MKS PAMP – CARBON FOOTPRINTS OF PLATINUM 999.5 LARGE BAR

Product Emissions Report

July 2024

Contents

1.1. Introduction

This report presents the footprinting study results calculated for MKS PAMP to measure the carbon footprints of their Platinum 999.5 Bars. Footprint Expert v5 is a Carbon Trust developed and owned footprinting tool that was used to calculate the results.

This report conforms to the requirements for public disclosure of the life cycle GHG emissions of products laid out in the "Code of Good Practice for product GHG emissions and reductions". It aims to provide the basis to allow consistent information for product GHG emissions and reduction, assessed in conformity with the ISO 14067 standard.

1.2. Background Information

Table 1: MKS PAMP Products Carbon Footprint - Background Information

Category	Description
Company name	MKS PAMP SA
Company contact information	Prom. de Saint-Antoine 10, 1204 Geneva, Switzerland
Product name(s)	Platinum 999.5 Bar
Boundary	Cradle-to- grave
Standards, specifications and/or other documents used for footprinting methodology against which the company has been assessed for conformity	ISO 14067 Standard Carbon Trust Product Carbon Footprint - Requirements for Certification v2.0
Name of the independent, third-party verifier	Carbon Trust Assurance Ltd
Level of assurance achieved	Reasonable
Date of certification	01/01/2024 – 31/12/2025
Functional unit	$kgCO_2e$ per kg of Platinum 999.5 Bar
Data period	01/07/2022 – 30/06/2023
Product consistency criteria (PCC)	Product Category Criteria Form for Precious Metals

1.3. Results

Status	Product Name	SKU	Total annual production (kg)
Carbon Measured	Platinum 999.5 - Large Bar	ZPTLB00004	1,619.24

The overall emissions are reported in Table 2 below. Detailed emissions results are shown in **Section 1.11.**

Table 2: Footprinting results Platinum 999.5 Bar Results (Cradle-to-Grave) – Global Market

	Total Emissions	Emissions per KG	Contribution per kgCO2e/kg
Fossil Emissions	1,241,302.36	766.60	100%
Biogenic Emissions	933.95	0.58	0.08%
Biogenic Removals	(368.48)	(0.23)	-0.03%
LUC Emissions	34.65	0.02	0.00%
Total fossil footprint	**1,241,302.36**	**766.60**	
Total Biogenic & LUC Emissions	**600.11**	**0.37**	
Total Emissions	**1,241,902.46**	**766.97**	

1.4. Data

The data quality assessments were carried out based on a key developed internally at Carbon Trust. The overall data quality for the project was good because of the granularity of the data received and its completeness.

1.5. Key Assumptions

Table 4 in Section 1.9.1 outlines the key assumptions that have been made.

1.6. Interpretation of results

An overall breakdown of the emissions associated with the various products and process steps for each product are reported in **Table 6: Platinum 999.5 Bar Results (Cradle-to-Grave) – Global Market.** This table demonstrates that the highest emission process is that of the raw material (recycled platinum) which accounts for 84% of the total footprint.

1.7. Disclaimer on uncertainty

The emissions figures provided in this report have been calculated in accordance with the requirements of ISO 14067 standard, using the primary and secondary sources of data specified above. Based on ISO 14067 standard method of assessment, we believe that our assessment has identified 95% of the likely GHG emissions associated with the full life cycle of the products covered in this report. However, readers should be aware that even primary sources of data are subject to variation over time, and the figures given in this report should be considered as our best estimates, based on reasonable cost of evaluation.

1.8. Boundary

The process map for the Platinum 999.5 Bars is as follows:

Figure 1: Life Cycle Stages

1.8.1. Raw materials

Platinum inputs come from recycled sources. The activity data provided by MKS PAMP was the total mass of the raw material inputs for each footprinted product over the reporting year.

The largest emission source within the raw materials was the input metal. The emission factors used for the platinum was taken from The Life Cycle Assessment of Platinum Group Metals (PGMs) Report[1], provided by MKS PAMP and calculated using the EU Product Environmental Footprint Circular Footprint Formula (PEF CFF).

