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DIAMOND, INDUSTRIAL [ADVANCE RELEASE]

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Diamond, Industrial

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In 2018, U.S. synthetic diamond production was estimated to be 184 million carats with an estimated value of $84.5 million. No natural industrial diamond mining took place in the United States, but an estimated 32.6 million carats of used industrial diamond (natural and synthetic) valued at $5.38 million was recycled (secondary production). U.S. imports of natural and synthetic industrial diamond bort, dust and powder, grit, and stone totaled 549 million carats valued at $73.5 million, and exports totaled 159 million carats valued at $74.4 million. The estimated U.S. apparent consumption of natural and synthetic industrial diamond bort, dust and powder, grit, and stone totaled 607 million carats with an estimated value of $89.0 million. Total industrial diamond output worldwide was estimated by the U.S. Geological Survey (USGS) to be 14.7 billion carats. This was the combination of 62.2 million carats of natural industrial diamond and 14.6 billion carats of synthetic industrial diamond (tables 1, 2).

Diamond is best known as a gemstone, but some of its unique properties make it ideal for many industrial and research applications. Current information on gem-grade diamond can be found in the Gemstones chapter of the USGS Minerals Yearbook, volume I, Metals and Minerals. Diamond that does not meet gem-quality standards for clarity, color, shape, or size is used as industrial-grade diamond. Total production and consumption quantities and values in tables 1 and 2 are estimated based on past and current reported data. Trade data in this chapter are from the U.S. Census Bureau. All percentages in the chapter were calculated using unrounded data.

Production

The USGS conducts an annual survey of domestic synthetic industrial diamond producers and a survey of the U.S. firms that recover diamond wastes. Of the two U.S. synthetic industrial diamond producers, one responded to the USGS survey, and of the three leading U.S. firms that recover diamond wastes, two responded to the USGS survey. Production quantities and values for the nonreporting companies were estimated based on industry production trends, reports from producers that did respond, other industry sources, and discussions with consultants within the industrial diamond industry. The USGS does not conduct surveys of domestic producers of polycrystalline diamond (PCD) or chemical vapor deposition (CVD) diamond for quantity or value of annual production.

The United States was one of the world's leading producers of synthetic industrial diamond in 2018. The United States accounted for an estimated output of 184 million carats valued at $84.5 million (table 1). Only two U.S. companies produced synthetic industrial diamond during the year—Mypodiamond Inc. (Smithfield, PA) and Hyperion Materials & Technologies, Inc. (Worthington, OH). In July 2018, Sandvik Hyperion announced that it had been acquired from Sandvik AB by Kohlberg Kravis Roberts & Co. L.P. The newly acquired company was renamed Hyperion Materials & Technologies (Hyperion Materials & Technology, Inc., 2018). By type, U.S. primary production was entirely diamond bort, dust and powder, and grit. The lower value of U.S. industrial diamond production in 2018 compared with that in 2017 was the result of Hyperion ceasing the only U.S. synthetic diamond stone production and producing only bort, dust and powder, and grit whose value has been decreasing over the past few years.

In 2018, at least four U.S. companies also manufactured PCD from synthetic diamond dust and powder and grit. These companies were Dennis Tool Co. (Houston, TX); MegaDiamond, A Schlumberger Company (Provo, UT); Sandvik Coromant—Precorp Inc. (Spanish Fork, UT); and US Synthetic Corp. (Orem, UT). The USGS does not conduct surveys of domestic producers of PCD or CVD diamond.

In 2018, an estimated 32.6 million carats of used industrial diamond (natural and synthetic) valued at $5.38 million was recycled (secondary production) in the United States (table 1). Secondary production was made up of 32.5 million carats of bort, dust and powder, and grit valued at $5.16 million and 130,000 carats of diamond stone valued at $218,000 (table 2). Recycling firms recovered most of this material from used diamond drill bits, diamond tools, and other diamond-containing wastes. Additional diamond was recovered during the year from residues generated in the manufacture of PCD.

The recovery and sale of industrial diamond was the principal business of two U.S. companies in 2018—International Diamond Services Inc. (Houston, TX) and National Research Co. (Chesterfield, MI). In addition to these companies, other domestic firms may have recovered industrial diamond in smaller secondary operations.

In 1954, scientists at General Electric Co. manufactured the first synthetic bits of diamond grit using a high-pressure, high-temperature (HPHT) method. In 1956, the first commercially available synthetic diamond was produced by HPHT at General Electric. High-quality diamonds of 1 carat or more are difficult to produce consistently, even in the controlled environment of a laboratory using the HPHT method. After more than 60 years of development, several synthetic diamond companies were able to produce relatively large high-quality industrial diamonds that had the same characteristics and properties as mined industrial diamonds, and billions of carats of synthetic diamonds were manufactured annually by the HPHT process, mostly for industrial applications (Linares, 2013).

In 1954, a patent was issued for a CVD-type-diamond growth technique. The CVD technique transforms carbon into plasma, which is then precipitated onto a substrate as diamond. Initially, the creation of gem-quality CVD synthetic diamond was not possible, but in the mid-1980s, scientists discovered how to reproducibly grow microscopic diamond crystals to cover surfaces using the CVD process (Linares, 2013). In the early 2000s, CVD process technology was further developed enabling the growth of large single, extremely pure diamond crystals. Synthetic diamond producers discovered the temperature, gas composition, and pressure combination that resulted in the growth of a single diamond crystal and were able to produce synthetic stones that ranged from 1 to 2 carats.

No commercial diamond mines operated in the United States during 2018. The Arkansas Department of Parks and Tourism operated a dig-for-fee diamond mine for hobbyists at Crater of Diamonds State Park in Murfreesboro, AR.

Consumption

Diamond is the hardest known material and has the highest thermal conductivity of any material at room temperature. Diamond is more than twice as hard as the next hardest materials, cubic boron nitride and silicon nitride. Because of its hardness, diamond has been used for centuries as an abrasive in cutting, drilling, grinding, and polishing. Even though it has a higher unit cost than alternative abrasive materials, diamond has proven to be more cost effective in many industrial processes because it cuts faster and lasts longer than alternatives. Diamond also has chemical, electrical, optical, and thermal characteristics that make it the best material available for wear- and corrosion-resistant coatings, special lenses, heat sinks in electrical circuits, wire drawing, computing, and other advanced technologies.

Both natural and synthetic diamonds have industrial uses. Synthetic industrial diamond is superior to its natural diamond counterpart because its properties can be tailored to specific applications and it can be produced in large quantities.

