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Platinum group metals: an enabler for hydrogen ... not a barrier

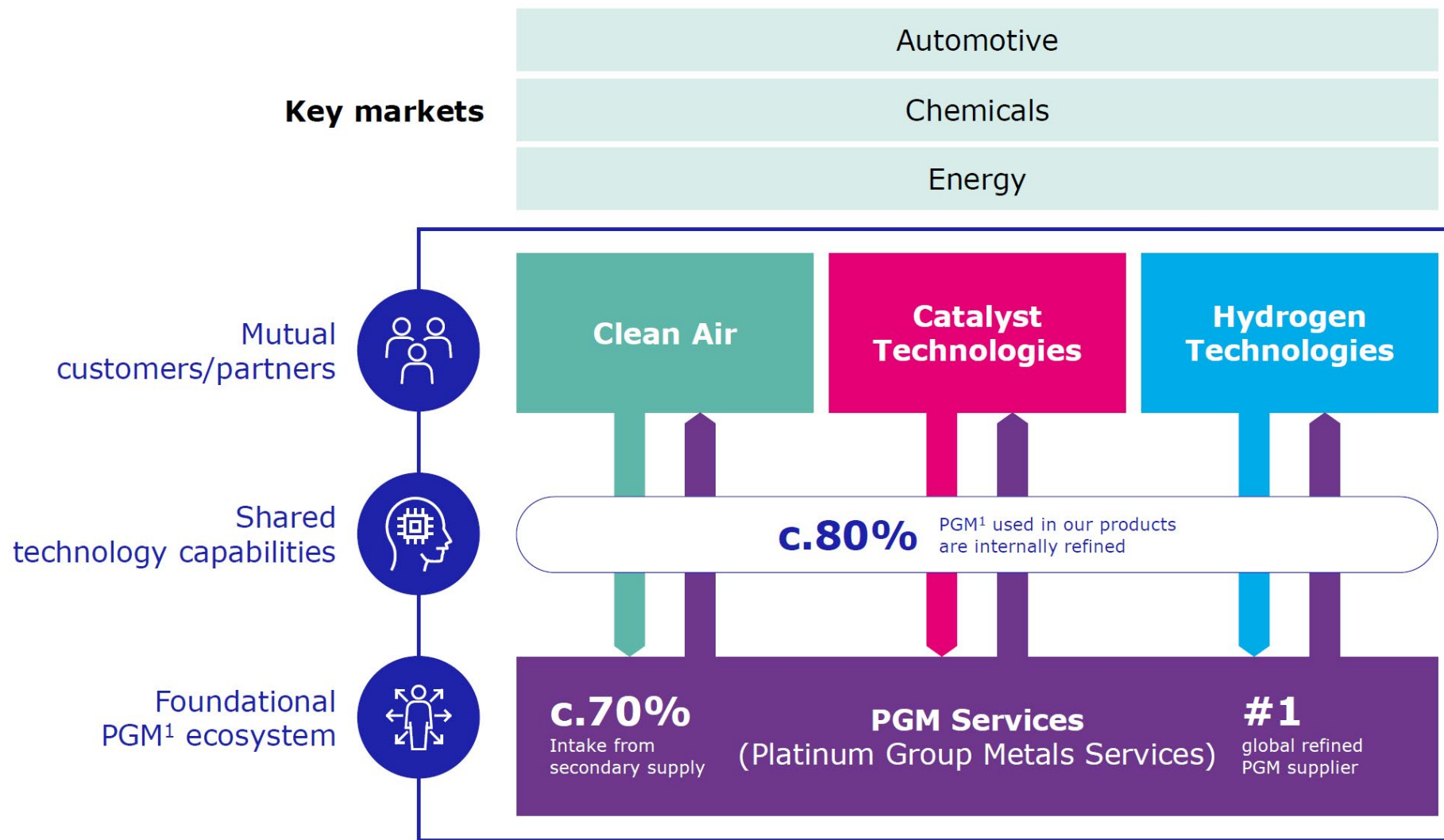
Marge Ryan, Johnson Matthey

4 April 2023

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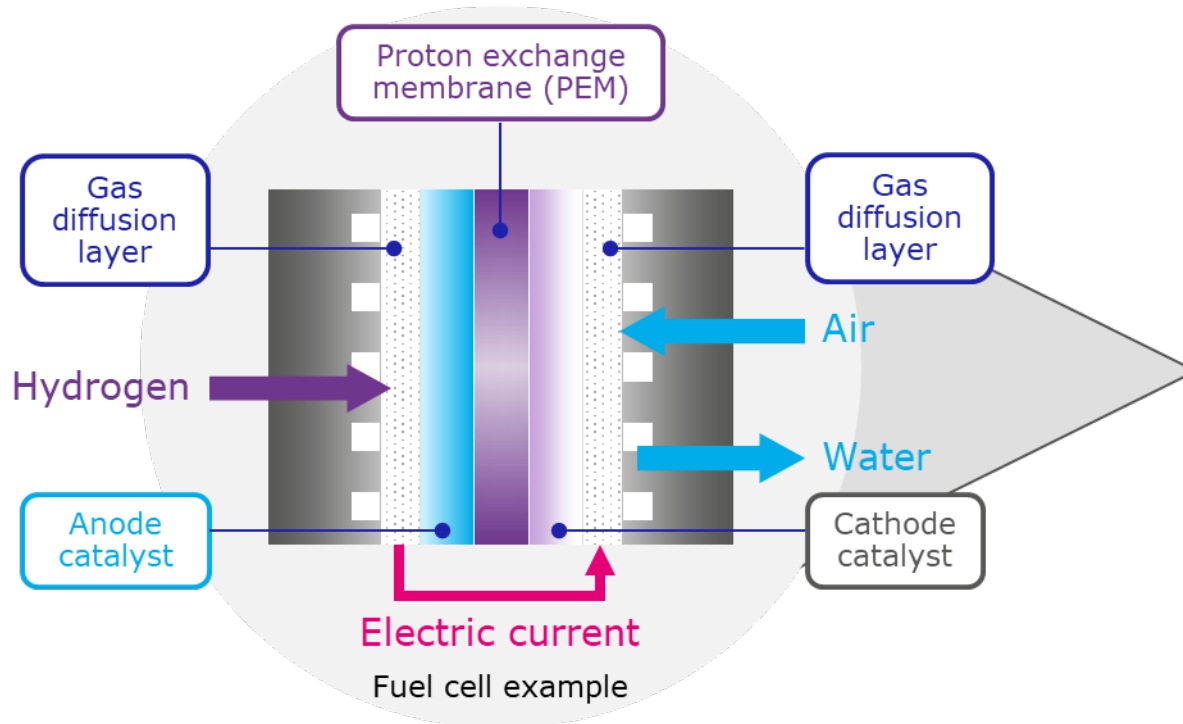
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Johnson Matthey understands the platinum group metals



