WORLD GOLD COUNCIL

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Gold in the Global Economy
Market, mining and modernisation

Foreword

Demand for gold is at record levels, with interest extending from rural labourers to central banks and international investors. There are many reasons behind this trend: geopolitical tensions, economic uncertainty, demographic changes and structural shifts in market access.

The road from mine to market is long and complex, however, with multiple actors playing their part along the way in every region of the world. This report was born as we considered the challenges ahead for the industry and how a spirit of collaborative innovation and cross-industry learning could help move the industry forward.

Gold in the Global Economy delves into the dynamics behind gold supply and demand, considering where gold is used, how it is used and the contribution it makes to the global economy. It draws on the World Gold Council's extensive knowledge of the gold market.

Adding to this knowledge, Clareo's team of experts helped to analyse the challenges and barriers faced by the industry today, the steps underway to address those challenges and the opportunities that lie ahead across the value chain.

While challenges and headwinds are certainly significant, applying a paradigm of innovation and of collaboration – from production right through to retail – has the potential to position the gold industry at the forefront of the global mining and metals sector, through technical innovation and responsible provenance.

It's this potential we aim to unlock.

Terry Heymann
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Executive Summary

Gold has played a fundamental role in society since ancient times. Admired for its beauty and treasured for its economic value, gold's unique attributes have been recognised for thousands of years.

Today, those attributes continue to define and differentiate gold. Prized by investors, cherished by consumers and deployed in a range of technological applications, gold is an asset like no other, contributing to cultural traditions, financial stability, wealth creation and industrial markets.

In recent years, recognition of gold's unique characteristics has propelled annual consumption to record levels of almost 5,000 tonnes per annum, fuelled by demand from consumers, investors, central banks and industrial users. Around three-quarters of that demand is satisfied by newly mined gold, yet supply increases by little more than 1.5% annually, providing a favourable long-term backdrop for the market.

Supply growth is constrained for multiple reasons, not least because gold miners tend to operate in some of the most remote and challenging regions of the world. In spite of these tough operating conditions, responsible miners can make a real difference, contributing approximately US$60 billion annually to host economies, including taxes, employee wages, and payments to local communities and suppliers.

Nonetheless, producers, refiners and retailers of gold are under scrutiny like never before. Stakeholders are calling for more robust environmental, social and governance (ESG) processes and this has led to sustained and consistent progress.

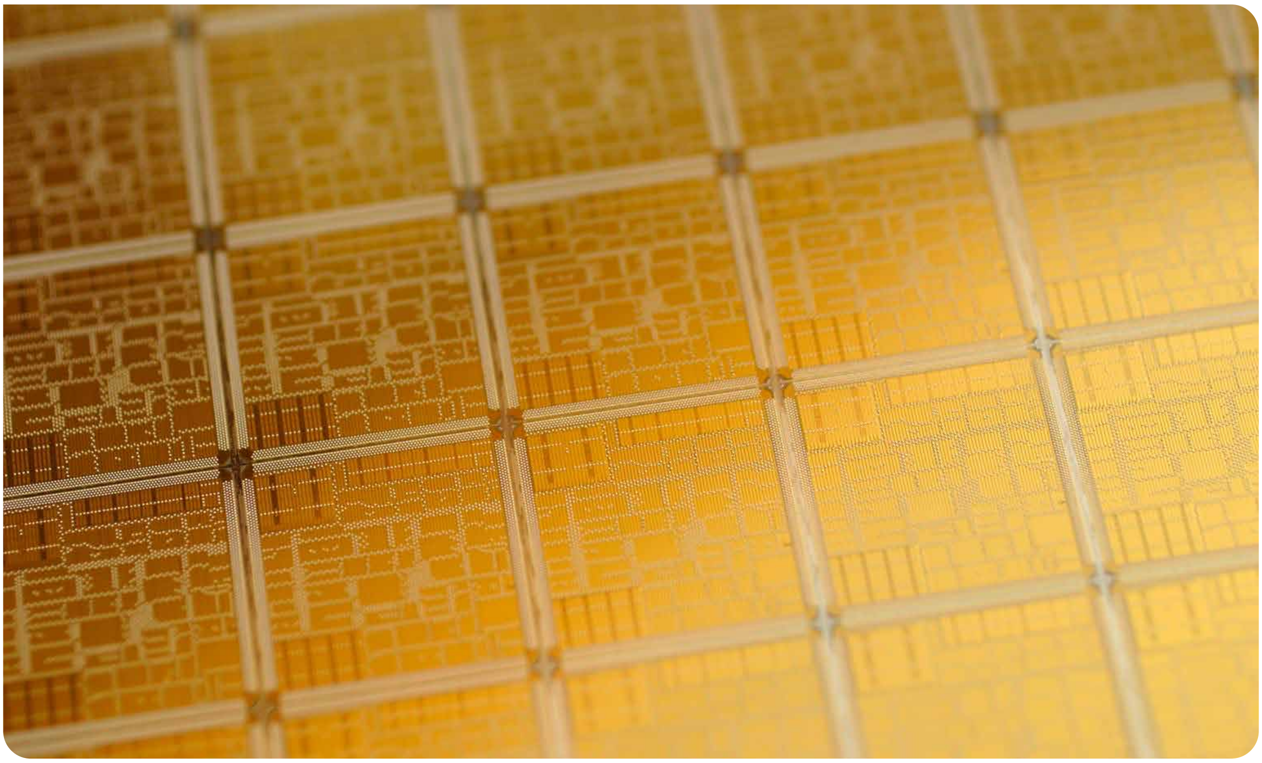
This report analyses gold's role in the global economy – from those who mine and refine it to those who cherish it, invest in it and make use of it. Analysing supply and demand trends across the globe, our report makes three central observations:

1. Interest in gold is broad, deep and growing, fuelled by demand from sovereign states, investors, savers and consumers.
2. Gold mining can deliver widespread social, economic and environmental benefits, when supported by advances in technology and new operational models.
3. Challenges persist across the gold industry, but these present an opportunity to drive change through innovation and ensure that gold is a fit-for-the-future asset.

Evolution in demand

Economic, social and geopolitical trends have contributed to fundamental shifts in demand for gold. Across the globe, rising tensions and financial market uncertainties are fuelling interest among institutional investors and retail savers, supported by increased ease of access to physical gold and gold-backed funds. Among central banks, there has been sustained gold buying since the Global Financial Crisis, accelerating still further in recent years. In China and India, rising wealth has fostered retail appetite for bars, coins and jewellery, reinforcing gold's cultural and financial significance across Asia. And in industry, gold's durability, conductivity and malleability make it a core component of AI infrastructure and other advanced technologies.

Even as demand flows evolve across the globe, the supply chain is also undergoing unprecedented change.



Supply chain in the spotlight

Amid growing calls for tangible evidence of responsible practice along the value chain, gold miners are at the forefront of technological and operational innovations to reduce harmful emissions, drive efficiency, forge stronger partnerships with local communities and root out criminal activity.

