Styldrift –Royal Bafokeng Platinum

PGMS – METALS OF THE FUTURE

2023 PGMs INDUSTRY DAY

Roger Baxter, CEO, Minerals Council South Africa

28 March 2023, Johannesburg

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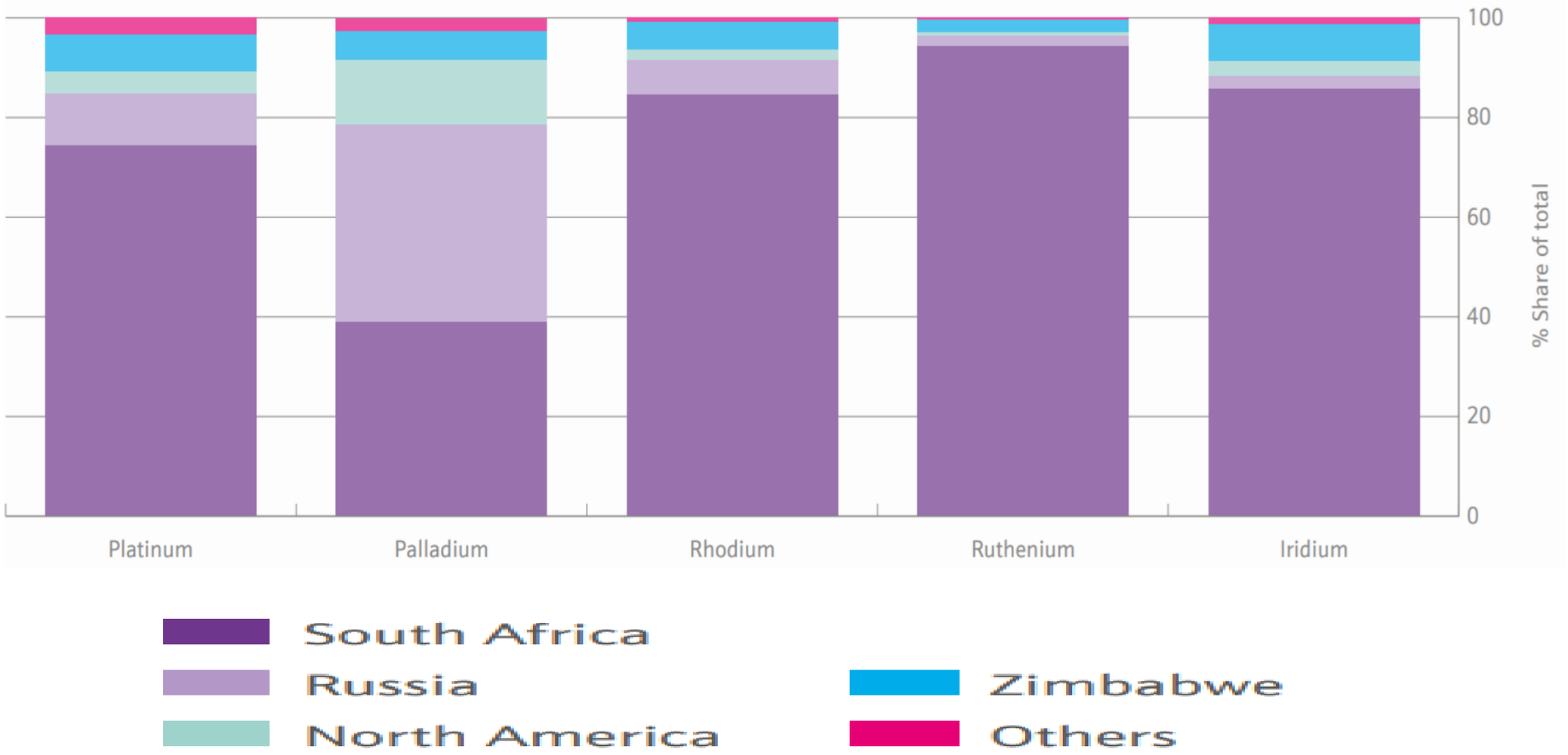
PGMS – South Africa is the key source

RSA PGM reserves at 87%



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Source: Johnson Matthey

Unlocking South Africa's long-term PGM potential

- The draft National Platinum Strategy for RSA, developed by the MCSA.
- The focus is to realize the world's largest PGM resource through developing markets, that enable the growth of the PGM mining sector. This would add about R8 trillion to South Africa's economy by 2050, and about another 1 million direct and indirect jobs.
- Strategy needs collaboration between government and industry to tackle short term challenges (electricity, security, rail, local government, local community development) while at the same time investing in demand creation and in the long-term mining future.
- A concerted and coordinated effort by the public and private sector, supported by the framework of a national strategy, is essential to enhance the short-term and ensure that the future realizes the promise**.**

As President Mandela said, a vision without action is just day-dreaming, action with out a vision is merely passing time.
But a Vision with Action can change the World.