Platinum group metals: catalysing PEM hydrogen technology

Principally used in **PEM fuel cells** (convert hydrogen and oxygen into electricity and water) & **PEM electrolyzers** (convert water into hydrogen and oxygen)



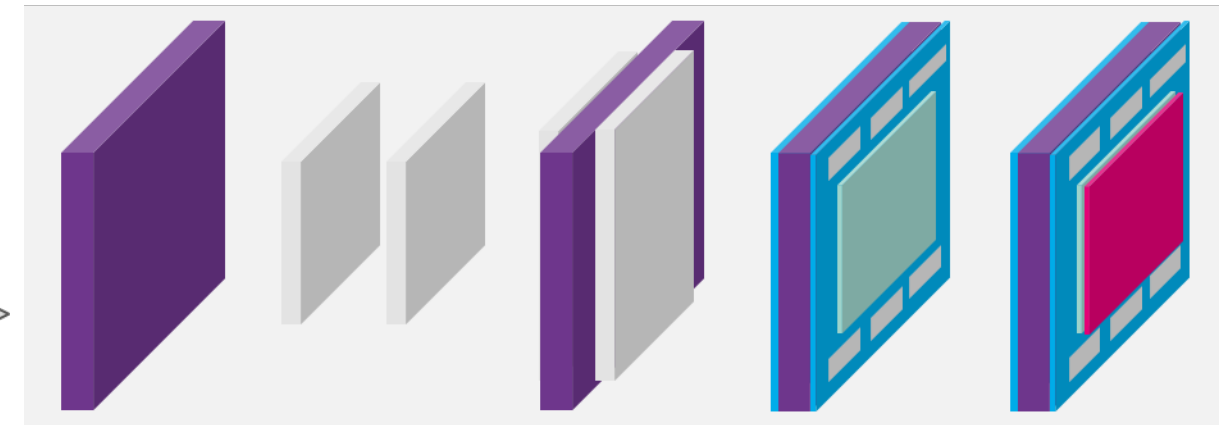
Proton exchange membrane (PEM)
Membrane and associated supports

PGM Catalysts
Anode and cathode layers

Catalyst coated membrane (CCM)
'3-layer system'

Sealed CCM
'5-layer system'

Membrane electrode assembly (MEA)
'7-layer system'



