germany, Bolivia, Peru
TIN	84	Brazil, Bolivia, Indonesia, China
COBALT	82	Zambia, Norway, Canada, Zaire, Finland
TANTALUM	80	Australia, Germany, Canada, Thailand
CHROMIUM	78	South Africa, Turkey, Zimbabwe, Russia, Finland
POTASH	74	Canada, Belarus, Germany, Israel, Russia
BARITE	65	China, India, Mexico
IODINE	62	Japan, Chile
NICKEL	61	Canada, Norway, Australia, Dominican Republic
ANTIMONY	60	China, Mexico, South Africa, Hong Kong
STONE (dimension)	57	Italy, Spain, India, Canada
PEAT	55	Canada
MAGNESIUM COMPOUNDS	50	China, Canada, Mexico, Greece, Austria
ASBESTOS	46	Canada
ZINC	41	Canada, Mexico, Peru, Spain
DIAMOND (dust, grit & powder)	36	Ireland, China, Russia
SELENIUM	33	Canada, Philippines, Japan, Belgium, United Kingdom
SILICON	33	Norway, Brazil, Canada, Russia
GYPSUM	30	Canada, Mexico, Spain
PUMICE	29	Greece, Zaire, Turkey, Ecuador
ALUMINUM	25	Canada, Russia, Venezuela, Brazil
CADMIUM	21	Canada, Mexico, Belgium, Germany
IRON and STEEL	21	European Union, Canada, Japan, Brazil, South Korea
NITROGEN (fixed), AMMONIA	20	Trinidad and Tobago, Canada, Former Soviet Union, Mexico
IRON ORE	18	Canada, Brazil, Venezuela, Australia, Mauritania
SULFUR	18	Canada, Mexico
CEMENT	17	Canada, Spain, Greece, Venezuela, Mexico
LEAD	15	Canada, Mexico, Peru, Australia
SALT	15	Canada, Mexico, Bahamas, Chile
SODIUM SULFATE	15	Canada, Mexico
VERMICULITE	15	South Africa
MICA, scrap and flake (natural)	10	Canada, India
PERLITE	8	Greece
COPPER	6	Canada, Chile, Mexico
RARE EARTHS	2	Australia
LIME	1	Canada, Mexico

Additional commodities for which there is some import dependency include:

Bismuth	Mexico, Belgium, China, Peru
Gallium	France, Germany, Russia, United Kingdom, Hungary
Germanium	United Kingdom, Belgium, Germany, China
Ilmenite	South Africa, Australia, Canada
Indium	Canada, France, Italy, Belgium, Russia
Iron and steel slag	Canada, Japan
Kyanite	South Africa, France
Mercury	Canada, Russia, Germany
Platinum	South Africa, United Kingdom, Belgium, Germany
Rhenium	Chile, Germany, United Kingdom, Russia, Kazakstan
Rutile	Australia, Sierra Leone, South Africa
Silver	Mexico, Canada, Peru, Chile
Thorium	Australia
Titanium (sponge)	Russia, Japan, China
Vanadium	Russia, South Africa, Canada, Mexico
Zirconium	Australia, South Africa

SIGNIFICANT EVENTS, TRENDS, AND ISSUES

The Mineral Sector of the U.S. Economy

The U.S. economy and, consequently, the demand for minerals grew at more moderate rates in 1995 compared with stronger performances the previous year. Demand for metals such as steel and copper was relatively stable. For example, the decline in steel consumed in motor vehicle manufacturing (reflecting lower vehicle sales) for the first half of 1995 was offset by an increase in steel consumed in construction during the same period. More detailed information on events, trends, and issues in the mineral and material sector is presented below and in the commodity sections that follow.

Overall Performance

The value of processed materials of mineral origin produced in the United States during 1995 was estimated to be $395 billion, an increase of almost 10% compared with 1994. The estimated value of U.S. raw nonfuel minerals production in 1995 was $38 billion, about 7% more than in 1994. The value of U.S. minerals production has increased in 30 of the last 35 years.

Total U.S. trade in raw minerals and processed materials of mineral origin was valued at $77 billion in 1995. Imports of processed mineral materials were valued at an estimated $49 billion, while exports of these materials were valued at an estimated $23 billion. Imports of metal ores and concentrates increased almost 12% to $1.4 billion and imports of raw industrial minerals rose 7% to $900 million. Raw minerals exports showed much greater variance, with metal ores and concentrates jumping 64% to $1.7 billion while raw industrial minerals exports increased by a more moderate 8% to $1.3 billion.

Demand for metals and other mineral-based materials used extensively in motor vehicle manufacturing declined slightly in 1995. Auto loan interest rates that increased more than 2% during the first half of 1995 and the recent shift from purchases of new to purchases of used vehicles were factors in the 2% decline in domestic car and light truck sales for the first three quarters of the year. This declining vehicle demand was interrupted by a large increase in August 1995 (comparable to year-earlier results) that was spurred by generous lease agreements and large cash rebates to reduce inventories. However, a month-long strike by union workers against operations of the Nation's largest automotive-carrier firm (accounting for one-third of U.S. cars and trucks transported to dealers), reduced September vehicle sales by as much as 50,000 cars (more than 4%). Auto firms that build cars and light trucks in the United States and Canada were expected to reduce fourth quarter production by more than 2% compared with the fourth quarter of the previous year. International monetary exchange rates continued to favor U.S. automobile manufacturers in 1995 (especially in relation to Japan). The motor vehicle manufacturing sector is a major consumer of other mineral-based materials as well as steel: chiefly aluminum, copper, lead, platinum-group metals, zinc, glass, and plastics.

The domestic construction industry provided for modest growth in minerals demand. The construction sector is the largest consumer of brick clay, cement, sand and gravel, and stone. Road construction expenditures in 1995 maintained the high levels of the last few years as a result of the 6-year Federal highway and mass transit program reauthorized in 1991. Large amounts of asphalt, cement, crushed stone, and sand and gravel are used in road-building. Apartment building construction, which jumped almost 60% in 1994 (largely resulting from a sharp increase in the construction of luxury apartments), grew an additional 10% in 1995. The apartment construction sector is a major consumer of brick clay, cement, sand and gravel, steel, and stone.

Responding to domestic and world demand for fertilizer nutrients, the domestic mineral fertilizer manufacturing sector operated at full capacity, which resulted in a strong demand for fixed nitrogen, phosphate rock, and sulfur. Although global fertilizer nutrient consumption increased substantially, crop yields at the farm level, where they are consumed, were lower because of adverse weather conditions in North America and other factors.

Key Events and Issues

The Uruguay Round of the General Agreements on Tariffs and Trade (GATT) became effective January 1, 1995. GATT rules, such as those which address market access affected by tariff and nontariff market barriers, are significant to U.S. minerals producers. For example, GATT Uruguay Round agreements eliminate tariffs (during a 10-year period) on steel imposed by the United States and its trading partners, including the European Union and Japan.

Legislation to reform the Mining Law of 1872 has been considered by the Congress and the Administration for the last several years; however, legislation to reform the Mining Law was not enacted in 1995. The Mining Law gives U.S. citizens and corporations the right to prospect

TABLE 1.—U.S. MINERAL INDUSTRY TRENDS

	1991	1992	1993	1994	1995[e]
Total mine production:[1]					
Metals	11,000	11,500	10,800	12,100	13,200
Industrial minerals	20,000	20,600	21,200	23,000	24,400
Coal	21,400	21,000	18,800	20,100	19,700
Employment:[2]					
Coal mining	110	103	86	90	86
Metal mining	44	42	40	39	42
Industrial minerals, except fuels	78	76	76	78	81
Chemicals and allied products	580	567	573	579	583
Stone, clay, and glass products	403	396	399	411	421
Primary metal industries	545	525	520	538	554
Average weekly earnings of production workers:[3]					
Coal mining	761	755	767	802	830
Metal mining	639	655	659	700	736
Industrial minerals, except fuels	531	550	585	611	639
Chemicals and allied products	602	625	639	654	675
Stone, clay, and glass products	474	490	506	526	536
Primary metal industries	563	587	611	641	639

[e]Estimated.

[1]Million dollars.

[2]Thousands of production workers.

[3]Dollars.

Sources: U.S. Bureau of Mines; U.S. Department of Energy, Energy Information Administration; U.S. Department of Labor, Bureau of Labor Statistics.

for certain minerals on particular Federal Lands and confers the right to file claims that permit the claimants to mine and sell minerals found. The Mining Law does not provide for a royalty payment to the Federal Government for minerals that are mined. Under the Mining Law, claimants also may apply for a patent that transfers ownership of minerals and mineral lands to the claimant.

The Administration and Congress addressed a number of environmental statutes during 1995 involving domestic mineral issues. These included the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); the Resource Conservation and Recovery Act (RCRA); the Clean Water Act (CWA); and the Clean Air Act (CAA). Efforts regarding RCRA and CERCLA took both environmental and economic concerns into consideration. Deliberations regarding reauthorization of pertinent statutes are expected to continue in 1996.

In Congress, the House approved a CWA reauthorization bill, which would revise and restrict the role of the U.S. Environmental Protection Agency (EPA) in wetlands programs and would change the approach used in managing storm water runoff. The Senate did not approve a reauthorization bill. A comprehensive safe drinking water bill was introduced in the House and was referred to the Subcommittee for Health and Environment. A Senate bill on safe drinking water was not introduced.

In May 1995, the EPA announced plans to develop a strategy to improve how it addresses environmental issues associated with hardrock mining. The strategy would cover future, current, inactive and abandoned mines, smelters, and associated facilities in the metal, phosphate, uranium, and industrial minerals sectors. It would use a multi-program/stakeholder, geographic approach. EPA stated that it intends "...to apply both regulatory and nonregulatory tools in a more effective manner, based upon clearly articulated goals..." and that the strategy "...should...help...avoid creating unfunded public liabilities with respect to hardrock mining sites." EPA will consult with stakeholders on the goals, objectives, and recommendations of this strategy to help ensure their input.[1]

In June 1995, EPA directed its regional offices to develop strategies for fiscal years 1996 and 1997 that focus its enforcement and compliance assistance resources on the primary nonferrous metals, petroleum refining, and dry cleaning industries, which have been identified as "national priority sectors" because of "...noncompliance histories, Toxic Release Inventory releases, and transregional impacts." In addition, the EPA regional offices must develop strategies for at least two "significant sectors" including mining, iron and basic steel products, coal-fired powerplants, agricultural practices, industrial organic chemicals, and plastic materials and synthetics.[2]

During 1995, the EPA continued to implement the 1990 Amendments to the CAA. It released the first 13 draft protocols under its "enhanced monitoring" program. These particular protocols address mineral processing. Under the "enhanced monitoring" program, owners and operators of sources of air emissions will be required to submit site-specific protocols with their applications for operating permits. EPA anticipates developing about 300 such protocols during the next 5 years. Mining and minerals processing operations are expected to be required to comply with the requirements of the "enhanced monitoring" program.

EPA also promulgated a final rule designed to reduce the quantity of emissions of lead compounds and other air toxics from secondary lead smelters. The final rule is estimated to reduce emissions from secondary lead smelters by about 1,400 metric tons per year. The implementation of this regulation is expected to result in an annual cost of $2.8 million, consisting of $1.9 million for installation of control devices and $0.9 million for monitoring, reporting, and record keeping.

EPA and the Chicago Board of Trade held the third annual acid rain allowance auction. The auction is part of EPA's program to reduce sulfur dioxide emissions by one-half, and gives powerplants, brokers, and private citizens the opportunity to buy and sell sulfur dioxide allowances.

In fiscal year 1995, the Defense Logistics Agency sold excess mineral materials valued at $414 million (See "Government Stockpile" in the commodity sections that follow). The Defense Production Act, which provides authority for priorities, allocations, and defense-related supply expansions, is expected to continue.

Outlook

The U.S. economy is expected to continue to grow at a moderate rate for the near term, providing a mild stimulus to the Nation's materials-consuming industries. Inflation is expected to remain low, thus permitting a continuance of low interest rates conducive to an expanding economy. Although motor vehicle sales have declined slightly from their 1994 peak, relatively strong sales can be expected to be maintained because of moderate auto loan interest rates and advantageous monetary exchange rates (especially in respect to Japan). The 6-year Federal highway and mass transit program reauthorized at yearend 1991 will continue to provide an impetus for consumption of stone, sand and gravel, and steel through 1997. The demand prospect for mineral fertilizer materials (e.g., fixed nitrogen, phosphate rock, potash, and sulfur) is expected to be robust in the coming year because low world grain and oilseed stocks should stimulate increased planting.

Significant International Events

The global economic restructuring of the past few years continued in 1995 as protectionist policies were replaced by investment incentives and by mining law and business reforms in recognition of the importance of natural resource development to the economic health of all countries. Lesser developed countries in South America, Africa, Central Eurasia, and Asia also encouraged domestic and foreign private investment in the development and ownership of mineral resources. North American companies shifted many of their operations from the United States and Canada, where they perceived a deteriorating business environment to countries world-wide that were seeking to attract international mining companies. According to a recent survey by the Natural Resources Industry Institute, North American precious-metal mining companies spent about 80% of their 1988 expenditures within the United States. Since 1992, however, only 39% of total expenditures were spent in the United States.[3]

The North American Free Trade Agreement (NAFTA) and Mexico's new investment law, both in their second year in 1995, prompted more participation by Canadian and U.S. mining companies in exploration and mining

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

	1991	1992	1993	1994	1995[e]
Gross domestic product (billion dollars)	5,725	6,020	6,343	6,738	7,070
Capital expenditures (billion dollars):					
All industries	529 [1]	546 [1]	490	549 [p]	601
Manufacturing	184 [1]	174 [1]	134	144 [p]	182
Mining and construction	10 [2]	9 [2]	31	35 [p]	36
Industrial production (1987=100):					
Total index	104	108	112	118	121
Manufacturing	104	108	113	120	123
Stone, clay, and glass products	92	95	99	105	106
Primary metals	99	102	107	115	115
Iron and steel	101	105	112	118	118
Nonferrous metals	96	98	101	109	110
Chemicals and chemical products	111	115	119	124	127
Mining	100	99	98	100	102
Metals	154	164	162	159	163
Coal	108	108	103	112	114
Oil and gas extraction	96	93	93	93	94
Stone and earth minerals	96	99	101	107	115
Capacity utilization (percent):[3]					
Total industry	79	80	82	84	84
Mining	87	87	87	90	91
Metals	83	87	84	82	84
Stone and earth minerals	81	84	85	90	97
Housing starts (thousands of units)	1,014	1,200	1,288	1,457	1,542
Automobile production (thousands of units)	5,439	5,664	5,981	6,614	6,426
Highway construction, all public, expenditures (billion dollars)	29	29	30 [p]	33 [e]	34

[e]Estimated. [p]Preliminary.

[1]From survey of new plant equipment and expenditures.

[2]From survey of new plant equipment and expenditures, mining industry only.

[3]1995 estimates based on seasonally adjusted figures.

Sources: U.S. Department of Commerce, Federal Reserve Board, American Automobile Manufacturers' Association, and U.S. Department of Transportation.

development projects in Mexico. Benefits to North American industry were matched by a revival of the Mexican mining industry, which was able to sell products at increased world market prices.

Throughout the world, mining laws were increasing and becoming more strict in response to increasing sensitivities of potential environmental damage. Requirements for environmental impact assessments and operations monitoring by companies were becoming more common; but often, resources were unavailable for strict governmental enforcement of these requirements. Even though exploration and mine development were increasingly encouraged, these activities were made more difficult and costly by unclear and unevenly applied regulations and by the involvement of bureaucratic units in lengthy project evaluations. In India, for example, opposition increased over the development of major bauxite mining and alumina refining projects in the State of Orissa, even though the Government of India was actively promoting increased mining investment.

In 1995, the International Labour Organisation agreed on standards for health and safety issues within the world mining industry, including mine design, operations, and maintenance. Of particular importance to employees was the establishment of the right of any employee to leave any location within a mine that appeared to be significantly dangerous. Several recommendations of the Leon Commission, which reviewed all aspects of mine safety, were adopted.

Latin America and Canada

Mining investment by North American, Australian, and European companies continued to shift to South America where mining law and tax reforms have been progressing since 1988. Exploration regulations were revised, corporate tax rates were reduced, trade barriers were decreased, permitting processes were streamlined, mine-development regulations were made more favorable to developers, and allowable equity-ownership by foreign investors was increased.

The Chilean Ministry of Mines reported that private investment in Chile's mining sector exceeded $3 billion in 1994, and additional investments totaling nearly $2.2 billion was projected through 1997. In Venezuela, gold exploration and mining activity continued at a rapid pace after British, Canadian, U.S., and Venezuelan mining companies spent $180 million in 1994. Reportedly, investments during the next 4 years in Venezuela were anticipated to increase to $1.5 billion. Peru anticipated $7 billion in new investments in the next 3 years. Mexico attempted to reverse a condition of excessive debt, inflation, and exodus of foreign capital by privatizing industry and changing mining and tax laws. Pemex, the State-owned petroleum company, announced that it would be selling its petrochemical complexes without any restriction to foreign ownership.

Mexico's membership in NAFTA was a significant factor in attracting foreign interest in the country's mineral resources; however, an unintended consequence to the Mexican steel industry was increased steel imports as Mexican protectionism declined, while exports to the United States decreased as protectionism there, increased. U.S. exports of steel to Mexico for the first half of 1995 exceeded pre-NAFTA levels, clearly illustrating U.S. firms' significant NAFTA-induced advantages over their competitors from Europe and Asia. NAFTA helped Mexico increase other exports and aided its economic recovery, thereby increasing its demand for U.S. goods and services. Nevertheless, critics in the United States continued to attack NAFTA after it went into effect on January 1, 1994.

NAFTA partners Canada and Mexico supported the proposal to make Chile the fourth member of the pact. Although talks between the three NAFTA partners and Chile were reported to be continuing, support for the proposal in the United States was mixed.

Asia and the Pacific

Asian and Pacific countries clearly recognized mineral resource development as important to their future economic health. Notable examples among developing countries were China, India, Indonesia, the Philippines, and Vietnam. With the exception of Japan, which experienced a major earthquake, notable minerals development progress was made throughout the region.

The Government of India revised its national minerals policy, providing good news for local and international investors. Joint ventures were promoted, allowable foreign equity capital in joint mining ventures was increased to 50%, and restrictions were removed on 13 minerals once reserved for the public sector. The Government was considering proposals to increase the size of exploration concessions available to foreign companies and to change tax structures and royalty rates. Mineral resource revenues were a major factor in the robust annual economic growth rate of Indonesia, which has one of the world's broadest resource bases. In March 1995, Indonesia announced plans to build its first copper smelter and refinery near the industrial port of Surabaya, East Java.

New mining legislation in Vietnam also was expected to promote the interest of foreign investors who would be guaranteed the right to exploit mineral resources found. A major beneficiary would be Australian mining companies, which already had established interests in Vietnam. Earlier, Vietnam had joined the Association of South East Asian Nations (comprising Brunei, Indonesia, Malaysia, the Philippines, Singapore, and Thailand), which was committed to increasing economic cooperation with Australia and New Zealand.

The Chinese Government decided to cut export tax rebates to exporters from 17% to 14%. Originally, exporters could receive a rebate of the 17% value-added tax that they paid on their products for export, but alleged cheating on tax rebates caused the Government to make claims of lost revenue. However, rebates remained unchanged for contracts signed for the export of large turnkey equipment valued at more than $10 million and

TABLE 3.—VALUE OF NONFUEL MINERAL PRODUCTION IN THE UNITED STATES AND PRINCIPAL NONFUEL MINERALS PRODUCED IN 1995[1]

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
Alabama	$678,000	18	1.80	Cement (portland), stone (crushed and broken), lime, sand and gravel (construction), clays, cement (masonry).
Alaska	594,000	21	1.58	Zinc, gold, sand and gravel (construction), lead, stone (crushed and broken), silver.
Arizona	4,150,000	1	11.00	Copper, sand and gravel (construction), molybdenum, cement (portland), silver, stone (crushed and broken).
Arkansas	479,000	27	1.27	Bromine, stone (crushed and broken), sand and gravel (construction), cement (portland), lime, sand and gravel (industrial).
California	2,680,000	3	7.14	Cement (portland), sand and gravel (construction), boron minerals, gold, stone (crushed and broken), diatomite.
Colorado	448,000	28	1.19	Molybdenum, sand and gravel (construction), cement (portland), gold, stone (crushed and broken), zinc.
Connecticut[2]	80,900	44	.22	Stone (crushed and broken), sand and gravel (construction), stone (dimension), clays, gemstones.
Delaware[2]	8,900	50	.02	Sand and gravel (construction), magnesium compounds, gemstones.
Florida	1,390,000	9	3.69	Phosphate rock, stone (crushed and broken), cement (portland), sand and gravel (construction), clays, titanium concentrates.
Georgia	1,670,000	5	4.45	Clays, stone (crushed and broken), cement (portland), sand and gravel (construction), stone (dimension), cement (masonry).
Hawaii[2]	106,000	43	.28	Stone (crushed and broken), cement (portland), sand and gravel (construction), cement (masonry), gemstones.
Idaho	399,000	31	1.06	Phosphate rock, molybdenum, sand and gravel (construction), gold, silver, stone (crushed and broken).
Illinois	820,000	16	2.18	Stone (crushed and broken), cement (portland), sand and gravel (construction), sand and gravel (industrial), lime, clays.
Indiana	581,000	23	1.55	Stone (crushed and broken), cement (portland), sand and gravel (construction), lime, cement (masonry), stone (dimension).
Iowa	484,000	26	1.29	Stone (crushed and broken), cement (portland), sand and gravel (construction), gypsum, lime, cement (masonry).
Kansas	492,000	25	1.31	Helium (Grade-A), salt, cement (portland), stone (crushed and broken), helium (crude), sand and gravel (construction).
Kentucky	401,000	30	1.07	Stone (crushed and broken), lime, cement (portland), sand and gravel (construction), clays, cement (masonry).
Louisiana	362,000	33	.96	Salt, sulfur (Frasch), sand and gravel (construction), stone (crushed and broken), sand and gravel (industrial), lime.
Maine	58,600	45	.16	Sand and gravel (construction), cement (portland), stone (crushed and broken), cement (masonry), stone (dimension), peat.
Maryland	341,000	34	.91	Stone (crushed and broken), cement (portland), sand and gravel (construction), cement (masonry), stone (dimension), clays.
Massachusetts	206,000	39	.55	Stone (crushed and broken), sand and gravel (construction), lime, stone (dimension), clays, peat.

See footnotes at end of table.

TABLE 3.—VALUE OF NONFUEL MINERAL PRODUCTION IN THE UNITED STATES AND PRINCIPAL NONFUEL MINERALS PRODUCED IN 1995[1]—continued

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
Michigan	$1,460,000	8	3.89	Iron ore, cement (portland), sand and gravel (construction), stone (crushed and broken), salt, magnesium compounds.
Minnesota	1,490,000	7	3.96	Iron ore, sand and gravel (construction), stone (crushed and broken), sand and gravel (industrial), stone (dimension), lime.
Mississippi	125,000	42	.33	Sand and gravel (construction), clays, cement (portland), stone (crushed and broken), sand and gravel (industrial), gemstones.
Missouri	1,110,000	10	2.95	Stone (crushed and broken), lead, cement (portland), lime, zinc, sand and gravel (construction).
Montana	581,000	22	1.55	Gold, copper, cement (portland), molybdenum, sand and gravel (construction), palladium metal.
Nebraska	142,000	41	.38	Sand and gravel (construction), cement (portland), stone (crushed and broken), clays, lime, cement (masonry).
Nevada	2,920,000	2	7.79	Gold, silver, sand and gravel (construction), diatomite, lime, cement (portland).
New Hampshire[2]	39,500	47	.11	Sand and gravel (construction), stone (crushed and broken), stone (dimension), gemstones, clays.
New Jersey	289,000	37	.77	Stone (crushed and broken), sand and gravel (construction), sand and gravel (industrial), clays, greensand marl, peat.
New Mexico	1,080,000	11	2.87	Copper, potash, sand and gravel (construction), cement (portland), stone (crushed and broken), perlite.
New York	863,000	15	2.30	Salt, stone (crushed and broken), sand and gravel (construction), cement (portland), zinc, wollastonite.
North Carolina	743,000	17	1.98	Stone (crushed and broken), phosphate rock, lithium minerals, sand and gravel (construction), feldspar, sand and gravel (industrial).
North Dakota	24,500	49	.07	Sand and gravel (construction), lime, sand and gravel (industrial), clays, gemstones, peat.
Ohio	871,000	14	2.32	Stone (crushed and broken), sand and gravel (construction), salt, lime, cement (portland), sand and gravel (industrial).
Oklahoma	388,000	32	1.03	Stone (crushed and broken), cement (portland), sand and gravel (construction), sand and gravel (industrial), salt, iodine.
Oregon	261,000	38	.70	Stone (crushed and broken), sand and gravel (construction), cement (portland), lime, diatomite, gemstones.
Pennsylvania[2]	1,050,000	12	2.81	Stone (crushed and broken), cement (portland), lime, sand and gravel (construction), cement (masonry), stone (dimension).
Rhode Island[2]	29,500	48	.08	Sand and gravel (construction), stone (crushed and broken), sand and gravel (industrial), gemstones.
South Carolina	426,000	29	1.13	Stone (crushed and broken), cement (portland), gold, sand and gravel (construction), cement (masonry), clays.
South Dakota	315,000	35	.84	Gold, cement (portland), stone (crushed and broken), sand and gravel (construction), stone (dimension), lime.
Tennessee	660,000	19	1.76	Stone (crushed and broken), zinc, cement (portland), gemstones, sand and gravel (construction), clays.
Texas	1,620,000	6	4.31	Cement (portland), stone (crushed and broken), sand and gravel (construction), magnesium metal, lime, salt.

See footnotes at end of table.

TABLE 3.—VALUE OF NONFUEL MINERAL PRODUCTION IN THE UNITED STATES AND PRINCIPAL NONFUEL MINERALS PRODUCED IN 1995[1]—continued

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
Utah	$1,810,000	4	4.83	Copper, gold, magnesium metal, molybdenum, potash, cement (portland).
Vermont[2]	52,800	46	.14	Stone (crushed and broken), stone (dimension), sand and gravel (construction), talc and pyrophyllite, gemstones.
Virginia	517,000	24	1.38	Stone (crushed and broken), cement (portland), lime, sand and gravel (construction), kyanite, cement (masonry).
Washington	613,000	20	1.63	Sand and gravel (construction), magnesium metal, stone (crushed and broken), gold, cement (portland), lime.
West Virginia	193,000	40	.51	Stone (crushed and broken), cement (portland), sand and gravel (industrial), salt, lime, sand and gravel (construction).
Wisconsin[2]	295,000	36	.79	Copper, stone (crushed and broken), sand and gravel (construction), lime, sand and gravel (industrial), gold.
Wyoming	976,000	13	2.60	Soda ash, clays, helium (Grade-A), cement (portland), stone (crushed and broken), sand and gravel (construction).
Undistributed	187,000	—	.50	
Total	37,600,000	XX	100.00	

XX Not applicable.

[1]Data rounded by the U.S. Bureau of Mines 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" figure.

electronic products valued in excess of $1 million. The Chinese Government amended its rules governing royalties for Sino-foreign oil and gas onshore joint ventures. The amendments provided royalty exemptions for oilfields in Qinghai, Xinjiand, and Xizang, where annual production was less than 1 million metric tons of oil and 2 billion cubic meters of gas. Royalties for Sino-foreign oil and gasfields were reduced by 5% in other provinces and autonomous regions of China.

The Philippine Government welcomed international mining companies when it established a new mining law in early 1995. As a result, mineral-exploration permit applications tripled.

Australia continued to be a major player in the international minerals market place. Australia already ranked among the world's six leading producers of bauxite, bismuth, iron ore, gold, lead, lithium, manganese, mineral sands, silver, tantalum, uranium, and zinc. Mineral exploration expenditures for the year ending June 30, 1995, far exceeded expectations and, as a result, known mineral resources increased significantly.

The catastrophic earthquake on January 17, 1995, in the Kobe-Osaka area of Japan severely affected the mineral sector of the country by damaging much of the infrastructure in the area. In the mineral sector, iron and steel and affiliated galvanizing facilities were most affected by the earthquake, followed by lead and zinc smelting and refining facilities, and a steel rolling mill. Titanium sponge and high-purity silicon metal production facilities also were adversely affected. Although the impact on iron and steel production facilities was severe, operations returned to normal levels within 7 months. Distribution networks for all mineral products were not totally repaired by yearend 1995.

Africa

Mining development continued at a slow pace owing to the reluctance of foreign investors to risk funds because of political and economic uncertainties and poor infrastructure. In an effort to generate interest among investors, the World Bank's Multilateral Investment Guarantee Agency sponsored an African mining investment conference in Toronto, Canada, in May 1995. Meanwhile, investors informed representatives of African governments of changes in the political and economic climate that would be necessary to attract investors.

The exploration emphasis in Africa was still on gold, but interest in undeveloped copper deposits in the Zaire portion of the Copper Belt and in diamonds and nickel was increasing. South African companies were very active in exploration in Africa.

Environmental issues assumed a more prominent role in South Africa as they have throughout the world. Opposition increased to issuing exploration permits for alluvial diamonds in the Limpopo River border area between Mozambique, South Africa, and Zimbabwe. Such exploration would conflict with the proposal to combine the Kruger and Gorongosa Game Parks into a giant international park. Controversy continued over whether to issue a permit to mine large titanium and zirconium sand reserves at St. Lucia, near Richards Bay. Opposition continued to a proposed steel mill at Saldanha Bay on the western coast, which is a tourist area.

Middle East

Saudi Arabia's new 5-year economic development plan, intended to slash public spending, diversify its oil-dominant economy, and to decrease its dependence on imports, predicted a 9% growth in the minerals sector; the most rapid rise expected for any sector of the economy. This exceptional growth would be the result of greater foreign and Saudi private sector participation in the mining industry. High-priority mineral development projects were the Khnaiguiyah zinc-copper deposits, the al Masane polymetallic deposit, a phosphate mining project, an iron-ore pelletizing project, construction of a zinc smelter, a new copper smelter and refinery, and construction of the largest gold refinery in the Persian Gulf region. Oman continued to pursue a plan to diversity its economy, even though oil and gas were expected to dominate its foreign earnings for the foreseeable future. Oman planned in 1995 to privatize its state-run mining concern, Oman Mining. The company's assets included a custom smelter at Lasail, in northern Oman, which processed copper sulfide concentrates, and two massive sulfide deposits, 100 kilometers south of Lasail, that were in advanced-stage development. The country also was seeking joint venture partners to explore and develop its gold resources.

Europe and Central Eurasia

The European Union (EU) increased from 12 to 15 members on January 1, 1995, when Austria, Finland, and Sweden were included. In June, three Baltic nations, Latvia, Lithuania, and Estonia, signed Association Agreements with the EU, which formally advances them toward eventual EU membership. In addition, Slovenia and the EU initialed an Association Agreement that was awaiting final signature at yearend.

After a period of slow growth and severe recession in most areas, Western Europe's national economies began to improve. Investment activity increased significantly during 1995. Support for high-cost production was withdrawn or significantly reduced by various Governments and privatization efforts continued. The Brussels-based association of mining industries, Euromines, announced its plans to promote minerals exploration, environmental issues, research and development, and energy/taxation policy in the EU. This major initiative was designed to stimulate new growth in the European mining industry that had been declining for the past decade. Mineral production at existing mines had been declining significantly and dependence on imports of foreign concentrates had risen steadily to what some had considered economically unhealthy levels.

A major problem facing the minerals industries of the countries of the Former Soviet Union (FSU) was the depletion of their raw material base and the fall in production capacity. This was caused by the lack of investment funds to maintain production and exploration. Domestic consumption of mineral products within the FSU continued to fall. This was coupled with an inability of FSU consumers to make timely payments for their purchases, which in conjunction with the rapid deflation of the ruble and rising costs for energy, transportation, labor and other inputs, created great incentives for FSU producers to export their output to hard currency markets.

The fastest rising minerals exports to world markets were aluminum, copper, ferroalloys, nickel, pig iron, and rolled steel. Since independence, Kazakstan had been privatizing the economy and making its markets and manufacturing operations more accessible to foreign investors. The number of joint ventures had grown since 1990 from 15 to more than 2,000 in 1995. During 1995, 18 state-owned enterprises were being readied for privatization. By late 1995, foreign companies managed dozens of large industrial enterprises. New laws, such as the recently adopted Law on Oil and the Law on State Regulation of Relationships, defined the rights of foreign investors regarding the extraction and sale of hydrocarbons, and precious metals and stones.

For additional information on international minerals events, please call (703) 648-7732.

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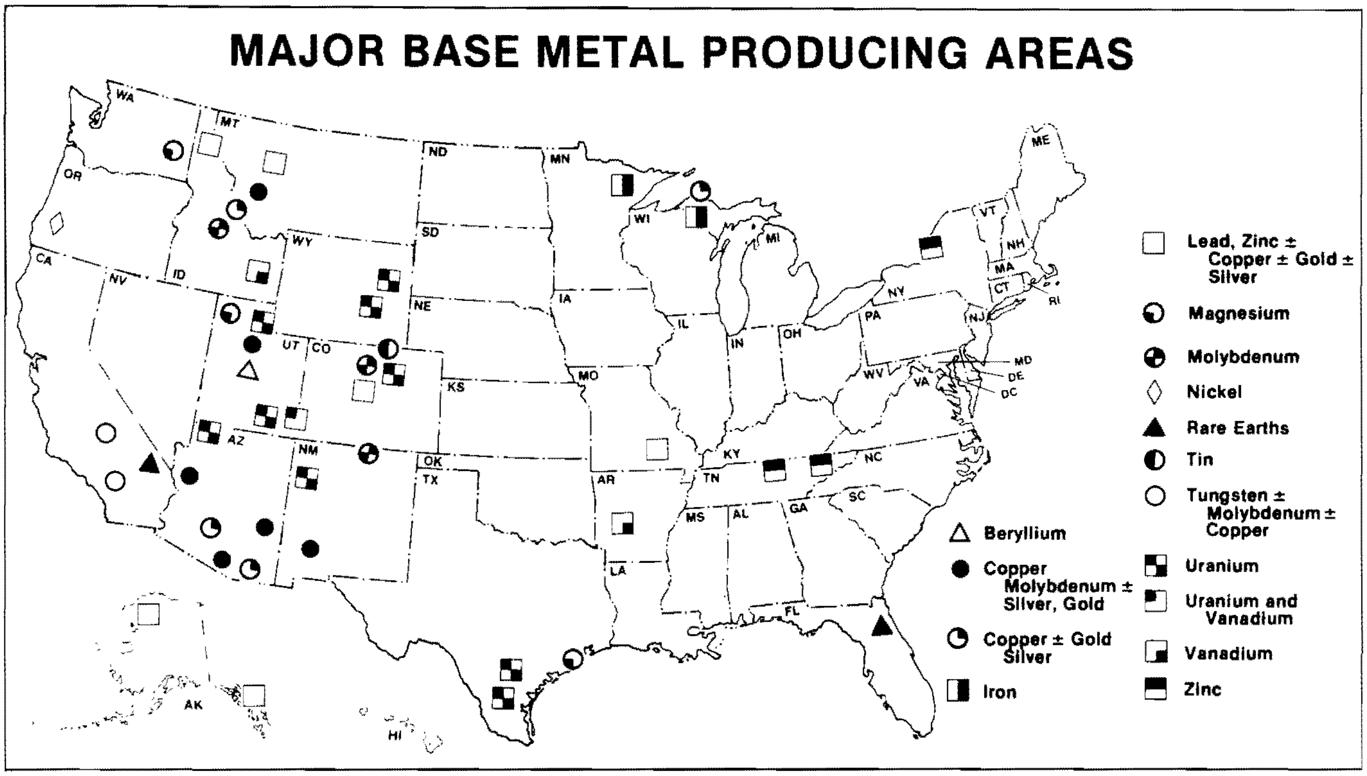
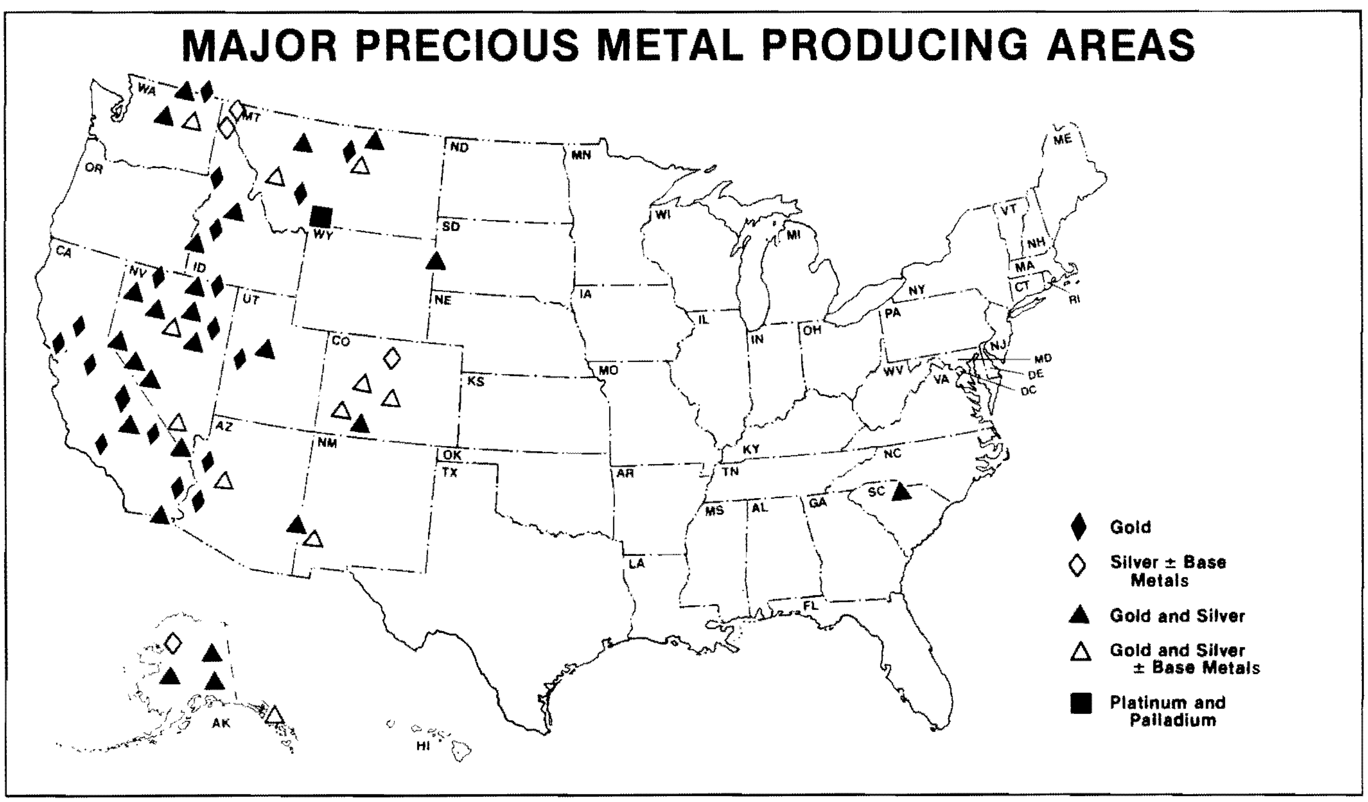
[1]Perciasepe, R., E. Laws, and W. Yellowtail. U.S. Environmental Protection Agency Letter. Washington, DC, May 12, 1995, 5 pp.

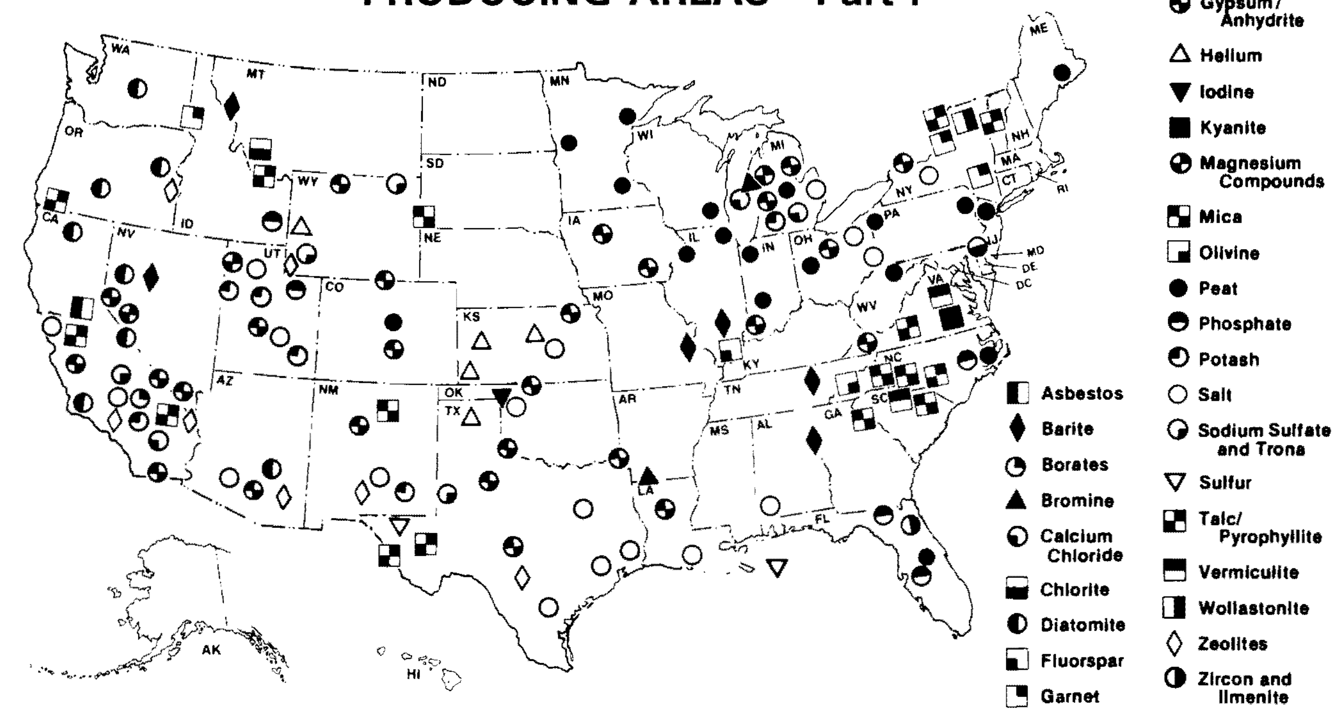
[2]EPA Targets Refining, Dry Cleaning, Metals Sectors for Future Enforcement. U.S. Environmental Protection Agency, Inside EPA, v. 16, No. 26, June 30, 1995, pp. 1, 6-7.

[3]Webster R. Mining Goes Global. Mining Voice, v. 1, No. 3, July-Aug. 1995, p. 18-21.

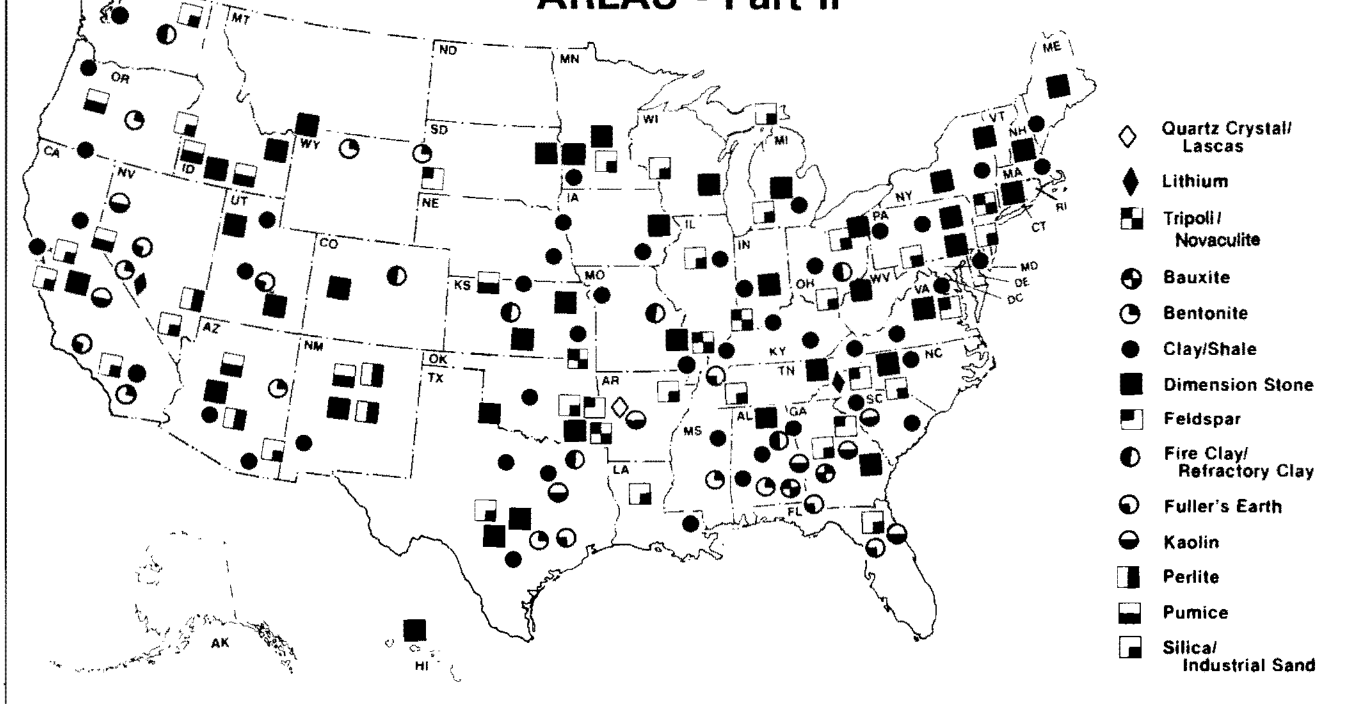

MAJOR BASE METAL PRODUCING AREAS
Lead, Zinc ± Copper ± Gold ± Silver
Magnesium
Molybdenum
Nickel
Rare Earths
Tin
Tungsten ± Molybdenum ± Copper
Uranium
Uranium and Vanadium
Vanadium
Zinc
Beryllium
Copper Molybdenum ± Silver, Gold
Copper ± Gold Silver
Iron


MAJOR PRECIOUS METAL PRODUCING AREAS
Gold
Silver ± Base Metals
Gold and Silver
Gold and Silver ± Base Metals
Platinum and Palladium

MAJOR INDUSTRIAL ROCK AND MINERAL PRODUCING AREAS - Part I



MAJOR INDUSTRIAL ROCK AND MINERAL PRODUCING AREAS - Part II



ALUMINUM[1]

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

Domestic Production and Use: In 1995, 13 companies operated 22 primary aluminum reduction plants. Montana, Oregon, and Washington accounted for 35% of the production; Kentucky, North Carolina, South Carolina, and Tennessee, 20%; other States, 45%. Based on published market prices, output of primary metal in 1995 was valued at $6.3 billion. Aluminum consumption, by an estimated 25,000 firms, was centered in the East Central United States. Transportation accounted for an estimated 28% of domestic consumption in 1995; packaging, 28%; building, 17%; electrical, 8%; consumer durables, 8%; and other uses, 11%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Primary	4,121	4,042	3,695	3,299	3,350
Secondary (from old scrap)	1,320	1,610	1,630	1,500	1,600
Imports for consumption	1,490	1,730	2,540	3,380	3,300
Exports	1,760	1,450	1,210	1,370	1,700
Shipments from Government stockpile excesses[2]	—	(55)	—	—	—
Consumption, apparent[3]	5,040	5,730	6,600	6,880	6,500
Price, ingot, average U.S. market (spot), cents per pound	59.5	57.5	53.3	71.2	85.0
Stocks: Aluminum industry, yearend	1,780	1,880	1,980	2,070	2,100
LME, U.S. warehouses, yearend	168	214	168	16	10
Employment: Primary reduction[e]	19,900	20,000	18,700	17,800	17,900
Secondary smelter[e]	3,600	3,600	3,600	3,600	3,600
Net import reliance[4] as a percent of apparent consumption	E	1	19	30	25

Recycling: Aluminum recovered in 1995 from purchased scrap was about 3.3 million tons, of which about 50% came from new (manufacturing) scrap and 50% from old scrap (discarded aluminum products). Aluminum recovered from old scrap was equivalent to about 25% of apparent consumption.

Import Sources (1991-94): Canada, 68%; Russia, 12%; Venezuela, 5%; Brazil, 2%; and other, 13%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Unwrought (in coils)	7601.10.3000	2.6% ad val.	18.5% ad val.
Unwrought (other than aluminum alloys)	7601.10.6000	Free	11.0% ad val.
Waste and scrap	7602.00.0000	Free	Free.

Depletion Allowance: None.[1]

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Aluminum	57	—	—	—

Prepared by **Patricia A. Plunkert, (703) 648-4979.**

ALUMINUM

Events, Trends, and Issues: Domestic primary aluminum production increased slightly in 1995 as companies continued their temporary shutdowns in production capacity. By the end of the year, domestic smelters were operating at about 80% of engineered or rated capacity.

U.S. imports for consumption remained at elevated levels. Imports from Russia continued on track to exceed 600,000 tons for the second consecutive year. This dramatic increase in imports during the last 3 years has made Russia second only to Canada as a major shipper of aluminum products into the United States. Exports of aluminum increased significantly as domestic demand for aluminum began to slow from the rapid growth rates evident during the last 2 years.

The price of primary aluminum ingot trended downward during the first 9 months of 1995. In January, the average monthly U.S. spot price for primary ingot quoted by Platt's Metals Week was 99.7 cents per pound; by September, the price had decreased to 81.8 cents per pound. Prices on the London Metal Exchange (LME) followed the trend of U.S. spot prices. The monthly average LME cash price for September was 79.9 cents per pound. Prices in the aluminum scrap markets paralleled the general trend of primary ingot prices. The buying price for aluminum used beverage can scrap, as quoted by American Metal Market, decreased from a 70- to 72-cent-per-pound range in January to a 62- to 64-cent-per-pound range at the end of September.

World inventories of metal held by the LME continued to decrease dramatically during the first half of the year. By the end of August, inventories held by the LME had decreased by more than 2 million tons from their record high of 2.66 million tons at the end of May 1994. In September 1995, however, this rate of decline had slowed considerably. Inventories of metal held by producers, as reported by the International Primary Aluminium Institute, fluctuated during the first half of the year.

World Smelter Production and Capacity:

	Production		Yearend capacity	
	1994	1995[e]	1994	1995[e]
United States	3,300	3,350	4,160	4,180
Australia	1,320	1,300	1,420	1,420
Brazil	1,200	1,210	1,210	1,210
Canada	2,250	2,240	2,280	2,280
France	400	400	422	422
Norway	857	845	887	887
Russia	2,670	2,710	2,970	2,970
Venezuela	580	600	610	630
Other countries	6,570	6,650	8,020	8,180
World total (rounded)	19,100	19,300	22,000	22,200

World Resources: Domestic aluminum requirements cannot be met by domestic bauxite resources. Potential 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, wood, and steel can substitute for aluminum in construction. Glass, plastics, paper, and steel can substitute for aluminum in packaging.

[e]Estimated. E Net exporter.
[1]See also Bauxite.
[2]Data in parentheses denote stockpile acquisitions.
[3]Domestic primary metal production + recovery from old aluminum scrap + net import reliance.
[4]Defined as imports - exports + adjustments for Government and industry stock changes.
[5]See Appendix B.

ANTIMONY

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

Domestic Production and Use: Primary antimony metal and oxide were produced by six companies operating six processing plants utilizing both foreign and domestic feed material. Two plants were in Texas, and one each was in Idaho, Montana, Nebraska, and New Jersey. A very small amount of antimony was recovered as a byproduct from the smelting of lead and silver-copper ores. Virtually all antimony metal and oxide produced domestically were derived from imports. The estimated value of primary antimony metal and oxide produced in 1995 was $160 million. The estimated distribution of antimony uses was flame retardants, 58%; transportation, including batteries, 21%; chemicals, 8%; ceramics and glass, 7%; and other, 6%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Mine	W	W	W	W	W
Smelter: Primary	16,400	20,100	22,600	25,500	23,000
Secondary	19,300	19,900	20,700	24,300	20,000
Imports for consumption	28,800	31,200	30,900	41,500	32,000
Exports of metal, alloys, oxide, and waste and scrap	4,440	5,770	4,220	7,850	2,600
Consumption, apparent[1]	42,000	44,600	45,700	59,200	50,200
Price, average, cents per pound[2]	82	79	77	178	240
Stocks, yearend	10,200	8,740	9,080	10,900	11,000
Employment, plant[e]	115	115	100	100	100
Net import reliance[3] as a percent of apparent consumption	53	60	62	57	60

Recycling: Almost 20,000 tons or 99% of secondary antimony was recovered as antimonial lead, most of which was consumed by the battery industry.

Import Sources (1991-94): Metal: China, 86%; Hong Kong, 4%; Mexico, 3%; Thailand, 1%; and other, 6%. Ore and concentrate: China, 34%; Bolivia, 28%; Canada, 9%; Kyrgyzstan, 8%; and other, 21%. Oxide: China, 36%; Mexico, 20%; Bolivia, 17%; South Africa, 14%; and other, 13%. Total: China, 59%; Mexico, 11%; South Africa, 6%; Hong Kong, 3%; and other, 21%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[4] 12/31/95
Ore and concentrates	2617.10.0000	Free	Free.
Antimony and articles thereof, including waste and scrap	8110.00.0000	Free	4.4¢/kg.
Antimony oxide	2825.80.0000	Free	4.4¢/kg.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Antimony	27,600	1,060	27,500	865

Prepared by James F. Carlin, Jr, (703) 648-4985.

ANTIMONY

Events, Trends, and Issues: In 1995, antimony production from domestic source materials was derived mainly from the recycling of lead-acid batteries. Recycling plus U.S. mine output supplied less than one-half of the estimated domestic demand.

The antimony metal price was characterized by a modest downward drift, compared with the sharp price rises of 1994. The antimony metal price started the year at $2.80 per pound and by midyear had declined to $2.20 per pound, still high by historical standards. The supply disruptions in China that had characterized most of the prior year seemed to have abated somewhat in 1995, although definitive reports from China were difficult to obtain. There were also scattered reports of earlier supply problems in Kyrgyzstan easing somewhat. Also a factor in sustained high prices during the past 2 years was continued strong demand for antimony trioxide in flame-retardant materials, especially plastics.

Government stockpile sales of antimony continued for the third year, after being restarted in 1993 for the first time since 1988. Public Laws 99-661 and 102-484 provided the authorization for the sales. In 1995, solicitations for sales were held on the third Thursday of each month. Antimony was stockpiled in Government warehouses in 13 locations, with the Somerville, NJ, depot holding the largest amount.

Environmental and ecological problems associated with the treatment of antimony raw materials were minimal, since all domestic processors of raw materials now avoid sulfide-containing materials.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[5]	Reserve base[5]
	1994	1995[e]		
United States	W	W	80,000	90,000
Bolivia	5,700	6,000	310,000	320,000
China	80,000	80,000	NA	NA
Kyrgyzstan	2,500	3,000	NA	NA
Mexico	1,500	2,000	180,000	230,000
Russia	7,000	7,000	NA	NA
South Africa	5,600	6,000	240,000	250,000
Other countries	4,000	4,000	3,400,000	3,800,000
World total (may be rounded)	[6]106,000	[6]108,000	4,200,000	4,700,000

World Resources: U.S. resources are mainly in Idaho, Nevada, Alaska, and Montana. Principal identified world resources, estimated at 5.1 million tons, are in China, Bolivia, Kyrgyzstan, Russia, South Africa, and Mexico. Additional antimony resources may occur in "Mississippi Valley Type" lead deposits in the Eastern United States.

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

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Domestic mine production + secondary production from old scrap + net import reliance (see footnote 3).
[2]New York dealer price for 99.5% to 99.6% metal, c.i.f. U.S. ports.
[3]Defined as imports - exports + adjustments for Government and industry stock changes.
[4]See Appendix B.
[5]See Appendix C for definitions. Numbers for "other countries" include those for China, Kyrgyzstan, and Russia although specific numbers for those counties are not currently available.
[6]Excludes U.S. production.

