



# 2010 Minerals Yearbook

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## PLATINUM-GROUP METALS

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In 2010, Stillwater Mining Co. (SMC) (Billings, MT) was the only domestic mine producer of platinum-group metals (PGMs) from its Stillwater Mine near Nye, MT, and its East Boulder Mine south of Big Timber, MT. OJSC MMC Norilsk Nickel (Moscow, Russia), which had been the majority owner of SMC since 2003, sold its entire stake in SMC to a number of independent investors. SMC produced 15,100 kilograms (kg) of platinum and palladium in 2010, 8% less than the 16,500 kg that was produced in 2009 (Stillwater Mining Co., 2011a, p. 52–53). Defense National Stockpile Center reported no PGM sales in 2010; 18 kg of iridium and 261 kg of platinum remained in the stockpile. Palladium stocks were exhausted in 2004.

In 2010, the automobile industry continued to be a major consumer of PGMs. Autocatalysts accounted for approximately 77% of rhodium consumption, 57% of palladium consumption, and 46% of platinum consumption on a global basis. Jewelry was the second leading use of platinum in 2010, at 31% of global consumption, down from 41% in 2009. The jewelry use declined because of the rise in platinum price in 2010 compared with that of 2009 (Butler, 2011, p. 28–30).

## Legislation and Government Programs

In December, the American Eagle Palladium Bullion Coin Act of 2010 was signed into law (Public Law 111–303), authorizing the U.S. Treasury to produce palladium bullion coins for sale to investors. Production of the coins was dependent upon the outcome of an independent study to determine if adequate demand existed for the coins to be minted and issued at no cost to the taxpayer. The coins were planned to be 1 troy ounce with a face value of \$25 (Johnson Matthey, 2010).

## Production

**Primary.**—During 2010, the Stillwater Mine produced 8,420 kg of palladium and 2,520 kg of platinum, 10% and 12% less, respectively, relative to production in 2009. PGM production from the East Boulder Mine was 4,150 kg (3,220 kg of palladium and 930 kg of platinum), which was a 2% and 3% decrease, respectively, in palladium and platinum production compared with that of 2009. Total palladium and platinum production for SMC decreased by 8% and 10%, respectively, compared with production in 2009. Production of rhodium in 2010 was 62 kg, which was one-half the amount of production in 2009 (Stillwater Mining Co., 2011a, p. 53). The company milled 1.10 million metric tons (Mt) of ore from the mines, slightly more than that in 2009. Decreased production at the Stillwater Mine was attributed to lower grade ore in the offshaft area as well as infrastructure rehabilitation and increased ground support requirements that slowed mining in some areas for several weeks. SMC increased its recycling business; consolidated the business in the metallurgical complex

in Columbus, MT; and created a new corporate subsidiary, Stillwater Metals Co., for its recycling operations. Construction was completed on a new x-ray assay facility at the recycling complex, which increased SMC's receiving and sampling capacity fourfold. About 40% of the recycled material was from material purchased by SMC, and the remainder was toll processed for others for a fee. SMC moved its headquarters office to Billings, MT, from Columbus, MT, in 2010 (Stillwater Mining Co., 2011b).

Mining productivity in terms of mill feed was similar to that of 2009, at 2,130 metric tons per day (t/d) at the Stillwater Mine and 1,100 t/d at the East Boulder Mine. In 2011, SMC planned to resume mining on the east side of the Stillwater Mine, which has higher ore grades than the offshaft area (Stillwater Mining Co., 2011a, p. 10).

SMC's sales contract with Ford Motor Co. (Dearborn, MI) expired at yearend. The company entered into new contracts with Ford, General Motors Corp. (Detroit, MI), and BASF Corp. (Florham Park, NJ). The new sales contracts were based on prevailing market prices and were for fixed ounces of PGMs to be delivered on a monthly basis (Stillwater Mining Co., 2011a, p. 10).

SMC planned to proceed with two mine expansion projects in the Stillwater Complex—the Graham Creek project, immediately to the west of the East Boulder Mine, and the Blitz project, immediately to the east of the Stillwater Mine. Both projects were within the boundaries of existing mining permits. The Graham Creek project would extend the East Boulder Mine about 2,500 meters (m) further west, and production from the project was expected to be 6 Mt of ore grading at 13 grams per metric ton (g/t) PGMs. The Blitz project would extend about 4,100 m to the east of the Stillwater Mine via two footwall laterals and was expected to yield as much as 9.5 Mt of ore grading at 22 g/t PGMs. Development and resource evaluation of both projects was expected to take place during the next 5 to 6 years (Stillwater Mining Co., 2011a, p. 5–6). SMC also completed its acquisition of Marathon PGM Corp.'s (Toronto, Ontario, Canada) Marathon PGM-copper project in Ontario. The Marathon project was scheduled to come into production during the next 3 years and produce 6,220 kilograms per year (kg/yr) of platinum and palladium for as many as 12 years. SMC also announced that it entered into a definitive agreement to acquire Benton Resources Corp.'s (Thunder Bay, Ontario, Canada) Bermuda Property. The 7,300-hectare Bermuda Property was located along the eastern and northern margins of the Coldwell Complex near Marathon, Ontario, and was adjacent to SMC's recently purchased Marathon PGM-copper project. Through the agreement, SMC would also acquire Benton's royalty position on the Marathon PGM-copper deposit (Stillwater Mining Co., 2011a, p. 7–8).

SMC announced the exit of its majority stockholder, Norimet Ltd. (London, United Kingdom), a wholly owned subsidiary of OJSC MMC Norilsk Nickel (Moscow, Russia). Norimet sold its entire 51.3% stake in SMC in two separate secondary offerings (Stillwater Mining Co., 2011a, p. 9).

At yearend 2010, SMC reported proven and probable reserves of 41.0 Mt with an average grade of 15 g/t containing about 620,000 kg of palladium and platinum, with an in-situ palladium-to-platinum ratio of about 3.57 to 1. Average mill head grades ranged from 16 g/t at the Stillwater Mine to 12 g/t at the East Boulder Mine. SMC's proven and probable reserves of PGMs are contained in the J-M Reef, an ore body within the layered mafic and ultramafic igneous rocks of the Stillwater Complex. SMC planned to produce 15,600 kg of PGMs in 2011 (Stillwater Mining Co., 2011a, p. 8, 10, 14).