Fuel cell and electrolysis components

Ionomer
ePTFE

Carbon
PGM /
other metal
Ionomer

Membrane
Anode catalyst
Cathode catalyst

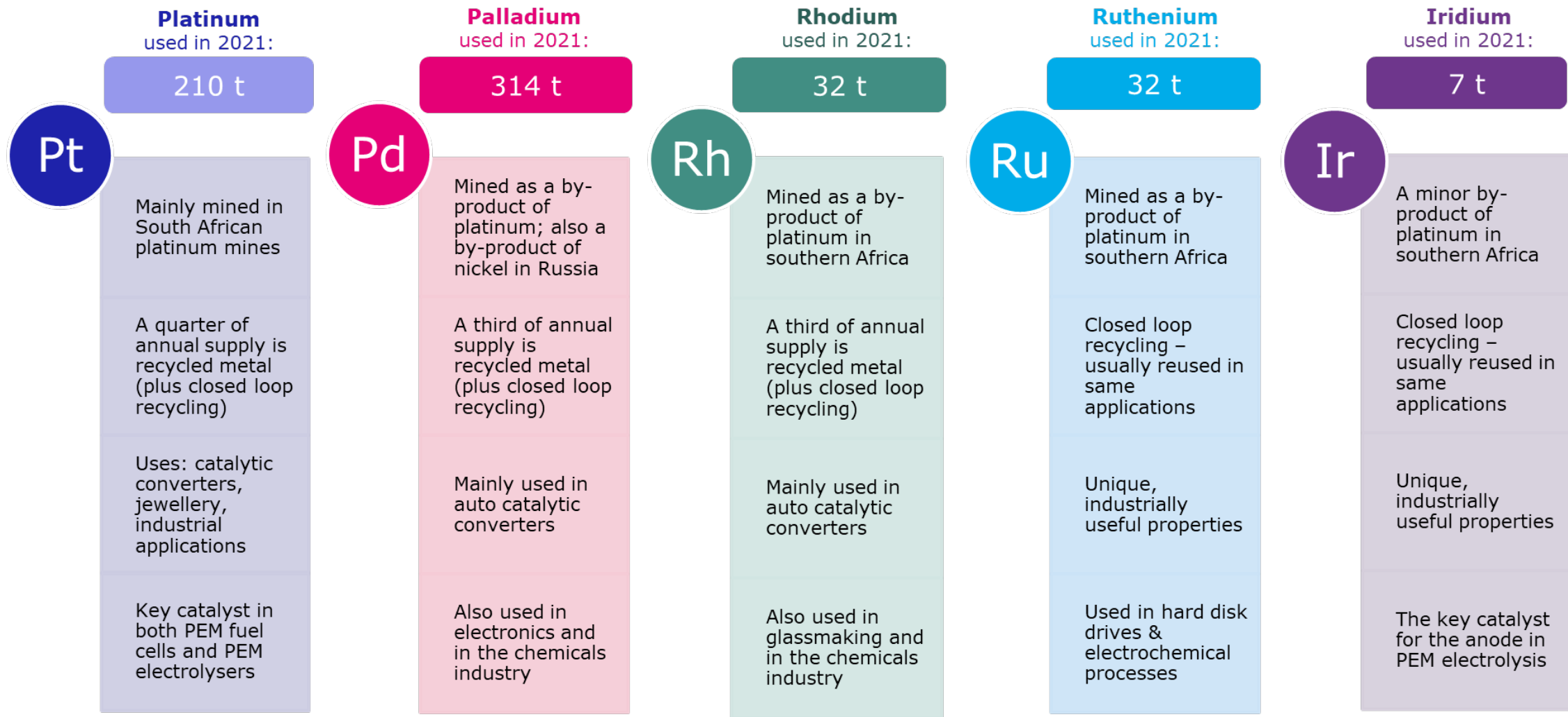
CCM
Seals

Sealed CCM
Gas diffusion layer