The United States remained one of the world's leading markets for industrial diamond in 2018. According to production estimates and trade data, U.S. apparent consumption of industrial diamond during the year increased by 78% in quantity to an estimated 607 million carats valued at $89.0 million compared with 342 million carats valued at $140 million in 2017 (table 1). Apparent consumption was the combination of 19.2 million carats of natural industrial diamond valued at $9.35 million and 588 million carats of synthetic industrial diamond valued at $79.6 million. By type, apparent consumption was the combination of 606 million carats of diamond bort, dust and powder, and grit valued at $81.5 million and 1.08 million carats of diamond stone valued at $7.45 million (table 2). Increases in U.S. apparent consumption of industrial diamond were owing to growth in the construction, electronics, oil and gas, and transportation (aerospace, automotive, and maritime) industries. Industrial diamond was used for cutting, drilling, grinding, and polishing purposes by these industries (Grand View Research, Inc., 2019).

In 2018, the United States industrial sectors that consumed the majority of industrial diamond in cutting and drilling tools and as abrasives were construction, machinery manufacturing, exploration drilling (for minerals, natural gas, and oil), stone cutting and polishing, and transportation systems (infrastructure and vehicles). Highway construction and repair and stone cutting, combined, accounted for most of the consumption of industrial diamond. Research and high-technology uses included close-tolerance machining of ceramic parts for the aerospace industry, heat sinks in electronic circuits, lenses for laser radiation equipment, polishing of silicon wafers and disk drives, and other applications in the computer industry.

Diamond tools have numerous industrial functions. Diamond drilling bits and reaming shells are used for exploration and production of minerals, natural gas, and oil. Other applications of diamond bits and reaming shells include foundation testing, concrete inspection, and masonry drilling. The primary uses of point diamond tools are for dressing and truing grinding wheels and for boring, cutting, finishing, and machining applications. Beveling glass for automobile windows is another application. Cutting dimension stone and cutting and grooving concrete in highway reconditioning are the main uses of diamond saws; other applications include cutting composites and forming refractory shapes for furnace linings. Very fine diamond saws are used to slice brittle metals and crystals into thin wafers for electronic and electrical devices. Diamond wire dies are essential for high-speed drawing of fine wire, especially from hard, high-strength metals and alloys. The primary uses of diamond grinding wheels include edging plate glass, grinding dies, grinding parts for optical instruments, and sharpening and shaping carbide machine tool tips.

Two types of natural diamond are used by industry—diamond stone (generally larger than 60 mesh, or 0.25 millimeters) and diamond bort, dust and powder, and grit (smaller, fragmented material). Diamond stone is used mainly in drill bits and reaming shells, but also is incorporated into single- or multiple-point diamond tools, diamond saws, diamond wheels, and diamond wire dies. Diamond bort is used for drill bits and as a loose grain abrasive for polishing. Other tools that incorporate natural diamond include bearings, engraving points, glass cutters, and surgical instruments.

Synthetic diamond dust and powder and grit are used in diamond grinding wheels, saws, impregnated bits and tools, and as a loose abrasive for polishing. Diamond grinding wheels can be as large as 1 meter in diameter.

Loose powders made with synthetic diamond for polishing are used primarily to finish cutting tools, drill bits, gemstones, jewel bearings, optical surfaces, reaming shells, silicon wafers, and wiredrawing dies for computer chips. Hundreds of other products made from ceramics, glass, metals, and plastics also are finished with diamond powders.

Consumption quantity and value data are not available for PCD or for CVD diamond. Two types of PCDs used by industry are polycrystalline diamond compacts (PDCs) and polycrystalline diamond shapes (PDSs). The use of PDCs and PDSs continues to increase for many of the applications cited above, including some of those that employ natural diamond. PDCs and PDSs are used in the manufacture of single- and multiple-point tools, and PDCs are used in a majority of the diamond wiredrawing dies.

Since the mid-1980s, usage of CVD diamond has seen strong growth and has been increasingly accepted by multiple industries as an enhanced material of choice owing to its properties of exceptional strength, hardness, durability, stiffness, high thermal conductivity, chemical inertness, and electrical isolation.

Early applications for CVD diamond focused largely on thin- and thick-film PCD for cutting tools and dressing applications because of the mechanical properties of diamond. Newer applications that take advantage of CVD diamond's mechanical properties include wear parts, such as watch gears and chemical mechanical polishing pad conditioners. Diamond has tremendous potential for electronics applications because of its high thermal conductivity. It can significantly improve thermal management while remaining highly cost competitive with other materials. CVD diamond is used in microelectronic components, such as high-speed processors, medical devices, wide bandgap radio frequency (RF) devices, power conversion devices, and opto-electronic devices (light-emitting diodes, laser diodes) that generate exceptionally high heat densities requiring innovative approaches to thermal management. Diamond coatings are increasingly being used in these applications because the thermal conductivity of diamond is 10 times that of silicon. Micro-electro-mechanical systems (MEMS), such as RF MEMS resonators, have design needs that can be met using diamond as a base material because of its very high resistance to being deformed elastically when a force is applied and because of its durability in harsh environments. Historically, diamond has been perceived as an expensive material, but advances in CVD diamond manufacturing, such as the development of microwave carbon plasma technology and the development of higher throughput hot filament CVD diamond reactors, have significantly reduced diamond costs and allowed for the use of CVD diamond for an increasing number of applications.

In addition to the existing opportunities for synthetic diamond for use as gemstones, research and development projects by several companies that use single-crystal CVD diamond materials in high-voltage power switches, lasers, quantum communications and computing, and water treatment and purification have been ongoing (Scio Diamond Technology Corp., 2012; WD Lab Grown Diamonds, 2019).

