

PRECIOUS APPRAISAL

No. 39
28th November 2022



MARKET SPOTLIGHT

Green hydrogen cost will decline steeply as manufacturing base expands

Announcements of green hydrogen projects have continued to grow this year, culminating in the COP27 summit in Egypt earlier this month. Globally, more than 40 nations have now unveiled hydrogen strategies in one form or another. The EU announced its REPowerEU initiative to make Europe independent of Russian fossil fuels well before 2030. This includes the aim to add 17.5 GW of electrolyser manufacturing capacity by 2025 within the EU. The estimate of global electrolyser manufacturing (all types) in 2022 is just 15.2 GW per year (source: Bloomberg New Energy Finance (BNEF)), of which approximately a third is in Europe.

A major hurdle for green hydrogen's expansion is its higher cost versus grey or blue hydrogen. Proton exchange membrane (PEM) electrolysers are often deemed the most suitable for producing green hydrogen owing to their faster response to variable power input, as with renewable sources, compared to other electrolyser technologies. A substantial proportion of PEM electrolyser cost is manufacturing CAPEX, including the cost of iridium and platinum used on the catalytic membrane. Most hydrogen is currently made from fossil fuels at a much lower cost than green hydrogen.

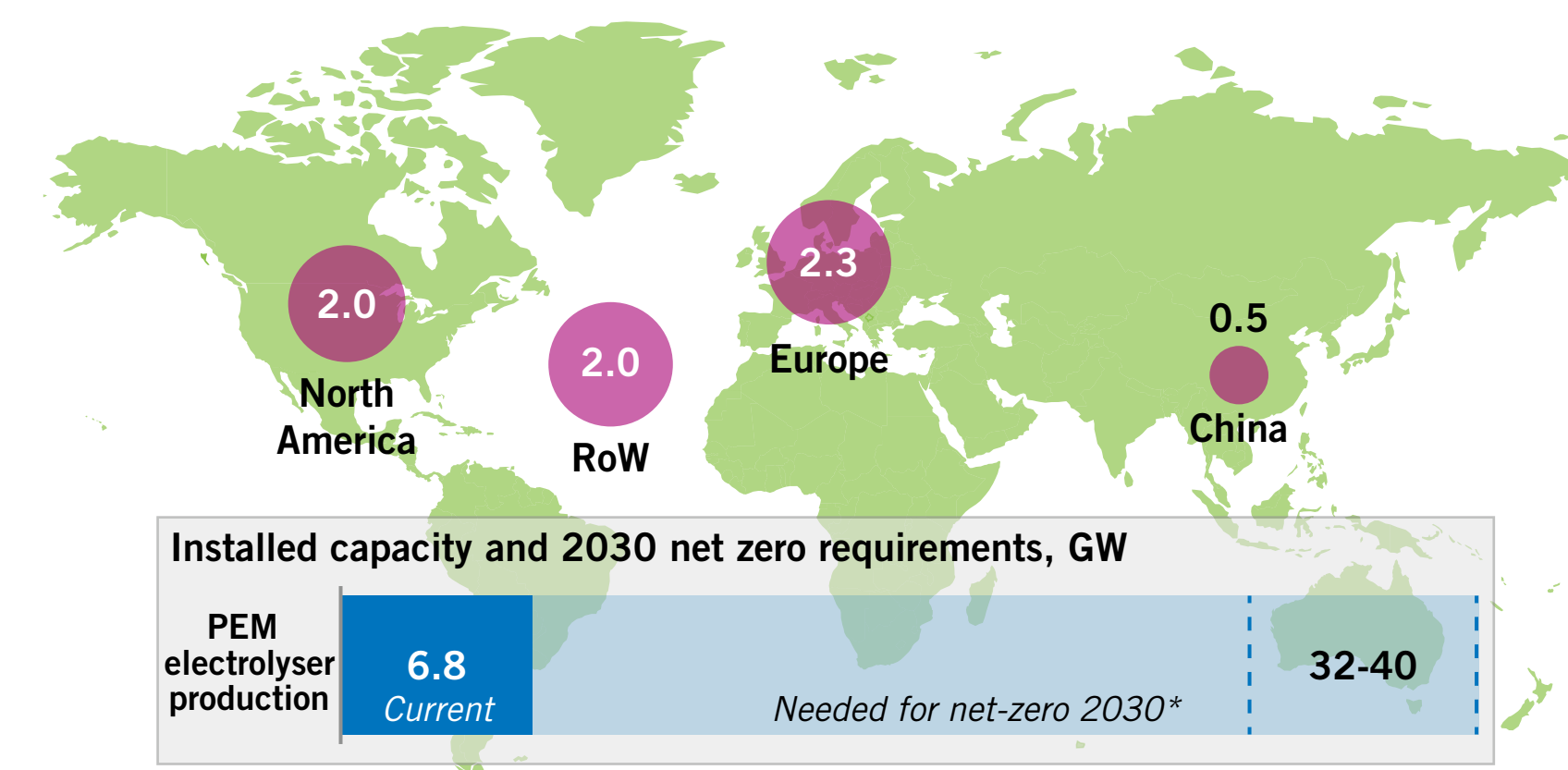
Photovoltaics (PV) faced similar price barriers when first introduced. As the manufacturing base of a product or technology increases, the cost of the product and process should decrease owing to the refining of techniques and economies of scale. This process was accelerated for PV in China by government-mandated annual efficiency improvements. Thrifting of silver paste was a contributing factor to the falling cost over that period. Similarly, iridium can, and is being thrifted from electrolysers to reduce the cost.