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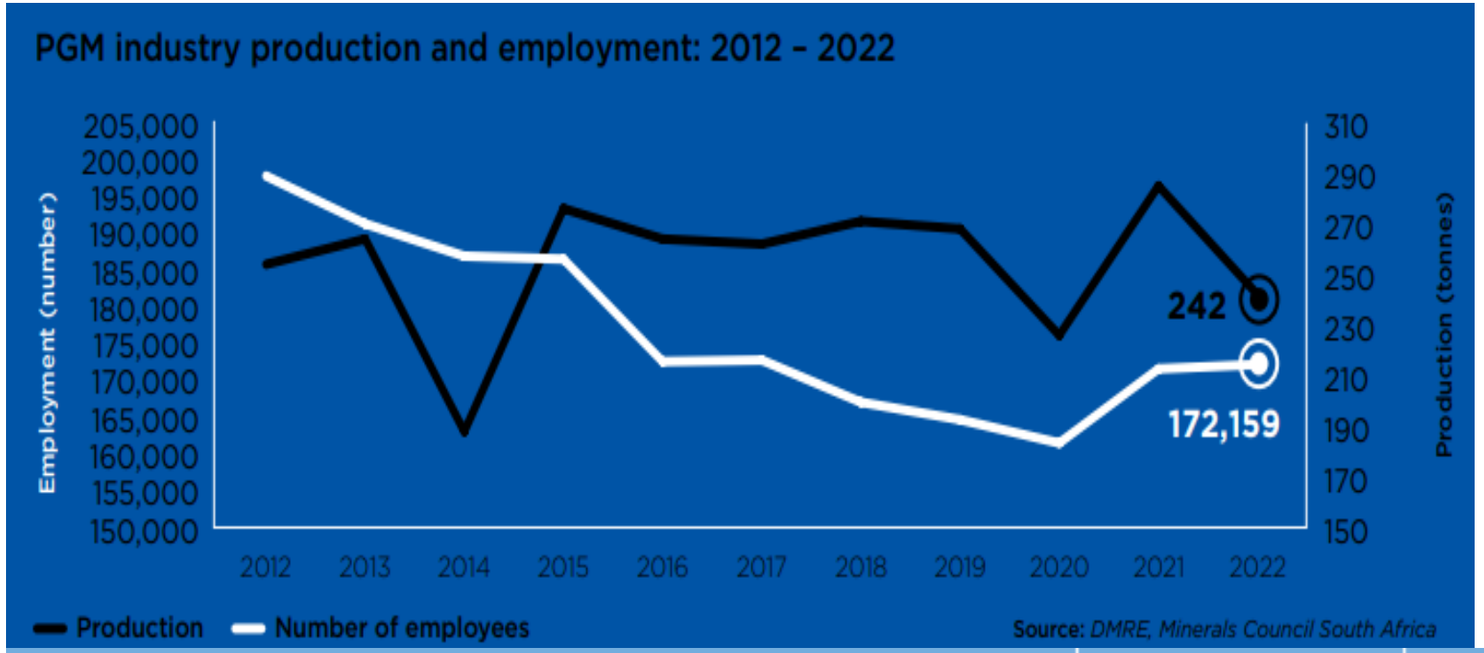
South Africa's PGM mining industry



Year	Total sales (tonnes)	Sales in Rbillion
2013	266	84
2014	230	78
2015	286	94
2016	282	96
2017	283	97
2018	268	105
2019	243	136
2020	193	190
2021	277	347

PGM	2022	% Change on prior year	2019 to 2022
Direct Employees (number)	172,159	0.3%	4.6%
Employee Earnings (rand billion)	66.8	-0.8%	20.3%
Royalties (rand billion)	5.7	106.1%	409.5%
Production (tonnes)	242	-15.2%	-9.8%
Total Sales (rand billion)	287.4	-17.1%	111.3%
Percentage of value exported 22	92.7%		

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PGMs – The Green Metals

195.1	78
Pt	
platinum	

106.4	46
Pd	
palladium	

102.9	45
Rh	
rhodium	

192.2	77
Ir	
iridium	

101.1	44
Ru	
ruthenium	

- PGMs in **autocatalysts** transform noxious exhaust gases – hydrocarbons, nitrogen oxide and carbon monoxide into more benign components of water, carbon dioxide and nitrogen gas.
- **Green hydrogen** made in electrolysers via renewable energy - key to decarbonising heavy industry & everyday activities
- **PGM-based proton exchange membrane** (PEM) technology well-suited to using intermittent renewable energy feed (such as from solar)
- **Hydrogen fuel cells** – efficient & environmentally friendly alternative for delivering power
- **Platinum** – effective catalyst for PEM **electrolysers** and **fuel cells**
- **Iridium** – key to hydrogen economy, in PEM electrolysers with platinum to produce hydrogen
- **Ruthenium** - effective in PEM fuel cells with platinum, scalable from small devices to heavy duty transport

