

## PLATINUM-GROUP METALS

(Palladium, platinum, iridium, osmium, rhodium, and ruthenium)

[Data in kilograms of contained platinum-group metals (PGMs) unless otherwise noted]

**Domestic Production and Use:** One company in Montana produced PGMs with an estimated value of about \$880 million. Small quantities of primary PGMs also were recovered as byproducts of copper-nickel mining in Michigan; however, this material was sold to foreign companies for refining. The leading domestic use for PGMs was in catalytic converters to decrease harmful emissions from automobiles. PGMs are also used in catalysts for bulk-chemical production and petroleum refining; dental and medical devices; electronic applications, such as in computer hard disks, hybridized integrated circuits, and multilayer ceramic capacitors; glass manufacturing; investment; jewelry; and laboratory equipment.

<b><u>Salient Statistics—United States:</u></b>	<b><u>2018</u></b>	<b><u>2019</u></b>	<b><u>2020</u></b>	<b><u>2021</u></b>	<b><u>2022<sup>e</sup></u></b>
Mine production: <sup>1</sup>					
Palladium	14,300	14,300	14,600	13,700	11,000
Platinum	4,160	4,150	4,200	4,020	3,300
Imports for consumption: <sup>2</sup>					
Palladium	92,900	84,300	76,400	72,600	63,000
Platinum	58,500	42,300	64,800	67,900	56,000
PGM waste and scrap	40,700	35,200	185,000	185,000	49,000
Iridium	1,020	875	1,620	2,310	1,700
Osmium	25	(3)	1	1	—
Rhodium	14,500	15,000	20,700	16,500	13,000
Ruthenium	17,900	11,200	13,900	18,000	15,000
Exports: <sup>4</sup>					
Palladium	52,900	55,500	48,600	43,900	45,000
Platinum	18,900	17,400	28,900	29,400	28,000
PGM waste and scrap	31,700	20,800	33,200	37,800	38,000
Rhodium	2,010	1,210	1,480	1,350	720
Other PGMs	2,500	1,330	1,440	2,180	1,200
Consumption, apparent: <sup>5, 6</sup>					
Palladium	96,300	85,100	80,300	81,400	68,000
Platinum	53,700	37,000	48,200	53,500	42,000
Price, dollars per troy ounce: <sup>7</sup>					
Palladium	1,036.43	1,544.31	2,205.27	2,419.18	2,200
Platinum	882.66	866.94	886.02	1,094.31	980
Iridium	1,293.27	1,485.80	1,633.51	5,158.40	4,700
Rhodium	2,225.30	3,918.78	11,205.06	20,254.10	17,000
Ruthenium	244.41	262.59	271.83	576.12	600
Employment, mine, number	1,242	1,379	1,475	1,598	1,600
Net import reliance <sup>6, 8</sup> as a percentage of apparent consumption:					
Palladium	42	34	35	35	26
Platinum	74	67	75	72	66

**Recycling:** About 110,000 kilograms of palladium and platinum was recovered globally from new and old scrap in 2022, including about 40,000 kilograms of palladium and 11,000 kilograms of platinum recovered from automobile catalytic converters in the United States.

**Import Sources (2018–21):** Palladium: Russia, 34%; South Africa, 30%; Italy, 8%, Germany, 8%; and other, 20%. Platinum: South Africa, 34%; Germany, 18%; Switzerland, 14%; Italy, 7%; and other, 27%.

**Tariff:** All unwrought and semimanufactured forms of PGMs are imported duty free. See footnotes for specific Harmonized Tariff Schedule of the United States codes.

