MKS PAMP – Carbon Footprints of 12.5kg Gold Grains (Specific Sources; CCV and Minera Florida)

Product Emissions Report

April 2024

Contents

1. Summary

1.1. Introduction

This report presents the footprinting study results calculated for MKS PAMP to measure the carbon footprints of **Gold Grains** from specific sources, namely Cripple Creek and Victor and Minera Florida, and the mix product of both sources. FPX Multi SKU v1.1 (Footprint Expert) 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)	Gold Grains – CCV Gold Grains – Minera Florida Gold Grains – CCV/ Minera Florida
Boundary	Cradle-to-gate
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 – 31/12/2024
Functional unit	kgCO_2e per kg of gold grain
Data period	15/06/2023 – 14/06/2024

1.3. Results

The overall emissions are reported in Table 3 below. Detailed emissions results are shown in **Section 1.11**

Table 2: List of footprinted products

Status	Product Name	Source	SKU
Carbon Neutral	Gold Grains	Cripple Creek & Victor	ZAUGR00097
Carbon Measured	Gold Grains	Cripple Creek & Victor	ZAUGR00091
Carbon Neutral	Gold Grains	Minera Florida	ZAUGR00098
Carbon Measured	Gold Grains	Minera Florida	ZAUGR00086
Carbon Neutral	Gold Grains	CCV/ Minera Florida	ZAUGR00100
Carbon Measured	Gold Grains	CCV/ Minera Florida	ZAUGR00093

Table 3: Footprinting results - Gold Grains Results (Cradle-to-Gate) – Global Market

	Gold Grains - CCV	Gold Grains - Minera Florida	Gold Grains - Minera Florida/ CCV
Fossil emissions	39,301,253.84	5,085,777.33	3,573,161.37
Biogenic emissions	31.73	8.06	3.38
Biogenic removals	-0.61	-0.15	-0.06
Land Use Change	1.07	173,037.58	21,711.27
Total annual production (kg)	1,525.00	387.50	162.50
Total fossil footprint (kgCO2e)	**39,301,253.84**	**5,085,777.33**	**3,573,161.37**
Total Biogenic & LUC Emissions (kgCO2e)	**32.20**	**173,045.49**	**21,714.59**
Total Emissions (kgCO2e)	**39,301,286.04**	**5,258,822.82**	**3,594,875.96**
Total Emissions (kgCO2e/kg)	**25,771.34**	**13,571.16**	**22,122.31**

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 1.10 Methodology 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 **Tables 7 – Table 9.** These tables demonstrate that the highest emission process is that of the raw material (raw gold).

Land Use Change (LUC) emissions were not calculated in the previous product footprints but have been included for this product footprint to keep up with current standards and best practices, such as Land Sector and Removals Guidance from the Greenhouse Gas Protocol (GHGP) and World Resource Institute (WRI).

The LUC methodology follows the 2019 IPCC Guidelines for National Greenhouse Gas Inventories. The equations and default constants used in the methodology are revised for specific land and biomes. To calculate LUC emissions, direct LUC equations and methodology were used. Indirect LUC has not been accounted for due to the lack of internationally agreed procedure.

Further details are recorded in section 1.9.1 Methodological Choices.

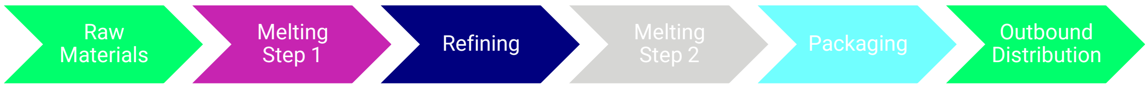
1.7. Disclaimer on uncertainty

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 gold grains are as follows:

Figure 1: Life Cycle Stages



1.8.1. Raw materials

The largest emission source within the raw materials was the gold input for the gold grains. 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 emission factors used for the gold were taken from the specific supplier's emissions data within the SKARN database which is used within the mining industry. 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 emission factors used for the gold were calculated using the EU Product Environmental Footprint Circular Footprint Formula (PEF CFF). The virgin emission factor for gold was calculated for specific suppliers provided by MKS PAMP.