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Source: Sibanye Stillwater

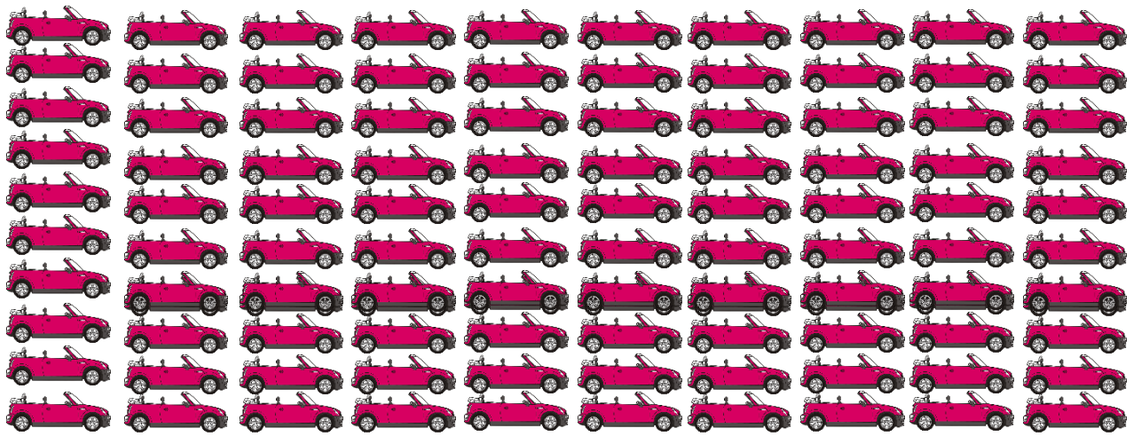
PGMs – The Green Metals

Since the 1970's Nox, Sox, CO, HCs, and particulate emissions down 99% in cars and busses. PGMs played a key role.

Emissions from one car sold in 1970s

=

Emissions from 100 cars sold in 2021



PGMs, technology development and standards enabled this to happen

PGM vehicle emission catalysts including exhaust system catalysts, catalysed particulate filters and emission absorbers convert 99% of combustion engine pollutants (HC, CO, NOx, and particulates) enabling vehicle producers to meet EU, Japanese and USA standards

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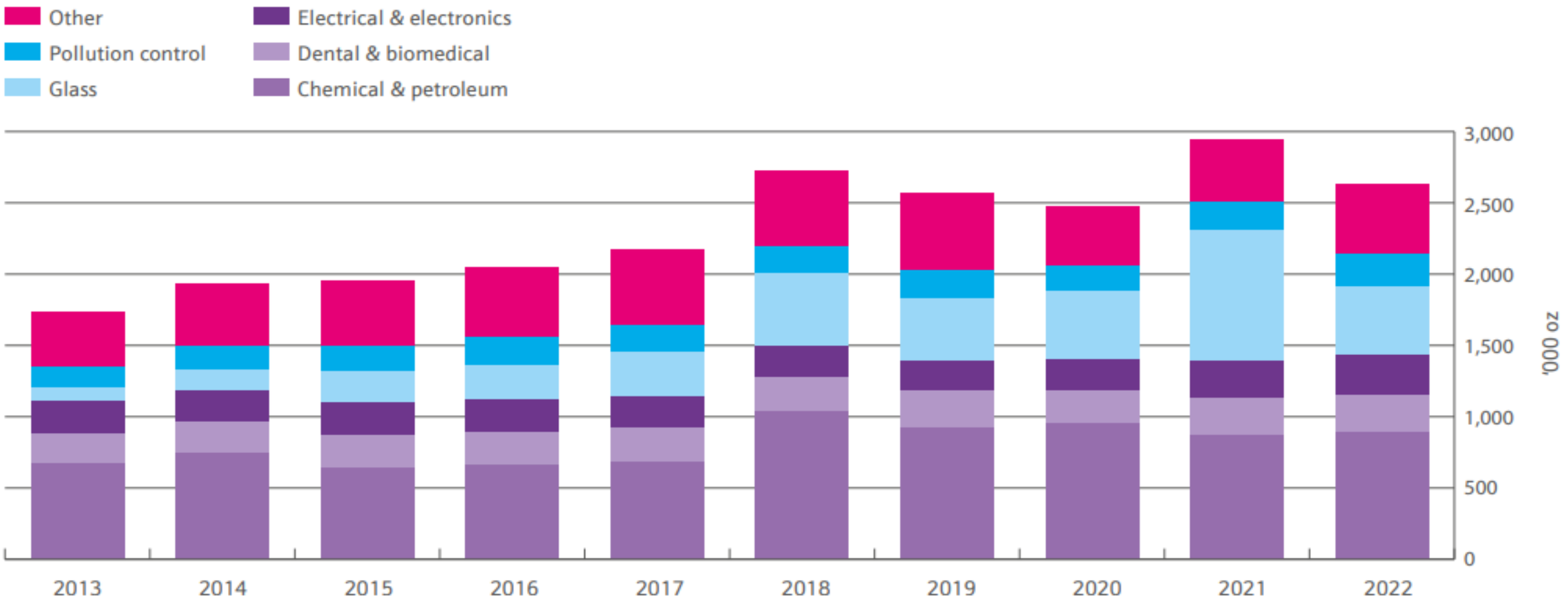
Source: UD Dept Transport