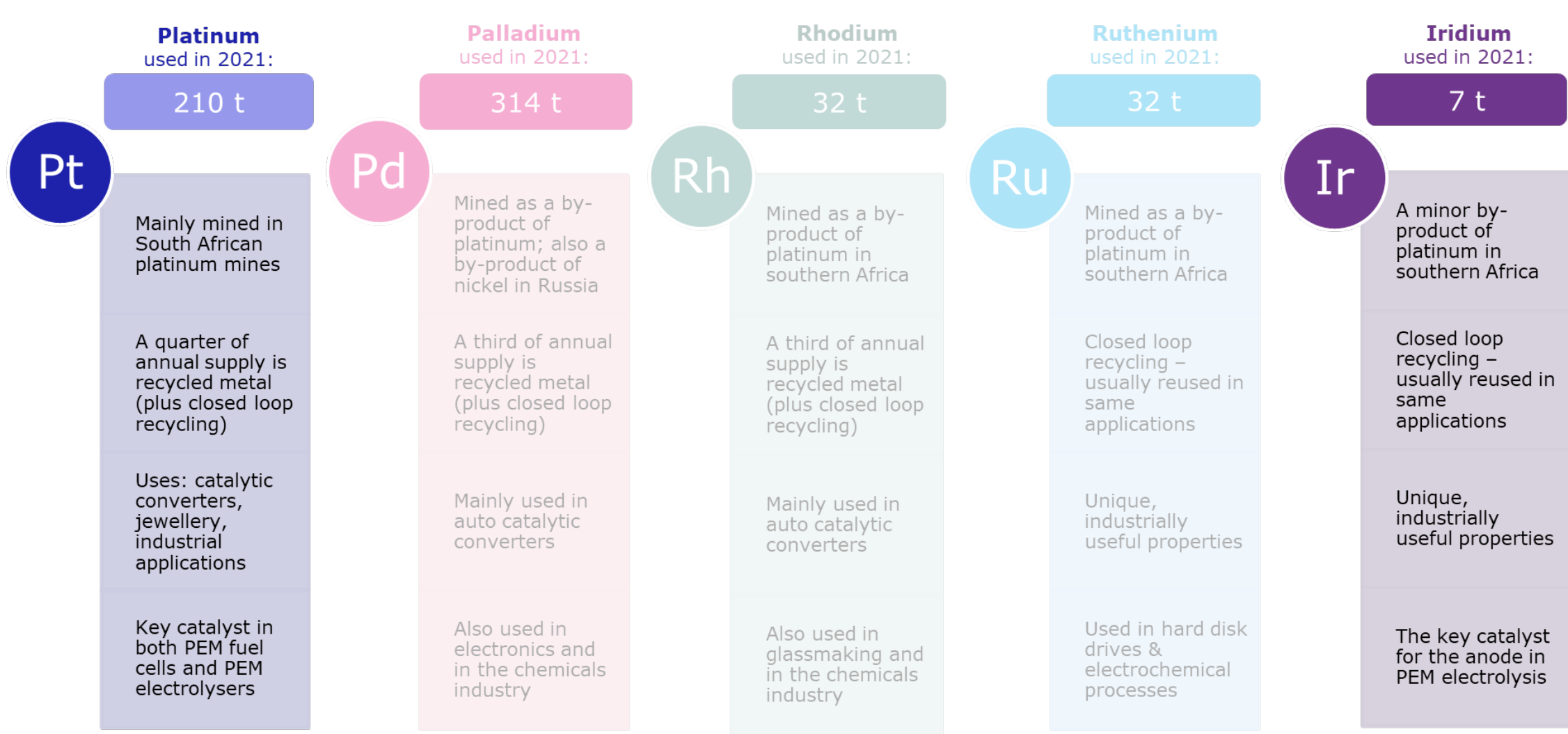


Hydrogen Tech World Conference 2023

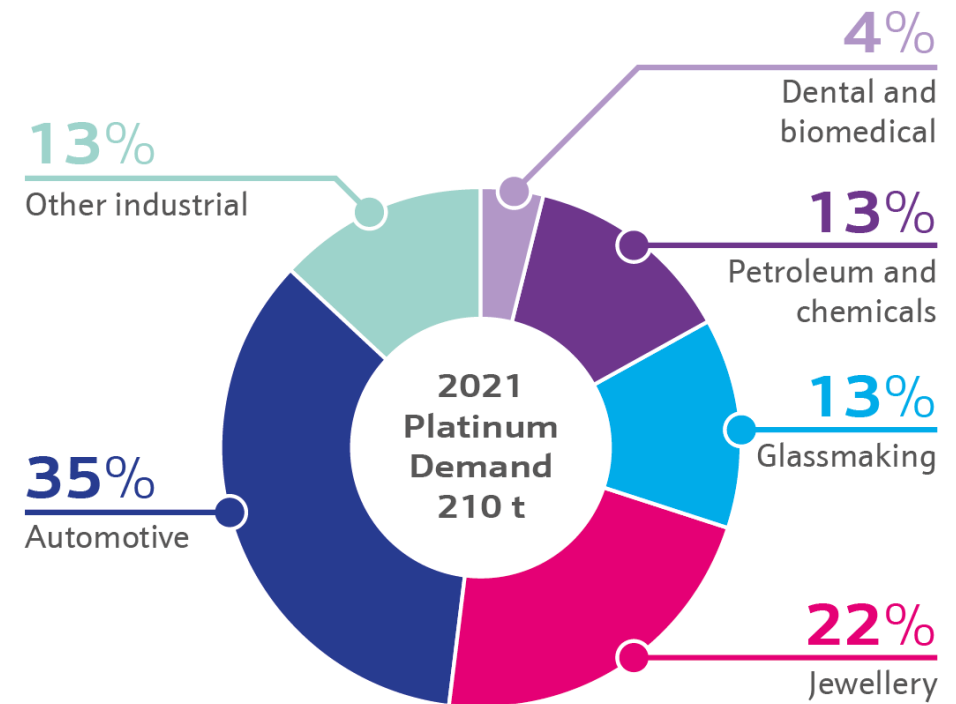
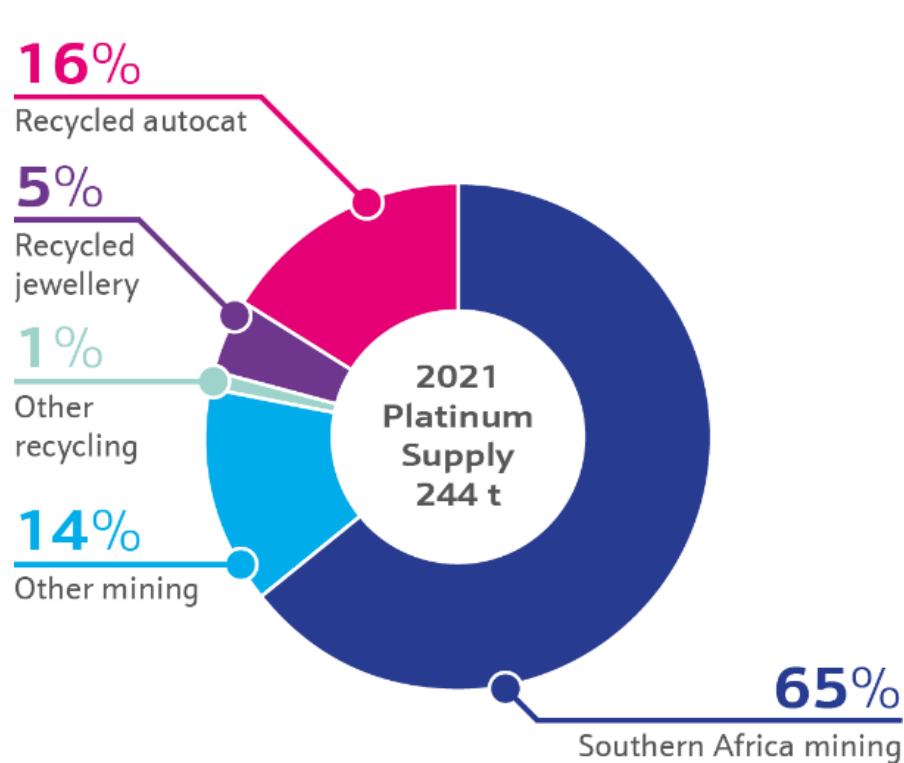
What are the platinum group metals?