ARSENIC

(Data in metric tons, unless noted)

Domestic Production and Use: All arsenic metal and compounds consumed in the United States were imported, principally from China. More than 95% of the arsenic consumed was in compound form, principally as arsenic trioxide. Three principal manufacturers of wood preservatives consumed most of the arsenic trioxide for the production of arsenic acid for formulation of chromated copper arsenate (CCA) wood preservatives. Arsenic acid was also consumed by one manufacturer of arsenical herbicides. Metallic arsenic was consumed in the manufacture of nonferrous alloys, principally in lead alloys used in lead-acid batteries. About 15 tons of high-purity arsenic was consumed in the manufacture of semiconductor materials. About 80% of all arsenic was consumed in the production of wood preservatives; the balance was consumed in glass manufacturing, agricultural chemicals, nonferrous alloys, and miscellaneous uses. The value of arsenic metal and compounds consumed was estimated at $24 million.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Imports for consumption:					
Metal	1,010	740	767	1,330	800
Trioxide[1]	27,100	30,700	27,500	27,500	31,000
Compounds[2]	374	40	—	5	350
Exports, metal	233	94	364	79	100
Consumption, apparent, arsenic content	21,600	23,900	21,300	21,500	24,000
Price, cents per pound, average:[3]					
Trioxide, Mexican	25	29	33	32	33
Metal, Chinese	68	56	44	40	72
Net import reliance[4] as a percent of apparent consumption	100	100	100	100	100

Recycling: Process water and contaminated run-off collected at wood treatment plants are reused in pressure treatment. Gallium arsenide scrap from the manufacture of semiconductor devices is reprocessed for gallium and arsenic recovery. Domestically, no arsenic is recovered from arsenical residues and dusts at nonferrous smelters, though some of these materials are processed for recovery of other metals.

Import Sources (1991-94): China, 44%; Chile, 19%; Mexico, 12%; and other, 25%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Metal	2804.80.0000	Free	13.2¢/kg.
Trioxide	2811.29.1000	Free	Free.
Sulfide	2813.90.1000	Free	Free.
Acid[6]	2811.19.1000	2.3%	4.9%.

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

Government Stockpile: None.

Prepared by **Daniel L. Edelstein, (703) 648-4978.**

ARSENIC

Events, Trends, and Issues: Domestic demand for arsenic in the wood preservative industry increased for the second consecutive year. In 1994 the growth corresponded to strong growth in housing industry indicators— both housing starts and building permits issued rose by about 13%, and new home sales rose by about 6%. While these indicators are expected to decline in 1995 from the previous year's levels, consumption for in-process construction, as well as restocking by distributors of pressure treated lumber, accounted for continued growth in 1995.

In August, the Environmental Protection Agency (EPA) proposed treatment standards for the land disposal of wastes from wood preserving operations. Wastes from the wood preserving industry had been listed as hazardous in 1990. In the proposed standards, EPA recommended the application of Universal Treatment Standards to these wastes. At the same time EPA was proposing these standards, it invited comments on wood preserving industry concerns that wastewaters, including drippage reclamation, were part of the production process, and therefore should receive a variance from proposed regulation.

Tightness in the arsenic metal market, caused by supply disruptions reported in China, resulted in the average December 1994 customs price for arsenic metal surging to 92 cents per pound. During the first half of 1995, the tightness eased and prices declined—the customs price averaged 72 cents per pound during the first 6 months of 1995.

World Production, Reserves, and Reserve Base:

	Production (Arsenic trioxide) 1994	1995[e]	Reserves and reserve base[7] (Arsenic content)
United States	—	—	
Belgium	2,000	2,000	
Chile	6,300	6,300	World reserves and reserve base are believed to be about 20 and 30 times, respectively, annual world production.
China	13,000	13,000	
France	6,000	6,000	
Ghana[8]	500	500	
Kazakstan	1,500	1,500	
Mexico	4,400	4,400	
Namibia	2,300	2,300	
Philippines	2,000	2,000	
Russia	1,500	1,500	
Other countries	3,500	3,500	
World total	43,000	43,000	

World Resources: World resources of copper and lead contain about 11 million tons of arsenic. Substantial resources of arsenic occur in copper ores in northern Peru and the Philippines and in copper-gold ores in Chile. In addition, world gold resources, particularly in Canada, contain substantial resources of arsenic.

Substitutes: Substitutes for arsenic compounds exist in most of its major uses, though arsenic compounds may be preferred because of lower cost and superior performance. The wood preservatives pentachlorophenol and creosote may be substituted for CCA when odor and paintability are not problems and where permitted by local regulations. A recently developed alternative, ammoniacal copper quaternary, which avoids use of chrome and arsenic, has yet to gain widespread usage. Nonwood alternatives, such as concrete, steel, and vinyl or plastic lumber, may be substituted in some applications for treated wood. A South American hardwood, ipe, which requires no chemical treatment, has been used in some localities in oceanfront boardwalks.

[e]Estimated.
[1]Arsenic trioxide (As_2O_3) contains 75.7% arsenic by weight.
[2]Almost entirely arsenic acid.
[3]Calculated from Bureau of the Census import data.
[4]Defined as imports - exports + adjustments for Government and industry stock changes.
[5]See Appendix B.
[6]Tariff is free for Israel, Caribbean Basin Countries, and designated Beneficiary Developing Countries. For Canada, the tariff is 1.8¢/kg.
[7]See Appendix C for definitions. The reserve base for the United States was estimated at 80,000 tons.
[8]Byproduct of gold ore roasting. Excludes production of noncommercial grade material estimated at 9,000 tons per year.

ASBESTOS

(Data in thousand metric tons, unless noted)

Domestic Production and Use: One firm in California accounted for 100% of domestic production. Asbestos was consumed in roofing products, 47%; friction products, 35%; gaskets 10%; and other, 8%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production (sales), mine	20	16	14	10	9
Imports for consumption	35	32	31	26	24
Exports	26	25	28	18	13
Shipments from Government stockpile excesses	—	—	—	—	—
Consumption, apparent	35	33	32	27	24
Price: average value, dollars per ton, f.o.b.	383	394	435	506	W
Stocks, producer, yearend	W	W	W	W	W
Employment, mine and mill	70	70	70	30	30
Net import reliance[1] as a percent of apparent consumption	26	21	9	30	46

Recycling: Insignificant.

Import Sources (1991-94): Canada, 99%; and other, 1%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[2] 12/31/95
Asbestos	2524.00.0000	Free	Free.

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

Government Stockpile:

Stockpile Status—9-30-95
(Metric tons)

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Amosite	30,849	—	30,849	—
Chrysotile	9,768	—	9,768	—
Crocidolite	33	—	33	—

Prepared by Robert L. Virta, (703) 648-7726.

ASBESTOS

Events, Trends, and Issues: Domestic sales of asbestos declined 10% from that of 1994. Imports and exports decreased 8% and 28% respectively, according to the Bureau of the Census. It is likely that a large percentage of the exports were either reexports, asbestos-containing products, or nonasbestos products. Exports of asbestos fiber are estimated to be less than 9,000 tons. Apparent consumption declined 11%. All of the asbestos consumed in the United States was chrysotile. Canada remained the largest supplier of asbestos for domestic consumption.

The U.S. Environmental Protection Agency proposed to remove asbestos processing (asbestos milling, manufacturing and fabrication) from the 1990 amendments to the Clean Air Act. The action was taken because measured emissions at several facilities were lower than previously estimated.

The U.S. Occupational Safety and Health Administration amended its asbestos standard for general industry, construction, and the shipyard industry. The changes included less stringent requirements for removal of roof cements, coating, mastics, and flashings; clarification of the definition of friable materials; and modified training and health screening requirements.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[3]	Reserve base[3]
	1994	1995[e]		
United States	10	9	Moderate	Large
Brazil	175	170	Moderate	Moderate
Canada	518	510	Large	Large
China	240	240	Large	Large
Kazakstan	300	300	Large	Large
Russia	800	800	Large	Large
South Africa	95	95	Moderate	Moderate
Zimbabwe	150	145	Moderate	Moderate
Other countries	122	120	Large	Large
World total (may be rounded)	2,410	2,390	Large	Large

World Resources: The world has 200 million tons of identified resources and an additional 45 million tons classified as hypothetical resources. The U.S. resources are large, but are composed mostly of short fibers.

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 were considered as possible asbestos substitutes for products in which the reinforcement properties of fibers were not required. No single substitute was as versatile and as cost effective as asbestos.

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

BARITE

(Data in thousand metric tons, unless noted)

Domestic Production and Use: Barite sales in 1995 were about the same as 1994's level of 580,000 tons, and the value was unchanged at $21 million. Sales came from five States, with slightly less than 85% of the total coming from Nevada. The second largest producing State was Georgia. About 1,300 tons of ground barite from both domestic production and imports were sold in 1995, as reported by the domestic grinders and crushers. Nearly 90% of the barite sold in the United States in 1995 was used as a weighing agent in oil- and gas-well-drilling fluids, mostly in the Gulf of Mexico region, with much smaller amounts used in the Pacific coast areas. Barite was also used in the production of paint, rubber, glass, and barium chemicals.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Sold or used, mine	448	326	315	583	600
Imports for consumption:					
Crude barite	841	323	766	1,020	1,050
Ground barite	46	31	38	58	80
Other	10	12	11	13	10
Exports	43	12	18	14	20
Consumption, apparent[1] (crude barite)	1,290	668	1,100	1,640	1,710
Consumption[2] (ground and crushed)	1,270	999	1,090	1,250	1,310
Price, average value, dollars per ton, mine	47.57	60.22	61.16	37.22	41.00
Employment, mine and mill[e]	400	350	330	350	400
Net import reliance[3] as a percent of apparent consumption	66	52	72	65	65

Recycling: None.

Import Sources (1991-94): China, 68%; India, 21%; Mexico, 5%; and other, 6%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[4] 12/31/95
Crude barite	2511.10.5000	$1.25/mt	$3.94/mt.
Ground barite	2511.10.1000	$2.56/mt	$7.38/mt.
Witherite[5]	2511.20.0000	2.4% ad val.	30% ad val.
Oxide, hydroxide, and peroxide[6]	2816.30.0000	2% ad val.	10.5% ad val.
Other sulfates[6]	2833.27.0000	0.6% ad val.	4.2% ad val.
Other chlorides[6]	2827.38.0000	4.2% ad val.	28.5% ad val.
Other nitrates[6]	2834.29.5000	3.5% ad val.	10% ad val.
Carbonate[6]	2836.60.0000	2.3% ad val.	8.4% ad val.

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

Government Stockpile: None.

Events, Trends, and Issues: The demand for barite, as indicated by the ground and crushed barite consumption figures, increased from that recorded in 1994. The increase occurred following increased petroleum prices and stable gas prices and continued high oil and gas price expectations. The drilling in the Gulf of Mexico for deep natural gas deposits in Louisiana, offshore Louisiana, south Texas, offshore Texas and Oklahoma continues unabated. The demand for jack up drilling rigs and semisubmersible drilling rigs in the Gulf of Mexico was strong. There was an increase of 18% in light, sweet crude futures prices from the last week of December 1994 to the week of May 5, 1995, while natural gas prices increased during the same period by 5%. The rotary drill rig count in the United States for December 23, 1994, was 813 rigs and by May 5, 1995 was down to 664, which was also down from a year ago of 719 rigs. Later in 1995, the rig count rose sharply and was reported at 763 rigs for the week of October 13, but was down from 828 rigs for the week of October 14, 1994. The explanation of this decline in drilling rigs along with good barite consumption is attributed to new technologies.[7] Owing to new seismic technology, fewer wells are required to establish and develop reserves. Other technologies, such as horizontal and directional drilling, have reduced the number of wells needed to access a reservoir effectively. Measurement-while-drilling, logging-while-drilling, increased drill bit effectiveness and durability, new well completion techniques, and new well stimulation services have all combined to increase flow rates, reduce well drilling and maintenance costs, and reduce the number of wells while keeping product flowing profitably at present prices.

Prepared by **James P. Searls, (703) 648-7724.**

BARITE

Imports for consumption of lower-cost foreign barite surpassed domestic production by more than 120%. Major sources of imported barite are China, India, and Mexico. These countries have high grade deposits, relatively low labor costs, and relatively low (per ton-mile) cost for ocean transportation to the locations of the Gulf coast crusher and grinder plants. China and India have reportedly had problems in their mines, such as floods, diminishing high purity-reserves, and quality control. Often, ocean transportation is lower per ton than rail transportation from Georgia and Missouri to end-use regions. Nevada mines, crushers, and grinders are competitive in the California market and are trying to reenter the Gulf of Mexico market through negotiated railroad tariff reductions.

The principal environmental impact of chemically inert barite is the land disturbance normally associated with mining. Mud pits at petroleum well drilling sites that contain some barite are treated according to the chemical content other than barite. The mud in the pits may be dewatered and covered, dewatered and spread over the ground, or transported to special waste handling facilities depending on the base drilling fluid (water or oil).

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[8]	Reserve base[8]
	1994	1995[e]		
United States	583	600	30,000	60,000
Algeria	45	40	2,000	8,000
Belgium	30	30	1,000	3,000
Brazil	45	45	1,000	2,000
Canada	55	60	11,000	14,600
China	1,500	1,500	38,000	150,000
France	70	75	2,000	2,500
Germany	135	150	1,000	1,500
India	510	400	30,000	32,000
Iran	100	100	NA	NA
Ireland	60	55	1,000	1,500
Italy	60	50	2,000	2,000
Kazakstan	150	150	NA	NA
Mexico	150	180	7,000	8,500
Morocco	265	250	10,000	11,000
Romania	105	100	NA	NA
Thailand	49	60	9,000	15,000
Tunisia	30	30	3,200	5,700
Turkey	140	140	4,000	20,000
United Kingdom	40	40	200	700
Other countries	190	195	21,000	160,000
World total (may be rounded)	4,300	4,250	170,000	500,000

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 in all categories are about 2 billion tons, but only about 550 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. However, none of these substitutes has had a major impact on the barite drilling mud industry.

[e]Estimated. NA Not available.
[1]Sold or used by domestic mines - exports + imports.
[2]Domestic and imported crude barite sold or used by domestic grinding establishments.
[3]Defined as imports - exports + adjustments for Government and industry stock changes.
[4]See Appendix B.
[5]Per metric ton.
[6]Per kilogram.
[7]The Oil & Gas Journal, PennWell Publishing Co., Tulsa, OK, v. 93, No. 39, Sept. 25, 1995, pp. 49-55.
[8]See Appendix C for definitions.

BAUXITE AND ALUMINA[1]

(Data in thousand metric dry tons, unless noted)

Domestic Production and Use: In 1995, three companies operated surface bauxite mines in Alabama and Georgia. Virtually all domestic ore was consumed in the production of nonmetallurgical products, such as abrasives, chemicals, proppants, and refractories. Approximately 95% of the total bauxite consumed in the United States during 1995 was converted to alumina. Primary aluminum smelters received approximately 90% of the alumina supply. Annual alumina capacity was 5.6 million tons, with four Bayer refineries in operation at yearend.

Salient Statistics—United States:[2]	1991	1992	1993	1994	1995[e]
Production, bauxite, mine	W	W	W	W	W
Imports of bauxite for consumption[3]	12,300	11,400	11,900	11,200	10,000
Imports of alumina[4]	4,590	4,700	3,940	3,120	3,900
Exports of bauxite[3]	58	68	92	137	130
Exports of alumina[4]	1,350	1,140	1,240	1,040	650
Shipments of bauxite from Government stockpile excesses	—	437	565	5	150
Consumption, apparent, bauxite and alumina (in aluminum equivalents)[5]	4,610	4,860	4,510	3,840	4,000
Price, bauxite, dollars per ton, f.o.b. mine	15-18	15-18	15-24	15-24	15-18
Stocks, bauxite, industry, yearend	2,600	2,300	1,600	1,600	1,000
Employment, bauxite mine	35	35	35	35	20
Net import reliance,[6] bauxite and alumina as a percent of apparent consumption	100	100	100	99	99

Recycling: None.

Import Sources (1991-94):[7] Bauxite: Guinea, 34%; Jamaica, 30%; Brazil, 14%; Guyana, 13%; and other, 9%. Alumina: Australia, 73%; Jamaica, 10%; Suriname, 6%; and other, 11%. Total: Australia, 33%; Jamaica, 21%; Guinea, 19%; Brazil, 9%; and other, 18%.

Tariff: Import duties on bauxite and alumina were abolished in 1971 by Public Law 92-151. Only imports from non-most-favored nations were dutiable. Countries that supplied commercial quantities of bauxite or alumina to the United States during the first 8 months of 1995 had most-favored-nation status.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Bauxite, metal grade:				
Jamaica-type	11,100	739	10,900	[8]610
Suriname-type	4,980	—	4,980	—
Bauxite, refractory-grade, calcined	208	21	146	[9]11

Events, Trends, and Issues: World output of bauxite and alumina for 1995 increased to accommodate the increase in world primary aluminum metal production.

U.S. alumina plant engineered capacity remained essentially unchanged from that of yearend 1994. However, capacity utilization decreased as a result of the temporary closure of a 635,000-ton-per-year alumina plant in St. Croix, VI.

Prepared by **Patricia A. Plunkert, (703) 648-4979.**

BAUXITE AND ALUMINA

Spot prices for metallurgical-grade alumina, as published by Metal Bulletin, increased dramatically during the first three quarters of 1995. The price range began the year at $127 to $130 per ton. By the end of September, the price range had increased to $320 to $340 per ton. In early October, the price had decreased slightly to a range of $290 to $310 per ton.

The fiscal year 1996 Annual Materials Plan (AMP) submitted by the Defense National Stockpile Center proposed the sale of 915,000 dry metric tons of metallurgical-grade bauxite (610,000 tons of Jamaican-type and 305,000 tons of Suriname-type) during the period October 1, 1995 to September 30, 1996. In addition, the FY 1996 AMP provided for the sale of 81,000 calcined metric tons of refractory-grade bauxite from the National Defense Stockpile. These are the maximum amounts that could be sold under the new AMP and not necessarily the amounts that would actually be offered for sale.

World Bauxite Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[10]	Reserve base[10]
	1994	1995[e]		
United States	W	W	20,000	40,000
Australia	41,700	42,700	5,600,000	7,900,000
Brazil	8,120	8,500	2,800,000	2,900,000
Greece	1,600	1,600	600,000	650,000
Guinea	14,400	14,500	5,600,000	5,900,000
Guyana	2,100	2,100	700,000	900,000
Hungary	900	900	300,000	300,000
India	5,400	5,500	1,000,000	1,200,000
Jamaica	11,700	12,000	2,000,000	2,000,000
Suriname	3,440	3,400	580,000	600,000
Venezuela	4,790	5,000	320,000	350,000
Other countries	12,700	12,400	3,500,000	5,100,000
World total (rounded)	[11]107,000	[11]109,000	23,000,000	28,000,000

World Resources: Bauxite resources are estimated to be 55 to 75 billion tons, in South America (33%), Africa (27%), Asia (17%), Oceania (13%), and elsewhere (10%). Domestic resources of bauxite are inadequate to meet long-term 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-based refractories. Although more costly, silicon carbide and alumina-zirconia substitute for bauxite-based abrasives.

[e]Estimated. W Withheld to avoid disclosing company proprietary data.

[1]See also Aluminum. As a general rule, 4 tons of bauxite are required to produce 2 tons of alumina, which, in turn, provide 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 (all in aluminum equivalents).

[6]Defined as imports - exports + adjustments for Government and industry stock changes (all in aluminum equivalents).

[7]Aluminum equivalents.

[8]Sold under long-term contract commenced in 1993.

[9]Dry equivalent weight—16,500 metric tons.

[10]See Appendix C for definitions.

[11]Excludes U.S. production.

BERYLLIUM

(Data in metric tons of contained beryllium, unless noted)

Domestic Production and Use: One company in Utah mined bertrandite ore and recovered beryllium hydroxide from this ore and from imported and domestic beryl. Beryllium hydroxide was shipped to a plant in Ohio, where it was converted into beryllium metal, alloys, and oxide. Another company in Pennsylvania purchased beryllium oxide from Asia and converted this material into beryllium alloys. Small quantities of beryl were recovered as a byproduct of U.S. pegmatite mining operations in various States. Beryllium consumption of 200 tons was valued at approximately $71 million, based on the producer price for beryllium-copper master alloy. Beryllium was used as an alloy and oxide in electronic components, 57%; as an alloy and oxide in electrical components, 20%; as an alloy, oxide, and metal in aerospace and defense applications, 13%; and as an alloy, metal, and oxide in other applications, 10%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, mine	174	193	198	173	225
Imports for consumption, ore and metal	55	6	8	53	30
Exports, metal	33	41	20	29	55
Shipments from Government stockpile excesses[1]	—	[2]15	[2]31	[2](2)	[2](19)
Consumption, apparent	203	159	183	198	200
Price, dollars:					
Domestic, metal, vacuum-cast ingot, per pound	308	308	308	275	275
Domestic, metal, powder blend, per pound	280	280	295	295	295
Domestic, beryllium-copper master alloy, per pound of contained beryllium	160	160	160	160	160
Domestic, beryllium oxide, powder, per pound	72.50	72.50	72.50	72.50	70.50
Imported ore, per stu (20 pounds) BeO	113	NA	NA	NA	NA
Stocks, consumer, yearend	112	111	114	113	113
Employment:					
Mine, full-time equivalent employees[e]	25	25	25	25	25
Primary refineries[e]	400	400	400	400	400
Net import reliance[3] as a percent of apparent consumption	14	E	E	13	E

Recycling: Substantial quantities of new scrap generated in the processing of beryllium-copper alloys were recycled. Small quantities of obsolete military equipment containing metallic beryllium were recycled.

Import Sources (1991-94): Ore, metal, scrap, and master alloy: Russia, 30%; Germany, 21%; China, 11%; Brazil, 11%; and other, 27%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[4] 12/31/95
Ore and concentrates	2617.90.0030	Free	Free.
Unwrought beryllium	8112.11.6000	8.5% ad val.	25.0% ad val.
Beryllium, wrought	8112.19.0000	5.5% ad val.	45.0% ad val.
Beryllium-copper master alloy	7405.00.6030	6.0% ad val.	28.0% ad val.
Beryllium oxide or hydroxide	2825.90.1000	3.7% ad val.	25.0% ad val.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Beryl ore (11% BeO)	545	—	545	—
Beryllium-copper master alloy	268	—	—	—
Beryllium metal	363	—	—	—

Prepared by **Deborah A. Kramer, (703) 648-7719.**

BERYLLIUM

Events, Trends, and Issues: Although U.S. beryllium demand remained flat, the mix of end products changed slightly. Beryllium metal demand decreased, but demand for beryllium alloys and beryllium oxide ceramics increased. Much of the increase in alloy demand was in automotive electronics and telecommunications and computers. One new application for beryllium-aluminum alloys was in some military helicopter electrooptical systems. Because a U.S. firm has developed a castable beryllium-aluminum alloy, this material could be used to replace aluminum in housings for avionics or in small structural components.

Two U.S. firms began importing beryllium metal and alloys from Kazakstan during 1994. As a result of this importation, beryllium metal from Kazakstan became ineligible for special duty status under the Generalized System of Preferences on July 1, 1995, because the country exceeded its competitive need limits in 1994.

The Defense Logistics Agency continued to offer 2,000-pound lots of beryl from the National Defense Stockpile for sale once a month. No bids for the material were received.

Beryllium dust and fines have been recognized as the cause of berylliosis, a chronic lung disease. Harmful effects are minimized by maintaining a clean workplace and requiring the use of safety equipment.

World Mine Production, Reserves, and Reserve Base:

	Mine production	
	1994	1995[e]
United States	173	225
Argentina	—	1
Brazil	34	30
China[e]	55	55
Kazakstan[e]	4	4
Russia[e]	32	30
Zimbabwe	1	1
Other countries	1	1
World total	300	347

Reserves and reserve base[5]

The United States has very little beryl that can be economically handsorted from pegmatites. The Spor Mountain area, Utah, contains a large reserve base of bertrandite, which was being mined. Domestic deposits of bertrandite ores in Utah and Texas contain about 21,000 tons of beryllium. The world reserves and reserve base are not adequately delineated.

World Resources: No quantitative information is available on foreign resources of beryllium-bearing minerals and rocks. The identified resources of beryllium in known domestic deposits are estimated at 66,000 tons of contained beryllium.

Substitutes: Because of the relatively high price of beryllium, uses are expected to continue principally in applications that require its light weight, high strength, and high thermal conductivity. Steel, titanium, and graphite composites may be substituted for beryllium metal; phosphor bronze may be substituted for beryllium-copper alloys, but with substantial loss of performance. Aluminum nitride can substitute for beryllium oxide in some applications.

[e]Estimated. E Net exporter. NA Not available.
[1]Data in parentheses denote stockpile acquisitions.
[2]Data represent the net difference between the estimated beryllium content of beryl shipped for upgrading and stockpile receipts of beryllium metal. These data are not included in import reliance calculations.
[3]Defined as imports - exports + adjustments for Government and industry stock changes.
[4]See Appendix B.
[5]See Appendix C for definitions.

BISMUTH

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

Domestic Production and Use: One refinery in Nebraska produced bismuth as a byproduct of lead refining. Thirty-five companies in the Eastern United States accounted for 84% of the bismuth reported consumed in 1995. Based on the average annual price, reported consumption was valued at $12.2 million. Bismuth was used in pharmaceuticals and chemicals, 53%; fusible alloys and solders, 28%; metallurgical additives, 17%; and other, 2%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, refinery	W	W	W	W	W
Imports for consumption	1,410	1,620	1,330	1,660	1,400
Exports[1]	75	90	70	160	120
Shipments from Government stockpile excesses	57	91	—	145	139
Consumption, reported	1,260	1,300	1,300	1,470	1,500
Price, average, domestic dealer, dollars per pound	3.00	2.66	2.50	3.25	3.75
Stocks, yearend, consumer	247	272	323	297	350
Employment, plant[e]	30	30	30	30	30
Net import reliance[2] as a percent of apparent consumption	W	W	W	W	W

Recycling: Bismuth was recovered from fusible alloy scrap, contributing about 5% of the U.S. supply.

Import Sources (1991-94): Mexico, 37%; Belgium, 27%; China, 12%; Peru, 8%; and other, 16%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[3] 12/31/95
Articles thereof, including waste and scrap	8106.00.0000	Free	7.5% ad val.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Bismuth	366	136	366	139

Events, Trends, and Issues: Growth in the domestic consumption of bismuth was slow despite the development of several new applications designed to provide nontoxic substitutes for lead. New products include bismuth brass, pigments, ceramic glazes, fishing sinkers, shot for hunting, solders, lubricating greases, and crystal ware. In order to make a large impact on the market, lead would have to be restricted or banned for a significant use, such as plumbing fixtures. Seven large faucet makers, representing about one-half of domestic faucet sales, agreed to remove essentially all lead from plumbing fixtures in the settlement of a suit brought by California and the Natural Resources Defense Fund. The brass industry tested several bismuth and bismuth-selenium free-machining brasses that could be used as a replacement for leaded brass in plumbing fixtures. Both machining and leach test results were very encouraging. Selenium is added to lower the amount of bismuth required.

Prepared by **Robert D. Brown, Jr., (703) 648-4984.**

BISMUTH

World production of bismuth also has remained fairly flat due mainly to low prices and level demand. In 1994 and 1995, output from China and Korea decreased because of reduced tungsten production. World lead production has also declined in recent years, limiting the amount of bismuth that can be produced. Concerns over possible shortages caused the price to increase rapidly in July 1994, from about $2.50 per pound to $4.00 per pound. Since then, the price has been lowered to $3.65 per pound. The Defense Logistics Agency (DLA) sold 139 tons of bismuth from the National Defense Stockpile in 1995; this was slightly more than the entire amount authorized for disposal in fiscal year 1995. The DLA was authorized to dispose of 136 tons in fiscal year 1996.

The U.S. Fish and Wildlife Service again conditionally approved the use of 97% bismuth-3% tin shot for waterfowl hunting in the 1995-96 hunting season. Recent studies have shown bismuth-tin shot to be nontoxic to waterfowl. Bismuth-tin shot is an alternative to steel shot, which replaced lead shot for waterfowl hunting several years ago. Bismuth-tin shot has much better dropping power than steel shot.

The feasibility study for the Tasna Mine in Bolivia was completed. It is the only mine in the world where bismuth is the primary product.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	1994	1995[e]		
United States	W	W	9,000	14,000
Australia	—	—	18,000	27,000
Bolivia	—	—	5,000	10,000
Canada	131	150	5,000	30,000
China	700	800	20,000	40,000
Japan	150	150	9,000	18,000
Kazakstan	25	25	5,000	10,000
Mexico	900	950	10,000	20,000
Peru	1,000	1,000	11,000	42,000
Other countries	110	100	15,000	35,000
World total (rounded)	[5]3,020	[5]3,200	110,000	250,000

World Resources: Bismuth is recovered in the United States during the processing of domestic and imported lead ores and concentrates. Other potential domestic sources include byproduct recovery from molybdenum or tungsten processing, although most of these domestic reserves are subeconomic. World reserves of bismuth are usually associated with lead deposits, except in China and Korea, where bismuth is found with tungsten ores, and Australia, where it is found with copper-gold ores. Bismuth minerals rarely occur in sufficient quantities to be mined as principal products, except in Bolivia and possibly China.

Substitutes: Antibiotics, magnesia, and alumina can replace bismuth in pharmaceutical applications. 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 in holding jigs for machining. Glycerine-filled glass bulbs replace bismuth alloys as a triggering device for fire sprinklers. Selenium, tellurium, or lead could replace bismuth in free machining alloys.

[e]Estimated. W Withheld to avoid disclosing company proprietary data.
[1]Includes bismuth, bismuth alloys, and waste and scrap.
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]See Appendix B.
[4]Most of reserves and reserve base represent bismuth recoverable from the lead reserve base. See Appendix C for definitions.
[5]Excludes U.S. production.

BORON

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

Domestic Production and Use: The estimated value of boric oxide contained in minerals and compounds produced in 1995 was $462 million. Domestic production of boron minerals primarily as sodium borates, by four companies was centered in southern California. The largest producer operated an open pit tincal and kernite mine and associated compound plants. A second firm, using Searles Lake brines as raw material at two plants, accounted for the remaining output. A third company continued to process small amounts of calcium and calcium sodium borates. A fourth company began an in-situ process at midyear. Principal consuming firms were in the North Central and Eastern States. The reported end-use distribution pattern for boron compounds consumed in the United States in 1994 was glass products, 56%; agriculture, 7%; fire retardants, 6%; soaps and detergents, 5%; and other, 26%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production[1]	626	554	574	550	602
Imports for consumption, gross weight:					
Borax	4	6	14	14	14
Boric acid	3	3	10	18	18
Colemanite	8	12	36	40	40
Ulexite	6	17	60	60	60
Exports, gross weight of boric acid and refined borates	601	569	555	550	230
Consumption: Apparent	346	308	356	373	287
Reported	262	345	321	296	NA
Price, dollars per ton, granulated pentahydrate borax in bulk, c.l., works[2]	247	250	304	294	294
Stocks, yearend[3]	NA	NA	NA	NA	NA
Employment	1,100	900	900	900	900
Net import reliance[4] as a percent of apparent consumption	E	E	E	E	E

Recycling: Insignificant.

Import Sources (1991-94): Boric acid: Italy, 57%; Chile, 31%; and other, 12%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Borates:			
Refined borax:			
Anhydrous	2840.11.0000	0.07¢/kg	0.28¢/kg.
Other	2840.19.0000	0.07¢/kg	0.28¢/kg.
Other	2840.20.0000	3.7% ad val.	25% ad val.
Perborates:			
Sodium	2840.30.0010	3.7% ad val.	25% ad val.
Other	2840.30.0050	3.7% ad val.	25% ad val.
Boric acids	2810.00.0000	1.5% ad val.	8.5% ad val.
Natural borates:			
Calcium	2528.90.0010	Free	Free.
Sodium	2528.10.0000	Free	Free.
Other	2528.90.0050	Free	Free.

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

Government Stockpile: None.

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BORON

Events, Trends, and Issues: The United States was the world's largest producer of boron compounds during 1995 and exported about one-half of domestic production. Exported materials competed with borax, boric acid, colemanite, and ulexite primarily from Turkey, the second largest producer of boron compounds and the largest producer of ore in the world.

Imports of borates from northern Chile continued. About 150,000 tons per year of ulexite is mined in Chile for the production of boric acid; synthetic colemanite; and ulexite for use in ceramics, insulating and reinforcing fiberglass, and agriculture. Shipments are from the Port of Arica.

U.S. companies were improving their process to lessen environmental effects, improve worker safety, and increase efficiency of the operations. In situ production of colemanite began in May using a patented process. Wells are used to pump solution from deposits between 360 and 540 meters under the surface. The boron rich solution is processed to produce a high-purity colemanite. Another company was using a remote haulage vehicle that allows the haulage operator to remain in a safer area of the mine and therefore lessens the chance of an accident due to a roof fall. The lake operations continued to implement improvements that will allow increased production. The process injects heated water from another operation into the upper-mixed layer and recycles the water to produce borax. The largest producing company approved plans to recycle pond waste through dryers and then magnetic separators to reclaim borax. The reclaimed borax would be processed as a supplement to mined ore, thus increasing production efficiency while improving the environment.

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

	Production—all forms		Reserves[7]	Reserve base[7]
	1994	1995[e]		
United States	1,110	1,110	40,000	80,000
Argentina	140	140	2,000	9,000
Bolivia	10	10	4,000	19,000
Chile	110	110	8,000	41,000
China	120	120	27,000	36,000
Iran	1	1	1,000	1,000
Kazakstan	80	80	14,000	15,000
Peru	27	30	4,000	22,000
Russia	190	190	40,000	44,000
Turkey	1,250	1,250	30,000	150,000
World total (may be rounded)	3,000	3,000	170,000	420,000

World Resources: Large domestic resources of boron materials occur in California, chiefly in sediments and their contained brines. Extensive resources also occur in Turkey. World resources are adequate to supply demand at current rates for the foreseeable future.

Substitutes: Substitution for boron materials is possible in applications such 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 the use of chlorine bleach and other enzymes. Some enamels use other glass producing substances, such as phosphates. Insulation substitutes include foams and mineral wools.

[e]Estimated. E Net exporter. NA Not available.
[1]Minerals and compounds sold or used by producers; includes both actual mine production and marketable products.
[2]Chemical Marketing Reporter.
[3]Stocks data are not available and are assumed to be zero for net import reliance and apparent consumption calculations.
[4]Defined as imports - exports + adjustments for Government and industry stock changes.
[5]See Appendix B.
[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 noted)

Domestic Production and Use: The quantity of bromine sold or used in the United States from companies operating in Arkansas and Michigan accounted for 100% of elemental bromine production valued at an estimated $186 million. Arkansas continued to be the Nation's leading bromine producer, and bromine was the leading mineral commodity in terms of value produced in the State.

Estimated bromine use was fire retardants, 27%; agriculture, 15%; petroleum additives, 15%; well drilling fluids, 10%; sanitary preparations, 5%; and other uses, 28%. Other uses included intermediate chemicals used in the manufacture of other products, and bromide solutions used alone or in combinations with other chemicals.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production[1]	170	171	177	195	211
Imports for consumption, elemental bromine and compounds[2]	24	15	19	20	20
Exports, elemental bromine and compounds	17	22	19	20	25
Consumption, apparent[3]	169	157	267	197	206
Price, cents per kilogram, bulk, purified bromine	73.2	73.3	69.5	70.0	88.0
Stocks, producer, yearend, elemental bromine[e]	—	—	—	—	—
Employment, plant	1,200	1,600	1,600	1,600	1,700
Net import reliance[4] as a percent of apparent consumption	—	—	—	—	E

Recycling: Approximately 35% of U.S. bromine production was converted to byproduct sodium bromide solutions, which were recycled to obtain elemental bromine. This recycled bromine is not included in the virgin bromine production reported by the companies.

Import Sources (1991-94): Israel, 76%; Netherlands, 20%; and France, 4%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Bromine	2801.30.2000	7% ad val.	37% ad val.
Ammonium, calcium, or zinc bromide	2827.59.2500	Free	25% ad val.
Decabromodiphenyl and octabromodiphenyl oxide	2909.30.0700	18.6% ad val.	15.4¢/kg + 70.5% ad val.
Ethylene dibromide	2903.30.0500	5.4% ad val.	46.3% ad val.
Hydrobromic acid	2811.19.3000	3.4% ad val.	25% ad val.
Potassium bromate	2829.90.0500	2.5% ad val.	25% ad val.
Potassium or sodium bromide	2827.51.0000	Free	22¢/kg.
Methyl bromide	2903.30.1520	Free	25% ad val.
Sodium bromate	2829.90.2500	3.0% ad val.	25% ad val.
Tetrabromobisphenol A	2908.10.2500	1.4¢/kg + 18% ad val.	15.4¢/kg + 62% ad val.

Depletion Allowance: 5% on brine wells (Domestic and Foreign).

Government Stockpile: None.

Events, Trends, and Issues: Two bromine companies announced plans to expand domestic capacity. One of the companies announced that their bromine production capacity would be increased 30% at its plant in Magnolia, AR. A third company planned to build a bromine plant with capacity between 9 and 14 million kilograms at Manistee, MI. The plant would produce elemental bromine and brominated salts from brines used to produce magnesium. The plant was expected to be completed in late 1996.

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BROMINE

The Environmental Protection Agency planned to work on an essential-use exemption for methyl bromide in the event effective alternatives are not found by 2001. Methyl bromide was listed as a Class I ozone depleting substance in the 1990 Clean Air Act and is scheduled to be phased out in 2001.

Producers of brominated flame retardants have voluntarily agreed to phase out production of some grades of flame retardants considered capable of emitting toxic byproducts when incinerated. The agreement was reached by a joint policy board on chemical safety at the Paris-based Organization for Economic Cooperation and Development (OECD).

Israel, the second largest producer of bromine in the world, canceled the public offering of a 22% share in the state-owned chemical company. The delay in privatization was as a result of the offering not meeting the Government's minimum price.

Israel and Jordan announced a memorandum of understanding to construct a $50 million bromine plant on the Jordanian side of the Dead Sea. The 50-50 joint venture would be managed by the Jordanians, but technical and marketing assistance would be provided by Dead Sea Bromine. The facility would have a capacity of 11 million kilograms per year of bromine. Dead Sea signed an agreement with a domestic producer to provide bromine during a 20-year period.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[6]	Reserve base[6]
	1994	1995[e]		
United States[1]	195.0	211.0	11,000	11,000
Azerbaijan	3.0	3.0	300	300
China	19.0	19.0	NA	NA
France	2.5	2.5	1,600	1,600
Germany	.8	.8	36	36
India	1.4	1.4	([7])	([7])
Israel	135.0	135.0	([8])	([8])
Italy	.3	.3	([7])	([7])
Japan	15.0	15.0	([9])	([9])
Spain	.2	.2	1,400	1,400
Turkmenistan	8.0	8.0	700	700
Ukraine	4.0	4.0	400	400
United Kingdom	28.0	28.0	([7])	([7])
World total (rounded)	410.0	430.0	NA	NA

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. The bromine content of underground water in Poland has been estimated at 36 million tons.

Substitutes: Chlorine and iodine may be substituted for bromine in a few chemical reactions and for sanitation purposes. Aniline and some of its derivatives, methanol, ethanol, and gasoline-grade tertiary butyl alcohol, are effective nonlead substitutes for ethylene dibromide and lead in gasoline in some cars. There are no comparable substitutes for bromine in various oil and gas well completion and packer applications. Alumina, magnesium hydroxide, organic chlorine compounds, and phosphorus compounds can be substituted for bromine as fire retardants in some uses.

[e]Estimated. E Net exporter. NA Not available.
[1]Sold or used by U.S. producers.
[2]Imports calculated from items shown in tariff section.
[3]Includes recycled product beginning in 1993.
[4]Defined as imports - exports + adjustments for Government and industry stock changes.
[5]See Appendix B.
[6]See Appendix C for definitions.
[7]From waste bitterns associated with solar salt.
[8]From the Dead Sea.
[9]From seawater.

CADMIUM

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

Domestic Production and Uses: Two companies, one in Illinois and one in Tennessee, recovered cadmium as a byproduct of the smelting and refining of zinc concentrates. A third company, in Colorado, had been recovering cadmium from other nonferrous sources, such as lead smelter baghouse dust, but halted operations in mid-1993. Based on the average New York dealer price, the output of primary metal in 1995 was valued at $5.3 million. The estimated consumption pattern included batteries, 65%; pigments, 14%; coatings and plating, 9%; stabilizers for engineering plastics and similar synthetic products, 9%; nonferrous alloys, 2%; and other including electrooptics, 1%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, refinery	1,680	1,620	1,090	1,010	1,300
Imports for consumption, metal	2,040	1,960	1,420	1,110	1,040
Exports of metal, alloys, and scrap	448	213	38	1,450	1,050
Shipments from Government stockpile	—	—	185	209	450
Consumption, apparent	3,080	3,330	2,940	1,020	1,600
Price, average, dollars per pound, 99.95% purity in 5-short ton lots, New York dealer	2.01	0.91	0.45	1.13	1.84
Stocks, yearend, producer and distributor	835	868	582	439	540
Employment, smelter and refinery	190	190	195	125	125
Net import reliance[1] as a percent of apparent consumption	46	51	63	1	21

Recycling: Cadmium recycling has been practical only for nickel-cadmium batteries, some alloys, and dust from electric arc furnaces operated by the steel industry. The exact amount recycled is not known. In 1994, the U.S. steel industry generated more than 500,000 tons of electric furnace dust, typically containing 0.003% to 0.07% Cd. Seventeen States are in the process of setting up collection networks for recycling nickel-cadmium batteries.

Import Sources (1991-94): Metal: Canada, 39%; Mexico, 14%; Belgium, 12%; Germany, 8%; and other, 27%.

Tariff: Item	Number	Canada and Mexico 12/31/95	Most favored nation (MFN) 12/31/95	Non-MFN[2] 12/31/95
Cadmium sulfide	2830.30.0000	Free	3.1% ad val.	25% ad val.
Pigments and preparations based on cadmium compounds	3206.30.0000	Free	3.1% ad val.	25% ad val.
Unwrought cadmium; waste and scrap; powders	8107.10.0000	Free	Free	33¢/kg.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Cadmium	2,020	243	2,020	338

Events, Trends, and Issues: Demand for rechargeable nickel-cadmium (Ni-Cd) batteries continues to grow in the Western World, although at a somewhat slower rate than in past years. More than 60% of cadmium consumed by Western countries now goes into batteries, making batteries the principal end use for the chemical element. Japan continues to be, by far, the largest refiner of cadmium and is also a net importer of cadmium metal. About 93% of the cadmium consumed by Japanese industry goes into batteries.

About 75% of the Ni-Cd batteries being produced by Western manufacturers are for cordless electronic equipment. The remaining 25% are used for industrial purposes, such as emergency power supplies for telephone exchanges and hospital operating rooms. This ratio could change dramatically if sales of electric vehicles (EV's) accelerate in the United States, the European Union, and Japan. Ni-Cd batteries could conceivably capture 30% of the midterm (2000-2005) EV battery market, but competition from nickel-metal hydride batteries may be intense because of environmental

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CADMIUM

concerns about cadmium. Much of the present battery research is driven by the impending 1998 deadline requiring 2% of new vehicles sold in California to be emission free. The U.S. Advanced Battery Consortium, a partnership between domestic automobile manufacturers and the Electric Power Research Institute, is working with the U.S. Department of Energy to develop and evaluate advanced battery systems for EV's. The Electric Transportation Coalition, the Electric Vehicle Association of the Americas, and several other support groups are also helping to make affordable EV's a reality. In November 1995, a Swedish public-service organization ordered 150 EV's from a French automobile manufacturer. France is planning to have 100,000 EV's on its highways by the year 2000.

On May 11, 1995, the U.S. Environmental Protection Agency published new, simplified regulations governing the collection and management of spent Ni-Cd batteries and several other widely generated hazardous wastes. The new regulations are designed to encourage environmentally sound recycling of Ni-Cd batteries and keep them out of the municipal waste stream. The bulk of the batteries currently being collected go to a nickel and chromium recovery facility in western Pennsylvania. There, the batteries are crushed, blended with furnace dusts from stainless steel plants, and then smelted in an electric arc furnace. The Pennsylvania plant recently acquired the necessary refining equipment and technology to produce cadmium sticks from the lead-zinc-cadmium dust that collects in the plant's baghouse.

Domestic demand for pigments based on cadmium sulfide and cadmium sulfoselenide reportedly is only one-eighth as large as it was in 1988. The U.S. market for cadmium pigments has shrunk dramatically because of the adoption of stricter environmental regulations and the increased availability of alternative pigments. Both suppliers and consumers are concerned about recyclability and potential liability. Further substitution, however, is becoming increasingly difficult. The alternatives still cannot match many of the properties of cadmium pigments (e.g., color brightness, opacity, heat and light stability, etc.) that have made them popular for decades. Replacement of key cadmium pigments by organic substitutes is not straightforward, especially in applications that require high temperature or pressure processing. Many manufacturers of polyvinylchloride continue to use cadmium-bearing stabilizers to keep their products from degrading when exposed to heat or sunlight. The most popular stabilizers are mixtures of cadmium and barium organic salts (e.g., stearate).

The price of cadmium metal plummeted between 1990-93, bottoming out at an alltime low of $0.38 to $0.48 per pound on June 10, 1993. The collapse was driven by global recessionary forces, loss of markets due to environmental concerns, and the introduction of stricter Federal occupational exposure standards in 1992. The price has partially recovered since 1993 and stood at $2.05 to $2.20 per pound on Nov. 24, 1995.

World Refinery Production, Reserves, and Reserve Base:

	Refinery production		Reserves[3]	Reserve base[3]
	1994	1995[e]		
United States	1,010	1,300	70,000	210,000
Australia	910	950	55,000	150,000
Belgium	1,560	1,600	—	—
Canada	2,130	2,300	80,000	170,000
Germany	1,120	1,200	6,000	8,000
Japan	2,630	2,800	10,000	15,000
Mexico	646	700	35,000	40,000
Other countries	8,110	8,000	280,000	380,000
World total (rounded)	18,100	18,900	540,000	970,000

World Resources: Estimated world resources of cadmium were about 6 million tons based on zinc resources containing about 0.3% cadmium. The zinc-bearing coals of the midcontinental United States and Carboniferous-age coals of other countries also contain large potential resources of cadmium.

Substitutes: Coatings of zinc or vapor-deposited aluminum can substitute for cadmium in some plating applications. However, cadmium is still required in situations where the surface characteristics of the coating are critical (e.g., fasteners for aircraft). Cerous sulfide (Ce_2S_3) is being evaluated as an alternative to some of the red, cadmium-based pigments used to color plastics.

[e]Estimated.
[1]Defined as imports - exports + adjustments for Government and industry stock changes.
[2]See Appendix B.
[3]See Appendix C for definitions.

CEMENT

(Data in thousand metric tons, unless noted)[1]

Domestic Production and Use: One State agency and 45 companies operated 118 plants in 37 States to produce 73.5 million tons of portland cement, 3.5 million tons of masonry cement, and minor quantities of other cement in 1995. The value of the production was about $4.7 billion. At yearend, the capacity of 110 plants producing portland cement clinker, including 3 white cement facilities, reached a level of approximately 233,000 tons daily. Allowing for an average of about 40 days downtime for maintenance and rebricking kilns, the apparent annual clinker production capacity, excluding Puerto Rico, was 76.0 million tons. An additional eight plants operated grinding mills only for imported, purchased, or interplant transfers of clinker. Estimated finish grinding capacity, excluding Puerto Rico, was 91 million tons. The 5 largest companies composed 40% of the clinker production capacity, and the 10 largest accounted for 65%. Fifty percent of the portland cement production came from the following six States in declining order: California, Texas, Pennsylvania, Missouri, Michigan, and Florida. Uses of cement by type of customer were 68% for ready-mix concrete; 14% for manufacturers of concrete products such as block, pipe, and prestressed precast concrete; 9% by highway contractors; 6% by building material dealers; and 3% by other contractors, Government agencies, and miscellaneous users.

Salient Statistics—United States:[2]	1991	1992	1993	1994	1995[e]
Production, portland, masonry, and other	67,193	69,585	73,807	77,900	77,000
Shipments from mills, including masonry cement	72,108	77,814	81,404	89,733	90,000
Imports for consumption	7,893	6,166	7,060	11,303	15,824
Exports	633	746	625	633	600
Consumption, apparent[3]	74,000	75,400	80,514	91,160	92,000
Price, average mill value, dollars per ton	55.54	54.61	56.36	61.88	62.00
Stocks, mill yearend	6,009	5,272	4,788	4,805	4,800
Employment, mine and mill[e]	18,000	18,100	18,000	18,000	18,000
Net import reliance[4] as a percent of apparent consumption	10	7	8	13	17

Recycling: None.

Import Sources (1991-94): Canada, 39%; Spain, 11%; Greece 8%; Venezuela 7%; Mexico, 6%; and other, 29%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Cement clinker	2523.10.0000	Free	$1.32/mt.
White nonstaining portland cement	2523.21.0000	18¢/mt	$1.76/mt.
Other portland cement	2523.29.0000	Free	$1.32/mt.
Aluminous cement	2523.30.0000	Free	$1.32/mt.
Other hydraulic cement	2523.90.0000	Free	$1.32/mt.

Depletion Allowance: Certain raw materials for cement production, such as limestone, bauxite, and gypsum, have depletion allowances.

Government Stockpile: None.

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CEMENT

Events, Trends, and Issues: In 1995, U.S. demand for cement was about 90 million tons, slightly above that of 1994. Imports of cement were up by approximately 40%. The continued strong cement demand led some cement plants to increase cement production by upgrading or modernizing existing facilities. Due to shortages of cement in some areas, cement plants sought to supplement their cement supply by using granulated slag as a replacement for portland cement.

The U.S. Environmental Protection Agency (EPA) issued its final determination on Cement Kiln Dust (CKD). This action was required by the Resource Conservation and Recovery Act. The EPA concluded that additional control of CKD was warranted in order to protect the public from human health risks and to prevent environmental damage resulting from current disposal of this waste. Under Subtitle C of RCRA, the EPA was to develop a tailored set of standards for CKD that would control releases to ground water.

World Production and Capacity:

	Cement production		Yearend clinker capacity	
	1994	1995[e]	1994	1995[e]
United States (includes Puerto Rico)	77,900	77,000	76,000	76,000
Brazil	26,000	28,000	31,000	31,000
China	400,000	410,000	360,000	362,000
France	20,200	24,000	27,000	27,000
Germany	40,400	40,400	49,000	49,000
India	54,000	55,000	64,000	64,000
Italy	40,000	45,000	45,000	45,000
Japan	91,500	92,000	93,000	93,000
Korea, South	52,100	53,000	45,000	45,000
Russia	50,000	55,000	140,000	140,000
Spain	26,000	30,000	30,000	30,000
Turkey	30,000	32,000	27,000	27,000
Other countries	461,000	445,000	411,000	415,000
World total (rounded)	1,370,000	1,390,000	1,400,000	1,400,000

World Resources: Although domestic resources of raw materials are adequate, they are sometimes remote from cement market areas. Countries deficient in one or more raw materials have experienced little difficulty importing their requirements.

Substitutes: Aluminum, steel, fiberglass, wood, stone, and clay products may be used in the building and construction markets.

[e]Estimated.
[1]See Appendix A for conversion to short tons.
[2]Excludes Puerto Rico and the Virgin Islands.
[3]Adjusted to eliminate duplication of imports shipped by domestic cement manufacturers.
[4]Defined as imports - exports + adjustments for Government and industry stock changes.
[5]See Appendix B.

CESIUM

(Data in kilograms of cesium content, unless noted)

Domestic Production and Use: Although cesium was not recovered from any domestically mined ores, it is believed that at least one domestic company manufactured cesium products from imported pollucite ore. Cesium, usually in the form of chemical compounds, was used in research and development and was used commercially in electronic, photoelectric, and medical applications.

Salient Statistics—United States: Salient statistics, such as production, consumption, imports, and exports, are not available.

The cesium market is very small. As a result, there is no active trading in the metal and therefore no official market price. However, several companies publish prices for cesium and cesium compounds. These prices are relatively stable over time periods up to several years in length. The per-unit price for the metal or compound purchased from these companies varies inversely with the quantity of material purchased. For example, in 1995, one company offered 1-gram ampoules of 99.98%-grade cesium metal at $40.80. The price for 100 grams of the same material from this company was $535.00 or $5.35 per gram. At another company, the price for a 1-gram ampoule of 99.95% pure cesium was $45.30.

Recycling: None.

Import Sources (1991-94): The United States is 100% import reliant. Although there is no information on the countries shipping cesium-bearing material to the United States, it is believed that Canada is the major source of this raw material. Other possible sources of cesium-bearing material include Germany and the United Kingdom.

Tariff:

Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[1] 12/31/95
Alkali metals, other	2805.19.0000	6.4% ad val.	25% ad val.
Chlorides, other	2827.39.5000	3.7% ad val.	25% ad val.

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

Government Stockpile: None.

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CESIUM

Events, Trends, and Issues: It was estimated that U.S. demand for cesium remained essentially unchanged. The United States is likely to continue to be dependent upon foreign sources unless domestic deposits are discovered or technology is developed to use low-grade raw materials. The high cost and extreme reactivity of cesium limit its application at present. Because of the small scale of production of cesium products, no significant environmental problems have been encountered.

World Mine Production, Reserves, and Reserve Base: Data on mine production of cesium are not available. Cesium forms independent minerals in pegmatites and is commonly obtained as a coproduct in the processing of titanium, beryllium, and lithium minerals. Reserves and the reserve base are associated mainly with the cesium silicate mineral pollucite, concentrates of which contain more than 20% cesium.

	Reserves[2]	Reserve base[2]
Canada	70,000,000	73,000,000
Namibia	7,000,000	9,000,000
Zimbabwe	23,000,000	23,000,000
Other countries	NA	NA
World total (may be rounded)	100,000,000	110,000,000

World Resources: World resources of cesium are not known.

Substitutes: The properties of rubidium and its compounds are quite similar to those of cesium and its compounds; thus, rubidium and cesium are used interchangeably in many applications.

NA Not available.
[1]See Appendix B.
[2]See Appendix C for definitions.

CHROMIUM

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

Domestic Production and Use: The United States consumes about 12% of world chromite ore production in various forms of imported materials (chromite ore, chromium ferroalloys, chromium metal, and chromium chemicals). Imported chromite was consumed by two chemical firms, one metallurgical firm, and four refractory firms to produce chromium chemicals, chromium ferroalloys, and chromite-containing refractories, respectively. Consumption of chromite ore by end use was: metallurgical and chemical industry, 94%; refractory industry, 6%. Consumption of chromium ferroalloys and metal by end use was: stainless and heat-resisting steel, 79%; full-alloy steel, 8%; superalloys, 3%; and other end uses, 10%. The value of chromium materials consumption was about $385 million. Secondary chromium is recovered from stainless steel scrap.

Salient Statistics—United States:[1]	1991	1992	1993	1994	1995[e]
Production: Mine	—	—	—	—	—
Secondary	96	102	92	99	117
Imports for consumption	310	324	330	273	379
Exports	18	18	21	33	13
Government stockpile releases	17	(30)	68	49	30
Consumption: Reported (excludes secondary)	323	334	327	307	270
Apparent[2] (includes secondary)	413	378	484	390	537
Price, chromite, yearend:					
Turkish, dollars per metric ton, Turkey	130	110	110	110	230
South African, dollars per metric ton, South Africa	50	60	60	60	80
Stocks, industry, yearend	118	118	103	101	76
Net import reliance[3] as a percent of apparent consumption	73	73	75	75	78

Recycling: In 1995, chromium contained in purchased stainless steel scrap accounted for 22% of demand.

Import Sources (1991-94): Chromium contained in chromite ore and chromium ferroalloys and metal: South Africa, 40%; Turkey, 16%; Zimbabwe, 7%; Russia, 6%; and other, 31%.

Tariff:[4] Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Ore and concentrate	2610.00.0000	Free	Free.
Ferrochromium, high-carbon	7202.41.0000	1.9% ad val.	7.5% ad val.

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

Government Stockpile: The stockpile conversion programs by which stockpiled chromite ore is upgraded to ferrochromium and nonstockpile grade ferrochromium is upgraded to chromium metal were completed in 1994.

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95	Average chromium content
Chromite ore:					
Chemical-grade	175	44.7	144	45.4	28.6%
Metallurgical-grade	509	308	509	127	28.6%
Refractory-grade	255	78.4	110	72.6	[e]23.9%
Chromium ferroalloys:					
High-carbon ferrochromium	738	—	427	0.528	71.4%
Low-carbon ferrochromium	283	—	—	—	71.4%
Ferrochromium-silicon	52.9	—	—	—	42.9%
Chromium metal	7.69	—	—	—	[e]100%

Events, Trends, and Issues: Chromite ore is not produced in the United States, Canada, or Mexico. Chromite ore is produced in the Western Hemisphere only in Brazil and Cuba. Virtually all of Brazilian production is consumed in Brazil. Cuban production is small. The two largest chromite ore producers, accounting for two-thirds of world production, are Kazakstan and South Africa. Both are currently in the process of major political change. Economic and political

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CHROMIUM

reorgan ization in the Former Soviet Union has resulted in reduced demand. This lull in demand may be followed by strong growth-driven demand resulting from the institution of reforms in those countries. South Africa has been the major supplier of chromite ore to Western industrialized countries. In 1989-90, world demand for ferrochromium by the metallurgical industry exceeded supply, resulting in increased prices followed by production capacity expansion. Chromite ore prices also increased slightly. The end of the cold war in 1991 coincided with generally weak economic conditions that reduced chromium demand. In 1995, prices recovered from having been suppressed by excess production capacity resulting from the dissolution of the U.S.S.R.[6] in 1991 and excess ferrochromium capacity resulting from expansion worldwide during 1990-92. Western economy demand remains firm while industry restructures.

