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TUNGSTEN [ADVANCE RELEASE]

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Tungsten

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In 2020, there was no domestic production of tungsten concentrates. 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 decreased by 23% compared with imports in 2019. On the basis of total 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 tungsten materials in 2020 was 9,650 metric tons (t), 18% less than that in 2019 (tables 1, 5). Cemented carbide parts for cutting and wear-resistant applications was the leading end use for tungsten and accounted for nearly 60% of consumption (table 5).

In 2020, world tungsten mine production was 78,400 t of tungsten content, 4% lower than 82,000 t (revised) in 2019 (tables 1, 15). China continued to be the leading producer of tungsten concentrates, representing more than 80% of world production (table 15). Scrap continued to be an important source of tungsten raw materials globally, although reduced production and use of tungsten products in 2020 resulted in constrained scrap availability (International Tungsten Industry Association, 2021, p. 6–7).

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 (WO_3). The short ton unit, which is used in the United States, is 1% of a short ton [20 pounds (lb)], and WO_3 is 79.3% tungsten by weight. A short ton unit of WO_3, therefore, equals 20 lb of 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 WO_3, therefore, equals 10 kg of 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. In 2018, 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 (Trump, 2017; U.S. Department of the Interior, Office of the Secretary, 2018).

National Defense Stockpile.—During fiscal year 2020 (October 1, 2019, through September 30, 2020), the U.S. Department of Defense, Defense Logistics Agency Strategic Materials (DLA Strategic Materials), sold 747 t of tungsten in ores and concentrates and 33 t of tungsten metal powder; 615 t of tungsten in ores and concentrates and 33 t of tungsten metal powder were sold during calendar year 2020. The quantities of tungsten materials remaining in the stockpile at the end of the calendar year are listed in tables 1 and 2.

The Annual Materials Plan for fiscal year 2020 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 fiscal year 2021 (October 1, 2020, through September 30, 2021) remained the same as those in fiscal year 2020. In addition to disposals, DLA Strategic Materials listed the possible acquisition of 5 t, gross weight, of tungsten-rhenium metal in fiscal year 2021, unchanged from that in fiscal years 2020 and 2019 (Defense Logistics Agency Strategic Materials, 2018, 2019, 2020a, 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 (U.S. Securities and Exchange Commission, 2012, p. 56274–56275).

In 2021, the U.S. Government Accountability Office (GAO) published an overview of the conflict minerals disclosures submitted for 2020. A GAO analysis of a sample of 2020 filings estimated that 58% of the companies were able to make preliminary determinations of their conflict minerals' country of origin and that this percentage was similar to what GAO estimated for filings submitted for 2015 through 2019. 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. In 2020, 78% of the companies conducted due diligence to further investigate the source and chain of custody of the conflict minerals in their products, a similar percentage to what GAO found in 2018 and 2019. Of these companies, 44% could not determine whether their conflict minerals originated in covered countries, 38% reported that their conflict minerals may have originated in covered countries, and 18% did not clearly report

their determinations. Although reporting companies were not required to identify which conflict minerals they used, most companies did identify the specific conflict minerals used in their products and 57% 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, 2021, p. 3, 7, 11–13, 15, 18–19).

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 ores and concentrates. There was no domestic production of tungsten concentrates reported in 2020.

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. Net production and producer stocks of tungsten materials in 2020 were withheld to avoid disclosing company proprietary data (table 3).

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 for 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. U.S. estimated consumption of tungsten materials in 2020 was 18% less than that in 2019, largely the result of economic disruptions owing to the global coronavirus disease 2019 (COVID-19) pandemic. Nearly 60% of U.S. tungsten consumption was used to produce cemented carbide parts.

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 2020, the number of rigs operating each week in the United States was stable from January through late March, then decreased steeply from late March through late May, before leveling out and then gradually trending upward from mid-October through yearend. The average number of weekly operating rigs in 2020 was 54% less than the average number of operating rigs in 2019 (433 rigs in 2020 compared with 943 rigs in 2019) (Baker Hughes Inc., 2021).

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 2020 to avoid disclosing company proprietary data pertaining to scrap consumption.

Prices

Except for the annual average U.S. price for tungsten ore concentrate, which remained unchanged from that in 2019, annual average U.S. prices for tungsten materials decreased for the second consecutive year. The weekly U.S. spot price for tungsten ore concentrate reported by S&P Global Platts Metals Week remained at $240 to $250 per short ton unit ($265 to $276 per metric ton unit) throughout the year, which was an annual average of $270 per metric ton unit (table 1).

During the year, the weekly U.S. APT price reported by Platts decreased from a high of $250 to $260 per short ton unit ($276 to $287 per metric ton unit) to a low of $210 to $230 per short ton unit ($231 to $254 per metric ton unit). Monthly

average APT prices reported by Fastmarkets MB generally trended downward from a high of $243 per metric ton unit in February and March to a low of $209 per metric ton unit in July and August, before trending upward to $228 per metric ton unit in December. The annual average of Platts' U.S. APT prices was 18% lower than that in 2019 and the annual average of Fastmarkets MB's APT prices was 9% lower than that in 2019 (table 1).

The U.S. free market ferrotungsten price reported by Platts fluctuated between a low of $22 to $23 per kilogram of tungsten content to a high of $27 to $30 per kilogram of tungsten content. The annual average price was $23.53 per kilogram of tungsten content, 27% lower than that in 2019 (table 1).

Foreign Trade

In 2020, 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 2,940 t, 13% less than the 3,370 t exported in 2019.

In 2020, 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 10,700 t, 23% less than the 13,900 t imported in 2019 (tables 11–14). China remained the leading supplier of imported tungsten to the United States, accounting for 29% of all tungsten imports in 2020. The tungsten content of imports from China was 3,070 t in 2020, 29% less than the 4,320 t imported in 2019. The distribution of materials imported from China was as follows: tungsten metal powder, 27%; APT, 22%; tungsten carbide powder, 19%; wrought tungsten, 13%; tungsten waste and scrap, 9%; tungsten oxides, 6%; unwrought tungsten, 4%; and ferrotungsten, ores and concentrates, other tungstates, and other tungsten compounds, each with less than 0.5%. Other countries that supplied 5% or more of United States tungsten imports were Germany (12%), Bolivia (10%), Taiwan (8%), and Canada and Portugal (5% each).

The tungsten content of U.S. imports of ores and concentrates was 27% less than that in 2019. In 2020, the leading suppliers of imports of tungsten ores and concentrates were Bolivia, 54%; Portugal, 27%; and Russia, 8% (table 11).