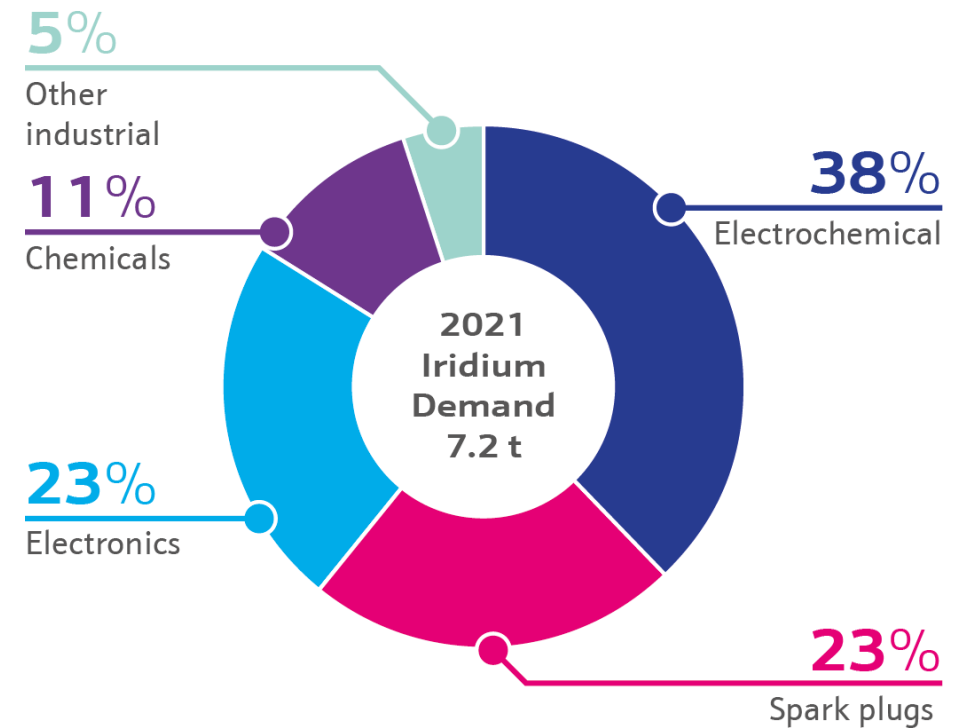
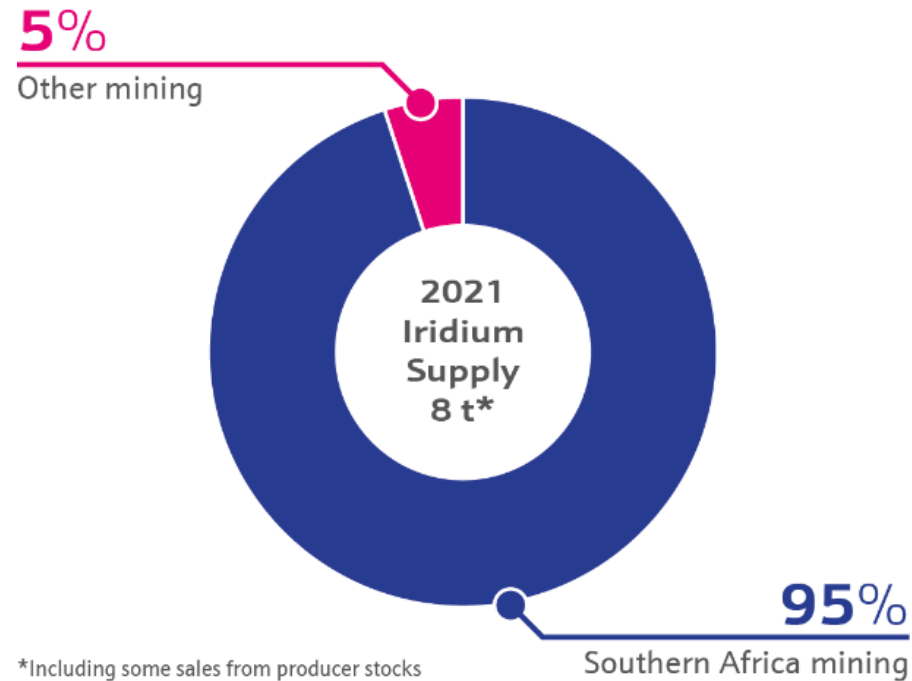
PGM most relevant to PEM hydrogen technologies



