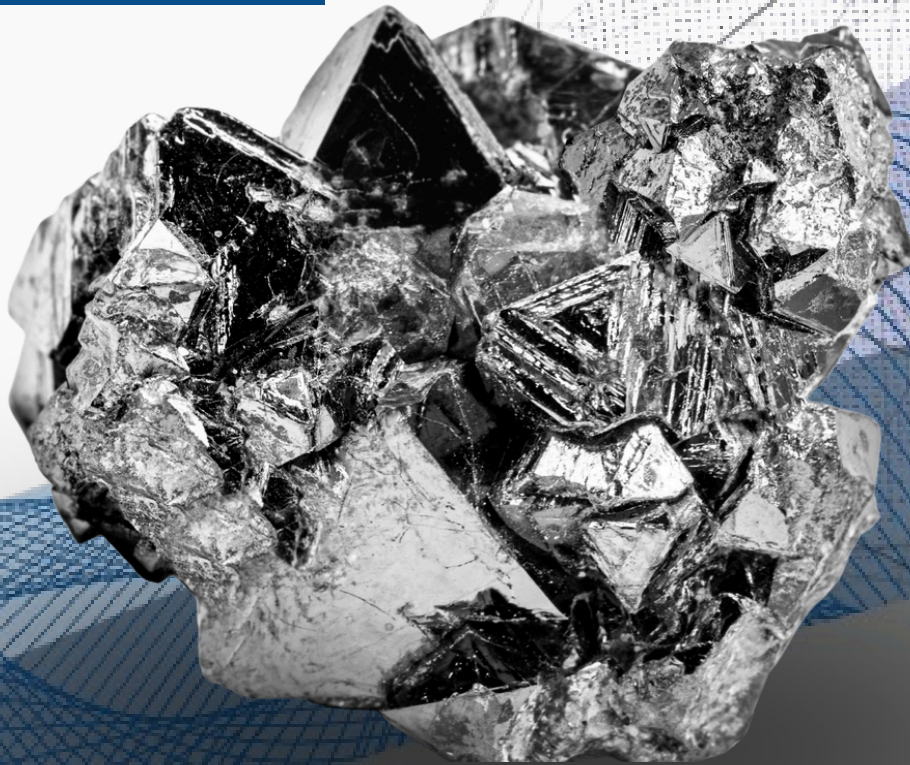


# PGM Fact Sheet Osmium

76

**Os**

Osmium



Supply &  
Demand



Applications



Trends



Geology

May 2026

# PGM FACTSHEETS 2026 - OSMIUM

Written by SFA (Oxford)

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## OVERVIEW

Osmium (Os), a platinum group metal, is a rare and highly dense element known for its bluish-white appearance, extreme hardness, and brittleness. It is the densest naturally occurring element and has a very high melting point (3,033°C). Osmium exhibits excellent wear resistance and forms a volatile oxide, osmium tetroxide (OsO<sub>4</sub>).

Osmium is primarily obtained as a by-product of platinum and nickel refining, as it occurs in trace quantities within platinum group metal ores. Global production volumes are extremely limited due to its geological rarity and the complexity of its separation.

The most significant applications of osmium are associated with its chemical properties rather than its metallic form. It is widely used, though in small quantities, in electron microscopy to examine tissue samples and is a very effective dihydroxylation catalyst particularly in the synthesis of molecules for the pharmaceutical, agrochemical and other fine chemical markets. In metallic form, osmium is used in specialized, wear-resistant alloys for applications such as electrical contacts, fountain pen nibs, and instrument pivots, where durability is critical.

Although osmium shares chemical similarities with other platinum group metals, its industrial use is extremely limited because of its rarity, toxicity in oxidized form, and processing challenges. Nevertheless, its unique properties ensure its continued role in certain scientific, medical, and industrial applications.

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## PRIMARY SUPPLY

Primary osmium supply is tied to the platinum group metals (PGM) mining and refining chain, and South Africa is the dominant source of osmium-bearing refinery streams. Whether osmium is recovered depends on flowsheet decisions to isolate it rather than lose it, and industrial recovery is concentrated in a small number of specialist refiners, including Heraeus (operations in Port Elizabeth, South Africa and Hanau, Germany), Johnson Matthey in the UK, and Colonial Metals in the US, which recover osmium from concentrates and alloys.

In South African circuits, osmium is treated as an impurity and most is lost before final precious metal refining; at two other major South African PGM producers, the majority of osmium is lost in the BMR (Base Metals Refinery) waste streams rather than captured as product. At the BMR stage, osmium goes to multiple loss streams including selenium-tellurium residues sent for further refining to specialized refineries, losses in the final alkaline leach, and vaporisation in the concentrate drier prior to shipment to the PMR (Precious Metals Refinery).