The Product Environmental Footprint (PEF) is a life cycle assessment (LCA) based method to quantify the environmental impacts of products established by the EU. The overarching purpose of PEF is to enable to reduce the environmental impacts of goods, accounting for supply chain activities (from extraction of raw materials, through production and use and to final waste management). This purpose is achieved through the provision of detailed requirements for modelling the environmental impacts of the flows of material/energy and the emissions and waste streams associated with a product throughout its life cycle.

The Circular Footprint Formula (PEF CFF) provides the approach that shall be used to estimate the overall emissions associated to a certain process involving recycling and/or energy recovery. These moreover also relate to waste flows generated within the system boundary.

The emission factor applied to the input gold material was calculated using the following two formulae which have been derived from PEF CFF below. An adaptation has been made in multiplying it with EvLUC to account for land use change from mining,

Pr = R2 x (1−A)MQL+R1A

EF = Pr x Er + (1-Pr) x Ev + Pr x Er + (1-Pr) x Ev LUC

Table 4: Explanation of PEF CFF formula

Parameter	Definition
Pr	The portion of the emission factor which can use Er (the recycled content)
Ev	Specific emissions and resources consumed (per functional unit) arising from the acquisition and pre-processing of virgin material.
Ev LUC	Specific emissions and resources consumed (per functional unit) arising from land use change emissions caused by extraction of the virgin material
Er	Specific emissions and resources consumed (per functional unit) arising from the recycling process of the recycled (reused) material, including collection, sorting and transportation process.
Er LUC	Specific emissions and resources consumed (per functional unit) arising from land use change emissions caused by the recycled material
R1	Proportion of material in the input to the production that has been recycled from a previous system.
R2	Proportion of the material in the product that will be recycled (or reused) in a subsequent system. R_2 shall therefore take into account the inefficiencies in

	the collection and recycling (or reuse) processes. R_2 shall be measured at the output of the recycling plant. *For MKS PAMP precious metals, R2 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 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 as MKS PAMP’s facility.

Gold grains are packaged into plastic boxes. Then 4 plastic boxes are packaged together in a cardboard box. Each product comes with a security label, warranty certificate and MKS PAMP label.

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 by road from MKS PAMP in Switzerland to Zurich airport or to the final customers in Switzerland. The gold grains remain in Switzerland and are transported by road freight.

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 FPC v4.7 transportation calculator.

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 the gold grains, from the raw materials entering the facility and going through the melting stages, refining and packaging.
- 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. This includes upstream packaging of the raw material inputs, namely the chemicals and gold, and land use chance for 2% of procured gold where the mine source could not be verified and accurately calculated. Table 4 outlines the key assumptions that have been made.
- Land use change calculation tool follows the 2019 IPCC Guidelines for National Greenhouse Gas Inventories. Equations and default constants used in the methodology are revised for specific land and biomes.

Table 5: List of Assumptions

Process Step	Key assumption
Water	Input was is assumed to be the sum of the output black and white water.
End of life	Where specific packaging disposal data could not be provided, assumptions were made based on the percentage of gold sold in each geographical region and applied to each SKU to calculate end of life emissions per country.
Emission factors	For the raw materials where emission factors were not found, a generic Ecoinvent organic chemical emission factor was applied.
Allocation of inputs	The data received was for the family group of the product and not per different SKU, essentially it was for all the gold grains produced, hence an allocation key was created which was then