The emission factor applied to the input material was calculated using the following two formulae which have been derived from PEF CFF:

$$Pr = R2 \times (1-A)MQL + R1A$$

$$EF = Pr \times Er + (1-Pr) \times Ev$$

[1] The Life Cycle Assessment of Platinum Group Metals (PGMs) Report

Table 3: Explanation of PEFCFF formula

Parameter	Definition
E_v	Specific emissions and resources consumed (per functional unit) arising from the acquisition and pre-processing of virgin material.
E_r	Specific emissions and resources consumed (per functional unit) arising from the recycling process of the recycled (reused) material, including collection, sorting and transportation process.
R_1	Proportion of material in the input to the production that has been recycled from a previous system.
R_2	Proportion of the material in the product that will be recycled (or reused) in a subsequent system. R2 shall therefore take into account the inefficiencies in the collection and recycling (or reuse) processes. R2 shall be measured at the output of the recycling plant. *R_2 is assumed to be 100%*
A	Allocation factor of burdens and benefits (jointly: “credits”) between supplier and user of recycled materials. *For metals, this value is 0.2.*
MQL	The recycling process shall account for material quality loss during recycling, which is pre-defined for most materials. *For metals, this value is 1.*

Definitions from: PowerPoint-Präsentation (europa.eu)

For other chemical inputs, emission factors were taken from the FPX v4.7 database, BEIS 2022 and EcoInvent 3.9.1. In the cases when the emission factors were not available in either database, an emission factor of a similar chemical was applied from EcoInvent.

1.8.2. Manufacturing

The raw materials were transported to MKS PAMP’s manufacturing facility in Switzerland.

The activity data provided by MKS PAMP included the distance and mode of transport for each of the raw materials, as well as supplier location. Using these distances, the air freight, road freight and sea freight (if applicable) FPX v4.7 calculators were used to find the emission factors for each ingredient’s upstream transport.

For manufacturing, electricity was the main energy source and 100% of the electricity was derived from hydroelectric power. Other energy sources used at the plant were natural gas and propane. This activity data was provided by MKS PAMP in MWh / year (for electricity) and m^3 / year (for natural gas and propane) for each process step. IEA 2023 emission factor was used for electricity as they use renewable energy. Emission factors from BEIS 2022 were used for natural gas and propane. For each process step a specific amount of $kgCO_2e$ emissions were associated with them, namely for example the first melting or the anode casting.

There were the following waste streams: black water, white water, non-precious metal waste, used crucibles. Waste activity data was derived from input data provided by MKS PAMP and BEIS 2022 was used for waste treatment emission factors.

1.8.3. Packaging

Packaging was carried out at MKS PAMP's facility in Ticino, Switzerland.

MKS PAMP provided two packaging methods for the Platinum 999.5 Bars. An equal split for each packaging method was assumed for the total platinum production.

The first method packages the bars (between 15 and 40 – assumed 27) on a pallet, separated by cardboard with a label and certificate.

The second method, packages 3 bars into a recycled plastic box. These bars have a security label and MKS PAMP label. They are wrapped in a polyethylene wrap for protection.

In terms of activity data, the mass of materials for one box or pallet was provided. These masses were then scaled up to account for the total production output for each product. Emission factors applied to these packaging materials came from the Carbon Trust's FPX v4.7 database.

1.8.4. Downstream Distribution

Finished products are transported globally by road and air transportation.

For each country, the activity data was calculated using the specific mode and distance of the type of transport used. Emission factors were applied to these activity data which derive from Carbon Trust FPX v4.7 transportation calculator.

1.8.5. End of life

For the platinum bars it is assumed 100% of the metal is recycled. The End-of-Life profile for packaging was calculated using BEIS 2022 disposal emission factors and the disposal method percentages of the different countries of the sold products.

1.9. Methodology

1.9.1. Methodological choices

Significant methodological choices for calculating the product footprint of MKS PAMP's SKUs are listed below:

- Calculation models were based on templates available in Footprint Expert Multi SKU and Footprint Expert 4.7 (FPX). These were set out in the different life cycle stages of platinum bar, from processing the metals to packing, distribution and end of life.