Chromium releases into the environment are regulated by the U.S. Environmental Protection Agency. Workplace exposure is regulated by the U.S. Occupational Safety and Health Administration.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[7]	Reserve base[7]
	1994	1995[e]	(shipping grade)[8]	
United States	—	—	—	10,000
Albania	223	250	6,100	6,100
Brazil	360	400	10,000	18,000
Finland	573	600	38,000	46,000
India	909	1,000	27,000	59,000
Iran	129	130	2,400	2,400
Kazakstan	2,020	2,500	320,000	320,000
Russia	143	150	4,000	460,000
South Africa	3,590	3,800	3,100,000	5,500,000
Turkey	790	800	8,000	20,000
Zimbabwe	517	550	140,000	930,000
Other countries	319	400	29,000	38,000
World total (rounded)	9,570	10,600	3,700,000	7,400,000

World Resources: World resources exceed 11 billion tons of shipping-grade chromite, sufficient to meet conceivable demand for centuries. About 95% of chromium resources are geographically concentrated in southern Africa. Reserves and reserve base are geographically concentrated in southern Africa and Kazakstan. The largest U.S. chromium resource is in the Stillwater Complex in Montana.

Substitutes: There is no substitute for chromite ore in the production of ferrochromium, chromium chemicals, or chromite refractories. There is no substitute for chromium in stainless steel, the major end use of chromium, nor for chromium in superalloys, the major strategic end use of chromium. Chromium-containing scrap can substitute for ferrochromium in metallurgical uses. Substitutes for chromium-containing alloys, chromium chemicals, and chromite refractories generally increase cost or limit performance. According to the National Academy of Sciences, substituting chromium-free materials for chromium-containing products could result in savings of about 60% of chromium used in alloying metals, about 15% of chromium used in chemicals, and 90% of chromite used in refractories given 5 to 10 years to develop technically acceptable substitutes and accept increased cost.

[e]Estimated.
[1]Data in thousand metric tons of contained chromium, unless noted otherwise.
[2]Calculated demand for chromium is production + imports - exports + stock adjustment.
[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, chapter 26, sections 4661 and 4672) are subject to excise tax.
[5]See Appendix B.
[6]As constituted before Dec. 1991.
[7]See Appendix C for definitions. Reserves and reserve base data rounded to no more than 2 significant figures.
[8]Shipping-grade chromite ore is deposit quantity and grade normalized to 45% Cr_2O_3.

CLAYS

(Data in thousand metric tons, unless noted)

Domestic Production and Use: In 1995, clays were produced in most States except Alaska, Delaware, Hawaii, Rhode Island, Vermont, and Wisconsin. The leading 90 firms supplied 25% of the output, and about 203 firms provided the remainder. Together, these firms operated about 983 mines. Estimated value of all marketable clay produced was about $1.8 billion. Major domestic uses for specific clays were estimated as follows: kaolin—55% paper, 8% kiln furniture, 6% fiberglass, 4% grogs, and 4% paint; ball clay—30% floor and wall tile, 13% pottery, and 24% sanitaryware; fire clay—69% grogs, calcines, and firebrick; bentonite—25% foundry sand bond, 21% drilling mud, and 18% iron ore pelletizing; fuller's earth—75% absorbent uses and 12% insecticide dispersant; and common clay—50% brick, 27% cement, and 14% lightweight aggregate.

Salient Statistics—United States:[1]	1991	1992	1993	1994	1995[e]
Production, mine:					
Kaolin	9,550	8,740	8,830	8,770	9,490
Ball clay	784	854	911	1,050	975
Fire clay[2]	474	383	459	458	412
Bentonite	3,310	2,950	2,870	3,290	3,540
Fuller's earth	2,320	2,410	2,480	2,640	2,500
Common clay	24,600	24,900	25,300	25,900	29,700
Total[3]	41,020	40,200	40,900	42,200	46,600
Imports for consumption	35	41	39	36	39
Exports	4,000	4,160	4,150	4,620	4,505
Consumption, apparent	37,060	36,100	36,600	37,600	42,100
Price, average, dollars per ton:					
Kaolin	96	107	107	116	115
Ball clay	43	42	42	43	49
Fire clay	28	27	25	26	26
Fuller's earth	100	100	92	93	108
Common clay	5	5	5	5	5
Bentonite	37	39	36	41	58
Stocks, yearend[4]	NA	NA	NA	NA	NA
Employment:[e] Mine	5,500	5,000	4,500	3,950	4,900
Mill	9,000	9,000	9,000	9,000	9,000
Net import reliance[5] as a percent of apparent consumption	E	E	E	E	E

Recycling: Insignificant.

Import Sources (1991-94): Mexico, 31%; China, 20%; United Kingdom, 20%; Canada, 15%; and other, 14%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[6] 12/31/95
Kaolin and other kaolinitic clays, whether or not calcined[7]	2507.00.0000	26¢/t	$2.46/t.
Bentonite[7]	2508.10.0000	31.5¢/t	$3.20/t.
Fuller's and decolorizing earths[7]	2508.20.0000	19.7¢/t	$1.48/t.
Fire clay[7]	2508.30.0000	39.4¢/t	$1.97/t.
Common blue and other ball clays[7]	2508.40.0010	37.4¢/t	$1.97/t.
Other clays[7]	2508.40.0050	37.4¢/t	$1.97/t.
Chamotte or dinas earth	2508.70.0000	Free	Free.
Activated clays and earths[8]	3802.90.2000	2.5% ad val.	0.6¢ per kg + 30% ad val.
Expanded clays and mixtures[8]	6806.20.0000	3.9% ad val.	30%. ad val.

Depletion Allowance: Kaolin, ball clay, bentonite, fuller's earth, and fire clay, 14% (Domestic), 14% (Foreign); clay used for extraction of alumina or aluminum compounds, 22% (Domestic); clay and shale used for making brick, tile, and lightweight aggregate, 7.5% (Domestic), 7.5% (Foreign); clay used in making drainage and roofing tile, flowerpots, and kindred products, 5% (Domestic), 5% (Foreign).

Government Stockpile: None.

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CLAYS

Events, Trends, and Issues: The total tonnage and value of clays sold or used by domestic producers increased 10% and 13%, respectively, in 1995. There was an increase in sales and/or use for bentonite, common clay, and kaolin, with the largest increases being in common clay and kaolin. Imports for consumption increased 8% to 39,000 tons. China and Mexico were the major sources for imported clays. Exports decreased 2% to 4.5 million tons. Canada, Finland, Japan, and the Netherlands were major markets for exported clays. U.S. apparent consumption was estimated to be 42 million tons.

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

World Resources: Clays are divided for commercial purposes into kaolin, ball clay, fire clay, bentonite, fuller's earth, and common clay. Resources of these types of clay are extremely large except for lesser resources of high-grade ball clay and sodium-bentonite. Resources of kaolin in Georgia are estimated to be 5 to 10 billion tons.

Substitutes: Limited substitutes and alternatives, such as talc and whiting, are available for filler and extender applications.

[e]Estimated. E Net exporter. NA Not available.
[1]Excludes Puerto Rico.
[2]Refractory uses only.
[3]Data may not add to total 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 B.
[7]Per metric ton.
[8]Ad valorem per kilogram.

COBALT

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

Domestic Production and Use: Domestic mine production ceased at the end of 1971, and the only U.S. cobalt refinery stopped processing imported nickel-cobalt matte in late 1985. Most secondary cobalt is derived from recycled superalloy or cemented carbide scrap and from spent catalysts. About 13 recyclers accounted for nearly all the cobalt recycled in superalloy scrap. There were two producers of extra-fine cobalt powder: One produced powder from imported primary metal and another produced powder from recycled materials. In addition to the powder producers, seven processors were known to be active in the production of cobalt compounds. More than 100 industrial consumers were surveyed on a monthly or annual basis. About 85% of U.S. consumption of cobalt was in five major end uses. Superalloys, used mainly in aircraft gas turbine engines, accounted for about 40% of U.S. demand; catalysts, approximately 13%; paint driers, about 12%; magnetic alloys, about 10%; cemented carbides, about 10%; and other uses, 15%. The total estimated value of cobalt consumed in 1995 was $450 million.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Mine	—	—	—	—	—
Secondary	1,580	1,610	1,570	1,510	1,500
Imports for consumption	6,920	5,760	5,950	6,780	6,800
Exports	1,540	1,420	795	1,360	1,400
Shipments from Government stockpile excesses	—	—	289	1,500	1,100
Consumption:					
Reported (includes secondary)	7,190	6,370	6,420	6,870	6,900
Apparent (includes secondary)	7,790	6,590	7,310	8,400	8,400
Price, average annual spot for cathodes, dollars per pound	16.92	22.93	13.79	24.66	28.70
Stocks, industry, yearend	2,400	1,760	1,460	1,500	1,100
Net import reliance[1] as a percent of apparent consumption	80	76	79	82	82

Recycling: About 1,500 tons of cobalt was recycled from purchased scrap in 1995. This represented about 22% of estimated reported consumption for the year.

Import Sources (1991-94): Cobalt contained in metal, oxide, and salts: Zambia, 26%; Norway, 16%; Canada, 14%; Zaire, 14%; and other, 30%. Since 1991, imports from Canada, Zaire, and Zambia have decreased, while imports from Finland, Norway, and Russia have increased.

Tariff: Item	Number	Most favored nation (MFN)[2] 12/31/95	Non-MFN[3] 12/31/95
Unwrought cobalt, alloys	8105.10.3000	5.3% ad val.	45% ad val.
Unwrought cobalt, other	8105.10.6000	Free	Free.
Cobalt matte, waste and scrap	8105.10.9000	Free	Free.
Wrought cobalt and cobalt articles	8105.90.0000	5.1% ad val.	45% ad val.
Chemical compounds:			
Cobalt oxides and hydroxides	2822.00.0000	0.1% ad val.	1.7% ad val.
Cobalt sulfates	2833.29.1000	1.4% ad val.	6.5% ad val.
Cobalt chlorides	2827.34.0000	4.2% ad val.	30% ad val.
Cobalt carbonates	2836.99.1000	4.2% ad val.	30% ad val.
Cobalt acetates	2915.23.0000	4.2% ad val.	30% ad val.
Cobalt ores and concentrates	2605.00.0000	Free	Free.

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

Government Stockpile: Sales of National Defense Stockpile cobalt began in March 1993. According to the Defense Logistics Agency's Annual Materials Plan for fiscal year 1996, the maximum amount of cobalt that could be sold in the year beginning October 1, 1995, would be 1,810 tons (4 million pounds).

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Cobalt	20,100	1,010	1,930	1,830

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COBALT

Events, Trends, and Issues: World cobalt supply and demand were considered to be in close balance. World refinery production in the first half of 1995 was higher than production during the first half of 1994. Cobalt exports from Russia and sales from the National Defense Stockpile continued to contribute to supply. In spite of the supply/demand balance, prices remained high. The free market price for cobalt cathode was between $27 and $31 per pound from January through mid-October. The cobalt reference price set by Zaire and Zambia was $25 per pound from October 1994 through mid-February 1995, when it was increased to $27.50 per pound.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	1994	1995[e]		
United States	—	—	—	860,000
Albania	10	—	—	23,000
Australia	2,100	2,400	23,000	90,000
Canada	4,330	5,100	45,000	260,000
Cuba	1,000	1,100	1,000,000	1,800,000
New Caledonia[5]	800	800	230,000	860,000
Philippines	—	—	—	400,000
Russia	3,300	3,300	140,000	230,000
Zaire	2,000	2,000	2,000,000	2,500,000
Zambia	3,500	3,300	360,000	540,000
Other countries	1,490	1,500	90,000	1,200,000
World total (may be rounded)	18,500	19,500	4,000,000	8,800,000

World Resources: The cobalt resources of the United States are estimated to be about 1.3 million tons. Most of these resources are in Minnesota, but other important occurrences are in Alaska, California, Idaho, Missouri, Montana, and Oregon. Although large, most domestic resources are in subeconomic concentrations that will not be economical in the foreseeable future. In addition, with the exception of Idaho, any cobalt production from these deposits would be as a byproduct of another metal. The identified world cobalt resources are about 11 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 Zaire and Zambia. In addition, millions of tons of hypothetical and speculative cobalt resources exist in manganese nodules and crusts on the ocean floor.

Substitutes: Periods of high prices and concern about availability have resulted in various efforts to conserve, reduce, or substitute cobalt. In many applications, further 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 hydroformulation catalysts; and manganese, iron, cerium, or zirconium in paints.

[e]Estimated.
[1]Defined as imports - exports + adjustments for Government and industry stock changes.
[2]No tariff for Canada or Mexico.
[3]See Appendix B.
[4]See Appendix C for definitions.
[5]Overseas territory of France.

COLUMBIUM (NIOBIUM)

(Data in thousand kilograms of columbium content, unless noted)

Domestic Production and Use: There has been no significant columbium-mining industry since 1959, with the exception of small unreported quantities of columbium-bearing concentrates produced in 1989-92. Most metal, ferrocolumbium, other alloys, and compounds were produced by six companies with seven plants. Feed for these plants included imported concentrates, columbium oxide, and ferrocolumbium. Consumption was mainly as ferrocolumbium by the steel industry and as columbium alloys and metal by the aerospace industry, with plants in the Eastern and Midwestern United States, California, and Washington. The estimated value of reported columbium consumption, in the form of ferrocolumbium and nickel columbium, in 1995 was about $56 million. Major end-use distribution of reported columbium consumption was as follows: high-strength low-alloy steels, 38%; carbon steels, 30%; superalloys, 18%; stainless and heat-resisting steels, 13%; and other, 1%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, mine	([1])	([1])	—	—	—
Imports for consumption:					
Concentrates, tin slags, and other[2]	NA	NA	NA	NA	NA
Ferrocolumbium[e]	2,130	2,450	2,190	2,590	3,000
Exports, concentrate, metal, alloys, waste, and scrap[e]	270	350	300	320	400
Consumption, reported:					
Raw material	NA	NA	NA	NA	NA
Ferrocolumbium[e 3]	2,410	2,470	2,470	2,750	2,830
Consumption, apparent	3,310	3,500	3,500	3,700	3,900
Price: Columbite, dollars per pound[4]	2.83	2.83	2.67	2.60	2.90
Pyrochlore, dollars per pound[5]	2.75	2.75	2.75	NA	NA
Stocks, industry, processor and consumer, yearend	NA	NA	NA	NA	NA
Employment, processor	NA	NA	NA	NA	NA
Net import reliance[6] as a percent of apparent consumption	100	100	100	100	100

Recycling: Insignificant.

Import Sources (1991-94): Brazil, 65%; Canada, 25%; Germany, 4%; and other, 6%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[7] 12/31/95
Columbium ores and concentrates	2615.90.6030	Free	Free.
Columbium oxide	2825.90.1500	3.7% ad val.	25% ad val.
Ferrocolumbium	7202.93.0000	5.0% ad val.	25% ad val.
Columbium, unwrought:			
Waste and scrap	8112.91.0500	Free	Free.
Alloys, metal, and powders	8112.91.4000	4.9% ad val.	25% ad val.
Columbium, wrought	8112.99.0000	5.2% ad val.	45% ad val.

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

Government Stockpile: The uncommitted inventories shown below include 341,000 kilograms in nonstockpile-grade concentrates and 151,000 kilograms in nonstockpile-grade ferrocolumbium; and 50,000 kilograms in concentrates, 113,000 kilograms in ferrocolumbium, and 54,000 kilograms in columbium metal ingots with status (inventory) not yet determined.

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Columbium:				
Carbide powder	10	—	—	—
Concentrates	831	—	—	—
Ferrocolumbium	535	—	—	—
Metal	54	—	—	—

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COLUMBIUM (NIOBIUM)

Events, Trends, and Issues: For the first one-half-year, overall reported consumption of columbium increased by about 10% compared with that of the previous year. Consumption of columbium by the steelmaking sector rose by about 6%, influenced by a 7% increase in raw steel production. Additionally, demand for columbium in superalloys was up significantly, affected by an improving aerospace market. For the same period, overall columbium imports were down slightly. Brazil was the leading supplier, providing more than 60% of total imports. In mid-October, the published price for columbite ore was quoted at a range of $2.80 to $3.20 per pound of contained columbium and tantalum pentoxides. The published price for steelmaking-grade ferrocolumbium was quoted at $6.58 per pound of contained columbium, and for high-purity ferrocolumbium and nickel columbium at $18.50 and $20.50 per pound of contained columbium, respectively. The published price for columbium oxide was quoted at $8.17 per pound of oxide, and the published price for columbium metal was quoted at a range of $30 to $50 per pound.

It is estimated that in 1996 domestic columbium mine production will be zero and U.S. apparent consumption will be about 4 million kilograms. The majority of total U.S. demand will be mainly supplied by columbium imports in upgraded forms.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[e 8]	Reserve base[e 8]
	1994	1995[e]		
United States	—	—	—	Negligible
Australia	81	90	NA	NA
Brazil	12,700	11,000	3,300,000	3,600,000
Canada	2,320	2,400	140,000	410,000
Nigeria	17	20	64,000	91,000
Rwanda	3	3	NA	NA
Zaire	1	5	32,000	91,000
Zimbabwe	1	1	NA	NA
Other countries[9]	—	1	6,000	9,000
World total (rounded)	15,200	13,500	3,500,000	4,200,000

World Resources: Most of the world's identified resources of columbium are outside the United States and occur mainly as pyrochlore in carbonatite deposits. On a worldwide basis, resources are more than adequate to supply projected needs. The United States has approximately 360 million kilograms of columbium resources in identified deposits, most of which were considered uneconomic at 1995 prices for columbium.

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

[e]Estimated. NA Not available.
[1]A small unreported quantity was produced.
[2]Metal, alloys, synthetic concentrates, and columbium oxide.
[3]Includes nickel columbium and a small quantity of other columbium materials.
[4]Average value, contained pentoxides for material having a Cb_2O_5 to Ta_2O_5 ratio of 10 to 1.
[5]Average value, contained pentoxide.
[6]Defined as imports - exports + adjustments for Government and industry stock changes.
[7]See Appendix B.
[8]See Appendix C for definitions.
[9]Excludes any production from Bolivia, China, and countries in the Former Soviet Union.

COPPER

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

Domestic Production and Use: Domestic mine production in 1995 continued its upward trend, begun in 1984, rising to almost 1.9 million metric tons valued at about $5.7 billion. The five principal mining States, in descending order, Arizona, Utah, New Mexico, Montana, and Michigan, accounted for 97% of domestic production; copper was also recovered at mines in seven other States. While copper was recovered at about 40 mines operating in the United States, 15 mines accounted for about 95% of production. Seven primary and 4 secondary smelters, 7 electrolytic and 6 fire refineries, and 15 solvent extraction-electrowinning operations were operating at yearend. Refined copper and direct melt scrap were consumed at about 35 brass mills, 15 rod mills, and 600 foundries, chemical plants, and miscellaneous consumers. Copper and copper alloy products were consumed[1] in building construction, 42%; electric and electronic products, 22%; industrial machinery and equipment, 13%; transportation equipment, 13%; and consumer and general products, 10%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Mine	1,630	1,760	1,800	1,810	1,890
Refinery: Primary[2]	1,580	1,710	1,790	1,830	1,910
Secondary[3]	418	433	460	392	370
Copper from all old scrap	518	554	543	500	490
Imports for consumption:					
Ores and concentrates	61	102	37	82	150
Refined	289	289	343	470	420
All imports	512	593	637	763	830
Exports: Ores and concentrates	253	266	227	261	250
Refined	263	177	217	157	240
All exports	806	676	685	752	850
Consumption: Refined, reported	2,050	2,180	2,360	2,680	2,590
Apparent, primary and old scrap[4]	2,090	2,300	2,510	2,680	2,570
Price, average, cents per pound:					
Domestic producer, cathode	109.3	107.4	91.6	111.0	137
London Metal Exchange, high-grade	106.0	103.7	86.8	104.6	132
Stocks, yearend, refined[5]	132	205	153	119	135
Employment, mine and mill, thousands	13.7	13.6	13.3	13.2	13.3
Net import reliance[6] as a percent of apparent consumption	E	2	7	13	6

Recycling: Old scrap, converted to refined metal and alloys, provided 460,000 tons of copper or 18% of apparent consumption. Purchased new scrap, derived from copper fabricating operations, yielded 850,000 tons of contained copper; 80% of the copper contained in new scrap was consumed at brass mills. Of the total copper recovered from scrap, copper smelters and refiners recovered 27%; ingot makers, 10%; brass mills, 58%; and miscellaneous manufacturers, foundries, and chemical plants, 5%. Copper in all old and new, refined or remelted scrap comprised 39% of U.S. copper supply.

Import Sources (1991-94): Canada unalloyed, 49%; Chile, 18%; Mexico, 12%; and other, 21%. Refined copper comprised 57% of imports of unwrought copper.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Canada 12/31/95	Mexico 12/31/95	Non-MFN[7] 12/31/95
Unrefined copper; anodes	7402.00.0000	0.8% ad val.[8]	Free	0.6% ad val.[8]	6% ad val.[8]
Refined and alloys; unwrought	7403.00.0000	1% ad val.	Free	Free	6% ad val.
Copper powder	7406.10.0000	4.3% ad val.	1.6% ad val.	Free	49% ad val.
Copper wire (bare)	7408.11.6000	3.8% ad val.	1.2% ad val.	Free	28% 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.

Events, Trends, and Issues: World mine production of copper, which had declined in the previous 2 years, rose by

Prepared by **Daniel L. Edelstein, (703) 648-4978.**

COPPER

about 400,000 tons, principally owing to major increases in production in Canada, Chile, Indonesia, and the United States. Higher prices allowed several Canadian mines to reopen. In Chile, a full year's production from a mine commissioned late in 1994 and expansions of existing mines accounted for most of the increase. Though plans were underway to recapture some lost capacity in Zaire, political turmoil continued to keep that country's copper production all but shuttered. While world production of refined copper rose by about 400,000 tons, world consumption rose by more than 500,000 tons. As a result, global inventories declined for the second consecutive year; in June, the combined stocks held on both the Commodity Exchange, Inc. (COMEX) and the London Metal Exchange, Ltd. (LME) fell to the lowest level in 5 years. Conversely, prices rose to their highest levels in 5 years. The LME opened U.S. warehouses early in the year: The first deliveries to these warehouses were made in July, when LME copper traded at a slight premium compared with that on COMEX.

In the United States, mine production rose as a result of capital investments made at several mines during the past 2 years, increased capacity utilization at several leaching operations that had been affected by heavy rains in 1993-94, and a major expansion at one mine late in 1994. Several small operations were also scheduled for startup late in 1995. One underground mine in Michigan that had experienced rising costs during 1994 closed in September, along with its associated refinery; the smelter had closed earlier in the year. In Utah, a large new smelter, replacing an existing smelter, started production at midyear. A major secondary smelter closed at yearend 1994, followed by its associated refinery and wire rod mill in February and October, respectively. Domestic demand for refined copper declined in 1995, following 3 years of exceptional growth.

Domestic copper companies continued to look toward South American investments to increase their capacity and lower their average production costs. Three domestic companies continued to invest in Peruvian properties acquired in 1994, and one company acquired the rights to develop the El Abre project in Chile.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[9]	Reserve base[9]
	1994	1995[e]		
United States	1,810	1,890	45,000	90,000
Australia	416	420	7,000	23,000
Canada	623	740	11,000	23,000
Chile	2,220	2,350	88,000	163,000
China	350	350	3,000	8,000
Indonesia	322	380	11,000	15,000
Kazakstan	202	220	14,000	20,000
Peru	399	400	7,000	24,000
Philippines	110	115	7,000	11,000
Poland	328	340	20,000	36,000
Russia	573	600	20,000	30,000
Zaire	40	40	10,000	30,000
Zambia	385	350	12,000	34,000
Other countries	1,660	1,600	55,000	100,000
World total (rounded)	9,430	9,800	310,000	610,000

World Resources: Land-based resources are estimated at 1.6 billion tons of copper, and resources in deep-sea nodules are estimated at 0.7 billion tons.

Substitutes: Aluminum substitutes for copper in various products, such as electrical equipment, automobile radiators, and refrigerator tubing. Titanium and steel are used in heat exchangers, and steel is used for artillery shell casings. Optical fiber substitutes for copper in some telecommunications applications. Plastics also substitute for copper in water pipe, plumbing fixtures, and many structural applications.

[e]Estimated. E Net exporter.

[1]Some electrical components are included in each end use. Estimated after Copper Development Association, 1994.

[2]Includes production from imported ores and concentrates.

[3]From both primary and secondary refineries.

[4]Defined as primary refined production + copper from old scrap converted to refined metal and alloys + refined imports - refined exports ± changes in refined stocks.

[5]Held by industry, Government, and the Commodity Exchange, Inc.; Government stocks were liquidated in 1993.

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

[7]See Appendix B.

[8]Value of copper content.

[9]See Appendix C for definitions.

DIAMOND (INDUSTRIAL)

(Data in million carats, unless noted)

Domestic Production and Use: Synthetic diamond production maintained its record-high level. Most industrial diamond produced domestically was synthetic grit and powder. The output was from two firms, one each in New Jersey and Ohio. Seven firms recovered and sold industrial diamond as the principal product. About 35 firms recovered industrial diamond in secondary operations. Major uses of all industrial diamond were machinery, 27%; mineral services, 18%; stone and ceramic products, 17%; abrasives, 16%; contract construction, 13%; transportation equipment, 6%; and other, 3%. The mineral services industry, primarily drilling, accounted for 59% of stone consumption.

Salient Statistics—United States:[1]	1991	1992	1993	1994	1995[e]
Bort, grit, and powder and dust, natural and synthetic:					
Production: Manufactured diamond	90.0	95.0	105	104	115
Secondary	3.5	3.4	15.9	16.0	26.1
Imports for consumption	70.0	97.3	133	174	200
Exports and reexports	78.8	83.6	107	153	120
In manufactured products[e]	.6	.6	.6	.4	.8
Sales from Government stockpile excesses	5.0	10.4	—	2.0	.2
Consumption, apparent	89.1	122	146	141	222
Price, value of imports, dollars per carat	.83	.70	.61	.51	.46
Net import reliance[2] as a percent of apparent consumption	E	19	18	15	36
Stones, natural:					
Production: Mine	—	—	—	—	—
Secondary	.3	.1	.1	.1	.3
Imports for consumption	7.6	9.8	5.2	2.8	3.9
Exports and reexports[3]	2.9	5.6	3.4	4.4	5.6
Sales from Government stockpile excesses	—	—	1.3	3.1	.3
Consumption, apparent	5.0	4.3	1.9	1.5	—
Price, value of imports, dollars per carat	6.68	4.56	6.85	9.41	6.66
Net import reliance[2] as a percent of apparent consumption	94	98	95	95	E

Recycling: About 26.4 million carats were salvaged in secondary production from salvage stone, sludge, and swarf.

Import Sources (1991-94): Bort, grit, and powder and dust, natural and synthetic: Ireland, 63%; China, 7%; Russia, 7%; and other, 23%. Stone, natural: United Kingdom, 30%; Zaire, 23%; Ireland, 16%; and other, 31%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[4] 12/31/95
Miners' diamond, carbonados	7102.21.1010	Free	Free.
Other	7102.21.1020	Free	Free.
Industrial diamond, natural advanced	7102.21.3000	3.9% ad val.	30% ad val.
Industrial diamond, natural not advanced	7102.21.4000	Free	Free.
Industrial diamond, other	7102.29.0000	Free	Free.
Dust, grit, or powder	7105.10.0000	Free	Free.

Prepared by **Industrial Diamond Specialist (703) 648-7721.**

DIAMOND (INDUSTRIAL)

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

Government Stockpile: Excess crushing bort and industrial stones were sold at auction.

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Crushing bort	2.0	—	1.7	0.22
Industrial stones	5.1	0.09	2.1	0.26

Events, Trends, and Issues: The industrial diamond industry experienced another robust year, and U.S. consumption is estimated to have increased significantly. Total U.S. sales, including exports, were up. It is estimated that the industrial diamond worldwide market performed similarly to the U.S. market. Companies in Ireland, South Africa, Sweden, Germany, South Korea, and the United States increased production capacity for synthetic industrial diamond during 1995.

World Mine Production, Reserves, and Reserve Base:[5]

	Mine production		Reserves[e 6]	Reserve base[e 6]
	1994	1995[e]		
United States	—	—	—	Unknown
Australia	23.8	23.0	500	900
Botswana	5.0	5.0	130	200
Brazil	.9	.9	5	15
China	.9	.8	10	20
Russia	8.5	8.0	40	65
South Africa	5.8	6.0	70	150
Zaire	13.0	5.0	150	350
Other countries	.8	1.3	80	200
World total (may be rounded)	58.7	50.0	980	1,900

World Resources: The potential to discover diamond resources in the United States, Canada, and Russia has improved. However, evaluation of deposits already discovered will take several more years. Technology has been developed to synthesize diamond for industrial use worldwide in the range of sizes of powder, dust, and grit; and firms in the United States and Japan manufacture synthetic stones. World resources of natural industrial diamond in the stone-size range are unknown.

Substitutes: Competitive materials are cubic boron nitride, fused aluminum oxide, and silicon carbide as manufactured abrasive materials and garnet, emery, and corundum as natural abrasive minerals. Synthesized polycrystalline diamond was competitive with natural stones in many applications. Research continued on additional uses of synthetic polycrystalline compacts and shapes as substitutes for stones and the uses of diamond films and diamond-like carbon coatings.

[e]Estimated. E Net exporter.
[1]Industry stocks and employment were unknown.
[2]Defined as imports - exports including reexports + adjustments for Government and industry stock changes.
[3]Includes diamonds in manufactured abrasive products.
[4]See Appendix B.
[5]Natural industrial diamond only.
[6]See Appendix C for definitions.

DIATOMITE

(Data in thousand metric tons, unless noted)

Domestic Production and Use: The estimated value of processed diatomite, f.o.b. plant, was $174 million in 1995. Six companies with 12 processing facilities in 4 States produced diatomite. California and Nevada were the principal producing States. End uses of diatomite were filter aid, 73%; fillers, 14%; and other, 13%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production[1]	610	595	599	613	670
Imports for consumption	1	([2])	([2])	([2])	([2])
Exports	152	163	165	157	145
Consumption, apparent	458	432	436	456	525
Price, average value, dollars per ton, f.o.b. plant	229	237	251	248	259
Stocks, producer, yearend	36	36	36	36	36
Employment, mine and plant[e]	1,000	1,000	1,000	1,000	1,000
Net import reliance[3] as a percent of apparent consumption	E	E	E	E	E

Recycling: None.

Import Sources (1991-94): Mexico, 60%; France, 22%; Canada, 5%; and other, 13%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[4] 12/31/95
Diatomite, crude or processed	2512.00.0000	Free	Free.

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

Government Stockpile: None.

Prepared by **Diatomite Specialist, (703) 648-7710.**

DIATOMITE

Events, Trends, and Issues: The United States remained the largest producer and consumer of diatomite and exported processed diatomite to more than 50 countries, primarily for filtration use.

All domestic mining is by open pit, and challenging land use problems exist. Control of dust in mining is assisted by the high moisture content of the crude ore. Effective control of silica dust in processing is facilitated by enclosure of the process.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[5]	Reserve base[5]
	1994	1995[e]		
United States[1]	613	670	250,000	500,000
Denmark[6]	96	95		NA
France	250	250	Other	2,000
Germany	52	50	countries:	NA
Korea, South	70	70	550,000	NA
Mexico	46	50		2,000
Spain	36	40		NA
Former Soviet Union[7]	120	120		NA
Other countries	157	160		NA
World total (may be rounded)	1,440	1,500	800,000	Large

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

Substitutes: Many alternate materials can be substituted for diatomite. However, the unique properties of diatomite assure its continuing use for many applications. Expanded perlite, asbestos, and silica sand compete for filtration purposes, although, in most instances, diatomite is a superior material. Alternate filler materials include talc, ground silica sand, ground mica, clay, perlite, vermiculite, and ground limestone. For thermal insulation, materials such as brick, clay, asbestos, 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 B.
[5]See Appendix C for definitions.
[6]Includes sales of moler production.
[7]As constituted before Dec. 1991.

FELDSPAR

(Data in thousand metric tons, unless noted)

Domestic Production and Use: U.S. feldspar production (including aplite) in 1995 had an estimated value of $32 million. The three largest producers accounted for about two-thirds of the output, with five other companies supplying the remainder. Operations in North Carolina provided more than 60% of the output and facilities in five other States contributed smaller quantities.

Production of lithium ores and mica yielded moderate quantities of byproduct or coproduct feldspar and feldspar-silica mixtures and feldspar processors reported coproduct recovery of mica and silica sand.

Feldspar is ground for industry use 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 31 States and to foreign destinations, including Canada and Mexico. In ceramics and glass, feldspar functions as a flux. Estimated 1995 end-use distribution of domestic feldspar was glass, 63%; and pottery and other, 37%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, marketable	580	726	770	765	770
Imports for consumption	18	13	7	7	8
Exports	8	18	18	17	17
Consumption, apparent	590	721	759	755	761
Price, average value, marketable production, dollars per ton	44.83	39.31	40.78	40.78	41.56
Stocks, producer, yearend[1]	NA	NA	NA	NA	NA
Employment, mine and preparation plant	430	400	400	400	400
Net import reliance[2] as a percent of apparent consumption	E	2	E	E	E

Recycling: Insignificant.

Import Sources (1991-94): Mexico, 99%; and other, 1%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[3] 12/31/95
Feldspar	2529.10.0000	Free	49¢/t.

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

Government Stockpile: None.

Prepared by **Michael J. Potter, (703) 648-7723.**

FELDSPAR

Events, Trends, and Issues: Feldspar consumption in plumbing fixtures, tile, and glass fiber insulation reflected trends in construction activity. Total construction spending for 1995 was projected by a non-Government source to show an increase of 2% to 3% compared with that of 1994. In residential construction, total housing starts were expected to decrease about 8% in 1995 to 1.3 million units. All segments of nonresidential construction were projected to have good growth: commercial (office, retail, and hotel construction), industrial, and institutional. Residential remodeling was also active.

Shipments of glass containers, feldspar's largest end use, were forecast to decrease about 3% in 1995, according to the same non-Government source cited above. Glass has faced competition from plastic and other types of containers.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves and reserve base[4]
	1994	1995[e]	
United States	765	770	Significant in the United States and assumed to be similar in other countries.
Brazil	145	145	
France	300	310	
Germany	350	350	
India	67	70	
Italy	1,600	1,600	
Japan	53	60	
Korea, South	500	510	
Mexico	130	130	
Norway	100	100	
Russia	55	55	
Spain	200	210	
Thailand	600	600	
Turkey	500	500	
Uzbekistan	70	70	
Venezuela	230	230	
Other countries	585	590	
World total	6,250	6,300	

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 granites, pegmatites, and feldspathic sands generally have not been compiled. There is ample geologic evidence that resources are immense, although not always conveniently accessible from the principal centers of consumption.

Substitutes: Feldspar can be replaced in some of its end uses by feldspar-silica mixtures, clays, talc, pyrophyllite, spodumene, or electric-furnace slag. Imported nepheline syenite, however, was the major alternate 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]See Appendix B.
[4]See Appendix C for definitions.

FLUORSPAR

(Data in thousand metric tons, unless noted)

Domestic Production and Use: In 1995, fluorspar shipments totaled 48,000 tons from one mining company in southern Illinois. An estimated 74% of the reported fluorspar consumption in the United States in 1995 went into the production of hydrofluoric acid (HF) in Louisiana, Texas, and Kentucky. HF is the primary ingredient from which virtually all organic and inorganic fluorine-bearing chemicals are produced, and is also a key ingredient in the processing of aluminum and uranium. An estimated 9% of the fluorspar was consumed as a flux in steelmaking and in iron and steel foundries. The remainder was consumed in aluminum fluoride manufacture, primary aluminum production, glass manufacture, enamels, welding-rod coatings, and other end uses or products. To supplement domestic fluorine supplies, about 52,300 tons of fluorosilicic acid (equivalent to 92,000 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, and to make aluminum fluoride for the aluminum industry.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Finished, all grades[e 1]	58	51	56	[2]49	48
Fluorspar equivalent from phosphate rock	106	106	116	97	102
Imports for consumption:					
Acid grade	412	423	434	433	419
Metallurgical grade	83	111	63	59	112
Fluorspar equivalent from hydrofluoric acid plus cryolite	128	106	99	108	124
Exports[3]	74	14	13	24	52
Sales from Government stockpile	—	4	21	273	186
Consumption: Apparent[4]	485	569	537	543	603
Reported	484	485	447	486	510
Stocks, yearend, consumer and dealer	69	72	75	300	335
Employment, mine and mill[e]	180	180	180	180	180
Net import reliance[5] as a percent of apparent consumption	88	91	90	91	92

Recycling: Primary aluminum producers recycled HF and fluorides from smelting operations. HF is recycled in the petroleum alkylation process.

Import Sources (1991-94): China, 56%; South Africa, 23%; Mexico, 16%; and other, 5%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[6] 12/31/95
Acid grade (more than 97% CaF_2)	2529.22.0000	$1.66/t	$5.51/t.
Metallurgical grade (less than 97% CaF_2)	2529.21.0000	Free	13.5% ad val.

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

Government Stockpile: In fiscal year 1995, the Defense National Stockpile Center (DNSC) was originally authorized to sell 40,000 short dry tons (sdt) of metallurgical grade and 200,000 sdt of acid grade. The disposal authority was subsequently revised to 80,000 sdt of metallurgical grade and 90,000 sdt of acid grade. During the period January through September 1995, the DNSC sold 40,000 Sdt of metallurgical grade from the stockpile at Memphis, TN; 40,000 sdt of metallurgical grade from the stockpile at Pine Bluff, AR; and 89,000 sdt of acid grade from the stockpile at Northgate, CO. An additional 36,000 sdt of acid grade was sold from the Northgate, CO, stockpile, pending approval of the fiscal year 1996 annual materials plan.

Prepared by **M. Michael Miller, (703) 648-7716.**

FLUORSPAR

Stockpile Status—9-30-95
(Thousand short dry tons)

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Acid grade	545	300	516	89
Metallurgical grade	289	73	289	80

Events, Trends, and Issues: China, the world's largest fluorspar producer, restructured its export license/quota system in an attempt to address problems with the existing system. Bids by exporters were restricted to those that fell within a certain percentage range above and below the established average bidding price. The price range was determined by the bidding committee based on international market price, domestic supply, and export costs. The price range was announced prior to the commencement of bidding.

As required by the Montreal Protocol and the Clean Air Act Amendments of 1990, most U.S. production of chlorofluorocarbons (CFC's) ceased on December 31, 1995. The current market for CFC's and their replacements is muddled. The demand for the major replacement, HFC-134a, is lower than expected. Producers of HCFC-22 are finding that feedstock costs are high and margins low. In the case of HFC-134a, many customers are still relying on CFC-12, which will no longer be produced for domestic use after December 31, 1995. Producers expect U.S. supplies of CFC-12 will likely be exhausted by 1997-98.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[7 8]	Reserve base[7 8]
	1994	1995[e]		
United States	49	48	W	10,000
Brazil	90	90	W	W
China	2,100	2,100	27,000	46,000
France	125	120	10,000	14,000
Kenya	64	70	2,000	3,000
Mexico	327	490	19,000	23,000
Morocco	85	90	W	W
South Africa	174	230	30,000	36,000
Spain	95	90	6,000	8,000
United Kingdom	59	60	2,000	3,000
Other countries	682	680	[9]114,000	[10]167,000
World total (may be rounded)	3,850	4,070	210,000	310,000

World Resources: Identified world fluorspar resources were approximately 400 million tons of contained fluorspar. Resources of equivalent fluorspar from domestic phosphate rock were approximately 32 million tons. World resources of fluorspar from phosphate rock were estimated at 330 million tons.

Substitutes: Olivine and/or dolomitic limestone were used as substitutes for fluorspar. Byproduct fluorosilicic acid from phosphoric acid production was used as a substitute in aluminum fluoride production.

[e]Estimated. W Withheld to avoid disclosing company proprietary data.
[1]Shipments.
[2]Includes fluorspar from National Defense Stockpile reprocessed by Ozark-Mahoning Co., Illinois.
[3]Exports are all general imports reexported.
[4]Excludes fluorspar equivalent of fluorosilicic acid, hydrofluoric acid, and cryolite.
[5]Defined as imports - exports + adjustments for Government and industry stock changes.
[6]See Appendix B.
[7]See Appendix C for definitions.
[8]Measured as 100% calcium fluoride.
[9]Includes Brazil, Morocco, and the United States.
[10]Includes Brazil and Morocco.

GALLIUM

(Data in kilograms of gallium content, unless noted)

Domestic Production and Use: No domestic primary gallium recovery was reported in 1995. Two companies in Oklahoma and Utah recovered and refined gallium from scrap and impure gallium metal. Imports of gallium, which supplied most of U.S. gallium consumption, were valued at about $3.5 million. Gallium arsenide (GaAs) components represented about 95% of domestic gallium consumption. About 65% of the gallium consumed was used in optoelectronic devices, which include light-emitting diodes (LED's), laser diodes, photodetectors, and solar cells. Integrated circuits represented 33% of gallium demand, and the remainder was used in research and development, specialty alloys, and other applications. Optoelectronic devices were used in areas such as consumer goods, medical equipment, industrial components, telecommunications, and aerospace applications. Integrated circuits were used in defense applications and high-performance computers.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, primary[e]	—	—	—	—	—
Imports for consumption	11,300	8,480	15,600	16,900	15,500
Exports	NA	NA	NA	NA	NA
Consumption: Reported	11,200	10,600	11,300	15,500	15,000
Consumption: Apparent	NA	NA	NA	NA	NA
Price, yearend, dollars per kilogram, 99.99999%-pure	525	425	400	395	425
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, refinery[e]	20	20	20	20	20
Net import reliance[1] as a percent of apparent consumption	NA	NA	NA	NA	NA

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

Import Sources (1991-94): France, 41%; Germany, 26%; Russia, 13%; United Kingdom, 4%; and other, 16%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[2] 12/31/95
Gallium metal	8112.91.1000	3.7% ad val.	25.0% ad val.
Gallium arsenide wafers, undoped	2851.00.0010	2.8% ad val.	25.0% ad val.
Gallium arsenide wafers, doped	3818.00.0010	Free	25.0% ad val.

Depletion Allowance: Not applicable.

Government Stockpile: None.

Prepared by **Deborah A. Kramer, (703) 648-7719.**

GALLIUM

Events, Trends, and Issues: One area in which intense research is being conducted is in the production of laser diodes and LED's that emit blue light. Researchers in the United States and Japan are committing significant resources toward producing gallium nitride with blue light-emitting properties. As an example, the Advanced Projects Research Agency awarded a $3.6 million contract to a consortium of private companies to develop gallium nitride technology. Blue LED's are useful because, when combined with green and red LED's, they enable the production of full-color displays. Applications for blue laser diodes include high-capacity optical disk drives, higher quality facsimile machines, submicron semiconductor device manufacturing, and medical applications.

As one step to developing high-capacity optical switches for information processing, U.S. researchers demonstrated a practical method for integrating high-performance, GaAs-based optoelectronics with high-density silicon-based circuitry on a single semiconductor chip. This type of component can be used for processing optical signals, such as infrared light that travels along fiber optic lines, electronically.

GaAs technology, originally developed for military applications, has continued to be adapted for commercial uses. Night-vision image intensifiers, based on GaAs, have evolved from solely military uses to widespread applications in security, law enforcement, and industrial low-light monitoring. Recent advances in night-vision technology have produced modules that were specifically designed for video cameras, allowing low- and no-light video recording capabilities for professional photographers and videographers. In addition, defense specifications are becoming more flexible, allowing adaptation of commercial off-the-shelf equipment to military uses.

World Production, Reserves, and Reserve Base: Data on world production of primary gallium were unavailable because data on the output of the few producers were considered to be proprietary. However, in 1995, world primary production was estimated to be about 35,000 kilograms, with Germany, Russia, and Japan as the largest producers. Countries with smaller output were China, Hungary, Kazakstan, and Slovakia. Refined gallium production was estimated to be about 60,000 kilograms. France was the largest producer of refined gallium, using as feed material crude gallium produced in Australia that had been stockpiled since 1990. Germany and Japan were the other large gallium refining countries.

Gallium occurs in very small concentrations in many rocks and ores of other metals. Most gallium was produced as a byproduct of treating bauxite, and the remainder was produced from residues from zinc processing. Significant reserves of gallium also occur in oxide minerals derived from surficial weathering of zinc-lead-copper ores. Only part of the gallium present in bauxite and zinc ores was recoverable, and the factors controlling the recovery were proprietary. Therefore, a meaningful estimate of current reserves could not 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 can be considered to have only long-term availability.

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 are 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 light-emitting diodes. Indium phosphide components can be substituted for GaAs-based infrared laser diodes, and GaAs competes with helium-neon lasers in visible laser diode applications. Silicon is the principal competitor for GaAs in solar cell applications. Because of their enhanced properties, GaAs-based integrated circuits are used in place of silicon in many defense-related applications, and there are no effective substitutes for GaAs in these applications.

[e]Estimated. NA Not available.

[1]Defined as imports - exports + adjustments for Government and industry stock changes.

[2]See Appendix B.

GARNET, INDUSTRIAL[1]

(Data in metric tons of garnet, unless noted)

Domestic Production and Use: Garnet was produced in 1995 by five firms, four in New York and one in Idaho. Output of refined material was valued at $11.2 million. The end uses for garnet were abrasives in the petroleum industry, 41%; filtration media, 20%; transport manufacturing, 19%; finishing wood furniture, 10%; electronic components, 7%; and ceramics and glass, 3%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production (crude)	50,900	54,100	44,000	51,000	53,300
Sold by producers (refined)	48,000	46,100	55,800	40,600	47,900
Imports for consumption[e]	5,000	6,000	12,200	6,000	5,000
Exports[e]	10,000	8,880	11,400	10,000	7,260
Consumption, apparent	44,000	45,700	56,600	37,500	44,900
Price, range of value, dollars per ton	60-2,000	100-2,000	100-2,000	100-2,000	85-1,500
Stocks, producer[e]	11,100	8,640	4,900	4,000	4,720
Employment, mine and mill	150	150	150	160	180
Net import reliance[2] as a percent of apparent consumption	E	E	E	E	E

Recycling: None.

Import Sources (1991-94): Australia, 85%; India, 11%; and China, 4%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[3] 12/31/95
Emery, natural corundum, natural garnet, and other natural abrasives, crude	2513.21.0000	Free	Free.
Emery, natural corundum, natural garnet, and other natural abrasives, other than crude	2513.29.0000	0.6¢/kg.	2.2¢/kg.
Natural abrasives on woven textile	6805.10.0000	2.0% ad val.	20% ad val.
Natural abrasives on paper or paperboard	6805.20.0000	2.0% ad val.	20% ad val.
Natural abrasives sheets, strips, disks, belts, sleeves, or similar form	6805.30.0000	2.0% ad val.	20% ad val.

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

Government Stockpile: None.

Prepared by **Industrial Garnet Specialist, (703) 648-7721.**

GARNET, INDUSTRIAL

Events, Trends, and Issues: Imports from Australia continued to be used in the U.S. filtration and blasting media markets, but did not appear to affect domestic production negatively. The market appears to be large enough to absorb additional imports without harming U.S. producers. The garnet reclaim plant in Harvey, LA, was used intermittently as a distribution warehouse. Currently, evaluation and feasibility studies are underway on major garnet deposits in Arizona, California, Colorado, Montana, and New Mexico.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	1994	1995[e]		
United States	40,600	47,900	5,000,000	25,000,000
Australia	30,000	30,000	1,000,000	7,000,000
China	18,000	15,000	Moderate to Large	Moderate to Large
India	10,000	15,000	500,000	20,000,000
Other countries	2,000	2,000	6,500,000	20,000,000
World total (rounded)	101,000	110,000	Moderate	Large

World Resources: Garnets occur worldwide in a variety of rocks, particularly gneisses and schists. They also occur as contact-metamorphic deposits in crystalline limestones, pegmatites, and serpentinites, and in high-temperature intrusive contacts and vein deposits. Alluvial garnet also is a coproduct with many heavy mineral sand and gravel deposits in the world. Large domestic resources of garnet are concentrated in coarsely crystalline gneiss near North Creek, NY. One of the world's largest known garnet deposits in Rangley County, ME, is not currently being mined. The medium-grained ore from this deposit, has an unusually high garnet concentration of 50% to 60%. Significant resources of garnet also occur in Idaho, Montana, New Hampshire, North Carolina, and Oregon. World resources of garnet are large.

Substitutes: Garnet is competitive in abrasive applications with natural and manufactured abrasives, such as diamond, cubic boron nitride, fused aluminum oxide, silicon carbide, and quartz sand; in filtration media with ilmenite, magnetite, and plastics; and in nonskid surfaces with emery.

[e]Estimated. E Net exporter.
[1]Excludes gem and synthetic garnet.
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]See Appendix B.
[4]See Appendix C for definitions.

GEMSTONES[1]

(Data in million dollars, unless noted)

Domestic Production and Use: Output of natural gemstones was primarily from Tennessee, Alabama, Arkansas, North Carolina, Oregon, and Arizona. Output of synthetic gemstones was primarily from 14 firms; 4 in Arizona, 3 in California, and 1 each in Massachusetts, Michigan, New Jersey, New Mexico, North Carolina, Ohio, and Washington. It was estimated that visitors found 185 carats of diamonds in the Crater of Diamonds State Park in Arkansas. There was considerable production of freshwater pearls in Tennessee; turquoise in Arizona and Nevada; beryl, tourmaline, and amethyst in Maine; tourmaline, beryl, kunzite, and garnet in California; and sapphire in Montana. Major uses were jewelry, carvings, and gem and mineral collections.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Natural[2]	84.4	66.2	57.7	50.5	75.5
Synthetic	17.9	18.9	18.1	22.2	24.4
Imports for consumption	4,640	4,950	5,850	6,440	6,520
Exports, including reexports	1,710	1,450	1,630	2,240	2,510
Consumption, apparent	3,030	3,480	4,300	4,270	4,110
Price	Variable, depending on size, type, and quality				
Stocks, yearend[3]	NA	NA	NA	NA	NA
Employment, mine[4]	800	800	1,000	1,000	850
Net import reliance[5] as a percent of apparent consumption	97	98	98	98	98

Recycling: Insignificant.

Import Sources (1991-94 by value): Israel, 28%; India, 25%; Belgium, 15%; United Kingdom, 5%; and other, 27%. Diamond imports were about 90% of the total value of gem imports.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[6] 12/31/95
Diamonds, unworked or sawn	7102.31.0000	Free	Free.
Diamond, less than ½ carat	7102.39.0010	Free	10% ad val.
Diamond, cut, more than ½ carat	7102.39.0050	Free	10% ad val.
Precious stones, unworked	7103.10.2000	Free	Free.
Precious stones, simply sawn	7103.10.4000	21% ad val.	50% ad val.
Rubies, cut	7103.91.0010	Free	10% ad val.
Sapphires, cut	7103.91.0020	Free	10% ad val.
Emeralds, cut	7103.91.0030	Free	10% ad val.
Other precious, cut but not set	7103.99.1000	2.1% ad val.	10% ad val.
Other precious stones, other	7103.99.5000	21% ad val.	50% ad val.
Imitation precious stones	7018.10.2000	2.8% ad val.	20% ad val.
Synthetic cut, but not set	7104.90.1000	3.1% ad val.	10% ad val.
Pearls, natural	7101.10.0000	Free	10% ad val.
Pearls, cultured	7101.21.0000	2.1% ad val.	10% ad val.
Pearls, imitation not strung	7018.10.1000	8% ad val.	60% ad val.

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

Government Stockpile: The National Defense Stockpile (NDS) does not contain an inventory of gemstones per se. However, portions of the industrial diamond inventory are of near-gem or gem quality. Additionally, the beryl and quartz inventories contain some gem-quality materials and the inventory of synthetic ruby and sapphire could be used by the gem industry. The Defense Logistics Agency is currently disposing of materials from the NDS.

Prepared by **Gemstones Specialist (703) 648-7721.**

GEMSTONES

Events, Trends, and Issues: In the past, except for a few gem diamonds found each year in Arkansas, U.S. diamond production was insignificant. However, test mining is underway at two mines in the Colorado-Wyoming Stateline district. Domestic commercial gemstone production includes agates, beryls, freshwater pearls, garnets, jade, jasper, mother-of-pearl, opals, peridot, quartz, sapphire, tourmalines, and turquoise. Significant steps are being made in the marketing of lines of jewelry made with U.S. gemstones.

Exploration for diamonds continues in Alaska, Colorado, Michigan, Minnesota, Wisconsin, and Wyoming. The second phase of the diamond exploration project, bulk sampling, at the Crater of Diamonds State Park in Arkansas has been approved. Significant diamond exploration efforts by multiple companies continued in the Northwest Territories of Canada and in several areas in Australia.

World Mine Production,[7] Reserves, and Reserve Base:

	Mine production		Reserves and reserve base[8]
	1994	1995[e]	
United States	—	—	World reserves and reserve base of gem diamond are substantial. No reserves or reserve base data are available for other gemstones.
Angola	270	300	
Australia	19,500	20,000	
Botswana	11,000	11,000	
Brazil	600	600	
Central African Republic	370	400	
China	230	250	
Ghana	580	600	
Namibia	1,280	1,300	
Russia	8,500	8,500	
Sierra Leone	155	200	
South Africa	5,000	5,000	
Venezuela	220	200	
Zaire	4,000	4,000	
Other countries	5,230	5,300	
World total (rounded)	56,900	57,700	

World Resources: Most of the world gem diamond reserves are in southern Africa, Russia, and Western Australia. Estimation of a reserve base is now difficult to determine because of the changing economic evaluation of near-gem materials and new discoveries in Australia, Canada, and Russia.

Substitutes: Plastics, glass, metals, wood, paper, and other materials are substituted for gemstones. Synthetic materials that have the same appearance and chemical and physical properties are substituted for natural gemstones. Simulants are materials of similar appearance, but with different chemical and physical properties, that are substituted for natural gemstones.

[e]Estimated. NA Not available.
[1]Excludes industrial diamond and garnet. See Diamond (Industrial) and Garnet (Industrial).
[2]Natural includes production of freshwater pearls, natural and cultured.
[3]Stocks data are not available and are assumed to be zero for apparent consumption and net import reliance calculation.
[4]Estimate includes operators of fee site deposits.
[5]Defined as imports - exports + adjustments for Government and industry stock changes.
[6]See Appendix B.
[7]Data in thousands of carats of gem diamond.
[8]See Appendix C for definitions.

GERMANIUM

(Data in kilograms of germanium content, unless noted)

Domestic Production and Use: The value of domestic refinery production of germanium, based on the 1995 producer price, was approximately $13.8 million. Industry generated scrap, imported concentrates, and some processed residues from certain domestic ores were the feed materials for refined germanium production in 1995. The domestic industry consisted of three germanium refineries, one each in New York, Oklahoma, and Pennsylvania, and a mining operation in Tennessee. The company in Tennessee exported germanium-bearing residues generated from the production of zinc metal. The major end uses for germanium were fiber-optic systems, 40%; infrared optics, 15%; detectors, 10%; semiconductors (including transistors, diodes, and rectifiers), 5%; and other applications (catalysts, phosphors, metallurgy, and chemotherapy), 30%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, refinery[e]	15,000	13,000	10,000	10,000	10,000
Total imports[1]	27,000	13,000	15,000	15,000	13,000
Exports	NA	NA	NA	NA	NA
Consumption[e]	33,000	33,000	29,000	25,000	25,000
Price, producer, yearend, dollars per kilogram:					
Zone refined	1,060	1,060	1,060	1,060	1,375
Dioxide, electronic grade	660	660	660	660	880
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, plant[e 2]	100	100	100	100	110
Net import reliance[3] as a percent of apparent consumption	NA	NA	NA	NA	NA

Recycling: More than 50% of the metal used during the manufacture of most electronic and optical devices is routinely recycled as new scrap. As a result of the low unit use of germanium in microelectronic devices, little germanium returns as old scrap.

