



2018 Minerals Yearbook

TUNGSTEN [ADVANCE RELEASE]

TUNGSTEN

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In 2018, world tungsten mine production was essentially unchanged from that in 2017 (table 15). Roskill Information Services Ltd. (2019, p. 1–5) estimated that 2018 world tungsten supply and consumption were greater than those in 2017 because of an increase in secondary (scrap) consumption and that the global tungsten market was essentially in balance, following at least 7 years of oversupply. Tungsten prices in China, Europe, and the United States generally trended upward during the first half of 2018 and then trended downward during the second half. The annual average U.S. spot price for tungsten concentrate was \$326 per metric ton unit, a 33% increase from the annual average price of \$245 per metric ton unit in 2017, but below the annual average price of \$358 per metric ton unit in 2013. Key issues that influenced the tungsten market in 2018 included supply constraints resulting from production halts associated with environmental inspections in China, concerns over the eventual dispersal of large stocks of ammonium paratungstate (APT) held by the defunct Fanya Metal Exchange (China), and uncertainty in the supply-demand outlook resulting from the trade dispute between the United States and China (Metal Bulletin Daily, 2018; Argus Media group, 2019, p. 1–2; Roskill Information Services Ltd., 2019, p. 1–6, 59–64).

In 2018, 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). The United States imported a record-high level of tungsten materials in 2018 (tables 11–14). 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. In 2018, U.S. production of tungsten materials decreased, apparent consumption (defined as mine production plus secondary production plus imports minus exports plus adjustments for Government and industry stock changes) was essentially unchanged, and reported consumption increased compared with those in 2017 (tables 1, 3, 5).

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 it useful in a wide variety of commercial, industrial, and military applications. The leading use for tungsten is as tungsten carbide in cemented carbides, which are wear-resistant materials used by the construction, metalworking, mining, and oil and gas drilling industries. Pure or doped tungsten metal is used for contacts, electrodes, and wires in electrical, electronic, heating, lighting, and welding applications. Tungsten also is used to make alloys and composites to substitute for lead in ammunition and other products; heavy-metal alloys for armaments, heat sinks, radiation shielding, and weights and counterweights; superalloys for turbine engine parts; tool steels; and wear-resistant alloy parts and coatings. Tungsten chemicals are

used to make catalysts, corrosion-resistant coatings, dyes and pigments, fire-resistant compounds, lubricants, phosphors, and semiconductors.

Most data in this report 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 report are in metric tons of contained tungsten. Most tungsten prices and many tungsten statistics from other sources 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), and WO_3 is 79.3% tungsten by weight. A short ton unit of WO_3 , therefore, equals 20 pounds of WO_3 and contains 7.19 kilograms (kg) (15.86 pounds) 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 pounds) of tungsten.

Legislation and Government Programs

Critical Minerals.—In May, the U.S. Department of the Interior, in coordination with other executive branch agencies, published a list of 35 mineral commodities, including tungsten (U.S. Department of the Interior, Office of the Secretary, 2018). The list was developed to serve as an initial focus, pursuant to Executive Order 13817, “A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals” (Trump, 2017).

National Defense Stockpile.—During fiscal year 2018 (October 1, 2017, through September 30, 2018), the U.S. Department of Defense, Defense Logistics Agency Strategic Materials (DLA Strategic Materials), sold 1,220 metric tons (t) of tungsten in ores and concentrates; 1,170 t of tungsten in ores and concentrates was sold during calendar year 2018 (table 2). 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 2018 provided the maximum quantities of tungsten materials available for disposal, as listed in table 2. The quantities of tungsten ores and concentrates and tungsten metal powder available during fiscal year 2019 (October 1, 2018, through September 30, 2019) remained unchanged. In addition to disposals, DLA Strategic Materials listed the possible acquisition of 5 t, gross weight, of tungsten-rhenium metal in fiscal year 2018, unchanged from that in fiscal year 2017. The quantity of tungsten-rhenium metal that could be acquired in fiscal year 2019 remained at 5 t (Defense Logistics Agency Strategic Materials, 2016, 2017, 2018a, b).

Conflict Minerals.—The U.S. Securities and Exchange Commission (SEC) was responsible for implementing 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. Wolframite, one of two principal minerals mined for tungsten,

was included in the list of conflict minerals. Section 1502 defined “conflict minerals” as cassiterite, columbite-tantalite, gold, wolframite, or their derivatives. 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 2019, the U.S. Government Accountability Office (GAO) reported that the conflict minerals disclosures submitted for 2018 showed trends similar to those filed for 2016 and 2017. A GAO analysis of a sample of 2018 filings estimated that 56% of the companies were able to determine the country of origin of their conflict minerals, an increase compared with 53% of the companies that filed in 2017. 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. For those companies that conducted due diligence on the source and chain of custody of the conflict minerals in their products, an estimated 61% reported that they could not definitively confirm the source of the conflict minerals and almost all reported that they could not determine whether the minerals financed or benefited armed groups. Although reporting companies were not required to identify which conflict minerals they used, of the 76% that did, 63% reported using tungsten. Tungsten concentrate production from Congo (Kinshasa) and adjoining countries had been only 1% to 2% of world production in recent years (table 15) (U.S. Government Accountability Office, 2019, p. 9–12).

Production

Domestic production statistics for tungsten are based on data collected by the U.S. Geological Survey (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 known production of tungsten concentrates in 2018.

Thor Mining PLC (United Kingdom) completed a scoping study on the potential viability of developing its Pilot Mountain project, approximately 200 kilometers (km) southeast of Reno, NV. The study 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).

Till Capital Ltd. (Bermuda) planned to sell the Springer mine complex in Pershing County, NV. The complex consisted of a former underground scheelite mine, a beneficiation plant, and a processing circuit designed to produce either APT or calcium tungstate (also known as synthetic scheelite) (Till Capital Ltd., 2019, p. 5).

The USGS monthly “Tungsten Concentrate and Tungsten Products Survey” canvassed companies that consumed 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 on the basis of prior survey results or information from other sources. U.S. processors of tungsten materials are listed in table 4. Total net production of tungsten metal powder and tungsten carbide powder was 6% less than that in 2017 (table 3).

Consumption

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 2018 to avoid disclosing company proprietary data pertaining to scrap consumption.

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.

Total U.S. reported consumption of tungsten materials to make end-use products in 2018 was 5% more than that in 2017. Consumption to make cemented carbides was 6% more than consumption in 2017; consumption to make superalloys was 8% less; consumption to make other alloys was more than consumption in 2017; and estimated consumption to make steels, mill products, and for chemical applications was essentially unchanged from consumption in 2017. Compared with consumption in 2017, U.S. end users in 2018 consumed more ferrotungsten and tungsten carbide powder, less scrap, and about the same amount of tungsten metal powder. Estimated consumption of tungsten compounds in chemical applications remained unchanged (table 5).

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 oil and natural gas. In 2018, the number of rigs operating each week in the United States trended upward. The average number of weekly operating rigs in 2018 was 18% more than the average number of operating rigs in 2017 (1,032 rigs in 2018 compared with 876 rigs in 2017) (Baker Hughes Inc., 2019).

Prices

Annual average U.S. prices for tungsten concentrate, APT, and ferrotungsten continued the upward trends that began in 2017 but did not reach the average highs in 2013 for concentrate, 2012 for APT, and 2011 for ferrotungsten.

The weekly U.S. spot price for tungsten ore concentrate reported by Platts Metals Daily began the year at \$265 to \$275 per short ton unit (\$292 to \$303 per metric ton unit), trended upward to reach a high of \$280 to \$330 per short ton unit (\$309 to \$364 per metric ton unit) during May and June, then decreased slightly to \$280 to \$320 per short ton unit (\$309 to \$353 per metric ton unit) before December, when it dropped to \$240 to \$250 per short ton unit (\$265 to \$276 per metric ton unit). The annual average of Platts’ U.S. tungsten ore concentrate spot prices was 33% higher than that in 2017

(table 1), but still 9% less than the annual average of \$358 per metric ton unit in 2013.

The weekly U.S. APT price reported by Platts began the year at \$295 to \$325 per short ton unit (\$325 to \$358 per metric ton unit), trended upward to reach a high of \$320 to \$360 per short ton unit (\$353 to \$397 per metric ton unit) during May to October, then trended downward to \$280 to \$290 per short ton unit (\$309 to \$320 per metric ton unit) by yearend. The annual average of Platts' U.S. APT prices was 31% higher than that in 2017 (table 1), but still 19% less than the annual average of \$449 per metric ton unit in 2012.

The U.S. free market ferrotungsten price reported by Platts followed a similar pattern. It started the year at \$38 to \$45 per kilogram of contained tungsten, increased to \$45 to \$50 per kilogram of contained tungsten from March into December, and then decreased in mid-December to \$33 to \$35 per kilogram of contained tungsten. The annual average price was 23% higher than that in 2017 (table 1), but still 10% less than the annual average of \$51.18 per kilogram of contained tungsten in 2011.

Although the Fanya Metal Exchange (China) ceased operations in 2015 following an investment scandal, the exchange reportedly held 29,651 t, gross weight, of APT (containing nearly 20,900 t of tungsten) at yearend 2018. This was estimated to be equivalent to almost 3 months of China's APT production. Throughout 2018, the potential that releases from this large quantity of tungsten intermediate could suppress increases in global tungsten prices and production remained a concern for the tungsten market (Metal Bulletin Daily, 2016, 2018; Xu, 2017; Roskill Information Services Ltd., 2019, p. 74–75).

