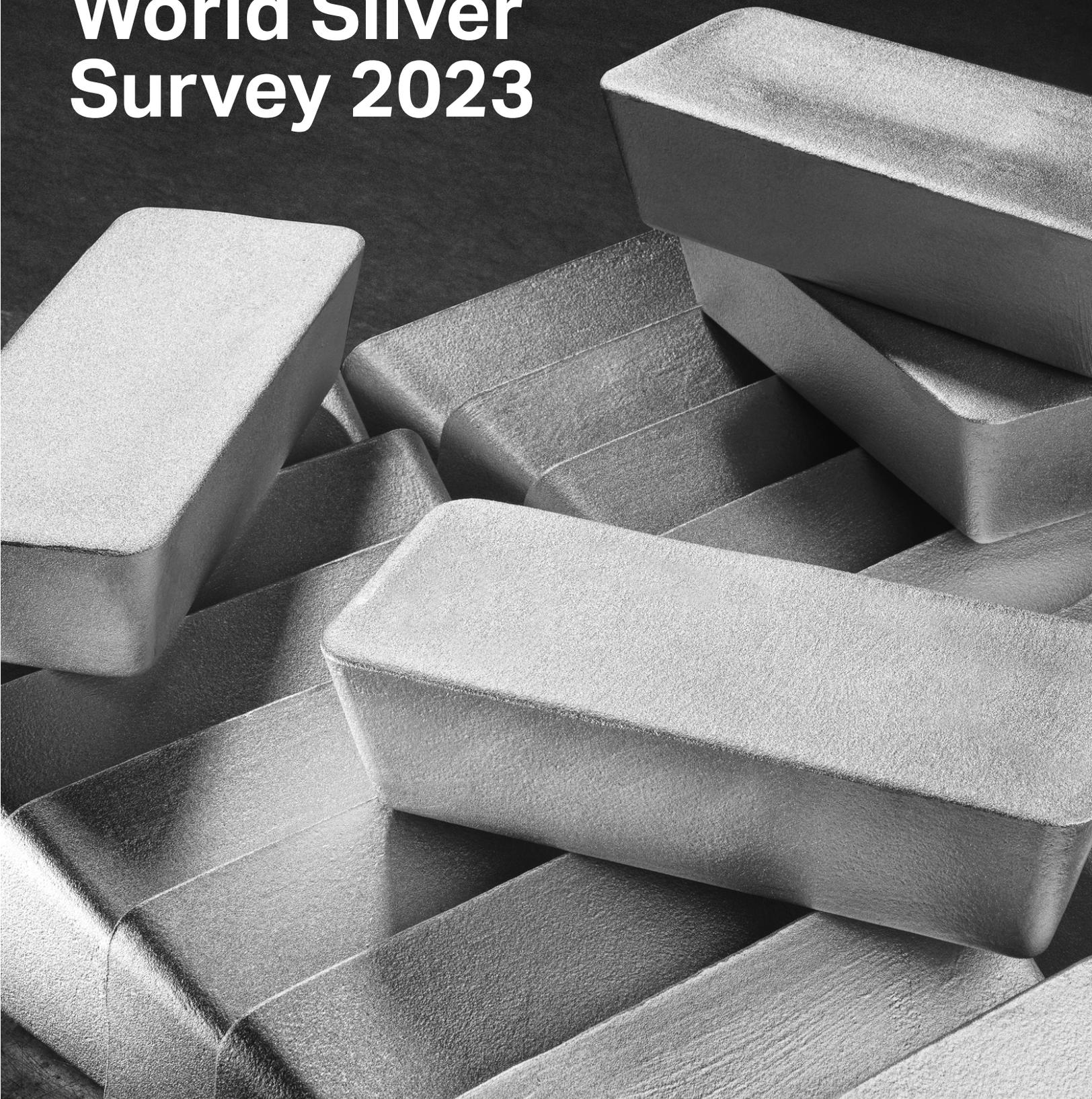


# World Silver Survey 2023



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# Metals Focus

## World Silver Survey 2023

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This is the thirty-third annual edition of the World Silver Survey produced for The Silver Institute. World Silver Survey 2023 was produced by the Metals Focus team. The information contained herein is based in part on the analysis of publicly available data such as hallmarking series, trade statistics, company reports and other public-domain information. More importantly, it is also based on a large series of interviews with the industry's main players, carried out over the year by the team. This work generates the essential data to allow the compilation of reliable estimates for world supply and demand and inform the analysis of market structures, and the degree of significance of any changes and developments.

Metals Focus is grateful to the many miners, refiners, bullion dealers, bankers and fabricators throughout the world who have contributed their time and information to ensuring that the picture of the industry described in the World Silver Survey is as complete and accurate as possible.

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## Fresnillo plc



Fresnillo plc is the world's largest primary silver producer and Mexico's largest gold producer, listed on the London and Mexican Stock Exchanges under the symbol FRES.

Fresnillo plc has eight operating mines, all of them in Mexico - Fresnillo, Saucito, Juanicipio, Ciénega, Herradura, Soledad-Dipolos<sup>1</sup>, Noche Buena and San Julián (Veins and Disseminated Ore Body), one development project - the Pyrites Plant at Fresnillo, which has been completed and is awaiting tie-in of the plant to the national electricity grid, and four advanced exploration projects – Orisyvo, Rodeo, Guanajuato and Tajitos as well as a number of other long term exploration prospects.

Fresnillo plc has mining concessions and exploration projects in Mexico, Peru and Chile.

Fresnillo plc has a strong and long tradition of exploring, mining, a proven track record of mine development, reserve replacement, and production costs in the lowest quartile of the cost curve for silver. Fresnillo plc's goal is to maintain the Group's position as the world's largest primary silver company and Mexico's largest gold producer.

<sup>1</sup> Operations at Soledad-Dipolos are currently suspended.

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Peñoles is a mining group with integrated operations in smelting and refining non-ferrous metals, and producing chemicals. Peñoles is the world's top producer of refined silver, metallic bismuth and sodium sulfate, and the leading Latin American producer of refined gold and lead. The Company was founded in 1887 and it is part of "Grupo BAL", a privately held diversified group of independent Mexican companies. Peñoles' shares have traded on the Mexican Stock Exchange since 1968 under the ticker PE&OLES. Peñoles highlights:

- Began operations in 1887 as a mining company.
- Has integrated operations in the areas of exploration, mining, metallurgy and chemicals.
- Listed on the Mexican Stock Exchange since 1968; the stock is included in the IPC index.
- One of the largest net exporters in Mexico's private sector.

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In 2022, Pan American produced 18.5 million ounces of silver and 552.5 thousand ounces of gold. As at June 30, 2022, proven and probable silver mineral reserves were approximately 514.9 million ounces and proven and probable gold mineral reserves were approximately 3.6 million ounces.

Learn more at [panamericansilver.com](https://panamericansilver.com)

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# Chapter 1

- The silver market was in a 237.7Moz (7,393t) deficit in 2022, a likely all-time record.
- Strong demand gains across a number of key segments were the principal driver of this outcome, while supply was effectively unchanged.
- In spite of such strong fundamentals, the average price fell by 14% to \$21.73, due to pressure from institutional investor activity, against a backdrop of rising US interest rates.

## Summary

### Introduction

Once again, 2022 was a year of sharp contrasts between silver's fundamentals and institutional investor attitudes towards the metal; while the silver market saw what may well have been the largest deficit on record, professional investors were indifferent or bearish for much of the year.

This is neither unusual or surprising. We have seen similar contrasts often emerge in the history of the silver market. After all, several factors that are positive for institutional investment (for instance financial market turmoil and weak GDP growth) are negative for key demand segments, such as industrial, jewelry and silverware. Crucially, institutional investment often dominates price action, which in turn affects those price elastic elements of demand. Last but not least, the contrast between institutional activity and supply-demand fundamentals is arguably necessary for the silver market to function. After all, deficits need to be filled by metal sold by professional investors, while surpluses need to be absorbed by them.

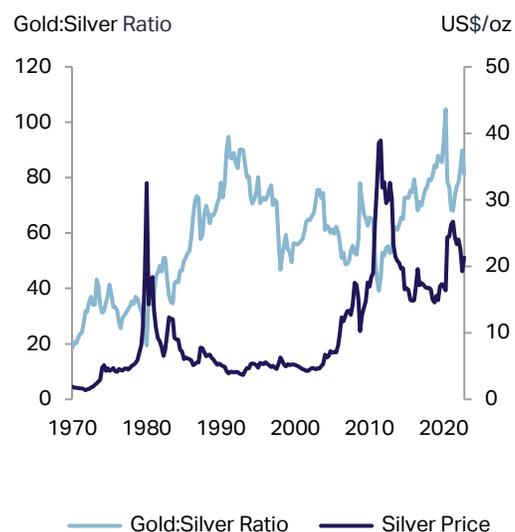
In 2022, a key driver of this discrepancy was rising and persistent inflation. In terms of physical demand, it encouraged strong bar and coin purchases by retail investors, seeking to protect their wealth from an effective fiat currency devaluation. In contrast, inflation pushed institutional investors away from silver, as it fueled policy rate hikes by the Fed and, just as importantly, market expectations of a continued hawkish stance, driving US yields higher.

The downward pressure on silver prices from this further boosted physical demand. This was perhaps most pronounced in India, where on top of already exceptionally strong demand, low prices encouraged the entire supply chain to replenish its stocks. This followed two pandemic-hit years of inventory draw-downs. There were other, price agnostic, drivers of demand growth last year. Most notable among these was the strength of industrial fabrication, in large part linked to the robust solar industry, but also reflecting a post-pandemic recovery in a number of other markets. Indeed, were it not for China's zero-COVID policies, global silver demand would have likely been even greater than the all-time high of 1,242.4Moz (38,643t) it realized in 2022.

A lack of supply gains was another factor contributing to last year's deficit. Limited organic growth, project delays and disruptions resulted in a marginal decline in mine production while recycling barely rose.

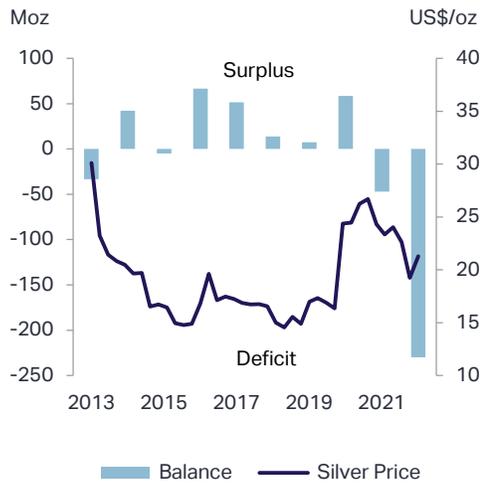
All this culminated in a 237.7Moz (7,393t) deficit, most likely also an all-time record. (There is some uncertainty, as differences in definitions, coverage and methodology between Metals Focus and past data providers to the Silver Institute complicate comparing balances over the past few decades.)

### Silver Prices & Gold:Silver Ratio\*



\* Quarterly averages  
Source: Bloomberg

## Market Balance



Source: Metals Focus, Bloomberg

Importantly, the combined 2021 and 2022 deficits more than offset the cumulative surpluses of the previous 11 years.

Of course, silver prices rarely take their cue from market fundamentals and are instead largely driven by professional investor activity; 2022 was no exception. For reasons touched on earlier and discussed in detail in Chapter 3, institutional investors were not keen on silver for large parts of the year. This explains why the silver price was generally under pressure from mid-April through to mid-October and also why its average was 14% lower y/y.

Looking ahead, in spite of the recent boom in investor demand and the rally, we believe that 2023 will see much of a repeat of last year. While lower y/y at 142.1Moz (4,419t), we forecast another hefty deficit for the year. We also think that institutional investment will eventually run out of steam, as we believe that the current market consensus that the Fed will be forced to cut rates in H2 will be proven wrong. This should see silver fall to the low \$18.00s before year-end, culminating in a full year average of \$21.30, down 2%.

## Silver Supply and Demand

| Million ounces                       |                |                |                |                |                |              |               |                |                |                |             | Year on Year |  |  |
|--------------------------------------|----------------|----------------|----------------|----------------|----------------|--------------|---------------|----------------|----------------|----------------|-------------|--------------|--|--|
|                                      | 2014           | 2015           | 2016           | 2017           | 2018           | 2019         | 2020          | 2021           | 2022           | 2023F          | 2022        | 2023F        |  |  |
| <b>Supply</b>                        |                |                |                |                |                |              |               |                |                |                |             |              |  |  |
| Mine Production                      | 882.0          | 896.8          | 899.8          | 863.6          | 850.3          | 836.6        | 782.2         | 827.6          | 822.4          | 842.1          | -1%         | 2%           |  |  |
| Recycling                            | 160.4          | 146.9          | 145.6          | 147.0          | 148.5          | 148.0        | 166.0         | 175.3          | 180.6          | 181.1          | 3%          | 0%           |  |  |
| Net Hedging Supply                   | 10.7           | 2.2            | -              | -              | -              | 13.9         | 8.5           | -              | -              | -              | na          | na           |  |  |
| Net Official Sector Sales            | 1.2            | 1.1            | 1.1            | 1.0            | 1.2            | 1.0          | 1.2           | 1.5            | 1.7            | 1.7            | 13%         | -1%          |  |  |
| <b>Total Supply</b>                  | <b>1,054.2</b> | <b>1,046.9</b> | <b>1,046.4</b> | <b>1,011.7</b> | <b>1,000.0</b> | <b>999.5</b> | <b>957.9</b>  | <b>1,004.5</b> | <b>1,004.7</b> | <b>1,024.9</b> | <b>0%</b>   | <b>2%</b>    |  |  |
| <b>Demand</b>                        |                |                |                |                |                |              |               |                |                |                |             |              |  |  |
| Industrial (total)                   | 440.9          | 443.4          | 477.4          | 515.3          | 511.2          | 509.7        | 488.7         | 528.2          | 556.5          | 576.4          | 5%          | 4%           |  |  |
| Electrical & Electronics             | 269.8          | 272.3          | 308.9          | 339.7          | 331.0          | 327.3        | 321.8         | 351.0          | 371.5          | 382.3          | 6%          | 3%           |  |  |
| ...of which photovoltaics            | 48.4           | 54.1           | 93.7           | 101.8          | 92.5           | 97.8         | 100.0         | 110.0          | 140.3          | 161.1          | 28%         | 15%          |  |  |
| Brazing Alloys & Solders             | 53.3           | 51.0           | 49.0           | 50.8           | 51.9           | 52.3         | 47.4          | 50.4           | 49.0           | 49.8           | -3%         | 2%           |  |  |
| Other Industrial                     | 117.8          | 120.1          | 119.5          | 124.8          | 128.3          | 130.1        | 119.4         | 126.8          | 136.0          | 144.4          | 7%          | 6%           |  |  |
| Photography                          | 41.0           | 38.2           | 34.7           | 32.4           | 31.4           | 30.7         | 26.9          | 27.7           | 27.5           | 26.4           | -1%         | -4%          |  |  |
| Jewelry                              | 193.5          | 202.5          | 189.1          | 196.2          | 203.1          | 201.4        | 150.5         | 181.5          | 234.1          | 199.5          | 29%         | -15%         |  |  |
| Silverware                           | 53.5           | 58.3           | 53.5           | 59.4           | 67.1           | 61.3         | 31.2          | 40.7           | 73.5           | 55.7           | 80%         | -24%         |  |  |
| Net Physical Investment              | 283.0          | 309.3          | 212.9          | 155.8          | 165.5          | 187.0        | 204.8         | 274.0          | 332.9          | 309.0          | 22%         | -7%          |  |  |
| Net Hedging Demand                   | -              | -              | 12.0           | 1.1            | 7.4            | -            | -             | 3.5            | 17.9           | -              | 409%        | na           |  |  |
| <b>Total Demand</b>                  | <b>1,011.9</b> | <b>1,051.7</b> | <b>979.7</b>   | <b>960.2</b>   | <b>985.7</b>   | <b>990.0</b> | <b>901.9</b>  | <b>1,055.6</b> | <b>1,242.4</b> | <b>1,167.0</b> | <b>18%</b>  | <b>-6%</b>   |  |  |
| <b>Market Balance</b>                | <b>42.3</b>    | <b>-4.8</b>    | <b>66.7</b>    | <b>51.5</b>    | <b>14.4</b>    | <b>9.5</b>   | <b>56.0</b>   | <b>-51.1</b>   | <b>-237.7</b>  | <b>-142.1</b>  | <b>365%</b> | <b>-40%</b>  |  |  |
| Net Investment in ETPs               | -0.3           | -17.1          | 53.9           | 7.2            | -21.4          | 83.3         | 331.1         | 64.9           | -125.8         | -30.0          | na          | -76%         |  |  |
| <b>Market Balance less ETPs</b>      | <b>42.6</b>    | <b>12.3</b>    | <b>12.9</b>    | <b>44.3</b>    | <b>35.8</b>    | <b>-73.8</b> | <b>-275.1</b> | <b>-116.1</b>  | <b>-111.9</b>  | <b>-112.1</b>  | <b>-4%</b>  | <b>0%</b>    |  |  |
| Silver Price (US\$/oz, London price) | 19.08          | 15.68          | 17.14          | 17.05          | 15.71          | 16.21        | 20.55         | 25.14          | 21.73          | 21.30          | -14%        | -2%          |  |  |

Source: Metals Focus

## Global Supply



Source: Metals Focus, Bloomberg

## Silver Supply in 2022

In 2022, global **mine production** fell marginally, dropping by 0.6% y/y to 822.4Moz (25,578t). This followed strong growth in the previous year, when production had risen by 5.8% as mines recovered from the disruption caused by the COVID-19 pandemic. Last year's decline was the result of lower by-product output from lead/zinc mines, particularly in China and Peru. Silver production from this source fell by 3.5% y/y to 248.2Moz (7,719t). Partially offsetting this drop was higher silver output from gold and copper mines, which rose by 1.0% to 129.5Moz (4,028t) and 0.8% to 212.0Moz (6,593t) respectively. Meanwhile, production from primary silver mines was almost flat year-on-year, rising by just 0.1% to 228.2Moz (7,099t).

Peru suffered the greatest decline in output in 2022 (-8.5Moz, 263t) due to the suspension of mining at Uchucchacua in Q4.21, falling grades at several major mines and disruption due to social unrest. The next biggest declines came in Australia (-4.2Moz, 131t) and Bolivia (-2.8Moz, 88t). However, these losses were largely offset by higher output elsewhere. This included Mexico (+3.1Moz, 98t), Argentina (+3.0Moz, 94t) and Russia (+2.2Moz, 67t).

**Recycling** activity rose for a third year in a row, with the 3% lift taking the total to a 10-year high of 180.6Moz (5,618t). As in 2021, the primary contributor to this was the 7% rise in industrial scrap, which in turn reflected a rise in the processing of spent ethylene oxide (EO) catalysts. Jewelry and silverware recycling saw only marginal increases as gains centered on Russia and India were countered by a range of modest losses elsewhere. Photographic scrap saw a notable 7% drop on the back of ongoing structural declines.

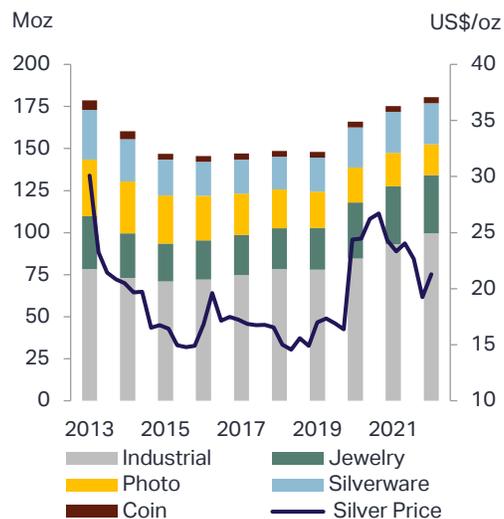
Building on the gains seen in 2021, net supply from the **official sector** rose by a healthy 13% last year to its highest since 2013, but remained trivial in absolute terms at just 1.7Moz (54t).

## Silver Demand in 2022

Following the strong rebound in 2021, total silver demand saw yet another notable jump last year, with total offtake growing by 18% to 1,242Moz (38,643t), the highest in our series going back to 2010. There was a small drop in photographic and brazing alloys demand, but all other fabrication sectors saw growth to record highs.

Offtake from the **industrial** segment posted another high in 2022, reaching 556.5Moz (17,309t). Some of this reflected the structural benefits accruing from green economy applications, in particular the notable growth in photovoltaics (PV). Here the increase in PV cell production was much faster than silver thrifting, and this in turn helped drive the 6% rise for global electronics & electrical demand. That apart, the sector was also supported by electrification within the automotive segment and other investment in power

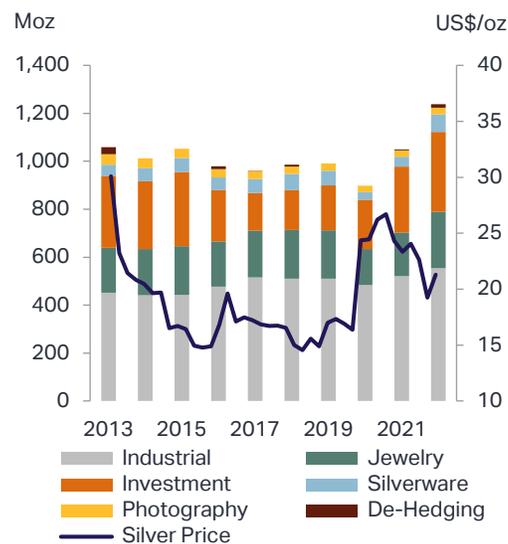
## Global Recycling, by Source



Source: Metals Focus, Bloomberg

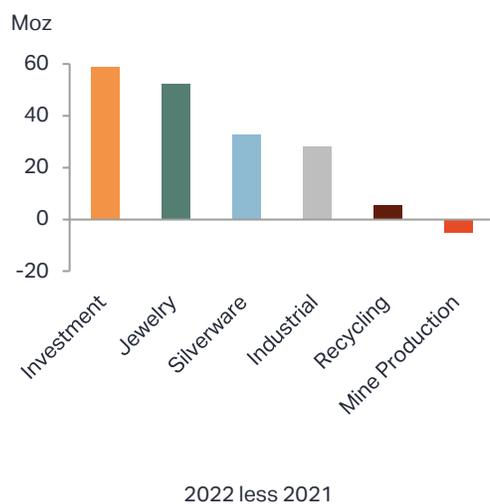


## Global Demand



Source: Metals Focus, Bloomberg

## Supply/Demand Swings by Sector



2022 less 2021

Source: Metals Focus

generation and distribution. A rise in vehicle output, 5G network investments and growth for the construction industry also assisted this segment.

Similarly, other industrial demand rose, chiefly due to growth for ethylene oxide (EO) catalysts, while brazing alloys & solders fell due mainly to COVID-losses in China. The overall total was also helped by thrifting and substitution (outside of PV) remaining modest. Apart from a 6% decline in Europe, all regions saw growth. India led with a 24% jump followed by East Asian (+7% despite a decline in Japan) and North America (+6%).

After a modest rise in 2021 on the back of a post-COVID rebound, **photographic** demand resumed its structural downtrend in 2022 to touch 27.5Moz (855t). It was not all negative though with sales of consumer and professional film and paper both edging higher, albeit from historic lows.

Silver **jewelry** fabrication soared by 29% last year to 234.1Moz (7,280t), a record high for our series starting in 2010. This was mostly driven by India where pent-up demand, post-pandemic, combined with heavy re-stocking by retailers and a move to higher purities led to volumes doubling compared to 2021 (up 60% on pre-COVID levels). Excluding India, jewelry fabrication dipped by 0.3%. Within this, US demand dipped from a bumper 2021 as the country began to see the normalization of consumer expenditure, while the drop in China reflected the negative impact of tight pandemic controls, and an economic slowdown. In contrast, notable gains were seen in Europe where a rise in local consumption helped even as exports from Italy fell. Elsewhere, Thailand, Indonesia and Turkey also saw growth, on the back of a post-pandemic recovery in exports and/or improvements in domestic sales.

Outperforming jewelry in percentage terms, **silverware** demand in 2022 saw astounding growth of 80% to 73.5Moz (2,286t), a record high for our series back to 2010. As with jewelry, gains here were almost entirely down to India where demand saw a more than 100% jump last year on the back of employment and incomes returning to pre-pandemic levels.

**Physical investment** rose for a fifth straight year to a new high of 332.9Moz (10,356t). There was relatively modest growth in the US (albeit from a historically high in 2021) where the market had to contend with extended product shortages and exceptionally high premiums. Australian physical investment rose by 15% y/y in 2022 while European demand was essentially flat y/y as Germany, its largest market, grappled with an unexpected and sudden VAT change. India emerged as the top performer last year (+188% y/y) with silver investment benefiting from lower prices and bargain hunting. Investors and traders there also stocked up on silver in anticipation of a duty hike after the duty on gold was raised by 5% in July 2022.

The global delta-adjusted producer **hedge** book fell by 17.9Moz (557t) to 18.6Moz (577t) in 2022 as the falling spot price made hedging less attractive. Forwards decreased by 8.3Moz (268t) and options by 9.6Moz (308t).

## Chapter 2

- We forecast yet another sizable deficit for 2023, as fair sized demand losses are met with slight gains in supply.
- Mine production rises by 2.4% as projects ramping-up are partly offset by disruptions, lower grades and closures.
- More gains are expected for industrial fabrication and, although jewelry and silverware are lower than their exceptional 2022 levels, they remain historically high.
- Prices suffer a marginal decline, as recent gains are offset by liquidations in H2.

# Market and Price Outlook

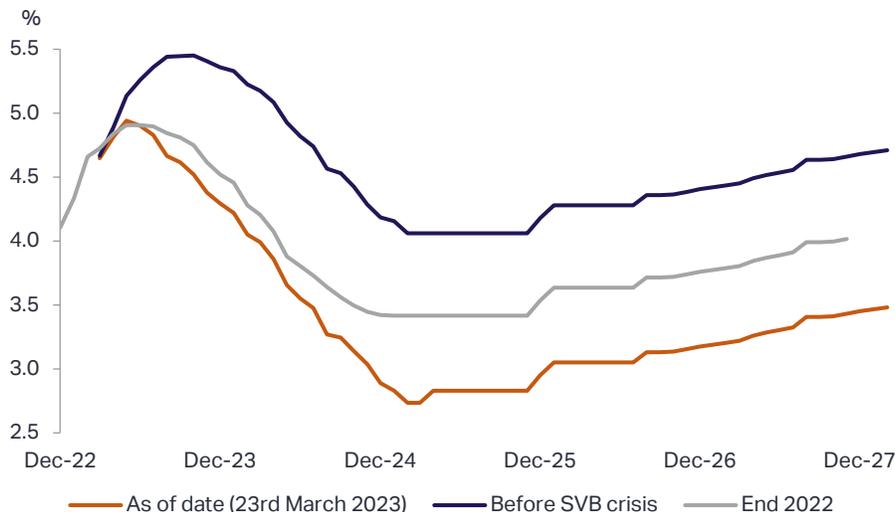
## Introduction

As we write this introduction in late March, it is tempting to refer to the extraordinary events in financial markets during the past few weeks, assert that uncertainties have become more prevalent, and how hard this makes forecasting market trends. Sadly, this is now becoming a cliché. What were once seen as “once in a generation” events have become increasingly regular affairs in recent years. We will not attempt to explain or predict geopolitical events, plagues or natural disasters. We do, however, have a strong view on why events like the bank failures of March are happening. Following nearly 15 years of near-zero interest rates, successive QE programs and unprecedented fiscal stimulus, systemic tail risks have become fatter. Markets have become addicted to stimulus, low yields (until recently) have forced portfolio managers to riskier options, and assets across the board have been artificially inflated, making it hard to identify value.

On balance, this environment is positive for safe haven assets like silver (and gold). Similarly positive is the market deficit that silver will remain in this year, as a result of factors discussed in detail later in this chapter. Nevertheless, in spite of these two supportive developments, Metals Focus expects the silver price will come under pressure in the second half of the year.

This reflects three key assumptions. The first is our (increasingly non-consensus) view that there will be no cuts in US policy rates this year. We therefore believe that an adjustment is due in the current pricing in the

### Implied Fed Funds Rate



Source: Bloomberg

## Gold, Silver & Copper Prices

Index, 3rd January 2022 = 100



Source: Bloomberg, Metals Focus

market (for example in Fed Funds Futures) of reductions of around 50-75 basis points from US rates' peak during 2023.

Second, silver is currently enjoying a safe haven premium linked to the risk that the banking crisis will proliferate. In Metals Focus' opinion, continued interventions by authorities tend to perpetuate growing systemic risks. At the same time, we have to acknowledge that, in the near-term, the protection of bank deposits in the US and the rescue of Credit Suisse have calmed markets and will prevent the crisis from widening.

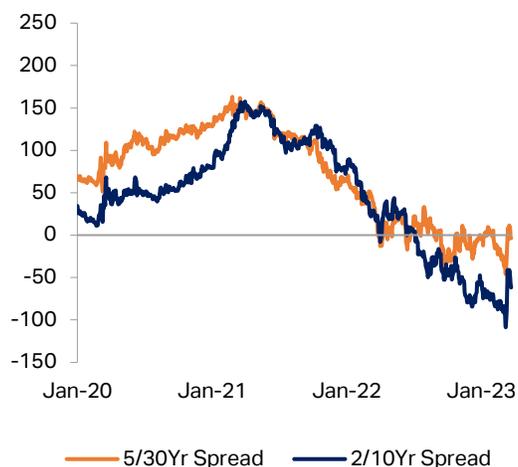
Third, we believe that even in the absence of a crisis, equity prices are due a sizable correction to reflect the reality of earnings projections, as well as a world where interest rates are no longer zero. Stock market liquidations will likely see some selling of gold (for instance where it was used as a portfolio diversifier or at times when investors need to raise cash to meet margins) and this should also weigh on silver.

Based on the above, Metals Focus' forecasts see the silver price move broadly sideways over the next few months, before suffering liquidations in the second half of the year. By Q4, we expect the price will trade in the low \$18s. This will result in a full year average of \$21.30, 2% lower y/y.

Turning to silver's fundamentals, we expect 2023 will see another large deficit for silver, amounting to 142.1Moz (4,419t). While down significantly from last year's figure, this is the second largest deficit in more than 20 years. Adding up the supply shortfalls of 2021-2023, global silver inventories by the end of this year will have fallen by 430.9Moz (13,403t) from their end-2020 peak. To put this into perspective, it is equivalent to more than half of annual mine production and also more than half of the inventories held in London vaults offering custodian services, as reported by the LBMA.

## US Yield Curves

Basis points

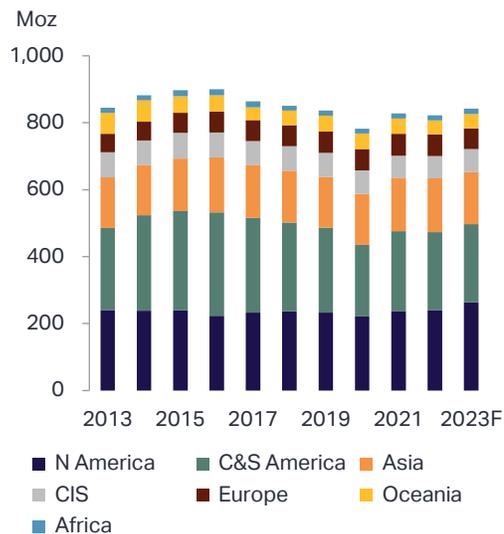


Source: Bloomberg, Metals Focus

Underpinning this outcome is yet another year of strong silver demand. In 2023, we expect industrial fabrication will reach another all-time high, boosted by continued gains in photovoltaic (PV) applications as well as healthy offtake from other industrial segments. Bar & coin demand and jewelry fabrication are expected to fall short of last year's exceptional levels, but the former remains historically high (up 33% on the 2010-19 average) while the latter holds firm (up 7% versus 2010-19). Supply, by contrast, is expected to achieve only small single-digit gains.

It is finally worth adding that the deficit conditions we have seen in recent years and expect will persist in 2023 are likely to continue for the foreseeable future. While this goes beyond the scope of this World Silver Survey, the projections featured in the latest Metals Focus 5-Year Quarterly Forecast suggest supply shortages will remain a theme for the silver market throughout the next five years.

### Mine Production Forecast



Source: Metals Focus

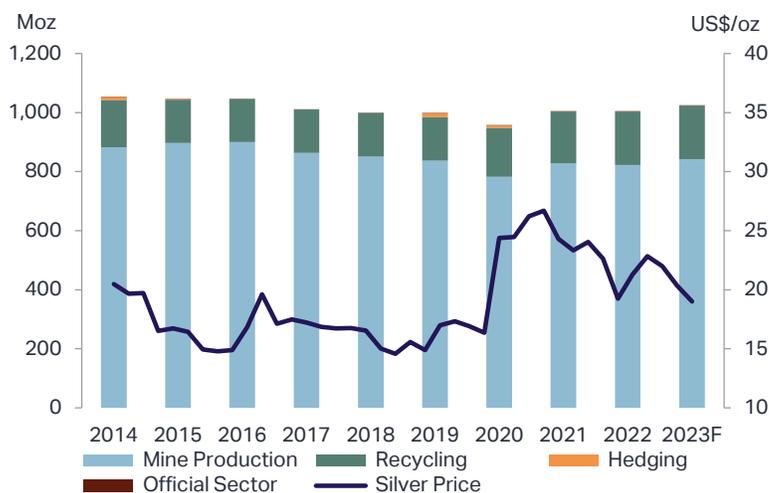
## Supply Outlook

Global silver **mine production** is expected to return to growth in 2023 and rise by 2.4% y/y to 842.1Moz (26,193t). This will be largely driven by new silver projects coming on-line and ramping up. For example, Juanicipio, a JV between Fresnillo and MAG Silver, is expected to reach full production capacity in the first half of the year and be a major driver of growth in Mexico (+18.7Moz, 582t). Meanwhile, the continued ramp-up of Kinross' La Coipa and expected commissioning of Gold Fields' Salares Norte towards the end of the year will help push Chilean output higher (+12.4Moz, 385t). Our forecast assumes that Buenaventura's Uchucchacua in Peru will resume operations in the final quarter of the year. However, Peruvian output is expected to decline (-7.1Moz, 221t) as social unrest disrupts mining operations and grades continue to fall at several major mines. Production is also expected to be lower in Argentina (-5.6Moz, 174t), due to the closure of Pan American Silver's Manantial Espejo, and in China (-4.0Moz, 124t), as silver by-product output is forecast to fall in conjunction with the continued decline in domestic lead/zinc production.

We anticipate **hedging** activity will remain neutral in 2023. Some expiring contracts are likely to be replaced, but no significant additions are expected as the cost benefit of hedging has receded with the lower price.

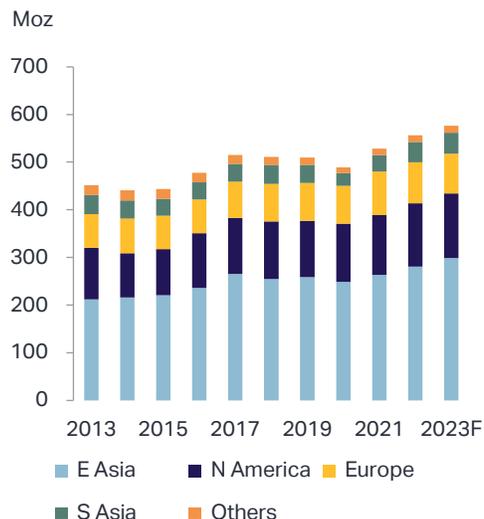
Even though by a small margin, **recycling** is set to increase for a fourth straight year in 2023 to its highest since 2012. The upside will again be led by the industrial sector due to ongoing drivers such as higher ethylene oxide changeouts, albeit to a lesser extent than last year. The gains here will be offset by a further drop for photography and losses for jewelry and silverware thanks chiefly to a fall in India through lower prices and weaker distress selling as the rural economy recovers.

### Global Supply Forecast



Source: Metals Focus, Bloomberg

### Industrial Fabrication Forecast



Source: Metals Focus

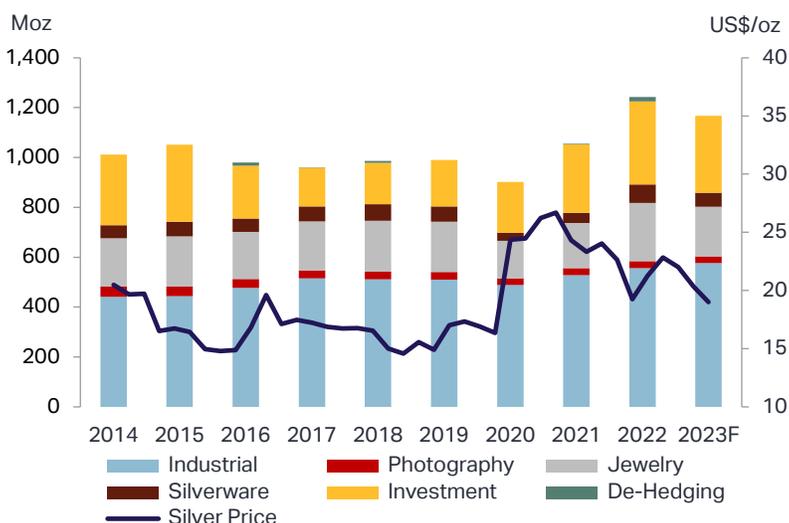
## Demand Outlook

Led by end-uses in the green economy, **industrial** demand is forecast to rise yet again, by 4% to a new record high this year. The drivers behind these gains include GDP growth, investment in PV, power grids and 5G networks, a return to growth for consumer electronics and rising vehicle output. Also important is thrifting and substitution in general staying modest. That said, recent worries surrounding the banking industry may bring uncertainty to the first half of the year and, second, we are unlikely to see a repeat of last year’s stock build of silver to safeguard against supply chain bottlenecks. The structural fall in **photographic** demand is also likely to continue in 2023.

**Jewelry** fabrication is set to fall by 15% this year, as demand reverts to pre-COVID levels. This is mainly driven by India which normalizes after the surge of 2022. Chinese demand is forecast to recover by 10% as the impact of COVID wanes, but economic uncertainty still weighs on consumer spending. The outlook for Western demand is mixed with Europe almost flat due to the cost-of-living crisis and uncertain economic outlook. North America, on the other hand, posts a small rise as the economic backdrop remains benign. We also forecast **silverware** demand to fall by 24% to 55.7Moz (1,731t), mostly due to India as pent-up demand wanes and stocking by the trade normalizes.

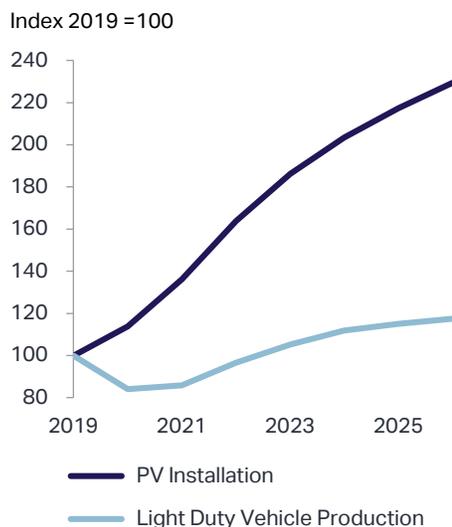
Net **physical investment** is forecast to ease in 2023 by 7% as most key markets post a drop after a strong 2022, especially in the US, where investment has been growing solidly for four years. In Europe, demand is likely to suffer as German investment adapts to a new fiscal regime. The forecast drop in India is based on the fact that investment normalizes after a significant jump in 2022. We also expect a slight drop of 30Moz (933t) for ETPs, against a far steeper decline in 2022.

### Global Demand Forecast



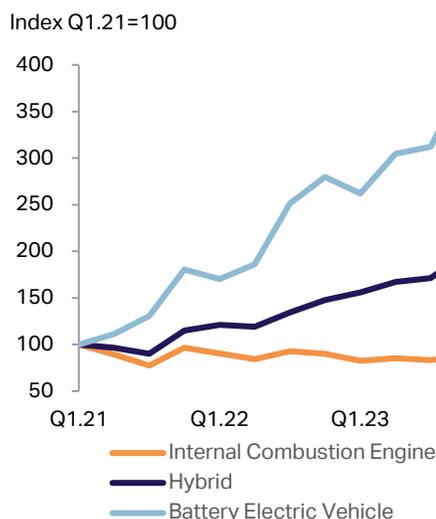
Source: Metals Focus, Bloomberg

## Longer-Term Industrial Demand Indicators



Source: GTM, Metals Focus, LMC Automotive, A GlobalData Company

## Quarterly Vehicle Production by Powertrain



Source: Metals Focus, LMC Automotive, A GlobalData Company

## The Longer-Term Outlook for Silver

Rising silver **mine production** this year is expected to be followed by continued growth over the medium term. This will be driven by higher output from established mines and new projects coming on-line. However, mined output over the longer term, four to five years out, is forecast to begin to decline. This will be due to losses from grade decline and reserve depletion at existing operations exceeding the new production that is expected to come on-line from the current project-pipeline. A re-start of Pan American Silver's Escobal in Guatemala, which has been in care and maintenance since 2017, could provide a meaningful uplift to global output. However, any re-start is dependent on the completion of a consultation process with the local community, which currently remains on-going.

**Recycling** is expected to swing from stability this year to medium term losses and then later gains, chiefly due to price led swings for jewelry and silverware. Industrial scrap in contrast should see steady structural gains, while photographic recycling's structural decline should continue.

Total demand in the next few years is expected to hold broadly steady as growth in industrial offtake is balanced by swings elsewhere. Gains for **industrial** end-uses are based in part on structural factors. These include a shift to renewable energy supplies, the electrification of vehicles and the roll-out of 5G networks. This builds on cyclical factors such as overall GDP growth and specifics such as a return to gains for consumer electronics, a further rise in vehicle output and growth for the construction industry. Some new (or newer) uses (such as PV) will see further thriving and/or substitution in silver use but thriving overall is expected to remain slight as, for most applications, silver use is already running at the bare minimum. All this explains why we expect industrial demand to outpace overall GDP growth, marking a turnaround from the last decade's situation.

**Jewelry** offtake is forecast to return to growth in the medium term, before easing later on, largely in reaction to forecast prices swings. Structural changes look modest and on balance mildly positive (such as rising purities in India). Similarly, **silverware** looks set to see initial gains and later losses driven by price-led swings in India. One positive is Western demand's structural slide having largely ended. That is not the case for **photographic** demand whose structural slide continues and could even accelerate.

**Retail investment** is likely to ease from last year's record as market saturation, disappointment over price weakness, tax changes in Germany and a healthier global economy undermine interest. However, levels in the next few years should remain well above historic lows due to initial bargain hunting, later trend following and a still supportive backdrop of geopolitical tensions. Some investors may also be spurred on by the persistent and heavy deficits that the above supply/demand elements look set to generate.

# Chapter 3

- Silver investment was mixed last year, with physical investment hitting a record high while ETPs saw their biggest outflows since 2011.
- Following a sharp pullback during the previous year, 2022 saw silver trading volumes fall on most main exchanges.
- With inflation likely to gradually ease, non-yielding precious metals, including silver, will have to contend with rising real rates, which will raise the opportunity cost of holding them.

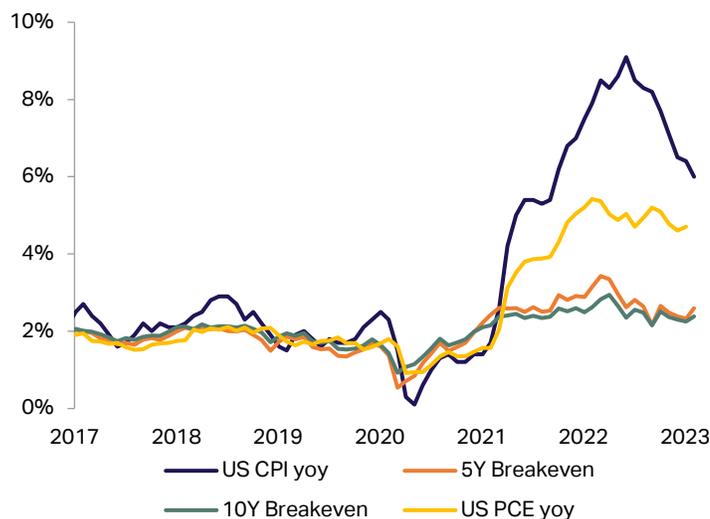
## Investment

### Introduction

Silver investment was mixed in 2022, both across different segments (notably retail and professional activity), but also over the course of the year. This variation was fueled by geopolitical developments, the macro-economic backdrop and market volatility. In this context, institutional investment was decidedly mixed. After strong interest in the aftermath of the war in Ukraine erupting, rising real rates led professional investors to shun silver for much of the year, particularly during Q3.22 when futures positions turned net short. ETPs saw their largest annual outflows since 2011 (-11% y/y). The year also saw further losses in silver exchanges' trading volumes. By contrast, sales of silver bars and coins registered a fifth consecutive year of growth (+22% y/y) and in the process achieved a record high of 332.9Moz (10,356t).