Prices

Natural and synthetic industrial diamond had prices with a range of values, depending on their crystallinity, purity, shape, size, and in the case of synthetic diamond, the absence or presence of metal coatings. In 2018, the unit value for primary diamond bort, dust and powder, and grit material produced was $0.46 per carat, and no primary diamond stone was produced (table 2). This was a 16% decrease in value compared to the previous year. The unit value for recycled (secondary) diamond bort, dust and powder, and grit material produced was $0.16 per carat, and the unit value for recycled diamond stone material was $1.68 per carat (table 2). These values were a 4% decrease for recycled diamond bort, dust and powder, and grit material and a 23% decrease for recycled diamond stone material compared with the previous year. In 2018, U.S. imports of all types of industrial diamond had a unit value of $0.13 per carat, a 34% decrease in unit value compared with the previous year. These imports were a combination of natural diamond that had an average unit value of $1.65 per carat (a 43% decrease from the previous year) and synthetic diamond that had a unit value of $0.12 per carat (a 23% decrease from the previous year) (table 1). By type, diamond imports were the combination of diamond bort, dust and powder, and grit (natural and synthetic) that had a unit value of $0.12 per carat (a 24% decrease from the previous year) and diamond stone (natural and synthetic) that had a unit value of $7.60 per carat (a 41% decrease from the previous year) (table 2). These unit values for imported (natural and synthetic) diamond bort, dust and powder, grit, and stone were higher than the reported unit values for the same size fractions of domestically produced diamond listed above.

Foreign Trade

The United States continued to lead the world in industrial diamond trade in 2018; imports were received from 33 countries or localities and exports and reexports were sent to 46 countries or localities (tables 3–6). Although the United States has been a major producer of synthetic diamond for decades, expanding domestic markets have become more reliant on foreign sources of industrial diamond in recent years. U.S. markets for natural industrial diamond have always been dependent on imports and secondary recovery operations because natural industrial diamond was not produced domestically.

In 2018, U.S. imports of industrial-quality diamond stones (natural and synthetic) decreased by 22% from those in 2017 to 951,000 carats valued at $7.23 million (table 3). Imports of natural diamond bort, dust and powder, and grit decreased by 4% from those in 2017 to 4.97 million carats valued at $2.71 million. Imports of synthetic diamond bort, dust and powder, and grit increased by 52% from those in 2017 to 543 million carats valued at $63.6 million (table 4).

Reexports accounted for a significant portion of total exports; therefore, exports and reexports are listed separately in tables 5 and 6 so that U.S. trade and consumption can be calculated more accurately. In 2017 and 2018, the United States did not export industrial diamond stones. U.S. reexports of industrial diamond stone decreased by 13% from those in 2017 to 852,000 carats valued at $13.6 million, having a unit value of $15.90 per carat (table 5). U.S. exports of industrial diamond bort, dust and powder, and grit (natural and synthetic) decreased slightly from those in 2017 to 159 million carats valued at $74.4 million, having a unit value of $0.47 per carat. Reexports of industrial diamond bort, dust and powder, and grit (natural and synthetic) decreased by 8% from those in 2017 to 20.3 million carats valued at $7.49 million, having a unit value of $0.37 per carat (table 6). Trade quantity and value data were not available for PCD or CVD diamond.

World Industry Structure

Global natural rough diamond production decreased slightly during 2018 to 147 million carats from 151 million carats in 2017. The world's leading rough diamond producers were as follows: Russia, producing 43.2 million carats or 29% of total world production; Botswana, with 24.4 million carats (17%); Canada, with 23.2 million carats (16%); Congo (Kinshasa), with 15.1 million carats (10%); Australia, with 14.1 million carats (10%); South Africa, with 9.91 million carats (7%); and Angola, with 8.41 million carats (6%). Other countries produced 9.02 million carats (6%). Of the 147 million carats of total natural diamond production, 85.1 million carats (58% of total diamond production) was gemstone diamond, and 62.2 million carats (42% of total diamond production) was industrial diamond (table 7). In 2018, the value of worldwide rough diamond production increased slightly to $14.5 billion from the 2017 value of $14.1 billion (Kimberley Process, The, 2018, 2019). Total combined natural and synthetic industrial diamond output worldwide was estimated by the USGS to be approximately 14.7 billion carats (table 1).

The two leading diamond producers, by quantity and value, were OJSC ALROSA and DeBeers Group in 2018. ALROSA's production was 24% of total global quantity and 22% of total global value; De Beers' production was 23% of total global quantity and 33% of total global value. The third-ranked company was Rio Tinto Ltd., which produced 12% of total global production quantity and approximately 5% of global production value (De Beers Group UK Ltd., 2019, p. 7).

In 2002, the international rough diamond certification system, the Kimberley Process Certification Scheme (KPCS), was agreed upon by the United Nations (UN) member nations, the diamond industry, and related nongovernmental organizations to prevent the shipment and sale of conflict diamonds. Conflict diamonds are diamonds that originate from areas controlled by forces or factions opposed to legitimate and internationally recognized Governments and are used to fund military action in opposition to those Governments or in contravention of the objectives of the UN Security Council. The KPCS monitors rough diamond trade in both gemstone and industrial diamond. The KPCS includes the following key elements: the use of forgery-resistant certificates and tamper-proof containers for shipments of rough diamonds; internal controls and procedures that provide credible assurance that conflict diamonds do not enter the legitimate diamond market; a certification process for all exports of rough diamonds; the gathering, organizing, and sharing of import and export data on rough diamonds with other participants of relevant production; credible monitoring and oversight of the international certification scheme for rough diamonds; effective enforcement of the provisions of the certification scheme through dissuasive and proportional penalties for violations; self-regulation by the diamond industry that fulfills minimum requirements; and sharing information with all other participants on relevant rules, procedures, and legislation as well as examples of national certificates used to accompany shipments of rough diamonds. The European Union assumed the chair of the KPCS from January 1 through December 31, 2018. As of December 31, 2018, the 55 participants represented 81 nations (including the 28 member nations of the European Union counted as a single participant). The participating nations in the KPCS account for approximately 99.8% of the global production and trade of rough diamonds (Kimberley Process, The, 2020).

In 2018, natural industrial diamond production was reported from 13 countries (table 7). Natural industrial diamond production worldwide was estimated to be 62.2 million carats, a 7% decrease compared with 67.0 million carats in 2017. Russia was the leading country in the production of natural industrial diamond at 19.0 million carats or 31% of world production, followed by Australia with 13.8 million carats (22%), Congo (Kinshasa) with 12.1 million carats (19%), Botswana with 7.31 million carats (12%), South Africa with 5.95 million carats (10%), and Zimbabwe with 2.93 million carats (5%). These six countries produced 98% of the world's natural industrial diamond (table 7). Synthetic industrial diamond production worldwide was estimated to be more than 14.6 billion carats, a slight increase compared with that in 2017. China was the leading producing country, followed by the United States, Russia, Ireland, and South Africa, in descending order of quantity. These five countries produced about 99% of the world's synthetic industrial diamond.

