

IS SILVER THE CHEAPEST ASSET ON THE PLANET?



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Executive summary

- ▶ Silver is a precious metal, a monetary metal and an industrial metal with a surprisingly wide range of uses. It's not that well understood by investors and tends to get overshadowed by gold but, perhaps, not for much longer.
- ▶ We think that the provocative title of this essay is justified by silver's attractive fundamentals. The "official figures" from the Silver Institute estimate that the silver market has been in deficit for the past five years, and the deficit is increasing.
- Silver supply from mining is relatively inelastic, as new mines can take at least 10 years from discovery to commissioning. Identifiable above-ground stocks in London, the US and Shanghai have been in sharp decline since 2020.
- Photovoltaic demand for silver in solar panels exploded in 2023 and, in our opinion, is substantially underestimated in the official figures. Based on our analysis, the deficit for silver is bigger than the consensus believes.
- ▶ We expect that a shortage of silver will emerge going forward. In the meantime, the gold/silver ratio stands, currently, at 85x, making silver look cheap in an historical context. During the past century, it has been highly volatile in a range of 15x-20x during the peaks in gold/silver bull markets to more than 100x for short periods.



Poised to emerge from its golden shadow

Provocative title but justified, in our opinion

We've chosen a provocative title for this essay, but it's one we think is justified given the shortage of silver that we see emerging. This should translate into growing investor interest as silver's attractive fundamentals become widely appreciated. In our opinion, they are currently not that well understood by most investors, both professional and retail.

An illustrious history and exciting future

Why has silver's long and illustrious history faded from people's minds during the past century and why are more people not drawing attention to its exciting future? In all likelihood, it has something to do with being overshadowed by its much higher-profile precious metals cousin, gold – even though the drivers for supply and demand for the two metals only partially overlap.

This is not surprising.

Silver has been "entwined" with gold

In his seminal work, *The Golden Constant*, Professor Roy Jastram demonstrated empirically how gold maintained its value over the centuries, both through periods of inflation and deflation. In the preface to the sequel, *Silver - The Restless Metal*, Jastram wrote:

"In the preparation of my book The Golden Constant, I found the history of silver was entwined with that of gold. Every avenue of investigation of gold led me to silver, too. The two metals were found together in nature, were combined in the artefacts of early man, were used together in sacred rituals, and were held to be precious everywhere. When used as coinage, both became the means by which wealth was measured and commerce carried on."

Silver is traded globally

To begin with, let's provide some background on silver, how it's traded and what it's used for. In terms of financial markets, it is traded globally – primarily in London on the LBMA, in New York on the COMEX exchange (part of CME Group), in Tokyo on the Tokyo Commodity Exchange (TOCOM) and in Shanghai on the Shanghai Gold Exchange.

A metal with multiple classifications

Silver has some unique characteristics, as well as a surprisingly wide range of applications. It can be classified as a:

- precious metal;
- monetary metal; and
- ▶ industrial metal.

Precious metal

Silver is one of the precious metals – along with gold, platinum, palladium and rhodium – which are defined as rare metallic elements having a high economic value. They also tend to be less reactive than other metals and resistant to corrosion. Due to its precious nature, silver, like gold, is also widely used in jewellery.

Monetary metal dating back 5,000 years

If we start at the beginning, silver was and, to an extent, still is, a monetary metal. In fact, it was used as money even more than gold between 3,000BC and the end of the nineteenth century. The British pound is a reference to the pound coin, which originally weighed 12 troy ounces of "sterling silver" – having a purity of at least 92.5%. The US was on a silver standard monetary system until 1873. China was on a silver standard until 1935.



Wide range of industrial uses

The most reflective metal, hence its photovoltaic use in solar panels

Silver is also an industrial metal and has a whole range of uses; for example, in electronics and electrical components, medicine and green energy. Silver is the best conductor of electricity, being superior to copper, and is used in a multitude of products that contain electronic components, including smart phones, computers, cars and consumer/industrial appliances. Painting silver in the form of ink onto a surface creates an electronic pathway, thereby reducing the need for wires.