	used to determine the amount of gold grains produced and consequently the amount of materials/utilities is used.
Raw Materials	Given the start date of the project, MKS PAMP Provided 10 months of production data, so an appropriate calculation was made to made calculation to uplift to data for 12 months.
Raw Materials	The virgin emission factor for gold was provided by MKS PAMP for all its suppliers, where there were none, an emission factor taken from the from a World Gold Council public study was used.
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
Land Use Change (LUC) Calculation methodology	The LUC methodology follows the 2019 IPCC Guidelines for National Greenhouse Gas Inventories. Equations and default constants used in the methodology are revised for specific land and biomes. To calculate land use change, direct LUC equations and methodology were used. iLUC has not been accounted for due to the lack of internationally agreed procedure.
Assessment period	A 20-year assessment period is used to assess LUC of the mine, following the IPCC's 2003 Good Practice Guidance for Land Use, Land Use Change and Forestry, and its default value of 20 years. The linear discounting method is used to allocated emissions over the assessment period.
Exclusion	Assume no land use change where land type is rocky/ desert or where there have been no visible expansions or change to the land scape in the last 20 years.
Methodology	Using the gold procured by MKS PAMP, we calculated a percentage of gold MKS PAMP procures of total gold produced by the mine. The percentage is used to apportion the hectares of the mine for only the amount procured by MKS PAMP.
Mass Balance	MKS Pamp inputs include raw metals, chemicals and water. To balance the input and output materials, it is assumed that all chemicals are wasted as copper sulphates.
End of life	Waste disposal percentages per each country were uplifted to ensure that the total added up to 100%
Downstream Distribution	Downstream distribution of gold grains is calculated from production data.

1.9.2. Allocation

MKS PAMP produces many more products at their facility than the products in scope. Therefore, MKS PAMP calculated raw material inputs, outputs, and energy usage for each process step for all products in scope. We used the production data to calculate the utilities and inputs for 1kg of produced product. This was then multiplied by the production to calculate the inputs for each process step.

For the specific source inbound gold – MKS PAMP provided a percentage allocation for these sources for the provenance feed as follows.

- CCV Inbound – 100% allocated to provenance.
- Minera Florida Inbound – 50% allocated to provenance.

There was an additional allocation made to the CCV and Minera Florida provenance gold to account for the gold which was used to produce the CCV and Minera Florida Gold Grains. The amount of produced gold grains was taken from Outbound Transportation and the 7.5% of waste was added back to calculate total input gold grains weight, which was deducted from the gold allocated to Large and Kilo provenance bars.

The gold used to produce the provenance bars was split between large gold bars and kilobars based on the percentage of large bars and kilobars or total gold bars produced. These percentages were worked out from the production data file provided by MKS PAMP.

Finally, there was an allocation made for the Minera Florida/ CCV mix gold grains product. MKS PAMP provided us with the percentage split, confirming that this product was made up of 29.91% Minera Florida Gold and 70.01% CCV gold. This split was used to ensure that LUC emissions was only allocated to the gold from Minera Florida, as there were no LUC emissions arising from the sourced CCV Gold.

1.9.3. Allocation due to recycling

Recycling allocation is calculated using the PEF CEFF calculator.

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 the MKS PAMP 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.

Scores range from “Excellent” to “Lowest” with an excellent score representing data at the most granular level, in units which relate directly to the best available emission factors. An example of lower quality data would be data derived from proxies or uncalibrated assumptions. The table below provides some guidance and example data for the Carbon Trust scoring system. Note that the final data quality results, presented in Table 5, shows scores ranging between very good and excellent with an overarching score of Good, scores rated good and acceptable have an overarching score of Medium and the lower scores all fall under a Low score.

Data Quality Score	Scoring Guidance	Example Data
Excellent	Data at granular level in units that directly relate to the best available emission factor	Tonnes of “Steel grade XY”
Very Good	Data with some granularity (eg by country) in units that directly relate to the best available emissions factors	Tonnes of “Steel BOF production” or aluminium extruded
Good	Data in units that are a good proxy for emissions	Tonnes of “Gold” or “Silver”
Acceptable	Data in units that are a reasonable proxy for emissions	Tonnes of “Metals”
Low Quality	Data in units that are a low-quality proxy for emissions	Spend on “parts” or “components”
Lower Quality	Data in units that are a lower quality proxy for emissions	Spend on “goods”
Lowest Quality	Data from uncalibrated assumptions	Unknown

Generally, data quality for the project ranged between good and excellent with some acceptable scoring. Overall, the activity data was consistent with the boundary year, provided in some granularity and could be matched with the best available emission factors. In some cases, such as the land use change, assumptions were made around the mine data (see **Table 4** for full assumption list), which were appropriate and reasonable, such as the allocation of hectares based on the procured raw materials of total mine production and some proxies where mine data was unavailable. More primary data for the land use change emissions calculation would result in a higher data quality score. **Table 5** summarises the data quality assessment of the most material data points.

