

# 2021 Minerals Yearbook

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## TUNGSTEN [ADVANCE RELEASE]

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# TUNGSTEN

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In 2021, there was no domestic production of tungsten concentrate. Most of the U.S. supply of tungsten raw materials consisted of imports, scrap, and sales from the National Defense Stockpile (NDS). Total U.S. imports of tungsten materials and products increased by 13% compared with total imports in 2020. Based on estimated tungsten content, China continued to be the leading supplier of tungsten in materials and products imported by the United States (tables 11–14).

U.S. estimated consumption of selected tungsten materials in 2021 was 10,600 metric tons (t), 10% more than that in 2020 (tables 1, 5). Cemented carbide parts for cutting and wear-resistant applications was the leading end use for tungsten and accounted for more than 60% of estimated consumption (table 5).

In 2021, world tungsten mine production was 83,800 t of tungsten content, compared with 83,100 t (revised) in 2020 (tables 1, 15). China continued to be the leading producer of tungsten concentrate, representing an estimated 85% of world production. Scrap continued to be an important source of tungsten raw materials globally, although less production and use of tungsten products in 2019 and 2020 than previously resulted in constrained scrap availability in 2021 (International Tungsten Industry Association, 2022, p. 2, 8).

Most data in this chapter have been rounded to no more than three significant digits. Totals and percentages were calculated from unrounded data. Unless otherwise specified, all statistics in this chapter are in metric tons of tungsten content. Most tungsten prices and many tungsten statistics from sources other than the U.S. Geological Survey (USGS) are quoted in units of tungsten trioxide ( $\text{WO}_3$ ). The short ton unit, which is used in the United States, is 1% of a short ton [20 pounds (lb)], and  $\text{WO}_3$  is 79.3% tungsten by weight. A short ton unit of  $\text{WO}_3$ , therefore, equals 20 lb of  $\text{WO}_3$  and contains 7.19 kilograms (kg) (15.86 lb) of tungsten. The metric ton unit, which is used in most other countries, is 1% of a metric ton (10 kg). A metric ton unit of  $\text{WO}_3$ , therefore, equals 10 kg of  $\text{WO}_3$  and contains 7.93 kg (17.48 lb) of tungsten.

## Government Actions and Legislation

**Critical Minerals.**—Critical minerals are defined as nonfuel minerals or mineral materials essential to the economic and national security of the United States, the supply chain of which are vulnerable to disruption, and that serve an essential function in the manufacturing of a product, the absence of which would have significant consequences for the U.S. economy or national security. Tungsten was included in a list of 35 critical minerals published by the U.S. Department of the Interior in coordination with other executive branch agencies in 2018. In 2021, a draft revised list of critical minerals was released for public comment and tungsten ranked number 20 out of 50 commodities listed in terms of supply chain risk from highest to lowest (Trump, 2017;

U.S. Department of the Interior, Office of the Secretary, 2018; U.S. Geological Survey, 2021).

In November 2021, Congress enacted the Infrastructure Investment and Jobs Act, which included multiple provisions supporting critical mineral research and domestic production and processing. The act included support for the USGS Earth Mapping Resources Initiative, which was intended to integrate topographic, geologic, geochemical, and geophysical mapping data with mineral resource data to help identify areas in the United States that may have the potential to contain undiscovered critical mineral resources. The act also included measures to improve the quality and timeliness of the Federal permitting and review processes with respect to critical mineral production on Federal land and a grant program for research to advance critical mineral mining, recycling, and reclamation (U.S. Congress, 2021, p. 530, 533–535, 550–552; U.S. Geological Survey, undated).

**National Defense Stockpile.**—During fiscal year (FY) 2021 (October 1, 2020, through September 30, 2021), the U.S. Department of Defense, Defense Logistics Agency Strategic Materials (DLA Strategic Materials), sold 770 t of tungsten in ores and concentrates and 93 t of tungsten metal powder; 919 t of tungsten in ores and concentrates and 93 t of tungsten metal powder were sold during calendar year 2021. This depleted the stock of tungsten metal powder. The quantity of tungsten ores and concentrates remaining in the stockpile at the end of the calendar year is listed in tables 1 and 2.

The Annual Materials Plan for FY 2021 provided the maximum quantities of tungsten materials available for disposal, as listed in table 2. The maximum quantities of tungsten ores and concentrates and tungsten metal powder available for disposal during FY 2022 (October 1, 2021, through September 30, 2022) remained the same as those in FY 2021. In addition to disposals, the DLA Strategic Materials listed the possible acquisition of 5 t, gross weight, of tungsten-rhenium metal in FY 2021, unchanged from that in FY 2020. No acquisitions of tungsten-rhenium metal were authorized for FY 2022 (Defense Logistics Agency Strategic Materials, 2019, 2020, 2021a, b).

**Conflict Minerals.**—In 2012, the U.S. Securities and Exchange Commission (SEC) implemented section 1502 of the Dodd-Frank Wall Street Reform and Consumer Protection Act, which was related to the use of minerals determined to be financing conflict in the Democratic Republic of the Congo [Congo (Kinshasa)] or an adjoining country. Section 1502 defined “conflict minerals” as cassiterite, columbite-tantalite, gold, wolframite, or their derivatives. Wolframite is one of two principal minerals mined for tungsten. The act required U.S. publicly listed companies for which conflict minerals or their derivatives were necessary to the functionality or manufacture of their products to disclose annually whether

any of those minerals originated in Congo (Kinshasa) or an adjoining country. The act also included a provision for the U.S. Government Accountability Office (GAO) to report annually on the effectiveness of the SEC disclosure rule in promoting peace and security in Congo (Kinshasa) and adjoining countries (U.S. Securities and Exchange Commission, 2012, p. 56274–56275).

In 2022, the GAO published the results of its analysis of a sample of company conflict minerals disclosures submitted for 2021 and the results of a review of the situation in eastern Congo (Kinshasa) from 2014 through 2021. The GAO analysis of 2021 filings estimated that 66% of the companies were able to make preliminary determinations of their conflict minerals' country of origin, 14% more than the 58% in 2020. Of these companies, the sources of their conflict minerals were estimated as follows: 47% could not determine whether their conflict minerals originated in covered countries, 44% reported that their conflict minerals may have originated in covered countries, 8% did not clearly report their determinations, and 4% determined that their conflict minerals were not from covered countries. The ability of reporting companies to identify the country of origin of their conflict minerals continued to be hindered by lack of access to suppliers and complex supply chains involving many suppliers and processing facilities. In addition, some companies reported that their suppliers did not respond to requests for information or provided incomplete or incorrect information. Although reporting companies were not required to identify which conflict minerals they used, more than one-half of the companies identified the specific conflict minerals used in their products and 56% reported using tungsten. Tungsten concentrate production from Congo (Kinshasa) and adjoining countries (Burundi, Rwanda, and Uganda) had been only 1% to 2% of world production in recent years (table 15) (U.S. Government Accountability Office, 2022, p. 35, 37, 39–40, 42–43).

The GAO's review of the situation in Congo (Kinshasa) concluded that "Overall peace and security in the eastern part of the Democratic Republic of the Congo (DRC) has not improved since 2014 because of persistent, interdependent factors that fuel violence by non-state armed groups" and that according to various sources, one of the main factors that contributed to the conflict was natural resource exploitation (U.S. Government Accountability Office, undated).

## Production

Domestic production statistics for tungsten are based on data collected by the USGS by means of two separate voluntary surveys. Statistics that result from these surveys are listed in tables 1 and 3. The annual "Tungsten Ore and Concentrate Survey" covered the production, purchase, disposition, and stocks of tungsten ore and concentrate. There was no domestic production of tungsten concentrate reported in 2021.

The USGS monthly "Tungsten Concentrate and Tungsten Products Survey" canvassed four companies that consumed ammonium paratungstate (APT), tungsten-bearing scrap, and (or) tungsten concentrate to produce tungsten carbide powder, tungsten chemicals, and (or) tungsten metal powder. Where possible, data for nonrespondents to the survey were estimated based on prior survey results or information from other sources.

U.S. processors of tungsten materials are listed in table 4. Data on net production and producer stocks of tungsten materials in 2021 were withheld to avoid disclosing company proprietary data (table 3).

In November, Golden Metal Resources Ltd. (United Kingdom) [a wholly owned subsidiary of Power Metal Resources Plc. (United Kingdom)] exercised an option to acquire a 100% interest in the Pilot Mountain project, approximately 200 kilometers (km) southeast of Reno, NV. The former owner, Thor Mining plc (United Kingdom), completed a scoping study on Pilot Mountain in 2018, which indicated that an open pit mining operation at the project's Desert Scheelite tungsten-copper deposit could have an operational life of 12 years and produce approximately 1,000 metric tons per year (t/yr) of scheelite in concentrate, as well as copper-silver and zinc-silver concentrates (Thor Mining plc, 2018; Power Metal Resources Plc., 2022, p. 68, 78–79).