Silver is the most reflective metal, reflecting 95% of the visible spectrum, which accounts for its photovoltaic use in solar panels. If you go back more than 20-30 years, photographic film and processing was a major use of silver. That's no longer the case due to digital photography, but the decline has come to a halt. In the medical sector (classified as an industrial use), silver acts as a biocide, killing microbes. It's incorporated in medical garments and face masks.

The table below shows the estimates for silver demand in 2023.

Silver demand estimates 2023		
Use	m oz.	%
Industrial	654.4	56.8
Electronics	251.6	21.8
Photovoltaic	193.5	16.8
Alloys/solders	50.2	4.4
Other industrial	159.0	13.8
Photography	27.0	2.3
Jewellery	203.1	17.6
Silverware	55.2	4.8
Net investment incl. ETFs	201.0	17.4
Net hedging	12.2	1.1
Total demand	1,152.8	100.0

Source: Silver Institute



The "official figures" come from the Silver Institute, although we believe they underestimate photovoltaic demand

Supply deficit for past five years and expected to continue

Silver's supply shortage

A key element of our investment thesis for silver is the continuance of the supply deficit and growing awareness of shortage in physical metal. The estimates for silver supply and demand, provided by the Silver Institute, are considered to be the "official figures" for the silver industry. Having said that, along with other commentators, we are increasingly questioning the accuracy of these figures, especially in terms of underestimating photovoltaic demand.

Despite our concern that the Silver Institute may have been underestimating photovoltaic demand in recent years, especially in 2023, its estimates show that the silver market has been in deficit for the past five years, during 2019-23. The chart below shows the persistent deficit in silver supply since 2019 and the Silver Institute's projection of an increase in the deficit in 2024 – which we believe understates the actual magnitude of the deficit.



Source: Hardman & Co Research, the Silver Institute

Total silver supply from mines and recycling was just over 1.0bn oz in 2023

Silver supply consists of three elements

Breaking down the figures for 2023, for example, total supply was estimated at 1,011m oz, while total demand – including investment in physical silver and physical silver ETFs – was at 1,153m oz, giving a theoretical supply deficit of 142m oz.

Let's consider the different components of silver supply in more detail and the outlook, which, at anywhere near the current price, we expect to remain relatively stable. It's important to emphasise that, as with gold, silver supply is more complex than with other commodities. There are three components:

- mine supply;
- recycling; and
- above-ground inventories.

In terms of the aggregate of mine production and recycling, the former accounts for approximately 80%-85% from mine production and the balance from recycling.



Due to long lead times, mine supply tends not to change much from year-toyear

Mine supply has been on a declining trend since 2016...

The first component is mine supply, which doesn't change much from year-to-year. The process of building a new silver mine – from discovery to production – can easily take 10 years, or even longer. The largest producing country is Mexico, which produced about 200m oz of silver in 2023. In second and third places, respectively, were China and Peru, with slightly over 100m oz.

The inelasticity of mine supply is one reason why it will be difficult for silver supply to react rapidly to evidence of shortage and will be a key factor for the silver price going forward. Based on Silver Institute estimates, mine production peaked in 2016 at 900m oz and was estimated to have been 831m in 2023, a decline exceeding 8%.



Source: Hardman & Co Research, the Silver Institute

...and we expect it to remain relatively stable for the next few years

similar to last year, declining marginally to 823.5m oz (830.5m oz). This reflects a rebound in Mexico's production of 5.6m oz as the large Penasquito mine returns to full production, following last year's strike action. US production is expected to rise by 3.5m oz due to the ramp-up of Coeur's Rochester expansion and a recovery in output from Hecla's Lucky Friday mine, following the fire in 2023. On the negative side, Peru's production could decline by 17.9m oz, according to the Silver Institute, due to permitting issues for Hochschild's Royropata mine and production halts at two mines, one each owned by Hochschild and Buenaventura. Looking beyond 2024, we expect that silver mine supply will remain relatively stable during the coming few years.

In 2024, as the chart shows, the Silver Institute expects mine production to remain

More than 70% of silver production from mines is as a by-product

There is another aspect of mine supply, which is worth highlighting and could have a positive impact on the silver price. About 72% of annual silver production is from mines that, primarily, are targeting lead-zinc, copper and gold and for which silver is a by-product. Weakness in global economic growth, leading to a cut in mine production of lead, zinc or copper, would have the knock-on effect of curtailing silver supply, notwithstanding demand for silver.