Foreign Trade

The tungsten content of U.S. exports was 3,500 t, slightly less than the 3,550 t (revised) exported in 2017 (tables 6–10). The tungsten content of U.S. imports was a record high of 14,400 t, 5% more than the 13,700 t imported in 2017 (tables 11–14). China remained the leading supplier of imported tungsten to the United States, accounting for 32% of all tungsten imports in 2018. The tungsten content of imports from China was essentially unchanged at 4,660 t in 2018 compared with 4,700 t in 2017. The distribution of materials imported from China was as follows: APT, 31%; tungsten metal powder, 18%; tungsten oxides, 14%; tungsten carbide powder, 13%; tungsten waste and scrap, 9%; wrought tungsten, 8%; unwrought tungsten, 4%; ferrotungsten, 2%; and ores and concentrates, other tungstates, and other tungsten compounds, less than 1% each. Other countries that supplied 5% or more of United States tungsten imports were as follows: Bolivia, 9%; Germany, 8%; the United Kingdom, 6%; and Canada and Portugal, 5% each.

The tungsten contained in U.S. imports of ores and concentrates was 3% more than that in 2017. In 2018, the leading suppliers of imports of tungsten ores and concentrates were Bolivia (31%), Portugal (19%), Spain (16%), the United Kingdom (15%), and Russia (5%) (table 11).

U.S. imports of APT were slightly less than those in 2017 (table 12). In 2018, most of the APT imports were from China, 66%, and Germany, 29%. 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 2018, U.S. net import reliance for tungsten as a percentage of apparent consumption was more than 50%. The actual value was withheld to avoid disclosing company proprietary data.

World Review

Estimated world production of tungsten concentrates was essentially unchanged from that in 2017 (revised) and remained below the record-high-production level of 2015 (table 15). China continued to be the leading producer of tungsten concentrates with 80% of total world production in 2018. Vietnam was the second-ranked producing country, with 6% of world production; followed by Mongolia and Russia, with 2% each. Combined production outside of China increased by 14% in 2018, which counterbalanced an equivalent tonnage decrease in estimated production from China. World tungsten mine production was supplemented by tungsten recovered from scrap to supply global consumption. Industry analysts estimated that, in 2018, tungsten concentrates represented 70% to 72% of global tungsten supply, and tungsten scrap represented 28% to 30% (International Tungsten Industry Association, 2019, p. 6–7; Roskill Information Services Ltd., 2019, p. 16–17).

Australia.—For the second consecutive year, Tasmania Mines Ltd. was the sole producer of tungsten in Australia. The company produced a small amount of scheelite concentrate from its Kara open pit magnetite mine south of Burnie in Tasmania (Geoscience Australia, 2020, p. 63).

Production at Almonty Industries Inc.'s Wolfram Camp tungsten-molybdenum mine and beneficiation plant west of Cairns, Queensland, remained suspended throughout the year. Almonty began the suspension in early 2016 to construct a new tailings dam and to upgrade the beneficiation plant. By yearend 2018, Almonty decided that it was in the best interests of the company to cease funding the plant upgrade and, as a result, the two companies that owned the mining operation (Wolfram Camp Mining Pty. Ltd. and Tropical Metals Pty. Ltd.) were placed into voluntary liquidation (Almonty Industries Inc., 2019, p. 4).

Specialty Metals International Ltd. planned a staged development of its Mt. Carbine project, west of Port Douglas in northern Queensland. The company intended to produce tungsten concentrates from stockpiled tailings and low-grade ore before beginning open pit mining. At yearend, Specialty Metals was in advanced negotiations with Cronimet Holding GmbH regarding Cronimet's participation in the development of the project. The companies aimed to begin production in 2019 (Specialty Metals International Ltd., 2019, p. 3).

Thor Mining updated a feasibility study on its Molyhilit tungsten-molybdenum project northeast of Alice Springs, Northern Territory. The study confirmed a 7-year mine life as an open pit operation, with potential extensions from either underground mining or developing Thor Mining's adjacent

Bonya tenements. Molyhil's production would average approximately 990 t/yr of tungsten in scheelite concentrate (125,000 metric ton units per year of WO_3) and a byproduct molybdenite concentrate. Thor Mining appointed an advisor to assist with finalizing offtake agreements and project financing (Thor Mining PLC, 2019, p. 2–3).

King Island Scheelite Ltd. (KIS) continued to study the feasibility of reestablishing open pit mining and beneficiation operations at the former King Island Scheelite Mine on King Island, northwest of Tasmania. During the year, KIS engaged a technical consulting firm to design and cost a beneficiation plant to treat ore from the proposed Dolphin Mine. The proposed operation was expected to have lower capital and operating costs compared with those of previous studies, owing mainly to a redesign of the flow sheet, which focused on gravity separation supplemented by a flotation circuit (King Island Scheelite Ltd., 2019, p. 4–5).

Tungsten Mining NL purchased the development-ready Watershed tungsten project, northwest of Cairns, Queensland, from Vital Metals Ltd. A 2014 feasibility study projected that an open pit mine and beneficiation plant at Watershed could produce approximately 2,100 t/yr of tungsten in concentrate. In addition to acquiring Watershed, Tungsten Mining entered an agreement with GWR Group Ltd. to purchase the Hatches Creek tungsten project northeast of Alice Springs, Northern Territory, and continued working to develop its Mt. Mulgine tungsten project approximately 350 km north-northeast of Perth, Western Australia (Vital Metals Ltd., 2014, p. 1, 22; Tungsten Mining NL, 2019, p. 3–4).

Austria.—Wolfram Bergbau und Hütten AG (WBH, owned by Sandvik AB, Sweden) 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. The Bergla plant also processed imported tungsten concentrates, secondary raw materials (scrap), and intermediate products such as APT and tungsten oxides (Wolfram Bergbau und Hütten AG, 2019, p. 1–2).

Canada.—The Sisson Project Limited Partnership [Northcliff Resources Ltd. and Todd Minerals Ltd. (New Zealand)] owned the Sisson tungsten-molybdenum project in east-central New Brunswick. During the year, the partnership focused on collecting information needed for mine permits and leases and continuing with engineering studies to optimize the project's mining parameters and metallurgical recoveries, with the objective of reducing capital and operating costs. A 2013 feasibility study on the project was based on 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. APT production was expected to average approximately 4,420 t/yr of contained tungsten during the 27-year mine life (Northcliff Resources Ltd., 2019, p. 4–8).

China.—In 2018, China's production of concentrates decreased slightly to an estimated 65,000 t of contained tungsten, which accounted for 80% of world production (table 15). During the year, environmental and safety inspections of mines and processing plants continued; compliance added to mining and processing costs and reduced production at some operations. In addition, on January 1, a new environmental tax on air and

water pollutants, solid wastes, and excessive noise became effective (Manthey and Fu, 2018; Sun, 2018, p. 14, 28; Argus Media group, 2019, p. 7; China Molybdenum Co., Ltd., 2019, p. 15, 32–33; Roskill Information Services Ltd., 2019, p. 102).

Despite its position as the world's leading producer of mined tungsten, China imported significant quantities of tungsten concentrates in recent years. In 2018, China imported approximately 3,440 t of tungsten in concentrates, which was 21% of global production outside China. The leading sources of these imports were North Korea (41%), Vietnam (21%), Russia (14%), and Burma and Rwanda (9% each) (Zen Innovations AG, undated). Scrap recycling also contributed to China's tungsten raw materials supply.

The Ministry of Industry and Information Technology set standards in 2016 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 (China Molybdenum Co., Ltd., 2017, p. 39; Roskill Information Services Ltd., 2019, p. 105).

The Government continued to regulate the production of tungsten concentrates by requiring exploration and mining permits, prohibiting foreign investment in tungsten exploration and mining, setting production quotas, and performing environmental and safety inspections. In late 2018, the Government announced that the approval of 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. The Government regulated tungsten exports by issuing export licenses (Sun, 2018, p. 21–23, 37; Roskill Information Services Ltd., 2019, p. 101, 104–105; Zhang and others, 2019).

China's Ministry of Natural Resources increased the total tungsten concentrate production quota for 2018 by 9.5% to 100,000 t (65% WO_3), equivalent to approximately 51,500 t of contained tungsten. Of the quota, 76% was for operations mining tungsten as the principal product and 24% was in the comprehensive use category, which represented tungsten produced as a coproduct or byproduct. The quota was distributed among 17 Provinces, 2 of which received 64% of the total—Jiangxi, 39%, and Hunan, 25%. China's concentrate production was typically greater than the quota. For example, the 2018 quota of 100,000 t (65% WO_3) was equivalent to approximately 51,500 t of contained tungsten, but production was estimated to be 65,000 t of contained tungsten (Sun, 2018, p. 21–22).

Congo (Kinshasa).—In 2018, 67% of the tungsten concentrate produced by artisanal miners in Congo (Kinshasa) was from Sud-Kivu Province and 33% was from Maniema Province. As discussed in the "Legislation and Government Programs" section of this report, 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. Congo (Kinshasa), Burundi, 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 tungsten, tantalum, and tin from the mines to the processors (International Tin Association Ltd., 2019; Ministère des Mines, 2019).

Kazakhstan.—At yearend, JSC NMC Tau-Ken Samruk and Xiamen Tungsten Co., Ltd. (China) agreed to establish a joint venture to build mining and beneficiation operations at two tungsten deposits in the Qaraghandy Region—North Katpar and Upper Kairaktinskoye—and a hydrometallurgical plant to produce APT from the tungsten concentrates produced from the mines (JSC NMC Tau-Ken Samruk, 2018).