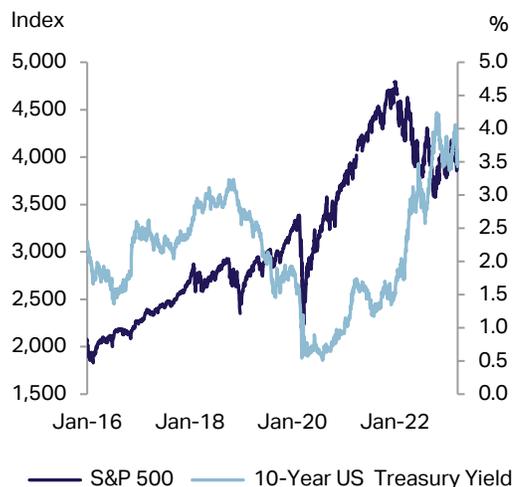
Among the key drivers of the silver price in 2022 was the jump in geopolitical concerns following the start of the Russia-Ukraine war. This in turn exacerbated inflationary pressures as commodity prices soared, particularly in the energy complex. Precious metals investment continued to benefit from nominal rates still being low and real rates negative at the beginning of the year. This, combined with worries about stagflation or even a recession, kept price expectations positive and in turn encouraged retail investors to buy hard assets including physical silver. The steep decline in LBMA silver stocks, along with the phenomenal jump in Indian silver imports, also gained much attention last year, contributing to the positive retail sentiment.

### US Actual Inflation & Forward Inflation Expectations



Source: Bloomberg

### S&P 500 and 10-Year US Treasury Yield



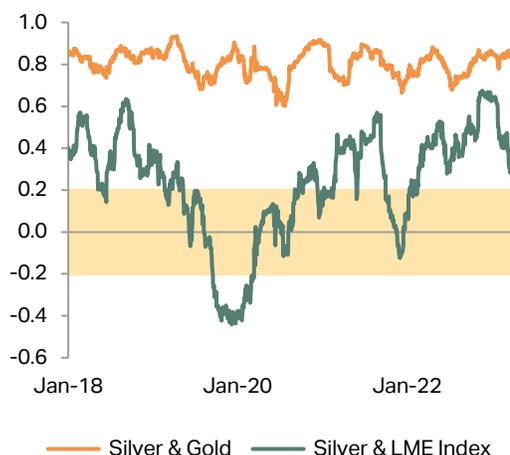
Source: Bloomberg

The outbreak of the Russia-Ukraine war in early 2022 initially benefited both gold and silver; the gold:silver ratio was stable in a 75-80 range for much of Q1. Precious metals came under pressure, however, from late April as aggressive rate hikes by the Fed pushed the US dollar and Treasury yields higher. This raised the cost of holding precious metals for institutional investors and, with silver’s higher beta, the ratio widened to over 85.

Expectations of sharply higher interest rates in the US were also joined by growing recessionary concerns and this fueled more underperformance by silver, as the metal suffered both as a precious and an industrial commodity. These pressures saw the gold:silver ratio touching 95 by September. A pullback to back below 80 then emerged towards the end of the year amid expectations that the Fed would slow its pace of rate hikes. Silver underperformed early on in 2023 despite tailwinds from China’s re-opening and the benefit provided to industrial metals as expectations that the Fed would adopt a more dovish stance encouraged investors to buy into gold.

Amid all this, institutional and retail investment sentiment diverged at times during 2022. Geopolitical uncertainties, concerns about growth and inflation, all supported retail interest throughout the year. This was especially true when professional activity weighed on silver, as retail investors, particularly in North America and Europe, took advantage of ensuing low prices to purchase silver coins and bars, pushing combined sales in these two regions to the highest total in Metals Focus’ series. Indian physical investment saw a stunning recovery after two-years of below par demand, as lower prices and investment holdings starting the year at a low level led to renewed buying.

### Silver’s Correlation with Gold and the LME Index\*



\*Rolling 60-day correlation coefficients between log-returns in the average silver price and changes in the average gold price and the LME Index. Observations within the yellow box are not statistically significant, at a 10% significance level.  
Source: Metals Focus, Bloomberg

### Outlook

The March banking crisis has provided a boost to precious metals. Moreover, there remains much uncertainty regarding what the ripple effects of recent events will be on global financial conditions. Worse yet, the risk that more bank failures emerge cannot be ruled out. All this naturally has consequences for US monetary policy. It is telling that, in spite of Fed Chairman Jerome Powell stating in March that there are no plans to reduce policy rates in 2023, the markets were pricing in several cuts over the second half of the year. This explains the strong support silver and gold prices are enjoying as we write this report in late March.

Our base case, however, continues to see headwinds for silver emerging later this year. We agree with the consensus view that US interest rates will soon peak, but we think cuts are unlikely before next year, for reasons explained in detail in Chapter 2. With inflation likely to gradually ease, non-yielding precious metals including silver will have to contend with rising real rates, which will raise the opportunity cost of holding them. This is likely to prompt liquidations, particularly by professional investors later in the year.

## Annual Turnover on Major Commodity Exchanges & LBMA<sup>1</sup>

| Million ounces         | 2021    | 2022   | Y/Y  |
|------------------------|---------|--------|------|
| SHFE <sup>2</sup>      | 111,623 | 91,037 | -18% |
| CME                    | 98,348  | 85,383 | -13% |
| LBMA                   | 91,615  | 93,741 | 2%   |
| SGE T+D <sup>2</sup>   | 22,150  | 5,872  | -73% |
| MCX                    | 4,158   | 4,347  | 5%   |
| CME Micro <sup>3</sup> | 2,197   | 2,000  | -9%  |
| Tocom/OSE              | 13      | 12     | -10% |

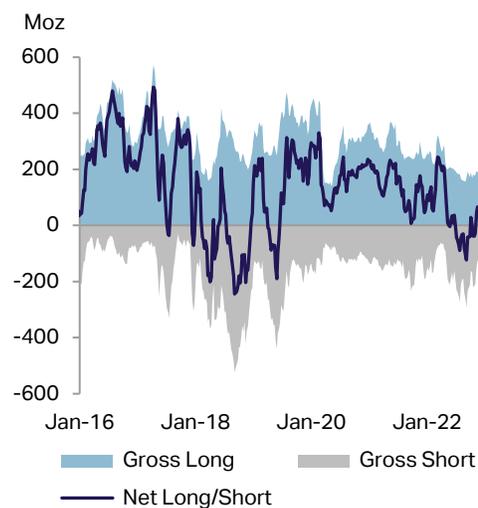
1. Turnover on all exchanges includes futures, spot or deferred contracts where applicable; turnover on LBMA includes spot, swaps and forwards.

2. The SHFE and SGE record each transaction twice, from the point of view of the buyer and also the seller. However, to compare these volumes with other exchanges, the reported figures have been halved (as shown above).

3. On the CME, 5,000oz for its standard futures contract & 1,000oz for micro futures contract.

Source: Bloomberg, respective exchanges

## Investor Positions on the CME\*



\*Managed money positions; Source: CFTC

## Institutional Investor Activity

Institutional sentiment was mixed in 2022. The Russia-Ukraine war boosted interest in the first half of the year but the support from geopolitical developments faded later in the year in the face of rising interest rates as central banks, particularly the Fed, responded aggressively to tame inflation, which touched multi-decade highs. Institutional investors had to contend with rising real rates as the year progressed, which led to sizable liquidations by professional investors around August and September. Against this backdrop, silver trading volumes on commodity exchanges and in the OTC market weakened last year.

## Commodity Exchanges

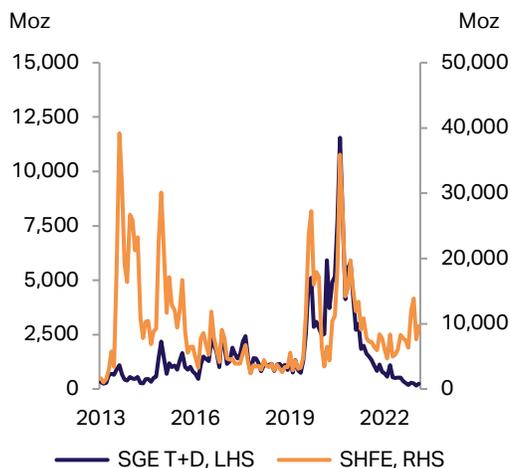
Following a sharp pullback in the previous year, 2022 saw silver trading fall on most main exchanges. For example, annual turnover of the main **CME** contract fell by 13% y/y in 2022 to its lowest level since 2015, led by declines over the first eight months. Aside from a short-term boost in February and March, investors generally maintained a bearish stance towards silver. This was reflected in managed money positioning, with the net long falling from a two-year high of 243Moz (7,571t) on March 8th into negative territory in May for the first time in two years. A jump in tactical shorting saw net shorts widen to 124Moz (3,848t) in September as hawkish Fed comments undermined precious metals. Silver's industrial credentials meant that it faced additional headwinds from growing recession fears and extended lockdowns in China.

During the last quarter, sentiment improved towards the complex, and so net investor positioning returned to a net long in November, before hitting an eight-month high of 144Moz (4,481t) by year-end. So far this year, concerns of a more hawkish Fed were abruptly reversed as the banking crisis fueled expectations that rate increases may soon end and that cuts could follow later in the year, encouraging institutional buying of silver (and gold).

The **Shanghai Futures Exchange** (SHFE), the largest exchange for silver futures trading, also saw volumes fall again and by a heavy 18%. The drop on this exchange, where retail investors account for most speculative silver trading, was mainly due to a perceived lack of price upside over the year. Silver trading volumes on the **Shanghai Gold Exchange** (SGE) fell by a steeper 73%. Retail investors also dominate trading here and so a further tightening of restrictions on their activities was a key factor behind this dramatic drop.

The **Multi Commodity Exchange of India** (MCX) was the only exchange that saw annual turnover rise. Higher trading was seen in H2, as a result of improved sentiment towards the metal and also a widening spread between spot and futures prices, which encouraged investors to buy spot and sell MCX futures.

### SGE & SHFE Silver: Monthly Turnover



Source: Shanghai Gold Exchange, Shanghai Futures Exchange

### Over-the-Counter Market (OTC)

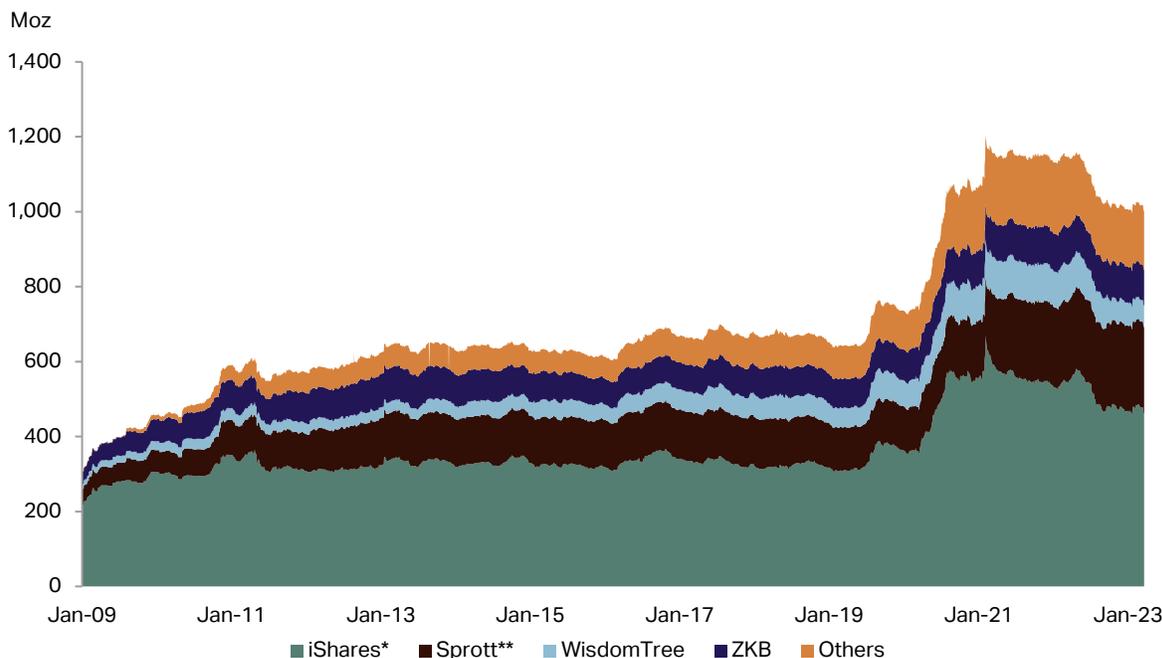
OTC activity was mixed last year; using LBMA trading turnover as a proxy, activity unsurprisingly spiked in March 2022, and then again in May. It is worth noting, however, that in both instances the upside was nowhere near as pronounced compared with early 2021 during the Reddit-squeeze. These episodes aside, LBMA trading volumes during 2022 were broadly similar to those of a year ago. That said, there were reports of improved demand for metal accounts, particularly from high-net-worth (HNW) investors concerned about rising inflation.

2023 saw a relatively quiet start with conditions broadly similar to last year. However, strong positive interest emerged in late Q1 and through to the time of writing as the banking crisis emerged. The rise in OTC activity as this crisis unfolded was most keenly felt in Europe due to the challenges facing the Swiss banking sector. However, even then, the upturn in LBMA trading volumes was relatively modest.

### Exchange-Traded Products (ETPs)

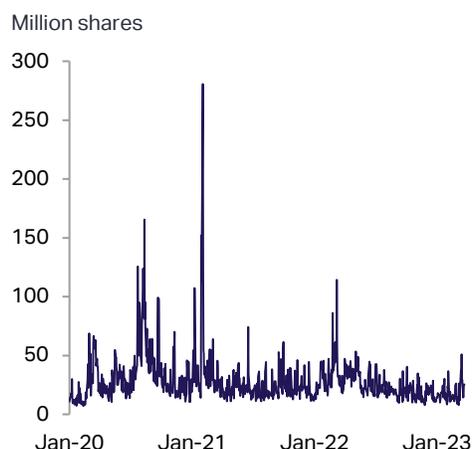
In 2022, silver ETPs recorded their largest annual outflows since 2011. At the end of the year, combined holdings stood just above 1,006Moz (31,290t), down by 11% or 125.7Moz (3,912t) from the end of 2021.

### Silver ETP Holdings



\*iShares Silver Trust; \*\*Combined holdings of Sprott Gold & Silver and Sprott Silver  
Source: Bloomberg, respective issuers

## iShares Silver Trust Daily Turnover



Source: Bloomberg

The bulk of outflows were concentrated over May-September. Prior to that, silver holdings were elevated, supported by safe-haven demand; escalating Russia-Ukraine tensions, culminating in the invasion, had underpinned investor interest in the precious metals complex. The combined silver ETP holdings by end-April were only 5% shy of the all-time peak seen in February 2021. As mentioned earlier, unfavorable macroeconomic factors, including the tightening of monetary policy by major central banks (in particular the hawkish Fed), the strong US dollar and growing concerns about global growth, undermined silver investment later. Similar to the futures market, silver ETP holdings eased notably during Q2-Q3 to their lowest level since July 2020. Thereafter, with a 26% price growth in the last quarter, the outflow in silver ETPs remained limited. By end-2022, combined holdings edged lower by a marginal 1% compared to the end-September level.

This resilient performance has continued this year to date. In contrast with the decline in institutional buying and the volatile start to the year for coin and bar purchases, changes in silver ETPs during the past few weeks remained limited. Combined holdings by end-February stood at 1,017Moz (31,633t) and so these were back to the level seen in November 2022. More recently, the surge in precious metals prices, including silver, due to the recent banking crisis and ongoing uncertainty in the market has led to some short-term profit-taking. Total holdings stood at 1,001Moz (31,137t) on March 29th, taking the year-to-date change to a mere -0.5%.

## Physical Investment

2022 was an outstanding year for global physical investment in silver. Bar and coin demand jumped by 22% y/y to a new high of 332.9Moz (10,356t). This outcome was led by a healthy recovery in India, where demand had collapsed the year before. Gains in the US and Australia were relatively modest in 2022, although each still set a new record total. In contrast, physical investment in Germany slipped last year, but still remained exceptionally robust.

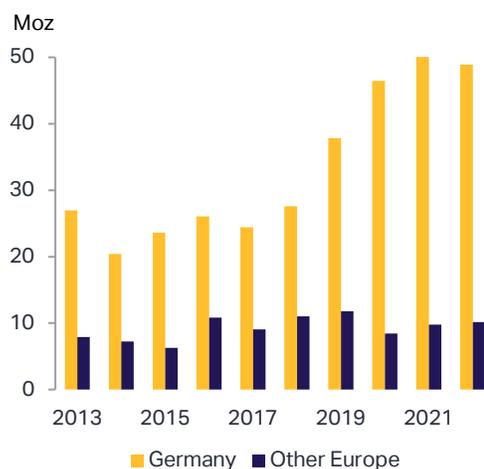
## Physical Investment Forecast

| Million ounces      | 2022         | 2023F        | Y/Y        |
|---------------------|--------------|--------------|------------|
| Bars                | 175.0        | 159.0        | -9%        |
| Coins               | 157.9        | 150.1        | -5%        |
| <b>Global Total</b> | <b>332.9</b> | <b>309.0</b> | <b>-7%</b> |

Source: Metals Focus

Looking first at the **US**, silver coin and bar demand may have only edged higher last year, by an estimated 4% to 134.0Moz (4,169t), but this still set a new high. It is also worth remembering that during 2010-20, US demand had averaged "just" 92.8Moz (2,886t), which puts into perspective how strong retail buying has been during 2021-22. What is perhaps equally surprising is how little selling back of silver bars and coins there has been by US retail investors. Between 2010-22, the US market absorbed 1.284Bn oz (39,928t) of silver bars and coins. That is a tremendous quantity, yet the dealer community has had to contend with only very modest levels of silver buybacks. This lack of investors selling back silver bars and coins continued in early 2023, when retail interest fell sharply (until the onset of the banking crisis). In the gold market, liquidations during January to early March jumped to levels last seen pre-pandemic, but for silver liquidations were still modest.

## Germany and Europe Retail Investment



Source: Metals Focus

Returning to last year, the US market, in keeping with 2021, had to contend with extended product shortages and exceptionally high wholesale and retail premiums (this was most pronounced for coins). This lasted through to late Q4, when the market finally slowed. Even at that point though, in absolute terms, sales remained healthy. The Russia-Ukraine war unsettled investors, but arguably just as important were concerns that US inflation would continue to rise, in the process becoming more entrenched. Finally, although it is difficult to quantify, there is the deep-seated mistrust of the US Administration, and this concern still accounts for an important share of purchases in the silver market.

In **Europe**, physical investment was essentially unchanged y/y in 2022 at 64.6Moz (2,011t) but this should not detract from what was another exceptional performance for the region. This was led by **Germany** which is by far Europe's largest physical silver investment market and, although its demand eased by 3%, this was mostly due to an unexpected and sudden VAT change (see below).

In keeping with many other retail markets, the Russia-Ukraine war and growing inflationary concerns drove much of this buying. In a similar vein to 2021, a lack of product availability, which saw delivery times remain drawn out, meant that retail premiums remained exceptionally high, although this did not act as a deterrent. It is worth bearing in mind that the German market is heavily biased towards bullion coins, with a retail market share of around 85%. As such, sovereign mints had to manage very strong order books in their two largest markets, the US and Germany. The production constraints they faced further added to the lack of product availability.

## US Physical Investment: Bar versus Coin

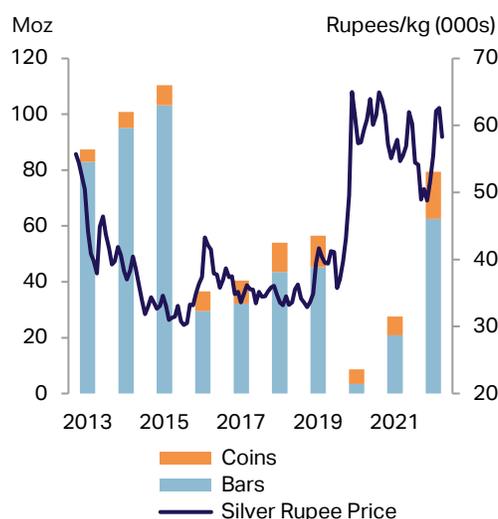


Source: Metals Focus

One reason for the bias towards coins was the favorable tax treatment afforded to non-EU silver bullion coins. This started in 2014 and was abruptly ended in September 2022. Although the scheme was then extended to end-2022, all silver investment products from January 2023 are subject to the same 19% VAT. As a result, the market effectively collapsed, resulting in first quarter sales dropping by over 80% y/y. Although we expect the market to eventually recover, it will take some time for the public to accept the new fiscal regime and so, as a result, full year sales are expected to fall by 11% y/y.

**Australian** physical investment in silver rose by 15% y/y in 2022, from an already exceptionally high base, to reach 17.3Moz (539t). This was the highest since at least 2010, the starting point of Metals Focus' series. Indeed, in our discussions with local dealers and manufacturers it was clear that, for many, the past two years have been the strongest that they have ever experienced. Demand was underpinned by similar factors to those seen in North America and Europe, namely concerns about the global macro and geopolitical environment. Within that, in addition to the wider issues of high inflation, global markets downside risk and the war in Ukraine, Australian investors'

## Indian Coin & Bar Demand



Source: Metals Focus, Bloomberg

interest in silver was further boosted by concerns about the country's overheated property market and its deteriorating relationship with China.

Building on the strong recovery in 2021, which followed 2020's heavy liquidations, **Indian** physical investment saw a staggering 188% jump last year and touched 79.4Moz (2,470t), its highest since the 2015 record. Importantly, while investment demand was lower than previous highs, it was still 40% higher compared to pre-pandemic levels of 2019.

Last year, silver investment benefited from lower prices and bargain hunting but much of this was also due to fresh investment buying as many investors had liquidated their holdings in 2020 and 2021. They had done so back then when prices rallied to near 2011 highs in the domestic market as this enabled many investors exit positions they had been holding for the previous few years. That apart, investment in India is also influenced by jewelry and silverware market activity. Individuals involved in jewelry and silverware are frequently big investors, often buying silver during low-price periods to be fabricated (and effectively disinvested) later. After being subdued for two years, jewelry and silverware demand made a strong comeback last year, both touching a record high. This provided confidence to the trade to start investing again and led to the jump in physical investment last year.

Another important factor that helped investment demand, particularly during H2.22, was expectations about a silver import duty hike. After the government raised the import duty on gold in July 2022 by 5%, investors and traders stocked up on silver in anticipation of a duty hike, as the tariff on both metals has typically moved in tandem since 2013 (the tax was finally raised in February 2023). That aside, investment activity was also supported last year by the revival in the arbitrage trade. The aim here is to benefit from a price discrepancy between the spot and the futures contract, so investors (mainly high-net-worth individuals) buy silver bars and sell futures on the exchange.

## Physical Investment

| Million ounces      | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         | 2022         | Y/Y        |
|---------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------------|
| United States       | 122.0        | 111.9        | 124.8        | 101.1        | 55.7         | 47.1         | 47.9         | 91.1         | 129.1        | 134.0        | 4%         |
| India               | 87.4         | 100.8        | 110.4        | 36.5         | 40.5         | 54.0         | 56.5         | 8.7          | 27.6         | 79.4         | 188%       |
| Germany             | 27.0         | 20.4         | 23.6         | 26.1         | 24.4         | 27.6         | 37.8         | 46.5         | 50.3         | 48.9         | -3%        |
| Australia           | 4.9          | 4.3          | 4.3          | 5.1          | 3.3          | 3.6          | 3.5          | 11.4         | 15.0         | 17.3         | 15%        |
| Canada              | 6.6          | 7.4          | 7.6          | 7.2          | 4.7          | 4.6          | 5.0          | 7.5          | 10.6         | 12.0         | 14%        |
| China               | 24.4         | 14.8         | 13.9         | 13.8         | 9.4          | 9.0          | 7.9          | 8.7          | 7.8          | 7.4          | -6%        |
| Other Europe        | 7.9          | 7.3          | 6.3          | 10.8         | 9.1          | 11.0         | 11.8         | 8.4          | 9.8          | 10.1         | 4%         |
| Others              | 20.5         | 16.1         | 18.3         | 12.3         | 8.7          | 8.7          | 16.6         | 22.6         | 23.9         | 23.8         | -1%        |
| <b>Global Total</b> | <b>300.8</b> | <b>283.0</b> | <b>309.3</b> | <b>212.9</b> | <b>155.8</b> | <b>165.5</b> | <b>187.0</b> | <b>204.8</b> | <b>274.0</b> | <b>332.9</b> | <b>22%</b> |

Source: Metals Focus

## Indexed Silver Prices



Source: Metals Focus, Bloomberg

The difference between spot and futures pricing was 8-14% during the year. Our estimates suggest that outstanding positions in these trades reached around 6-9Moz (250-400t) during 2022.

For 2023, we expect investment demand to stay high in absolute terms but it is expected to post an 11% y/y drop to 70.7Moz (2,199t). This is mainly premised on the fact that investment buying from the trade will normalize this year after the significant jump in 2022. However, other retail investors should remain keen on silver.

Physical investment in **China** recorded another decline of 6% to 7.4Moz (229t), driven by losses in both the bar and coin markets. Due to silver's VAT treatment (13% is levied on the total value of silver products, whereas gold and platinum are exempt), silver bar and coin markets are dominated by gifting and collector demand. Last year, the severe impact of the COVID outbreak, pandemic prevention measures and the slowdown in China's economy undermined collectors' purchases.

Gifting demand also dropped with limited socializing and corporate activities, due to the tight prevention controls under the zero-COVID policy last year. In addition, the mintage plan in 2022 was down by 4%. In 2023, we expect physical silver investment to increase by 9%, given the fading impact of pandemic era disruptions and signs of a healthy improvement in China's economic growth and consumer sentiment.

## Coins & Medals Fabrication

| Million ounces      | 2013         | 2014         | 2015         | 2016         | 2017        | 2018        | 2019        | 2020         | 2021         | 2022         | Y/Y       |
|---------------------|--------------|--------------|--------------|--------------|-------------|-------------|-------------|--------------|--------------|--------------|-----------|
| Canada              | 29.3         | 30.8         | 35.4         | 33.6         | 18.9        | 18.4        | 23.0        | 28.8         | 36.4         | 35.8         | -2%       |
| Australia           | 8.6          | 8.5          | 12.7         | 13.2         | 10.7        | 10.4        | 12.7        | 17.3         | 20.0         | 24.1         | 21%       |
| United States       | 45.8         | 46.4         | 49.1         | 39.4         | 19.3        | 17.1        | 20.5        | 32.7         | 32.2         | 21.1         | -35%      |
| UK                  | 2.5          | 2.2          | 3.5          | 3.5          | 3.1         | 3.5         | 3.2         | 9.7          | 15.7         | 19.3         | 23%       |
| India               | 4.5          | 5.7          | 7.2          | 7.1          | 8.3         | 10.5        | 11.3        | 5.2          | 6.7          | 16.9         | 150%      |
| Austria             | 14.5         | 4.6          | 7.3          | 3.4          | 2.1         | 2.1         | 2.9         | 7.2          | 12.3         | 12.2         | -0.2%     |
| South Africa        | 0.8          | 0.0          | 0.6          | 0.0          | 1.2         | 3.7         | 3.6         | 7.9          | 10.3         | 8.2          | -20%      |
| China               | 14.1         | 13.7         | 13.7         | 12.9         | 8.6         | 8.6         | 7.3         | 8.1          | 7.3          | 7.0          | -3%       |
| Germany             | 1.3          | 1.3          | 1.9          | 4.3          | 4.0         | 4.0         | 3.9         | 3.9          | 3.9          | 3.9          | 0%        |
| Mexico              | 0.7          | 0.7          | 1.1          | 1.2          | 1.2         | 0.6         | 0.4         | 0.4          | 0.6          | 0.6          | 6%        |
| Others              | 7.3          | 6.6          | 6.7          | 5.8          | 5.4         | 6.3         | 7.6         | 7.2          | 8.2          | 8.8          | 8%        |
| <b>Global Total</b> | <b>129.4</b> | <b>120.6</b> | <b>139.2</b> | <b>124.3</b> | <b>82.8</b> | <b>85.4</b> | <b>96.2</b> | <b>128.3</b> | <b>153.5</b> | <b>157.9</b> | <b>3%</b> |

Source: Metals Focus

## Above-Ground Silver Stocks

2022 saw the silver market register its second consecutive deficit. Crucially, at 237.7Moz (7,393t), last year's shortfall was likely an all-time record. We should caution that differences in Metals Focus' definitions and coverage and that of previous authors of the World Silver Survey complicate comparisons of data from different eras. It is also interesting to note that the deficits of 2021 and 2022 have more than wiped out the cumulative gains in silver above-ground stocks that we saw over 2010-2020 inclusive.

All this is important as we believe it is ushering in a new era for the silver market. Historically, due to silver's vast inventory overhang, the price of the metal was driven by its link with gold and ultimately macroeconomic factors. As a new normal of silver being in structural deficits is fast emerging, that link over time is likely to change. For the time being, we believe that there remain enough inventories – London vaulted stocks alone after all amount to more than one year's mine production. However, given our expectations that demand will continue to exceed supply for the foreseeable future, eventually much of this stockpile will be depleted. The effect of this on the price may be amplified by a possible reluctance by ETP holders to liquidate.

It is important to stress here that this does not suggest the world will run out of silver. After all, our above-ground stock

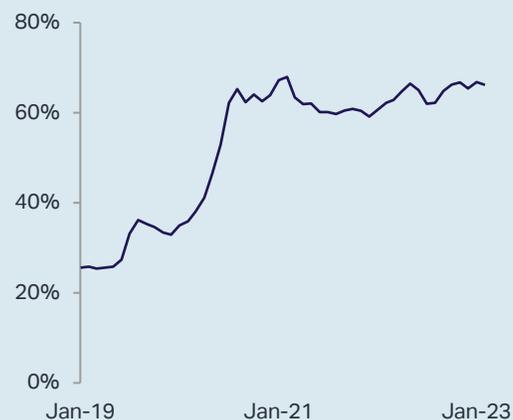
### Identifiable Silver Bullion Inventories\*

| Million ounces | 2020           | 2021           | 2022           | Y/Y         |
|----------------|----------------|----------------|----------------|-------------|
| London vaults  | 1,080.5        | 1,161.5        | 840.9          | -28%        |
| CME            | 396.5          | 355.7          | 299.0          | -16%        |
| SGE            | 130.0          | 73.9           | 69.0           | -7%         |
| SHFE           | 95.2           | 75.9           | 69.2           | -9%         |
| <b>Total</b>   | <b>1,702.3</b> | <b>1,666.9</b> | <b>1,278.1</b> | <b>-23%</b> |

\*Year-end; Source: Metals Focus, LBMA, CME, SGE, SHFE

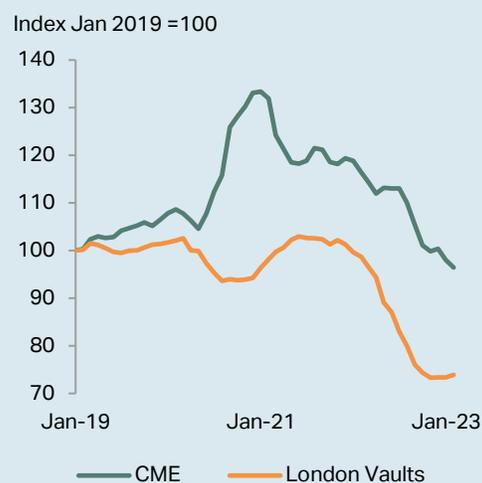
definition does not include coins and small bars held by individual investors around the world. In the past 10 years alone, such investors accumulated more than 2.4 billion ounces (over 75,000t) of silver in such forms. Some of that could eventually be sold back, at the right price. However, historically we have seen that such holdings are far more inert than wholesale stocks, for example metal held in silver's terminal markets. Turning back to 2022, global identified/reported stocks fell by 388.8Moz (12,093t) over the course of the year. The lion's share of this decline came from London vaults, which saw outflows of over 320Moz (nearly 10,000t). Combining total reported stock changes with our estimated deficit suggests that unreported silver inventories rose by 151.1Moz (4,700t).

### London Vault Silver Inventories\*: Percent Held as ETPs



\*Includes silver stored at LBMA-member custodian vaults  
Source: Metals Focus, LBMA, Bloomberg

### CME vs London\* Vault Inventories



\*Includes silver stored at LBMA-member custodian vaults  
Source: Metals Focus, LBMA, CME

## Chapter 4

- Global silver mine supply fell by 0.6% y/y in 2022 to 822.4Moz (25,578t), largely due to a drop in Peruvian production.
- Inflation in almost all key input costs last year drove primary silver miners' all-in sustaining costs up by 15.8% y/y.
- Mined output is expected to rise by 2.4% y/y in 2023 to 842.1Moz (26,193t) as a number of new projects ramp-up.

# Mine Supply

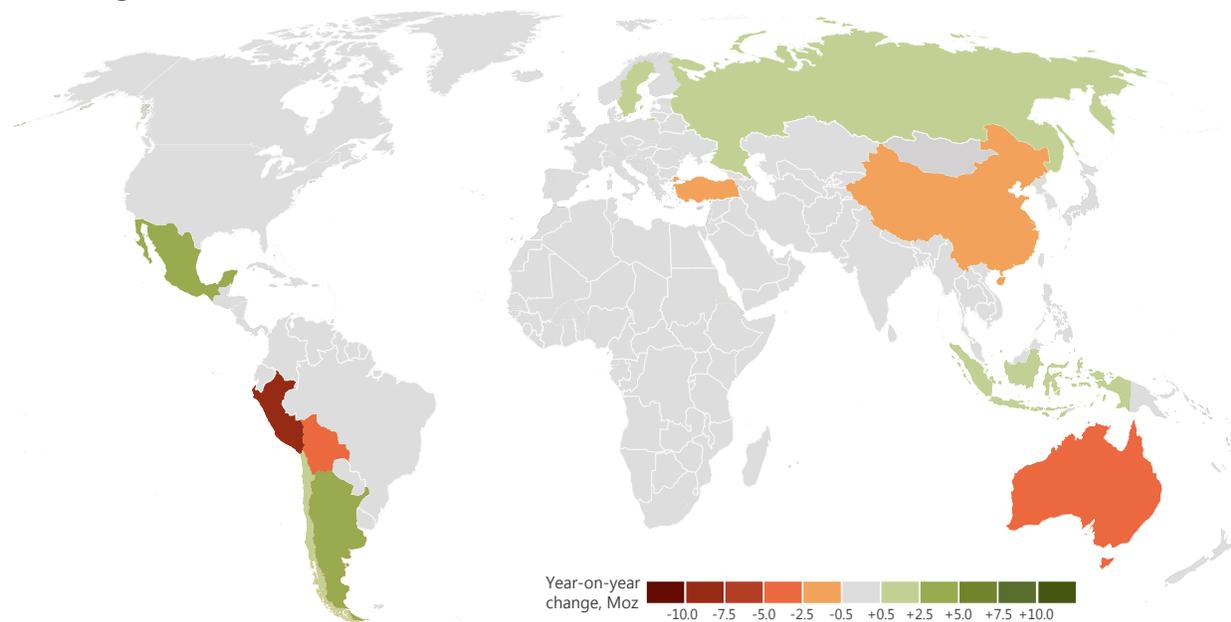
## Mine Production

Global mined silver production fell marginally in 2022, by 0.6% y/y to 822.4Moz (25,578t). This followed strong growth of 5.8% the previous year as mines recovered from the disruption caused by COVID. Output in 2022 was 20.8Moz (648t) lower than our forecast in last year's World Silver Survey as several major new projects were delayed; Buenaventura's Uchucchacua did not resume production as had been anticipated, while several other mines were impacted by unexpected disruptions.

Last year's drop in global silver production was driven by lower by-product output from lead/zinc mines (-3.5%). This was partially offset by higher silver production from gold (+1.0%) and copper (+0.8%) mines. Meanwhile, output from primary silver mines was almost flat year-on-year (+0.1%). At the country level, Peruvian output fell by the most (-8.5Moz, 263t), followed by Australia (-4.2Moz, 131t) and Bolivia (-2.8Moz, 88t). These losses were partially offset by rising output from Mexico (+3.1Moz, 98t), Argentina (+3.0Moz, 94t) and Russia (+2.2Moz, 67t).

This year, we expect mined silver supply to rise by 2.4% y/y to 842.1Moz (26,193t). This will largely be due to additions from new projects. Juanicipio, for example, is expected to reach full capacity in H1.23 and this will be a major driver of growth in Mexico. Elsewhere, the continued ramp-up of La Coipa and commissioning of Salares Norte will push Chilean output higher. Our forecast also assumes Uchucchacua resuming production towards the end of 2023.

### Major Changes to Global Mine Production, 2022 versus 2021



Source: Metals Focus

## Top 20 Producing Countries

| Million ounces     | 2021         | 2022         | Y/Y        |
|--------------------|--------------|--------------|------------|
| Mexico             | 196.0        | 199.2        | 2%         |
| China              | 112.9        | 111.8        | -1%        |
| Peru               | 115.5        | 107.0        | -7%        |
| Poland             | 42.0         | 42.4         | 1%         |
| Chile              | 41.2         | 41.9         | 2%         |
| Russia             | 39.0         | 41.1         | 6%         |
| Bolivia            | 41.5         | 38.7         | -7%        |
| Australia          | 42.8         | 38.5         | -10%       |
| United States      | 32.6         | 32.4         | -1%        |
| Argentina          | 27.9         | 30.9         | 11%        |
| India              | 22.2         | 22.3         | 1%         |
| Kazakhstan         | 15.0         | 14.8         | -1%        |
| Sweden             | 13.9         | 14.8         | 6%         |
| Indonesia          | 10.2         | 11.4         | 11%        |
| Canada             | 9.1          | 8.7          | -5%        |
| Morocco            | 8.0          | 8.5          | 6%         |
| Uzbekistan         | 6.8          | 7.0          | 3%         |
| Turkey             | 5.5          | 4.7          | -14%       |
| Dominican Republic | 3.4          | 2.9          | -16%       |
| Panama             | 2.5          | 2.8          | 12%        |
| Others             | 39.7         | 40.4         | 2%         |
| <b>Total</b>       | <b>827.6</b> | <b>822.4</b> | <b>-1%</b> |

Source: Metals Focus

## North America

Silver mine production in North America rose by 1.1% y/y to 240.2Moz (7,472t). Higher production in Mexico (+3.1Moz, 98t) offset reduced output from the US (-0.2Moz, 6.3t) and Canada (-0.4Moz, 13.2t).

The 1.6% y/y growth in **Mexico** was largely driven by the ramp-up of new projects that have come on-line in recent years. SilverCrest Metals' Las Chispas (+1.7Moz, 53t) commenced production in 2022. Cerro Los Gatos (+2.7Moz, 84t), operated by Gatos Silver, continued to ramp-up, achieving record silver production in 2022. Fresnillo, the world's largest silver producer, raised its silver output by 2.2% y/y (+1.1Moz, 34t). This was driven by a gradual ramp-up at Juanicipio (+3.8Moz, 117t) and higher ore volumes processed at Fresnillo (+1.6Moz, 51t). These increases were partially offset by production declines at San Julián (-2.5Moz, 78t), Saucito (-0.5Moz, 14t) and Ciénega (-0.7Moz, 23t) due to decreased ore throughput and lower grades. Output also dropped at Newmont's Peñasquito (-1.9Moz, 58t) and First Majestic's San Dimas (-1.4Moz, 45t) due to lower grades and recovery rates.

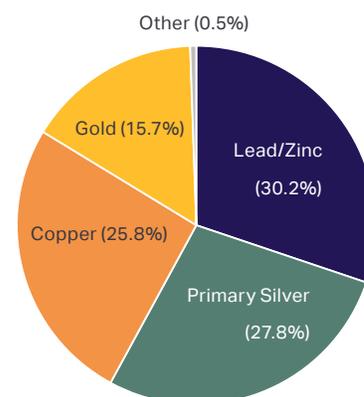
In the **US**, output fell by 0.6% y/y to 32.4Moz (1,007t). However, Hecla recorded higher production at Lucky Friday (+0.8Moz, 26t) and Greens Creek (+0.5Moz, 16t). This was due to increased efficiencies from a new underground mining technique at Lucky Friday and higher ore throughput and grades at Greens Creek. These increases were surpassed by falls elsewhere, the biggest of which was at Hycroft (-0.4Moz, 11t), operated by Hycroft Mining, as the mine came to the end of its life.

**Canadian** silver production dropped for the third consecutive year, falling by 4.6% y/y to 8.7Moz (270t). The largest decline occurred at Hudbay's Flin Flon (-0.3Moz, 10t) as the processing facility was shut down in mid-2022 following the depletion of reserves at the associated 777 mine.

## Silver Mine Production by Source Metal in 2022

| Million ounces          | Primary      |              |              |              |            |
|-------------------------|--------------|--------------|--------------|--------------|------------|
|                         | Lead/Zinc    | Silver       | Copper       | Gold         | Other      |
| North America           | 34.7         | 135.5        | 13.7         | 56.0         | 0.4        |
| Central & South America | 65.8         | 42.4         | 78.5         | 44.2         | 0.0        |
| Europe                  | 14.5         | 1.5          | 48.4         | 1.4          | 0.0        |
| Africa                  | 3.8          | 6.2          | 4.0          | 2.8          | 0.0        |
| CIS                     | 12.0         | 19.6         | 23.8         | 9.6          | 2.6        |
| Asia                    | 100.0        | 9.0          | 38.3         | 11.0         | 1.5        |
| Oceania                 | 17.4         | 14.1         | 5.3          | 4.6          | 0.0        |
| <b>Total</b>            | <b>248.2</b> | <b>228.2</b> | <b>212.0</b> | <b>129.5</b> | <b>4.5</b> |

Source: Metals Focus



## Top 20 Producing Companies

| Million ounces                   | 2021 | 2022              | Y/Y  |
|----------------------------------|------|-------------------|------|
| Fresnillo <sup>1</sup>           | 50.0 | 51.1              | 2%   |
| KGHM Polska Miedz <sup>2,3</sup> | 43.9 | 42.7              | -3%  |
| Newmont <sup>2</sup>             | 31.4 | 29.7              | -5%  |
| Glencore                         | 31.5 | 23.8              | -25% |
| Hindustan Zinc <sup>4,5,6</sup>  | 22.2 | 22.3              | 1%   |
| Polymetal International          | 20.4 | 21.0              | 3%   |
| Codelco <sup>2</sup>             | 22.9 | 19.2 <sup>8</sup> | -16% |
| Southern Copper                  | 19.0 | 18.6              | -2%  |
| Pan American Silver              | 19.2 | 18.5              | -4%  |
| Industrias Peñoles <sup>7</sup>  | 14.5 | 15.9              | 10%  |
| Volcan Cia Minera                | 15.0 | 14.3              | -5%  |
| Hecla Mining Company             | 12.9 | 14.2              | 10%  |
| South32 <sup>2</sup>             | 14.4 | 12.3              | -14% |
| Boliden                          | 11.9 | 12.1              | 2%   |
| BHP <sup>2</sup>                 | 12.5 | 11.7              | -6%  |
| Hochschild Mining                | 12.2 | 11.0              | -10% |
| First Majestic Silver            | 12.8 | 10.5              | -18% |
| Sumitomo Corporation             | 13.5 | 10.3              | -24% |
| Nexa Resources                   | 8.8  | 10.0              | 13%  |
| Coeur Mining                     | 10.1 | 9.8               | -2%  |

NB: 1 - Excludes Silverstream contract, 2 - Payable production, 3 - KGHM Group figures including Polish and international operations, 4 - Hindustan Zinc is a Vedanta Group company, 5 - Production from integrated operations only, 6 - Refined Silver, 7 - Excludes 100% Fresnillo, 8 - Estimate

Source: Company Reports, Metals Focus

## Mine Production Forecast by Region

| Million ounces      | 2022         | 2023F        | Y/Y       |
|---------------------|--------------|--------------|-----------|
| N America           | 240.2        | 263.5        | 10%       |
| C&S America         | 230.9        | 233.6        | 1%        |
| Asia                | 159.7        | 155.7        | -2%       |
| CIS                 | 67.6         | 68.6         | 1%        |
| Europe              | 65.8         | 62.0         | -6%       |
| Oceania             | 41.4         | 42.7         | 3%        |
| Africa              | 16.8         | 16.0         | -5%       |
| <b>Global Total</b> | <b>822.4</b> | <b>842.1</b> | <b>2%</b> |

Source: Metals Focus

## Central & South America

Silver production in Central and South America fell by 3.2% y/y to 230.9Moz (7,181t). This was largely due to a significant drop in output from Peru (-8.5Moz, 263t) and Bolivia (-2.8Moz, 88t), partially mitigated by rising production from the likes of Argentina (+3.0Moz, 94t) and Chile (+0.7Moz, 22t).