In 2018, 99% of the total global combined output of natural and synthetic industrial diamond was produced in China, Ireland, Russia, South Africa, and the United States. Synthetic diamond accounted for more than 99% of global diamond production and consumption.

Worldwide diamond exploration spending increased by 43% to $297 million in 2018 from $208 million in 2017. This $297 million global diamond exploration budget was 3% of the $9.62 billion global nonferrous mineral exploration budget. The success rate in diamond exploration has been estimated to be less than 1%, and no major new deposits have been discovered in more than 20 years (Kumar, 2019; Petra Diamonds Ltd., undated).

World Review

Botswana.—Rough diamond production in Botswana was 24.4 million carats in 2018, a 6% increase compared with 23.0 million in 2017, accounting for 17% of total global production. Botswana diamond production was valued at $3.53 billion, a 6% increase compared with that in 2017 (Kimberley Process, The, 2018, 2019).

The Jwaneng diamond mine in the Kalahari Desert of south-central Botswana was wholly owned by Debswana Diamond Co. (Pty.) Ltd. The company was planning the Cut 9 expansion project to extend mine life by 11 years and extract an additional 50 million carats. During 2018, the company was conducting feasibility studies for the project (Motsoeneng, 2018).

Canada.—Rough diamond production in Canada was 23.2 million carats in 2018, about the same as that in 2017, accounting for 16% of total global production. Diamond production in Canada was valued at $2.10 billion, a slight increase compared with that in 2017 (Kimberley Process, The, 2018, 2019).

The Diavik Diamond Mine in the Northwest Territories was jointly owned by Rio Tinto Group (60%) and Dominion Diamond Mines ULC (40%). Diavik was Canada's largest diamond mine in terms of carat production. The mine plan was built on four diamond-bearing kimberlite pipes. The four kimberlite pipes that were being mined in 2018, A21, A154 South, A154 North, and A418, are very high grade. Diavik began an extension project of the A21 kimberlite pipe pit during 2016 that was in development during 2017 and 2018. The first kimberlite ore from the A21 kimberlite pipe was delivered in March 2018. The mine was expected to continue production into 2025. In October 2018, a 552-carat yellow diamond was found at the Diavik mine. This is the largest diamond ever found in North America (De Beers Group UK Ltd., 2017, p. 7; 2018b, p. 7; Dominion Diamond Mines ULC, 2020; Rio Tinto Group, 2020).

The Gahcho Kué Mine in the Northwest Territories commenced commercial production in March 2017 and continued to produce throughout 2018. The mine, with an approximate mine life of 12 years, was jointly owned by De Beers Canada, Inc. (51%) and Mountain Province Diamonds Inc. (49%). The mine owners anticipated average annual diamond production of 4.5 million carats (Diamond Loupe, The, 2018; De Beers Group UK Ltd., 2020).

The Renard Mine, Quebec's first diamond mine, was wholly owned by Stornoway Diamond Corp. The mine had a 14-year mine life and an average annual diamond production of 1.6 million carats. Stornoway announced in September 2018 that it had completed rampup of its planned sustainable underground mine production (Diamond Loupe, The, 2018; Stornoway Diamond Corp., 2018).

Lesotho.—Rough diamond production in Lesotho was 1.29 million carats in 2018, a 15% increase from that in 2017, but accounted for less than 1% of total global production. Diamond production in Lesotho had a value of $377 million, a 10% increase compared with that in 2017 (Kimberley Process, The, 2018, 2019).

The Liqhobong Diamond Mine in the Maluti Mountains of northern Lesotho began ramping up production in late 2016 and had its first full year of commercial production in 2018, when reported production was 836,000 carats. The mine was owned by Firestone Diamonds plc (75%) and the Government of Lesotho (25%) (De Beers Group UK Ltd., 2017, p. 7; Firestone Diamonds plc, 2018).

Russia.—Rough diamond production in Russia was 43.2 million carats in 2018, a slight increase compared with that in 2017, accounting for 29% of total global production. Diamond production in Russia was valued at $3.98 billion, a 3% decrease compared with that in 2017 (Kimberley Process, The, 2018, 2019).

ALROSA officially commissioned and started mining at the Verkhne-Munskoe Diamond Field in Yakutia on October 31, 2018. Four kimberlite pipes were explored during the last quarter of 2018—Zapolyarnaya, Deimos, Novinka, and Komsomolskaya-Magnitnaya. ALROSA estimated that the deposit would yield 1.8 million carats of rough diamonds per year, and the estimated reserves of the Verkhne-Munskoe diamond field were sufficient to operate for more than 20 years. The development of the Verkhne-Munskoe diamond deposit was ALROSA's largest investment project (ALROSA Group, 2018).

South Africa.—Rough diamond production in South Africa was 9.91 million carats in 2018, a slight increase compared with that in 2017, accounting for 7% of total global production. Diamond production in South Africa was valued at $1.23 billion, a 6% decrease compared with that in 2017 (Kimberley Process, The, 2018, 2019).

In July 2018, De Beers decided to proceed with the responsible closure and rehabilitation of the Voorspoed Mine in Free State Province following an unsuccessful attempt to identify a suitable operator to acquire the mine. De Beers Consolidated Mines Pty. Ltd. safely closed the mine in December 2018, but the South African Department of Mineral Resources continued looking for an operator capable of purchasing the mine (De Beers Group UK Ltd., 2018a; Petra Diamonds Ltd., undated). De Beers also operated the Venetia Mine in Limpopo Province, where it was conducting a $2 billion project to take the mine underground and extend its operating life into the 2040s (De Beers Group UK Ltd., 2018a).

Outlook

China is expected to remain the world's leading producer of synthetic industrial diamond, with annual production exceeding 14 billion carats. The United States is likely to continue to be one of the world's leading markets for industrial diamond into the next decade and likely will remain a significant producer and exporter of synthetic industrial diamond. U.S. industrial diamond production and apparent consumption are expected to continue increasing as manufacturing sectors that use industrial diamond continue experiencing economic growth. U.S. demand for industrial diamond is likely to continue in the construction sector as the United States continues building and repairing the Nation's highway system.

Global rough diamond production decreased by 3% during 2018 owing to mine closures and lower output as mines approached the ends of their mine life. The world's largest diamond mines have matured and are past their peak production levels. The Argyle Mine in Australia, Diavik Mine in Canada, Komsomolskaya Diamond Mine in Russia, and Victor Mine in Canada are all expected to close by the end of 2025. As these mines are depleted, global production is expected to continue to decline in quantity. The global production of natural diamond is forecast to steadily decrease to 120 million carats in 2030 (De Beers Group UK Ltd., 2019, p. 7; Petra Diamonds Ltd., undated).