Korea, Republic of.—Almonty Korea Tungsten Corp. (a wholly owned subsidiary of Woulfe Mining Corp., which is fully owned by Almonty Industries Inc.) continued to work on financing, development, and permitting for its Sangdong tungsten project southeast of Seoul in Gangwon Province. In late 2017, Almonty entered into an engineering, procurement, and construction contract for the development and construction of a beneficiation plant. In early 2018, Almonty signed contracts for the following: a 10-year offtake agreement for tungsten concentrate from the mine, a site clearance contract for the new processing plant, and a mine development contract for underground galleries through the target mining zones. Late in the year, Almonty announced that the financing approval process being undertaken by KfW IPEX-Bank GmbH was in the late stage of finalization. By yearend, Almonty had started mine development work. Based on an updated feasibility study, ore from the underground mine would be processed by mineral flotation to produce a scheelite concentrate during a mine life of 8 years. The capacity of the project would be approximately 2,000 t/yr of tungsten in concentrate (Wheeler and Wells, 2016, p. 193, 282; Almonty Industries Inc., 2018a, b; 2019, p. 8–9).

Portugal.—During the year, Almonty continued to focus on cost reduction at the Panasqueira Mine and beneficiation plant in Covilha, Castelo Branco District. Production of tungsten in wolframite concentrate increased by 7% from that in 2017. The increase was attributed to continued increases in the grade of ore mined under the revised mine plan implemented after Almonty's acquisition of the operation in 2016. During the year, Cronimet Mining Processing SA Pty. Ltd. was installing x-ray ore sorting equipment to treat tailings from Panasqueira's heavy-media separation unit. This equipment was expected to increase the mine's overall tungsten recovery rate by 10%, beginning around mid-2019 (Almonty Industries Inc., 2019, p. 7).

W Resources PLC (United Kingdom) concluded the purchase of land hosting the deposit outcrop and trial mine facilities for the Régua project, 95 km east of Porto in north-central Portugal. During the year, the company decided to do additional drilling to update the resource estimate. W Resources planned to develop a low-cost underground mine, truck the ore to a nearby existing crushing plant, and once a new large-scale beneficiation plant is installed at W Resource's La Parrilla tungsten mine in Spain, move La Parrilla's older beneficiation plant to Régua (W Resources PLC, 2019, p. 3–4).

Russia.—In 2018, most of Russia's tungsten in concentrate was produced from the following four operations, in descending order of tungsten production: Primorsky GOK JSC's Vostok-2 Mine in Primorskiy Krai; JSC Zakamensk's Barun-Narynskoe operation, which produced concentrates from tailings in Buryatiya Republic; CJSC Novoorlovsky GOK's Spokoininskoe Mine in the Transbaikalian region; and LLC Lermontovsky Mining and Processing Plant's (KGUP "PRIMTEPLOENERGO") Lermontovsky Mine in Primorskiy Krai. Some of the remaining tungsten was mined from two tin operations in the Khabarovsk Territory, one of which (Pravourmiyskiy) recovered tungsten in concentrate (Ministry of Natural Resources and Ecology of the Russian Federation, 2019, p. 209–211).

In 2018, production of hydrometallurgical intermediates (APT and yellow tungsten oxide) in Russia increased from about 1,500 t of contained tungsten to about 2,000 t, and production of ferrotungsten decreased from about 1,200 t of contained tungsten to about 870 t. Two hydrometallurgical tungsten processing plants were operational—Kirovgradskiy Zavod Tverdykh Splavov OAO's Kirovgrad Hard Alloys plant in Sverdlovsk Oblast and Wolfram Company's Hydrometallurg plant at Nalchik, Kabardino-Balkariya Republic. Two operations had the capability to produce ferrotungsten—Wolfram Company's plant in Unecha, Bryansk Oblast, and OOO Moliren's plant in Roshal, Moscow region. As a result of low APT prices, in 2018, part of the APT production line at Hydrometallurg was converted to recover molybdenum trioxide from spent catalysts. Also in 2018, the Unecha ferrotungsten plant launched production of ferromolybdenum and molybdenum bars (Gorbachev, 2019, p. 25, 31; Ministry of Natural Resources and Ecology of the Russian Federation, 2019, p. 211; Roskill Information Services Ltd., 2019, p. 152).

Wolfram Company continued to build its Primorwolfram Mine at the Zabytoe tungsten-tin deposit in Primorskiy Krai. The mine was expected to produce about 80 t of tungsten in concentrate by yearend 2019, 400 t in 2020, and 550 t in 2021. The company also had licenses to develop the nearby Lazurnoe and Verkhnepriiskovoe deposits (Gorbachev, 2019, p. 21, 24).

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 "Legislation and Government Programs" section of this chapter and participated in the iTSCi program described in the "Congo (Kinshasa)" section.

Spain.—Daytal Resources Spain, S.L. (a subsidiary of Almonty) produced scheelite concentrate from its Los Santos Mine and beneficiation plant in Salamanca Province. Although quarterly production statistics were not available after the quarter ending in March 2018, Almonty reported that the amount of tungsten in concentrate produced each quarter in 2018 was 26% to 36% higher than that produced during the equivalent quarter in 2017. The increased production was attributed to lower strip ratios and improved tungsten recovery rates in 2018 compared with those in 2017. Almonty continued

to focus on controlling and reducing costs during the year (Almonty Industries Inc., 2019, p. 7).

In early 2018, W Resources secured funding to develop its La Parrilla tungsten and tin mine in the Extremadura region in the Provinces of Badajoz and Caceres and signed offtake agreements with WBH and a leading supplier to the U.S. tungsten market. The company began construction of the open pit mine and the crusher, jig-and-mill, and large-scale beneficiation plants, as well as water, power, and other services. By yearend, W Resources had produced and shipped tungsten concentrate, using its existing beneficiation plant and tailings as feed. The company successfully completed a series of production runs with mined ore and planned to increase concentrate production incrementally as various plants were commissioned. During the “T2” phase of the project, W Resources planned to mine 2 million metric tons per year of ore and to produce 2,700 t/yr of tungsten concentrate containing approximately 1,450 t/yr of tungsten and 200 t/yr of tin concentrate (W Resources PLC, 2017, p. 2, 6–7, 10; 2019, p. 2–3).

At yearend, Saloro SLU, the project-operating company for the Barruecopardo joint venture [Oaktree Capital Management, L.P. and Ormonde Mining PLC (Ireland)], was nearly done with construction and had begun commissioning at the Barruecopardo tungsten project in Salamanca Province. Barruecopardo was to be a 9-year open pit operation, with a potential for expansion underground. Ore would be beneficiated using gravity methods to produce approximately 2,060 t/yr of tungsten in scheelite concentrate at full production after a 1-year rampup period. Saloro had an offtake agreement with Noble Resources International Pte. Ltd., under which Noble would purchase all the tungsten concentrate produced from the mine during its first 5 years of operation (Ormonde Mining PLC, 2014; 2018a, p. 10, 12; 2018b).

United Kingdom.—Wolf Minerals Ltd. (Australia) continued its efforts to improve plant availability, throughput, and recovery rates at its Hemerdon tungsten and tin project in Devon, northeast of Plymouth. The project consisted of the Drakelands open pit mine and a beneficiation plant, which were expected to have an average production of 2,920 t/yr of tungsten in wolframite concentrate and 563 t/yr of tin in concentrate after rampup. Despite improved operating performance during the first half of the year, Wolf Minerals could not maintain positive cash flow nor arrange enough funding to continue operations. In October, the company went into voluntary administration (Ferrier Hodgson, 2018, p. 6; Wolf Minerals Ltd., 2018; 2019, p. 29).

Uzbekistan.—Ingichki Metals LLC (an Uzbekistan-Russia joint venture) reportedly had produced scheelite concentrate since 2008, from tailings generated during previous mining operations at the Ingichki Mine in Samarkand. The concentrates were sent to processors in Uzbekistan and elsewhere (Roskill Information Services Ltd., 2019, p. 167; Ingichki Metals LLC, undated).

In 2018, IFG Capital Partners SA (Luxembourg) signed an agreement with the State Committee of the Republic of Uzbekistan on Geology and Mineral Resources (GOSCOMGEOLOGY) to study the feasibility of developing the Yakhton tungsten deposit in Samarkand. Later in the year, IFG Capital and SUN Group (India) signed an agreement

with GOSCOMGEOLOGY on the joint development of six additional tungsten deposits—Gussay, Ingichke, Kara-Tyube, Koytash, Lyangar, and Sarykul—with the objective of producing tungsten concentrates for export to North America and Europe (IFG Capital Partners SA, 2018a, b).

Vietnam.—Nui Phao Mining Co. Ltd. (Masan Resources Corp.) produced 4,350 t of tungsten in concentrate from its Nui Phao open pit polymetallic mine in Thai Nguyen Province, 15% less than the 5,140 t produced in 2017. During the year, Nui Phao continued to upgrade the tungsten circuit in the beneficiation plant, which resulted in an increase in the tungsten recovery rate. The decrease in tungsten concentrate production was attributed to lower ore grades from the mine and lower throughput at the beneficiation plant (Masan Resources Corp., 2018, p. 18; 2019, p. 9, 26, 78).

