INTERNATIONAL PLATINUM GROUP METALS ASSOCIATION

# The Carbon Footprint of Platinum Group Metals

## A Best Practice Guidance for the Calculation of Greenhouse Gas Emissions of primary produced PGMs

Source: Implats

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1st Edition

## Legal Disclaimer

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The document reflects the current state of discussion in the platinum group metals industry and wider LCA community concerning the calculation of GHG emissions for primary platinum group metals. Discussions within the wider industry and LCA community on calculating GHG emissions are ongoing; methods and underlying parameters experience updates and are aligned with regulatory initiatives. The IPA therefore plans to review and update the guidance in the future on a regular basis to ensure its alignment with the latest methods, newest data, and regulatory requirements.

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Source: Anglo American

# Determining the Global Warming Potential of Platinum Group Metals

## 1. Introduction

Climate change and its effect on our natural environment is a matter of global social and political concern. Greenhouse gas (GHG) emissions, which contribute to global warming, are a major driver of climate change, and there is increasing pressure from regulators, investors, end-users and society as a whole to limit the release of carbon into the earth's atmosphere. This intensifies the drive to decarbonise the metals and mining sector.

Metals production and associated mining processes are estimated to account for 8-10% of all GHG emissions globally [1]. Due to produced tonnages and energy intensity, carbon steel is the major contributor to GHG emissions from metal production, followed by aluminum and copper. Thanks to their comparatively low production levels, platinum group metals (PGM) are relatively small contributors with roughly 0.03% of global emissions, according to International Platinum Group Metals Association (IPA) estimates. Platinum group metals are key enablers of the energy transition, e.g. in fuel cells or as components in proton exchange membrane (PEM) electrolysers for hydrogen production. Nonetheless, the platinum group metals industry is also in the focus of climate change mitigation measures, and companies are working towards reducing GHG emissions.

The climate change impact of a product is the sum of all greenhouse gas emissions over the production stages of the relevant product, including related production of consumables and electricity. The impact is expressed as carbon dioxide equivalents ($CO_2$-eq) per kg of product and includes, besides $CO_2$, other so-called “climate relevant gases“ (i.e., gases contributing to climate change).

Measuring GHG emissions is an important step in understanding the global warming impact of production of total emissions, in identifying hot spots where significant emissions occur and in developing industry- and company-level strategies and roadmaps towards net carbon neutrality.

The most common, globally accepted tool for measuring climate change potential at product level is an environmental life cycle assessment (LCA). LCA provides data and information on environmental impact categories. Since 2010, the IPA has carried out two full-scale LCAs on platinum group metals production and is currently engaged on a third. IPA has now brought its experience to account in producing this guide to best practice in calculating the carbon footprint of primary platinum group metals.

## 2. Purpose of this Guidance

The purpose of this guidance is to provide producers of platinum group metals and their stakeholders - end users (customers), legislators, academia, LCA practitioners and non-governmental organisations (NGOs) - with a standardized and transparent approach to calculating and reporting the climate change impact for all relevant GHG emissions (expressed in $CO_2$-eq) from the primary production of refined platinum group metals, including the mining, concentration and smelting of platinum group metals ores.

The guidance uses ISO 14040 and 14044 [2] standards on environmental management as a starting point, but as these standards are generic in nature, the guidance presents specific principles, requirements and methodologies for quantifying GHG emissions from primary platinum group metals production processes and the associated cradle-to-gate carbon footprints of their products and precursors. It ensures that data communicated by platinum group metals producers are coherent and based on the same calculations, methods, and parameters.

The guidance also aligns with the GHG Protocol's Product Life Cycle Accounting and Reporting Standard [3], which builds on the framework and requirements established in the ISO standards. Both the GHG Protocol and the ISO standards allow for the development of Product Rules (PR) or Product Category Rules (PCR) to add sufficient detail allowing for product comparisons in a consistent and credible manner. The guidance is intended to provide such details while at the same time allowing companies to apply rules from both standards which best fit their processes.

**Table 1: The IPA Carbon Footprint Guidance's relation to other standards**

| Standard/Guidance | ISO LCA Standards | GHG Protocol Standard | IPA Carbon Footprint Guidance |
|---|---|---|---|
| **Impact addressed** | • Environmental impact as<br>- Carbon footprint<br>- Water footprint<br>- Resource use<br>- Toxicity<br>- (...) | • Climate impact as<br>- Carbon Footprint | • Climate impact as<br>- Carbon footprint |
| **Unit** | Different, according to data category | $CO_2$-eq | $CO_2$-eq |
| **Relevant standards** | • 14040 (framework)<br>• 14044 (LCA guideline)<br>• 14067 (carbon footprint of products) | • "A Corporate Accounting and Reporting Standard"<br>• "Product Life Cycle Accounting and Reporting Standard"<br><br>GHG Protocol builds on ISO Standard | • Guidance builds on ISO and GHG Protocol<br><br>-> It harmonizes CF reporting for PGMs while complementing ISO and GHG Protocol in a PGM-specific way |
| **Field of application** | • Applies to all materials for all environmental impact categories | • Applies to all materials for carbon footprint only | • Applies only to primary production of PGMs and for carbon footprint only |
| **Level of detail** | • High-level, generic | • High-level, still generic | • Tailored to primary PGM production |

# 3. System Boundary and Data Collection

## 3.1 System Boundary

A system boundary is the set of criteria that determines which unit processes, inputs, outputs, and impacts are to be considered in building an inventory of GHG emissions associated with a product up to the gate of the factory which produces it. This type of system boundary is also known as ‚cradle-to-gate‘. A unit process is a discrete step in the production cycle of a product.