## Consumption

Tungsten is a whitish-gray metal with the highest melting point and one of the highest densities of all metals. When combined with carbon to make tungsten carbide, it is almost as hard as diamond. These and other properties make tungsten useful in a wide variety of commercial, industrial, and military applications. The leading use was as tungsten carbide in cemented carbides, which are wear-resistant materials used primarily by the construction, defense, metalworking, mining, and petroleum and natural gas drilling industries (International Tungsten Industry Association, 2009, p. 5–6, 8, 44, 124; Roskill Information Services Ltd., 2020, p. 3–5, 55–58).

The main use of tungsten metal powder was to make tungsten carbide powder. Tungsten metal powder also was used to make coils, contacts, disks, electrodes, filaments, pins, reflectors, rods, sheets, structural parts, and wires in electrical, electronic, heating, lighting, medical, and other applications. When combined with other metals or materials, tungsten metal powder was used to make alloys and composites to substitute for lead in ammunition and other products; heavy-metal alloys for kinetic energy penetrators and fragmentation devices, radiation shielding, rigid tools for machining, rotating inertia members, and weights and counterweights; and a variety of other alloys for numerous products used in various industries (International Tungsten Industry Association, 2009, p. 7, 9–10, 67, 95, 105–108, 115; Roskill Information Services Ltd., 2020, p. 5, 56–58).

Ferrotungsten, a master alloy of tungsten and iron, was used mainly to make tool steels. Nickel-base master alloys, including nickel-tungsten alloys and more complex nickel alloys containing aluminum, chromium, molybdenum, tungsten, and (or) other metallic elements, were used to make superalloys. Tungsten chemicals were used to make catalysts, dyes and pigments, heavy liquids for separations based on material density, lubricants, phosphors, self-darkening windowpanes, semiconductors, and to shield X-rays or enhance X-ray opacity in medical and dental applications. Tungsten-containing scrap was used as a substitute for other tungsten materials in a number of end-use applications, including cemented carbides, superalloys and stellites (corrosion- and wear-resistant alloys), and tool steels (Lassner and Schubert, 1999, p. 317–320;

International Tungsten Industry Association, 2009, p. 60–62, 66, 69–70, 107–108, 110–111; 2011; Roskill Information Services Ltd., 2020, p. 3–5, 56–58).

Statistics on consumption of tungsten in end-use applications by U.S. metal consumers were developed from the voluntary “Consolidated Consumers Survey.” For this survey, nearly 50 tungsten consumers were canvassed on a monthly or annual basis. Reported consumption and stocks data in tables 1 and 5 include estimates to account for nonrespondents.

In 2021, U.S. estimated consumption of tungsten materials was 10% more than that in 2020. The increase was mainly the result of an estimated 12% increase in tungsten consumption by the cemented carbide industry, the leading end use for tungsten, with more than 60% of estimated U.S. consumption. In 2021, cemented carbide use was estimated to increase in all industry sectors compared with that in 2020, except for the automotive sector, which in 2021 was estimated to decrease compared with that in 2020.

Weekly reports of the number of operating drilling rigs give an indication of the demand for tungsten carbide in the form of cemented carbide components used to explore for or produce petroleum and natural gas. In 2021, the number of rigs operating each week in the United States steadily increased from 360 rigs on January 8 to 586 rigs on December 31. The average number of weekly operating rigs in 2021 was 10% more than the average number of operating rigs in 2020 (478 rigs in 2021 compared with 433 rigs in 2020) (Baker Hughes Inc., 2023).

U.S. apparent consumption of all tungsten materials, as calculated from net imports, secondary production, and changes in Government and industry stock levels, was withheld in 2021 to avoid disclosing company proprietary data pertaining to scrap consumption.

## Prices

In 2021, the annual average prices reported by Argus Metals International for tungsten ore concentrate, APT, and ferrotungsten each increased, after decreasing in 2019 and 2020 (table 1). In 2021, monthly average tungsten concentrate prices, ex-works China, trended upward from January to August before gradually trending downward through December. The average price for tungsten concentrate, ex-works China, in December 2021 was 30% higher than that in December 2020. Argus’s monthly average prices for tungsten concentrate, in-warehouse Rotterdam, generally trended upward in 2021, and the average price in December 2021 was 49% higher than that in December 2020.

Argus’s monthly average prices for APT, in-warehouse Rotterdam, trended upward during 2021, and the average APT price in December 2021 was 46% higher than that in December 2020. During the first half of 2021, Argus’s monthly average prices for ferrotungsten, free on board North America warehouse, were relatively stable. During the second half of 2021, monthly average ferrotungsten prices generally trended upward. The average ferrotungsten price in December 2021 was 34% higher than that in December 2020.

## Foreign Trade

In 2021, the United States exported APT and other tungstates, ferrotungsten, tungsten carbide powder, tungsten metal powders, tungsten ores and concentrates, tungsten waste and scrap, unwrought tungsten, and wrought tungsten forms (tables 6–10). The tungsten content of U.S. exports was 3,410 t, 16% more than the 2,950 t (revised) exported in 2020.

In 2021, the United States imported APT and other tungstates; ferrotungsten; tungsten carbide powder; tungsten metal powders; tungsten ores and concentrates; tungsten oxides, chlorides, and other tungsten compounds; tungsten waste and scrap; unwrought tungsten; and wrought tungsten forms (tables 11–14). The tungsten content of U.S. imports was 12,000 t, 13% more than the 10,700 t imported in 2020. China remained the leading supplier of imported tungsten to the United States, accounting for 22% of all tungsten imports in 2021 compared with 29% in 2020. The tungsten content of imports from China was 2,640 t in 2021, 14% less than the 3,070 t imported in 2020. The distribution of materials imported from China was as follows: tungsten carbide powder, 27%; APT and wrought tungsten, 21% each; tungsten metal powder, 12%; tungsten oxides, 8%; unwrought tungsten and tungsten waste and scrap, 5% each; and ferrotungsten, ores and concentrates, other tungstates, and other tungsten compounds, each with 1% or less. Other countries and localities that supplied 5% or more of United States tungsten imports were Germany (14%), Vietnam (13%), Canada (8%), Bolivia (7%), Austria (6%), and Taiwan (5%).

The tungsten content of U.S. imports of ores and concentrates was 21% less than that in 2020. In 2021, the leading suppliers of imports of tungsten ores and concentrates were Bolivia, 50%; Portugal, 23%; and Russia, 8% (table 11).

U.S. imports of APT were 4% less than those in 2020. In 2021, most of the APT imports were from China (53%) and Germany (46%) (table 12). U.S. imports of other tungstates, including sodium tungstate but not calcium tungstate, were slightly less than those in 2020. In 2021, the leading suppliers of other tungstate imports were Taiwan (51%), Vietnam (30%), and India (11%) (table 14). U.S. imports of tungsten oxides were nearly three times those in 2020. In 2021, the leading supplier of tungsten oxides imports was Vietnam (75%), followed by China (14%) and Germany (9%) (table 14). Imports of other tungsten materials are presented in tables 13 and 14.

Net import reliance as a percentage of apparent consumption is one measure of the adequacy of current domestic production to meet demand. Net import reliance is defined as imports minus exports plus adjustments for Government and industry stock changes. Releases from stocks, including shipments from the NDS, were counted as part of import reliance, regardless of whether they were imported or produced in the United States. In 2021, U.S. net import reliance as a percentage of apparent consumption for tungsten was more than 50%. The actual value was withheld to avoid disclosing company proprietary data.



## World Review

Estimated world production of tungsten concentrate was 83,800 t. China continued to be the leading producer of tungsten concentrate, accounting for 85% of total world production in 2021. Vietnam was the second-ranked producing country, accounting for 6% of world production, followed by Russia, 3%, and Bolivia and Rwanda, 2% each. In 2021, China's production was estimated to be unchanged from that in 2020 and combined production outside of China increased by 6% (table 15).

Most of the world's tungsten was mined from industrial-scale mechanized mining operations. Artisanal and (or) small-scale mining accounted for all or some of the tungsten mined in Bolivia, Brazil, Burundi, Congo (Kinshasa), Nigeria, Rwanda, Uganda, Vietnam, and possibly Burma, North Korea, and elsewhere (Roskill Information Services Ltd., 2020, p. 23, 135, 180, 187, 195, 202; Sparks, 2020). World tungsten mine production was supplemented by tungsten recovered from scrap, both new scrap generated by industry during the production of products, and old scrap, which was products or parts discarded by consumers after use. The International Tungsten Industry Association (2022, p. 7–8) estimated that in 2021, global supply for the production of tungsten intermediates and first use products was 75% concentrate and 25% scrap.