Diamond offers many advantages for precision machining and longer tool life. In fact, even the use of wear-resistant diamond coatings to increase the life of materials that compete with diamond is a rapidly growing application. Increased tool life not only leads to lower costs per unit of output but also means fewer tool changes and longer production runs. In view of the many advantages that come from increased tool life and reports that diamond film surfaces can increase durability, much wider use of diamond as an engineering material is expected.

PCD for abrasive tools and wear parts is likely to continue to replace competing materials in many industrial applications by providing closer tolerances as well as extending tool life. For example, PDCs and PDSs will continue to displace natural diamond stone and tungsten carbide products used in the drilling and tooling industries.

CVD technology can produce extremely pure diamond crystals that have great potential in computer technology in the production of diamond computer chips when their cost becomes competitive. These diamond computer chips work at a much higher frequency or faster speed and can be placed in higher temperature environments than the silicon chips currently used in computers. Eventually, diamond computer chips may replace silicon chips in computers. CVD diamond annealed using the low-pressure, high-temperature microwave plasma process may have applications in high-pressure research, optical applications that take advantage of the outstanding transparency of diamond, and in quantum computing to store quantum information in vacancy centers in the diamond's crystal lattice.

CVD diamond is likely to be used to provide an alternative process to existing water purification processes. This technology will use single-crystal diamond electrodes for electrochemical water purification.

Truing and dressing applications will remain a major domestic end use for natural industrial diamond stone. Diamond stones for these applications have not yet been manufactured economically. New mines and more producers selling in the rough diamond market will maintain ample supplies in the short term, and competition introduced by the additional sources also may temper price increases.

Demand for synthetic diamond bort, dust and powder, and grit is expected to remain greater than for natural diamond material. Constant-dollar prices of synthetic diamond products are likely to continue to decline as production technology becomes more cost effective. The decline is even more likely if competition from low-cost producers in China and Russia continues to increase.

References Cited

ALROSA Group, 2018, ALROSA recovers first large diamond from Verkhne-Munskoe deposit: Moscow, Russia, ALROSA Group press release, November 7. (Accessed July 27, 2020, at http://eng.alrosa.ru/alrosa-recovers-first-large-diamond-from-verkhne-munskoe-deposit/.)

De Beers Group UK Ltd., 2017, The diamond insight report in brief—2017: London, United Kingdom, De Beers Group UK Ltd., March, 28 p. (Accessed August 8, 2018, at https://www.debeersgroup.com/~/media/Files/D/De-Beers-Group/documents/reports/library/diamond-insight-report-2017.pdf.)

De Beers Group UK Ltd., 2018a, De Beers Group to proceed with closure of Voorspoed Mine: London, United Kingdom, De Beers Group UK Ltd. press release, July 31. (Accessed August 12, 2019, at https://www.debeersgroup.com/media/company-news/2018/de-beers-group-to-proceed-with-closure-of-voorspoed-mine.)

De Beers Group UK Ltd., 2018b, The diamond insight report 2018: London, United Kingdom, De Beers Group UK Ltd., April 24, 52 p. (Accessed August 12, 2019, at https://www.debeersgroup.com/~/media/Files/D/De-Beers-Group/documents/reports/insights/the-diamond-insight-report-2018.pdf.)

De Beers Group UK Ltd., 2019, The diamond insight report 2019: London, United Kingdom, De Beers Group UK Ltd., October 28, 52 p. (Accessed June 12, 2020, at https://www.debeersgroup.com/~/media/Files/D/De-Beers-Group/documents/reports/insights/the-diamond-insight-report-2019.pdf.)

De Beers Group UK Ltd., 2020, Gahcho Kué Mine: London, United Kingdom, De Beers Group UK Ltd. (Accessed June 12, 2020, at https://canada.debeersgroup.com/operations/mining/gahcho-kue-mine.)

Diamond Loupe, The, 2018, 2017 global rough diamond production hits new high: Antwerp, Belgium, The Diamond Loupe, September 7. (Accessed August 8, 2019, at https://www.thediamondloupe.com/mining-and-exploration/2018-07-09/2017-global-rough-diamond-production-hits-new.)

Dominion Diamond Mines ULC, 2020, The Diavik Diamond Mine is Canada's largest diamond mine in terms of carat production: Calgary, Alberta, Canada, Dominion Diamond Mines ULC. (Accessed July 14, 2020, at https://www.ddmines.com/diavik-mine-operations/.)

Firestone Diamonds plc, 2018, FY2018 final results: London, United Kingdom, Firestone Diamonds plc, September 28, 19 p. (Accessed July 14, 2020, at https://www.firestonediamonds.com/wp-content/uploads/2018-Annual-Results-Presentation.pdf.)

Grand View Research, Inc., 2019, Industrial diamond market size, share & trends analysis report by type (synthetic, natural), by application (construction, electronics, transportation), by region (MEA, APAC, North America), and segment forecasts, 2019–2025: San Francisco, CA, Grand View Research, Inc., July, 118 p. (Accessed August 17, 2019, at https://www.grandviewresearch.com/industry-analysis/industrial-diamond-market.)

Hyperion Materials & Technologies, Inc., 2018, KKR completes Hyperion acquisition and names Ron Voigt CEO: Worthington, OH, Hyperion Materials & Technologies press release, July 2. (Accessed July 27, 2020, at https://www.hyperionmt.com/en/Company/News/article-1/.)

Kimberley Process, The, 2018, Annual global summary—2017 production, imports, exports and KPC counts: New York, NY, The Kimberley Process, 1 p. (Accessed August 1, 2019, at https://kimberleyprocessstatistics.org/static/pdfs/public_statistics/2017/2017GlobalSummary.pdf.)

Kimberley Process, The, 2019, Kimberley Process rough diamond statistics-annual global summary-2018 production, imports, exports and KPC counts: New York, NY, The Kimberley Process, 1 p. (Accessed August 1, 2018, at https://kimberleyprocessstatistics.org/static/pdfs/public_statistics/2018/2018GlobalSummary.pdf.)

Kimberley Process, The, 2020, The Kimberley Process: New York, NY, The Kimberley Process. (Accessed June 12, 2020, via http://www.kimberleyprocess.com/.)

