Frequently asked question

Platinum Group Metals Life Cycle Assessment

1. What is a life cycle?

A life cycle describes the consecutive and interlinked stages of a product or service system, from the extraction of natural resources to the final disposal.

2. What is a life cycle assessment?

As defined by ISO in their Principles and Guidelines for Life Cycle Assessment (ISO 14040.2), an LCA is a systematic set of procedures for compiling and examining the inputs and outputs of materials and energy and the associated environmental impacts directly attributable to the functioning of a product or service system throughout its life cycle. It shows where the greatest environmental impacgts occur and where improvements would deliver the most benefits.

A typical LCA study consists of four phases:

1. Goal and Scope: The goal and scope outline the rationale of the study, the anticipated use of the results, the boundary conditions, and the assumptions use to analyse the product system under consideration.
2. Life Cycle Inventory (LCI): The life cycle inventory stage quantifies the material and energy use and environmental releases for the product system being studied. These results can be used in isolation to understand emissions, waste or resource use. Additionally, the results can provide insights which may lead to product design improvements.
3. Life Cycle Impact Assessment (LCIA): the evaluation of the environmental relevance of the inputs and outputs of the system.
4. Interpretation: interpretation of the study results, including recommendations and limitations of the study as well as an analysis of the validity of the results based on those limitations.

3. What does the IPA life cycle assessment cover?

The IPA Life Cycle Assessment is a cradle-to-gate study that quantifies the environmental impacts of primary and secondary production of platinum group metals (PGMs) and their use in catalytic converters (autocatalysts) for the first time on an industry-wide level. It is highly representative of the industry, covering 64% of global PGM supply. On the input side this includes, inter alia, the amount of ore mined and processed, electric energy, fuel, water, explosives, and process chemicals. On the output side they cover e.g. emissions to air and water, as well as waste. These data are shown in relation to the production of 1kg of platinum, 1 kg of palladium, and 1 kg rhodium, and the production and use phase of 1 Three-Way-Catalyst (TWC) in a 1.6 l gasoline engine, and 1 Diesel Oxidation Catalyst (DOC) and 1 Catalysed Soot Filter (CSF) in a 2.0 l diesel engine vehicle.

The cradle-to-gate life cycle inventory (LCI) also includes the production of fuel and ancillary materials, and represents all resource use and emissions caused by PGM production as well as the use of PGMs in a catalytic converter application.

3. Why has IPA conducted this assessment?

The IPA membership carried out this study in order to generate a reliable, current and independent dataset of the environmental footprint of PGMs and PGM-containing products and to enable it to identify areas in the PGM life cycle where it can improve its environmental performance.

4. What are the life cycle data used for?

The life cycle data are intended for internal use by the IPA and for commication to LCA practitioners, LCA database providers, end-users of PGMs and other selected stakeholders.

5. What are so-called 'impact categories'?

Process in-puts and outputs can be aggregated and presented in terms of impact categories. The life cycle community has defined a total of 15 impact categories. The most relevant ones are global warming potential (which describes the total of emissions as CO2 equivalents, including carbon dioxide, methane and other relevant gases) and primary energy demand (the total amount of energy which goes into the production of 1 kg of product, here 1 kg of platinum, 1 kg of palladium, and 1 kg of rhodium, including electrical energy from various sources including fossil fuels).

6. Which PGM products were covered by the IPA LCA?

The IPA LCA covers the production of platinum, palladium, and rhodium as they are the most widely used out of the PGM family, and the production and use of an autocatalyst in a three-way-catalyst in a 1.6 l gasoline engine, and a diesel oxidation catalyst and a diesel soot filter in a 2.0 l diesel engine over a 160,000km lifetime.

The use phase was modeled on the European region using a EURO 5 model vehicle (gasoline and diesel) from an internationally approved and widely used database (PE International: GaBi, 2010) with emissions lowest at 133 CO2/km driven and an assumed lifetime of 160,000 km. For the catalyst a typical mix of PGMs of 72% primary PGMs and 28% secondary (recycled) was assumed.