The system boundary for primary platinum group metals production includes four main unit processes, and their sub-processes, for which data are to be collected:

- mining (both open pit and underground)
- concentration (ore crushing, milling, froth flotation)
- smelting (drying, smelting, converting)
- refining (separation, leaching, purifying)

The system boundary also includes:

- transport of raw materials into and between processes
- on-site and off-site generation of electricity
- production of fuels, utilities and auxiliary materials required in the unit processes
- treatment of wastewater and processing of waste

The co-products for which a global warming impact are to be calculated are the six platinum group metals, platinum, palladium, rhodium, iridium, ruthenium, and osmium. Apart from osmium, which is produced in very small quantities and has few end-uses, the primary platinum group metals are used in a wide range of applications including emissions control, the manufacture of industrial products, chemicals and fuels, jewellery, medical and dental treatments, and components for electronic systems.

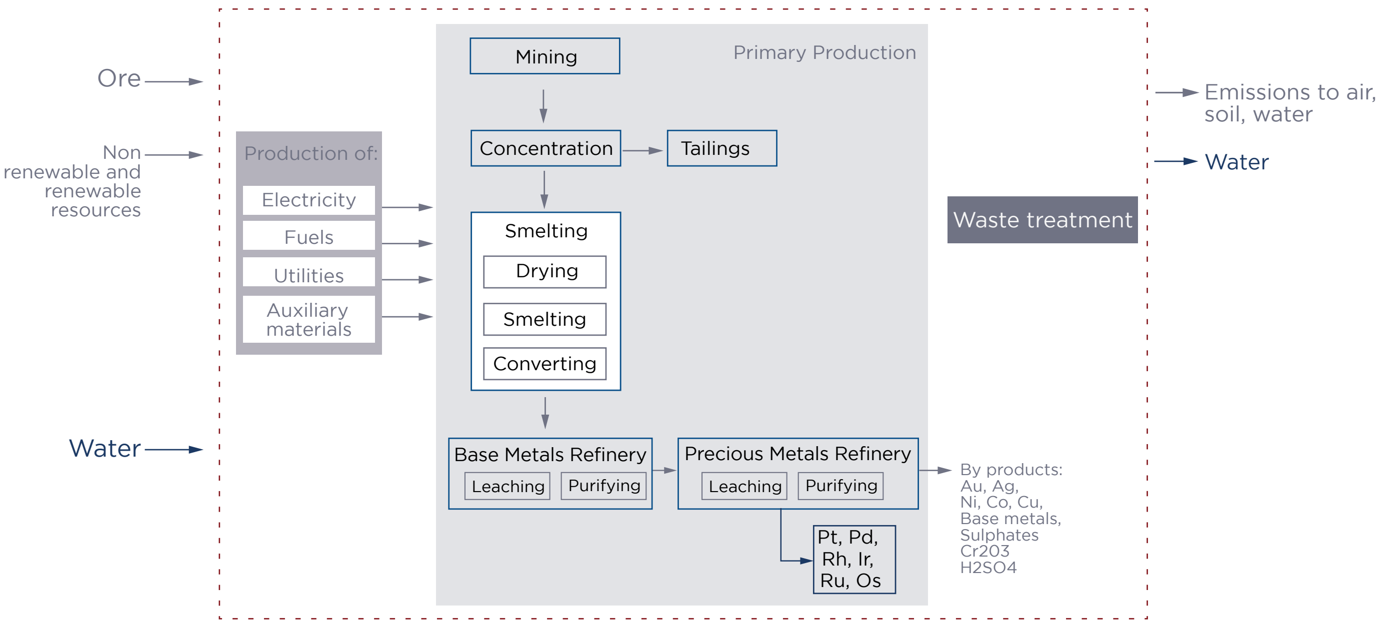
By-products which occur during primary production of platinum group metals are also considered. Such by-products include the precious metals gold and silver, the base metals nickel, copper and cobalt and compounds such as sulphuric acid and sodium sulphate. Their inclusion in the calculation of global warming impact is further explained in Section 6.1.

Recycling of platinum group metals is either integrated into the primary production process or, more commonly, treated in specialist recycling facilities where metal scraps and solutions are recycled into new products or pure metal, following similar pyro- and hydrometallurgical processes as in primary concentration and refining.

The focus of this guidance is on GHG emissions from the primary production of platinum group metals. It might be augmented in a future update with additional guidance on calculating the carbon footprint of end-of life secondary platinum group metal materials.

The system boundary for primary production is shown in a simplified flowchart in Figure 1.

**Figure 1: System boundary of primary platinum group metals production showing the processes, inputs and outputs in scope. System boundary is shown in red.**




In calculating a carbon footprint, it is usual to exclude from the system boundary processes for which representative data cannot easily be collected or when prior studies have shown the overall GHG impacts of the processes to be insignificant.

Several processes are excluded from the system boundary for platinum group metals production, such as the refining processes associated with further treatment of by-products, the transport of fuel, materials and human resources to the site, transport of refined platinum group metals to the customer, waste transport and emissions associated with business administration.

The exclusion of any process is determined by cut-off criteria. Processes which contribute less than 1% to the total GHG emissions of platinum group metals production can be excluded, provided that the excluded processes cumulatively amount to less than 3% of the total emissions. This approach aligns with EU Product Environmental Footprint Methods.[4].

The processes included in and excluded from the system boundary are shown in Table 2. They are based on experience of the collection and updating of life cycle data for platinum group metals production by the IPA [5-7]. The excluded processes have been shown to be below the above cut-off criteria.