PGMs are critical for the global economy

Industrial demands for platinum



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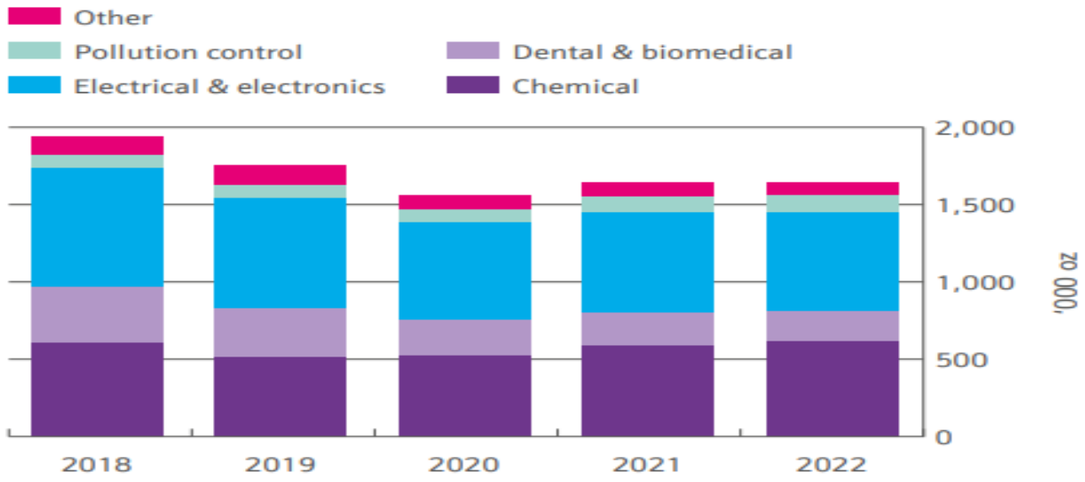
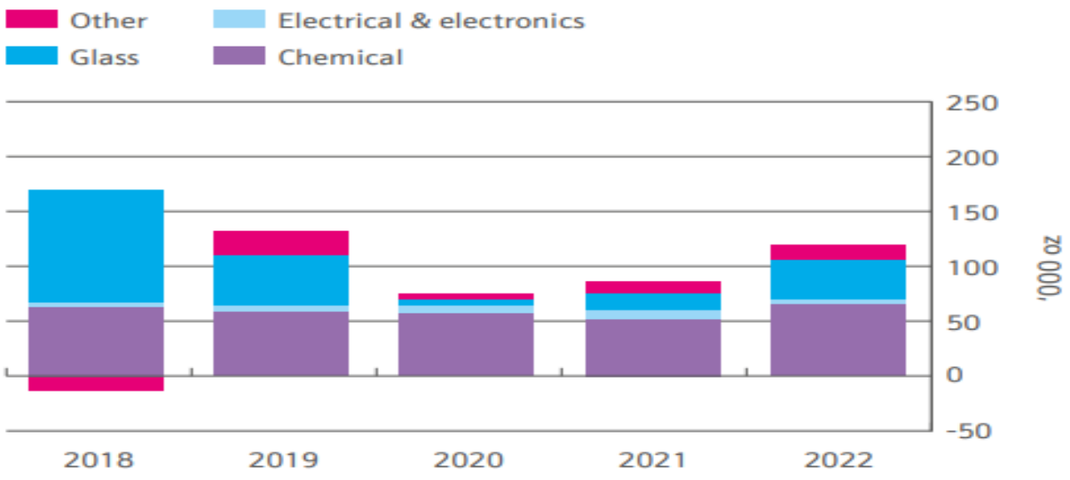
Source: Johnson Matthey