Import Sources (1991-94): United Kingdom, 16%; Belgium, 15%; Germany, 14%; China, 13%; and other,[4] 42%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Germanium oxides	2825.60.0000	3.7% ad val.	25% ad val.
Waste and scrap	8112.30.3000	Free	Free.
Metal, unwrought	8112.30.6000	3.5% ad val.	25% ad val.
Other	8112.30.9000	5.3% ad val.	45% ad val.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Germanium	68,207	—	7	—

Prepared by Errol D. Sehnke, (703) 648-4981.

GERMANIUM

Events, Trends, and Issues: The monthly average free market price for minimum 99.99% germanium dioxide, published by Metal Bulletin (London), began to increase rapidly in February 1995 and reached the range of $850 to $950 per kilogram in August; it began to soften somewhat in September. Improved worldwide demand for the fiber optics sector and continued concern over supplies from the republics of the Former Soviet Union led to a very tight world supply of germanium materials in 1995. In the near term, it is expected that this shortfall in supply will be moderated by increased production from North American sources and increased shipments from China. It is currently projected that fiber optics will provide the principal market for germanium well into the next century.

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 1994	Refinery production 1995[e]	Reserves[6]	Reserve base[6]
United States	10,000	10,000	450,000	500,000
Other countries	40,000	35,000	NA	NA
World total	50,000	45,000	NA	NA

World Resources: The available resources of germanium are associated with some zinc and lead-zinc-copper sulfide ores. Potential worldwide germanium resources would increase substantially if germanium were to be recovered from ash and flue dusts resulting from burning certain coals for power generation.

Substitutes: Less expensive silicon can be substituted for germanium in certain electronic applications. Certain bimetallic compounds of gallium, indium, selenium, and tellurium can also be substituted for germanium. Germanium is more reliable in some high-frequency and high-power applications and more economical as a substrate for some light-emitting diode applications. In infrared guidance systems, zinc selenide or germanium glass substitute for germanium metal, but at the expense of performance.

[e]Estimated. NA Not available.

[1]Does not include imports of germanium dioxide 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]Total imports from republics of the Former Soviet Union (Estonia, Russia, and Ukraine) account for 23% of the 1991-94 imports.

[5]See Appendix B.

[6]See Appendix C for definitions.

GOLD

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

Domestic Production and Use: Gold was produced by about 200 lode mines, a dozen or more large placer mines (nearly all in Alaska), and numerous smaller placer mines, mostly in Alaska and Western States. In addition, a small amount of domestic gold was recovered as a byproduct of processing base metals, chiefly copper. Twenty-five lode mines yielded the majority of the gold produced in the United States. The value of 1995 mine production was approximately $4.0 billion. Commercial-grade refined gold came from about 2 dozen producers. A few dozen companies dominated the fabrication of gold into commercial products. Jewelry manufacturing was centered principally in the New York, NY, and Providence, RI, areas; other concentrations of these businesses were in California, Florida, and Texas.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Mine	294	330	331	326	320
Refinery: Primary	225	284	243	241	240
Secondary	153	163	152	148	150
Imports[2]	154	159	144	114	115
Exports[2]	220	308	726	395	365
Consumption, reported	114	110	91	76	75
Stocks, yearend, Treasury[3]	8,146	8,146	8,145	8,143	8,143
Price, dollars per ounce	363.29	344.97	360.91	385.41	385.00
Employment, mine and mill[e]	15,100	14,800	14,700	14,200	13,900
Net import reliance[4] as a percent of apparent consumption	E	E	E	E	E

Recycling: The U.S. Bureau of Mines estimates that approximately 150 metric tons of gold was recovered from the total scrap recycled in the United States In 1995, including both manufacturing (new) scrap and post-consumer (old) scrap.

Import Sources (1991-94):[2] Canada, 70%; Bolivia, 6%; Chile, 5%; Switzerland, 4%; and other, 15%.

Tariff: Most imports of unwrought gold, including bullion and doré, enter 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 Government-wide secondary precious metals recovery program.

Events, Trends, and Issues: Domestic gold mine production in 1995 was estimated at slightly below the record levels of recent years, but at a high-enough amount to maintain the U.S. position as the world's second largest gold-producing nation, after South Africa. Domestic output continued to be dominated by Nevada and California, where combined production accounted for nearly 80% of the U.S. total. The trend for recent U.S. gold exploration activity, which appeared to have peaked in about 1988, continued to decline in 1995 as North American exploration companies sought opportunities in other regions of the world. The principal focus of recent exploration activity has been on several South American nations, where favorable geological terrains, combined with recently liberalized mining regulations, hold the promise of greater long-term success and reduced risk to the currently limited pool of investment capital available for international mining ventures. In addition, exploration and mine development opportunities were actively pursued during the year in the southwestern Pacific, western Africa, and the republics of the Former Soviet Union.

Prepared by **Errol D. Sehnke, (703) 648-4981.**

GOLD

During the first 10 months of the year, the Engelhard Industries/London daily price of gold ranged from a low of about $373 per troy ounce in January to nearly $397 in April. These extremes were nearly identical to the low and high reported for all of 1994. This stagnation in gold prices was further reinforced during the September-through-mid-October period, when prices ranged narrowly from about $382 to nearly $387.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[5]	Reserve base[5]
	1994	1995[e]		
United States	326	320	5,400	5,900
Australia	256	250	3,400	3,700
Brazil	76	80	700	1,200
Canada	146	145	1,300	3,300
China[e]	160	160	NA	NA
Russia	147	150	3,100	3,400
South Africa	580	530	18,000	29,000
Uzbekistan	75	80	3,000	3,300
Other countries	500	500	9,300	11,000
World total (rounded)	2,300	2,200	[6]44,000	[6]61,000

Of an estimated 119,000 tons of gold mined from historical times through 1995, about 15% is believed to have been lost, used in dissipative industrial uses, or otherwise unrecoverable or unaccounted for. Of the remaining 102,000 tons, an estimated 35,000 tons are official stocks held by central banks, and about 67,000 tons are privately held as coin, bullion, and jewelry.

World Resources: Total world resources of gold are estimated at 75,000 tons, of which 15% to 20% are byproduct resources. South Africa has about one-half of all world resources, and Brazil and the United States have about 12% each. Some of the 9,000-ton U.S. resource would be recovered as byproduct gold.

Substitutes: Base metals clad with gold alloys are widely used in electrical/electronic and jewelry products 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. NA Not available.

[1]Metric ton (1,000 kg) = 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 metric tons; and (e) Net bullion flow (in metric tons) to market from foreign stocks at the New York Federal Reserve Bank: 61.6 (1991), 136.4 (1992), 582.2 (1993), 216.6 (1994), and 300.0 (estimated, 1995).

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

[4]Defined as imports - exports + adjustments for Government and industry stock changes.

[5]See Appendix C for definitions.

[6]Excludes China and some other countries for which data were not available.

GRAPHITE (NATURAL)

(Data in thousand metric tons, unless noted)

Domestic Production and Use: Natural graphite was not produced domestically in 1995. Natural graphite was consumed by several hundred manufacturing firms, primarily in the Northeastern and Great Lakes regions. The main uses of natural graphite were estimated to be in refractories, 27%; brake linings, 21%; packings, 13%; lubricants, 6%; dressings and molds in foundry operations, 6%; and other, 27%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, mine	—	—	—	—	—
Imports for consumption	34	50	52	53	60
Exports	19	20	17	20	30
Consumption, apparent	14	30	35	33	30
Price, imports (average dollars per ton at foreign ports):					
Flake	970	708	612	629	635
Lump and chip (Sri Lankan)	1,440	1,070	789	709	600
Amorphous (Mexican)	119	125	127	138	150
Stocks, yearend	NA	NA	NA	NA	NA
Employment, mine, mill, and processing plant	—	—	—	—	—
Net import reliance[1] as a percent of apparent consumption	100	100	100	100	100

Recycling: None; however, the U.S. Bureau of Mines process to recover flake graphite from kish, a steelmaking waste, has been tested in the pilot-plant stage.

Import Sources (1991-94): Mexico, 30%; Canada, 27%; China, 20%; Madagascar, 7%; Brazil, 5%; and other, 11%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[2] 12/31/95
Crystalline flake (not including flake dust)	2504.10.1000	Free	3.6¢/kg.
Other	2504.90.0000	Free	10% ad val.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Sri Lanka, amorphous lump	5	—	—	—
Madagascar, crystalline flake	14	1	14	1
Other than Sri Lanka and Madagascar crystalline	2	1	2	1

Prepared by **Graphite Specialist, (703) 648-7710**

GRAPHITE (NATURAL)

Events, Trends, and Issues: Graphite was near to supply-demand balance in 1995. Demand was met largely by imports of flake from Canada, China, and Madagascar; lump and chip from Sri Lanka; and amorphous graphite from China and Mexico. Imports of all kinds of graphite were up 13% from those of 1994. Exports were up 50%.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[3]	Reserve base[3]
	1994	1995[e]		
United States	—	—	—	1,000
Brazil	29	30	500	1,000
Canada	16	20	1,500	2,700
China	320	320	5,500	310,000
India	75	70	740	740
Korea, South	78	80	3,200	20,000
Madagascar	8	10	980	980
Mexico	44	40	3,100	3,100
Other countries	149	150	5,500	43,000
World total (may be rounded)	719	720	[e]21,000	380,000

Resources: Domestic resources are relatively small, although the rest of the world's inferred reserve base exceeds 800 million tons of recoverable graphite. Deposits in Alabama, Alaska, New York, Pennsylvania, and Texas were not economically viable.

Substitutes: Substitute materials are more costly and/or do not perform as well as natural graphite for most applications. 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 operations. Molybdenum disulfide competes as a dry lubricant, but is more sensitive to oxidative conditions.

[e]Estimated. NA Not available.

[1]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.

[2]See Appendix B.

[3]See Appendix C for definitions.

GYPSUM

(Data in thousand metric tons, unless noted)

Domestic Production and Use: In 1995, output of crude gypsum was 17 million tons valued at $116 million. Leading States were Oklahoma, Iowa, Texas, Michigan, Nevada, California, and Indiana, which together accounted for 75% of total output. Thirty-one companies mined crude gypsum at 58 mines in 19 States, and 14 companies calcined gypsum at 73 plants in 27 States. Of the total supply of crude gypsum (25.9 million tons, including 1.1 million tons of byproduct gypsum), 20.0 million tons was calcined for gypsum products, and 6.0 million tons was used mainly as cement retarder or as agricultural land plaster. Calcined gypsum was sold as prefabricated product or as industrial or building plaster. Sales of gypsum for use in cement were 3.5 million tons and for agriculture and other uses, 2.5 million tons.

Available capacity of operating gypsumboard plants in the United States at yearend 1995 was 24.6 billion square feet per year. Sales of gypsumboard products were 23.5 billion square feet, which represented a capacity utilization of 96%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Crude	14,000	14,800	15,800	17,200	17,300
Byproduct	618	630	846	950	1,100
Calcined	13,900	15,100	15,200	16,700	17,000
Prefabricated products (million square feet)	17,600	19,200	21,400	23,200	23,500
Imports, crude, including anhydrite	6,930	7,180	7,390	8,470	8,000
Exports, crude, not ground or calcined	67	98	69	89	110
Consumption, crude, apparent[1]	21,100	22,300	24,000	26,200	25,900
Price: Average crude, f.o.b. mine, dollars per ton	6.72	6.82	6.74	6.70	6.80
Average calcined, f.o.b. plant, dollars per ton	17.27	16.58	17.88	17.23	18.00
Stocks, producer, crude, yearend	2,020	2,350	2,320	2,600	2,700
Employment, mine and calcining plant	6,800	6,700	6,700	6,700	6,700
Net import reliance[2] as a percent of apparent consumption	31	31	31	30	30

Recycling: A relatively small amount of byproduct gypsum generated in flue gas desulfurization, phosphate rock acidulation, and other chemical processes is used for agricultural and wallboard purposes.

Import Sources (1991-94): Canada, 69%; Mexico, 22%; Spain, 5%; and other, 4%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[3] 12/31/95
Gypsum; anhydrite	2520.10.0000	Free	Free.

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

Government Stockpile: None.

Prepared by **Gypsum Specialist (703) 648-7721.**

GYPSUM

Events, Trends, and Issues: Sales of gypsum products increased for the fourth consecutive year, but remained slightly below the record highs of 1989. Increased demand and rising wallboard prices improved the financial position of most of the companies.

In 1995, the gypsum wallboard industry shipped 23.5 billion square feet. Imports of wallboard, principally from Canada, were 570 million square feet. Wallboard exports to 60 different countries were 100 million square feet.

As long as the cost of land for solid waste disposal continues to be economical and solid waste pollution remains noncritical, only a small amount of the potentially useful byproduct gypsum scrubbed from powerplant stack gases and produced by chemical plants will be used. Several plants mix small amounts of byproduct gypsum into their wallboard products.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	1994	1995[e]		
United States	17,200	17,300	700,000	Large
Australia	2,000	2,100		
Canada	8,500	8,500	450,000	Large
China	10,500	11,000		
Egypt	1,200	1,200		
France	5,000	5,000		
India	1,900	1,900		
Iran	8,430	8,500		
Italy	1,200	1,200	Reserves and reserve base are large in major producing countries, but data are not available.	
Japan	5,300	5,300		
Mexico	5,530	5,500		
Poland	830	800		
Spain	7,250	7,500		
Thailand	8,140	8,000		
United Kingdom	2,500	2,800		
Other countries	15,500	16,000		
World total (rounded)	101,000	103,000	Large	Large

World Resources: Domestic resources are adequate, but are unevenly distributed. There are no gypsum deposits on the eastern seaboard of the United States, and large imports from Canada augment the domestic supply of crude ore in these industrial areas. Large deposits occur in the Great Lakes region, midcontinent region, California, and other States. Foreign resources are adequate, but are not evenly distributed.

Substitutes: Other construction materials may be substituted for gypsum, especially cement, lime, lumber, masonry, and steel. There is no practical substitute for gypsum in portland cement. Byproduct gypsum now substitutes for crude gypsum in special agricultural applications, and it is beginning to be utilized in place of crude gypsum for cement set-retarding and manufacturing wallboard.

[e]Estimated.
[1]Defined as crude + byproduct + net import reliance.
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]See Appendix B.
[4]See Appendix C for definitions.

HELIUM

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

Domestic Production and Use: During 1995, the estimated value of Grade-A (99.995% or better) helium extracted at the U.S. Bureau of Mines Exell Helium Plant was $13.5 million; the estimated value of Grade-A helium extracted by private industry was about $190 million. The total sales value for domestic consumption and exports was $203.5 million. Thirteen private industry plants and one Bureau facility extracted helium from natural gas: five of the privately owned plants were in Kansas, four in Texas, two in Colorado, one each in Utah and Wyoming. An additional six private industry plants refined helium directly from the Bureau's crude helium pipeline: four of the plants were in Kansas, one in Oklahoma, and one in Texas. The estimated 1995 domestic consumption of 78 million cubic meters (2.8 billion cubic feet) was used for cryogenic applications, 24%; welding cover gas, 20%; pressurizing and purging, 19%; controlled atmospheres, 11%; leak detection, 5%; mixtures, 3%; and other, 18%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Helium extracted from natural gas[2]	86.4	92.0	99.3	112	117
Withdrawn from storage[3]	1.7	2.4	(3.8)	(11.6)	(12.1)
Grade-A helium sales	88.1	94.4	95.6	100	104
Imports for consumption	—	—	—	—	—
Exports[4]	27.1	30.7	28.0	25.0	26.0
Consumption, apparent[4]	61.0	63.7	67.5	75.4	78.4
Employment, plant[e]	600	600	615	630	635
Net import reliance[5] as a percent of apparent consumption	E	E	E	E	E

Price: The price of Grade-A gaseous helium was $1.983 per cubic meter ($55 per thousand cubic feet) f.o.b. Bureau facilities in 1995. The Bureau's price for bulk liquid helium was $2.524 per cubic meter measured as gas ($70 per thousand cubic feet), with additional charges for container services and rent. Private industry's price for gaseous helium was about $1.802 per cubic meter ($50 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 (1991-94): None.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[6] 12/31/95
Helium	2804.29.0010	3.7% ad val.	25.0% 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: The U.S. Bureau of Mines stockpile is a separate operation run pursuant to Public Law 86-777. During 1995, the Bureau accepted over 37 million cubic meters (1,340 million cubic feet) of private helium for storage and redelivered nearly 22 million cubic meters (800 million cubic feet) for a net increase in privately owned storage of more than 15 million cubic meters (541 million cubic feet). On September 30, 1995, 951 million cubic meters (34.3 billion cubic feet) of helium was in storage, of which 94 million cubic meters (3.4 billion cubic feet) was owned by private firms.

Events, Trends, and Issues: A refined helium plant near Keyes, OK, began production in 1995. A crude helium plant is being built near Baker, OK, and it is expected to be in production in 1996. Some of the crude helium production is being stored at the USBM storage field.

Prepared by **Joseph B. Peterson, (806) 376-2614.**

HELIUM

It is estimated that in 1996, domestic production of helium will be more than 106 million cubic meters (3.8 billion cubic feet), and that U.S. apparent consumption will be more than 72 million cubic meters (2.6 billion cubic feet). Exports from the United States probably will continue to decline due to startup of an Algerian helium plant during 1995.

World Production, Reserves, and Reserve Base:

	Production		Reserves[7]	Reserve base[7]
	1994	1995[e]		
United States	100.4	104.4	8,200	[8]13,000
Algeria	NA	3.8	NA	2,100
Canada	NA	NA	NA	2,100
China	NA	NA	NA	1,100
Netherlands	NA	NA	NA	720
Poland	1.4	1.4	NA	830
Former Soviet Union[9]	4.2	4.2	4.2	9,200
Other countries	NA	NA	NA	2,100
World total (may be rounded)	106	114	NA	31,000

World Resources: The identified helium resources of the United States were estimated to be about 13 billion cubic meters (470 billion cubic feet) as of January 1, 1994. This includes 1.0 billion cubic meters (34 billion cubic feet) of helium stored in the Cliffside Field, 6.8 billion cubic meters (250 billion cubic feet) of helium in helium-rich natural gas (0.30% helium or more), and 5.2 billion cubic meters (190 billion cubic feet) in helium-lean natural gas (less than 0.30% helium). It is postulated that, by the end of the century, most of the helium-rich natural gasfields currently supplying helium will be exhausted except for the Hugoton and Riley Ridge Fields. These currently depleting gasfields contain an estimated 4.4 billion cubic meters (160 billion cubic feet) of helium. The remaining 2.4 billion cubic meters (86 billion cubic feet) of helium-rich gas resources is nondepleting. Riley Ridge contains 3.4 billion cubic meters (120 billion cubic feet) of helium of which 2.0 billion cubic meters (72 billion cubic feet) is now included in the depleting classification because this gas is now being produced. Future supplies will probably come from known helium-rich natural gas with little fuel value and helium-lean resources. The identified helium-lean resources of 5.2 billion cubic meters (190 billion cubic feet) include 1.3 billion cubic meters (46 billion cubic feet) of measured and 3.9 billion cubic meters (140 billion cubic feet) of indicated helium resources.

Helium resources of the world exclusive of the United States were estimated to be 18.0 billion cubic meters (650 billion cubic feet). The locations and volumes of the principal deposits, in billion cubic meters, are the Former Soviet Union, 9.2; Algeria, 2.1; Canada, 2.1; China, 1.1; Poland, 0.8; and the Netherlands, 0.7. An international consortium started production at a plant in Algeria that will recover about 8.3 million cubic meters of helium per year. As of January 1, 1995, the U.S. Bureau of Mines had analyzed nearly 20,000 gas samples from 26 countries and the United States in a program to identify world helium resources.

Substitutes: There is no substance that can be substituted for helium 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 flammability 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.
[1]Measured at 101.325 kilopascals absolute (14.696 psia) and 15° C. 27.737 cubic meters of helium at 15° C, 101.325 kPa (absolute) = 1 Mcf of helium at 70° F and 14.7 psia.
[2]Helium content of both Grade-A and crude helium (consisting of approximately 70% helium and 30% nitrogen).
[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.
[7]See Appendix C for definitions.
[8]All domestic measured and indicated helium resources in the United States.
[9]As constituted before Dec. 1991.

ILMENITE[1]

(Data in thousand metric tons of contained TiO_2, unless noted)

Domestic Production and Use: Two firms produced ilmenite concentrate from three heavy-mineral sands operations in Florida and one produced ilmenite in California as a byproduct of sand and gravel production. Based on average prices, the value of U.S. ilmenite consumption in 1995 was about $250 million. Major coproducts of ilmenite from heavy mineral sand deposits are rutile and zircon. About 99% of the ilmenite and titanium slag was consumed by five titanium pigment producers. The remainder was used in welding rod coatings and for manufacturing alloys, carbide, and chemicals.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production	W	W	W	W	W
Imports for consumption[2]	462	615	564	584	608
Exports[e]	12	16	7	9	12
Consumption:[2] Reported	751	882	889	W	920
Apparent	W	W	W	W	W
Price, dollars per metric ton:					
Ilmenite:					
Bulk, 54% TiO_2, f.o.b. Australian ports	72	65	63	77	80
Slag:[e]					
80% TiO_2, f.o.b. Sorel, Quebec	293	276	276	278	300
85% TiO_2, f.o.b. Richards Bay, South Africa	293	322	330	334	350
Stocks, mine, distributor and consumer, yearend[2]	218	254	218	208	200
Employment, mine and mill[3]	395	400	395	400	400
Net import reliance[4] as a percent of apparent consumption	W	W	W	W	W

Recycling: None.

Import Sources (1991-94): South Africa, 60%; Australia, 25%; Canada, 10%; and other, 5%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Ilmenite and ilmenite sand	2614.00.6020	Free	Free.
Titanium slag	2620.90.5000	Free	Free.

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

Government Stockpile: None.

Prepared by **Joseph M. Gambogi, (703) 648-7718.**

ILMENITE

Events, Trends, and Issues: Another record year of titanium pigment production resulted in a moderate increase in the domestic consumption of ilmenite plus titanium slag. Total imports of ilmenite plus slag increased about 4% with Australia, Canada, and South Africa contributing more than 75% of imports. Imports from Brazil, India, and Ukraine increased significantly.

Exploration and development of titanium mineral deposits were on the rise in 1995. In South Africa, a new producer of titanium concentrates was expected to commission a titanium slag operation by yearend. At full production, the operation was expected to produce 195,000 tons per year of slag. In Western Australia, plans were announced to proceed with the development of the Beenup deposit. The deposit was reported to be 4% heavy mineral sands and low in impurities with the potential for 500,000 tons per year of ilmenite.

Domestic environmental problems related to ilmenite include (1) land use conflicts where heavy-mineral sands deposits exist principally along the Atlantic coast and (2) the potential for water pollution from pigment-producing processes. Solutions to the latter problem include the development of economic, environmentally acceptable processes for making synthetic rutile or titanium tetrachloride from lower grade ilmenites and the development of methods to recover and recycle spent sulfuric acid as well as to neutralize and control the effluents produced. The two U.S. producers using the sulfate process treated their spent acid effluent with calcium carbonate and lime, producing a gypsum byproduct.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[6]	Reserve base[6]
	1994	1995[e]		
United States	W	W	8,000	59,000
Australia	1,010	1,030	33,000	88,000
Brazil	50	50	18,000	18,000
Canada (slag)	611	610	31,000	36,000
China	78	80	30,000	41,000
Egypt	—	—	—	1,700
Finland	—	—	1,400	1,400
India	162	170	30,000	38,000
Italy	—	—	—	2,200
Madagascar	—	—	—	19,000
Malaysia	159	160	—	1,000
Norway (ilmenite and slag)	315	320	40,000	40,000
South Africa (slag)	632	750	63,000	63,000
Sri Lanka	32	30	13,000	13,000
Ukraine	75	100	5,900	13,000
Other countries	32	8	1,000	1,000
World total (rounded)	[7]3,160	[7]3,310	270,000	440,000

World Resources: Ilmenite supplies about 90% of the world's demand for titaniferous material. World ilmenite resources total about 1 billion tons of titanium dioxide. Major resources occur in Australia, Canada, China, India, New Zealand, Norway, South Africa, Ukraine, and the United States.

Substitutes: Rutile and synthetic rutile were extensively used to produce titanium dioxide pigment.

[e]Estimated. W Withheld to avoid disclosing company proprietary data.
[1]See also Rutile and Titanium and Titanium Dioxide.
[2]Includes titanium slag from Canada, Norway, and South Africa and leucoxene from Australia.
[3]Includes operating employees shown under Rutile, subject to the same footnoted comments.
[4]Defined as imports - exports + adjustments for Government and industry stock changes.
[5]See Appendix B.
[6]See Appendix C for definitions.
[7]Excludes U.S. production.

INDIUM

(Data in metric tons, unless noted)

Domestic Production and Use: No indium was recovered from ores in the United States in 1995. Domestic indium production was derived from the upgrading of lower-grade imported indium metal. Two companies, one each in New York and Rhode Island, were the major producers of indium metal and indium products in 1995. Several firms produced high-purity indium shapes, alloys, and compounds. Thin film coatings, which are used in applications such as liquid crystal displays and electroluminescent lamps, continued to be the largest end use. Indium semiconductor compounds were used in infrared detectors, high-speed transistors, and high-efficiency photovoltaic devices. Estimated uses in 1995 were about the same as in 1994: coatings, 45%; solders and alloys, 35%; electrical components and semiconductors, 15%; and research and other, 5%. The estimated value of primary metal consumed in 1995, based on the average price, was $16.1 million.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, refinery	NA	NA	NA	NA	—
Imports for consumption	36.3	36.3	73.4	70.2	73.0
Exports	NA	NA	NA	NA	NA
Consumption[e]	30.0	30.0	35.0	40.0	43.0
Price, average annual, dollars per kilogram (99.97% indium)	230	218	200	138	375
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment	NA	NA	NA	NA	NA
Net import reliance[1] as a percent of apparent consumption	NA	NA	NA	NA	NA

Recycling: Small quantities of old scrap were recycled. Substantial amounts of new scrap were recovered from the fabrication of indium products.

Import Sources (1991-94): Canada, 51%; France, 14%; Italy, 12%; Belgium, 7%; Russia, 7%; and other, 9%. Imports from Russia increased dramatically in 1994.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[2] 12/31/95
Unwrought, waste and scrap	8112.91.3000	Free	25% ad. val.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Indium	1.56	—	—	—

Prepared by **Robert D. Brown, Jr., (703) 648-4984.**

INDIUM

Events, Trends, and Issues: Estimated domestic indium consumption increased to 43 tons. Concern over increased world demand resulted in price increases beginning in January and continuing through most of 1995. World production increased slightly in 1995, as the world market remained close to a balance of supply and demand. Producers were barely able to keep pace with growing world demand, especially in Japan, which consumes more than 80 tons per year, almost all for electronic applications. Canada remained the world's largest producer of indium, with output from the major producer being marketed through a U.S. company.

World Refinery Production, Reserves, and Reserve Base:

	Refinery production[e]		Reserves[3]	Reserve base[3]
	1994	1995		
United States	NA	—	300	600
Belgium	18	18	([4])	([4])
Canada	40	40	700	2,000
China	10	10	400	1,000
France	25	25	([4])	([4])
Italy	12	12	([4])	([4])
Japan	30	33	100	150
Peru	1	4	100	150
Russia	5	5	200	300
Other countries	4	4	800	1,500
World total (may be rounded)	145	150	2,600	5,700

World Resources: Indium occurs predominantly in solid solution in sphalerite, a sulfide ore of zinc. Significant quantities of indium also are contained in ores of copper, lead, and tin, but many deposits are either subeconomic or information does not exist to formulate reliable estimates. Indium is recovered almost exclusively as a byproduct of zinc. Estimates of the average indium content of the Earth's crust range from 50 to 200 parts per billion. The average indium content of zinc deposits ranges from less than 1 to 100 parts per million. The highest known concentrations of indium occur in vein or replacement sulfide deposits, usually associated with tin-bearing minerals. However, these types of deposits are often difficult to process economically.

Substitutes: Gallium arsenide can substitute for indium phosphide in solar cells and semiconductor applications. Silver-zinc oxide or tin oxide are lower-cost substitutes for indium-tin oxide in transparent conductive coatings for glass. Hafnium can replace indium alloys for use in nuclear reactor control rods.

[e]Estimated. NA Not available.
[1]Defined as imports - exports + adjustments for Government and industry stock changes.
[2]See Appendix B.
[3]Estimate based on the indium content of zinc ores. See Appendix C for definitions.
[4]Reserves for European countries are included in "Other countries."

IODINE

(Data in thousand kilograms, elemental iodine, unless noted)

Domestic Production and Use: Iodine produced in 1995 from companies operating in Oklahoma accounted for 100% of the elemental iodine value estimated at $20 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 production. A third company continued production at Vici, OK, and exported iodine to Germany. Of the consumers that participate in the annual survey, 25 plants reported consumption of iodine in 1994. Major consumers were located in the East. Prices of crude iodine in drums published in October ranged between $11.50 and $12.50 per kilogram. Imports of iodine through July averaged $9.32 per kilogram.

Establishing an accurate end-use pattern for iodine was difficult because intermediate iodine compounds were marketed before reaching their final end uses. The downstream uses of iodine were as animal feed supplements, catalysts, inks and colorants, pharmaceutical, photographic equipment, sanitary and industrial disinfectants, stabilizers, and other uses.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production	2,000	2,000	1,900	1,600	1,800
Imports for consumption, crude content	3,600	3,700	3,600	4,400	4,300
Exports	1,300	1,800	1,200	1,300	1,300
Shipments from Government stockpile excesses	36	115	0.045	218	17
Consumption:					
Apparent	4,300	3,900	4,300	4,800	4,800
Reported	3,200	3,400	3,500	3,600	NA
Price, average c.i.f. value, dollars per kilogram, crude	10.16	9.03	7.98	7.56	9.32
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, processing plant	50	50	35	35	35
Net import reliance[1] as a percent of apparent consumption	54	52	56	66	62

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

Import Sources (1991-94): Japan, 53%; Chile, 46%; and other, 1%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[2] 12/31/95
Iodine, crude	2801.20.0000	Free	Free.
Iodide, calcium and cuprous	2827.60.1000	Free	25% ad val.
Iodide, potassium	2827.60.2000	2.8% ad val.	7.5% ad val.

Depletion Allowance: 5% on brine wells (Domestic and Foreign); 14% on solid minerals (Domestic), 14% (Foreign).

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Stockpile-grade	2,360	18	2,360	17

Prepared by Phyllis A. Lyday, (703) 648-7713.

IODINE

Events, Trends, and Issues: Japan continued to be the largest producer of iodine in the world. Production was primarily from underground brines associated with gas production.

Chile was the second largest producer with three companies producing iodine during the year. Two satellite plants of the world's largest iodine producer based in Chile, that closed during 1994 were reopened in June 1995. The plants are located 100 kilometers from the main iodine mines. Production and sales of iodine derivatives from the largest company were primarily to South America, Africa, and Asia. The company announced plans to increase iodine production by 2,000 metric tons per year to a total of 5,000 metric tons per year. In October the company entered into a joint venture with a U.S. domestic consumer. The U.S. domestic company also had iodine derivatives facilities in France that sold primarily in North America and Europe that were part of the agreement.

The U.S. Government announced sales of stockpiled iodine in March and September; 454,000 kilograms of iodine would be offered for sale during fiscal year 1996.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[3]	Reserve base[3]
	1994	1995[e]		
United States	1,600	1,800	550,000	550,000
Azerbaijan	400	400	NA	NA
Chile	5,600	5,600	900,000	1,200,000
China	500	500	400,000	400,000
Indonesia	15	15	100,000	100,000
Japan	6,400	6,400	4,000,000	7,000,000
Turkmenistan	250	250	170,000	NA
World total (rounded)	14,800	15,000	NA	NA

World Resources: In addition to the fields listed in the reserve base, seawater contains 0.05 parts per million iodine, or approximately 34 billion kilograms. 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, oil, and nitrate, the seaweed industry represented a major source of iodine prior to 1959 and is a large resource.

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

[e]Estimated. NA Not available.
[1]Defined as imports - exports + adjustments for Government and industry stock changes.
[2]See Appendix B.
[3]See Appendix C for definitions.

IRON ORE[1]

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

Domestic Production and Use: Value of usable ore shipped from mines in Minnesota, Michigan, and six other States in 1995 was estimated at $1.6 billion. Iron ore was produced by 16 companies operating 16 mines, 10 concentration plants, and 10 pelletizing plants. The mines included 15 open pits and 1 underground operation. Virtually all ore was concentrated before shipment. Nine mines operated by six companies accounted for 98.8% of production.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, usable	56.8	55.6	55.7	58.4	62.0
Shipments	56.8	55.6	56.3	57.6	62.0
Imports for consumption	13.3	12.5	14.1	17.5	18.0
Exports	4.0	5.1	5.1	5.0	5.0
Consumption: Reported (ore and total agglomerate)[3]	66.4	75.1	76.8	77.7	78.0
Apparent	63.4	65.6	66.2	70.9	75.3
Price (Oct.), Lake Superior pellets, cents per ltu of Fe[4]	72.5-74.0	72.5-74.0	72.5-74.0	72.5-74.0	72.5-74.0
Stocks, mine, dock, and consuming plant, yearend, excluding byproduct ore	25.4	22.9	21.3	21.3	21.0
Employment, mine, concentrating and pelletizing plant, quarterly average	7,800	8,000	7,800	7,200	7,000
Net import reliance[5] as a percent of apparent consumption (iron in ore)	11	12	14	18	18

Recycling: Insignificant.

Import Sources (1991-94): Canada, 55%; Brazil, 20%; Venezuela, 20%; Australia, 2%; and other, 3%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[6] 12/31/95
Concentrates	2601.11.0030	Free	Free.
Coarse ores	2601.11.0060	Free	Free.
Fine ores	2601.11.0090	Free	Free.
Pellets	2601.12.0030	Free	Free.
Briquettes	2601.12.0060	Free	Free.
Sinter	2601.12.0090	Free	Free.

Depletion Allowance: 12.0% (Domestic), 11.2% (Foreign).

Government Stockpile: None.

Events, Trends, and Issues: Domestic iron ore production, driven by demand from the U.S. steel industry, increased in 1995 for the third consecutive year. Imports increased slightly and exports, which go primarily to regular customers in Canada, were little changed.

The U.S. steel industry was undergoing structural changes potentially negative to the iron ore sector. Flat-rolled minimills under construction or proposed could add 17 million tons of capacity to the flat-rolled market by the end of the decade. Also, tougher environmental regulations, especially those restricting coke oven gas emissions, was expected to force the closure of some older integrated facilities. However, those changes also provided potential benefits to those companies providing alternatives to scrap. Because of concern over the availability of low residue scrap, investment in alternative ironmaking technologies has become more attractive and a number of companies have moved in that direction. One alternative to scrap is direct-reduced iron (DRI). Four projects were under consideration that, if completed, would increase U.S. DRI capacity from 0.5 to 4.2 million metric tons per year.

Prepared by **William S. Kirk, (703) 648-4962.**

IRON ORE

Internationally, iron ore consumption increased and prices increased after declining for the previous 3 years. There was a trend in the international market away from sintering of iron ore toward pelletization. This was driven, in large part, by environmental considerations. Australia and Brazil continued to be the leading exporters of iron ore with a combined total of close to 60% of the world total. The United States continued to be a net importer of iron ore.

Since 1983, five areas or countries—China, Europe, the Former Soviet Union (FSU), Japan and North America—have accounted for more than 80% of the world's pig iron production. In three of these areas (Europe, Japan, and North America) pig iron production has remained virtually constant. In recent years, production has fallen considerably in the FSU and risen dramatically in China. Production has also increased substantially in other parts of Asia, particularly India, South Korea, and Taiwan. Even including the mature Japanese market, Asia's share of world pig iron production has increased in recent years. This trend is expected to continue.

The increase in consumption in Asia is expected to benefit Australia primarily. Australia and Brazil each account for about 30% of the world total of exports, while the next closest exporter accounts for less than 10% of the world total. Of the two, Australia appears to be better positioned to take advantage of growth of iron ore consumption in Asia because of Australia's proximity and the consequent lower freight rates.

World Mine Production, Reserves, and Reserve Base:[7]

	Mine production		Crude ore		Iron content	
	1994	1995[e]	Reserves	Reserve base	Reserves	Reserve base
United States	58	60	16,000	25,000	3,800	6,000
Australia	129	130	16,000	28,000	10,000	18,000
Brazil	166	170	11,000	17,000	6,500	10,000
Canada	37	37	12,000	26,000	4,600	10,000
China[e]	240	250	9,000	9,000	3,500	3,500
France	3	3	2,200	2,200	900	900
India	57	58	5,400	12,000	3,300	6,300
Liberia	—	—	900	1,600	500	800
Mauritania	9	10	400	700	200	300
Russia	135	135	64,000	78,000	24,000	29,000
South Africa	32	33	4,000	9,300	2,500	5,900
Sweden	20	20	3,000	4,600	1,600	2,400
Other countries	115	120	7,400	16,000	2,300	6,300
World total (rounded)	1,000	1,000	150,000	230,000	65,000	100,000

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 is the only source of primary iron. In some operations, ferrous scrap constitutes up to 7% of the blast furnace burden. Scrap is extensively used in steelmaking and in iron and steel foundries.

[e]Estimated.
[1]See also 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. Consumption data are not entirely comparable to those of 1987 and earlier years owing to changes in data collection.
[4]Delivered rail of vessel at lower lake ports.
[5]Defined as imports - exports + adjustments for Government and industry stock changes.
[6]See Appendix B.
[7]See Appendix C for definitions.

IRON AND STEEL[1]

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

Domestic Production and Use: The iron and steel industry and ferrous foundries produced goods valued at about $70 billion. The steel industry consisted of 79 companies that produced raw steel at 116 locations, with combined raw steel production capability of 102 million tons. Indiana accounted for about 22% of total raw steel production, followed by Ohio, 16%, and Pennsylvania, 9%. Pig iron was produced by 15 companies operating integrated steel mills, with approximately 58 blast furnaces, of which about 41 were in continuous operation. Integrated companies accounted for about 64% of total steel production, including output of their electric arc furnaces. The distribution of steel shipments was estimated as follows: warehouses and steel service centers, 25%; transportation (predominantly for automotive production), 16%; construction, 15%; cans and containers, 5%; and other, 39%. Ferrous foundries, numbering about 1,000, were importers of pig iron into the United States, mainly from Brazil and Russia.

Salient Statistics—United States:[1]	1991	1992	1993	1994	1995[e]
Pig iron production[2]	44.1	47.4	48.2	49.4	51.0
Steel production:	79.7	84.3	88.8	91.2	95.0
Basic oxygen furnaces, percent	60.0	62.0	60.6	60.7	61.0
Electric arc furnaces, percent	38.4	38.0	39.4	39.3	39.0
Open hearth furnaces, percent	1.6	—	—	—	—
Continuously cast steel, percent	75.8	79.3	85.7	89.5	91.0
Shipments:					
Steel mill products	71.5	74.6	80.8	86.3	89.0
Steel castings[3]	0.9	0.9	1.4	1.7	1.8
Iron castings[3]	6.9	7.4	11.9	13.5	14.0
Imports of steel mill products	14.4	15.5	17.7	27.3	28.0
Exports of steel mill products	5.8	3.9	3.6	3.5	4.5
Apparent steel consumption[4]	80.8	86.2	92.0	104.0	108.0
Producer price index for steel mill products (1982=100)[5]	109.5	106.4	108.2	113.4	121.0
Steel mill product stocks at service centers, yearend[6]	5.4	5.3	5.7	6.6	7.1
Total employment, average[7]					
Blast furnaces and steel mills	199,000	187,000	175,000	172,000	171,000
Iron and steel foundries	126,000	120,000	119,000	125,000	130,000
Net import reliance[8] as a percent of apparent consumption	12	13	15	22	21

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

Import Sources (1991-94): European Union (EU),[9] 33%; Canada, 20%; Japan, 13%; Brazil, 8%; South Korea, 7%; and other, 19%.

Tariff:[10] Item	Number	Most favored nation (MFN)[11] 12/31/95	Canada 12/31/95	Mexico 12/31/95	Non-MFN[12] 12/31/95
Pig iron	7201.10.0000	Free	Free	Free	$1.11/t.
Carbon steel:					
Semifinished	7207.12.0050	3.8%	1.2%	3.3%	20%.
Structural shapes	7216.33.0090	0.8%	0.2%	0.7%	2%.
Bars, hot-rolled	7213.20.0000	1.7%	0.5%	1.5%	5.5%.
Line pipe	7305.11.1060	1.7%	0.5%	1.5%	5.5%.
Tinplate	7210.12.0000	3.2%	1%	2.8%	6%.
Sheets, hot-rolled	7208.24.5030	4.4%	1.4%	3.9%	20%.
Hot-rolled, pickled	7208.24.1000	4.6%	1.5%	4%	0.4¢/kg+20%.
Cold-rolled	7209.22.0000	4.6%	1.5%	4%	0.4¢/kg+20%.
Galvanized	7210.49.0090	5.8%	1.9%	5.2%	21.5%.
Stainless steel:					
Semifinished	7218.90.0015	4.7%	1.5%	4.1%	29%.
Bars, cold-finished	7222.20.0075	9.5%	3.1%	8.4%	29%.
Pipe and tube	7304.41.0045	[13]6.8%	[13]2.2%	Free	36%.
Cold-rolled sheets	7219.33.0035	9.1%	3%	8%	29%.

Prepared by **Iron and Steel Specialist (703) 648-4972.**

IRON AND STEEL

Depletion Allowance: Not applicable.

Government Stockpile: None.

Events, Trends, and Issues: Steel production and shipments by U.S. companies continued at near effective capacity during 1995. With demand strong, steel prices continued the climb that began in 1993. As a result, the industry continued to be generally profitable.

Strong market conditions, combined with the success of new thin slab continuous casting technology, have led to a spate of new steel plant construction. Over 10 million tons of new steel plant capacity, almost all of it for flat-rolled products, was started up or under construction in the United States in 1995.

Imports of steel mill products continued at near-record levels. Steel companies themselves were responsible for importing an estimated 4 million tons of semifinished steel for finishing in the United States. This was in addition to about 2 million tons of semifinished steel imported by companies that do not have steelmaking capability.

Exports were primarily regular shipments to Canadian and Mexican customers. At midyear, domestic demand softened slightly. In response, domestic companies increased their export sales. In particular, exports of hot-rolled steel to the Far East reversed the usual trend of imports from that region.

World Production:

	Pig iron		Raw steel	
	1994	1995[e]	1994	1995[e]
United States	49.4	51.0	91.2	95.0
Brazil	25.2	25.0	25.7	25.0
China	96.4	100.0	91.5	90.0
European Union (EU)[9]	97.7	100.0	151.8	160.0
Japan	73.8	76.0	98.3	105.0
Korea, South	21.2	22.0	33.7	36.0
Russia	36.1	39.0	48.8	50.0
Ukraine	20.0	18.0	23.8	22.0
Other countries	92.2	99.0	161.1	177.0
World total (may be rounded)	512.0	530.0	726.0	760.0

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 property 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.
[1]Production and shipments data source is the American Iron and Steel Institute (AISI); 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. Department of Commerce, Bureau of the Census. Data for years prior to 1993 may not be comparable due to changes in survey panel.
[4]Defined as steel shipments + imports - exports + adjustments for industry stock changes + adjustment for imports of semifinished steel products.
[5]Bureau of Labor Statistics.
[6]Steel Service Center Institute.
[7]Bureau of Labor Statistics. Blast furnaces and steel mills: SIC 3312; Iron and steel foundries: SIC 3320.
[8]Defined as imports - exports + adjustments for Government and industry stock changes.
[9]Data are for the expanded European Union, which, as of Jan. 1, 1995, was joined by Austria, Finland, and Sweden.
[10]All tariff percentages are ad valorem.
[11]No tariff for Israel and certain Caribbean and Andean nations.
[12]See Appendix B.
[13]No tariff for use in civil aircraft.

IRON AND STEEL SCRAP[1]

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

Domestic Production and Use: Total value of 1995 domestic purchases (receipts of ferrous scrap by all domestic consumers from brokers, dealers, and other outside sources) and exports was estimated at $9 billion, compared with $8 billion in 1994. The steel industry accounted for about three-fourths of the domestic scrap consumption, using scrap together with pig iron to produce steel products for the construction, transportation, oil and gas, machinery, container, appliance, and various other consumer industries. The ferrous castings industry consumed most of the remainder to produce cast-iron and steel products, such as motor blocks, pipe, and machinery parts. Relatively small quantities were used for producing ferroalloys, for the precipitation of copper, and by the chemical industry; these uses totaled less than 1 million tons.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Home scrap	22	21	21	20	21
Purchased scrap[2]	49	50	54	57	62
Imports for consumption[3]	1.2	1.4	1.6	1.9	2.2
Exports[3]	9.5	9.4	10.0	9.0	10.4
Consumption: Reported	62	63	68	70	74
Price, average, dollars per metric ton delivered:					
No. 1 Heavy Melting composite price, Iron Age Average: Pittsburgh, Philadelphia, Chicago	91.74	83.88	109.98	124.58	130.00
Stocks, consumer, yearend	4.1	3.7	3.7	4.1	4.5
Employment, dealers, brokers, processors[4]	37,000	37,000	37,000	37,000	37,000
Net import reliance[5] as a percent of apparent consumption	E	E	E	E	E

Recycling: All iron and steel scrap is recycled material, consisting of about 30% home scrap, 25% prompt industrial scrap, and 45% old (obsolete) scrap.

Import Sources (1991-94): Canada, 78%; Venezuela, 8%; Mexico, 6%; Japan, 4%; and other, 4%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[6] 12/31/95
Iron and steel waste and scrap:			
No. 1 bundles	7204.41.0020	Free	74¢/mt.
No. 1 Heavy Melting	7204.49.0020	Free	74¢/mt.
No. 2 Heavy Melting	7204.49.0040	Free	74¢/mt.
Shredded	7204.49.0070	Free	74¢/mt.

Depletion Allowance: Not applicable.

Government Stockpile: None.

Prepared by Iron and Steel Scrap Specialist. (703) 648-4972.

IRON AND STEEL SCRAP

Events, Trends, and Issues: Raw steel production in 1995 was estimated at about 95 million tons, about 4% more than that produced in 1994. Net shipments of steel mill products were estimated at about 89 million tons compared with 86.3 million tons for 1994.

The domestic ferrous castings industry shipped an estimated 14 million tons of all types of iron castings in 1994, and an estimated 1.8 million tons of steel castings, including investment castings.

Scrap prices in the United States continued at fairly high levels throughout the year, as a result of strong demand. 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 $130 per metric ton, about 4% higher than in 1994.

The price for nickel-bearing stainless steel scrap delivered to purchasers in Pittsburgh was much higher in 1995 than in 1994 due to higher prices for nickel and molybdenum. The average price as reported by *Iron Age Scrap Price Bulletin*, was about $1,100 per metric ton, compared with about $708 in 1994.

Total exports of ferrous scrap increased to about 10.4 million metric tons with an estimated value of about $1.7 billion.

The problem of accidental smeltings/meltings of radioactive sources contained in scrap continues to be a concern. The U.S. Nuclear Regulatory Commission has created a Working Group to evaluate current regulations concerning the control of and accountability for licensed devices and to develop recommendations for alternative regulatory approaches.

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

World Resources: Not applicable.

Substitutes: Approximately 2 million tons of direct-reduced iron, a potential substitute for iron and steel scrap, was used in the United States in 1995.

[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.
[5]Defined as imports - exports + adjustments for Government and industry stock changes.
[6]See Appendix B.

IRON AND STEEL SLAG

(Data in thousand metric tons, unless otherwise noted)

Domestic Production and Use: In 1995, an estimated 21 million tons of iron and steel slags (byproducts of iron and steelmaking), valued at $154 million, were sold or used. About 60% of this amount was iron slag with an f.o.b. value of about $126 million, and the balance was steel slag with an f.o.b. value of $29 million. There were 17 slag producing firms, with 5 processing only iron slag, 1 processing only steel slag, and the remainder processing both iron and steel slag. Iron-blast-furnace slags were processed at 27 facilities in 12 States; these slags consisted of air-cooled, expanded, and granulated types. Steel slags from open-hearth, basic oxygen, and electric arc furnaces were processed at 76 facilities in 28 States. Approximately 60% of the Nation's iron and steel slags were produced in Indiana, Ohio, Michigan, and Illinois. Iron and steel slags were used mainly as construction materials. Iron slag was typically used as road base, 45%; asphaltic concrete aggregate and other concrete products, 34%; fill, 8%; and other, 13%. Steel slags were typically used as road base, 40%; asphaltic concrete aggregate, 15%; fill, 17%; and other, 28%. Of all iron and steel slag products shipped, 85% traveled by truck, with an average marketing range of 30 miles; 4% traveled by waterway, with an average marketing range of 250 miles; and 4% traveled by rail, with an average marketing range of 175 miles. The remaining 7% was used at the plant site.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, marketable	20,300	21,400	19,000	20,100	21,000
Imports for consumption	150	100	162	199	210
Exports	5	4	4	4	4
Consumption, reported	20,300	21,400	19,000	20,100	21,000
Price average value, dollars per ton, f.o.b. plant	6.60	6.25	6.65	6.77	7.33
Stocks, yearend	NA	NA	NA	NA	NA
Employment[e]	3,000	3,000	3,000	2,500	2,500
Net import reliance[1] as a percent of reported consumption	1	1	1	1	1

Recycling: Prior to processing, some steel slag is recycled to blast furnaces, directly or as agglomerates, as a source of iron and flux materials. The exact amount recycled is not known; however, it may be as high as 80% of the steel slag generated each year. Ferrous scrap, recovered from slag during processing, is also recycled to blast and steel furnaces.

Import Sources (1991-94): Canada, 95%; Japan, 3%; and other, 2%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[2] 12/31/95
Granulated slag	2618.00.0000	Free	10% ad val.
Basic slag	3103.20.0000	Free	Free.
Slag, dross, scalings, from manufacture of iron and steel	2619.00.3000	23.6¢/t	73.8¢/t.

Depletion Allowance: Not applicable.

Government Stockpile: None.

Prepared by Iron and Steel Slag Specialist, (703) 648-7712.

IRON AND STEEL SLAG

Events, Trends, and Issues: The amount of iron and steel slag consumed increased by a small amount. While iron slag consumption overall stayed about the same, the amount of iron slag that was expanded or granulated increased. This was due to slag being used in greater quantities as a replacement for portland cement.

The fact that portland cement was in short supply impacted the slag industry. Cement companies, for the first time, began to look into the possibility of purchasing granulated iron slag from slag processing companies and grinding it at the cement plant site. This was to expand the amount of cement available. Iron slag imports have also increased steadily since 1992.

Studies continued to be conducted to determine whether blast furnace slag was a good and effective replacement of portland cement for oil field use. The research produced conflicting results. Other research focused on the performance of cement blends containing slag.

The U.S. Environmental Protection Agency included slag in its comprehensive Guideline for Procurement for Products Containing Recycled Materials. Ground granulated blast furnace slag was included among the recycled products that could be used in cement and concrete for a variety of applications. The guideline designated items that could be made with recovered materials and recommended for procurement practices in order to foster markets for materials recovered from solid waste.

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

World Resources: Not applicable.

Substitutes: Crushed stone and sand and gravel are the predominant aggregate substitutes in construction materials.

[e]Estimated. NA Not available.
[1]Defined as imports - exports + adjustments for Government and industry stock change.
[2]See Appendix B.

KYANITE AND RELATED MINERALS

(Data in thousand metric tons, unless noted)

Domestic Production and Use: One firm in Virginia, with integrated mining and processing operations, produced kyanite from hard-rock open pit mines. Synthetic mullite was produced by three companies in Georgia, Kentucky, and New York. It was estimated that 90% of the kyanite/mullite output was used in refractories: 55% for smelting and processing ferrous metals, 20% for nonferrous metals, and 15% for glassmaking and ceramics. Nonrefractory uses accounted for the remainder.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Mine	W	W	W	W	W
Synthetic mullite	W	W	W	W	W
Imports for consumption (andalusite)	5	6	12	8	7
Exports[e]	33	35	33	35	35
Shipments from Government stockpile excesses	—	—	—	—	—
Consumption, apparent	W	W	W	W	W
Stocks, producer	NA	NA	NA	NA	NA
Employment, kyanite mine and plant[e]	150	150	150	150	150
Net import reliance[1] as a percent of apparent consumption	W	W	W	W	W

Price: U.S. kyanite, 54%-60% Al_2O_3, 35-325 Tyler mesh, 18-ton lots, explant, raw, \$116 to \$146 per ton; calcined, \$210 to \$240 per ton. Andalusite, Transvaal, South Africa, 57.5% Al_2O_3, 2,000 ton bulk, f.o.b., \$180 to \$200; 59.5% Al_2O_3, 2,000 ton bulk, f.o.b., \$200 to \$220.

Recycling: Insignificant.

Import Sources (1991-94): South Africa, 97%; and France, 3%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[2] 12/31/95
Andalusite, kyanite, and sillimanite	2508.50.0000	Free	Free.
Mullite	2508.60.0000	3.9% ad val.	30% ad val.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Kyanite, lump	1.1	—	1.1	—

Prepared by Michael J. Potter, (703) 648-7723.

KYANITE AND RELATED MATERIALS

Events, Trends, and Issues: Iron and steel making, the largest end user of refractories, was projected to show an increase in output of about 3% compared with that of the previous year, according to a nongovernment source. Of two large end markets for raw steel, auto production was down somewhat, but nonresidential construction was active.

In September and October, bids were solicited for 1,077 tons of kyanite by the Defense National Stockpile Center; however, no offers were made.

World Mine Production, Reserves, and Reserve Base:

	Mine production[e]		Reserves and reserve base[3]
	1994	1995	
United States	W	W	Large in the United States and South Africa; assumed to be large in other countries.
France	50	50	
India	27	30	
South Africa	191	190	
Other countries	9	10	
World total[4]	277	280	

World Resources: Immense 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 area and in Idaho. Other resources are in aluminous gneiss in southern California. These resources are not economical at present, but some may be eventually. The characteristics of kyanite resources in the rest of the world are believed 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. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Defined as imports - exports + adjustments for Government and industry stock changes.
[2]See Appendix B.
[3]See Appendix C for definitions.
[4]Excludes the United States and countries for which information is not available.

LEAD

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

Domestic Production and Use: The value of recoverable mined lead in 1995, based on the average U.S. producer price, was $345 million. Seven lead mines in Missouri plus lead-producing mines in Alaska, Colorado, Idaho, and Montana yielded most of the total. Primary lead was processed at two smelter-refineries in Missouri, a smelter in Montana, and a refinery in Nebraska. More than 90% of secondary production came from 18 plants with annual capacities of 6,000 tons or more. Lead was consumed at about 200 manufacturing plants. Transportation was the major end use, with about 85% consumed in batteries, fuel tanks, solder, seals, and bearings. Electrical, electronic, and communications uses (including batteries), ammunition, TV glass, construction (including radiation shielding), and protective coatings accounted for approximately 8% of consumption. The balance was used in ballast and weights, ceramics and crystal glass, tubes and containers, type metal, foil, wire, and specialized chemicals.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Mine, lead in concentrates	477	407	362	370	390
Primary refinery:					
From domestic ore	324	284	310	328	340
From imported materials[1]	22	21	25	23	25
Secondary refinery, old scrap	830	861	838	858	870
Imports for consumption, lead in concentrates	12	5	1	1	3
Exports, lead in concentrates	88	72	42	39	10
Imports for consumption, metal, wrought and unwrought	122	198	202	237	240
Exports, metal, wrought and unwrought	102	70	59	54	60
Shipments from Government stockpile excesses, metal	—	—	35	63	40
Consumption: Reported	1,250	1,240	1,290	1,450	1,400
Apparent	1,230	1,270	1,360	1,470	1,450
Price, average, cents per pound: U.S.	33.5	35.1	31.7	37.2	42.0
London	25.3	24.5	18.4	24.8	27.0
Stocks, metal, producers, consumers, yearend	81	103	95	77	80
Employment: Mine and mill (peak)	2,300	1,700	1,500	1,300	1,300
Primary smelter, refineries	700	600	600	600	600
Secondary smelters, refineries	1,700	1,700	1,800	1,800	1,800
Net import reliance[2] as a percent of apparent consumption	6	10	15	18	15

Recycling: Recovery of lead from scrap batteries was approximately 825,000 tons (816,000 tons in 1994).

Import Sources (1991-94): Lead in concentrates: Mexico, 51%; Canada, 29%; Peru, 13% and other, 7%. Metal, wrought and unwrought: Canada, 67%; Mexico, 21%; Peru, 7%; Australia, 2%; and other, 3%. Total lead content: Canada, 67%; Mexico, 21%; Peru, 8%; Australia, 2%; and other, 2%.