U.S. imports of APT were 24% less than those in 2019 (table 12). In 2020, all the APT imports were from China (62%) and Germany (38%). 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 2020, 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 concentrates was 4% lower than that in 2019 (revised). China continued to be the leading producer of tungsten concentrates, accounting for 84% of total world production in 2020. Vietnam was the second-ranked producing country, accounting for 6% of world production, followed by Russia, 3%. In 2020, China's production decreased by 4% compared with that in 2019, and combined production outside of China decreased by 5% (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 included products or parts discarded by consumers after use. The International Tungsten Industry Association (2021, p. 6–7) estimated that in 2020, global supply for the production of tungsten intermediates and first use products was 78% concentrates and 22% scrap.

Australia.—Two operations produced tungsten concentrates in 2020—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. (formerly named Specialty Metals International 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. In 2020, EQ Resources and Cronimet Australia Pty. Ltd. completed the installation and commissioning of an X-ray-transmission ore-sorting pilot plant at the Mt. Carbine operations west of Port Douglas in northern Queensland State. By yearend, approximately 1,100 t, gross weight, of tungsten concentrate had been produced from historical mine tailings and shipped to tungsten processors in Austria, the United States, and Vietnam (EQ Resources Ltd., 2021, p. 2–4).

King Island Scheelite Ltd. (KIS) released an updated mineral reserve estimate and revised feasibility study for its Dolphin tungsten project on Tasmania's King Island. KIS planned to reestablish mining at the former King Island Scheelite Mine. Based on the increased reserves and a simplified process flowsheet, the proposed operation would produce approximately 25,900 t of tungsten in gravity concentrates during a 14-year mine life, with a maximum annual production of nearly 3,300 t of tungsten in concentrate in year 7. Mining would be from an open pit during the first 8 years, followed by underground mining for a further 6 years. KIS had offtake agreements with Wolfram Bergbau und Hütten AG (WBH, owned by Sandvik AB, Sweden) and Kalon Resources Ltd. (owned by Noble Group Holdings Ltd., Hong Kong) for about 70% of its annual production. KIS forecast that the mine and beneficiation plant could be in production within 1.5 years from the date of finalizing financing (King Island Scheelite Ltd., 2020, p. 1–2, 4, app. p. 5–6, 39; 2021, p. 2, 10–12).

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 metal powders and tungsten carbide powders were produced. The Bergla plant also processed imported tungsten concentrates, secondary raw materials (scrap), and intermediate products such as APT, sodium tungstate, and tungsten oxides (Wolfram Bergbau und Hütten AG, 2021, p. 1–2).

Bolivia.—Bolivia was the fourth-ranked global producer of tungsten concentrates, 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 (Roskill Information Services Ltd., 2020, p. 135).

Canada.—In June, Masan High-Tech Materials Corp. (formerly Masan Resources Corp.) (Vietnam) completed the acquisition of the global tungsten business of H.C. Starck GmbH (Germany). The acquisition included H.C. Starck Canada Inc.'s plant in Sarnia, Ontario Province, which converted tungsten oxide from Masan High-Tech to tungsten metal, tungsten carbide, and cast tungsten carbide powders (Masan High-Tech Materials Corp., 2021, p. 78, 176, 275).

Northcliff Resources Ltd. continued to collect information to finalize applications for critical leases and permits to support a production decision on its Sisson tungsten-molybdenum project in east-central New Brunswick Province. In December, at the request of the company, the New Brunswick Department of Environment and Climate Change extended the project's construction commencement deadline by 2 years to December 3, 2022. The 2013 feasibility study on the project proposed an open pit mine, a beneficiation plant to produce tungsten and molybdenum concentrates, and an onsite processing plant to convert the scheelite concentrate to APT. Construction was expected to take 2 years after project financing, offtake agreements, and construction permits were finalized. APT production was expected to average approximately 4,400 metric tons per year (t/yr) of tungsten content during the 27-year mine life (Northcliff Resources Ltd., 2021a, p. 6–8; 2021b, p. 5).

China.—In 2020, China's production of tungsten concentrates decreased by 4% to an estimated 66,000 t of tungsten content, accounting for 84% of world production (table 15). The decrease was attributed to reduced production from Jiangxi Province, the country's leading tungsten mining area, owing to lockdowns to prevent the spread of the COVID-19 pandemic, a decrease in ore grades, and heavy rainfall. Despite its position as the world's leading producer of mined tungsten, China imported significant quantities of tungsten concentrates in recent years. In 2020, China imported approximately 1,640 t of tungsten content in concentrates, 12% more than the 1,460 t imported in 2019. The quantity of China's imports of tungsten concentrates in 2020 represented 13% of global production outside China. The leading sources of these imports were Vietnam (34%), North Korea (25%), Burma (13%), Rwanda (8%), and Spain (6%). Scrap recycling also contributed to China's tungsten raw materials supply (Roskill Information Services Ltd., 2020, p. 141–142; Argus Media group, 2021, p. 12; International Tungsten Industry Association, 2021, p. 8–9; United Nations Statistics Division, undated).

China was the world's leading consumer of tungsten. The International Tungsten Industry Association (2021, p. 11) estimated that China consumed 72% of world tungsten supply in 2020, including recycled material. In 2020, China's exports of tungsten materials, including carbide powder, ferrotungsten, metal powders, oxides, and tungstates, were estimated to have decreased by 34% to 36% compared with those in 2019, owing to reduced tungsten consumption outside China (Argus Media group, 2021, p. 24; International Tungsten Industry Association, 2021, p. 4).

The Chinese Government regulated the production of tungsten concentrates 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 (Fu, 2019; GoodWill Business Management Agency, 2020; Roskill Information Services Ltd., 2020, p. 140–141, 143–146).

China's Ministry of Natural Resources set the total tungsten concentrate production quota for 2020 at the same level as that for 2019—105,000 t (65% WO_3), equivalent to approximately 54,100 t of tungsten content. Of the quota, 74% was for operations mining tungsten as the principal product and 26% 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 2020 quota of 105,000 t (65% WO_3) was equivalent to approximately 54,100 t of tungsten content, but production was estimated to be 66,000 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 (Beijing Seetao Culture Media Co., Ltd., 2020).

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. In late 2018, the Government released guidance for centralizing the tungsten-processing industry in Hunan and Jiangxi Provinces (Roskill Information Services Ltd., 2020, p. 143–144).

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

Masan High-Tech's acquisition of H.C. Starck's tungsten business included H.C. Starck's shares in two Chinese joint ventures. Jiangwu H.C. Starck Tungsten Products Co., Ltd. produced APT and tungsten oxides, and H.C. Starck Jiangwu Tungsten Specialities (Ganzhou) Co. Ltd. produced tungsten

metal and tungsten carbide powders (Masan High-Tech Materials Corp., 2021, p. 267, 273–274).

At yearend 2019, the city of Ganzhou in Jiangxi Province, China, launched the Ganzhou Rare Metal Exchange for trading tungsten, rare earths, and other minor metals (Thomson Reuters, 2020).