- Global warming potential (GWP) factors were taken from the FPX Reference Database and EcoInvent 3.9.1.
- Materiality methodology and cut-off criteria: any process that constituted less than 1% of total emissions was excluded from the assessment.

Table 4 outlines the key assumptions that have been made.

Table 4: List of Assumptions

Process Step	Key assumption
Water	Assumed that the sum of black and white wastewater was that of input water.
Emission factors	For the raw materials where emission factors were not found, a generic Ecoinvent organic chemical emission factor was applied.
End of Life	Waste percentages per each country have been uplifted to ensure that final total amounts to 100%
Land Use Change	Assume no land use change for sourced platinum due to recycled nature of the sourced raw materials
Allocation of inputs	Input materials were split between platinum and the co-products (platinum sponge and grain). There are two melting steps for platinum processing. Platinum Grains are removed from the process after the first melting step. It is assumed that the second melting step requires 1.3kWh of electricity to melt 1kg of platinum. The energy required for sponge and bars in the second melting step was calculated and deducted from total energy. The remaining energy consumption was split per kg per each of the platinum products.
Allocation of inputs	The PGM process maps, shows that several co-products are produced during the PGM department production of the Platinum 999.5 Bars. All processing energy should be split between the platinum products and the other metals. Due to the nature of the continuous process, it is impossible to accurately allocate inputs and utilities to each of the co-products. In an effort to calculate the footprint on a more conservative approach, MKS PAMP have provided the energy required for the entire PGM department (not just Platinum 999.5 Bars). The processing energy and chemicals have been assigned to the platinum products. Note that the processing emissions are immaterial when compared to the input material, due to the high value of the secondary platinum EF.
Raw Materials	10 months of data for the raw materials was provided in the raw data file, this was uplifted to calculate a value for 12 months.
Raw materials	Potassium fluoroborate EF was not reported in Ecoinvent 3.9.1 so the EF for sodium fluoroborate was used instead
Raw materials	For trimercaptotriazine and many chemicals in the minting department, a specific chemical could not be found in EcoInvent 3.9.1 so the 'chemical, organic//[GLO] chemical production, organic' was used instead
End of life	In terms of the PEF CFF, a 100% recycling rate of finished Platinum 999.5 Bars is assumed. Due to the nature and value of the product, we assume that this will not be disposed of through waste streams and will eventually be recycled. Furthermore, the products are sold branded and stored in vaults so unlikely that they are purchased for further processing.

1.9.2. Allocation of inputs

MKS PAMP produce several products at their facility. Raw materials, outputs and utilities were provided for each process step for all products within project scope.

The Platinum 999.5 Bar is a product which is produced within the Platinum Group Metals (PGM) department. There are several products from the PGM department process: platinum grains, Platinum 999.5 Bars, platinum sponge, and other PGMs and fine metals in various metal muds.

The PGM department process involves high- and low-grade inputs and some materials are cycled through parts of the process multiple times in a circular fashion, depending on the make-up of the input and the desired output products. The chemicals and metals are added continuously fed into the reactor, which produces the various fine metal products, as well as waste. As mentioned, the process is circular, and outputs are produced at different points, which results in a challenge to accurately allocate emissions. Without submetering it is impossible to accurately allocate emissions from the manufacturing process to each of the output (co-)products.

The chosen approach is to assign all manufacturing emissions to the platinum products. This means that the manufacturing emissions are over-estimated for platinum, as the non-platinum co-products are not being allocated any of these emissions. This means the footprint estimate is conservative, though the scale of over-estimation is insignificant compared to the overall footprint which remains dominated by the input raw materials.

There are two suggested adjustments that could be considered in the future:

1. Economic allocation could be used to allocate manufacturing emissions between the co-products. This option was discussed with MKS PAMP but was ultimately decided against as inappropriate for their process. This approach would require an allocation of the manufacturing energy emissions (excluding final platinum-only melt) and chemical use between all co-products rather than platinum only. The difference to footprint would be immaterial, due to the very high emission factor of the input material. It would also potentially lead to under-reporting as it could be the case that more energy/chemicals are required for refining platinum than iridium, for example. Furthermore, the co-product metals are not all necessarily sold, some stay in the department for other uses, so economic allocation would be reliant on assumptions and would not impact the footprint in a material way.

