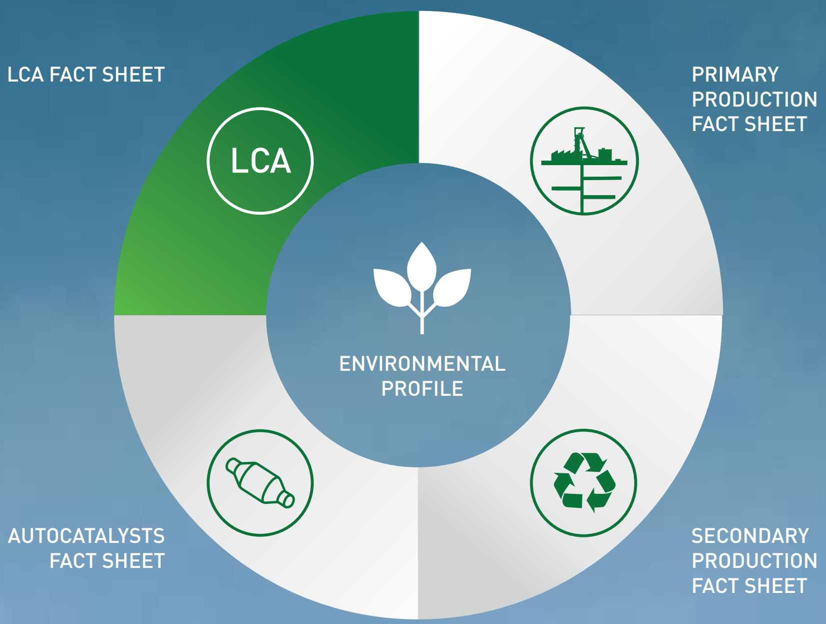
LCA

THE LIFE CYCLE ASSESSMENT OF PLATINUM GROUP METALS (PGMs)

PLATINUM GROUP METALS
THE POWER TO *IMPROVE LIVES*

IPA
International
Platinum Group Metals
Association



IPA fact sheets come in a series. Download them all at www.ipa-news.com

THE LIFE CYCLE ASSESSMENT OF PLATINUM GROUP METALS (PGMs)

LCA

Introduction

An LCA Study conducted by the IPA has quantified the environmental impact of primary and secondary production of platinum group metals (PGMs) for the first time on an industry-wide level. This document belongs to a series of fact sheets reflecting the results of the IPA LCA Study that was completed in 2013. The LCA Fact Sheet focuses on technical and methodological information from the study.

Goal and scope of the IPA LCA Study

The IPA LCA followed the "cradle-to-gate" approach which covers the processes within the life cycle of the product from the extraction of the raw materials to the finished product. The LCA was executed by PE International according to the requirements of the International Standard Organisation ISO 14040 and ISO 14044 to withstand evaluation by a critical review panel if required by IPA. 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. In addition, the LCI was employed to assess the benefits of PGMs in applications such as autocatalysts.

Based on input from IPA members, the study focused on quantifying the environmental impact of the average production of PGMs, the fabrication of autocatalysts using PGMs as well as the use of these catalytic converters in a EURO 5 vehicle system over a lifetime of 160,000km. This enabled the evaluation of the benefits of PGMs during the vehicle's lifetime.

Cradle-to-gate life cycle of PGMs
IMAGE CREDIT: *Platinum Ore.* **Johnson Matthey.**

Key findings based on LCI and LCA results

IMPACTS

ELECTRICITY DEMAND

Power consumption during mining and ore beneficiation has been identified as the major impact of the production of PGMs on the environment. This is due to the low grade of ore and difficult mining conditions as well as the composition of the South African power grid where more than 90% of electricity is produced from burning hard coal.

RECYCLING REDUCES IMPACT

The results indicate that, as is often the case, secondary production has a much lower impact than primary production. This is expected for various reasons, including the vast difference in the concentration of PGMs between primary and secondary sources.

GWP / PED

The environmental impacts of PGM production have been quantified for a variety of categories; the two most requested categories Global Warming Potential (GWP)[1] and Primary Energy Demand (PED)[2] are presented below.