**Australia.**—Two operations produced tungsten concentrate in 2021—one owned by Tasmania Mines Pty. Ltd. and a second operated by Mt. Carbine Retreatment Management Pty. Ltd. (a joint venture of EQ Resources Ltd. and Cronimet Australia Pty. Ltd.). Tasmania Mines produced a small amount of byproduct scheelite concentrate from its Kara open pit magnetite mine south of Burnie in the State of Tasmania (EQ Resources Ltd., 2021b, p. 81; Geoscience Australia, 2022, p. 6–7, 51).

Mt. Carbine Retreatment Management produced tungsten concentrate from historical mine tailings and from stockpiled low-grade ore at the gravity plant at EQ Resources' Mt. Carbine operations west of Port Douglas in northern Queensland State. In December, EQ Resources completed a bankable feasibility study on expanding production from Mt. Carbine. The study focused on restarting production from the Andy White open pit to extract high-grade ore and supplementing that production with concentrate produced from the low-grade stockpile by Mt. Carbine Retreatment Management. The project would be developed in phases, with phases 1 and 2 producing from the open pit and phase 3 expanding the pit and rehabilitating the underground mine. During phases 1 and 2, annual production of tungsten concentrate with a minimum grade of 50% WO<sub>3</sub> would range between 950 and 8,000 t, gross weight. Separate scheelite and wolframite concentrates would be produced. Cronimet had the sole offtake agreement for EQ Resources' concentrate (EQ Resources Ltd., 2021a, p. 6; 2021b, p. 15, 24, 31, 83; 2021c).

Group 6 Metals Ltd. (formerly King Island Scheelite Ltd.) received the financial commitments and shareholder approval needed to proceed with the Dolphin tungsten project on Tasmania's King Island. The project entailed redeveloping and reestablishing mining at the former King Island Scheelite Mine at Grassy, which Group 6 renamed as the Dolphin Tungsten Mine. The proposed operation would produce approximately 2,200 t/yr of tungsten in concentrate during a 14-year mine life. During the first 8 years, the operation would

produce approximately 2,100 t/yr of tungsten in concentrate from an open pit mine. This would be followed by 6 years of underground mining producing approximately 2,400 t/yr of tungsten in concentrate. In November, Group 6 executed a contract with Gekko Systems Pty. Ltd. for the design, procurement, construction, and commissioning of the project's processing plant and related facilities. Group 6 forecast that the mine and beneficiation plant would be in production by March 2023 and had offtake agreements with Wolfram Bergbau und Hütten AG (WBH, owned by Sandvik AB, Sweden) and Traxis Group (Luxembourg) for about 65% of Dolphin's expected annual production during the first 4 years of operation (King Island Scheelite Ltd., 2021a, p. 4, 7; 2021b; Group 6 Metals Ltd., 2022a, p. 4; 2022b, p. 8–9, 13, 16, 18).

**Austria.**—WBH operated the Mittersill scheelite mine and beneficiation plant in the State of Salzburg. The Mittersill Mine supplied concentrate feed for WBH's Bergla processing plant near St. Martin in the State of Styria, where tungsten oxide, tungsten metal powders, and tungsten carbide powders were produced. The Bergla plant also processed imported tungsten concentrate from large industrial mines and from cooperative and small-scale mines in Africa or South America, secondary raw materials (scrap), and intermediate products such as APT, sodium tungstate, and tungsten oxides. In 2021, the Bergla plant consumed 6,466 t of tungsten in raw materials, of which 14% was concentrate from Mittersill and 86% was imported. During the year, WBH continued to work on a project for a second underground ore screening and crushing plant, which was expected to begin operating in 2023 (Wolfram Bergbau und Hütten AG, 2022, p. 1–2, undated a, b; Bundesministerium Finanzen, 2023, p. 45, 95).

**Bolivia.**—Bolivia was the fourth-ranked global producer of tungsten concentrate, after China, Vietnam, and Russia (table 15). Most of the country's tungsten was produced by small-scale mining operations in La Paz Department in western Bolivia. According to the Bolivian Government, in 2021, 57% of Bolivia's production was from mining cooperatives and 43% of its production was from privately owned mines (Roskill Information Services Ltd., 2020, p. 135).

**Brazil.**—A Brazilian-German partnership of companies, Government departments, and universities participated in a joint research project on the recovery of tungsten from low-grade tailings. The ReWoRK project included participants from Brazil's Equilibrium Engenharia e Meio Ambiente, Mineracao Tomaz Salustino S.A., and Universidade Federal do Rio Grande do Norte and Germany's Federal Institute for Geosciences and Natural Resources and H.C. Starck Tungsten GmbH [a subsidiary of Masan High-Tech Materials Corp. (Vietnam)] (Federal Ministry of Education and Research, 2019, 2022; Masan High-Tech Materials Corp., 2022, p. 74).

**China.**—In 2021, China's production of tungsten concentrate was estimated to be 71,000 t of tungsten content, unchanged from that in 2020 and accounted for 85% of world production (table 15). Three Provinces accounted for more than 85% of China's tungsten concentrate production—Jiangxi (38%), Hunan (35%), and Henan (13%). Despite its position as the world's leading producer of mined tungsten, China imported significant quantities of tungsten concentrate in recent years.

In 2021, China imported approximately 2,980 t of tungsten in concentrate, 90% more than the 1,570 t imported in 2020. The quantity of China's imports of tungsten concentrate in 2021 represented 23% of global production not including China. The leading sources of these imports were Burma (35%), Bolivia (13%), Spain (12%), Vietnam (11%), Rwanda (9%), Russia (6%), and Burundi (3%). Scrap recycling also contributed to China's tungsten raw materials supply, and in 2021, China consumed an estimated 12,000 t of tungsten in scrap (Hanns, 2022, p. 16; International Tungsten Industry Association, 2022, p. 8–10, 15; Zen Innovations AG, undated).

China was the world's leading consumer of tungsten. The International Tungsten Industry Association (2022, p. 12) estimated that China consumed 67% of world tungsten supply in 2021, including recycled material. In 2021, China continued to increase its production of downstream products, and for the first time, China converted more than one-half of its APT production to cemented carbide parts. Three Provinces (Fujian, Hunan, and Jiangxi) accounted for 78% of China's APT production and four Provinces (Fujian, Hunan, Jiangxi, and Sichuan) accounted for 70% of China's cemented carbide production. In 2021, China's exports of tungsten materials, including carbide powder, ferrotungsten, metal powders, oxides, and tungstates, were estimated to have increased by 60% to 65% compared with those in 2020, owing to increased tungsten consumption outside China (Argus Media group, 2022, p. 16, 19; Hanns, 2022, p. 16–18; International Tungsten Industry Association, 2022, p. 15, 18).

The Chinese Government regulated the production of tungsten concentrate by requiring exploration and mining permits; prohibiting foreign investment in tungsten exploration, mining, and mineral processing; setting production quotas; and performing environmental and safety inspections. In late 2018, the Government announced that, effective through 2021, the approval of new tungsten mining licenses would remain suspended except for specific cases, such as for applicants that were state-owned producers or applications for mines in areas of high poverty (Roskill Information Services Ltd., 2020, p. 140–141, 143–146; China Briefing from Dezan Shira and Associates, 2021; CM Group, 2021; Fastmarkets MB, 2021).

According to the China Tungsten Industry Association (Hanns, 2022, p. 13), China's production capacity for tungsten concentrate increased slightly to 177,000 t (65% WO<sub>3</sub>), equivalent to approximately 91,200 t of tungsten content. The increase was attributed to the implementation of resource replacement projects, technical transformation, and capacity expansion in some mines. China's Ministry of Natural Resources increased the total tungsten concentrate production quota for 2021 by 3% to 108,000 t (65% WO<sub>3</sub>), equivalent to approximately 55,700 t of tungsten content. Of the quota, 75% was for operations mining tungsten as the principal product and 25% was in the comprehensive use category, which represented tungsten produced as a coproduct or byproduct, mainly from molybdenum mining. China's concentrate production was typically greater than the quota. For example, the 2021 quota of 108,000 t (65% WO<sub>3</sub>) was equivalent to approximately 55,700 t of tungsten content, but production was estimated to be 71,000 t of tungsten content. Roskill Information Services

Ltd. (2020, p. 143–144) stated that although some miners ignored production quotas in the past, there was evidence that more effort would be made to enforce the quotas in the future (table 15; CM Group, 2021).

The Ministry of Industry and Information Technology maintained standards for the tungsten industry, which included minimum production levels and operational lives for mines; minimum production capacities for APT, ferrotungsten, and recycling plants; and detailed requirements for comprehensive use of resources and energy consumption, environmental protection, equipment, production safety and skills, product quality, and regulatory management. The Government also directed the tungsten industry to centralize tungsten processing in Hunan and Jiangxi Provinces (Roskill Information Services Ltd., 2020, p. 143–144).

China's Ministry of Commerce regulated tungsten exports by issuing export licenses. Approval to export tungsten materials and products in 2020 and 2021 was granted to 16 companies, consisting of 13 producers and 3 trading companies (Argus Media group, 2019; Roskill Information Services Ltd., 2020, p. 140, 144).