In 2010, PGM exploration continued at several locations in the United States. The most advanced projects were in the Duluth Complex of Minnesota. PolyMet Mining Corp.'s (Hoyt Lakes, MN) primary focus continued to be completion of the environmental review and permitting process to enable construction and operation of the NorthMet Mine. U.S. Army Corps of Engineers and the U.S. Forest Service, colead Federal agencies responsible for the environmental impact statement (EIS) reviewing PolyMet's copper-nickel-precious metals project, published a notice of intent to complete a supplemental draft EIS. The colead Federal agencies were working with the Minnesota Department of Natural Resources, the State lead agency, the U.S. Environmental Protection Agency, and other cooperating agencies involved in the EIS process. The supplemental draft EIS included a proposed land exchange between the U.S. Forest Service Superior National Forest and PolyMet. The land exchange was expected to improve intermingled and inefficient ownership patterns and eliminate conflicts if minerals development was to expand in the future. The lands that would be received by the Superior National Forest consisted of forest and wetland habitat as well as lake frontage. The supplemental draft EIS was expected in the summer of 2011, with the final EIS anticipated 6 to 9 months later (PolyMet Mining Corp., 2010).

Duluth Metals Ltd. (Toronto, Ontario, Canada) entered into a joint venture with Antofagasta plc (London, United Kingdom) to advance the copper-nickel-PGM Nokomis Project in the Duluth Complex, MN. Prefeasibility and bankable feasibility studies on the Nokomis deposit were expected to be completed by 2013 (Duluth Metals Ltd., 2010b). Duluth Metals planned to complete exploratory and development drilling, mine planning, metallurgical testing, prefeasibility and feasibility studies, as well as continued environmental data collection and analysis on Nokomis by March 2012 (Duluth Metals Ltd., 2010c). Duluth Metals also planned to begin an exploration program for copper-nickel-PGM deposits on its properties in the Duluth Complex which fall outside the areas of the Nokomis deposit; these were not included in the Antofagasta joint venture. Duluth Metals planned a drilling program on the new properties, on which historical drilling activity was very limited. The company thought that mineralization on these properties was similar to that of the Nokomis deposit. Duluth Metals had previously concentrated on the discovery and advancement of the Nokomis deposit (Duluth Metals Ltd., 2010d).

Duluth Metals entered into an agreement with Franconia Minerals Corp. (Spokane Valley, WA) in which Duluth would acquire 100% of the outstanding common shares of Franconia. Franconia's main asset was a 70% interest in the Birch Lake, Maturi, and Spruce Road nickel-copper-PGM deposits in the Duluth Complex in northeastern Minnesota, through the Birch Lake joint venture. The Franconia assets, which were near Duluth Metals' Nokomis deposit, were planned to be rolled into Twin Metals Minnesota LLC, the Duluth Metals (60%) and Antofagasta plc (40%) joint venture. The transaction was subject to approval by Franconia shareholders at a special meeting expected to take place in February 2011 (Duluth Metals Ltd., 2010a).

In Alaska, Pure Nickel, Inc. (Toronto, Ontario, Canada) continued exploration of the nickel-copper-cobalt-PGM MAN property 265 kilometers (km) south-southeast of Fairbanks. Pure Nickel completed 6,700 meters of drilling in 2010, which was funded by its partner, ITOCHU Corp. (Tokyo, Japan). A new company was created, called MAN Alaska LLC, to hold the MAN property claims. MAN Alaska LLC was jointly owned by Nevada Star Resource Corp. (Bellevue, WA) (70%), a wholly owned subsidiary of Pure Nickel, and ITC Mineral Resources Development Inc. (Tokyo, Japan) (30%), a wholly owned subsidiary of ITOCHU (Pure Nickel, Inc., 2011, p. 3).

**Secondary.**—In 2010, PGMs were recycled from three main sources—autocatalysts, electronics, and jewelry. The global recovery of platinum from recycling of autocatalysts increased by 31% in 2010 compared with that of 2009, reaching 33,700 kg. In North America, recovery of platinum from catalytic converters was an estimated 18,000 kg of platinum, which was a 36% increase compared with that in 2009, and represented roughly 53% of global autocatalyst recycled material. Recovery of platinum from catalytic converters increased by 29% and 20% in Europe and Japan, respectively, and was unchanged in China compared with 2009 quantities. In the rest of the world, recycling of autocatalysts produced about 11% more platinum in 2010 compared with that of 2009. Globally, recycling of autocatalysts increased partly as a result of car scrappage incentive programs put in place in 2009. Catalysts collected from scrapped automobiles were processed in 2010. About 311 kg of platinum was recovered from electronics recycling in 2010, which was the same amount recovered in 2009. About 23,200 kg of platinum was recovered from the jewelry industry globally, an increase of 32% compared with that of 2009 (Butler, 2011, p. 24).

About 41,200 kg of palladium was recovered from autocatalysts globally in 2010, an increase of 37% compared with that of 2009. Roughly 60% of global recycled palladium came from North America. Palladium recovery from autocatalysts in North America increased by 46% to 24,600 kg, and that in Europe increased by 20% to 10,400 kg relative to that in 2009. Palladium recovery from autocatalysts in Japan increased by 50% and that in China increased by 43% compared with levels in 2009. Recycling of palladium from electronics totaled 113,700 kg in 2010, an increase of 11% compared with that of 2009. Recycling of palladium from the jewelry industry totaled about 2,490 kg in 2010, which was about 14% less than that of 2009. In 2010, global recovery of rhodium from autocatalysts increased by 26% to 7,300 kg (Butler, 2011, p. 24).

SMC's recycling program recovered 12,400 kg of PGMs in 2010, an increase of 59% as compared with that of 2009. Recycled material sales were \$168.6 million in 2010, which was more than double the 2009 sales value (Stillwater Mining Co., 2011a, p. 50).

## Consumption

In 2010, global platinum sales totaled 245,000 kg, a 16% increase compared with sales in 2009. About 46% of the total was consumed by the autocatalyst industry, about 31% by the jewelry industry, and about 8% was used as investment. The remainder was used in other industries including chemical, electrical, glassmaking, and medical and biomedical. Platinum use in the autocatalyst sector increased by 43% as a result of an increase in light-duty vehicle production, which in turn was the result of the effects of the global economic downturn (Butler, 2011, p. 4).

Global palladium sales were 299,000 kg in 2010, about 23% more than those in 2009. About 57% of the total was used by the autocatalyst industry, about 15% by the electronics industry, and about 11% as investment. The remaining amount was used in industries such as chemical, dental, jewelry, and others (Butler, 2011, p. 36).

In 2010, U.S. apparent consumption of refined platinum was estimated to be about 139,000 kg, a 19% decrease from the apparent consumption of 171,000 kg in 2009. Apparent domestic palladium consumption was estimated to be about 44,300 kg, a 15% decrease from 52,100 kg in 2009.

**Palladium.**—Palladium use in autocatalysts increased by 35% globally to 170,000 kg in 2010 compared with 2009 consumption. Demand in Europe increased by 33% to 41,000 kg. The increase was partly a result of auto scrappage plans which had the effect of increased sales for small gasoline-powered, rather than diesel, vehicles. Additionally, European automakers continued to increase substitution of palladium for platinum in diesel catalytic converters, with most diesel catalysts containing about 25% palladium. European automakers increased exports in 2010, with the majority going to gasoline markets such as China.