Silver production from **Peru** declined by 7.3% y/y to 107.0Moz (3,330t). A major factor was the suspension of mining at Buenaventura's Uchucchacua (-3.7Moz, 116t) in Q4.21. The mine remained suspended throughout 2022 as Buenaventura continue to undertake work aimed at improving the efficiency of the mine. Furthermore, Pan American Silver placed Morococha (-2.0Moz, 62t) into care and maintenance in early 2022. This was due to an expansion at Chinalco's neighboring Toromocho copper mine, which requires the processing plant at Morococha to be relocated. Production also dropped at Antamina (-3.5Moz, 108t), whose majority owners are Glencore and BHP, due to lower grades. Lastly, social unrest led to disruption at several silver producing mines, such as MMG's Las Bambas (-0.3Moz, 11t) and Glencore's Antapaccay (-0.2Moz, 5t).

In **Bolivia**, silver output fell by 6.8% y/y to 38.7Moz (1,203t). The greatest contributor to this was lower production from San Cristobal (-2.9Moz, 89t), which was acquired by San Cristobal Mining (SCM) from Sumitomo Corporation in February 2023.

In **Argentina** production rose by 11% y/y to 30.9Moz (94t). The biggest driver of this rise was AngloGold Ashanti's Cerro Vanguardia (+1.5Moz, 45t) followed by Yamana's Cerro Moro (+0.5Moz, 17t), both of which had higher grades and ore throughput. Silver production also increased in **Chile**, rising by 1.7% to 41.9Moz (1,302t). This was due to the commissioning of Kinross' La Coipa gold mine in Q1.22. This deposit has a high silver content and produced 4.6Moz (142t) during the year, offsetting falls in by-product silver output from copper mines.

## Asia

Silver output in Asia was almost flat, rising by just 0.2% y/y to 159.7Moz (4,966t). Increases in countries such as Indonesia (+1.2Moz, 36t) were matched by lower output in the likes of China (-1.1Moz, -35t).

**Indonesian** production increased for the third consecutive year, rising by 11% to 11.4Moz (353t). Growth in Indonesia over the last three years has primarily been the result of the continued ramp-up of underground mining at Grasberg. This was again the case in 2022, when the mine increased output by 0.4Moz (12t). However, the majority of this expansion is now complete and silver output is expected to flatten moving forward. In contrast, silver production in **China** fell by 1.0% y/y to 111.8Moz (3,476t). This was primarily driven by lower by-product output from lead/zinc mines in the country.

## Mine Production

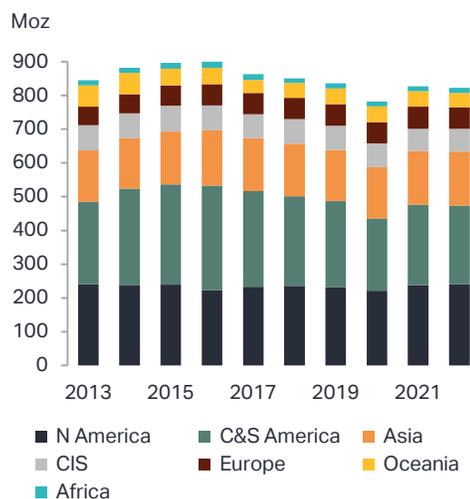
| Million ounces                            | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         | 2022         | Y/Y          |
|---|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>North America</b>                      |              |              |              |              |              |              |              |              |              |              |              |
| Mexico                                    | 187.1        | 185.4        | 192.1        | 174.3        | 187.0        | 194.5        | 187.8        | 180.2        | 196.0        | 199.2        | 2%           |
| United States                             | 33.6         | 37.9         | 35.0         | 37.0         | 33.2         | 29.8         | 31.4         | 31.7         | 32.6         | 32.4         | -1%          |
| Canada                                    | 19.9         | 15.2         | 11.9         | 11.6         | 12.7         | 11.8         | 13.5         | 9.4          | 9.1          | 8.7          | -5%          |
| <b>Sub-total</b>                          | <b>240.7</b> | <b>238.5</b> | <b>239.0</b> | <b>222.8</b> | <b>232.8</b> | <b>236.1</b> | <b>232.6</b> | <b>221.3</b> | <b>237.7</b> | <b>240.2</b> | <b>1%</b>    |
| <b>Central &amp; South America</b>        |              |              |              |              |              |              |              |              |              |              |              |
| Peru                                      | 123.0        | 126.0        | 135.6        | 152.3        | 155.0        | 146.5        | 135.1        | 101.6        | 115.5        | 107.0        | -7%          |
| Chile                                     | 37.6         | 50.2         | 48.1         | 46.6         | 40.4         | 40.0         | 38.2         | 47.4         | 41.2         | 41.9         | 2%           |
| Bolivia                                   | 41.4         | 43.1         | 42.0         | 43.5         | 38.5         | 38.3         | 37.1         | 29.9         | 41.5         | 38.7         | -7%          |
| Argentina                                 | 26.6         | 29.6         | 36.4         | 31.9         | 29.2         | 30.9         | 32.9         | 24.0         | 27.9         | 30.9         | 11%          |
| Dominican Republic                        | 2.6          | 4.4          | 3.1          | 3.9          | 4.9          | 5.1          | 4.5          | 4.1          | 3.4          | 2.9          | -16%         |
| Brazil                                    | 1.0          | 1.1          | 1.6          | 2.5          | 2.8          | 2.3          | 2.2          | 2.2          | 2.3          | 2.4          | 4%           |
| Panama                                    | 0.1          | 0.0          | -            | -            | -            | -            | 0.9          | 1.6          | 2.5          | 2.8          | 12%          |
| Guatemala                                 | 9.1          | 27.6         | 27.7         | 27.0         | 10.8         | -            | -            | -            | -            | -            | na           |
| Others                                    | 3.3          | 3.4          | 2.6          | 2.0          | 2.0          | 2.5          | 3.0          | 3.0          | 4.1          | 4.2          | 2%           |
| <b>Sub-total</b>                          | <b>244.7</b> | <b>285.3</b> | <b>297.1</b> | <b>309.8</b> | <b>283.5</b> | <b>265.5</b> | <b>253.9</b> | <b>213.9</b> | <b>238.5</b> | <b>230.9</b> | <b>-3%</b>   |
| <b>Europe</b>                             |              |              |              |              |              |              |              |              |              |              |              |
| Poland                                    | 38.8         | 38.4         | 39.2         | 40.9         | 41.7         | 40.9         | 40.4         | 39.4         | 42.0         | 42.4         | 1%           |
| Sweden                                    | 10.8         | 12.7         | 15.8         | 16.4         | 15.5         | 15.0         | 14.4         | 13.4         | 13.9         | 14.8         | 6%           |
| Portugal                                  | 1.4          | 1.5          | 1.5          | 1.4          | 1.3          | 2.9          | 3.1          | 3.1          | 3.1          | 2.5          | -21%         |
| Spain                                     | 1.2          | 1.1          | 1.4          | 1.5          | 1.9          | 2.1          | 2.1          | 2.5          | 2.7          | 2.3          | -15%         |
| Finland                                   | 0.1          | 0.1          | 0.1          | 0.1          | 0.1          | 0.1          | 1.1          | 1.6          | 1.5          | 1.5          | 0%           |
| Others                                    | 2.6          | 2.5          | 2.4          | 2.3          | 2.4          | 2.0          | 2.7          | 3.1          | 2.7          | 2.3          | -13%         |
| <b>Sub-total</b>                          | <b>55.0</b>  | <b>56.4</b>  | <b>60.3</b>  | <b>62.6</b>  | <b>62.9</b>  | <b>63.0</b>  | <b>63.7</b>  | <b>63.1</b>  | <b>66.0</b>  | <b>65.8</b>  | <b>-0.2%</b> |
| <b>Africa</b>                             |              |              |              |              |              |              |              |              |              |              |              |
| Morocco                                   | 7.4          | 7.8          | 9.0          | 10.0         | 10.3         | 7.8          | 9.1          | 8.0          | 8.0          | 8.5          | 6%           |
| Eritrea                                   | 0.5          | 1.7          | 3.2          | 3.2          | 2.5          | 1.7          | 1.6          | 2.3          | 2.2          | 2.2          | -1%          |
| South Africa                              | 2.4          | 1.8          | 1.9          | 1.9          | 2.2          | 1.6          | 2.0          | 1.3          | 1.3          | 1.7          | 29%          |
| Botswana                                  | 0.8          | 0.8          | 0.1          | 0.1          | 0.0          | 0.0          | 0.0          | 0.0          | 0.6          | 1.7          | 162%         |
| Others                                    | 4.7          | 3.3          | 3.5          | 2.2          | 2.4          | 2.4          | 2.5          | 2.5          | 2.6          | 2.8          | 6%           |
| <b>Sub-total</b>                          | <b>15.8</b>  | <b>15.4</b>  | <b>17.7</b>  | <b>17.5</b>  | <b>17.4</b>  | <b>13.6</b>  | <b>15.2</b>  | <b>14.1</b>  | <b>14.8</b>  | <b>16.8</b>  | <b>14%</b>   |
| <b>Commonwealth of Independent States</b> |              |              |              |              |              |              |              |              |              |              |              |
| Russia                                    | 44.4         | 46.1         | 51.1         | 46.6         | 42.0         | 43.1         | 44.7         | 42.1         | 39.0         | 41.1         | 6%           |
| Kazakhstan                                | 21.3         | 18.1         | 16.1         | 17.4         | 18.9         | 19.8         | 17.0         | 17.4         | 15.0         | 14.8         | -1%          |
| Uzbekistan                                | 5.9          | 5.9          | 5.9          | 5.9          | 5.9          | 5.9          | 6.1          | 6.3          | 6.8          | 7.0          | 3%           |
| Armenia                                   | 2.3          | 2.4          | 2.5          | 2.4          | 2.6          | 2.0          | 2.4          | 2.6          | 2.5          | 2.5          | -2%          |
| Tajikistan                                | 0.6          | 1.0          | 1.1          | 1.3          | 1.5          | 1.5          | 1.4          | 1.5          | 1.5          | 1.5          | -3%          |
| Others                                    | 0.2          | 0.2          | 0.3          | 0.6          | 0.5          | 0.6          | 0.6          | 0.6          | 0.6          | 0.7          | 9%           |
| <b>Sub-total</b>                          | <b>74.7</b>  | <b>73.6</b>  | <b>77.0</b>  | <b>74.3</b>  | <b>71.5</b>  | <b>72.9</b>  | <b>72.3</b>  | <b>70.5</b>  | <b>65.5</b>  | <b>67.6</b>  | <b>3%</b>    |

## Mine Production

| Million ounces      | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         | 2022         | Y/Y         |
|---------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------------|
| <b>Asia</b>         |              |              |              |              |              |              |              |              |              |              |             |
| China               | 118.1        | 119.0        | 119.1        | 121.3        | 116.4        | 110.6        | 111.5        | 109.5        | 112.9        | 111.8        | -1%         |
| India               | 10.7         | 8.4          | 12.0         | 14.0         | 16.9         | 21.2         | 20.4         | 21.6         | 22.2         | 22.3         | 1%          |
| Indonesia           | 7.8          | 7.0          | 9.9          | 10.8         | 10.0         | 10.3         | 7.6          | 8.8          | 10.2         | 11.4         | 11%         |
| Turkey              | 6.5          | 6.4          | 6.6          | 6.7          | 4.9          | 4.7          | 3.2          | 4.0          | 5.5          | 4.7          | -14%        |
| Iran                | 2.2          | 2.3          | 2.2          | 2.5          | 2.5          | 2.5          | 2.6          | 2.7          | 2.7          | 2.8          | 1%          |
| Philippines         | 1.3          | 0.7          | 1.0          | 1.1          | 1.0          | 1.0          | 1.0          | 0.8          | 1.0          | 1.8          | 83%         |
| Mongolia            | 1.3          | 1.7          | 2.0          | 2.2          | 1.8          | 1.7          | 1.6          | 1.7          | 1.8          | 1.6          | -6%         |
| Laos                | 1.1          | 1.3          | 1.7          | 1.6          | 1.4          | 1.2          | 1.1          | 0.9          | 1.0          | 0.8          | -11%        |
| Thailand            | 1.2          | 1.1          | 0.8          | 1.3          | 0.1          | 0.1          | 0.1          | 0.1          | 0.1          | 0.1          | 0%          |
| Others              | 1.8          | 1.8          | 1.6          | 2.1          | 1.9          | 2.3          | 2.2          | 2.4          | 2.1          | 2.4          | 11%         |
| <b>Sub-total</b>    | <b>151.8</b> | <b>149.6</b> | <b>156.8</b> | <b>163.7</b> | <b>157.0</b> | <b>155.6</b> | <b>151.3</b> | <b>152.5</b> | <b>159.4</b> | <b>159.7</b> | <b>0%</b>   |
| <b>Oceania</b>      |              |              |              |              |              |              |              |              |              |              |             |
| Australia           | 59.2         | 59.4         | 46.0         | 45.6         | 36.0         | 40.3         | 42.6         | 43.0         | 42.8         | 38.5         | -10%        |
| Papua New Guinea    | 3.0          | 3.1          | 2.3          | 3.2          | 2.1          | 3.0          | 4.7          | 3.8          | 2.9          | 2.7          | -8%         |
| Others              | 0.5          | 0.6          | 0.6          | 0.4          | 0.4          | 0.3          | 0.1          | 0.1          | 0.1          | 0.1          | 44%         |
| <b>Sub-total</b>    | <b>62.6</b>  | <b>63.1</b>  | <b>48.9</b>  | <b>49.2</b>  | <b>38.6</b>  | <b>43.6</b>  | <b>47.4</b>  | <b>46.9</b>  | <b>45.8</b>  | <b>41.4</b>  | <b>-10%</b> |
| <b>Global Total</b> | <b>845.3</b> | <b>882.0</b> | <b>896.8</b> | <b>899.8</b> | <b>863.6</b> | <b>850.3</b> | <b>836.6</b> | <b>782.2</b> | <b>827.6</b> | <b>822.4</b> | <b>-1%</b>  |

Source: Metals Focus

## Global Mine Production



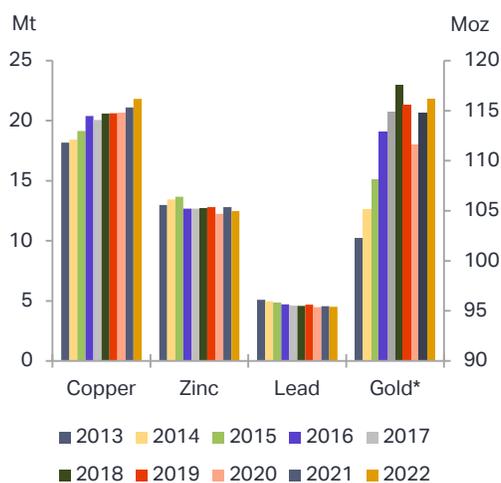
Source: Metals Focus

## Other Regions

Silver production in Oceania decreased by 9.6% y/y to 41.4Moz (1,287t) in 2022. This was driven by a fall in production from **Australia**, down by 9.9% to 38.5Moz (1,199t) largely due to planned lower tonnage throughput at South32's Cannington while crushing infrastructure was relocated. There was also lower output from **Papua New Guinea**, which dropped 8.2% to 2.7Moz (84t), as production at Harmony's Hidden Valley was impacted by a conveyor belt failure and planned lower tonnages.

In the CIS, silver production rose by 3.3% y/y to 67.6Moz (2,103t), underpinned by an increase in **Russia**. The first full year of production at Polymetal's Nezhda helped propel output up by 2.2Moz to 41.1Moz (1,280t). Silver production in Europe remained virtually flat year-on-year at 65.8Moz (2,047t). This was despite higher silver in concentrate production (+0.4Moz, 13t) from KGHM's operations in **Poland** due to increased underground mining rates. In Africa, silver production rose by 14% y/y to 16.8Moz (523t) as output increased in **Botswana** due to Khoemacau's namesake mine ramping up to full production following the completion of construction in mid-2022.

### Global By-Product Production



\*Gold in Moz, RHS  
Source: ICSG, ILZSG, Metals Focus

### By-Product Analysis

The majority of silver is produced as a by-product from mines targeting other metals. Last year, 72% of mined silver production came from lead/zinc, copper and gold mines. In 2022, copper and gold production increased by 3.4% and 1.3% respectively. Conversely, zinc output fell by 2.5% and lead production dropped by 1.5%.

**Lead/zinc** mines are the biggest contributor to global mined silver supply, producing 248.2Moz (7,719t) in 2022, 30% of the global total. China is by far the biggest producer of both lead and zinc, accounting for 43% and 32% of global mined output respectively. However, output from the country has been in long-term decline due to reserve depletion and more stringent environmental regulations. This trend continued in 2022 with lead and zinc output from China falling by 0.9% and 2.3% respectively. Silver production from China followed a similar trend, falling by 1.0%. Globally, silver output from lead/zinc mines dropped by 3.5% as lower by-product output from countries, such as Peru and Australia, added to the drop in Chinese output.

By-product silver production from **copper** mines increased by 0.8% y/y in 2022, reaching 212.0Moz (6,593t) and accounting for 26% of global mine supply. This rise was associated with a 3.4% rise in mined copper output. The biggest growth in copper production came in the Democratic Republic of the Congo, where output rose by 26% y/y as Ivanhoe’s Kamao-Kakula project ramped up. Elsewhere, Indonesian output grew by 28%, as Grasberg continued to increase its underground mining rates, while Peruvian production rose by 4.8%, partly due to Anglo American bringing their Quellaveco project on-line. In contrast, production from the world’s biggest copper producer, Chile, fell by 5.3% y/y due to the impact of a drought in 2022, alongside falling grades at many major mines.

**Gold** mines produced 129.5Moz (4,028t) of silver in 2022, 16% of global silver output. This was a rise of 1.0% y/y, closely matching the 1.3% increase in total gold production. This was largely driven by a 13% rise in Chinese output as operations in Shandong province returned to normal production rates following safety stoppages in 2021. Partially offsetting this was an 8% drop in Russian output due to lower grades at several major mines and the impact of sanctions following Russia’s invasion of Ukraine.

By-product silver production is expected to remain almost flat in 2023, rising by just 0.3%. This will be the result of higher silver output from gold mines, largely due to rising production from Kinross’ La Coipa and the commencement of production at Gold Fields’ Salares Norte in late 2023. Silver production from copper mines is also expected to be higher. However, these gains will largely be offset by lower output from lead/zinc mines as Chinese production continues to decline, and as falling grades, coupled with social unrest, lead to lower output from Peruvian operations.

### Mine Production by Source Metal



Source: Metals Focus

# Disruption to Mined Silver Supply

Unexpected disruptions in 2022 impacted mined silver supply and also has implications for production in the longer-term. The greatest disruptions to silver producers last year occurred as a result of Russia's invasion of Ukraine and social unrest in Peru.

Despite the difficulties caused by the sanctions imposed following the invasion of Ukraine, **Russian** silver production increased by 6% y/y. This highlights that miners operating there have largely been able to continue producing at normal rates. The only major drop in production in 2022 came from Kupol, where output is estimated to have fallen by 1.5Moz (47t) after Kinross suspended operations at the mine and subsequently sold their Russian assets to Highland Gold Mining. This was a direct result of Russia's invasion and the company's decision to exit the country.

Even if there was only a limited impact on Russian silver production in 2022, sanctions imposed on Russia are having an impact on the country's silver producers in other ways. Companies operating there now face difficulties importing equipment from western sources, either due to sanctions or companies choosing to stop exporting to Russia. This has implications for the procurement of new equipment for development projects and spare parts for existing operations. This will impact production in the longer-term as it will lead to project delays and increased equipment downtime if spare parts cannot be sourced. For example, Polyus' giant Sukhoi Log gold project has been delayed as the company had to find alternative processing equipment manufacturers, which will require a re-design of the processing plant. In addition, western sources of financing have been cut off for Russian producers. This will make financing new projects more difficult and lead to project delays which will impact the longer-term supply pipeline for silver and other metals being mined in Russia.

In addition, the economic impact of sanctions is pushing up the cost of production for miners in Russia. For instance, all-in sustaining costs at Polymetal's Dukat, the largest primary silver mine in the world, rose by 44% y/y to \$12.88/oz in 2022. Polymetal stated that the biggest increase in their costs came from domestic inflation and increased logistical costs. This led to both higher operating costs and capital expenditure.

**Peruvian** silver output fell by 7.3% y/y in 2022, causing it to drop behind China as the third biggest global producer. This decline in output was largely the result of the halting of mining at Buenaventura's Uchucchacua and Pan American Silver's Morococha. However, social unrest in Peru also led to disruption at many mines in the country and reduced silver output.

When President Pedro Castillo was impeached in December 2022, an upsurge in protests in the country began. It resulted in logistical challenges in the supply chain as the "mining corridor", a crucial highway used by mining companies to obtain supplies for operations, was blocked. Demonstrators have demanded early elections and the resignation of President Dina Boluarte. Roadblocks have been in place across the country and some mines were attacked, disrupting normal operations.

Shortages of critical supplies at MMG's Las Bambas copper mine resulted in halting production in February 2023. In 2022, it produced 3.9Moz (121t) of silver even after reducing its operations to 30% of capacity in November due to a separate protest. Buenaventura also suspended operations at its Julcani silver mine in December 2022 for 12 days due to a blockade at the mine's entrance. This was followed by another suspension in February 2023 for ten days after protesters illegally entered part of the mine's facilities and forced workers to leave the premises. Other affected operations with significant silver production include Cerro Verde and Orcopampa whose movement of staff, supplies and product was disrupted in December 2022. These disruptions are impacting short-term production in Peru but may also discourage investment, with potential implications for silver production from the country over the longer-term.

Disruption to silver supply has not been limited to Russia and Peru. In **Panama**, First Quantum's Cobre Panama copper mine suspended processing in February 2023 following stalled negotiations with the government over a new mining contract. However, the parties reached a draft agreement in March and operations have resumed. The mine produced 2.8Moz (87t) of silver in 2022. In **Mexico**, disruption was averted when Newmont agreed to union demands over securing the full 10% share of the profit-sharing bonus at its Peñasquito operation under Mexican law following an overhaul of rules in 2021.

## Primary Silver Production Costs

| US\$/oz (by-product*)              | 2021         | 2022         | Y/Y        |
|------------------------------------|--------------|--------------|------------|
| <b>North America</b>               |              |              |            |
| Total Cash                         | 4.55         | 4.92         | 8%         |
| All-In Sustaining                  | 13.84        | 14.97        | 8%         |
| <b>Central &amp; South America</b> |              |              |            |
| Total Cash                         | 7.27         | 7.22         | -1%        |
| All-In Sustaining                  | 13.10        | 13.94        | 6%         |
| <b>CIS</b>                         |              |              |            |
| Total Cash                         | 5.71         | 9.10         | 59%        |
| All-In Sustaining                  | 8.93         | 12.88        | 44%        |
| <b>Asia</b>                        |              |              |            |
| Total Cash                         | -0.32        | 0.14         | na         |
| All-In Sustaining                  | 6.09         | 7.49         | 23%        |
| <b>Oceania</b>                     |              |              |            |
| Total Cash                         | -6.52        | -5.12        | na         |
| All-In Sustaining                  | -2.90        | 1.19         | na         |
| <b>Global Total</b>                |              |              |            |
| <b>Total Cash</b>                  | <b>4.13</b>  | <b>4.91</b>  | <b>19%</b> |
| <b>All-In Sustaining</b>           | <b>11.53</b> | <b>13.36</b> | <b>16%</b> |

\* Costs shown on a by-product accounting basis.

Source: Metals Focus Silver Mine Cost Service

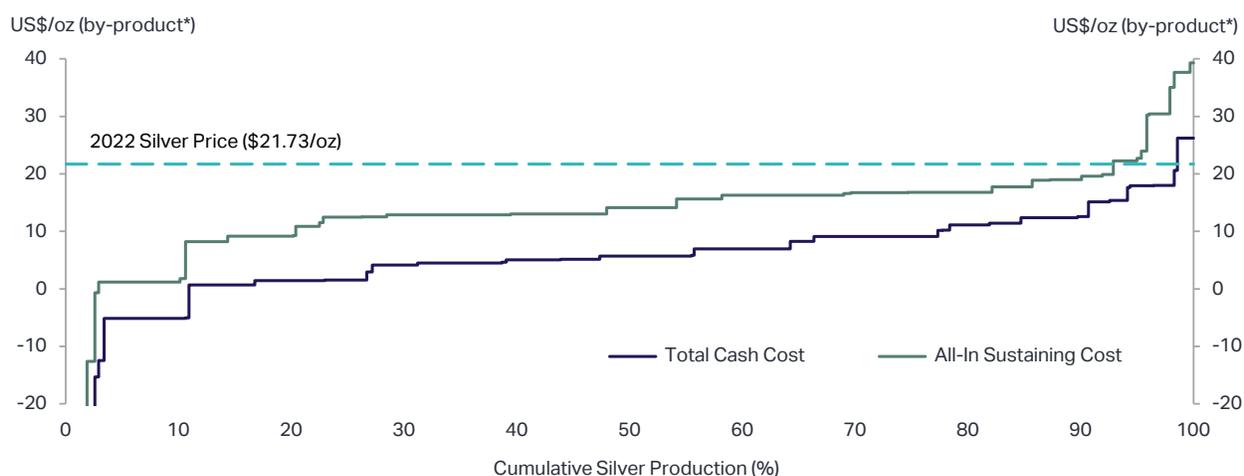
## Primary Silver Production Costs

Primary silver mining total cash costs (TCC) and all-in sustaining costs (AISC) increased significantly in 2022, due to inflation for almost all miners' key input costs. TCC rose by 19.0% y/y to \$4.91/oz, while AISC was up by 15.8% y/y to \$13.36/oz. The following cost analysis covers roughly 75% of primary silver mine supply. These operations derive most of their revenue from silver over the life-of-mine.

Disruptions in global supply chains and government policies in response to the COVID pandemic had been exerting upward pressure on miners' costs in 2021. This situation was then exacerbated by Russia's invasion of Ukraine in February 2022 and the subsequent rise in oil and gas prices. This fed through to higher diesel and energy costs alongside increased prices of key consumables for miners, such as cyanide and explosives. Furthermore, inflation and tight labor markets, both generally and specifically in the mining sector, pushed labor costs higher. These factors impacted both operating costs and capital expenditure last year with on-site costs up 10% y/y and sustaining capital expenditure up 18% y/y.

Most silver mines are polymetallic in nature and produce significant amounts of lead, zinc, gold and/or other metals. Revenue generated from these metals lowers cash costs as by-product credits. In 2022, zinc prices increased by 15.6% y/y, while gold remained almost flat and copper and lead prices fell by 5.5% and 2.5% respectively. The higher zinc price pushed by-product credits from zinc higher, while increased gold production from these miners pushed revenues from gold up. These increases surpassed lower revenues from lead

## Global Primary Silver Mine Production Costs in 2022

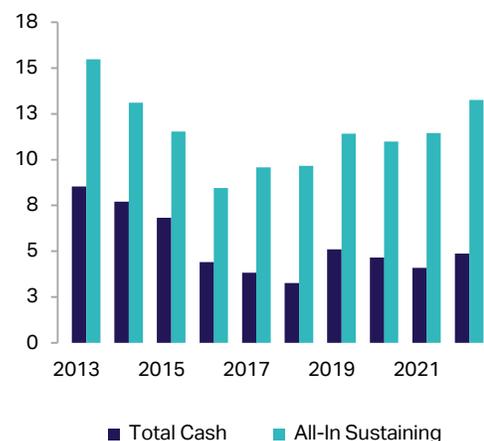


\* Cost shown on a by-product accounting basis.

Source: Metals Focus Silver Mine Cost Service

## Global Production Costs

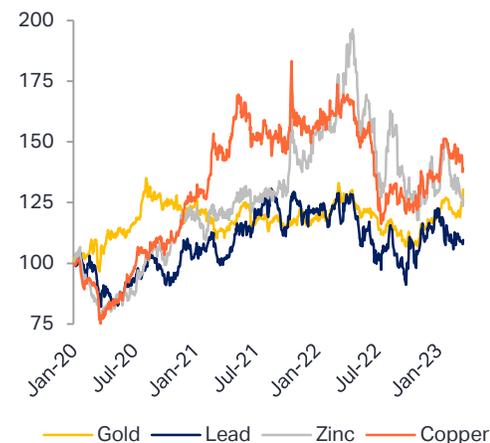
US\$/oz (by-product\*)



\*Cost shown on a by-product accounting basis  
Source: Metals Focus Silver Mine Cost Service

## By-Product Metal Prices

Index, Jan-20 = 100



Source: Bloomberg, Metals Focus

and copper, resulting in a 6.6% rise in overall by-product credits for silver miners. This helped reduce the impact of rising costs. However, the higher AISC, combined with a 13.5% y/y drop in the silver price, meant that average AISC margins for primary silver miners fell by 38.5% y/y to \$8.37/oz.

This year, inflationary pressure is expected to ease as central banks' monetary policies, designed to reduce inflation, take effect. In addition, oil and gas prices dropped significantly in the second half of 2022 and have remained on a downward trajectory so far in 2023. These factors will likely lead to flat or marginally lower costs this year. By-product credits can be expected to trend lower in 2023 as the zinc price has weakened after reaching a peak in H1.22 and the gold price is expected to stay at a similar yearly average to 2022. These factors combined are expected to result in flat to marginally higher AISC for primary silver miners in 2023.

## Regional Performances

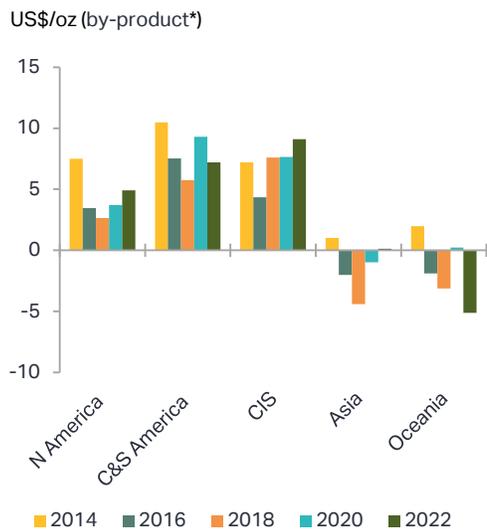
Average TCC and AISC of primary silver mines operating in North America increased to \$4.92/oz (+8.0%) and \$14.97/oz (+8.2%) respectively. These were primarily driven by higher cost inflation in Mexico, along with a stronger Mexican peso against the US dollar, which made local costs more expensive in US dollar terms. By-product credits in the region increased due to the rise in gold and zinc revenues, but were not enough to offset cost inflation.

In Mexico, TCC averaged \$4.99/oz (+12.7%) and AISC averaged \$14.98/oz (+9.4%) as annual inflation continued to break records, reaching its highest level since 2000. The strengthening of the Mexican peso by 0.9% y/y to the US dollar also contributed to the rise in costs. In addition, several operations continued to increase sustaining capital and near-mine exploration expenditure. This contributed to higher AISC at Saucito (\$16.80/oz, +77%), San Julián (\$13.04/oz, +57%) and Palmarejo (\$15.63/oz, +29%).

In the US, costs at Hecla's Greens Creek mine rose. TCC increased from -\$0.65/oz in 2021 to \$0.70/oz and reported AISC grew to \$5.77/oz (+80.9%). This was driven by input cost inflation, which led to higher costs despite increased by-product revenues. Lucky Friday, also owned by Hecla, had the opposite trend reporting a drop in TCC to \$5.06/oz (-23.3%) and AISC to \$12.86/oz (-10.3%). This was due to a 12% improvement in silver grades.

In Central & South America, average TCC dropped marginally to \$7.22/oz (-0.8%) and AISC increased to \$13.94/oz (+6.5%). The suspension of mining at Buenaventura's Uchucchacua and the closure of Pan American Silver's Morococha both contributed to lower TCC as these were higher cost operations. Additional factors included a 1.8% rise in by-product credits (as zinc prices and by-product production increased) and a continued weakening of the Argentine peso against the US dollar. Meanwhile, double-digit growth in sustaining capital resulted in higher AISC.

## Regional Total Cash Costs



\* Cost shown on a by-product accounting basis.  
Source: Metals Focus Silver Mine Cost Service

In Peru, costs at Pan American Silver’s Huaron rose, with TCC and AISC increasing to \$6.15/oz (+55.7%) and \$11.04/oz (+41.7%) respectively. This was the result of inflationary cost increases and higher sustaining capital spending related to equipment replacements, refurbishments and mine deepening. In Argentina, SSR Mining reported a 25.3% increase in TCC and 25.0% rise in AISC to \$13.23/oz and \$15.50/oz, respectively, at its Puna operations. This was due to significantly higher prices for fuel, electricity and reagents as local annual inflation reached 95%.

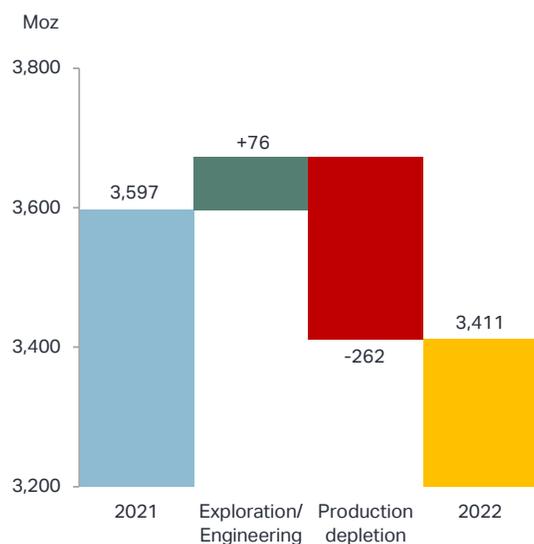
In the CIS, Polymetal’s Dukat had higher TCC and AISC, which rose to \$9.10/oz (+59.4%) and \$12.88/oz (+44.2%) respectively as annual local inflation reached 13.7% and the Russian ruble strengthened by 5.2% against the US dollar. In addition, Dukat processed lower grade ore and sustaining capital expenditure increased. However, these were partially offset by higher recovery rates and increased by-product credits.

At South32’s Cannington, in Australia, TCC increased from -\$6.52/oz to -\$5.12/oz, while AISC rose to \$1.19/oz from -\$2.90/oz. This was the result of processing low-grade silver ores and a 7.8% annual inflation rate, despite higher zinc revenues and a weaker Australian dollar.

## Reserves & Resources

Global reserves at primary silver mines and projects totaled 3,411Moz (106,136t) in 2022. This was a drop of 5.2% y/y, or 186Moz (5,794t), as mining depletion exceeded additions from resource upgrades. Total identified resources excluding reserves stood at 7,671Moz (238,599t). This was a modest drop of 0.6% y/y as the conversion of resources into reserves surpassed additions of newly discovered resources.

## Reserve Replacement – Primary Silver Mines and Projects



Source: Metals Focus

For the third consecutive year, silver reserves at Fresnillo declined, falling by 23.7Moz (738t) in 2022. This was mainly due to mining depletion, higher cost assumptions and increased cut-off grades at Saucito (-9.0Moz, 278t), Fresnillo (-7.9Moz, 246t), and San Julián DOB (-5.0Moz, 156t). Reserves at Cerro Los Gatos dropped by 46.8Moz (1,456t). This was largely due to the correction in the original resource model, which led to an over estimation of reserves, alongside depletion from mining. At Dukat, reserves were reduced by 29.0Moz (902t) due to mining extraction. Estimates for reserve replacement were not concluded as Polymetal’s exploration activities in Russia were impacted by sanctions. Meanwhile, successful exploration programs at Coeur continue to increase its reserves through resource conversion. Expansion studies added 18.7Moz (583t) to Rochester’s reserves while new exploration targets lifted Palmajero’s reserves by 3.4Moz (105t). Reserves at Hecla’s Keno Hill rose by 13.0Moz (403t) following positive results from infill drilling at the Bermingham deposit. This helped Hecla achieve the highest silver reserves in the company’s history.

## Value of Completed Deals



Values aggregated in the year deals are announced  
Source: Bloomberg

## Corporate Activity

In 2022, the value of merger and acquisition activity in the primary silver sector increased sharply, rising to a four-year high of \$82m. However, this value is just a fraction of the \$1.9bn high achieved in 2018 and only five transactions were completed during the year.

By far the biggest silver mining deal completed in 2022 was Endeavour Silver's \$70m acquisition of the Pitarrilla project from SSR Mining. Pitarrilla is one of the world's largest undeveloped silver projects and is located in Durango state, Mexico. In December 2022 Endeavour published a new resources estimate for the project which identified 591Moz (18,382t) of silver alongside 1,379Mlb of lead and 3,241Mlb of zinc in the indicated and inferred resource category. The company plans to undertake further exploration drilling in 2023 to continue development of this resource. The remaining deals in 2022 related to minority investments in silver companies and small acquisitions of early stage exploration properties.

In 2023 so far, there have been two notable deals announced in the silver mining sector. In February, San Cristobal Mining (SCM) acquired the San Cristobal mine from Sumitomo Corporation. San Cristobal is the biggest silver mine in Bolivia with estimated production of 9.2Moz (288t) in 2022 and an approximate seven year mine life. The value of this transaction has not yet been announced. Later in the same month, Hecla announced a deal to acquire ATAC Resources and its Rackla and Connaught exploration projects in the Yukon, Canada. This deal will be a share transaction and had an initial valuation of \$19m; it has yet to be completed.

## Producer Hedging

Net de-hedging continued in 2022. At year-end, the global delta-adjusted hedge book had outstanding hedges for 18.6Moz (577t), a fall of 49% y/y and the lowest point since 2018. Forward contracts decreased by 8.3Moz (268t) to 5.3Moz (164t) as Hochschild Mining and Zijin Mining let their books wind down. Options fell by 9.6Moz (308t) to 13.3Moz (413t) as all hedged producers except Minera Frisco reduced the volume of their contracts.

The proportion of put options in the options book rose to a two year high of 88% mid-year, suggesting producer sentiment towards the price was more bearish than in previous years. This had, however, moved back towards a more balanced 53% share by year-end. The average duration of contracts fell in 2022. At the end of the year, just Harmony and Minera Frisco had contracts extending beyond Q4.23, although these only run until the end of 2024.

Peñoles undertook minimal hedging throughout the year and reduced its hedge book in Q4.22. At year-end, their hedge book contained 14.9Moz (464t) in outstanding contracts, a reduction of 30% y/y. Of this, 12.7Moz (393t) were in option contracts with prices of \$21.8/oz and \$31.9/oz for the puts and calls

## Hedge Book Composition\*

| Million ounces | 2021        | 2022        | Y/Y         |
|----------------|-------------|-------------|-------------|
| Forwards       | 13.6        | 5.3         | -61%        |
| Options        | 22.9        | 13.3        | -42%        |
| <b>Total</b>   | <b>36.5</b> | <b>18.6</b> | <b>-49%</b> |

\*Delta-adjusted positions at year-end

Source: Metals Focus

### Hedge Book Evolution\*



\* Delta adjusted position at year-end  
Source: Metals Focus

respectively. Forward contracts stood at 2.2Moz (71t), of which 2.1Moz (65t) were sold forwards with a strike price of \$23.8/oz, while 0.15Moz (5t) were bought forwards with a strike price of \$23.9/oz.

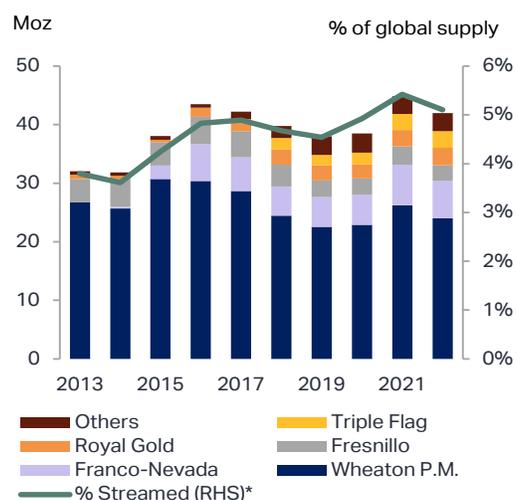
At year-end, Minera Frisco had outstanding collars of 3.3Moz (103t). Average prices for the puts and calls were \$18.2/oz and \$23.9/oz respectively. These contracts had a negative fair value of 119.7m Mexican pesos. Harmony had outstanding collars for 0.6Moz (19t), covering 16% of production at Hidden Valley for 2023 and 2024. These contracts have average prices of \$24.9/oz and \$27.9/oz for the puts and calls respectively. Harmony recorded losses on its silver contracts equaling 20m South African rand in 2022.

### Silver Streaming

Silver production covered by streaming and royalty contracts experienced a 7% y/y decline, falling to 42.0Moz (1,306t) in 2022. The Antamina mine, responsible for approximately one-fifth of the world’s total silver streaming and royalty production, experienced a 19% y/y slump in silver output, thereby contributing to the fall in global totals.

The 2.9 Moz (90t) y/y total decline was largely attributed to Wheaton Precious Metals, which witnessed a 2.2Moz (69t) fall in output stemming from closures, divestments, and lower grades at the Antamina and Peñasquito mines. Moreover, other key players in the sector, namely Franco-Nevada and Fresnillo, also suffered from a contraction in silver production. Franco-Nevada’s dip was associated with reduced grades at the Antamina and Antapaccay mines, while Fresnillo’s drop came from a decline in ore throughput and grade. Royal Gold, on the other hand, continued its incremental growth trajectory, adding 0.2Moz (5t) on the back of gains from Khoemacau. Triple Flag also continued to experience incremental growth through higher output from Buriticá and ATO.

### Silver Royalty and Streaming



\*Percentage of global mine supply covered by royalty and streaming agreements.  
Source: Metals Focus

The fall in silver streaming and royalty production outpaced the decline in global silver supply, with the percentage of global mine supply covered by such production falling to 5.1%. New streaming and royalty deals inked in 2022 reflected a trend of recent years, with a focus on project financing as opposed to producing assets. However, production from such deals will take years to materialize. Wheaton Precious Metals, for instance, committed to paying \$176m for a share of future gold and silver production from the Curipamba project. Meanwhile, Franco-Nevada acquired an additional 0.5% royalty on the Eskay Creek project for \$21m.

With organic growth options constrained, companies turned to M&A to expand their portfolios. Triple Flag’s acquisition of Maverix for \$606m enabled it to acquire over 0.5Moz (16t) of annual silver production, while Sandstorm Gold’s purchase of Nomad for \$590m added approximately 0.25Moz (8t) per annum.

# Chapter 5

- Silver recycling grew by 3% in 2022 to a 10-year high of 180.6Moz (5,618t).
- The key driver was the 7% rise in industrial scrap, mostly driven by the recycling of spent EO catalysts.
- Jewelry, silverware and coin scrap in contrast were almost unchanged, while photography's structural slide continued.
- Recycling in 2023 is forecast to rise by just 0.3%, as ongoing industrial gains are offset by losses for jewelry and silverware.