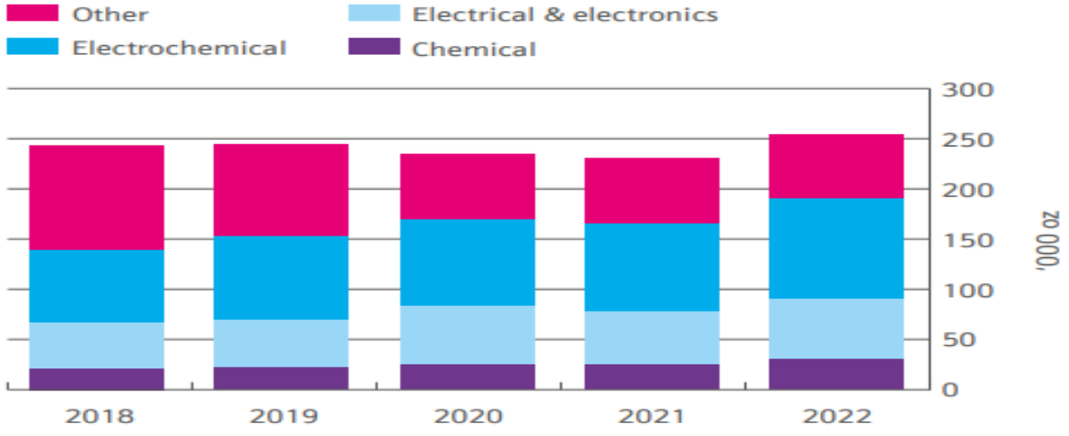
Industrial demand for palladium



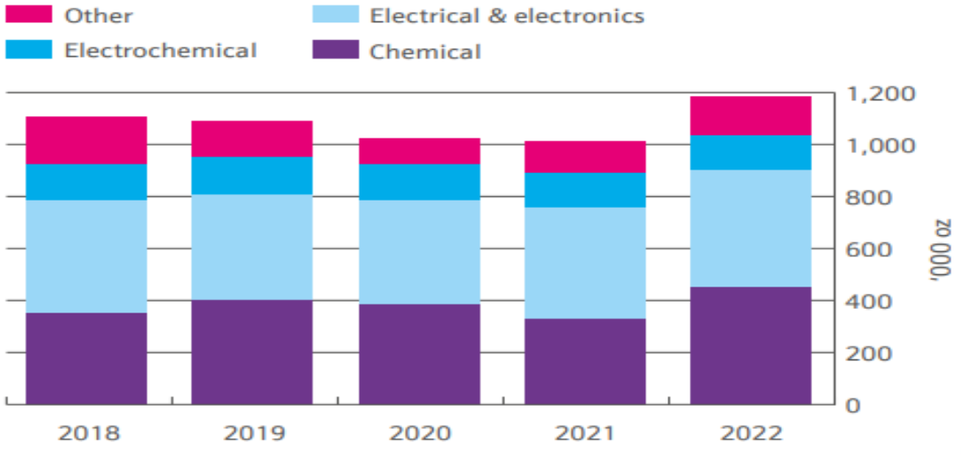
Industrial demand for rhodium



Industrial demand for iridium



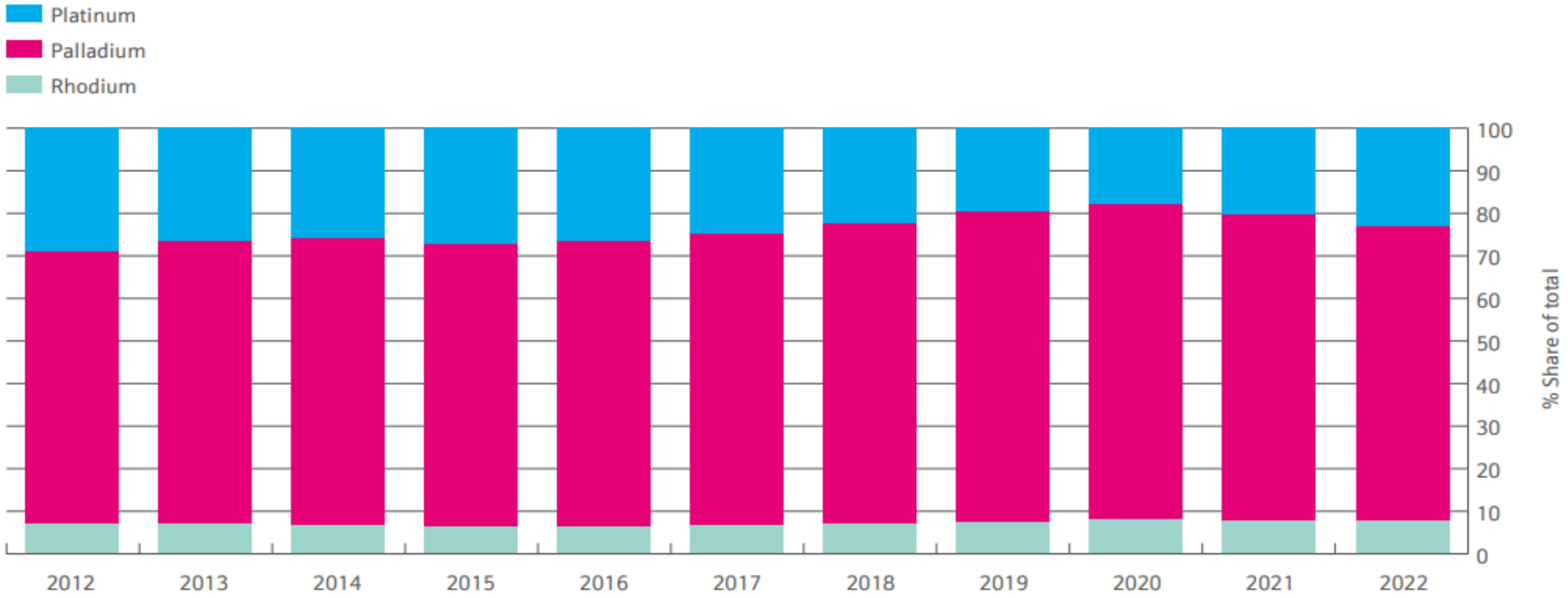
Industrial demand for ruthenium



Source: Johnson Matthey

PGMS in the automotive industry

- Palladium is the most used metal to make autocatalysts, followed by platinum and rhodium – SA is the largest source of all three metals combined



Source: Johnson Matthey

Greening the environment, reducing carbon intensity

1. PGMs' green credentials are long-standing – autocatalysts, electrolysis and fuel cells

2. PGMs are already playing a crucial and growing role in the global energy transition to net zero. At least 30 countries have developed or are developing hydrogen strategies towards decarbonising their economies.