Much has been achieved but challenges remain. Gold's value as a trusted asset does not just depend on its intrinsic qualities but also on how it is produced, refined, sold and stored. Transparency, responsible sourcing and environmental performance have become critical considerations, defining gold's legitimacy among regulators, responsible investors, lenders and consumers.

This creates a series of challenges for the gold industry, as it strives to deliver ESG change, while responding to a fast-moving regulatory environment. Innovation can provide many of the answers. But industry players are under growing pressure to ensure they are abreast of new developments and can adapt swiftly to stakeholder demands.

The opportunity is clear: gold that can prove its origin, integrity, and sustainability, will strengthen its position as a credible, resilient asset in a changing financial landscape. The long-term relevance of gold depends not just on being scarce — but on being trusted, transparent, and responsible.

To that end, this report makes four key points:

1. The value of gold is recognised globally, evidenced by rising and widespread demand.
2. The gold industry faces growing calls for change.
3. Key players are already adapting their models and delivering on their obligations, capitalising on technology and cross-industry learnings.
4. Now the entire industry must follow suit, adopting new processes, exploring new partnerships and driving transparency along the supply chain.

Gold plays a critical role in socioeconomic growth, financial stability and cultural traditions. Now more than ever, there is an opportunity to ensure gold's global contribution is understood and appreciated.

The industry is being called upon to step up and act. Heeding those calls should usher in a new era for gold, built on trust, understanding and confidence in gold's role as a force for good.

1. Global demand for gold

Gold has been recognised as a unique commodity since prehistoric times. Used by ancient civilisations across the globe, gold was the dominant form of exchange for centuries and served as the backbone of the monetary system until the 1970s. No longer used in this way, gold continues to play an integral role in society. It remains a cornerstone of global economic stability, is increasingly perceived as a core investment asset and makes a central contribution to cultural traditions worldwide.

Demand for gold extends across four key sectors: investment, jewellery, central banks and technology. Each is fuelled by distinct drivers, and it is this diversity of demand that makes gold so different from other asset classes and so widely prized by sovereign states, institutions and individuals.

Structural changes have benefited gold too. The introduction of Exchange Traded Funds (ETFs) in 2002 opened the market to many more investors by making it simpler and more cost-effective to buy gold. Growing prosperity in China and India has had a material impact on demand, as both countries have a strong affinity with gold. And central banks, particularly those in emerging markets, have become consistent buyers of gold.

Gold as an investment asset

Gold has been valued as an investment asset and a store of wealth for thousands of years. Those characteristics remain as relevant today as in ancient times. For modern investors, gold offers three key benefits: it delivers long-term returns, improves diversification and enhances liquidity.

Long-term returns

Unlike stocks and bonds, gold pays no interest or dividends. But unlike almost every other asset, it is no one's liability and cannot be debased. Data stretching back decades underscores gold's ability to deliver long-term gains. Over the past 50 years, gold has delivered average annual returns of 8%, higher than many other asset classes, including bonds. That outperformance can be seen in the past three, five, 10 and 20 years as well and in recent times, gold has delivered even greater returns, rising 26% in the first half of 2025, to become one of the best-performing investments across financial markets. This strong performance is no coincidence. World Gold Council research[1] shows that the gold price over the long term

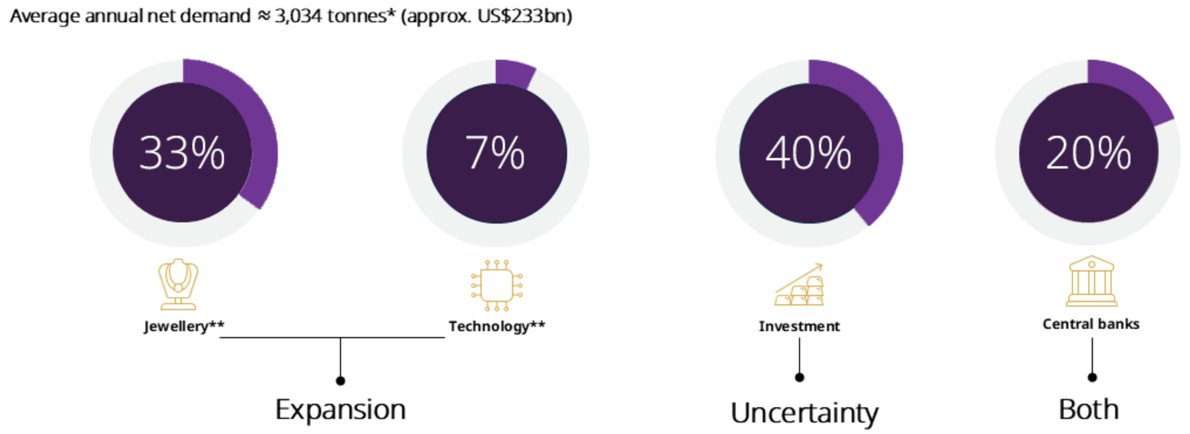


Chart: Average annual demand for gold – by sector

1. https://www.gold.org/goldhub/research/golds-long-term-expected-return-glter

closely mirrors global GDP and is materially higher than inflation. Simply put, gold can make a positive contribution to long-term portfolio returns.

Gold acts as a highly effective hedge against inflation too. Based on historical performance, when inflation is running at 2-5%, gold delivers a nominal average return of close to 8.5% and a real return of more than 5% per annum. When inflation exceeds 5%, gold comes into its own, delivering an average real return of more than 14%.

Diversification

Effective diversification can be hard to find because financial assets often move synchronously when economic or geopolitical conditions deteriorate. Equities tend to fall when GDP growth stalls; commodities and real estate may follow suit and bonds can tumble when interest rates rise. Gold is different. When stock or bond markets lose ground, investors turn to gold.

During the Global Financial Crisis, equities and other risk assets plummeted in value, along with hedge funds, real estate and commodities that were long considered portfolio diversifiers. Gold soared, rising 21% between December 2007 and February 2009. Gold held its own in 2020 and 2022 as well, when equities and bonds were in retreat.

Gold does not just do well when times are hard, however. When economic conditions are benign, consumers acquire gold for its beauty, cultural heritage and wealth preservation properties.

These unrivalled characteristics mean that gold provides true diversification.

Liquidity

The gold market is large, global, and highly liquid. The WGC estimates that physical gold holdings by investors and central banks are worth approximately US$5.1 trillion, with a further US$1 trillion added through derivatives traded on exchanges or the over-the-counter (OTC) market.

The gold market is also more liquid than several major financial markets, with trading volumes similar to those of US Treasury Bills, averaging over US$200 billion per day in 2024.

This scale and depth mean that the market can comfortably accommodate large institutional investors. Crucially, gold's liquidity does not dry up, even at times of financial stress. This means that investors can meet their liabilities when less liquid assets in their portfolio are difficult to sell or are mispriced.