Nui Phao’s tungsten concentrate and tungsten raw materials from other sources—including chemical intermediates such as calcium and sodium tungstate, wolframite concentrates from iTSCi member suppliers in Rwanda, and concentrates from the NDS—were processed to APT, blue and yellow tungsten oxides, and sodium tungstate at the nearby Nui Phao–H.C. Starck Tungsten Chemicals Manufacturing joint-venture processing plant. In 2018, the plant consumed 4,440 t of tungsten in concentrate from Nui Phao and 743 t of tungsten in raw materials from other sources, compared with 5,150 t from Nui Phao and 166 t from other sources in 2017. Total APT production, on the basis of contained tungsten, decreased by 5% from 5,180 t in 2017 to 4,910 t in 2018. In August, Nui Phao acquired H.C. Starck’s 49% stake in the tungsten chemicals plant and changed the name of the controlling company to Masan Tungsten LLC. The company planned to increase the production capacity of the chemicals plant from 5,900 t/yr of contained tungsten to 9,500 t/yr of contained tungsten and was in discussion with suppliers of raw materials for strategic acquisition or long-term offtake agreements (Masan Group Corp., 2018, p. 1, 4, 15; Masan Resources Corp., 2019, p. 9, 26, 78; Masan Tungsten LLC, 2019).

Two additional companies produced APT and downstream tungsten materials from concentrates and scrap in southern Vietnam—Sanher Tungsten Vietnam Co. Ltd. in Dong Nai Province and Tejing (Vietnam) Tungsten Co., Ltd. in Tay Ninh Province. Two companies had the capability to produce ferrotungsten—Vietnam Youngsun Tungsten Industry Co., Ltd., at its plant in Halong City, Quang Ninh Province, and Asia Tungsten Products Vietnam Ltd. [Asia Tungsten Products Co., Ltd. (Hong Kong), a joint venture between ATC Alloys Ltd. and a private businessman], at its plant in the Vinh Bao district near the Port of Haiphong. The Asia Tungsten Products plant did not operate during calendar years 2017 and 2018 (ATC Alloys Ltd., 2017, p. 4; 2019, p. 4, 6).

Zimbabwe.—RHA Tungsten Pvt. Ltd. [National Indigenisation and Economic Empowerment Fund (NIEEF) and Premier African Minerals Ltd.] maintained its tungsten operation in northwestern Zimbabwe on care-and-maintenance status while Premier negotiated with NIEEF regarding the project’s ownership. During the year, RHA undertook drilling for mine planning and identified potential improvements to the beneficiation plant. By late 2018, NIEEF stated their

intention to retain ownership, but to invest in RHA to restart the mine under Premier's management (Premier African Minerals Ltd., 2019, p. 1, 3).

Outlook

World tungsten supply likely will continue to be dominated by China's production and exports. China's Ministry of Natural Resources increased the total tungsten production quota for 2019 to 105,000 t (65% WO₃), equivalent to approximately 54,100 t of contained tungsten (Ministry of Natural Resources, 2019). 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.

In the next few years, tungsten concentrate production from Australia, Portugal, Russia, and Spain is expected to increase as producers improve output from established mines or begin and ramp up production from new mines. As discussed in the "World Review" section, numerous companies worked to develop tungsten deposits, produce tungsten concentrate from stockpiled tailings, or restart production from inactive mines in Africa, Australia, Eurasia, and North America. In the decade ending 2028, an estimated 32,000 t/yr of tungsten in concentrate could be generated from tungsten mine projects under development (Roberts, 2018, p. 14). 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 oil and gas drilling.

The transportation sector is estimated to account for approximately one-third of global tungsten consumption. Future growth in tungsten use is expected to be strongly influenced by trends in vehicle production. Although the production of electric vehicles (EV) requires less tungsten for machining engine and gearbox parts than the production of vehicles with internal combustion engines, forecasts of strong growth in EV production are expected to partly counterbalance any decrease in unit consumption of tungsten per vehicle (Argus Media group, 2018a, p. 5).

The global shift towards light-emitting diode lamps is expected to reduce demand for tungsten mill products used in incandescent and fluorescent lamps, but because lighting applications represent only a small fraction of overall tungsten use, this is not expected to have a large impact on overall tungsten demand. Increased use of additive manufacturing ("3D printing") 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; and the growing use of tungsten hexafluoride in semiconductor manufacturing (Argus Media group, 2018b, p. 5–6; Roberts, 2018, p. 22–23).

References Cited

- Almonty Industries Inc., 2018a, Almonty announces the commencement of the mine development work at its wholly-owned Sangdong Mine: Toronto, Ontario, Canada, Almonty Industries Inc. news release, November 27, 4 p. (Accessed July 24, 2020, at https://almonty.com/wp-content/uploads/2019/07/AII_NR181127.pdf.)
- Almonty Industries Inc., 2018b, Almonty Industries Inc. announces signing of site clearance contract, mine development contract, signing date for a technical and pilot plant full subsidy and commencement of construction work at Sangdong Mine: Toronto, Ontario, Canada, Almonty Industries Inc. news release, April 23, 4 p. (Accessed July 24, 2020, at https://almonty.com/wp-content/uploads/2019/07/AII_NR180423.pdf.)
- Almonty Industries Inc., 2019, Management's discussion and analysis for the three-month period ended December 31, 2018: Toronto, Ontario, Canada, Almonty Industries Inc., February 14, 28 p. (Accessed August 14, 2020, at https://almonty.com/wp-content/uploads/2019/06/AII_MDA_Q1_191231_FINAL_SEDAR.pdf.)
- Argus Media group, 2018a, [untitled]: Argus Tungsten Monthly Outlook, no. 18–4, April 11, 12 p.
- Argus Media group, 2018b, [untitled]: Argus Tungsten Monthly Outlook, no. 18–11, November 14, 12 p.
- Argus Media group, 2019, [untitled]: Argus Tungsten Monthly Outlook, no. 19–3, March 13, 12 p.
- ATC Alloys Ltd., 2017, Half year report—31 December 2016: West Perth, Western Australia, Australia, ATC Alloys Ltd., 24 p. (Accessed July 23, 2020, at
- ATC Alloys Ltd., 2019, Half year report—31 December 2018: West Perth, Western Australia, Australia, ATC Alloys Ltd., 21 p. (Accessed July 23, 2020, at
- Baker Hughes Inc., 2019, North America rotary rig count (Jan 2000–current): Baker Hughes Inc., July 26. (Accessed August 9, 2019, via <http://phx.corporate-ir.net/phoenix.zhtml?c=79687&p=irol-reports&other>.)
- China Molybdenum Co., Ltd., 2017, 2016 annual report: Luoyang, China, China Molybdenum Co., Ltd., 240 p. (Accessed January 25, 2018, at http://www.chinamolyc.com/06invest/DOC/E_03993_AR007_HKEx.pdf.)
- China Molybdenum Co., Ltd., 2019, 2018 annual report: Luoyang, China, China Molybdenum Co., Ltd., 268 p. (Accessed July 31, 2020, at http://www.chinamolyc.com/06invest/DOC/2019/E_03993_20190424.pdf.)
- Defense Logistics Agency Strategic Materials, 2016, Annual Materials Plan for FY 2017 for possible acquisition of new NDS stocks: Fort Belvoir, VA, Defense Logistics Agency Strategic Materials news release, October 3, 1 p. (Accessed July 23, 2020, at https://www.dla.mil/Portals/104/Documents/Strategic%20Materials/Announcements/3118%20FY17%20AMP_ACQ.pdf.)
- Defense Logistics Agency Strategic Materials, 2017, Annual Materials Plan for FY 2018 [potential acquisitions]: Fort Belvoir, VA, Defense Logistics Agency Strategic Materials news release, October 1, 1 p. (Accessed July 23, 2020, at
- Defense Logistics Agency Strategic Materials, 2018a, Annual Materials Plan for FY 2019 [potential acquisitions]: Fort Belvoir, VA, Defense Logistics Agency Strategic Materials news release, October 3, 1 p. (Accessed July 23, 2020, at
- Defense Logistics Agency Strategic Materials, 2018b, Annual Materials Plan for FY 2019 [potential disposals]: Fort Belvoir, VA, Defense Logistics Agency Strategic Materials news release, October 3, 1 p. (Accessed July 23, 2020, at

