



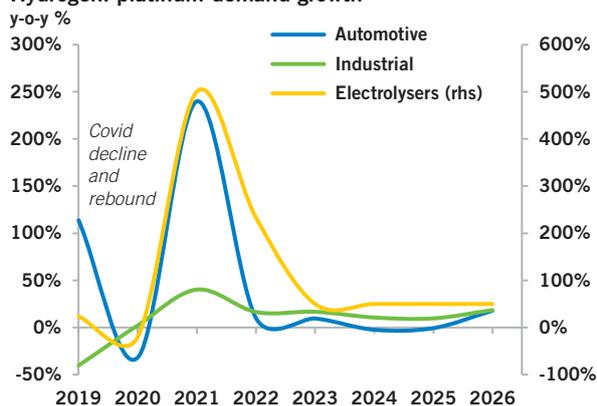
MARKET SPOTLIGHT

Hydrogen ICE: iridium gains but platinum has losses and gains

Hydrogen internal combustion engines (ICEs) could be the future for powering large vehicles and non-road and stationary equipment. Hydrogen can be burned in a combustion engine, which has some standard engine parts, with a fuel injection and ignition system for the hydrogen. This means that manufacturing and repairs are straightforward with existing technology and infrastructure. The hydrogen engine is a similar size and cost to a diesel engine, whereas fuel cells are currently much more expensive, as are batteries which also add dramatically to the weight of trucks or excavators. Non-road equipment tends to be run for a significant portion of the working day and may even do two shifts, meaning that the frequency and time needed for recharging also make batteries unsuitable.

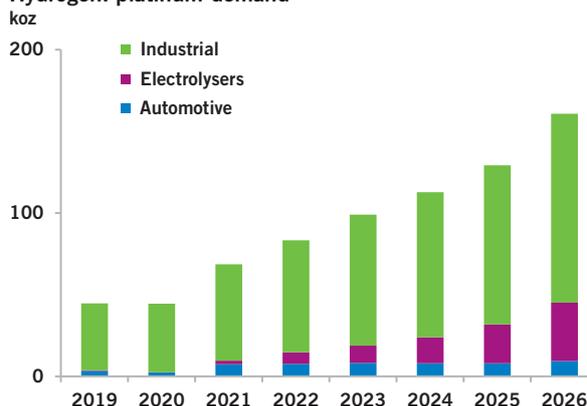
Hydrogen engines may not require autocatalysts, removing some PGM demand. There may be some NOx emissions, but the engine temperature can be controlled to limit those and selective catalytic reduction (no PGMs) used if necessary. The US, Europe and Japan have legislation for emissions from non-road equipment that results in some modest PGM demand (~160 koz Pt, ~40 koz Pd) for autocatalysts.

Hydrogen: platinum demand growth



Source: SFA (Oxford). Note: Industrial fuel cells include stationary and non-road applications such as trains, materials handling equipment etc.

Hydrogen: platinum demand



Platinum could still benefit if the hydrogen engine is the way to decarbonise heavy machinery. To properly decarbonise this sector, the hydrogen needs to be green, i.e. produced from renewable energy with electrolysers. Of these, proton exchange membrane (PEM) electrolysers use platinum (and iridium) as catalysts. The loss of platinum demand for vehicle catalysts could be exceeded by additional demand from electrolysers. Platinum, or iridium, could also gain from previously diesel engines now requiring spark plugs. Platinum use in electrolysers is only a few thousand ounces at present, but it is expected to grow rapidly as the hydrogen economy expands.

Hydrogen engines will soon be available. JCB is investing £100 million in the development of hydrogen engines for its non-road equipment, with the first vehicles expected to be available by the end of 2022. Rolls-Royce is developing gas engines for power generation that can run with 10% hydrogen now and up to 100% in 2023. In the near term, the limiting factor for sales is likely to be hydrogen availability.



PRECIOUS METALS REVIEW

79 Au Gold

	Close	Weekly change	High	Date	Low	Date
\$/oz	1,786	0.99%	1,814	22/10/2021	1,760	18/10/2021
€/oz	1,535	0.66%	1,557	22/10/2021	1,518	19/10/2021

Russia's central bank is buying gold again, adding 3.1 tonnes to its reserves in September and taking the total to 2,298.5 tonnes. This follows a similar purchase in July, which was the first addition to its reserves by the central bank since April 2020. Globally, central banks have purchased 376.5 tonnes in the first eight months of the year (source: World Gold Council). The full-year total will comfortably exceed the 104.4 tonnes acquired last year, but is likely to fall well short of 2019's 645.1 tonnes.