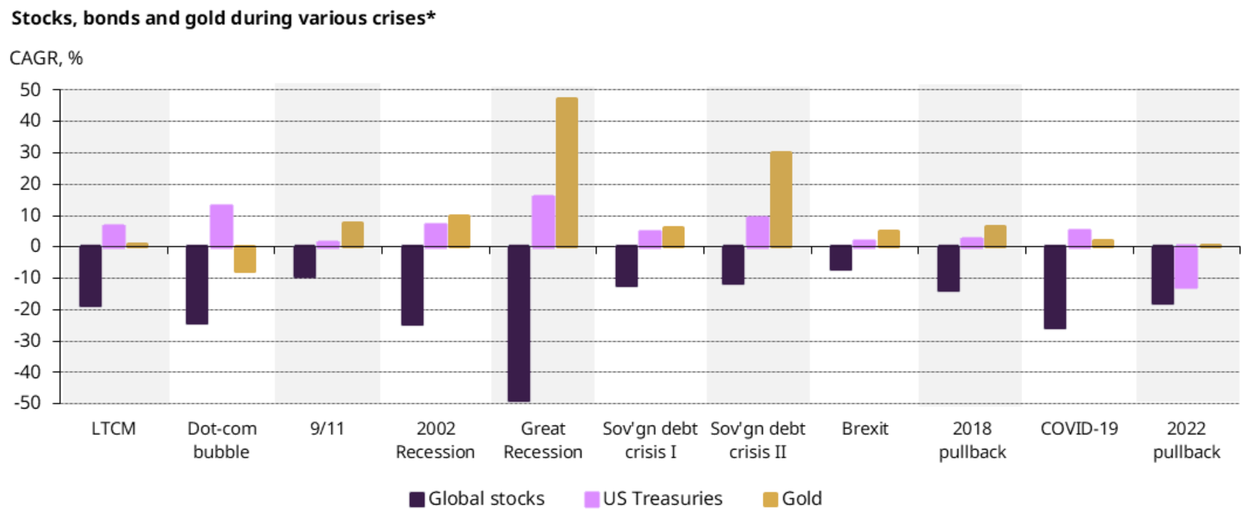


Chart: Gold price tends to increase in periods of systemic risk

Sustainability

Many large investors now incorporate sustainability objectives into their investment strategies. Gold can play an important role in this regard as well. Gold that is produced by companies adhering to high sustainability standards helps reduce investor risks. Gold also has a potential role to play in reducing investor exposure to climate-related risks. Research suggests that gold may perform better than many mainstream asset classes under various long-term climate scenarios, particularly if climate-related events trigger or exacerbate market volatility or if the world's transition to a net zero carbon economy is volatile.[2]

Long-term returns, effective diversification, and liquidity all benefit overall investment portfolio performance. In combination, they suggest that gold can play a key role as a strategic asset in a well-balanced investment portfolio.

Retail investment

Retail investment, where individual, non-professional investors buy and sell financial instruments for their personal accounts, is an important component of the gold market. Whilst retail investment activity is often fuelled by rising incomes, consumer motivations reflect those of institutional investors: wealth preservation, inflation protection and portfolio diversification. In a global survey[3] of over 17,000 consumers, three principal reasons were cited for buying gold: it is a safeguard against inflation and currency fluctuations; it does not lose value over the long term, and it generates a feeling of security.

In emerging markets, where few financial products are available or general banking penetration is limited, gold takes on even greater importance, enhancing financial security and driving financial inclusion. Today, developing economies account for nearly three-quarters of gold consumption and rising incomes in these regions have had a significant impact on gold demand. For lower-income countries in particular, gold is a major household financial asset, especially when formal financial markets are undeveloped or local currencies have been volatile.

Consumers can access the gold market in several ways. Most purchase bars, coins and jewellery from retailers but they can also invest in managed gold products. These allow consumers to purchase gold and have it stored or 'managed' on their behalf in a vault. Products include digital gold accounts, gold accumulation plans, physically-backed gold tokens and even gold-backed ETFs. Introduced just over 20 years ago by the World Gold Council with State Street Investment Management, these exchange-traded funds have transformed investment in gold, creating a market valued at more than US$300 billion.

Central banks

Central bank reserves play a critical role in global financial stability. Assets held as reserves need to provide safety, liquidity and returns, and gold is one of the very few assets to meet these criteria. As such, central banks view gold as an important asset financially, strategically and politically.

The Global Financial Crisis precipitated a step-change in central bank attitudes towards gold. Concerned about vulnerabilities in the global financial system, central banks became net buyers of gold, acquiring more than 7,000 tonnes of gold in the past 15 years. Interest has intensified in recent times and today central banks account for approximately 20% of annual demand.

Average daily trading volumes over the last year in US dollars*

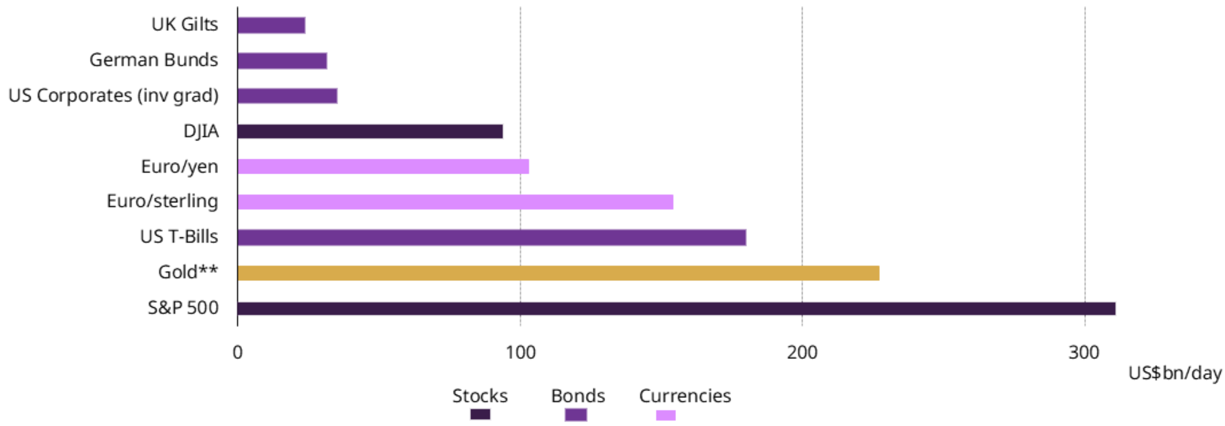


Chart: Gold price tends to increase in periods of systemic risk

2. https://www.gold.org/goldhub/esg/gold-and-climate-change-research
3. retailinsights.gold

Central banks from emerging and developing economies account for the vast majority of recent purchases and demand remains robust. In the first half of 2025, central banks purchased more than 415 tonnes of gold, despite elevated prices. Although the pace of buying has moderated, the outlook for central bank demand remains healthy.

While the Global Financial Crisis provoked a resurgence of interest in gold, other factors have also contributed to growing central bank demand. Rising geopolitical tension, for example, has prompted some policymakers to consider alternatives to the US dollar, even adopting de-dollarisation policies to reduce their dependence on the US currency.