Recycling supply is also expected to remain relatively stable, absent a significant increase in the silver price The second component of silver supply is recycling. Silver is relatively easy to recycle from jewellery and silverware and can also be recycled from some industrial scrap, including catalysts and some electronic components. Silver recycling was relatively stable during 2015-19 at just under 150m oz., before seeing sharp upward growth during 2020-21. During the past two years, recycling volume has been steady at about 178m-179m oz. Like mine supply, silver recycling is expected to remain relatively stable for the next few years unless a significant rise in the price encourages more recycling, especially in the form of jewellery and silverware.



Gold and silver differ from other commodities in having a high stock-toflow ratio

Above-ground inventories are "theoretical" supply

Above-ground silver inventories are likely in the range 1.5bn-2.0bn oz...

Thirdly, and this differs with other commodities, apart from gold, there are substantial above-ground inventories of silver. This is because silver bought for investment purposes is hoarded, rather than consumed like oil, copper or wheat. For most commodities, inventories at any given time are usually a fraction of annual production. In the case of gold and silver, inventories are substantially more than annual production; this is especially the case for gold, as so little is consumed for industrial purposes. The technical term for this is a "high stock-to-flow" ratio.

We should note, however, that above-ground inventories represent "theoretical" supply. In the case of gold and silver held for investment purposes, much of it is held as a long-term investment and may only be available to the market at substantially higher prices, or maybe not at all.

In silver's case, we believe that above-ground inventories are in the region of 1,500m-2,000m oz or 1.5bn-2.0bn oz (excluding jewellery and silverware). This is double annual production of about 1.0bn oz from mine supply and recycling, giving a stock-to-flow ratio of 2.0. At the end of 2023, the Silver Institute estimated that "Identifiable Silver Bullion Inventories" amounted to 1.229.9m oz.

Identifiable silver bullion inventories				
(m oz.)	2020	2021	2022	2023
London vaults (LBMA)	1,080.5	1,161.5	840.9	856.2
CME (COMEX)	396.5	355.7	299.0	277.9
SGE	130.0	73.9	69.0	46.5
SHFE	95.2	75.9	69.2	38.2
Other	n/a	2.7	7.4	4.1
Total	1,702.3	1,666.9	1,285.5	1,229.9

Source: Silver Institute

Identifiable silver inventories include London, US and Shanghai...

...which have seen a 472.4m outflow in the past three years

Dishoarding can't be relied on if investment and industrial demand are rising simultaneously

The table shows that this is based on the aggregate of published figures for inventory in LBMA vaults in London, CME (COMEX) in the US and the Shanghai Gold Exchange (SGE) and Shanghai Futures Exchange (SHFE) in China. It excludes non-disclosed inventories in other financial centres; notably, Zurich, Hong Kong, Singapore and Tokyo – hence our estimate of 1.5bn-2.0bn oz.

The total reduction in Identifiable Silver Bullion Inventories from end-2020 to end-23 is 472.4m oz. However, we think that the table above is telling in that it supports the argument that the silver market has been in deficit during recent years; i.e., that the market has had to rely on dishoarding from these vaults to satisfy demand.

During the past three years, the silver price has been highly volatile, both to the upside and the downside. However, it can't be assumed that the status quo will be maintained, especially if silver enters a prolonged bull market and both investment and industrial demand are rising simultaneously. Indeed, industrial demand could be crowded out, if investment demand is strong.



Decoding the complex issue of silver demand

Silver demand is likely significantly higher than the "official figures" suggest

It's our belief that global silver demand is significantly higher than the current figures from the Silver Institute acknowledge. The reason for this, as we will show, primarily relates to green energy and the explosive growth in photovoltaic use for solar power, which occurred in 2023, in particular.

What was the growth in silver use in solar installations in 2023?

Our aim is to estimate the increase in silver usage in 2023 and compare it with the Silver Institute's "official figures" and the recent changes to its historical figures. On 29 November 2023, Bloomberg's primary research service, BloombergNEF, reported that:

"...the solar industry is installing record volumes worldwide...BloombergNEF has increased its build forecast yet again for this year to 413 gigawatts, largely due to mainland China...Installed volumes are up 64% from 2022, exceeding our previous estimates."

