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2018 Minerals Yearbook

SELENIUM AND TELLURIUM [ADVANCE RELEASE]

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Selenium and Tellurium

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In 2018, selenium and tellurium were not refined in the United States. Three copper refineries produced either semirefined selenium and tellurium or selenium- and tellurium-containing copper anode slimes, and all production was exported for further processing or discarded into tailings. U.S. imports and exports of selenium decreased in 2018 compared with those in 2017, whereas imports and exports of tellurium increased in 2018 compared with those in 2017. The average Platts Metals Week New York dealer price for 99.5%-pure selenium in 2018 increased by 76% to $18.97 per pound from of $10.78 per pound in 2017. The average price for 99.99%-pure tellurium (in warehouse, Rotterdam), as reported by Argus Media group–Argus Metals International, increased by 96% in 2018 to $73.67 per kilogram from $37.63 per kilogram in 2017 (table 1).

Except for two mines in China that began mining tellurium as a principal product in 2010 and one mine in Sweden that recovered tellurium from gold-telluride ores, selenium and tellurium were recovered as byproducts of nonferrous metal mining in 2018, principally from anode slimes produced during the electrolytic refining of copper. Selenium and tellurium can also be recovered as byproducts of gold, lead, nickel, platinum-group metals, and zinc.

Production

Three primary electrolytic copper refineries produced selenium- and tellurium-containing intermediate products in the United States in 2018. ASARCO LLC's (Tucson, AZ) copper refinery in Amarillo, TX, produced semirefined selenium and tellurium, which were exported to Mexico for further processing. Freeport-McMoRan Inc.'s (Phoenix, AZ) copper refinery in El Paso, TX, produced and exported semirefined material containing tellurium to Asia. Rio Tinto Kennecott's [a subsidiary of Rio Tinto plc (United Kingdom)] copper refinery in Garfield, UT, generated selenium- and tellurium-containing slimes, which were discarded into tailings. Most of the selenium and tellurium in the slimes came from copper ores mined in Arizona and Utah. Domestic production data for selenium and tellurium were withheld to avoid disclosing company proprietary data.

Consumption

Selenium.—In 2018, domestic and global consumption data for selenium were unavailable. In 2010, the latest year for which data were available, major global applications for selenium were, in descending order of estimated consumption, in electrolytic manganese and metallurgy, glass manufacturing, agriculture, chemicals and (or) pigments, and electronics (Selenium Tellurium Development Association, 2010).

The main metallurgical end use for selenium in 2018 was for the production of electrolytic manganese in China, where selenium dioxide (SeO_2) was substituted for sulfur dioxide to reduce the power required to operate electrolytic cells. Consumption of SeO_2 in China in 2018 was estimated to be 970 metric tons (t), a decrease of 60 t from an estimated consumption of 1,030 t in 2017. In other metallurgical applications, selenium was used with bismuth to substitute for lead as a free-machining agent in brass plumbing fixtures. Metallurgical-grade selenium also was used as an additive to cast iron, copper, lead, and steel alloys (Xu, 2019).

In the glass industry, selenium was used to decolorize the green tint caused by iron impurities in container glass and other soda-lime silica glass. It was also used in art and other glass to produce a ruby red color and in architectural plate glass to reduce solar heat transmission through the glass.

Selenium is a micronutrient essential to human and animal health, and in areas with selenium-poor soils, selenium was added to fertilizer and applied to acreage used to grow animal feed to increase selenium in the diet of animals and, in turn, the diet of humans. This practice was more common in countries other than the United States.

Cadmium sulfoselenide compounds were used as pigments in ceramics, glazes, paints, and plastics. Selenium pigments have good heat stability, react well to moisture, and are resistant to ultraviolet or chemical exposure. These pigments produce a wide range of red, orange, and maroon colors but, because of the relatively high cost and the toxicity of cadmium-based pigments, their use was limited to applications where cost was not the prevailing factor and human contact was limited, such as art pieces.

Tellurium.—Industry estimates in 2010, the latest year for which data were available, for global tellurium consumption by application were solar panels, 40%; thermoelectric applications, 30%; metallurgical uses, 15%; and other, 15% (Selenium Tellurium Development Association, 2010).