**Depletion Allowance:** 22% (domestic), 14% (foreign).

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### Government Stockpile:<sup>9</sup>

<u>Material</u>	<u>Inventory as of 9-30-22</u>	<u>FY 2022</u>		<u>FY 2023</u>	
		<u>Potential acquisitions</u>	<u>Potential disposals</u>	<u>Potential acquisitions</u>	<u>Potential disposals</u>
Iridium	15	—	15	—	15
Platinum	261	—	261	—	261

**Events, Trends, and Issues:** Production at a domestic mine continued but was constrained owing to operational challenges and flooding that took place in June 2022. Production of PGMs in South Africa, the world's leading producer of PGM-containing mined material, decreased compared with that in 2021 owing to operational challenges at some mines, including disruptions to the supply of electricity, temporary closures of processing facilities, and scheduled maintenance of smelters. A slow economic recovery from coronavirus disease 2019 (COVID-19) pandemic shutdowns and declining capital investments also negatively affected production. Constrained automobile production owing to semiconductor chip shortages, declining diesel passenger vehicle production, inflation, and slow economic growth are expected to result in decreased demand for palladium, platinum, and rhodium used in catalytic converters. Demand could be offset, however, by the development of PGM-based proton-exchange membrane fuel cells (also known as polymer electrolyte membrane fuel cells) used in hydrogen storage and transportation technologies.

The estimated annual average price of ruthenium in 2022 increased by 4% compared with that in 2021, whereas the estimated prices for rhodium, platinum, palladium, and iridium decreased by 16%, 10%, 9%, and 9%, respectively.

### World Mine Production and Reserves:

	<u>Mine production</u>				<u>PGM reserves</u> <sup>10</sup>
	<u>Palladium</u>		<u>Platinum</u>		
	<u>2021</u>	<u>2022<sup>e</sup></u>	<u>2021</u>	<u>2022<sup>e</sup></u>	
United States	13,700	11,000	4,020	3,300	900,000
Canada	15,000	15,000	6,000	6,000	310,000
Russia	<sup>e</sup> 86,000	88,000	<sup>e</sup> 21,000	20,000	5,500,000
South Africa	84,300	80,000	142,000	140,000	63,000,000
Zimbabwe	12,400	12,000	14,700	15,000	1,200,000
Other countries	<u>2,540</u>	<u>2,500</u>	<u>4,270</u>	<u>4,200</u>	NA
World total (rounded)	214,000	210,000	192,000	190,000	70,000,000

**World Resources:**<sup>10</sup> World resources of PGMs are estimated to total more than 100 million kilograms. The largest resources and reserves are in the Bushveld Complex in South Africa.

**Substitutes:** Palladium has been substituted for platinum in most gasoline-engine catalytic converters because of the historically lower price for palladium relative to that of platinum. About 25% of palladium can routinely be substituted for platinum in diesel catalytic converters; the proportion can be as much as 50% in some applications. For some industrial end uses, one PGM can substitute for another, but with losses in efficiency.

<sup>e</sup>Estimated. NA Not available. — Zero.

<sup>1</sup>Estimated from published sources.

<sup>2</sup>Includes data for the following Harmonized Tariff Schedule of the United States codes: 7110.11.0010, 7110.11.0020, 7110.11.0050, 7110.19.0000, 7110.21.0000, 7110.29.0000, 7110.31.0000, 7110.39.0000, 7110.41.0010, 7110.41.0020, 7110.41.0030, 7110.49.0010, 7112.92.0000, 7112.92.0100, and 7118.90.0020.

<sup>3</sup>Less than ½ unit.

<sup>4</sup>Includes data for the following Schedule B codes: 7110.11.0000, 7110.19.0000, 7110.21.0000, 7110.29.0000, 7110.31.0000, 7110.39.0000, 7110.41.0000, 7110.49.0000, 7112.92.0000, and 7112.92.0100.

<sup>5</sup>Defined as primary production + secondary production + imports – exports.

<sup>6</sup>Excludes imports and (or) exports of waste and scrap.

<sup>7</sup>Engelhard Corp. unfabricated metal.

<sup>8</sup>Defined as imports – exports.

<sup>9</sup>See Appendix B for definitions.

<sup>10</sup>See Appendix C for resource and reserve definitions and information concerning data sources.