**Table 2: Processes included and excluded from the system boundaries**

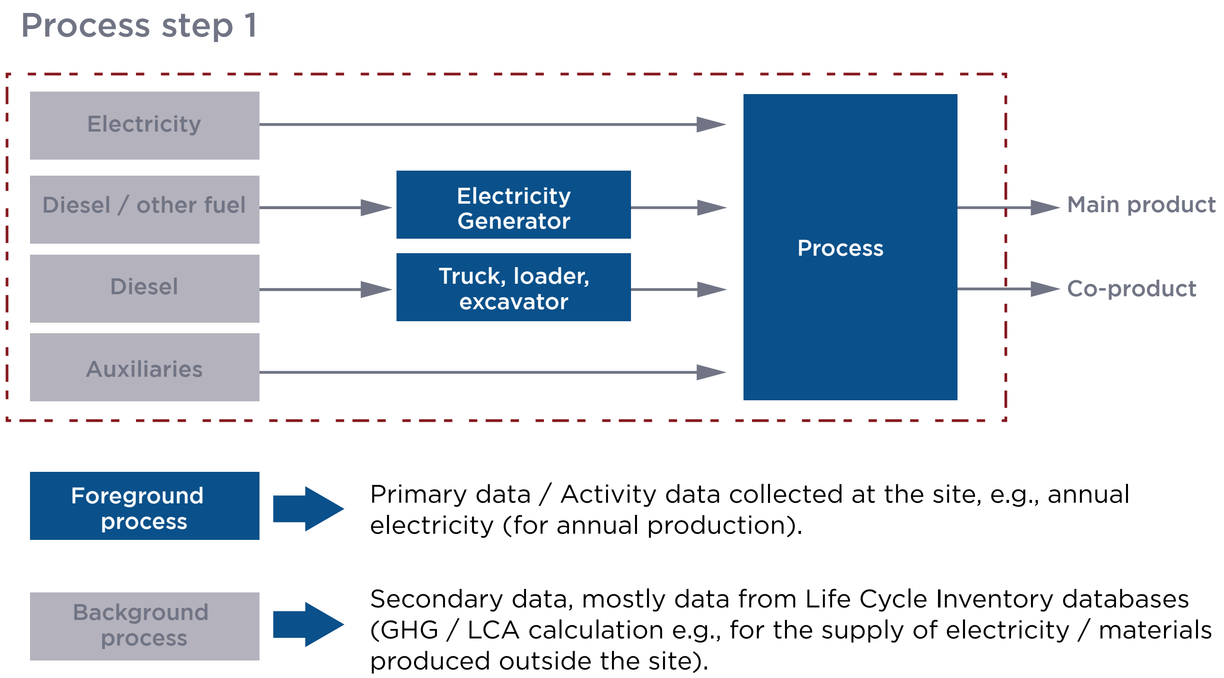
| Included | Excluded |
|---|---|
| Mining of platinum group metals ore from open pits and underground, including the removal of overburden and waste rock; extraction of material from tailings | Refining processes associated with further treatment of by-products such as e.g., cobalt, copper, and nickel |
| Concentration of platinum group metals ore, including comminution (crushing and milling) and froth flotation | |
| Drying, smelting, and converting the concentrated ore into a nickel- and copper-rich converter matte containing the platinum group metals | Transport of fuels, ancillary / auxiliary material to site |
| Refining, including separation of platinum group metals and base metals, leaching and purification | Transport to customer |
| Transport of ore, concentrates, matte and solutions of platinum group metals, secondary raw materials | Transport of waste |
| Ancillary / auxiliary materials used onsite | Production of capital equipment and infrastructure |
| All relevant water inputs and outputs | Transport of human resources and business administration |
| Climate-related onsite direct emissions | |

### 3.2 Data Collection

Data collection follows the setting of the system boundaries, with main processes subdivided into sub-processes using the following generic approach:

**Figure 2: System boundaries are defined for each process step.**

**Figure 3: Generic setting of system boundaries**




Data collection should be carried out over a twelve-month period encompassing a calendar or company financial year to avoid any distortion from seasonal or production cycle variations such as maintenance periods.

Data quality checks should be undertaken by an independent third party. These can include checks for completeness, mass balance, energy contents, water balance, carbon balance, metallurgical balance, and other similar balance checks.

## 4. Greenhouse Gas Emissions

### 4.1 Relevant Emissions

The mechanism of the greenhouse effect can be observed on a small scale in a greenhouse; incoming solar energy is trapped, causing the internal temperature to rise. This effect also occurs on a global scale. When short-wave ultraviolet radiation from the sun meets the earth’s surface some energy is reemitted as longer wave infrared radiation. Instead of directly heading back out to space, some of this infrared radiation is absorbed by greenhouse gases in the troposphere and re-radiated in all directions, including back to earth. This results in a warming effect at the earth’s surface. In addition to the natural mechanism, the greenhouse effect is enhanced by human activities.

Several gases contribute to the global warming potential. The predominant greenhouse gas emitted is carbon dioxide ($CO_2$). It enters the atmosphere through the combustion of fossil fuels (coal, natural gas, oil), biofuels, waste, and other carbon-containing materials such as biomass. It can also result from chemical processes such as the manufacture of cement.

Other relevant gases contributing to the global warming potential are methane ($CH_4$) which is emitted during the production and transport of coal, natural gas, and oil. It might also be emitted from livestock and other agricultural practices. Nitrous oxide ($N_2O$) and fluorinated gases are other climate relevant gases contributing to climate change [8].

The Intergovernmental Panel on Climate Change (IPCC) publishes values of the 100-year global warming potential (GWP) for diffe-

**Table 3: GWP values for most relevant Greenhouse Gases [9]**

| Greenhouse Gas Name | Chemical formula | GWP values for 100-year time horizon |
|---|---|---|
| Carbon dioxide | $CO_2$ | 1 |
| Methane | $CH_4$ | 28 |
| Nitrous oxide | $N_2O$ | 265 |
| Chlorofluorocarbons (CFCs) | | 2-13.900 |
| Hydrofluorocarbons (HFCs) | | 4-12.400 |
| Perfluorinated Compounds | | 6.630-23.500 |
| Fluorinated Ethers | | 1-12.400 |
| Perfluoropolyethers | | 9.710 |
| Hydrocarbon and others | | 9-376 |

rent greenhouse gases. Use of these values is recommended for converting life cycle inventory results into an indicator of climate change impact (kg $CO_2$-eq).