The Ganzhou Rare Metal Exchange traded tungsten, rare earths, and other minor metals. In late December, the exchange reportedly was to become part of China Rare Earth Group Co., Ltd., a newly established state-owned enterprise that included three of China's "Big Six" state-owned rare-earth-producing companies and two research companies (Daly, 2020, 2021; Zhou and Brooke, 2022).

**Congo (Kinshasa).**—Tungsten was produced in eastern Congo (Kinshasa) by artisanal miners, often as a byproduct of mining tin and (or) coltan (an ore containing niobium and tantalum). In 2021, 59% of the tungsten concentrate produced was from Sud-Kivu Province, 28% was from Maniema Province, and 13% was from Nord-Kivu Province. As discussed in the "Government Actions and Legislation" section, companies reporting to the United States SEC are subject to the conflict minerals rules in the Dodd-Frank Wall Street Reform and Consumer Protection Act with regard to tungsten exports from Congo (Kinshasa) and adjoining countries. Burundi, Congo (Kinshasa), Rwanda, and Uganda each participated in the International Tin Association Ltd.'s ITA Tin Supply Chain Initiative (iTSCi) to assist companies with due diligence and responsible sourcing of minerals from high-risk areas by establishing traceability in the supply chains for tantalum, tin, and tungsten from the mines to the processors (International Tin Association Ltd., 2022, p. 3, 9; Ministère des Mines, 2022, p. 32).

**Germany.**—H.C. Starck Tungsten's Goslar plant processed tungsten-bearing scrap to produce tungsten carbide powders, tungsten metal powders, and a variety of tungsten chemicals. In 2021, H.C. Starck installed new mixing equipment for processing soft scrap. Soft scrap, such as cutting or grinding sludge, powders, sweepings, and turnings, is inherently variable. By homogenizing the scrap feed, the new equipment was expected to maintain high flexibility and throughput of the materials processed and improve the efficiency and economics of recycling soft scrap (Masan High-Tech Materials Corp., 2022, p. 73, 255).

Saxony Minerals & Exploration AG focused on the planning and approval process for its Pöhla project in the State of Saxony. A feasibility study was completed in 2020 on ore extracted from an exploratory shaft in the Pöhla-Globenstein deposit and processed at its pilot plant in Mittweida to produce tungsten concentrate and fluorite concentrate. The study supported a mining and processing operation to produce tungsten, fluorite, tin, and zinc for a period of at least 30 years (Saxony Minerals & Exploration AG, 2022, attachment 4, p. 1, 3, 5–7, 9–10, 15).

**Kazakhstan.**—Jiaxin International Resources Investment Co., Ltd. [a joint venture held by China Merchants Bank Company Ltd. and Jiangxi Copper Investment Co. Ltd. (Hong Kong)] and China Civil Engineering Group Co., Ltd. signed an agreement on the main mineral processing project for Jiaxin's Baku Tower project, an open pit tungsten mine and beneficiation plant at the Bakuta deposit (also referred to as Boguta or Boguty) in Almaty Province. Construction was scheduled to begin in May and expected to take about 2 years. According to China Tungsten Online Manufacturing & Sales, the mine was forecast to produce about 7,700 t/yr of tungsten in concentrate during a mine life of 29 years (China Tungsten Online Manufacturing & Sales, 2020; SMM Information & Technology Co., Ltd., 2021; Jiangxi Copper Co., Ltd., 2022, p. 13).

**Korea, Republic of.**—Almonty Industries Inc. (Canada) continued work on financing for and development of its Sangdong tungsten project southeast of Seoul in Gangwon Province. Based on a 2020 independent technical assessment of the project, the underground mine and a mineral flotation plant would produce a scheelite concentrate during an initial mine life of 13 years. Average production from the project would be approximately 1,800 t/yr of tungsten in concentrate. According to the company, the fully permitted project was characterized by a potential long-life mine based on inferred resources, a tungsten ore grade more than twice the global average for tungsten deposits, a high rate of tungsten recovery from ore to concentrate, and a low operating cost. Almonty's engineering, procurement, and construction contract with S-Material Handling Co., Ltd. specified a construction period of 18 months and a commissioning period of 6 months (Almonty Industries Inc., 2021, p. 18–19; 2022a, p. 7, 15–16, 57–58; 2022c, p. 37 and appendix F, p. 5–6, 64).

**Portugal.**—The sole producer of tungsten concentrate in Portugal was the Panasqueira Mine and beneficiation plant in Covilha, Castelo Branco District, which was owned by Beralt Tin & Wolfram (Portugal), S.A. (a subsidiary of Almonty). Annual production of tungsten in wolframite concentrate from 2019 to 2021 was less than that in 2018 because Almonty had decided to mine lower grade ore so that it could do work to ensure access to higher grade ore in the future. The decrease in production from 2020 to 2021 was attributed to a slightly lower volume of ore being mined and beneficiated as compared with that in 2020. During 2021, Almonty continued to focus on reducing production costs at Panasqueira. Some of Panasqueira's wolframite concentrate was committed to customers based in Japan under a long-term supply agreement; the remainder was sold to customers in Europe and North America (Almonty Industries Inc., 2022a, p. 20; 2022b, p. 7, 9, 14).

**Russia.**—During the previous decade, Russia's production of tungsten in concentrate had decreased by more than 50%, the amount of concentrate produced from freshly mined ore had decreased, but the amount of concentrate produced from tailings and stockpiled ore had increased. Nearly all of the tungsten produced in Russia was from the following five companies, in descending order of tungsten production: JSC Primorsky GOK's Vostok-2 scheelite tungsten mine in Primorskiy Kray; JSC Zakamensk's Barun-Narynskoe operation, which produced concentrate from tungsten-molybdenum tailings in Buryatiya Republic; CJSC Novoorlovsky GOK's Spokoininskoye wolframite tungsten mine in Zabaysk Kray (the Transbaikal region); LLC Lermontovsky GOK's Lermontovskoye scheelite tungsten mine in Primorskiy Kray; and LLC Pravourmiyskoye's Pravourmiyskoe tin-tungsten mine in Khabarovsk Kray (Ministry of Natural Resources and Environment of the Russian Federation, 2022, p. 288–291).

Russian tungsten concentrate was processed either within Russia or exported. Russia also imported tungsten concentrate. Wolfram Company, JSC's Hydrometallurg plant at Nalchik, Kabardino-Balkariya Republic, consumed Russian concentrate to produce APT and tungsten oxides. JSC Kirovgrad Hard Alloys Plant in Sverdlovsk Province consumed Russian concentrate to produce tungsten oxide and downstream metal powders and sintered products. Two plants consumed imported feed to produce tungsten materials. Wolfram Company's plant in Unecha, Bryansk Province, produced metal powders, tungsten bars, and ferrotungsten. LLC Moliren's plant, in Roshal, Moscow Province, also produced ferrotungsten (Ministry of Natural Resources and Environment of the Russian Federation, 2022, p. 283, 291–292; JSC Kirovgrad Hard Alloys Plant, undated; Wolfram Company, JSC, undated a–c).

In 2021, two tungsten mines were under development. The most advanced was Elbrus Mining Company LLC's project to restart production from the former Tyznyauz underground tungsten-molybdenum mine in Kabardino-Balkariya Republic. Construction of the mine, which was to have the capacity to produce about 4,300 t/yr of tungsten in scheelite-molybdenum concentrate, was scheduled to be completed in 2024. Elbrus was a subsidiary of the State Corporation for the Promotion of the Development, Manufacture, and Export of High Tech Products (Rostec). As part of the Tyznyauz project, Rostec subsidiary Nevgidromet LLC planned to build a hydrometallurgical processing plant with the capacity to produce 4,500 t/yr of tungsten oxide (approximately 3,600 t/yr of tungsten) and 1,000 t/yr of molybdenum oxide at Nevinnomyssk, Stavropol Kray (Ministry of Natural Resources and Environment of the Russian Federation, 2022, p. 288, 293–294).

SevKavNedra LLC was preparing to construct an underground mine at the Kti-Teberda scheelite deposit in the Karachayevo-Cherkessiya Republic. The mine was expected to begin production in 2025 with an average production of 2,600 t/yr of tungsten in concentrate. Development of Primorsky GOK's open pit mine at the Skrytoye scheelite tungsten deposit in Primorskiy Kray was postponed indefinitely. This mine had been expected to begin production in 2024 with the capacity to produce about 2,400 t/yr of tungsten in concentrate (Ministry of



Natural Resources and Environment of the Russian Federation, 2022, p. 288, 293–294, 297; JSC Giprotsvetmet, undated).

**Rwanda.**—Rwanda had numerous tungsten mining operations; most were artisanal, and some were small-scale semi-industrial operations. In many of the operations, tungsten (as wolframite) was the principal commodity being mined; in some, wolframite was mined as a byproduct of tin (as cassiterite) and (or) niobium and tantalum (as coltan). Rwanda is included in the Dodd-Frank legislation discussed in the “Government Actions and Legislation” section and participated in the iTSCi program described in the “Congo (Kinshasa)” section.