Indian gold imports jumped year-on-year from 12 tonnes to 91 tonnes in September, helped by the lower gold price. This was convenient for jewellery fabricators as India is entering the festival season with Diwali in early November. This year, gold jewellery sales are likely to be higher than last year (315.9 t), but are unlikely to return to normal levels (500-600 t) because the impact of Covid on the economy has been significant for a second year.

47 Ag Silver

	Close	Weekly change	High	Date	Low	Date
\$/oz	24.25	4.01%	24.83	22/10/2021	23.02	18/10/2021
€/oz	20.85	3.66%	21.32	22/10/2021	19.84	18/10/2021

Silver surges as the dollar drops. The silver price climbed above \$24/oz for the first time in six weeks and outperformed gold, bringing the gold:silver ratio down to 74 from 80 at the end of September. It seems that the US dollar is having more of an influence than inflation, which is surprising considering how strongly inflation is now rising. Inflation was 5.4% in the US in September,

holding above 5% for a fifth straight month, and it came in at 4.1% in Germany, the highest in almost 30 years. For now though, silver, like gold, remains in the same trading range that it has been in for over a year. More than a sharp two-day rally will be needed to confirm that the trend has finally changed.

78 Pt Platinum

	Close	Weekly change	High	Date	Low	Date
\$/oz	1,047	-1.08%	1,080	22/10/2021	1,036	18/10/2021
€/oz	900	-1.42%	927	22/10/2021	892	20/10/2021

More Pandas in China. The People's Bank of China will produce platinum Panda coins for the first time since 2005 to mark the 40th anniversary of the first Panda coin. In total, 10,000 30 g coins and 100,000 1 g coins will be minted, with just 10% available for sale outside China. Platinum coin demand has been relatively strong this year, with the US Mint increasing its mintage to 75,000 1 oz platinum American Eagle coins from 56,500 oz.

Anglo Platinum's output is being boosted by processing stock that built up while the Anglo Converter Plant

(ACP) was out of action. The company produced 663.5 koz of refined platinum in the third quarter. Anglo has maintained its guidance of 4.2-4.4 moz (6E) of mined production and 4.8-5.0 moz of PGM sales. While some metal has been used to rebuild refined metal inventory in Q3'21, a similar result in Q4'21 would see the company easily meet guidance. However, there was no announcement on the Der Brochen project, for which a decision is expected this quarter. Der Brochen would replace the Mototolo mine as it comes to the end of its life, maintaining production levels.



PRECIOUS METALS REVIEW

⁴⁶ Pd **Palladium**

	Close	Weekly change	High	Date	Low	Date
\$/oz	2,014	-3.20%	2,126	20/10/2021	1,977	18/10/2021
€/oz	1,732	-3.44%	1,828	20/10/2021	1,710	18/10/2021

Nornickel is on track to beat palladium production guidance. After the first three quarters, Nornickel has produced 1.91 moz of palladium. The company has guidance of 2.35-2.41 moz, but simply producing the same amount of palladium in Q4'21 as in the third quarter (598 koz) would result in 2.5 moz of output. That would push the palladium market further into surplus this year, given the reduced demand from the automotive sector owing to the semiconductor chip shortage, which should limit the price upside.

Full refined output should resume in Q2'22. The Oktyabrsky mine has been operating at full capacity since mid-May, while the Taimyrsky mine reached 80% of capacity in June. It is currently running at 85% capacity and the return to full capacity has now been pushed back to December. Consequently, the return to 100% capacity of refined production will not be achieved until Q2'22 owing to the long processing pipeline.

⁴⁵ Rh ⁴⁴ Ru ⁷⁷ Ir **Rhodium, Ruthenium, Iridium**

	Rhodium	Ruthenium	Iridium
Reporting week	\$15,350/oz	\$645/oz	\$4,850/oz
Previous week	\$15,550/oz	\$670/oz	\$4,850/oz