Values for the most relevant greenhouse gases and their global warming potential, taken from the IPCC's Fifth Assessment Report completed in 2014, are shown in Table 3. IPCC updates the GWP values for the most relevant greenhouse gases on a regular basis. It is therefore recommended to check for the latest available IPCC data and to use those.

The predominant greenhouse gas emitted from refined platinum group metals production is carbon dioxide ($CO_2$). Other gases relevant to the global warming potential, such as methane or nitrous oxide, are also or have the potential to be released during the various steps of platinum group metals mining, ore preparation, smelting and refining.

Note: When gathering LCA data, carbon dioxide emissions from fossil fuels and biomass should be reported separately.

## 4.2 GHG Protocol: Determining Scope Emissions

An ISO 14044-compliant LCA can be used to provide data for GHG reporting on a company basis rather than a product basis. The Greenhouse Gas Protocol corporate standard for product life cycles establishes comprehensive global standardized frameworks to measure and manage GHG emissions from private and public sector operations, value chains and mitigation actions. The reporting requirements of the GHG Protocol go beyond those of ISO 14044; however, the Protocol is complementary to the ISO standard.

The GHG Protocol classifies a company's GHG emissions into three main types (Scope 1, Scope 2 and Scope 3). This approach is commonly used to demonstrate whether emissions occur onsite, are related to indirect offsite processes, or associated with upstream processes.

The Scope emissions are defined as follows [10]:

- Scope 1: Direct GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.; emissions from chemical production in owned or controlled process equipment.

- Scope 2: Scope 2 accounts for GHG emissions from the generation of purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.

- Scope 3: Scope 3 emissions are a consequence of the activities of the company but occur from sources not owned or controlled by the company. Some examples of Scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

To maintain data consistency and comparability across the industry, classification according to the GHG Protocol corporate standard into Scope 1, 2 and 3 emissions is recommended to be done based on the production processes in the value chain.

Table 4 lists the process steps that give rise to GHG emissions in the production of platinum group metals and their assignment to the Scopes according to the GHG Protocol.

**Table 4: GHG emissions in platinum group metals production according to the GHG Protocol**

| Process step | Description | Scope emission |
|---|---|---|
| Direct activities | Combustion emissions associated with fuels, reductants and other process emissions (air and water emissions). | Scope 1 |
| Electricity onsite | Emissions associated with electricity generated onsite | Scope 1 |
| Electricity | Electricity from the national or local electricity grid (cradle-to-customer basis)* | Scope 2 |
| Raw materials | Platinum group metals-containing raw materials sourced from third parties (e.g., ore concentrates, converter matte) | Scope 3 |
| Auxiliaries | GHG emissions associated with production of all upstream auxiliary raw materials such as e.g., chemicals | Scope 3 |
| Fuels, reductants | Upstream production of fuels and reductants used in the process | Scope 3 |
| Lubricants | Upstream production of lubricants used in the process | Scope 3 |
| Explosives | Upstream production of explosives used in the process | Scope 3 |
| Wastewater | Municipal waste-water treatment. The emissions associated with onsite water treatment fall under direct activities | Scope 3 |
| Water | Upstream production of tap water | Scope 3 |
| Transport | Includes the fuel for transport (the production thereof), transport of raw materials, human resources and combustion of associated fuels | Scope 3 |
| Credit | Impact associated with the credit of a by-product assuming the conventional production route of the respective by-product | Scope 3 |
| Waste | Treatment of all wastes (landfill and incineration) | Scope 3 |

*In LCA-related databases, fuel combustion, fuel supply and grid losses are not reported separately. These are, therefore, all assigned to the Scope 2 category of emissions from production processes.

Note: For determining Scope 3 GHG emissions from primary platinum group metals production, only upstream emissions are included.

For platinum group metals production, this means that Scope 3 emissions are limited to input materials (e.g., fuel, auxiliaries, reductant, explosives, lubricants), upstream waterproduction and wastewater and waste treatment, as well as transport taking place within or in between production sites.

## 5. Assessing the Impact of GHG Emissions

In accordance with ISO 14040 [11] and 14044, a GHG impact assessment is derived from the GHG inventory, in which process inputs and outputs have been determined.

The production processes and associated substances which have been considered for GHG emissions and the selected characterization factors for global warming potential, as shown in Table 2, should be reported.

The potential climate change impact of each GHG emitted and removed in the course of primary platinum group metals production is calculated by multiplying the mass of GHG released or removed by the 100-year global warming potential given by the IPCC for the particular gas in units of kg $CO_2$-eq per kg emission. The total carbon footprint, or GHG inventory, is the sum of these calculated impacts.

When comparing impacts across time, the characterization factors applied to emission inventories should be the same for all periods under study. The carbon footprint data of refined platinum group metals should be updated every five years, in line with requirements formulated by, e.g., the European Commission in its Product Environmental Footprint [12]. A more frequent update may take place if a significant change occurs in the production process or any

other parameters affecting the emission intensity of platinum group metals. The following conditions, as mentioned in the GHG Protocol, would trigger a significant change:

1. Structural changes in platinum group metals production, including a significant process change in operation, technology advancement, raw material, or energy.

2. Changes in calculation methodology or improvements in the accuracy of emission factors or activity data or inclusion of new types of sources that result in a significant impact on the emissions data.