**Spain.**—In 2021, commercial production of tungsten concentrate took place at two mines in Spain—the Barruecopardo Mine in Salamanca Province in the Castilla-Leon Autonomous Community and the La Parrilla Mine in Caceres Province in the Extremadura Autonomous Community. W Resources Plc’s La Parrilla Mine produced 221 t of tungsten in concentrate in 2021 compared with 131 t produced in 2020. In 2021, quarterly production steadily increased through September 30 but declined during the quarter ending in December owing to a variety of factors, including limited access to medium- and high-grade ore, supply chain issues regarding replacement parts, and heavy rainfall that constrained ore-crushing operations (W Resources Plc, 2021, p. 3; 2022; Ministerio Para La Transición Ecológica Y El Reto Demográfico, 2023, p. 12, 315).

The Los Santos tungsten mine in Salamanca Province, owned by Daytal Resources Spain, S.L. (a subsidiary of Almonty), remained on care-and-maintenance status throughout the year. Almonty planned to restart production of scheelite concentrate from stockpiled tailings in early 2023, after modifying the beneficiation plant to improve its tungsten recovery rate (Almonty Industries Inc., 2022a, p. 5, 34–40).

**United Kingdom.**—Tungsten West Ltd. completed a bankable feasibility study on restarting production at the Hemerdon Mine, signed offtake agreements with Global Tungsten & Powders Corp. (United States) and WBH for the sale of tungsten concentrate, and was listed on the London Stock Exchange’s Alternative Investment Market. Hemerdon was an open pit tungsten and tin mine and beneficiation plant in Devon County, northeast of Plymouth, which ceased operation in October 2018 when former owner Wolf Minerals Ltd. (Australia) went into voluntary administration. Tungsten West determined that modifications were needed on the beneficiation plant to improve its performance before the operation could restart. The modifications were intended to resolve problems resulting from the friability of the main tungsten mineral present in the ore, which was ferberite, the iron-rich variety of the wolframite mineral group. Tungsten West planned to begin production in late 2022 and, after an 8-month rampup, produce separate concentrates containing 2,780 t/yr of tungsten and 388 t/yr of tin during an 18.5-year mine life (Tungsten West plc, 2021, p. 12, 17, 20–21, 23, 104).

**Vietnam.**—Vietnam was the world’s second-ranked producer of tungsten concentrate, supplying an estimated 6% of world production (table 15). Nui Phao Mining Co. Ltd. (Masan High-Tech) produced tungsten concentrate from the Nui Phao open pit polymetallic mine in the Dai Tu District in Thai Nguyen

Province. In 2021, Nui Phao Mining’s production of tungsten and byproduct bismuth and copper increased from that in 2020. The tungsten concentrate produced at the mine was sent to the nearby Masan Tungsten LLC tungsten chemicals manufacturing plant where it was processed with tungsten raw materials from other sources—concentrate and other tungsten-bearing materials—to produce APT, blue and yellow tungsten oxides, and sodium tungstate. In 2021, Masan Tungsten increased the plant’s feed capacity from about 5,200 t/yr of tungsten content to more than 5,900 t/yr of tungsten content. The increase in capacity provided flexibility in the grade of feed used and was expected to result in improved resource use (Masan High-Tech Materials Corp., 2022, p. 22, 89–91, 248–249, 254).

In 2021, two other companies in Vietnam were capable of processing tungsten concentrate. Asia Tungsten Products Vietnam Ltd. [a wholly owned subsidiary of Asia Tungsten Products Co., Ltd. (Hong Kong), which was a joint venture between Tungsten Metals Group Ltd. (Australia) and a private partner] had the capability to produce ferrotungsten at its plant in the Vinh Bao District near the Port of Haiphong. Tungsten Vietnam Joint Stock Co. had the capability to produce sodium tungstate at its plant in Song Cong, Thai Nguyen Province. The Responsible Minerals Initiative, an organization that provides resources for companies that can be used to address responsible mineral sourcing issues in their supply chains, reported that APT and downstream tungsten materials producer Tejing (Vietnam) Tungsten Co., Ltd. ceased smelting or refining tungsten at its plant in Tay Ninh Province in 2021 (Tungsten Vietnam Joint Stock Co., 2021; Asia Tungsten Products Vietnam Ltd., undated; Responsible Minerals Initiative, undated a, b).

**Zimbabwe.**—RHA Tungsten Pvt. Ltd. [National Indigenisation and Economic Empowerment Fund (NIEEF) and Premier African Minerals Ltd. (British Virgin Islands)] kept its tungsten mine in northwestern Zimbabwe on care-and-maintenance status. During the year, Premier evaluated options for restarting production by either underground or open pit mining. Because Premier held a minority share in RHA, it was not willing to provide additional funding beyond the investments it had already made in the operation, other than continuing to pay care-and-maintenance costs. The company continued to discuss future options with NIEEF to fund the restart (Premier African Minerals Ltd., 2021; 2022, p. 3, 46–47).

## Outlook

World tungsten supply likely will continue to be dominated by China’s production and exports. In addition to maintaining production quotas, China’s Government is expected to continue to manage the production and export of tungsten through various regulations and guidelines.

Roskill Information Services Ltd. (2020, p. 12–13) forecasted that an increasing amount of global tungsten supply will need to come from new mine production to meet demand in the next decade. Scrap will continue to be an increasingly important source of raw material for the tungsten industry worldwide.

Tungsten consumption is strongly influenced by general economic conditions. Future consumption of tungsten in cemented carbides, which is the leading end-use material, will depend on the performance of the following industry sectors:

automotive and aircraft production; construction; electronics manufacturing, where cemented carbide microdrills are used on circuit boards; general manufacturing; large equipment manufacturing; mining; and petroleum and natural gas drilling.

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TABLE 1  
SALIENT TUNGSTEN STATISTICS<sup>1</sup>

(Metric tons, tungsten content, unless otherwise specified)

	2017	2018	2019	2020	2021	
United States:						
Concentrate:						
Production <sup>e, 2</sup>	--	--	--	--	--	
Consumption <sup>e, 2, 3</sup>	W	W	W	W	W	
Exports	531	284	583	480	441	
Imports for consumption	3,920	4,050	2,760	2,020	1,590	
Stocks, December 31:						
Consumer <sup>e, 2, 3</sup>	W	W	W	W	W	
U.S. Government <sup>4</sup>	10,200	8,990	8,330	7,600	6,570	
Price:						
In-warehouse Rotterdam, 65% tungsten trioxide grade, duty unpaid <sup>5</sup>	dollars per dry metric ton unit of tungsten trioxide	NA	261	198	172	225
Ex-works China, minimum 65% tungsten trioxide <sup>6</sup>	dollars per metric ton	NA	NA	12,798	12,216	15,790
Ammonium paratungstate:						
Production <sup>e, 2</sup>	W	W	W	W	W	
Consumption <sup>e, 2, 3</sup>	W	W	W	W	W	
Exports	97	106	34	36	116	
Imports for consumption	2,230	2,200	1,430	1,080	1,040	
Stocks, December 31, producer and consumer <sup>e, 2</sup>	W	W	W	W	W	
Price, in-warehouse Rotterdam, duty unpaid <sup>6</sup>	dollars per metric ton unit of tungsten trioxide	243	311	242	218	288
Ferrotungsten:						
Production <sup>e</sup>	--	--	--	--	--	
Consumption <sup>e, 2</sup>	94	126	111	96	87	
Exports	45	104	43	15 <sup>r</sup>	19	
Imports for consumption	209	143	96	38	26	
Stocks, December 31, consumer <sup>e, 2</sup>	36	35	20	18	19	
Price, free on board North America Warehouse, 75% minimum tungsten, duty paid <sup>6</sup>	dollars per kilogram of tungsten content	33.11	41.76	36.40	34.65	39.72
Primary products:						
Net production <sup>e, 2, 7</sup>	7,760	7,330	7,230	W	W	
Consumption <sup>e, 2, 8</sup>	11,300	11,800	11,800	9,650	10,600	
Stocks, December 31:						
Producer <sup>e, 2, 7</sup>	621	559	554	W	W	
Consumer <sup>e, 2, 8</sup>	551	519	496	495	489	
U.S. Government <sup>4</sup>	125	125	126	93	--	
World, production of concentrate <sup>9</sup>	81,400 <sup>r</sup>	80,700	82,700 <sup>r</sup>	83,100 <sup>r</sup>	83,800	

<sup>e</sup>Estimated. <sup>r</sup>Revised. NA Not available. W Withheld to avoid disclosing company proprietary data. -- Zero.

<sup>1</sup>Table includes data available through November 14, 2022. Data are rounded to no more than three significant digits, except "Price."

<sup>2</sup>Includes reported data and U.S. Geological Survey estimates.

<sup>3</sup>Reported by tungsten processors.