Congo (Kinshasa).—Tungsten was produced in Congo (Kinshasa) by artisanal miners, often as a byproduct of mining tin and (or) coltan (an ore containing niobium and tantalum). In 2020, 52% of the tungsten concentrate produced by artisanal miners in Congo (Kinshasa) was from Sud-Kivu Province and 48% was from Maniema 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., 2021, p. 1; Ministère des Mines, 2021).

Germany.—Masan High-Tech's acquisition of H.C. Starck's tungsten business included H.C. Starck's oldest and largest tungsten plant in Goslar, where much of the raw material used was secondary (scrap) tungsten, either purchased from the market or received from customers as part of dedicated recycling or conversion programs. Products included tungsten carbide powders, tungsten metal powders, and a variety of tungsten chemicals. This site was also the location for research and development for new products and processes (H.C. Starck Tungsten GmbH, 2021; Masan High-Tech Materials Corp., 2021, p. 147, 272).

In November, Saxony Minerals & Exploration AG completed a feasibility study on its Pöhla project in the State of Saxony. The company based the study on results from ore extracted from an exploratory shaft in the Pöhla-Globenstein deposit and processed at its pilot plant in Mittweida, where tungsten and fluorspar concentrates were produced. The study reportedly was based on an operation with the capacity to produce 2,000 t/yr of tungsten concentrate (containing approximately 1,000 t/yr of tungsten). During the year, Saxony progressed through various stages of the planning approval process (Roskill Information Services Ltd., 2020, p. 170; Saxony Minerals & Exploration AG, 2020, p. 8–11).

Kazakhstan.—In November, Jiaxin International Resources Investment Co., Ltd. [a joint venture held by China Merchants Bank Company Ltd. and Jiangxi Copper Investment Co. Ltd. (Hong Kong)] started construction of its 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 expected to take about 2 years. According to Chinatungsten Online, the mine's stage 1 production was forecast to be about 7,700 t/yr of tungsten in concentrate (Shanghai International Mining Exchange, 2016; Chinatungsten Online, 2020; Jiangxi Copper Co., Ltd., 2021, p. 23, 136).

Korea, Republic of.—Almonty Industries Inc. (Canada) continued to work on financing for and development of its Sangdong tungsten project southeast of Seoul in Gangwon Province. Based on a 2016 feasibility study, the project entailed an underground mine and a mineral flotation plant that would produce a scheelite concentrate during an initial mine life of 12 to 13 years. Average production from the project would be approximately 1,750 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. In 2020, Almonty finalized a loan agreement with KfW IPEX-Bank GmbH (Germany) for 75% of the capital expenditure to develop and operate the mine. Almonty renegotiated and amended its offtake agreement with U.S. tungsten processor Global Tungsten & Powders Corp. for tungsten concentrate, increasing the floor price and extending the agreement to 15 years. In November, Almonty officially began mine construction by breaking ground for a portal but needed to refinance various long-term debt facilities and raise additional capital before it could complete the development and construction of the project (Almonty Industries Inc., 2020a, p. 15, 17–18, 26, 28; 2020b; 2021a, p. 17, 28; 2021b, p. 7–11, 54, 57, 59).

Portugal.—During the year, Almonty continued to focus on cost reduction at the Panasqueira tungsten mine and beneficiation plant in Covilha, Castelo Branco District. As the year progressed, the grade of ore mined increased as expected under the mine plan and the tungsten recovery rate improved. 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., 2021a, p. 20; 2021b, p. 10).

In early February, W Resources PLC (United Kingdom) began trial mining at its Régua project, 95 kilometers east of Porto in north-central Portugal. Mining activities were suspended owing to restrictions related to the COVID-19 pandemic and, in September, the trial mining license expired. W Resources planned to resume mining and plant construction once a full mining license has been granted (W Resources PLC, 2021, p. 4).

Russia.—In 2020, tungsten concentrates were produced from mined ore, stockpiled ore, and tailings. Ninety-nine percent of the tungsten produced in Russia was from the following five operations, in descending order of tungsten production: JSC Primorsky GOK's Vostok-2 scheelite tungsten mine in Primorskiy Kray; CJSC Novoorlovsky GOK's Spokoininskoye wolframite tungsten mine in Zabaykalsk Kray (the Transbaikal region); JSC Zakamensk's Barun-Narynskoe operation, which produced tungsten concentrates from tungsten-molybdenum tailings in Buryatiya Republic; LLC Lermontovsky GOK's Lermontovskoye scheelite tungsten mine in Primorskiy Kray; and LLC Pravourmiyskoye's Pravourmiyskoe tin-tungsten mine in the Khabarovsk Kray. The production from Lermontovsky was from stockpiled low-grade ore because no mining took place in 2020 (Ministry of Natural Resources and Environment of the Russian Federation, 2021, p. 272–274, 278).

Tungsten concentrates produced in Russia were processed either within Russia or exported. Russia also imported tungsten concentrates. Wolfram Company, JSC's Hydrometallurg plant at Nalchik, Kabardino-Balkariya Republic, consumed Russian concentrates to produce APT and tungsten oxides. JSC Kirovgrad Hard Alloys Plant in Sverdlovsk Province consumed Russian concentrates 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 and tungsten bars and had the capability to produce ferrotungsten from ore concentrates. LLC Moliren's plant, in Roshal, Moscow region, had the capability to produce ferrotungsten (Ministry of Natural Resources and Environment of the Russian Federation, 2021, p. 269, 274; JSC Kirovgrad Hard Alloys Plant, undated; Wolfram Company, JSC, undated a–c).

In 2020, four tungsten mines were under development. Wolfram Company's Primorwolfram LLC underground mine at the Zabytoe tungsten-tin deposit in Primorskiy Kray was in the most advanced stage of development. In 2020, the company produced a small amount of tungsten in concentrate from a pilot plant built in 2019 to determine the optimal processing technology for the ore. Commercial production was expected to begin in 2023, with production estimated at 360 t/yr of tungsten in concentrate (Ministry of Natural Resources and Environment of the Russian Federation, 2021, p. 273–276).

The other three tungsten mines were as follows: Primorsky GOK's open pit mine at the Skrytoye scheelite tungsten deposit in Primorskiy Kray, which was forecast to begin production in 2024 and have the capacity to produce about 2,400 t/yr of tungsten in concentrate; SevKavNedra LLC's underground scheelite mine at the Kti-Teberda deposit in the Karachayevo-Cherkesiya Republic, which was forecast to begin production in 2025 and produce between 1,400 and 3,300 t/yr of tungsten in concentrate; and Elbrus Mining Company LLC's project to restart production from the former Tyrnyauz underground tungsten-molybdenum mine in Kabardino-Balkariya Republic, which was expected to have the capacity to produce about 4,300 t/yr of tungsten in scheelite-molybdenum concentrate and was forecast to begin production in 2026, although news reports indicated that production might be moved forward to the end of 2023. 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 Tyrnyauz 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 (Globus, 2020; Ministry of Natural Resources and Environment of the Russian Federation, 2021, p. 273, 275–278; Elbrusmetal JSC, undated a, b).