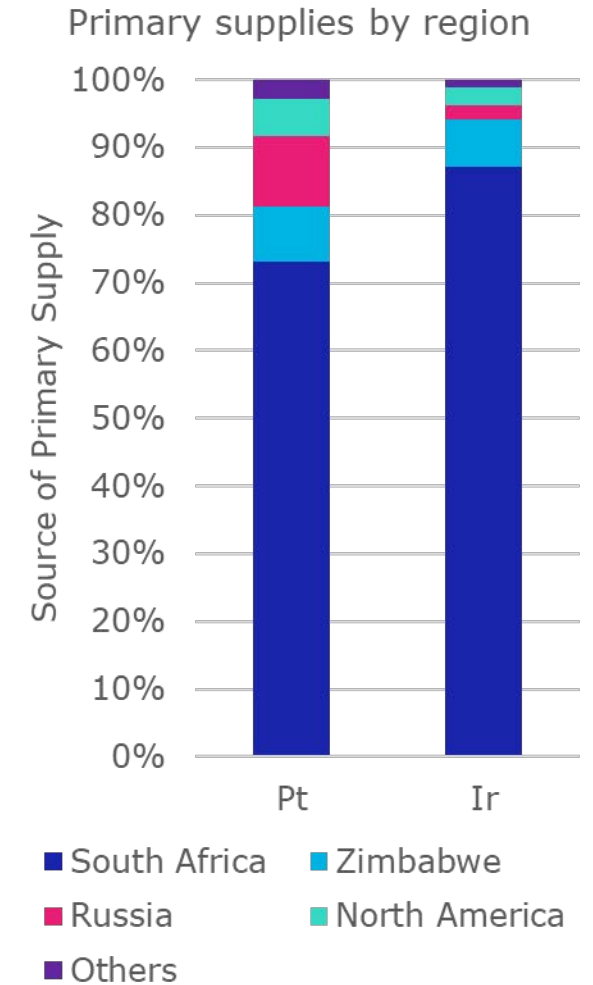
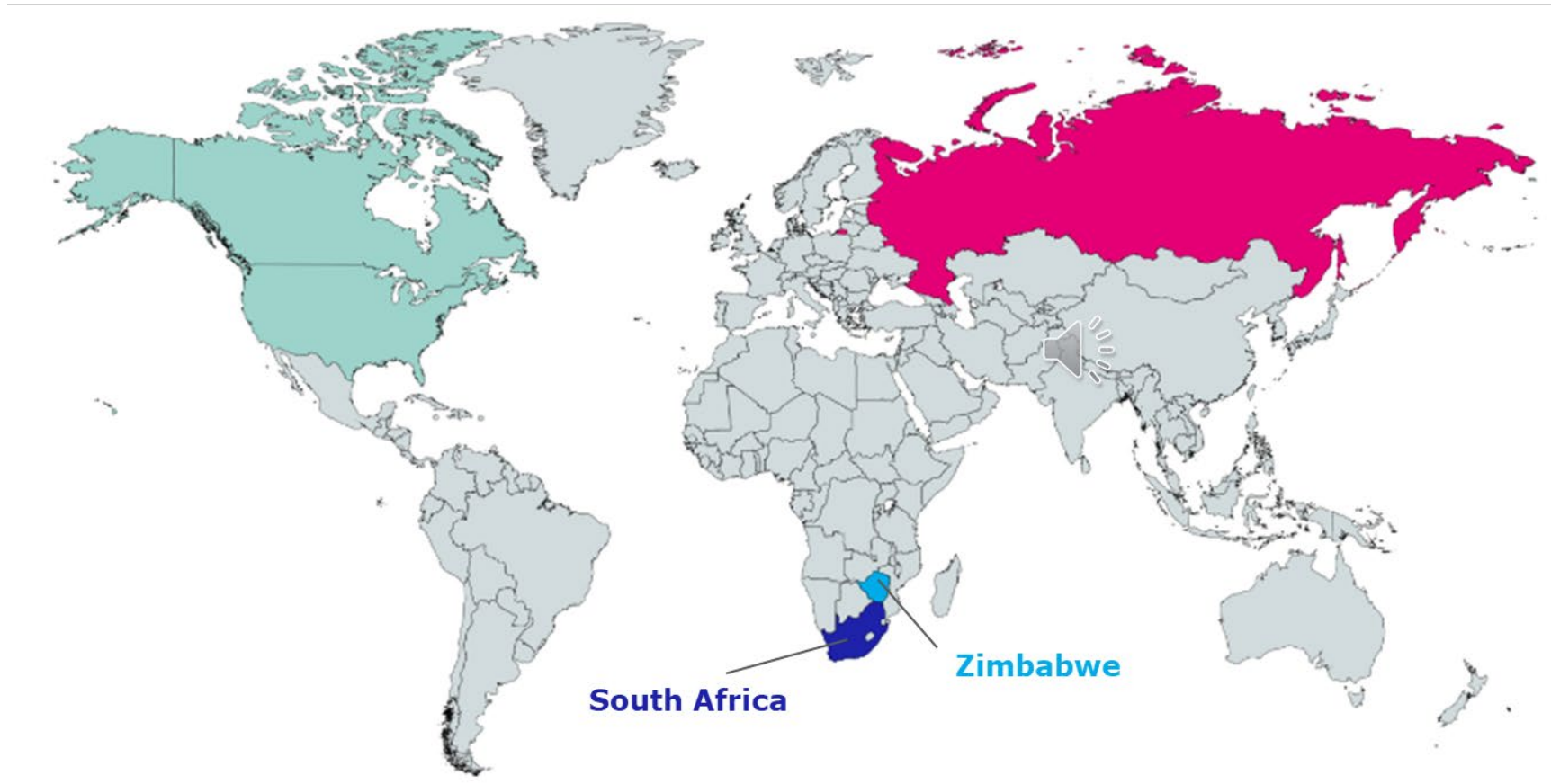
Platinum: a well-supplied metal that is ready for a new market