In 2018, three major types of thin-film photovoltaic (PV) cells were in commercial production. They were, in descending order of megawatts (MW) produced in 2018, cadmium telluride (CdTe) (2,394 MW), amorphous silicon (1,314 MW), and copper indium gallium diselenide (1,284 MW). However, thin-film solar cells accounted for only about 4% of all solar cells produced globally in 2018; the majority of PV solar-cell production continued to be dominated by the conventional crystalline silicon technology. Global PV-cell and module production in 2018 was estimated by the National Renewable Energy Laboratory to be 105 gigawatts (GW). China produced about 85 GW of solar cells and modules in 2018. Worldwide cumulative installations were led by China with 175 GW (42%); Japan, 55.5 GW (13%); the United States, 49.7 GW (12%); and Germany, 45.3 GW (11%).

Within the United States, First Solar, Inc. (Tempe, AZ) produced an initial run of a new series of CdTe solar panels in Ohio, announced the expansion of their CdTe manufacturing facility near the existing Ohio facility, began construction on a second facility in Vietnam, and completed construction of a new facility in Malaysia. The new Vietnam facility would double the CdTe-panel production capacity of the initial site and was expected to start production in early 2019 and produce 1.2 gigawatts per year (GW/yr). First Solar announced plans to build a new manufacturing plant in Lake Township, OH, near the existing Perrysburg, OH, facility; the new plant will have an annual capacity of 1.2 GW and was expected to begin production in late 2019. First Solar completed construction of their Malaysia facility that had a capacity of 1.2 GW/yr and started commercial shipments in the second quarter of 2018. Tellurium consumption for solar panels, based on information from 2010, was estimated to be 91 metric tons per gigawatt of production of CdTe solar cells (Zweibel, 2010; First Solar, Inc., 2018a–c, 2019, p. 4–5, 54; Sam Kobreich, Energy Analyst, National Renewable Energy Laboratory, written commun., November 25, 2019).

Other uses for tellurium include thermal imaging and thermoelectric cooling. In thermal-imaging devices for infrared sensors and heat-seeking missiles, mercury-cadmium-telluride is built up on a base of cadmium-zinc-telluride and is used to convert the raw image into a crisp screen picture in a cryo-cooled environment. Semiconducting bismuth telluride is used in thermoelectric cooling devices. These devices consist of a series of semiconducting material couples that, when connected to a direct current, cause one side of the thermoelement to cool and the other side to heat. Thermoelectric coolers are used in electronics and military applications, such as the cooling of infrared detectors, integrated circuits, laser diodes, and medical instrumentation, as well as in high-end automobiles to cool cup holders and seats. In China, these devices were used in refrigerators, water dispensers, and other home appliances.

In metallurgy, tellurium is used in steel as a free-machining additive, in copper to improve machinability without reducing conductivity, in lead to improve resistance to vibration and fatigue, in cast iron to help control the depth of chill, and in malleable iron as a carbide stabilizer.

Tellurium is used as a vulcanizing agent and as an accelerator in the processing of rubber and in catalysts for synthetic fiber production. Other applications include the use of tellurium as a pigment to produce blue and brown colors in ceramics and glass.

Prices

The annual average New York dealer price for 99.5%-pure selenium, as reported by S&P Global–Platts Metals Week, was $18.97 per pound in 2018, 76% greater than the annual average price in 2017 (table 1). In 2018, the average monthly price of selenium in January was $12.50 per pound, increased to $20 per pound in March, rose slightly to $20.50 per pound from June through September, then decreased slightly to $20 per pound for the rest of the year. This average monthly price was the highest since March 2016.

The average annual price for 99.99%-pure tellurium (in warehouse, Rotterdam), as reported by Argus Media group–Argus Metals International, increased by 96% in 2018 to $73.67 per kilogram from $37.63 per kilogram in 2017 (table 1). The average monthly tellurium price was $52.50 per kilogram in January 2018, continuing the rise from the low of $29 per kilogram in the last quarter of 2016, and rose until it reached $101.25 per kilogram in June and July 2018 and ended the year at $80.00 per kilogram.

Foreign Trade

Selenium.—Exports of selenium in 2018 decreased by 35% to 158 t from the revised total of 242 t in 2017 (table 2). In descending order of quantity, Hong Kong, the Republic of Korea, Egypt, China, and Mexico were the leading destinations for selenium exports in 2018 and collectively accounted for 85% of the export tonnage. Exports to China decreased by 30.0 t; Japan, by 19.4 t; Russia, by 19.3 t; Hong Kong, by 14.0 t; and the Republic of Korea, by 10.5 t. These decreases were partially offset by exports to Egypt, which increased to 24.1 t from no exports in 2017. Exports to Russia decreased to none in 2018. Based on unrounded data, the annual average unit value of exports in 2018 was $18.35 per kilogram ($8.32 per pound), 16% more than the revised 2017 annual average (table 2).