Tverdosplav JSC was developing a project to beneficiate stockpiled wolframite ore at the Inkurskoye deposit in Buryatiya Republic. In 2020, Tverdosplav began preliminary mining of the stockpiles and beneficiated some of the ore to tungsten concentrate. The project was expected to have the capacity to produce about 90 t/yr of tungsten in concentrate (Ministry of Natural Resources and Environment of the Russian Federation, 2021, p. 273, 276, 278).

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 early 2020, tungsten concentrates were being produced from three mines in Spain—Los Santos and Barruecopardo, both in Salamanca Province in the Castile and Leon Autonomous Community, and La Parrilla in the Provinces of Badajoz and Caceres in the Extremadura Autonomous Community. Since 2018, tungsten production in Spain decreased owing to the depletion of ore at one mine, although the overall decrease was lessened by production beginning at two new mines (Ministerio Para La Transición Ecológica Y El Reto Demográfico, 2022, p. 12–13).

Daytal Resources Spain, S.L. (a subsidiary of Almonty) produced scheelite concentrate from tailings at Los Santos until February, when Almonty placed the operation on care-and-maintenance status to focus on finalizing financing for its Sangdong Mine project in the Republic of Korea. Almonty planned to reopen Los Santos in late 2021 after modifying the plant to increase its tungsten recovery rate (Almonty Industries Inc., 2021b, p. 33–34, 40).

Production of scheelite concentrate at the Barruecopardo Mine, operated by Saloro SLU and owned by Oaktree Capital Management, L.P., and of tungsten concentrate at W Resources's La Parrilla Mine was suspended temporarily during part of March and April owing to a countrywide lockdown in response to the COVID-19 pandemic. In addition to the effect of the suspension, production during La Parrilla's first full year of operation was reduced because of necessary improvements to the beneficiation plant. By yearend, La Parrilla produced 131 t of tungsten content in concentrate (Slade, 2020; W Resources PLC, 2021, p. 2–3).

Uganda.—In early 2020, KI3R Minerals International Ltd. (United Kingdom) ceased operations at Nyamuliro Wolfram Mines in Rubanda District. The closure was attributed to a Government ban on exporting raw minerals. In 2019, Uganda Revenue Authority staff were directed to enforce a 2011 ban on the export of unprocessed minerals (Oydek, 2019; Independent, The, 2020).

United Kingdom.—Tungsten West Ltd. studied the feasibility of restarting production at the Hemerdon Mine in Devon County, northeast of Plymouth. The project consisted of an open pit tungsten and tin mine and beneficiation plant, which closed in 2018 when former owner Wolf Minerals Ltd. (Australia) went into voluntary administration. Tungsten West planned to complete the study by early 2021 and raise funding to add X-ray transmission ore sorting, modify and upgrade the beneficiation plant, and restart production. The company expected steady-state production to be approximately 2,800 t/yr of tungsten and 388 t/yr of tin during an 18.5-year mine life (Ramanathan, 2020; Fastmarkets MB, 2021; Tungsten West Plc, 2021, p. 12, 17, 20).

Vietnam.—Vietnam was the world's second-ranked producer of tungsten concentrates, supplying an estimated 6% of world production (table 15). Vietnam imported additional concentrates to feed its downstream tungsten processing industry. In 2020, Vietnam imported 322 t of tungsten in concentrate, a decrease from the 467 t imported in 2019 (United Nations Statistics Division, undated).

In June, Masan High-Tech completed the acquisition of H.C. Starck's tungsten business, a global leader in the development, production, and sale of high-performance tungsten chemicals, tungsten carbide powder, and tungsten metal powder. More detail on this transaction is provided in the "Canada," "China," and "Germany" sections (Masan High-Tech Materials Corp., 2021, p. 6, 246).

Nui Phao Mining Co. Ltd. (Masan High-Tech Materials Corp.) produced tungsten concentrate from the Nui Phao open pit polymetallic mine in the Dai Tu District in Thai Nguyen Province. The company reported that it treated 2.1% more ore than in 2019, mainly owing to a 1.3% increase in throughput per hour and a 1.3% increase in plant availability compared with those in 2019. The resulting concentrate was sent to the nearby Masan Tungsten LLC tungsten chemicals manufacturing plant. Masan Tungsten processed Nui Phao's tungsten concentrate and tungsten raw materials from other sources—including tungsten concentrates and other tungsten-bearing materials—to produce APT, blue and yellow tungsten oxides, and sodium tungstate. In 2020, Masan High-Tech produced intermediate products with 8,070 t of tungsten content, based on full-year production at the Masan Tungsten plant in Vietnam and 7 months of production from the newly acquired H.C. Starck plant in Germany. This was a 67% increase from Masan Tungsten's 2019 production of intermediate products with 4,820 t of tungsten content (Masan High-Tech Materials Corp., 2021, p. 18, 22, 244–245, 250).

In addition to Masan Tungsten, two other companies in Vietnam were listed by the Responsible Minerals Initiative (RMI) as operating smelters or refiners of tungsten materials. Asia Tungsten Products Vietnam Ltd. had the capability to produce ferrotungsten at its plant in the Vinh Bao District near the Port of Haiphong, and Tejing (Vietnam) Tungsten Co., Ltd. had the capability to produce APT and downstream tungsten materials at its plant in Tay Ninh Province. RMI reported that APT producer Sanher Tungsten Vietnam Co. Ltd. ceased smelting or refining tungsten in Dong Nai Province in 2016 and that ferrotungsten producer Vietnam Youngsun Tungsten Industry Co., Ltd. ceased smelting or refining tungsten at its plant in Halong City, Quang Ninh Province, in 2018 (Responsible Minerals Initiative, undated a, b).

The Asia Tungsten Products plant reportedly produced some ferrotungsten in December. The plant previously produced ferrotungsten in mid-2019, when Asia Tungsten Products completed a contract processing run to demonstrate the operating condition of the plant, which had been on care-and-maintenance status during 2017 and 2018 (ATC Alloys Ltd., 2019; Asia Tungsten Products Vietnam Ltd., 2020).

Zimbabwe.—RHA Tungsten Pvt. Ltd. [National Indigenisation and Economic Empowerment Fund (NIEEF) and Premier African Minerals Ltd. (British Virgin Islands)] kept its tungsten operation in northwestern Zimbabwe on care-and-maintenance status. According to Premier, the mine could not be restarted until NIEEF either provided funding for the operation or arranged to have another source fund it (Premier African Minerals Ltd., 2021, p. 2, 7).