6. Are the resulting data reliable and robust?

The LCA study is ISO 14040 compliant and covers the main production technologies as well as the main PGM producing regions except Russia. It accounts for 70% of primary PGM production, 60% of secondary and 90% of autocatalyst production. The reference year (2009/10) had normal production operations in all participating companies. The LCA was conducted and all data verified by the LCA/LCI consultancy with the greatest experience in applying life cycle assessment methodology to the production of metals. The methodology, input data, and final results were reviewed by an independent technical LCA expert.

7. Which companies participated in the exercise?

Eleven companies participated in the exercise (out of 15 IPA member companies). The update covers the main global and regional PGM mining companies including Anglo American Platinum, Impala Platinum, Lonmin Plc, VALE, Royal Bafokeng Platinum, Stillwater Mining Company and secondary and autocatalyst producers such as BASF, Johnson Matthey, Umicore, Heraeus Precious Metals, and Tanaka.

8. What are the major PGM producing regions and are they all covered in the?

The main PGM producing countries and regions comprise Russia, Canada, South Africa and The United States. All major PGM producing regions except Russia are included.

9. Are all production processes covered?

The LCA covers all main production processes for the production of PGMs “from cradle to gate”, which means from ore extraction, the production of other raw materials, energy supply and the production of the PGMs themselves. The cradle-to-gate life cycle inventory also includes the production of fuel and ancillary materials, and represents all resource use and emissions caused by PGM production as well as the use of PGMs in a catalytic converter application.

10. The PGM carbon footprint and primary energy demand are significant. Is it from an environmental point of view preferable to avoid the use of PGMs?

The primary production of PGMs, the transfer of metal from below ground resource to above ground material stock, should be regarded as an investment in products that offer significant environmental benefits (emissions reduction) and allow the production of a wide range of resource efficient and sustainable products (from catalysts to medical appliances; from fertilizers in agriculture to electronic appliances). The environmental burden is already offset by the use phase in a car; and the high and repeatable recyclability of PGMs reduce the overall environmental burden PGM production even more with each recycling round.

Recycling could not occur if there had not been a primary ounce of PGMs produced beforehand. Ensuring the steady supply of PGMs to meet society’s current and future needs requires both increased levels of recycling and ongoing investments in primary production.

Additionally, PGMs are produced in low volumes (approx. 400 tonnes of PGMs produced annually), several orders of magnitude lower than many common metals. Due to their high value, they are also used in very tiny quantities.

11. What are the parameters in PGM mining influencing the primary energy demand of PGM production?

In PGM mining, the most relevant parameters affecting the energy use (and consequently the carbon footprint) are the power consumption during mining and ore beneficiation. These two energy-intensive processes precede the final separation of metals during refining, thereby producing not only PGMs, but also several other base metal products such as nickel, copper and cobalt, and other precious metal products such as iridium, osmium, ruthenium, gold and silver, which are not considered in this study. In South Africa, more than 90% of electricity is produced from the combustion of hard coal with causes a significant impact on the overall carbon footprint of PGM production.

12. Why are there sometimes significant differences between the data resulting from the study and data in public data bases such as Eco Invent?

This is the first study looking at the impacts on the primary and secondary production of PGMs. Data which can be found in public databases such as EcoInvent or the European Commission Life Cycle Database are often old data or even modeled data from assumptions or extrapolations from partial data of unknown quality. There is a lag between the finalization of a LCA such has been achieved for PGMs and its integration into third party data bases.

14. Can one compare the life cycle data of PGMs with other metal commodities?

A comparison of the LCA for PGMs with other metals is not meaningful as the methodologies of data collection, aggregation, allocation and analysis differ. Furthermore, PGMs are produced in low volumes, several orders of magnitude lower than many common metals.

16. Who has access to PGM life cycle data?

The data as well as the full life cycle update report can be made available upon request through the IPA website (www.ipa-news.com). The data are currently incorporated into the GaBi database of PE International.

17. Are site or company specific data available?

No. Life cycle data comprise highly sensitive information of competitive importance. If available, they would allow the calculation of production costs, process efficiencies and show production capacities. The LCA study comprises only aggregated information for the industry globally

18. Will you update the life cycle data?

The collection of life cycle data is very costly and resource intensive. Any future update can only be contemplated when significant changes – in technology, type and location of ore bodies, etc. – have occurred and have been in operation long enough to have generated a multi-year history of consistent data.