Kumar, Iniya, 2019, Global mining and exploration trends: Research Triangle, NC, Beroe Inc., August 21. (Accessed July 14, 2020, at https://www.beroeinc.com/article/global-mining-and-exploration-trends/.)

Linares, Robert, 2013, CVD-Grown synthetic diamonds, part 1—History: Carlsbad, CA, Gemological Institute of America, April 30. (Accessed September 19, 2019, at https://www.gia.edu/news-research-CVD-grown-part1.)

Motsoeneng, Tiisetso, 2018, De Beers, Botswana plan to expand Jwaneng diamond mine: Thomson Reuters, April 6. (Accessed July 27, 2020, at https://www.reuters.com/article/ozabs-us-debswana-expansion-idAFKCN1HD0XN-OZABS.)

Petra Diamonds Ltd., [undated], Industry overview: London, United Kingdom, Petra Diamonds Ltd. (Accessed July 27, 2020, at https://www.petradiamonds.com/our-industry/industry-overview/.)

Rio Tinto Group, 2020, Diavik: Melbourne, Victoria, Australia, Rio Tinto Group. (Accessed September 1, 2020, at https://www.riotinto.com/en/operations/canada/diavik.)

Scio Diamond Technology Corp., 2012, Scio Diamond Technology releases letter to shareholders: Greenville, SC, Scio Diamond Technology Corp. press release, January 4. (Accessed August 17, 2017, at https://globenewswire.com/news-release/2012/01/04/464634/241868/en/SCIO-Diamond-Technology-Releases-Letter-to-Shareholders.html.)

Stornoway Diamond Corp., 2018, Stornoway achieves full underground mine design capacity: Longueuil, Quebec, Canada, Stornoway Diamond Corp. press release, September 4. (Accessed July 27, 2020, at http://www.stornowaydiamonds.com/English/investors/news-releases/press-release-details/2018/Stornoway-Achieves-Full-Underground-Mine-Design-Capacity/default.aspx.)

WD Lab Grown Diamonds, 2019, Highly customizable diamond wafers: Laurel, MD, WD Lab Grown Diamonds. (Accessed August 17, 2019, at https://www.wdlabgrowndiamonds.com/industrial.)

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

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

Diamond (Industrial). Ch. in Mineral Commodity Summaries, annual.

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

Other

De Beers Consolidated Mines Ltd. annual reports, 1998–2001.

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

Finer Points, quarterly.

Industrial Diamond Review, quarterly.

World Diamond Industry Directory & Yearbook, 1998–99.

TABLE 1

SALIENT NATURAL AND SYNTHETIC INDUSTRIAL DIAMOND STATISTICS, BY TYPE[1]

(Thousand carats and thousand dollars)

	2014	2015	2016	2017	2018
United States:					
Natural:					
Secondary production:[e]					
Quantity	21,900	31,700	33,000	5,600	16,200
Value	10,600	1,710	1,770	932	2,580
Exports:					
Quantity	8,990	6,050	4,710	6,710	2,850
Value	5,670	4,710	3,790	4,410	2,880
Imports for consumption:					
Quantity	5,580	6,580	4,930	6,370	5,830
Value	32,700	25,100	20,400	18,400	9,650
Synthetic:					
Primary production:[e]					
Quantity	124,000	119,000	125,000	129,000	184,000
Value	84,200	117,000	123,000	129,000	84,500
Secondary production:[e]					
Quantity	22,400	31,900	33,400	6,000	16,400
Value	11,900	2,170	2,310	1,790	2,800
Exports:					
Quantity	154,000	133,000	129,000	155,000	156,000
Value	74,900 r	62,800	60,000	68,700	71,500
Imports for consumption:					
Quantity	679,000	270,000 r	213,000	357,000 r	543,000
Value	75,200	52,500 r	47,500 r	54,700 r	63,900
Apparent consumption, natural and synthetic:[e, 2]					
Quantity	690,000	319,000	275,000	342,000 r	607,000
Value	134,000	131,000	131,000	140,000 r	89,000
World, production:[e]					
Natural	55,600 r	59,800 r	57,900 r	67,000 r	62,200
Synthetic	17,400,000	15,500,000	14,300,000	14,600,000	14,600,000
Total, natural and synthetic	17,500,000	15,500,000	14,300,000	14,700,000 r	14,700,000

[e]Estimated. [r]Revised.

[1]Table includes data available through February 3, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Domestic primary and secondary production plus imports minus exports.

TABLE 2

SALIENT U.S. INDUSTRIAL DIAMOND STATISTICS, BY SIZE FRACTION[1]

(Thousand carats and thousand dollars)

	2014	2015	2016	2017	2018
Bort, dust and powder, grit:					
Primary production:[e]					
Quantity	52,600	39,600	41,600	41,200	184,000
Value	17,300	20,800	21,900	22,600	84,500
Secondary production:[e]					
Quantity	43,700	63,500	66,100	11,200	32,500
Value	21,300	3,410	3,530	1,860	5,160
Exports:					
Quantity	163,000	140,000	134,000	161,000	159,000
Value	80,500	67,500	63,800	73,200	74,400
Imports for consumption:					
Quantity	682,000	275,000	216,000	362,000	548,000
Value	76,700	54,700	49,200	57,400	66,300
Apparent consumption:[2]					
Quantity	616,000	239,000	190,000	253,000	606,000
Value	34,800	11,400	10,900	17,000	81,500
Stone:					
Primary production:[e]					
Quantity	71,900	79,200	83,200	87,400	--
Value	66,900	96,300	101,000	106,000	--
Secondary production:[e]					
Quantity	518	185	360	392	130
Value	1,240	463	544	856	218
Exports:					
Quantity	--	--	--	--	--
Value	--	--	--	--	--
Imports for consumption:					
Quantity	2,160	1,310	1,370	1,230	951
Value	31,200	22,900	18,700	15,800	7,230
Apparent consumption:[2]					
Quantity	74,600	80,700	84,900	89,000	1,080
Value	99,300	120,000	120,000	123,000	7,450

[e]Estimated. -- Zero.

[1]Table includes data available through February 3, 2021. Data are rounded to no more than three significant digits.

[2]Domestic primary and secondary production plus imports minus exports.