Global Warming Potential (kg CO_2-eq/g)

Primary Energy Demand (MJ/g)

Summary result of the Life Cycle Impact Assessment for the average production of 1 gram of PGMs*
SOURCE: IPA LCA Study 2013[3]

*Data in round figures

BENEFITS

AUTOCATALYSTS

The emissions reductions as a result of the use of a catalytic converter outweigh the emissions generated during the production of the catalyst including PGMs and other related materials used to support the functionality of the catalyst.

CO / HC / NO_X / PM

Over 1.3 tonnes of toxic and harmful pollutants including carbon monoxide, hydrocarbons, oxides of nitrogen and particulate matter are avoided by the catalytic converter systems in one EURO 5 gasoline and one EURO 5 diesel vehicle in use over 160,000km; this is equivalent to a reduction in these emissions of up to 97%.

HEALTHY LIFE

The positive effect of emissions reductions can be quantified using the World Health Organization's (WHO) metric of Disability-Adjusted Life Year or DALY. A DALY is used to quantify the burden of disease or morbidity on human life. 7.86 days of healthy life (DALY) is gained for one EURO 5 diesel and one EURO 5 gasoline car over a distance of 160,000km.

1 The Global Warming Potential is calculated in carbon dioxide equivalents (CO2-Eq). This means that the greenhouse potential of an emission is given in relation to CO2.
2. The Primary Energy Demand is the quantity of energy directly withdrawn from the hydrosphere, atmosphere or geosphere or energy source without any anthropogenic change.
3. IPA Study mix representing the global average primary and secondary production of PGMs by the participating members.

LCA Study Quick Facts

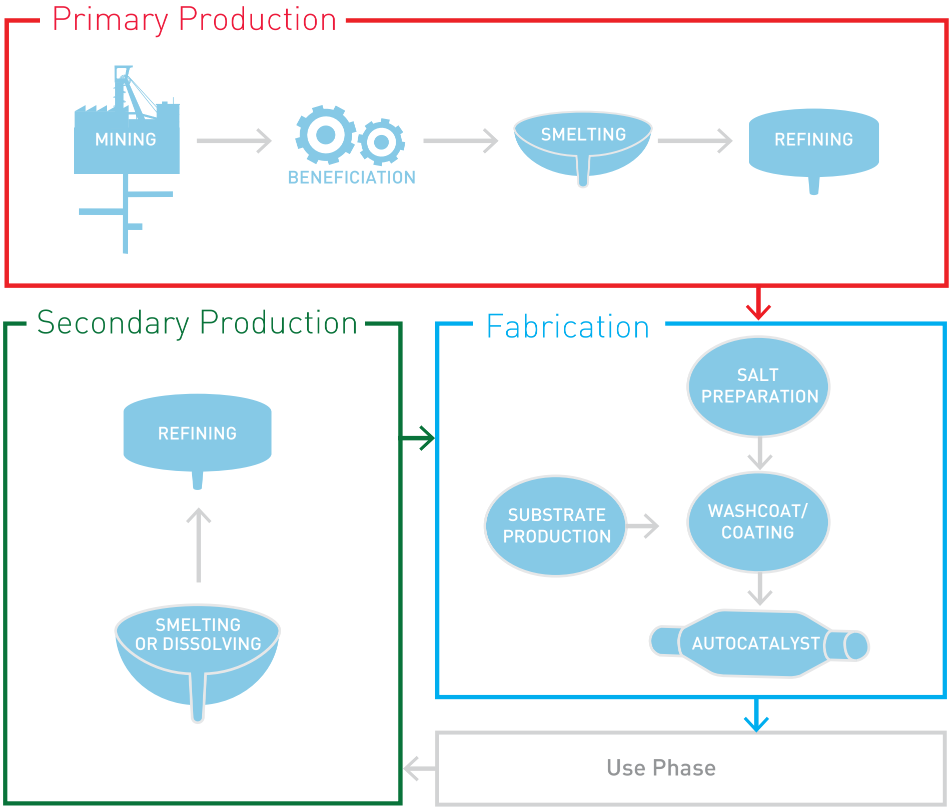
LIFE CYCLE STAGE	PRIMARY	SECONDARY	AUTOCATALYST FABRICATION
GEOGRAPHICAL COVERAGE	South Africa, USA, Canada	Belgium, UK, Japan	UK, Germany
INDUSTRY COVERAGE	70%	60%	90%
OVERALL INDUSTRY REPRESENTATION	• Eleven out of fifteen IPA members, covering 64% of the global PGM industry		
TEMPORAL COVERAGE	• Fiscal year 2009/2010 for primary data • GaBi[3] (2010) database for upstream process data (non-primary data such as data of consumed material, energy carriers etc.)		
METHODOLOGY	• Cradle-to-gate LCI • LCA model created using GaBi 5 Software system (PEI) • Economic allocation in mining, concentration, and base metal refining, and mass allocation in PGM refining • Use phase: modeled on European region using a EURO 5 model vehicle (gasoline and diesel) from the GaBi[3] (2010) database, with emissions lowest at 133g CO_2/km driven, and an assumed lifetime of 160,000km		
FUNCTIONAL UNITS	• 1kg of platinum (Pt), 1kg of palladium (Pd), 1kg of rhodium (Rh) • 1 Three Way Catalyst (TWC) in a 1.6l gasoline engine vehicle over 160,000km lifetime • 1 Diesel Oxidation Catalyst (DOC) and 1 Catalysed Soot Filter (CSF) in a 2.0l diesel engine vehicle over 160,000km lifetime[4]		
IMPACT CATEGORIES	• Primary Energy Demand • Global Warming Potential • Acidification Potential • Eutrophication Potential • Photochemical Ozone Creation Potential • Abiotic Depletion Potential		
QUALITY	• Conducted by renowned consultancy (PE International) according to ISO 14040 & 14044 • Data reviewed by an independent technical expert for quality and accuracy		