Tariff: Item	Number	Most favored nation (MFN)[3] 12/31/95	Non-MFN[4] 12/31/95
Unwrought (Refined)	7801.10.0000	3.3% ad val.	10.0% ad val.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Lead	422	2	422	25

Prepared by **Gerald R. Smith, (703) 648-4983.**

LEAD

Events, Trends, and Issues: During 1995, prices for lead increased moderately in the U.S. market. The average North American producer price for the first 10 months of the year was about 2.5% more than the average for the final 3 months of 1994. By contrast, average London Metal Exchange prices declined by slightly more than 6% during the same period compared with the average for the final 3 months of 1994. U.S. mine production rose about 5% as a result of increased output by one of the major producers. Primary and secondary refinery production increased by approximately 4% and 2%, respectively, the latter principally owing to the opening of a new and enlarged secondary smelter-refinery by one of the major producers at midyear. U.S. consumption declined slightly following a record year in which demand was heavy for both original equipment and replacement lead-acid batteries in the automotive industry.

On June 23, 1995, the U.S. Environmental Protection Agency (EPA) issued its final rule on National Emission Standards for Hazardous Air Pollutants from Secondary Lead Smelting. This rulemaking will affect secondary lead smelters that use blast, reverberatory, rotary, or electric furnaces to recover lead, primarily from used lead-acid automotive-type batteries. The EPA rule was pursuant to the Clean Air Act, as amended in 1990, and covered the emission of several chemicals identified in the Clean Air Act as hazardous air pollutants. EPA also published information in July and September 1995 on the identification of lead-based paint hazards, lead-contaminated dust, and lead-contaminated soil. This information was designed to serve as guidance until the promulgation of final rules on such identification.

U.S. Government stockpile disposals of lead from the National Defense Stockpile continued during the year. The Defense National Stockpile Center (DNSC) revised its fiscal year 1995 Annual Materials Plan (AMP) in April 1995 to reflect an increase in the quantity of lead projected for disposal. The revision, covering the period October 1, 1994 to September 30, 1995, increased the maximum quantity that may be sold to about 54,430 metric tons from the original AMP of 32,000 metric tons. As part of the fiscal year 1995 sales, the DNSC initiated solicitation in May 1995, on the sale of 16,350 metric tons of lead on a negotiated long-term basis. For the fiscal year 1996 AMP beginning October 1, 1995, DNSC designated a limit of 54,300 metric tons of lead that may be sold during the period October 1, 1995 through September 30, 1996.

A company in Atlanta, GA, opened a new lead-acid battery recycling facility at Columbus, GA, in mid-June. The facility is designed to recycle about 9 million batteries annually, replacing an older plant at the Columbus site that had the capacity to recycle only about one-fourth as many batteries.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[5]	Reserve base[5]
	1994	1995[e]		
United States	370	390	8,000	20,000
Australia	537	540	19,000	34,000
Canada	172	170	4,000	13,000
China	340	350	7,000	11,000
Mexico	170	150	1,000	2,000
Morocco	73	70	500	1,000
Peru	220	200	2,000	3,000
South Africa	96	100	2,000	3,000
Sweden	113	100	500	1,000
Other countries	710	700	24,000	36,000
World total (may be rounded)	2,800	2,800	68,000	120,000

World Resources: In recent years, significant lead resources have been demonstrated in association with zinc and/or silver or copper in Alaska, Australia, Canada, China, India, Mexico, Pakistan, and South Africa. Identified lead resources of the world total over 1.5 billion tons.

Substitutes: Substitution of plastics has reduced the use of lead in building construction, electrical cable covering, and cans and containers. Aluminum, tin, iron, and plastics 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.

[e]Estimated.
[1]Included in imports for calculating net import reliance (see footnote 2).
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]No tariff for Mexico and 0.9% ad val. for Canada.
[4]See Appendix B.
[5]See Appendix C for definitions.

LIME[1 2]

(Data in thousand metric tons, unless noted)[3]

Domestic Production and Use: In 1995, lime producers at 113 plants in 33 States sold or used 18.5 million tons (20.4 million short tons) of lime valued at about $1,190 million, an increase of about 1.1 million tons (1.2 million short tons) and $170 million from 1994 levels. Most of the increase was accounted for by commercial and captive producers reporting higher quicklime production. Ten companies, operating 28 plants, accounted for 66% of domestic output. Principal producing States, in decreasing order, were Ohio, Missouri, Alabama, Pennsylvania, Kentucky, Texas, and Illinois. These seven States produced 11.5 million tons (12.7 million short tons) or 62% of the total output. Based on monthly data, the leading markets were chemical and industrial, steel, environmental, and construction.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production[4]	15,700	16,200	16,800	17,400	18,500
Imports for consumption	158	193	201	204	290
Exports	47	59	69	74	75
Consumption, apparent[5]	15,800	16,300	16,900	17,500	18,700
Quicklime average value, dollars per ton at plant	55.04	55.48	55.02	56.43	62.70
Hydrate average value, dollars per ton at plant	69.78	72.15	67.84	67.71	77.10
Stocks, yearend	NA	NA	NA	NA	NA
Employment, mine and plant	5,500	5,500	5,500	5,500	5,500
Net import reliance[6] as a percent of apparent consumption	<1	<1	<1	<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 plants are not included as production in order to avoid duplication.

Import Sources (1991-94): Canada, 91%; Mexico, 8%; and other, 1%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[7] 12/31/95
Quicklime	2522.10.0000	Free	0.2¢/kg.[8]
Slaked lime	2522.20.0000	Free	0.3¢/kg.[8]
Hydraulic lime	2522.30.0000	Free	0.2¢/kg.[8]

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

Government Stockpile: None.

Prepared by **M. Michael Miller, (703) 648-7716.**

LIME

Events, Trends, and Issues: The deadline for phase I compliance with sulfur dioxide (SO_2) emission regulations of the Clean Air Act Amendments of 1990 was January 1, 1995. After that date, it is unlawful for any affected utility unit to emit SO_2 in excess of the tonnage limitation of the utility's emission allowances. To supply lime for this flue gas desulfurization market (FGD), the lime industry planned to install in excess of 1.8 million tons per year (2.0 million short tons per year) of new capacity by yearend 1995. Kilns are being added to existing plants in Kentucky, Nevada, Tennessee, and West Virginia, and a new plant is being built in Missouri.

The surge in demand by the FGD and steel markets temporarily outstripped the construction of new production capacity. As a result, after an extended period of price stagnation, lime prices increased dramatically in 1995. During the period 1985-94, the value per ton of quicklime as prepared for sale, increased on average only 1.1% per year. But in inflation-adjusted constant 1994 dollars, the value per ton of quicklime decreased an average of 2.1% per year. Based on a sampling of producers, quicklime and hydrate values per ton are projected to be up 11% and 14%, respectively in 1995. The prices vary by region and are affected by regional shortages and long-term supply contracts.

World Lime Production and Limestone Reserves and Reserve Base:

	Production		Reserves and reserve base[9]
	1994	1995[e]	
United States	17,400	18,500	Adequate for all countries listed.
Belgium	1,750	1,700	
Brazil	5,700	5,700	
Canada	2,390	2,400	
China	19,500	20,000	
France	2,500	2,500	
Germany	7,500	7,500	
Italy[10]	3,500	3,500	
Japan (quicklime only)	7,710	7,700	
Mexico	6,500	6,500	
Poland	2,500	2,500	
Romania	3,000	3,000	
South Africa, (sales)	1,600	1,600	
United Kingdom	2,500	2,500	
Other countries	34,000	34,000	
World total (rounded)	118,000	120,000	

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 uses, such as agriculture, fluxing, and sulfur removal. Limestone contains less reactive material, is slower to react, and may have other disadvantages to lime depending on the use; 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.

[e]Estimated. NA Not available.
[1]Data are for quicklime, hydrated lime, and refractory dead-burned dolomite.
[2]Excludes Puerto Rico, unless noted.
[3]See Appendix A for conversion to short tons.
[4]Sold or used by producers.
[5]Stocks data are not available; stock changes are assumed to be zero for apparent consumption and net import reliance calculations.
[6]Defined as imports - exports + adjustments for Government and industry stock changes.
[7]See Appendix B.
[8]Rates include weight of the container.
[9]See Appendix C for definitions.
[10]Includes hydraulic lime.

LITHIUM

(Data in metric tons of contained lithium, unless noted)

Domestic Production and Use: The United States was the largest producer and consumer of lithium minerals and compounds worldwide. The value of domestic lithium production was estimated to be about $115 million in 1995. Two companies produced lithium compounds for domestic consumption as well as for export to other countries.

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 and synthetic rubber production.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production	W	W	W	W	W
Imports for consumption	590	770	810	851	1,000
Exports	2,400	2,100	1,700	1,700	2,000
Consumption: Apparent	W	W	W	W	W
Consumption: Estimated[1]	2,600	2,300	2,300	2,500	2,500
Price, yearend, dollars per kilogram:					
Lithium carbonate	4.21	4.32	4.21	4.41	4.60
Lithium hydroxide, monohydrate	5.37	5.53	5.71	5.62	5.90
Stocks, producer, yearend	W	W	W	W	W
Employment, mine and mill[e]	230	230	230	230	230
Net import reliance[2] as a percent of apparent consumption	E	E	E	E	E

Recycling: Insignificant.

Import Sources (1991-94): Chile, 98%; and other, 2%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[3] 12/31/95
Other alkali metals	2805.19.0000	6.4% ad val.	25% ad val.
Lithium oxide and hydroxide	2825.20.0000	3.7% ad val.	25% ad val.
Lithium carbonate:			
U.S.P. grade	2836.91.0010	3.7% ad val.	25% ad val.
Other	2836.91.0050	3.7% ad val.	25% ad val.

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

Government Stockpile: None.

Prepared by Joyce A. Ober, (703) 648-7717.

LITHIUM

Events, Trends, and Issues: The Department of Energy (DOE) sold 41 million kilograms of lithium hydroxide monohydrate, material that was excess from the thermonuclear weapons programs of the 1950's and 1960's. Two U.S. companies purchased the material and will receive shipments during the next 6 years. Up to 30% of the stocks will be available on the open market at the established contract price for 6 months. The remainder of the 30% will be purchased at the end of the period by the two companies under terms of the contract.

One buyer was one of the two domestic lithium producers. The other was a company based in California that recycles lithium batteries at its Trail, British Columbia, Canada, plant. The lithium compounds recovered from the batteries are marketed as additives to improve the long-term stability of concrete. The California company also will sell the DOE lithium hydroxide monohydrate as a concrete additive also.

Two new lithium carbonate operations approached completion. A plant in Western Australia was expected to begin production of lithium carbonate from spodumene ore by yearend. A U.S. company continued development of its brine deposit in Argentina and expected lithium carbonate production to begin early in 1997. Further lithium carbonate projects were under consideration in Canada, Chile, and Zimbabwe.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	1994	1995[e]		
United States	W	W	340,000	410,000
Argentina[e]	8	8	NA	NA
Australia[e]	1,700	1,800	370,000	440,000
Bolivia	—	—	—	5,400,000
Brazil	32	32	910	NA
Canada	630	650	180,000	360,000
Chile	2,000	2,100	1,300,000	1,400,000
China[5]	320	320	NA	NA
Namibia[e]	40	40	NA	NA
Portugal	180	180	NA	NA
Russia[5]	800	800	NA	NA
Zaire	—	—	—	320,000
Zimbabwe	380	350	23,000	27,000
World total (rounded)	[6]6,100	[6]6,300	[7]2,200,000	[8]8,400,000

World Resources: The identified lithium resources total 760,000 tons in the United States and 12 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 zinc, magnesium, calcium, and mercury as anode material in primary batteries. Lithium carbonate is not considered an essential ingredient in aluminum potlines. Substitutes for aluminum-lithium alloys as structural materials are composite materials consisting of glass, polymer, or boron fibers in engineering resins.

[e]Estimated. E Net exporter. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Based primarily on monitoring at the concentrate stage and assuming a 15% lithium loss during conversion of concentrate into chemicals.
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]See Appendix B.
[4]See Appendix C for definitions.
[5]These estimates denote only an approximate order of magnitude; no basis for more exact estimates is available. Output by China and Russia has never been reported.
[6]Excludes U.S. production.
[7]Excludes Argentina, China, Namibia, Portugal, and Russia.
[8]Excludes Argentina, Brazil, China, Namibia, Portugal, and Russia.

MAGNESIUM COMPOUNDS[1]

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

Domestic Production and Use: Seawater and natural brines accounted for about 72% of U.S. magnesium compounds production. Magnesium oxide and other compounds were recovered from seawater by four companies in California, Delaware, Florida, and Texas; from well brines by three companies in Michigan; and from lake brines by two companies in Utah. Magnesite was mined by one company in Nevada, and olivine was mined by two companies in North Carolina and Washington. About 67% of the magnesium compounds consumed in the United States was used for refractories. The remainder was consumed in agricultural, chemical, construction, environmental, and industrial applications.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production	442	418	386	345	300
Imports for consumption	156	179	256	287	350
Exports	57	49	52	46	50
Consumption, apparent	541	548	590	586	600
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, plant[e]	650	650	650	600	600
Net import reliance[2] as a percent of apparent consumption	18	24	35	41	50

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

Import Sources (1991-94): China, 62%; Canada, 13%; Mexico, 5%; Greece, 5%; and other, 15%.

Tariff:[3] Item	Number	Most favored nation (MFN) 12/31/95	Canada 12/31/95	Non-MFN[4] 12/31/95
Crude magnesite	2519.10.0000	Free	Free	$10.33/t.
Dead-burned and fused magnesia	2519.90.1000	0.3¢/kg.	Free	1.7¢/kg.
Caustic-calcined magnesia	2519.90.2000	$1.66/t	Free	$20.70/t.

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

Government Stockpile: None.

Prepared by **Deborah A. Kramer, (703) 648-7719.**

MAGNESIUM COMPOUNDS

Events, Trends, and Issues: Magnesia imports, primarily from China, continued to affect the U.S. magnesium compounds industry. In addition to these imports supplying a greater share of demand, higher prices for Chinese magnesia led to increased refractory magnesia prices. Export licenses for Chinese magnesite that were instituted in 1994 and continued throughout 1995 had the effect of increasing prices for exported material. As a result, U.S. firms that were using Chinese magnesite as a raw material source passed the price increases to their customers. At the same time, the largest magnesite producer in China announced that it was curtailing production, particularly on lower grade products, and was concentrating on high-grade magnesia.

One of the two U.S. magnesium chloride producers in Utah, with operations in Ogden, announced that is was purchasing the other producer, which has facilities in Wendover. The Ogden firm also announced that it had completed an expansion of its facilities, nearly tripling its annual magnesium chloride hexahydrate production capacity from 11,000 tons to 32,000 tons. A further expansion to 91,000 tons is planned for the end of 1996. Along with the expansion, the company will introduce a new magnesium chloride deicing agent. The largest domestic magnesium sulfate producer planned to add 25,000 tons per year of magnesium sulfate solution capacity in Utica, IL, by the end of 1995. Many Midwest customers were converting the magnesium sulfate crystal that the company already produces at the Utica site into solution, and the company was increasing capacity to meet this need.

As part of framework agreement reached in 1994 to loosen sanctions, the President signed an Executive Order allowing the importation of magnesite from North Korea. One U.S. company has signed a supply agreement with a North Korean firm to import some magnesia into the United States. Shipments were expected to begin in the summer. With the increased prices for Chinese magnesia, magnesite from North Korea could become a growing source of U.S. supply in the future, depending on the quality.

World Mine Production, Reserves, and Reserve Base:

	Magnesite production		Magnesite reserves and reserve base[5]	
	1994	1995[e]	Reserves	Reserve base
United States	W	W	10,000	15,000
Australia	79	100	NA	NA
Austria	173	170	15,000	20,000
Brazil	72	70	45,000	65,000
China[e]	432	400	750,000	1,000,000
Greece	58	60	30,000	30,000
India	144	140	30,000	45,000
Korea, North[e]	461	460	450,000	750,000
Russia[e]	173	160	650,000	730,000
Serbia and Montenegro	20	20	5,000	10,000
Slovakia[e]	346	350	20,000	30,000
Spain	115	120	10,000	30,000
Turkey	288	280	65,000	160,000
Other countries	95	100	420,000	480,000
World total (may be rounded)	[6]2,460	[6]2,430	2,500,000	3,400,000

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

World Resources: Resources from which magnesium compounds may 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, and magnesium-bearing evaporite minerals are enormous, and magnesia-bearing brines are estimated to constitute a resource in billions of tons. Magnesium hydroxide can be recovered from seawater.

Substitutes: Alumina, silica, and chromite 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 B.
[5]See Appendix C for definitions.
[6]Excludes the United States.

MAGNESIUM METAL[1]

(Data in thousand metric tons, unless noted)

Domestic Production and Use: Three companies in Texas, Utah, and Washington produced primary magnesium in 1995 valued at approximately $460 million. An electrolytic process was used at plants in Texas and Utah to recover magnesium from seawater and lake brines, respectively. A thermic process was used to recover magnesium from dolomite in Washington. The aluminum industry remained the largest consumer of magnesium, accounting for 55% of domestic primary metal use. Magnesium was a constituent in aluminum-base alloys that were used for packaging, transportation, and other applications. Castings and wrought magnesium products accounted for 20% of U.S. consumption of primary metal; desulfurization of iron and steel, 12%; reducing agent in nonferrous metals production, 6%; cathodic protection, 2%; and other uses, 5%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Primary	131	137	132	128	140
Secondary	51	57	59	62	60
Imports for consumption	32	12	37	29	33
Exports	55	52	39	45	37
Consumption: Reported, primary	92	94	101	112	110
Apparent	134	142	148	149	167
Price: Metals Week, U.S. spot Western, dollars per pound	1.43	1.50	1.46	1.63	2.10
Metal Bulletin, free market, dollars per metric ton	NA	2,625	2,260	3,125	4,300
Stocks, producer and consumer, yearend	27	13	26	19	18
Employment[e]	1,650	1,450	1,400	1,400	1,400
Net import reliance[2] as a percent of apparent consumption	E	E	E	E	E

Recycling: In 1995, about 30,000 tons of the secondary production was recovered from old scrap.

Import Sources (1991-94): Canada, 46%; Russia, 29%; Mexico, 6%; Ukraine, 6%; and other, 13%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Canada 12/31/95	Mexico 12/31/95	Non-MFN[3] 12/31/95
Unwrought metal	8104.11.0000	8.0% ad val.	2.4% ad val.	Free	100% ad val.
Unwrought alloys	8104.19.0000	6.5% ad val.	1.9% ad val.	3.9% ad val.	60.5% ad val.
Wrought metal	8104.90.0000	14.8¢/kg on Mg content + 3.5% ad val.	4.4¢/kg on Mg content + 1% ad val.	Free	88¢/kg on Mg content + 20.0% ad val.

Depletion Allowance: Dolomite, 14% (Domestic and Foreign); magnesium chloride, 5% (Domestic and Foreign).

Government Stockpile: None.

Events, Trends, and Issues: Reduced imports, particularly from Russia, and increased demand, primarily for diecastings, led to a tight supply of magnesium in the United States. Free market magnesium prices climbed sharply during the year to reach a high of $4,450 per ton in mid-August. Prices stabilized after August, but did not begin to decline until October.

On April 26, the International Trade Commission (ITC) announced its determinations in the final antidumping investigations of magnesium imports from China, Russia, and Ukraine. The ITC determined that the United States magnesium industry was injured by imports of pure magnesium from these three countries, but it was not injured by imports of alloy magnesium. This decision confirms final duties announced by the Department of Commerce in March setting deposit rates as follows: for China, 108.26%; for Russia, 0% to 100.25%, depending on the importer and the producer; and for Ukraine, 79.87% to 104.27%, depending on the importer.

Several companies were planning additional magnesium production capacity around the world. A Canadian firm announced that it would construct a demonstration plant in Pointe Claire, Quebec, to start operation by early 1996. If the demonstration plant proves successful, the company planned to start construction of a 58,000-ton-per-year plant

Prepared by **Deborah A. Kramer, (703) 648-7719.**

MAGNESIUM METAL

in 1997, with the first commercial metal production early in 2000. The company planned to recover magnesium from asbestos tailings using a combination of leaching, dehydration, and electrolysis. The Norwegian magnesium producer announced that it would increase magnesium production at both its plants in Norway and Canada so that they would be running at full capacity by the second half of 1995. Total annual capacity for the two plants is estimated to be about 88,000 tons. A regional firm announced that it had completed a prefeasibility study to construct a 25,000-ton-per-year primary magnesium plant in Iceland. The final feasibility study, which will be completed in September, will reflect the company's design to use inexpensive local geothermal energy for the plant. Cost of the plant was estimated at $250 million, and construction would take 2 to 3 years.

The State Planning Commission of China announced ambitious plans to more than double its production in the next 2 years. The Minhe magnesium smelter in Qinghai Province was expected to double its capacity to about 6,500 tons per year by the end of 1995. A joint venture between Chinese and Japanese companies was scheduled to start production in September in Jiangsu Province with an annual capacity of 4,000 tons. China's Jilin Province planned to construct four magnesium plants with a total production capacity of 8,200 tons per year. The new plants were scheduled to start up in 1996. The Linjiang Government also planned two plants with a total capacity of 6,000 tons per year. Several other city and provincial governments were seeking foreign investment to build new magnesium facilities.

A U.S. magnesium desulfurization reagent producer opened a new magnesium granule plant in Walkerton, IN, at the end of June. The new plant replaced two older plants in two other Indiana cities. Production capacity for magnesium granules from secondary magnesium remained essentially unchanged at 5,400 tons per year, but capacity for preblended desulfurization reagent doubled to 43,500 tons per year. The projected capacity for a new Indiana magnesium scrap refining plant was tripled to 32,000 tons per year. The plant was originally designed for a 10,000-ton-per-year capacity when it was announced in late 1994. Construction of the facility is slated to begin in early 1996, with initial start-up in late 1997. A total of 24,000 tons of capacity will be dedicated to high-purity secondary ingot, and 8,000 tons will be for magnesium chips for desulfurization. A domestic diecastings producer planned to build a new magnesium diecasting plant in Hannibal, MO. Initially the plant will operate two 1,200-ton cold chamber diecasting machines, but the company may triple the plant's capacity within 3 to 5 years.

World Primary Production, Reserves, and Reserve Base:

	Primary production	
	1994	1995[e]
United States	128	140
Brazil	10	10
Canada	29	47
China[e]	11	12
France	9	10
Japan	3	—
Kazakstan[e]	15	15
Norway	28	35
Russia[e]	25	35
Serbia and Montenegro	2	2
Ukraine[e]	7	5
World total	267	311

Reserves and reserve base[4]

Domestic magnesium metal production is derived from natural brines and dolomite, and 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 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 billions of tons, and magnesium can be recovered from seawater at places along world coastlines where salinity is high.

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

[e]Estimated. E Net exporter.
[1]See also Magnesium Compounds.
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]See Appendix B.
[4]See Appendix C for definitions.

MANGANESE

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

Domestic Production and Use: Manganese ore containing 35% or more manganese was not produced domestically in 1995. Manganese ore was consumed mainly by about 15 firms with plants principally in the Eastern and Midwestern United States. The majority of ore consumption was related to steel production, directly in pig iron manufacture and indirectly through upgrading ore to ferroalloys and metal. Ore was used otherwise for such nonmetallurgical purposes as producing dry cell batteries, as an ingredient in plant fertilizers and animal feed, and as a colorant for brick. Leading identifiable end uses of manganese were construction, machinery, and transportation, which were estimated, on a revised basis, to be 23%, 14%, and 12%, respectively, of total manganese demand. Most of the rest went to a variety of other iron and steel applications. Value of domestic consumption was estimated from foreign trade data as about $400 million.

Salient Statistics—United States:[1]	1991	1992	1993	1994	1995[e]
Production, mine[2]	—	—	—	—	—
Imports for consumption:					
Manganese ore	234	247	232	331	300
Ferromanganese	320	304	347	336	350
Silicomanganese[3]	258	257	316	273	300
Exports:					
Manganese ore	66	13	16	15	12
Ferromanganese	15	13	18	11	10
Shipments from Government stockpile excesses:[4]					
Manganese ore	173	425	254	134	120
Ferromanganese	(67)	(128)	(1)	9	32
Consumption, reported:[5]					
Manganese ore	472	438	389	449	470
Ferromanganese	346	339	341	347	360
Consumption, apparent, manganese[6]	598	596	696	694	710
Price, average value, 46% to 48% Mn metallurgical ore, dollars per mtu cont. Mn, c.i.f. U.S. ports	3.72	3.25	2.60	2.40	2.40
Stocks, producer and consumer, yearend:					
Manganese ore	275	276	302	269	250
Ferromanganese	50	28	30	36	33
Net import reliance[7] as a percent of apparent consumption	100	100	100	100	100

Recycling: Scrap recovery specifically for manganese was negligible, but a significant amount was recycled through processing operations as a minor component of ferrous and nonferrous scrap and steel slag.

Import Sources (1991-94): Manganese ore: Gabon, 62%; Australia, 18%; Brazil, 7%; Mexico, 7%; and other, 6%. Ferromanganese: South Africa, 33%; France, 25%; Brazil, 11%; Mexico, 9%; and other, 22%. Manganese contained in all manganese imports: South Africa, 25%; Gabon, 14%; France, 12%; Brazil, 11%; and other, 38%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[8] 12/31/95
Ore and concentrate	2602.00.0040/60	Free	2.2¢/kg of contained Mn.
Manganese dioxide	2820.10.0000	4.7% ad val.	25% ad val.
High-carbon ferromanganese	7202.11.5000	1.5% ad val.	10.5% ad val.
Silicomanganese	7202.30.0000	3.9% ad val.	23% ad val.
Metal, unwrought	8111.00.4500	14% ad val.	20% ad val.

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

Government Stockpile: Committed inventories and disposals tabulated may include nonstockpile-grade material. The Defense Logistics Agency, U.S. Department of Defense, listed additional uncommitted inventories of nonstockpile-grade materials, as follows: 16,400 tons of natural battery ore, 81 tons of chemical ore, and 392,000 tons of metallurgical ore. The Government's disposal program extended to all types of ore plus electrolytic metal.

Prepared by **Thomas S. Jones, (703) 648-4973.**

MANGANESE

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Battery: Natural ore	112	1	112	0.2
Synthetic dioxide	3	—	3	—
Chemical ore	149	2	149	4
Metallurgical ore	888	188	888	25
Ferromanganese:				
High-carbon	965	—	760	18
Medium-carbon	18	—	—	2
Silicomanganese	2	—	—	—
Electrolytic metal	12	1	12	1

Events, Trends, and Issues: The price of metallurgical ore was unchanged, but, beginning late in the first quarter of 1995, a rising price trend developed for ferromanganese and silicomanganese. Domestic demand for manganese ferroalloys was strengthened by the greatest level of raw steel production since 1981. A large price increase for silicomanganese also was driven by an even greater price escalation for ferrosilicon and switching of foreign ferroalloy producers back to ferrochromium from silicomanganese. Antidumping actions taken in December 1994 promoted diversification of the U.S. silicomanganese supply. Manganese is an essential element for people, animals, and plants, but it can be harmful in excessive amounts. Thus, manganese can be an industrial poison, but is not a hazard generally.

World Mine Production, Reserves, and Reserve Base:[9]

	Mine production 1994	Mine production 1995[e]	Reserves	Reserve base
United States	—	—	—	—
Australia	[e]980	950	26,000	72,000
Brazil	[e]897	820	21,000	56,000
China	[e]1,180	1,180	40,000	100,000
Gabon	[e]663	720	45,000	150,000
Georgia	[e]240	200	7,000	49,000
India	[e]607	640	24,000	36,000
Mexico	112	120	4,000	9,000
South Africa	[e]1,210	1,300	370,000	4,000,000
Ukraine	[e]1,052	1,100	135,000	520,000
Other countries	[e]243	300	Small	Small
World total (rounded)	[e]7,190	7,300	680,000	5,000,000

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 and the Former Soviet Union (FSU) account for more than 80% of the world's identified resources; South Africa accounts for more than 80% of the total exclusive of China and the FSU.

Substitutes: There is no satisfactory substitute for manganese in its major applications.

[e]Estimated.
[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]More nearly represents amount consumed than does reported consumption; internal evaluation indicates that reported consumption of silicomanganese is considerably understated.
[4]Net quantity including effect of stockpile upgrading program. Data in parentheses denote increases in inventory.
[5]Total manganese consumption cannot be approximated from consumption of manganese ore and ferromanganese because of the use of ore in making manganese ferroalloys and metal.
[6]Thousand metric tons, manganese content. Based on estimates of average content for all significant components except imports, for which content is reported.
[7]Defined as imports - exports + adjustments for Government and industry stock changes.
[8]See Appendix B.
[9]Thousand metric tons, manganese content. See Appendix C for definitions.

MANUFACTURED ABRASIVES

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

Domestic Production and Use: Fused aluminum oxide was produced by four companies in seven plants in the United States and Canada. The production of regular-grade fused aluminum oxide represented utilization of 70% of the rated industry capacity and was valued at about $55 million. Production of high-purity fused aluminum oxide utilized about 89% of rated industry capacity and was valued at about $14 million. Silicon carbide was produced by three companies in four plants in the United States and Canada. U.S. and Canadian production of crude silicon carbide utilized about 81% of rated industry capacity and was valued at about $42 million.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, United States and Canada (crude):					
Fused aluminum oxide, regular	138,000	143,000	132,000	133,000	129,000
Fused aluminum oxide, high-purity	24,500	24,200	21,300	29,200	24,100
Silicon carbide	78,900	84,300	74,900	84,700	W
Imports for consumption[e]					
Fused aluminum oxide	140,000	136,000	158,000	145,000	141,000
Silicon carbide	70,000	89,000	115,000	110,000	136,000
Exports					
Fused aluminum oxide	11,000	12,000	11,000	13,000	10,000
Silicon carbide	10,000	14,000	17,000	16,000	16,200
Consumption: Apparent					
Fused aluminum oxide	NA	NA	NA	NA	NA
Silicon carbide	NA	NA	NA	NA	NA
Price, range of value, dollars per ton					
Fused aluminum oxide, regular	381	395	362	361	353
Fused aluminum oxide, high-purity	619	594	621	557	470
Silicon carbide	500	516	540	531	W
Stocks, producer	NA	NA	NA	NA	NA
Employment, mine and mill	NA	NA	NA	NA	NA
Net import reliance[1] as a percent of apparent consumption	NA	NA	NA	NA	NA

Recycling: The U.S. Bureau of Mines estimates that about 39,000 tons of fused aluminum oxide is recycled and that silicon carbide recycling is about 5,000 tons.

Import Sources (1991-94): Fused aluminum oxide crude: Canada, 90%; and other, 10%. Fused aluminum oxide grain: Austria, 34%; Canada, 31%; Germany, 6%; Brazil, 5%; and other, 24%. Silicon carbide crude: Canada, 61%; China; 34%, and other, 5%. Silicon carbide grain: Norway, 44%; Germany, 15%; Brazil, 11%; Canada, 7%; and other, 23%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[2] 12/31/95
Fused aluminum oxide, crude	2818.10.1000	Free	Free.
Fused aluminum oxide, grain	2818.10.2000	0.7¢/kg	2.2¢/kg.
Silicon carbide, crude	2849.20.1000	Free	Free.
Silicon carbide, grain	2849.20.2000	0.7¢/kg	2.2¢/kg.

Depletion Allowance: None.

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Fused aluminum oxide, crude	196,000	—	196,000	—
Fused aluminum oxide, grain	33,200	2,010	33,200	2,490
Silicon carbide, crude	25,100	2,880	25,100	4,080

Prepared by **Manufactured Abrasives Specialist, (703) 648-7721.**

MANUFACTURED ABRASIVES

Events, Trends, and Issues: The fused aluminum oxide industry appears to have stopped its decline and has stabilized at current production levels. One silicon carbide plant stopped production during 1995. Large volumes of low cost silicon carbide from China, appears to have affected U.S. and Canadian production.

World Production Capacity:

	Fused aluminum oxide capacity		Silicon carbide capacity	
	1994	1995[e]	1994	1995[e]
United States and Canada	245,000	245,000	103,000	83,000
Argentina	—	—	6,000	6,000
Australia	100,000	100,000	—	—
Austria	60,000	60,000	—	—
Brazil	96,000	96,000	43,000	43,000
China	300,000	300,000	250,000	250,000
France	45,000	45,000	16,000	16,000
Germany	86,000	86,000	36,000	36,000
India	20,000	20,000	13,000	13,000
Japan	55,000	55,000	90,000	90,000
Mexico	—	—	25,000	25,000
Norway	—	—	80,000	80,000
Venezuela	—	—	20,000	20,000
Other countries	450,000	450,000	250,000	250,000
World total (rounded)	1,500,000	1,500,000	930,000	910,000

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

Substitutes: Industrial diamond, cubic boron nitride, and other natural and manufactured abrasives can be used in most applications.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Defined as imports - exports + adjustments for Government and industry stock changes.
[2]See Appendix B.

MERCURY

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

Domestic Production and Use: Mercury was produced as a byproduct at nine gold mining operations in Nevada, California, and Utah. Other gold mines in these States were believed to have recovered mercury, but data were not available to make estimates. Several companies in the Eastern and Central United States recovered mercury from worn out or obsolete items such as batteries, electrical apparatus, fluorescent lamps, instruments, and dental amalgams. Mercury also was recovered at chlorine and caustic soda plants. The value of mercury used in the United States was estimated at $3.6 million. It was estimated that 28% of domestic consumption was used in the production of chlorine and caustic soda, 23% for electronic and electrical applications, 16% for instruments and related products, and 33% for other uses.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Mine[2]	58	64	W	W	W
Secondary, industrial	165	176	350	466	450
Imports for consumption	56	92	40	129	500
Exports	786	977	389	316	220
Shipments from Government stocks:[3]					
National Defense Stockpile	103	267	543	86	—
U.S. Department of Energy	215	103	—	—	—
Consumption: Reported	554	621	558	483	480
Apparent	W	W	W	W	W
Price, average value, dollars per flask, New York, dealer	122.42	201.39	187.00	194.45	250.00
Stocks, industry, yearend[4]	313	436	384	368	450
Employment, mine and mill, average (primary production)	3	—	—	—	—
Net import reliance[5] as a percent of apparent consumption	W	W	W	W	W

Recycling: Secondary and redistilled mercury accounted for 65% of domestic consumption in 1995.

Import Sources (1991-94): Canada, 49%; Russia, 37%; Germany, 13%; and other, 1%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[6] 12/31/95
Mercury	2805.40.0000	1.7% ad val.	5.7% ad. val.

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

Government Stockpile: In addition to the quantities shown below, 146 tons of secondary mercury was held by the U.S. Department of Energy at Oak Ridge, TN.

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Mercury	4,410	34.7	4,410	—

Prepared by **Mercury Specialist, (703) 648-4982.**

MERCURY

Events, Trends, and Issues: Imports of mercury increased dramatically in 1995, after the temporary suspension of sales of mercury from the National Defense Stockpile (NDS) in 1994. NDS sales will not resume until the U.S. Environmental Protection Agency and the Defense Logistics Agency can determine a way to sell the mercury to ensure that its use will not lead to environmental problems.

Consumption remained nearly the same because of the gradual elimination of mercury from many products and processes. Mercury use in consumer batteries has dropped to about 5 tons per year since its use has been restricted to alkaline button cells for hearings aids, pagers, and other small electronic devices. Military and medical equipment still use mercuric-oxide batteries, because of the lack of acceptable substitutes. State and Federal studies are continuing on the development of effective substitutes for mercury in switches, electrical devices, and dental amalgams; however, commercial production is not expected for several years.

Recovery of mercury from scrap materials has remained nearly the same for the past 2 years. Mercury is recovered from spent batteries, tilt switches, measuring devices, fluorescent light tubes, chlorine and caustic soda wastewater sludges, dental amalgams, and other products.

A new low-mercury fluorescent light tube became available in late 1995. The 1.22-meter (4-foot) tube contains only 10 milligrams of mercury compared with 22.8 milligrams in currently produced lamps. This is down from an industry average of 38.4 milligrams per tube in 1990. The low-mercury content in these lamps should allow for their disposal as nonhazardous waste.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[7]	Reserve base[7]
	1994	1995[e]		
United States	W	W	3,000	4,000
Algeria	475	450	2,000	3,000
China	500	500	([8])	([8])
Mexico	10	10	5,000	9,000
Italy	—	—	—	69,000
Kyrgyzstan	200	200	7,500	13,000
Spain	300	1,700	76,000	90,000
Ukraine	50	50	2,500	4,000
Other countries	223	200	30,000	48,000
World total (may be rounded)	1,760	3,100	130,000	240,000

World Resources: World mercury resources are estimated at nearly 600,000 tons, principally in Kyrgyzstan, Russia, Slovenia, Spain, and Ukraine. These are sufficient for another century or more, especially with declining consumption rates.

Substitutes: Lithium, nickel-cadmium, and zinc-air compounds are substitutes for mercury-zinc batteries. Indium compounds substitute for mercury in alkaline batteries. Diaphragm and membrane cells replace mercury cells in the electrolytic production of chlorine and caustic soda. Ceramic composites can replace dental amalgams; organic compounds have replaced mercury fungicides in latex paint. Digital instruments have replaced mercury thermometers in many applications.

[e]Estimated. W Withheld to avoid disclosing company proprietary data.
[1]One metric ton (1,000 kilograms) = 29.0082 flasks.
[2]Mercury was recovered only as a byproduct of gold mining.
[3]Metal sold from the National Defense Stockpile and surplus secondary mercury released from U.S. Department of Energy stocks.
[4]Consumer stocks only.
[5]Defined as imports - exports + adjustments for Government and industry stock changes.
[6]See Appendix B.
[7]See Appendix C for definitions.
[8]Included in "Other countries."

MICA (NATURAL), SCRAP AND FLAKE[1]

(Data in thousand metric tons, unless noted)

Domestic Production and Use: Scrap and flake mica production, excluding low-quality sericite, decreased about 5% in 1995. North Carolina accounted for about 65% of U.S. production. The remaining output came from Georgia, New Mexico, South Carolina, and South Dakota. Scrap mica was recovered principally from mica and sericite schist and from feldspar, kaolin, and lithium beneficiation. The bulk of domestic production was processed into small particle-size mica by wet and dry grinding. Primary uses were joint compound, paint, roofing, oil well drilling additives, and rubber products. The value of 1995 scrap mica production was estimated at $7.5 million. Ground mica sales were valued at $29 million. There were 10 domestic producers of scrap and flake mica.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production:[2 3] Mine	103	85	88	109	104
Ground	75	84	92	95	91
Imports, mica powder and mica waste	11	12	14	18	16
Exports, mica powder and mica waste	4	4	5	6	7
Consumption, apparent[4]	84	95	105	97	100
Price, average, dollars per ton, reported:					
Scrap and flake	54	51	51	66	65
Ground:					
Wet	640	745	838	1,007	1,000
Dry	150	168	152	151	150
Stocks, producer, yearend[e]	7	7	7	14	13
Employment, mine[e 5]	80	80	80	364	360
Net import reliance[6] as a percent of apparent consumption	11	12	12	1	10

Recycling: None.

Import Sources (1991-94): Canada, 90%; India, 6%; and other, 4%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[7] 12/31/95
Mica powder	2525.20.0000	1.9% ad val.	20% ad val.
Mica waste	2525.30.0000	Free	8.8¢/ kg.

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

Government Stockpile: None.

Prepared by James B. Hedrick, (703) 648-7725.

MICA (NATURAL), SCRAP AND FLAKE

Events, Trends, and Issues: Production of ground mica in the United States increased for the fourth consecutive year after 4 years of decline. The increase is a reflection of a continued improvement in construction activity. The United States remained the major producer of scrap and flake mica in 1995. Imported mica is used primarily for making mica paper and as a filler and reinforcer in plastics.

The principal environmental impact of mica mining was the land disturbance commonly associated with surface mining.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[8]	Reserve base[8]
	1994	1995[e]		
United States[2]	109	104	Large	Large
Canada	18	18	Large	Large
India	2	2	Large	Large
Korea, South	8	8	Large	Large
Russia	25	25	Large	Large
Other countries	52	52	Large	Large
World total	214	209	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, vermiculite, and perlite 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.
[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, including 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 B.
[8]See Appendix C for definitions.

MICA (NATURAL), SHEET[1]

(Data in metric tons, unless noted)

Domestic Production and Use: A minor amount of sheet mica, estimated at less than 500 kilograms, was produced in 1995. The domestic consuming industry was dependent on imports and shipments of Government stockpile excesses to meet demand. During 1995, an estimated 920 tons of mica split block and mica splittings valued at $1.3 million was consumed by 14 companies in 7 States, mainly in the East and Midwest. Most was fabricated into parts for electronic and electrical equipment. An additional 1,200 tons of imported worked mica valued at $7.8 million was also consumed.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, mine[e]	(2)	(2)	(2)	(2)	(2)
Imports, split block, splittings, other	2,340	3,460	4,310	6,320	9,430
Exports, crude and rifted, and plates, sheets, and strips	616	606	909	1,110	1,310
Shipments from Government stockpile excesses	2	264	165	134	600
Consumption, apparent	1,780	2,250	2,180	5,350	8,710
Price, average value, dollars per kilogram, muscovite mica, reported:					
Block	85	80	95	66	80
Splittings	1.54	1.53	1.55	1.59	1.60
Stocks, fabricator and trader, yearend[e]	NA	NA	502	503	510
Net import reliance[3] as a percent of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (1991-94): India, 88%; Brazil, 4%; Finland, 3%; China, 2%; and other, 3%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[4] 12/31/95
Split block mica	2525.10.0010	Free	Free.
Mica splittings	2525.10.0020	Free	Free.
Unworked-other	2525.10.0050	Free	Free.
Plates, sheets, and strips of agglomerated or reconstructed mica	6814.10.0000	Free	Free.
Worked mica and articles of mica-other	6814.90.0000	Free	Free.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Block:				
Muscovite	1,895	116	1,836	321
Phlogopite	59	—	—	—
Film, muscovite	337	123	337	132
Splittings:				
Muscovite	6,234	59	6,234	59
Phlogopite	546	13	542	26

Prepared by James B. Hedrick, (703) 648-7725.

MICA (NATURAL), SHEET

Events, Trends, and Issues: Demand for sheet mica remained at about the same level as that of the previous year. Imports remained the primary source of sheet mica, and shipments from Government stockpile excesses remained a minor source of supply. The availability of good quality mica remains in short supply. There were no environmental problems associated with the manufacture of mica products.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[5]	Reserve base[5]
	1994	1995[e]		
United States	([2])	([2])	Very small	Small
India	3,000	3,000	Very large	Very large
Russia	1,500	1,500	Moderate	Large
Other countries	900	900	Moderate	Large
World total	5,400	5,400	Large	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.

Substitutes: Many materials can be substituted for mica in many electrical and electronic 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 uses.

[e]Estimated. NA Not available.
[1]See also Mica (Natural), Scrap and Flake.
[2]Less than ½ unit.
[3]Defined as imports - exports + adjustments for Government and industry stock changes.
[4]See Appendix B.
[5]See Appendix C for definitions.

MOLYBDENUM

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

Domestic Production and Use: In 1995, molybdenum, valued at about $280 million (based on average oxide price), was produced by 10 mines. A mine in Colorado mined molybdenum ore, whereas nine mines in Arizona, California, Montana, New Mexico, and Utah recovered molybdenum as a byproduct. Two 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 producers accounted for about 75% of the molybdenum consumed. Major end-use applications were as follows: machinery, 35%; electrical, 15%; transportation, 15%; chemicals, 10%; oil and gas industry, 10%; and other, 15%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, mine	53,000	50,000	37,000	47,000	59,000
Imports for consumption	2,600	3,200	6,500	6,500	10,000
Exports, all primary forms	36,000	36,000	30,000	37,000	40,000
Consumption: Reported	17,000	17,000	18,000	19,000	26,000
Apparent	19,000	21,000	16,000	25,000	29,000
Price, average value, dollars per kilogram[1]	5.27	4.85	5.13	4.60	5.00
Stocks, mine and plant concentrates, product producers and end-use consumers	17,000	22,000	20,000	12,000	12,000
Employment, mine and plant, molybdenum production	1,000	750	680	700	700
Net import reliance[2] as a percent of apparent consumption	E	E	E	E	E

Recycling: Secondary molybdenum in the form of metal or superalloys was recovered, but the amount was small. About 1,000 metric tons of molybdenum was reclaimed from spent catalysts. Although some molybdenum was recycled as a minor constituent of scrap alloy steels and iron, the use of such scrap did not generally depend on its molybdenum content.

Import Sources (1991-94): Chile, 20%; China, 27%; Canada, 15%; United Kingdom, 14% and other, 24%.

Tariff Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[3] 12/31/95
Molybdenum ore and concentrates, roasted	2613.10.0000	13.1¢/kg + 1.9% ad val.	$1.10/kg + 15% ad val.
Molybdenum ore and concentrates, other	2613.90.0000	19.4¢/kg	77.2¢/kg.
Molybdenum chemicals:			
Molybdenum oxides and hydroxides	2825.70.0000	3.2% ad val.	20.5% ad val.
Molybdates of ammonium	2841.70.1000	4.3% ad val.	29% ad val.
Molybdates, all others	2841.70.5000	3.7% ad val.	25% ad val.
Molybdenum pigments:			
Molybdenum orange	3206.20.0020	3.7% ad val.	25% ad val.
Miscellaneous chemical products:			
Mix of two or more inorganic compounds of molybdenum	3823.90.3400	2.8% ad val.	18% ad val.
Ferroalloys:			
Ferromolybdenum	7202.70.0000	4.5% ad val.	31.5% ad val.
Molybdenum metals:			
Powders	8102.10.0000	12.9¢/kg + 1.8% ad val.	$1.10/kg + 15% ad val.
Unwrought	8102.91.1000	13.9¢/kg + 1.9% ad val.	$1.10/kg + 15% ad val.
Waste and scrap	8102.91.5000	Free	Free.
Wrought	8102.92.0000	6.6% ad val.	60% ad val.
Wire	8102.93.0000	6.2% ad val.	60% ad val.
Other	8102.99.0000	5.1% ad val.	45% ad val.

Prepared by **John W. Blossom, (703) 648-4964.**

MOLYBDENUM

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

Government Stockpile: None.

Events, Trends, and Issues: U.S. mine output of molybdenum in 1995 increased 26% compared with that of 1993. Reported consumption of molybdenum increased about 36%; exports and U.S. producer inventories were the same as those of 1994.

It is estimated that in 1996 domestic mine production of molybdenum will be 60,000 metric tons and that U.S. reported consumption will be 30,000 metric tons.

The domestic price for technical-grade molybdic oxide averaged $5.00 per kilogram of contained molybdenum during 1995. Mine capacity utilization was 60%.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	1994	1995[e]	(thousand metric tons)	
United States	47,000	59,000	2,700	5,400
Armenia	500	500	20	30
Bulgaria	100	100	([5])	10
Canada	10,000	11,000	450	910
Chile	16,000	16,000	1,100	2,500
China	18,000	18,000	500	1,000
Iran	1,000	1,000	50	140
Kazakstan	500	500	130	200
Mexico	2,600	2,600	90	230
Mongolia	1,500	1,500	30	50
Peru	3,000	3,000	140	230
Russia	4,500	4,500	240	360
Uzbekistan	700	700	60	150
Other countries	—	—	—	590
World total (may be rounded)	104,000	118,000	5,500	12,000

World Resources: Identified resources amount to about 5.6 million metric tons of molybdenum in the United States and more than 12 million metric tons in the world. Molybdenum occurs both as the principal metal sulfide in large low-grade porphyry molybdenum deposits and as a subsidiary 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, cast irons, and nonferrous metals. In fact, because of the availability and versatility of the metal, industry has sought to develop new materials that benefit from the alloying properties of molybdenum. Potential substitutes for molybdenum include chromium, vanadium, columbium, 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]Major producer price per kilogram of molybdenum contained in technical-grade molybdic oxide.
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]See Appendix B.
[4]See Appendix C for definitions.
[5]Less than ½ unit.

NICKEL

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

Domestic Production and Use: The only nickel mining and smelting complex in the United States, near Riddle, OR, reopened in March 1995. On a monthly or annual basis, 187 facilities reported nickel consumption. The principal consuming State was Pennsylvania, followed by West Virginia and New Jersey. Approximately 44% of the primary nickel consumed went into stainless and alloy steel production, 35% into nonferrous alloys and superalloys, 14% into electroplating, and 7% into other uses. Ultimate end uses were as follows: transportation, 29%; chemical industry, 14%; electrical equipment, 10%; construction, 9%; fabricated metal products, 8%; petroleum, 8%; machinery, 7%; household appliances, 6%; and other, 9%. Total estimated value of apparent primary consumption was $1.3 billion.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Mine	5,520	6,670	2,460	—	1,650
Plant	7,070	8,960	4,880	—	8,200
Imports:[1] Ore	371	3,580	2,970	—	8,200
Primary	132,000	119,000	126,000	127,000	151,000
Secondary	6,210	9,510	6,710	6,060	8,400
Exports: Primary	9,100	8,560	7,180	7,440	9,900
Secondary	27,800	25,300	26,000	34,500	41,900
Consumption: Reported, primary	109,000	101,000	105,000	107,000	126,000
Reported, secondary	53,500	55,900	54,000	58,600	65,600
Apparent, primary	125,000	119,000	122,000	134,000	159,000
Price, average annual, London Metal Exchange					
Cash, dollars per metric ton	8,156	7,001	5,293	6,340	8,245
Cash, dollars per pound	3.699	3.176	2.401	2.876	3.740
Stocks: Government, yearend	33,800	33,800	31,600	26,800	16,500
Consumer, yearend	15,900	17,400	14,400	10,200	10,800
Producer, yearend[2]	11,800	10,100	15,700	10,200	10,500
Employment, yearend: Mine	8	10	2	1	15
Smelter	277	250	33	22	250
Port facility[3]	—	23	5	3	25
Net import reliance[4] as a percent of apparent consumption	61	59	63	64	61

Recycling: About 66,000 tons of nickel was recovered from purchased scrap in 1995. This represented about 34% of reported consumption for the year.

Import Sources (1991-94): Canada, 47%; Norway, 15%; Australia, 11%; Dominican Republic, 6%; and other, 21%.

Tariff: Item	Number	Canada, Mexico, and Most favored nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Nickel oxide, chemical grade	2825.40.0000	Free	Free.
Ferronickel	7202.60.0000	Free	6.6¢/kg.
Nickel oxide, metallurgical grade	7501.20.0000	Free	Free.
Unwrought nickel	7502.10.0000	Free	6.6¢/kg.
Waste and scrap	7503.00.0000	Free	6.6¢/kg.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Nickel	18,000	3,650	16,800	7,980

Events, Trends, and Issues: Demand for nickel-bearing stainless steel has improved substantially in the United States since 1992. However, a large part of the increase was being met by imported stainless, in decreasing order, from the European Union, Japan, and Canada. U.S. production of stainless steel increased 3% between 1993-94, with nickel-bearing grades accounting for 65% of the 1.83 million tons made in 1994. Domestic shipments of stainless sheet and strip were at an all-time high in 1995.

Prepared by **Peter H. Kuck, (703) 648-4965.**

NICKEL

Growing demand for austenitic stainless steel in the developing countries and an improving global economy have turned nickel prices around after 3 years of recession. Nickel supply and demand have been closely balanced since early 1995, lifting prices to more traditional levels. On Nov. 27, 1995, the London Metal Exchange (LME) cash price for 99.8%-pure nickel stood at $8,497 per metric ton ($3.85 per pound), up significantly from late 1993. Increased speculation in cut cathode and briquets has caused the price to be more volatile than in the past. LME inventories peaked at 151,000 tons on Nov. 24, 1994, and have been falling ever since. Some analysts are forecasting an undersupply situation for the 1996-99 period. Prices continue to be kept in check by large exports of cathode and powder from Russia to the West.

The prospects of undersupply have encouraged producers to open new mines in Australia and New Caledonia and upgrade older operations elsewhere. The discovery of a world class nickel-copper-cobalt deposit at Voisey Bay, Labrador, drastically altered the nickel supply picture and changed long-range thinking about future exploration targets in other parts of the Subarctic. In June 1994, a Canadian company entered into a joint venture with the Government of Cuba to upgrade mining and beneficiating operations at Moa Bay. Since then, two other prominent companies–one based in Australia and one in South Africa–have begun actively exploring for nickel in Cuba.

Programs were underway in the European Union, Japan, and the United States to develop advanced nickel-based batteries for electric vehicles. Beginning in 1997, 2% of all motor vehicles sold within California must have zero tailpipe emissions–a requirement only electric vehicles can presently satisfy.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[6]	Reserve base[6]
	1994	1995[e]		
United States	–	1,650	23,000	2,500,000
Australia	79,000	80,000	2,200,000	6,800,000
Botswana	20,600	22,000	480,000	900,000
Brazil	32,000	34,000	670,000	4,300,000
Canada	150,000	150,000	6,200,000	14,000,000
China	36,900	37,000	730,000	900,000
Colombia	26,100	27,000	560,000	740,000
Cuba	26,900	28,000	18,000,000	23,000,000
Dominican Republic	30,500	31,000	450,000	680,000
Finland	7,190	7,100	80,000	100,000
Greece	18,800	19,000	450,000	900,000
Indonesia	81,200	83,000	3,200,000	13,000,000
New Caledonia	96,000	100,000	4,500,000	15,000,000
Philippines	9,850	10,000	410,000	11,000,000
Russia	240,000	235,000	6,600,000	7,300,000
South Africa	30,100	32,000	2,500,000	2,600,000
Ukraine	4,000	4,000	90,000	90,000
Zimbabwe	13,500	14,000	77,000	100,000
Other countries	3,800	4,400	160,000	10,000,000
World total (rounded)	906,000	920,000	47,000,000	110,000,000

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

Substitutes: With few exceptions, substitutes for nickel would result in increased cost or some tradeoff in the economy or performance of the product. Present and potential nickel substitutes include aluminum, coated steels, and plastics in the construction and transportation industries; nickel-free specialty steels in the power generating, petrochemical, and petroleum industries; titanium and plastics in severe corrosive applications; and platinum, cobalt, and copper in catalytic uses.

[e]Estimated.
[1]Imports for consumption.
[2]Stocks of producers, agents, and dealers held only in the United States.
[3]Employment at port facility in Coos Bay, OR, used exclusively for drying and transhipping imported nickel ore.
[4]Defined as imports - exports + adjustments for Government and industry stock changes.
[5]See Appendix B.
[6]See Appendix C for definitions.

NITROGEN (FIXED)—AMMONIA

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

Domestic Production and Use: U.S. ammonia producers operated at near 100% of capacity under prevailing conditions of supply-demand balance, firm prices for nitrogen compounds in all forms, and favorable profit margins. Domestic ammonia was valued at about $4 billion, f.o.b. barge, New Orleans. Sixty percent of total U.S. ammonia production capacity was concentrated in the States of Louisiana, 40%; Oklahoma, 14%; and Texas, 6%; owing to large indigenous reserves of natural gas feedstock. Ammonia plants in the Midwest accounted for another 16% of capacity, with the remainder equally divided between the Southern, Southeastern, and Western States. Downstream nitrogen compound operating rates ranged from 90% to more than 100%. Urea producers operated at 104% of design capacity, compared with 89% in 1994, while diammonium phosphate and monoammonium phosphate (DAP and MAP) rates improved to 95% from 91% in 1994.

Approximately 80% of U.S. apparent domestic ammonia consumption was for fertilizer use, including anhydrous ammonia for direct application, urea, ammonium nitrate, ammonium phosphates, and other nitrogen compounds. Ammonia was also used to produce plastics, synthetic fibers, and resins, 10%; explosives, 4%; and numerous other chemicals, 6%.

Salient Statistics—United States:[1]	1991	1992	1993	1994	1995[e]
Production[2]	12,800	13,400	12,600	13,400	13,200
Imports for consumption	2,740	2,690	2,660	3,450	3,600
Exports	580	354	378	215	200
Consumption, apparent	14,800	15,600	15,100	16,500	16,600
Stocks, producer, yearend	936	1,060	852	956	1,000
Price, dollars per ton, average annual, f.o.b. gulf coast[3]	117	106	121	211	230
Employment, plant	2,500	2,500	2,500	2,500	2,500
Net import reliance[4] as a percent of apparent consumption	14	14	17	19	20

Recycling: None.

Import Sources (1991-94): Trinidad and Tobago, 32%; Canada, 29%; Former Soviet Union, 21%; Mexico, 12%; and other, 6%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Ammonia, anhydrous	2814.10.0000	Free	Free.
Ammonia, aqueous	2814.20.0000	Free	Free.