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) forecasts that an increasing amount of global tungsten supply will need to come from new mine production to meet demand in the next decade. As discussed in the "World Review" section, in the next few years, tungsten concentrate production from Australia, Kazakhstan, the Republic of Korea, Portugal, Russia, Spain, and the United Kingdom is expected to begin or increase as producers start or ramp up production from new or newly reopened mines or improve output from established mines. In addition, numerous companies worked to develop new mines or restart production from inactive mines in Australia, Eurasia, and North America. The amount, location, and timing of new production will depend, in part, on tungsten prices and (or) companies' ability to acquire funding. 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.

The automotive sector was estimated to represent nearly 30% of global tungsten consumption in 2020, mainly as cemented carbide tools used for machining vehicle components. As a result, future growth in tungsten use is expected to be strongly influenced by trends in vehicle production. Electric vehicles (EVs) require less machining than vehicles with internal combustion engines; therefore, the projected transition from producing vehicles with internal combustion engines to producing EVs is expected to reduce the unit consumption of tungsten per vehicle produced. In addition, the overall growth rate of vehicle production is expected to decrease with increasing trends towards shared and on-demand vehicle use. The reduced growth rate of cemented carbide use for the automotive sector is expected to be offset by increased consumption by other industry sectors that use cemented carbide products, however (Roskill Information Services Ltd., 2020, p. 11, 57, 234–236; Argus Media group, 2021, p. 19, 45, 52).

The global shift towards using light-emitting diode lamps is expected to continue to reduce demand for tungsten mill products for incandescent and fluorescent lamps, but because lighting applications are estimated to represent less than 5% of overall tungsten use, this is not expected to have a large effect on overall tungsten demand. Increased use of additive

manufacturing ("3D printing"), which produces near-net shape parts, could reduce the need for tungsten in cemented carbides and tool steels, although the fundamental need for tungsten as a tool material is expected to remain into the foreseeable future. In contrast, trends that could result in increased tungsten consumption include growth in civilian aircraft production; increased military spending; more stringent clean air requirements, which could generate demand for tungsten chemicals in catalysts that remove nitrogen oxides from gaseous effluents; the growing use of tungsten hexafluoride in semiconductor manufacturing; and the addition of tungsten to battery electrodes for EVs and other applications (Argus Media group, 2018, p. 5; Roberts, 2018, p. 22–23; Roskill Information Services Ltd., 2020, p. 11, 234, 267–268, 280; H.C. Starck Tungsten Powders, 2022; Lane, 2022; Trento, undated).

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TABLE 1
SALIENT TUNGSTEN STATISTICS[1]

(Metric tons, tungsten content, and dollars per metric ton unit, unless otherwise specified)

	2016	2017	2018	2019	2020
United States:					
Concentrates:					
Production[e, 2]	--	--	--	--	--
Consumption[e, 2, 3]	W	W	W	W	W
Exports	183	531 [r]	284	583 [r]	480
Imports for consumption	3,580	3,920	4,050	2,760	2,020
Stocks, December 31:					
Consumer[e, 2]	W	W	W	W	W
U.S. Government[4]	11,600	10,200	8,990	8,330	7,600
Price:					
U.S. spot quotation[5]	148	245	326	270	270
In-warehouse China[6]	69,200	90,700	107,000	88,700	85,000
Ammonium paratungstate:					
Production[e, 2]	W	W	W	W	W
Consumption[e, 2, 3]	W	W	W	W	W
Exports	108	97	106	34	36
Imports for consumption	1,020	2,230	2,200	1,430	1,080
Stocks, December 31, producer and consumer[e, 2]	W	W	W	W	W
Price:					
U.S. market[5]	198	278	364	308	253
European and U.S. markets[7]	191	242	313	246	225
Ferrotungsten:					
Production[e]	--	--	--	--	--
Consumption[e, 2]	97	94	126	111	96
Exports	23	45	104	43	6
Imports for consumption	236	209	143	96	38
Stocks, December 31, consumer[e, 2]	36	36	35	20	18
Price, U.S. free market[5, 8]	29.88	37.28	45.91	32.27	23.53
Primary products:					
Net production[e, 2, 9]	7,500	7,760	7,330	7,230	W
Consumption[e, 2, 10]	10,400	11,300	11,800	11,800	9,650
Stocks, December 31:					
Producer[e, 2, 9]	544	621	559	554	W
Consumer[e, 2, 10]	531	551	519	496	495
U.S. Government[4]	125	125	125	126	93
World, production of concentrate[11]	78,400	81,200 [r]	80,700 [r]	82,000 [r]	78,400

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data. -- Zero.

[1]Table includes data available through September 8, 2021. Data are rounded to no more than three significant digits, except for ferrotungsten prices.

[2]Includes reported data and U.S. Geological Survey estimates.

[3]Reported by tungsten processors.

[4]Source: Defense Logistics Agency Strategic Materials.

[5]Annual averages calculated from weekly prices reported by S&P Global Platts Metals Week.

[6]Annual averages in Chinese Yuan renminbi per metric ton calculated from weekly prices reported by Fastmarkets MB.

[7]Annual averages calculated from monthly prices reported by Fastmarkets MB; cost, insurance, and freight, Rotterdam and Baltimore, duty-free.

[8]Dollars per kilogram of tungsten content.

[9]Includes tungsten metal powder and tungsten carbide powder produced from metal powder; excludes cast and crystalline tungsten carbide powder and chemicals.

[10]Includes ammonium paratungstate and other tungsten chemicals, ferrotungsten, tungsten metal powder, tungsten carbide powder, and tungsten scrap.

[11]May include estimated data.

TABLE 2
U.S. GOVERNMENT NATIONAL DEFENSE STOCKPILE TUNGSTEN STATISTICS IN 2020[1]

(Metric tons, tungsten content)

Material	Inventory, yearend[2]		Annual Materials Plan[3, 4]	Sales		Inventory decrease[5]	
	Fiscal year[3]	Calendar year		Fiscal year[3]	Calendar year	Fiscal year[3]	Calendar year
Ores and concentrates	7,660	7,600	1,360	747	615	703	728
Tungsten metal powder	107	93	125	33	33	18	34
Total	7,770	7,690	1,490	780	648	721	762

[1]Table includes data available through August 30, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]The yearend inventories included 1 metric ton, gross weight, of tungsten alloy and 5 metric tons, gross weight, of tungsten-rhenium metal.
[3]Twelve-month period ending September 30, 2020.
[4]Potential disposal or sale. The Annual Materials Plan also included the possible acquisition of 5 metric tons, gross weight, of tungsten-rhenium metal.
[5]From previous year.

Source: Defense Logistics Agency Strategic Materials.