Consumption in the North American autocatalyst sector increased to 42,300 kg, a 33% increase relative to that of 2009 owing to increased auto production and sales. Palladium consumption in the Japanese autocatalyst industry was 25,300 kg, a 38% increase compared with that of 2009. Palladium consumption for autocatalysts in China increased to 30,300 kg, a 42% increase relative to that of 2009. Palladium consumption for autocatalysts in the rest of the world increased by 28% to 30,300 kg relative to that of 2009 (Butler, 2011, p. 36–39).

On a global basis, palladium consumption by the jewelry industry was 19,300 kg, a 20% decrease in 2010 compared with that of 2009. The decrease was largely a result of the 32% drop in demand from China, to 11,800 kg of palladium, partly because of higher prices as well as sufficient levels of stock. Nevertheless, China was again by far the leading user of palladium for jewelry, with 61% of world consumption in that sector. The much smaller markets in Europe and North America showed increases in palladium use in jewelry in 2010. Consumption in Europe was 2,180 kg of palladium, a 40%

increase relative to that of 2009, and consumption in North America was 2,020 kg, an 8% increase compared with that of 2009. Consumption in Japan was 2,330 kg of palladium, a 6% decrease relative to that of 2009 (Butler, 2011, p. 39–40).

World palladium consumption in dental alloys was 18,000 kg in 2010, which was about 9% less than consumption in 2009. Japan and North America each consumed about 43% of the global consumption in that sector. The chemical industry consumed 12,300 kg of palladium in 2010, a 22% increase from that in 2009. In the chemical industry, palladium was used mainly as a catalyst in manufacturing bulk chemicals, including purified hydrogen peroxide, nitric acid, purified terephthalic acid, and vinyl acetate monomer, which was a component of many resins and plastics. The global increase in palladium demand was the result of increased consumer demand for end products that use these various chemicals in their manufacturing. Consumption of palladium by the electronics industry was 43,900 kg in 2010, which was a 3% increase compared with that of 2009, a result of increased consumer purchasing of electronic products. Demand increased both for resistors and for multilayer ceramic capacitors (MLCCs), which have widespread use in electronic circuitry. Use of palladium in other applications increased by 21% in 2010 compared with that of 2009. Such uses included stationary-source emission control and petroleum refining catalysts. Purchases of palladium for investment increased to 33,700 kg, 74% higher than those of 2009. Holdings in exchange-traded funds (ETFs) were 68,400 kg at yearend 2010, an increase of 84% compared with holdings at yearend 2009 (Butler, 2011, p. 42).

**Platinum.**—Global use of platinum in the autocatalyst sector increased by 43% to 97,200 kg in 2010 compared with that in 2009. Consumption in Europe was about 45,600 kg of platinum in 2010, which was 51% more than that of 2009, and accounted for about 47% of the global total. The market share of light-duty diesel vehicles in Europe increased to about 48% in 2010 from 46% in 2009. Consumption in the autocatalyst sector for North America was 15,100 kg, an increase of 31% in 2010 relative to that of 2009 owing to the increase in automobile purchases in response to the global financial upswing. In Japan, platinum demand in the autocatalyst sector was 17,000 kg, about 38% more than that of 2009. In China, demand for platinum in the autocatalyst sector increased by 44% to 16,300 kg. Consumption of platinum for autocatalysts increased by 44% in other areas of the world in 2010 relative to that of 2009 (Butler, 2011, p. 25–28).

In 2010, global consumption of platinum in the jewelry industry decreased as a result of higher metal prices. Consumption in this sector was 75,100 kg of platinum, a 14% decrease compared with that of 2009. Consumption in North America increased by 30% relative to that of 2009, partly in response to a narrowing of the price difference between gold and platinum in 2010. Consumption in Europe and Japan decreased by 5% and 3%, respectively. Consumption in China decreased by 21% during the same time period. China remained, by far, the leading consumer of platinum in this sector at 51,300 kg, accounting for 74% of global consumption of platinum for jewelry (Butler, 2011, p. 28–30).



Global use of platinum in the chemical sector was 13,800 kg in 2010, which was an increase of 53% compared with that of 2009. The increase was a result of increased capacity utilization in chemical plants in response to a stronger global economy. In contrast to other industrial sectors, purchases of platinum by the petroleum refining industry decreased by 19% to 5,230 kg in 2010, a result of decreased capacity utilization in response to lingering effects of the economic downturn of 2009. The global consumption of platinum in electrical applications increased by 16%, to 6,840 kg in 2010, compared with that of 2009, owing to strengthening consumer demand (Butler, 2011, p. 31–32).

Because of its high melting point and resistance to corrosion, platinum equipment is used in the glassmaking industry. Platinum consumed in the glass industry skyrocketed to 10,700 kg in 2010 from 311 kg in 2009. The dramatic increase was a result of several factors, including increased consumer demand for flat-panel displays that use platinum in the production of liquid crystal displays, and increased industrial demand for fiberglass in the building industry. Consumption in the medical and biomedical sector was 7,930 kg, which was slightly higher than that in 2009. Consumption in other end uses increased to 7,900 kg, a 34% increase relative to that of 2009. These categories included use in automotive sensors, coating of aircraft turbine blades, and spark plugs. Investment demand for platinum decreased slightly to 20,200 kg. By yearend 2010, platinum holdings in ETFs increased to 37,300 kg (Butler, 2011, p. 25–33).

In 2010, the U.S. Mint did not sell any platinum American Eagle Bullion coins (U.S. Mint, 2011).

**Other PGMs.**—Global rhodium consumption in 2010 was 27,200 kg, a 22% increase compared with that of 2009. A majority of rhodium use, 77% in 2010, was in the production of autocatalysts. In 2010, rhodium use in autocatalysts increased to 22,500 kg, which was 17% more than that of 2009. Demand for rhodium in the autocatalyst sector increased in China, Japan, and North America as a result of increasing vehicle production. In contrast, rhodium demand decreased in Europe because of thrifting by autocatalyst manufacturers. Use of rhodium in the glass manufacturing sector increased sharply to 1,770 kg, a 200% rise in 2010 compared with that in 2009. The increase was owing to increased demand for fiberglass and flat-panel glass. Consumption of rhodium in the chemical sector increased by 26% to 2,110 kg in 2010 owing to increased capacity utilization rates in oxoalcohol manufacturing plants in Asia. Demand from the electrical sector increased by 33% in 2010, to 124 kg, whereas demand in other applications was down by 5% from that of 2009, at 622 kg (Butler, 2011, p. 44).