## Recycling

### Introduction

Global silver recycling in 2022 rose by 3% to a 10-year high of 180.6Moz (5,618t). This was chiefly due to the 7% lift in industrial scrap, which was largely due to a further rise in the processing of spent ethylene oxide (EO) catalysts. In contrast, jewelry and silverware recycling were essentially flat y/y. Their swing from the heavy gains in 2020 to modest growth in 2021 largely explains why the increase in the global total slowed from 12% in 2020, to 6% in 2021, and then 3% last year. Coin scrap (chiefly the melting down of unsold commemoratives and old circulating coins) inched up by 1%. It was only photographic scrap that saw a fall (a notable 7%) in 2022 on the back of ongoing structural declines. A further drop for photography, plus a swing to losses for jewelry and silverware this year, will largely counter ongoing industrial gains, curbing growth in the total yet further to just 0.3%.

### Industrial

Industrial recycling rose by a robust 7% last year to a record high for our series back to 2010. Much of this was due to the processing of spent EO catalysts, which in turn reflects ongoing strong capacity growth in this field (global capacity increased by 9% in 2022 to just over 45,000t versus just under 25,000t in 2010). While strong, gains in this field actually slowed last year as 2021 had seen a one-off boost from the changeout of catalysts scheduled for 2020 being postponed by COVID to the following year. Outside of EOs, the rest of industrial scrap rose a more modest 5% due to such background factors as a growing pool of product and the trend to tighter or better enforced waste legislation. There was also some contribution from a further post-COVID improvement in logistics, all of which helped electronic scrap for instance. E-scrap also saw a slight boost from greater volumes of 'secure destruction' (where data bearing items are destroyed) and yields holding steady, and despite much higher energy costs.

One area being monitored is the recovery of silver from end-of-life photovoltaic panels. At present, receipts are slight due to few panels having been installed 20 years ago (their typical lifespan), recycling being hard to make economic (studies point to a range of \$20-\$25 for breakeven) and a fair sized share of old panels not being captured by the recycling chain (estimates we have seen claim only 1 in 10 is being recycled). That will not change notably in 2023. However, ongoing if slower growth for EO scrap, plus gains in other areas, will generate a forecast 7% rise for the total this year.

### Jewelry

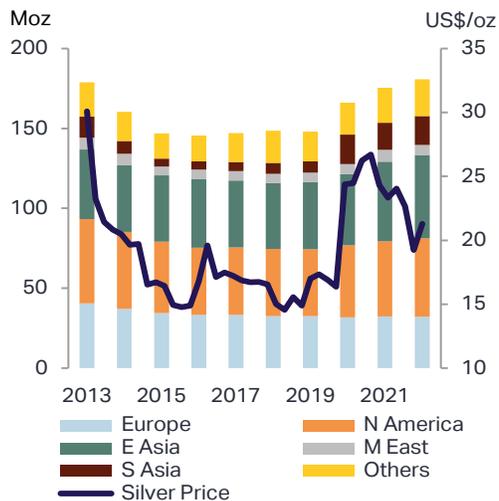
Jewelry recycling in 2022 rose by a trivial 0.3% to 34.5Moz (1,073t), although that was still a 10-year high. Overall stability, however, masks a wide range of outcomes. For example, material gains were seen in Russia on the back of

## Global Recycling Forecast by Region

| Million ounces      | 2022         | 2023F        | Y/Y         |
|---------------------|--------------|--------------|-------------|
| Europe              | 32.2         | 31.1         | -3%         |
| North America       | 49.0         | 51.7         | 5%          |
| Middle East         | 6.2          | 6.0          | -3%         |
| South Asia          | 18.1         | 16.3         | -10%        |
| East Asia           | 52.1         | 55.3         | 6%          |
| CIS                 | 13.7         | 12.3         | -10%        |
| Other               | 9.2          | 8.4          | -9%         |
| <b>Global Total</b> | <b>180.6</b> | <b>181.1</b> | <b>0.3%</b> |

Source: Metals Focus

## Global Recycling



Source: Metals Focus, Bloomberg

distress selling in the wake of the post-Ukraine sanctions, while in India high rupee prices and improved logistics fed through to first half-centered gains. In contrast, losses were sizable for the Middle East (especially Turkey) and North Africa, chiefly as a result of consumers being reluctant to relinquish hard assets in politically and economically uncertain times. Recycling in the US was also quiet and volumes in Europe barely rose. Scrap this year globally is forecast to drop by 8% thanks chiefly to losses in India through lower prices and weaker distress selling as the rural economy recovers, and due to partial normalization in Russia (and the broader CIS).

### Silverware

Similarly to jewelry, silverware scrap in 2022 inched up by 0.5% to 24.4Moz (760t), an eight-year high. Increases were again visible for Russia and South Asia for reasons similar to those above for jewelry. One major difference was the sizable decline for the US where we received uniform feedback that receipts of old silverware were down (often by double-digit amounts), due to a belief that near-market stocks (unlike in Europe) are now sufficiently depleted to make notable losses the norm in the absence of any price spike. Further attrition in the US, plus a price-led drop in India and normalization in Russia lead us to forecast a 7% decline for global scrap in 2023.

### Photography

Photographic recycling in 2022 fell by 7% to 18.5Moz (575t) as the structural decline continued (a drop greater than in 2021 when temporary support from improving logistics meant a slip of 5%). Losses still centered on lower receipts of old x-rays, chiefly as the digitization of archived material has been mostly completed. An emphasis on the historic is revealed by fabrication in 2022 falling by under 1%. This meant broad stability in recovery from the residual niche of consumer film and liquids. Industrial x-ray scrap was also flat to slightly up y/y. Assessing flows is harder now as market share swings can be large as companies quit due to ever falling volumes, leading to temporary gains for the survivors. A further structural fall is expected this year, cutting photographic scrap's share of the total to just 9% compared to 21% in 2010.

## Recycling by Source

| Million ounces      | Year on Year |              |              |              |              |              |              |              |              |              |           |             |
|---------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-----------|-------------|
|                     | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         | 2022         | 2023F        | 2022      | 2023F       |
| Industrial          | 73.0         | 70.9         | 72.0         | 74.8         | 78.4         | 77.9         | 84.6         | 93.1         | 99.6         | 106.6        | 7%        | 7%          |
| Photographic        | 31.0         | 28.6         | 26.4         | 24.5         | 23.1         | 21.6         | 21.0         | 20.0         | 18.5         | 17.0         | -7%       | -8%         |
| Jewelry             | 26.5         | 22.6         | 23.5         | 23.9         | 24.1         | 24.9         | 33.2         | 34.4         | 34.5         | 31.7         | 0%        | -8%         |
| Silverware          | 25.1         | 21.3         | 20.4         | 20.2         | 19.6         | 20.2         | 23.8         | 24.3         | 24.4         | 22.7         | 0%        | -7%         |
| Coin                | 4.8          | 3.5          | 3.3          | 3.6          | 3.3          | 3.4          | 3.4          | 3.5          | 3.6          | 3.2          | 1%        | -12%        |
| <b>Global Total</b> | <b>160.4</b> | <b>146.9</b> | <b>145.6</b> | <b>147.0</b> | <b>148.5</b> | <b>148.0</b> | <b>166.0</b> | <b>175.3</b> | <b>180.6</b> | <b>181.1</b> | <b>3%</b> | <b>0.3%</b> |

Source: Metals Focus

## Recycling

| Million ounces       | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         | 2022         | Y/Y          |
|----------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>Europe</b>        |              |              |              |              |              |              |              |              |              |              |              |
| Germany              | 10.6         | 10.2         | 9.9          | 9.7          | 9.4          | 9.8          | 9.9          | 9.6          | 9.7          | 9.9          | 2%           |
| Italy                | 8.1          | 6.6          | 5.8          | 5.5          | 5.2          | 5.0          | 5.1          | 4.8          | 4.8          | 4.6          | -5%          |
| UK                   | 6.2          | 5.8          | 5.6          | 5.4          | 5.3          | 5.1          | 5.0          | 4.8          | 4.5          | 4.3          | -5%          |
| France               | 5.0          | 4.3          | 3.8          | 3.4          | 3.2          | 3.1          | 3.1          | 3.1          | 3.3          | 3.2          | -4%          |
| Others               | 10.8         | 10.2         | 9.4          | 9.4          | 10.3         | 9.4          | 9.5          | 9.5          | 10.0         | 10.3         | 3%           |
| <b>Sub-total</b>     | <b>40.6</b>  | <b>37.2</b>  | <b>34.5</b>  | <b>33.4</b>  | <b>33.4</b>  | <b>32.5</b>  | <b>32.6</b>  | <b>31.7</b>  | <b>32.4</b>  | <b>32.2</b>  | <b>-0.5%</b> |
| <b>CIS</b>           |              |              |              |              |              |              |              |              |              |              |              |
| Russia               | 9.9          | 8.0          | 6.7          | 6.5          | 7.9          | 10.0         | 8.5          | 9.3          | 10.3         | 11.3         | 10%          |
| Others               | 2.3          | 1.8          | 1.4          | 1.4          | 1.7          | 1.9          | 1.8          | 2.0          | 2.2          | 2.4          | 10%          |
| <b>Sub-total</b>     | <b>12.2</b>  | <b>9.8</b>   | <b>8.1</b>   | <b>8.0</b>   | <b>9.6</b>   | <b>11.9</b>  | <b>10.3</b>  | <b>11.3</b>  | <b>12.5</b>  | <b>13.7</b>  | <b>10%</b>   |
| <b>North America</b> |              |              |              |              |              |              |              |              |              |              |              |
| United States        | 46.9         | 43.5         | 40.6         | 37.9         | 38.2         | 38.2         | 37.9         | 41.0         | 42.8         | 44.7         | 4%           |
| Others               | 5.6          | 4.7          | 4.1          | 4.1          | 4.0          | 4.0          | 4.0          | 4.1          | 4.3          | 4.4          | 3%           |
| <b>Sub-total</b>     | <b>52.5</b>  | <b>48.2</b>  | <b>44.7</b>  | <b>42.0</b>  | <b>42.2</b>  | <b>42.2</b>  | <b>41.9</b>  | <b>45.2</b>  | <b>47.0</b>  | <b>49.0</b>  | <b>4%</b>    |
| <b>Middle East</b>   |              |              |              |              |              |              |              |              |              |              |              |
| Turkey               | 3.7          | 3.4          | 2.5          | 2.5          | 2.5          | 2.7          | 2.7          | 2.5          | 2.7          | 2.2          | -20%         |
| Others               | 3.8          | 3.7          | 3.0          | 3.5          | 3.5          | 3.0          | 3.2          | 3.8          | 4.6          | 4.0          | -13%         |
| <b>Sub-total</b>     | <b>7.4</b>   | <b>7.1</b>   | <b>5.5</b>   | <b>6.0</b>   | <b>6.0</b>   | <b>5.7</b>   | <b>5.9</b>   | <b>6.3</b>   | <b>7.3</b>   | <b>6.2</b>   | <b>-15%</b>  |
| <b>South Asia</b>    |              |              |              |              |              |              |              |              |              |              |              |
| India                | 12.3         | 7.5          | 4.6          | 4.9          | 5.4          | 6.3          | 6.6          | 15.9         | 14.7         | 15.4         | 5%           |
| Others               | 0.8          | 0.5          | 0.3          | 0.3          | 0.4          | 0.5          | 0.5          | 2.6          | 2.2          | 2.7          | 22%          |
| <b>Sub-total</b>     | <b>13.2</b>  | <b>7.9</b>   | <b>5.0</b>   | <b>5.2</b>   | <b>5.8</b>   | <b>6.8</b>   | <b>7.1</b>   | <b>18.5</b>  | <b>16.9</b>  | <b>18.1</b>  | <b>7%</b>    |
| <b>East Asia</b>     |              |              |              |              |              |              |              |              |              |              |              |
| China                | 22.3         | 22.3         | 23.2         | 23.1         | 22.8         | 23.0         | 23.7         | 26.1         | 31.4         | 34.7         | 11%          |
| Japan                | 11.4         | 11.0         | 11.0         | 11.4         | 11.4         | 10.9         | 10.5         | 10.0         | 9.5          | 9.1          | -5%          |
| Taiwan               | 3.5          | 3.3          | 2.6          | 3.0          | 2.8          | 2.6          | 2.9          | 2.9          | 3.0          | 2.7          | -9%          |
| Others               | 6.4          | 5.2          | 4.6          | 5.3          | 4.7          | 4.7          | 4.9          | 5.4          | 6.0          | 5.6          | -6%          |
| <b>Sub-total</b>     | <b>43.6</b>  | <b>41.8</b>  | <b>41.4</b>  | <b>42.7</b>  | <b>41.7</b>  | <b>41.2</b>  | <b>41.9</b>  | <b>44.4</b>  | <b>49.9</b>  | <b>52.1</b>  | <b>4%</b>    |
| <b>Other Regions</b> |              |              |              |              |              |              |              |              |              |              |              |
| C&S America          | 4.0          | 3.5          | 3.1          | 3.4          | 3.5          | 3.5          | 3.6          | 3.8          | 4.2          | 4.4          | 5%           |
| Africa               | 3.0          | 3.0          | 2.8          | 2.8          | 2.9          | 2.8          | 2.9          | 3.0          | 3.6          | 3.2          | -10%         |
| Oceania              | 2.3          | 2.1          | 2.0          | 2.0          | 1.9          | 1.9          | 1.9          | 1.7          | 1.6          | 1.6          | 0%           |
| <b>Sub-total</b>     | <b>9.2</b>   | <b>8.5</b>   | <b>7.8</b>   | <b>8.2</b>   | <b>8.3</b>   | <b>8.3</b>   | <b>8.3</b>   | <b>8.6</b>   | <b>9.3</b>   | <b>9.2</b>   | <b>-2%</b>   |
| <b>Global Total</b>  | <b>178.8</b> | <b>160.4</b> | <b>146.9</b> | <b>145.6</b> | <b>147.0</b> | <b>148.5</b> | <b>148.0</b> | <b>166.0</b> | <b>175.3</b> | <b>180.6</b> | <b>3%</b>    |

Source: Metals Focus

# Chapter 6

- The recovery in India saw the country's bullion imports hit a record high in 2022.
- This also underpinned a record level of UK bullion exports last year, which saw London vault holdings drop to a reporting low.
- While US imports fell, they remained historically high, reflecting the health of US physical investment and industrial demand.
- The return to a premium in China helped drive exports lower in 2022, although they were still the second highest total on record.

## Bullion Trade

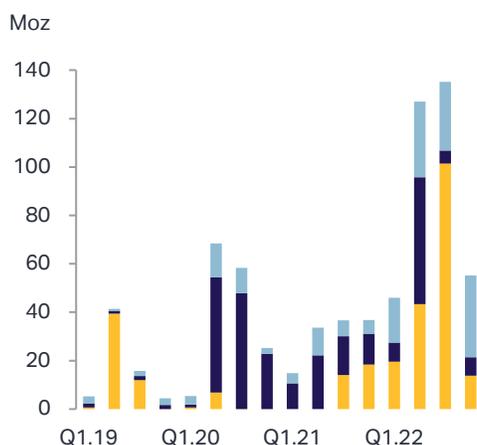
### Introduction

One of the most notable features of last year's silver market was India's record imports of silver bullion, which surged by 244% to 306.6Moz (9,535t), as at times weak prices led to both a jump in demand and restocking of a depleted supply chain. This in turn underpinned the near doubling of UK exports, which also achieved a record total of 363Moz (11,302t) in 2022. Aside from the strength of the Indian market, gains for physical investment and industrial demand more widely explain why UK imports fell to their lowest since 2005, as there was far less recourse to deliver Good Delivery bars into London. The health of the silver coin and bar markets also account for the near two-fold rise in Turkish bullion imports, which at 64.2Moz (1,998t) saw the country become the eighth largest importer of silver bullion in 2022 (against 15th place in 2021). By contrast, Japanese imports fell by 26% to 55.9Moz (1,739t), although this represented just a three-year low, as the country's industrial offtake lost market share to overseas competitors.

### Europe

London remains home to the world's largest identifiable stock of bullion. At end-2022, these holdings stood at 840.9Moz (26,155t), which was the lowest total on record (the LBMA's data series goes back to July 2016). The scale of the drawdown was also quite dramatic, with vault stocks dropping by 320.5Moz (9,970t) in the space of just 12 months. To put this into perspective, there has only been one occasion, in 2017, when the full year change in London silver inventories exceeded 100Moz (3,000t). Even though holdings of those exchange-traded products (ETPs) stored in London dropped by 20% last year, their share of total silver stored in the capital actually rose, from 59% at end-2021 to 65% at end-2022.

### UK Bullion Exports\*

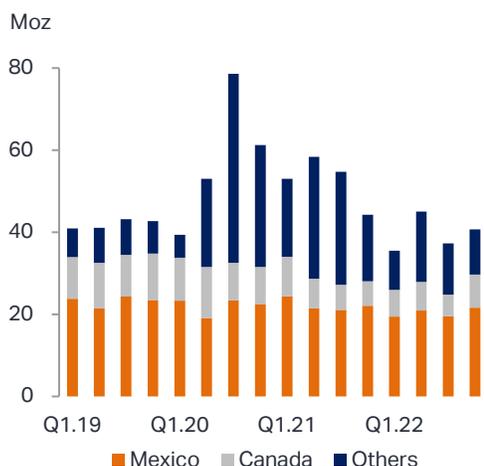


Source: Metals Focus, S&P Global; \*Gross weight

Returning to last year, the sharp fall in silver bullion stocks held in London reflected a massive jump in exports, together with a slump in the inbound trade. Taking each in turn, UK bullion exports doubled in 2022, achieving a record high of 363.4Moz (11,302t). The bulk of this upside was due to a surge in shipments to India, most of which was delivered by air cargo. While air routes have certainly been used in the past, it was unprecedented to see them used so consistently for European shipments last year. (As an aside, sea freight tended to be used for silver delivered to India from East Asia.) UK exports to Switzerland and Turkey also jumped, by a combined 64.4Moz (2,004t), reflecting strong US retail demand for their investment products.

Unsurprisingly, UK silver bullion imports collapsed in 2022. This reflected the strength of global silver demand, which therefore meant silver was often delivered to manufacturing centers, rather than being converted into Good Delivery Bars and shipped to the UK.

### US Bullion Imports\*



Source: Metals Focus, S&P Global; \*Gross weight

Turning to the CIS, the Russia-Ukraine war means that Russian trade data is no longer available. In terms of the other key silver markets in the CIS, Kazakh exports partially recovered, rising by 3%, albeit to just a two-year high of 31.5Moz (979t), while Uzbek shipments eased by 7% to 6.2Moz (200t).

### North America

US imports fell last year by 9% to an estimated 239.0Moz (7,434t). Even so, the total remained historically high, reflecting the overall strength of US physical investment and industrial demand. The former explains the ongoing scale of Turkish physical investment imports, which in 2022 jumped by 162% to 28.3Moz (880t), while deliveries of four nines Good Delivery Bars from South Korea and Kazakhstan totaled a combined 29.4Moz (915t), almost double the volume imported in 2021. These gains were offset by lower deliveries from Poland, the UK and Switzerland, whose combined shipments were some two-thirds lower at 18.3Moz (569t).

### Middle East

Middle East bullion exports rose by 140% in 2022 to 32.2Moz (1,001t), having already increased 81% the previous year. This was entirely due to a surge in Turkish exports, which was supported by higher deliveries to the US, as they were in 2021. This reflected shortages of physical investment products there, due to elevated retail bar and coin purchases. Middle East bullion imports also grew, driven by robust Turkish inflows of 64.1Moz (1,993t), tripling y/y. As for 2023, we forecast a decline in both trade flows, due to expectations of somewhat softer US bar and coin demand.

### South Asia

India imported a record 306.6Moz (9,535t) of silver last year, up a massive 244% on 2021. While imports in 2020 and 2021 were subdued, compared to historical levels, those in 2022 were 88% higher than the 10-year average. This rise was mainly due to bargain hunting by consumers, inventory rebuild by the trade and the return of investors who had heavily reduced their near-market holdings. Nearly two-thirds of shipments arrived between May and October, coinciding with the price correction. Strong orders saw domestic market premiums (versus the landing cost) average \$0.45/oz during this time, compared to \$0.15 for the entire year. With increasing demand and long delivery lead times, many importers started bringing silver in via air, rather than by sea; our research shows that at this time, more than 70% of metal arrived in this manner. Even so, the order backlog was so large that it often took 2-3 weeks for metal to arrive in India, in spite of using air freight.

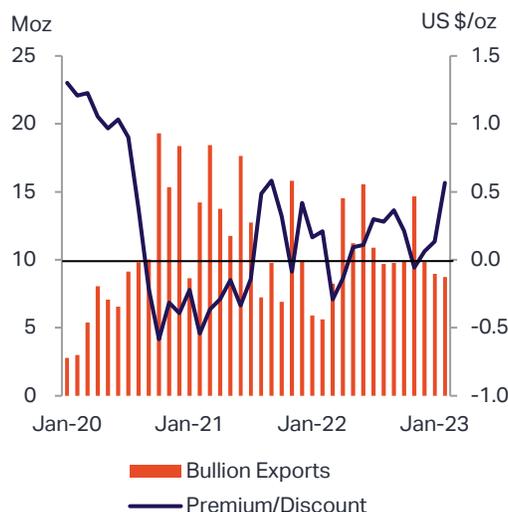
About half of imports were from the UK, followed by Hong Kong (24%) and China (9%). As air shipments dominated in 2022, there was also a major change in the mix of arrival points. Normally, Sri City and Kandla are the preferred choice due to the Free Trade Warehouse Zones (FTWZ) and deep sea ports. However, last year Delhi took top spot, taking in 35% of shipments,

### Indian Silver Bullion Imports\*



Source: Metals Focus, S&P Global; \*Gross weight

## Chinese Bullion Exports\*



Source: Metals Focus, S&P Global; \*Gross weight

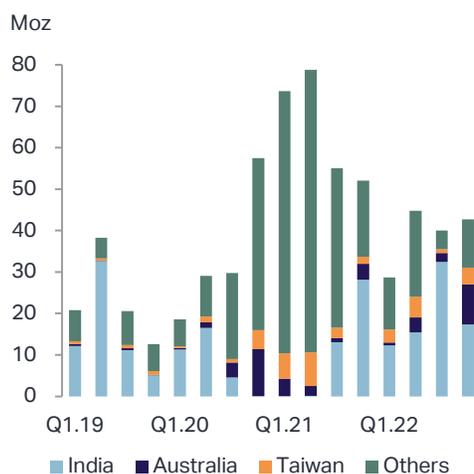
followed by Sri City (24%), GIFT City (17%) and the Ahmedabad Air Cargo Complex (8%). While air cargo dominated in 2022, its share should fall considerably this year as demand returns to more normal levels.

## East Asia

China has traditionally been a net exporter of silver due to the structural oversupply of the metal in the local market. In part, this is fueled by the large volumes of refined silver produced both from the processing of imported base metal concentrates and from domestic mines, whose output ranks second globally. Last year, silver bullion exports recorded a notable fall, mainly because of the high base in 2021 and the local price's return to trading at a premium (with 13% VAT inclusive) to loco-London for most of the year.

Bullion exports from mainland China fell by 14% in 2022 to 125.8Moz (3,913t), but was still the second highest on record. Most of the losses were in the first three months due to the COVID outbreak and pandemic prevention measures. It is worth noting that even though domestic prices traded at a heavy discount to loco-London, outflows in March more than halved as Shanghai was under complete lockdown. Bullion exports over the rest of the year posted slight growth. A strong rebound was seen from April as logistics issues and pandemic prevention measures eased slightly. In addition, the sharp recovery in Indian imports encouraged shipments from China. This was reflected in the inventory declines for the two main Chinese exchanges; stocks held by the Shanghai Gold Exchange fell to a four-year low of 69Moz (2,147t) by the end of 2022, while the Shanghai Futures Exchange reported stocks at end-August of 43.7Moz (1,360t), levels last seen in June 2019.

## Hong Kong Bullion Exports\*



Source: Metals Focus, S&P Global; \*Gross weight

Metals Focus' estimates of silver imports into Mainland China (which includes adjustments to certain reported flows) fell by 28% to 6.3Moz (195t). First, the refining of imported base metal silver-containing concentrates rose to a record high (fueled by the market's demand for zinc), curbing the need for refined silver imports. Second, the local price discount at times discouraged the manufacture of imported bullion into products for re-export (known as a "processing trade" where the imported bullion is no longer subject to VAT).

Hong Kong bullion imports were unchanged y/y at 109.7Moz (3,413t). Mainland China remained the largest bullion supplier to the Hong Kong market, with imports from there rising further by 3% to a record high of 94.6Moz (2,943t), fueled by the major flows seen in April and November (when the discount in the Chinese market created arbitrage opportunities among bullion banks and traders). In contrast, bullion exports recorded a dramatic decline of 40% to 156Moz (4,857t). The drop was primarily seen in shipments to the UK. As a result, India became once more the largest destination for Hong Kong, surging by 87% to 77.7Moz (2,416t) due to the local physical market's re-stocking activities and solid rebound in demand.

# Chapter 7

- Industrial silver fabrication increased by 5% in 2022 to a record high of 556.5Moz (17,309t).
- Electronics & electrical demand rose by 6% thanks to PV installations, power grid investment, automotive's recovery and limited thrifting. Brazing alloys fell by 3% as losses in China outweighed gains in most countries. Other industrial offtake grew by 7% due mainly to gains for EO catalysts.
- Offtake is expected to grow by a further 4% to another high in 2023, with rising PV end-use again to the fore.

## Industrial & Photography

### Industrial Demand

#### Introduction

Industrial silver demand rose by 5.4% to 556.5Moz (17,309t) in 2022, a new record high. This was partly driven by the structural gains from green economy applications. Improvements in photovoltaics (PV) were particularly noticeable as the increase in cell production was much faster than silver thrifting and this helped drive the 6% rise for electronics & electrical demand. Investment in power generation and distribution, and a firmer automotive sector also assisted here. However, the end of the post-pandemic boom meant that the consumer electronics sector had to cope with excessive inventories. Silver demand for ethylene oxide (EO) catalysts also recorded solid gains, fueled by capacity expansion, leading the 7% rise for our other industrial category. Only brazing alloys fell (by 3%) as gains in most countries (due to such factors as a robust construction industry) were outweighed by COVID losses in China.

We forecast industrial demand growth of 4% this year, with end-uses in the green economy a key driving force. However, the recent wobbles in the banking industry may bring uncertainty to the first half and we are unlikely to see a repeat of last year's stock build to safeguard against logistical problems. Inventory adjustments also mean we may have to wait until the second half for consumer electronics demand to recover. This explains why growth in 2023 should be slower than last year despite China emerging from last year's COVID restrictions.

#### Europe

Offtake in Europe fell by a notable 6% in 2022 to 85.9Moz (2,671t). While seemingly a poor result, that was still the second highest in our series back to 2010 and the result was exclusively driven by losses in Germany and the UK; all other countries in the region saw gains.

The decline for the UK was due to weaker export demand, in particular as those manufacturers on the continent supplying China struggled against the backdrop of COVID restrictions on the Mainland. In contrast, losses in Germany should be seen in the context of strong growth during 2020-21, especially in electrical and electronics, which could not be repeated last year. However, this downturn needs to be put into perspective, with the 2022 total still well above pre-pandemic levels. The growth seen elsewhere was supported by general decarbonization moves such as making buildings 'greener', in particular in the installation of heat pumps. New technology power generation and distribution also fed through to higher silver use within Europe and as exports overseas. The 5% increase in vehicle production also

### Global Industrial Demand Forecast

| Million ounces      | 2022         | 2023F        | Y/Y       |
|---------------------|--------------|--------------|-----------|
| Europe              | 85.9         | 83.1         | -3%       |
| North America       | 132.9        | 135.8        | 2%        |
| South Asia          | 42.6         | 44.3         | 4%        |
| East Asia           | 280.9        | 298.7        | 6%        |
| Others              | 14.3         | 14.6         | 2%        |
| <b>Global Total</b> | <b>556.5</b> | <b>576.4</b> | <b>4%</b> |

Source: Metals Focus

## Industrial Demand

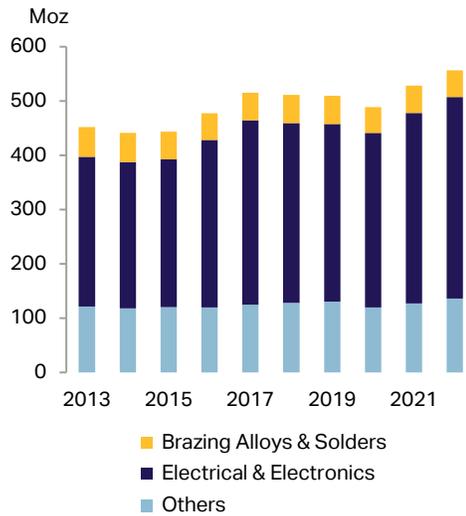
| Million ounces       | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         | 2022         | Y/Y        |
|----------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------------|
| <b>Europe</b>        |              |              |              |              |              |              |              |              |              |              |            |
| Germany              | 26.8         | 27.1         | 26.1         | 26.3         | 27.0         | 27.9         | 26.0         | 30.5         | 35.5         | 30.9         | -13%       |
| United Kingdom       | 13.9         | 16.1         | 14.8         | 15.8         | 19.1         | 20.2         | 22.3         | 21.2         | 24.6         | 22.2         | -10%       |
| France               | 9.5          | 9.1          | 8.6          | 8.4          | 8.7          | 9.1          | 9.3          | 8.5          | 9.6          | 10.3         | 6%         |
| Italy                | 8.3          | 8.5          | 8.5          | 8.4          | 8.7          | 9.1          | 9.2          | 7.8          | 9.2          | 9.6          | 4%         |
| Others               | 12.3         | 12.1         | 11.8         | 11.9         | 12.3         | 12.6         | 12.6         | 11.2         | 12.5         | 12.9         | 3%         |
| <b>Sub-total</b>     | <b>70.7</b>  | <b>72.9</b>  | <b>69.9</b>  | <b>70.8</b>  | <b>75.9</b>  | <b>78.9</b>  | <b>79.4</b>  | <b>79.2</b>  | <b>91.4</b>  | <b>85.9</b>  | <b>-6%</b> |
| <b>North America</b> |              |              |              |              |              |              |              |              |              |              |            |
| United States        | 101.7        | 88.1         | 90.9         | 108.8        | 111.8        | 114.9        | 112.7        | 117.3        | 120.5        | 127.1        | 6%         |
| Others               | 5.8          | 4.6          | 5.7          | 6.0          | 5.6          | 5.7          | 5.9          | 5.0          | 5.4          | 5.7          | 6%         |
| <b>Sub-total</b>     | <b>107.5</b> | <b>92.6</b>  | <b>96.7</b>  | <b>114.8</b> | <b>117.4</b> | <b>120.6</b> | <b>118.6</b> | <b>122.3</b> | <b>125.9</b> | <b>132.9</b> | <b>6%</b>  |
| <b>South Asia</b>    |              |              |              |              |              |              |              |              |              |              |            |
| India                | 40.3         | 37.9         | 35.7         | 35.9         | 37.3         | 40.2         | 37.8         | 26.7         | 34.2         | 42.6         | 24%        |
| <b>Sub-total</b>     | <b>40.3</b>  | <b>37.9</b>  | <b>35.7</b>  | <b>35.9</b>  | <b>37.3</b>  | <b>40.2</b>  | <b>37.8</b>  | <b>26.7</b>  | <b>34.2</b>  | <b>42.6</b>  | <b>24%</b> |
| <b>East Asia</b>     |              |              |              |              |              |              |              |              |              |              |            |
| China                | 92.3         | 97.3         | 100.2        | 102.1        | 117.4        | 121.3        | 121.3        | 111.4        | 120.6        | 151.6        | 26%        |
| Japan                | 86.7         | 87.0         | 90.5         | 104.6        | 118.3        | 103.2        | 108.7        | 109.5        | 113.2        | 98.3         | -13%       |
| South Korea          | 22.2         | 20.2         | 19.0         | 18.0         | 19.1         | 19.1         | 18.4         | 17.4         | 18.7         | 19.8         | 6%         |
| Taiwan               | 10.5         | 10.5         | 10.2         | 10.0         | 9.4          | 9.7          | 8.8          | 9.0          | 9.5          | 9.9          | 4%         |
| Others               | 0.7          | 1.0          | 1.2          | 1.3          | 1.2          | 1.2          | 1.3          | 1.1          | 1.2          | 1.3          | 5%         |
| <b>Sub-total</b>     | <b>212.4</b> | <b>216.1</b> | <b>221.0</b> | <b>236.0</b> | <b>265.3</b> | <b>254.7</b> | <b>258.5</b> | <b>248.5</b> | <b>263.3</b> | <b>280.9</b> | <b>7%</b>  |
| <b>Other Regions</b> |              |              |              |              |              |              |              |              |              |              |            |
| C&S America          | 6.7          | 7.0          | 6.9          | 7.2          | 6.5          | 3.9          | 2.4          | 1.2          | 1.2          | 1.4          | 12%        |
| Middle East          | 6.0          | 6.9          | 6.4          | 5.8          | 6.0          | 6.0          | 5.7          | 4.9          | 5.2          | 5.9          | 14%        |
| Oceania              | 4.4          | 4.4          | 4.3          | 4.4          | 4.2          | 4.4          | 4.5          | 3.6          | 4.2          | 4.5          | 7%         |
| CIS                  | 2.4          | 1.9          | 1.5          | 1.6          | 1.6          | 1.7          | 1.8          | 1.5          | 1.8          | 1.5          | -16%       |
| Africa               | 1.4          | 1.3          | 1.0          | 0.9          | 0.9          | 1.0          | 1.0          | 0.9          | 0.9          | 1.0          | 8%         |
| <b>Sub-total</b>     | <b>20.8</b>  | <b>21.5</b>  | <b>20.1</b>  | <b>19.9</b>  | <b>19.3</b>  | <b>16.9</b>  | <b>15.4</b>  | <b>12.0</b>  | <b>13.3</b>  | <b>14.3</b>  | <b>7%</b>  |
| <b>Global Total</b>  | <b>451.7</b> | <b>440.9</b> | <b>443.4</b> | <b>477.4</b> | <b>515.3</b> | <b>511.2</b> | <b>509.7</b> | <b>488.7</b> | <b>528.2</b> | <b>556.5</b> | <b>5%</b>  |

## Breakdown of Industrial Demand by Sector

| Million ounces         | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021  | 2022  | Y/Y |
|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----|
| Electrical/Electronics | 275.4 | 269.8 | 272.3 | 308.9 | 339.7 | 331.0 | 327.3 | 321.8 | 351.0 | 371.5 | 6%  |
| Brazing Alloys         | 54.8  | 53.3  | 51.0  | 49.0  | 50.8  | 51.9  | 52.3  | 47.4  | 50.4  | 49.0  | -3% |
| Other Industrial       | 121.5 | 117.8 | 120.1 | 119.5 | 124.8 | 128.3 | 130.1 | 119.4 | 126.8 | 136.0 | 7%  |

Source: Metals Focus

## Global Industrial Demand



Source: Metals Focus

assisted, as did rising vehicle sophistication and electrification (where the emphasis is on power management). Limited thrifting / substitution and the onshoring of various production lines to improve supply chain reliability was reported as further helping. Lastly, new techniques in the field of electronics printing gave a slight boost to demand. Growth is again forecast for most countries this year as the region looks likely to avoid recession and through further investment in green technologies. However, further losses in the UK mean Europe as a whole is forecast to see a 3% dip in offtake.

### North America

Industrial demand in North America rose by a robust 6% in 2022 to an 11-year high of 132.9Moz (4,133t). All sectors grew, with the greatest gains being for other industrial offtake (up 8%, due to a strong year for EO catalysts), while electronics & electrical and brazing & solders demand both rose by 4%.

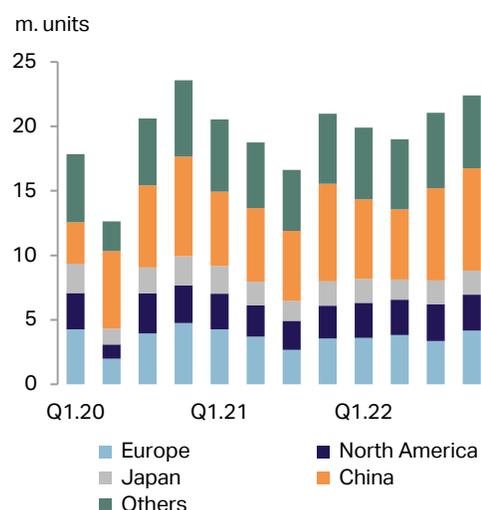
The largest component, electronics & electrical, was boosted by ongoing investment in green technologies, in particular PV. This led to higher output of powders for export, chiefly to East Asia as the home of panel production. We are starting to see the start of cell manufacturing in Europe to diversify the supplier base and so flows of powders (or the associated pastes) could begin to change. The green wave also had benefits for silver use in the automotive space due to battery electric vehicles' (BEVs) higher silver loadings (mostly related to power management). However, industry sources report that early estimates of the BEV multiple for silver use in comparison to internal combustion engine (ICE) vehicles are starting to look too high. In fact, of greater importance for 2022 silver use here was the 10% rebound in North American vehicle production as the chip crisis eased. Automotive end use was also boosted by the ongoing rise in vehicle sophistication, such as the onboard diagnostics to transmit real-time emission levels as legislation tightens. Other new areas such as printed silver for wearable devices also grew fast, but their contribution to the total remained slight.

## Electrical & Electronics Demand

| Million ounces         | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         | 2022         | Y/Y       |
|------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-----------|
| China/Hong Kong        | 61.2         | 65.2         | 67.2         | 70.3         | 85.2         | 88.7         | 88.1         | 80.8         | 90.0         | 124.4        | 38%       |
| Japan                  | 72.2         | 73.6         | 75.8         | 91.0         | 104.2        | 88.9         | 94.3         | 96.6         | 98.6         | 83.2         | -16%      |
| United States          | 56.0         | 44.2         | 46.9         | 65.0         | 66.9         | 68.7         | 65.6         | 66.6         | 70.8         | 73.9         | 4%        |
| Germany                | 17.7         | 18.2         | 17.3         | 17.7         | 18.3         | 19.0         | 17.1         | 21.4         | 25.7         | 20.6         | -20%      |
| India                  | 14.9         | 14.3         | 13.6         | 13.8         | 14.3         | 15.3         | 13.6         | 11.7         | 14.9         | 17.2         | 15%       |
| South Korea            | 8.7          | 9.3          | 8.5          | 8.3          | 8.6          | 8.4          | 7.9          | 7.4          | 7.9          | 8.3          | 4%        |
| Others                 | 44.7         | 45.1         | 42.9         | 42.9         | 42.3         | 42.0         | 40.7         | 37.3         | 43.0         | 44.0         | 2%        |
| <b>Global Total</b>    | <b>275.4</b> | <b>269.8</b> | <b>272.3</b> | <b>308.9</b> | <b>339.7</b> | <b>331.0</b> | <b>327.3</b> | <b>321.8</b> | <b>351.0</b> | <b>371.5</b> | <b>6%</b> |
| of which Photovoltaics | 50.5         | 48.4         | 54.1         | 93.7         | 101.8        | 92.5         | 97.8         | 100.0        | 110.0        | 140.3        | 28%       |

Source: Metals Focus

## Global Light Duty Vehicle Quarterly Production



Source: LMC Automotive

Of greater importance to offtake was growth for one of demand's bedrocks, contact materials. Production grew thanks to GDP growth, investment in the construction industry, plus the benefit of rebuilding after storm damage. Last year also saw robust offtake for the defense / aerospace sector. Lastly, two background factors are worth noting. First, ongoing logistics challenges (such as trucking delays) meant the supply chain had to maintain inventories that were higher than normal. Second, silver prices never achieved a level that triggered thrifting and/or substitution of any scale.

That latter point was however relevant for brazing alloys as the year saw a further modest swing from copper-based (and silver using) to aluminum-based HVAC systems (heating, ventilation and air-conditioning). Despite that, this field saw overall growth for similar reasons to the above, namely GDP growth, higher vehicle output and a healthy construction industry. It was also boosted by robust demand in the extractive industries.

The final area, other industrial demand, saw gains largely based on growth for EO catalyst production. This in turn was a product of the 9% rise in global EO capacities, itself reflecting a strong post-COVID rebound. High energy prices can impact this sector as they can delay change-outs (cutting gross demand), but there was compensation from a shift to catalysts with a higher silver loading as that cost is worthwhile to boost operating efficiencies.

Further growth for EOs help drive our forecast of another 2% rise in North American industrial demand this year. Most other demand segments should also register gains on the back of GDP growth plus the start of possible benefits from the US' Inflation Reduction Act.

### South Asia

Industrial demand in 2022 in **India** saw a second year of gains owing to the recovery that has emerged since the end of the pandemic. As a result, silver offtake rose by 24% y/y to 42.6Moz (1,324t), its highest since 2012.

## Brazing Alloys & Solder Demand

| Million ounces      | 2013        | 2014        | 2015        | 2016        | 2017        | 2018        | 2019        | 2020        | 2021        | 2022        | Y/Y        |
|---------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|
| China               | 24.0        | 25.0        | 25.5        | 24.1        | 24.5        | 24.8        | 25.1        | 22.5        | 22.1        | 19.5        | -12%       |
| United States       | 6.1         | 6.0         | 5.7         | 5.9         | 6.2         | 6.4         | 6.5         | 6.0         | 6.5         | 6.8         | 3%         |
| Germany             | 4.9         | 4.6         | 4.4         | 4.3         | 4.2         | 4.2         | 4.1         | 4.3         | 4.7         | 5.0         | 7%         |
| India               | 2.4         | 2.3         | 2.1         | 2.2         | 2.2         | 2.3         | 2.2         | 1.7         | 2.7         | 3.0         | 10%        |
| South Korea         | 3.0         | 2.7         | 2.6         | 2.3         | 2.4         | 2.4         | 2.3         | 2.1         | 2.2         | 2.3         | 3%         |
| Japan               | 2.0         | 1.9         | 1.8         | 1.8         | 2.0         | 2.1         | 2.1         | 1.9         | 2.1         | 2.2         | 2%         |
| Others              | 12.5        | 10.8        | 8.9         | 8.6         | 9.2         | 9.7         | 10.0        | 8.8         | 9.9         | 10.3        | 4%         |
| <b>Global Total</b> | <b>54.8</b> | <b>53.3</b> | <b>51.0</b> | <b>49.0</b> | <b>50.8</b> | <b>51.9</b> | <b>52.3</b> | <b>47.4</b> | <b>50.4</b> | <b>49.0</b> | <b>-3%</b> |

Source: Metals Focus

# Understanding India's 'Other Industrial' Segment

Indian industrial demand ranges between 35-45Moz (1,100-1,400t) a year, of which roughly half sits in the 'Other Industrial' category. This segment is divided broadly into plating, pharmaceuticals / chemicals, food, zari (silver thread) and the glass industry. Some of these areas (such as food, clothing and sectors within the chemical industry) are unique to India and so are worth exploring further.

More than half of the demand within this segment comes from plating. This is widely used in manufacturing jewelry, decorative articles and functional utensils. The former two, when made from copper and brass, are often electroplated with silver to give the look and feel of sterling silver. With the increase in silver prices, demand for these silver plated articles has risen. This was very much in line with demand for gold plated silver jewelry which has risen in response to firmer gold prices.

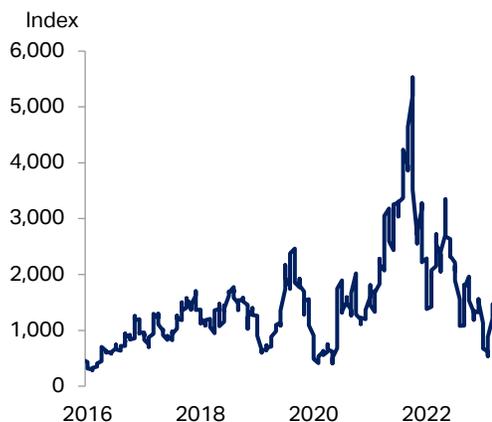
The food industry is the next biggest area, accounting for about 20% of other industrial demand. Varakh (a thin silver foil) is produced by pounding silver into thin layers, then used to garnish/ decorate Indian desserts and sweets. Another interesting use of silver is to coat cardamom seeds and betel nuts used as mouth fresheners. Other food applications include using silver in an Ayurvedic (a traditional Indian medicine with a 5,000-year history) herbal supplement called Chyawanprash. Silver is a key ingredient due to its antibacterial properties.

