April 2025

EXECUTIVE SUMMARY

The IPA has finished its third industry-wide life cycle assessment (LCA) of global platinum group metals (PGMs) production, updating the previous study that used 2017 data. We regularly update these reports to provide the industry and stakeholders with the most accurate and relevant environmental performance information. The latest LCA, which has been critically reviewed, uses 2022 production data and includes a projection for the Global Warming Potential (GWP) of global primary production in 2030.

Energy is key

Although the results show an increase in GWP for primary production in South Africa between 2017 and 2022, this rise was largely driven by temporary external factors – most notably, higher CO_2 emissions from the national electricity mix. Since then, South Africa's reliance on coal-powered electricity has declined significantly, from 87.4% in 2019 [1] to 76% in 2023 [2], highlighting the country's accelerating shift toward cleaner energy sources.

Decarbonization is underway

Both the South African government and South African PGM producers are committed to adopting renewable energy solutions, enhancing energy efficiency, and promoting sustainability throughout the value chain. Our CO_2 scenario projection for 2030 underscores the potential for further emissions reductions as these initiatives gain momentum.

Given that South African producers account for a significant share of production volumes in our LCA study - and considering the substantial reliance on hard-coal generated electricity until 2022 - our scenario focuses exclusively on improvements within South Africa, without incorporating potential advancements in other PGM-producing regions, such as the USA or Russia.

Depending on the specific changes implemented in the 2030 scenario for the South African power supply per PGM producer, the estimated reduction in GWP ranges from 35% to 61%.
In the best-case scenario, it is assumed that purchased concentrates and raw materials from third parties, when processed at the mines, will benefit from the same renewable energy investments as the mines' own material. Conversely, the conservative scenario presumes that no such improvements will occur in these materials.

[1] Data from the International Energy Agency always reflect a delay of three years, in this case, 2019 was used for the 2022 study.
[2] 2023 data on the South African grid were used as benchmark for the 2030 scenario as the Draft Integrated Resource Plan of the South African government relates to that year.

Summary of reduction potentials in 2030 compared to 2022

kg CO_2 eq. per kg	2022 Baseline	2030 Conservative Scenario	2030 Best Scenario
Platinum	36,828	18,333	14,383
Palladium	28,094	18,179	15,937
Rhodium	38,027	18,612	14,507
Iridium	42,096	19,456	14,564
Ruthenium	42,000	19,486	14,954

Reducing impact through recycling

LCA 3 also underscores the vital role of recycling in sustainable PGM use. Direct comparisons for secondary production between 2017 and 2022 were not possible due to changes in participating companies; however, the latest data is of significantly higher quality and further confirms the strong environmental benefits of PGM recycling.

LCA Study Quick Facts

Life cycle stage	**Primary PGM Production**	**Secondary PGM Production**
Geographical coverage	Russia, South Africa, USA, Zimbabwe	China, Germany, Japan, South Africa, UK, USA
Industry coverage	95% of global supply	approx. 60% of global supply
Overall industry representation	10 out of 12 Members of the IPA	
Time coverage	Production year 2022	
Technology coverage	• Global production and technology mix covered • Technological representation for each stage of production process given • Both pyrometallurgical and hydrometallurgical technologies considered	
Methodology	• Cradle-to gate Life Cycle Inventory • LCA model created using LCA for Experts software system (Sphera) • Life cycle inventory data taken from MLC database 2023.2 • Combination of mass and economic allocation for PGM production	
Functional unit	The functional unit is the reference value for which the results of the study are calculated. Generally, a functional unit should reflect the function provided by the product being assessed. The following mass-based functional units, equal to the reference flow, have been designated for this study:	
	• 1 kg of Platinum (Pt) (>99,95%), • 1 kg of Palladium (Pd) (>99,95%), • 1 kg of Rhodium (Rh) (>99,90%) • 1 kg of Iridium (Ir) (>99,90%), and • 1 kg of Ruthenium (Ru) (>99,90%)	• 1 kg of Platinum (Pt) (>99,95%), • 1 kg of Palladium (Pd) (>99,95%), and • 1 kg of Rhodium (Rh) (>99,90%)
Impact categories and indicators used	Primary Energy Demand, Global Warming Potential, Acidification Potential, Eutrophication Potential, Photochemical Ozone Creation Potential, Blue Water Consumption	
Quality assurance	• Conducted by renowned consultancy (Sphera) in conformity to ISO 14040 (2006) and ISO 14044 (2006). • Critical Review by Prof. Dr. Matthias Finkbeiner, Technical University Berlin, in accordance with ISO 14044 section 6.2 and ISO 14071	