Osmium follows ruthenium through the circuit and is removed during ruthenium purification, where oxidation using nitric acid or peroxide forms osmium tetroxide (OsO<sub>4</sub>) that goes to vent scrubbers, so any operation that loses ruthenium also loses osmium. Amplats (now Valterra Platinum) recovered osmium in its PMR as potassium osmate until around the year 1990; subsequent recovery reviews, including during EPMP (Enhanced Platinum Metals Refinery) design

work, concluded recovery was not to be pursued due to complexity and hazard. Historically, an osmiridium concentrate was also produced by tabling (gravity concentration) by Evander Kinross Gold Plant / Evander Mine operations in South Africa, with that osmiridium concentrate containing mainly Pt-Ru-Os-Ir-Au with no significant Pd or Rh, and reportedly refined through a local refinery, but this processing route is believed to have ceased around the year 2020.

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## SECONDARY SUPPLY

Secondary osmium supply exists in principle (PGM-bearing scrap streams), but recovery is constrained by the same separation and economics problem: if refiners are not set up (or not incentivised) to isolate osmium, it will not appear as reported secondary production even if it is present in feed. Furthermore, for some of the more traditional osmium applications, i.e. as staining agent in electron microscopy, the osmium will be consumed in its use and is not recyclable.

## MARKET ANALYSIS, TRADE & PRICES

### GLOBAL MARKET

Osmium is treated as part of the PGM basket and, in trade classifications, is normally reported together with iridium and ruthenium. Reliable quantitative information about osmium supply and demand is extremely scarce. Global volumes produced and traded are expressed in kilograms per annum, and companies do not report production and sales.

### EU TRADE

Heraeus (Hanau, Germany), sells osmium metal, but also its compounds (in solid, powder and solution forms) from its South African refinery

Ames Goldsmith Ceimig (Dundee, UK) supplies osmium metal sponge and salts, with links to its group company Colonial Metals in the US.

Umicore (Brussels, Belgium) and Johnson Matthey (London, UK) both manufacture and import a wide range of PGM chemical products, but do not currently appear to handle osmium compounds.

Several chemical and laboratory supply companies offer osmium products for sale, sourced from upstream manufacturers.

### EU IMPORT RELIANCE

The EU's import reliance for osmium at the processing/refining stage cannot robustly be determined from Combined Nomenclature (CN) trade data alone, because osmium is often grouped under various codes with iridium and ruthenium (see appendix). Europe-based suppliers of osmium compounds are reliant mainly on imports from South Africa. As such, any geopolitical barriers to import present in the other platinum group metal streams will apply to osmium.

## PRICE & PRICE VOLATILITY

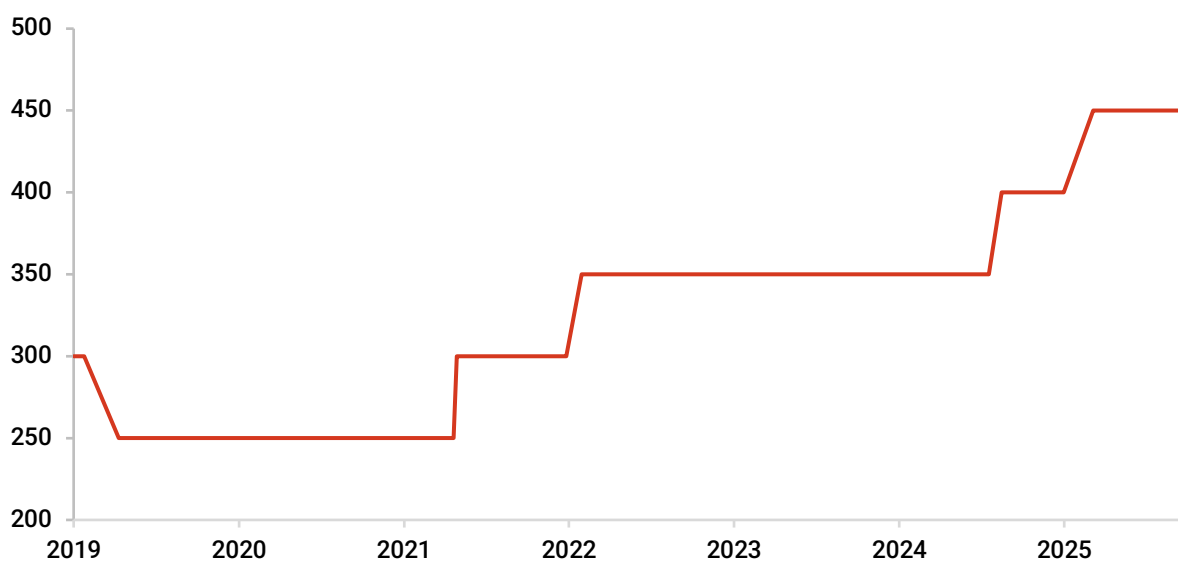
Osmium is not mined as an independent commodity, but rather as a minor by-product of PGM or nickel mining. Refining is highly complex, so only a small portion of the osmium mined is ever recovered. Global production volumes are extremely small, of the order of hundreds of kilograms per year.