Keep in mind this provisional estimate for 64% growth in solar installations. The other significant statistic was that China accounted for a staggeringly high 60% of global installations.

On 4 March 2024, BloombergNEF updated its 2023 forecast and published an estimate for 2024 solar installations.

"The photovoltaic industry added about 444 gigawatts of new capacity in 2023, a 76% growth on 2022 build. Prices of solar modules are at record lows, and supply of components is plentiful. End-user markets are booming while manufacturers struggle to make a profit. Installations this year will top 520GW."

Silver loadings in solar increasing significantly

So, all things being equal, 76% seems like a reasonable estimate for growth in silver usage in solar installation in 2023. However, there is another factor to take into account. For some years, the solar industry was attempting to "thrift" on silver in order to reduce costs. However, this trend has not only stopped but reversed, driven by higher silver loadings in more efficient solar panels.

New solar cells use 30%-80% more silver

Briefly, N-type solar cells consisting of the three cell types of TOPCon, HJT and IBC are replacing the older PERC-type cells and this changeover is happening rapidly. Industry participants estimate that N-type solar panels have an efficiency of 25.7% versus 23.6% for PERC or "P-type" and are not affected by light-induced degradation. A research article, *The silver learning curve for photovoltaics and projected silver demand for net-zero emissions by 2050*, published by Wiley in 2022, estimated that N-type solar cells require 20.4-26.0 mg/W of silver, representing a 30%-80% increase on P-type.

We estimate 270m-300m oz. of silver demand for photovoltaics in 2023...

In our opinion, a reasonable estimate of the growth in silver used in solar installations last year is about 100%; i.e. that it roughly doubled. Based on the Silver Institute's estimate for photovoltaic silver usage in 2022 of 140.3m oz. – published in its 2023 World Silver Survey – it should have amounted to ca.270m-300m oz. However, that's where things took an unexpected turn.

...but the Silver Institute changed its historical demand estimates

The 2024 World Silver Survey was published on 17 April 2024 and, without explanation, the Silver Institute significantly reduced all of its historical estimates for silver usage for photovoltaics. The comparisons in the 2023 and 2024 surveys are shown in the table below – with the 2022 comparisons highlighted. The table also shows the 2023 estimate for photovoltaic demand of 193.5m oz. – far below the 270m-300m oz. which we think was reasonable.



Silver Institute's estimates for photovoltaic demand 2018-23						
m oz.	2018	2019	2020	2021	2022	2023
World Silver Survey 2023	92.5	97.8	100.0	110.0	140.3	
World Silver Survey 2024	87.0	74.9	82.8	88.9	118.1	193.5

Source: Silver Institute

Readers can draw their own conclusions

Revised 2019 estimate seems questionable

Based on the new estimate for 2022 demand, the 193.5m oz. of photovoltaic demand in 2023 was 64% above the revised 2022 estimate. Readers can draw their own conclusions, but we believe that this estimate was substantially too low – although it was in line with BloombergNEF's provisional estimate for 2023 growth in global solar installations, based on the downward revised 2022 estimate.

The downward revisions to the historical estimates for photovoltaic demand also threw up an anomaly in the 2019 estimates, which we've also highlighted. The original estimate of 6% growth to 97.8m oz was dramatically altered to a 14% decline to 74.9m oz. from a lower 2018 estimate. However, we've found four estimates for global solar installations in 2019, which put the growth rate at between 7% and 14%. Even with some thrifting, the Silver Institute's estimates of silver's photovoltaic usage seem questionable.

Global solar installations 2018 and 2019 (GW)				
	2018	2019	Change %	
BloombergNEF	106	118	+11	
Wood Mackenzie	110	123	+12	
IEA	104	111	+7	
TrendForce	99	113	+14	

Source: Silver Institute

Do the Silver Institute's demand figures include aerospace and defence?