Looking ahead, gold is likely to retain its importance as a reserve asset. The World Gold Council's latest Central Bank Gold Reserves (CBGR) survey[4] – revealed that 95% of respondents expect global gold reserves to increase over the next twelve months.

The survey provides in-depth analysis of central bank attitudes to gold, with respondents highlighting three key facets likely to drive continued interest in gold this year: gold's performance during times of crisis, its ability to act as a hedge against inflation and act as a store of value, and its role as an effective diversification tool. Gold's unique characteristics and role as a strategic asset continue to be valued by central banks as well.

Market	2024 tonnage	Annual y/y change (%)
India	563.4	-2
China	511.4	-24
Americas	175	-3
Middle East	157	-8
Europe	67.5	-4

Chart: Gold price tends to increase in periods of systemic risk

Jewellery

Jewellery accounts for around 33% of annual demand for gold, and the industry has a critical role to play in many parts of the globe. Whilst there are many large-scale jewellery manufacturers, production remains labour-intensive, as even machined pieces often require finishing by skilled craftspeople. There is also a large and vibrant artisanal jewellery industry, employing hundreds of thousands of people and helping to develop and sustain traditional skills from generation to generation. On a global basis, the jewellery industry employs more than two million individuals.

Preferences vary in terms of design and caratage, but across the world, gold jewellery is valued for its aesthetic appeal and wealth preservation properties. Unlike investment demand, interest in jewellery tends to fall when gold prices rise, reflecting greater sensitivity to short-term price fluctuations. Last year was a case in point, when demand fell 11% in volume terms to just over 2,100 tonnes, hit by a slump in activity from China, which left India as the world's largest jewellery market for the second time in three years.

Despite this, the value of jewellery purchased through 2024 rose 9% to a record US$144 billion, fuelled by the soaring gold price.

4. https://www.gold.org/goldhub/research/central-bank-gold-reserves-survey-2025

In focus: Indian jewellery demand

Gold is intrinsic to Indian culture, closely tied to religious beliefs, tradition and festivals. In recent times, India has overtaken China as the largest jewellery market in the world, following a period of rapid change and evolving demographics. Demand is driven primarily by festivals and weddings, with bridal jewellery alone accounting for at least 50% of market share. There are no official records, but the country is estimated to have around 11-13 million weddings per year. With women marrying at an average age of 22 and with more than half of the country's over 1.4 billion population estimated to be below the age of 25, demand for bridal jewellery looks set to remain strong for many years, particularly because gold gifted to a woman for her wedding is solely her property, making it an important form of financial security.

Much of the Indian gold market is very traditional, reflecting important cultural and religious ties. But change is underway, with new tastes and designs driven by economic growth, globalisation and shifting consumer preferences. In recent years, for example, demand has grown for lightweight and studded jewellery, in contrast to more established 22-carat pieces.[5]

Over the long term, gold jewellery demand in India will be determined by developments in economic growth, income growth and wealth distribution, as well as the rate of urbanisation.

Technology

Whilst technology is the smallest component of gold demand, accounting for around 7% annually, it has an important and growing role. In 2024, the technology sector used 326 tonnes of gold, up 7% year-on-year. Much of this increase came from high-end AI infrastructure, including memory chips, processors and sensors. Gold's superior electrical conductivity and resistance to corrosion make it an important component for these products, and demand is rising as AI becomes a cornerstone of modern technology.

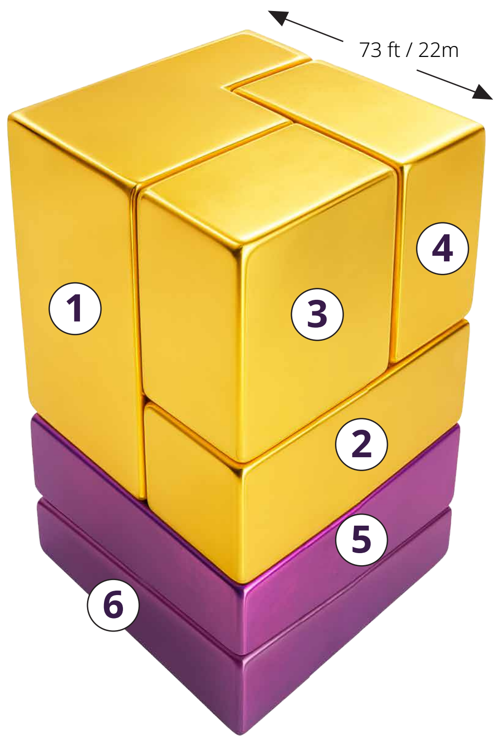


Chart: Above-ground stocks of gold

Total above-ground stock (end-2024): 216,265 tonnes

1. **Jewellery** ~97,149t, 45%
2. **Bars and coins (including gold backed ETFs)** ~48,634t, 22%
3. **Central banks** ~37,755t, 17%
4. **Other** ~32,727t, 15%
5. **Reserves** ~54,770t*
6. **Resources** ~132,110t*t

5. https://www.gold.org/goldhub/research/jewellery-demand-and-trade-india-gold-market-series

Alongside AI hardware, gold features in billions of electronic devices and plays a role in aerospace, space technology and green energy advances, such as clean hydrogen and carbon dioxide transformation. Gold is even used in healthcare, from cancer treatment to lateral flow tests.

Gold will almost certainly remain a critical component for many of these processes, especially high-end or safety-critical applications where its resistance to corrosion gives it an edge over potentially cheaper substitutes. A valuable resource across multiple sectors, gold's unique properties underscore its continued relevance in the ever-evolving technology landscape.

Gold as a liquid asset

Basel III is an international framework that sets standards and minimum capital requirements for banks around the world. Under Basel III rules, gold is not officially recognised as a High Quality Liquid Asset (HQLA). However, many in the industry believe this should change. As defined in the international Basel Framework, High Quality Liquid Assets need to satisfy certain fundamental and market-related characteristics. Evidence suggests that gold satisfies many of these.

Fundamental characteristics include:

- Low risk – gold is an asset that does not hold credit risk.
- Ease and certainty of valuation – while gold does not fit common valuation models used for bonds or some stocks, its behaviour is determined by market forces with readily available market prices.
- Low correlation with risky assets – gold is an effective diversifier that performs well in periods of crisis.

Market-related characteristics include:

- Active and sizeable market – the gold market is large and liquid, trading more than US$120 billion per day on average on the over-the-counter market alone.
- Low volatility – gold's volatility is at a par with that of 30-year US Treasuries and below individual stocks.
- Flight to quality – gold tends to be the recipient of investment flows during periods of risk, also evidenced by its negative correlation with the stock market.

In focus: The role of gold in ASEAN countries

The ASEAN region is one of the most diverse and economically vibrant in the world, comprising ten Southeast Asian nations: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. Southeast Asia is a very good case study as to the importance of gold across different cultures and levels of national economic development. Gold has a long-established foothold in these economies, with demand exceeding 180 tonnes last year, according to the World Gold Council's Gold Demand Trends data.