<sup>4</sup>Source: Defense Logistics Agency Strategic Materials.

<sup>5</sup>Concentrates with a range of 50% to 70% tungsten trioxide. Annual averages calculated from monthly average prices reported by Argus Tungsten Analytics.

<sup>6</sup>Annual averages calculated from monthly prices reported by Argus Tungsten Analytics.

<sup>7</sup>Includes tungsten metal powder and tungsten carbide powder produced from metal powder; excludes cast and crystalline tungsten carbide powder and chemicals.

<sup>8</sup>Includes ammonium paratungstate and other tungsten chemicals, ferrotungsten, tungsten metal powder, tungsten carbide powder, and tungsten scrap.

<sup>9</sup>May include estimated data.

TABLE 2  
U.S. GOVERNMENT NATIONAL DEFENSE STOCKPILE TUNGSTEN STATISTICS IN 2021<sup>1</sup>

(Metric tons, tungsten content)

Material	Inventory, yearend <sup>2</sup>		Annual Materials Plan <sup>3,4</sup>	Sales		Inventory decrease <sup>5</sup>	
	Fiscal year <sup>3</sup>	Calendar year		Fiscal year <sup>3</sup>	Calendar year	Fiscal year <sup>3</sup>	Calendar year
Ores and concentrates	6,850	6,570	1,360	770	919	813	1,030
Tungsten metal powder	--	--	125	93	93	107	93
Total	6,850	6,570	1,490	863	1,010	920	1,130

-- Zero.

<sup>1</sup>Table includes data available through October 21, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>The yearend inventories included 5 metric tons, gross weight, of tungsten-rhenium metal.

<sup>3</sup>Twelve-month period ending September 30, 2021.

<sup>4</sup>Potential disposal or sale. The Annual Materials Plan also included the possible acquisition of 5 metric tons, gross weight, of tungsten-rhenium metal.

<sup>5</sup>From previous year. Negative numbers represent an increase in inventory level.

Source: Defense Logistics Agency Strategic Materials.

TABLE 3  
U.S. NET PRODUCTION AND STOCKS OF TUNGSTEN PRODUCTS<sup>1,2</sup>

(Metric tons, tungsten content)

	Tungsten metal powder	Tungsten carbide powder	Total
Net production: <sup>3</sup>			
2020	W	W	W
2021	W	W	W
Stocks, December 31, producer:			
2020	W	W	W
2021	W	W	W

W Withheld to avoid disclosing company proprietary data.

<sup>1</sup>Table includes data available through October 21, 2022.

<sup>2</sup>Based on reported data and U.S. Geological Survey estimates.

<sup>3</sup>Net production equals receipts plus gross production minus quantity used to make other products listed.

TABLE 4  
U.S. PROCESSORS OF TUNGSTEN IN 2021<sup>1,2</sup>

Company	Plant location	Products <sup>3</sup>						
		Intermediate products					Powders	
		Ammonium paratungstate	Ammonium metatungstate	Calcium tungstate	Sodium tungstate	Tungsten oxides	Tungsten metal powders	Tungsten carbide powders
Buffalo Tungsten Inc.	Depew, NY						X	X
Chem-Met Co., The	Clinton, MD			X	X			
Elmet Technologies, Inc.	Lewiston, ME						X	
Global Tungsten & Powders Corp. <sup>4</sup>	Towanda, PA	X	X			X	X	X
Kennametal Inc.	Fallon, NV							X
Do.	Huntsville, AL						X	X
Niagara Refining LLC <sup>5</sup>	Depew, NY	X				X		
Tundra Companies	White Bear Lake, MN						(6)	

Do. Ditto.

<sup>1</sup>Table includes data through October 21, 2022.

<sup>2</sup>Consumers of ammonium paratungstate, tungsten-bearing scrap, tungsten concentrate, and (or) tungsten oxides.

<sup>3</sup>Does not include intermediate products produced solely for internal use. Companies may also have produced downstream products such as alloy powders, cast tungsten carbide powders, matrix powders, ready-to-press grade powders, thermal spray powders, and (or) sintered products, but these are not included.

<sup>4</sup>A division of Plansee Group's Ceratizit Group.

<sup>5</sup>A joint venture of Sumitomo Electric Carbide Inc. and New York Tungsten LLC (a subsidiary of Buffalo Tungsten Inc.).

<sup>6</sup>Any production was estimated to be consumed internally.

TABLE 5  
U.S. ESTIMATED CONSUMPTION AND STOCKS OF TUNGSTEN PRODUCTS<sup>1, 2, 3</sup>

(Metric tons, tungsten content)

	2020	2021
Consumption by end use:		
Steels	82	82
Superalloys	410	425
Other alloys <sup>4</sup>	W	W
Cemented carbides <sup>5</sup>	5,500	6,170
Mill products made from metal powder	W	W
Chemical	88	88
Total	9,650	10,600
Consumption by form:		
Ferrotungsten	96	87
Tungsten metal powder	W	W
Tungsten carbide powder	5,790	6,450
Tungsten scrap <sup>6</sup>	W	W
Other tungsten materials <sup>7</sup>	88	88
Total	9,650	10,600
Stocks, December 31, consumer:		
Ferrotungsten	18	19
Tungsten metal powder	31	W
Tungsten carbide powder	392	392
Tungsten scrap <sup>6</sup>	41	W
Other tungsten materials <sup>7</sup>	13	13
Total	495	489

W Withheld to avoid disclosing company proprietary data; included in "Total."

<sup>1</sup>Table includes data available through October 21, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Does not include materials used in making primary tungsten products.

<sup>3</sup>Includes reported data and U.S. Geological Survey estimates.

<sup>4</sup>Includes welding and hard-facing rods and materials, wear- and corrosion-resistant alloys, and nonferrous alloys.

<sup>5</sup>Includes cast carbide dies or parts, cemented and sintered carbides, and diamond tool matrices.

<sup>6</sup>May include tungsten bars and other solid metal forms.

<sup>7</sup>Includes tungsten chemicals.



TABLE 6  
U.S. EXPORTS OF TUNGSTEN ORES AND CONCENTRATES, BY COUNTRY OR LOCALITY<sup>1,2</sup>

Country or locality	2020			2021		
	Quantity		Value (thousands)	Quantity		Value (thousands)
	Gross weight (metric tons)	Tungsten content <sup>3</sup> (metric tons)		Gross weight (metric tons)	Tungsten content <sup>3</sup> (metric tons)	
Canada	(4)	(4)	\$4	3	2	\$38
China	--	--	--	2	1	21
Estonia	18	9	245	--	--	--
Germany	4	2	17	--	--	--
Hong Kong	105	54	327	--	--	--
Netherlands	77	40	1,290	89	46	309
Russia	52	27	323	40	21	492
Vietnam	674	348	2,030	720	371	1,360
Other	(4) <sup>r</sup>	(4) <sup>r</sup>	15 <sup>r</sup>	2	1	123
Total	931	480	4,250	855	441	2,350

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Table includes data available through October 21, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>U.S. Census Bureau Schedule B number 2611.00.0000.

<sup>3</sup>Estimated from reported gross weight using 51.5% tungsten.

<sup>4</sup>Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 7  
U.S. EXPORTS OF AMMONIUM PARATUNGSTATE, BY COUNTRY OR LOCALITY<sup>1,2</sup>

Country or locality	2020		2021	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
Brazil	(3)	\$3	14	\$125
Germany	--	--	55	486
Mexico	12	111	8	70
South Africa	22	198	--	--
Switzerland	--	--	5	46
United Kingdom	--	--	28	131
Other	2 <sup>r</sup>	21 <sup>r</sup>	6	57
Total	36	333	116	915

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Table includes data available through October 21, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Includes other ammonium tungstates, such as ammonium metatungstate. U.S. Census Bureau Schedule B number 2841.80.0010.

<sup>3</sup>Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 8  
U.S. EXPORTS OF TUNGSTEN METAL POWDERS, BY COUNTRY OR LOCALITY<sup>1,2</sup>

Country or locality	2020			2021		
	Quantity		Value	Quantity		Value
	Gross weight (metric tons)	Tungsten content <sup>3</sup> (metric tons)		Gross weight (metric tons)	Tungsten content <sup>3</sup> (metric tons)	
Brazil	7	6	\$307	9	8	\$453
Canada	113	90	5,220	514	412	18,000
China	2	2	183	4	3	299
Czechia	17	14	859	10	8	466
France	1	1	94	5	4	284
Germany	10	8	536	48	38	1,880
India	8	6	477	5	4	282
Kazakhstan	3	3	121	2	2	90
Korea, Republic of	10	8	1,070	5	4	412
Mexico	21	17	1,100	21	17	1,090
Netherlands	22	18	875	19	15	731
Peru	5	4	301	7	5	416
Russia	1	1	81	4	3	178
South Africa	5	4	536	9	7	958
United Arab Emirates	(4)	(4)	36	9	7	206
United Kingdom	4	4	201	2	1	192
Vietnam	4	3	134	--	--	--
Other	23 <sup>r</sup>	18 <sup>r</sup>	1,240 <sup>r</sup>	15	12	942
Total	256	205	13,400	687	550	26,900

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Table includes data available through October 21, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>May include tungsten alloy powders. U.S. Census Bureau Schedule B number 8101.10.0000.