The cost of green hydrogen production is falling. Next to solar, PEM electrolysis is a comparatively immature market. However, rapid growth in manufacturing capacity is expected and costs are expected to fall rapidly in line with this increase. Installed capacity of PEM electrolysers has grown by 460% since 2019, outperforming alkaline electrolysis in growth terms, and now accounts for approximately half of the installed GW of

hydrogen production capacity. Costs of PEM electrolysers are estimated to decrease by ~9% each time the manufacturing capacity doubles (source: Oxford Institute for Energy Studies). As PEM electrolyser manufacturing is estimated to more than double next year (source: BNEF), a >10% reduction in average costs is possible.

Thrifting iridium should allow hydrogen demand to be met. Current hydrogen-related usage is estimated to account for more than 5% of iridium demand this year. As a small market, future demand growth from PEM electrolysis has the potential to require a significant portion of iridium mine supply. Reductions in the amount of metal used per MW of hydrogen production capacity can help to mitigate this. Research on reducing the amount of iridium used, while maintaining efficiency along with improved recycling, could eventually cut iridium usage by up to an order of magnitude. The pace of PEM deployment should not therefore be held back by supply issues.

Global PEM electrolyser production capacity by region, GW



Source: SFA (Oxford), BNEF, IEA, company reports, EU Commission, Hydrogen Council. *Assuming ~40% PEM share of global electrolyser capacity.

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Gold

79 Au	CLOSE		WEEKLY CHANGE		HIGH	DATE	LOW	DATE
	\$/oz		-0.16%		1,761	25/11/2022	1,729	23/11/2022
	€/oz		-0.67%		1,704	22/11/2022	1,673	23/11/2022

Shanghai Gold Exchange withdrawals are on track to fall short of strong 2021. Withdrawals from the Shanghai Gold Exchange for October bring the year-to-date total to 1,314 tonnes, 6% lower than the 1,394 tonnes by the end of October last year. October's withdrawals were 28% lower year-on-year, and nearly halved month-on-month – more than would be expected based on seasonality alone. Price premiums in China have fallen as Covid cases have risen, indicating softening demand on the domestic market. India experienced a strong festive season for gold demand. The build-up to the Dhanteras festival saw a 10-15% improvement in year-on-year gold demand (source: World Gold Council) which, given the strong sales in 2021, shows that sentiment was remarkably good in October. Since then, the gold price in rupees hit its highest level since May earlier this month and demand weakened as a result. Local gold prices swung from near parity with London prices to a discount of up to \$34.20/oz on 16 November, the largest discount since early July as retailers tried to attract sales amidst high prices. If gold prices remain relatively elevated and Covid cases continue to rise in China, regional seasonal demand in the two largest gold markets (together accounting for almost 50% of global demand) may be subdued to year-end.