3. The combination of green hydrogen displacing natural gas, and fuel cell electric vehicles (FCEV) displacing internal combustion engine vehicles could result in net carbon dioxide savings of up to 11% of the Paris Agreement's 2030 targets.

4. Annual platinum demand in 2030 from FCEVs and electrolysers of between 1.6 million ounces and 2.4 million ounces provides a growth opportunity for South Africa – the biggest source of primary platinum -- of between 34% and 51% by 2030 from the current base of 4.7 million ounces.

5. Investments of more than $300bn up to 2030 in hydrogen as demand increases sevenfold up to 2050, with two thirds of hydrogen supply coming from electrolysis

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Source: WPIC

Platinum market demand – four main drivers

AUTOMOTIVE
31–43%*

Main markets; Europe, Japan

Platinum is used in catalysts to reduce harmful emissions

Fuel cell vehicles, a type of electric car, also use platinum

INDUSTRIAL
22–27%*

Main markets; China, North America

Platinum is used in applications such as fertiliser manufacture, hard disks and pacemakers

JEWELLERY
24–32%*

Main markets; North America, China, Japan

Platinum is seen as superior to gold (and priced accordingly) – so jewellers make a higher margin

Platinum seen as metal of love

INVESTMENT
0–20%*

Investors can buy Exchange Traded Funds (ETFs), bars, coins, etc

Investors can also gain exposure through platinum futures equities etc

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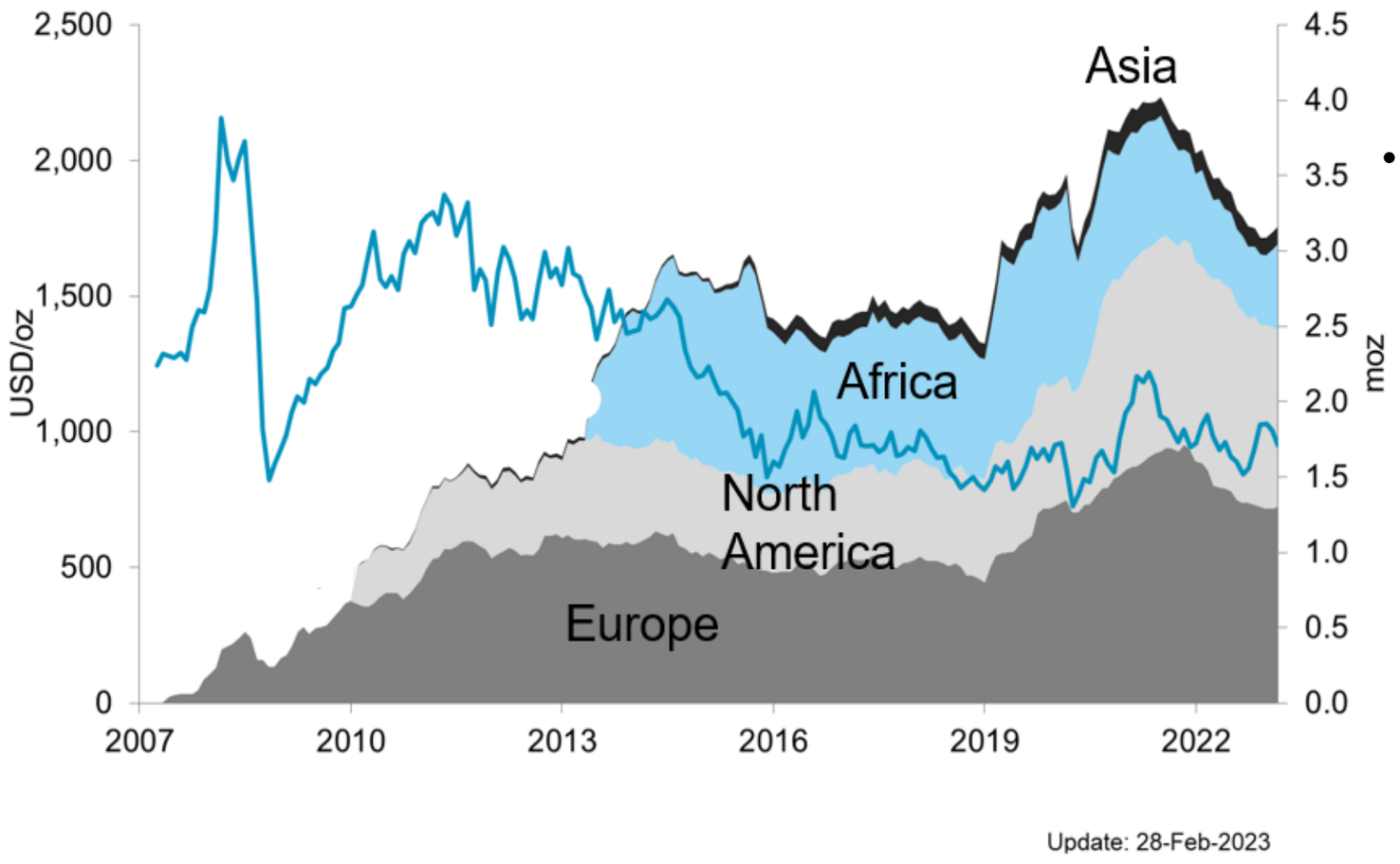
Source: WPIC