3. Discovery of significant errors, or cumulative errors that are collectively significant.

The frequency of inventory data collection should be informed by the frequency of significant changes in emissions intensity of the process(es) under study. These may be different for different emission sources.

# 6. Modelling Parameters

## 6.1 Allocation

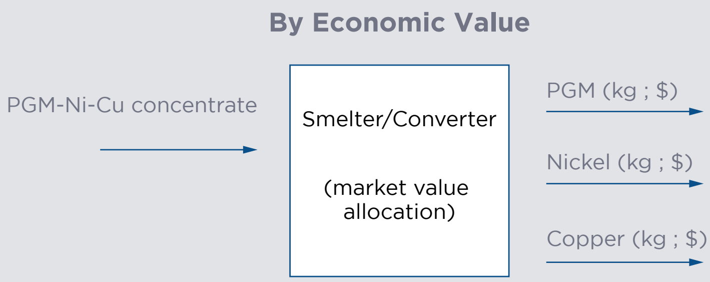
When a production process delivers by-products with economic value alongside the product for which GHG emissions are intended to be calculated, the GHG emissions associated with the production processes should be partitioned between the main product or products and their by-products.

The primary production of platinum group metals typically yields several other products which have economic value at the factory gate:
- Base metals (nickel, copper, cobalt)
- Other precious metals (gold, silver)
- Other metallic and non-metallic by-products (sulphuric acid, ammonium sulphate, sodium sulphate, chromium oxide).

Partitioning of emissions is carried out by means of a multi-output allocation, the method typically applied in industries where a range of different products occur together. Multi-output allocation generally follows the requirements of ISO 14044, section 4.3.4.2, with the allocation rule most suitable for each respective process step applied within that process. To determine which allocation rule to use, ISO proposes a stepwise procedure:

- Step 1: where possible, allocation is to be avoided, either by dividing the unit process into two or more subprocesses; or by expanding the product system (system expansion) to eliminate a by-product from the product system.

**Figure 4: Economic allocation factor calculation**




$$\text{PGM Allocation factor} = \frac{\text{PGM kg} * \text{PGM \$}}{(\text{PGM kg} * \text{PGM \$}) + (\text{Ni kg} * \text{Ni \$}) + (\text{Cu kg} * \text{Cu \$})}$$

- Step 2: where allocation cannot be avoided, the inputs and outputs shall be partitioned between the different products reflecting their underlying physical relationships.

- Step 3: where allocation cannot be avoided and no physical relationships can be established, the inputs and outputs shall be allocated in a way that reflects other relationships between the main products and by-products, such as e.g., economic value, mass, or a combination of economic value and mass.

In platinum group metals production, it is difficult to avoid allocation, because the main products and the by-products are co-mingled up until the refinery stage of the production process. A combination of economic value and mass allocation is then generally used as follows:

*Economic allocation* is used between the processes upstream from the precious metal refinery where precious metals and base metals occur together. The different metals have vastly different economic values and production volumes (e.g., platinum [low production volume, high market value] versus nickel or copper [high production volume and lower market value]). A mass allocation would not represent the value of the products and the rationale for producing the different metals. An allocation factor is calculated and applied for each metal, as illustrated below (Figures 4 & 5). The prices used in economic allocation should be multi-year period averages (a minimum of three years is recommended) with their sources [13, 14] documented.

In Table 5 below, approximate economic allocation factors are calculated based on typical ratios between precious and base metals from the Merensky Reef orebody in South Africa. The sum of the allocation factors is equal to 1. Prices applied are averaged over the three years to September 2023.

Where exclusively precious metals occur together, as in the refining process following separation of the base and precious metals streams, a *mass allocation* is used to define the environmental profile since the precious metals spend the same amount of time circulating in the precious metal refinery and therefore use the same amount of energy and consumables to achieve maximum recovery.

This combination of economic allocation and mass allocation is currently considered to be the most suitable approach to a multi-output allocation for primary platinum group metals production. However, alternative mixes of economic and/or mass allocation may be chosen for the unit processes, provided that adequate granularity of assay data is available, and that each specific case is highlighted, explained and justified.

As recommended by the agreed guidance in the metals industry [15], system expansion is used to allocate a GHG value to the non-metallic by-products sulphuric acid, ammonium sulphate and sodium sulphate. System expan-

**Table 5: Example calculation of allocation factors by economic value**

| Product | Volume of product produced | Price $/kg | Value $ | Allocation factor |
|---|---|---|---|---|
| PGM | 0.003 kg PGM | 60,250 | 180 | 0.88 |
| Nickel | 1 kg Ni | 21 | 21 | 0.10 |
| Copper | 0.56 kg Cu | 8 | 4.5 | 0.02 |