'Tis the season for gold. Eight of the last ten years have seen the dollar weaken in December and in those years it has fallen by 2% on average. Conversely, the gold price tends to rise in the last month of the year, having done so in the previous five years. Gold's average December price gain in the last decade is 0.9%, including years when it declined, and in more recent years, the larger the decline in November, the larger the gains that could be expected in December. Given the recent pullback in dollar strength, much of the year-end dollar depreciation that may be expected could already be priced in. At the FOMC meeting in December a lower 50bp hike is expected, which could already be accounted for in the weaker dollar.

PRECIOUS METALS REVIEW

Silver



	CLOSE	WEEKLY CHANGE	HIGH	DATE	LOW	DATE
\$/oz	21.37	1.54%	21.68	24/11/2022	20.59	21/11/2022
€/oz	20.55	1.05%	20.81	24/11/2022	20.11	21/11/2022

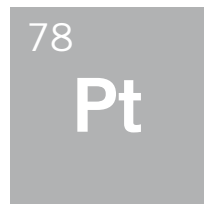
US Mint silver coin sales outpacing gold counterparts in November.

Month-to-date, more than 1.4 million Silver American Eagles have been sold, already exceeding the year-to-date monthly average by 33%. In comparison, month-to-date gold coin sales are lagging behind the monthly average sales total of 96,450 oz, with only 6,000 oz sold so far. Silver coin demand from the US Mint is on track to for the second-best month of the year, in terms of sales volume. Another 100 koz of sales would improve on February’s 1.5 moz of silver coin demand, although December tends to be a low-sales month for silver coin investment demand. Annual sales are likely to be much lower in 2022 as for much of the year monthly sales have been nearly two-thirds lower, on average, compared with 2021. Higher sales are usually seen in January as the new mintage of coins is released, attracting higher demand and possibly encouraging consumers to defer purchases into the new year.

The silver price reversed direction last week posting a 1.5% return after finding support at around \$20.80/oz. Silver is likely to again meet resistance at around \$22.25/oz. The dollar index cooled further last week on dovish Fed meeting minutes and the first direct suggestion that the Fed’s actions may exceed what is required to bring inflation down to acceptable levels, raising the possibility of a US recession.

PRECIOUS METALS REVIEW

Platinum



	CLOSE	WEEKLY CHANGE	HIGH	DATE	LOW	DATE
\$/oz	982	-0.25%	1,004	24/11/2022	967	21/11/2022
€/oz	944	-4.13%	976	22/11/2022	942	25/11/2022

Yen strength prompts Japanese investors to take profits. The 18.5% return on the platinum price in dollar terms since August has outperformed all other precious metals and PGMs. Despite the significant run in the price, investment in global exchange traded funds (ETFs) has been net negative, mirroring the trend across gold and silver ETFs. In Japan, investors tend to be strongly influenced by the platinum price. The ¥4,000/g level acts as a psychological point above which investors tend to take profits, liquidating ETF positions. This pattern has repeated year-to-date as selling occurred in June, and again in October when the price breached this key level. The platinum price reached a peak of ¥4,688/g this month and, month-to-date, net outflows from Japanese funds have totalled 10,700 oz, equal to a 10% reduction in total holdings. In comparison, North American funds, although net negative in terms of holdings year-to-date, added 22 koz of platinum in October as the price in dollar terms neared a seven-month high.

South Africa-UK collaboration on fuel cells and platinum supply in the works. A recently announced bilateral collaboration between the UK and South Africa will work to support investment in South Africa’s PGM exploration, production, and beneficiation activities. The deal also includes aims to promote hydrogen fuel cell projects. Currently, platinum demand for hydrogen applications accounts for only around 1% of total platinum demand, although robust growth is forecast for the 2020s. Increasing research and development investment pathways could help accelerate the uptake of fuel cell vehicles and capture more platinum demand sooner.

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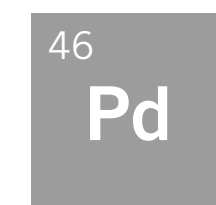
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Palladium



	CLOSE	WEEKLY CHANGE	HIGH	DATE	LOW	DATE
\$/oz	1,834	-6.52%	1,926	21/11/2022	1,807	25/11/2022
€/oz	1,745	-8.02%	1,877	21/11/2022	1,740	25/11/2022

The door to reduced Covid measures could be slammed shut in China, again threatening automotive demand. Last week, daily new Covid cases in mainland China exceeded 40,000 for the first time since the Shanghai outbreak. This time around, cases are less geographically concentrated and partial lockdowns are spreading in multiple cities. China's auto sales have been helped by tax breaks in H2'22 and are holding up surprisingly well year-to-date, having reached >19 million passenger cars to date, just below 2018 levels but above sales seen in 2019-2021. Automotive palladium demand is forecast to reach a record 2.65 moz this year, however sporadic lockdowns are likely to raise uncertainty and rein in consumer demand for new vehicles in the remaining weeks of 2022. As the largest single palladium autocatalyst market, lower than expected demand at the tail end of the year would put downward pressure on metal prices.