TABLE 3

U.S. IMPORTS FOR CONSUMPTION OF INDUSTRIAL DIAMOND STONES, BY COUNTRY OR LOCALITY[1]

(Thousand carats and thousand dollars)

	Natural industrial diamond stones[2]				Miners' carbonados and other industrial diamond, natural and synthetic[3]			
	2017		2018		2017		2018	
Country or locality	Quantity	Value[4]	Quantity	Value[4]	Quantity	Value[4]	Quantity	Value[4]
Angola	(5)	8	(5)	5	--	--	--	--
Australia	118	910	57	514	22	135	11	99
Belgium	2	19	--	--	--	--	--	--
Botswana	251 r	7,460 r	12	1,010	2	224	(5)	21
Brazil	15	18	--	--	--	--	--	--
Canada	3	179	11	570	--	--	--	--
Congo (Kinshasa)	17	203	21	143	(5)	1	(5)	4
Guyana	--	--	--	--	1	96	--	--
India	314	307	320	322	20	220	2	200
Namibia	20	76	5	19	--	--	--	--
Russia	53	43	99	74	(5)	14	--	--
Sierra Leone	(5)	4	20	12	(5)	3 r	(5)	19
South Africa	386	5,490 r	241	3,970	2	187	151	146
United Kingdom	1	128	--	--	(5)	28	--	--
Other	(5)	1 r	(5)	2	(5)	2	(5)	97
Total	1,180	14,800	787	6,640	47	909 r	164	587

rRevised. -- Zero.

1Table includes data available through February 3, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

2Includes glazers' and engravers' diamond unset, Harmonized Tariff Schedule of the United States (HTS) codes 7102.21.3000 and 7102.21.4000 for natural industrial diamond stone.

3HTS codes 7102.21.1010 and 7102.21.1020 for miners' carbonados and other industrial diamond, natural and synthetic.

4Customs value.

5Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 4

U.S. IMPORTS FOR CONSUMPTION OF DIAMOND BORT, DUST AND POWDER, AND GRIT, BY COUNTRY OR LOCALITY[1]

(Thousand carats and thousand dollars)

	Natural[2]				Synthetic[3]			
	2017		2018		2017		2018	
Country or locality	Quantity	Value[4]	Quantity	Value[4]	Quantity	Value[4]	Quantity	Value[4]
Australia	55	36	--	--	26	25	211	163
Austria	15	7	--	--	60	32	25	15
Belgium	4	3	26	20	609	251	636	199
Canada	--	--	--	--	268	14	--	--
China	635	477	600	307	279,000 r	28,800 r	467,000	40,500
Finland	--	--	--	--	147	94	98	60
Germany	170	42	60	15	363	84	1,030	156
Hong Kong	--	--	2	4	756 r	116 r	594	177
India	3,040	1,660	2,770	1,430	496	258	861	192
Ireland	96	38	--	--	28,700 r	11,400	28,400	9,810
Israel	--	--	51	85	288	121	34	9
Italy	8	6	--	--	120	50	--	--
Japan	37	14	14	6	510 r	615 r	795	674
Korea, Republic of	112	45	155	55	23,900	6,760	23,100	6,330
Romania	--	--	--	--	2,040 r	1,270 r	2,920	1,160
Russia	40	23	243	118	16,300	2,220	14,700	2,210
Singapore	--	--	--	--	173	69	85	51
South Africa	100	64	73	49	87	23	21	14
Switzerland	345	316	251	124	2,080 r	1,840	1,540	1,360
United Arab Emirates	--	--	--	--	100	27	--	--
United Kingdom	481	327	637	424	595	190	1,040	469
Other	35	19	80	74	34	12	98	57
Total	5,170	3,080	4,970	2,710	357,000 r	54,300 r	543,000	63,600

rRevised. -- Zero.

[1]Table includes data available through February 3, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Harmonized Tariff Schedule of the United States (HTS) codes 7105.10.0011 and 7105.10.0015 for natural diamond.

[3]HTS codes of the United States codes 7105.10.0020, 7105.10.0030, and 7105.10.0050 for synthetic diamond.

[4]Customs value.

Source: U.S. Census Bureau.

TABLE 5
U.S. REEXPORTS OF INDUSTRIAL DIAMOND STONES, BY COUNTRY OR LOCALITY[1]

(Thousand carats and thousand dollars)

	Industrial unworked diamond[2]			
	2017		2018	
Country or locality	Quantity	Value[3]	Quantity	Value[3]
Belgium	71	3,390	92	3,900
Canada	114	950	85	830
Germany	6	275	4	217
Hong Kong	17	4,760	10	205
India	1	4	6	5
Ireland	19	52	--	--
Israel	545	277	--	--
Japan	100	5,850	88	5,720
Korea, Republic of	14	990	12	731
Mexico	8	207	6	119
Taiwan	9	295	20	403
Thailand	1	44	1	58
United Arab Emirates	(4) r	91	--	--
United Kingdom	67	2,030	522	1,360
Other	7	38	7	31
Total	981	19,200	852	13,600

[r]Revised. -- Zero.
[1]Table includes data available through February 3, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Harmonized Tariff Schedule of the United States code 7102.21.0000.
[3]Values are free alongside ship.
[4]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 6

U.S. EXPORTS AND REEXPORTS OF INDUSTRIAL DIAMOND BORT, DUST AND POWDER, AND GRIT, BY COUNTRY AND OR LOCALITY[1, 2]

(Thousand carats and thousand dollars)