3 Ganzheitliche Bilanzierung (German for holistic balancing/life cycle engineering).

4 A typical catalyst is made up of a mix of PGMs sourced from both primary and secondary production. The PGM mix in the study is based on the gross weight of PGMs used in autocatalysts and the gross weight of PGMs recycled from end-of-life autocatalysts in 2010. This consists of approximately 72% primary PGMs and 28% recycled PGMs.

LCA system boundaries

The diagram below shows the system boundaries for the IPA LCA Study:



The manufacture of downstream co-products, the canning process and the collection of spent autocatalysts are not included in this study.

Methodological background

The primary production of platinum, palladium and rhodium typically yields several other base metal products such as nickel, copper and cobalt and other precious metal products, such as iridium, osmium, ruthenium, gold and silver, due to these metals being a component of the PGM orebody. The secondary production of PGMs also yields other co-products due to the variation in raw material feed. These products are not included within the scope of this study and are therefore treated as co-products and separated from the system using a combination of economic and mass allocation.

Within secondary production, it is common in the PGM industry to treat a mixed feed of materials, which may include automotive and industrial catalysts, electronic scrap and by-product materials. Consequently it is challenging for an LCA to allocate the environmental footprint of a particular process either to individual metals or to an individual feed such as autocatalysts. The IPA LCA Study has adopted a pragmatic approach and has used a mixed feed to model the average footprint for the secondary production of PGMs. Thus, while the results of the LCA study are valid as an industry average, they are not suited for the analysis of specific secondary production processes, especially for comparison purposes. Similarly, the LCA results for primary production are averaged from inputs from mining operations which vary from one another in terms of the characteristics of their ores and should not be used to analyse one particular mine or participating company, or their production processes.

PLATINUM GROUP METALS
THE POWER TO *IMPROVE LIVES*

IPA International Platinum Group Metals Association

ABOUT THE IPA

The IPA is a non-profit organisation representing 80% of the mining, production and fabrication companies in the global platinum group metals (PGM) industry, comprising platinum, palladium, iridium, rhodium, osmium and ruthenium.

CONTACT INFORMATION

International Platinum Group Metals Association
Schiess-Staett-Str. 30, 80339 Munich – Germany
Phone +49-89-5199-6770, Fax +49-89-5199-6719
info@ipa-news.com, www.ipa-news.com