- Ferrier Hodgson, 2018, Wolf Minerals Limited (administrator appointed) ACN 121 831 472—Voluntary administrators' report: Perth, Western Australia, Australia, Ferrier Hodgson, November 5, 75 p. (Accessed August 14, 2020, at <http://www.publicnow.com/view/E167E94C608DE05EE18AEE6DF958967DD0279B78.>)
- Geoscience Australia, 2020, Australia's identified mineral resources 2019: Canberra, Australian Capital Territory, Australia, Geoscience Australia, 86 p. (Accessed April 6, 2020, at https://d28rz98at9flks.cloudfront.net/132457/132457_00_0.pdf.)
- Gorbachev, Denis, 2019, Russian market update: International Tungsten Industry Association Annual General Meeting, 32d, Stresa, Italy, October 17–18, presentation, 33 p.
- IFG Capital Partners SA, 2018a, IFG Capital signs exclusive agreement for \$300m tungsten cluster in Uzbekistan; aims to become a top-three global producer: Strassen, Luxembourg, IFG Capital Partners SA press release, October 1. (Accessed July 29, 2020, at <http://ifg-capital.com/ifg-capital-signs-exclusive-agreement-for-300m-tungsten-cluster-in-uzbekistan-aims-to-become-a-top-three-global-producer/>.)
- IFG Capital Partners SA, 2018b, IFG Capital signs Uzbek tungsten agreement: Strassen, Luxembourg, IFG Capital Partners SA press release, July 23. (Accessed July 29, 2020, at <http://ifg-capital.com/ifg-capital-signs-uzbek-tungsten-agreement/>.)
- Ingichki Metals LLC, [undated], [untitled]: Tashkent, Uzbekistan, Ingichki Metals LLC. (Accessed July 29, 2020, at <https://www.ingichkimetals.com/>.)
- International Tin Association Ltd., 2019, Our purpose—Achieving together: Hertfordshire, United Kingdom, International Tin Association Ltd. (Accessed July 17, 2019, at <https://www.itsci.org/purpose/>.)
- International Tungsten Industry Association, 2019, Statistical overview of supply and demand in 2018: London, United Kingdom, International Tungsten Industry Association, September, 20 p.
- JSC NMC Tau-Ken Samruk, 2018, National Company Tau-Ken Samruk attracts strategic investor to implement the project on production of high processed tungsten products: Nur-Sultan, Kazakhstan, JSC NMC Tau-Ken Samruk news release, December 25. (Accessed July 24, 2020, at <http://tks.kz/en/national-company-tau-ken-samruk-attracts-strategic-investor-to-implement-the-project-on-production-of-high-processed-tungsten-products/>.)
- King Island Scheelite Ltd., 2019, Interim financial statements—Six months ended 31 December 2018: Sydney, New South Wales, Australia, King Island Scheelite Ltd., February 13, 28 p. (Accessed July 21, 2020, at <https://www.asx.com.au/asxpdf/20190213/pdf/4421hbj1tjlmw9.pdf>.)
- Manthey, Ewa, and Fu, Huaqing, 2018, New round of environmental inspections start in Jiangxi Province; market mulls impact on tungsten prices: Metal Bulletin Daily, no. 9588.3, November 28, p. 7. (Accessed July 31, 2020, via <http://www.metalbulletin.com/>.)
- Masan Group Corp., 2018, Growth fundamentals intact—90% core NPAT growth for 9m 2018 and tracking full year 2018 core profit estimates: Ho Chi Minh City, Vietnam, Masan Group Corp. news release, October 29, 16 p. (Accessed July 28, 2020, at <https://masangroup-cms-production.s3-ap-southeast-1.amazonaws.com/iblock/1d0/1d01432de2580b2b3d4cbaec30431ac0/9ed07a5ec8ba8f3aec4b0a1dbac232fc.pdf>.)
- Masan Resources Corp., 2018, Annual report 2017: Ho Chi Minh City, Vietnam, Masan Resources Corp., 163 p. (Accessed July 18, 2018, at <http://masangroup-cms-production.s3-ap-southeast-1.amazonaws.com/iblock/59c/59cf7c587969efa6ce4f4cd2978ff6c7/a86901ac19202917bfb05c6c33d2faa2.pdf>.)
- Masan Resources Corp., 2019, Annual report 2018: Ho Chi Minh City, Vietnam, Masan Resources Corp., 181 p. (Accessed September 24, 2019, at <https://masangroup-cms-production.s3-ap-southeast-1.amazonaws.com/iblock/a06/a063dbe09213e1d4c837e4a06132f81e/65aeedc6b52bf1258a726073097ff6ae.pdf>.)
- Masan Tungsten LLC, 2019, Masan Tungsten Limited Liability Company due diligence report for mineral supplies in 2018 ('OECD step 5 report'): Ho Chi Minh City, Vietnam, Masan Tungsten LLC, January, 4 p. (Accessed July 28, 2020, at <http://masangroup-cms-production.s3-ap-southeast-1.amazonaws.com/iblock/720/7202379625c651b438bbf86bd120d198/f42589d497249ff29a6b4df504bbee93.pdf>.)
- Metal Bulletin Daily, 2016, 2017 preview—Chinese tungsten prices will continue journey of recovery as market reaches consensus on price floor: Metal Bulletin Daily, no. 9489.4, December 22, p. 9. (Accessed January 9, 2017, via <http://www.metalbulletin.com/>.)
- Metal Bulletin Daily, 2018, ITIA 2018—Key talking points ahead of the Chengdu conference: Metal Bulletin Daily, no. 9579.1, September 24, p. 8–9. (Accessed July 23, 2020, via <http://www.metalbulletin.com/>.)
- Ministère des Mines, 2019, [untitled]: Kinshasa, Democratic Republic of the Congo, Ministère des Mines, 29 p. (Accessed July 17, 2019, at http://www.mines-rdc.cd/fr/wp-content/uploads/documents/Statistiques/2018/STATISTIQUES_MINIERES_EXERCICE%20_2018.pdf.) [In French.]
- Ministry of Natural Resources, 2019, 2019 annual rare earth tungsten mine mining total control index announced: Beijing, China, Ministry of Natural Resources, November 12. (Accessed July 30, 2020, at http://www.gov.cn/xinwen/2019-11/12/content_5451202.htm.)
- Ministry of Natural Resources and Ecology of the Russian Federation, 2019, State report—On condition and use—Mineral and raw materials—Russian Federation in 2018: Moscow, Russia, Ministry of Natural Resources and Ecology of the Russian Federation, 424 p.
- Northcliff Resources Ltd., 2019, Management's discussion and analysis for the year ended October 31, 2018: Vancouver, British Columbia, Canada, Northcliff Resources Ltd. news release, January 29, 16 p. (Accessed April 2, 2020, via <https://www.sedar.com/DisplayCompanyDocuments.do?lang=EN&issuerNo=00030606>.)
- Ormonde Mining PLC, 2014, Tungsten offtake agreement with Noble Group for Barruecopardo: Dublin, Ireland, Ormonde Mining PLC, March 24, 1 p. (Accessed March 8, 2019, at https://polaris.brighterir.com/public/ormonde_mining/news/rms/story/ewvooyqr.)
- Ormonde Mining PLC, 2018a, Annual report 2017: Dublin, Ireland, Ormonde Mining PLC, 63 p. (Accessed September 24, 2018, at http://ormondemining.com/wp-content/uploads/2018/06/Ormonde-AR17-64-pages-A4_web.pdf.)
- Ormonde Mining PLC, 2018b, Barruecopardo tungsten project—Construction and commissioning update: Dublin, Ireland, Ormonde Mining PLC, December 14, 1 p. (Accessed April 3, 2020, at https://polaris.brighterir.com/public/ormonde_mining/news/rms/story/wvq553x.)
- Premier African Minerals Ltd., 2019, Annual report—31 December 2018: Tortola, British Virgin Islands [United Kingdom], Premier African Minerals Ltd., 81 p. (Accessed July 15, 2019, via <https://www.premierafricanminerals.com/investors/reports>.)
- Roberts, Jessica, 2018, Tungsten mine projects—Will there be enough supply to meet demand?: International Tungsten Industry Association Annual General Meeting, 31st, Chengdu, China, September 25–27, presentation, 24 p.
- Roskill Information Services Ltd., 2019, Tungsten outlook to 2028 (13th ed.): London, United Kingdom, Roskill Information Services Ltd., 269 p.
- Specialty Metals International Ltd., 2019, Half year financial report—31 December 2018: Melbourne, Victoria, Australia, Specialty Metals International Ltd., 19 p. (Accessed April 9, 2019, via <http://www.specialitymetalsintl.com.au/asx2019>.)
- Sun, Xudong, 2018, China market update: International Tungsten Industry Association Annual General Meeting, 31st, Chengdu, China, September 25–27, presentation, 54 p.
- Thor Mining PLC, 2018, Twelve year open pit life for Desert Scheelite Pilot Mountain scoping study: London, United Kingdom, Thor Mining PLC ASX announcement, September 7, 10 p. (Accessed September 10, 2018, at <http://www.thormining.com/-/thor/lib/docs/asx%20releases/20180907%20Pilot%20Mountain%20Scoping%20Study.pdf>.)
- Thor Mining PLC, 2019, Half-yearly report for the six months ended 31 December 2018: London, United Kingdom, Thor Mining PLC, 17 p. (Accessed March 6, 2019, at <https://www.asx.com.au/asxpdf/20190301/pdf/4433zm4n15lm84.pdf>.)
- Till Capital Ltd., 2019, Management's discussion and analysis for the years ended December 31, 2018 and 2017: Hamilton, Bermuda, Till Capital Ltd., April 26, 23 p. (Accessed May 1, 2019, at <https://www.sedar.com/GetFile.do?lang=EN&docClass=7&issuerNo=00035778&issuerType=03&projectNo=02906577&docId=4506680>.)
- Trump, D.J., 2017, A Federal strategy to ensure secure and reliable supplies of critical minerals—Executive Order 13817 of December 20, 2017: Federal Register, v. 82, no. 246, December 26, p. 60835–60837. (Accessed December 2, 2019, at <https://www.govinfo.gov/content/pkg/FR-2017-12-26/pdf/2017-27899.pdf>.)
- Tungsten Mining NL, 2019, Half-year financial report—31 December 2018: West Perth, Western Australia, Australia, Tungsten Mining NL, 22 p. (Accessed May 1, 2019, at <https://www.tungstenmining.com/wp-content/uploads/2019/03/TGN-190308-Half-Year-Accounts.pdf>.)
- U.S. Department of the Interior, Office of the Secretary, 2018, Final list of critical minerals 2018: Federal Register, v. 83, no. 97, May 18, p. 23295–23296. (Accessed May 6, 2019, at <https://www.govinfo.gov/content/pkg/FR-2018-05-18/pdf/2018-10667.pdf>.)