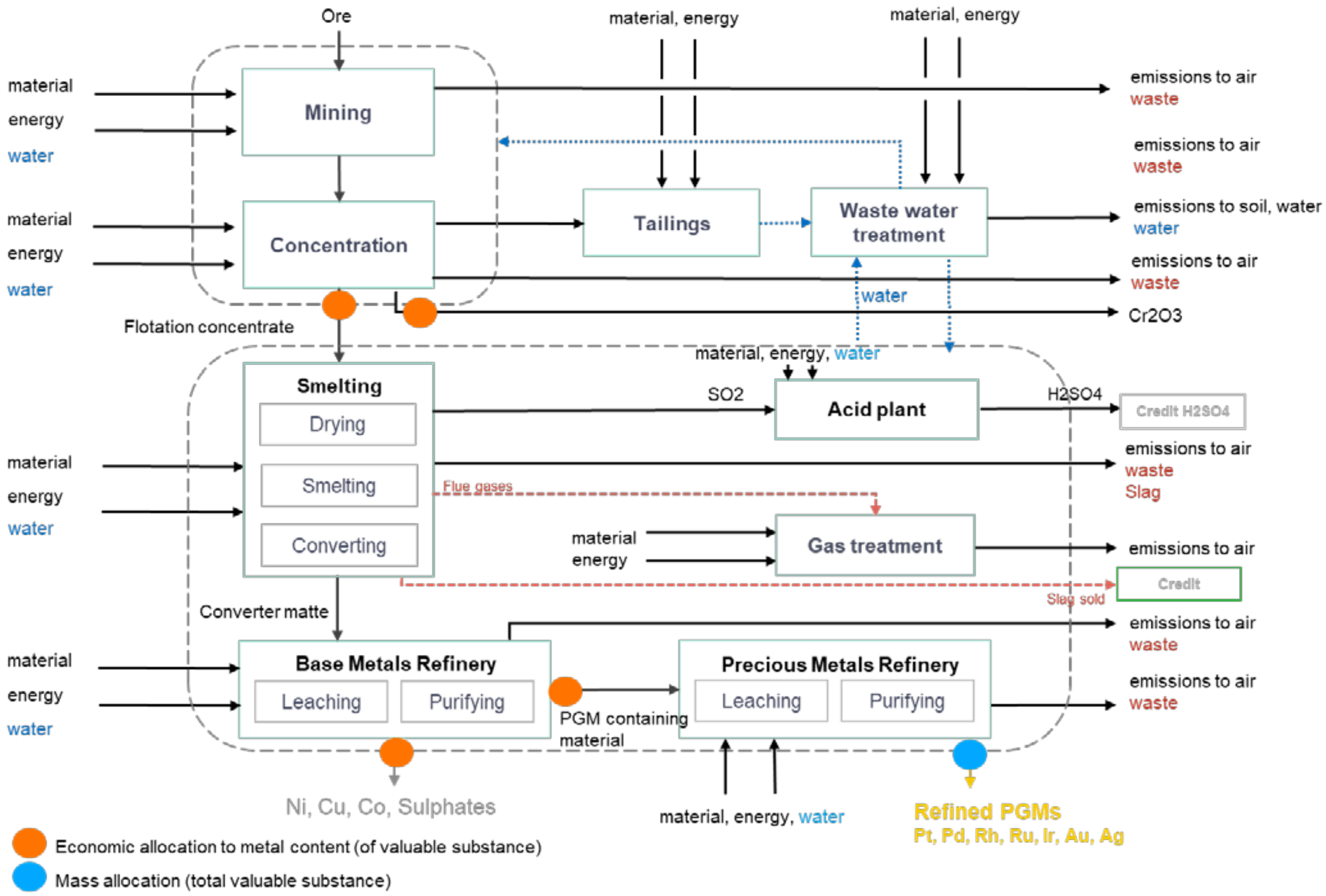


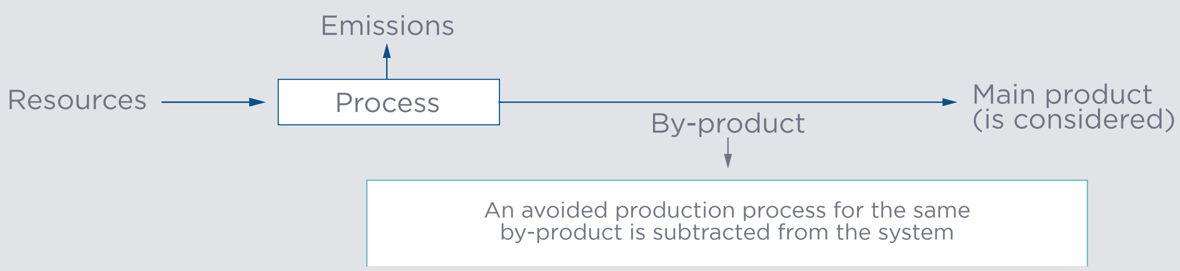

**Figure 5: Allocation methodology applied for primary production of PGMs**

sion considers the existence of an alternative route to produce the by-product(s). The principle of system expansion is based on the assumption that the by-product saves or avoids another product with equivalent function. It requires that this inventory (of the by-product) will be included into the system boundaries and inverted (i.e., subtracted from the analysed system). This results in an environmental credit for the system analysed, in accordance with the amount of by-product produced.

The GHG calculation must transparently disclose the credits and what kind of credits, i.e., what is the conventional method for producing the by-product that has been considered? The origin of the dataset used for the conventional production method and its reference year needs to be declared and should be from a reliable, globally accepted data source.

System expansion is not used in the case of the metal by-products since the primary production

**Figure 6: Generic example for system expansion**



of valuable metals such as nickel and copper can also yield amounts of platinum group metals. If this process is provided with credits, not only would it negate the production of nickel and copper, but also of significant quantities of platinum group metals. This would unreasonably and unfavourably affect the overall LCA for platinum group metals.

Multi-*input* allocation shall be applied for waste processes including energy recovery, landfill, and wastewater treatment. When allocation becomes necessary during the data collection phase, the most suitable allocation rule for the respective process steps shall be applied and documented.

ISO 14044:2006 makes a number of recommendations regarding allocation:
- The choice of allocation method must be explained and justified.
- The sum of the allocated inputs and outputs of a unit process shall be equal to the inputs and outputs of the unit process before allocation.
- If alternative allocation procedures could be applicable, a sensitivity analysis shall be conducted to illustrate the consequences of the departure from the selected approach.
- The analysis shall always be transparently presented and explained, and the allocation approach justified.

### 6.2. Electricity

Due to the energy intensity of platinum group metals production, the use of electricity is a significant factor contributing to total GHG emissions.