Depletion Allowance: Not applicable.

Government Stockpile: None.

Prepared by **Nitrogen Specialist, (703) 648-7711.**

NITROGEN (FIXED)—AMMONIA

Events, Trends, and Issues: The U.S. fertilizer industry experienced one of its best years in history, bolstered by global supply-demand balance and solid export demand for domestic fertilizers and grain. Prices for most nitrogen commodities were at 20-year highs, operating costs were down, and profit margins up. Ammonium phosphate exports to China, India, and other ports of call continued to soar. The favorable situation and projected outlook precipitated the announcement of a new round of capacity expansion by the U.S. nitrogen fertilizer industry, including the construction of new capacity and debottlenecking activities in the United States, Canada, and Trinidad and Tobago. Canadian producers also planned to reactivate several idle ammonia plants, and debottleneck existing capacity.

U.S. ammonia import tonnage continued at record levels, led by Trinidad and Tobago, the Former Soviet Union, Canada, and Mexico, in order of importance. A dramatic 100% increase in shipments from the Black Sea Port of Yuzhny, Ukraine, to more than 1 million product tons, was largely offset by a decline in Mexican and Persian Gulf shipments. The U.S. urea trade deficit was projected to fall marginally to 1.8 million tons of product from 2.2 million tons in 1994.

Although domestic feedgrain acreage fell 9%, and foodgrains, 2%, from 1994 levels, overall crop acreage declined only 2% owing to a rebound in oilseeds and cotton. A wet spring hampered fertilizer application and lowered yields. The outlook for 1996 was optimistic, in light of prospects for improved domestic fertilizer demand and a continuation of firm market conditions for fertilizers and grains at the global level.

Because readily available nitrogen compounds can be formulated into explosives such as those used to destroy the federal building in Oklahoma City, OK, in April 1995, the U.S. Congress, federal law enforcement and other Government agencies, and the private sector were working cooperatively to implement measures to counteract terroristic activities.

World Ammonia Production, Reserves, and Reserve Base:

	Plant production		Reserves and reserve base[6]
	1994	1995[e]	
United States	13,400	13,200	Available atmospheric nitrogen and sources of natural gas for production of ammonia are considered adequate for all listed countries.
Canada	3,470	3,700	
China	19,800	20,200	
Germany	2,130	2,600	
India	7,330	7,900	
Indonesia	3,010	3,200	
Japan	1,430	1,450	
Mexico	2,030	2,000	
Netherlands	2,370	2,400	
Russia	7,260	7,800	
Trinidad and Tobago	1,650	1,700	
Ukraine	3,000	3,500	
Other countries	25,100	26,000	
World total (rounded)	92,000	96,000	

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 demand.

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 Bulletins MA28B and MQ28B (DOC).
[3]Source: Green Markets Fertilizer Intelligence Weekly, a Pike and Fischer publication.
[4]Defined as imports - exports + adjustments for Government and industry stock changes.
[5]See Appendix B.
[6]See Appendix C for definitions.

PEAT

(Data in thousand metric tons, unless noted)[1]

Domestic Production and Use: The estimated f.o.b. plant value of marketable peat production in the contiguous United States was about $16 million in 1995. Alaskan peat output was valued at $450,000 by the State Department of Natural Resources, Division of Geological and Geophysical Surveys, in Fairbanks, AK. Large firms, operating bogs over a wide geographic area in the United States, reported relatively level production, along with a moderate increase in sales. Peat was harvested and processed by about 70 producers in 21 States. Reed-sedge peat accounted for about 70% of total U.S. peat production by volume, followed by sphagnum moss, 18%; humus, 7%; and hypnum moss, 5%. Geographically, about 85% of U.S. peat production was from the Great Lakes, and Southeast Regions, led by Florida, Michigan, and Minnesota, in order of importance. The remainder was produced in the Midwest, Northeast, and West.

Approximately 95% of domestic peat was sold for horticulture/agriculture usage, including general soil improvement, potting soils, earthworm culture, the nursery business, and golf course maintenance and construction, in order of importance. Other applications included seed inoculants, vegetable cultivation and mushroom culture, mixed fertilizers, and packing for flowers and plants. In the industrial sector, peat found widespread use as an oil absorbent, an efficient filtration medium for the removal of waterborne contaminants in mine waste steams, and municipal storm drainage. Peat also was used as an effective sterile absorbent in feminine hygiene products, and, to a lesser extent, as a fuel source.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production	632	599	616	574	580
Commercial sales	703	652	612	552	580
Imports for consumption	573	639	648	669	700
Exports	13	22	8	23	20
Consumption, apparent[2]	1,250	1,230	1,290	1,240	1,290
Price, average value, f.o.b. mine, dollars per ton	25.29	25.68	27.54	27.22	27.00
Stocks, producer, yearend	298	308	269	252	220
Employment, mine and plant	650	650	650	650	650
Net import reliance[3] as a percent of apparent consumption	49	49	53	53	55

Recycling: None.

Import Sources (1991-94): Canada, 100%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[4] 12/31/95
Peat	2703.00.0000	Free	Free.

Depletion Allowance: 5% (Domestic).

Government Stockpile: None.

Prepared by **Peat Specialist, (703) 648-7711.**

PEAT

Events, Trends, and Issues: Several operations were idled owing to permitting problems associated with increasingly stringent federal regulations and the proliferation of subsidized composting programs. A major horticultural peat firm in the United States planned to exit in the business, given the existing climate of diminishing returns.

The Canadian sphagnum peat industry continued to capitalize on the environmentally restricted U.S. peat industry by shipping another record high volume. In 1995, Canadian peat shipments to the United States were proceeding at an annual rate of 720,000 tons, representing an increase of about 7% in volume and 3% in value. Thus, the aggressive marketing strategy adopted some years back by the Canadian industry resulted in an increase in the U.S. net import reliance from 53% to 55% between 1994 and 1995. The value of Canadian peat shipped to the U.S. marketplace was projected to reach about $130 million at U.S. Customs, eclipsing the value to the total U.S. peat industry by approximately eightfold.

The public and private sectors introduced new peat products, including renewable sphagnum top moss used as a decorative accessory by the florist industry and encapsulated sphagnum moss beads that effectively captured heavy metals in industrial waste stream effluents. The outlook for horticulture during the remainder of the century is bright, according to U.S. Department of Agriculture market research studies. U.S. production will likely be governed principally by future wetlands environmental regulation, the ability to permit new bogs, competition from recycled natural organic materials, and Canadian competition.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[5]	Reserve base[5]
	1994	1995[e]		
United States	574	580	15,000	6,400,000
Belarus	16,000	18,000	([6])	([6])
Canada	1,020	1,200	22,000	300,000,000
Estonia	5,500	5,500	([6])	([6])
Finland	8,550	7,000	64,000	6,400,000
Germany	2,980	2,900	42,000	450,000
Ireland	6,650	6,500	160,000	820,000
Latvia	5,000	5,000	([6])	([6])
Lithuania	4,700	4,800	([6])	([6])
Russia	64,000	60,000	([6])	([6])
Sweden	1,650	1,700	([6])	([6])
Ukraine	21,000	21,000	([6])	([6])
Other countries	942	1,000	4,900,000	150,000,000
World total (rounded)	139,000	135,000	5,200,000	460,000,000

World Resources: World resources of peat were estimated to be 1.9 trillion tons, of which the Former Soviet Union has about 770 billion tons and Canada about 510 billion tons. Domestic deposits of peat occur in all 50 States, with estimated resources of about 310 billion tons or about 16% of the world total.

Substitutes: Natural organic materials may be composted and compete in certain 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]Defined as production + imports - exports + adjustments for industry stocks.
[3]Defined as imports - exports + adjustments for Government and industry stock changes.
[4]See Appendix B.
[5]See Appendix C for definitions.
[6]Included with "Other countries."

PERLITE

(Data in thousand metric tons, unless noted)

Domestic Production and Use: The estimated value (f.o.b. mine) of processed perlite produced in 1995 was $21.1 million. Crude ore production came from eight mines operated by six companies in four Western States. New Mexico continued to be the major producing State. Processed ore was expanded at 64 plants in 32 States. The principal end uses were building construction products, 71%; filter aid, 11%; horticultural aggregate, 9%; fillers, 7%; and other, 2%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production[1]	514	541	569	644	719
Imports for consumption[e]	54	65	70	70	85
Exports[e]	29	29	26	30	25
Consumption, apparent	540	577	613	684	779
Price, average value, dollars per ton, f.o.b. mine	29.33	30.32	30.63	30.03	29.40
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, mine and mill	120	115	115	125	125
Net import reliance[2] as a percent of apparent consumption	5	6	7	6	8

Recycling: Not available.

Import Sources (1991-94): Greece, 100%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[3] 12/31/95
Mineral substances, not specifically provided for	2530.10.0000	Free	Free.

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

Government Stockpile: None.

Prepared by **Wallace P. Bolen, (703) 648-7727.**

PERLITE

Events, Trends, and Issues: Processed ore production and apparent consumption increased for the fourth straight year. Increased sales of domestic perlite coupled with booming imports helped make 1995 a remarkable year for the perlite industry. Most of the increased sales went to the construction materials markets, particularly for formed products.

Imports of perlite from Greece increased to 85,000 tons in 1995. It is estimated that in 1996, domestic production of processed perlite will total 740,000 tons and apparent consumption, 800,000 tons.

Perlite mining had the normal problems of disposal of overburden and the conditions of the abandoned pit sites, but overall, the mining of perlite disturbed a relatively small surface area. Mining generally occurred in remote areas, and environmental problems were not severe.

Domestic perlite continued to encounter transportation cost disadvantages in some areas of the Eastern United States compared with Greek imports. However, Western U.S. perlite exports to Canada partially offset imports into the Eastern United States. Foreign interests were actively investigating the possibility of exporting their perlite into the United States.

New uses of perlite were being researched, which may increase domestic consumption.

World Processed Perlite Production, Crude Ore Reserves, and Reserve Base:

	Production		Reserves[4]	Reserve base[4]
	1994	1995[e]		
United States	644	719	50,000	200,000
Greece	200	230	50,000	300,000
Japan	200	200	(5)	(5)
Turkey	250	260	(5)	(5)
Other countries	286	291	600,000	1,500,000
World total	1,580	1,700	700,000	2,000,000

World Resources: Too little information is available in perlite-producing countries to estimate resources with any reliability.

Substitutes: Alternate 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 B.
[4]See Appendix C for definitions.
[5]Included with "Other countries."

PHOSPHATE ROCK

(Data in thousand metric tons, unless noted)

Domestic Production and Use: Phosphate rock ore was mined by 10 firms in 4 States, and upgraded into an estimated 45.5 million metric tons of marketable product valued at about $1 billion, f.o.b. mine. Florida and North Carolina accounted for about 85% of total domestic output, with the remainder produced in southeastern Idaho and northwestern Utah. Approximately 88% of U.S. phosphate rock demand was for conversion into wet-process phosphoric acid and superphosphoric acid used principally as intermediates in the manufacture of granular and liquid ammonium phosphate fertilizers for domestic consumption and export. About 50% of U.S. wet-process phosphoric acid production was consumed for exports in the form of upgraded granular diammonium and monoammonium phosphate fertilizer materials, triple superphosphate fertilizer, and as merchant grade phosphoric acid. Industrial applications accounted for about 6% of U.S. phosphate rock demand, while another 6% was directly exported, principally to countries in the Far East and Western Europe. Calcium phosphate animal feed supplements, essential to livestock nutrition, were derived from defluorinated phosphoric acid and defluorinated phosphate rock, while purified phosphoric acid was used in a variety of industrial applications. Phosphate rock was mined by three western firms as feedstock for high-purity, industrial-grade elemental phosphorus manufacture in wholly owned electric furnace facilities in Idaho and Montana. Hydrofluosilicic acid and oxides of uranium and vanadium were recovered as value added byproducts of phosphate manufacture.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production[1]	48,100	47,000	35,500	41,100	45,500
Sold or used by producers	44,700	45,100	40,100	44,100	44,800
Imports for consumption	552	1,530	1,430	1,800	1,800
Exports	5,080	3,720	3,200	2,800	3,000
Consumption[2]	40,200	42,900	38,300	43,100	43,600
Price, average value, dollars per ton, f.o.b. mine[3]	23.06	22.53	21.38	20.42	20.50
Stocks, producer, yearend	10,200	12,600	9,220	5,980	6,500
Employment, mine and beneficiation plant	5,900	5,800	5,600	5,000	5,000
Net import reliance[4] as a percent of apparent consumption	E	E	4	5	E

Recycling: None. Limited to phosphate rock conversion products.

Import Sources (1991-94): Morocco, 99%; and other, 1%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Natural calcium phosphates:			
Unground	2510.10.0000	Free	Free.
Ground	2510.20.0000	Free	Free.

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

Government Stockpile: None.

Prepared by **Phosphate Rock Specialist, (703) 648-7711.**

PHOSPHATE ROCK

Events, Trends, and Issues: The U.S. phosphate industry continued to experience favorable economic trends in 1995, associated with a sustained period of supply-demand balance that commenced during 1994. Phosphate rock mines were operating at 90% of capacity and wet-process phosphoric acid and elemental phosphorus plants at near 100% owing to favorable demand. Ammonium phosphate plants operated at 95% of capacity to satisfy strong export demand. U.S. planted crop acreage and domestic fertilizer consumption are expected to increase significantly between 1995 and 1996 owing to below normal grain inventories at the domestic and global levels. Balanced phosphate supply-demand conditions at the global level were favored by a combination of restricted production and relatively low grain inventories.

Major restructuring of the domestic phosphate industry continued into 1995, as evidenced by the acquisition and consolidation of mines and plants in North Carolina and northern Florida by a major Canadian potash firm, together with the acquisition and consolidation of a new mining operation in central Florida by an existing U.S. phosphate producer. In a related move, an emerging force in the fertilizer industry based in western Canada purchased a phosphate fertilizer production facility and phosphate rock reserves near Soda Springs, ID. A new 3.2-million-ton-per-year mine at South Pasture in Hardee County, FL, commenced operations in the fall of 1995. Production from the new mine supplied phosphate rock to a wholly owned conversion facility at Plant City, FL.

World phosphate rock production increased substantially compared with output in 1994.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[6]	Reserve base[6]
	1994	1995[e]		
United States	41,100	45,500	1,200,000	4,400,000
Brazil	3,940	3,900	330,000	370,000
China	26,000	27,000	210,000	210,000
Israel	4,000	4,000	180,000	180,000
Jordan	4,220	5,000	90,000	570,000
Kazakstan[7]	2,080	2,500	—	100,000
Morocco and Western Sahara	19,800	20,000	5,900,000	21,000,000
Russia	7,920	8,500	—	1,000,000
Senegal	1,600	1,500	—	160,000
South Africa	2,550	3,000	2,500,000	2,500,000
Togo	2,150	2,400	—	60,000
Tunisia	5,700	6,500	—	270,000
Other countries	6,960	7,500	1,000,000	2,500,000
World total (rounded)	128,000	137,000	11,000,000	34,000,000

World Resources: Phosphate rock resources occur principally as sedimentary marine phosphorites. Significant igneous occurrences are found in Russia and South Africa. Large phosphate resources have been identified on the continental shelves and on sea mounts in the Atlantic and Pacific Oceans.

Substitutes: There are no substitutes for phosphorus in agriculture.

[e]Estimated. E Net exporter.
[1]Marketable.
[2]Defined as sold or used + imports - exports.
[3]Marketable phosphate rock, weighted value, all grades, domestic and export.
[4]Defined as imports - exports + adjustments for Government and industry stock changes.
[5]See Appendix B.
[6]See Appendix C for definitions.

PLATINUM-GROUP METALS

(Platinum, palladium, rhodium, ruthenium, iridium, osmium)
(Data in kilograms,[1] unless noted)

Domestic Production and Use: Ore containing the platinum-group metals (PGM) was mined, concentrated, and smelted in Montana, and the resultant PGM matte was exported to Belgium for refining and separation of the individual PGM. In addition, refined PGM were recovered as byproducts of copper refining by two companies in Texas and Utah. Secondary metal was refined by about 20 firms, mostly on the east and west coasts. PGM were sold by at least 90 processors and retailers, largely in the Northeast, and were used primarily by the following industries: automotive, electrical and electronic, chemical, and dental and medical. The automotive, chemical, and petroleum-refining industries used PGM mainly as catalysts. The other industries used PGM in a variety of ways that took advantage of their chemical inertness and refractory properties. Domestic mine production of platinum and palladium was valued at $60 million in 1995.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Mine production:[2] Platinum	1,490	1,650	2,050	1,960	2,000
Palladium	5,190	5,440	6,780	6,440	6,000
Imports for consumption: Refined					
Platinum	51,500	57,600	57,200	56,500	70,000
Palladium	60,600	61,100	78,900	92,500	110,000
Rhodium	6,570	7,750	7,210	7,820	9,000
Ruthenium	2,590	2,740	4,490	9,880	6,000
Iridium	520	207	896	926	1,000
Osmium	46	57	130	55	100
Exports: Refined					
Platinum	12,900	12,100	16,100	15,500	16,000
Palladium	13,600	17,700	26,200	29,900	30,000
Rhodium	592	834	767	791	1,000
Price, average, New York, dollars per troy ounce:					
Platinum	377.02	360.90	374.77	406.19	430.00
Palladium	89.06	89.07	122.97	144.15	160.00
Rhodium	3,916.33	2,465.24	1,137.36	762.57	510.00
Employment, mine	469	500	400	445	400

Recycling: Processing recycled material, including both new and old scrap, resulted in the recovery of an estimated 60 metric tons of PGM during 1995.

Import Sources (1991-94): Platinum: South Africa, 64%; United Kingdom, 10%; Belgium, 4%; Germany, 4%; and other, 18%. Palladium: Russia, 31%; South Africa, 29%; United Kingdom, 14%; Belgium, 13%; and other, 13%.

Tariff: All unwrought and semimanufactured PGM can be imported duty free.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Platinum	13,700	—	—	—
Palladium	39,300	—	—	—
Iridium	920	—	—	—

In addition to these quantities, the Stockpile contains 406 kilograms of nonstockpile grade platinum and 69 kilograms of nonstockpile grade palladium.

Prepared by Robert G. Reese Jr., (703) 648-4980.

PLATINUM-GROUP METALS

Events, Trends, and Issues: Domestic mine production of platinum and palladium remained essentially unchanged from the previous year, despite slight improvements in the average price of both metals. It was believed that domestic PGM consumption declined slightly, owing in part to lower sales of new cars and trucks.

In 1995, the average platinum price increased for the third consecutive year. Through the first 9 months, the price ranged between $404 and $462 per troy ounce. Similarly, the average palladium price increased for the fourth consecutive year. During the first 9 months of 1995, palladium prices ranged between $154 and $179. Analysts attributed the higher prices in part to problems in the South African mining industry, and to new technology developments.

World Mine Production, Reserves, and Reserve Base:

	Mine production				PGM	
	Platinum		Palladium		Reserves[3]	Reserve base[3]
	1994	1995[e]	1994	1995[e]		
United States[2]	1,960	2,000	6,440	6,000	250,000	780,000
Canada	6,000	6,000	7,000	7,000	250,000	280,000
Russia	15,000	15,000	40,000	40,000	5,900,000	6,000,000
South Africa	102,000	100,000	44,000	44,000	50,000,000	59,000,000
Other countries	2,700	3,000	1,800	2,000	31,000	31,000
World total (rounded)	128,000	130,000	99,200	100,000	56,000,000	66,000,000

World Resources: World resources of PGM are estimated to be 100 million kilograms. U.S. resources are estimated to be 9 million kilograms.

Substitutes: Some automotive companies have substituted palladium for the higher priced platinum in catalytic converters. Palladium is less resistant to poisoning by sulfur and lead than platinum; however, palladium may be useful in controlling emissions from diesel-powered vehicles.

[e]Estimated.
[1]Multiply by 32.1507 to convert kilograms to troy ounces.
[2]Estimates from published sources.
[3]See Appendix C for definitions.

POTASH

(Data in thousand metric tons of K_2O equivalent, unless noted)

Domestic Production and Use: In 1995, the value of production of marketable potash, f.o.b. mine was about $300 million, owing to steady or increasing prices. Domestic potash production was from southeastern New Mexico, where four companies operated five mines by conventional underground mining of bedded deposits. This potash was beneficiated by flotation, heavy media separation, dissolution-recrystallization, and washing, providing 75% of the U.S. total. In Utah, one company was able to bring underground bedded potash to the surface by solution mining. The potash was recovered from the brine by solar evaporation and flotation. Another Utah company collected subsurface brines from an interior basin for solar evaporation and flotation. A third company used solar evaporation to concentrate the brines of the North Arm of the Great Salt Lake. In California, one company recovered potash, coproducts borax pentahydrate, soda ash, and saltcake from subsurface brines from an interior basin using mechanical evaporation. In Michigan, a company announced in June a capacity increase to about 90,000 tons from the 30,000-ton pilot plant. This design uses solution mining and recovery by mechanical evaporation. The fertilizer industry used more than 85% of the U.S. potash sales, and the chemical industry used close to 15%. About 70% of the potash was produced as potassium chloride (muriate of potash). Potassium sulfate (sulfate of potash) and potassium magnesium sulfate (sulfate of potash-magnesia), required by certain crops and soils, composed about 25% of potash production. Potash was transported by train, truck, and barges to warehouses, wholesalers, and retailers, with some potash being sold from barges used as temporary warehouses. Retailers sold potash and potash blended with other fertilizers in dry or liquid form for distribution.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, marketable	1,750	1,710	1,510	1,400	1,460
Imports for consumption	4,160	4,250	4,360	4,740	4,700
Exports	624	663	415	462	450
Consumption, apparent	5,240	5,350	5,430	5,750	5,670
Price, dollars per metric ton of K_2O, average, muriate, f.o.b. mine[1]	131	134	128	131	135
Stocks, producer, yearend	343	283	305	234	280
Employment: Mine	1,010	1,000	795	845	900
Mill	990	1,180	910	810	840
Net import reliance[2] as a percent of apparent consumption	69	68	72	76	74

Recycling: None.

Import Sources (1991-94): Canada, 91%; Belarus, 2%; Germany, 2%; Israel, 2%; Russia, 1%; and other, 2%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[3] 12/31/95
Crude salts, sylvinite, etc.	3104.10.0000	Free	Free.
Potassium chloride	3104.20.0000	Free	Free.
Potassium sulfate	3104.30.0000	Free	Free.
Potassium nitrate	2834.21.0000	Free	Free.
Potassium-sodium nitrate mixtures	3105.90.0010	Free	Free.

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

Government Stockpile: None.

Events, Trends, and Issues: The world's largest potash producers withheld production from the world market for another year. The world remained in over capacity but by a reduced amount. Several producers around the world operated at partial capacity to maintain prices, while countries with capacities of less than 25% of world total capacity and even some Canadian and U.S. mines operated at full capacity. The Canadian potash industry operated at about 90% capacity, about 80% for the largest producer and 100% for all the others; producers in the Former Soviet Union (FSU) operated at about 60% capacity. New Mexico producers operated at about 85% capacity for the year.

Prepared by **James P. Searls, (703) 648-7724.**

POTASH

A Canadian muriate of potash producer purchased a U.S. located muriate of potash and phosphate producer from a French firm. A U.S. potash producer purchased a Canadian potash mine and mill. A U.S. sulfate of potash producer in Utah withdrew from the purchase of a nearby muriate of potash producer.

In 1995, a wet spring in the wheat and corn/soybean regions of the United States hampered fertilizer application, lowering potash consumption. A strong demand for potash in countries around the Pacific Basin helped North American potash exports, keeping potash plants producing and prices remained relatively steady in the central United States. Internationally, prices rose, as indicated by prices at Vancouver, British Columbia, Canada, through the first half of the year. Prices were weaker in the southwestern United States where imports from offshore and Canada edged prices down slightly.

It is estimated that in 1996, domestic mine production will be 1.4 million tons and that the U.S. apparent consumption will be 6.0 million tons.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	1994	1995[e]		
United States	1,400	1,460	76,000	260,000
Azerbaijan[e]	50	50	NA	NA
Belarus	2,510	2,800	800,000	1,000,000
Brazil	240	270	50,000	600,000
Canada	8,040	11,100	4,400,000	9,700,000
Chile	70	90	10,000	50,000
China	25	25	320,000	320,000
France	870	840	12,000	33,000
Germany	3,290	3,200	740,000	890,000
Israel	1,260	1,300	45,000	[5]590,000
Italy	—	—	20,000	40,000
Jordan	930	950	45,000	[5]590,000
Russia	2,500	2,700	1,800,000	[6]2,200,000
Spain	680	700	20,000	35,000
Thailand	—	—	30,000	100,000
Ukraine	78	100	25,000	30,000
United Kingdom	580	600	23,000	30,000
World total (rounded)	22,500	26,200	8,400,000	17,000,000

World Resources: Estimated domestic potash resources total about 6 billion tons. Most of this lies at depths between 1,800 and 3,000 meters in a 3,100-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. An unknown, but apparently large, quantity of potash resources lies about 2,100 meters under central Michigan. The U.S. reserve figure above contains 25 million tons of reserves in central Michigan. Estimated world resources total about 250 billion tons. The potash deposits in the FSU contain large amounts of carnallite; it is not clear if this can be mined in a free market competitive economy. Large resources, about 10 billion tons and mostly carnallite, occur in Thailand.

Substitutes: There are no substitutes for potassium as an essential plant nutrient and essential requirement for animals and humans. Manure and glauconite are low-potassium-content sources that can be transported short distances to crop fields.

[e]Estimated. NA Not available.

[1]Average prices based on actual sales; excludes soluble and chemical muriates.

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

[3]See Appendix B.

[4]See Appendix C for definitions.

[5]Total reserve base in the Dead Sea is equally divided between Israel and Jordan.

[6]A reserve of 22,300,000 was reported by I. D. Sokolov in Basic Tasks of the Potash Industry up to the Year 2000, Zhurnal Vsesoyuznogo Khimicheskogo Obshchestva Im. D. I. Mendeleyeva, v. 32, No. 4, July-Aug. 1987, pp. 383-387.

PUMICE AND PUMICITE

(Data in thousand metric tons, unless noted)

Domestic Production and Use: The estimated value of pumice and pumicite sold or used in 1995 was $12.6 million. Domestic output came from 13 producers in 6 States. The principal producing States were New Mexico and Oregon, with combined production accounting for about 65% of the national total. The remaining production was from Arizona, California, Idaho, and Kansas. About 64% of the pumice was consumed for building blocks and the remainder was used in abrasives, concrete, laundries, and many other uses.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, mine[1]	401	481	469	490	544
Imports for consumption	118	257	143	143	237
Exports[e]	13	11	18	18	18
Consumption, apparent	506	727	594	615	763
Price, average value, dollars per ton, f.o.b. mine or mill	22.90	30.99	25.68	24.08	23.15
Stocks, yearend	NA	NA	NA	NA	NA
Employment, mine and mill	50	50	50	50	55
Net import reliance[2] as a percent of apparent consumption	21	34	21	20	29

Recycling: Not available.

Import Sources (1991-94): Greece, 67%; Zaire, 8%; Turkey, 7%; Ecuador, 6%; and other, 12%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[3] 12/31/95
Crude or in irregular pieces, including crushed pumice	2513.11.0000	Free	Free.
Other	2513.19.0000	0.3¢/kg	1.7¢/kg.

Depletion Allowance: 5% (Domestic), 5% (Foreign).

Government Stockpile: None.

Prepared by Wallace P. Bolen, (703) 648-7727.

PUMICE AND PUMICITE

Events, Trends, and Issues: The apparent consumption of 763,000 tons in 1995 was the highest since 1986 when 851,000 tons was consumed. Increased demand for pumice in lightweight concrete and building block was the major factor influencing increased consumption.

It is estimated that in 1996 domestic mine production of pumice and pumicite will remain around 540,000 tons, with U.S. apparent consumption at approximately 750,000 tons. Imports, mainly from Greece, continue to maintain markets on the East Coast and Gulf Coast States of the United States. Imports increased in 1995, returning to well over 200,000 tons after several lean years.

Although pumice and pumicite were plentiful in the Western United States, changes that occur in laws and public land designations could make many deposits decreasingly accessible to mining. Pumice and pumicite was sensitive to mining cost and should domestic production cost increase, it was expected that imports and competing materials might replace domestic pumice in many markets.

All domestic mining of pumice in 1995 was by open pit methods and generally occurred in relatively 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 geographical area.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	1994	1995[e]		
United States[1]	490	544	Large	Large
Chile	450	450	NA	NA
France	500	525	NA	NA
Germany	650	680	NA	NA
Greece	900	1,000	NA	NA
Italy	5,200	5,200	NA	NA
Spain	700	700	NA	NA
Turkey	1,000	1,100	NA	NA
Other countries	1,500	1,500	NA	NA
World total (rounded)	11,400	11,700	NA	NA

World Resources: The identified domestic resources of pumice and pumicite in the West are estimated to be at least 25 million tons. The estimated resources in the Western and Great Plains States are 250 million to 450 million tons.

Substitutes: Transportation cost determines the maximum distance that pumice and pumicite can be shipped and remain competitive with alternate materials. Competitive materials that can be substituted for pumice and pumicite for several end uses include expanded shale and clay, diatomite, and crushed aggregates.

[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 B.

[4]See Appendix C for definitions.

QUARTZ CRYSTAL (INDUSTRIAL)

(Data in metric tons, unless noted)

Domestic Production and Use: Domestic production of cultured quartz crystal has been relatively steady for the past 5 years. Lascas[1] production continued in Arkansas. Virtually all quartz crystal consumed in electronic applications was synthetic. Four companies produced cultured quartz crystal using lascas as feed material. Quartz crystal was essential for making piezoelectric filter devices that separated portions of the frequency spectrum and oscillators to a single frequency signal source. Filters and oscillators were used for a wide variety of communication and instrumentation purposes.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Mine[2]	454	778	454	544	500
Plant, cultured (as grown)	441	407	394	294	300
Imports for consumption:					
Lascas	NA	NA	NA	NA	NA
Natural electronic	NA	NA	NA	NA	NA
Exports:					
Lascas	—	—	—	—	—
Natural electronic	NA	NA	NA	NA	NA
Cultured (mostly lumbered)[3]	53	15	24	38	30
Shipments from Government stockpile excesses, natural electronic	44	89	134	96	—
Consumption, reported:					
Lascas[4]	556	494	407	500	400
Natural electronic	1	([5])	([5])	([5])	([5])
Cultured[6]	365	286	306	360	350
Price, average value, dollars per kilogram:					
Lascas	0.85	0.90	1.23	1.20	1.20
Cultured (lumbered)	66.37	105.67	251.69	300.00	300.00
Stocks, industry, yearend:					
Lascas (for cultured crystal only)	283	99	150	190	190
Natural electronic (fabricator)	([5])	1	1	1	1
Cultured (fabricator)	99	104	100	100	100
Employment, mine, processing plant[e]	10	10	10	10	10
Net import reliance[7] as a percent of apparent consumption, lascas	NA	NA	NA	NA	NA

Recycling: None.

Import Sources (1991-94): This information is no longer available.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[8] 12/31/95
Sands:			
Other than natural	2506.10.0010	Free	Free.
Other	2506.10.0050	Free	Free.
Quartzite	2506.21.0000	Free	Free.

Prepared by **Quartz Crystal Specialist, (703) 648-7721.**

QUARTZ CRYSTAL (INDUSTRIAL)

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Quartz crystal	237	258	237	—

Events, Trends, and Issues: Japan remained both the leading producer and consumer of cultured quartz crystal because of its lower cost per unit and its prominence as a producer of electronic components in which these crystals are used. Specially grown cultured seed crystals have nearly replaced natural seed in most domestic operations. The Former Soviet Union and China are major producers, also. Very small quantities of Brazilian natural quartz are used as seed for growing cultured quartz and for a few direct applications such as deep-well pressure transducers.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[8]	Reserve base[9]
	1994	1995[e]		
United States[e 2]	544	500	Moderate	Moderate
Brazil	NA	NA	Large	Large
Other countries	NA	NA	NA	NA
World total	NA	NA	Large	Large

World Resources: Limited resources of 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 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. Other materials, such as dipotassium tartrate, are usable only in specific applications as oscillators and frequency filters.

[e]Estimated. NA Not available.
[1]Lascas is a nonelectronic-grade quartz used as a feedstock for growing cultured quartz crystal and for production of fused quartz.
[2]Lascas only; specimen and jewelry material excluded.
[3]Quantities calculated from pricing information.
[4]Excluding quartz crystal used by the fused quartz industry.
[5]Less than ½ unit.
[6]Reported consumption of cultured quartz includes cultured quartz consumed by growers as well as by manufacturers of intermediate products and finished crystal units.
[7]Defined as imports - exports + adjustments for Government and industry stock changes.
[8]See Appendix B.
[9]See Appendix C for definitions.

RARE EARTHS[1]

(Data in metric tons of rare-earth oxide (REO) content, unless noted)

Domestic Production and Use: Rare earths were mined by one company in 1995. Bastnasite, a rare-earth fluocarbonate mineral, was mined as a primary product in California. Domestic production of monazite ceased at yearend 1994 as a result of decreased demand for thorium-bearing minerals. The United States was a leading producer and processor of rare earths and continued to be a major exporter and consumer of rare-earth products. Domestic ore production was valued at an estimated $82 million. Refined rare-earth products were produced primarily by three companies; one with a plant in Mountain Pass, CA, another with operations in Phoenix, AZ, and Freeport, TX, and a third with a plant in Chattanooga, TN. The estimated value of refined rare earths consumed in the United States was more than $500 million. Principal uses were in petroleum fluid cracking catalysts, automotive pollution control systems, metallurgical applications, glass polishing, glass additives, ceramics, permanent magnets, phosphors for color television and fluorescent lighting, laser crystals, and electronics.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production:					
Bastnasite concentrates[2]	16,500	20,700	17,800	20,700	28,700
Monazite concentrates	W	W	W	W	W
Imports:[3]					
Thorium ore (monazite)	—	—	—	—	22
Rare-earth metals, alloys	271	352	235	284	406
Cerium compounds	545	806	1,270	1,890	3,230
Mixed REO's	892	295	249	354	570
Rare-earth chlorides	1,550	728	1,080	2,410	1,270
Rare-earth oxide, compounds	2,770	3,100	3,730	5,140	5,470
Ferrocerium, alloys	83	94	105	92	88
Exports:[3]					
Thorium ore, monazite	—	—	3	27	—
Rare-earth metals, alloys	71	44	194	329	456
Cerium compounds	1,370	1,930	1,620	4,460	4,750
Other rare-earth compounds	1,790	1,310	1,090	2,410	1,610
Ferrocerium, alloys	1,860	2,430	4,270	3,020	4,040
Consumption, apparent[4]	22,100	21,400	17,000	18,200	29,400
Price, dollars per kilogram, yearend:					
Bastnasite concentrate, REO basis	2.87	2.87	2.87	2.87	2.87
Monazite concentrate, REO basis	.93	.41	.40	.46	.45
Mischmetal, metal basis	11.02	12.68	12.68	12.68	12.68
Stocks, producer and processor, yearend	W	W	NA	NA	NA
Employment, mine and mill	411	372	352	350	280
Net import reliance[4 5] as a percent of apparent consumption	25	33	E	E	2

Recycling: Small quantities, mostly permanent magnet scrap.

Import Sources (1991-94): Monazite: Australia, 100%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[6] 12/31/95
Thorium ores and concentrates (monazite)	2612.20.0000	Free	Free.
Rare-earth metals, whether or not intermixed or interalloyed	2805.30.0000	5.0% ad val.	31.3% ad val.
Cerium compounds	2846.10.0000	6.9% ad val.	35% ad val.
Mixtures of REO's except cerium oxide	2846.90.2010	Free	25% ad val.
Mixtures of rare-earth chlorides, except cerium chloride	2846.90.2050	Free	25% ad val.
Rare-earth compounds, individual REO's (excludes cerium compounds)	2846.90.8000	3.7% ad val.	25% ad val.
Ferrocerium and other pyrophoric alloys	3606.90.3000	5.9% ad val.	56.7% ad val.

Prepared by **James B. Hedrick, (703) 648-7725.**

RARE EARTHS

Depletion Allowance: Percentage method, Monazite, 22% on thorium content and 14% on rare-earth content (Domestic), 14% (Foreign). Bastnasite and xenotime, 14% (Domestic and Foreign).

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
REO in sodium sulfate	—	457	—	457

Events, Trends, and Issues: Domestic demand for rare earths in 1995 was estimated to be higher than in 1994. Compared with 1994, the use of rare earths in most end uses increased as the domestic economy improved. Rare-earth prices remained competitive throughout 1995, although a slight firming of the prices from China was reported in the first half of the year. China remained a major source of separated rare-earth compounds and alloys and is expected to continue as a major world supplier.

The *Third International Conference on Rare Earths Development & Application* was held in Baotou, Inner Mongolia, China, on August 21-25, 1995. The *21st Rare Earth Research Conference* is scheduled to meet in the United States in Duluth, MN, on July 7-11, 1996.

World Mine Production, Reserves, and Reserve Base:

	Mine production[e] 1994	Mine production[e] 1995	Reserves[7]	Reserve base[7]
United States	[8]20,700	[8]28,700	13,000,000	14,000,000
Australia	3,300	3,000	5,200,000	5,800,000
Brazil	400	400	280,000	310,000
Canada	—	—	940,000	1,000,000
China	[8]30,600	30,000	43,000,000	48,000,000
India	2,500	2,500	1,100,000	1,300,000
Malaysia	[8]234	250	30,000	35,000
South Africa	400	400	390,000	400,000
Sri Lanka	120	120	12,000	13,000
Thailand	150	150	1,000	1,100
Former Soviet Union	6,000	6,000	19,000,000	21,000,000
Zaire	28	30	1,000	1,000
Other countries	5	5	21,000,000	21,000,000
World total (rounded)	64,500	72,000	100,000,000	110,000,000

World Resources: Rare earths are relatively abundant in the Earth's crust, but discovered minable concentrations are less common than for most other ores. It is expected that substantial additional resources will be discovered as the industry enters its fourth decade of major industrial expansion. U.S. and world resources are contained primarily in bastnasite and monazite. Bastnasite 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. Xenotime, rare-earth-bearing clays, loparite, phosphorites, apatite, eudyalite, secondary monazite, cheralite, and spent uranium solutions comprise most of the remaining resources. Undiscovered resources of rare earths are believed to be very large relative to expected demand.

Substitutes: Substitutes are available for many applications, but generally are less effective.

[e]Estimated. E Net exporter. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Data includes lanthanides and yttrium, but excludes most scandium. See also Scandium and Yttrium.
[2]As reported in Unocal Corp. annual reports and as authorized from Molycorp personnel. Data rounded to three significant digits.
[3]REO equivalent or contents of various materials were estimated. Data from Bureau of the Census. Data rounded to three significant digits.
[4]Monazite concentrate production was not included in the calculation of apparent domestic consumption and net import reliance. Data rounded to three significant digits.
[5]Defined as imports - exports + adjustments for Government and industry stock changes.
[6]See Appendix B.
[7]See Appendix C for definitions.
[8]Number reported in literature or from company representatives.

RHENIUM

(Data in kilograms of rhenium content, unless noted)

Domestic Production and Use: During 1995, ores containing rhenium were mined by eight operations. Rhenium compounds are included in molybdenum concentrates derived from porphyry copper deposits in the southwestern United States, and rhenium itself was 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 high-temperature superalloys used in jet engine components, representing about 20% and 70%, 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 is used in superalloys, improving the strength properties, at high temperatures (1,000° C), of nickel alloys. Some of the uses for rhenium alloys were in thermocouples, temperature controls, heating elements, ionization gauges, mass spectrographs, electron tubes and targets, electrical contacts, metallic coatings, vacuum tubes, crucibles, electromagnets, and semiconductors. The estimated value of rhenium consumed in 1995 was $8 million.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Product: Content[1]	19,200	16,200	12,200	15,500	18,000
Imports for consumption	14,400	12,100	5,900	8,200	11,000
Exports			Negligible		
Consumption: Estimated	8,900	6,800	6,900	12,900	14,000
Apparent	W	W	W	W	W
Price, average value, dollars per kilogram:					
Metal powder, 99.99% pure	1,500	1,500	1,500	1,560	1,600
Ammonium perrhenate	1,300	1,100	1,100	1,100	1,100
Stocks, yearend, consumer, producer, dealer	W	W	W	W	W
Employment[2]			Small		
Net import reliance[3] as a percent of apparent consumption	W	W	W	W	W

Recycling: Small amounts of molybdenum-rhenium and tungsten-rhenium scrap were processed during the past few years by several companies.

Import Sources (1991-94): Chile, 57%; Germany, 27%; United Kingdom, 8%; and other, 8%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[4] 12/31/95
Other inorganic acids, other—rhenium, etc.	2811.19.5050	4.2% ad val.	25% ad val.
Salts of peroxometallic acids, other—ammonium perrhenate	2841.90.2000	3.1% ad val.	25% ad val.
Rhenium, etc., (metals) waste and scrap	8112.91.0500	Free	Free.
Rhenium, (metals) unwrought; powders	8112.91.5000	3.7% ad val.	25% ad val.
Rhenium, etc., (metals) wrought; etc.	8112.99.0000	5.5% ad val.	45% ad val.

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

Government Stockpile: None.

Prepared by **John W. Blossom, (703) 648-4964.**

RHENIUM

Events, Trends, and Issues: During 1995, the rhenium metal price was about the same as in 1995, averaging about $1,600 per kilogram for rhenium metal and $1,100 per kilogram for ammonium perrhenate. Imports of rhenium increased for 1995 compared with those of 1994. Chile, Germany, Japan, and Sweden supplied the majority of the rhenium imported. The United States relies on imports for much of its supply of rhenium.

It is estimated that in 1996, U.S. consumption of rhenium will be about 14,000 kilograms.

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 also prevents most of the rhenium from escaping into the atmosphere.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[5]	Reserve base[5]
	1994	1995[e]		
United States	500	500	310,000	400,000
Armenia	15,500	18,000	390,000	4,500,000
Canada	100	100	95,000	120,000
Chile	3,000	3,000	32,000	1,500,000
Kazakstan	4,000	4,000	1,300,000	2,500,000
Peru	200	200	190,000	250,000
Russia	3,000	3,000	45,000	550,000
Uzbekistan	300	300	59,000	400,000
Other countries	100	100	91,000	360,000
World total (may be rounded)	26,700	29,200	2,500,000	11,000,000

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 Kazakstan, 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. W Withheld to avoid disclosing company proprietary data.

[1]Calculated rhenium contained in MoS_2 concentrates. Recovered quantities are considerably less and are withheld.

[2]Less than 100.

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

[4]See Appendix B.

[5]See Appendix C for definitions.

RUBIDIUM

(Data in kilograms of rubidium content, unless noted)

Domestic Production and Use: Although rubidium is not recovered from any domestically mined ores, it is believed that at least one domestic company manufactured rubidium products from imported lepidolite ore. Small quantities of rubidium, usually in the form of chemical compounds, were used mainly in research and development. Rubidium also was used in electronic and medical applications.

Salient Statistics—United States: Salient statistics such as production consumption, imports, and exports are not available.

The rubidium market is very small. There is no active trading in the metal and therefore no market price. However, several companies publish prices for rubidium and rubidium compounds. These prices are relatively stable over time periods up to several years in length. The per-unit price for the metal or compounds purchased from these companies varies inversely with the quantity of material purchased. For example, in 1995, one company offered 1-gram ampoules of 99.8% grade rubidium metal at $42.40. The price for 100 grams of the same material from this company was $571.00 or $5.71 per gram. At another company, the price for a 1-gram ampoule of 99.6% pure rubidium was $42.40.

Recycling: None.

Import Sources (1991-94): The United States is 100% import reliant. Although there is no information on the countries shipping rubidium-bearing material to the United States, it is believed that Canada is the major source of this raw material.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[1] 12/31/95
Alkali metals, other	2805.19.0000	6.4% ad val.	25% ad val.

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

Government Stockpile: None.

Prepared by Robert G. Reese, Jr., (703) 648-4980.

RUBIDIUM

Events, Trends, and Issues: Rubidium and its compounds were largely the subject of laboratory study and were of little commercial significance. No major breakthroughs or developments were anticipated that would change the production or consumption patterns. Domestic rubidium production is entirely dependent on imported lepidolite ores. Because of the small scale of production of rubidium products, no significant environmental problems have been encountered.

World Mine Production, Reserves, and Reserve Base: Data on mine production of rubidium are not available. Reserves and the reserve base[2] for rubidium in North America were estimated at 2 million kilograms and 2.3 million kilograms, respectively.

World Resources: Rubidium forms no known minerals in which it is the predominant metallic constituent. It occurs chiefly as a replacement for potassium, especially in minerals formed late in the crystallization of pegmatites. Meaningful estimates of world rubidium resources have not been made, but lepidolite, a potassium lithium mica, may contain up to 1.35% rubidium, and pollucite, a cesium silicate, may contain up to 3.15% rubidium.

Substitutes: The properties of cesium and its compounds are so similar to those of rubidium and its compounds that compounds of rubidium and cesium are used interchangeably in many applications.

[1]See Appendix B.
[2]See Appendix C for definitions.

RUTILE[1]

(Data in thousand metric tons of contained TiO_2, unless noted)

Domestic Production and Use: Rutile was produced at one mine in Florida. At two other mines in Florida, rutile was included in a bulk concentrate containing mostly ilmenite and leucoxene. The major coproduct of these mines is zircon. Synthetic rutile was produced at one plant in Alabama. The value of U.S. rutile consumption in 1995, including synthetic rutile, was about $240 million. Two firms, with facilities in Nevada and Oregon, used titanium tetrachloride primarily made from rutile to manufacture titanium. Of 16 consuming firms, mainly in the Eastern United States, 5 companies used 96% of the rutile consumed to produce titanium dioxide (TiO_2) pigment. Welding-rod coatings and miscellaneous applications, which include fiberglass and titanium metal, consumed 4%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production	W	W	W	W	W
Imports for consumption[2]	226	299	349	311	300
Exports[e]	4	7	3	4	9
Shipments from Government stockpile excesses	—	—	1	18	17
Consumption: Reported[2]	336	438	436	478	490
Consumption: Apparent	W	W	W	W	W
Price, dollars per ton of rutile, yearend:					
Bulk, f.o.b. Australian ports	545	405	378	420	600
Bulk, f.o.b. U.S. east coast	628	NA	NA	NA	NA
Stocks, mine, distributor and consumer, yearend	197	140	179	141	130
Employment, mine and mill[3]	395	400	395	400	400
Net import reliance[4] as a percent of apparent consumption	W	W	W	W	W

Recycling: None.

Import Sources (1991-94): Australia, 50%; South Africa, 26%; Sierra Leone, 22%; and other, 2%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Rutile concentrate	2614.00.6040	Free	Free.
Synthetic rutile	2614.00.3000	5% ad val.	30% ad val.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Stockpile-grade rutile (gross weight)	0.27	12.3	0.03	16.9

Prepared by **Joseph M. Gambogi, (703) 648-7718.**

RUTILE

Events, Trends, and Issues: Another record year of titanium pigment production resulted in a slight increase in the domestic consumption of natural and synthetic rutile. Total imports of the two forms of rutile decreased about 4%. Australia and South Africa supplied about 95% of total imports.

Early in 1995, rebel forces took control of mining operations at Sierra Leone's sole producer of natural rutile. Although control of the mine was later regained by Government forces, the mine was not believed to be operating at yearend. The operation was the largest natural rutile operation in the world and supplied about one-third of the world's supply of natural rutile.

Prices for rutile and synthetic rutile concentrates increased significantly in 1995. Rising prices were driven by the loss of Sierra Leone as a major source of supply and an upswing in global demand for pigments.

The Defense Logistics Agency (DLA) continued its program to dispose of rutile held in the National Defense Stockpile (NDS). As of September, DLA had awarded almost all of the rutile held in the Government's NDS. Only 267 dry tons of rutile were left in the NDS as uncommitted inventory.

Fewer environmental pollution problems are encountered when pigment is produced from rutile rather than ilmenite. The chloride process, using a rutile feed, generates about 0.2 ton of waste per ton of TiO_2 product; the sulfate process, using ilmenite, generates about 3.5 tons of waste per ton of product. Producing synthetic rutile from ilmenite results in about 0.7 ton of waste, mainly iron oxide, per ton of product. Direct chlorination of ilmenite generates about 1.2 tons of waste, mainly ferric chloride, per ton of TiO_2.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[6]	Reserve base[6]
	1994	1995[e]		
United States	W	W	500	1,800
Australia	212	220	4,300	43,000
Brazil	2	2	40	85,000
India	13	13	6,600	7,700
Italy	—	—	—	8,800
Sierra Leone	131	40	3,100	3,100
South Africa	73	80	8,300	8,300
Sri Lanka	2	2	4,800	4,800
Ukraine	3	3	2,500	2,500
World total (may be rounded)	[7]440	[7]360	30,000	160,000

World Resources: Identified world resources of rutile (including anatase) total about 230 million tons of contained TiO_2. Major rutile resources occur in Australia, India, Italy, Sierra Leone, South Africa, and the United States.

Substitutes: Ilmenite, titaniferous slag, and synthetic rutile made from ilmenite may be used instead of natural rutile for making pigment, metal, and welding-rod coatings.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]See also Ilmenite and Titanium and Titanium Dioxide.
[2]Includes synthetic rutile.
[3]Employment at three sand deposit operations in Florida, which produced either rutile concentrate or a titanium mineral concentrate, where ilmenite and zircon were major coproducts and where employees were not assigned to specific commodities.
[4]Defined as imports - exports + adjustments for Government and industry stock changes.
[5]See Appendix B.
[6]See Appendix C for definitions.
[7]Excludes U.S. production.

SALT

(Data in thousand metric tons, unless noted)

Domestic Production and Use: Domestic production of salt increased an estimated 9% in 1995, with total value exceeding an estimated $960 million. Twenty-seven companies operated 67 plants in 14 States. The estimated percentage of salt sold or used, by type, was salt in brine, 46%; rock salt, 36%; vacuum pan, 9%; and solar salt, 9%.

The chemical industry consumed about 39% of total salt sales, with salt brine representing about 88% of the type of salt used for feedstock. Chlorine and caustic soda manufacture was the main consuming sector within the chemical industry. Salt for highway deicing accounted for 35% of U.S. demand. The remaining markets for salt, in declining order, were distributors, 10%; food and agricultural, 6%; general industrial, 6%; primary water treatment, 1%; and other, 3%.

Salient Statistics—United States:[1]	1991	1992	1993	1994	1995[e]
Production	36,300	36,000	39,200	39,800	43,300
Sold or used by producers	35,900	34,800	38,200	39,500	42,300
Imports for consumption	6,190	5,390	5,870	9,630	8,000
Exports	1,780	992	688	742	825
Consumption, apparent	40,300	39,200	43,400	48,400	49,500
Price, average value of bulk, pellets and packaged salt, dollars per ton, f.o.b. mine and plant:					
Vacuum and open pan salt	114.75	113.20	111.97	114.24	115.00
Solar salt	27.78	32.56	34.51	34.77	37.00
Rock salt	19.25	19.63	20.28	22.33	22.00
Salt from brine	5.45	4.35	5.24	5.40	6.00
Stocks, producer, yearend[e 2]	414	1,230	1,000	300	1,000
Employment, mine and plant	4,150	4,150	4,150	4,150	4,150
Net import reliance[3] as a percent of apparent consumption	11	11	12	18	15

Recycling: None.

Import Sources (1991-94): Canada, 46%; Mexico, 25%; Bahamas, 13%; Chile, 10%; and other, 6%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[4] 12/31/95
Iodized salt	2501.00.0000	Free	26% ad val.

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

Government Stockpile: None.

Events, Trends, and Issues: After 18 months of continuous flooding, the Retsof, NY, rock salt mine, which was the largest underground room-and-pillar mine in the Western Hemisphere, officially closed on September 11, 1995. In anticipation of a potential supply shortage during the winter months of 1996, about 2.3 million tons of rock salt were stockpiled on the surface ready for use. The company planned to replace the mine, which had an annual capacity of 3.6 millions tons, with another underground rock salt mine of similar capacity at Hampton Corners in Groveland, NY. The new mine was scheduled to be operational in 1997.

A mine accident occurred at an underground rock salt operation in the St. Magdalen Islands, Quebec, Canada. Ocean water entered the mine around the mine shaft and continued to flood until mine engineers stabilized the waterflow. Efforts were still underway by yearend to save the mine, which had an annual capacity of about 1.2 millions tons.

Prepared by **Dennis S. Kostick, (703) 648-7715.**

SALT

A vacuum pan salt facility at Manistee, MI, closed in November after many years of production. To counter this loss, a new refined salt operation was announced in Tennessee where high-quality salt will be recovered as a byproduct from a titanium dioxide facility. Discharged waste containing iron chloride and hydrochloric acid will be treated with soda ash to produce iron carbonate, which can be used in water treatment chemicals, and sodium chloride.

The domestic chloralkali industry, which uses substantial quantities of salt, operated at nearly 100% of production capacity throughout the year. Most of the output was for polyvinyl chloride and vinyl chloride monomer manufacture, particularly for shipment overseas. Despite the negative discussions about the harmful affects of chlorine in the environment, consumption remained strong with demand forecast to grow 1.5% to 2.0% annually.

A downturn in Japanese synthetic soda ash production slated for 1996 probably will not result in a decline in salt usage as Japanese chlorine manufacturers increase capacity, thereby requiring additional salt supplies in the near future.

The outlook for the domestic salt industry is optimistic for the next few years depending on the severity of this winter's weather. Many climatologists were forecasting below-normal temperatures and the likelihood of adverse conditions that would require deicing salt.

World Production, Reserves, and Reserve Base:

	Production		Reserves and reserve base[5]
	1994	1995[e]	
United States[1] (sold or used)	39,500	42,300	Large. Economic and subeconomic deposits of salt are substantial in principal salt-producing countries. The oceans comprise an inexhaustible supply of salt.
Australia	7,800	8,000	
Brazil	5,250	5,500	
Canada	11,500	11,100	
China	29,700	30,000	
France	5,440	5,500	
Germany	12,700	13,000	
India	9,500	9,500	
Italy	3,100	3,500	
Mexico	7,460	7,500	
Poland	3,800	3,800	
Russia	3,000	3,400	
Spain	3,400	3,500	
Ukraine	3,500	3,500	
United Kingdom	5,700	5,600	
Other countries	28,700	29,300	
World total (may be rounded)	180,000	185,000	

World Resources: World resources of salt are practically unlimited. 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.
[1]Excludes Puerto Rico.
[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 production and salt sold or used.
[3]Defined as imports - exports + adjustments for Government and industry stock changes.
[4]See Appendix B.
[5]See Appendix C for definitions.

SAND AND GRAVEL (CONSTRUCTION)[1]

(Data in million metric tons, unless noted)[2]

Domestic Production and Use: Construction sand and gravel valued at $3.8 billion was produced by 4,250 companies from 6,000 operations in 50 States. Leading States, in order of volume, were California, Texas, Michigan, Ohio, Washington, Arizona, Illinois, Minnesota, Wisconsin, and Indiana, which together accounted for about 52% of the total output. It is estimated that, of the 879 million metric tons of construction sand and gravel produced in 1995, about 35% were unspecified uses. Of the remaining total, about 42% was used as concrete aggregates; 24% for road base and coverings and road stabilization; 14% as asphaltic concrete aggregates and other bituminous mixtures; 13% as construction fill; 2% for concrete products such as blocks, bricks, pipes, etc.; 1% for plaster and gunite sands; and the remainder for snow and ice control, railroad ballast, roofing granules, filtration, 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 1995 was about 644 million tons, which represents a decrease of 1.9% compared with the same period of 1994. Additional production information by quarters for each State, geographic region, and the United States is published in the Quarterly Mineral Industry Survey for Crushed Stone and Sand and Gravel.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production	[e]708	834	[e]869	891	879
Imports for consumption	1	1	1	1	2
Exports	1	1	1	1	1
Consumption, apparent	708	834	869	891	878
Price, average value, dollars per ton	3.96	4.01	4.06	4.20	4.29
Stocks, yearend	NA	NA	NA	NA	NA
Employment, quarry and mill[e]	41,430	41,600	42,000	42,500	42,500
Net import reliance[3] as a percent of apparent consumption	—	—	—	—	—

Recycling: Asphalt road surfaces and cement concrete surfaces and structures were recycled on a limited, but increasing, basis.

Import Sources (1991-94): Construction sand and gravel: Canada, 65%; Bahamas, 16%; Antigua and Barbuda, 5%; and other, 14%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[4] 12/31/95
Sand, construction	2505.90.0000	Free	Free.
Gravel, construction	2517.10.0000	Free	30% ad val.