U.S. Government Accountability Office, 2019, Conflict minerals—2018 company reports on mineral sources were similar in number and content to those filed in the prior 2 years: Washington, DC, U.S. Government Accountability Office, GAO-19-607, September, 36 p. (Accessed April 15, 2020, at <https://www.gao.gov/assets/710/701232.pdf>.)

U.S. Securities and Exchange Commission, 2012, Conflict minerals—Final rule: Federal Register, v. 77, no. 177, September 12, p. 56274–56365. (Accessed January 8, 2018, at <https://www.gpo.gov/fdsys/pkg/FR-2012-09-12/pdf/2012-21153.pdf>.)

Vital Metals Ltd., 2014, Watershed feasibility study confirms strong economics for 2.5 Mtpa tungsten operation: Subiaco, Western Australia, Australia, Vital Metals Ltd., September 17, 30 p. (Accessed August 14, 2020, at <https://www.asx.com.au/asxpdf/20140917/pdf/42s8j6f3sf3ps1.pdf>.)

W Resources PLC, 2017, La Parrilla Mine, Extremadura, Spain—Financial investment decision report: London, United Kingdom, W Resources PLC, August, 15 p. (Accessed March 8, 2019, at <https://wresources.com/wp-content/uploads/2017/09/WRES-Final-Investment-Decision-Report-FINAL.pdf>.)

W Resources PLC, 2019, Annual report 2018: London, United Kingdom, W Resources PLC, 48 p. (Accessed September 23, 2019, at https://wresources.com/wp-content/uploads/W-Resources-AR2018_WEB.pdf.)

Wheeler, Adam, and Wells, Andrew, 2016, Update of the feasibility study technical report for the Sangdong tungsten project, South Korea—Prepared for Almonty Korea Tungsten Corporation: Almonty Industries Inc., January 18, 297 p. (Accessed August 14, 2020, at https://almonty.com/wp-content/uploads/2019/06/Sangdong_FS_Jan16_V9.pdf.)

Wolf Minerals Ltd., 2018, Quarterly activities report—For the three months ended 30 June 2018: Subiaco, Western Australia, Australia, Wolf Minerals Ltd., July 18, 7 p. (Accessed April 6, 2020, at <https://www.asx.com.au/asxpdf/20180718/pdf/43wm1r5gf25550.pdf>.)

Wolf Minerals Ltd., 2019, Annual report—For the financial year ended 30 June 2018: Subiaco, Western Australia, Australia, Wolf Minerals Ltd., 64 p. (Accessed April 6, 2020, at <https://www.asx.com.au/asxpdf/20191219/pdf/44cr17sz0k0skm.pdf>.)

Wolfram Bergbau und Hütten AG, 2019, Wolfram Bergbau & Hütten AG due diligence report for mineral supplies in year 2018: St. Martin im Sulmtal, Austria, Wolfram Bergbau und Hütten AG, March 12, 13 p. (Accessed April 3, 2020, at https://www.wolfram.at/wp-content/uploads/2019/03/WBH-OECD-step-5-report-2018_final.pdf.)

Xu, Anna, 2017, Xiamen tungsten conf—Four things we learned in Xiamen: Metal Bulletin Daily, no. 9535.5, November 17, p. 1–2. (Accessed March 6, 2017, via <http://www.metalbulletin.com/>.)

Zen Innovations AG, [undated], Global trade statistics database (Global Trade Tracker): Bern-Kehrsatz, Switzerland, Zen Innovations AG. (Accessed September 24, 2019, via <https://www.globaltradetracker.com>.)

Zhang, Z.A., Tsoi, V., Jalinous, F., Burke, R., Xu, L., and Li, L., 2019, China further removes foreign investment restrictions: New York, NY, White & Case LLP client alert, July 15, 4 p. (Accessed July 31, 2020, at <https://www.whitecase.com/sites/default/files/2019-07/china-further-removes-foreign-investment-restrictions.pdf>.)

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Historical Statistics for Mineral and Material Commodities in the United States. Data Series 140.

Tungsten. Ch. in Mineral Commodity Summaries, annual.

Tungsten. Ch. in United States Mineral Resources, Professional Paper 820, 1973.

Tungsten. International Strategic Mineral Issues Summary Report, Circular 930–O, 1998 (ver. 1.1, 2014).

Tungsten. Mineral Industry Surveys, monthly.

Tungsten (W). Ch. in Metal Prices in the United States Through 2010, Scientific Investigations Report 2012–5188, 2013.

Tungsten Recycling in the United States in 2000. Circular 1196–R, 2011.

Other

Argus Tungsten Monthly Outlook.

DATAWEB. U.S. International Trade Commission.

Defense Logistics Agency Strategic Materials, U.S. Department of Defense.

Fastmarkets, daily.

Federal Register, daily.

International Tungsten Industry Association.

Materials Flow of Tungsten in the United States. U.S. Bureau of Mines Information Circular 9388, 1994.

Roskill Information Services Ltd.

Tungsten Industry of the U.S.S.R., The. U.S. Bureau of Mines Mineral Issues, 1988.

Tungsten. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985.

Tungsten. Mineral Profile, British Geological Survey, 2011.

UN Comtrade. United Nations.

USA Trade Online. U.S. Census Bureau.

TABLE 1
SALIENT TUNGSTEN STATISTICS¹

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

	2014	2015	2016	2017	2018
United States:					
Concentrates:					
Production	NA	NA	--	--	--
Consumption	W	W	W	W	W
Exports	1,230	398	183	532	284
Imports for consumption	4,080	3,970	3,580	3,920 ^r	4,050
Stocks, December 31:					
Consumer	W	W	W	W	W
U.S. Government ²	11,600	11,600	11,600	10,200	8,990
Price, U.S. spot quotation ³	348	302	148	245	326
Ammonium paratungstate:					
Production	W	W	W	W	W
Consumption ⁴	W	W	W	W	W
Exports	653	310	108	97	106
Imports for consumption	1,780	1,270	1,020	2,230	2,200
Stocks, December 31, producer and consumer	W	W	W	W	W
Price:					
U.S. market ³	358	299	198	278	364
European free market ⁵	357	227	191	242	313
Ferrotungsten:					
Production	--	--	--	--	--
Consumption	107	227	100	97	129
Exports	76	29	23	45	104
Imports for consumption	454	269	236	209	143
Stocks, December 31, consumer	W	35	36	36	35
Price, U.S. free market ^{3,6}	46.74	30.21	29.88	37.28	45.91
Primary products:					
Net production ⁷	6,310	6,080	7,500	7,760	7,330
Consumption ⁸	11,600	11,100	10,400	11,300	11,800
Stocks, December 31:					
Producer ⁷	674	493	544	621	559
Consumer ⁸	676	541	531	551	535
U.S. Government ²	125	125	125	125	125
World, production of concentrate	82,100 ^r	83,800	78,300 ^r	81,200 ^r	81,100

^rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data. -- Zero.

¹Table includes data available through November 8, 2019. Data are rounded to no more than three significant digits, except prices.

²Source: Defense Logistics Agency Strategic Materials.

³Annual averages calculated from weekly prices reported by Platts Metals Week.

⁴Reported by tungsten processors.

⁵Annual averages calculated from monthly prices reported by Metal Bulletin.

⁶Dollars per kilogram of contained tungsten.

⁷Includes tungsten metal powder and tungsten carbide powder produced from metal powder; excludes cast and crystalline tungsten carbide powder and chemicals.

⁸Includes ammonium paratungstate and other tungsten chemicals, ferrotungsten, tungsten metal powder, tungsten carbide powder, and tungsten scrap.

TABLE 2
U.S. GOVERNMENT NATIONAL DEFENSE STOCKPILE TUNGSTEN STATISTICS IN 2018¹

(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	9,170	8,990	1,360	1,220	1,170	1,220	1,180
Tungsten metal powder	125	125	125	--	--	(6)	(6)
Total	9,300	9,120	1,490	1,220	1,170	1,220	1,180

-- Zero.

¹Table includes data available through January 18, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

²The yearend inventories included 1 metric ton, gross weight, of tungsten alloy and 5 metric tons, gross weight, of tungsten-rhenium metal.

³Twelve-month period ending September 30, 2018.

⁴Potential barter, disposal, rotation, sale, or upgrade. The Annual Materials Plan also included the possible acquisition of 5 metric tons, gross weight, of tungsten-rhenium metal.

⁵From previous year.

⁶Less than ½ unit increase.

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			
2017	W	W	7,760
2018	W	W	7,330
Stocks, December 31, producer:			
2017	W	W	621
2018	W	W	559

W Withheld to avoid disclosing company proprietary data.

¹Table includes data available through November 8, 2019. Data are rounded to no more than three significant digits.

²Data for cast and crystalline tungsten carbide powder and tungsten chemicals are withheld to avoid disclosing company proprietary data; not included in "Total."

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

TABLE 4
U.S. PROCESSORS OF TUNGSTEN IN 2018^{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.	

¹Table includes data through July 18, 2019.

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

³A division of Plansee Group.