The region is not just a major consumer of gold; it plays a key role across the value chain. Indonesia and the Philippines are home to significant gold mining operations; Singapore is a major trading and refining centre, and the jewellery created in Thailand and Indonesia is prized around the world for craftsmanship, forward-thinking designs and value for money.

Vietnam is the largest gold-consuming nation in Southeast Asia and World Gold Council research[6] revealed that 81% of Vietnamese view gold as a safeguard against political and economic uncertainty. A similar number of respondents believe gold confers long-term financial security and a majority of those surveyed trusted it more than fiat currencies.

In other ASEAN markets, including Indonesia and Malaysia, gold pawning is a huge business, facilitating access to credit for individuals and small businesses. Indonesia's biggest pawn shop operator, PT Pegadaian, is state-owned and the country is home to several popular digital gold platforms that facilitate gold transactions in small denominations. Four years ago, Indonesia pioneered a blockchain-based, precious metals-backed payments and savings platform operating outside the banking system to increase financial inclusion. Known as PosGo Syariah, this Sharia-compliant mobile platform allows users to trade gold and silver, as well as save, transact and manage their wealth in digital tokens without the need for bank accounts.

In focus: Gold and financial inclusion

In many emerging markets, formal banking penetration can be stubbornly low, creating a significant obstacle to growth and development. In response, governments, NGOs and international organisations have made financial inclusion a major policy objective.

Gold can play a central role in this regard. WGC research[7] shows that gold is widely perceived as an attractive financial asset: its physical nature, the ease with which it can be bought and sold, and its historical outperformance compared to currencies and many other asset classes are big drivers of demand. In many parts of the world, gold is used as a store of value, pawned or deployed as collateral to obtain credit. In a growing number of markets, such as Vietnam, gold is used for payments.

Gold can also bring the financial security needed to start a business or help individuals meet unexpected costs, such as healthcare expenses. Where consumers trust and understand gold, retail banks can build on this understanding to offer gold-backed banking products to customers. Often seen as a long-term asset, gold can also help ensure financial freedom in retirement, with many individuals holding gold for the long-term.

In rural areas where access to bank accounts is, on average, lower, gold can - and often does - fill the gap. As such, gold helps to foster financial stability, particularly among under-served and marginalised communities: women, children, rural populations and the working poor.

In short, gold is seen as a vehicle to support financial empowerment in many ways, including:

- A form of savings, to protect individual and household wealth
- A means of passing wealth to the next generation or marking major personal milestones
- Access to credit, by using gold as collateral
- To meet unexpected financial costs such as medical bills
- To make payment for 'big ticket' items, such as houses and cars.

Key takeaways

- Demand for gold is exceptionally diverse, spanning investment, adornment, central bank reserves and technology.
- This diversity of demand means that gold is more resilient across economic cycles than almost any other asset, recognised as a long-term wealth preservation tool the world over.
- Gold also plays a central role in Asian economies, helping to combat financial inclusion, generate wealth and contribute to festivals and weddings across the region.

6. https://retailinsights.gold/regional-spotlights/vietnam/investment.html
7. https://retailinsights.gold/index.html

2. Supplying the market, responsibly

Gold mining underpins the modern gold market, supporting demand from investors, consumers, central banks and businesses. Around three quarters of ongoing demand for gold is sourced from mine supply, equating to more than 3,500 tonnes of newly-mined gold annually.

Gold mining fuels social and economic growth, creating value and delivering opportunities that extend far beyond the mine site. Often working in areas with scant existing infrastructure or alternative economic activity, responsible operators generate employment, upskill workers and transform local communities. In the process, they catalyse socio-economic growth in places that need it most.

WGC research shows that, last year alone, member companies directly contributed US$60.4 billion to host economies in taxes and royalties, payments to suppliers, employee wages and contributions to communities.[8] Responsible miners do not just build mines, they support entrepreneurship, helping local people, often women, to run businesses that cater to community needs. Gold miners frequently build schools and health centres on or near their mines too, and will often build renewable energy plants that long outlive their mines.

Today, miners can move even faster, leveraging technology and curating new business models to reinforce gold mining's positive contribution to society and host communities.

The second section of this report focuses on mined supply, from exploration, extraction and processing, to technical, environmental and community factors. We also analyse the social, environmental and technological shifts that are driving change across the industry, delivering results and reinforcing gold mining's positive contribution to society.

Driving exploration efficiency

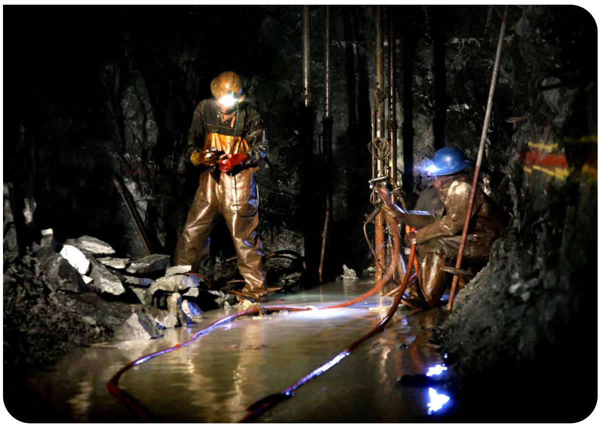
Gold mining is a long and complex process. Mine sites are often in remote and challenging locations and there are many steps from discovery to first production[9], including economic feasibility studies, social and environmental permitting and planning more broadly. Projects frequently take 15 to 20 years to become commercially viable and success is never guaranteed. Today, however, technology can catalyse change, driving efficiency, improving extraction processes and reducing miners' carbon footprint.

At the exploration stage, machine learning can make a tangible difference, enhancing analysis of geophysical and geochemical data to improve targeting and reduce the need for drilling. Newmont Corporation is already benefiting from these advances. The world's largest gold mining group, Newmont has materially improved resource estimation and narrowed the scope of exploration by using artificial intelligence to analyse vast geological datasets. The company has also implemented AI-driven drilling systems at its Nevada operations[10], reducing operational costs by 25%, while enhancing extraction accuracy.

BHP focuses primarily on base metals, but the group is setting an industry benchmark in AI-driven exploration, which is now being mirrored by gold companies including Newmont.

KoBold Metals, a startup backed by investors including Bill Gates and Jeff Bezos, employs AI to discover new sources of critical metals such as copper, lithium, and cobalt. By compiling extensive geological data and applying machine learning algorithms, KoBold identifies promising exploration sites more efficiently than traditional methods.

Technology to drive exploration efficiency is available and being used in mining of other commodities – highlighting the imperative for gold mining to glean learnings from across the sector.



8. https://www.gold.org/esg/the-social-and-economic-contribution-of-gold-mining-2024-data-update
9. https://www.spglobal.com/market-intelligence/en/news-insights/research/discovery-to-production-averages-15-7-years-for-127-mines
10. https://thesiliconreview.com/2025/03/newmont-ai-drilling-nevada?utm

Process enhancements

Gold mining is traditionally associated with high energy consumption, significant water use and substantial tailings. Today, however, mining companies are increasingly attuned to these issues, striving to improve their environmental performance well beyond minimum compliance demands.