As an example, primary platinum group metal concentrates are generally of low grade compared with copper and nickel sulphide concentrates. This is directly linked to a low sulphur content. While copper and nickel sulphide smelters can use this high sulphur content as fuel to autogenously smelt the concentrate, platinum group metals concentrate is dried and smelted directly in the electric furnace. In addition, the high magnesium (MgO) content in platinum group metals concentrates increases the slag liquidus temperature well above the operating temperature of copper and nickel smelters. Both aspects result in a high electricity consumption.

The GHG emissions related to the production of electricity consumed in the platinum group metals production processes, waste and wastewater treatment, ancillary processes and any other processes included in the system boundary must be carefully assessed and included in the inventory.

GHG emissions from electricity supply can vary significantly, depending on the specific electricity power generation technology applied by a company onsite or by its upstream electricity supplier, or due to variations in the carbon content of a country- or region-specific energy mix (e.g., coal, natural gas or renewables).

Electricity supplied from external sources generates Scope 2 emissions. It should be included according to the requirements formulated in ISO 14067 [16] and the EU PEF Guidance, using a hierarchical approach:

a. Supplier-specific electricity product shall be used if, for a country, there is a 100% tracking system in place, or if
   i. available, and
   ii. the set of minimum criteria to ensure the contractual instruments are reliable is met.
b. The supplier-specific total electricity mix shall be used if:
   i. available, and
   ii. the set of minimum criteria to ensure the contractual instruments are reliable is met.
c. The average EU residual grid mix, consumption mix (EU+EFTA), or region representative residual grid mix, consumption mix.
d. As a last option, the country-specific electricity mix shall be used, and transparently documented.

For a. and b., the contractual instruments used for electricity modelling shall meet the criteria as described in GHG Protocol Scope 2 Guidance. For companies operating outside the EU, a national residual grid mix might not be available. To allow data comparability, companies operating within the EU shall also be allowed to report their GHG emissions with the national grid mix.

$CO_2$ emission factors from electricity and heat generation for countries globally, as well as for different electricity generation technologies, can be found in life cycle databases or in publications such as the International Energy Agency's Annual Emissions Factors report [17].

As defined in the GHG Protocol Corporate Accounting and Reporting Standard [18], companies are allowed to report their Scope 2 GHG emissions by using the country-specific grid mix and by using the supplier-specific electricity product/mix or, in the absence of a supplier-specific electricity product/mix, the national residual grid mix.

Further guidance on the modelling of the "country-specific residual grid mix, consumption mix", and on the modelling of onsite electricity production, can be found in ISO 14067 and the EU PEF guidance.

Emissions from electricity generated onsite are considered as a Scope 1 emission (direct onsite) in terms of the GHG Protocol. They are calculated based on the fuels combusted (e.g., diesel) or converted (e.g., hydrogen).

### 6.3. Fuel Combustion

The greenhouse gas emissions which are related to the combustion of fuels consumed during the production process shall be calculated by using default emission factors which are published by the International Panel on Climate Change in their 2006 report [19]. If emission factors from different sources are used (e.g., national inventories), they shall be mentioned in a summary report.

## 7. Third Party Verification

Transparent documentation and interpretation of the results verified by a third party is of critical importance.

GHG emission calculations must always be reported in a transparent way, referring to ISO 14040 and ISO 14044 as a basis. They are to be presented with an overview on the methods and modelling parameters used and on the distribution of emissions from different Scopes and credits, as well as a sensitivity analysis. This method also aligns with the requirements for environmental product declarations formulated in the International EPD System [20].

The GHG Protocol Product Life Cycle Accounting and Reporting Standard formulates several requirements when results are presented. The GHG accounting and reporting of a product inventory shall follow the principles of relevance, accuracy, completeness, consistency, and transparency. These principles shall also be applied when communicating GHG emissions from platinum group metals to third parties.

The results of the total greenhouse gas emissions from platinum group metals production shall be documented by the product

manufacturer in an ISO-based GHG report. If the calculations were made by a third party, this shall be declared in the document.

The ISO-based GHG report shall inform on the cradle-to-gate GHG emissions of 1 kg (the "functional unit" in an LCA study) of the individual platinum group metal. It shall include, as a minimum:

- all relevant parameters chosen as listed in this guide
- the allocation method applied together with a justification and explanation
- the electricity mix underlying the calculations
- the parameters used for fuel combustion
- a distinction of primary and secondary data used (if relevant)
- a statement of the system boundary applied, identifying any excluded processes and estimating their proportion of total GHG emissions for comparison with the EU Product Environmental Footprint Guidance.

Credits included in the footprint of the functional unit should be disclosed in such a way that the reader can easily calculate the footprint both with and without the inclusion of credits in the footprint.

The report shall indicate the reference year for which the data were collected.

The reported data shall be accompanied by a certificate from an independent third party confirming that the GHG data calculations were carried out in conformity with ISO guidelines.

# Glossary

## Abbreviations

| | |
|---|---|
| CFC | Chlorofluorocarbons |
| $CO_2$-eq | Carbon Dioxide Equivalents |
| EPD | Environmental Product Declaration |
| GHG | Greenhouse Gas Emissions |
| GWP | Global Warming Potential |
| HFC | Hydrofluorocarbons |
| IPCC | Intergovernmental Panel on Climate Change |
| IPA | International Platinum Group Metals Association |
| ISO | International Standardization Organization |
| LCA | Life Cycle Assessment |
| LCI | Life Cycle Inventory |
| PEF | Product Environmental Footprint |
| PGM | Platinum Group Metals |

## Terminology

- *By-products:* Products occurring together with the main product. Products that are not the main purpose of the production process.
- *Characterization factor:* Quantitative representation of the relative importance of a specific intervention. Here: GWP of climate relevant gases.
- *Platinum group metals (PGMs):* Platinum group metals (platinum, palladium, rhodium, iridium, ruthenium) with a metal purity of 99.95% for Pt, Pd, Rh; 99,90% for Ir and Ru.
- *Emission factor:* Factor of $CO_2$-eq per unit of fuels consumed, such as e.g., oil, gas, coal.
- *Primary data:* Life cycle data based on input and output data of a specific company.
- *Secondary data:* Aggregated life cycle data averaged over several producers, as found in public and commercial databases.