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

TABLE 5
U.S. REPORTED CONSUMPTION AND STOCKS OF TUNGSTEN PRODUCTS^{1,2,3}

(Metric tons, tungsten content)

	2017	2018
Consumption by end use:		
Steels	87	87
Superalloys	619	572
Other alloys ⁴	W	W
Cemented carbides ⁵	6,550	6,930
Mill products made from metal powder	W	W
Chemical	88	88
Total	11,300	11,800
Consumption by form:		
Ferrotungsten	97	129
Tungsten metal powder	W	W
Tungsten carbide powder	6,640	7,210
Tungsten scrap ⁶	W	W
Other tungsten materials ⁷	88	88
Total	11,300	11,800
Stocks, December 31, consumer:		
Ferrotungsten	36	35
Tungsten metal powder	32	29
Tungsten carbide powder	420	420
Tungsten scrap ⁶	51	38
Other tungsten materials ⁷	13	13
Total	551	535

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

¹Table includes data available through August 2, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

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

³Includes estimates.

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

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

⁶Includes tungsten bars.

⁷Includes tungsten chemicals.

TABLE 6
U.S. EXPORTS OF TUNGSTEN ORES AND CONCENTRATES, BY COUNTRY OR LOCALITY^{1,2}

Country or locality	2017			2018		
	Quantity		Value (thousands)	Quantity		Value (thousands)
	Gross weight (metric tons)	Tungsten content ³ (metric tons)		Gross weight (metric tons)	Tungsten content ³ (metric tons)	
Austria	785	405	\$8,420	--	--	--
Brazil	--	--	--	2	1	\$30
Canada	1	(4)	6	9	5	100
France	2	1	169	(4)	(4)	29
Germany	7	4	138	--	--	--
Ireland	--	--	--	3	2	34
Korea, Republic of	21	11	460	2	1	22
Netherlands	--	--	--	29	15	497
Portugal	76	39	698	--	--	--
Switzerland	--	--	--	58	30	1,040
Turkey	(4)	(4)	5	7	3	15
United Kingdom	--	--	--	245	126	4,130
Vietnam	139	72	649	194	100	1,580
Other	(4) ^r	(4)	5 ^r	2	1	45
Total	1,030	532	10,500	551	284	7,520

^rRevised. -- Zero.

¹Table includes data available through October 30, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States code 2611.00.0000.

³Estimated from reported gross weight using 51.6% tungsten.

⁴Less 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	2017		2018	
	Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
	Colombia	1	\$8	1
Denmark	54	476	41	362
Dominican Republic	--	--	5	23
Ecuador	21	273	--	--
France	--	--	2	22
Germany	3	50	34	192
Hungary	16	145	15	130
India	--	--	1	10
Japan	1	10	2	16
Korea, Republic of	1	5	--	--
Peru	--	--	5	41
Other	1 ^r	20	1	13
Total	97	987	106	818

^rRevised. -- Zero.

¹Table includes data available through October 30, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

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

Source: U.S. Census Bureau.

TABLE 8
U.S. EXPORTS OF TUNGSTEN METAL POWDERS, BY COUNTRY OR LOCALITY^{1,2}

Country or locality	2017			2018		
	Quantity		Value (thousands)	Quantity		Value (thousands)
	Gross weight (metric tons)	Tungsten content ³ (metric tons)		Gross weight (metric tons)	Tungsten content ³ (metric tons)	
Austria	6	5	\$296	(4)	(4)	\$8
Belgium	2	2	119	33	26	1,260
Brazil	5	4	242	6	5	323
Canada	122	98	6,010	79	63	4,610
Chile	5	4	175	6	5	353
China	4	3	222	5	4	384
Czechia	30	24	579	25	20	870
France	9	7	339	8	7	587
Germany	67	53	2,640	27	21	1,630
India	10	8	647	31	25	931
Japan	4	4	217	3	3	226
Korea, Republic of	12	9	1,130	9	7	994
Mexico	30	24	1,690	49	40	2,820
Peru	8	6	436	6	5	348
Russia	3	3	190	2	2	101
Saudi Arabia	101	81	4,840	11	9	486
South Africa	10	8	1,040	6	5	560
United Kingdom	3	2	200	3	3	245
Other	28 ^r	22 ^r	1,430 ^r	14	11	923
Total	458	367	22,500	325	260	17,700

^rRevised.

¹Table includes data available through October 30, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

²May include tungsten alloy powders. Harmonized Tariff Schedule of the United States code 8101.10.0000.

³Estimated from reported gross weight using 80% tungsten.

⁴Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 9
U.S. EXPORTS OF TUNGSTEN CARBIDE POWDER, BY COUNTRY OR LOCALITY^{1,2}

Country or locality	2017		2018	
	Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
Australia	30	\$1,000	44	\$1,510
Austria	191	1,670	310	7,350
Belgium	1	132	7	114
Brazil	12	614	12	643
Canada	176	9,390	240	14,600
China	37	2,120	46	2,590
Czechia	57	1,630	119	3,130
Denmark	4	143	3	114
Dominican Republic	5	846	(3)	7
France	4	193	4	188
Germany	151	8,930	194	12,200
Hong Kong	3	191	1	97
India	13	768	13	787
Indonesia	1	68	6	324
Ireland	3	38	7	116
Japan	44	3,020	45	2,500
Korea, Republic of	20	1,680	13	874
Luxembourg	1	36	6	58
Malaysia	4	151	2	138
Mexico	3	146	3	129
Netherlands	2	110	5	139
Peru	2	117	3	168
Philippines	5	456	5	557
Saudi Arabia	19	956	(3)	13
Singapore	13	1,260	19	1,500
Spain	1	59	3	122
Taiwan	58	2,990	40	2,940
Thailand	13	136	1	103
United Kingdom	19	1,740	19	1,630
Other	12 ^r	791 ^r	15	983
Total	901	41,400	1,180	55,700

^rRevised.

¹Table includes data available through October 30, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States code 2849.90.3000.

³Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 10
U.S. EXPORTS OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY OR LOCALITY¹

Product and country or locality	HTS ² code	2017		2018	
		Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
Ferrotungsten and ferrosilicon tungsten:	7202.80.0000				
Brazil		8	\$41	2	\$59
Canada		2	75	3	106
China		(3)	38	17	39
Dominican Republic		3	13	--	--
El Salvador		(3)	4	9	28
Germany		2	116	--	--
Hong Kong		5	13	28	73
Japan		1	77	9	77
Mexico		2	84	1	72
Singapore		--	--	3	7
South Africa		14	45	27	69
United Kingdom		2	6	2	5
Other		6 ^r	162 ^r	4	216
Total		45	673	104	752
Unwrought tungsten: ^{4, 5, 6}	8101.94.0000				
Australia		30	109	(3)	3
Austria		230	4,960	(3)	18
Canada		90	1,990	32	2,370
Finland		86	1,850	(3)	14
Germany		5	242	5	355
Luxembourg		32	672	--	--
Mexico		11	478	8	551
Netherlands		202	3,030	--	--
Philippines		--	--	65	570
Singapore		6	252	5	502
Spain		10	184	2	211
Taiwan		5	29	(3)	13
Vietnam		--	--	7	183
Other		16 ^r	583 ^r	10	843
Total		725	14,400	135	5,630
Waste and scrap: ⁷	8101.97.0000				
Canada		101	1,380	113	1,180
China		13	154	--	--
Finland		50	1,520	92	3,090
Germany		108	1,990	149	2,030
Israel		11	153	--	--
Japan		19	207	52	772
Korea, Republic of		16	136	6	76
Netherlands		42	248	6	226
Philippines		5	39	--	--
Sweden		5	42	--	--
United Kingdom		71	1,590	104	2,100
Vietnam		--	--	121	976
Other		10 ^r	81 ^r	1	25
Total		450	7,540	645	10,500

See footnotes at end of table.

TABLE 10—Continued
 U.S. EXPORTS OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY OR LOCALITY¹

Product and country or locality	HTS ² code	2017		2018	
		Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
Wrought tungsten: ^{4, 8}	8101.96.0000, 8101.99.1000, 8101.99.8000				
Austria		17	\$849	26	\$1,870
Canada		30	4,680	18	2,500
China		6	1,350	24	3,210
Costa Rica		6	804	5	666
Denmark		(3)	34	2	168
France		2	222	1	198
Germany		30	3,050	51	4,290
Hungary		6	858	--	--
India		4	689	2	245
Israel		1	336	4	468
Italy		4	435	4	428
Japan		95	20,700	434	36,300
Korea, Republic of		1	244	3	586
Mexico		174	18,900	162	19,300
Poland		3	1,030	(3)	121
Singapore		2	421	1	347
Taiwan		2	434	2	257
Turkey		(3)	21	2	273
United Arab Emirates		10	786	7	792
United Kingdom		5	1,000	6	1,570
Other		13 ^r	2,370 ^r	14	2,290
Total		410	59,200	768	75,900
Tungsten compounds: ⁹	2841.80.0040				
Canada		9	26	4	12
China		4	280	1	99
Egypt		--	--	1	18
Germany		1	62	(3)	18
Malaysia		4	43	3	34
Other		1	68	1	109
Total		19	479	10	291

¹Revised. -- Zero.

¹Table includes data available through October 30, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States.

³Less than ½ unit.

⁴May include alloys.

⁵Content estimated from reported gross weight using 95% tungsten.

⁶Includes bars and rods produced simply by sintering; excludes powders and waste and scrap.

⁷Content estimated from reported gross weight using 70% tungsten.

⁸Includes 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 HTS codes 8101.96.0000 and 8101.99.1000, 80% tungsten for HTS code 8101.99.8000.