Summary of primary production results per kg of metal

Impact Category	Pt	Pd	Rh	Ir	Ru
Global Warming Potential [kg CO_2 eq.]	36,828	28,094	38,027	42,096	42,000
Primary Energy Demand [MJ]	494,563	425,546	508,222	548,987	547,114
Acidification Potential [Mole of H+ eq.]	1,687	4,507	1,446	887	926
Eutrophication Potential [Mole of N eq.]	687	450	715	812	811
Photochemical Ozone Creation Potential [kg NMVOC eq.]	258	380	249	236	238
Blue Water Consumption [kg]	297,006	243,960	305,879	335,220	329,931

Summary of secondary production results per kg of metal

Impact category	Pt	Pd	Rh
Global Warming Potential [kg CO_2 eq.]	477	497	497
Primary Energy Demand [MJ]	9,976	10,370	10,402
Acidification Potential [Mole of H+ eq.]	1.26	1.29	1.30
Eutrophication Potential [Mole of N eq.]	3.68	3.70	3.77
Photochemical Ozone Creation Potential [kg NMVOC eq.]	0.95	0.95	0.97
Blue Water Consumption [kg]	2,419	3,654	3,458

Key Messages & Take-aways from LCA 3 and the CO_2 Scenario Study

- PGMs have high environmental impacts due to energy-intensive processing but are crucial metals for applications in low-carbon technologies such as green hydrogen and fuel cells.
- The value chain strives for the most resource-efficient solutions to provide PGMs to their customers while closing the material loop. Recycling of PGMs significantly reduces the environmental burden at each next life cycle.
- The GWP impact of primary production assessed for the reference year 2022 has increased compared to 2017; this can be attributed to three main factors:
  1. The higher CO_2 emissions from the South African electricity mix due to a decreased efficiency of the South African hard coal power plants.
  2. The influence of the increased market price (10-year average) for PGMs.
  3. Increased mining of low-grade ore body.
- The PGM industry has a decarbonization roadmap in place which will result in a considerable decrease in the Global Warming Potential of primary produced PGMs by 2030.
- Growing replacement of hard-coal generated electricity by renewable energy in South Africa will heavily reduce the carbon footprint of primary production by 2030.
- The overall reduction in GWP modelled for 2030 is between 35% and 61%, depending on whether a conservative or best-case scenario is modelled.
- Each PGM producer invests different volumes in renewable energy, and the production volume for each PGM varies by producer. Hence, the PGMs mainly mined in South Africa (Pt, Rh, Ir, and Ru) benefit more in our model than Pd, as decarbonization efforts of other regions (USA, Russia) were out of the scope of our CO_2 scenario.
- Increased efficiency in processing, and shifts towards greener mining technologies, are expected to further drive emissions reductions.
- The LCA study results for secondary production, showcasing a significantly lower footprint assigned to the recycling of EoL material, underscore the vital role of recycling in ensuring the circularity of PGMs.
- Secondary producers, while not having been part of the CO_2 scenario presented here, also contribute to the reduction of carbon emissions by heavily investing in the use of renewable energy and by increasing the efficiency of PGM use in applications, often referred to as thrifting.
- Future LCA updates will aim to address data gaps (such as water accounting, water impact assessment based on water scarcity for the different regions, transport of EoL scrap to recyclers, metals emissions to air) and refine impact assessments.

- More details on LCA 3 and the CO_2 study are available from the LCA 3 Fact Sheet on the website www.ipa-news.com.
- LCA 3 data is available through the IPA website (navigate to LCA Data Access).
- Get in touch at LCA@ipa-news.com