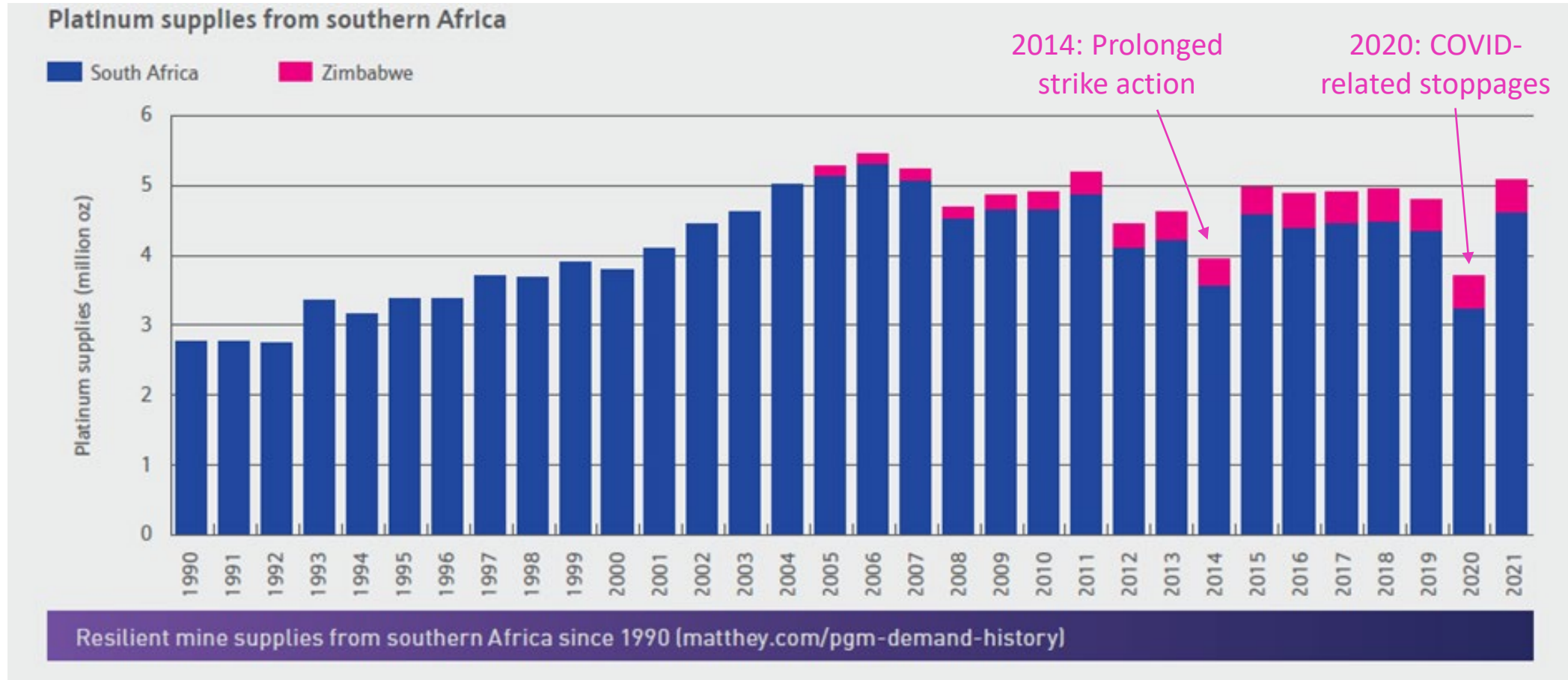
Iridium: constrained supply still allows major industrial uses



Platinum and iridium mining: concentrated in Southern Africa



Southern African PGM mining: regulated and resilient



PGM recycling: a routine, value-driven practice



- Visible in reported figures
- Source of market supply

Pt

- Not reported
- Reduces market demand

Pt

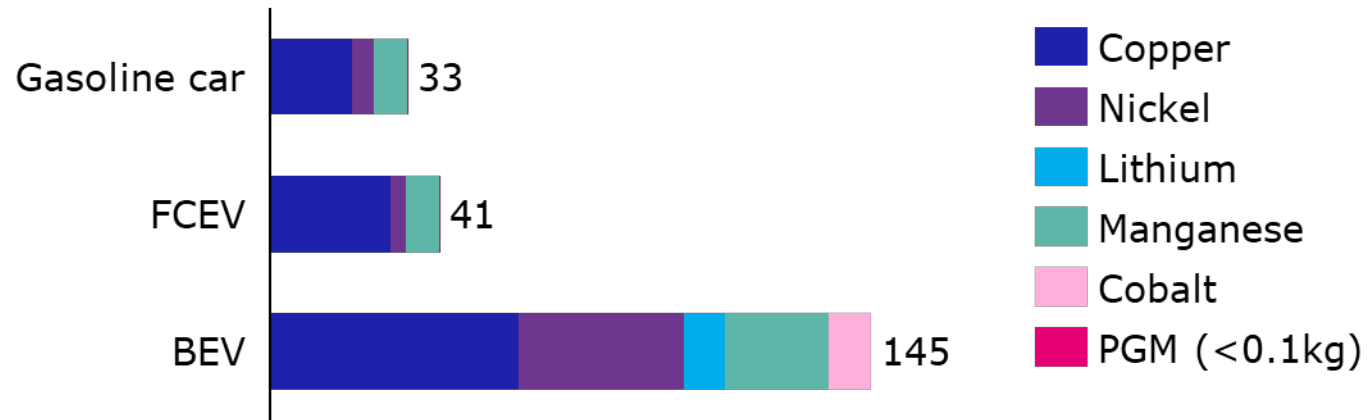
Ir

Total recycling losses comprise:

- Any losses during usage
- Any **collection** losses
- Any processing losses

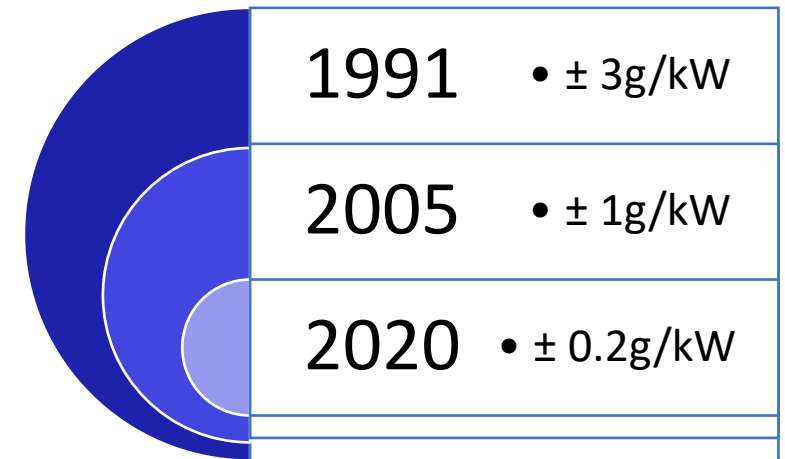
PGM intensity: relatively low... and getting lower