⁹Includes 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	2017		2018	
	Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
Argentina	--	--	35	\$1,170
Australia	--	--	28	698
Bolivia	1,250	\$23,600	1,270	37,600
Brazil	6	119	2	70
Burma	12	264	7	227
Burundi	73	1,340	76	1,900
Chile	--	--	(3)	6
China	1	44	(3)	23
India	--	--	7	243
Japan	(3)	3	--	--
Kazakhstan	--	--	1	34
Mexico	1	47	(3)	3
Mongolia	130	2,740	152	4,370
Poland	9	200	15	364
Portugal	548	14,000	766	24,500
Russia	686 ^r	13,800	222	7,310
Rwanda	38	844	27	819
Singapore	(3)	9	--	--
Spain	496	11,800	663	19,100
Thailand	25	412	79	1,540
Uganda	53	904	84	1,440
United Kingdom	570	12,500	610	16,300
Uzbekistan	9	195	--	--
Vietnam	13	438	--	--
Total	3,920 ^r	83,200	4,050	118,000

^rRevised. -- Zero.

¹Table includes data available through October 22, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States codes 2611.00.3000 and 2611.00.6000.

³Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 12
U.S. IMPORTS FOR CONSUMPTION OF AMMONIUM PARATUNGSTATE, BY COUNTRY OR LOCALITY^{1,2}

Country or locality	2017		2018	
	Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
China	1,400	\$31,100	1,450	\$47,000
Germany	609	12,100	632	16,000
Kuwait	--	--	50	824
Mexico	--	--	2	35
Vietnam	220	4,910	61	1,680
Total	2,230	48,100	2,200	65,500

-- Zero.

¹Table includes data available through October 22, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes 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	2017		2018	
	Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
Canada	3	\$76	--	--
China	93	2,620	92	\$3,100
Korea, Republic of	11	300	8	297
Netherlands	--	--	8	233
Russia	33	759	12	397
Switzerland	17	355	19	643
Vietnam	52	1,680	4	127
Total	209	5,800	143	4,800

-- Zero.

¹Table includes data available through September 27, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized 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 LOCALITY¹

Product and country or locality	HTS ² code	2017		2018	
		Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
Tungsten metal powders: ³	8101.10.0000				
Austria		4	\$141	29	\$1,330
Canada		251	9,910	230	12,300
China		681	22,500	838	37,700
France		7	324	8	570
Germany		30	1,550	13	990
Hong Kong		--	--	5	199
India		3	50	5	177
Israel		22 ^r	801 ^r	33	1,410
Japan		38	2,940	49	5,460
Korea, Republic of		242	9,420	203	9,990
United Kingdom		4	215	5	268
Vietnam		1	22	14	514
Other		4 ^r	218 ^r	6	319
Total		1,290 ^r	48,100 ^r	1,440	71,200
Tungsten carbide powder:	2849.90.3000				
Austria		370	13,400	321	14,600
Belgium		(4)	15	6	326
Canada		266	9,320	410	20,500
China		670	22,200	627	30,800
Czechia		4	212	--	--
Finland		--	--	7	319
France		10	1,300	20	2,380
Germany		14	813	7	413
Hong Kong		--	--	13	711
Israel		91 ^r	3,960 ^r	105	5,400
Japan		(4)	50	2	88
Korea, Republic of		13	555	4	243
Spain		3	95	(4)	17
United Kingdom		2	74	2	37
Other		3 ^r	195 ^r	4	162
Total		1,450 ^r	52,200 ^r	1,530	76,100
Unwrought tungsten: ^{3,5}	8101.94.0000				
Canada		22	397	--	--
China		191	5,990	182	7,290
Netherlands		9	241	--	--
Russia		22	521	--	--
Other		3	180 ^r	2	200
Total		247	7,330	183	7,490

See footnotes at end of table.

TABLE 14—Continued
U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS,
BY COUNTRY OR LOCALITY¹

Product and country or locality	HTS ² code	2017		2018	
		Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
Waste and scrap: ⁶	2620.99.2000, 8101.97.0000				
Austria		236	\$1,680	302	\$3,510
Belgium		27	264	31	705
Brazil		7	122	7	192
Canada		34	565	70	1,160
Chile		20	356	12	209
China		400	11,000	424	14,900
Czechia		52	1,400	39	970
Finland		3	83	9	311
Germany		360	6,260	450	11,600
India		28 ^r	679 ^r	31	972
Ireland		2	22	24	378
Israel		48	1,020	9	256
Japan		85	597	110	1,070
Luxembourg		287	1,840	200	2,440
Mexico		291	5,560	442	9,120
Netherlands		13	186	33	958
Poland		185	3,890	387	10,300
Russia		17	316	38	1,090
Singapore		8	171	23	408
South Africa		--	--	16	367
Spain		32	327	14	235
Taiwan		(4)	8	23	719
United Kingdom		131	2,560	255	6,540
Other		14 ^r	354 ^r	15	479
Total		2,280	39,300	2,960	68,900
Wrought tungsten: ^{3,7}	8101.96.0000, 8101.99.1000, 8101.99.8000				
Austria		40	4,960	53	7,250
Canada		4	691	6	914
China		461	30,600	372	31,500
Czechia		5	719	4	823
France		13	2,160	6	1,200
Germany		23	4,010	11	2,540
Hong Kong		9	380	3	237
Hungary		5	629 ^r	1	178
Japan		11	4,760	12	6,540
Mexico		3	203	(4)	22
Seychelles		6	879	--	--
Singapore		3	486	3	531
Sweden		5	1,610	3	772
Taiwan		5	752	3	478
Thailand		(4)	40	19	5,480
United Kingdom		3	641	3	864
Vietnam		9	248	--	--
Other		6	2,010 ^r	6	2,330
Total		612	55,800	506	61,700

See footnotes at end of table.

TABLE 14—Continued
U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS,
BY COUNTRY OR LOCALITY¹

Product and country or locality	HTS ² code	2017		2018	
		Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
Tungsten oxides:	2825.90.3000				
China		803	\$18,600	675	\$25,300
Germany		40	698	42	1,350
Russia		37	1,130	--	--
Vietnam		125	2,530	13	668
Other		5	94	(4)	3
Total		1,010	23,000	730	27,400
Other tungstates:	2841.80.0020, 2841.80.0050				
China		5	138	3	111
Germany		5	210	6	477
India		11	302	16	481
Vietnam		362	6,520	559	12,800
Other		(4)	28	(4)	59
Total		383	7,200	584	13,900
Other tungsten compounds and chemical products: ⁸	2827.39.4000, 2850.00.1000, 3824.90.3500				
Germany		10	216	25	495
Japan		71	1,240	88	1,550
Other		1	52	2	57
Total		82	1,510	115	2,100

¹Revised. -- Zero.

¹Table includes data available through October 25, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States.

³May include alloys.

⁴Less than ½ unit.

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

⁶Includes ash and residues, mainly tungsten.

⁷Includes 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.

⁸Includes tungsten chlorides, hydrides, and nitrides, and mixtures containing tungsten.

Source: U.S. Census Bureau.

TABLE 15
TUNGSTEN: WORLD CONCENTRATE PRODUCTION, BY COUNTRY OR LOCALITY¹

(Metric tons, tungsten content)

Country or locality ²	2014	2015	2016	2017	2018
Australia	477	348	108	20 ^c	20 ^c
Austria	819	861	954	975	936
Bolivia ³	1,252	1,460	1,110	994	1,365
Brazil	510	432	200 ^c	200 ^c	200 ^c
Burma ^{c,4}	247	144	183 ^r	215 ^r	215
Burundi ^{c,5}	23	9	63	120 ^r	100
Canada ⁶	2,344	1,600 ^c	--	--	--
China	65,000	67,000	64,000	67,000	65,000
Congo (Kinshasa) ^c	8	51	73	120	180
Korea, North ^{c,7}	70	70	50	310	1,410
Mongolia	557	351	732 ^r	510 ^r	1,938
Nigeria ^{c,8}	290	70	60	50	20
Peru	61	110	--	--	--
Portugal	671	474	549	669 ^r	715
Russia	3,775	3,262	2,672	2,094	1,500 ^c
Rwanda ^{c,3}	1,000	850	820	720	920
Spain	822	835	699	564	750 ^c
Thailand ^{c,9}	99	35	33	65 ^r	69
Uganda	63	36	41	62	100 ^c
United Kingdom	--	155	736	1,086	900 ^c
United States	NA	NA	--	--	--
Vietnam ¹⁰	4,000 ^r	5,600	5,200 ^r	5,400 ^r	4,800
Zimbabwe ¹¹	--	NA	NA	NA	NA
Total	82,100 ^r	83,800	78,300 ^r	81,200 ^r	81,100

^cEstimated. ^rRevised. NA Not available. -- Zero.

¹Table includes data available through October 15, 2019. All data are reported unless otherwise noted. Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

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

³Production based on reported exports.

⁴Based on fiscal year production of tungsten and tin-tungsten concentrates reported by the Central Statistical Organization.

⁵Based on gross weight reported by the Institut de Statistiques et d'Etudes Economiques du Burundi.

⁶Datum for 2014 based on production reported by North American Tungsten Corp.; datum for 2015 based on half-year production from North American Tungsten Corp. and an estimate for production from July through October 2015.

⁷Production estimated based on imports reported by China.

⁸Production estimated based on reported imports from Nigeria.

⁹Based on data from the Department of Primary Industries and Mines.

¹⁰Mine production reported by the International Tungsten Industry Association.

¹¹Production began in 2015, but information was inadequate to make reliable estimates of output.