In 2018, U.S. imports for consumption of selenium, including SeO_2, decreased slightly to 458 t from 469 t in 2017. Based on unrounded data, the annual average unit value of all imported selenium materials, by selenium content, in 2018 was $41.35 per kilogram ($18.76 per pound), 13% more than that in 2017 (table 3).

In 2018, imports of selenium metal decreased slightly to 445 t from 450 t in 2017. The major sources of selenium were China, the Philippines, Canada, Germany, Mexico, and Belgium, in descending order of quantity, collectively accounting for 82%. Imports from the Philippines, Canada, Chile, and China increased by 28.3 t, 21.7 t, 17.0 t, and 16.1 t, respectively. These increases were offset by decreases in imports from Mexico, the Republic of Korea, and Germany, which decreased by 45.6 t, 24.0 t, and 18.4 t, respectively, from those in 2017. Based on unrounded data, the annual average unit value of all imported selenium metal in 2018 was $41.14 per kilogram ($18.66 per pound), 12% more than that in 2017.

In 2018, imports for consumption of SeO_2, by selenium content, decreased by 33% to 12.3 t from 18.5 t in 2017 (table 3). Three countries—the Philippines, China, and Germany, in decreasing order of quantity—collectively supplied the United States with 93% of SeO_2 imports in 2018. There were no imports of SeO_2 from Canada in 2018, a decrease from 7.3 t in 2017. Based on unrounded data, the annual average unit value of SeO_2 imports, with respect to selenium content, was $49.13 per kilogram ($22.28 per pound), a 35% increase compared with that in 2017.

Tellurium.—In 2018, tellurium exports were 4,150 kg, an 80% increase compared with exports in 2017 (table 4). The main destinations were the Netherlands, Jordan, and Canada, which collectively accounted for 96% of total tellurium exports. Exports of tellurium to the Netherlands and Mexico increased by 3,330 kg and 180 kg, respectively, from no exports in 2017. These were offset by decreased exports to Jordan and Canada, which decreased by 839 kg and 594 kg, respectively. Imports

for consumption of tellurium increased by 18% compared with imports in 2017 (table 5). The leading suppliers, in descending order of quantity, were Canada, China, and Germany, which collectively accounted for 95% of the total imports of tellurium into the United States. Imports from Canada and Germany increased by 17,400 kg and 14,700 kg, respectively (table 5). Based on unrounded data, the annual average unit value of tellurium exports in 2018 was $105.22 per kilogram (47.73 per pound), a 37% decrease compared with that in 2017, whereas the annual average unit value of tellurium imports in 2018 was $85.81 per kilogram ($39.91 per pound), a 10% increase compared with that in 2017 (tables 4 and 5).

World Review

Global selenium and tellurium output cannot be determined with certainty because some companies and countries do not report production and trade in scrap and semirefined products may be included with refined metal trade data. World production of selenium, excluding output from Australia, Iran, Kazakhstan, Mexico, the Philippines, Uzbekistan, and the United States (for which available information was inadequate to make reliable estimates of output), was estimated to have increased slightly to 2,810 t in 2018 compared with the revised production of 2,790 t in 2017 (table 6). World production of tellurium, not including Australia, Belgium, Chile, Colombia, Germany, Kazakhstan, Mexico, the Philippines, Poland, and the United States (for which available information was inadequate to make reliable estimates of output), was estimated to have decreased slightly to 460 t from 467 t in 2017 (table 7).

China.—China was the leading global producer of selenium and tellurium and accounted for 33% and 61% of world production, respectively (tables 6, 7). China produced an estimated 930 t of selenium in 2018, unchanged from that in 2017. Estimated production of tellurium in China was 280 t, a 3% decrease from 290 t in 2017.

In 2018, the Government of China's National Development and Reform Commission (NDRC) announced the installation of 30 GW of solar capacity, down from the 53 GW of solar capacity in 2017. The NDRC also announced a cut in the national subsidy for solar power generated, in order to reduce overcapacity of photovoltaic power stations. This shift in policy was to be kept in place until at least 2020 and new solar projects that required subsidies were unlikely to be approved (Argus Metals International, 2018a).