Global consumption of ruthenium increased by 79% to 32,000 kg in 2010 relative to that in 2009. The consumption of ruthenium in electrical applications increased to 23,400 kg from 10,500 kg in 2009, mainly a result of increased consumption of primary ruthenium in the hard disk industry. Electrochemical demand was 4,100 kg, a 39% increase compared with that of 2009. Its use in the chemical sector rose to 3,110 kg, a 12% increase compared with that in 2009. Consumption of ruthenium in other applications decreased to 1,340 kg, 20% less than that in 2009 (Butler, 2011, p. 45).

Global consumption of iridium increased strongly to 10,400 kg in 2010 from 2,520 kg in 2009. The largest increase of iridium use was in the electrical sector at 6,030 kg in 2010 compared with 218 kg in 2009. Iridium crucibles are used in the electronics industry to grow high-purity single crystals for use in various applications. Single crystal sapphire was used in the production of back-lit light-emitting diode televisions. Increased demand for these televisions led to increased demand for iridium crucibles (Butler, 2011, p. 45).

## Prices

In 2010, the Engelhard annual average price of palladium doubled and that of platinum increased by 34% compared with the 2009 annual average prices. As for the other PGMs, the 2010 iridium annual price increased by 53%, and rhodium and ruthenium annual prices increased by 55% and 104%, respectively, compared with the 2009 prices (table 1).

**Iridium.**—In the beginning of January, the price of iridium was \$420 per troy ounce. The price increased steadily through May, when it reached \$715 per troy ounce. The price held steady until late October, when it increased to \$745 per troy ounce, and ended the year at \$780 per troy ounce, which was a 30-year high. The large price increase was the result of increased purchases of iridium by the electrochemical and electronics sectors.

**Palladium.**—Palladium prices began the year at \$422 per troy ounce, increased to \$573 per troy ounce in April, and decreased to \$433 per troy ounce in late May. For the rest of the year, the price trend was upwards in response to increased investor interest and increased demand from the automobile sector. The palladium price ended the year at \$800 per troy ounce, which was its highest level in 10 years.

**Platinum.**—Although the platinum price was volatile throughout the year, the annual average price reached an alltime high. Platinum began the year at \$1,510 per troy ounce, increased to \$1,750 per troy ounce in late April, and decreased to \$1,495 per troy ounce in late May. The price remained below \$1,600 per troy ounce until mid-September, when it increased steadily through the beginning of November, when it reached the year's high at \$1,790 per troy ounce. The price ended the year at \$1,754 per troy ounce. The price increase toward the yearend was driven by strong investment demand.

**Rhodium.**—The rhodium price began the year at \$2,625 per troy ounce, increased to \$2,975 per troy ounce in mid-April, then decreased steadily for the next 5 months, dropping to \$2,120 per troy ounce in mid-August. The price increased to \$2,350 per troy ounce in late September and ended the year at \$2,425 per troy ounce. The midyear price decline was owing to lack of buying interest. The increase toward yearend was in response to news of increased car sales in China.

**Ruthenium.**—The ruthenium price increased strongly during the first half of the year and then decreased strongly in the second half of the year. The price began the year at \$170 per troy ounce, rose to \$245 per troy ounce in early May, where it remained until late June, and then decreased steadily for the next 6 months to end the year at \$180 per troy ounce. The ruthenium

price increased owing to purchasing by the electronics sector and decreased owing to decreased industrial demand.

## Foreign Trade

In 2010, the U.S. net import reliance as a percentage of apparent consumption was estimated to be 74% for refined palladium and 98% for refined platinum. Imports of refined palladium in 2010 increased slightly to 70,700 kg from 69,700 kg in 2009, with three countries accounting for about 72% of refined palladium imports in 2010—South Africa (33%), Russia (26%), and the United Kingdom (13%). Imports of platinum, including waste, scrap, and coins, decreased by 17% in 2010 to 152,000 kg, from 183,000 kg in 2009. Excluding waste and scrap, three countries accounted for 73% of imports of platinum in 2010—South Africa (50%), the United Kingdom (15%), and Germany (9%). Refined imports of other PGM decreased by 10% in 2010 compared with those of 2009. Imports of iridium increased by 132% to 3,530 kg; those of rhodium and osmium increased by 15% and 12%, respectively, and those of ruthenium decreased by 33% compared with those of 2009. Three countries accounted for 89% of the imports of other PGM in 2010—South Africa (66%), the United Kingdom (12%), and Germany (11%) (tables 2, 3).

About 38,100 kg of palladium was exported in 2010, an increase of 26% relative to palladium exports in 2009. Exports of platinum, including waste and scrap, increased by 17% to 55,100 kg, and exports of rhodium increased by 90% compared with exports in 2009. Exports of iridium, osmium, and ruthenium decreased by 8% during the same time period (table 4).

## World Review

In 2010, world mine production of PGMs increased by 4% to 467,000 kg compared with 449,000 kg in 2009 (table 5). South Africa, the world's leading producer of PGMs, accounted for 62% of total mine production in 2010; Russia accounted for 26%, Zimbabwe accounted for 4%, and Canada and the United States each accounted for 3%. In 2010, platinum production from South Africa totaled 148,000 kg, which represented 77% of world platinum production and was a 5% increase relative to South African production in 2009. Global output of palladium increased to 202,000 kg, with Russia and South Africa accounting for 42% and 41%, respectively, of the total. The United States accounted for 6% of world palladium production. World production of other PGMs (iridium, osmium, ruthenium, and rhodium) in 2010 increased by 3% as compared with that of 2009. South Africa was the dominant producer, accounting for 78% of the total global production of other PGMs.

**Botswana.**—In 2010, Norilsk Nickel produced 3,330 kg of palladium and 560 kg of platinum as byproducts from its nickel operations at the Tati Mine. These quantities represented increases of 7% and 6%, respectively, in palladium and platinum production compared with that in 2009 (OJSC MMC Norilsk Nickel, 2011, p. 4).

**Canada.**—North American Palladium Ltd. (Toronto) produced 2,960 kg of palladium and 156 kg of platinum from its Lac des Isles Mine. The mine was reopened in April 2010

after having been placed on care-and-maintenance status in October 2008 in response to low metal prices (North American Palladium Ltd., 2011).

Xstrata plc (Zug, Switzerland) continued to produce PGM as byproducts from nickel mining operations at Sudbury, although production figures were not released. Xstrata's Nickel Rim South Mine probably produced more than 1,900 kg of platinum and a similar amount of palladium (Butler, 2011, p. 21). Vale Inco Ltd. (Toronto) produced 1,870 kg of palladium and 1,090 kg of platinum as byproducts of its nickel operations at Sudbury. These data reflect production decreases for palladium and platinum of 61% and 66%, respectively, relative to production in 2009. Production was severely affected by a year-long strike which ended in July 2010 (Butler, 2011, p. 21).