<sup>3</sup>Estimated from reported gross weight using 80% tungsten.

<sup>4</sup>Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 9  
U.S. EXPORTS OF TUNGSTEN CARBIDE POWDER, BY COUNTRY OR LOCALITY<sup>1,2</sup>

Country or locality	2020		2021	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
Australia	42	\$1,240	33	\$1,010
Austria	39	662	13	222
Belgium	9	409	4	227
Brazil	4	153	5	197
Canada	128	4,860	173	6,330
China	32	887	23	740
Czechia	9	184	6	455
Denmark	4	167	3	140
Germany	52	2,450	49	1,620
Hong Kong	4	304	1	96
Japan	26	2,010	28	2,410
Korea, Republic of	18	675	29	1,070
Malaysia	3	183	1	77
Mexico	7	338	13	534
Netherlands	3	141	(3)	26
Saudi Arabia	1	61	8	415
Spain	3	40	6	25
Taiwan	3	147	4	376
United Kingdom	10	835	2	215
Other	19 <sup>r</sup>	1,560 <sup>r</sup>	21	1,750
Total	415	17,300	422	17,900

<sup>r</sup>Revised.

<sup>1</sup>Table includes data available through October 21, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>U.S. Census Bureau Schedule B number 2849.90.3000.

<sup>3</sup>Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 10  
U.S. EXPORTS OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY OR LOCALITY<sup>1</sup>

Product and country or locality	Schedule B number <sup>2</sup>	2020		2021	
		Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
Ferrotungsten and ferrosilicon tungsten:	7202.80.0000				
Canada		12 <sup>r</sup>	\$84	5	\$18
India		(3)	9	7	198
Netherlands		--	--	7	288
Vietnam		4	9	--	--
Other		-- <sup>r</sup>	-- <sup>r</sup>	(3)	14
Total		15 <sup>r</sup>	101	19	518
Unwrought tungsten: <sup>4, 5, 6</sup>	8101.94.0000				
Canada		12	753	19	1,280
China		2	122	4	334
Taiwan		251	2,690	(3)	20
Other		8	531 <sup>r</sup>	7	700
Total		274	4,100	30	2,340
Waste and scrap: <sup>7</sup>	8101.97.0000				
Austria		17	340	14	475
Belgium		33	280	46	481
Canada		72	799	101	1,230
China		7	71	14	72
Czechia		26	152	--	--
Estonia		4	36	--	--
Finland		94	2,550	13	432
Germany		233	4,060	188	5,100
India		11	90	8	68
Israel		6	80	--	--
Japan		29	385	29	341
Korea, Republic of		12	261	--	--
Malaysia		92	637	295	1,960
Mexico		4	38	1	12
Netherlands		--	--	18	391
Pakistan		146	1,180	129	1,030
Philippines		28	238	10	84
Taiwan		13	242	26	401
United Kingdom		120	1,820	92	1,810
Total		948	13,300	986	13,900
Wrought tungsten: <sup>4, 8</sup>	8101.96.0000, 8101.99.1000, 8101.99.8000				
Australia		15	7,850	1	192
Austria		38	2,240	70	4,290
Brazil		11	851	1	366
Canada		20	2,860	21	2,880
China		19	2,350	37	3,150
Costa Rica		8	2,040	16	3,210
Finland		(3)	21	110	3,070
France		2	272	2	276
Germany		6	920 <sup>r</sup>	7	1,160
India		3	284	3	446
Ireland		2	306	1	322
Israel		20	1,510	36	3,150
Japan		245	17,400	5	737
Korea, Republic of		1	411	3	666
Luxembourg		(3)	19	6	359
Mexico		155	19,300	86	25,000
Philippines		4	548	11	2,480

See footnotes at end of table.



TABLE 10—Continued  
U.S. EXPORTS OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY OR LOCALITY<sup>1</sup>

Product and country or locality	Schedule B number <sup>2</sup>	2020		2021	
		Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
Wrought tungsten: <sup>4,8</sup> —Continued	8101.96.0000, 8101.99.1000, 8101.99.8000				
Singapore		2	\$545	2	\$631
Taiwan		3	382	1	353
United Kingdom		4	876	7	1,250
Other		10 <sup>r</sup>	1,990 <sup>r</sup>	9	1,730
Total		566	63,000	436	55,700
Tungsten compounds: <sup>9</sup>	2841.80.0040				
Canada		5	12	2	6
China		3	37	62	4,520
Malaysia		1	12	9	101
Mexico		(3)	8	1	67
Vietnam		--	--	333	5,950
Other		(3)	63	(3)	78
Total		10	133	407	10,700

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Table includes data available through October 21, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Schedule B is the U.S. Census Bureau classification for products being exported from the United States.

<sup>3</sup>Less than ½ unit.

<sup>4</sup>May include alloys.

<sup>5</sup>Content estimated from reported gross weight using 95% tungsten.

<sup>6</sup>Includes bars and rods produced simply by sintering; excludes powders and waste and scrap.

<sup>7</sup>Content estimated from reported gross weight using 70% tungsten.

<sup>8</sup>Includes bars and rods other than those produced simply by sintering; profiles, plates, sheets, strip, and foil; wire; and other wrought products. Contents estimated from reported gross weights using the following percentages: 95% tungsten for Schedule B numbers 8101.96.0000 and 8101.99.1000, and 80% tungsten for Schedule B number 8101.99.8000.

<sup>9</sup>Includes only other tungstates.

Source: U.S. Census Bureau.

TABLE 11  
U.S. IMPORTS FOR CONSUMPTION OF TUNGSTEN ORES AND CONCENTRATES,  
BY COUNTRY OR LOCALITY<sup>1,2</sup>

Country or locality	2020		2021	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
Australia	6	\$121	43	\$1,190
Bolivia	1,090	21,900	797	17,000
Burundi	--	--	12	241
China	1	46	6	228
Congo (Kinshasa)	59	1,300	--	--
Czechia	3	35	--	--
Estonia	--	--	11	249
Germany	1	26	46	1,170
Netherlands	--	--	6	237
Poland	7	98	--	--
Portugal	539	15,600	368	9,730
Russia	156	3,910	133	3,890
Rwanda	85	1,830	39	828
Spain	47	955	58	1,250
Thailand	--	--	41	986
Uganda	17	376	11	184
Vietnam	--	--	18	461
Other	2 <sup>r</sup>	73 <sup>r</sup>	(3)	17
Total	2,020	46,300	1,590	37,700

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Table includes data available through October 21, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Harmonized Tariff Schedule of the United States codes 2611.00.3000 and 2611.00.6000.

<sup>3</sup>Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 12  
U.S. IMPORTS FOR CONSUMPTION OF AMMONIUM PARATUNGSTATE, BY COUNTRY OR LOCALITY<sup>1,2</sup>

Country or locality	2020		2021	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
China	670	\$19,900	552	\$19,500
Germany	408	9,130	473	9,410
Philippines	--	--	12	226
Total	1,080	29,000	1,040	29,100

-- Zero.

<sup>1</sup>Table includes data available through October 21, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Includes other ammonium tungstates, such as ammonium metatungstate. Harmonized Tariff Schedule of the United States code 2841.80.0010.

Source: U.S. Census Bureau.

TABLE 13  
U.S. IMPORTS FOR CONSUMPTION OF FERROTUNGSTEN AND  
FERROSILICON TUNGSTEN, BY COUNTRY OR LOCALITY<sup>1, 2</sup>

Country or locality	2020		2021	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
Austria	--	--	16	\$503
Korea, Republic of	8	\$282	--	--
Russia	19	527	3	73
Ukraine	11	273	--	--
Vietnam	--	--	8	286
Total	38	1,080	26	862

-- Zero.

<sup>1</sup>Table includes data available through October 21, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Harmonized Tariff Schedule of the United States code 7202.80.0000.

Source: U.S. Census Bureau.