Typical critical metal content per medium passenger car,
kg/vehicle



Source: JM analysis/FVV study/IEA

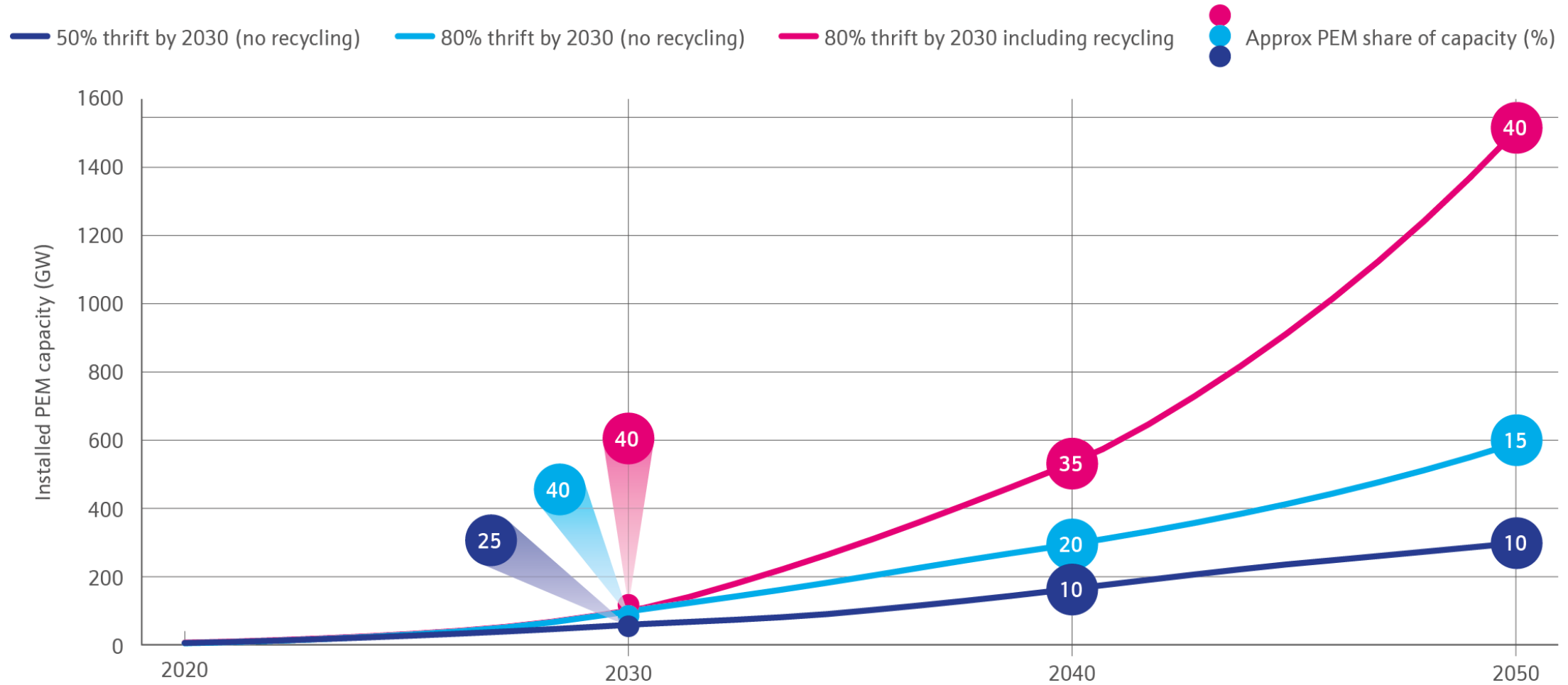
PGM intensity in fuel cells has
already seen steady decline...
more to come



The power of PGM recycling & thrift together: iridium example

[See: Recycling and thrift: the answer to the iridium question in electrolyser growth | Johnson Matthey](#)

The impact of thrift and recycling on PEM capacity, based on 1.5 tonnes p.a. iridium supply



Platinum & iridium: challenging the myths



They are expensive, it would be better to switch to cheaper alternatives



Recycling will be difficult and mining is subject to geopolitical risk & ESG concerns



There is not enough available to support the growth we need in hydrogen



Platinum & iridium: challenging the myths



They are expensive, it would be better to switch to cheaper alternatives

They are used in **small quantities**: expensive on a per-gram basis, not on a total equipment cost basis. PGM are an **investment**: performance is unparalleled and they can be recycled and reused.



Recycling will be difficult and mining is subject to geopolitical risk & ESG concerns

Recycling happens **routinely** today. Primary supply from southern African mines is typically from **highly regulated** companies that report on ESG performance, support **local communities** and are investing to **reduce environmental footprint**.



There is not enough available to support the growth we need in hydrogen

JM is an expert in PGM research, we project market growth can be accommodated within available supplies – with **efficient metal** use through thrifting and recycling.

Final comments

- PGM markets face different dynamics from base metal/battery metal markets.
- Thrifting and recycling of PGM are well-established and value-driven.
- PGM value is thus a benefit for circularity (while PGM cost contributes <5% to total equipment cost).
- With expected levels of thrifting and recycling, the necessary targets in FCEV and green hydrogen deployment can be reached.

The PGM present an opportunity for the energy transition, not a barrier.



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