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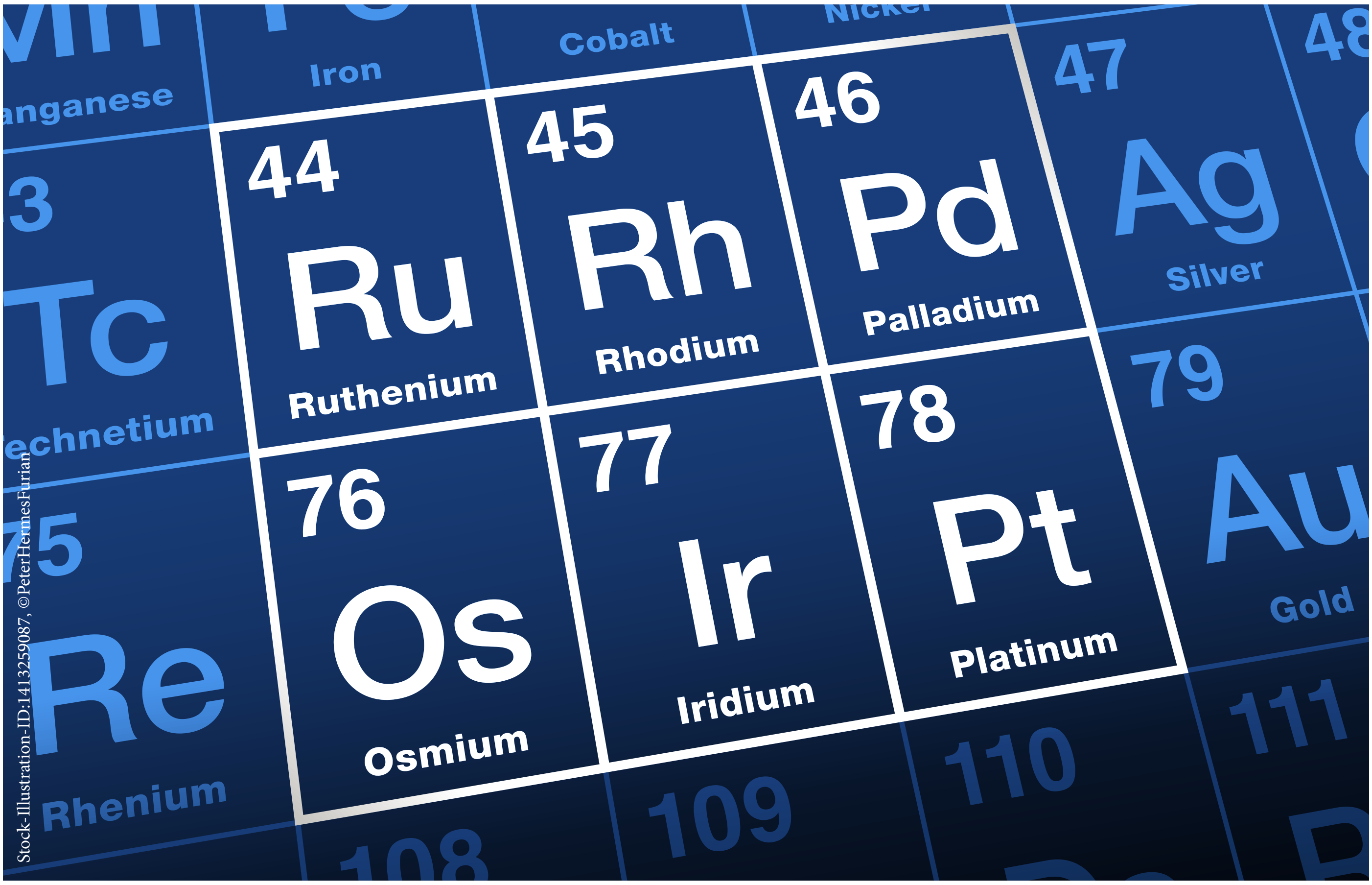
## Figures



## Tables




IPA
INTERNATIONAL PLATINUM GROUP METALS ASSOCIATION

The International Platinum Group Metals Association (IPA) is a non-profit association that represents the worldwide leading mining, production and fabrication companies in the global platinum group metals (PGMs) industry, comprising platinum, palladium, iridium, rhodium, osmium and ruthenium. The mining members of the IPA represent around 87% of all primary production of platinum group metals, which are the focus of this guidance document.

The PGM industry is strongly committed to the principles of responsible mining and sourcing with the aim to communicate transparently on the status of sustainability assurance of its members. Under the umbrella of the IPA, the industry conducts life cycle assessments (LCA) on a regular basis and has generated and made available industry average data on the production and recycling of its metals to help industry and stakeholders to assess and understand the life cycle and environmental impacts of its materials and products.

The carbon footprint of primary produced PGMs has been assessed for platinum, palladium, rhodium, ruthenium, and iridium, based on the 2017 production year. In April 2023, the IPA commenced its third industry wide LCA on the primary production of platinum, palladium, rhodium, iridium, and ruthenium, as well as the secondary production of platinum, palladium, rhodium and ruthenium. Results are expected to be available in 2024.

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