Our research suggests that a further 10% goes to the zari (silver thread) industry. Zari is typically used in garments like sarees for women, or sherwanis/kurtas for men which have embroidery made of zari. This industry is highly fragmented, with very few large, organized players. Interestingly, as silver prices rose over the years, thrifting became more common, and the sector now uses more plated than pure silver zari. "Real" silver is only used in expensive clothing, whereas plated zari is used in most ethnic items.

The pharmaceuticals/chemicals and hygiene industry enjoys a 10% market share. Here, silver use (such as catalysts in the pharmaceutical industry) is broadly similar to the rest of the world. Two products on the chemical side are worth mentioning: silver nitrate and silver sulphate are used in testing effluents from factories before discharge, thereby helping with pollution control. A new area here is masks, facewash and other hygiene products being manufactured post-pandemic with silver ions to protect against infection. The remaining share of other industrial is silver used in industries such as glass, paints and laboratory equipment.

Although silver use is wide-ranging, this category is expected to see only modest growth in the coming years, mainly due to thrifting. That said, given that the segment is largely unorganized and local silver prices are trading at record highs, more regulations (except in the food industry) would be needed to limit this thrifting.

## Baltic Dry Index\*



\* The Baltic Dry Index is a shipping and trade index created by the London-based Baltic Exchange. It is reported as a proxy for the cost of transporting raw materials by sea. Source: Bloomberg

The electronics and electrical segment grew by 15% y/y to 17.2Moz (534t), a new high. This reflected strong domestic and export demand, plus a capacity shift from China as companies try to cut dependency on single countries and diversify their electrical components supply chains. A zero-COVID policy and strict lockdowns in China also meant that many Indian companies started buying locally. Moreover, some global companies that previously imported products from China have shifted to Indian suppliers. Electronics exports therefore continued to grow. For instance, cell phone exports have surpassed \$5bn this fiscal year (April 2022 to March 2023), compared to last year's \$2.2bn. In the domestic market, high voltage (HV) and even more so low voltage (LV) segments performed well. The real estate market also boomed (there were record housing sales in the top seven cities), which led to greater demand for electrical contacts. Furthermore, a shift towards premium products positively impacted silver loadings in contacts as they help increase durability and efficiency.

Growth was almost as fast in brazing alloys & solders, as a 10% gain delivered a record high of 3.0Moz (94t). As in 2021, the thrust came from robust export

# Nanosilver's Rapid Growth in Environmental Testing and Remediation

Silver nanoparticles (AgNPs) are defined as a nanomaterial that is 1-100nm in size and, compared to silver in its more traditional form, display unique electrical, optical and catalytic properties, as well as extraordinary antibacterial activity. AgNPs therefore have a frontline role to play in monitoring and remediating environmental damage. This role has been further boosted by the development of green synthesis of AgNPs, an eco-friendly way of making them. Although offtake in terms of silver ounces is extremely limited today, growing environmental concerns mean the annual growth rate of AgNPs is set to remain in double-digits for the foreseeable future. We address below some of the areas in which AgNPs can be deployed.

## Detection and monitoring

Environmental disasters need to be detected as rapidly as possible in order to enact swift countermeasures. Many common detection methods for water and airborne contaminants are extremely time-consuming and costly as they require laboratory analysis and a high level of expertise. In contrast, colorimetric sensors, which are optical sensors that instantly change color when influenced by external stimuli, provide rapid, cost-effective on-site detection. AgNPs can be used in such sensors, thanks to their surface properties which are extraordinarily efficient at absorbing and scattering light. The presence of heavy toxic metals, such as lead, mercury, arsenic and cadmium can therefore be immediately observed by anyone, enabling fast remedial action to be taken.

AgNPs can also be used in environmental monitoring, via radio frequency identification (RFID) technology. This well-established system enables wireless short-to-medium range tracking and identification of objects. Next generation RFID tags, however, can now also offer sensor abilities. Changes in temperature, humidity and ammonia in soil, for example, can be measured and relayed in agricultural contexts, which face increasingly stringent government regulations for environmental safety. Such information can also offer productivity gains, driving further growth. Furthermore, RFID tags require fewer components than standard monitoring devices, allowing them to be both compact and lower cost.

## Water safety

Water safety is a major global environmental and public health issue. The efficacy of membrane technology, which separates

contaminants from water, has shown significant improvements with the incorporation of AgNPs in a variety of media such as polyurethane foam, ceramics, paper and textiles. Bacteria such as E. Coli in drinking water can prove fatal, but the presence of AgNPs in membranes has been shown to almost entirely deactivate E.Coli. Wastewater treatment facilities, meanwhile, have been found to be hotbeds for bacteria conveying antibiotic resistant genes (ARGs), particularly those receiving effluents from hospitals and pharmaceutical industries. AgNPs, however, have been found to disable the ability of ARGs in bacteria to be passed on, as well as removing antibiotics-related contaminants and other pharmaceuticals from wastewater. Such treatment is cost-effective, efficient and easy to recover post-treatment.

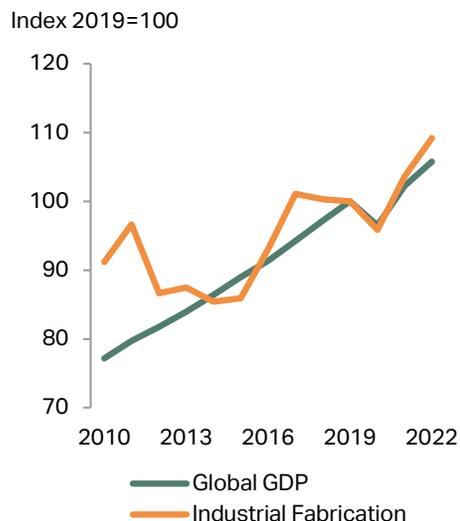
## Pollution remediation

The build-up of synthetic organic dyes is an increasing problem in our environment. These dyes are ubiquitous in industries, including textiles, tanneries, cosmetics, food and medicine and pose a severe threat to our environment, as they are mostly toxic, non-biodegradable and carcinogenic. They have been found in water, sediment and wild fish and their presence needs monitoring and, ideally, removal. One such removal method is photocatalysis, which is the degradation of compounds in light. AgNPs can capture light energy and use it to degrade and/or oxidize a wide range of compounds, such as dyes (and pesticides) in soil and water, rendering them harmless. The use of light is highly valuable due to its wide availability and cost effectiveness, compared to the various chemical, physical and biological methods of removal that have also been employed.

## Looking ahead

AgNPs are set to have a future in a wide range of environmental applications, thanks to the huge scope of their properties. There are, of course, challenges that come with any new technology. In the case of AgNPs, their environmental impact must be properly assessed and controlled. That said, growth in demand for silver in the manufacture of AgNPs is set to increase strongly for the foreseeable future as the need for environmental protection and remediation becomes ever more urgent, with rapid developments in technology and cost effectiveness enabling their use in a growing number of fields.

## Industrial Fabrication versus Global GDP



Source: IMF, Metals Focus

demand as global companies try to reduce their dependence on China. Thrifting also fell, in part as consumers are more focused on quality.

Demand gains were strongest for the 'other industrial' category, with a leap of 35% to 22.4Moz (696t), taking offtake back to pre-pandemic levels. Silver plating performed exceptionally well, driven by the return of gifting demand as festivities and weddings resumed in full swing. As a result, sales of both decorative articles, made from copper and brass and plated with silver, and silver-plated jewelry grew. Varakh (silver foil on sweets) also saw robust growth as festivals and weddings were celebrated without restrictions. However, other areas such as zari (silver thread) and pharmaceuticals/chemicals remained flat y/y, with the former hit by slower exports and the latter suffering from fewer elections (silver nitrate is used in indelible ink).

We expect total industrial demand to grow only marginally this year as broader economic momentum is expected to slow. A further clear uptick might require a significant structural push from government policies and a clear benefit from any geopolitical developments.

### East Asia

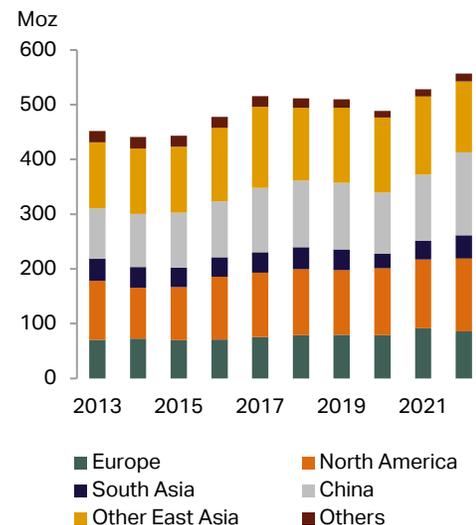
East Asian industrial silver demand rose by 7% to 280.9Moz (8,738t) in 2022. This was chiefly due to rising end-use in the green economy, broader investment in energy generation and distribution and a recovery in the automotive sector. All this offset the slowdown in consumer electronics.

**Chinese** industrial silver demand rose by 26% y/y to 151.6Moz (4,716t) in 2022. This was partly a result of soaring PV installations at home and globally as the energy crisis triggered by geopolitical tensions has allowed the green economy to perform better than expected. The figures for China were also boosted by accelerated localization policies to protect against possible trade disputes. There was also robust investment in grid construction and rising automotive electronics end-use. This helps explain why gains were larger than GDP growth of 3% and could occur given damage to consumer confidence from COVID management and persistent stress in real estate.

On the PV front, local installation progress in the first three quarters was relatively slow due to extreme price fluctuations in upstream raw materials. However, a surge during Q4 lifted capacity additions to 87.4GW, a 59% rise. Moreover, catalyzed by the sharp rise in electricity prices in overseas markets, energy sovereignty became more urgent and this drove growth for the global market. This allowed China's PV module exports to hit a record high, reaching 154.5GW, an increase of 56%, with Europe accounting for 46% of these shipments.

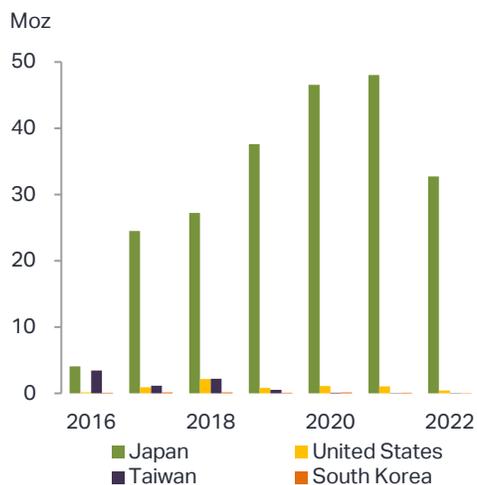
It is worth noting that Chinese manufacturers have made breakthroughs in silver powder and paste technologies. They are now capable of replacing

## Global Industrial Demand by Region



Source: Metals Focus

### Chinese PV Silver Powder Imports\*



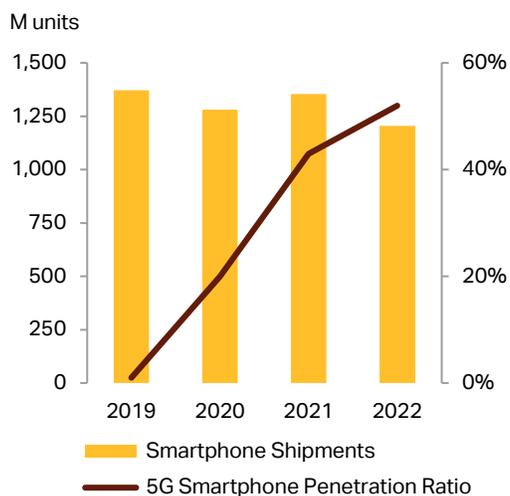
\* Gross weight  
Source: S&P Global

Japanese companies as powder suppliers in high-end pastes for PERC (passivated emitter and rear cell) and TOPCon (tunnel oxide passivated contact) cells. This allowed China to surpass Japan to become the largest country in supplying PV silver powders, with the localization rate now over 60%. Prospects for PV remains bright this year, as global installations may exceed 300GW for the first time. China will continue to benefit here as it accounts for more than 80% of solar panel output.

Consumer electronics fabrication plummeted as both individual and enterprise spending slumped, as COVID directly affected incomes and resulted in a sharp decline in consumer confidence. Notebook/PCs led the way with double-digit losses from the highs of 2021 as the pandemic boom ended and markets swung into oversupply. Smartphone sales also fell to their lowest level in nearly a decade, in part reflecting a lack of affordability. In contrast, automotive electronics performed well in the context of rising vehicle electrification and the growing popularity of BEVs. In the electrical sector, China boosted investment in power grid infrastructure and accelerated 5G network deployment to stimulate the domestic economy, but the collapse in the real estate market still weighed heavily on both HV and LV apparatus sales.

Consumer electronics demand is expected to remain weak in the first half of this year, with the market only recovering in Q3.23 as supply chains work through their excess inventory. However, robust demand from PV, power grids and 5G networks, along with gains from electronics are forecast to generate demand growth of around 20% for the electrical & electronics segment in 2023.

### 5G Smartphone Shipments



Source: Statista, Metals Focus

Brazing alloy demand fell 12% to 19.5Moz (606t) in 2022. Offtake in HVAC was dragged lower by turmoil in the real estate market, while end-use in railroad construction slipped for the fourth consecutive year (and is expected to do so again this year) as the peak of investment has passed. In contrast, automotive and aerospace end-uses remained healthy. In 2023, this demand segment is expected to grow slightly, driven by auto-related applications and the expected rise in fixed asset investment.

Industrial demand in **Japan** fell by 13% last year to 98.3Moz (3,056t). This was exclusively due to a 16% drop in electronics & electrical demand. The market share gains Chinese PV powder makers enjoyed in 2022 were largely at the expense of Japanese fabricators. After all, Chinese manufacturers have a huge advantage of buying silver locally at a discount to the international price. It seems that in 2022 the quality gap between Chinese and Japanese powders narrowed enough to encourage a shift. Indeed, this is also why we forecast further losses in Japanese demand for this year. Other areas of industrial demand fared better and were up last year. However, these gains were somewhat limited by zero-COVID policy headwinds.

# Silver Prospects Bright as Shifts between PV Technologies Counter Thrifiting

After nearly two decades of development, the solar industry is entering a new era. This is because the growth of installed capacity has greatly exceeded expectations (driven by the awareness of green economy and energy sovereignty), and also because a technological breakthrough has brought new high-efficiency N-type cells (which have higher silver loadings) into mass production. Given the rapid growth of PV installations, the consumption of silver powder has increased significantly over the years. Our statistics show that global consumption of PV silver powder in 2022 reached 140.3Moz (4,365t), almost triple the level in 2010. Even though silver loadings per unit fell for traditional cells, powder offtake should still be on the rise due to the trend toward N-type cells and the bright prospects for PV installations over the next few years.

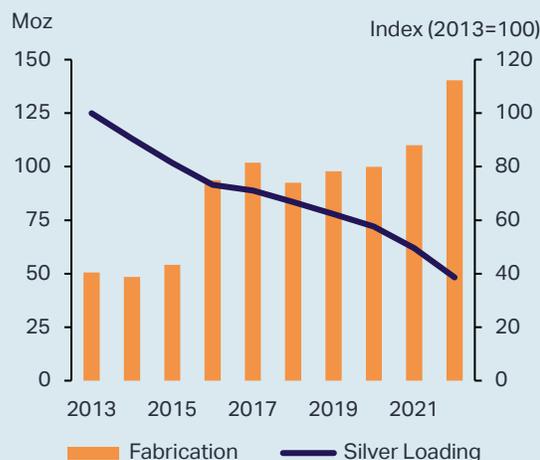
Our analysis of the market share of various solar cell technologies shows that PERC was still the norm with a market share of nearly 90% in late 2022. However, with rapid efficiency improvements and cost reductions, TOPCon is expected to replace PERC as the main choice within three years. The amount of silver consumed by each solar cell technology varies widely. Currently, the silver loading per unit of TOPCon is 1.3-1.5 times that of PERC, and that of HJT (heterojunction technology) is 1.6-1.8 times PERC. Therefore, as the technology shifts from P-type to N-type cells, silver usage is projected to increase significantly. In order to lessen the impact of silver price volatility and to enhance competitiveness, manufacturers have invested heavily and made impressive progress in silver thrifiting and substitution in recent years, mainly through the three aspects of process optimization, alternative materials, and improved cell structure design. (Silver accounts for the second largest share of total PV module costs after silicon wafers.)

Process optimization involves the development of high-precision stencil printing, as an alternative to traditional wire mesh, to overcome the limits of screen printing in aspect ratio, line width and uniformity. This has allowed the finger width to shrink sharply from 45um to below 15um in the past five years. Moreover, the introduction of inkjet printing and 3D metal printing technologies has contributed to an additional silver saving of over 20%. Furthermore, the industry continued to evolve cell design by increasing the number of busbars (BBs), but trimming their width, which cuts overall silver use. In 2022, 9BB technology enjoyed a

market share of more than 90% and there is no doubt that a level of 12BB and above will be reached in the short-term. To achieve further cost reductions, the industry consensus is advancing towards busbar-less design, which may bring about thrifiting of 30-50%. As for alternative materials, silver-coated copper powder and electroplated copper are the two major substitutes for silver. Silver-coated copper is mainly used on the backside finger lines and in low-temperature paste for HJT as its sintering process (<200C) can effectively suppress the oxidation issue for copper. The low-temperature paste, with a silver content of 44%, has proven its performance and reliability, and the industry is aiming for the next target of 30% silver content. Finally, electroplating is a non-contact metallization technology, which deposits copper on the substrate without any silver. It has not yet been widely used due to the high investment required.

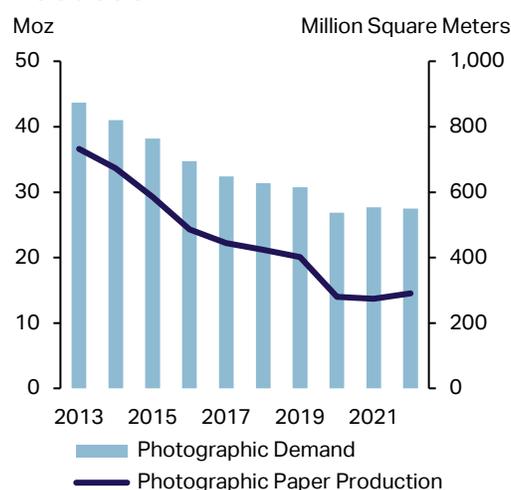
All the above innovations mean silver loadings per cell should continue to decline, and facilitate the adoption rate of N-type solar cells (TOPCon and HJT) with better competitiveness. The growth rate of silver demand in PV should therefore still be lower than the rise in installed capacity due to this thrifiting and substitution. However, the overall increase in silver offtake in PV should remain a driving force behind total industrial silver demand.

PV Silver Demand & Cell Loadings\*



\*denotes silver loadings per photovoltaic cell;  
Source: BNEF, Metals Focus

## Photographic Demand & Paper Production



Source: Metals Focus, Photofinishing Newsletter

**South Korean** industrial offtake rose by 6% last year, benefiting from rising vehicle output and growing electrification in this area. In contrast, other segments, including semiconductor and consumer electronic components, saw a slowdown in the second half of 2022. The country is expected to face more challenges this year as subdued economic conditions for key trading partners continue to hurt electronics exports. **Taiwan's** industrial offtake grew by 4%, in part as it continued to benefit from the supply chain's restructuring away from mainland China.

## Photographic Demand

Silver demand in photographic applications remained broadly flat last year at 27.5Moz (855t). Sales of consumer and professional film and paper both edged higher, nearing their respective pre-pandemic levels, although these were already at historic lows. There are tentative signs that film photography is making a return, as a number of film makers not only revived some discontinued films last year, but also introduced new film stocks. Black and white film, which has higher silver loadings than color film, achieved solid gains. Indeed, demand overtook product availability, although this was in part caused by supply chain issues.

Global offtake from the medical sector remained stable, as growth in traditional x-rays in some emerging markets was offset by increased digitization in others, especially India (industrialized markets have already almost entirely shifted into digital). Offtake from non-destructive testing (NDT) x-rays also remained flat, with their value benefiting from the fact that such images cannot be manipulated. The motion picture industry also stayed constant, albeit at a trivial level in terms of silver demand. Despite the artistic merits of analog films, they are almost always digitized for distribution.

Longer-term silver use in photography is set to recede further. In film and paper, further losses are likely, due partly to the fact that silver halide printing is done on unrecyclable paper that contains plastic. Analog x-rays in the medical and NDT arenas will also see attrition thanks respectively to the falling cost of digital technology and the possible roll-out of artificial intelligence techniques that can detect if a digital image has been altered.

## Photographic Demand

| Million ounces      | 2013        | 2014        | 2015        | 2016        | 2017        | 2018        | 2019        | 2020        | 2021        | 2022        | Y/Y        |
|---------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|
| Europe & N America  | 32.7        | 29.9        | 27.2        | 24.3        | 22.4        | 21.4        | 20.6        | 20.4        | 20.4        | 19.8        | -3%        |
| East Asia           | 9.8         | 9.8         | 9.6         | 9.0         | 8.7         | 8.4         | 8.3         | 6.5         | 7.3         | 7.7         | 5%         |
| Others              | 1.2         | 1.3         | 1.3         | 1.4         | 1.4         | 1.6         | 1.8         | -           | -           | -           | n/a        |
| <b>Global Total</b> | <b>43.7</b> | <b>41.0</b> | <b>38.2</b> | <b>34.7</b> | <b>32.4</b> | <b>31.4</b> | <b>30.7</b> | <b>26.9</b> | <b>27.7</b> | <b>27.5</b> | <b>-1%</b> |

Source: Metals Focus

# Chapter 8

- Global silver jewelry demand jumped by 29% in 2022 to a record 234.1Moz (7,280t).
- India drove the bulk of these gains, due to a rebound in consumption and restocking. The rest of the world was flat y/y as a post-COVID recovery for most countries offset losses in China, Russia and the US.
- Jewelry offtake is forecast to fall by 15% in 2023 as India normalizes. Demand elsewhere is forecast to rise by 4%.
- Silverware fabrication in 2022 surged by 80%, but is forecast to fall by 24% this year chiefly through swings for India.

## Jewelry & Silverware

### Jewelry

#### Introduction

Silver jewelry demand shot up by 29% in 2022 to a record high of 234.1Moz (7,280t). This was mostly due to a surge in India; if we exclude that country, volumes dipped by 0.3%. India's gains centered on a post-COVID rebound in consumption, heavy re-stocking by retailers and higher purities. Other countries seeing notable gains included Italy, Thailand, Indonesia and Turkey, on the back of a post-pandemic recovery in exports and/or local sales. Three countries saw notable declines: the US (as local sales eased from a bumper 2021), Russia (due to post-Ukraine sanctions) and, most importantly, China (due to COVID damage to incomes and confidence). Global demand is forecast to fall by a sizable 15% in 2023 as offtake in India comes down to earth. The rest of the world however sees gains of 4% resulting from ongoing gains for local consumption and/or exports.

#### Europe

European jewelry **fabrication** rose by a modest 3% in 2022, but that still took levels to a 12-year high of 32.0Moz (995t). Much of the increase was due to a rise in local consumption (detailed on page 56), plus further but smaller re-stocking by retailers. In contrast, export data suggests losses on that front.

Exports are dominated by Italy, which in 2022 fell by 6% (in fine weight terms). That typically would be sufficient to cut total fabrication, but industry sources responded uniformly that growth occurred. Re-exports and exports of jewelry in semi-manufactured form can trigger data discrepancies, but there is no sign of either last year. A swing to unofficial shipments can also make official figures less useful. It is possible that this occurred to a degree in 2022 as travel became easier post-COVID, but the unofficial segment of silver exports has always been extremely modest, certainly in contrast to gold. Instead, it appears that the official data may just be misleading, as is often the case with export statistics. For example, basis Italian customs data, there was a 26% drop for flows to the US, whereas inflows into the US basis that country's customs data fell by 15%. That said, a fall in shipments to the US is felt to have occurred as US consumption eased and earlier furious levels of re-stocking ended. In contrast, exports to the rest of the EU rose modestly, as did shipments to Latin America (led by flows to the entrepôt of Panama). The only destinations to see notable losses were Hong Kong and Russia.

European fabrication in 2023 is expected to be roughly flat y/y. We had originally forecast a fair drop, due to the cost of living crisis and an uncertain outlook. However, the mood at the Vicenza jewelry show and during a recent trip to Italy was very positive and, if maintained, offtake could even inch up.

### Global Jewelry Fabrication Forecast

| Million ounces      | 2022         | 2023F        | Y/Y         |
|---------------------|--------------|--------------|-------------|
| Europe              | 32.0         | 31.5         | -1%         |
| North America       | 18.8         | 19.1         | 2%          |
| Middle East         | 10.4         | 10.9         | 5%          |
| South Asia          | 115.1        | 75.7         | -34%        |
| East Asia           | 50.5         | 54.7         | 8%          |
| CIS                 | 3.4          | 3.4          | 0%          |
| Others              | 3.9          | 4.1          | 3%          |
| <b>Global Total</b> | <b>234.1</b> | <b>199.5</b> | <b>-15%</b> |

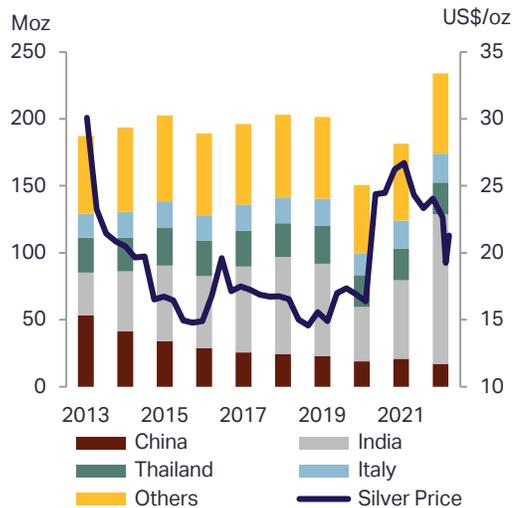
Source: Metals Focus

## Jewelry Fabrication

| Million ounces       | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         | 2022         | Y/Y        |
|----------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------------|
| <b>Europe</b>        |              |              |              |              |              |              |              |              |              |              |            |
| Italy                | 17.9         | 19.5         | 20.0         | 18.8         | 19.5         | 19.3         | 19.9         | 16.2         | 21.1         | 21.8         | 3%         |
| Germany              | 3.5          | 3.4          | 3.5          | 3.4          | 3.4          | 3.5          | 3.5          | 3.1          | 3.6          | 3.4          | -5%        |
| France               | 2.0          | 1.9          | 2.0          | 2.0          | 1.9          | 1.9          | 1.8          | 1.6          | 1.7          | 1.9          | 9%         |
| Others               | 4.6          | 4.7          | 4.7          | 4.6          | 4.7          | 4.6          | 4.7          | 3.8          | 4.6          | 4.9          | 7%         |
| <b>Sub-total</b>     | <b>27.9</b>  | <b>29.6</b>  | <b>30.2</b>  | <b>28.7</b>  | <b>29.5</b>  | <b>29.3</b>  | <b>29.9</b>  | <b>24.7</b>  | <b>31.0</b>  | <b>32.0</b>  | <b>3%</b>  |
| <b>North America</b> |              |              |              |              |              |              |              |              |              |              |            |
| United States        | 12.3         | 13.0         | 13.6         | 12.9         | 13.2         | 13.0         | 12.9         | 11.5         | 13.2         | 12.8         | -3%        |
| Canada               | 3.7          | 3.9          | 3.5          | 3.6          | 3.4          | 3.2          | 3.2          | 2.7          | 3.7          | 3.7          | -1%        |
| Mexico               | 4.5          | 5.4          | 5.7          | 5.8          | 4.9          | 5.0          | 4.5          | 3.1          | 2.2          | 2.3          | 6%         |
| <b>Sub-total</b>     | <b>20.6</b>  | <b>22.3</b>  | <b>22.9</b>  | <b>22.3</b>  | <b>21.5</b>  | <b>21.2</b>  | <b>20.6</b>  | <b>17.3</b>  | <b>19.1</b>  | <b>18.8</b>  | <b>-2%</b> |
| <b>Middle East</b>   |              |              |              |              |              |              |              |              |              |              |            |
| Turkey               | 4.9          | 6.3          | 6.7          | 4.9          | 4.9          | 5.9          | 6.0          | 4.4          | 6.9          | 7.2          | 5%         |
| Others               | 2.5          | 2.6          | 3.1          | 3.0          | 2.8          | 3.4          | 3.0          | 2.3          | 2.8          | 3.2          | 12%        |
| <b>Sub-total</b>     | <b>7.4</b>   | <b>8.9</b>   | <b>9.8</b>   | <b>7.8</b>   | <b>7.7</b>   | <b>9.3</b>   | <b>9.0</b>   | <b>6.8</b>   | <b>9.7</b>   | <b>10.4</b>  | <b>7%</b>  |
| <b>South Asia</b>    |              |              |              |              |              |              |              |              |              |              |            |
| India                | 31.8         | 45.1         | 56.6         | 53.9         | 64.2         | 72.5         | 69.0         | 40.5         | 58.7         | 111.6        | 90%        |
| Others               | 1.2          | 1.7          | 2.1          | 2.0          | 2.4          | 2.7          | 2.5          | 1.5          | 2.1          | 3.4          | 65%        |
| <b>Sub-total</b>     | <b>33.0</b>  | <b>46.8</b>  | <b>58.7</b>  | <b>55.9</b>  | <b>66.5</b>  | <b>75.2</b>  | <b>71.6</b>  | <b>42.0</b>  | <b>60.8</b>  | <b>115.1</b> | <b>89%</b> |
| <b>East Asia</b>     |              |              |              |              |              |              |              |              |              |              |            |
| Thailand             | 26.1         | 24.7         | 28.2         | 26.6         | 26.9         | 25.2         | 28.5         | 23.9         | 23.4         | 23.7         | 1%         |
| China                | 53.4         | 41.1         | 33.8         | 28.7         | 25.5         | 24.3         | 22.8         | 18.9         | 20.8         | 17.1         | -18%       |
| Indonesia            | 4.1          | 6.1          | 4.9          | 5.2          | 5.1          | 5.3          | 5.6          | 4.8          | 3.7          | 4.4          | 18%        |
| South Korea          | 3.3          | 2.9          | 3.1          | 2.7          | 2.7          | 2.5          | 2.5          | 2.0          | 2.3          | 2.2          | -1%        |
| Japan                | 1.2          | 1.3          | 1.4          | 1.4          | 1.5          | 1.6          | 1.7          | 1.5          | 1.4          | 1.3          | -5%        |
| Others               | 1.7          | 1.6          | 1.5          | 1.5          | 1.6          | 1.7          | 1.8          | 1.5          | 1.6          | 1.8          | 8%         |
| <b>Sub-total</b>     | <b>89.9</b>  | <b>77.8</b>  | <b>72.9</b>  | <b>66.2</b>  | <b>63.3</b>  | <b>60.5</b>  | <b>62.8</b>  | <b>52.7</b>  | <b>53.2</b>  | <b>50.5</b>  | <b>-5%</b> |
| <b>Other Regions</b> |              |              |              |              |              |              |              |              |              |              |            |
| CIS                  | 4.4          | 4.0          | 4.5          | 4.3          | 4.1          | 3.7          | 3.5          | 3.7          | 3.9          | 3.4          | -13%       |
| C&S America          | 2.1          | 2.2          | 2.0          | 2.0          | 1.9          | 2.0          | 2.1          | 1.8          | 2.1          | 2.2          | 5%         |
| Africa               | 1.2          | 1.2          | 1.1          | 1.0          | 1.0          | 1.1          | 1.1          | 0.9          | 1.0          | 1.0          | 9%         |
| Oceania              | 0.6          | 0.6          | 0.6          | 0.6          | 0.7          | 0.7          | 0.7          | 0.5          | 0.6          | 0.7          | 10%        |
| <b>Sub-total</b>     | <b>8.3</b>   | <b>8.1</b>   | <b>8.1</b>   | <b>8.1</b>   | <b>7.8</b>   | <b>7.5</b>   | <b>7.5</b>   | <b>7.0</b>   | <b>7.6</b>   | <b>7.3</b>   | <b>-4%</b> |
| <b>Global Total</b>  | <b>187.1</b> | <b>193.5</b> | <b>202.5</b> | <b>189.1</b> | <b>196.2</b> | <b>203.1</b> | <b>201.4</b> | <b>150.5</b> | <b>181.5</b> | <b>234.1</b> | <b>29%</b> |

Source: Metals Focus

### Global Jewelry Fabrication



Source: Metals Focus, Bloomberg

Industry feedback on jewelry **consumption** in Europe last year points to modest growth on the back of a post-COVID economic recovery, improving consumer sentiment and minimal COVID disruption to consumer buying. The start of a swing in expenditure from goods to services was also blunted as Europe benefits from sizable inbound tourism. That said, modest growth might look understated given the available data. UK silver hallmarking for example was up 19%, but this benefited from retailer restocking - a phenomenon seen elsewhere in the region. Sales by leading retailer, Pandora, in 2022 were also up by 15% in the UK and 10% in Germany. However, there are clear signs that the value of sales outperformed the fine weight as branded goods and the top-end saw the best results. Value distortion was even greater in France; official turnover data points to 20% growth for the whole jewelry (and watch) market, but strength for the luxury brands means that figure has almost no relevance for silver. Consumption in Europe this year is expected to see first half weakness due to the cost of living crisis (ytd UK hallmarking is down 33% y/y), making a slight dip for the full year likely.

### North America

**US** silver jewelry fabrication fell by 3% in 2022, but that was almost all due to a strong 2021 performance when demand shot up by 15%. Few were expecting a repeat of such an outcome, nor were people disappointed by last year’s results. Our related measure of jewelry consumption (fabrication plus net imports and adjusted for stock changes) showed very similar moves.

The fact that consumption eased was due to several factors. First, we began to see the normalization of consumer expenditure, namely a shift from goods to services (in particular travel) as COVID and its restrictions became a distant memory. Second, so-called ‘revenge shopping’ (the novelty of in-store purchases) faded. Third, the end to Federal stimulus checks meant purchases by lower income groups had to become more considered. Fourth, there was a fashion swing to the yellow look and, while that was of clear benefit to karat gold, sales of gold-plated silver also performed well (we should also not forget that silver jewelry typically sells to a different type of customer, one usually younger and more fashion-conscious). Trade sources also talked about a desire by consumers to purchase tokens of affection for loved ones in such troubling times and this was felt to explain why gold jewelry has tended to outperform silver; the former’s consumption last year also dipped y/y, but was 10% up on 2019, whereas silver was on a par with that pre-pandemic year.

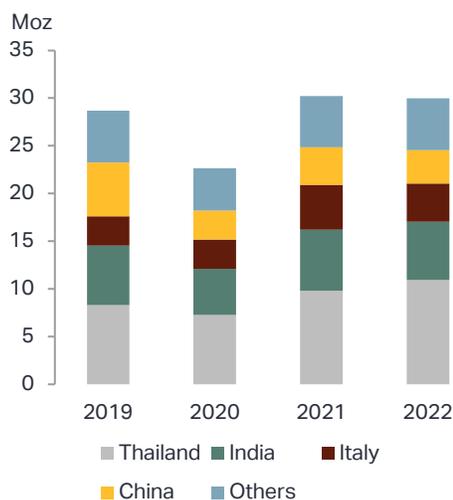
That silver jewelry consumption held up was in turn due to another set of factors. Most important of these was the macroeconomic backdrop; the jobs market continued to be solid, savings remained relatively high and recession was avoided. Silver jewelry also retained its appeal to its target demographic and has adapted well to the new world of omni-channel shopping. The value of sales also held up as branded and higher price point jewelry outperformed.

### Italian Jewelry Fabrication



Source: Metals Focus, Bloomberg

## US Jewelry Imports



Source: Metals Focus

That fabrication broadly matched these consumption trends was in part down to inventory developments. Heavy re-stocking in 2021 did much to boost demand that year, but further stock growth took place in 2022. Expectations of a continuation to boom time meant that in mid-2022 many retailers still had high inventories but, as talk of a slowdown grew, concern among fabricators emerged that orders could dry up as retailers worked through their stocks. However, these fears proved overdone as most retailers were keen to maintain a good level of stocks in the run up to the all-important holiday season and consumption strength in that period meant overstocking by year-end was limited. Local production was also not displaced by imports as these too fell (by 1%). While a small change overall, imports from the largest origin, Thailand, grew by over 10%, whereas shipments from India, China and Italy all fell notably.

During 2022, the impact of the negative factors on consumption mostly applied to the second half and the caution associated with that remained the key theme among the industry as 2023 began. As long as the economic background remains benign however we believe there is scope for a modest y/y increase, although a return to 2021 levels seems unlikely.

## Middle East

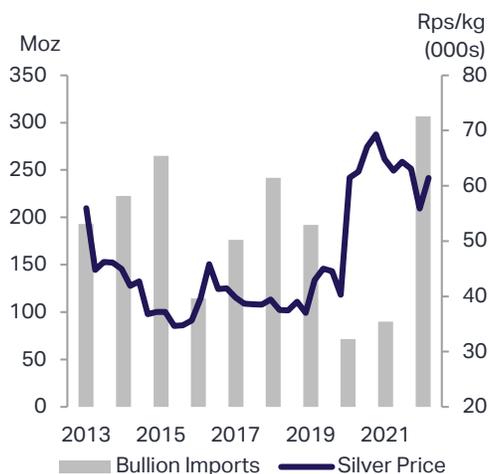
Jewelry demand in the Middle East increased by 7% in 2022 to 10.4Moz (323t). **Turkey**, the largest fabricator, saw a rise of 5% which was driven by another record for exports. Local sales also improved by 14% as consumers brought forward their purchases amid high inflation and the erosion of their earnings. For this year, we forecast a 5% increase in regional offtake as export growth is forecast to continue, mainly due to ongoing consumption gains in key destination markets.

## South Asia

After posting a notable recovery in 2021, activity in the world's largest fabricator, **India**, continued to rebound, achieving a record high last year. At 111.6Moz (3,472t), fabrication nearly doubled year-on-year. This meant India's fabrication in 2022 was around 60% higher than 2019 levels and 80% higher than the five-year average. Several factors contributed to this surge: a rise in local consumption; aggressive re-stocking by the trade; an increasing number of organized retailers offering silver jewelry; the success of online brands, and the ongoing improvement in purity levels driven by the rising popularity of 925 sterling silver.

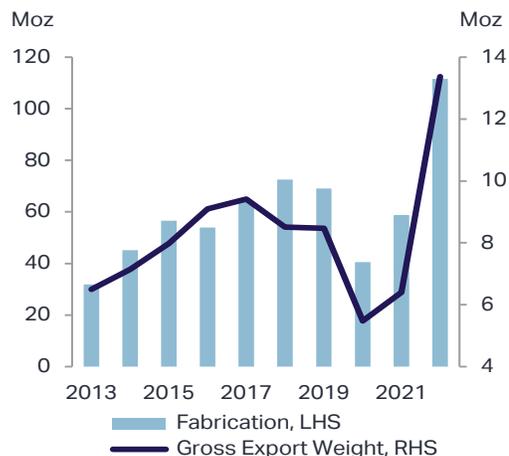
Looking at the aforementioned factors in detail, one of the big drivers of fabrication last year was aggressive re-stocking by the trade. With pandemic related uncertainty and high silver prices weighing on the previous two years, a large part of the trade had run down inventory levels anticipating weak consumer demand. To put this into context, India's fabrication nearly halved in 2020 and notwithstanding 2021's strong rebound, fabrication that year

## Indian Bullion Imports



Source: Metals Focus, S&P Global, Bloomberg

### Indian Jewelry Fabrication



Source: Metals Focus, S&P Global

was still 15% lower compared to pre-pandemic levels. As a result, there was significant pent-up demand for jewelry.

However, as the Indian economy recovered quickly from the lockdowns and the COVID associated economic slump, consumer sentiment improved faster than expected. With weddings and festival related demand resuming in earnest in 2022, the pent-up demand of the preceding two years was released as consumption and, in turn re-stocking by retailers gathered momentum. The relatively low price of silver in the domestic market also aided re-stocking by traders and retailers. While the inventory benefit was largely a 2022 phenomenon, there were other structural factors that supported demand last year. In this respect, the growth of organized gold retailers has benefited silver jewelry fabrication as an increasing number of these stores now also display silver jewelry, offering a wider reach for silver products. This has been driven by the higher margins available to retailers when selling silver jewelry, in contrast to gold, where intense competition has squeezed trade margins. That apart, many stand-alone silver jewelry shops have opened over the last few years, which is testament to how the local market is developing.

The growth in market share of organized players has, in turn, boosted the penetration of higher purity, 925 sterling silver items in recent years, especially for lightweight fashion jewelry. Metals Focus estimates the share of 925 jewelry now ranges between 12-15% compared to less than 5% ten years ago. Aside from the traditional organized players, 925 has been aggressively marketed by new-age jewelry startups that focus on online sales. Some successful online-only brands are now selling 925 fashion silver jewelry, which continues to gain market share, albeit from a very low base. Another segment seeing tremendous growth has been gold-plated silver jewelry, which resembles karat gold.

### Chinese Jewelry Fabrication



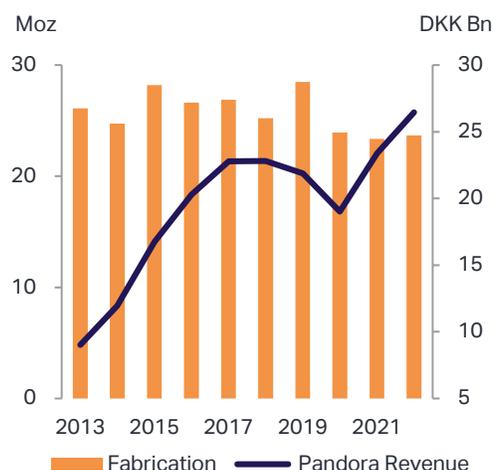
Source: Metals Focus, Bloomberg

For 2023, we expect Indian demand to return to 'normal' levels, with a 35% drop to 72.6Moz (2,257t), which was last seen in 2018. Along with a fall in re-stocking, concerns about a slowing economy, elevated inflation and risks to farm output, due to expectations of El Niño weather conditions (which create hotter summers and a deficient monsoon), will weigh on demand this year.

### East Asia

**Chinese** silver jewelry fabrication weakened by 18% in 2022 to 17.1Moz (531t) due to the severe impact of tight pandemic controls, poor consumer sentiment and an economic slowdown. The year began with a COVID outbreak spreading across the country, and it was not until mid-May that most cities saw prevention policies easing and footfall in shopping malls improving. However, the key southwest region for silver jewelry remained lackluster throughout the summer. Furthermore, sales over the National Day Holiday (October 1st-7th, traditionally a peak season for jewelry demand)

## Thai Jewelry Fabrication



Source: Metals Focus, Pandora A/S

were disappointing because of impaired consumer sentiment and a lack of support from sales in tourist areas. After the country shifted away from its zero-COVID policy in early December, widespread infection rates weighed on demand. Lastly, silver jewelry exports recorded a notable decline.

Previous years' divergence in performance between retail shops and online channels accelerated in 2022, driven by the latter's price advantages, COVID issues (fears of contracting the virus or quarantine policies) and the growing popularity of livestream sales. In contrast, retail stores suffered from fierce competition, lockdown policies and lower profit margins. As a result, leading silver jewelry retailers have closed some stores, switching capital investment to develop exclusive online collections. Regarding product assortments, "antique-crafted silver" bangles, stylish layered collections, and designs with pearls and zircon outperformed other areas.

Silver jewelry demand during the 2023 Chinese New Year Holiday posted only mild growth as consumer attention centered on gold. Although COVID interventions have ended, economic uncertainty and weak confidence will continue to weigh on Chinese consumers' spending on discretionary items in the short to medium-term. We now expect a post-COVID recovery of 10% for the full year to 18.8Moz (584t), which is 18% lower than in 2019.

**Thai** jewelry fabrication last year rose by just 1% to 23.7Moz (737t) and so remained well below pre-pandemic levels. This reflected a mixed picture for exports and only a modest recovery for the domestic market. Discussions with the trade revealed that export orders for some locations remained robust as they look to move away than China. This has especially benefited those factories that work closely with buyers in the US and Europe. While orders from the US were strong during the first nine months, a material slowdown was witnessed during Q4.22 as many large wholesalers and retailers in the US were holding sizable inventories.