Depletion Allowance: (Domestic and Foreign) Common varieties, 5%.

Government Stockpile: None.

Prepared by **Wallace P. Bolen, (703) 648-7727.**

SAND AND GRAVEL (CONSTRUCTION)

Events, Trends, and Issues: Construction sand and gravel output decreased 1.4% in 1995. It is estimated that 1996 domestic production and U.S. apparent consumption will be about 890 million tons each, a 1.3% increase.

The construction sand and gravel industry continued to be concerned with safety and health regulations and environmental restrictions. Shortages in urban and industrialized areas were expected to continue to increase due to local zoning regulations and land development. This is expected to continue to cause a movement of sand and gravel operations away from highly populated centers.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves and reserve base[5]
	1994	1995[e]	
United States	891	879	The reserves and reserve base are controlled largely by land use and/or environmental constraints. Local shortages of sand or gravel are common.
Other countries	NA	NA	
World total	NA	NA	

World Resources: Sand and gravel resources of the world are large. However, due to their geographic distribution, environmental restrictions, and quality requirements for some uses, their extraction is sometimes uneconomic. The most important commercial sources of sand and gravel have been river flood plain, river channel, and glacial deposits. Marine deposits are being used presently in the United States, mostly for beach erosion control, but as a source of construction aggregates in other countries.

Substitutes: Crushed stone remains the predominant alternative for construction aggregate use.

[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.
[4]See Appendix B.
[5]See Appendix C for definitions.

SAND AND GRAVEL (INDUSTRIAL)[1]

(Data in thousand metric tons, unless noted)[2]

Domestic Production and Use: Industrial sand and gravel valued at nearly $479 million was produced by 88 companies from 152 operations located in 38 States. Leading States, in order of volume, were Illinois, Michigan, New Jersey, California, and Wisconsin. Combined production from these states represented 44% of the national total. About 39% of the national tonnage was used as glassmaking sand, 24% as foundry sand, 6% as abrasive sand, 5% as hydraulic fracturing sand, and the remainder for many other uses.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production	23,200	25,200	26,200	27,300	28,200
Imports for consumption	83	164	44	22	60
Exports	1,490	1,340	1,750	1,880	1,910
Consumption, apparent	21,900	24,000	24,500	25,400	26,400
Price, average value, dollars per ton	16.81	17.24	17.33	17.86	17.02
Stocks, yearend	NA	NA	NA	NA	NA
Employment, quarry and mill[e]	1,500	1,500	1,500	1,500	1,500
Net import reliance[3] as a percent 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 amount of reused silica.

Import Sources (1991-94): Belgium, 39%; Australia, 30%; Germany, 27%; Guyana, 2%; and other, 2%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[4] 12/31/95
95% or more silica and not more than 0.6% iron oxide	2505.10.1000	Free	$1.97/t.

Depletion Allowance: Industrial sand or pebbles, 14% (Domestic and Foreign).

Government Stockpile: None.

Prepared by Wallace P. Bolen, (703) 648-7727.

SAND AND GRAVEL (INDUSTRIAL)

Events, Trends, and Issues: The United States was the world's largest producer and consumer of industrial sand and gravel based on estimated world production figures. However, it was difficult to collect definitive numbers on silica sand and gravel production in most nations because of the wide range of terminologies and specifications for silica from country to country. Attempts to improve the accuracy of data on world industrial sand and gravel production are ongoing, and revisions should be expected.

The United States remained a major exporter of silica sand, shipping sand to almost every region of the world. This was attributed to the high quality and advanced processing techniques of a large variety of grades of silica, meeting virtually every specification for silica sand and gravel. Imports of silica are generally of two types: small-quantity shipments of very high purity silica or a few large shipments of lower grade silica that is shipped only when special circumstances were achieved (i.e., very favorable freight rates).

Industrial sand and gravel sold or used increased about 2% in 1995 compared with 1994. It is estimated that 1996 domestic production and U.S. apparent consumption will be about 28 million tons and 26 million tons, respectively.

The industrial sand and gravel industry continued to be concerned with safety and health regulations and environmental restrictions in 1995. Local shortages were expected to continue to increase owing to local zoning regulations and land development alternatives. This is expected to continue to cause a movement of sand and gravel operations away from high-population centers.

World Mine Production, Reserves, and Reserve Base:

	Mine production[e]		Reserves and reserve base[5]
	1994	1995	
United States	27,300	28,200	
Australia	2,500	2,800	Large. Silica is abundant in the Earth's crust. The reserves and reserve base are controlled by the location of population centers.
Austria	6,460	6,600	
Belgium	2,480	2,400	
Brazil	2,700	2,800	
Canada	1,600	1,800	
France	6,000	6,000	
Germany	10,000	10,000	
India	1,300	1,300	
Italy	4,000	4,000	
Japan	3,940	4,000	
Mexico	1,360	1,400	
Netherlands	20,000	20,000	
Paraguay	2,000	2,000	
South Africa	1,920	2,000	
Spain	2,000	2,100	
Sweden	1,500	1,500	
United Kingdom	3,600	3,800	
Other countries	9,740	10,000	
World total (rounded)	110,000	113,000	

World Resources: Sand and gravel resources of the world are sizable. 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 source of industrial silica sand, occur throughout the world.

Substitutes: Silica sand continues to be the major material used for glassmaking and for foundry and molding sands; alternates are zircon, olivine, staurolite, and chromite sands.

[e]Estimated. E Net exporter. NA Not available.
[1]See also Sand and Gravel (Construction).
[2]See Appendix A for conversion to short tons.
[3]Defined as imports - exports + adjustments for Government and industry stock changes.
[4]See Appendix B.
[5]See Appendix C for definitions.

SCANDIUM

(Data in kilograms of scandium oxide content, unless noted)

Domestic Production and Use: Demand for scandium decreased in 1995. Although scandium was not mined domestically in 1995, quantities sufficient to meet demand were available from concentrates and tailings. Principal domestic sources of scandium were byproduct concentrates previously produced at Bingham Canyon, UT, and tailings previously generated by mining fluorite at Crystal Mountain, MT. Companies in Mead, CO, Urbana, IL, and Garfield, NJ, processed scandium ores, concentrates, and low-purity compounds to produce refined scandium products. 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 derived from both domestic and foreign sources. Principal uses for scandium in 1995 were metallurgical research, high-intensity metal halide lamps, analytical standards, electronics, and laser research.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, refinery	W	W	W	W	W
Imports for consumption	NA	NA	NA	NA	NA
Exports	NA	NA	NA	NA	NA
Consumption	W	W	W	W	W
Price, yearend, dollars:					
Per kilogram, oxide, 99.0% purity	2,000	1,500	1,600	1,600	1,500
Per kilogram, oxide, 99.9% purity	3,500	3,000	3,300	3,300	3,300
Per kilogram, oxide, 99.99% purity	6,000	5,000	5,200	5,200	5,100
Per kilogram, oxide, 99.99% purity	10,000	10,000	9,000	9,000	7,650
Per gram, powder, metal[1]	296.00	372.00	372.00	372.00	372.00
Per gram, sublimed, metal[2]	248.20	312.00	312.00	169.00	169.00
Per gram, scandium bromide, 99.99% purity[3]	NA	NA	80.00	80.00	80.00
Per gram, scandium chloride, 99.99% purity[3]	NA	NA	62.00	37.00	37.00
Per gram, scandium fluoride, 99.99% purity[3]	NA	NA	129.00	77.00	77.00
Per gram, scandium iodide, 99.999% purity[3]	NA	NA	78.00	78.00	78.00
Stocks	NA	NA	NA	NA	NA
Employment	10	12	12	12	8
Net import reliance[4] as a percent of apparent consumption	NA	NA	NA	NA	NA

Recycling: Minor, recovered from laser crystal rods.

Import Sources (1991-94): Not available.

Tariff:

Item	Number	Most-favored-nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Mineral substances not elsewhere specified or included: Including scandium ores	2530.90.0000	Free	Free.
Rare-earth metals, scandium and yttrium, whether or not intermixed or inter-alloyed including scandium	2805.30.0000	5.0% ad val.	31.3% ad val.
Mixtures of rare-earth oxides except cerium oxide, including scandium oxide mixtures	2846.90.2010	Free	25% ad val.
Rare-earth compounds, including individual rare-earth oxides, hydroxides, nitrates, and other individual compounds, including scandium oxide	2846.90.8000	3.7% ad val.	25% ad val.
Aluminum alloys, other: Including scandium-aluminum	7601.20.9090	Free	10.5% ad val.

Depletion Allowance: Percentage method, 14% (Domestic), 14% (Foreign).

Government Stockpile: None.

Prepared by **James B. Hedrick, (703) 648-7725.**

SCANDIUM

Events, Trends, and Issues: Nominal prices for domestically produced scandium compounds were unchanged or lower for the third consecutive year. The supply of domestic and foreign scandium remained sufficient to meet demand. Demand decreased in the United States in 1995 and the total market remained small. Domestic increases in demand were almost exclusively the result of increased demand for metal halide lighting.

The price of scandium materials varies greatly based on purity and quantity. The weight-to-price ratio of scandium metals and compounds was generally much higher for gram quantities than for kilogram quantities. Kilogram prices for scandium metal ingot were typically double the cost of the starting scandium compound while higher-purity distilled or sublimed metal ranged from four to six times the cost of the starting material.

World Mine Production, Reserves, and Reserve Base: Scandium was produced as a byproduct material in China, Kazakstan, and Russia. Foreign mine production data was not available. No scandium was mined in the United States in 1995. Scandium occurs in many ores in trace amounts but has not been found in sufficient quantities to be considered a reserve or reserve base.[6] 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 because it lacks affinity to combine with the common ore-forming anions. It is widely dispersed in the lithosphere and forms solid solutions in over a 100 minerals. In the Earth's crust, scandium is primarily a trace constituent of ferromagnesium minerals. Concentrations in these minerals (amphibole-hornblende, pyroxene, and biotite) 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 rare-earth minerals, wolframite, columbite, cassiterite, beryl, garnet, muscovite, phosphates, and the aluminum phosphate minerals. Recent domestic production has been primarily from the scandium-yttrium silicate mineral, thortveitite, and from byproduct leach solutions from uranium operations. Future production is expected as a byproduct from tantalum tailings.

The principal domestic scandium resource is fluorite tailings from the Crystal Mountain deposit near Darby, Montana. Tailings from the mined-out fluorite operations, which were generated from 1952 to 1971, contain thortveitite and other associated scandium-enriched minerals. Resources are also contained in the tungsten, molybdenum, and titanium minerals from the Climax molybdenum deposit in Colorado, and in kolbeckite (sterrettite), varisite, and crandallite at Fairfield, UT. Other low-grade domestic resources are present in ores of aluminum, iron, molybdenum, nickel, phosphate, tantalum, tin, titanium, tungsten, zinc, and zirconium. Process residues from tungsten and tantalum operations in the United States also contain significant amounts of scandium.

Foreign resources are known in China, Kazakstan, Madagascar, Norway, and Russia. China's resources are in tin, tungsten, and iron in Fujian, Guangdong, Guangxi, Jiangxi, and Zhejian Provinces. Resources in Russia and Kazakstan are in the Kola Peninsula apatites and in uranium-bearing deposits, respectively. Scandium also occurs as an accessory mineral in the aplites of the Shilovo-Konveno Massif in the Ural Mountains. Scandium in Madagascar is concentrated in pegmatites in the Befanamo area. Resources in Norway are contained in the thortveitite-rich pegmatites of the Iveland-Evje region and a deposit to the north near Finnmark. An occurrence of the mineral, thortveitite is reported for Kobe, Japan. Undiscovered scandium resources are believed to be very large.

Substitutes: In scandium's few applications, such as lighting and lasers, it is generally not subject to substitution.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Less than 250 micron, 99.9% purity, 1991 through 1995 prices converted from 0.5 gram price, from Alfa Aesar.
[2]Lump, sublimed dendritic 99.99% purity, from Alfa Aesar.
[3]Bromide, chloride, and fluoride in crystalline or crystalline aggregate form and scandium iodide as powder from Alfa Aesar.
[4]Defined as imports - exports + adjustments for Government and industry stock changes.
[5]See Appendix B.
[6]See Appendix C for definitions.

SELENIUM

(Data in metric tons of selenium content, unless noted)

Domestic Production and Use: Primary selenium was recovered from anode slimes generated in the electrolytic refining of copper. Three copper refineries, one in Utah and two in Texas, accounted for domestic production of primary selenium. The value of production was $4 million. Anode slimes from other primary electrolytic refiners were exported for processing. The estimated consumption of selenium by end use was as follows: electronics, 35%; glass manufacturing, 30%; chemicals and pigments, 20%; and other, including agriculture and metallurgy, 15%. In electronics, high-purity selenium was used primarily as a photoreceptor on the drums of plain paper copiers. In glass manufacturing, selenium was used as a decolorant in container glass and other soda-lime silica glasses and to reduce solar heat transmission in architectural plate glass. Cadmium sulfoselenide red pigments, which have good heat stability, were used in ceramics and plastics. Chemical uses included rubber compounding chemicals, gun bluing, catalysts, human dietary supplements and antidandruff shampoos. Dietary supplements for livestock were the largest agricultural use. Selenium was added to copper, lead, and steel alloys to improve their machinability.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, refinery	260	243	283	360	360
Imports for consumption, metal and dioxide	344	371	382	411	410
Exports, metal, waste and scrap	210	175	261	246	250
Consumption, apparent[1]	510	490	460	530	540
Price, dealers, average, dollars per pound, 100-pound lots, refined, yearend	5.41	5.13	4.90	4.75	4.50
Stocks, producer, refined, yearend	W	W	W	W	W
Employment	NA	NA	NA	NA	NA
Net import reliance[2] as a percent of apparent consumption	50	48	39	31	33

Recycling: There was no domestic production of secondary selenium. Scrap xerographic materials were exported for recovery of the contained selenium. An estimated 100 tons of selenium metal recovered from scrap was imported in 1995.

Import Sources (1991-94): Canada, 44%; Philippines, 18%; Japan, 13%; Belgium, 11%; and other, 14%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[3] 12/31/95
Selenium metal	2804.90.0000	Free	Free.
Selenium dioxide	2811.29.2000	Free	Free.

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

Government Stockpile: None.

Prepared by Robert D. Brown, Jr., (703) 648-4984.

SELENIUM

Events, Trends, and Issues: Domestic selenium demand did not change in 1995, but world demand increased, especially in China, Europe, and South America. World selenium production remained at about the 1994 level, so the oversupply situation was eased. The use of selenium in glass and as a micronutrient remained strong.

Selenium remained a candidate as an additive to no-lead, free-machining brass for plumbing applications. Ordinary free-machining brass contains up to 7% lead. Industry consortia are testing several lead-free brasses that could be used as substitutes when more stringent regulations on lead in drinking water take effect. Bismuth is the main additive; however, its supply is limited and selenium reduces the quantity of bismuth needed.

World Refinery Production, Reserves, and Reserve Base:

	Refinery production		Reserves[4]	Reserve base[4]
	1994	1995[e]		
United States	360	360	10,000	19,000
Belgium	250	250	—	—
Canada	300	300	6,000	15,000
Chile	45	45	19,000	30,000
Finland	31	31	—	—
Germany	120	120	—	—
Japan	595	600	—	—
Peru	14	14	2,000	5,000
Philippines	40	40	2,000	3,000
Serbia and Montenegro	40	40	1,000	1,000
Sweden	50	50	—	—
Zambia	25	25	3,000	6,000
Other countries	15	15	27,000	55,000
World total (may be rounded)	[5]1,880	[5]1,890	70,000	130,000

World Resources: In addition to the reserve base of selenium, which is contained in identified economic copper deposits, 2.5 times this quantity of selenium was estimated to exist in copper or other metal deposits that were undeveloped, of uneconomic grade, or as yet undiscovered. Coal contains an average of 1.5 parts per million of selenium, which is about 80 times the average for copper deposits, but recovery of selenium from coal appears unlikely in the foreseeable future.

Substitutes: High-purity silicon has replaced selenium in high-voltage rectifiers and is the major substitute for selenium in low-and medium-voltage rectifiers. Other inorganic semiconductor materials, such as silicon, cadmium, tellurium, gallium, and arsenic, as well as organic photoconductors, substitute for selenium in photoelectric applications. Other substitutes include cerium oxide in glass manufacturing; tellurium in pigment and rubber compounding; and bismuth, lead, and tellurium in free-machining alloys.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1]Calculated using reported shipments, imports of selenium metal, and estimated exports of selenium metal, excluding scrap.

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

[3]See Appendix B.

[4]See Appendix C for definitions.

[5]In addition to the countries listed, Australia, China, India, Kazakstan, Russia, the United Kingdom, and Zimbabwe are known to produce refined selenium.

SILICON

(Data in thousand metric tons of silicon content, unless noted)

Domestic Production and Use: Estimated value of silicon metal and alloys (excluding semiconductor-grade silicon) produced in the United States in 1995 was about $570 million. Ferrosilicon was produced by five companies in six plants, while production of silicon metal was distributed between five companies in eight plants. Most of the ferrosilicon and silicon metal plants were east of the Mississippi River or in the Pacific Northwest. Most ferrosilicon was consumed in the ferrous foundry and steel industries, predominantly in the eastern one-half of the United States. The main consumers of silicon metal were aluminum producers and the chemical industry.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production	363	370	367	390	390
Imports for consumption	164	193	212	245	240
Exports	35	38	31	32	60
Consumption, apparent	500	532	557	607	580
Price,[1] average, cents per pound Si:					
Ferrosilicon, 50% Si	38.3	36.9	40.8	43.9	54.5
Ferrosilicon, 75% Si	37.0	35.4	40.6	40.8	55.1
Silicon metal	61.5	60.0	66.4	64.1	67.8
Stocks, producer and consumer, yearend	64	57	48	44	34
Employment, plant[e]	2,300	2,300	NA	NA	NA
Net import reliance[2] as a percent of apparent consumption	27	30	34	36	33

Recycling: Insignificant.

Import Sources (1991-94): Norway, 19%; Brazil, 17%; Canada, 13%; Russia, 10%; and other, 41%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[3] 12/31/95
Ferrosilicon, 55%-80% Si:			
More than 3% Ca	7202.21.1000	1.1% ad val.	11.5% ad val.
Other	7202.21.5000	1.5% ad val.	11.5% ad val.
Ferrosilicon, 80%-90% Si	7202.21.7500	1.9% ad val.	9% ad val.
Ferrosilicon, more than 90% Si	7202.21.9000	5.8% ad val.	40% ad val.
Ferrosilicon, other:			
Ferrosilicon, more than 2% Mg	7202.29.0010	Free	4.4¢/kg Si.
Ferrosilicon, other	7202.29.0050	Free	4.4¢/kg Si.
Silicon, more than 99.99% Si	2804.61.0000	3% ad val.	25% ad val.
Silicon, 99.00%-99.99% Si	2804.69.1000	5.3% ad val.	21% ad val.
Silicon, other	2804.69.5000	8.3% ad val.	45% ad val.

Depletion Allowance: Quartzite, 14% (Domestic and Foreign); gravel, 5% (Domestic and Foreign).

Government Stockpile: Information on silicon carbide in the National Defense Stockpile is discussed in the "Manufactured Abrasives" chapter.

Events, Trends, and Issues: Overall consumption for silicon decreased compared with that of the previous year. Demand for silicon ferroalloys closely follows overall iron and steel production, whereas demand for silicon metal largely reflects the health of the aluminum and chemical industries. Consumption of ferrosilicon and miscellaneous silicon alloys was about 350,000 tons, while consumption of silicon metal was about 230,000 tons.

In mid-October, the "dealer import" price for 50%-grade ferrosilicon was $0.64 to $0.66 per pound, the import price for 75%-grade ferrosilicon was $0.64 to $0.655 per pound, and the import price for silicon metal was $0.72 to $0.75 per pound. Escalating prices for both ferrosilicon and silicon metal were being influenced by the respective tight markets, antidumping duties imposed in the United States and Europe, and declining exports to the West from China and producing countries of the Former Soviet Union.

Prepared by **Larry D. Cunningham, (703) 648-4977.**

SILICON

For the first one-half-year, total gross ferrosilicon imports decreased by about 25%. Norway and Iceland were the leading suppliers, with about 60% of both total quantity and value. For the same period, silicon metal imports were up slightly, with Russia providing about 35% of both total quantity and value.

It is estimated that in 1996 domestic production of silicon-containing ferroalloys and metal will be about 400,000 tons and U.S. apparent consumption will be about 600,000 tons.

World Production, Reserves, and Reserve Base:

	Production[e]		Reserves and reserve base[4]
	1994	1995	
United States	390	390	The reserves and reserve base in most major producing countries are ample in relation to demand. Quantitative estimates are not available.
Australia	30	30	
Brazil	250	250	
Canada	55	60	
China	715	720	
Egypt	30	30	
France	85	90	
Iceland	40	40	
India	55	60	
Kazakstan	230	230	
Norway	350	350	
Poland	50	50	
Romania	20	20	
Russia	340	340	
South Africa	100	100	
Spain	20	20	
Ukraine	260	260	
Venezuela	30	30	
Other countries	120	130	
World total	3,170	3,200	

World Resources: The 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.

Substitutes: Various metals and alloys, such as aluminum and silicomanganese, can be substituted for ferrosilicon in some applications. Germanium and gallium arsenide are the principal substitutes for silicon in semiconductor and infrared applications.

[e]Estimated. NA Not available.
[1]Based on U.S. dealer import price.
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]See Appendix B.
[4]See Appendix C for definitions.

SILVER

(Data in metric tons[1] of silver content, unless noted)

Domestic Production and Use: Silver produced by about 120 mines in 18 States had an estimated value of $250 million. The following four States accounted for nearly three-fourths of the 1995 mine production: Nevada, 44%; Arizona, 11%; Idaho, 11%; and Montana, 5%. Precious metal ores accounted for approximately one-half of domestic silver production; the other one-half was recovered from base metal ores. There were 22 principal refiners of commercial-grade silver. About 30 fabricators accounted for more than 90% of the silver consumed in arts and industry. The remainder was consumed mostly by small companies and artisans. The largest silver fabricators were principally in the Northeast. Approximately 50% of the refined silver consumed domestically in 1995 was used in the manufacture of photographic products; 20% in electrical and electronic products; 10% in electroplated ware, sterlingware, and jewelry; and 20% in other uses.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Mine	1,860	1,800	1,640	1,480	1,500
Refinery: Primary	1,880	2,160	1,790	1,810	1,800
Recycled	1,700	1,760	2,020	1,700	1,700
Imports for consumption[2]	2,700	3,220	2,500	2,600	3,000
Exports[2]	841	1,010	811	967	1,500
Shipments from Government stockpile excesses	255	356	404	186	300
Price, average, New York, dollars per troy ounce	4.04	3.94	4.30	5.29	5.30
Stocks, yearend: Treasury Department[3]	1,030	775	912	882	850
COMEX, CBT[4]	8,760	9,380	10,500	10,400	6,000
Department of Defense	23	29	34	15	20
Employment, mine and mill[5]	1,900	1,600	1,100	1,000	1,000

Recycling: About 2,000 metric tons of silver was recovered from recycled material in 1995.

Import Sources[2] (1991-94): Mexico, 38%; Canada, 33%; Peru, 16%; Chile, 10%; and other, 3%.

Tariff: No duties are imposed on imports of unrefined silver or refined bullion.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Silver	1,450	—	1,450	232

Prepared by **Robert G. Reese, Jr., (703) 648-4980.**

SILVER

Events, Trends, and Issues: Domestic silver production remained essentially unchanged from the previous year, despite a slight improvement in the average price. Although analysts estimated that domestic silver consumption increased in 1995, it was believed that the increase was met through a decrease in investor-held stocks.

The Government continued to dispose of the silver held in the National Defense Stockpile, using it primarily for the production of commemorative coins and the Eagle silver bullion coins. In nearly 14 years, from 1982 through late 1995, the Government has reduced the quantity of silver held in the stockpile from nearly 4,300 metric tons to less than 1,500 metric tons.

In 1995, the average silver price remained essentially unchanged from the previous year. Through the first 9 months, the daily price ranged between $4.39 and $6.02 per troy ounce.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[6]	Reserve base[6]
	1994	1995[e]		
United States	1,480	1,500	31,000	72,000
Australia	1,060	1,100	29,000	33,000
Canada	758	900	37,000	47,000
Mexico	2,330	2,200	37,000	40,000
Peru	1,700	1,600	25,000	37,000
Other countries	6,570	6,600	120,000	190,000
World total (rounded)	13,900	14,000	280,000	420,000

World Resources: Approximately two-thirds of world silver resources are associated with copper, lead, and zinc deposits. The remaining one-third is in vein deposits in which silver is the most valuable metallic component. Although most recent discoveries have been primarily gold and silver deposits, significant future reserves and resources are expected from major base metal discoveries that contain byproduct silver.

Substitutes: Aluminum and rhodium substitute for silver in mirrors and other reflecting surfaces. Tantalum can be used in place of silver for surgical plates, pins, and sutures. Stainless steel is an alternate material used widely in the manufacture of table flatware. Nonsilver batteries being developed may replace silver batteries in some applications. Silverless black and white film, film with reduced silver content, and xerography are alternatives to some uses of silver in photography.

[e]Estimated.
[1]One metric ton (1,000 kilograms) = 32,150.7 troy ounces
[2]Refined bullion, plus silver content of ores, concentrates, precipitates, and doré; excludes coinage, and waste and scrap material.
[3]Balance in Mint only.
[4]COMEX: Commodity Exchange Inc., New York. CBT: Chicago Board of Trade.
[5]Source: Mine Safety and Health Administration.
[6]Includes silver recoverable as a byproduct of base metal ores. See Appendix C for definitions.

SODA ASH

(Data in thousand metric tons, unless noted)

Domestic Production and Use: Five companies in Wyoming and one in California composed the U.S. soda ash (sodium carbonate) industry, which was the largest in the world. The six producers, with a combined annual nameplate capacity of 11 million tons, operated at 89% of nameplate capacity. Sodium bicarbonate, sodium sulfate, potassium chloride, potassium sulfate, borax, and other minerals were produced as coproducts from sodium carbonate production in California. Sodium bicarbonate, sodium sulfite, sodium tripolyphosphate, and chemical caustic soda were manufactured as coproducts at several of the Wyoming soda ash plants. The total estimated value of domestic soda ash produced in 1995 was $750 million.[1]

The reported distribution of soda ash by end use was glass, 51%; chemicals, 22%; soap and detergents, 13%; distributors, 5%; miscellaneous, 3%; and pulp and paper, water treatment, and flue gas desulfurization, 2% each.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production[2]	9,000	9,380	8,960	9,320	9,800
Imports for consumption	134	72	89	79	80
Exports	2,730	2,960	2,800	3,230	3,600
Consumption: Reported	6,280	6,320	6,310	6,240	6,280
Apparent	6,460	6,360	6,350	6,260	6,280
Price: Quoted, yearend, soda ash, dense, bulk, f.o.b. Green River, WY, dollars per short ton	98.00	98.00	98.00	105.00	105.00
F.o.b. Searles Valley, CA, same basis	123.00	123.00	123.00	130.00	130.00
Average sales value (natural source), f.o.b. mine or plant, same basis	84.18	80.93	74.34	70.44	76.00
Stocks, producer, yearend	234	371	274	203	200
Employment, mine and plant	2,800	2,800	2,800	2,800	2,800
Net import reliance[3] as a percent 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 (1991-94): Canada, 99%; and other, 1%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[4] 12/31/95
Disodium carbonate	2836.20.0000	1.2% ad val.	8.5% ad val.

Depletion Allowance: 14% (Domestic), 14% (Foreign). For natural only.

Government Stockpile: None.

Events, Trends, and Issues: In February, a large section of one Wyoming mine collapsed and generated a seismic event that had a 5.2 magnitude on the Richter scale. The accident temporarily resulted in a short-term supply disruption that was soon overcome. The cause of the catastrophe was still under investigation by yearend.

In April, the European Union Commission issued provisional antidumping duties on imports of U.S. soda ash after a 2-year investigation. The duties ranged from 0% to 14.3%, depending on the producer. European glass manufacturers and U.S. soda ash producers lobbied the Commission to reduce or rescind the duties. In October, the definitive duties that replaced the provisional ones were lowered ranging from 0% to 8.9%. Furthermore, the duties will be reevaluated after 1 year rather than the customary 5 years. Despite this favorable ruling, U.S. soda ash demand was forecast to remain strong throughout 1996 without any significant exports to Europe.

Prepared by **Dennis S. Kostick, (703) 648-7715.**

SODA ASH

Because of strong export sales and increased domestic soda ash consumption in the flat glass, chemical, and pulp and paper sectors, the industry raised its off-list price of soda ash by $15 per short ton, effective July 1. Several small accounts and some quarterly contracts were the primary targets for the action. Larger buyers with long-term contracts that are negotiated by yearend may have to pay more for their soda ash in 1996 because supplies may be limited due to increased demand.

The outlook for soda ash through 1996 is extremely favorable. Opportunities for additional shipments to Europe appear optimistic, beginning possibly as early as 1997, as European soda ash demand continues to grow.

World Production, Reserves, and Reserve Base:

	Production		Reserves[5 6]	Reserve base[6]
Natural	1994	1995[e]		
United States	9,320	9,800	[7]23,000,000	[7]39,000,000
Botswana	140	100	400,000	NA
Chad	NA	NA	7,000	NA
Kenya	245	250	50,000	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)	9,700	10,200	24,000,000	40,000,000
World total, synthetic (rounded)	21,000	21,000	—	—
World total (rounded)	31,000	31,000	—	—

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 metric tons of identified soda ash resources could be recovered from the 56 billion tons of bedded trona[5] 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 a combination of conventional, continuous, and shortwall mining equipment, is the primary method of mining Wyoming trona ore. The method has an average 45% mining recovery, which is higher than the 30% average mining recovery from solution mining. Improved solution mining techniques, such as horizontal drilling to establish communication between well pairs, could increase this extraction rate and enable companies to develop some of the deeper economic trona. Wyoming trona resources are being depleted at the rate of about 15 million tons per year (8.3 million tons of soda ash). Searles and Owens Lakes 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. Commercial mining of nahcolite is presently being done by one producer in Colorado, and two other companies are trying to obtain financing for development of competing nahcolite projects. None of the ventures are associated with oil shale mining or with dawsonite recovery.

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.
[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]See Appendix B.
[5]The reported quantities are sodium carbonate only. About 1.8 tons of trona yields 1 ton of sodium carbonate.
[6]See Appendix C for definitions.
[7]From trona, nahcolite, and dawsonite sources.

SODIUM SULFATE

(Data in thousand metric tons, unless noted)

Domestic Production and Use: The domestic natural sodium sulfate industry consisted of two producers operating a total of two plants in California and Texas. Total production of natural and synthetic sodium sulfate increased an estimated 24% compared with that of the previous year. Approximately 44% of total production was a byproduct from facilities that manufacture rayon and various chemicals. The total value of sodium sulfate sold was an estimated $50 million.

End uses of sodium sulfate were soap and detergents, 40%; pulp and paper, 25%; textiles, 19%; glass, 5%; and miscellaneous, 11%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Natural	354	337	327	298	325
Synthetic[1]	366	216	210	166	250
Imports for consumption	157	158	163	190	170
Exports	103	155	89	65	70
Consumption, apparent (natural and synthetic)	778	544	616	597	675
Price: Quoted, sodium sulfate (100% Na_2SO_4), bulk, f.o.b. works, East, dollars per short ton	114.00	114.00	114.00	114.00	114.00
Average sales value (natural source), f.o.b. mine or plant, dollars per metric ton	87.34	91.79	76.53	81.25	84.00
Stocks, producer, yearend, natural	35	47	42	34	34
Employment, well and plant	240	240	240	240	240
Net import reliance[2] as a percent of apparent consumption	7	E	13	22	15

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 (1991-94): Canada, 95%; Mexico, 4%; and other, 1%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[3] 12/31/95
Disodium sulfate:			
Saltcake (crude)	2833.11.1000	Free	Free.
Other	2833.11.5000	0.4% ad val.	3.6% ad val.
Anhydrous	2833.11.5010	0.4% ad val.	3.6% ad val.
Other	2833.11.5050	0.4% ad val.	3.6% ad val.

Depletion Allowance: 14% (Domestic), 14% (Foreign). For natural only.

Government Stockpile: None.

Prepared by **Dennis S. Kostick, (703) 648-7715.**

SODIUM SULFATE

Events, Trends, and Issues: Demand for powdered laundry detergents in Mexico increased, causing Mexican producers of natural sodium sulfate to export less material to the United States. This resulted in more U.S. supply being distributed in domestic markets rather than imported material.

Soap and detergent manufacturers reformulated certain detergents using additional quantities of sodium sulfate that possibly substituted for higher priced zeolites and surfactants in powdered formulations. This trend is opposite of what had been occurring as superconcentrates and liquid detergents had been growing and displacing the less-expensive powdered rivals for about the past 7 years.

A new battery acid recycling operation that recovers byproduct sodium sulfate began production at Columbus, GA. The plant had an annual capacity of about 30,000 tons of sodium sulfate. Two other battery recyclers in New York and Louisiana were scheduled to come on-stream in 1996, with 25,000 tons and 15,000 tons of capacity, respectively.

World Production, Reserves, and Reserve Base:

	Production		Reserves[4]	Reserve base[4]
Natural	1994	1995[e]		
United States	298	325	860,000	1,400,000
Argentina	10	10	NA	NA
Canada	312	300	84,000	270,000
Iran	280	290	NA	NA
Mexico	500	550	170,000	230,000
Spain	600	600	180,000	270,000
Turkey	80	80	100,000	NA
Turkmenistan[5]	50	50	NA	200
Other countries	170	160	100,000	200,000
World total, natural (may be rounded)	2,300	2,400	[6]3,300,000	[7]4,600,000
World total, synthetic (rounded)	1,600	1,600	—	—
World total (rounded)	3,900	4,000	—	—

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 in World Production, 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 metric tons of sodium sulfate resource, representing about 35% of the lake 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 can also be obtained as a byproduct from the production of ascorbic acid, 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-than-perfect results.

[e]Estimated. E Net exporter. NA Not available.
[1]Source: Bureau of the Census. Synthetic production data are revised in accordance with recent updated Census statistics.
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]See Appendix B.
[4]See Appendix C for definitions.
[5]Part of the Former Soviet Union. Data are inadequate to formulate reliable estimates for individual countries of the Former Soviet Union.
[6]Excludes Argentina, Iran, and Turkmenistan. Includes non-producing nations.
[7]Excludes Argentina, Iran, and Turkey. Includes non-producing nations.

STONE (CRUSHED)[1]

(Data in million metric tons, unless noted)[2]

Domestic Production and Use: Crushed stone valued at $7 billion was produced by 1,600 companies operating 3,900 active quarries in 48 States. Leading States, in order of production, were Texas, Pennsylvania, Missouri, Florida, Georgia, Illinois, Ohio, Virginia, North Carolina, and Tennessee, together accounting for about 53% of the total output. It is estimated that, of the 1.28 billion tons of crushed stone produced in 1995, about 32% were unspecified uses. Of the remaining total, about 83% was used as construction aggregates mostly for highway and road construction and maintenance; 14% for chemical and metallurgical uses including cement and lime manufacture; 2% for agricultural purposes; and 1% for special uses and products. To provide a more accurate estimation of the consumption patterns for crushed stone, the "unspecified uses" are not included in the above percentages. Of the total crushed stone produced in 1995, about 72% was limestone and dolomite; 15%, granite; 7%, traprock; and the remaining 6%, were shared, in descending order of quantity, by sandstone and quartzite, miscellaneous stone, calcareous marl, shell, marble, volcanic cinder and scoria, and slate.

The estimated output of crushed stone in the 48 conterminous States shipped for consumption in the first 9 months of 1995 was 925 million tons, which represents an increase of about 4.7% compared with the same period of 1994. Additional production information by quarters for each State, geographic region, and the United States is published in the Quarterly Mineral Industry Survey for Crushed Stone and Sand and Gravel.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production	997	[e]1,050	1,120	1,230	1,280
Imports for consumption	5	7	8	9	9
Exports	2	4	5	5	6
Consumption, apparent	1,000	[e]1,053	1,123	1,234	1,280
Price, average value, dollars per metric ton	5.15	5.31	5.30	5.39	5.48
Stocks, yearend	NA	NA	NA	NA	NA
Employment, quarry and mill[e] [3]	74,780	75,000	76,000	77,000	77,500
Net import reliance[4] as a percent of apparent consumption	—	—	—	—	—

Recycling: Road surfaces made of asphalt and crushed stone and, to a lesser extent, cement concrete surfaces and structures were recycled on a limited but increasing basis in most States.

Import Sources (1991-94): Canada, 51%; Mexico, 28%; Bahamas, 11%; and other, 10%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Crushed and broken stone	2517.10.0000	Free	30% ad val.

Depletion Allowance: (Domestic and Foreign) 14% for chemical and metallurgical uses; 5% if used for riprap, ballast, road material, concrete aggregate, and similar purposes.

Government Stockpile: None.

Prepared by **Valentin V. Tepordei, (703) 648-7728.**

STONE (CRUSHED)

Events, Trends, and Issues: Crushed stone output increased 4.4% in 1995. It is estimated that 1996 domestic production and U.S. apparent consumption will be about 1.33 billion tons each, a 3.9% increase.

The crushed stone industry continued to be concerned with safety regulations and environmental restrictions. Shortages in some urban and industrialized areas were expected to continue to increase owing to local zoning regulations and land development alternatives. This is expected to continue to cause a relocation of crushed stone quarries away from high-population centers.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves and reserve base[6]
	1994	1995[e]	
United States	1,230	1,280	Adequate except special types and local shortages.
Other countries	NA	NA	
World total	NA	NA	

World Resources: Stone resources of the world are very large. High-purity limestone and dolomite suitable for chemical and metallurgical use are limited in many geographical 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 aggregate include sand and gravel, 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]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 B.
[6]See Appendix C for definitions.

STONE (DIMENSION)[1]

(Data in thousand metric tons, unless noted)

Domestic Production and Use: Dimension stone totaling 1.32 million tons (1.46 short tons) valued at $220 million was produced by 172 companies at 257 quarries in 36 States. Dimension stone was used in rough blocks in building, 17%; ashlar, 16%; rough blocks for monuments, 11%; dressed monumental, 10%; and other, 46%. Leading producing States were Indiana, Georgia, and Vermont, which together accounted for 39% of the output. Of the total, 42% was granite; 31%, limestone; 14%, sandstone; 3%, slate; 3%, marble; and 7%, other.

Salient Statistics—United States:[2]	1991	1992	1993	1994	1995[e]
Production: Tonnage	1,160	1,140	1,280	1,190	1,320
Value, million dollars	211	198	226	218	220
Imports for consumption, value, million dollars	475	404	398	440	470
Exports, value, million dollars	65	55	53	53	51
Consumption, apparent, value, million dollars	621	547	571	605	741
Price	Variable, depending on type of product				
Stocks, yearend	NA	NA	NA	NA	NA
Employment, quarry and mill[3]	3,000	3,000	3,000	3,000	3,000
Net import reliance[4] as a percent of apparent consumption (based on value)	66	64	60	64	57
Granite only:					
Production	573	594	624	499	554
Imports for consumption	553	466	494	NA	NA
Exports (rough and finished)	121	119	143	170	NA
Consumption, apparent	1,000	941	975	NA	NA
Price	Variable, depending on type of product				
Stocks, yearend	NA	NA	NA	NA	NA
Employment, quarry and mill[3]	1,500	1,500	1,500	1,500	1,500
Net import reliance[4] as a percent of apparent consumption (based on tonnage)	43	37	36	NA	NA

Recycling: Small amounts of dimension stone are recycled principally by restorers of old stone work.

Import Sources (1991-94) (based on value): Dimension stone: Italy, 45%; Spain, 11%; India, 9%; Canada, 6%; and other, 29%. Granite only: Italy, 46%; Canada, 15%; India, 14%; Brazil, 10%; Spain, 6%; and other, 9%.

Tariff: Dimension stone tariffs ranged from free to 7.5% ad valorem for most favored nations in 1995 according to type, size, value, and degree of preparation.

Prepared by **Dimension Stone Specialist, (703) 648-7710.**

STONE (DIMENSION)

Depletion Allowance: 14% (Domestic and Foreign); 5% if used for rubble and other nonbuilding purposes.

Government Stockpile: None.

Events, Trends, and Issues: Dimension stone imports increased 7% to a value of $470 million in 1995. Value of imports exceeded that of production for the 12th successive year.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves and reserve base[5]
	1994	1995[e]	
United States	1,190	1,320	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: Substitutes for dimension stone include concrete, steel, aluminum, resin agglomerated stone, and plastics.

[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 contained strontium,[1] unless 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. Primary strontium compounds were used in the faceplate glass of color television picture tubes, 69%; ferrite ceramic magnets, 11%; pyrotechnics and signals, 9%; and other, 11%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, strontium minerals	—	—	—	—	—
Imports for consumption:					
Strontium minerals	14,600	19,700	11,600	16,000	15,000
Strontium compounds	9,550	13,000	15,300	20,000	22,000
Exports, compounds	1,080	650	260	110	1,300
Shipments from Government stockpile excesses	—	—	—	—	—
Consumption, apparent, celestite and compounds	W	W	W	W	W
Price, average value of mineral imports at port of exportation, dollars per ton	77	68	73	68	72
Stocks, consumer, yearend, celestite only	W	W	W	W	W
Net import reliance[2] as a percent of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (1991-94): Strontium minerals: Mexico, 100%. Strontium compounds: Mexico, 84%; Germany, 15%; and other, 1%. Total imports: Mexico, 93% and Germany, 7%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Mexico 12/31/95	Non-MFN[3] 12/31/95
Celestite	2530.90.0010	Free	Free	Free.
Alkaline earth metals (strontium and barium)	2805.22.1000	3.7% ad val.	Free	25% ad val.
Compounds:				
Strontium nitrate	2834.29.2000	4.2% ad val.	Free	25% ad val.
Strontium carbonate	2836.92.0000	4.2% ad val.	Free	25% ad val.
Strontium oxide, hydroxide, peroxide	2816.20.0000	4.2% ad val.	Free	25% ad val.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Celestite[1]	5,100	—	5,100	—

Prepared by Joyce A. Ober, (703) 648-7717.

STRONTIUM

Events, Trends, and Issues: Although there is celestite in the National Defense Stockpile, none of it is stockpile grade; its total value is listed as zero. The stockpile goal was reduced to zero in 1969, and at that time the stockpile contained both 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 1996 Annual Materials Plan, announced at the end of September by the Defense Materials Stockpile Center, identified 3,300 tons of celestite to be offered for disposal.

World Mine Production, Reserves, and Reserve Base:[4]

	Mine production		Reserves[5]	Reserve base[5]
	1994	1995[e]		
United States	—	—	—	1,360,000
Algeria	5,400	5,400		
China	35,000	35,000		
Iran	20,000	20,000		
Mexico	70,000	75,000	Other:	Other:
Pakistan	1,500	1,500	6,800,000	10,600,000
Spain	12,000	12,000		
Tajikistan	NA	NA		
Turkey	40,000	40,000		
United Kingdom	1,000	—		
World total (may be rounded)	[6]180,000	[6]190,000	6,800,000	12,000,000

World Resources: Resources in the United States are several times the reserve base. World resources, although not thoroughly evaluated, are believed to exceed 1 billion tons.

Substitutes: Although it is possible to substitute 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 magnet. 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. W Withheld to avoid disclosing company proprietary data.
[1]The strontium content of celestite is 43.88%; this amount was used to convert units of celestite.
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]See Appendix B.
[4]Metric tons of strontium minerals.
[5]See Appendix C for definitions.
[6]Excludes Tajikistan.

SULFUR

(Data in thousand metric tons of sulfur, unless noted)

Domestic Production and Use: In 1995, elemental sulfur and byproduct sulfuric acid were produced at 168 operations in 30 States, Puerto Rico, and the U.S. Virgin Islands. Total shipments were valued at about $500 million. Total elemental sulfur production was 10.3 million metric tons; Texas and Louisiana accounted for 50% of domestic production. Elemental sulfur was recovered at petroleum refineries, natural gas processing plants, and coking plants by 59 companies at 150 plants in 26 States, Puerto Rico, and the U.S. Virgin Islands. Elemental sulfur was produced by one company at two mines in two States, using the Frasch method of mining. Byproduct sulfuric acid, representing 13% of sulfur in all forms, was recovered at 16 nonferrous smelters in 10 States by 11 companies. Domestic elemental sulfur provided 67% of domestic consumption, and byproduct acid 11%. The remaining 22% of sulfur consumed was imported sulfur and sulfuric acid. About 90% of sulfur was consumed in the form of sulfuric acid. Agricultural chemicals (primarily fertilizers) comprised 67% of sulfur demand; chemicals, organic and inorganic, 8%; metal mining, 6%; and petroleum refining, 5%. Other uses, accounting for 14% of demand, were widespread because a multitude of industrial products require sulfur in one form or another during some stage in their manufacture.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Frasch	2,870	2,320	[1]1,900	2,960	W
Recovered elemental	6,650	7,050	[2]7,720	7,160	[3]10,300
Other forms	1,310	1,300	1,430	1,380	1,500
Total	10,800	10,700	11,000	11,500	11,800
Shipments, all forms	11,100	11,000	10,500	11,700	12,000
Imports for consumption:					
Frasch and recovered	3,020	2,730	2,040	1,650	2,300
Sulfuric acid, sulfur content	603	649	797	696	650
Exports:					
Frasch and recovered	1,200	966	656	899	1,000
Sulfuric acid, sulfur content	49	46	46	46	65
Consumption, apparent, all forms	13,500	13,400	12,600	13,100	13,900
Price, reported average value, dollars per ton of elemental sulfur, f.o.b., mine and/or plant	71.45	48.14	31.86	28.60	35.00
Stocks, producer, yearend	1,190	809	1,380	1,160	600
Employment, mine and/or plant	3,100	3,200	3,100	3,100	3,100
Net import reliance[4] as a percent of apparent consumption	19	20	12	12	18

Recycling: About 3 million tons of spent acid was reclaimed from petroleum refining and chemical processes.

Import Sources (1991-94): Frasch and recovered: Canada, 65%; Mexico, 33%; and other, 2%. Sulfuric acid: Canada, 68%; Germany, 12%; Japan, 6%; Mexico, 5%; and other, 9%. Total sulfur imports: Canada, 65%; Mexico, 27%; and other, 8%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Sulfur, crude or unrefined	2503.10.0000	Free	Free.
Sulfur, all kinds, other	2503.90.0000	Free	Free.
Sulfur, sublimed or precipitated	2802.00.0000	Free	Free.
Sulfuric acid	2807.00.0000	Free	Free.

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

Government Stockpile: None.

Prepared by **Joyce A. Ober, (703) 648-7717.**

SULFUR

Events, Trends, and Issues: Conditions affecting the U.S. sulfur industry improved for the second consecutive year. Production, shipments, imports, exports, consumption, and prices increased. Stocks decreased. Supplies were tight throughout the year.

At the beginning of the year, one U.S. Frasch producer bought the sulfur assets of the only other U.S. Frasch producer. There was some question as to how long the Texas mine would continue to produce; however, the other operation, off the Louisiana coastline, was expected to operate at or above capacity for the foreseeable future. U.S. demand has been strong, especially for the phosphate fertilizer industry, and world trade was also expanding.

Domestic sulfur production is expected to increase slightly for the next few years, with Frasch production remaining relatively stable as long as both mines continue to operate. Recovered production should continue its slow, but consistent growth. Small quantities of sulfur or sulfuric acid recovered from electric powerplants should enter the market within the next few years. Apparent consumption of sulfur is projected to be 14 million tons in 1996.

World Production, Reserves, and Reserve Base:

	Production—All forms		Reserves[6]	Reserve base[6]
	1994	1995[e]		
United States	11,500	11,800	140,000	230,000
Canada	9,140	9,200	160,000	330,000
China	6,030	6,000	100,000	250,000
France	1,100	1,100	10,000	20,000
Iraq	800	600	130,000	500,000
Japan	2,900	2,900	5,000	15,000
Mexico	2,920	3,000	75,000	120,000
Poland	2,380	2,500	130,000	300,000
Russia	1,830	1,900	NA	NA
Saudi Arabia	1,600	1,600	100,000	130,000
Spain	702	600	50,000	300,000
Other countries	10,100	10,800	500,000	1,300,000
World total (may be rounded)	51,000	52,000	1,400,000	3,500,000

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 are 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: There are no adequate substitutes for sulfur at present or anticipated price levels; some acids, in certain applications, may be substituted for sulfuric acid.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1]Includes 10 months of Frasch sulfur data. Two remaining months of Frasch data included with recovered sulfur data to conform with proprietary data requirements.

[2]Includes corresponding Frasch sulfur data for November and December.

[3]Includes Frasch sulfur data.

[4]Defined as imports - exports + adjustments for Government and industry stock changes.

[5]See Appendix B.

[6]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 1995 domestic production was $35 million. There were 16 talc-producing mines in 7 States in 1995. Companies in Montana, New York, Texas, and Vermont accounted for 98% of domestic production. Ground talc was consumed in ceramics, 35%; paint, 19%; paper, 16%; plastics, 6%; roofing, 5%; cosmetics, 4%; and other, 15%. Two firms in North Carolina and one firm in California accounted for 100% of domestic pyrophyllite production, which increased slightly from that of 1994. Consumption was in ceramics, refractories, and insecticides, in decreasing order of tonnage.

Salient Statistics—United States:	1991	1992[1]	1993[1]	1994[1]	1995[e,1]
Production, mine	1,040	997	968	935	1,050
Sold by producers	864	817	900	923	959
Imports for consumption	67	80	100	155	110
Exports	178	175	135	154	190
Shipments from Government stockpile excesses	—	(2)	—	—	—
Consumption, apparent	929	902	933	936	970
Price, crude or ground, dollars per ton	11-308	15-325	13-400	7-350	7-560
Stocks, producer, yearend	80	80	80	80	80
Employment, mine and mill	880	880	800	750	750
Net import reliance[3] as a percent of apparent consumption	E	E	E	E	E

Recycling: Insignificant.

Import Sources (1991-94): China, 35%; Canada, 33%; Japan, 17%; and other, 15%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[4] 12/31/95
Crude, not ground	2526.10.0000	0.03¢/kg	0.6¢/kg.
Ground, washed, powdered	2526.20.0000	1.9% ad val.	35.0% ad val.
Cut or sawed	6815.99.2000	Free	2.2¢/kg.

Depletion Allowance: Block steatite talc: 22% (Domestic), 14% (Foreign). Other: 14% (Domestic), 14% (Foreign).

Government Stockpile:

Stockpile Status—9-30-95
(Metric tons)

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Talc, block and lump	982	—	980	—
Talc, ground	988	—	988	—

Prepared by Robert L. Virta, (703) 648-7726.

TALC AND PYROPHYLLITE

Events, Trends, and Issues: Production and sales increased from those of 1994. Apparent consumption increased 3% in 1995. Exports increased 23% from those of 1994. Belgium, Canada, Japan, and Mexico were the major importers of U.S. talc. Imports for consumption decreased 29% from those of 1994. Canada, China, and Japan supplied approximately 85% of the imported talc.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[5]	Reserve base[5]
	1994	1995[e]		
United States[1]	935	1,050	136,000	544,000
Brazil	440	440	14,000	54,000
China	2,400	2,400	Large	Large
India	442	450	4,000	9,000
Japan	999	990	132,000	200,000
Korea, South	710	710	14,000	18,000
Other countries	1,950	1,860	Large	Large
World total (may be rounded)	7,880	7,900	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 clay and pyrophyllite in ceramics; calcium carbonate, diatomite, kaolin, and mica in paint; calcium carbonate and kaolin in paper; clays, feldspar, mica, silica, and wollastonite in plastics; and calcium carbonate, kaolin, and silica in rubber.

[e]Estimated. E Net exporter.
[1]Excludes pyrophyllite.
[2]Less than ½ unit.
[3]Defined as imports - exports + adjustments for Government and industry stock changes.
[4]See Appendix B.
[5]See Appendix C for definitions.

TANTALUM

(Data in thousand kilograms of tantalum content, unless noted)

Domestic Production and Use: There has been no significant tantalum-mining industry since 1959, with the exception of small unreported quantities of tantalum-bearing concentrates produced in 1989-92. Most metal, alloys, and compounds were produced by four companies; tantalum units were obtained from imported concentrates and metal, and from foreign and domestic scrap. Tantalum was consumed mostly in the form of metal powder, ingot, fabricated forms, compounds, and alloys. The major end use for tantalum was in the production of electronic components, about 60%, mainly tantalum capacitors. The value of tantalum consumed in 1995 was estimated at about $160 million.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, mine	([1])	([1])	—	—	—
Imports for consumption, concentrate, tin slags, and other[2]	NA	NA	NA	NA	NA
Exports, concentrate, metal, alloys, waste, and scrap[e]	180	150	170	190	200
Consumption: Reported, raw material	NA	NA	NA	NA	NA
Apparent	370	375	410	430	470
Price, tantalite, dollars per pound[3]	30.06	28.19	26.41	26.24	26.90
Stocks, industry, processor, yearend	NA	NA	NA	NA	NA
Employment, processor	NA	NA	NA	NA	NA
Net import reliance[4] as a percent of apparent consumption	86	85	85	80	80

Recycling: Combined prompt industrial and obsolete scrap consumed represented about 20% of apparent consumption.

Import Sources (1991-94): Australia, 26%; Germany, 18% (majority of imports of unknown origin); Canada, 6%; Thailand, 6%; and other, 44%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[5] 12/31/95
Synthetic tantalum-columbium concentrates	2615.90.3000	Free	30% ad val.
Tantalum ores and concentrates	2615.90.6060	Free	Free.
Tantalum oxide	2825.90.9000	3.7% ad val.	25% ad val.
Potassium fluotantalate	2826.90.0000	3.1% ad val.	25% ad val.
Tantalum, unwrought:			
Waste and scrap	8103.10.3000	Free	Free.
Powders	8103.10.6030	3.5% ad val.	25% ad val.
Alloys and metal	8103.10.6090	3.5% ad val.	25% ad val.
Tantalum, wrought	8103.90.0000	5.3% ad val.	45% ad val.

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

Government Stockpile: The uncommitted inventories shown below include a negligible quantity in nonstockpile-grade metal and 456,000 kilograms in nonstockpile-grade minerals. The stockpile also contained 86,000 kilograms in tantalum metal ingots and 74,000 kilograms in both minerals and tantalum oxide with status (inventory) not yet determined.

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Tantalum:				
Carbide powder	13	—	—	—
Metal	159	—	—	—
Minerals	1,130	—	—	—

Prepared by **Larry D. Cunningham, (703) 648-4977.**

TANTALUM

Events, Trends, and Issues: Overall consumption of tantalum continued to improve. U.S. sales of tantalum capacitors for the first one-half-year increased by more than 40% compared with that of the similar period in 1994. For the same period, imports for consumption of tantalum mineral concentrates decreased by about 15%. Industry sources indicated that recycled and secondary materials were getting more attention as a source of tantalum supply. Recycled and secondary tantalum-bearing materials reportedly accounts for an estimated 25% of total western world tantalum supply. The published spot price for tantalite ore, which began the year at a range of $25.50 to $27.00 per pound of contained pentoxide, rose to $26.50 to $27.80 in early July where it remained through mid-October. Industry sources indicated that tantalum mill products sold at an average of about $170 per pound, and that tantalum capacitor-grade powder sold at an average of about $150 per pound.

It is estimated that in 1996 domestic mine production will be zero and U.S. apparent consumption will be less than 500,000 kilograms.

World Mine Production, Reserves, and Reserve Base:

	Mine production[e] [6] 1994	Mine production[e] [6] 1995	Reserves[e] [7]	Reserve base[e] [7]
United States	—	—	—	Negligible
Australia	238	250	4,500	9,100
Brazil	50	50	900	1,400
Canada	28	30	1,800	2,300
Malaysia	—	—	900	1,800
Nigeria	2	2	3,200	4,500
Rwanda	2	2	NA	NA
Thailand	—	—	7,300	9,100
Zaire	1	2	1,800	4,500
Zimbabwe	2	2	NA	NA
Other countries[8]	2	2	1,400	1,800
World total (may be rounded)	325	340	22,000	35,000

World Resources: Most of the world's resources of tantalum occur outside the United States. On a worldwide basis, identified resources of tantalum are considered adequate to meet projected needs. These resources are largely in Australia, Brazil, Canada, Egypt, Malaysia, Nigeria, Thailand, and Zaire. The United States has about 1.4 million kilograms of tantalum resources in identified deposits, most of which were considered uneconomic at 1995 prices.