The benefits are clear. Pioneers in this space reduce their exposure to energy, water, and tailings risks, and are better positioned to meet stricter ESG expectations and secure capital from sustainability-focused lenders and investors.

Orebody gains

Once a mine is up and running, orebody knowledge is a key performance driver, reducing risk, increasing recovery and supporting better long-term planning. Improving geological models, using downhole geophysics, machine learning and high-resolution drilling can optimise mine plans, reduce dilution and improve reconciliation. Newmont and BHP are both deploying advanced data analytics and geo-metallurgical modelling to fine-tune production strategies, increasing recovery while lowering energy and reagent intensity.

Greater understanding of the orebody also improves miners' ability to integrate ESG considerations into life-of-asset strategies, from water use to waste rock management and emissions intensity.

Flowsheet efficiency

Most gold operations process low-grade ore with conventional flowsheets. Efficiency gains in these circuits can deliver immediate reductions in energy, chemical use, and waste generation.

Technologies in deployment include:

- Sensor-based ore sorting, which removes waste rock prior to processing, reducing energy and reagent use[11]
- Digital twins, enabling simulation and real-time optimisation of grinding, flotation and leaching circuits
- Predictive maintenance, improving equipment reliability and reducing unplanned downtime and energy intensity.

Beyond incremental optimisation however, step-change improvements in concentrator performance can be achieved through flowsheet redesign. These advances improve mineral liberation, enable recovery at coarser particle sizes, reduce

energy and water use and support selective separation and tailings reduction. Examples include:

- Microwave treatment: Induces thermal stress that creates micro-fractures in target minerals, reducing comminution energy and improving downstream liberation.
  - ➔ Trialled by Anglo American as part of FutureSmart Mining[12]
- High-pressure grinding rolls (HPGR) with air classification: Enables more efficient grinding by applying inter-particle pressure and removing fines early.
  - ➔ Applied at at AngloGold Ashanti's (70%) Tropicana Gold Mine, WA, with energy and recovery benefits[13]
- Coarse particle flotation (CPF): Allows recovery of liberated particles at larger sizes, reducing energy demand for fine grinding.
  - ➔ HydroFloat™ applied at Newcrest's Cadia operation for early gangue rejection and plant stability[14].
- Ore preconditioning using High Voltage Pulse (HVP): Shown to selectively fracture copper–gold ores, enabling pre-concentration and mass rejection of up to 23% with minimal gold loss.
  - ➔ Case study: Low-grade Cu-Au ore, AusIMM Mill Operators Conference (2018)[15]

11. Trialled by Gold Fields
12. https://www.angloamerican.com/futuresmart/stories/our-industry/technology/using-microwave-technology-to-pre-condition-rock
13. https://www.koeppern-international.com/fileadmin/user_upload/downloads/Comminution/Paper_HPGR_case_study_SAG_conference_2015.pdf
14. https://www.ceecthefuture.org/resources/coarse-particle-flotation-at-cadia-valley-operations-2022
15. https://www.ausimm.com/publications/conference-proceedings/14th-ausimm-mill-operators-conference-2018/high-voltage-pulse-pre-concentration-study-using-a-low-grade-copper-gold-ore/

Leaching improvements

Cost-effective and efficient, cyanide remains the dominant reagent for gold leaching. But growing concerns around cyanide's environmental impact and effects on human health are driving gold miners to seek viable alternatives that reduce toxicity, improve selectivity and expand the range of ores that can be processed - particularly refractory and preg-robbing ores. Several of these technologies are now being piloted or deployed across the industry.

- Thiosulfate leaching: A non-toxic alternative to cyanide[16], effective for preg-robbing ores and materials with high organic content. SGS developed and demonstrated a thiosulfate system with comparable recoveries to cyanide and reduced environmental risk.
- Glycine-based leaching (GlyLeach™): Uses glycine as a lixiviant, often in combination with small amounts of cyanide or peroxide, for base metal-gold ores[17]. Developed by Curtin University in collaboration with Mining & Process Solutions (MPS) in Australia.
- Chloride-based leaching systems: Provides selective extraction of gold under controlled conditions[18], particularly in refractory and electronic waste streams. Barrick and Newmont have conducted R&D into chloride-based systems for difficult ores; companies such as Destiny Copper are also exploring this space.

These systems are not drop-in replacements for cyanide and typically require adjustments to circuit design, pH control and downstream recovery. However, they are increasingly viable in specific applications, such as gold-bearing e-waste, carbonaceous ores and deposits with complex mineralogy, where cyanide performance is poor or public opposition is high.

Water and tailings management

Tailings and water management present both environmental risk and social friction. Investors are increasingly concerned about tailings dam failures, while local communities and regulators worry about water quality and competition for what may be a scarce resource.

Across the gold sector, companies are advancing dry-stack and thickened tailings systems, as well as real-time monitoring technologies, to strengthen safety and reduce water use. Evolution Mining, AngloGold Ashanti, Newmont and Barrick, among others, are deploying these solutions at multiple sites.

- Evolution Mining has committed to dry-stack tailings at several operations, reducing water loss and structural risk.
- AngloGold Ashanti has implemented dry-stack tailings at its Brazilian operations, aligning with its broader tailings risk reduction program.
- Newmont and Barrick are investing in advanced dam monitoring systems that combine satellite data, sensors, and digital analytics for early detection and risk management.

Key innovations shaping tailings and water management include:

- Dry-stack and thickened tailings to minimise failure risk and water consumption.
- Tailings reprocessing to recover residual gold and stabilise legacy sites - a strategy long used by DRDGOLD in South Africa and increasingly adopted elsewhere.
- Closed-loop water systems to minimise freshwater withdrawal and reduce discharge liabilities.

These measures have several benefits. They reduce operational and environmental risk, as well as reducing non-technical risk by enhancing relationships with local communities and policymakers, and raising ESG scores deployed by institutional investors and sustainability finance providers.

Energy use and emissions

Energy use - particularly from diesel and grid electricity - remains the dominant source of Scope 1 and 2 emissions[19] in gold mining. Ventilation, comminution, dewatering, and pumping are all energy-intensive processes and many mines are in off-grid or remote regions, increasing their reliance on fossil fuels. Nonetheless, net-zero commitments have made emission reduction a strategic priority for the industry.