Similarly, there was slowdown in demand from Europe, especially Germany, which is an important buyer of Thai jewelry. Compared to these, export orders from the UK and India saw considerable growth. The growth in UK demand reflected a shift in business from China, whereas the significant growth in Indian orders was largely due to the Free Trade Agreement and robust domestic demand. This year, we expect fabrication growth to continue due to a further increase in exports and a pick-up in domestic demand which has so far lagged exports.

**Indonesian** jewelry fabrication rose by 18% to 4.4Moz (137t) in 2022. Despite that, fabrication was only similar to the ten-year average for demand. Fabrication last year benefited from a recovery in domestic sales as the economy recovered from COVID shocks, while there were also strong orders from Singapore and Australia, which offset a slowdown in US orders.

## Global Silverware Fabrication Forecast

| Million ounces      | 2022        | 2023F       | Y/Y         |
|---------------------|-------------|-------------|-------------|
| Europe              | 3.4         | 3.3         | -5%         |
| North America       | 1.7         | 1.7         | -2%         |
| Middle East         | 3.0         | 3.2         | 6%          |
| South Asia          | 60.2        | 42.1        | -30%        |
| East Asia           | 3.8         | 4.0         | 7%          |
| CIS                 | 0.8         | 0.8         | 0%          |
| Others              | 0.5         | 0.5         | 7%          |
| <b>Global Total</b> | <b>73.5</b> | <b>55.7</b> | <b>-24%</b> |

Source: Metals Focus

## Global Silverware Fabrication



Source: Metals Focus, Bloomberg

## Silverware

Global silverware demand in 2022 soared by 80% to 73.5Moz (2,286t), a record high for our series back to 2010; almost all was down to India. Offtake outside of South Asia fell by 1% as COVID losses in China and sanctions losses in Russia outweighed gains in many emerging markets (Western demand was broadly stable). With Indian offtake set to fall by 30% this year, global demand is forecast to be 24% lower.

**Indian** silverware fabrication rose for the second straight year, up an impressive 120% to a record 53.6Moz (1,667t) or 16% above the pre-pandemic high of 2018.

This jump was partly due to a robust economy; ever since lockdown restrictions were lifted, the Indian economy has been on a strong footing. According to the IMF and the World Bank, India has been the fastest-growing large economy. This allowed employment and incomes to return to pre-pandemic levels. The removal of restrictions also enabled festivities and weddings to fully return, leading to a sharp uptick in demand. In addition, with sentiment improving, corporate gifting demand resumed during the key festival of Diwali. Lower silver prices further aided consumption and gifting by individuals. Lastly, as economic activity returned to normal and silver prices traded lower, many retailers and wholesalers increased their

## Net Western Silverware Demand - A Silver Lining?

Our Western silverware demand figures might look disappointing, in that 2022's volumes were almost half those in 2010 and less than 20% of levels at the turn of the millennium. As detailed previously, this long-run slide is due to changing consumer tastes, such as the fading tradition of gifting silverware at weddings and christenings, and the casualization of dining. The key words here are 'long-run', as the possibility has arisen that demand has been so weak for so long that the pipeline of unwanted items that could come back to the market as recycled silver is running dry. Our statistics support this idea; Western silverware scrap for 2010-22 is over 160Moz (5,100t) greater than Western fabrication (net silverware imports would add to the figures, but the story remains the same). Our sources in North America feel that the pipeline is already faltering, even if a price spike were to drive a brief uplift. In contrast, our contacts in Europe, especially Italy, are doubtful that this has yet begun, given the scale of the pool of product. Even if the stocks story is not uniform, branded, custom-made and religious items make up a rising share of sales and these are less likely to ever get scrapped. As a result, looking ahead it is almost certain that net demand will fare better than our headline gross fabrication figures.

### Net\* Western Silverware Fabrication



Source: Metals Focus. \* Fabrication less scrap.

## Examples of Indian Silverware



Photographs courtesy of Silver Emporium

inventory levels. Many fabricators that Metals Focus spoke to noted that their production pipeline at any point in time was full for 5-6 months, underlining the magnitude of the lift in demand. Other interesting trends included further penetration of sterling silver, strong demand for high-end silverware and stand-alone silverware shops opening up across the country.

This year, we forecast silverware demand to fall by 30% to 37.5Moz (1,167t) as pent-up demand wanes and stocking by the trade normalizes. The other key headwind for this year's demand will be the possibility of weak monsoons due to El Niño concerns.

Silverware demand in **Nepal** more than doubled in 2022 to 6.2Moz (193t) due to pent-up demand linked to a post-COVID jump in the number of weddings (where silverware is traditionally used for gifting and during the ceremony). We expect demand to revert to pre-pandemic levels in 2023, easing by 30%.

**Chinese** demand fell by 15% in 2022 to 2.3Moz (72t), mainly due to the severe impact of tight pandemic measures, impaired consumer sentiment and a weak gifting market. This was despite online livestream sales continuing to improve. For 2023, we expect a 7% rise in demand through GDP growth and gradually improving sentiment. **Middle Eastern** silverware offtake rose by 9% in 2022 to 3.0Moz (94t) due to a notable rise in Turkish exports of 18%, much of which was bound for Israel and the US.

**European** demand was flat y/y, compared to average annual losses of 6% for 2011-21. This reflects losses for the now small mass market being balanced by gains for segments once seen as niches, namely custom-made, religious and branded items. Exports from lead fabricator Italy were also strong. **US** demand even rose modestly last year as postponed purchases fed through to higher consumption, as reflected in the double-digit jump in imports.

## Silverware Fabrication

| Million ounces      | 2013        | 2014        | 2015        | 2016        | 2017        | 2018        | 2019        | 2020        | 2021        | 2022        | Y/Y        |
|---------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|
| India               | 22.6        | 30.6        | 37.0        | 34.1        | 39.7        | 46.4        | 41.2        | 17.4        | 24.4        | 53.6        | 120%       |
| Nepal               | 2.6         | 3.6         | 4.3         | 4.0         | 4.6         | 5.4         | 4.8         | 2.0         | 2.8         | 6.2         | 124%       |
| China               | 8.0         | 6.0         | 3.7         | 3.1         | 3.4         | 3.5         | 3.3         | 2.5         | 2.7         | 2.3         | -15%       |
| Italy               | 2.8         | 2.8         | 2.7         | 2.5         | 2.3         | 2.2         | 2.0         | 1.3         | 1.7         | 1.7         | -3%        |
| United States       | 1.2         | 1.3         | 1.3         | 1.3         | 1.3         | 1.3         | 1.3         | 1.3         | 1.3         | 1.4         | 5%         |
| Others              | 8.9         | 9.2         | 9.0         | 8.5         | 8.2         | 8.4         | 8.7         | 6.7         | 7.8         | 8.3         | 5%         |
| <b>Global Total</b> | <b>46.2</b> | <b>53.5</b> | <b>58.3</b> | <b>53.5</b> | <b>59.4</b> | <b>67.1</b> | <b>61.3</b> | <b>31.2</b> | <b>40.7</b> | <b>73.5</b> | <b>80%</b> |

Source: Metals Focus

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## Appendix 1 - Silver Supply and Demand

| Tons                            |               |               |               |               |               |               |               |               |               |               | Year on Year |             |
|---------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--------------|-------------|
|                                 | 2014          | 2015          | 2016          | 2017          | 2018          | 2019          | 2020          | 2021          | 2022          | 2023F         | 2022         | 2023F       |
| <b>Supply</b>                   |               |               |               |               |               |               |               |               |               |               |              |             |
| Mine Production                 | 27,433        | 27,894        | 27,987        | 26,861        | 26,447        | 26,020        | 24,329        | 25,741        | 25,578        | 26,193        | -1%          | 2%          |
| Recycling                       | 4,988         | 4,568         | 4,527         | 4,573         | 4,620         | 4,604         | 5,164         | 5,453         | 5,618         | 5,633         | 3%           | 0%          |
| Net Hedging Supply              | 332           | 67            | -             | -             | -             | 434           | 264           | -             | -             | -             | na           | na          |
| Net Official Sector Sales       | 36            | 33            | 33            | 33            | 37            | 32            | 37            | 48            | 54            | 53            | 13%          | -1%         |
| <b>Total Supply</b>             | <b>32,789</b> | <b>32,563</b> | <b>32,548</b> | <b>31,466</b> | <b>31,104</b> | <b>31,089</b> | <b>29,794</b> | <b>31,242</b> | <b>31,250</b> | <b>31,879</b> | <b>0%</b>    | <b>2%</b>   |
| <b>Demand</b>                   |               |               |               |               |               |               |               |               |               |               |              |             |
| Industrial (total)              | 13,714        | 13,791        | 14,850        | 16,026        | 15,900        | 15,853        | 15,201        | 16,427        | 17,309        | 17,929        | 5%           | 4%          |
| Electrical & Electronics        | 8,393         | 8,470         | 9,609         | 10,566        | 10,296        | 10,181        | 10,011        | 10,918        | 11,555        | 11,889        | 6%           | 3%          |
| ...of which photovoltaics       | 1,507         | 1,684         | 2,915         | 3,166         | 2,877         | 3,043         | 3,109         | 3,423         | 4,365         | 5,011         | 28%          | 15%         |
| Brazing Alloys & Solders        | 1,657         | 1,586         | 1,524         | 1,579         | 1,613         | 1,626         | 1,475         | 1,566         | 1,524         | 1,549         | -3%          | 2%          |
| Other Industrial                | 3,665         | 3,735         | 3,716         | 3,881         | 3,991         | 4,046         | 3,715         | 3,943         | 4,229         | 4,491         | 7%           | 6%          |
| Photography                     | 1,276         | 1,188         | 1,080         | 1,009         | 977           | 956           | 836           | 862           | 855           | 822           | -1%          | -4%         |
| Jewelry                         | 6,018         | 6,300         | 5,883         | 6,103         | 6,316         | 6,263         | 4,680         | 5,645         | 7,280         | 6,204         | 29%          | -15%        |
| Silverware                      | 1,663         | 1,813         | 1,664         | 1,848         | 2,086         | 1,905         | 969           | 1,267         | 2,286         | 1,731         | 80%          | -24%        |
| Net Physical Investment         | 8,803         | 9,621         | 6,621         | 4,844         | 5,149         | 5,816         | 6,368         | 8,522         | 10,356        | 9,612         | 22%          | -7%         |
| Net Hedging Demand              | -             | -             | 374           | 35            | 230           | -             | -             | 110           | 557           | -             | 409%         | na          |
| <b>Total Demand</b>             | <b>31,473</b> | <b>32,713</b> | <b>30,472</b> | <b>29,865</b> | <b>30,658</b> | <b>30,794</b> | <b>28,053</b> | <b>32,833</b> | <b>38,643</b> | <b>36,298</b> | <b>18%</b>   | <b>-6%</b>  |
| <b>Market Balance</b>           | <b>1,315</b>  | <b>-150</b>   | <b>2,076</b>  | <b>1,601</b>  | <b>446</b>    | <b>295</b>    | <b>1,741</b>  | <b>-1,591</b> | <b>-7,393</b> | <b>-4,419</b> | <b>365%</b>  | <b>-40%</b> |
| Change in ETP Holdings          | -9            | -532          | 1,676         | 223           | -666          | 2,590         | 10,299        | 2,020         | -3,912        | -933          | na           | -76%        |
| <b>Market Balance less ETPs</b> | <b>1,324</b>  | <b>382</b>    | <b>400</b>    | <b>1,378</b>  | <b>1,112</b>  | <b>-2,295</b> | <b>-8,558</b> | <b>-3,611</b> | <b>-3,481</b> | <b>-3,486</b> | <b>-4%</b>   | <b>0%</b>   |
| Silver Price (US\$/oz)*         | 19.08         | 15.68         | 17.14         | 17.05         | 15.71         | 16.21         | 20.55         | 25.14         | 21.73         | 21.30         | -14%         | -2%         |

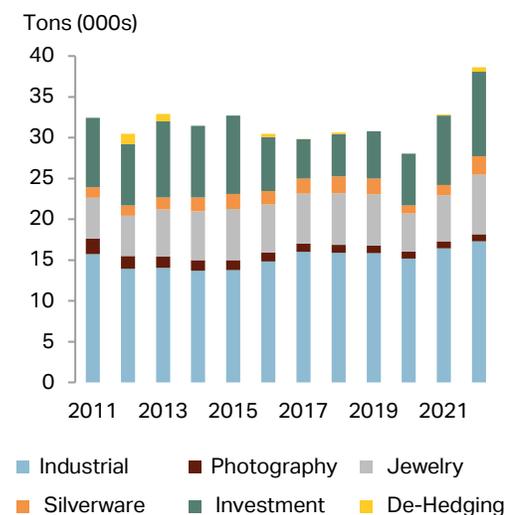
\*London Price. Source: Metals Focus

## Global Supply



Source: Metals Focus

## Global Demand



Source: Metals Focus

## Appendix 2 - Mine Production

| Tons                                      | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         | 2022         | Y/Y          |
|---|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>North America</b>                      |              |              |              |              |              |              |              |              |              |              |              |
| Mexico                                    | 5,821        | 5,767        | 5,975        | 5,421        | 5,815        | 6,049        | 5,840        | 5,605        | 6,097        | 6,195        | 2%           |
| United States                             | 1,046        | 1,180        | 1,090        | 1,150        | 1,031        | 926          | 976          | 986          | 1,013        | 1,007        | -1%          |
| Canada                                    | 618          | 472          | 369          | 361          | 393          | 368          | 419          | 293          | 284          | 270          | -5%          |
| <b>Sub-total</b>                          | <b>7,485</b> | <b>7,418</b> | <b>7,433</b> | <b>6,931</b> | <b>7,240</b> | <b>7,344</b> | <b>7,235</b> | <b>6,884</b> | <b>7,393</b> | <b>7,472</b> | <b>1%</b>    |
| <b>Central &amp; South America</b>        |              |              |              |              |              |              |              |              |              |              |              |
| Peru                                      | 3,827        | 3,918        | 4,218        | 4,737        | 4,820        | 4,556        | 4,202        | 3,160        | 3,593        | 3,330        | -7%          |
| Chile                                     | 1,169        | 1,562        | 1,496        | 1,448        | 1,257        | 1,243        | 1,189        | 1,474        | 1,281        | 1,302        | 2%           |
| Bolivia                                   | 1,287        | 1,340        | 1,306        | 1,353        | 1,196        | 1,192        | 1,153        | 930          | 1,292        | 1,203        | -7%          |
| Argentina                                 | 827          | 920          | 1,133        | 993          | 908          | 960          | 1,025        | 748          | 868          | 963          | 11%          |
| Dominican Republic                        | 82           | 136          | 95           | 122          | 152          | 159          | 141          | 129          | 106          | 89           | -16%         |
| Brazil                                    | 30           | 35           | 49           | 77           | 86           | 71           | 69           | 69           | 73           | 76           | 4%           |
| Panama                                    | 2            | 0            | -            | -            | -            | -            | 27           | 50           | 78           | 87           | 12%          |
| Guatemala                                 | 283          | 858          | 863          | 840          | 337          | -            | -            | -            | -            | -            | na           |
| Others                                    | 103          | 106          | 80           | 63           | 62           | 77           | 92           | 93           | 128          | 131          | 2%           |
| <b>Sub-total</b>                          | <b>7,611</b> | <b>8,874</b> | <b>9,241</b> | <b>9,635</b> | <b>8,818</b> | <b>8,258</b> | <b>7,898</b> | <b>6,653</b> | <b>7,419</b> | <b>7,181</b> | <b>-3%</b>   |
| <b>Europe</b>                             |              |              |              |              |              |              |              |              |              |              |              |
| Poland                                    | 1,208        | 1,195        | 1,218        | 1,272        | 1,297        | 1,272        | 1,257        | 1,226        | 1,307        | 1,319        | 1%           |
| Sweden                                    | 337          | 396          | 492          | 511          | 484          | 467          | 446          | 417          | 432          | 460          | 6%           |
| Portugal                                  | 45           | 47           | 46           | 43           | 40           | 91           | 95           | 96           | 98           | 78           | -21%         |
| Spain                                     | 36           | 35           | 44           | 46           | 59           | 66           | 65           | 78           | 84           | 72           | -15%         |
| Finland                                   | 2            | 2            | 3            | 3            | 3            | 2            | 33           | 50           | 46           | 46           | 0%           |
| Others                                    | 82           | 79           | 74           | 71           | 74           | 62           | 85           | 95           | 84           | 73           | -13%         |
| <b>Sub-total</b>                          | <b>1,711</b> | <b>1,755</b> | <b>1,876</b> | <b>1,946</b> | <b>1,957</b> | <b>1,959</b> | <b>1,981</b> | <b>1,962</b> | <b>2,052</b> | <b>2,047</b> | <b>-0.2%</b> |
| <b>Africa</b>                             |              |              |              |              |              |              |              |              |              |              |              |
| Morocco                                   | 230          | 244          | 281          | 311          | 319          | 243          | 284          | 249          | 248          | 263          | 6%           |
| Eritrea                                   | 16           | 53           | 98           | 98           | 79           | 54           | 50           | 72           | 68           | 68           | -1%          |
| South Africa                              | 75           | 55           | 58           | 60           | 68           | 51           | 62           | 39           | 41           | 53           | 29%          |
| Botswana                                  | 26           | 26           | 4            | 4            | 0            | 0            | 0            | 0            | 20           | 51           | 162%         |
| Others                                    | 146          | 102          | 109          | 69           | 74           | 75           | 78           | 79           | 82           | 87           | 6%           |
| <b>Sub-total</b>                          | <b>493</b>   | <b>479</b>   | <b>551</b>   | <b>543</b>   | <b>540</b>   | <b>424</b>   | <b>474</b>   | <b>439</b>   | <b>459</b>   | <b>523</b>   | <b>14%</b>   |
| <b>Commonwealth of Independent States</b> |              |              |              |              |              |              |              |              |              |              |              |
| Russia                                    | 1,380        | 1,434        | 1,590        | 1,450        | 1,305        | 1,341        | 1,391        | 1,309        | 1,212        | 1,280        | 6%           |
| Kazakhstan                                | 663          | 562          | 500          | 542          | 589          | 615          | 530          | 541          | 466          | 461          | -1%          |
| Uzbekistan                                | 182          | 182          | 182          | 185          | 185          | 185          | 189          | 195          | 212          | 218          | 3%           |
| Armenia                                   | 72           | 75           | 77           | 74           | 82           | 63           | 75           | 82           | 79           | 78           | -2%          |
| Tajikistan                                | 18           | 31           | 35           | 40           | 47           | 46           | 45           | 47           | 48           | 46           | -3%          |
| Others                                    | 7            | 7            | 11           | 20           | 15           | 18           | 20           | 18           | 19           | 20           | 9%           |
| <b>Sub-total</b>                          | <b>2,323</b> | <b>2,290</b> | <b>2,395</b> | <b>2,311</b> | <b>2,223</b> | <b>2,268</b> | <b>2,249</b> | <b>2,192</b> | <b>2,037</b> | <b>2,103</b> | <b>3%</b>    |

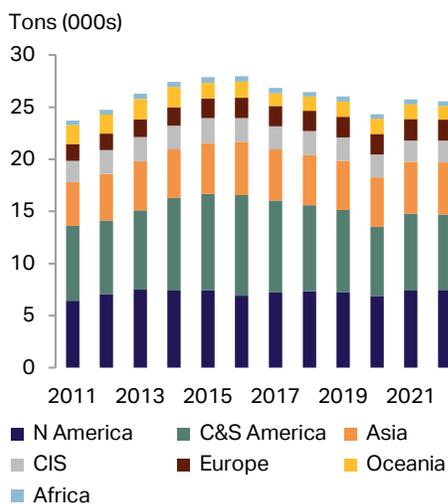
Source: Metals Focus

## Appendix 2 - Mine Production (continued)

| Tons                | 2013          | 2014          | 2015          | 2016          | 2017          | 2018          | 2019          | 2020          | 2021          | 2022          | Y/Y         |
|---------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|-------------|
| <b>Asia</b>         |               |               |               |               |               |               |               |               |               |               |             |
| China               | 3,674         | 3,701         | 3,705         | 3,774         | 3,620         | 3,439         | 3,468         | 3,407         | 3,511         | 3,476         | -1%         |
| India               | 333           | 261           | 374           | 436           | 526           | 658           | 633           | 671           | 689           | 694           | 1%          |
| Indonesia           | 244           | 219           | 308           | 335           | 313           | 320           | 235           | 275           | 317           | 353           | 11%         |
| Turkey              | 201           | 199           | 205           | 209           | 152           | 147           | 99            | 123           | 170           | 146           | -14%        |
| Iran                | 67            | 70            | 67            | 77            | 79            | 79            | 82            | 84            | 85            | 86            | 1%          |
| Philippines         | 40            | 23            | 30            | 35            | 32            | 30            | 31            | 24            | 31            | 57            | 83%         |
| Mongolia            | 39            | 52            | 62            | 68            | 54            | 53            | 51            | 51            | 55            | 51            | -6%         |
| Laos                | 33            | 40            | 52            | 51            | 43            | 37            | 34            | 29            | 30            | 26            | -11%        |
| Thailand            | 36            | 34            | 24            | 39            | 4             | 4             | 4             | 4             | 4             | 4             | 0%          |
| Others              | 55            | 55            | 51            | 67            | 61            | 71            | 69            | 74            | 67            | 73            | 11%         |
| <b>Sub-total</b>    | <b>4,722</b>  | <b>4,654</b>  | <b>4,878</b>  | <b>5,091</b>  | <b>4,883</b>  | <b>4,838</b>  | <b>4,707</b>  | <b>4,742</b>  | <b>4,958</b>  | <b>4,966</b>  | <b>0%</b>   |
| <b>Oceania</b>      |               |               |               |               |               |               |               |               |               |               |             |
| Australia           | 1,840         | 1,847         | 1,430         | 1,418         | 1,120         | 1,254         | 1,325         | 1,337         | 1,330         | 1,199         | -10%        |
| Papua New Guinea    | 92            | 95            | 72            | 100           | 66            | 93            | 146           | 119           | 91            | 84            | -8%         |
| Others              | 16            | 20            | 17            | 13            | 13            | 9             | 5             | 2             | 3             | 4             | 44%         |
| <b>Sub-total</b>    | <b>1,948</b>  | <b>1,962</b>  | <b>1,520</b>  | <b>1,531</b>  | <b>1,199</b>  | <b>1,356</b>  | <b>1,476</b>  | <b>1,459</b>  | <b>1,424</b>  | <b>1,287</b>  | <b>-10%</b> |
| <b>Global Total</b> | <b>26,292</b> | <b>27,433</b> | <b>27,894</b> | <b>27,987</b> | <b>26,861</b> | <b>26,447</b> | <b>26,020</b> | <b>24,329</b> | <b>25,741</b> | <b>25,578</b> | <b>-1%</b>  |

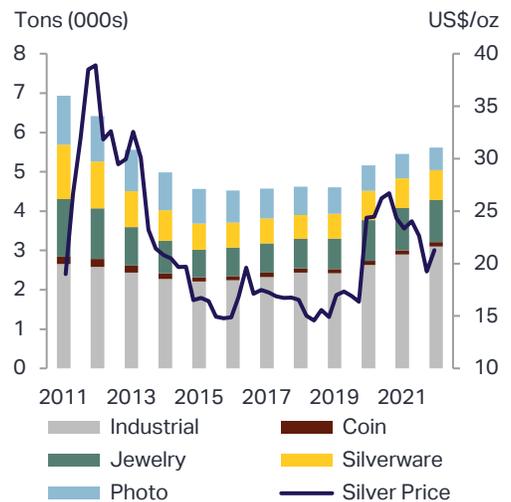
Source: Metals Focus

### Mine Supply by Region



Source: Metals Focus

### Recycling by Source



Source: Metals Focus, Bloomberg

## Appendix 3 - Recycling

| Tons                 | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         | 2022         | Y/Y          |
|----------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>Europe</b>        |              |              |              |              |              |              |              |              |              |              |              |
| Germany              | 330          | 318          | 307          | 303          | 291          | 306          | 307          | 297          | 302          | 307          | 2%           |
| Italy                | 252          | 206          | 182          | 171          | 163          | 156          | 158          | 150          | 149          | 142          | -5%          |
| UK                   | 192          | 182          | 174          | 168          | 163          | 159          | 156          | 148          | 141          | 135          | -5%          |
| France               | 156          | 134          | 118          | 106          | 101          | 98           | 97           | 97           | 104          | 99           | -4%          |
| Other                | 334          | 317          | 293          | 291          | 321          | 291          | 295          | 294          | 310          | 319          | 3%           |
| <b>Sub-total</b>     | <b>1,264</b> | <b>1,156</b> | <b>1,073</b> | <b>1,038</b> | <b>1,039</b> | <b>1,011</b> | <b>1,013</b> | <b>987</b>   | <b>1,007</b> | <b>1,002</b> | <b>-0.5%</b> |
| <b>CIS</b>           |              |              |              |              |              |              |              |              |              |              |              |
| Russia               | 307          | 249          | 208          | 203          | 246          | 310          | 264          | 290          | 319          | 351          | 10%          |
| Others               | 71           | 55           | 43           | 45           | 54           | 59           | 57           | 63           | 69           | 75           | 10%          |
| <b>Sub-total</b>     | <b>378</b>   | <b>304</b>   | <b>251</b>   | <b>247</b>   | <b>300</b>   | <b>369</b>   | <b>321</b>   | <b>353</b>   | <b>388</b>   | <b>426</b>   | <b>10%</b>   |
| <b>North America</b> |              |              |              |              |              |              |              |              |              |              |              |
| United States        | 1,459        | 1,352        | 1,262        | 1,180        | 1,188        | 1,187        | 1,178        | 1,276        | 1,330        | 1,389        | 4%           |
| Others               | 176          | 146          | 127          | 127          | 126          | 125          | 125          | 129          | 132          | 136          | 3%           |
| <b>Sub-total</b>     | <b>1,634</b> | <b>1,498</b> | <b>1,389</b> | <b>1,308</b> | <b>1,314</b> | <b>1,312</b> | <b>1,304</b> | <b>1,405</b> | <b>1,462</b> | <b>1,525</b> | <b>4%</b>    |
| <b>Middle East</b>   |              |              |              |              |              |              |              |              |              |              |              |
| Turkey               | 114          | 104          | 77           | 78           | 78           | 83           | 83           | 77           | 84           | 67           | -20%         |
| Others               | 118          | 116          | 94           | 109          | 108          | 95           | 100          | 119          | 144          | 126          | -13%         |
| <b>Sub-total</b>     | <b>232</b>   | <b>220</b>   | <b>171</b>   | <b>187</b>   | <b>185</b>   | <b>177</b>   | <b>183</b>   | <b>197</b>   | <b>228</b>   | <b>193</b>   | <b>-15%</b>  |
| <b>South Asia</b>    |              |              |              |              |              |              |              |              |              |              |              |
| India                | 384          | 232          | 144          | 153          | 167          | 196          | 205          | 495          | 457          | 480          | 5%           |
| Others               | 26           | 15           | 10           | 10           | 13           | 14           | 15           | 80           | 69           | 84           | 22%          |
| <b>Sub-total</b>     | <b>410</b>   | <b>247</b>   | <b>154</b>   | <b>163</b>   | <b>180</b>   | <b>210</b>   | <b>220</b>   | <b>576</b>   | <b>526</b>   | <b>564</b>   | <b>7%</b>    |
| <b>East Asia</b>     |              |              |              |              |              |              |              |              |              |              |              |
| China                | 693          | 693          | 721          | 718          | 709          | 717          | 738          | 813          | 975          | 1,079        | 11%          |
| Japan                | 354          | 342          | 343          | 354          | 354          | 340          | 326          | 310          | 296          | 282          | -5%          |
| Taiwan               | 110          | 101          | 81           | 93           | 88           | 81           | 89           | 91           | 93           | 84           | -9%          |
| Others               | 198          | 163          | 143          | 163          | 146          | 146          | 152          | 168          | 187          | 176          | -6%          |
| <b>Sub-total</b>     | <b>1,355</b> | <b>1,299</b> | <b>1,289</b> | <b>1,329</b> | <b>1,297</b> | <b>1,283</b> | <b>1,304</b> | <b>1,381</b> | <b>1,551</b> | <b>1,621</b> | <b>4%</b>    |
| <b>Other Regions</b> |              |              |              |              |              |              |              |              |              |              |              |
| C&S America          | 123          | 108          | 95           | 105          | 109          | 110          | 112          | 118          | 129          | 136          | 5%           |
| Africa               | 94           | 92           | 86           | 89           | 90           | 89           | 89           | 95           | 112          | 101          | -10%         |
| Oceania              | 70           | 64           | 61           | 61           | 60           | 60           | 58           | 53           | 49           | 49           | 0%           |
| <b>Sub-total</b>     | <b>287</b>   | <b>264</b>   | <b>242</b>   | <b>254</b>   | <b>258</b>   | <b>258</b>   | <b>260</b>   | <b>266</b>   | <b>291</b>   | <b>286</b>   | <b>-2%</b>   |
| <b>Global Total</b>  | <b>5,560</b> | <b>4,988</b> | <b>4,568</b> | <b>4,527</b> | <b>4,573</b> | <b>4,620</b> | <b>4,604</b> | <b>5,164</b> | <b>5,453</b> | <b>5,618</b> | <b>3%</b>    |

Source: Metals Focus

## Appendix 4 - Industrial Demand

| Tons                 | 2013          | 2014          | 2015          | 2016          | 2017          | 2018          | 2019          | 2020          | 2021          | 2022          | Y/Y        |
|----------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|------------|
| <b>Europe</b>        |               |               |               |               |               |               |               |               |               |               |            |
| Germany              | 833           | 842           | 812           | 818           | 841           | 868           | 809           | 948           | 1,104         | 962           | -13%       |
| United Kingdom       | 431           | 501           | 461           | 492           | 595           | 627           | 692           | 659           | 764           | 690           | -10%       |
| France               | 294           | 283           | 269           | 262           | 270           | 283           | 290           | 263           | 300           | 319           | 6%         |
| Italy                | 259           | 264           | 264           | 261           | 271           | 282           | 286           | 242           | 286           | 298           | 4%         |
| Others               | 383           | 376           | 367           | 370           | 383           | 393           | 391           | 350           | 390           | 403           | 3%         |
| <b>Sub-total</b>     | <b>2,200</b>  | <b>2,266</b>  | <b>2,173</b>  | <b>2,203</b>  | <b>2,360</b>  | <b>2,453</b>  | <b>2,468</b>  | <b>2,463</b>  | <b>2,843</b>  | <b>2,671</b>  | <b>-6%</b> |
| <b>North America</b> |               |               |               |               |               |               |               |               |               |               |            |
| United States        | 3,164         | 2,739         | 2,828         | 3,385         | 3,477         | 3,575         | 3,506         | 3,649         | 3,747         | 3,954         | 6%         |
| Others               | 179           | 142           | 178           | 187           | 175           | 177           | 184           | 155           | 169           | 179           | 6%         |
| <b>Sub-total</b>     | <b>3,343</b>  | <b>2,881</b>  | <b>3,007</b>  | <b>3,572</b>  | <b>3,653</b>  | <b>3,751</b>  | <b>3,690</b>  | <b>3,803</b>  | <b>3,916</b>  | <b>4,133</b>  | <b>6%</b>  |
| <b>East Asia</b>     |               |               |               |               |               |               |               |               |               |               |            |
| China                | 2,872         | 3,027         | 3,117         | 3,175         | 3,650         | 3,774         | 3,773         | 3,466         | 3,753         | 4,716         | 26%        |
| Japan                | 2,696         | 2,707         | 2,814         | 3,255         | 3,681         | 3,211         | 3,381         | 3,407         | 3,521         | 3,056         | -13%       |
| South Korea          | 689           | 629           | 590           | 561           | 593           | 595           | 571           | 541           | 582           | 617           | 6%         |
| Taiwan               | 327           | 328           | 318           | 310           | 292           | 302           | 275           | 281           | 295           | 308           | 4%         |
| Others               | 23            | 30            | 37            | 39            | 36            | 39            | 40            | 36            | 39            | 41            | 5%         |
| <b>Sub-total</b>     | <b>6,606</b>  | <b>6,721</b>  | <b>6,875</b>  | <b>7,340</b>  | <b>8,253</b>  | <b>7,921</b>  | <b>8,041</b>  | <b>7,730</b>  | <b>8,190</b>  | <b>8,738</b>  | <b>7%</b>  |
| <b>Other Regions</b> |               |               |               |               |               |               |               |               |               |               |            |
| South Asia           | 1,254         | 1,178         | 1,110         | 1,116         | 1,162         | 1,250         | 1,175         | 832           | 1,065         | 1,324         | 24%        |
| Middle East          | 187           | 213           | 200           | 181           | 187           | 186           | 176           | 151           | 161           | 184           | 14%        |
| Oceania              | 136           | 137           | 133           | 136           | 132           | 136           | 139           | 111           | 131           | 140           | 7%         |
| C&S America          | 208           | 219           | 215           | 223           | 201           | 121           | 76            | 36            | 38            | 43            | 12%        |
| CIS                  | 74            | 59            | 47            | 50            | 51            | 53            | 56            | 48            | 55            | 46            | -16%       |
| Africa               | 42            | 40            | 31            | 29            | 29            | 30            | 32            | 27            | 28            | 30            | 8%         |
| <b>Sub-total</b>     | <b>1,900</b>  | <b>1,846</b>  | <b>1,737</b>  | <b>1,735</b>  | <b>1,761</b>  | <b>1,775</b>  | <b>1,654</b>  | <b>1,205</b>  | <b>1,478</b>  | <b>1,767</b>  | <b>20%</b> |
| <b>Global Total</b>  | <b>14,049</b> | <b>13,714</b> | <b>13,791</b> | <b>14,850</b> | <b>16,026</b> | <b>15,900</b> | <b>15,853</b> | <b>15,201</b> | <b>16,427</b> | <b>17,309</b> | <b>5%</b>  |

## Appendix 5 - Electrical & Electronics Demand

| Tons                | 2013         | 2014         | 2015         | 2016         | 2017          | 2018          | 2019          | 2020          | 2021          | 2022          | Y/Y       |
|---------------------|--------------|--------------|--------------|--------------|---------------|---------------|---------------|---------------|---------------|---------------|-----------|
| China/Hong Kong     | 1,905        | 2,027        | 2,092        | 2,187        | 2,649         | 2,759         | 2,741         | 2,514         | 2,801         | 3,868         | 38%       |
| Japan               | 2,245        | 2,290        | 2,358        | 2,830        | 3,241         | 2,765         | 2,934         | 3,004         | 3,067         | 2,589         | -16%      |
| United States       | 1,742        | 1,373        | 1,460        | 2,021        | 2,080         | 2,136         | 2,040         | 2,072         | 2,203         | 2,300         | 4%        |
| Germany             | 551          | 568          | 539          | 550          | 569           | 592           | 533           | 666           | 799           | 639           | -20%      |
| India               | 462          | 444          | 424          | 428          | 444           | 475           | 422           | 365           | 464           | 534           | 15%       |
| South Korea         | 270          | 290          | 265          | 259          | 268           | 262           | 246           | 229           | 247           | 258           | 4%        |
| Others              | 1,390        | 1,402        | 1,333        | 1,335        | 1,315         | 1,306         | 1,265         | 1,161         | 1,337         | 1,368         | 2%        |
| <b>Global Total</b> | <b>8,566</b> | <b>8,393</b> | <b>8,470</b> | <b>9,609</b> | <b>10,566</b> | <b>10,296</b> | <b>10,181</b> | <b>10,011</b> | <b>10,918</b> | <b>11,555</b> | <b>6%</b> |

Source: Metals Focus

## Appendix 6 - Brazing Alloys & Solder Demand

| Tons                | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         | 2022         | Y/Y        |
|---------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------------|
| China               | 746          | 776          | 792          | 749          | 761          | 772          | 781          | 701          | 689          | 606          | -12%       |
| United States       | 190          | 187          | 177          | 182          | 192          | 198          | 202          | 186          | 203          | 210          | 3%         |
| Germany             | 152          | 144          | 137          | 133          | 132          | 130          | 126          | 135          | 146          | 156          | 7%         |
| India               | 73           | 70           | 66           | 67           | 69           | 71           | 68           | 54           | 85           | 94           | 10%        |
| South Korea         | 93           | 84           | 80           | 70           | 75           | 74           | 71           | 66           | 70           | 72           | 3%         |
| Others              | 449          | 395          | 334          | 322          | 351          | 368          | 378          | 333          | 374          | 386          | 3%         |
| <b>Global Total</b> | <b>1,704</b> | <b>1,657</b> | <b>1,586</b> | <b>1,524</b> | <b>1,579</b> | <b>1,613</b> | <b>1,626</b> | <b>1,475</b> | <b>1,566</b> | <b>1,524</b> | <b>-3%</b> |

## Appendix 7 - Photographic Demand

| Tons                | 2013         | 2014         | 2015         | 2016         | 2017         | 2018       | 2019       | 2020       | 2021       | 2022       | Y/Y        |
|---------------------|--------------|--------------|--------------|--------------|--------------|------------|------------|------------|------------|------------|------------|
| Europe & N. America | 1,017        | 931          | 847          | 755          | 696          | 666        | 641        | 634        | 636        | 617        | -3%        |
| East Asia           | 304          | 304          | 299          | 280          | 270          | 262        | 259        | 202        | 226        | 238        | 5%         |
| Others              | 39           | 41           | 41           | 45           | 42           | 49         | 56         | -          | -          | -          | na         |
| <b>Global Total</b> | <b>1,360</b> | <b>1,276</b> | <b>1,188</b> | <b>1,080</b> | <b>1,009</b> | <b>977</b> | <b>956</b> | <b>836</b> | <b>862</b> | <b>855</b> | <b>-1%</b> |

## Appendix 8a - Physical Investment

| Tons                | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         | 2022          | Y/Y        |
|---------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|---------------|------------|
| United States       | 3,795        | 3,482        | 3,882        | 3,144        | 1,732        | 1,464        | 1,489        | 2,833        | 4,014        | 4,169         | 4%         |
| India               | 2,719        | 3,136        | 3,435        | 1,136        | 1,259        | 1,680        | 1,757        | 269          | 858          | 2,470         | 188%       |
| Germany             | 839          | 635          | 735          | 810          | 760          | 857          | 1,177        | 1,445        | 1,564        | 1,521         | -3%        |
| Australia           | 154          | 135          | 133          | 158          | 104          | 111          | 109          | 354          | 467          | 539           | 15%        |
| Canada              | 206          | 230          | 237          | 225          | 147          | 142          | 156          | 232          | 329          | 374           | 14%        |
| China               | 758          | 459          | 434          | 429          | 292          | 280          | 245          | 269          | 243          | 229           | -6%        |
| Other Europe        | 246          | 226          | 196          | 337          | 282          | 342          | 367          | 263          | 304          | 316           | 4%         |
| Others              | 638          | 500          | 570          | 383          | 270          | 271          | 516          | 702          | 744          | 740           | -1%        |
| <b>Global Total</b> | <b>9,356</b> | <b>8,803</b> | <b>9,621</b> | <b>6,621</b> | <b>4,844</b> | <b>5,149</b> | <b>5,816</b> | <b>6,368</b> | <b>8,522</b> | <b>10,356</b> | <b>22%</b> |

## Appendix 8b - Coins & Medals Fabrication

| Tons                | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         | 2022         | Y/Y       |
|---------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-----------|
| Canada              | 913          | 959          | 1,102        | 1,045        | 588          | 572          | 716          | 897          | 1,132        | 1,113        | -2%       |
| Australia           | 267          | 266          | 394          | 409          | 333          | 325          | 394          | 537          | 622          | 751          | 21%       |
| United States       | 1,425        | 1,444        | 1,527        | 1,225        | 601          | 532          | 637          | 1,018        | 1,001        | 656          | -35%      |
| United Kingdom      | 78           | 67           | 109          | 109          | 96           | 109          | 99           | 302          | 489          | 599          | 23%       |
| India               | 140          | 176          | 224          | 220          | 257          | 328          | 351          | 161          | 210          | 524          | 150%      |
| Austria             | 451          | 144          | 227          | 107          | 64           | 65           | 90           | 224          | 382          | 381          | -0.2%     |
| South Africa        | 26           | 0            | 18           | 0            | 36           | 116          | 112          | 244          | 320          | 256          | -20%      |
| China               | 437          | 426          | 426          | 400          | 268          | 269          | 226          | 251          | 227          | 219          | -3%       |
| Germany             | 40           | 40           | 60           | 135          | 125          | 125          | 120          | 120          | 120          | 120          | 0%        |
| Mexico              | 21           | 22           | 33           | 36           | 38           | 19           | 12           | 14           | 18           | 19           | 6%        |
| Others              | 227          | 205          | 210          | 180          | 169          | 197          | 235          | 223          | 254          | 274          | 8%        |
| <b>Global Total</b> | <b>4,026</b> | <b>3,750</b> | <b>4,328</b> | <b>3,867</b> | <b>2,575</b> | <b>2,656</b> | <b>2,993</b> | <b>3,991</b> | <b>4,774</b> | <b>4,913</b> | <b>3%</b> |

Source: Metals Focus

## Appendix 9 - Jewelry Demand

| Tons                 | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         | 2022         | Y/Y        |
|----------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------------|
| <b>Europe</b>        |              |              |              |              |              |              |              |              |              |              |            |
| Italy                | 556          | 606          | 622          | 586          | 605          | 601          | 619          | 504          | 655          | 677          | 3%         |
| Germany              | 109          | 105          | 108          | 104          | 107          | 108          | 109          | 95           | 112          | 107          | -5%        |
| Others               | 204          | 208          | 209          | 204          | 205          | 203          | 203          | 169          | 197          | 211          | 8%         |
| <b>Sub-total</b>     | <b>869</b>   | <b>919</b>   | <b>938</b>   | <b>894</b>   | <b>917</b>   | <b>912</b>   | <b>931</b>   | <b>768</b>   | <b>964</b>   | <b>995</b>   | <b>3%</b>  |
| <b>North America</b> |              |              |              |              |              |              |              |              |              |              |            |
| United States        | 384          | 404          | 425          | 403          | 410          | 404          | 402          | 359          | 412          | 398          | -3%        |
| Canada               | 115          | 121          | 110          | 112          | 105          | 101          | 101          | 83           | 115          | 114          | -1%        |
| Mexico               | 141          | 168          | 177          | 180          | 153          | 155          | 139          | 97           | 68           | 72           | 6%         |
| <b>Sub-total</b>     | <b>640</b>   | <b>693</b>   | <b>711</b>   | <b>695</b>   | <b>668</b>   | <b>659</b>   | <b>642</b>   | <b>539</b>   | <b>595</b>   | <b>584</b>   | <b>-2%</b> |
| <b>Middle East</b>   |              |              |              |              |              |              |              |              |              |              |            |
| Turkey               | 151          | 195          | 208          | 152          | 153          | 184          | 186          | 138          | 215          | 225          | 5%         |
| Others               | 78           | 82           | 97           | 92           | 87           | 107          | 93           | 73           | 88           | 98           | 12%        |
| <b>Sub-total</b>     | <b>230</b>   | <b>277</b>   | <b>305</b>   | <b>244</b>   | <b>240</b>   | <b>291</b>   | <b>279</b>   | <b>210</b>   | <b>303</b>   | <b>324</b>   | <b>7%</b>  |
| <b>South Asia</b>    |              |              |              |              |              |              |              |              |              |              |            |
| India                | 990          | 1,404        | 1,760        | 1,677        | 1,995        | 2,256        | 2,148        | 1,260        | 1,827        | 3,472        | 90%        |
| Others               | 36           | 52           | 65           | 62           | 73           | 83           | 79           | 46           | 65           | 107          | 65%        |
| <b>Sub-total</b>     | <b>1,027</b> | <b>1,455</b> | <b>1,825</b> | <b>1,739</b> | <b>2,069</b> | <b>2,339</b> | <b>2,227</b> | <b>1,307</b> | <b>1,892</b> | <b>3,579</b> | <b>89%</b> |
| <b>East Asia</b>     |              |              |              |              |              |              |              |              |              |              |            |
| Thailand             | 812          | 769          | 877          | 828          | 837          | 785          | 886          | 745          | 726          | 737          | 1%         |
| China                | 1,662        | 1,280        | 1,050        | 893          | 794          | 755          | 709          | 589          | 648          | 531          | -18%       |
| Indonesia            | 128          | 191          | 152          | 163          | 157          | 163          | 175          | 149          | 117          | 137          | 18%        |
| Others               | 194          | 182          | 187          | 177          | 179          | 179          | 183          | 157          | 165          | 166          | 1%         |
| <b>Sub-total</b>     | <b>2,797</b> | <b>2,421</b> | <b>2,267</b> | <b>2,060</b> | <b>1,967</b> | <b>1,881</b> | <b>1,953</b> | <b>1,639</b> | <b>1,656</b> | <b>1,571</b> | <b>-5%</b> |
| <b>Other Regions</b> | <b>257</b>   | <b>251</b>   | <b>253</b>   | <b>251</b>   | <b>243</b>   | <b>234</b>   | <b>232</b>   | <b>216</b>   | <b>236</b>   | <b>227</b>   | <b>-4%</b> |
| <b>Global Total</b>  | <b>5,819</b> | <b>6,018</b> | <b>6,300</b> | <b>5,883</b> | <b>6,103</b> | <b>6,316</b> | <b>6,263</b> | <b>4,680</b> | <b>5,645</b> | <b>7,280</b> | <b>29%</b> |