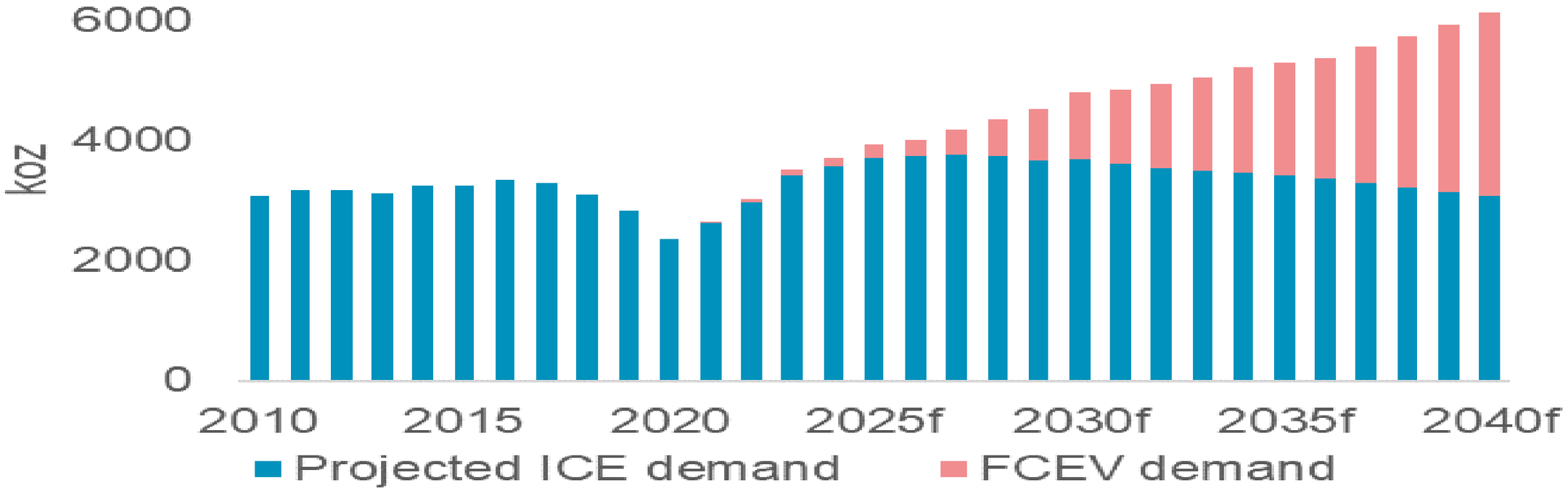
Investment in platinum grows – global ETF holdings



- As supply growth seldom matches demand growth, both investment demand and jewellery demand are price elastic and can provide metal to meet supply demand mismatches along the way

Source: WPiC

Demand for platinum in the auto sector will grow



- Platinum demand growth from substitution of palladium on a 1:1 basis.
- As demand for internal combustion engines eases through the 2030s, FCEVs become a main driver of platinum demand growth.
- Broad-based commercial adoption of FCEVs could add more than three-million ounces to yearly platinum demand in ten years.

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Source: WPIC

Demand for platinum in Heavy Duty FCEVs is promising

- Decarbonising freight transportation is critical to achieving net zero goals around the world and hydrogen fuel cells are poised to play a major role in achieving this.
- Heavy-duty FCEVs are expected to be one of the first segments of the hydrogen economy to achieve scale.
- Targeted growth in the total number of fuel cell trucks on the road is expected to rise from <1% 2020 to over 50% of the global truck market (currently between 2.3 million and 3 million) by 2035.
- Demand for platinum in FCEVs, based on this growth & passenger FCEVs, is expected to increase annual platinum demand by well over two million ounces (62 tons) by 2035; over 25 per cent of current annual demand.