**Russia.**—In 2010, Russia accounted for 42% of global mine production of palladium, 13% of platinum production, and 16% of other PGMs. Norilsk Nickel produced 84,700 kg of palladium and 20,600 kg of platinum in 2010, a slight increase for palladium and a 4% increase for platinum compared with 2009 production (OJSC MMC Norilsk Nickel, 2011). Russia's alluvial production was about 4,510 kg of platinum, which was a 3% decrease compared with 2009 production (Butler, 2011, p. 20–21).

**South Africa.**—In 2010, South African production of platinum and palladium increased by 5% and 9%, respectively, compared with 2009 production. The world's leading PGM producer, Anglo American Platinum Ltd. (Johannesburg), produced 79,900 kg of platinum and 45,100 kg of palladium in 2010, increases of 5% for platinum and 6% for palladium relative to production in 2009. Rhodium production was 10,200 kg in 2010, a decrease of 6% relative to that of 2009. The older operations on the western limb of the Bushveld Complex generally had lower output in 2010 relative to that of 2009, whereas production at the newer operations was generally higher. Output from the Khuseleka and Siphumelele Mines (formerly part of the Rustenburg section) was 4,000 kg and 2,900 kg of platinum and palladium, respectively, which were decreases of 17% and 14%, respectively, relative to that of 2009. Platinum production from the Mototolo Mine, a joint venture with Xstrata, was 3,360 kg, slightly lower than 2009 production. The Kroondal and Marikana Mines, operated as pool-and-share agreements with Aquarius Platinum Ltd. (Perth, Australia), produced 7,911 kg and 1,640 kg of platinum, respectively, which were increases of 9% and 32% respectively, relative to that of 2009. Operations at Mogalakwena continued to ramp up, and 2010 production was 8,100 kg, an increase of 10% relative to that of 2009. At Modikwa, a joint venture with African Rainbow Minerals Ltd. (ARM) (Sandton), platinum production was 4,030 kg, which was a 4% decrease relative to that of 2009. At the Bafokeng-Rasimone Platinum Mine (BRPM) joint venture with Royal Bafokeng Platinum (Johannesburg), refined platinum production was 5,740 kg, a 7% increase relative to 2009 production. Anglo expected to produce 80,900 kg of platinum in 2011 (Anglo American Platinum Ltd., 2011, p. 49–83).

Impala Platinum Holdings Ltd.'s (Johannesburg) refined production of platinum in 2010 was 33,700 kg, a 5% decrease compared with that of 2009. Output at the Impala Mine was

27,100 kg of platinum, an 8% decrease relative to that of 2009. The decrease was the result of safety stoppages following the deaths of 15 workers and the resulting revisions to mining methods. Production at Impala also decreased owing to a 2-week stoppage that took place as a result of a workers' strike. Marula Mine had a difficult year, and ramp up was slow. Production at Marula decreased to 2,180 kg of platinum, a 5% decrease relative to that of 2009. Production at the Two Rivers Mine included 4,400 kg of platinum in concentrate, which was a 19% increase compared with that of 2009 as a result of continued progress toward ramp up to full capacity. Impala expected to produce 4,670 kg/yr of platinum by 2013 from Two Rivers (Impala Platinum Holdings Ltd., 2011, p. 73–95).

In 2010, Northam Platinum Ltd. (Johannesburg) reported production from its Zondereinde Mine of nearly 10,000 kg of PGMs in concentrate, a 6% increase compared with production in 2009 (Northam Platinum Ltd., 2011, p. 5).

Lonmin plc (London) reported production for 2010 of 21,600 kg of platinum and 10,100 kg of palladium, increases of 5% each, relative to 2009 production. Rhodium production was 3,000 kg, a 6% increase relative to that of 2009. Ruthenium and iridium production were 4,700 kg and 1,000 kg, respectively, increases of 8% and 7%, respectively, relative to production in 2009. Production increased owing to an increase in quantity mined, improved grades, and improved recoveries in the concentrators (Lonmin plc, 2011, p. 4, 146).

Aquarius Platinum Ltd. (Bedford) resumed production at the Everest Mine in 2010 after completing repairs following subsidence of the mined-out portion of the mine in 2009. Aquarius' attributed production from Everest was 1,680 kg of PGM. Production from Platinum Mile was 205 kg of PGM, a decrease of 39% relative to that of 2009 owing to a decline in the amount of tailings material. The Blue Ridge Mine produced 523 kg of PGM, which was a slight increase compared with 2009 production. The Blue Ridge Mine was closed temporarily in September 2010 for redevelopment and was expected to reopen in July 2011. Aquarius had two pool-and-share agreements with Anglo Platinum, at the Kroondal and Marikana Mines. Aquarius' attributed production from the Kroondal Mine was 6,870 kg of PGM, an 8% increase relative to that of 2009. Production from the Marikana Mine was 1,990 kg of PGM, which was a 12% decrease relative to that of 2009. Production from the Chromite Tailings Retreatment Plant, a joint-venture project between Aquarius (50%), GB Mining and Exploration Ltd. (Johannesburg) (25%), and Sylvania South Africa Ltd. (West Perth) (25%), was 85 kg of PGM in 2010, compared with production of 110 kg of PGM in 2009, a decrease of 23% (Aquarius Platinum Ltd., 2011, p. 17–19).

ARM platinum division had several joint ventures in South Africa—Modikwa Platinum Mine, 50% jointly owned with Anglo Platinum; Nkomati Nickel Mine, 50% with Norilsk Nickel; and Two Rivers Platinum Mine, a project in which ARM held 55% and Implats 45%. Production from Modikwa was 4,090 kg of PGM, and from Nkomati, production was 1,600 kg of PGM. Modikwa production decreased by about 3% relative to that of 2009, whereas Nkomati production nearly doubled as a result of a large-scale expansion program. Two Rivers produced 4,380 kg of PGM during 2010, which was a 19% increase

relative to that of 2009 (African Rainbow Minerals Ltd., 2011, p. 38–40).

Eastern Platinum Ltd.'s (Vancouver, British Columbia, Canada) Crocodile River Mine produced 4,100 kg of PGMs in concentrate, a slight increase from that in 2009 (Eastern Platinum Ltd., 2011, p. 3).

Platmin Ltd.'s (Centurion) Pilanesburg Mine, which was still in the build-up stage, produced 1,870 kg of PGM in concentrate during its first full year of production (Platmin Ltd., 2011, p. 37).

Platinum Australia Ltd.'s Smokey Hills Mine produced about 964 kg of PGM in concentrate, which was an increase of 11% relative to that of 2009 but far less than had been anticipated. Platinum Australia faced a difficult year owing to performance issues with the mining contractor and the discovery of a previously undetected pothole in the proposed underground mining area. Potholes are geologic structures which result in displaced ore horizons (Platinum Australia Ltd., 2011, p. 2).