Substitutes: The following materials can be substituted for tantalum, but usually with less effectiveness: columbium in superalloys and carbides; aluminum and ceramics in electronic capacitors; glass, titanium, zirconium, columbium, and platinum in corrosion-resistant equipment; and tungsten, rhenium, molybdenum, iridium, hafnium, and columbium in high-temperature applications.

[e]Estimated. NA Not available.
[1]A small unreported quantity was produced.
[2]Metal, alloys, synthetic concentrates; exclusive of waste and scrap.
[3]Average value, contained tantalum pentoxides, 60% basis.
[4]Defined as imports - exports + adjustments for Government and industry stock changes.
[5]See Appendix B.
[6]Excludes production of tantalum contained in tin slags.
[7]See Appendix C for definitions.
[8]Excludes any production from Bolivia, China, and countries in the Former Soviet Union.

TELLURIUM

(Data in metric tons of tellurium content, unless noted)

Domestic Production and Use: Tellurium and tellurium dioxide of commercial grades were recovered from anode slimes at one electrolytic copper refinery in the United States. High-purity tellurium, tellurium master alloys, and tellurium compounds were produced by primary and intermediate processors from commercial-grade metal and tellurium dioxide. Tellurium was used mainly in the production of free-machining steels. It was used as a minor additive in copper and lead alloys and malleable cast iron, as an accelerator in rubber compounding, in thermoelectric applications, and as a semiconductor in thermal-imaging and photoelectric applications. Tellurium was added to selenium-base photoreceptor alloys to increase the photo speed. In 1995, the estimated consumption was for iron and steel products, 50%; catalysts and chemicals, 25%; additives to nonferrous alloys, 10%; photoreceptors and thermoelectric devices, 10%; and other uses, 5%.

Salient Statistics—United States:	1991	1992	1993	1994	1995
Production, refinery	W	W	W	W	W
Imports for consumption:					
Unwrought, waste and scrap[1]	29	48	45	27	40
Exports	NA	NA	NA	NA	NA
Consumption, apparent	NA	NA	NA	NA	NA
Price, dollars per pound, 99.7% minimum[2]	32	35	30	26	27
Stocks, producer, refined, yearend	W	W	W	W	W
Employment	NA	NA	NA	NA	NA
Net import reliance[3] as a percent of apparent consumption	NA	NA	NA	NA	NA

Recycling: There was no domestic secondary production of tellurium. However, some tellurium may have been recovered abroad from selenium-base photoreceptor scrap exported for recycling.

Import Sources (1991-94): Belgium, 20%; United Kingdom, 18%; Japan, 17%; Philippines, 16%; and other, 29%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[4] 12/31/95
Metal	2804.50.0000	Free	25.0% ad val.

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

Government Stockpile: None.

Prepared by Robert D. Brown, Jr., (703) 648-4984.

TELLURIUM

Events, Trends, and Issues: Domestic and world tellurium demand increased in 1995, and production also increased, resulting in a moderate increase in stocks. Detailed information on the world tellurium market was not available.

Cadmium-telluride remains among the most promising thin-film photovoltaic (PV) module compounds for power generation, achieving some of the highest power conversion ratios yet obtained. Domestic manufacturers are in a partnership with the National Renewable Energy Laboratories, part of the U.S. Department of Energy, to develop the U.S. PV industry and to enhance its worldwide competitiveness.

World Refinery Production, Reserves, and Reserve Base:

	Refinery production		Reserves[5]	Reserve base[5]
	1994	1995[e]		
United States	W	W	3,000	6,000
Canada	27	30	700	1,500
Japan	48	50	—	—
Peru	19	20	500	1,600
Other countries	NA	NA	16,000	29,000
World total (rounded)	[6]NA	[6]NA	20,000	38,000

World Resources: The reserve base includes only tellurium contained in economic copper deposits. Significant quantities of tellurium are contained in economic gold and lead deposits, but currently none is recovered. Deposits of coal, copper, and other metals that are undeveloped or of subeconomic grade contain several times the amount of tellurium contained in identified economic copper deposits. However, it is unlikely that tellurium contained in these deposits can be recovered economically.

Substitutes: The chief substitutes for tellurium are selenium, bismuth, and lead in metallurgical applications; selenium and sulfur in rubber compound applications; and selenium, germanium, and organic compounds in electronic applications.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Imports of boron and tellurium are grouped together under the Harmonized Code System; however, imports of boron are thought to be small relative to tellurium.
[2]Yearend prices quoted by the sole producer.
[3]Defined as imports - exports + adjustments for Government and industry stock changes.
[4]See Appendix B.
[5]See Appendix C for definitions. Tellurium contained in copper resources only.
[6]In addition to the countries listed, Australia, Germany, Kazakstan, the Philippines, Russia, and the United Kingdom produce refined tellurium, but output is not reported, and available information is inadequate for formulation of reliable production estimates.

THALLIUM

(Data in kilograms of thallium content, unless 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 was not recovered domestically in 1995. The estimated value of thallium consumed in 1995 was $210,000. Research and development in the use of thallium-base superconductor materials accounted for a significant portion of the thallium consumed domestically in 1995. Thallium also was used in electronics, alloys, glass manufacturing, and pharmaceuticals.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Imports for consumption[1]	1,013	838	273	630	700
Exports	NA	NA	NA	NA	NA
Consumption[e]	850	800	300	630	700
Price, metal, dollars per kilogram[2]	190	230	230	285	300
Net import reliance[3] as a percent of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (1991-94): Belgium, 69%; Canada, 27%; and United Kingdom, 4%.

Tariff: Item	Number	Most favored nation (MFN)[4] 12/31/95	Non-MFN[5] 12/31/95
Unwrought waste and scrap	8112.91.6000	5.2% ad val.	25% ad val.

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

Government Stockpile: None.

Prepared by **Gerald R. Smith, (703) 648-4983.**

THALLIUM

Events, Trends, and Issues: Research and development activities of both a basic and applied nature were conducted during 1995 to improve and expand the use of thallium. These experimental activities concerned essentially all existing uses of thallium as well as its potential use in superconductor alloys.

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.

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

	Mine production		Reserves[7]	Reserve base[7]
	1994	1995		
United States	(8)	(8)	32,000	120,000
Other countries	15,000	15,000	350,000	530,000
World total (may be rounded)	15,000	15,000	380,000	650,000

World Resources: World resources of thallium contained in zinc resources are about 17 million kilograms, most of which is in Europe, Canada, and the United States. An additional 630 million kilograms is in the world's coal resources. The average thallium content of the Earth's crust has been estimated at 0.7 parts per million.

Substitutes: While other light-sensitive materials can substitute for thallium and its compounds in specific electronic applications, ample supplies of thallium discourage development of substitute materials.

[e]Estimated. NA Not available.
[1]Unwrought and waste and scrap, including thallium contained in compounds.
[2]Estimated price of 99.99%-pure metal.
[3]Defined as imports - exports + adjustments for Government and industry stock changes.
[4]No tariff for Canada according to North American Free Trade Agreement.
[5]See Appendix B.
[6]Estimates, based on thallium content of zinc ores.
[7]See Appendix C for definitions.
[8]Thallium contained in mined base metal ores, estimated at 450 to 500 kilograms per year, is separated from the base metals but not extracted for commercial use.

THORIUM

(Data in metric tons of thorium oxide (ThO_2) equivalent, unless noted)

Domestic Production and Use: Monazite, a rare-earth and thorium phosphate mineral, was not mined domestically in 1995. In prior years, monazite had been recovered by dredging methods by one mine in Green Cove Springs, FL. Production had been as a byproduct during processing for titanium and zirconium minerals and monazite was recovered for its rare-earth content. Essentially all thorium compounds and alloys consumed by the domestic industry were derived from imports, stocks of previously imported materials, or materials purchased from U.S. Government stockpiles. About 14 companies processed or fabricated various forms of thorium for nonenergy uses, such as ceramics, carbon arc lamps, magnesium-thorium alloys, and welding electrodes. The value of thorium metal, alloys, and compounds used by the domestic industry was estimated to be about $200,000.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, refinery[1]	NA	—	—	—	—
Imports: Thorium ore and concentrates (monazite) gross weight	—	—	—	—	40
Imports: Compounds	43	14	18	3	10
Exports: Thorium ore and concentrates (monazite) gross weight	—	5	—	33	—
Exports: Compounds	3	<1	<1	<1	<1
Shipments from Government stockpile excesses	—	—	—	—	—
Consumption, reported[e]	54	40	13	17	NA
Price, yearend, dollars per kilogram:					
Nitrate, welding-grade[2]	NA	5.46	5.46	5.46	5.46
Nitrate, mantle-grade[3]	19.94	21.36	22.25	23.30	23.30
Oxide, yearend: 99.0% purity[4]	63.80	63.80	65.00	63.80	NA
99.9% purity[4]	NA	NA	NA	NA	88.50
99.99% purity	—	107.00	107.00	107.25	107.25
Stocks, industrial, yearend	NA	NA	NA	NA	NA
Employment, mine	—	—	—	—	—
Net import reliance[5] as a percent of apparent consumption	NA	NA	NA	NA	NA

Recycling: None.

Import Sources (1991-94): Monazite: Australia, 100%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[6] 12/31/95
Thorium ores and concentrates (monazite)	2612.20.0000	Free	Free.
Thorium compounds	2844.30.1000	7.3% ad val.	35% ad val.

Depletion Allowance: Percentage method: Monazite, 22% on thorium content, 14% on rare-earth and yttrium content (Domestic); 14% (Foreign).

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Thorium nitrate	3,219	—	2,969	—
(thorium oxide equivalent)	(1,540)	—	(1,420)	—

Prepared by James B. Hedrick, (703) 648-7725.

THORIUM

Events, Trends, and Issues: Domestic mine production of thorium-bearing minerals ceased in 1995 when the sole producer discontinued recovered. With mine production terminated, the United States is now 100% import dependent for additional supplies. Overall demand for thorium products has continued to decline.

A decision by the one mine producer in Florida to cease production of monazite in 1995 was the result of decreased worldwide demand for radioactive thorium-bearing ores. As a result of several domestic processors switching to thorium-free concentrates, the buildup of any thorium residues has switched from the domestic processor to the foreign ore refiner. Domestic consumption is forecast to continue to decline with annual demand in nonenergy uses expected to remain below 20 tons of equivalent thorium oxide. The use of thorium in United States has decreased significantly since 1990. Costs to monitor and dispose of thorium continued to increase and have resulted in most domestic processors switching 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 thorium's commercial value. It is forecast that thorium's use will continue to decline unless a low-cost disposal process is developed.

World Refinery Production, Reserves, and Reserve Base:

	Refinery production		Reserves[7]	Reserve base[7]
	1994	1995		
United States	—	—	158,000	298,000
Australia	NA	NA	300,000	340,000
Brazil	NA	NA	16,000	18,000
Canada	NA	NA	100,000	100,000
India	NA	NA	292,000	300,000
Malaysia	NA	NA	4,500	4,500
Norway	NA	NA	166,000	183,000
South Africa	NA	NA	35,000	39,000
Other countries	NA	NA	90,000	100,000
World total (rounded)	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 provinces similar to those of reserves. The largest share are 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 for thorium. Yttrium compounds have replaced thorium compounds in incandescent lamp mantles. Although the yttrium substitute is slightly lower in brightness, it is less brittle and nonradioactive. A magnesium alloy containing lanthanides, zirconium, and yttrium can substitute for magnesium-thorium alloys in aerospace applications. Research to develop nonradioactive substitutes continues in the industry.

[e]Estimated. NA Not available.

[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: Rhône-Poulenc Basic Chemical Co., f.o.b. port of entry, duty paid, ThO_2 basis, 1990-91. Rhône-Poulenc Canada Inc., f.o.b. Ontario, Canada, duty unpaid, 1992-93. Rhône-Poulenc Basic Chemicals Co., Shelton, CT, 1994.

[4]Source: Rhône-Poulenc Basic Chemicals Co., f.o.b. port of entry, duty paid.

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

[6]See Appendix B.

[7]See Appendix C for definitions.

TIN

(Data in metric tons of tin content, unless noted)

Domestic Production and Use: In 1995, there was no domestic tin mine production. Production of tin at the only U.S. tin smelter, at Texas City, TX, stopped in 1989. Twenty-five firms consumed about 86% of the primary tin. The major uses were as follows: cans and containers, 32%; electrical, 23%; construction, 9%; transportation, 11%; and other, 25%. The estimated value of primary metal consumption in 1995, based on the New York composite price, was $300 million.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Mine			Negligible		
Secondary (old scrap)	8,800	8,900	6,900	7,400	7,600
Secondary (new scrap)	5,300	4,900	4,200	4,200	4,300
Imports for consumption: Metal	29,100	27,300	33,700	32,400	32,000
Ore	1	—	—	—	—
Exports: Ingots, pigs, and bars[1]	970	1,890	2,600	2,560	2,000
Shipments from Government stockpile excesses	6,195	6,310	6,022	5,620	5,000
Consumption, reported: Primary	35,100	35,000	34,600	32,900	33,000
Secondary	9,670	10,100	11,900	8,490	9,000
Consumption, apparent	48,700	43,600	44,200	43,300	47,000
Price, average, cents per pound:					
New York market	259	283	239	255	290
New York composite	363	402	350	369	420
London	254	277	233	248	280
Kuala Lumpur	248	272	232	245	280
Stocks, consumer and dealer, yearend	13,800	10,700	10,800	10,400	10,000
Employment, mine and primary smelter[e]	5	5	5	—	—
Net import reliance[2] as a percent of apparent consumption	74	80	84	83	84

Recycling: About 12,000 tons of purchased old and new tin scrap, including tin alloys, was recycled in 1995. Of this, about 7,600 tons was old scrap. More than one-sixth of the tin consumed in the United States was recovered from old scrap at detinning plants and 28 secondary nonferrous metal processing plants.

Import Sources (1991-94): Brazil, 28%; Bolivia, 24%; Indonesia, 17%; China, 15%; and other, 16%.

Tariff: Most major imports of tin, including unwrought metal, waste and scrap, and unwrought tin alloys, enter duty free.

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Pig tin	129,668	—	121,729	10,975

Events, Trends, and Issues: The price of tin rose moderately through the year, buoyed by a general rise in base metal prices. There continued to be a world tin oversupply of about 35,000 tons.

World tin mine output in 1995 remained about the same as in recent years, the result of concerted producer efforts to restrict production.

Brazil became a member of the Association of Tin Producing Countries (ATPC). This was considered an important step since Brazil ranked as the world's third largest producer of mined tin. It followed by a year, the inclusion of China, the world's largest tin producer, in the ATPC. With these two large producers as members, the ATPC believed it could better control its efforts to restrict tin supply to lower world tin excess stocks.

Prepared by **James F. Carlin, Jr., (703) 648-4985.**

TIN

It was announced that in 1994 the domestic steel can recycling rate reached 53%. The rate was 48% in 1993, and 15% in 1988. More than 18 billion steel cans, weighing 1.55 million tons, were recycled in 1994. The industry's goal was to reach a 66% recycling rate for steel cans by the end of 1995; 66% is the traditional recycling rate for all steel products including appliances, cars, etc. The industry continued to emphasize the recycling of aerosol steel cans. It pointed to its success in Michigan, where a Statewide environmental campaign, sponsored and supported by a coalition of Government, industry, academic and environmental leaders was encouraging Michigan consumers to recycle empty aerosol cans along with other steel cans. Progress was also reported in trying to motivate a number of iron foundries to use scrap steel cans as part of their raw material charge. During the past few years, a small but growing number of iron foundries have been experimenting with melting used steel cans. Iron foundries are found in most of the 50 States, and they depend on steel scrap for about 50% of their charge material.

A major domestic tinplate producer announced plans to construct a new joint-venture tinplate mill in Belmont County, OH. Completion was anticipated for late 1996, and the cost was estimated at $80 million. It would be the first domestic tinplating facility built since the early 1960's, and would replace that producer's current 50-year-old tin mill.

The world tin industry's major research and development laboratory, based in the United Kingdom, began its first full year under its new structure. It is now privatized, with funding supplied by numerous major tin producing firms rather than by the ATPC. The organization reported progress in several areas of research to develop new tin uses; among these was a tin foil bottle capsule to replace lead foil on wine bottles, and a new noncyanide-based electrolyte called "Stanzec," an alloy of tin and zinc that could replace cadmium as an environmentally acceptable anticorrosion coating on steel.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[3]	Reserve base[3]
	1994	1995[e]		
United States	Negligible	Negligible	20,000	40,000
Australia	6,400	6,000	210,000	600,000
Bolivia	16,200	18,000	450,000	900,000
Brazil	27,000	25,000	1,200,000	2,500,000
China	50,000	50,000	1,600,000	1,600,000
Indonesia	34,000	34,000	750,000	820,000
Malaysia	6,400	6,000	1,200,000	1,200,000
Peru	14,000	15,000	20,000	40,000
Portugal	12,000	13,000	70,000	70,000
Russia	4,100	4,000	300,000	300,000
Thailand	4,000	4,000	940,000	940,000
Zaire	700	1,000	510,000	510,000
Other countries	9,000	4,000	180,000	620,000
World total (may be rounded)	[4]184,000	[4]180,000	7,000,000	10,000,000

World Resources: U.S. resources of tin, primarily in Alaska, were insignificant compared with those of the rest of the world. Sufficient world resources, principally in western Africa, southeastern Asia, Australia, Bolivia, Brazil, China, and Russia were available to sustain current production rates well into the next 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.
[1]Excludes reexports.
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]See Appendix C for definitions.
[4]Excludes U.S. production.

TITANIUM AND TITANIUM DIOXIDE[1]

(Data in metric tons, unless noted)

Domestic Production and Use: Titanium sponge metal was produced by two firms in Nevada and Oregon. Ingot was made by the two sponge producers and by nine other firms in seven States. About 30 companies produced titanium forgings, mill products, and castings. In 1995, an estimated 65% of the titanium metal was used in aerospace applications. The remaining 35% was used in the chemical process industry, power generation, marine, ordnance, medical, and other nonaerospace applications. The value of sponge metal consumed was about $180 million, assuming an average selling price of $4.00 per pound.

In 1995, titanium dioxide (TiO_2) pigment, valued at about $2.6 billion, was produced by 5 companies at 11 plants in 9 States. In 1995, TiO_2 was used in paint, varnishes, and lacquers, 47%; paper, 24%; plastics, 18%; and other, 11%. Other uses of TiO_2 included catalysts, ceramics, coated fabrics and textiles, floor coverings, printing ink, roofing granules and other.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, sponge	13,366	W	W	W	W
Imports for consumption, sponge	612	684	2,163	6,470	8,980
Exports, all metal forms	12,130	8,019	7,894	9,660	10,700
Shipments from Government stockpile excesses	—	—	—	—	—
Consumption of sponge metal, reported	13,594	14,165	15,140	17,200	21,000
Price, sponge, reported sales, dollars per pound, yearend	4.75	3.75	3.75	4.00	4.00
Stocks, sponge, industry yearend[e]	2,852	1,929	2,905	5,570	5,600
Employment, reduction plants[e]	850	350	350	300	300
Net import reliance,[2] sponge only, as a percent of apparent consumption	4	W	W	W	W
Titanium dioxide:					
Production	991,976	1,137,038	1,161,561	1,250,000	1,280,000
Imports for consumption	166,094	169,260	171,939	176,000	194,000
Exports	211,854	270,422	290,191	352,000	381,000
Consumption, apparent	936,000	1,000,000	1,030,000	1,100,000	1,090,000
Price, rutile, list, dollars per pound, yearend	0.99	0.94	0.94	0.93	0.96
Stocks, producer, yearend	72,108	108,173	123,079	106,000	111,000
Employment[e]	4,500	4,500	4,600	4,600	4,600
Net import reliance[2] as a percent of apparent consumption	E	E	E	E	E

Recycling: New scrap metal recycled by the titanium industry was about 20,000 tons in 1995. In addition, estimated use of titanium as scrap and in the form of ferrotitanium made from scrap by the steel industry was 4,700 tons; by the superalloy industry, 610 tons; and in other industries, 760 tons. Old scrap reclaimed was about 200 to 400 tons. Minor amounts of TiO_2 were recycled.

Import Sources (1991-94): Sponge metal: Russia, 67%; Japan, 18%; China, 6%; United Kingdom, 3%; Ukraine 3%; Former Soviet Union, 2%; and other, 1%. Titanium dioxide pigment: Canada, 32%; Germany, 14%; United Kingdom, 12%; France, 12%; and other, 30%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[3] 12/31/95
Waste and scrap metal	8108.10.1000	Free	Free.
Unwrought metal	8108.10.5000	15.0% ad val.	25.0% ad val.
Wrought metal	8108.90.6000	15.0% ad val.	45.0% ad val.
Titanium dioxide pigments	3206.10.0000	6.0% ad val.	30.0% ad val.
Titanium oxides	2823.00.0000	6.0% ad val.	30.0% ad val.

Depletion Allowance: Not applicable.

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TITANIUM AND TITANIUM DIOXIDE

Government Stockpile: In addition to the quantities shown below, the stockpile contained 9,860 tons of nonstockpile-grade sponge metal.

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Titanium sponge metal	23,600	—	—	—

Events, Trends, and Issues: Domestic production of titanium pigments was at a record level in 1995 and demand decreased slightly. A shift in the global supply demand scenario pushed demand closer to the available capacity resulting in moderate price increases. All of the major producers were in the process of expanding capacity.

Restocking of inventories by the aerospace industry and moderate growth in nonaerospace markets caused a significant increase in the reported consumption of titanium sponge in 1995. As in 1994, imports of sponge from Russia constituted a substantial portion of total imports. Ingot production from titanium sponge and scrap also increased significantly.

World Sponge Metal Production and Sponge and Pigment Capacity:

	Sponge production		Capacity 1995	
	1994	1995[e]	Sponge	Pigment
United States	W	W	29,500	1,330,000
Australia	—	—	—	150,000
Belgium	—	—	—	80,000
Canada	—	—	—	74,000
China[e]	2,000	2,000	7,000	40,000
Finland	—	—	—	80,000
France	—	—	—	230,000
Germany	—	—	—	350,000
Italy	—	—	—	80,000
Japan	14,400	16,000	25,800	320,000
Kazakstan[e]	5,000	5,000	35,000	1,000
Russia[e]	12,000	12,000	35,000	20,000
Spain	—	—	—	65,000
Ukraine[e]	—	—	—	120,000
United Kingdom[e]	—	—	—	275,000
Other countries	—	—	—	585,000
World total (may be rounded)	[4]33,000	[4]35,000	130,000	3,800,000

World Resources: Resources of titanium minerals are discussed in the sections on ilmenite and rutile. Most titanium for domestic sponge production was obtained from rutile or rutile substitutes. The sources for pigment production were ilmenite, slag, and rutile.

Substitutes: There are few substitutes for titanium in aircraft and space use without some sacrifice of performance. For industrial uses, high-nickel steel, zirconium, and, to a limited extent, the superalloy metals may be substituted. There is no cost-effective substitute for TiO_2 pigment.

[e]Estimated. E Net exporter. W Withheld to avoid disclosing company proprietary data.
[1]See also Ilmenite and Rutile.
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]See Appendix B.
[4]Excludes U.S. production.

TUNGSTEN

(Data in metric tons of tungsten content, unless noted)

Domestic Production and Use: In 1995, one mine in California produced tungsten concentrate. The mine operated at an annual rate well below capacity. End uses of tungsten included metalworking, mining, and construction machinery and equipment, 77%; electrical and electronic machinery and equipment and transportation, 10%; lamps and lighting, 9%; chemicals, 3%; and other, 1%. The total estimated value of primary tungsten materials consumed in 1995 was $390 million.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, mine shipments	W	W	W	W	W
Imports for consumption, concentrate	7,800	2,500	1,700	3,000	5,500
Exports, concentrate	21	38	63	44	—
Government stockpile shipments, concentrate	—	—	—	—	—
Consumption: Reported, concentrate	[1]5,300	4,300	[2]2,900	[2]3,600	7,000
Apparent, all forms	[3]11,800	7,100	7,100	10,900	15,900
Price, concentrate, dollars per mtu WO_3,[4] average:					
U.S. spot market, Metals Week	61	56	43	45	60
European market	59	58	35	42	83
Stocks, producer and consumer, yearend concentrate	1,800	750	640	800	850
Employment, mine and mill	57	47	33	20	20
Net import reliance[5] as a percent of apparent consumption	91	86	82	81	87

Recycling: During 1995, the quantity of scrap reprocessed into intermediates was about 2,100 tons, representing approximately 13% of apparent consumption of tungsten in all forms.

Import Sources (1991-94): China, 38%; Germany, 9%; Bolivia, 8%; Peru, 6%; and other, 39%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[6] 12/31/95
Ore and concentrate	2611.00.0000	37.5¢/kg W cont.	$1.10/kg W cont.
Ferrotungsten	7202.80.0000	5.6% ad val.	35.0% ad val.
Tungsten powders	8101.10.0000	10.5% ad val.	58.0% ad val.
Ammonium tungstate	2841.80.0010	10.0% ad val.	49.5% ad val.
Tungsten carbide	2849.90.3000	10.5% ad val.	55.5% ad val.

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

Government Stockpile: The inventory shown below includes the following quantities of nonstockpile-grade tungsten (tons): ore and concentrate, 10,060; ferrotungsten, 533; metal powder, 151; and carbide powder, 51.

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Ore and concentrate	34,600	—	—	—
Metal powder	900	—	—	—
Ferrotungsten	900	—	—	—
Carbide powder	900	—	—	—

Events, Trends, and Issues: Apparent consumption of tungsten products increased by about 6% during 1995 compared with that of 1994, as a result of continued growth in the U.S. economy that began in late 1993. Demand for cemented carbide end-use products was particularly strong compared with that of 1994, whereas demand in most other end-use sectors remained at a level near that of the previous year. However, demand for ferrotungsten was substantially lower.

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TUNGSTEN

Availability of tungsten materials from China, the major supplier to the world market, became progressively more limited during 1995. China National Minerals and Metals Import and Export Corp. (Minmetals) confirmed the temporary May 1995 closure of 21 mines it controlled, indicating that China was waiting until the international price of tungsten concentrate reached a predetermined level ($70 per metric ton unit of tungsten) before resuming production. China reportedly resumed production on September 10, 1995, with concentrates still priced below the $70 level. For the first time, China showed imports of concentrates, more than 400 tons in 1994 and more than 700 tons of concentrates in 1995.

Generalized System of Preferences (GSP) trade status was granted to an additional republic in the former U.S.S.R. Romania received GSP status, effective in March 1995, joining Russia, which was granted this status in October 1993, and Kazakstan and Ukraine in March 1994. Under GSP, imports from Romania will be permitted to enter the United States duty free rather than be assessed the duty that presently exists under Most-favored-nation trade status. Tungsten materials affected by the GSP status include concentrates, ferrotungsten, carbide powder blends, and certain forms of waste and scrap. There were no imports of tungsten materials from Romania, Kazakstan, and Ukraine following their receipt of GSP status. However, appreciable quantities of tungsten materials were imported from Russia during 1995, principally in the form of oxides and concentrates.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[7]	Reserve base[7]
	1994	1995[e]		
United States	W	W	140,000	200,000
Australia	—	—	5,000	130,000
Austria	—	—	10,000	15,000
Bolivia	500	400	53,000	100,000
Brazil	250	100	20,000	20,000
Burma	600	100	15,000	34,000
Canada	—	—	260,000	490,000
China	17,000	10,000	960,000	1,300,000
France	—	—	20,000	20,000
Kazakstan	100	4,000	—	38,000
Korea, South	200	—	58,000	77,000
Portugal	200	100	26,000	26,000
Russia	4,000	4,000	250,000	420,000
Tajikistan	100	100	—	23,000
Thailand	100	100	30,000	30,000
Turkmenistan	—	—	—	10,000
Other countries	3,000	1,000	280,000	370,000
World total (may be rounded)	26,000	20,000	2,100,000	3,300,000

World Resources: More than 90% of the world's estimated tungsten resources are outside the United States, with about 45% in China. In addition to China and the United States, countries with significant resource potential are Australia, Austria, Bolivia, Brazil, Burma, Canada, Kazakstan, North and South Korea, Peru, Portugal, Russia, Spain, Tajikistan, Thailand, Turkey, and Turkmenistan.

Substitutes: Cemented tungsten carbide remained a primary cutting-tool insert material because of its versatility in meeting technical requirements in many turning and milling operations. However, ceramics, ceramic-metallic composites, and other materials continued to be developed and utilized as substitutes to meet the changing needs of the world market. Increased quantities of carbide cutting-tool inserts were coated with nitrides, oxides, and carbides to extend the life of the inserts. Tungsten remained the preferred and essentially unsubstitutable material for filaments, electrodes, and contacts in lamp and lighting applications. A new electrodeless, non-tungsten lamp was introduced to the market, however, for commercial and industrial use.

[e]Estimated. W Withheld to avoid disclosing company proprietary data.
[1]Excludes 2 months of withheld data.
[2]Excludes 3 months of withheld data.
[3]Delay in recording material imported at yearend 1990 believed to have caused significant statistical distortion. Consumption estimated to be about 10,100 metric tons for each year.
[4]A metric ton unit (mtu) of tungsten trioxide (WO_3) contains 7.93 kilograms of tungsten.
[5]Defined as imports - exports + adjustments for Government and industry stock changes.
[6]See Appendix B.
[7]See Appendix C for definitions.

VANADIUM

(Data in metric tons of vanadium content, unless noted)

Domestic Production and Use: The U.S. vanadium industry consisted of nine firms, but only eight had active operations. Raw materials included Idaho ferrophosphorus slag, petroleum residues, spent catalysts, utility ash, and vanadium-bearing iron slag. The chief use of vanadium was as an alloying agent for iron and steel. Vanadium was also important in the production of aerospace titanium alloys and as a catalyst for the production of maleic anhydride and sulfuric acid. Major end-use distribution was as follows: transportation, 32%; machinery and tools, 34%; building and heavy construction, 21%; and other, 13%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production:					
Mine, recoverable basis	W	W	W	W	W
Mill, recovered basis[1]	W	W	W	W	W
Petroleum residues, recovered basis	2,250	1,350	2,870	2,740	2,500
Imports for consumption:					
Ores, slag, residues	882	838	1,450	1,900	1,500
Vanadium pentoxide, anhydride	133	206	70	294	150
Oxides and hydroxides, other	110	103	19	3	5
Aluminum-vanadium master alloys (gross weight)	73	50	19	38	50
Ferrovanadium	420	592	1,630	1,910	1,200
Exports:					
Vanadium pentoxide, anhydride	700	26	126	335	450
Oxides and hydroxides, other	1,110	1,110	895	1,050	1,100
Aluminum-vanadium master alloys (gross weight)	141	60	866	1,030	700
Other compounds	816	2,020	989	—	—
Ferrovanadium	94	213	219	374	350
Shipments from Government stockpile	—	—	—	—	—
Consumption: Reported	3,290	4,080	3,970	4,290	4,300
Apparent	W	W	W	W	W
Price, average, dollars per pound V_2O_5	2.85	2.28	1.45	2.95	2.80
Stocks, producer and consumer, yearend	935	1,080	900	1,110	1,000
Employment, mine and mill	490	430	430	400	430
Net import reliance[2] as a percent of apparent consumption	W	W	W	W	W

Recycling: Some tool steel scrap was recycled primarily for its vanadium content. Vanadium was also recycled as a minor component of scrap iron and steel alloys, which were recycled principally for their iron content. An increasing amount of vanadium was also recycled from spent chemical process catalysts.

Import Sources (1991-94):[3] Russia, 34%; South Africa, 29%; Canada, 20%; Mexico 12%; and other, 5%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[4] 12/31/95
Slag	2619.00.9030	Free	Free.
Ash and residues	2620.50.0000	Free	Free.
Vanadium pentoxide anhydride	2825.30.0010	16.0% ad val.	40% ad val.
Vanadium oxides and hydroxides, other	2825.30.0050	16.0% ad val.	40% ad val.
Vanadates	2841.90.1000	11.2% ad val.	40% ad val.
Ferrovanadium	7202.92.0000	4.2% ad val.	25% ad val.
Aluminum-vanadium master alloys	7601.20.9030	Free	10.5% ad val.
Waste and scrap	8112.40.3000	Free	Free.

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

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VANADIUM

Government Stockpile:

	Stockpile Status—9-30-95			
Material	**Uncommitted inventory**	**Committed inventory**	**Authorized for disposal**	**Disposals Jan.-Sept. 95**
Vanadium pentoxide	424	63	237	416

Events, Trends, and Issues: The U.S. International Trade Commission (ITC) determined on June 22, 1995, that ferrovanadium and nitrided vanadium imports from Russia caused injury to U.S. industry, and Russian exporters to the U.S. were subjected to antidumping deposits. The ITC voted 5 to 1 in the affirmative to find injury, concluding the antidumping investigation and putting in place the final antidumping margins set by the U.S. Department of Commerce. Deposit rates equal to those margins have been required since they were published in the Federal Register on May 26, 1995. They are as follows: Galt Alloys, Inc, 3.75%; Gesellschaft für Electrometallurgie mbH and its related companies, Shieldalloy Metallurgical Corp., and Metallurg, Inc., 11.72%; Odermet, Ltd., 10.10%; and Russia-wide, 108%.

Vanadium consumption in the United States for the first 6 months of 1995 increased by about 10% over consumption in the first 6 months of 1994. Consumption in the two largest end use categories, carbon and high-strength low-alloy steels, increased 6% and 13%, respectively, from consumption in the same period of 1994. Consumption in the full alloy sector was up 9% over last year's corresponding period, while consumption in the tool steel sector fell 16%. Consumption in the stainless and heat-resisting end use category, a small consuming sector, was up by about 20% in the first 6 months of the year over the same period in 1994.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[5]	Reserve base[5]
	1994	1995[e]		
United States	W	W	45,000	4,000,000
Australia	—	—	30,000	350,000
Brazil	—	—	—	24,000
China	5,000	5,500	2,000,000	3,000,000
Finland	—	—	—	100,000
Russia	10,000	10,500	5,000,000	7,000,000
South Africa	15,700	16,000	3,000,000	12,000,000
Other countries	3,200	3,500	—	1,000,000
World total (may be rounded)	[6]33,900	[6]35,000	10,000,000	27,000,000

World Resources: World resources of vanadium exceeded 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 are adequate to supply current domestic needs, a substantial part of U.S. demand is currently met by foreign material because of price advantages.

Substitutes: Steels containing various combinations of other alloying elements can be substituted for steels containing vanadium. Among various metals that are to some degree interchangeable with vanadium as alloying elements in steel are columbium, manganese, molybdenum, titanium, and tungsten. 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. W Withheld to avoid disclosing company proprietary data.
[1]Produced from domestic materials.
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]The European Union, Canada, and Austria produced vanadium alloys and chemicals solely from imported raw materials.
[4]See Appendix B.
[5]See Appendix C for definitions.
[6]Excludes U.S. production.

VERMICULITE

(Data in thousand metric tons, unless noted)

Domestic Production and Use: One company, with mining and processing facilities in South Carolina, remained the largest producer of vermiculite concentrate. Three other companies each had an active operation for producing concentrate; two in South Carolina, and one in Virginia. Most of the vermiculite concentrate was shipped to 25 exfoliating plants in 16 States. The end uses for exfoliated vermiculite were estimated to be agriculture, 55%; insulation, 23%; lightweight concrete aggregates, including concrete, plaster, and cement premixes, 16%; and other, 6%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production[1]	180	190	190	180	170
Imports for consumption[e]	38	40	30	30	35
Exports[e]	10	8	7	7	5
Consumption, apparent, concentrate	208	222	213	203	200
Consumption, exfoliated	136	140	140	130	130
Price, average value, concentrate, dollars per ton, f.o.b. mine	W	W	W	W	W
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, mine and mill[e]	230	230	230	230	230
Net import reliance[2] as a percent of apparent consumption	13	14	11	11	15

Recycling: Insignificant.

Import Sources (1991-94):[e] South Africa, 99%; and other, 1%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[3] 12/31/95
Mineral substances not specifically provided for	2530.10.0000	Free	Free.
Exfoliated vermiculite as mixtures and articles of heat-insulating, sound-insulating, or sound-absorbing materials	6806.20.0000	3.9% ad val.	30% ad val.

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

Government Stockpile: None.

Prepared by **Michael J. Potter, (703) 648-7723.**

VERMICULITE

Events, Trends, and Issues: During the past few years, agricultural (horticultural, soil conditioning, etc.) applications have been the largest end use of exfoliated vermiculite. According to a non-Government source, vermiculite is used in building boards of various types. For example, fine-sized, untreated vermiculite concentrates are included in fire-resistant plaster board, and exfoliated vermiculite is used in some lightweight wallboard and in various refractory board products. Ground, thermally exfoliated vermiculite is utilized as filler in friction materials, such as a replacement for asbestos in brake linings.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	1994	1995[e]		
United States[1]	180	170	25,000	100,000
Russia	40	40	NA	NA
South Africa	223	220	20,000	80,000
Other countries[5]	43	60	5,000	20,000
World total[5]	486	490	50,000	200,000

World Resources: Marginal reserves of vermiculite, occurring in Colorado, Nevada, North Carolina, Texas, and Wyoming, are estimated to be 2 to 3 million tons. Resources in other countries may include material that does not exfoliate as well as U.S. and South African vermiculite. Total world resources are estimated to be up to three times the reserve amount.

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, slate, and slag. 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. W Withheld to avoid disclosing company proprietary data.
[1]Concentrate sold and used by producers.
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]See Appendix B.
[4]See Appendix C for definitions.
[5]Excludes countries for which information is not available.

YTTRIUM[1]

(Data in metric tons of yttrium oxide (Y_2O_3) content, unless noted)

Domestic Production and Use: The rare-earth element, yttrium, was mined by one company as a constituent of the mineral bastnasite, but was not recovered as a separate element during processing. Bastnasite, a rare-earth fluocarbonate mineral, was mined as a primary product in California by surface methods. Bastnasite's yttrium content is very small and represents a potential minor source of the element. Yttrium used by the domestic industry was imported primarily as compounds.

Yttrium was used in many applications. Principal uses were in phosphors used in color televisions and computer monitors, trichromatic fluorescent lights, temperature sensors, and X-ray intensifying screens. As a stabilizer in zirconia, yttrium was used in 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 (YIG) were components in microwave radar to control high frequency signals. Yttrium was an important component in yttrium-aluminum garnets (YAG) 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 was also used in heating element alloys, superalloys, and high-temperature superconductors. The approximate distribution in 1995 by end use was as follows: lamp and cathode ray tube phosphors, 68%; structural ceramics and components, 29%; oxygen sensors, laser crystals, and miscellaneous, 3%.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production, mine	W	W	W	W	—
Imports for consumption:					
In monazite	—	—	—	—	—
In xenotime and yttrium concentrate[2]	NA	NA	NA	NA	NA
Exports, in ore and concentrate	NA	NA	NA	NA	NA
Consumption, estimated	NA	NA	NA	344	350
Price, dollars:[3]					
Monazite concentrate, per metric ton	494-532	207-241	204-238	233-272	229-267
Yttrium concentrate, per kilogram, 60% REO	32-33	32-33	NA	NA	NA
Yttrium oxide, per kilogram, 99.0% to 99.99% purity	116	15-116	16-116	20-116	17-110
Yttrium metal, per kilogram, 99.0% to 99.9% purity	550	140-550	135-350	135-350	150-200
Stocks, processor, yearend	NA	NA	NA	NA	NA
Employment[4]	411	372	352	350	280
Net import reliance[e 5]	100	100	100	100	100

Recycling: Small quantities, primarily from laser crystals and synthetic garnets.

Import Sources (1994):[e] Yttrium compounds: China 63%; United Kingdom, 29%; Hong Kong, 5%; Japan, 2%; and France, 1%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[6] 12/31/95
Thorium ores and concentrates (monazite)	2612.20.0000	Free	Free.
Rare-earth metals, scandium and yttrium, whether or not intermixed or interalloyed	2805.30.0000	5.0% ad val.	31.3% ad val.
Yttrium bearing materials and compounds containing by weight >19% but < 85% Y_2O_3	2846.90.4000	Free	25% ad val.
Rare-earth compounds, including yttrium oxide, yttrium nitrate, and other individual compounds	2846.90.8000	3.7% ad val.	25% ad val.

Depletion Allowance: Percentage method: Monazite: 22% on thorium content and 14% on yttrium and rare-earth content (Domestic), 14% (Foreign). Xenotime: 14% (Domestic and Foreign).

Government Stockpile: None.

Prepared by **James B. Hedrick, (703) 648-7725.**

YTTRIUM

Events, Trends, and Issues: Yttrium prices firmed during the year as China restricted the number of exporters. Despite the slightly higher prices, yttrium markets continued to be competitive. The U.S. economy showed strong growth in 1995 while demand for yttrium in most uses increased.

Yttrium was consumed primarily in the form of high-purity compounds, especially the oxide and nitrate. Yttrium-bearing deposits are being evaluated in several countries.

World Mine Production, Reserves, and Reserve Base:

	Mine production[7]		Reserves[8]	Reserve base[8]
	1994	1995[e]		
United States	W	—	120,000	130,000
Australia	60	60	100,000	110,000
Brazil	15	15	400	1,500
Canada	—	—	3,300	4,000
China	500	500	220,000	240,000
India	50	50	36,000	38,000
Malaysia	5	5	13,000	21,000
South Africa	14	14	4,400	5,000
Sri Lanka	2	2	240	260
Thailand	9	10	600	600
Former Soviet Union[9]	75	75	9,000	10,000
Zaire	1	1	570	630
World total (rounded)	[10]730	[10]730	510,000	560,000

World Resources: Large resources of yttrium in monazite and xenotime are available worldwide in ancient and recent placer deposits, weathered clay deposits, 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 relative to expected demand.

Substitutes: Substitutes for yttrium are available for some applications, but generally are much less effective. In most uses, especially in phosphors, electronics, and lasers, yttrium is not subject to substitution by other elements. As a stabilizer in zirconia ceramics, yttria may be substituted with calcia or magnesia.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]See also Rare-Earths and Scandium.
[2]This import category typically includes yttrium concentrates.
[3]Monazite concentrate price derived from Metals Bulletin; yttrium concentrate prices from Industrial Minerals (London); yttrium oxide and metal prices from Elements (a TradeTech publication), Molycorp Inc., and Rhône-Poulenc Basic Chemicals Co.
[4]Total employment at a rare-earth mine in California and at heavy-mineral sands operations in Florida and New Jersey. Employees were not assigned to specific commodities in calculating employment.
[5]Essentially all yttrium consumed domestically was imported or refined from imported ores and concentrates.
[6]See Appendix B.
[7]Includes yttrium contained in rare-earth ores.
[8]See Appendix C for definitions.
[9]As constituted before Dec. 1991.
[10]Excludes U.S. mine production.

ZINC

(Data in thousand metric tons of zinc content, unless noted)

Domestic Production and Use: The value of zinc mined in 1995 was about $700 million. Essentially all came from 25 mines, and 74% of it came from only 5 mines. More than 88% of the total mine output was from Alaska, Missouri, New York, and Tennessee; Alaska alone accounted for about one-half. Three primary and seven secondary smelters refined metal of commercial grade in 1995. About 75% of slab zinc consumption was in Illinois, Indiana, Michigan, New York, Ohio, and Pennsylvania. Of the total slab zinc consumed, about 53% was used in galvanizing, 20% in zinc-base alloys, 13% in brass and bronze, and 14% in other uses. Zinc compounds and dusts were used principally by the agricultural, chemical, paint, and rubber industries. Major coproducts of zinc mining and smelting were cadmium, germanium, lead, silver, and sulfur.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Mine, recoverable	518	523	488	570	600
Primary slab zinc	253	272	240	217	225
Secondary slab zinc[1]	122	128	141	139	140
Zinc from old scrap	119	132	109	116	120
Imports for consumption:					
Ore and concentrate	45	45	33	27	20
Slab zinc, scrap, and compounds	637	740	805	892	910
Exports: Slab zinc, scrap, and compounds	112	120	52	79	55
Ore and concentrate	382	307	311	389	400
Shipments from Government stockpile	—	—	18	39	15
Consumption: Apparent, slab zinc	933	1,040	1,140	1,190	1,230
Apparent, all forms	1,170	1,280	1,350	1,420	1,460
Industrial demand	835	964	1,090	1,180	1,210
Price, average, cents per pound:					
Domestic producers	52.8	58.4	46.2	49.3	53.0
London Metal Exchange, cash	50.7	56.2	43.6	45.3	47.0
Stocks, slab zinc, yearend	79	75	74	71	73
Employment: Mine and mill[e]	2,100	2,300	2,500	2,700	2,700
Smelter primary[e]	1,500	1,500	1,300	1,000	1,000
Net import reliance[2] as a percent of industrial demand	24	30	45	42	41

Recycling: In 1995, an estimated 370,000 tons of zinc in waste and scrap, including 120,000 tons in old scrap, was recovered in the form of slab zinc, brass, zinc-base alloys, dust, oxide, and other chemicals. Another 40,000 tons of zinc in scrap was exported, whereas 45,000 tons was imported.

Import Sources (1991-94): Ore and concentrate: Mexico, 46%; Peru, 32%; Canada, 11%; and other, 11%. Metal: Canada, 63%; Mexico, 11%; Spain, 7%; Peru, 6%; and other, 13%. Combined total: Canada, 61%; Mexico, 13%; Peru, 7%; Spain, 6%; and other, 13%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Canada 12/31/95	Mexico 12/31/95	Non-MFN[3] 12/31/95
Ore and concentrate	2608.00.0030	1.4¢/kg on lead content	0.5¢/kg on lead content	Free Free	3.7¢/kg on zinc content.
Unwrought metal	7901.11.0000	1.5% ad val.	0.4% ad val.	Free	5.0% ad val.
Alloys, casting-grade	7901.12.1000	15.8% ad val.	5.7% ad val.	15.2% ad val.	45.0% ad val.
Alloys	7901.20.0000	15.8% ad val.	5.7% ad val.	Free	45.0% ad val.
Waste and scrap	7902.00.0000	Free	Free	Free	11.0% ad val.
Hard zinc spelter	2620.11.0000	1.2% ad val.	0.4% ad val.	1.2% ad val.	5.0% ad val.
Zinc oxide	2817.00.0000	Free	Free	Free	5.5% ad val.

Prepared by **Zinc Specialist, (703) 648-4982.**

ZINC

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

Government Stockpile:

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Zinc	273	1.9	273	8.2

Events, Trends, and Issues: Domestic mine production increased 5% in 1995, primarily because of increased output at the Red Dog Mine in Alaska, the leading producer in the United States. Exports of zinc ore and concentrates also increased slightly, to 400 tons. The United States is expected to remain the world's largest exporter of zinc concentrates and importer of zinc metal for at least the next decade, because of inadequate refinery production capacity. Available primary annual capacity in 1995 was 326,000 tons.

Domestic zinc consumption continued its upward trend of the last 5 years, led by galvanizing and alloy production. The United States is the largest consumer of zinc and zinc products, but domestic metal production capacity accounts for less than one-third of the supply; Canada and Mexico were the leading sources of zinc to the United States. The North American Free Trade Agreement, which went into effect on January 1, 1995, lowered tariffs on zinc and zinc-containing products from Canada and Mexico.

Only 8.2 tons of zinc was sold from the National Defense Stockpile through September. Sales did not begin until April because of a 6-month suspension of sales imposed by Congress in response to industry concerns. The fiscal year 1996 Annual Materials Plan (AMP) authorizes 45,359 tons for disposal. The FY 1996 AMP also includes a provision that suspends sales if the world price falls more than 5% below the price on the date of enactment.

World Mine Production, Reserves, and Reserve Base:

	Mine production[4] 1994	Mine production[4] 1995[e]	Reserves[5]	Reserve base[5]
United States	598	630	16,000	50,000
Australia	995	1,000	17,000	65,000
Canada	984	1,100	21,000	56,000
China	780	850	5,000	9,000
Mexico	382	380	6,000	8,000
Peru	665	700	7,000	12,000
Other countries	2,400	2,410	72,000	130,000
World total (may be rounded)	6,810	7,070	140,000	330,000

World Resources: Conventional identified zinc resources of the world are about 1.8 billion tons. Zinc-bearing coals, mostly in the central United States, also have a resource potential of millions of tons of zinc that could be recovered during coal beneficiation.

Substitutes: Aluminum, plastics, and magnesium are major competitors as diecasting materials. Aluminum, steel, and plastics substitute for galvanized sheet. 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]Recovered from both new and old scrap.
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]See Appendix B.
[4]Zinc content of concentrate and direct shipping ore.
[5]See Appendix C for definitions.

ZIRCONIUM AND HAFNIUM

(Data in metric tons, unless noted)

Domestic Production and Use: Zircon sand was produced at two mines in Florida. Zirconium and hafnium metal were produced from zircon sand by two domestic producers, one in Oregon and another in Utah. Both metals are present in the ore typically in a Zr to Hf ratio of 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 about 10 other companies as well. Zirconia (ZrO_2) was produced from zircon sand at plants in Alabama, New Hampshire, New York, and Ohio, and the metal producer in Oregon.

Zircon refractories and foundry applications are the largest end uses for zirconium. Other end uses of zirconium include abrasives, chemicals, metal alloys, welding rod coatings, and sandblasting. The largest market for hafnium metal is as an addition in superalloys.

Salient Statistics—United States:	1991	1992	1993	1994	1995[e]
Production: Zircon (ZrO_2 content)[1]	67,000	70,300	W	W	W
Imports:					
Zirconium, ores and concentrates (ZrO_2 content)	23,200	24,300	45,500	53,300	68,200
Zirconium, alloys, waste and scrap (ZrO_2 content)	702	745	798	837	840
Zirconium oxide (ZrO_2 content)	NA	NA	1,950	2,400	3,700
Hafnium, unwrought, waste and scrap	3	2	3	5	5
Exports:					
Zirconium ores and concentrates (ZrO_2 content)	20,400	18,100	23,400	20,800	23,600
Zirconium alloys, waste and scrap (ZrO_2 content)	1,870	2,310	2,020	1,640	2,150
Consumption, zirconium ores and concentrates, apparent, (ZrO_2 content)[2]	72,700	78,000	W	W	W
Prices:					
Zircon, dollars per ton:					
Domestic	340	215	NA	NA	NA
Imported, f.o.b. U.S. east coast	340	255	200	278	330
Zirconium sponge, dollars per pound	9-12	9-12	9-12	9-12	9-12
Hafnium sponge, dollars per kilogram	165-210	165-210	165-210	165-210	165-210
Net import reliance as a percent of apparent consumption[2]					
Zirconium	1	8	12	W	W
Hafnium	NA	NA	NA	NA	NA

Recycling: Zirconium metal was recycled by four companies, one each in California, Michigan, New York, and Texas. The majority of the zirconium recycled came from scrap generated during metal production and fabrication. Zircon foundry mold cores and spent or rejected zirconia refractories are often recycled. Recycling of hafnium metal was insignificant.

Import Sources (1991-94): Zirconium ores and concentrates: Australia, 56%; South Africa, 43%; and other, 1%. Zirconium, wrought, unwrought, waste and scrap: France, 55%; Germany, 13%; Japan, 12%; Canada, 11%; and other, 9%. Hafnium, unwrought, waste and scrap: France, 96%; Germany, 3%; and other, 1%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/95	Non-MFN[3] 12/31/95
Zirconium ores and concentrates	2615.10.0000	Free	Free.
Germanium oxides and ZrO_2	2825.60.0000	3.7 ad val.	25% ad val.
Ferrozirconium	7202.99.1000	4.1% ad val.	25% ad val.
Zirconium, waste and scrap	8109.10.3000	Free	Free.
Zirconium, other unwrought, powders	8109.10.6000	4.2% ad val.	25% ad val.
Zirconium, other wrought, alloys	8109.90.0000	5.5% ad val.	45% ad val.
Unwrought hafnium, waste and scrap	8112.91.2000	Free	25.0% ad val.

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

Government Stockpile: In addition to 14,500 tons of baddeleyite ore held in the National Defense Stockpile, the U.S. Department of Energy (DOE) held over 500 tons of zirconium in various forms. DOE also maintained a supply of approximately 35 tons of hafnium.

Prepared by **Joseph M. Gambogi, (703) 648-7718.**

ZIRCONIUM AND HAFNIUM

Stockpile Status—9-30-95

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 95
Baddeleyite	14,500	—	—	—

Events, Trends, and Issues: Demand for zirconium ores and concentrates outpaced supply, causing prices to increase sharply. Increased demand was driven by consumption in the ceramics industry where zircon is used in ceramic tiles and glazes. Shortages of material were expected in the coming years.

Availability of hafnium continued to exceed supply. Surpluses were stockpiled in the form of hafnium oxide. The demand for nuclear-grade zirconium metal, the production of which necessitates hafnium's removal, produces more hafnium than can be consumed by the metal's uses.

Zirconium and hafnium exhibit nearly identical properties and are not separated for most applications. However, zirconium and hafnium are separated for certain nuclear applications. Because hafnium is a strong absorber of thermal neutrons, zirconium-clad fuel rods in nuclear reactors are hafnium-free to improve reactor efficiency. At the same time, hafnium is used in reactor control rods to regulate the fission process through neutron absorption.

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[e] (thousand metric tons)		Reserves[4] (million metric tons, ZrO_2)	Reserve base[4]	Reserves[4] (thousand metric tons, HfO_2)	Reserve base[4]
	1994	1995				
United States	W	W	1.7	5.3	32	97
Australia	502	500	6.3	27.0	114	484
Brazil	20	20	.4	.4	7	7
China[e]	15	15	.5	1.0	NA	NA
India	18	20	3.4	3.8	42	46
South Africa	245	260	14.3	14.3	259	259
Ukraine[e]	65	65	4.0	6.0	NA	NA
Other countries	21	20	.9	4.1	NA	NA
World total (may be rounded)	[5]890	[5]900	32	62	450	890

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 13-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 power plants. Zirconium can be used interchangeably with hafnium in certain superalloys; in others, only hafnium produces the desired or required grain boundary refinement.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]ZrO_2 content of zircon is typically 65%.
[2]Defined as imports - exports + adjustments for Government and industry stock changes.
[3]See Appendix B.
[4]See Appendix C for definitions.
[5]Excludes the United States.

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 (mt)	= 2,204.6 pounds, avoirdupois or 1,000 kilograms
1 metric ton (mt)	= 1.1023 short ton
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
1 troy pound	= 12 troy ounces

APPENDIX B

Non-Most-Favored-Nation Trade Areas

The countries or areas for which non-most-favored-nation (Non-MFN) rates apply are the following:

Afghanistan	Laos
Cambodia	North Korea
Cuba	Vietnam

Most favored nation (MFN), Non-MFN, and special tariff rates including the U.S. Generalized System of Preferences are given in the "Harmonized Tariff Schedule of the United States" published by the United States International Trade Commission, Washington, DC 20436. It is available in many public libraries or can be purchased from the United States Government Printing Office, Washington, DC 20402.

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 collects information about the quantity and quality of all mineral resources. In 1976, the Survey and the U.S. Bureau of Mines developed a common classification and nomenclature, which was published as U.S. Geological Survey 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 U.S. Geological Survey and the U.S. Bureau of Mines collaborated to revise Bulletin 1450-A. Their work was published in 1980 as U.S. Geological Survey 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 systems, designed generally for all mineral materials, is shown graphically in figures 1 and 2; their components and 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 to 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 subeconomic 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-

[1]Based on U.S. Geological Survey Circular 831, 1980.

base category, but it 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 figure 1. 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*

Cumulative Production	IDENTIFIED RESOURCES			UNDISCOVERED RESOURCES	
	Demonstrated		Inferred	Probability Range	
	Measured	Indicated		Hypothetical (or)	Speculative
ECONOMIC	Reserves		Inferred Reserves		
MARGINALLY ECONOMIC	Marginal Reserves		Inferred Marginal Reserves		
SUBECONOMIC	Demonstrated Subeconomic Resources		Inferred Subeconomic Resources		
Other Occurrences	Includes nonconventional and low-grade materials				

FIGURE 2.--*Reserve Base* and *Inferred Reserve Base* Classification Categories

<table>
<tr><td rowspan="3">Cumulative Production</td><td colspan="3">IDENTIFIED RESOURCES</td><td colspan="2">UNDISCOVERED RESOURCES</td></tr>
<tr><td colspan="2">Demonstrated</td><td rowspan="2">Inferred</td><td colspan="2">Probability Range</td></tr>
<tr><td>Measured</td><td>Indicated</td><td>Hypothetical (or)</td><td>Speculative</td></tr>
<tr><td>ECONOMIC</td><td colspan="2" rowspan="3">Reserve Base</td><td rowspan="3">Inferred Reserve Base</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>MARGINALLY ECONOMIC</td></tr>
<tr><td>SUBECONOMIC</td></tr>
<tr><td>Other Occurrences</td><td colspan="5">Includes nonconventional and low-grade materials</td></tr>
</table>

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