2. The second consideration is that if MKS PAMP decide to footprint one of the co-products, for example iridium, then the co-product allocation would need to be re-considered in order to avoid over-estimating both the platinum and iridium footprints.

The final melting stage is the only process step which is calculated separately and so creates a different footprint for the platinum sponge vs. the platinum grains and bars. MKS PAMP estimates that the last stage of melting melts 5kg of platinum in approximately 20 minutes in a 20kW furnace (1333 Wh per kg). As the platinum sponge does not go through this process, a calculation of the energy required for this processing step was calculated and split equally between Pt. Grains and Bars. This was then deducted from the total energy required for the PGM department and the remaining electricity consumption was split equally between the Platinum grains, sponge and bar co-products per kg.

1.9.3. Allocation due to recycling

Recycling allocation is calculated using the PEF CEFF calculator. The calculation outputs an emission factor, to be used for the input material, by looking at the recyclate input to the material and by considering how much of the material will be recycled at the end of the product's life. This was used for the packaging materials as well as for the metal, where the waste percentages were determined and multiplied with the specific waste methods. This final value was multiplied by the specific material.

Please refer to section 1.8.1 where further information is provided on the PEF CFF.

1.10. Data

1.10.1. Data Collection and Validation

MKS PAMP provided all activity data used for the analysis. All the input data drivers are summarised in the footprint model under their relevant process sheet. The main point of contacts for the data was MKS PAMP's ESG team. The Carbon Trust provided MKS PAMP with a data collection template for usage.

1.10.2. Data Quality

The data quality assessments were carried out based on a key developed internally at Carbon Trust. The overall data quality for the project was good, because overall the data was granular and of the required data period year. Table 5 summarises the data quality assessment of the most material data points.

Table 5: Data quality assessment for material data points

Data point	Activity Data Quality Indicator	Emission Factor Data Quality Indicator	Application Data Quality Indicator
Raw Materials	Good	Medium	Medium
Packaging	Good	Good	Good
Manufacturing	Medium	Good	Medium
Downstream distribution	Good	Good	Medium
End-of-Life	Good	Good	Good