PRECIOUS METALS REVIEW

Rhodium, Ruthenium, Iridium



	RHODIUM	RUTHENIUM	IRIDIUM
Reporting Week	\$14,450/oz	\$505/oz	\$4,050/oz
Previous Week	\$14,450/oz	\$505/oz	\$4,050/oz

Iridium is the outperformer of the minor PGMs this year so far. With returns of -2.4%, iridium has lost the least value year-to-date. Ruthenium has performed the worst, yielding a return of -12.1% year-to-date. All three minor PGMs have experienced a volatile year, their prices having surged owing to geopolitical events earlier in the year. However, with no sanctions on Russian metal and weaker economic growth across the board, prices have been declining. Iridium’s price strength may be aided by the swathe of green hydrogen announcements in 2022, and expectations of increasing demand for use in PEM electrolysis.

All the minor PGM prices remained stable last week. The iridium and ruthenium prices have been stable since the middle of October.

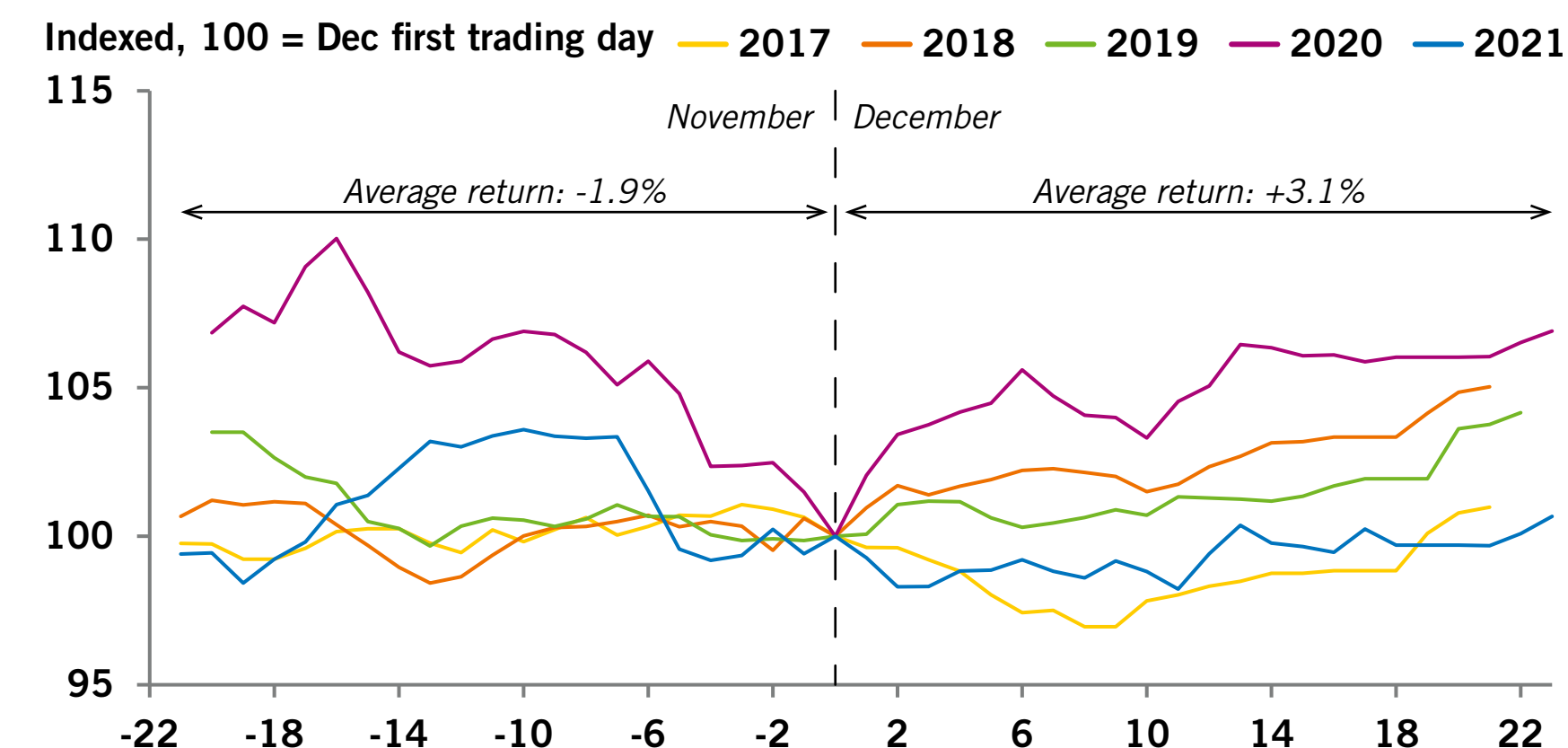
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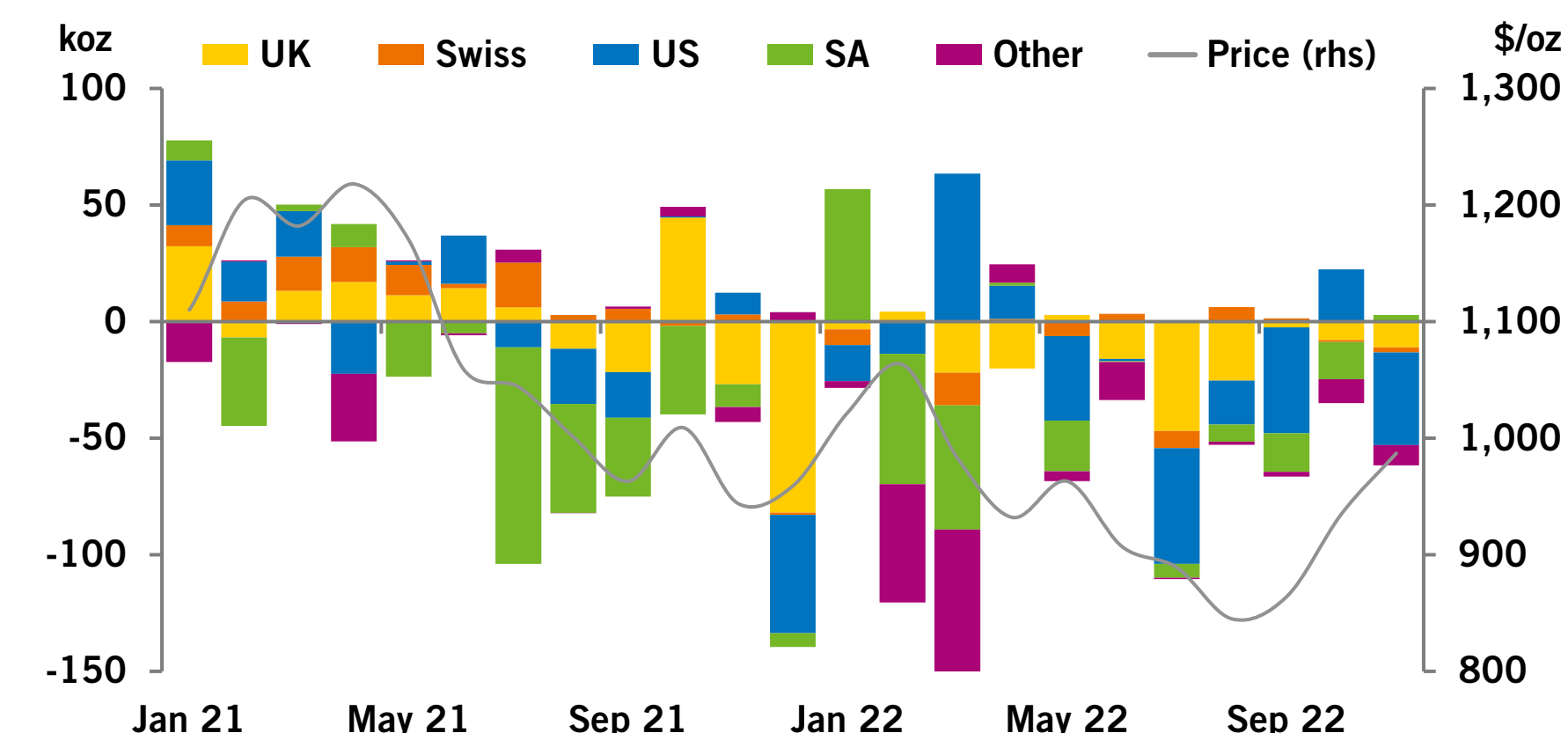
TRENDS AND INVESTMENTS