## Appendix 10 - Silverware Demand

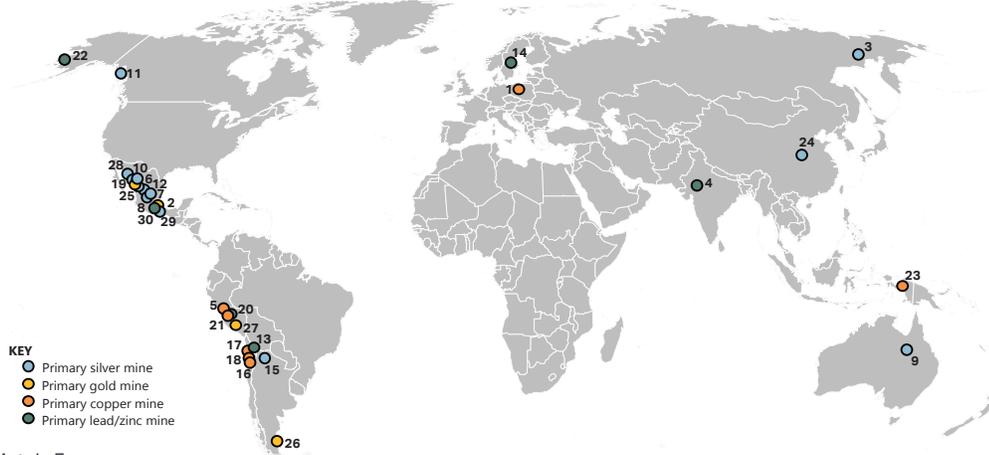
| Tons                | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020       | 2021         | 2022         | Y/Y        |
|---------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------------|--------------|--------------|------------|
| India               | 702          | 952          | 1,151        | 1,061        | 1,236        | 1,442        | 1,282        | 541        | 758          | 1,667        | 120%       |
| Nepal               | 81           | 110          | 134          | 123          | 143          | 167          | 149          | 63         | 86           | 193          | 124%       |
| China               | 250          | 188          | 122          | 98           | 105          | 107          | 103          | 77         | 85           | 72           | -15%       |
| Italy               | 87           | 88           | 86           | 78           | 71           | 68           | 63           | 39         | 53           | 54           | 3%         |
| United States       | 39           | 40           | 40           | 40           | 40           | 39           | 39           | 40         | 41           | 43           | 5%         |
| Others              | 277          | 285          | 281          | 264          | 254          | 262          | 269          | 209        | 244          | 257          | 5%         |
| <b>Global Total</b> | <b>1,436</b> | <b>1,663</b> | <b>1,813</b> | <b>1,664</b> | <b>1,848</b> | <b>2,086</b> | <b>1,905</b> | <b>969</b> | <b>1,267</b> | <b>2,286</b> | <b>80%</b> |

Source: Metals Focus

## Appendix 11 - Top 30 Silver Producing Mines

| Mine | Country                       | Ownership     | Million ounces   |      |                  |      |
|------|-------------------------------|---------------|--|------|------------------|------|
|      |                               |               | 2021   | 2022 | Y/Y              |      |
| 1    | KGHM Polska Miedź             | Poland        | KGHM Polska Miedź (100%)   | 41.9 | 42.3             | 1%   |
| 2    | Peñasquito                    | Mexico        | Newmont (100%)   | 34.2 | 32.4             | -5%  |
| 3    | Dukat                         | Russia        | Polymetal International (100%)   | 18.8 | 18.3             | -3%  |
| 4    | Sindesar Khurd <sup>2,3</sup> | India         | Hindustan Zinc (100%)  | 17.7 | 17.9             | 1%   |
| 5    | Antamina                      | Peru          | Glencore (33.75%) / BHP (33.75%) / Teck Resources (22.5%) <sup>5</sup> | 18.2 | 14.7             | -19% |
| 6    | San Julián                    | Mexico        | Fresnillo (100%)   | 16.8 | 14.3             | -15% |
| 7    | Fresnillo                     | Mexico        | Fresnillo (100%)   | 12.0 | 13.6             | 14%  |
| 8    | Saucito                       | Mexico        | Fresnillo (100%)   | 12.4 | 12.0             | -4%  |
| 9    | Cannington <sup>1</sup>       | Australia     | South32 (100%)   | 14.4 | 11.7             | -19% |
| 10   | Cerro Los Gatos               | Mexico        | Gatos Silver (70%) / Dowa Metals and Mining (30%)                      | 7.6  | 10.3             | 36%  |
| 11   | Greens Creek                  | United States | Hecla Mining Company (100%)  | 9.2  | 9.7              | 5%   |
| 12   | Juanicipio                    | Mexico        | Fresnillo (56%) / MAG Silver (44%)                                     | 3.2  | 9.3              | 190% |
| 13   | San Cristobal <sup>2</sup>    | Bolivia       | San Cristobal Mining (100%)  | 12.1 | 9.2              | -24% |
| 14   | Garpenberg                    | Sweden        | Boliden (100%)   | 8.8  | 8.8              | -1%  |
| 15   | Puna                          | Argentina     | SSR Mining (100%)  | 8.0  | 8.4              | 5%   |
| 16   | Ministro Hales <sup>1</sup>   | Chile         | Codelco (100%)   | 9.1  | 7.6 <sup>2</sup> | -16% |
| 17   | Collahuasi                    | Chile         | Glencore (44%) / Anglo American (44%) / Mitsui & Co (12%)              | 9.6  | 7.6              | -21% |
| 18   | Chuquibambilla <sup>1</sup>   | Chile         | Codelco (100%)   | 8.5  | 7.1 <sup>2</sup> | -16% |
| 19   | Palmarejo                     | Mexico        | Coeur Mining (100%)  | 6.8  | 6.7              | -2%  |
| 20   | Yauli                         | Peru          | Volcan Compañía Minera (100%)  | 7.4  | 6.7              | -9%  |
| 21   | Toromocho                     | Peru          | Chinalco (100%)  | 6.7  | 6.5              | -3%  |
| 22   | Red Dog <sup>2</sup>          | United States | Teck Resources (100%)  | 6.6  | 6.5              | -1%  |
| 23   | Grasberg <sup>4</sup>         | Indonesia     | Government of Indonesia (51.2%) / Freeport McMoRan (48.8%)             | 5.9  | 6.3              | 7%   |
| 24   | Ying                          | China         | Silvercorp Metals (77.5%) <sup>6</sup>                                 | 5.7  | 6.3              | 10%  |
| 25   | San Dimas                     | Mexico        | First Majestic Silver (100%)   | 7.6  | 6.2              | -19% |
| 26   | Cerro Moro                    | Argentina     | Yamana Gold (100%)   | 5.6  | 6.1              | 10%  |
| 27   | Inmaculada                    | Peru          | Hochschild Mining (100%)   | 6.2  | 5.9              | -5%  |
| 28   | La Colorada                   | Mexico        | Pan American Silver (100%)   | 5.2  | 5.9              | 15%  |
| 29   | San Jose                      | Mexico        | Fortuna Silver Mines (100%)  | 6.4  | 5.8              | -10% |
| 30   | Tizapa                        | Mexico        | Industrias Peñoles (51%) / Dowa Mining (39%) <sup>7</sup>              | 6.0  | 5.7              | -4%  |

NB: All numbers are silver contained in concentrate or doré unless stated otherwise, 1: Payable metal, 2: Estimate, 3: Refined silver, 4: Silver sold, 5: Mitsubishi Corporation, 6: Henan Non-Ferrous Geological & Mineral Resources Co (22.5%), 7: Sumitomo Corporation (10%)



Source: Company Reports, Metals Focus

## Appendix 12a - Top 20 Producing Companies

| Tons                             | 2021  | 2022             | Y/Y  |
|----------------------------------|-------|------------------|------|
| Fresnillo <sup>1</sup>           | 1,554 | 1,588            | 2%   |
| KGHM Polska Miedź <sup>2,3</sup> | 1,366 | 1,327            | -3%  |
| Newmont <sup>2</sup>             | 976   | 923              | -5%  |
| Glencore                         | 980   | 739              | -25% |
| Hindustan Zinc <sup>4,5,6</sup>  | 689   | 694              | 1%   |
| Polymetal International          | 635   | 653              | 3%   |
| Codelco <sup>2</sup>             | 711   | 596 <sup>8</sup> | -16% |
| Southern Copper                  | 590   | 577              | -2%  |
| Pan American Silver              | 596   | 574              | -4%  |
| Industrias Peñoles <sup>7</sup>  | 450   | 495              | 10%  |
| Volcan Cia Minera                | 467   | 445              | -5%  |
| Hecla Mining Company             | 401   | 441              | 10%  |
| South32 <sup>2</sup>             | 447   | 383              | -14% |
| Boliden                          | 371   | 377              | 2%   |
| BHP <sup>2</sup>                 | 388   | 364              | -6%  |
| Hochschild Mining                | 379   | 342              | -10% |
| First Majestic Silver            | 399   | 327              | -18% |
| Sumitomo Corporation             | 420   | 320              | -24% |
| Nexa Resources                   | 274   | 310              | 13%  |
| Coeur Mining                     | 313   | 305              | -2%  |

NB: 1 - Excludes Silverstream contract, 2 - Payable production, 3 - KGHM Group figures including Polish and international operations, 4 - Hindustan Zinc is a Vedanta Group company, 5 - Production from integrated operations only, 6 - Refined Silver, 7 - Excludes 100% Fresnillo, 8 - Estimate  
Source: Company Reports, Metals Focus

## Appendix 12b - Top 20 Producing Countries

| Tons                | 2021          | 2022          | Y/Y        |
|---------------------|---------------|---------------|------------|
| Mexico              | 6,097         | 6,195         | 2%         |
| China               | 3,511         | 3,476         | -1%        |
| Peru                | 3,593         | 3,330         | -7%        |
| Poland              | 1,307         | 1,319         | 1%         |
| Chile               | 1,281         | 1,302         | 2%         |
| Russia              | 1,212         | 1,280         | 6%         |
| Bolivia             | 1,292         | 1,203         | -7%        |
| Australia           | 1,330         | 1,199         | -10%       |
| United States       | 1,013         | 1,007         | -1%        |
| Argentina           | 868           | 963           | 11%        |
| India               | 689           | 694           | 1%         |
| Kazakhstan          | 466           | 461           | -1%        |
| Sweden              | 432           | 460           | 6%         |
| Indonesia           | 317           | 353           | 11%        |
| Canada              | 284           | 270           | -5%        |
| Morocco             | 248           | 263           | 6%         |
| Uzbekistan          | 212           | 218           | 3%         |
| Turkey              | 170           | 146           | -14%       |
| Dominican Republic  | 106           | 89            | -16%       |
| Panama              | 78            | 87            | 12%        |
| Others              | 1,235         | 1,255         | 2%         |
| <b>Global Total</b> | <b>25,741</b> | <b>25,578</b> | <b>-1%</b> |

Source: Metals Focus

## Appendix 12c - Mine Production Forecast by Region

| Tons                | 2022          | 2023F         | Y/Y       |
|---------------------|---------------|---------------|-----------|
| N America           | 7,472         | 8,196         | 10%       |
| C&S America         | 7,181         | 7,266         | 1%        |
| Asia                | 4,966         | 4,842         | -2%       |
| CIS                 | 2,103         | 2,132         | 1%        |
| Europe              | 2,047         | 1,929         | -6%       |
| Oceania             | 1,287         | 1,328         | 3%        |
| Africa              | 523           | 498           | -5%       |
| <b>Global Total</b> | <b>25,578</b> | <b>26,193</b> | <b>2%</b> |

Source: Metals Focus

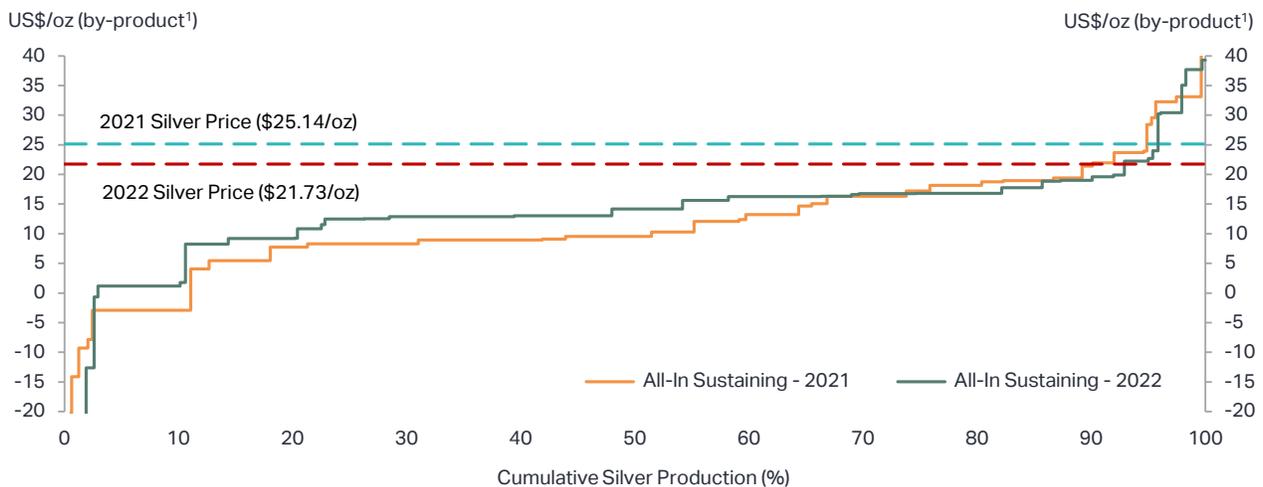
Appendix 13 - Primary Silver Production Costs (by-product<sup>1</sup>)

Year on Year

| US\$/oz (by-product)               | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021  | 2022  | 2021 | 2022 |
|------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|
| <b>North America</b>               |       |       |       |       |       |       |       |       |       |       |      |      |
| Total Cash Cost                    | 7.94  | 7.50  | 6.43  | 3.47  | 2.17  | 2.64  | 4.13  | 3.71  | 4.55  | 4.92  | 23%  | 8%   |
| Total Production Cost              | 14.28 | 13.43 | 11.66 | 8.63  | 8.20  | 8.48  | 10.53 | 10.00 | 10.31 | 11.09 | 3%   | 7%   |
| All-In Sustaining Cost             | 15.66 | 14.60 | 12.58 | 8.52  | 9.21  | 10.52 | 11.97 | 11.01 | 13.84 | 14.97 | 26%  | 8%   |
| <b>Central &amp; South America</b> |       |       |       |       |       |       |       |       |       |       |      |      |
| Total Cash Cost                    | 12.15 | 10.48 | 9.66  | 7.53  | 7.48  | 5.74  | 7.37  | 9.29  | 7.27  | 7.22  | -22% | -1%  |
| Total Production Cost              | 17.63 | 14.55 | 14.05 | 10.56 | 10.46 | 8.97  | 11.28 | 14.41 | 11.45 | 11.20 | -21% | -2%  |
| All-In Sustaining Cost             | 18.95 | 15.36 | 13.94 | 11.17 | 12.16 | 11.02 | 12.26 | 15.51 | 13.10 | 13.94 | -16% | 6%   |
| <b>CIS</b>                         |       |       |       |       |       |       |       |       |       |       |      |      |
| Total Cash Cost                    | 10.27 | 7.21  | 4.99  | 4.35  | 6.98  | 7.60  | 9.12  | 7.64  | 5.71  | 9.10  | -25% | 59%  |
| Total Production Cost              | 13.02 | 9.43  | 6.39  | 5.81  | 9.19  | 10.28 | 10.91 | 9.31  | 7.88  | 12.09 | -15% | 53%  |
| All-In Sustaining Cost             | 13.90 | 9.32  | 6.41  | 5.85  | 9.46  | 9.76  | 11.86 | 9.81  | 8.93  | 12.88 | -9%  | 44%  |
| <b>Asia</b>                        |       |       |       |       |       |       |       |       |       |       |      |      |
| Total Cash Cost                    | 1.52  | 1.03  | 1.11  | -2.02 | -4.58 | -4.42 | -2.36 | -0.99 | -0.32 | 0.14  | na   | na   |
| Total Production Cost              | 4.00  | 4.58  | 4.92  | 0.88  | -1.84 | -1.29 | 0.84  | 2.66  | 3.72  | 3.40  | 40%  | -9%  |
| All-In Sustaining Cost             | 37.81 | 8.89  | 9.59  | 3.53  | 3.61  | 1.51  | 3.65  | 5.60  | 6.09  | 7.49  | 9%   | 23%  |
| <b>Oceania</b>                     |       |       |       |       |       |       |       |       |       |       |      |      |
| Total Cash Cost                    | 3.55  | 1.99  | 2.16  | -1.90 | -2.12 | -3.12 | 3.46  | 0.24  | -6.52 | -5.12 | na   | na   |
| Total Production Cost              | 5.15  | 4.21  | 4.59  | 1.22  | 2.19  | 0.55  | 8.66  | 14.84 | 12.53 | 5.48  | -16% | -56% |
| All-In Sustaining Cost             | 6.84  | 5.27  | 5.52  | 1.22  | 2.83  | 2.66  | 9.14  | 6.71  | -2.90 | 1.19  | na   | na   |
| <b>Global Total</b>                |       |       |       |       |       |       |       |       |       |       |      |      |
| Total Cash Cost                    | 8.61  | 7.77  | 6.88  | 4.44  | 3.86  | 3.30  | 5.14  | 4.69  | 4.13  | 4.91  | -12% | 19%  |
| Total Production Cost              | 13.59 | 12.22 | 11.09 | 8.22  | 8.37  | 7.93  | 10.26 | 10.79 | 10.24 | 10.54 | -5%  | 3%   |
| All-In Sustaining Cost             | 15.59 | 13.22 | 11.63 | 8.52  | 9.66  | 9.74  | 11.51 | 11.08 | 11.53 | 13.36 | 4%   | 16%  |

Source: Metals Focus

## Global Primary Silver Mine Production Costs in 2022 (by-product)



1: Costs shown on a by-product accounting basis; Source: Metals Focus Silver Mine Cost Service

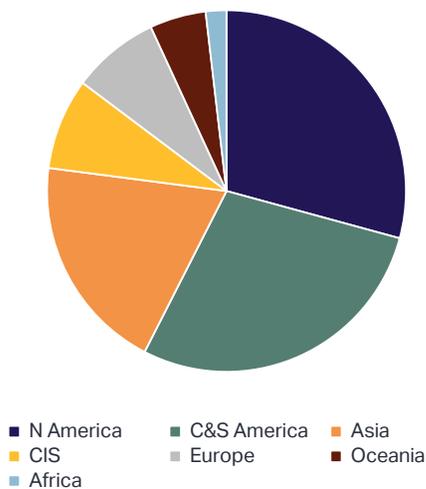
### Appendix 14 - Mine Production by Region & Primary Metal

Year on Year

| Million ounces                       | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         | 2022         | 2021      | 2022       |
|--------------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-----------|------------|
| <b>Regional Breakdown</b>            |              |              |              |              |              |              |              |              |              |              |           |            |
| North America                        | 240.7        | 238.5        | 239.0        | 222.8        | 232.8        | 236.1        | 232.6        | 221.3        | 237.7        | 240.2        | 7%        | 1%         |
| C&S America                          | 244.7        | 285.3        | 297.1        | 309.8        | 283.5        | 265.5        | 253.9        | 213.9        | 238.5        | 233.0        | 12%       | -2%        |
| Asia                                 | 151.8        | 149.6        | 156.8        | 163.7        | 157.0        | 155.6        | 151.3        | 152.5        | 159.4        | 160.3        | 5%        | 1%         |
| CIS                                  | 74.7         | 73.6         | 77.0         | 74.3         | 71.5         | 72.9         | 72.3         | 70.5         | 65.5         | 67.2         | -7%       | 3%         |
| Europe                               | 55.0         | 56.4         | 60.3         | 62.6         | 62.9         | 63.0         | 63.7         | 63.1         | 66.0         | 64.7         | 5%        | -2%        |
| Oceania                              | 62.6         | 63.1         | 48.9         | 49.2         | 38.6         | 43.6         | 47.4         | 46.9         | 45.8         | 41.6         | -2%       | -9%        |
| Africa                               | 15.8         | 15.4         | 17.7         | 17.5         | 17.4         | 13.6         | 15.2         | 14.1         | 14.8         | 15.3         | 5%        | 4%         |
| <b>Global Total</b>                  | <b>845.3</b> | <b>882.0</b> | <b>896.8</b> | <b>899.8</b> | <b>863.6</b> | <b>850.3</b> | <b>836.6</b> | <b>782.2</b> | <b>827.6</b> | <b>822.4</b> | <b>6%</b> | <b>-1%</b> |
| <b>Global Breakdown</b>              |              |              |              |              |              |              |              |              |              |              |           |            |
| Primary Silver                       | 266.4        | 285.9        | 291.0        | 288.4        | 263.6        | 247.0        | 236.1        | 207.8        | 227.9        | 228.2        | 10%       | 0%         |
| Gold                                 | 132.8        | 142.5        | 150.0        | 134.3        | 130.4        | 130.5        | 130.0        | 122.2        | 128.2        | 129.5        | 5%        | 1%         |
| Copper                               | 170.5        | 182.7        | 188.9        | 205.5        | 199.6        | 197.0        | 192.2        | 206.4        | 210.3        | 212.0        | 2%        | 1%         |
| Lead/Zinc                            | 270.0        | 265.3        | 261.7        | 265.1        | 263.2        | 268.7        | 273.2        | 241.0        | 257.1        | 248.2        | 7%        | -3%        |
| Other                                | 5.7          | 5.5          | 5.3          | 6.5          | 6.7          | 7.0          | 5.1          | 4.8          | 4.2          | 4.5          | -13%      | 8%         |
| <b>Global Total</b>                  | <b>845.3</b> | <b>882.0</b> | <b>896.8</b> | <b>899.8</b> | <b>863.6</b> | <b>850.3</b> | <b>836.6</b> | <b>782.2</b> | <b>827.6</b> | <b>822.4</b> | <b>6%</b> | <b>-1%</b> |
| <b>Global Breakdown (Percentage)</b> |              |              |              |              |              |              |              |              |              |              |           |            |
| Primary Silver                       | 31.5%        | 32.4%        | 32.4%        | 32.1%        | 30.5%        | 29.0%        | 28.2%        | 26.6%        | 27.5%        | 27.8%        |           |            |
| Gold                                 | 15.7%        | 16.2%        | 16.7%        | 14.9%        | 15.1%        | 15.4%        | 15.5%        | 15.6%        | 15.5%        | 15.7%        |           |            |
| Copper                               | 20.2%        | 20.7%        | 21.1%        | 22.8%        | 23.1%        | 23.2%        | 23.0%        | 26.4%        | 25.4%        | 25.8%        |           |            |
| Lead/Zinc                            | 31.9%        | 30.1%        | 29.2%        | 29.5%        | 30.5%        | 31.6%        | 32.7%        | 30.8%        | 31.1%        | 30.2%        |           |            |
| Other                                | 0.7%         | 0.6%         | 0.6%         | 0.7%         | 0.8%         | 0.8%         | 0.6%         | 0.6%         | 0.5%         | 0.5%         |           |            |

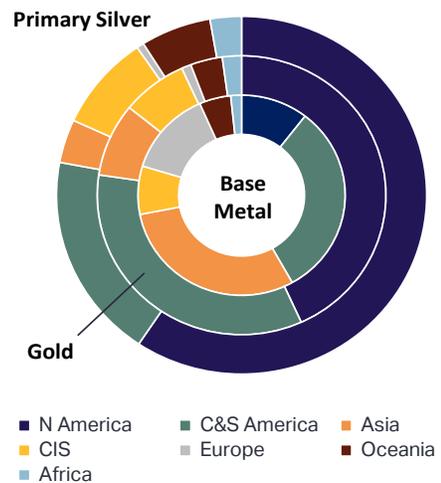
Source: Metals Focus

Mine Production by Region in 2022



Source: Metals Focus

Mine Production by Source Metal in 2022



Source: Metals Focus

## Appendix 15 - Nominal Silver Prices

| Year | Average <sup>1</sup><br>US\$/oz | Low <sup>2</sup><br>US\$/oz | High <sup>2</sup><br>US\$/oz | €/kg <sup>3</sup> | CNY/kg <sup>4</sup> | INR/kg | JPY/g | A\$/oz | MXN/oz | PEN/oz |
|------|---------------------------------|-----------------------------|------------------------------|-------------------|---------------------|--------|-------|--------|--------|--------|
| 1991 | 4.06                            | 3.61                        | 4.57                         | 103.83            | 696.01              | 2,970  | 17.55 | 5.20   | 12.24  | n/a    |
| 1992 | 3.95                            | 3.65                        | 4.34                         | 96.01             | 701.10              | 3,563  | 16.08 | 5.37   | 12.21  | 5.95   |
| 1993 | 4.31                            | 3.56                        | 5.50                         | 116.86            | 801.22              | 4,334  | 15.33 | 6.34   | 13.43  | 8.60   |
| 1994 | 5.28                            | 4.54                        | 5.95                         | 141.23            | 1,462.51            | 5,335  | 17.36 | 7.22   | 17.90  | 11.61  |
| 1995 | 5.20                            | 4.32                        | 6.15                         | 125.98            | 1,394.85            | 5,419  | 15.71 | 7.01   | 33.34  | 11.71  |
| 1996 | 5.20                            | 4.68                        | 5.88                         | 129.41            | 1,389.91            | 5,917  | 18.16 | 6.64   | 39.48  | 12.69  |
| 1997 | 4.90                            | 4.18                        | 6.40                         | 139.28            | 1,305.19            | 5,726  | 19.09 | 6.59   | 38.78  | 13.01  |
| 1998 | 5.54                            | 4.60                        | 7.93                         | 160.42            | 1,473.76            | 7,322  | 23.31 | 8.80   | 50.66  | 16.21  |
| 1999 | 5.22                            | 4.84                        | 5.81                         | 157.47            | 1,388.99            | 7,227  | 19.08 | 8.09   | 49.85  | 17.65  |
| 2000 | 4.95                            | 4.56                        | 5.56                         | 172.64            | 1,318.16            | 7,152  | 17.16 | 8.51   | 46.85  | 17.28  |
| 2001 | 4.37                            | 4.04                        | 4.86                         | 156.90            | 1,162.98            | 6,628  | 17.06 | 8.44   | 40.79  | 15.33  |
| 2002 | 4.60                            | 4.23                        | 5.15                         | 156.79            | 1,223.84            | 7,185  | 18.50 | 8.45   | 44.46  | 16.17  |
| 2003 | 4.88                            | 4.34                        | 6.01                         | 138.66            | 1,297.84            | 7,294  | 18.14 | 7.47   | 52.65  | 16.96  |
| 2004 | 6.66                            | 5.46                        | 8.45                         | 172.08            | 1,771.68            | 9,693  | 23.12 | 9.03   | 75.16  | 22.71  |
| 2005 | 7.31                            | 6.33                        | 9.27                         | 189.58            | 1,924.82            | 10,378 | 25.97 | 9.59   | 79.63  | 24.10  |
| 2006 | 11.55                           | 8.69                        | 15.22                        | 295.04            | 3,091.08            | 16,831 | 43.17 | 15.33  | 125.96 | 37.81  |
| 2007 | 13.38                           | 11.06                       | 16.22                        | 314.15            | 3,029.76            | 17,779 | 50.64 | 15.95  | 146.26 | 41.87  |
| 2008 | 14.99                           | 8.46                        | 21.36                        | 324.36            | 3,014.45            | 20,648 | 50.16 | 17.59  | 167.31 | 43.81  |
| 2009 | 14.67                           | 10.35                       | 19.46                        | 336.95            | 2,810.23            | 22,768 | 44.01 | 18.50  | 198.11 | 44.16  |
| 2010 | 20.19                           | 14.66                       | 30.95                        | 489.62            | 3,920.91            | 29,632 | 56.54 | 21.93  | 255.04 | 57.03  |
| 2011 | 35.12                           | 26.09                       | 49.80                        | 809.49            | 6,496.25            | 52,523 | 89.92 | 34.00  | 437.00 | 96.70  |
| 2012 | 31.15                           | 26.15                       | 37.48                        | 778.30            | 5,532.74            | 53,380 | 79.93 | 30.07  | 409.80 | 82.17  |
| 2013 | 23.79                           | 18.22                       | 32.46                        | 576.50            | 4,132.84            | 44,480 | 74.25 | 24.58  | 303.63 | 64.32  |
| 2014 | 19.08                           | 14.42                       | 22.18                        | 460.87            | 3,421.89            | 37,405 | 64.64 | 21.14  | 254.00 | 54.17  |
| 2015 | 15.68                           | 13.65                       | 18.49                        | 454.23            | 2,918.65            | 32,289 | 61.00 | 20.84  | 249.01 | 49.95  |
| 2016 | 17.14                           | 13.75                       | 21.14                        | 497.60            | 3,262.84            | 37,004 | 59.56 | 23.03  | 320.28 | 57.83  |
| 2017 | 17.05                           | 15.19                       | 18.65                        | 486.59            | 3,356.49            | 35,700 | 61.46 | 22.23  | 322.44 | 55.59  |
| 2018 | 15.71                           | 13.90                       | 17.70                        | 427.23            | 3,094.63            | 34,462 | 55.73 | 21.01  | 302.06 | 51.63  |
| 2019 | 16.21                           | 14.29                       | 19.65                        | 465.80            | 3,416.90            | 36,719 | 56.77 | 23.31  | 311.99 | 54.08  |
| 2020 | 20.55                           | 11.64                       | 29.86                        | 575.02            | 4,149.86            | 48,907 | 70.33 | 29.73  | 441.46 | 71.82  |
| 2021 | 25.14                           | 21.42                       | 30.10                        | 682.61            | 4,608.13            | 59,729 | 88.66 | 33.46  | 509.90 | 97.66  |
| 2022 | 21.73                           | 17.56                       | 26.94                        | 662.22            | 4,176.88            | 54,813 | 91.33 | 31.28  | 437.06 | 83.34  |

1: Average US\$ prices are based on the daily London Silver Fixing and (since 08/15/2014) the daily LBMA Silver Price. Unless otherwise specified, these US\$ prices in conjunction with Bloomberg Closing exchange rates have been used to illustrate annual average prices in other currencies.

2: High and low derived from intra-day spot prices

3: Euro price based on euro-quoted LBMA PM Fix from 1999 onwards and the dollar price converted into euros using Bloomberg synthetic exchange rates prior to that time

4: CNY price is the SGE AG (T+D) from 2006 onwards and based on London Silver Fixing converted into renminbi using Bloomberg exchange rates prior to that time. VAT has been subtracted from the quoted price.

Currency key: € - Euro, CNY - Chinese Yuan, INR - Indian Rupee, JPY - Japanese Yen, AUD - Australian dollar, MXN - Mexican peso, PEN - Peruvian nuevo sol

Source: Metals Focus, Bloomberg

## Appendix 16 - Real Silver Prices (Inflation Adjusted)

| Year | Average <sup>1</sup><br>US\$/oz | Low <sup>2</sup><br>US\$/oz | High <sup>2</sup><br>US\$/oz | €/kg <sup>3</sup> | CNY/kg <sup>4</sup> | INR/kg <sup>5</sup> | JPY/g | A\$/oz | MXN/oz | PEN/oz |
|------|---------------------------------|-----------------------------|------------------------------|-------------------|---------------------|---------------------|-------|--------|--------|--------|
| 1991 | 8.73                            | 7.77                        | 9.84                         | 203.11            | 2,197.75            | 23,282              | 19.56 | 10.54  | 125.44 | n/a    |
| 1992 | 8.25                            | 7.63                        | 9.07                         | 180.61            | 2,080.85            | 24,992              | 17.72 | 10.83  | 111.79 | n/a    |
| 1993 | 8.78                            | 7.25                        | 11.20                        | 211.18            | 2,073.24            | 28,589              | 16.73 | 12.57  | 113.84 | n/a    |
| 1994 | 10.48                           | 9.00                        | 11.80                        | 247.50            | 3,048.73            | 31,921              | 18.80 | 13.94  | 141.62 | 33.28  |
| 1995 | 10.05                           | 8.35                        | 11.89                        | 214.30            | 2,483.52            | 29,415              | 17.09 | 12.89  | 173.83 | 30.42  |
| 1996 | 9.73                            | 7.49                        | 11.00                        | 216.05            | 2,284.76            | 29,473              | 19.63 | 12.02  | 161.07 | 29.51  |
| 1997 | 9.01                            | 7.13                        | 11.78                        | 229.13            | 2,087.23            | 26,616              | 20.27 | 11.96  | 136.64 | 28.39  |
| 1998 | 10.03                           | 7.96                        | 14.36                        | 261.94            | 2,375.62            | 30,055              | 24.61 | 15.74  | 150.59 | 33.46  |
| 1999 | 9.20                            | 8.53                        | 10.25                        | 252.74            | 2,271.09            | 28,340              | 20.37 | 14.19  | 131.89 | 35.04  |
| 2000 | 8.45                            | 6.87                        | 10.23                        | 270.36            | 2,146.34            | 26,965              | 18.40 | 14.13  | 113.73 | 33.06  |
| 2001 | 7.34                            | 6.67                        | 8.27                         | 240.77            | 1,880.66            | 24,079              | 18.50 | 13.58  | 94.89  | 29.37  |
| 2002 | 7.55                            | 6.94                        | 8.44                         | 235.14            | 1,995.06            | 25,030              | 20.12 | 13.22  | 97.80  | 30.52  |
| 2003 | 7.85                            | 7.01                        | 9.68                         | 203.93            | 2,090.62            | 24,478              | 19.81 | 11.40  | 111.40 | 31.25  |
| 2004 | 10.38                           | 8.51                        | 13.18                        | 247.33            | 2,746.82            | 31,348              | 25.21 | 13.45  | 151.20 | 40.43  |
| 2005 | 11.03                           | 9.54                        | 13.98                        | 266.48            | 2,931.52            | 32,194              | 28.43 | 13.88  | 155.06 | 42.26  |
| 2006 | 16.99                           | 12.57                       | 22.38                        | 406.98            | 4,637.77            | 49,353              | 47.10 | 21.47  | 235.65 | 65.55  |
| 2007 | 18.91                           | 15.63                       | 22.92                        | 420.45            | 4,337.64            | 49,008              | 54.91 | 21.72  | 263.73 | 69.85  |
| 2008 | 21.16                           | 11.94                       | 30.15                        | 427.37            | 4,075.46            | 52,531              | 54.17 | 23.10  | 283.13 | 68.53  |
| 2009 | 20.17                           | 14.2                        | 26.75                        | 439.87            | 3,826.44            | 52,241              | 48.32 | 23.8   | 323.78 | 68.92  |
| 2010 | 27.34                           | 19.85                       | 41.91                        | 625.36            | 5,168.46            | 60,710              | 62.28 | 27.45  | 399.2  | 87.19  |
| 2011 | 46.19                           | 34.31                       | 65.50                        | 1,006.18          | 8,125.22            | 98,804              | 99.27 | 41.33  | 658.90 | 141.14 |
| 2012 | 40.27                           | 33.80                       | 48.45                        | 946.43            | 6,744.62            | 91,722              | 88.43 | 35.77  | 596.61 | 116.84 |
| 2013 | 30.30                           | 23.20                       | 41.34                        | 695.14            | 4,910.19            | 69,471              | 80.86 | 28.45  | 425.31 | 88.91  |
| 2014 | 24.11                           | 18.23                       | 28.04                        | 556.67            | 3,985.77            | 54,770              | 68.74 | 24.06  | 341.69 | 72.54  |
| 2015 | 19.68                           | 17.13                       | 23.20                        | 547.27            | 3,352.64            | 45,067              | 64.73 | 23.33  | 328.03 | 64.07  |
| 2016 | 21.07                           | 16.90                       | 25.99                        | 593.01            | 3,674.54            | 49,213              | 63.01 | 25.40  | 408.16 | 71.86  |
| 2017 | 20.52                           | 18.29                       | 22.46                        | 572.19            | 3,720.71            | 45,949              | 64.37 | 24.06  | 384.94 | 68.14  |
| 2018 | 18.55                           | 16.42                       | 20.91                        | 494.85            | 3,359.65            | 42,674              | 58.19 | 22.33  | 343.90 | 61.93  |
| 2019 | 18.72                           | 16.51                       | 22.69                        | 532.47            | 3,607.51            | 43,835              | 58.80 | 24.33  | 345.53 | 63.66  |
| 2020 | 23.41                           | 13.27                       | 34.02                        | 659.07            | 4,275.95            | 54,758              | 73.73 | 30.77  | 473.94 | 82.91  |
| 2021 | 26.76                           | 22.81                       | 32.04                        | 745.39            | 4,707.99            | 63,611              | 92.21 | 33.46  | 509.90 | 105.92 |
| 2022 | 21.73                           | 17.56                       | 26.94                        | 662.22            | 4,176.88            | 54,813              | 91.33 | 29.01  | 405.38 | 83.34  |

Based on respective countries' CPI. €/kg based on Eurozone CPI Index (Values until 1996 calculated using the Harmonized Index of Consumer Prices).

1: Average US\$ prices are based on the daily London Silver Fixing and (since 08/15/2014) the daily LBMA Silver Price. Unless otherwise specified, these US\$ prices in conjunction with Bloomberg Closing exchange rates have been used to illustrate annual average prices in other currencies.

2: High and low derived from intra-day spot prices

3: Euro price based on euro-quoted LBMA PM Fix from 1999 onwards and the dollar price converted into euros using Bloomberg synthetic exchange rates prior to that time.

4: CNY price is the SGE AG (T+D) from 2006 onwards and based on London Silver Fixing converted into renminbi using Bloomberg exchange rates prior to that time. VAT has been subtracted from the quoted price.

5: Indian prices were calculated based on the average CPI in the first nine months in 2021.

Currency key: € - Euro, CNY - Chinese Yuan, INR - Indian Rupee, JPY - Japanese Yen, AUD - Australian dollar, MXN - Mexican peso, PEN - Peruvian nuevo sol

Source: Metals Focus, Bloomberg

## Appendix 17 - LBMA &amp; CME Silver Prices

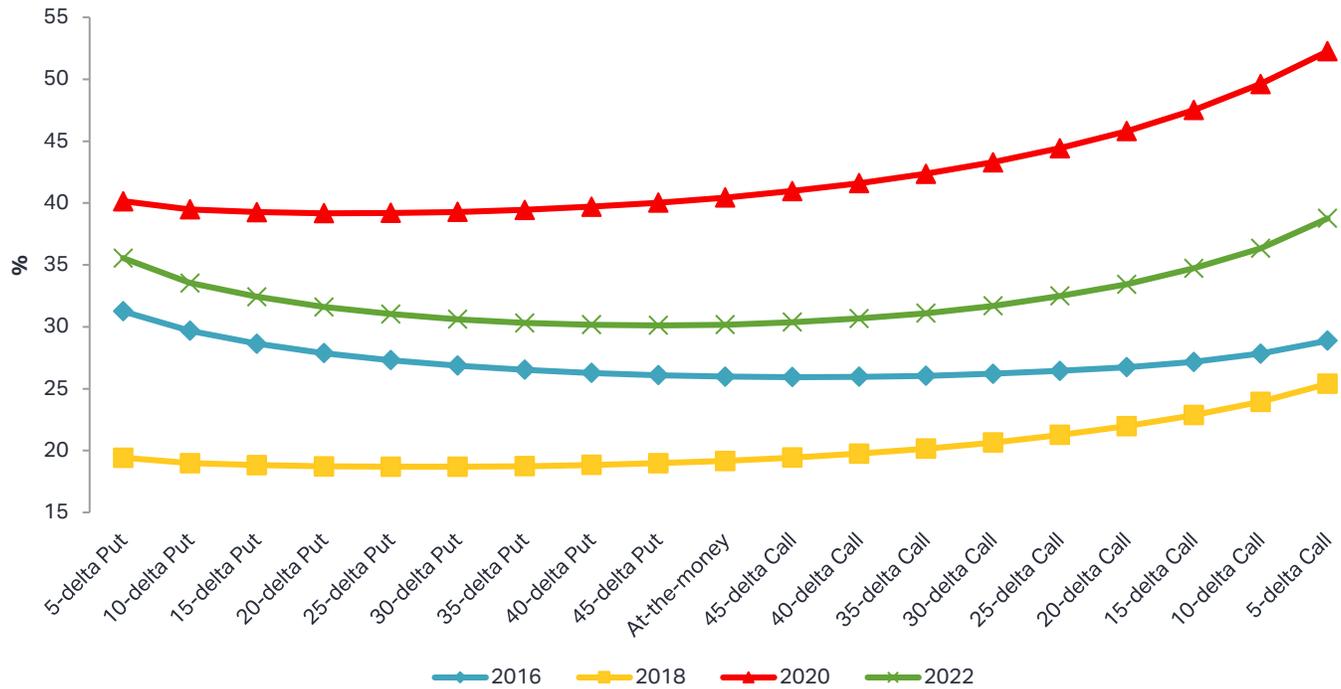
| US\$/oz | LBMA <sup>1</sup> |       |       | CME <sup>2</sup> |       |       |
|---------|-------------------|-------|-------|------------------|-------|-------|
|         | Year/Month        | Low   | High  | Average          | Low   | High  |
| 2004    | 5.50              | 8.29  | 6.66  | 5.52             | 8.22  | 6.70  |
| 2005    | 6.39              | 9.23  | 7.31  | 6.45             | 9.10  | 7.36  |
| 2006    | 8.83              | 14.94 | 11.55 | 8.87             | 14.94 | 11.62 |
| 2007    | 11.67             | 15.82 | 13.38 | 11.50            | 15.55 | 13.47 |
| 2008    | 8.88              | 20.92 | 14.99 | 8.79             | 20.79 | 15.00 |
| 2009    | 10.51             | 19.18 | 14.67 | 10.44            | 19.33 | 14.71 |
| 2010    | 15.14             | 30.70 | 20.19 | 14.83            | 30.94 | 20.26 |
| 2011    | 26.16             | 48.70 | 35.12 | 26.81            | 48.60 | 35.27 |
| 2012    | 26.67             | 37.23 | 31.15 | 26.29            | 37.21 | 31.19 |
| 2013    | 18.61             | 32.23 | 23.79 | 18.55            | 32.44 | 23.78 |
| 2014    | 15.28             | 22.05 | 19.08 | 15.41            | 22.09 | 19.07 |
| 2015    | 13.71             | 18.23 | 15.68 | 13.70            | 18.36 | 15.68 |
| 2016    | 13.58             | 20.71 | 17.14 | 13.75            | 20.70 | 17.18 |
| 2017    | 15.22             | 18.56 | 17.05 | 15.43            | 18.51 | 17.08 |
| 2018    | 13.97             | 17.52 | 15.71 | 13.98            | 17.62 | 15.72 |
| 2019    | 14.38             | 19.31 | 16.21 | 14.32            | 19.55 | 16.24 |
| 2020    | 12.01             | 28.89 | 20.55 | 11.77            | 29.26 | 20.72 |
| 2021    | 21.53             | 29.59 | 25.14 | 21.49            | 29.42 | 25.17 |
| 2022    | 17.77             | 26.18 | 21.73 | 17.67            | 26.90 | 21.82 |
| Jan-22  | 22.24             | 24.32 | 23.13 | 22.19            | 24.72 | 23.19 |
| Feb-22  | 22.36             | 25.32 | 23.47 | 22.38            | 24.71 | 23.56 |
| Mar-22  | 24.64             | 26.18 | 25.24 | 24.71            | 26.90 | 25.46 |
| Apr-22  | 23.16             | 25.92 | 24.54 | 23.09            | 26.24 | 24.68 |
| May-22  | 20.84             | 22.92 | 21.90 | 20.77            | 22.67 | 21.85 |
| Jun-22  | 20.42             | 22.26 | 21.49 | 20.35            | 22.28 | 21.54 |
| Jul-22  | 18.27             | 20.07 | 19.08 | 18.23            | 20.20 | 18.98 |
| Aug-22  | 17.95             | 20.60 | 19.75 | 17.88            | 20.85 | 19.68 |
| Sep-22  | 17.77             | 19.93 | 18.84 | 17.67            | 19.86 | 18.88 |
| Oct-22  | 18.39             | 20.93 | 19.36 | 18.07            | 21.10 | 19.40 |
| Nov-22  | 18.92             | 21.95 | 21.00 | 19.43            | 22.11 | 21.16 |
| Dec-22  | 22.14             | 23.95 | 23.24 | 22.34            | 24.27 | 23.55 |
| Jan-23  | 23.00             | 24.30 | 23.75 | 23.42            | 24.37 | 23.85 |
| Feb-23  | 20.53             | 24.44 | 22.01 | 20.79            | 23.62 | 21.99 |

1: Prices are based on the daily London Silver Fixing and (since 08/15/2014) the daily LBMA Silver Price.