There is no exchange-traded benchmark price, and there is no market transparency, with only small industrial quantities traded. Trade transparency is further limited as customs codes normally group osmium together with iridium and ruthenium.

Osmium products are normally priced at each transaction between the seller and buyer, including the nominal metal price plus associated fabrication, storage, transport and related costs.

In the past, companies like Engelhard (now BASF) would quote osmium prices in their Engelhard Industrial Bullion price sheet. Osmium prices have historically been very stable (due to lack of market liquidity), fixed in the 300-400\$/oz range since the 2000's. By analysing trade data and traded volumes, the price chart below has been collated by SFA (Oxford).

**Osmium average sponge price**  
\$/oz



Source: TradeDataPro

## DEMAND OUTLOOK

### GLOBAL AND EU USES AND END-USES

Industrial demand for osmium is highly concentrated in speciality chemical applications. Osmium tetroxide is used in syn-dihydroxylation reactions in organic synthesis and in high-value fine chemical and pharmaceutical applications. Additional uses include microscopy and biological staining, where  $\text{OsO}_4$  enhances contrast. A new medical application is the potential use of osmium-based compounds for anticancer agents.

Metallic osmium applications remain niche and are typically limited to specialised hard-wearing alloy components used for writing tips in pens, phonographic scanning needles, pins and shafts in instrument manufacturing. Platinum-osmium or osmium-iridium alloys are used in medical implants such as artificial heart valves or pacemakers. The jewellery industry comprises very limited demand.

### APPLICATIONS

Osmium's largest industrial end use is mainly as osmium tetroxide (and related osmate salts) used as oxidants/catalysts in chemical synthesis, for fine chemicals and some pharmaceutical intermediates.

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### ELECTRONIC

Osmium has limited use in hard, durable alloy components for niche precision applications. It does not have the breadth of electronics demand of the other PGMs.

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### CHEMICAL

The chemical sector is the main market for osmium. Applications are predominantly as catalysts in speciality synthesis routes. Osmium tetroxide is used for dihydroxylation in stereoselective organic synthesis for high-value fine chemical, pharmaceutical and agrochemical products.

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### JEWELLERY AND DENTAL

Osmium jewellery demand is negligible and largely confined to novelty or niche segments. There is no evidence of significant modern dental demand for osmium-containing alloys, and any historical use has been supplanted by alternative materials.

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### MEDICAL

A 90% platinum / 10% osmium alloy (Pt/Os 90/10) is used in surgical implants, including components for pacemakers and replacement pulmonary valves.

Osmium compounds are used in staining and fixing samples for electron microscopy and in medical implants. Osmium has also been used in optical components for space-based ultraviolet spectrometers. In biological sample preparation, osmium compounds are used to stabilise and preserve cellular membranes in tissue specimens.

## SUBSTITUTION

For many osmium uses (especially OsO<sub>4</sub>-catalysed organic reactions), while other catalysts may be available, there will be trade-offs in selectivity particularly, leading to additional costly purification steps to achieve the necessary product quality and performance. End users often prefer proven routes rather than re-qualifying chemistry, unless forced to by supply/security constraints.

## SUPPLY OUTLOOK

### SUPPLY FROM PRIMARY MATERIALS

PGMs are commonly supplied in multiple forms (unwrought metal, powders, semi-manufactured forms, and intermediate/product forms), and activity in the EU is generally downstream of initial mining/processing (refining/manufacturing).

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## GEOLOGY, GLOBAL RESOURCES & RESERVES

### GEOLOGY

The platinum-group metals (PGMs) are among the rarest elements in the Earth's crust. Reported upper-crust abundances for the PGM suite are on the order of parts per billion, and the metals occur together in nature, typically associated with nickel and copper, either in base-metal sulphide minerals or in a wide variety of PGM-bearing minerals and alloys.

Enrichment of PGMs to mineable grades occurs in a limited number of geological settings. The majority of global PGM resources and reserves are hosted in two deposit classes: (i) PGM-dominant layered intrusion-hosted deposits (platinum-dominant class), and (ii) nickel-copper sulphide deposits in which PGMs are recovered as by-products of Ni-Cu production.