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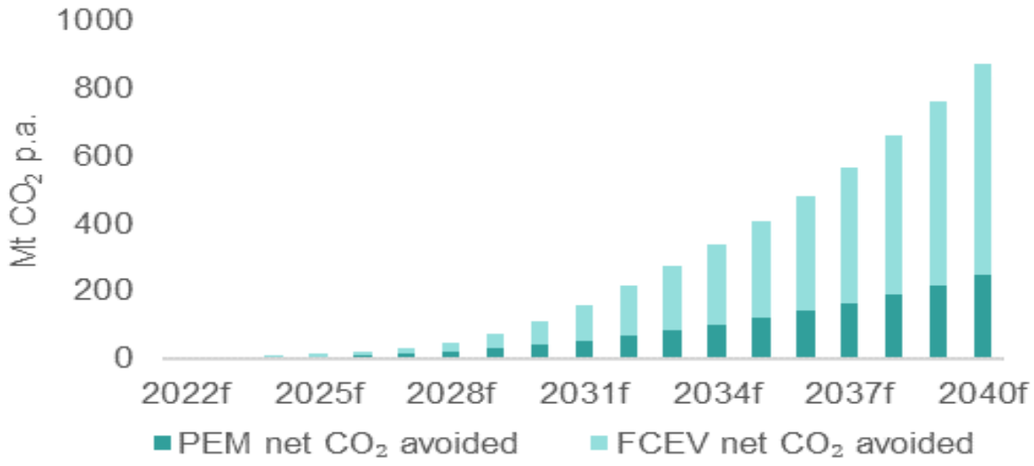
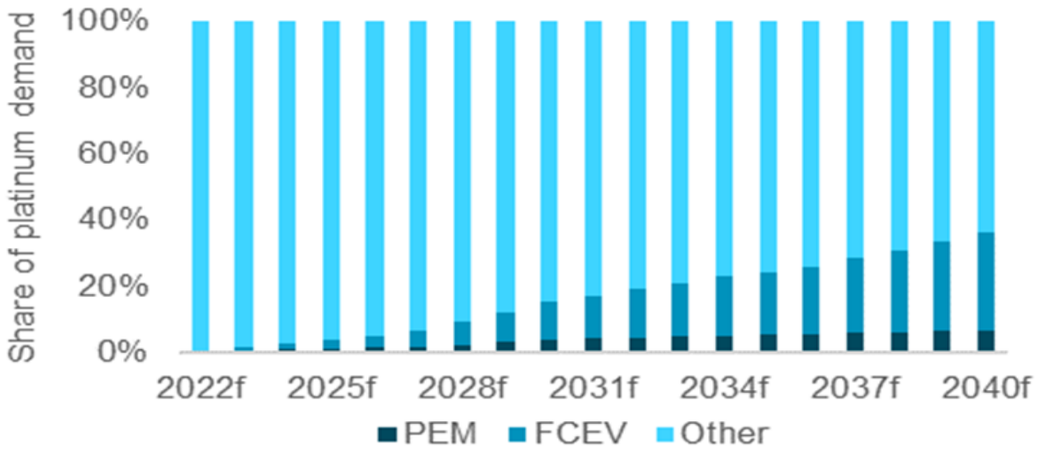
Source: WPIC

Green hydrogen production & FCEV usage may significantly reduce CO2 emissions





- Proton exchange membrane (PEM) electrolysers and fuel cell electric vehicles (FCEVs) have the potential to significantly reduce CO2 emissions, making material contributions to the UN's targeted CO2 cuts by 2030
- Platinum demand from PEM electrolysers and FCEVs becomes a meaningful component of global demand by 2030 and potentially the largest segment of platinum consumption by 2040
- Platinum-related green hydrogen production and use could contribute up to 11% of the Paris Agreement reductions necessary by 2030
- Global decarbonisation policy certainty is a key enabler as it will provide mining companies with the necessary medium-to-long-term demand certainty to be courageous and invest in capacity expansion

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Hydrogen raising investor interest in platinum

- **Green hydrogen offers:**
- Significant CO_2 saving potential
- Energy independence/security
- Hydrogen linked public funding and subsidy commitments of **>US$790 billion**
- Green hydrogen competitive with fossil fuels at current prices
- Attractive for private funding
- Platinum is a proxy for investing in hydrogen where there are limited publicly listed investment opportunities

Hydrogen uses and the role of PGMs in the hydrogen economy

- H_2 is used to displace natural gas in hard to electrify end uses and as a fuel in fuel cells and fuel cell electric vehicles
- Platinum and iridium are used in PEM electrolysers to make green hydrogen by splitting water into hydrogen and oxygen. Ruthenium may replace iridium.
- Platinum is used in fuel cells to generate electricity from hydrogen, with water and heat as the only by products.

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Source: WPIC

Minerals Council launched a Green Hydrogen Leadership Forum

- Members of the Minerals Council are charting a strategy on how to use green hydrogen to:

❖Create sustainable, cost-effective green energy

❖Decarbonise their mining operations

❖Address risks of global carbon border taxes for their products

❖Take pressure off the national electricity grid supplied by Eskom

❖Create pollution-free work environments for employees by using hydrogen fuel cell vehicles and machines underground and on surface

❖Collaborate with other key industries and partners (e.g. Energy Council)

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Our PGM miners are investing in the future

Anglo American Platinum:

- developed the world's largest hydrogen-powered mine haul truck
- Saving 900,000 litres of diesel per truck each year
- 50% to 70% reduction in emissions (scope 1 and 2 for open pit mines), while maintaining operating cost structure
- Set up AP Ventures as independent venture capital fund. Impala Platinum has joined.

Sibanye-Stillwater:

- Partnered with Heraeus Precious Metals to jointly research and develop novel Proton Exchange Membrane (PEM) electrolysers using ruthenium and iridium.
- Iridium is the scarcest of the PGMs and could constrain widespread adoption of PEMs
- Studying technologies that reduce or replace iridium with ruthenium or other metals to be cost competitive and creating a sustainable hydrogen ecosystem.

Impala Platinum:

- In 2016, developed and implemented first hydrogen fuel cell forklift and hydrogen refuelling station at its Springs refinery.
- Has invested R25 million in fuel cell development in SA in collaboration with the government and academic institutions

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Thank you

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