**Zimbabwe.**—In 2010, the Mimosa Mine, a joint venture between Aquarius Platinum and Impala, produced 6,260 kg of platinum, which was 7% more than that in 2009. Mimosa was operating at full capacity, and no expansions were planned for the next 5 years (Butler, 2011, p. 22). Production from Impala's Zimplats Mine was 5,490 kg of PGMs, which was 81% more than that in 2009. The phase I expansion project at Zimplats was near its full production capacity, and 4.2 Mt of ore was milled in 2010. The second phase of expansion at Zimplats was underway, including a third underground mine and a second concentrator. The phase 2 expansion was expected to be completed in 2014 and to achieve full production of 8,400 kg/yr of platinum (Impala Platinum Holdings, Ltd., 2011, p. 13, 64–73).

Anglo American Platinum's Unki Mine, near Gweru, continued development in 2010, and 392,000 metric tons of ore were mined. Anglo planned to refine as much as 933 kg of platinum during 2011 (Butler, 2011, p. 22).

## Outlook

The progress of the global economic recovery is expected to be the main driver of demand for PGMs owing to their use as industrial metals. The primary end use for palladium, platinum, and rhodium is for catalytic converters in the automotive industry; therefore, the outlook for that industry will have the greatest impact on the consumption and prices of these PGMs. Economic growth remains weak in most countries, but consumer confidence is returning, and industrial output is increasing. Global automobile production is likely to increase; therefore, an overall increase in demand for PGM in that sector is expected. Manufacturers continue to switch to palladium-based catalytic converters and to increase palladium loadings on diesel light-duty vehicles because of the price difference between platinum and palladium. Thus, the increase in automobile demand, particularly in emerging markets such as China, will likely affect palladium demand in particular. In the electronics sector, palladium demand is likely to increase as the global economy recovers because of increasing demand for consumer electronics in which palladium is used in MLCCs, as well as increased palladium loadings in the MLCCs. In the



glass sector, demand for platinum could decrease owing to an expected slowdown in new fiberglass production capacity installation. In the chemical sector, demand palladium is expected to rise because of an increase in construction of manufacturing facilities. The demand for platinum in the jewelry sector was expected to be about the same as that of 2009, whereas palladium jewelry demand is likely to be lower. The consumption of rhodium is expected to increase as a result of higher vehicle demand in many areas of the world. Ruthenium demand is expected to increase as a result of increased demand from the electrical and electrochemical sectors. Iridium demand is likely to decrease as a result of stock building of crucibles used for the growth of metal oxide single crystals.

On the supply side, platinum production from South Africa is expected to increase as a result of ramp up from new operations and additional output from reopened shafts that had been closed owing to low metal prices. Supply from Zimbabwe is expected to increase because of new mining projects, but this may be dependent on the political situation. Recycling of platinum and palladium is expected to increase, particularly in the automotive catalyst recycling sector.

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TABLE 1  
SALIENT PLATINUM-GROUP METALS STATISTICS<sup>1</sup>

		2006	2007	2008	2009	2010
United States:						
Mine production:						
Palladium, Pd content: <sup>2</sup>						
Quantity	kilograms	14,400	12,800	11,900	12,700	11,600
Value	thousands	\$150,000	\$148,000	\$136,000	\$108,000	\$199,000
Platinum, Pt content: <sup>2</sup>						
Quantity	kilograms	4,290	3,860	3,580	3,830	3,450
Value	thousands	\$158,000	\$162,000	\$182,000	\$149,000	\$179,000
Refinery production:						
Palladium, Pd content:						
Quantity	kilograms	5,660	7,410	7,650	7,820 <sup>r</sup>	7,920
Value	thousands	\$58,700	\$85,100	\$87,300	\$66,800 <sup>r</sup>	\$135,000
Platinum, Pt content:						
Quantity	kilograms	6,870	8,930	7,400	7,210 <sup>r</sup>	6,500
Value	thousands	\$253,000	\$375,000	\$376,000	\$280,000	\$338,000
Imports for consumption, refined:						
Iridium, Ir content	kilograms	2,800	3,410	2,550	1,520	3,530
Osmium, Os content	do.	56	23	11	68	76
Palladium, Pd content	do.	119,000	113,000	120,000	69,700	70,700
Platinum, includes waste, scrap, and coins, Pt content	do.	114,000	181,000	150,000	183,000	152,000
Rhodium, Rh content	do.	15,900	16,600	12,600	11,200	12,800
Ruthenium, Ru content	do.	36,000	48,700	49,800	21,200	14,100
Exports, refined:						
Iridium, osmium, and ruthenium, gross weight	do.	3,390	8,190	6,450	4,020	3,720
Palladium, Pd content	do.	53,100	41,800	26,400	30,300	38,100
Platinum, Pt content	do.	45,500	28,900	15,600	15,600	16,900
Rhodium, Rh content	do.	1,600	2,210	1,980	1,220	2,320
Stocks, National Defense Stockpile, December 31:						
Iridium, Ir content	do.	111	18	18	18	18
Platinum, Pt content	do.	261	261	261	261	261
Price, average:						
Iridium <sup>3</sup>	dollars per troy ounce	349.45	444.43	448.34	420.40	642.15
Palladium <sup>4</sup>	do.	322.93	357.34	355.12	265.65	530.61
Platinum <sup>4</sup>	do.	1,144.42	1,308.44	1,578.26	1,207.55	1,615.56
Rhodium <sup>4</sup>	do.	4,561.06	6,203.09	6,533.57	1,591.32	2,459.07
Ruthenium <sup>3</sup>	do.	193.09	573.74	324.60	97.28	198.45
Employment		1,720	1,630	1,360	1,270	1,350
World, mine production <sup>c</sup> , PGM content	kilograms	515,000 <sup>r</sup>	511,000 <sup>r</sup>	468,000 <sup>r</sup>	449,000 <sup>r</sup>	467,000

<sup>c</sup>Estimated. <sup>r</sup>Revised. do. Ditto.

<sup>1</sup>Data are rounded to three significant digits, except prices.

<sup>2</sup>Source: Stillwater Mining Co., 2010 annual report, p. 52.

<sup>3</sup>Price data are annual averages of daily Engelhard unfabricated quotations published in Platts Metals Week.

<sup>4</sup>Price data are annual Engelhard unfabricated quotations published in Platts Metals Week.