Table 6: Data quality assessment for material data points (Scale: Low, Medium, Good)

Data point	Activity Data Quality Indicator	Emission Factor Data Quality Indicator	Application Data Quality Indicator
Raw Materials	Good	Good	Good
Packaging	Good	Good	Good
Manufacturing	Good	Good	Good
Downstream distribution	Good	Good	Good
Land use change	Medium	Medium	Medium

1.11. Detailed results

An overall breakdown of the emissions associated with the various products and process steps is reported in Tables 7 - 9. Please refer to the complementary Excel file, [Phase 2 - Gold Grains MKS PAMP FPX], for a full breakdown of all product carbon footprints.

Table 7: Cripple Creek & Victor Gold Grains Results (Fossil, Biogenic & Land Use Change)

Life Cycle Stage	kgCO2e	kgCO2e/kg	Contribution per lifecycle stage
Upstream transport of input materials	12,956	8.50	0.03%
Raw materials (Gold)	39,285,771	25,761	99.96%
Raw materials (Chemicals)	1,632	1.07	0.004%

Utilities	576	0.38	0.002%
Waste	20	0.01	0.0001%
Packaging	168	0.11	0.0004%
Downstream distribution	164	0.11	0.0004%
Total footprint (kgCO2e)	**39,301,286**	**25,771**	**100%**

Figure 2: Cripple Creek & Victor Gold Grains Carbon Footprint

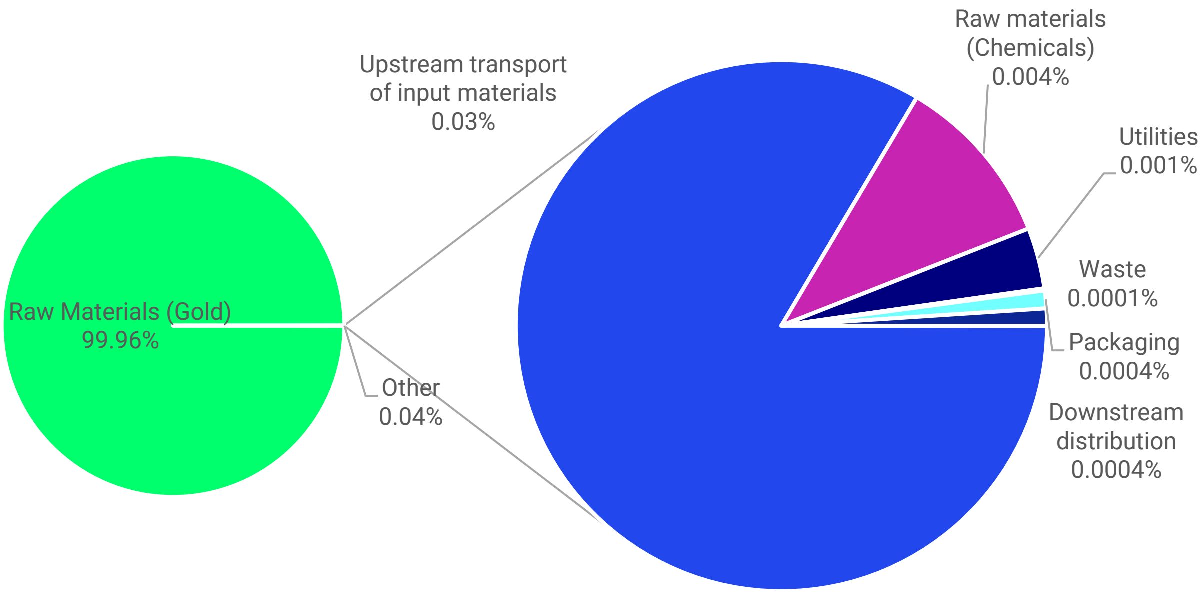


Table 8: Minera Florida Gold Grains Results (Fossil, Biogenic & Land Use Change)