According to the China Nonferrous Industry Association, the estimated selenium consumption in China decreased by 6% to 2,100 t in 2018 from 2,240 t in 2017. The electrolytic manganese industry remained the leading consumer of selenium in China, accounting for 46% of selenium consumption in 2018, followed by glass production, 19%; agriculture, 15%; electronics, 12%; and pigments, 8%. The selenium consumption was estimated to be less than the supply. Estimated tellurium consumption in China in 2018 increased to approximately 150 t from 130 t in 2017, and consumption was expected to be less than supply. Tellurium in China was consumed for various uses: thermal coolers (53%), metallurgy (27%), chemicals and photovoltaics (6% each), and other (8%) (Mai Liu, 2019, p. 10; Xu, 2019).

India.—In July, the Government of India announced import duties on solar cells from China and Malaysia. These duties started at 25% on July 30, 2018, were to be reduced to 20% on July 30, 2019, and reduced to 15% on January 30, 2020, for 6 months. These duties were implemented following a safeguard duty investigation, announced in December 2017, to determine if imports of cheap solar cells were a threat to the domestic industry in India. Initially, the Directorate General of Safeguards suggested a 70% safeguard duty on solar cell imports in response to a petition filed by the Indian Solar Manufacturers Association in July 2016, but the petition was temporarily withdrawn for revisions. According to CRISIL Ltd., imports from China and Malaysia accounted for approximately 80% of solar modules used in India (Argus Metals International, 2017, 2018b; CRISIL Ltd., 2017; Indian Solar Manufacturers Association, 2018).

Sweden.—Byproduct tellurium production at Boliden AB's Kankberg gold-tellurium mine increased by 28% in 2018 to 44,641 kg from 34,979 kg in 2017. Boliden reopened the Kankberg Mine in 2012, and the mine's life was expected to extend into 2020 (Boliden AB, 2019, p. 112).

Outlook

The supply of selenium and tellurium is directly affected by the production of the principal product from which it is derived—copper—and, to a lesser extent, by the production of gold, lead, nickel, platinum-group metals, and zinc produced from sulfide ores. Selenium prices slowly recovered throughout 2018, ending at a monthly average of $20 per pound ($44.10 per kilogram) in December. Tellurium prices also recovered and ended the year at an average monthly price of $80 per kilogram ($36.28 per pound). Recovery rates of selenium and tellurium from copper slimes are not expected to increase if selenium and (or) tellurium prices remain at or near those at yearend 2018. Tellurium markets are expected to remain slightly oversupplied in the near future, out to 2020, while selenium markets are expected to have a slight shortage owing to increased agricultural use in China (Mai Lui, 2019, p. 6; Xu, 2019).

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TABLE 1
SALIENT SELENIUM AND TELLURIUM STATISTICS[1]

(Kilograms, metal content, unless otherwise specified)

	2014	2015	2016	2017	2018
Selenium:					
United States:					
Production, primary refined	W	W	W	W	W
Exports	521,000	468,000	150,000	242,000 r	158,000
Imports for consumption[2]	475,000	457,000	433,000	469,000	458,000
Price, average, commercial grade,[3] dollars per pound	26.65 r	22.09	23.69	10.78	18.97
World, refinery production	2,530,000 r	2,690,000 r	2,840,000 r	2,790,000 r	2,810,000
Tellurium:					
United States:					
Production, primary refined	W	W	W	W	W
Exports	27,900	40,800	2,620	2,310	4,150
Imports for consumption	109,000	76,000	72,700	163,000	192,000
Price, average,[4] dollars per kilogram	119.37	78.12	31.45	37.63	73.67
World, refinery production	439,000	411,000	424,000 r	467,000	460,000

rRevised. W Withheld to avoid disclosing company proprietary data.
[1]Table includes data available through July 15, 2020. Data are rounded to no more than three significant digits, except prices.
[2]Includes selenium metal and the selenium content of selenium dioxide.
[3]Annual average New York dealer price for 99.5% selenium. Source: S&P Global–Platts Metals Week.
[4]Annual average price published by the Argus Media group–Argus Metals International for duties unpaid in warehouse, Rotterdam, 99.99% tellurium.