16. https://www.sgs.com/-/media/sgscorp/documents/corporate/brochures/sgs-min-wa018-thiosulphate-leaching-alternative-to-cyanide-in-gold-processing-en-11.cdn.en.pdf
17. https://www.draslovka.com/glt
18. https://www.sciencedirect.com/science/article/abs/pii/S0892687521005653
19. Scope 1 emissions are direct greenhouse gas emissions from sources owned or controlled by a company (e.g., fuel combustion in company vehicles or facilities). Scope 2 emissions are indirect emissions from purchased electricity, steam, heating, or cooling consumed by the company

In response, miners are adopting power system upgrades, equipment electrification and digital optimisation tools to lower their carbon footprint. Key examples include:

- Hybrid renewable microgrids: these integrate renewable energy sources such as solar and wind with battery storage and backup generators. Particularly effective for off-grid mines, these systems aim to increase renewable energy use, reduce reliance on fossil fuels and enhance energy security and reliability. Gold Fields' Agnew mine in Western Australia, for example, uses a hybrid renewable microgrid,[20] consisting of wind turbines, a solar farm, battery storage and gas-engine generators. Northern Star Resources has deployed solar, wind, and battery systems at multiple Australian operations.[21] The Tropicana Gold Mine (jointly owned by AngloGold Ashanti and Regis Resources) has introduced a hybrid renewable power station comprising wind, solar, battery storage, and gas generation.
- Electrification of mobile equipment: Gold miners are increasingly adopting Battery Electric Vehicles (BEVs) to reduce emissions and improve underground mining conditions. BEVs eliminate direct carbon emissions, reduce heat and noise, and can be part of a broader strategy to decarbonise operations. Many mining companies, including Gold Fields, and Agnico Eagle, are actively trialling and integrating BEVs into their underground fleets.[22]
- Power purchase agreements (PPAs) for renewables: Gold miners are increasingly introducing renewable energy systems - particularly at remote, off-grid operations historically dependent on diesel or gas-fired generation - to reduce emissions, stabilise energy costs, and improve energy security. Power Purchase Agreements (PPAs) are the contractual mechanism that typically enable these transitions, as companies integrate renewables into their operations and advance decarbonisation objectives. Newmont's long-term PPA with Collgar Renewables will materially reduce its Scope 2 emissions by 2030. AngloGold Ashanti's Australian arm entered a 10-year, 62 MW hybrid PPA with Pacific Energy, combining wind and solar generation to power its operations. And Agnico Eagle leverages PPAs and renewable assurances across its global portfolio - for example, Pinos Altos sources solar power under a PPA, while since 2023 Kittilä in Finland has secured commercial assurances that 100 % of its grid electricity is from zero-emission sources.[23,24]

These improvements directly affect the ESG profile of gold at the mine level - lowering Scope 1 and 2 emissions, improving safety, and reducing environmental liabilities. As investors increasingly assess assets on both financial and non-financial performance, producers who adopt these innovations are better positioned to access sustainability-linked financing, reduce reputational risk, and contribute to long-term industry stability.

From risk mitigation to value creation

Many in the gold industry no longer view social responsibility as compliance, recognising instead that community relationships can be a source of strength and differentiation.

- Community-centred innovation addresses local priorities, while creating business value through reduced risk and improved operations.
- Social return on investment metrics help quantify and communicate the shared value created through these approaches.
- International standards, such as the Responsible Gold Mining Principles (RGMPs)™ establish baseline expectations that companies can exceed through innovation.

Enhancing engagement through innovation

The power of mining as a development engine cannot be underestimated. Extending far beyond economic value creation, gold mining fuels social development, bolsters in-country growth and drives environmental stewardship. The sector creates well-paid jobs and promotes skills development, provides valuable tax revenues and generates important benefits for host communities, including investment in infrastructure. Today, however, the industry is under pressure to go further and faster, developing models and approaches that share value with local stakeholders, transparently and from the ground up.

20. https://arena.gov.au/knowledge-bank/gold-fields-agnew-gold-mine-final-report/
21. https://zenithenergy.com.au/zenith-energy-advances-the-jundee-renewables-project/
22.https://www.australianresourcesandinvestment.com.au/2021/06/08/reducing-the-carbon-footprint-of-gold-operations/, https://www.rocktechnology.sandvik/en/news-and-media/news-archive/2021/09/sandvik-and-gold-fields-partner-to-trial-bev-technology-in-australia/, https://fgmcommunity.com.au/news/ushering-in-a-new-era-of-sustainable-mining
23. https://www.collgar.com.au/post/newmont-signs-long-term-power-purchase-agreement-with-collgar-wind-farm
24. https://energyandmines.com/2023/07/anglogolds-australian-arm-enters-10-year-62mw-hybrid-ppa-with-pacific-energy/

Community-focused evolution

Traditional approaches to corporate social responsibility were once the norm across the mining industry. Today, many miners are pursuing a more strategic approach to stakeholder engagement, recognising the need to prioritise shared economic value, if they are to leave a positive impact and legacy on host communities. This is particularly important for gold miners. From large-scale operations to artisanal activity, gold mining is intricately linked to host communities, perhaps more so than any other commodity. To that end, forward-thinking miners are developing constructive partnerships with host communities, identifying local aspirations, employment opportunities and the potential for knowledge transfer.

The Mount Morgan mine in Queensland, Australia exemplifies this approach. When the site closed in 1990, the host community was affected environmentally, socially and economically. Historically a gold-mining powerhouse, Mount Morgan town lost skills, residents and socio-economic status when the mine ceased operations.

In recent years, however, Heritage Minerals has discovered a way to re-process the tailings, unlocking significant value.[25] Importantly, Heritage has focused on the host community in reopening the site, prioritising the procurement of local equipment and services, while employing local people and re-developing their skills. The operation is now sharing value with the community through both economic opportunity and environmental improvement, transforming a liability into an asset for all stakeholders.

Indigenous partnerships

Indigenous lands host or neighbour many gold deposits, making equitable partnerships a cornerstone of shared economic value and essential for sustainable development.

The concept of the 'triangle of trust'[26], established among mining companies, the government, and First Nations communities, is just one framework for partnership in mining; importantly, it creates a shared vision of prosperity for all stakeholders and owners from the outset of a project. This represents a positive change from consultation processes used in some countries, where local stakeholders are asked to respond to pre-existing proposals. Instead, the triangle of trust requires genuine dialogue between local communities, miners and government bodies before plans have even been submitted.

Greenstone Mine in Canada, one of Canada's largest and lowest-cost gold mines, exemplifies this approach. Five First Nations groups are involved in the mine, all with long-term relationship agreements in place, concrete outcomes in employment, training and procurement, as well as wealth-sharing mechanisms that extend beyond the life of mine.

In Australia, AngloGold Ashanti's 30-year partnership with the Carey Group represents one of the country's most enduring Indigenous business relationships, demonstrating the value of sustained collaboration and local capacity-building through mining operations.

True partnership models, allowing Indigenous communities to participate in and benefit from the long-term development of their lands, generates economic value and drives social development. But there are wider benefits too, building trust with host countries, enhancing ESG credentials among investors and highlighting social responsibility endeavours to end-consumers too.

Key takeaways

- The gold mining industry has made significant steps in recent years, but new technologies, new systems and new operating models provide miners with the opportunity to go further, faster.
- By adopting cutting-edge techniques and approaches, gold miners can drive efficiency gains, secure competitive advantage and improve stakeholder engagement along the value chain.
- This will support gold's legitimacy as a trusted asset and offer a model for other extractive industries, evidencing the importance of transparency, trust and technology and fostering growth through social progress.