TABLE 2  
U.S. IMPORTS FOR CONSUMPTION OF PLATINUM, BY COUNTRY<sup>1</sup>

Country	Grain and nuggets			Sponge			Other unwrought			Other			Waste and scrap			Coins	
	Quantity, Pt content (kilograms)	Value (thousands)	Value (\$1,420,000)	Quantity, Pt content (kilograms)	Value (thousands)	Value (\$129,000)	Quantity, Pt content (kilograms)	Value (thousands)	Value (\$174,000)	Quantity, Pt content (kilograms)	Value (thousands)	Quantity, Pt content (kilograms)	Value (thousands)	Quantity, Pt content (kilograms)	Value (thousands)	Quantity, Pt content (kilograms)	Value (thousands)
2009	16	\$474	\$1,420,000	37,100	\$129,000	\$174,000	5,910	\$136,000	\$334,000	512	\$20,500						
2010:																	
Argentina	9	306	--	6	399	69	1	169	8,690	--	--						
Australia	--	--	--	--	--	24,200	467	6	214	625							
Belgium	--	--	90,400	1,800	--	653	11	--	--	--							
Bolivia	--	--	--	--	--	--	--	9,310	1,110	--							
Brazil	--	--	10,500	222	--	17	(2)	3,260	17,800	--							
Canada	5	197	--	1	13	12,600	240	15,800	65,400	16	789						
Chile	--	--	--	--	--	--	--	977	188	--							
China	--	--	--	--	--	441	14	1,670	24,900	--							
Colombia	--	--	--	--	1,330	54,600	--	177	4,060	--							
France	--	--	1,590	84	3,990	918	43	369	10,000	--							
Germany	48	2,160	93,700	2,090	42,400	79,900	2,560	22,300	134,000	(2)	3						
Hong Kong	--	--	--	--	--	6	(2)	300	496	--							
India	--	--	3,110	64	179	394	7	65	3,060	--							
Israel	--	--	--	--	65	1,730	--	59	2,010	--							
Italy	--	--	93,100	1,800	--	4,970	88	384	22,800	--							
Japan	--	--	3,650	69	2,160	262	11	21,500	83,800	--							
Jordan	--	--	--	--	--	--	--	123	765	--							
Korea, Republic of	--	--	11,300	212	43	1,400	19	696	30,800	--							
Mexico	--	--	1,400	28	39	48	2	12,300	10,300	--							
Norway	--	--	69,600	1,350	--	770	49	--	--	--							
Russia	561	13,200	11,700	232	7	24,400	501	--	--	--							
Saudia Arabia	--	--	--	--	--	--	--	2,080	73,100	--							
Singapore	--	--	--	--	--	873	16	91	3,020	--							
Slovakia	--	--	--	--	--	10,200	181	--	--	--							
South Africa	1	64	1,010,000	20,100	8	7,280	149	--	--	(2)	9						
Switzerland	--	--	5,140	99	808	5,950	126	--	--	(2)	6						
Taiwan	--	--	5,700	110	4	216	2	1,270	19,900	--							
United Kingdom	14	605	183,000	3,570	6	6,390	122	17,700	35,500	19	1,310						
Other	4	209	--	7	254	793	38	501	13,100	(2)	19						
Total	644	16,700	1,590,000	31,700	3,790	183,000	4,650	111,000	565,000	46	2,760						

-- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 3  
U.S. IMPORTS FOR CONSUMPTION OF PLATINUM-GROUP METALS, BY COUNTRY<sup>1</sup>

Country	Unwrought palladium		Palladium, other		Iridium <sup>2</sup>		Osmium <sup>2</sup>		Ruthenium <sup>2</sup>		Rhodium <sup>2</sup>	
	Quantity, Pd content (kilograms)	Value (thousands)	Quantity, Pd content (kilograms)	Value (thousands)	Quantity, Ir content (kilograms)	Value (thousands)	Quantity, Os content (kilograms)	Value (thousands)	Quantity, Ru content (kilograms)	Value (thousands)	Quantity, Rh content (kilograms)	Value (thousands)
2009	62,300	\$568,000	7,350	\$62,300	1,520	\$20,800	68	\$551	21,200	\$55,700	11,200	\$530,000
2010:												
Austria	--	--	1	22	--	--	--	--	--	--	1	19
Belgium	431	7,490	--	--	1	69	--	--	--	--	747	60,900
Canada	1,340	30,600	1,350	33,100	--	--	--	--	--	--	(3)	2
China	197	3,700	27	522	--	--	16	117	--	--	(3)	3
France	72	251	--	--	--	--	--	--	--	--	--	--
Germany	4,450	72,500	150	1,960	235	3,330	--	--	1,930	7,300	1,250	88,900
Israel	--	--	50	343	--	--	--	--	--	--	--	--
Italy	1,880	33,700	277	5,610	20	344	--	--	--	--	108	7,300
Japan	2,290	18,600	107	1,030	6	127	--	--	439	2,830	191	14,200
Norway	4,170	64,700	--	--	--	--	--	--	--	--	130	9,470
Russia	15,100	241,000	3,110	58,200	--	--	--	--	--	--	1,790	91,800
South Africa	23,200	334,000	287	4,570	2,710	53,300	60	495	9,010	54,400	8,350	622,000
Switzerland	2,330	36,100	501	9,490	--	--	--	--	1	5	--	--
United Kingdom	8,960	147,000	453	7,500	549	8,740	--	--	2,740	17,900	265	19,400
Other	11	120	4	54	3	39	--	--	--	--	(3)	33
Total	64,400	990,000	6,310	122,000	3,530	65,900	76	612	14,100	82,500	12,800	914,000

-- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Unwrought and other forms.

<sup>3</sup>Less than ½ unit.

Source: U.S. Census Bureau.