Life Cycle Stage	kgCO2e	kgCO2e/kg	Contribution per lifecycle stage
Upstream transport of input materials	6,525	16.84	0.12%
Raw materials (Gold)	5,251,648	13,553	99.86%
Raw materials (Chemicals)	415	1.07	0.008%
Utilities	146	0.38	0.003%
Waste	5	0.01	0.0001%
Packaging	43	0.11	0.0008%
Downstream distribution	42	0.11	0.0008%
Total footprint (kgCO2e)	**5,258,823**	**13,571**	**100%**

Figure 3: Minera Florida Gold Grains Carbon Footprint

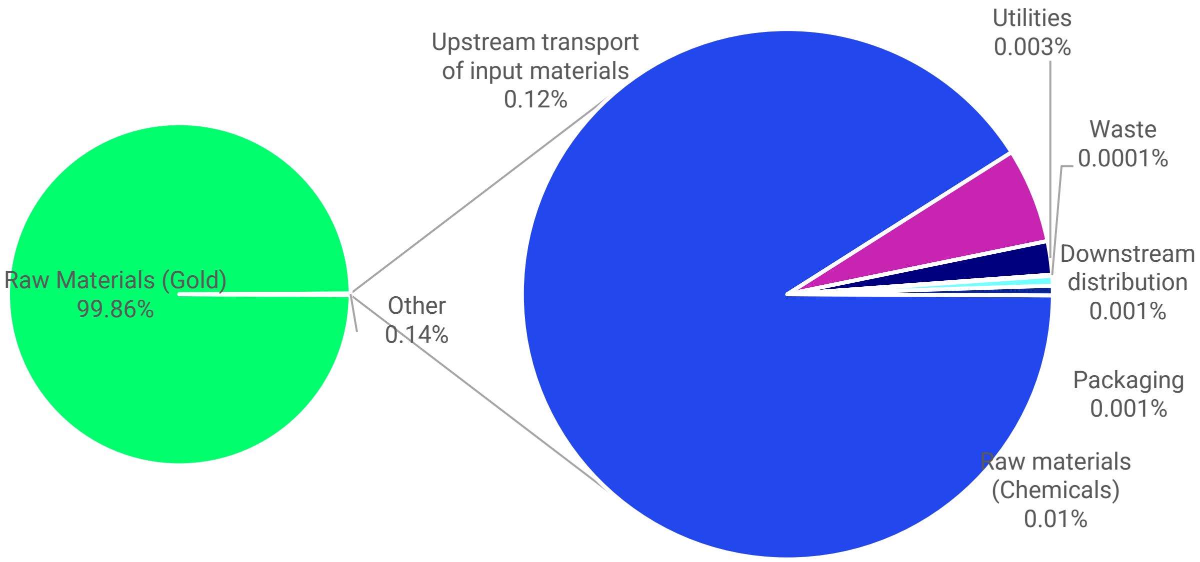
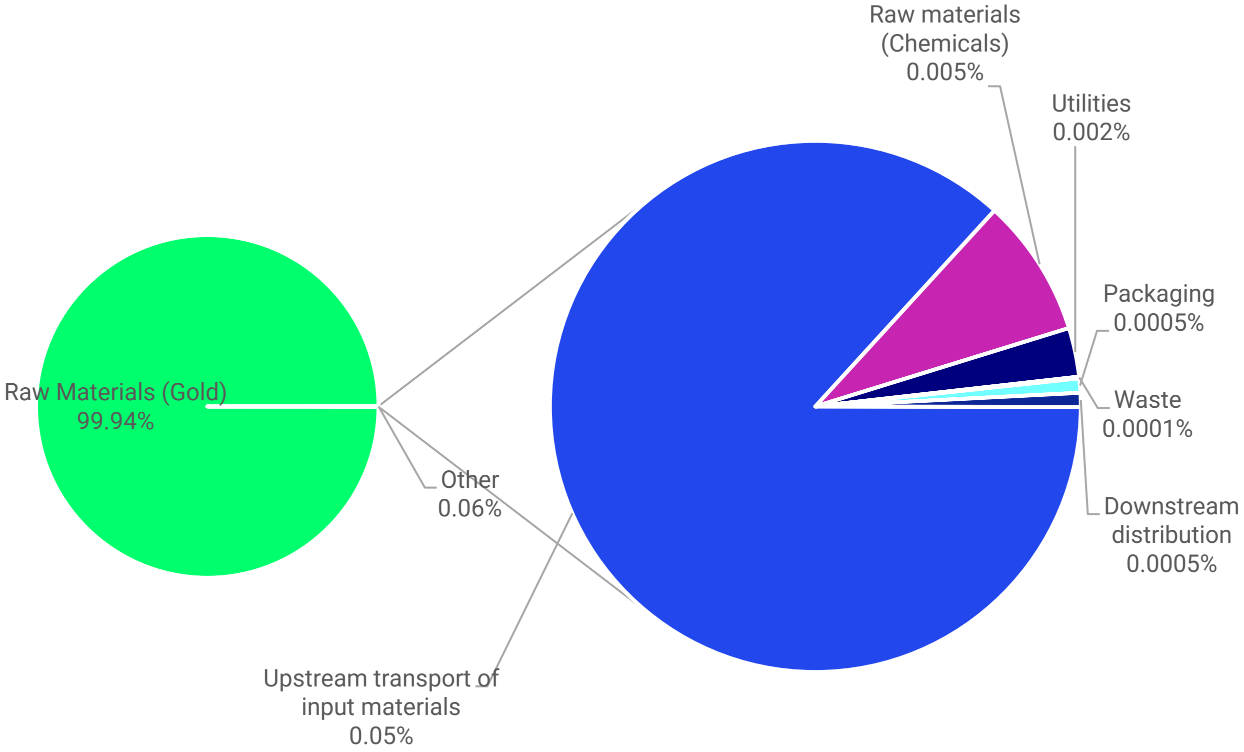