TABLE 14  
U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS,  
BY COUNTRY OR LOCALITY<sup>1</sup>

Product and country or locality	HTS <sup>2</sup> code	2020		2021	
		Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
Tungsten metal powders: <sup>3</sup>	8101.10.0000				
Austria		8	\$367	178	\$5,730
Canada		239	9,940	253	10,900
China		814	23,200	328	12,800
Côte d'Ivoire		--	--	18	468
Finland		6	184	--	--
France		9	493	8	444
Germany		13	784	41	1,590
India		6	193	--	--
Israel		362	12,700	77	3,120
Japan		87	2,930	46	1,920
Korea, Republic of		261	7,620	275	7,610
United Kingdom		3	190	1	53
Vietnam		42	1,050	63	1,770
Other		2	131	2	217
Total		1,850	59,800	1,290	46,600
Tungsten carbide powder:	2849.90.3000				
Argentina		--	--	3	124
Austria		222	7,980	450	17,500
Canada		167	6,520	484	18,100
China		584	23,800	726	31,100
France		5	595	6	620
Germany		4	258	16	626
Israel		134	4,650	159	5,820
Korea, Republic of		4	195	3	170
Luxembourg		(4)	6	13	548
Vietnam		2	59	32	1,210
Other		3	190 <sup>r</sup>	4	167
Total		1,120	44,200	1,900	76,100
Unwrought tungsten: <sup>3,5</sup>	8101.94.0000				
China		130	4,970	122	5,580
Germany		3	286	2	194
Japan		4	286	5	378
Russia		--	--	2	62
Vietnam		24	858	--	--
Other		2 <sup>r</sup>	68 <sup>r</sup>	1	88
Total		163	6,470	132	6,300
Waste and scrap: <sup>6</sup>	2620.99.2000, 8101.97.0000				
Austria		24	582	96	2,370
Belgium		40	916	14	269
Brazil		1	14	37	845
Canada		151	2,180	161	2,520
China		275	8,230	145	4,700
Cyprus		35	637	--	--
Czechia		19	457	69	1,140
Finland		10	197	4	120
France		71	1,070	--	--
Germany		614	11,100	911	18,600
Greece		11	246	--	--
India		14	290	160	4,500
Ireland		25	471	--	--
Israel		1	5	35	888

See footnotes at end of table.



TABLE 14—Continued  
U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS,  
BY COUNTRY OR LOCALITY<sup>1</sup>

Product and country or locality	HTS <sup>2</sup> code	2020		2021	
		Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
Waste and scrap: <sup>6</sup> —Continued	2620.99.2000, 8101.97.0000				
Japan		63	\$1,110	130	\$2,370
Luxembourg		230	3,620	209	3,670
Mexico		247	4,560	465	10,100
Peru		--	--	4	95
Poland		240	5,190	211	5,340
Russia		5	90	--	--
Saudi Arabia		--	--	13	190
Singapore		7	71	10	108
Spain		17	290	16	403
Taiwan		4	90	3	59
Thailand		32	827	--	--
Turkey		--	--	31	872
United Kingdom		79	1,340	73	1,810
Vietnam		20	604	30	929
Other		4 <sup>r</sup>	91 <sup>r</sup>	6	131
Total		2,240	44,300	2,830	62,000
Wrought tungsten: <sup>3,7</sup>	8101.96.0000, 8101.99.1000, 8101.99.8000				
Austria		21	4,060	21	4,210
China		388 <sup>r</sup>	29,400 <sup>r</sup>	545	41,000
Czechia		3	741	3	741
France		9	1,570	6	1,220
Germany		6	1,760	2	791
Hungary		2	1,010	2	1,150
Israel		(4)	165	6	524
Japan		19	6,460 <sup>r</sup>	18	6,880
Madagascar		--	--	10	298
Malaysia		(4)	11	(4)	8
Sweden		1	375	2	741
Taiwan		2	370	3	334
Other		8 <sup>r</sup>	2,750 <sup>r</sup>	7	2,820
Total		460 <sup>r</sup>	48,700 <sup>r</sup>	625	60,700
Tungsten oxides:	2825.90.3000				
Bolivia		--	--	14	297
China		176	4,400	201	6,240
Germany		165	5,000	131	4,000
Korea, Republic of		(4)	2	(4)	9
Vietnam		150	3,110	1,060	32,700
Total		491	12,500	1,400	43,200
Other tungstates:	2841.80.0050				
Australia		(4)	55	(4)	36
China		31	508	13	395
Germany		10	591	20	940
Hong Kong		47	782	--	--
India		24	658	117	3,430
Israel		--	--	10	200
Philippines		54	1,060	40	859
Taiwan		858	17,300	568	15,100
Vietnam		96	1,810	335	7,020
Total		1,120	22,800	1,100	28,000

See footnotes at end of table.

TABLE 14—Continued  
U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS,  
BY COUNTRY OR LOCALITY<sup>1</sup>

Product and country or locality	HTS <sup>2</sup> code	2020		2021	
		Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
Other tungsten compounds and chemical products: <sup>8</sup>	2827.39.4000, 2850.00.1000				
Canada		9	\$200	9	\$173
Colombia		3	51	--	--
Germany		28	522	14	295
Japan		52	906	69	1,220
Other		1	12	1	21
Total		92	1,690	94	1,710

<sup>1</sup>Revised. -- Zero.

<sup>1</sup>Table includes data available through October 21, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Harmonized Tariff Schedule of the United States.

<sup>3</sup>May include alloys.

<sup>4</sup>Less than ½ unit.

<sup>5</sup>Includes bars and rods produced simply by sintering; excludes powders and waste and scrap. Content estimated from reported gross weight using 95% tungsten.

<sup>6</sup>Includes ash and residues, mainly tungsten.

<sup>7</sup>Includes bars and rods other than those produced simply by sintering; foil, plates, profiles, sheets, and strip; wire; and other wrought products. Contents estimated from reported gross weights using the following percentages: 95% tungsten for HTS codes 8101.96.0000 and 8101.99.1000, and 80% tungsten for HTS code 8101.99.8000.

<sup>8</sup>Includes tungsten chlorides, hydrides, and nitrides.

Source: U.S. Census Bureau.

TABLE 15  
TUNGSTEN: WORLD CONCENTRATE PRODUCTION, BY COUNTRY OR LOCALITY<sup>1</sup>

(Metric tons, tungsten content)

Country or locality <sup>2</sup>	2017	2018	2019	2020	2021
Australia <sup>e</sup>	20	20	20	100	130
Austria	975	936	892	896 <sup>r</sup>	900 <sup>e</sup>
Bolivia <sup>3</sup>	994	1,365	1,064	1,347	1,563
Brazil	411	300 <sup>r, e</sup>	306 <sup>r</sup>	262 <sup>r</sup>	300 <sup>e</sup>
Burma <sup>e, 4</sup>	216	138 <sup>r</sup>	68 <sup>r</sup>	73 <sup>r</sup>	60
Burundi <sup>e, 5</sup>	120	92	130	140 <sup>r</sup>	100
China	67,000	65,000	69,000 <sup>e</sup>	71,000 <sup>r, e</sup>	71,000 <sup>e</sup>
Congo (Kinshasa) <sup>e</sup>	120	180	240 <sup>r</sup>	110	100
Korea, North <sup>e, 6</sup>	310	1,410	1,130	410	50
Mongolia <sup>e, 3</sup>	520 <sup>r</sup>	430 <sup>r</sup>	370 <sup>r</sup>	33 <sup>r</sup>	120
Nigeria <sup>e, 7</sup>	2	24	550 <sup>r</sup>	520 <sup>r</sup>	23
Portugal	669	715	518	535 <sup>r</sup>	502
Russia	2,144	2,234	2,433	2,274 <sup>r</sup>	2,300 <sup>e</sup>
Rwanda <sup>e, 3</sup>	720	940 <sup>r</sup>	900	860	1,340
Spain	564	856	414	238 <sup>r</sup>	400 <sup>e</sup>
Thailand <sup>e, 8</sup>	65	69	25 <sup>r</sup>	65 <sup>r</sup>	70
Uganda	62	188	145	11	-- <sup>e</sup>
United Kingdom	1,086	980 <sup>r, e</sup>	--	--	--
Vietnam <sup>9</sup>	5,400	4,800	4,500	4,225 <sup>r</sup>	4,800
Zimbabwe <sup>10</sup>	NA	NA	--	--	-- <sup>e</sup>
Total	81,400 <sup>r</sup>	80,700	82,700 <sup>r</sup>	83,100 <sup>r</sup>	83,800

<sup>e</sup>Estimated. <sup>r</sup>Revised. NA Not available. -- Zero.

<sup>1</sup>Table includes data available through November 14, 2022. All data are reported unless otherwise noted; totals may include estimated data. Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>In addition to the countries and (or) localities listed, Colombia and Uzbekistan may have produced tungsten concentrates, but available information was inadequate to make reliable estimates of output.

<sup>3</sup>Production based on reported exports.

<sup>4</sup>Based on production reported by the Republic of the Union of Myanmar Central Statistical Organization.

<sup>5</sup>Based on gross weight reported by the Burundi Institute of Statistics and Economic Studies.

<sup>6</sup>Production estimated based on imports reported by China.

<sup>7</sup>Production for 2017–19 estimated based on data from the Nigeria Extractive Industry Transparency Initiative; production for 2020–21 estimated based on reported imports from Nigeria.

<sup>8</sup>Based on data from the Department of Primary Industries and Mines.

<sup>9</sup>Source: International Tungsten Industry Association.

<sup>10</sup>Information was inadequate to make reliable estimates of output for 2017–18.