TABLE 3
U.S. NET PRODUCTION AND STOCKS OF TUNGSTEN PRODUCTS[1, 2]

(Metric tons, tungsten content)

	Tungsten metal powder	Tungsten carbide powder	Total
Net production:[3]			
2019	W	W	7,230
2020	W	W	W
Stocks, December 31, producer:			
2019	W	W	554
2020	W	W	W

W Withheld to avoid disclosing company proprietary data.
[1]Table includes data available through August 30, 2021. Data are rounded to no more than three significant digits.
[2]Includes reported data and U.S. Geological Survey estimates. Data for cast and crystalline tungsten carbide powder and tungsten chemicals are withheld to avoid disclosing company proprietary data; not included in "Total."
[3]Net production equals receipts plus gross production minus quantity used to make other products listed.

TABLE 4
U.S. PROCESSORS OF TUNGSTEN IN 2020[1, 2]

Company	Plant location
Buffalo Tungsten Inc.	Depew, NY.
Chem-Met Co., The	Clinton, MD.
Elmet Technologies, Inc.	Lewiston, ME.
Global Tungsten & Powders Corp.[3]	Towanda, PA.
Kennametal Inc.	Fallon, NV.
Do.	Huntsville, AL.
Niagara Refining LLC[4]	Depew, NY.
Tundra Companies	White Bear Lake, MN.

Do. Ditto.

[1]Table includes data through August 30, 2021.

[2]Consumers of ammonium paratungstate, tungsten-bearing scrap, tungsten concentrates, and (or) tungsten oxides.

[3]A division of Plansee Group.

[4]A joint venture of Sumitomo Electric Carbide Inc. and New York Tungsten LLC (a subsidiary of Buffalo Tungsten Inc.).

TABLE 5
U.S. ESTIMATED CONSUMPTION AND STOCKS OF TUNGSTEN PRODUCTS[1, 2, 3]

(Metric tons, tungsten content)

	2019	2020
Consumption by end use:		
Steels	82	82
Superalloys	562	410
Other alloys[4]	W	W
Cemented carbides[5]	6,940	5,500
Mill products made from metal powder	W	W
Chemical	88	88
Total	11,800	9,650
Consumption by form:		
Ferrotungsten	111	96
Tungsten metal powder	W	W
Tungsten carbide powder	7,200	5,790
Tungsten scrap[6]	W	W
Other tungsten materials[7]	88	88
Total	11,800	9,650
Stocks, December 31, consumer:		
Ferrotungsten	20	18
Tungsten metal powder	31	31
Tungsten carbide powder	392	392
Tungsten scrap[6]	41	41
Other tungsten materials[7]	13	13
Total	496	495

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

[1]Table includes data available through September 8, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Does not include materials used in making primary tungsten products.

[3]Includes reported data and U.S. Geological Survey estimates.

[4]Includes welding and hard-facing rods and materials, wear- and corrosion-resistant alloys, and nonferrous alloys.

[5]Includes diamond tool matrices, cemented and sintered carbides, and cast carbide dies or parts.

[6]May include tungsten bars and other solid metal forms.

[7]Includes tungsten chemicals.

TABLE 6

U.S. EXPORTS OF TUNGSTEN ORES AND CONCENTRATES, BY COUNTRY OR LOCALITY[1, 2]

Country or locality	2019			2020		
	Quantity		Value (thousands)	Quantity		Value (thousands)
	Gross weight (metric tons)	Tungsten content[3] (metric tons)		Gross weight (metric tons)	Tungsten content[3] (metric tons)	
Canada	5	3	$61	(4)	(4)	$4
Estonia	--	--	--	18	9	245
France	33	17	265	--	--	--
Hong Kong	--	--	--	105	54	327
India	19	10	30	--	--	--
Netherlands	347	179	5,300	77	40	1,290
Philippines	26	13	55	--	--	--
Russia	19	10	108	52	27	323
Switzerland	39	20	407	--	--	--
Thailand	202	104	400	--	--	--
Vietnam	436	225	1,400	674	348	2,030
Other	4 r	2 r	67 r	4	2	32
Total	1,130	583 r	8,090	931	480	4,250

rRevised. -- Zero.

[1]Table includes data available through August 9, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]U.S. Census Bureau Schedule B number 2611.00.0000.

[3]Estimated from reported gross weight using 51.5% tungsten.

[4]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 7

U.S. EXPORTS OF AMMONIUM PARATUNGSTATE, BY COUNTRY OR LOCALITY[1, 2]

Country or locality	2019		2020	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
Brazil	2	$14	(3)	$3
Germany	14	120	--	--
Japan	2	22	(3)	3
Mexico	15	133	12	111
South Africa	--	--	22	198
Other	3 r	24 r	1	18
Total	34	313	36	333

rRevised. -- Zero.

[1]Table includes data available through August 9, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Includes other ammonium tungstates, such as ammonium metatungstate. U.S. Census Bureau Schedule B number 2841.80.0010.

[3]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 8

U.S. EXPORTS OF TUNGSTEN METAL POWDERS, BY COUNTRY OR LOCALITY[1, 2]

Country or locality	2019			2020		
	Quantity			Quantity		
	Gross weight (metric tons)	Tungsten content[3] (metric tons)	Value (thousands)	Gross weight (metric tons)	Tungsten content[3] (metric tons)	Value (thousands)
Austria	5	4	$276	3	2	$96
Belgium	4	3	224	1	1	64
Brazil	11	9	474	7	6	307
Canada	86	69	4,740	113	90	5,220
Czechia	14	11	815	17	14	859
France	8	6	459	1	1	94
Germany	18	14	1,110	10	8	536
India	15	12	889	8	6	477
Japan	4	3	244	2	2	159
Korea, Republic of	5	4	524	10	8	1,070
Mexico	30	24	1,670	21	17	1,100
Netherlands	1	1	58	22	18	875
Peru	4	4	256	5	4	301
Saudi Arabia	20	16	1,200	2	1	87
South Africa	7	5	748	5	4	536
United Kingdom	8	7	717	4	4	201
Other	17 r	14 r	1,030 r	25	20	1,390
Total	257	206	15,400	256	205	13,400

rRevised.

[1]Table includes data available through August 9, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]May include tungsten alloy powders. U.S. Census Bureau Schedule B number 8101.10.0000.

[3]Estimated from reported gross weight using 80% tungsten.

Source: U.S. Census Bureau.