TABLE 2
U.S. EXPORTS OF SELENIUM[1]

Country or locality	2017		2018	
	Quantity (kilograms, Se content)	Value	Quantity (kilograms, Se content)	Value
Argentina	1,240	$19,200	1,350	$20,900
Australia	--	--	767	9,700
Brazil	1,280	20,500	488	11,100
Bulgaria	--	--	132	4,630
Canada	422 r	12,600 r	1,030	32,000
China	44,300	832,000	14,400	225,000
Colombia	336	6,950	--	--
Egypt	--	--	24,100	555,000
Finland	--	--	823	12,800
France	2,160	39,100	--	--
Germany	--	--	233	4,100
Hong Kong	69,500	1,170,000	55,400	1,110,000
India	--	--	3,050	47,300
Indonesia	13,800	214,000	6,610	102,000
Israel	699	15,200	--	--
Japan	19,800	308,000	360	5,570
Korea, Republic of	40,500	696,000	30,000	503,000
Mexico	15,100	213,000	10,200	150,000
Netherlands	3,290	51,000	--	--
Philippines	4,870	30,300	4,440	31,300
Russia	19,300	101,000	--	--
Saudi Arabia	--	--	118	5,610
South Africa	--	--	127	3,790
Turkey	2,190	34,000	--	--
United Kingdom	655	10,200	--	--
Venezuela	2,700	43,300	4,600	71,300
Total	242,000 r	3,820,000 r	158,000	2,900,000

rRevised. -- Zero.
[1]Table includes data available through July 15, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 3
U.S. IMPORTS FOR CONSUMPTION OF SELENIUM[1]

Class and country or locality	2017 Quantity (kilograms, Se content)	2017 Value	2018 Quantity (kilograms, Se content)	2018 Value
Selenium:				
Belgium	38,500	$1,300,000	32,100	$1,080,000
Canada	30,200	789,000	51,900	1,580,000
Chile	5,000	180,000	22,000	774,000
China	94,500	3,000,000	111,000	3,550,000
Germany	55,600	2,180,000	37,200	1,860,000
Hong Kong	--	--	11,000	517,000
India	8,180	301,000	9	5,400
Japan	31,500	1,840,000	28,100	2,380,000
Korea, Republic of	31,000	1,080,000	7,020	224,000
Luxembourg	--	--	54	12,100
Mexico	82,500	1,980,000	37,000	906,000
Netherlands	2	11,700	768	34,100
New Zealand	1,510	22,500	1,000	7,200
Philippines	68,300	3,730,000	96,500	5,140,000
Poland	--	--	9,140	209,000
Russia	2,500	92,800	1,000	37,800
United Kingdom	1,250	44,600	--	--
Total	450,000	16,600,000	445,000	18,300,000
Selenium dioxide:[2]				
Canada	7,260	168,000	--	--
China	5,430	248,000	4,610	242,000
Germany	4,960	221,000	1,940	111,000
Ireland	--	--	1	3,500
Japan	892	41,000	386	27,900
Malaysia	--	--	426	51,900
Philippines	--	--	4,990	171,000
Total	18,500	677,000	12,300	606,000
Grand total	469,000	17,200,000	458,000	18,900,000

-- Zero.

[1]Table includes data available through July 15, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Selenium content calculated as 71% of gross weight of material.

Source: U.S. Census Bureau.

TABLE 4
U.S. EXPORTS OF TELLURIUM[1]

Country or locality	2017 Quantity (kilograms, Te content)	2017 Value	2018 Quantity (kilograms, Te content)	2018 Value
Canada	904	$249,000	310	$154,000
Chile	--	--	1	5,110
China	82	17,300	--	--
India	20	7,000	--	--
Jordan	1,170	93,600	331	49,700
Mexico	--	--	180	9,050
Netherlands	--	--	3,330	216,000
Romania	--	--	1	2,760
Singapore	18	2,710	--	--
Switzerland	63	4,220	--	--
Taiwan	48	8,850	--	--
Total	2,310	383,000	4,150	436,000

-- Zero.