Within PGM-dominant layered intrusions, two ore types account for the majority of PGM production; the Merensky Reef type and the Chromitite reef type, best developed in the Bushveld Igneous Complex in South Africa. Typical mill-head grades reported for Merensky Reef ores are ~4–7 ppm 6E (Pt+Pd+Rh+Ru+Ir+Au) or ~4–6 ppm 4E (Pt+Pd+Rh+Au). The Chromitite reef type

(notably the UG2 chromitite) typically has relatively higher proportions of the minor PGMs (Rh, Ru, Ir and Os) compared with Merensky-type ores.

Osmium (Os) behaves as part of the Iridium-group Platinum Group Elements (IPGE) subgroup (Os-Ir-Ru) and is commonly hosted in refractory platinum group minerals, including sulphide minerals within the laurite-erlichmanite series and Os-bearing PGM phases in chromitites. In the UG2 chromitite, Os can be partitioned between base-metal sulphides (notably pentlandite) and discrete PGM phases; reconnaissance mass-balance work suggests that pentlandite may host an appreciable share of whole-rock Os in some samples, while a substantial fraction of Os can also be carried by discrete PGM (e.g. laurite with elevated Os and Ir).

In nickel-copper sulphide deposits, PGMs (including Os) are typically recovered as by-products when present at economically recoverable levels, with PGM grades reported to reach up to ~10 ppm in some Ni-Cu sulphide systems.

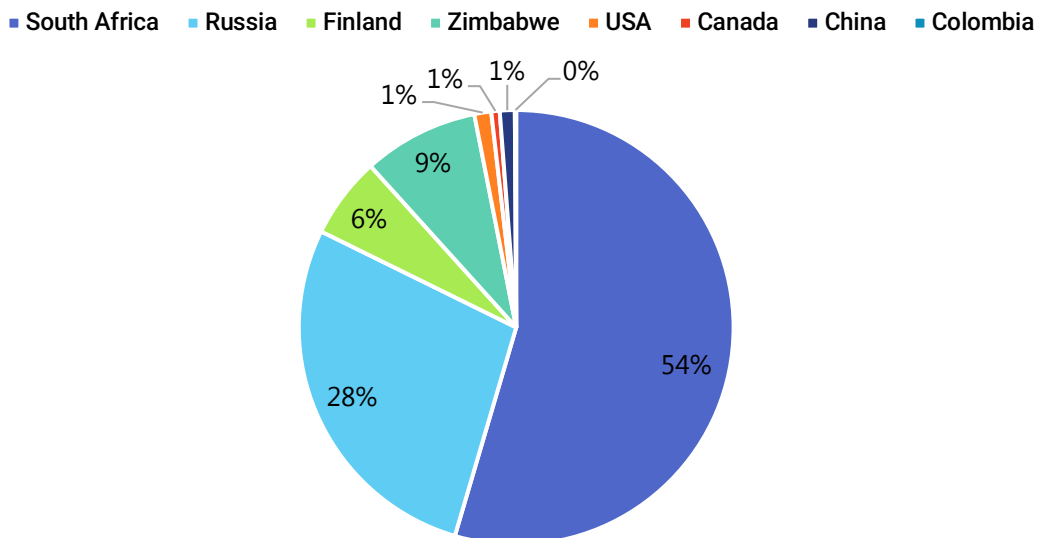
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#### GLOBAL RESOURCES & RESERVES

The USGS reports global PGM reserves of >76,000 tonnes and world PGM resources of >100,000 t concentrated in major Platinum Group Elements (PGE) provinces such as the Bushveld Complex (South Africa), The Great Dyke (Zimbabwe) and Norilsk-Talnakh intrusions (Russia).

Osmium-only reserves/resources are not robustly reported because PGM disclosures are normally aggregated (e.g., PGM total, PGM+Au, 4E/6E baskets) and Os is normally not separately assayed or published. Applying a conservative Os share of 0.1%–0.5% of contained PGMs implies an order of magnitude Os content of ~76–380 t in global PGM reserves (best estimate ~150 t) and ~100–500 t in global PGM resources (best estimate ~200 t).