TABLE 9

U.S. EXPORTS OF TUNGSTEN CARBIDE POWDER, BY COUNTRY OR LOCALITY[1, 2]

Country or locality	2019		2020	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
Argentina	4	$135	1	$25
Australia	28	1,010	42	1,240
Austria	59	859	39	662
Belgium	2	193	9	409
Brazil	5	392	4	153
Canada	187	10,200	128	4,860
China	60	2,180	32	887
Czechia	25	482	9	184
Denmark	1	47	4	167
Germany	92	6,320	52	2,450
Hong Kong	5	292	4	304
India	15	565	2	118
Indonesia	5	365	2	178
Ireland	13	336	--	--
Japan	55	3,540	26	2,010
Korea, Republic of	10	542	18	675
Malaysia	3	161	3	183
Mexico	13	501	7	338
Netherlands	4	187	3	141
Philippines	4	411	(3)	4
Saudi Arabia	7	414	1	61
Singapore	3	343	1	239
Spain	(3)	18	3	40
Taiwan	12 r	832 r	3	147
United Kingdom	18	1,290	10	835
Other	18 r	1,430 r	12	991
Total	649 r	33,000 r	415	17,300

rRevised.

[1]Table includes data available through August 9, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]U.S. Census Bureau Schedule B number 2849.90.3000.

[3]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 10

U.S. EXPORTS OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY OR LOCALITY[1]

Product and country or locality	Schedule B number[2]	2019 Tungsten content (metric tons)	2019 Value (thousands)	2020 Tungsten content (metric tons)	2020 Value (thousands)
Ferrotungsten and ferrosilicon tungsten:	7202.80.0000				
Brazil		8	$34	--	--
Canada		6	103	2	$84
Netherlands		20	657	--	--
South Africa		6	14	--	--
United Kingdom		3	7	--	--
Vietnam		--	--	4	9
Other		1	44	(3)	9
Total		43	859	6	101
Unwrought tungsten:[4, 5, 6]	8101.94.0000				
Canada		21	1,520	12	753
Germany		6	335	(3)	75
Mexico		5	305	2	101
Taiwan		18	196	251	2,690
Other		7	670 r	8	477
Total		56	3,030	274	4,100
Waste and scrap:[7]	8101.97.0000				
Austria		--	--	17	340
Belgium		4	34	33	280
Canada		125	1,780	72	799
China		--	--	7	71
Czechia		--	--	26	152
Estonia		--	--	4	36
Finland		112	2,070	94	2,550
Germany		107	2,260	233	4,060
Hong Kong		7	57	--	--
India		--	--	11	90
Israel		--	--	6	80
Japan		59	832	29	385
Korea, Republic of		3	39	12	261
Malaysia		129	1,090	92	637
Mexico		--	--	4	38
Netherlands		22	240	--	--
Pakistan		131	1,140	146	1,180
Philippines		23	199	28	238
Taiwan		13	231	13	242
United Kingdom		92	1,540	120	1,820
Other		3	67	--	--
Total		832	11,600	948	13,300
Wrought tungsten:[4, 8]	8101.96.0000, 8101.99.1000, 8101.99.8000				
Australia		1	143	15	7,850
Austria		60	3,520	38	2,240
Brazil		1	140	11	851
Canada		11	1,890	20	2,860
China		13	2,420	19	2,350
Costa Rica		8	1,080	8	2,040
Germany		12	1,650	6	926
India		3	319	3	284
Israel		1	198	20	1,510
Japan		604	47,500	245	17,400
Korea, Republic of		5	848	1	411
Mexico		203	22,400	155	19,300
Philippines		3	269	4	548
United Kingdom		4	1,120	4	876
Other		19 r	3,390 r	18	3,540
Total		947	86,800	566	63,000

See footnotes at end of table.

TABLE 10—Continued
U.S. EXPORTS OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY OR LOCALITY[1]

Product and country or locality	Schedule B number[2]	2019 Tungsten content (metric tons)	2019 Value (thousands)	2020 Tungsten content (metric tons)	2020 Value (thousands)
Tungsten compounds:[9]	2841.80.0040				
Canada		12	$35	5	$12
China		1	66	3	37
Malaysia		1	10	1	12
Mexico		1	100	(3)	8
Other		(3)	14	(3)	63
Total		15	224	10	133

[r]Revised. -- Zero.
[1]Table includes data available through August 9, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Schedule B is the U.S. Census Bureau classification for products being exported from the United States.
[3]Less than ½ unit.
[4]May include alloys.
[5]Content estimated from reported gross weight using 95% tungsten.
[6]Includes bars and rods produced simply by sintering; excludes powders and waste and scrap.
[7]Content estimated from reported gross weight using 70% tungsten.
[8]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; 80% tungsten for Schedule B number 8101.99.8000.
[9]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[1, 2]

Country or locality	2019 Tungsten content (metric tons)	2019 Value (thousands)	2020 Tungsten content (metric tons)	2020 Value (thousands)
Australia	--	--	6	$121
Bolivia	1,210	$30,900	1,090	21,900
Brazil	11	338	--	--
Burundi	54	1,390	--	--
Congo (Kinshasa)	9	229	59	1,300
Czechia	--	--	3	35
Mongolia	152	3,480	1	13
Nigeria	181	4,700	--	--
Poland	31	680	7	98
Portugal	536	17,500	539	15,600
Russia	189	5,320	156	3,910
Rwanda	23	635	85	1,830
Spain	278	7,300	47	955
Thailand	21	633	--	--
Uganda	61	1,180	17	376
Other	2	70	3	132
Total	2,760	74,400	2,020	46,300

-- Zero.
[1]Table includes data available through August 9, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Harmonized Tariff Schedule of the United States codes 2611.00.3000 and 2611.00.6000.

Source: U.S. Census Bureau.

TABLE 12
U.S. IMPORTS FOR CONSUMPTION OF AMMONIUM PARATUNGSTATE, BY COUNTRY OR LOCALITY[1, 2]

Country or locality	2019		2020	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
China	824	$24,900	670	$19,900
Germany	600	16,700	408	9,130
Japan	4	124	--	--
Total	1,430	41,700	1,080	29,000

-- Zero.

[1]Table includes data available through August 9, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]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[1, 2]

Country or locality	2019		2020	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
China	15	$478	--	--
Korea, Republic of	27	822	8	$282
Russia	32	935	19	527
Switzerland	6	229	--	--
Ukraine	5	147	11	273
Vietnam	11	325	--	--
Total	96	2,930	38	1,080

-- Zero.