Table 9: CCV/ Minera Florida Gold Grains Results (Fossil, Biogenic & Land Use Change)

Life Cycle Stage	kgCO2e	kgCO2e/kg	Contribution per lifecycle stage
Upstream transport of input materials	1,787	11	0.05%
Raw materials (Gold)	3,592,816	22,110	99.94%
Raw materials (Chemicals)	174	1.07	0.005%
Utilities	61	0.38	0.002%
Waste	2	0.01	0.0001%
Packaging	18	0.11	0.0005%
Downstream distribution	17	0.11	0.0005%
Total footprint (kgCO2e)	**3,594,876**	**22,122**	**100%**

Figure 4: CCV/ Minera Florida Gold Grains Carbon Footprint



1.12. Conclusions

The hotspot within the carbon footprint of the gold grains is that of the raw materials, namely the raw gold. This is due to the carbon intensity surrounding the emission factor.

1.13. Recommendations

1.13.1. Emissions reductions

The main emissions hotspot of the SKUs is the gold raw material input. Sourcing raw materials with a higher percentage of recycled content would be the most impactful way of reducing the product footprint. Moreover, switching to the use of low-carbon methods of transport, both upstream and downstream, will decrease this further. This might include alternative fuels, electric vehicles, or even more efficient delivery routes.

1.13.2. Data quality improvements

There are several recommendations to improve future recertification and results:

Other inputs (non-Gold): 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: Attaining 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.

Mine Data: For the calculation of land use change, a large amount of primary data research was required by the delivery team as the client did not hold specific data on the mines. Gaining visibility on the expansion of mines and land use change due to gold exploration will help with the calculation of the land use change emissions.

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.

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