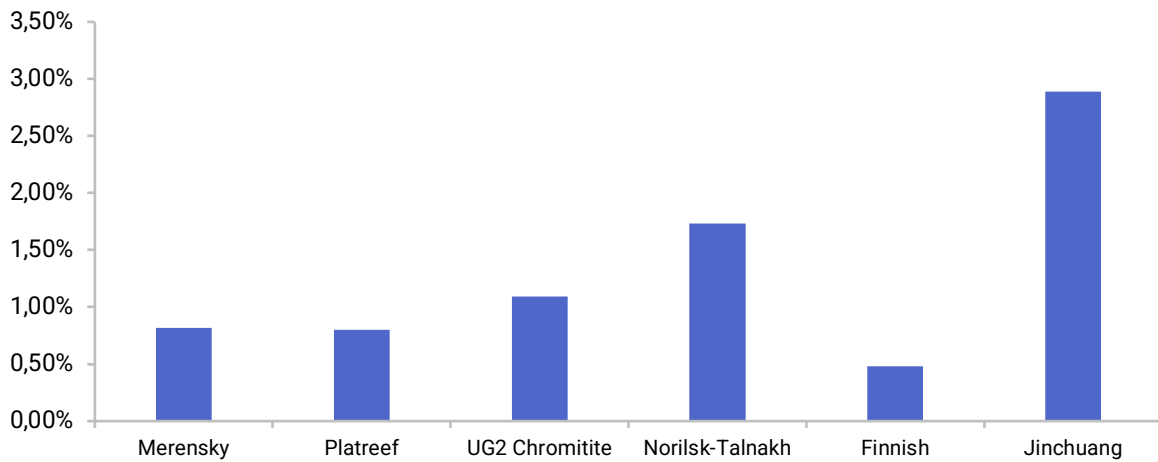
#### Osmium In-Situ Resources of the World



Source: Vermaak (1995)

### Osmium grade in major ore types

%



Source: Vermaak (1995)

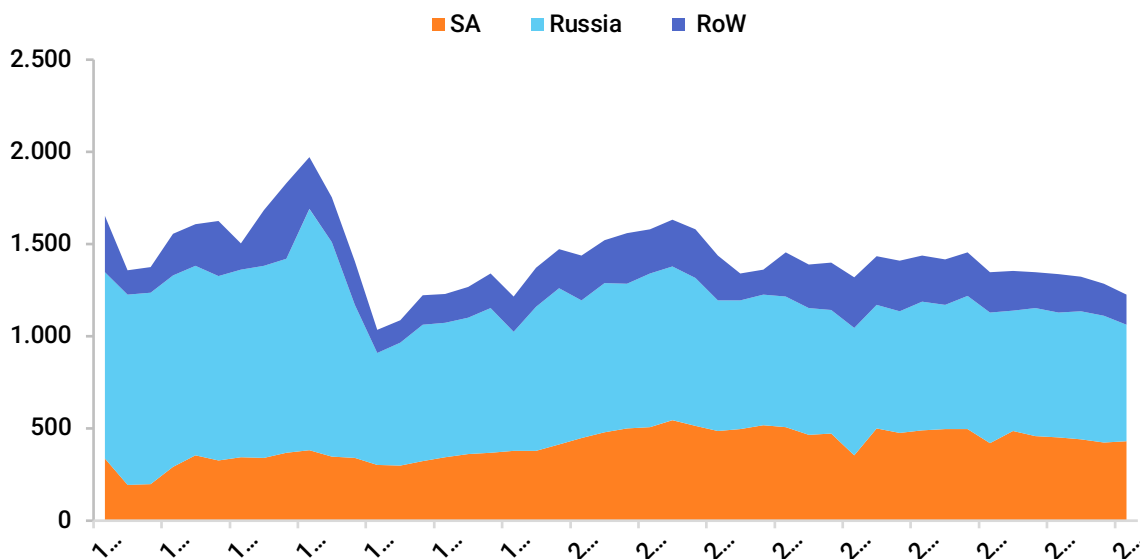
## EU RESOURCES & RESERVES

Vermaak (1995) identifies small Finnish deposits of osmium – Penikat, Suhanko and Naukas – where grades vary from 0.25% to 2.3%. As osmium is only a minor by-product in these deposits, the decision to mine or develop these will not be determined by osmium’s supply-demand or price dynamics.