[1]Table includes data available through July 15, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 5
U.S. IMPORTS FOR CONSUMPTION OF TELLURIUM[1]

Country or locality	2017 Quantity (kilograms, Te content)	2017 Value	2018 Quantity (kilograms, Te content)	2018 Value
Belgium	1,000	$61,100	1,500	$108,000
Canada	109,000	8,350,000	126,000	10,800,000
China	37,800	2,930,000	32,200	2,520,000
Germany	9,810	989,000	24,500	2,450,000
Hong Kong	23	15,000	--	--
Japan	1,540	84,100	1,380	102,000
Netherlands	1	2,380	4	10,700
Peru	--	--	70	3,790
Philippines	1,410	122,000	5,680	444,000
Russia	2,070	95,900	--	--
Switzerland	52	10,100	--	--
Ukraine	1	3,680	--	--
United Kingdom	22	13,800	--	--
Total	163,000	12,700,000	192,000	16,500,000

-- Zero.

[1]Table includes data available through July 15, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 6
SELENIUM: WORLD REFINERY PRODUCTION, BY COUNTRY OR LOCALITY[1]

(Kilograms, selenium content)

Country or locality[2]	2014	2015	2016	2017	2018
Belgium[e]	200,000	200,000	200,000	200,000	200,000
Canada[3]	142,000	156,000	175,000	72,000 [r]	61,000
China[e]	625,000	810,000	920,000	930,000	930,000
Finland	93,682	93,051	104,420	100,000 [r]	100,000 [e]
Germany[e]	250,000	250,000	300,000	300,000	300,000
India[e, 4]	17,000	17,000	17,000	17,000	17,000
Japan	782,451	772,768	752,173	729,132	768,000 [e]
Peru[e]	40,000	40,000	45,000	45,000	45,000
Poland	89,800	87,000	81,660 [r]	73,900 [r]	76,000 [e]
Russia	130,810	135,000	150,000	150,000 [e]	150,000 [e]
Serbia	17,255	14,950	18,300 [r]	19,000 [r]	18,000 [e]
South Africa, anode slimes[e]	12,000	13,000	15,000	12,000 [r]	9,000
Sweden	79,000 [r]	54,000 [r]	60,000 [r]	89,000 [r]	90,000 [e]
Turkey	52,658	50,000	--	50,000 [e]	50,000 [e]
United States	W	W	W	W	W
Total	2,530,000 [r]	2,690,000 [r]	2,840,000 [r]	2,790,000 [r]	2,810,000

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; not included in total. -- Zero.

[1]Table includes data available through April 26, 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.

[2]In addition to the countries and (or) localities listed, Australia, Iran, Kazakhstan, Mexico, the Philippines, and Uzbekistan may have produced refined selenium, but available information was inadequate to make reliable estimates of output. Australia is known to produce selenium in intermediate metallurgical products and has facilities to produce elemental selenium. In addition to having facilities for processing imported anode slimes for the recovery of selenium and precious metals, the United States has facilities for processing selenium scrap.

[3]Excludes selenium intermediates exported for refining.

[4]Production is based on fiscal year, with a starting date of April 1 of the year shown.

TABLE 7
TELLURIUM: WORLD REFINERY PRODUCTION, BY COUNTRY OR LOCALITY[1, 2]

(Kilograms, tellurium content)

Country or locality[3]	2014	2015	2016	2017	2018
Bulgaria	4,932	4,046	4,479	5,095 [r]	5,100 [e]
Canada[4]	8,000	10,000	18,000	49,000	25,000 [e]
China	320,000	285,000	280,000	290,000 [e]	280,000 [e]
Japan	36,919	37,356	32,911	37,754 [r]	57,700 [e]
Russia	32,500 [e]	35,000 [e]	42,900 [r]	44,000	42,000 [e]
South Africa[e]	5,600 [r]	6,300	6,800	5,700 [r]	5,500
Sweden	30,917	33,000	38,680	34,979	44,641
United States	W	W	W	W	W
Total	439,000	411,000	424,000 [r]	467,000	460,000

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; not included in total.

[1]Table includes data available through April 24, 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.

[2]Insofar as possible, data relate to refinery output only; thus, countries that produced tellurium contained in copper ores, copper concentrates, blister copper, or refinery residues but did not recover refined tellurium are excluded to avoid double counting. Data were not totaled because of exclusion of data from major world producers.

[3]In addition to the countries and (or) localities listed, Australia, Belgium, Chile, Colombia, Germany, Kazakhstan, Mexico, the Philippines, and Poland may have produced refined tellurium, but available information was inadequate to make reliable estimates of output.

[4]Excludes tellurium intermediates exported for refining.