Gold's returns in November and December



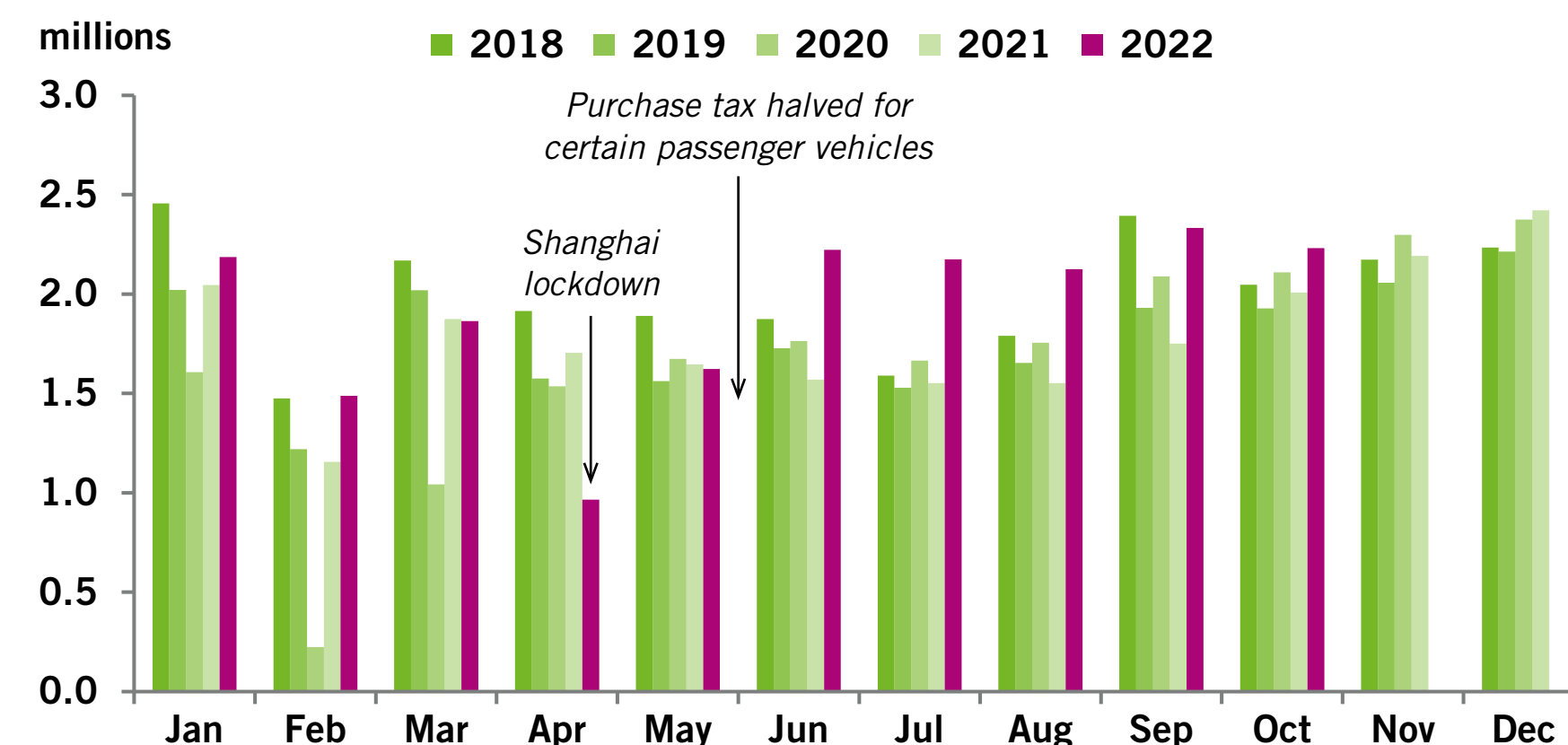
Source: SFA (Oxford), Bloomberg

Platinum ETF monthly net in/outflows



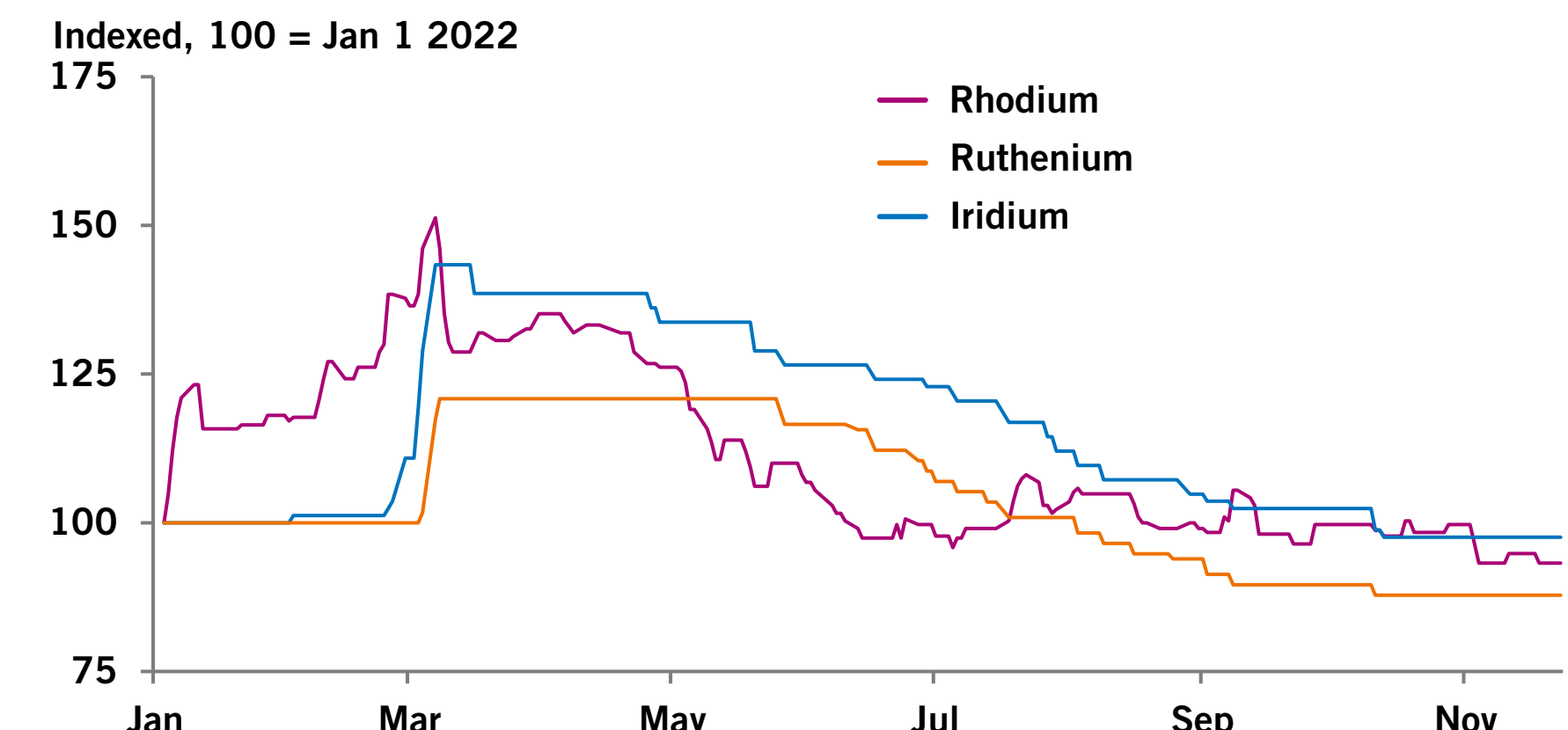
Source: SFA (Oxford), Bloomberg

China passenger car sales by month



Source: SFA (Oxford), Bloomberg

Small PGMs year-to-date price performance



Source: SFA (Oxford), Heraeus Precious Metals

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