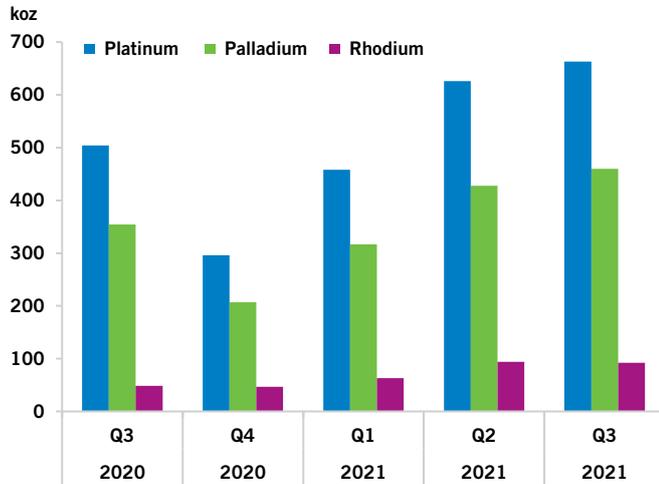
Anglo Platinum's rhodium production slipped slightly in Q3 to 92.3 koz, compared to 94.2 koz in Q2'21, despite processing some of the green matte stock that built up while the ACP was being repaired. The company purchased 6.3 koz of small PGMs for trading sales in

Q3'21, which is slightly higher than in Q2'21 (5.7 koz). The rhodium and ruthenium prices slipped slightly last week, while the iridium price was flat.



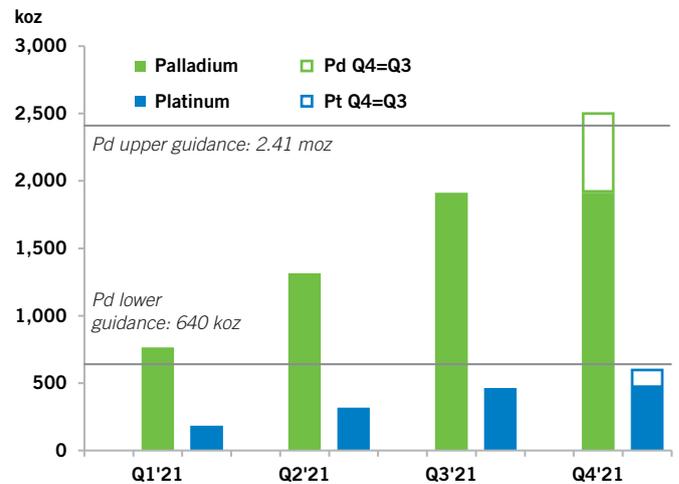
TRENDS AND INVESTMENTS

Anglo Platinum refined production



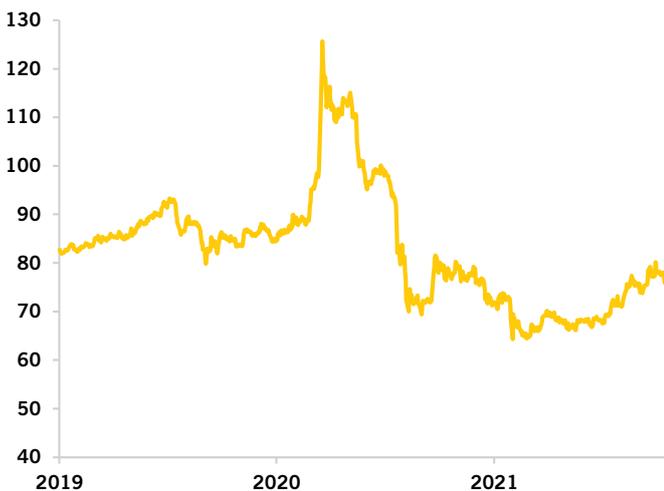
Source: Anglo Platinum company report

Nornickel cumulative refined output



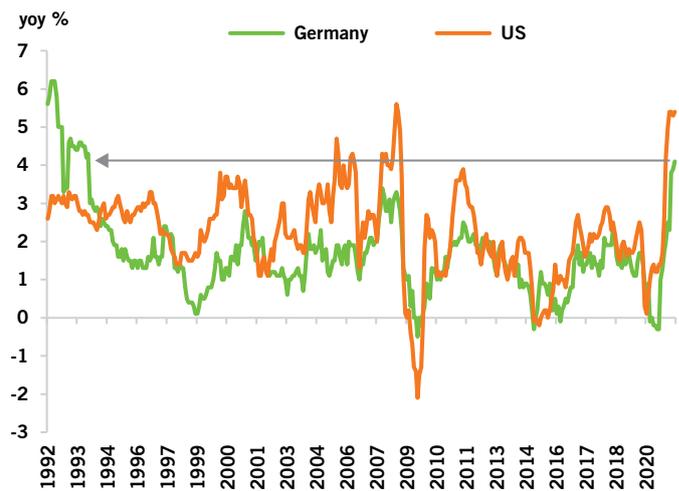
Source: Nornickel company reports, SFA (Oxford)

Gold:silver ratio



Source: SFA (Oxford), Bloomberg

CPI



Source: SFA (Oxford), Bloomberg

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