	Natural				Synthetic			
	2017		2018		2017		2018	
Country or locality	Quantity	Value[3]	Quantity	Value[3]	Quantity	Value[3]	Quantity	Value[3]
Exports:								
Austria	13	33	--	--	2,870	807	3,260	841
Belgium	677	338	152	274	845	194	79	17
Brazil	--	--	2	3	824	408	1,380	505
Canada	3,870	2,670	1,560	1,020	8,250	4,120	10,700	5,250
China	--	--	51	15	19,900	10,900	17,600	10,400
Germany	78	36	22	20	9,330	1,850	8,000	1,590
India	72	25	--	--	2,640	964	2,790	942
Indonesia	9	3	--	--	594	134	447	116
Israel	526	200	131	57	2,470	938	2,000	802
Italy	--	--	49	49	1,430	362	1,060	316
Japan	168	302	155	331	40,600	17,700	49,500	22,800
Korea, Republic of	49	13	96	21	19,700	7,460	20,600	8,130
Mauritius	--	--	--	--	245	260	298	437
Mexico	414	229	131	168	1,610	512	1,010	298
Netherlands	308	128	11	26	20,700	7,550	17,400	6,570
Philippines	--	--	--	--	299	142	217	67
Singapore	--	--	--	--	1,680	3,260	1,590	3,360
South Africa	51	32	--	--	240	184	536	380
Switzerland	124	74	147	67	5,010	4,480	3,690	2,980
Taiwan	--	--	4	3	5,220	2,680	6,300	3,050
Thailand	13	33	4	11	3,520	1,290	3,680	1,300
Turkey	--	--	--	--	2,590	841	585	204
United Kingdom	208	180	135	277	1,850	623	1,660	482
Other	129 r	118 r	205	534	2,110 r	1,070 r	1,470	674
Total	6,710	4,410	2,850	2,880	155,000	68,700	156,000	71,500
Reexports:								
Belgium	615	252	44	32	153	44	21	7
Canada	2,700	1,740	795	492	5,070	2,150	6,080	2,720
China	--	--	49	10	1,760	438	2,160	581
Germany	57	13	--	--	515	116	293	66
Israel	--	--	15	6	--	--	22	4
Japan	168	302	155	331	8,680	1,950	8,220	2,170
Korea, Republic of	--	--	--	--	1,050	443	1,220	555
Mexico	63	45	31	30	482	142	443	130
Peru	--	--	--	--	386	130	267	76
Singapore	--	--	--	--	5	18	2	5
Switzerland	--	--	--	--	7	3	--	--
Thailand	--	--	2	5	80	109	80	103
United Kingdom	71	32	5	5	65	16	139	29
Other	66 r	17 r	6	6	153 r	76 r	271	125
Total	3,740	2,400	1,100	917	18,400	5,640	19,200	6,570
Grand total	10,500	6,810	3,960	3,800	173,000	74,400	175,000	78,100

[r]Revised. -- Zero.

[1]Table includes data available through February 3, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Harmonized Tariff Schedule of the United States codes 7105.10.0010 for natural and 7105.10.0025 for synthetic.

[3]Values are free alongside ship.

Source: U.S. Census Bureau.

TABLE 7
DIAMOND (NATURAL): WORLD PRODUCTION, BY COUNTRY OR LOCALITY AND TYPE[1]

(Thousand carats)

Country or locality and type[2]	2014	2015	2016	2017	2018
Gemstones:					
Angola[3]	7,910	8,110 r	8,120 r	8,490 r	7,570
Australia[e, 4]	186	271	279	343	281
Botswana[e, 5]	17,300	14,500	14,400 r	16,100 r	17,100
Brazil, unspecified[6]	71	32	184	255	251
Cameroon, unspecified[7]	4	2	1	2	2
Canada, unspecified	12,012	11,677	13,036	23,234	23,194
Central African Republic[8]	--	--	9 e	38 e	11 e
China, unspecified	150 e	150 e	127 e	230 r	99
Congo (Brazzaville)	53	40	12	47	48
Congo (Kinshasa)[e, 9]	3,030 r	3,190 r	3,160 r	3,800 r	3,030
Côte d'Ivoire, unspecified	1	15	20	7	6
Ghana, unspecified	242	174	142	82	54
Guinea[e, 8]	131	134	90	145	234
Guyana, unspecified	100	118	140	52	62
India[10]	10 e	9 e	9	11	11 e
Lesotho, unspecified	346	304	342	1,126	1,294
Liberia[11]	39	41	38	43 r, e	48 e
Namibia, unspecified	1,918	2,053	1,718	1,948	2,397
Russia[e, 12]	21,500	23,500	22,600	23,900 r	24,200
Sierra Leone[e, 8]	496	400	439	231	593
South Africa[e, 13, 14]	3,220 r	3,290 r	3,320 r	3,880 r	3,960
Tanzania[e, 15]	215	184 r	205	259 r	328
Togo, unspecified	(16)	--	--	(16)	--
Zimbabwe[e, 17]	477	349	210	251	326
Total	69,400 r	68,500 r	68,600 r	84,500 r	85,100
Industrial:					
Angola[e, 3]	879	902	902	944 r	841
Australia[e, 4]	9,100	13,300	13,700	16,800	13,800
Botswana[e, 5]	7,400	6,320 r	6,150 r	6,890 r	7,310
Central African Republic[8]	--	--	2 e	10 e	3 e
Congo (Kinshasa)[e, 9]	11,900 r	12,600 r	12,400 r	15,300 r	12,100
Guinea[e, 8]	33	33	23	36	59
India[e, 10]	27	25 r	24	30	29
Indonesia	7	--	--	--	--
Liberia[11]	26	27	25	29 r, e	32 e
Russia[e, 12]	16,900	18,400	17,700	18,800	19,000
Sierra Leone[e, 8]	124	100	110	58	148
South Africa[e, 13, 14]	4,840 r	4,940 r	4,980 r	5,820 r	5,950
Tanzania[e, 15]	38	33 r	36 r	46 r	58
Zimbabwe[17]	4,290 e	3,140 e	1,890 e	2,260 e	2,930
Total	55,600 r	59,800 r	57,900 r	67,000 r	62,200
Grand total	125,000 r	128,000 r	127,000	151,000	147,000

See footnotes at end of table.

TABLE 7—Continued

DIAMOND (NATURAL): WORLD PRODUCTION, BY COUNTRY OR LOCALITY AND TYPE[1]

(Thousand carats)

[e]Estimated. [r]Revised. -- Zero.

[1]Table includes data available through October 11, 2019. All data are reported unless otherwise noted. Grand 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, Belarus, Germany, Ireland, the Republic of Korea, Nigeria, and Sweden may have produced natural diamond, but available information was inadequate to make reliable estimates of output.

[3]Approximately 90% gem quality and 10% industrial quality.

[4]Approximately 2% gem quality and 98% industrial quality.

[5]Approximately 70% gem and near-gem quality and 30% industrial quality.

[6]Private sector and artisanal mining. Includes near-gem and cheap-gem qualities.

[7]Artisanal mining.

[8]Approximately 80% gem quality and 20% industrial quality.

[9]Approximately 20% gem quality and 80% industrial quality; the majority of production is artisanal mining.

[10]Approximately 27% gem quality and 73% industrial quality.

[11]Approximately 60% gem quality and 40% industrial quality.

[12]Approximately 56% gem quality and 44% industrial quality.

[13]Includes artisanal mining.

[14]Approximately 40% gem quality and 60% industrial quality.

[15]Approximately 85% gem quality and 15% industrial quality.

[16]Less than ½ unit.

[17]Approximately 10% gem quality and 90% industrial quality.