## GLOBAL & EU MINE PRODUCTION

### Estimated contained Os associated with PGM production

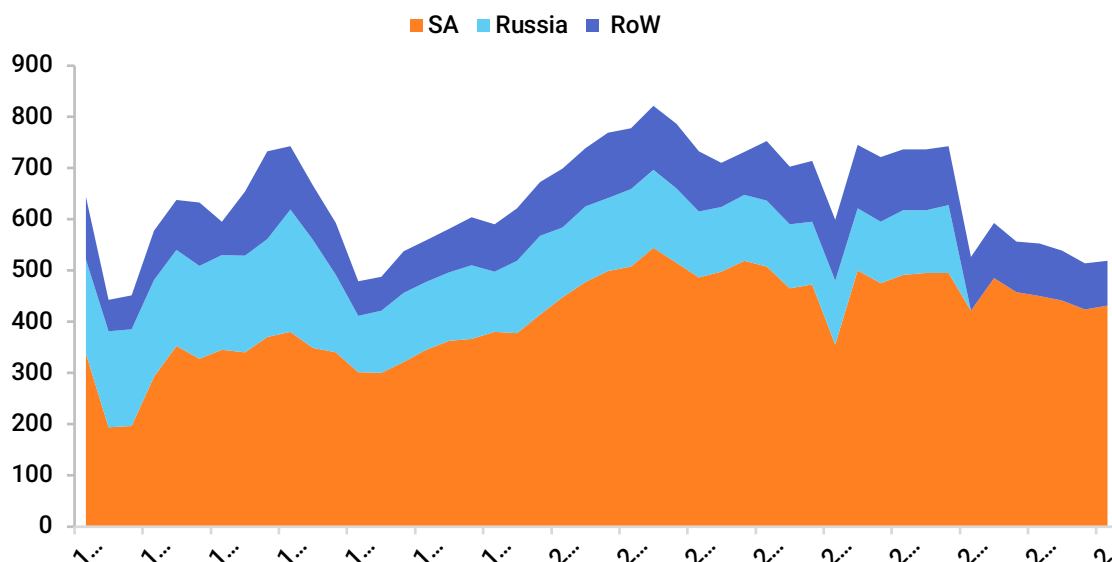
kg



Source: SFA (Oxford)

Based on estimated osmium resource grades, the *theoretical* osmium volume mined in ore by the major producers over the past few decades has been calculated above (Vermaak 1995, SFA (Oxford)).

### Estimated Realised Os production kg



Source: SFA (Oxford)

Actual osmium recovery is significantly less than osmium contained in ore, as several companies lose osmium in their efforts to recover the more valuable PGMs, or have decided to stop recovering it due to processing complexity, poor economics or lack of customers for the end product. Russian osmium recovery and sales were limited and stopped entirely by the end of the 2010s. Two out of four of the major refineries in South Africa do not recover osmium at all. Actual production of osmium is not reported, and the above estimates of annual production are based on SFA (Oxford) estimates from historical resource grade estimates, and company and expert guidance. Annual global production of osmium is likely to therefore have been limited to about 500kg-550kg/annum over 2024 and 2025. Osmium product sales over the period might not necessarily align with these numbers, as companies have tended to build up stockpiles over periods of low demand, and production and sales have therefore not been aligned historically. Although the Boliden operations in Sweden will likely have trace amounts of osmium in its PGM concentrates, it is unknown if any osmium contained is recovered.

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## PROCESSING

Osmium processing and separation relies on its ability to form osmium tetroxide ( $\text{OsO}_4$ ), which can be generated and recovered via distillation/absorption approaches. This characteristic that enables separation also makes  $\text{OsO}_4$  a volatile and highly toxic compound to handle.

Primary osmium supply is part of PGM mining and refining, so South Africa is the dominant source of osmium-bearing refinery streams, but recovery depends on whether operators and refiners choose to isolate osmium rather than lose it through the flowsheet. Only a small number of specialised refiners – including Heraeus with operations in Port Elizabeth and Hanau – recover osmium from third-party South African concentrates. In South African ore processing circuits, recovery is poor, and osmium is often treated as an impurity to be removed, with major losses occurring prior to final precious-metal refining and, in the case of two other major South African PGM producers, the majority of osmium is lost in base metals refinery waste streams, rather than being captured as product.

At the BMR stage, osmium is lost to multiple streams, including (i) SeTe (selenium-tellurium) residues that are sent onward to Umicore, (ii) losses in the final alkaline leach stage, and (iii) losses via vaporisation in the concentrate drier prior to shipment of concentrate to the PMR. Osmium follows ruthenium in the circuit, and is separated during ruthenium purification, where it is distilled off using nitric acid or peroxide to form  $\text{OsO}_4$ , which then goes to vent scrubbers instead of being recovered as a saleable stream. Consequently, any operation where ruthenium is lost generally represents a corresponding loss pathway for osmium.

Historically, an osmiridium concentrate was also produced by tabling (gravity concentration) by Evander Kinross Gold Plant / Evander Mines operations in South Africa, with that osmiridium concentrate containing mainly Pt-Ru-Os-Ir-Au with no significant Pd or Rh, and reportedly refined through a local refinery, but this processing route ceased as of 2020.

Once refined to sponge (or ingot), primary and secondary PGMs are indistinguishable and are traded and used as equivalents.

## SUPPLY FROM SECONDARY MATERIALS/PRODUCTION

### RECYCLING

Open loop recycling for osmium is very limited; any available volumes are extremely small, processes are complex and ultimate value is rarely high enough to justify the processing costs. Closed-loop recycling may occur within some chemical processes or specialised refining circuits, but osmium is not characterised by the same highly developed recycling networks of the other platinum group metals and is often lost in the customers' processes or discarded as a waste product.