2: Prices are based on the generic 1st futures contract.

Source: LBMA, CME Group, Bloomberg

## Appendix 18 - Year-End One-Month Silver Option Volatility Skew



Source: Bloomberg

## Appendix 19 - CME Activity &amp; Inventories

| Year/Month | Futures             |                            | Managed Money Positions in CME Futures |                    |                  |                         | CME Inventories <sup>2</sup> |
|------------|---------------------|----------------------------|--|--------------------|------------------|-------------------------|------------------------------|
|            | Volume <sup>1</sup> | Open Interest <sup>2</sup> | Long <sup>2</sup>                      | Short <sup>2</sup> | Net <sup>2</sup> | Net Change <sup>3</sup> |                              |
| 2017       | 115,175             | 966                        | 242                                    | 278                | -36              | -232                    | 243                          |
| 2018       | 119,935             | 881                        | 267                                    | 223                | 44               | 80                      | 294                          |
| 2019       | 120,746             | 1,149                      | 429                                    | 135                | 294              | 250                     | 317                          |
| 2020       | 130,633             | 857                        | 361                                    | 131                | 230              | -64                     | 397                          |
| 2021       | 98,348              | 701                        | 252                                    | 165                | 87               | -143                    | 356                          |
| 2022       | 85,383              | 649                        | 225                                    | 81                 | 144              | 57                      | 299                          |
| Jul-22     | 6,031               | 695                        | 184                                    | 273                | -89              | -93                     | 337                          |
| Aug-22     | 7,854               | 685                        | 156                                    | 261                | -105             | -16                     | 328                          |
| Sep-22     | 6,794               | 637                        | 172                                    | 213                | -40              | 65                      | 314                          |
| Oct-22     | 6,734               | 696                        | 177                                    | 216                | -39              | 2                       | 301                          |
| Nov-22     | 9,245               | 612                        | 185                                    | 117                | 68               | 107                     | 298                          |
| Dec-22     | 5,619               | 649                        | 225                                    | 81                 | 144              | 76                      | 299                          |
| Jan-23     | 6,830               | 691                        | 223                                    | 104                | 119              | -25                     | 292                          |
| Feb-23     | 8,161               | 620                        | 152                                    | 188                | -36              | -155                    | 287                          |

1: Aggregate volume over the period, 2: Position at end-period, 3: Net change versus previous end-period

Source: CME Group, CFTC, Bloomberg

## Appendix 20 - LBMA Monthly Silver Trading Volumes

| Moz          | Spot  | Swap &<br>Forward | Option | Loan, Lease<br>& Deposit | Total |
|--------------|-------|-------------------|--------|--------------------------|-------|
| <b>Month</b> |       |                   |        |                          |       |
| Jan-22       | 4,824 | 2,846             | 295    | 542                      | 8,508 |
| Feb-22       | 4,477 | 2,300             | 166    | 544                      | 4,642 |
| Mar-22       | 5,868 | 2,248             | 120    | 663                      | 5,988 |
| Apr-22       | 5,039 | 2,502             | 153    | 676                      | 5,192 |
| May-22       | 5,709 | 2,937             | 226    | 758                      | 5,935 |
| Jun-22       | 4,930 | 2,321             | 343    | 792                      | 5,273 |
| Jul-22       | 4,957 | 2,328             | 136    | 807                      | 5,093 |
| Aug-22       | 6,270 | 2,844             | 306    | 972                      | 6,576 |
| Sep-22       | 5,310 | 2,251             | 203    | 799                      | 5,514 |
| Oct-22       | 6,348 | 2,858             | 336    | 1,093                    | 6,684 |
| Nov-22       | 4,026 | 2,029             | 211    | 546                      | 4,237 |
| Dec-22       | 4,532 | 2,059             | 167    | 787                      | 4,699 |
| Jan-23       | 5,351 | 2,602             | 168    | 908                      | 5,519 |
| Feb-23       | 4,460 | 2,058             | 131    | 711                      | 4,592 |

Source: LBMA, Nasdaq, Bloomberg

## Appendix 21 - Chinese Silver Exchanges' Activity

| Moz    | Shanghai Gold Exchange           |                                | Shanghai Futures Exchange      |                                       |                                  |
|--------|----------------------------------|--------------------------------|--------------------------------|---------------------------------------|----------------------------------|
|        | Ag (T +D)<br>Volume <sup>1</sup> | Ag99.99<br>Volume <sup>1</sup> | Futures<br>Volume <sup>1</sup> | Futures<br>Open Interest <sup>2</sup> | SHFE<br>Inventories <sup>2</sup> |
| 2017   | 18,564                           | 7.5                            | 25,670                         | 145                                   | 43                               |
| 2018   | 12,596                           | 6.1                            | 20,428                         | 174                                   | 36                               |
| 2019   | 27,824                           | 3.7                            | 68,878                         | 370                                   | 63                               |
| 2020   | 67,191                           | 5.7                            | 172,279                        | 349                                   | 95                               |
| 2021   | 22,150                           | 4.3                            | 111,623                        | 321                                   | 76                               |
| 2022   | 5,872                            | 3.1                            | 91,037                         | 464                                   | 69                               |
| Jul-22 | 533                              | 0.6                            | 8,290                          | 411                                   | 46                               |
| Aug-22 | 362                              | 0.2                            | 7,799                          | 418                                   | 44                               |
| Sep-22 | 283                              | 0.1                            | 7,417                          | 338                                   | 47                               |
| Oct-22 | 186                              | 0.8                            | 6,327                          | 436                                   | 50                               |
| Nov-22 | 293                              | 0.2                            | 11,959                         | 453                                   | 54                               |
| Dec-22 | 263                              | 0.0                            | 13,886                         | 464                                   | 69                               |
| Jan-23 | 165                              | 0.0                            | 7,596                          | 412                                   | 70                               |
| Feb-23 | 252                              | 0.2                            | 9,659                          | 503                                   | 65                               |

1: Aggregate volume over the period, 2: Position at end-period;

N.B. Both the SGE and SHFE record each transaction twice, from the point of view of the buyer and also the seller. However, to compare these volumes with other exchanges, such as the CME, the figures in the table have been halved (as shown above). From 2020 onward, SHFE has been reporting the trading volume and open interest single-sided.

Source: SGE, SHFE, Bloomberg

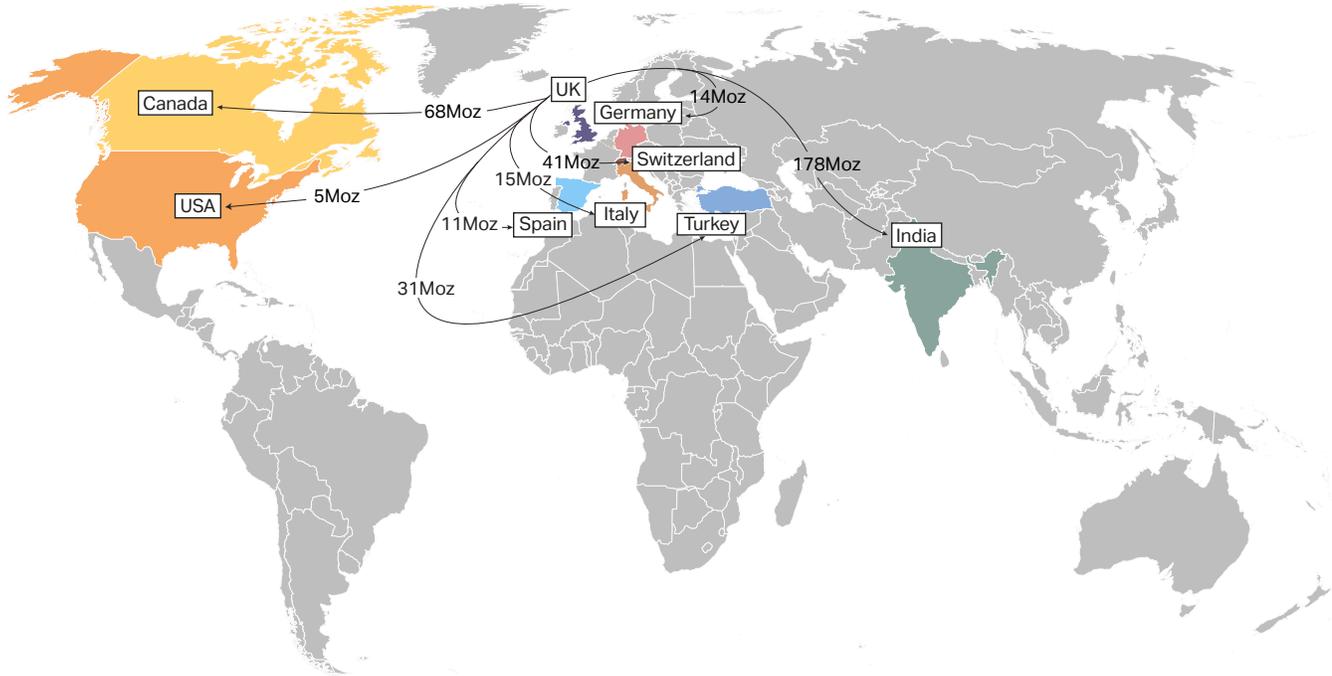
## Appendix 22 - Physically Backed Silver Exchange-Traded Product Holdings\*

| Moz        | iShares<br>Silver Trust | ZKB | WisdomTree | Sprott<br>Silver | Sprott<br>Gold & Silver | Others | Total<br>Holdings<br>(Moz) | Total<br>Value<br>(\$M) |
|------------|-------------------------|-----|------------|------------------|-------------------------|--------|----------------------------|-------------------------|
| Year/Month |                         |     |            |                  |                         |        |                            |                         |
| 2013       | 320                     | 85  | 35         | 49               | 77                      | 63     | 630                        | 12,288                  |
| 2014       | 330                     | 77  | 37         | 49               | 77                      | 59     | 629                        | 10,060                  |
| 2015       | 318                     | 69  | 41         | 49               | 77                      | 58     | 612                        | 8,469                   |
| 2016       | 341                     | 72  | 53         | 56               | 76                      | 65     | 663                        | 10,827                  |
| 2017       | 321                     | 80  | 60         | 56               | 75                      | 78     | 670                        | 11,364                  |
| 2018       | 317                     | 79  | 52         | 56               | 64                      | 78     | 647                        | 10,090                  |
| 2019       | 363                     | 83  | 69         | 60               | 58                      | 96     | 729                        | 13,276                  |
| 2020       | 559                     | 93  | 94         | 91               | 60                      | 170    | 1,067                      | 28,255                  |
| 2021       | 531                     | 100 | 95         | 154              | 60                      | 191    | 1,132                      | 26,127                  |
| 2022       | 467                     | 96  | 61         | 171              | 58                      | 153    | 1,006                      | 24,089                  |
| Jan-21     | 602                     | 94  | 97         | 93               | 60                      | 176    | 1,123                      | 30,783                  |
| Feb-21     | 616                     | 95  | 98         | 123              | 60                      | 183    | 1,176                      | 31,378                  |
| Mar-21     | 575                     | 95  | 101        | 131              | 60                      | 181    | 1,144                      | 27,457                  |
| Apr-21     | 567                     | 97  | 100        | 139              | 60                      | 179    | 1,143                      | 29,567                  |
| May-21     | 577                     | 98  | 101        | 146              | 60                      | 181    | 1,162                      | 32,115                  |
| Jun-21     | 558                     | 98  | 101        | 150              | 60                      | 183    | 1,150                      | 29,625                  |
| Jul-21     | 553                     | 99  | 101        | 151              | 60                      | 184    | 1,149                      | 29,288                  |
| Aug-21     | 551                     | 100 | 99         | 151              | 60                      | 184    | 1,144                      | 27,512                  |
| Sep-21     | 549                     | 100 | 100        | 152              | 60                      | 191    | 1,153                      | 24,815                  |
| Oct-21     | 547                     | 101 | 101        | 153              | 60                      | 190    | 1,152                      | 27,657                  |
| Nov-21     | 549                     | 100 | 100        | 154              | 60                      | 189    | 1,153                      | 26,363                  |
| Dec-21     | 531                     | 100 | 95         | 154              | 60                      | 191    | 1,132                      | 26,127                  |
| Jan-22     | 534                     | 100 | 98         | 154              | 60                      | 191    | 1,137                      | 25,571                  |
| Feb-22     | 546                     | 100 | 101        | 154              | 60                      | 188    | 1,148                      | 27,959                  |
| Mar-22     | 559                     | 99  | 96         | 159              | 59                      | 172    | 1,144                      | 28,388                  |
| Apr-22     | 575                     | 98  | 94         | 161              | 59                      | 163    | 1,151                      | 26,989                  |
| May-22     | 556                     | 99  | 94         | 161              | 59                      | 160    | 1,129                      | 24,581                  |
| Jun-22     | 541                     | 98  | 82         | 161              | 59                      | 157    | 1,099                      | 22,433                  |
| Jul-22     | 484                     | 98  | 82         | 161              | 59                      | 156    | 1,039                      | 20,852                  |
| Aug-22     | 466                     | 98  | 81         | 161              | 59                      | 155    | 1,020                      | 18,308                  |
| Sep-22     | 481                     | 98  | 61         | 164              | 59                      | 154    | 1,017                      | 19,346                  |
| Oct-22     | 483                     | 97  | 60         | 167              | 59                      | 153    | 1,019                      | 19,533                  |
| Nov-22     | 479                     | 98  | 62         | 170              | 58                      | 152    | 1,018                      | 21,952                  |
| Dec-22     | 467                     | 96  | 61         | 171              | 58                      | 153    | 1,006                      | 24,089                  |
| Jan-23     | 478                     | 96  | 60         | 171              | 58                      | 156    | 1,018                      | 23,406                  |
| Feb-23     | 479                     | 95  | 57         | 171              | 58                      | 157    | 1,017                      | 20,871                  |

\*Holdings at end-period; value calculated basis end-period price.

Source: Respective ETP providers, Bloomberg

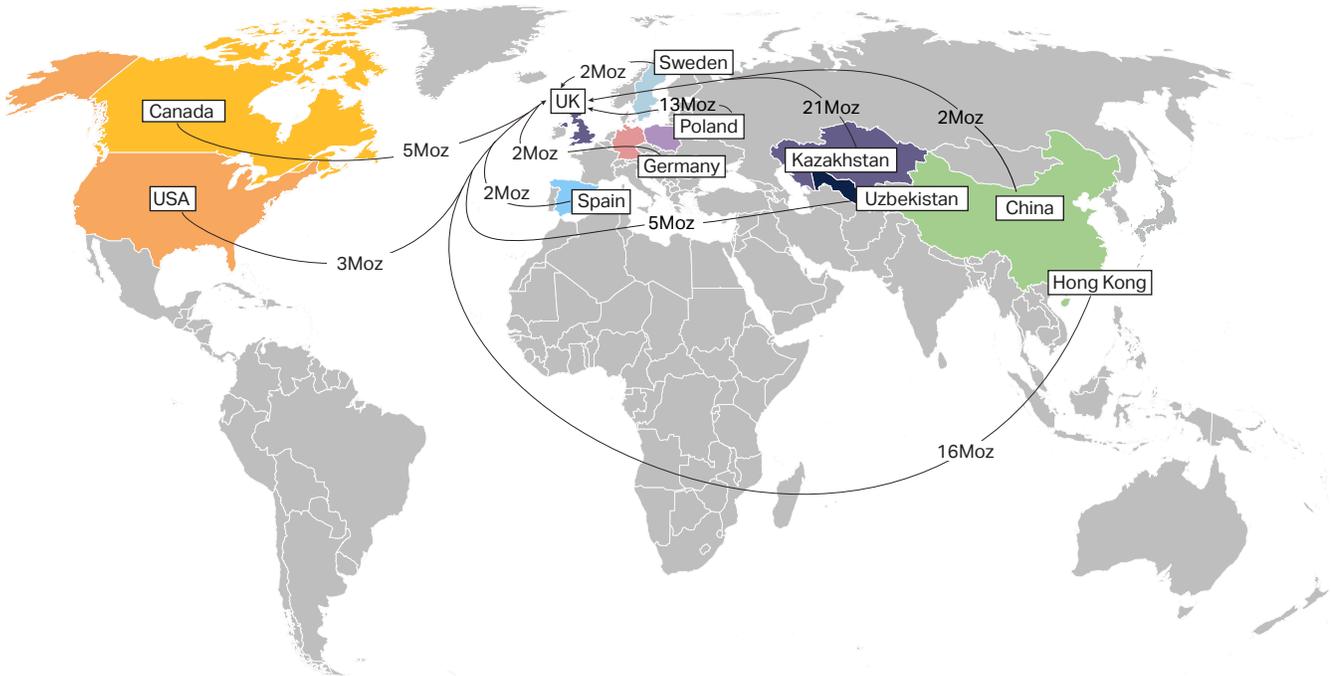
Appendix 23a - Selected United Kingdom Silver Bullion Exports in 2022



NB: In gross weight terms, exports shown account for 99% of total UK silver bullion exports in 2022

Source: HM Customs & Excise, Metals Focus

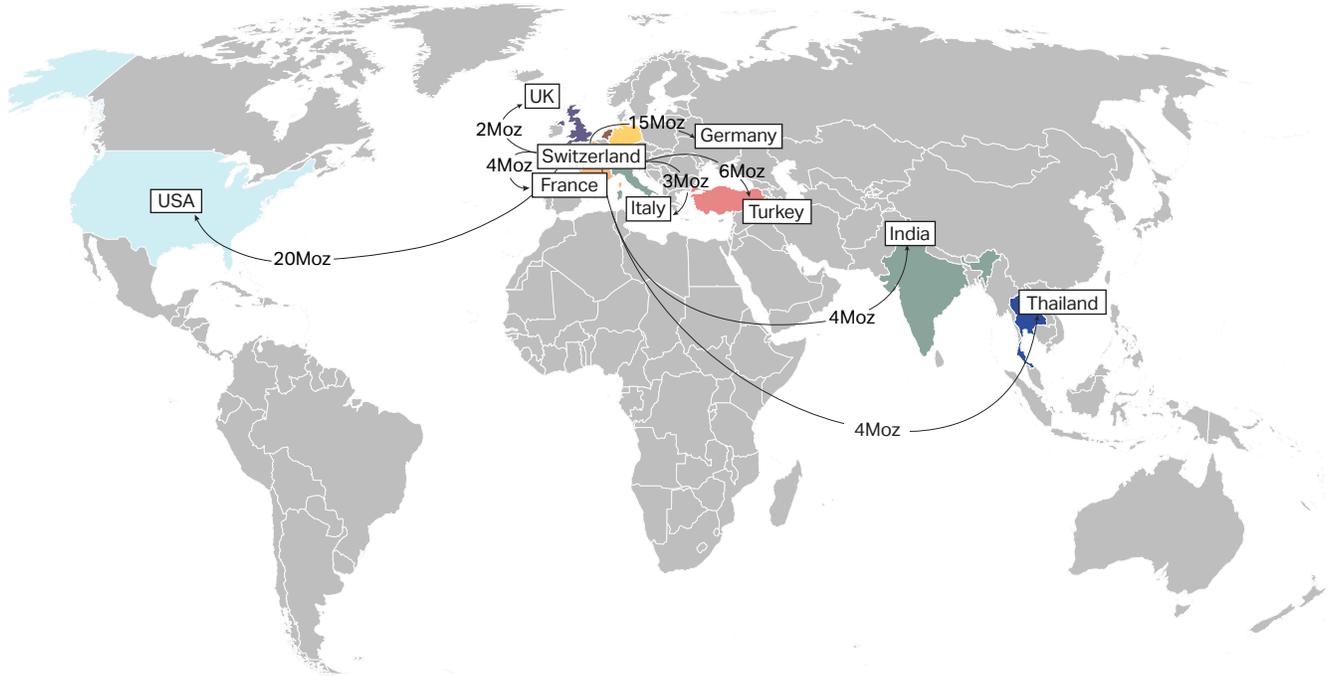
Appendix 23b - Selected United Kingdom Silver Bullion Imports in 2022



NB: In gross weight terms, imports shown account for 94% of total UK silver bullion imports in 2022

Source: HM Customs & Excise, Metals Focus

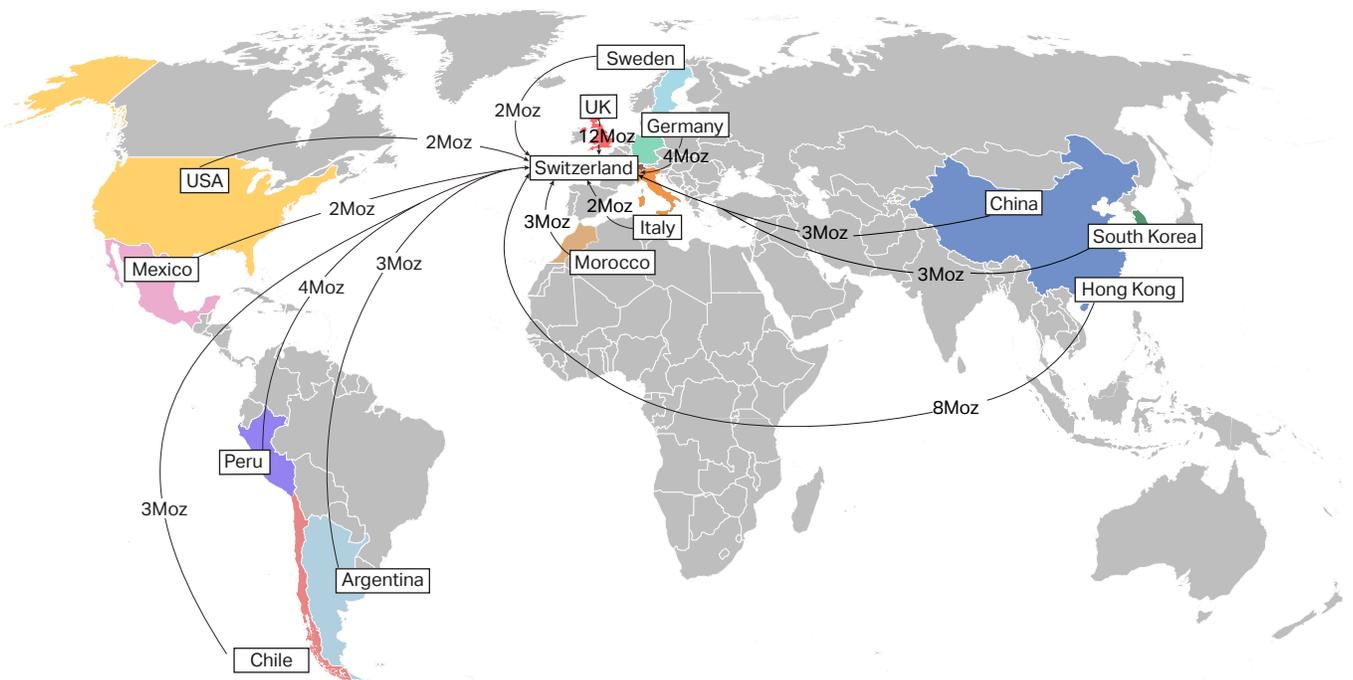
Appendix 24a - Selected Swiss Silver Bullion Exports in 2022



NB: In gross weight terms, exports shown account for 79% of total Swiss silver bullion exports in 2022.

Source: Swiss Customs Administration, Metals Focus

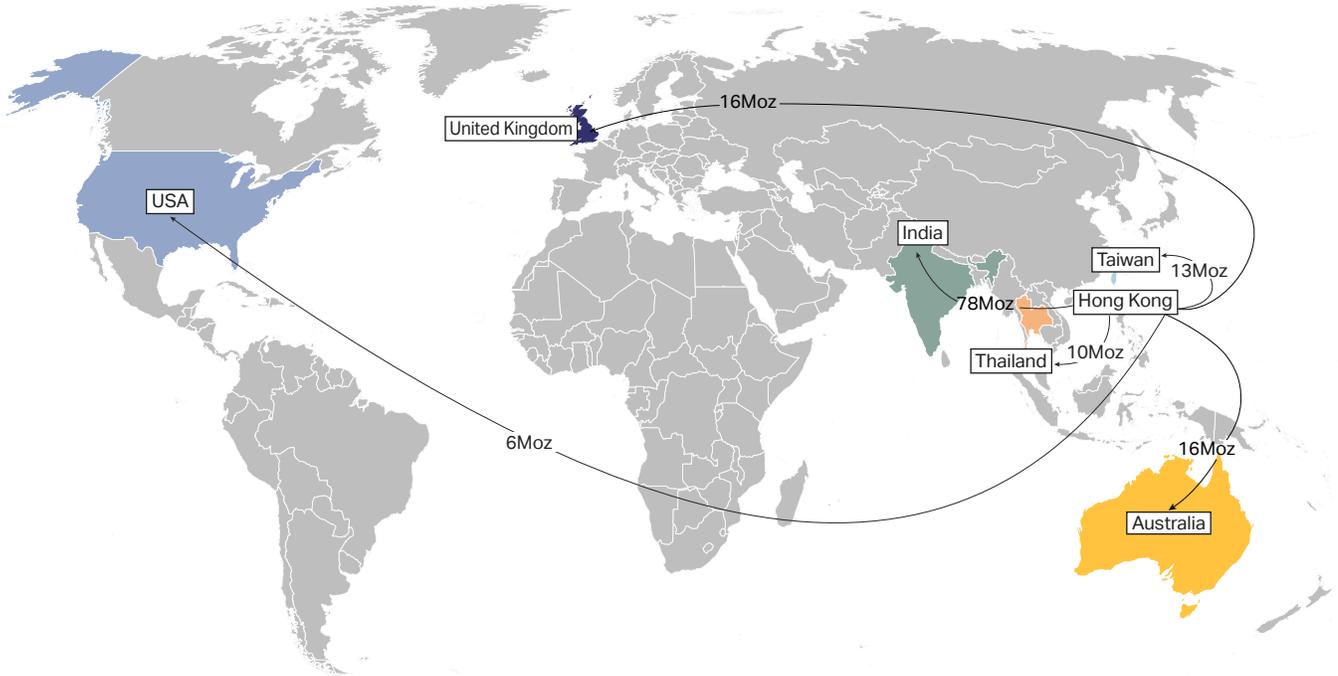
Appendix 24b - Selected Swiss Silver Bullion Imports in 2022



NB: In gross weight terms, imports shown account for 93% of total Swiss silver bullion imports in 2022.

Source: Swiss Customs Administration, Metals Focus

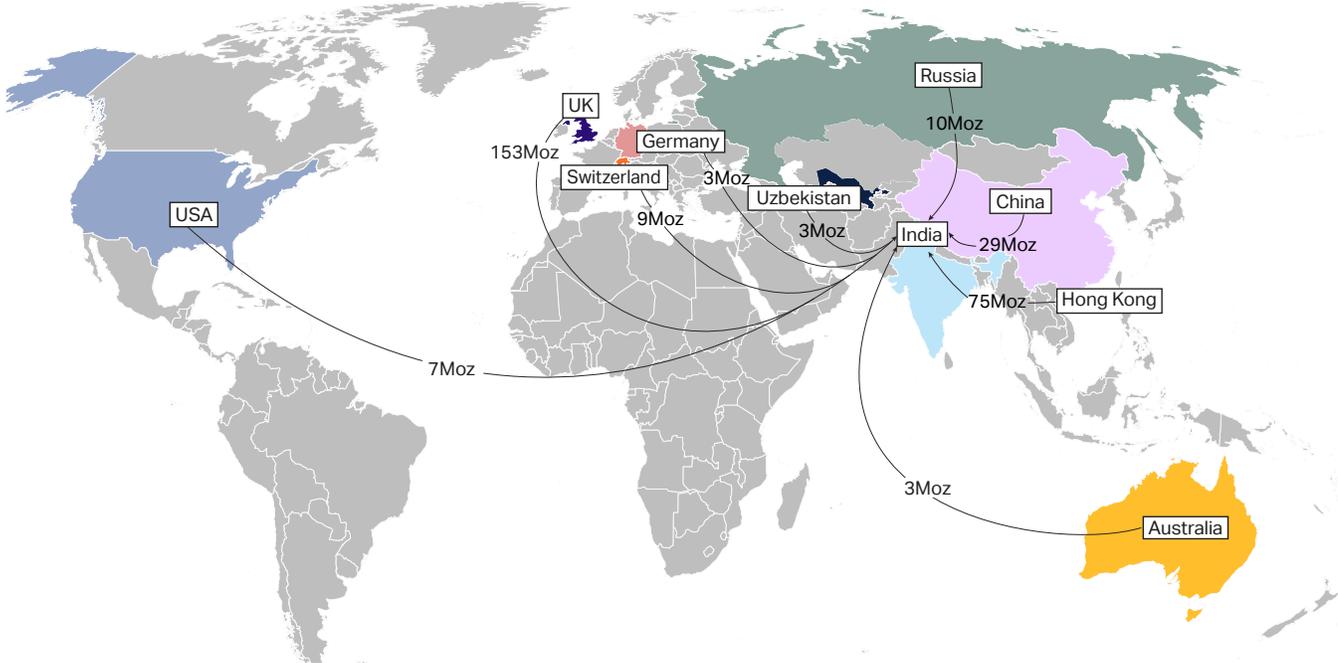
### Appendix 25 - Selected Hong Kong Silver Bullion Exports in 2022



NB: In gross weight terms, exports shown account for 89% of total Hong Kong silver bullion exports in 2022

Source: Hong Kong Census & Statistics Department, Metals Focus

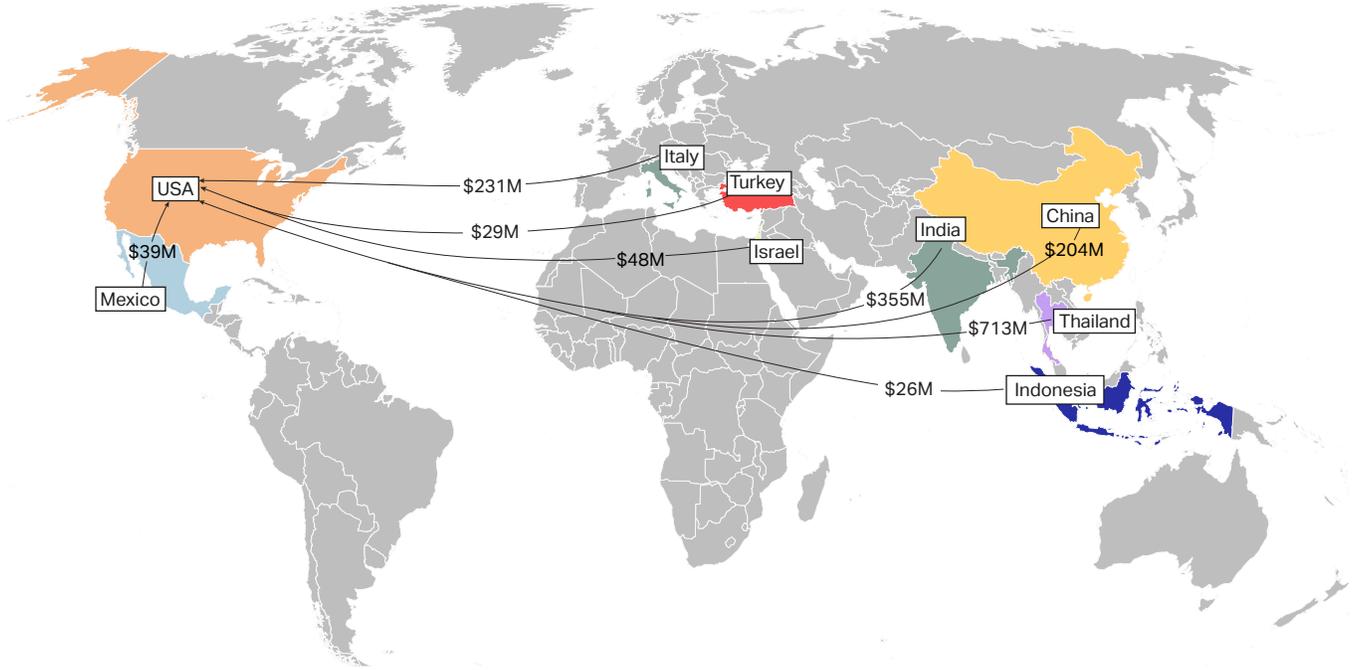
### Appendix 26 - Selected Indian Silver Bullion Imports in 2022



NB: In gross weight terms, imports shown account for 95% of total Indian silver bullion imports in 2022

Source: Ministry of Commerce, Metals Focus

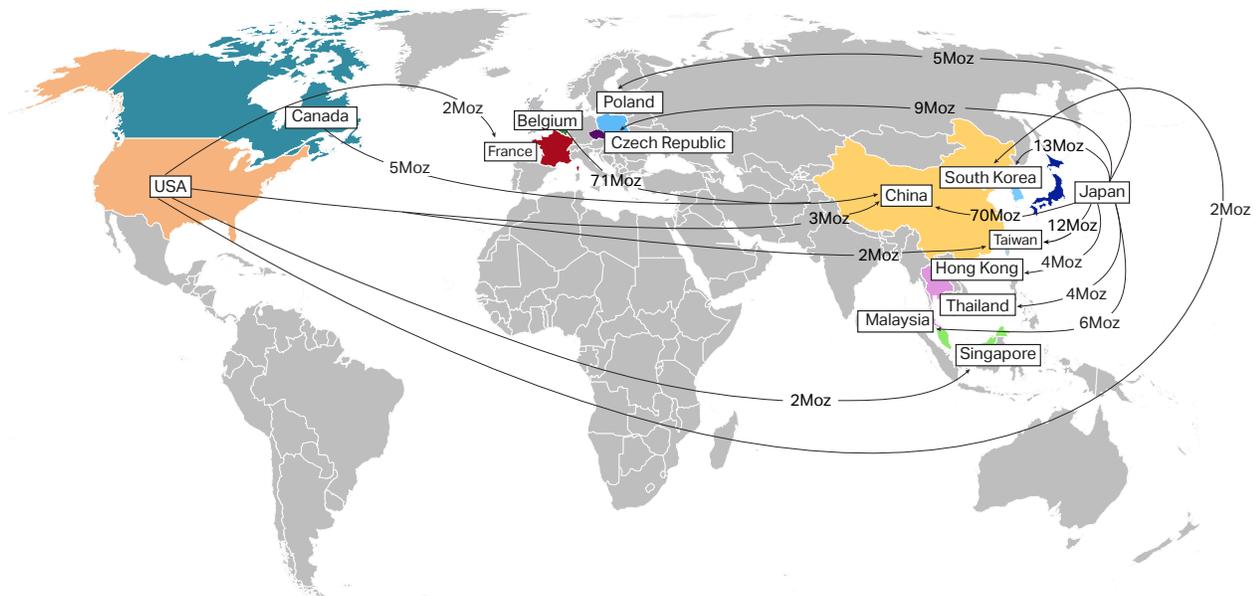
Appendix 27 - Value of Selected US Silver Jewelry Imports in 2022



NB: Imports shown represent around 90% of the total value of US silver jewelry imports in 2022

Source: Various

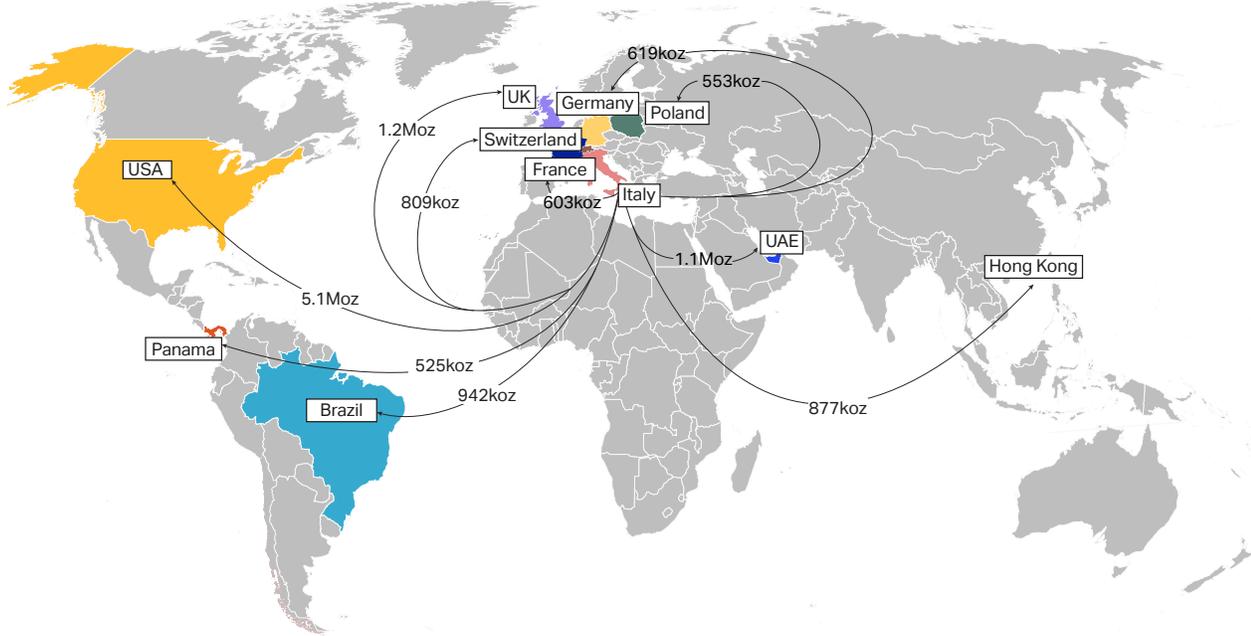
Appendix 28 - Selected Silver Powder Trade Flows in 2022



NB: Figures stated represent reported gross volumes of material shipped

Source: Various, Metals Focus

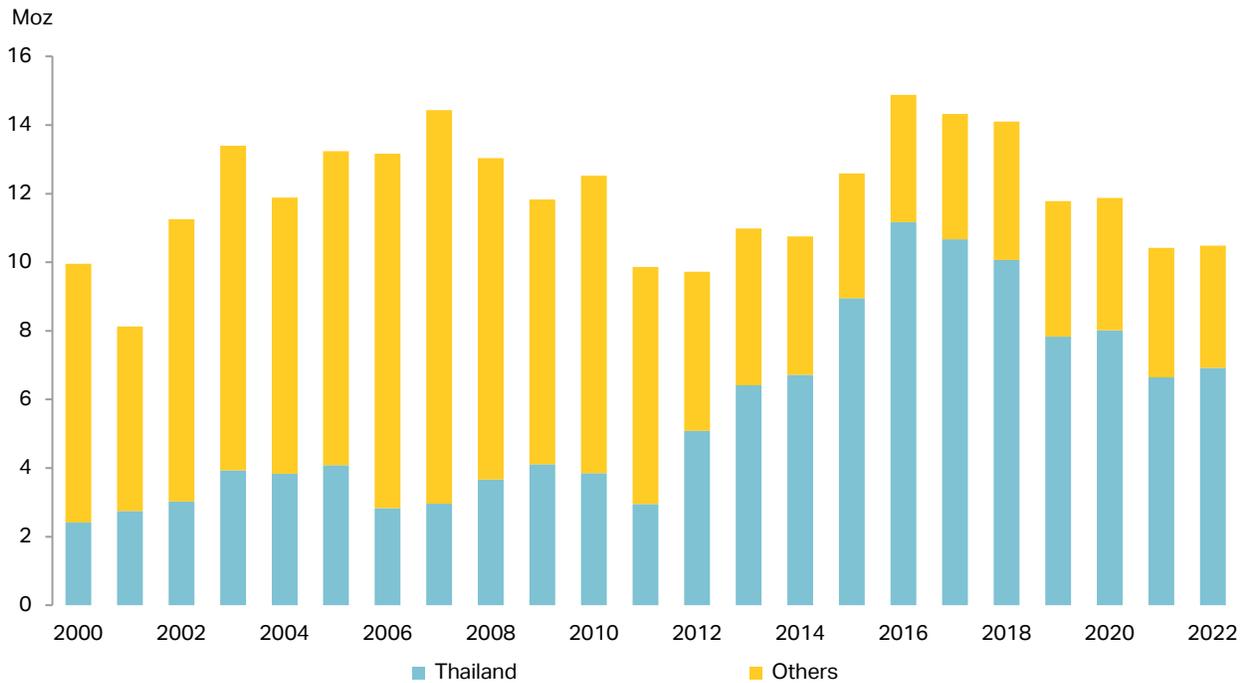
### Appendix 29 - Selected Italian Silver Jewelry Exports in 2022



NB: In gross weight terms, excluding re-exports. Shipments shown account for 58% of total Italian silver jewelry exports in 2022.

Source: Metals Focus, S&P Global

### Appendix 30 - German Silver Jewelry Imports



NB: In gross weight terms

Source: Metals Focus, S&P Global

## Notes & Definitions

### Notes

Throughout the tables, totals may not add up due to independent rounding.

What one country reports as an export to another may be different to the imports reported by the receiving country for a variety of reasons, including conflicting rules of origin, classifications and timing. As a result, similar flows on different maps and/or tables may not be reciprocal due to reporting variations. The tonnage figures shown are fine weights calculated by Metals Focus from the data provided by each origin for exports and by each destination for imports.

### Units

|                        |   |
|------------------------|---|
| <b>Troy ounce (oz)</b> | One troy ounce - 31.103 grams                               |
| <b>Ton (t)</b>         | One metric ton - 1,000 kilograms (kg) or 32,151 troy ounces |
| <b>Grade (g/t)</b>     | Grams per metric ton of rock                                |
| <b>Dollar (\$)</b>     | US dollar unless otherwise stated                           |

### Definitions

|                               |   |
|-------------------------------|---|
| <b>Fabrication</b>            | Captured in the country where the first transformation of silver bullion or grain into semi-finished and/or finished products takes place (such as silver nitrate or silver oxide).   |
| <b>Consumption</b>            | The sum of domestic jewelry fabrication plus imports, less exports, adjusted for changes in trade stocks.   |
| <b>Recycling</b>              | Covers the recovery of silver from fabricated products, including unused trade stocks. Excludes scrap generated during manufacturing (known as production or process scrap). The recycling is captured in the country where the scrap is generated, which may differ from where it is refined. The one exception to this is ethylene oxide, where the recycling of silver is measured at the point where it is recovered. |
| <b>Mineral Resources</b>      | A concentration of material in, or on, the earth's crust of such grade or quantity where there is a reasonable prospect for economic extraction.  |
| <b>Mineral Reserves</b>       | The economically mineable part of a measured or indicated mineral resource demonstrated by at least a preliminary feasibility study.  |
| <b>By-Product Costs</b>       | Revenue generated from additional metals produced at a mine alongside the primary metal. This revenue is subtracted from costs as a by-product credit.  |
| <b>Total Cash Cost</b>        | Includes all direct and indirect mine site cash costs related directly to the physical activities of producing metals, including mining, ore processing on-site general and administrative costs, third-party refining expenses, royalties and production taxes, net of by-product revenues.  |
| <b>Total Production Cost</b>  | Total cash costs, plus depreciation, amortization and reclamation and closure cost obligations relating to each operating unit.   |
| <b>All-In Sustaining Cost</b> | The sum of total cash costs plus community costs, sustaining capital expenses, corporate, general and administrative expenses (net of stock option expenses) and exploration expenses.  |

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