[1]Table includes data available through August 9, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]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[1]

Product and country or locality	HTS[2] code	2019		2020	
		Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
Tungsten metal powders:[3]	8101.10.0000				
Austria		132	$5,490	8	$367
Canada		279	11,700	239	9,940
China		1,100	41,000	814	23,200
Finland		(4)	43	6	184
France		1	49	9	493
Germany		24	1,530	13	784
Hong Kong		21	557	--	--
India		13	425	6	193
Israel		70	2,670	362	12,700
Japan		63	3,200	87	2,930
Korea, Republic of		131	5,560	261	7,620
United Kingdom		2	198	3	190
Vietnam		73	1,890	42	1,050
Other		5 r	221 r	2	131
Total		1,910	74,500	1,850	59,800
Tungsten carbide powder:	2849.90.3000				
Austria		347	14,400	222	7,980
Canada		366	16,800	167	6,520
China		1,050	45,000	584	23,800
France		12	1,490	5	595
Germany		4	311	4	258
Hong Kong		5	203	--	--
India		10	156	--	--
Israel		134	5,120	134	4,650
Korea, Republic of		(4)	14	4	195
Mexico		3	76	--	--
United Kingdom		7	356	(4)	13
Vietnam		6	194	2	59
Other		2	129 r	3	183
Total		1,940	84,200	1,120	44,200
Unwrought tungsten:[3, 5]	8101.94.0000				
China		214	8,510	130	4,970
Germany		5	462	3	286
Japan		--	--	4	286
United Kingdom		4	95	1	36
Vietnam		--	--	24	858
Other		1 r	127 r	1	32
Total		224	9,200 r	163	6,470

See footnotes at end of table.

TABLE 14—Continued
U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY OR LOCALITY[1]

Product and country or locality	HTS[2] code	2019 Tungsten content (metric tons)	2019 Value (thousands)	2020 Tungsten content (metric tons)	2020 Value (thousands)
Waste and scrap:[6]	2620.99.2000, 8101.97.0000				
Austria		154	$2,630	24	$582
Belgium		83	1,600	40	916
Brazil		42	706	1	14
Canada		260	4,870	151	2,180
Chile		21	424	2	45
China		389	11,900	275	8,230
Cyprus		--	--	35	637
Czechia		38	793	19	457
Estonia		19	361	--	--
Finland		3	89	10	197
France		105	1,810	71	1,070
Germany		640	12,700	614	11,100
Greece		--	--	11	246
Hong Kong		15	214	--	--
India		15	503	14	290
Ireland		16	308	25	471
Israel		14	364	1	5
Japan		60	840	63	1,110
Luxembourg		186	1,960	230	3,620
Mexico		403	7,820	247	4,560
Peru		11	320	--	--
Poland		369	8,250	240	5,190
Russia		5	166	5	90
Singapore		10	112	7	71
Spain		10	182	17	290
Sweden		12	287	--	--
Taiwan		--	--	4	90
Thailand		16	413	32	827
United Kingdom		166	3,720	79	1,340
Vietnam		25	865	20	604
Other		(4) r	8 r	3	46
Total		3,090	64,200	2,240	44,300
Wrought tungsten:[3, 7]	8101.96.0000, 8101.99.1000, 8101.99.8000				
Austria		33	5,490 r	21	4,060
Canada		22	1,400	1	134
China		420 r	33,200 r	386	29,300
Czechia		4	791 r	3	741
France		10	1,760	9	1,570
Germany		7	1,850	6	1,760
Japan		26	7,580	19	6,450
Taiwan		4	473 r	2	370
Thailand		8	2,150	--	--
Other		17 r	5,350 r	10	4,200
Total		552 r	60,100 r	458	48,600
Tungsten oxides:	2825.90.3000				
China		301	7,960	176	4,400
Germany		124	3,450	165	5,000
Korea, Republic of		(4)	4	(4)	2
Netherlands		20	525	--	--
Vietnam		120	3,100	150	3,110
Total		565	15,000	491	12,500

See footnotes at end of table.

TABLE 14—Continued
U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS,
BY COUNTRY OR LOCALITY[1]

Product and country or locality	HTS[2] code	2019 Tungsten content (metric tons)	2019 Value (thousands)	2020 Tungsten content (metric tons)	2020 Value (thousands)
Other tungstates:	2841.80.0050				
Australia		(4)	$80	(4)	$55
China		13	249	31	508
Germany		6	450	10	591
Hong Kong		42	920	47	782
India		37	994	24	658
Philippines		131	2,860	54	1,060
Taiwan		421	6,050	858	17,300
Vietnam		548	10,200	96	1,810
Total		1,200	21,800	1,120	22,800
Other tungsten compounds and chemical products:[8]	2827.39.4000, 2850.00.1000				
Canada		3	63	9	200
Colombia		5	90	3	51
Germany		35	642	28	522
Japan		90	1,590	52	906
Other		1	65	1	12
Total		135	2,450	92	1,690

[r]Revised. -- Zero.
[1]Table includes data available through August 9, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Harmonized Tariff Schedule of the United States.
[3]May include alloys.
[4]Less than ½ unit.
[5]Includes bars and rods produced simply by sintering; excludes powders and waste and scrap. Content estimated from reported gross weight using 95% tungsten.
[6]Includes ash and residues, mainly tungsten.
[7]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, 80% tungsten for HTS code 8101.99.8000.
[8]Includes tungsten chlorides, hydrides, and nitrides.

Source: U.S. Census Bureau.

TABLE 15
TUNGSTEN: WORLD CONCENTRATE PRODUCTION, BY COUNTRY OR LOCALITY[1]

(Metric tons, tungsten content)

Country or locality[2]	2016	2017	2018	2019	2020
Australia	108	20 e	20 e	20 e	100 e
Austria	954	975	936	892	890 e
Bolivia[3]	1,110	994	1,365	1,064	1,347
Brazil	323	411	400 e	400 e	400 e
Burma[e, 4]	182	216	77	82	80
Burundi[e, 5]	63	120	92 r	130	120
China	64,000	67,000	65,000	69,000	66,000 e
Congo (Kinshasa)[e]	73	120	180	190	110
Korea, North[e, 6]	50	310	1,410	1,130	410
Mongolia	732	284 r	386 r	166 r	70 e
Nigeria[e, 7]	7	2	24	25	25
Portugal	549	669	715	518	550
Russia	2,707	2,144	2,234	2,433 r	2,400 e
Rwanda[e, 3]	820	720	920	900	860
Spain	699	564	856	414 r	500 e
Thailand[e, 8]	33	65	69	40	40
Uganda	41	62	188	145 r	11
United Kingdom	736	1,086	1,000 e	--	--
Vietnam[9]	5,200	5,400	4,800	4,500	4,500 e
Zimbabwe[10]	NA	NA	NA	--	-- e
Total	78,400	81,200 r	80,700 r	82,000 r	78,400

eEstimated. rRevised. NA Not available. -- Zero.

[1]Table includes data available through July 28, 2021. 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.

[2]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.

[3]Production based on reported exports.

[4]Based on 2016–20 calendar year production of tungsten concentrates and 2016–18 fiscal year ending March 31 production of tin-tungsten concentrates reported by the Central Statistical Organization.

[5]Based on gross weight reported by the Burundi Institute of Statistics and Economic Studies.

[6]Production estimated based on imports reported by China.

[7]Production estimated based on reported imports from Nigeria.

[8]Based on data from the Department of Primary Industries and Mines.

[9]Source: International Tungsten Industry Association.

[10]Information was inadequate to make reliable estimates of output for 2016–18.