## OTHER CONSIDERATIONS

### HEALTH AND SAFETY ISSUES

Bulk osmium metal is not toxic but its oxide, osmium tetroxide is volatile, a strong oxidising agent and highly toxic, causing lung, skin, and eye damage (source: The Royal Society of Chemistry).

Consequently, use of osmium tetroxide is very limited and requires stringent exposure controls and appropriate respiratory protection in exposure scenarios (source: NIOSH).

The International Platinum Group Metals Association (IPA) has developed comprehensive guidance on the safe use of PGMs in the workplace. This guidance is used by PGM producers and downstream users to design and continually improve occupational health and safety programmes, helping to ensure that the benefits of PGM-containing technologies are delivered while protecting workers along the supply chain. *Source: [IPA](#)*

## ENVIRONMENTAL ISSUES

Osmium handling issues are dominated by the toxicity/volatility of  $\text{OsO}_4$  and the need for controlled containment and disposal in laboratory and industrial settings.

Osmium is both difficult and hazardous to refine, as  $\text{OsO}_4$  forms readily. Osmium processing is treated as a health-risk area requiring strong containment and scrubbing controls.

In 2025, the industry has published a  $\text{CO}_2$  scenario for primary production in 2030, based on investments by South African producers and the South African government into renewable energy, which shows a potential decrease in the  $\text{CO}_2$  footprint of mining of between 35% to 61%, depending of the metal (Bossi/Gediga, [Decarbonisation in the Mining of Platinum Group Metals – A CO2 Outlook to 2030 | Johnson Matthey Technology Review](#)).

The environmental footprint of primary produced and recycled osmium has not been formally assessed in the industry's life cycle assessments, mainly due to its low economic importance and insufficient data.

## NORMATIVE REQUIREMENTS

Safety data sheets and transport rules classify osmium tetroxide as UN 2471 with Class 6.1 and Packing Group I (high hazard), requiring specific labelling and handling controls. Osmium tetroxide ( $\text{OsO}_4$ ) is classified as acutely toxic by oral, inhalation, and dermal exposure routes. It is assigned Acute Toxicity Category 2 for oral exposure (H300: Fatal if swallowed) and inhalation exposure (H330: Fatal if inhaled), and Acute Toxicity Category 1 for dermal exposure (H310: Fatal in contact with skin).  $\text{OsO}_4$  is also classified as Skin Corrosion Category 1B (H314: Causes severe skin burns and eye damage) and Serious Eye Damage Category 1 (H318: Causes serious eye damage).

Potassium Osmate(VI) (typically supplied as Potassium Osmate(VI) Dihydrate) for transport is classified as UN 3288 ("Toxic solid, inorganic, n.o.s.") with Class 6.1 and Packing Group II, under DOT (US), IMDG, and IATA provisions. Potassium osmate is classified as corrosive to metals and presents acute toxicity and oxidising hazards. It is assigned Substance or Mixture Corrosive to Metals Category 1 (H290: May be corrosive to metals) and Acute Toxicity Category 3 for oral exposure (H301: Toxic if swallowed). It is further classified as Skin Corrosion Category 1B (H314:

Causes severe skin burns and eye damage) and Oxidising Liquid Category 2 (H272: May intensify fire; oxidizer). Accordingly, transport marking and documentation generally follow Class 6.1 (toxic) requirements for a PG II substance (rather than the dedicated UN entry used for osmium tetroxide), and SDSs explicitly indicate no Poison Inhalation Hazard designation for this entry.

Osmium(III) chloride hydrate for transport is classified as UN 3288 (Toxic solid, inorganic, n.o.s.), Class 6.1, Packing Group II, which drives Class 6.1 labelling and the associated packaging/handling controls under major transport frameworks (eg DOT/IMDG/IATA). Osmium(III) chloride hydrate is classified as corrosive to metals (Category 1; H290: May be corrosive to metals). It is also classified as skin corrosive (Category 1B; H314: Causes severe skin burns and eye damage) and as causing serious eye damage (Category 1; H318: Causes serious eye damage).

## SOCIOECONOMIC AND ETHICAL ISSUES

Osmium supply chains are linked to the broader PGM industry key producers, which is dominated by South Africa and Russia. Russia stopped recovering osmium some years ago. As with other PGMs, upstream mining and downstream refining involve material ESG considerations (worker exposure, industrial safety management, and local environmental controls), with  $\text{OsO}_4$  hazard management being central for osmium-related products.