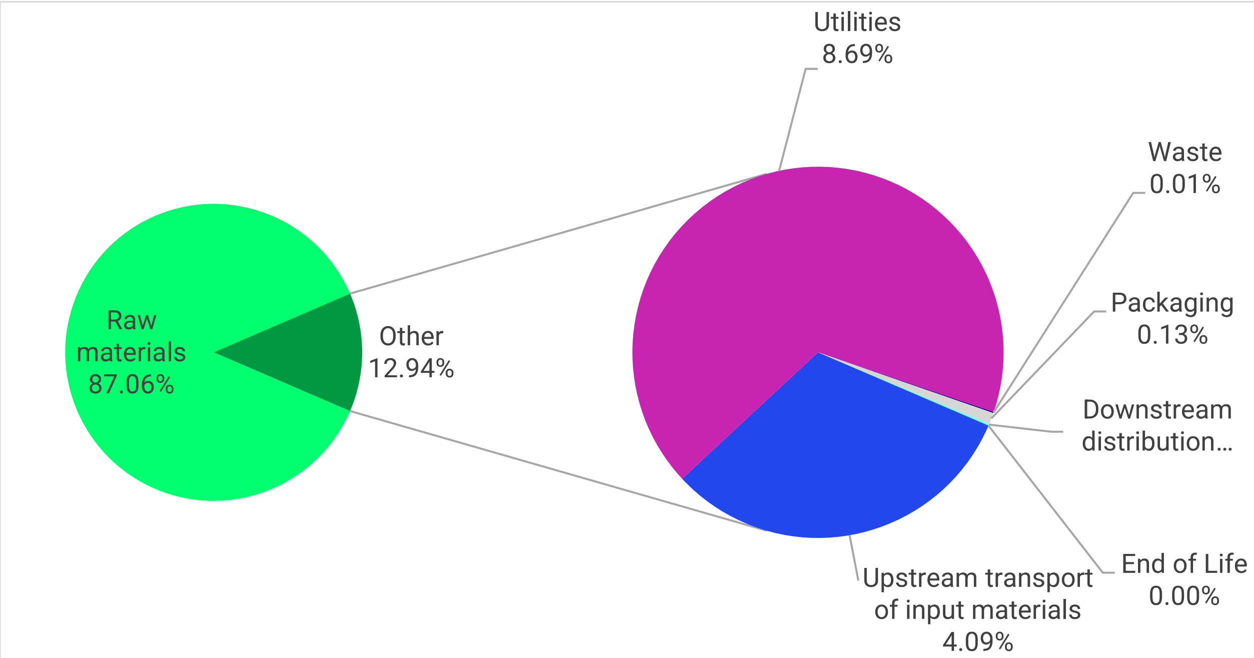
1.11. Results

An overall breakdown of the emissions associated with the various products and process steps is reported in Table 6 below. Please refer to the complementary Excel file, [Phase 3 Platinum MKS PAMP FPX Multi SKU – Final Version], for a full breakdown of all product carbon footprints.

Table 6: Platinum 999.5 Bar Carbon Footprint Results (Fossil, Biogenic & Land use change emissions)

Life Cycle Stage	kgCO2e	kgCO2e/kg	Contribution per kgCO2e/kg
Upstream transport of input materials	50,771.54	31.36	4.09%
Raw materials (Platinum)	1,045,145.53	645.45	84.16%
Raw materials (Chemicals)	35,658.96	22.02	2.87%
Utilities	107,858.04	66.61	8.68%
Waste	152.97	0.09	0.01%
Packaging	1,745.03	1.08	0.14%
Downstream distribution	285.63	0.18	0.02%
End of Life	284.76	0.18	0.02%
Total footprint (kgCO2e)	**1,241,902.46**	**766.997**	

Figure 2: Platinum 999.5 Bar Carbon Footprint Results



1.12. Conclusions

The main hotspot of the carbon footprint of the Platinum 999.5 Bars is that of the raw materials, namely the recycled platinum driven by the carbon intensity surrounding the emission factor.

1.13. Recommendations

1.13.1. Emissions reductions

Continuing to procure recycled metal for the raw materials is advised. Furthermore, switching to the use of low-carbon methods of transport, both upstream and downstream (business to business transport), will decrease the transport emissions. This might include alternative fuels, electric vehicles or even more efficient delivery routes. For third-party logistics, (retailer to consumer) we recommend that you engage with suppliers in switching to more sustainable transport options.

1.13.2. Data quality improvements

There are several recommendations to improve future recertification and results:

Raw materials (Platinum): What would be of interest is to receive more clear information on the source of the recycled metal and the original use of this metal.

Allocation of inputs: A key challenge with footprinting the Platinum 999.5 Bars was the allocation of emissions between the Platinum 999.5 Bars and the co-products such as platinum sponge and grains. This is especially challenging due to the complexity of the process which has multiple and different steps for high grade vs. low grade inputs. MKS PAMP could look to improve this by utilising sub-metering, in order to identify which process steps are the higher emitters.

Other inputs: Obtaining supplier-specific emission factors would increase the accuracy of the footprint as generic emission factors would no longer be required.

Inbound transportation and downstream distribution: Obtaining more clarity over the transportation stages could improve footprint accuracy. For example, it may be that the suppliers use electric vehicles, or particularly efficient logistical practices.

1.14. Disclaimer on potential uses of this report

The results presented in this report are unique to the assumptions and practices of MKS PAMP. The results are not meant as a platform for comparability to other companies and/or products. Even for similar products, differences in unit of analysis, use and end-of-life stage profiles, and data quality may produce incomparable results. The reader may refer to the ISO 14067 standard for additional insight into the GHG inventory process.

Annex 2: Certification Details (Third Party Sign-Off)

This product footprinting study has been subject to an independent critical review to verify whether the methodology used for this LCA is compliant with the ISO 14067 standard.

Category	Description
Name of the certifier	Charlotte Sagar, Rajul Shah
Date of certification	01/01/2024
Data valid until	31/12/2025

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