While we've focused on solar usage in this report, there are also question marks about the magnitude of demand from the aerospace and defence sector, in particular. Some commentators believe that the Silver Institute does not take into account demand from this sector, which might be similar in magnitude to photovoltaics. Aside from usage in electronics in aerospace, silver loadings, in some munitions, are believed to be significant. This includes torpedoes and missiles, like the Tomahawk cruise missile, with each one containing nearly 500 oz. of silver.



Silver as a financial asset and investment

Silver looks increasingly attractive as an investment

So, as we've just explained, and all other things being equal, we believe that the deficit in silver supply and demand is both bigger than the official figures suggest and likely to persist for the foreseeable future. It seems odd that the silver price hasn't performed better already. In part, we think that this reflects the drawdown in above-ground inventories. We'd also note that the Silver Institute's 2024 estimate sees an increase in the deficit from 142.2m oz. to 265.3m oz. This should make silver increasingly attractive as an investment, in our view. Looking ahead, we see a situation where there is not enough supply to satisfy the demand – at least anywhere near the current price of \$27/oz – as we expect the supply deficit to rise in the coming years.

How to invest in silver

Investing in silver can take various forms; for example:

- investment in physical bullion;
- ETFs backed by physical silver (we urge investors to take care in choosing ETFs);
 and
- silver mining stocks.

Silver investment can "crowd out" industrial demand

The more silver purchased as an investment, the bigger the supply deficit and the more potential crowding out of industrial demand. Consequently, if industrial and investment demand are rising simultaneously, this should exert a powerful effect on the silver price.

Silver and gold are stores of wealth

Both gold and silver, as monetary metals, act as stores of wealth and inflation hedges. These attributes are becoming important, as we've seen a shift during the past two years to a more inflationary environment. However, the debasement of currency has a long way to go, in our opinion. If we take the US, for example, the 2023 budget deficit was \$1.695tr. Budget deficits below a trillion dollars are unlikely to be seen again. Projections by the US Congressional Budget Office of Budget are for the deficit to be on a rising trend, reaching \$2.703tr in 2033.

Gold and silver are the only financial assets with no counterparty risk

The world, never mind the US, is awash in more than \$300tr of debt, and another debt crisis is inevitable at some point. On that note, it's worth emphasising a characteristic of gold and silver, which sets them apart from all other financial assets and might prove key in the next debt crisis – especially if policymakers resort to printing money to solve it. Physical gold and silver are the only financial assets that are not somebody else's liability.

Silver acts in a similar way to gold with a higher beta

Compared with gold right now, the fundamentals for silver look even more compelling. Gold and silver prices tend to move in tandem. While gold usually leads in the early stages of bull or bear markets, the move in silver tends to significantly outpace gold in due course; i.e., it has a higher beta. Gold has been making a series of all-time highs in recent months. In contrast, silver remains more than 40% below its all-time high of \$50/oz, which it reached in 1980 and again in 2011. Copper, for comparison, is 14% off its all-time high.

The gold/silver ratio

Finally, we'd like to highlight a key metric for silver, which makes it look attractive vis-à-vis gold. This is the gold/silver ratio; i.e., the number of ounces of silver that can be bought with an ounce of gold. It currently stands at 85x. That makes silver look very cheap in a historical context. The ratio was set at 12:1 in the Roman Empire and remained in the 12x-16x range until the late nineteenth century. During the



past century, it has been highly volatile – in a range of 15x-20x during the peaks in gold and silver bull markets up to more than 100x for short periods. While the ratio is currently 85x, the ratio at which silver is being mined relative to gold is only 7:1.



About the author



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Paul Mylchreest is an equity analyst covering the Mining sector at Hardman & Co.

Paul has 30 years' analytical experience, having started his career in the Chemicals sector. He was an Extel-rated analyst at S.G. Warburg, Schroders and Citibank. As well as a brief foray into Oil & Gas, he worked for several years as a Global Macro & Cross Asset strategist, firstly setting up on his own, and later working at US commodity trader, Archer Daniels Midland (ADM Inc.). He began his mining coverage at Crédit Agricole Chevreux in 2005.

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The full detail is on page 26 of the full directive, which can be accessed here: http://ec.europa.eu/finance/docs/level-2-measures/mifid-delegated-regulation-2016-2031.pdf

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