The social, economic and ethical issues of the South African PGM industry are covered in more detail in the platinum fact sheet.

## ECONOMIC IMPORTANCE OF OSMIUM FOR EXPORTING COUNTRIES

The economic contribution to mining company and hence producing country revenues is non-existent or trivial. Volumes produced are just at kilogram per annum levels, though most mining companies do not recover the metal contained in their ore. Osmium products are commonly stockpiled due to limited and irregular demand.

PGM mines in South Africa and Zimbabwe are not government-owned but are owned by publicly listed companies and their shareholders.

## RESEARCH AND DEVELOPMENT TRENDS

Current research activity involving osmium is largely limited to academic and exploratory. Topics reported include osmium-based electrocatalysts, hydrogen-related systems, and organometallic complexes. There is no evidence of commercial activity in low-carbon technologies currently.

## APPENDIX: HS/CN CODES

### OSMIUM METAL, SEMI-MANUFACTURED AND SCRAP

Level	Code	Description (short)
HS-6	7110.41	Metals; iridium, osmium, ruthenium, unwrought or in powder form
HS-6	7110.49	Metals; iridium, osmium, ruthenium, semi-manufactured
HS-6	7112.92	Waste and scrap of iridium, osmium and ruthenium (precious metal waste and scrap)
CN-8	7110 41 00	Metals; iridium, osmium, ruthenium, unwrought or in powder form
CN-8	7110 49 00	Metals; iridium, osmium, ruthenium, semi-manufactured
CN-8	7112 92 00	Waste and scrap of iridium, osmium and ruthenium

### OSMIUM COMPOUNDS (OSMATES, $OsO_4$ , OTHER SALTS)

Level	Code	Description (short)
HS-6	2843.9	Colloidal precious metals; inorganic or organic compounds of precious metals; amalgams – other compounds; amalgams
CN-8	2843 90 90	Other compounds; amalgams – other compounds – other (used for osmium tetroxide and other osmium compounds)

### OSMIUM REAGENT SOLUTIONS AND KITS

Level	Code	Description (short)
HS-6	3822	Diagnostic or laboratory reagents on a backing, prepared diagnostic or laboratory reagents
CN-8	3822 00 00	Diagnostic or laboratory reagents (sometimes used for formulated $OsO_4$ reagent kits/low-strength solutions)

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Commodities Intelligence Centre

<https://TradeData.pro>

## DEFINITIONS & METHODOLOGY FOR DATA

The demand, primary, and secondary data used to create charts and quoted in the text are based on Johnson Matthey's PGM Market Report dataset (most recent edition: May 2025) and have been updated with estimates to reflect the situation as of December 2025.

### **Primary supply**

Supply figures represent producers' sales of primary PGM and are allocated to the region where mining took place, rather than to the region of subsequent processing.

### **Secondary supply**

Secondary supply is the quantity of metal recovered from open-loop recycling (i.e. where the original purchaser does not retain ownership of the PGM).

Outside the automotive, jewellery and electronics markets, open-loop recycling is negligible.

Automotive recycling represents the weight of metal recovered from end-of-life vehicles and aftermarket scrap. It does not include warranty or production scrap.

### **Demand**

Demand figures for any given application represent the sum of industry demand for new metal in that application, net of any closed-loop recycling (i.e. where industry participants retain ownership of the metal: an example would be recycling of spent chemical catalysts, where the metal is retained to be used on fresh catalyst that replaces the spent charge).

Automotive demand is allocated to the region where the vehicle is manufactured and is accounted for at the time of vehicle production. It includes emissions catalysts on vehicles, motorcycles and three-wheelers, as well as fuel cell vehicles. Non-road mobile machinery is counted as industrial demand, in the pollution control category.

Jewellery demand is allocated to the region where the finished jewellery is manufactured, not to the region where it is sold.

### **Regional definitions**

Europe: EU+ (includes UK and Turkey but excludes Russia)

### **Open-loop recycling**

When the original purchaser of the metal does not retain control over the PGM, the metal is available to the market again once recovered. The main source of open-loop metal is automotive catalytic converters, which are widely recovered from scrapped vehicles and recycled to recover the contained platinum, palladium or rhodium contained. Some metal is also recovered from the jewellery and electronics markets.

### **Closed-loop recycling**

Refers to the situation where the metal remains within the application, e.g., when metal is recovered from used chemical catalysts and is used to produce fresh catalysts to replace the spent charge. While this metal is processed by PGM refiners, the equivalent amount of metal is usually returned to the original owner, who retains the metal value. As the net amount of metal in use has not changed, this returned metal is not counted towards market supply. Re-using metal in such way avoids the need for virgin mined metal, thereby contributing to make demand more sustainable.