TABLE 4  
U.S. EXPORTS OF PLATINUM-GROUP METALS, BY COUNTRY<sup>1</sup>

Country	Palladium		Platinum		Platinum, waste and scrap		Iridium, osmium, ruthenium		Rhodium	
	Quantity, Pd content (kilograms)	Value (thousands)	Quantity, Pt content (kilograms)	Value (thousands)	Quantity, Pt content (kilograms)	Value (thousands)	Quantity, gross weight (kilograms)	Value (thousands)	Quantity, Rh content (kilograms)	Value (thousands)
2009	30,300	\$229,000	15,600	\$522,000	31,600	\$523,000	4,020	\$34,400	1,220	\$48,400
2010:										
Argentina	6	10	83	3,910	--	--	--	--	--	--
Australia	772	8,240	21	982	(2)	3	5	73	--	--
Belgium	58	709	142	6,870	649	5,830	1	6	34	2,420
Brazil	645	10,700	34	1,620	--	--	--	--	42	3,080
Canada	4,730	39,800	1,130	56,200	44	1,880	10	139	1	98
China	1,830	25,900	451	19,900	62	3,500	561	7,000	813	48,900
Colombia	74	1,020	3	54	--	--	--	--	--	--
Czech Republic	739	1,500	--	--	--	--	--	--	--	--
Denmark	227	2,520	7	323	--	--	--	--	--	--
France	451	3,540	35	765	1	10	2	46	--	--
Germany	3,510	46,200	5,720	263,000	2,540	56,200	1,460	12,000	342	25,200
Hong Kong	1,100	15,300	113	5,120	(2)	36	82	1,170	231	14,000
India	232	1,540	309	15,700	--	--	3	35	9	652
Ireland	82	487	161	5,370	--	--	20	124	--	--
Israel	2,920	11,200	44	1,070	--	--	21	196	--	--
Italy	1,550	21,500	1,410	72,100	1	51	49	313	52	3,310
Japan	3,140	41,400	1,860	64,300	1,480	49,900	700	7,310	239	17,600
Korea, Republic of	1,480	17,600	82	3,590	--	--	2	26	4	369
Mexico	644	1,320	349	11,500	--	--	2	62	1	110
New Zealand	112	1,490	2	162	--	--	--	--	--	--
Norway	71	931	16	380	--	--	--	--	--	--
Saudi Arabia	43	442	1	13	--	--	--	--	262	7,450
Singapore	452	1,750	605	30,000	(2)	4	3	76	(2)	5
South Africa	83	345	53	1,120	4,620	23,000	1	21	7	865
Spain	203	1,400	1	39	--	--	1	9	--	--
Switzerland	7,090	108,000	2,990	156,000	6,560	169,000	1	16	9	765
Taiwan	2,190	18,200	59	2,280	--	--	640	4,810	8	750
Thailand	180	1,810	15	1,410	--	--	--	--	(2)	18
United Kingdom	3,330	32,700	1,060	44,500	22,200	791,000	151	3,280	261	5,910
Other	173	1,720	160	5,480	--	--	7	67	1	4,720
Total	38,100	419,000	16,900	775,000	38,200	1,100,000	3,720	36,800	2,320	136,000

-- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 5  
PLATINUM-GROUP METALS: ESTIMATED WORLD PRODUCTION, BY COUNTRY<sup>1,2</sup>

(Kilograms)

Country <sup>3</sup>	2006	2007	2008	2009	2010
<b>Palladium:</b>					
Australia <sup>4</sup>	750	600	580 <sup>r</sup>	590 <sup>r</sup>	580
Botswana	2,000	5,000	3,000	3,000	3,330
Canada	10,493 <sup>5</sup>	14,100 <sup>r</sup>	14,700 <sup>r</sup>	8,100 <sup>r</sup>	6,700
Japan <sup>6</sup>	5,400	5,500	5,500	5,600	5,600
Poland <sup>7,8</sup>	10	15	15	15	15
Russia	98,400	96,800	87,700	83,200 <sup>5</sup>	84,700
Serbia	15	15	15	15	15
South Africa <sup>5</sup>	86,265	83,643	75,537	75,118	82,222
United States <sup>5,9</sup>	14,400	12,800	11,900	12,700	11,600
Zimbabwe	4,022 <sup>5</sup>	4,180 <sup>5</sup>	4,386 <sup>5</sup>	5,680	7,000
<b>Total</b>	<b>222,000</b>	<b>223,000<sup>r</sup></b>	<b>203,000<sup>r</sup></b>	<b>194,000<sup>r</sup></b>	<b>202,000</b>
<b>Platinum:</b>					
Australia <sup>4</sup>	209	142	120 <sup>r</sup>	130 <sup>r</sup>	130
Botswana	300	700	600	600	560
Canada	8,510 <sup>r</sup>	8,000 <sup>r</sup>	8,500 <sup>r</sup>	4,600	3,900
Colombia <sup>5</sup>	1,438	1,526	1,369 <sup>r</sup>	929 <sup>r</sup>	998
Ethiopia <sup>10</sup>	4	5 <sup>5</sup>	10 <sup>5</sup>	8 <sup>r,5</sup>	8
Finland	800	800	800	800	800
Japan <sup>6</sup>	760	770	770	780	780
Poland <sup>7,8</sup>	20	25	25	25	25
Russia	29,000	27,000	25,000 <sup>r</sup>	24,500 <sup>r</sup>	25,100
Serbia	2	2	2	2	2
South Africa <sup>5</sup>	168,125	160,940	146,140	140,819	147,790
United States <sup>5,9</sup>	4,290	3,860	3,580	3,830	3,450
Zimbabwe	4,998 <sup>5</sup>	5,306 <sup>5</sup>	5,642 <sup>5</sup>	7,230	8,800
<b>Total</b>	<b>218,000<sup>r</sup></b>	<b>209,000<sup>r</sup></b>	<b>193,000<sup>r</sup></b>	<b>184,000<sup>r</sup></b>	<b>192,000</b>
<b>Other platinum-group metals:</b>					
Canada	5,000	4,000	4,000	2,600	2,600
Russia	15,600	14,500	12,500	11,900	12,000
South Africa <sup>5</sup>	53,138	59,449	53,999	55,456 <sup>r</sup>	57,292
Zimbabwe	864 <sup>5</sup>	1,695 <sup>5</sup>	1,804 <sup>5</sup>	800	1,300
<b>Total</b>	<b>74,600</b>	<b>79,600</b>	<b>72,300</b>	<b>70,800</b>	<b>73,200</b>
<b>Grand total</b>	<b>515,000<sup>r</sup></b>	<b>511,000<sup>r</sup></b>	<b>468,000<sup>r</sup></b>	<b>449,000<sup>r</sup></b>	<b>467,000</b>

<sup>r</sup>Revised.

<sup>1</sup>World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Table includes data available through May 20, 2011. Platinum-group metal (PGM) production by Germany, Norway, and the United Kingdom is not included in this table because the production is derived wholly from imported metallurgical products and to include it would result in double counting.

<sup>3</sup>In addition to the countries listed, China, Indonesia, and the Philippines are thought to produce PGM, and several other countries may also do so, but output is not reported quantitatively, and there is no reliable basis for the formulation of estimates of output levels. A part of this output not specifically reported by country is, however, presumably included in this table credited to Japan.

<sup>4</sup>PGM recovered from nickel ore that is processed domestically. PGM in exported nickel ore are extracted in the importing countries, such as Japan, and are thought to be included in the production figures for those countries.

<sup>5</sup>Reported figure.

<sup>6</sup>Production derived entirely from imported ores.

<sup>7</sup>Based on official Polish estimates.

<sup>8</sup>Estimates based on reported platinum- and palladium-bearing final (residual) slimes and then average Pt and Pd content from electrolytic copper refining.

<sup>9</sup>A very small quantity of byproduct platinum and palladium produced from gold-copper ores was excluded.

<sup>10</sup>Data for the Ethiopian calendar year ending July 7 of that stated. Yubdo Mine only. Platinum was also reportedly contained in gold