25. https://miningmagazine.com.au/new-tech-to-revitalise-mt-morgan-gold-mine/
26. https://www.canadianminingjournal.com/featured-article/establishing-the-triangle-of-trust-by-creating-a-shared-vision-of-prosperity/

Responsible Gold Mining Principles

The Responsible Gold Mining Principles[27] were developed by the World Gold Council to address shifts in societal and stakeholder expectations and show that the industry is responding to them.

- Covering material risks and opportunities across the ESG space, the RGMPs™ define what responsible gold mining means today. Principles include commitments on climate action, health and safety, human rights and supply chain integrity.
- Companies that adopt these Principles need to gain independent assurance of conformance, so providing measurable evidence that they are responding to stakeholder expectations and demonstrating progress in key ESG areas.
- The RGMPs™ are mandatory for WGC members but all gold mining companies are encouraged to adopt them.
- To address society's growing demand for responsible mining, the World Gold Council is working with leading mining industry partners on a consolidated standard that brings together the best aspects of four well-established standards, The Copper Mark's Risk Readiness Assessment (RRA), Mining Association of Canada's Towards Sustainable Mining (TSM), World Gold Council's Responsible Gold Mining Principles and ICMM's Mining Principles, into one global standard. The Consolidated Mining Standards Initiative (CMSI)[28] will clarify responsible mining and metals practices, and reduce complexities, across different geographies, commodities, and companies. The first public consultation took place in 2024, and in September 2025 the CMSI partners published its governance model.

27. https://www.gold.org/industry-standards/responsible-gold-mining
28. Consolidated Mining Standards Initiative: https://miningstandardinitiative.org/

3. Gold in a new era: Challenges and opportunities

Recent years have seen a decisive shift in stakeholder attitudes towards the corporate world. Sustainability, environmental awareness, social responsibility and strong governance have moved to centre stage and today, gold's status as a trusted store of value depends not just on its scarcity or liquidity, but on the credibility of how it is produced and traded.

Consumers want to understand if the gold they buy has been responsibly sourced and produced; investors and downstream industries are demanding stronger environmental and social performance; employees want reassurance that their employers treat suppliers with fairness and respect. And regulators need to ensure that industry players are complying with standards and demonstrating best practice.

The gold industry has a good story to tell. Large-scale mining companies have undertaken significant work to ensure their operations have a positive environmental and societal impact. The sector is a significant employer in host communities, generates valuable tax revenues and is making meaningful progress to reach net zero by 2050, in alignment with the Paris Agreement. However, challenges remain, not least around the transparency and integrity of the supply chain and the influence of illicit actors within the industry.

Artisanal and small-scale gold mining

Artisanal and small-scale gold mining (ASGM) represents one of the highest-risk segments of the gold supply chain. Over the past two decades, ASGM has expanded significantly, particularly in developing countries across Africa, Latin America, and Southeast Asia. Growth has been driven by persistently high gold prices, limited rural employment opportunities, and the relatively low capital requirements for entry into small-scale artisanal mining. As a result, ASGM has grown from roughly 4% of production 20 years ago to approximately 20% now. According to the World Bank, 15 to 20 million people are directly involved in ASGM, with up to 100 million people depending on it indirectly for their livelihoods.

Despite its economic significance, the majority of ASGM activity occurs outside formal legal and regulatory frameworks. This has raised serious concerns around environmental degradation, hazardous working conditions and the involvement of illicit actors. The widespread use of mercury in gold extraction has drawn particular international scrutiny, prompting global responses such as the Minamata Convention on Mercury.[29] Additionally, frameworks such as the OECD Due Diligence Guidance on the Responsible Sourcing of Minerals[30] have intensified focus on ASGM-linked supply chains, especially where there are risks of conflict financing or human rights violations.

In response to these challenges and in a bid to promote responsible practices, the World Gold Council published a study[31] on how best to combat the illicit financing of ASGM. The report includes a series of recommendations, designed to help ASGM actors to enter the formal supply chain, while driving standards, reducing the influence of illicit activities and diverting ASGM from the funding of conflict.

29. https://minamataconvention.org/en/about
30. https://www.oecd.org/en/publications/2016/04/oecd-due-diligence-guidance-for-responsible-supply-chains-of-minerals-from-conflict-affected-and-high-risk-areas_g1g65996.html
31. https://www.gold.org/news-and-events/press-releases/new-report-uncovers-scale-exploitation-artisanal-gold-miners-fund

The WGC has also partnered with industry stakeholders on initiatives that support the formalisation of ASGM, including scalable processing plant models and the deployment of new technologies that can track and verify the provenance of gold. Centralised processing plants can significantly enhance gold recovery rates, boosting miners' incomes. Processing plants also serve as key aggregation points in the gold value chain, promoting transparency and traceability.

To increase the role of responsible finance, the World Gold Council is working with central banks to develop and scale domestic ASGM purchase programmes. The programme aims to integrate responsibly-mined ASGM gold into formal markets, thereby reducing harmful environmental practices, shielding miners from exploitative intermediaries, and weakening the influence of illegal players across gold supply chains. In 2024 the WGC launched the London Principles.[32] Initially signed by four central banks (Banco de la República Colombia, Banco Central del Ecuador, Bank of Mongolia, and Bangko Sentral ng Pilipinas), more are signing up and committing to support ASGM formalisation through domestic purchases.

The interface between ASGM and large-scale mining (LSM) is another critical area of focus. A recent WGC report[33] explores this dynamic through case studies from 25 different mines. Highlighting examples of successful collaboration between industry, governments, civil society and responsible ASGM actors, it also stresses the need for enhanced cooperation and dialogue among stakeholders to effectively manage the ASGM-LSM relationship.

A range of other initiatives have been launched over the years by both regulators and industry bodies:

- The Financial Action Task Force (FATF) has identified gold as a high-risk sector for money laundering. This has prompted many jurisdictions to try and raise standards among gold dealers and retailers by tightening due diligence, suspicious transaction and activity reporting requirements. Today, regulators are placing greater emphasis on enforcement and increasing penalties for non-compliance.
- The OECD Due Diligence Guidance and regulations such as Dodd-Frank Section 1502 and the EU Conflict Minerals Regulation, require companies to conduct due diligence on the origins of gold.
- Audit and assurance requirements such as the LBMA's Responsible Sourcing Programme and the Responsible Minerals Initiative's RMAP are being used by refiners, traders and consumer brands to verify compliance.

When responsibly managed and supported by sound governance, ASGM has the potential to contribute meaningfully to sustainable economic development, benefiting individuals, communities, and national economies alike. Realising this potential, however, requires clear government leadership, robust regulatory frameworks and sustained investment in formalisation and capacity-building. While progress has been made, only continued commitment and collaboration across sectors will fully unlock the promise of ASGM and reduce harmful impacts.

Transparency through technology

As policies are developed and action plans created to drive out bad actors, technology can also play a central role in promoting trust and transparency across the industry. Environmental impact dashboards, social impact analytics and transparent feedback and grievance mechanisms can materially enhance community relations. Blockchain and digital tracking technologies can drive trust among consumers, authenticating gold's origin and creating verifiable records of environmental and social performance.

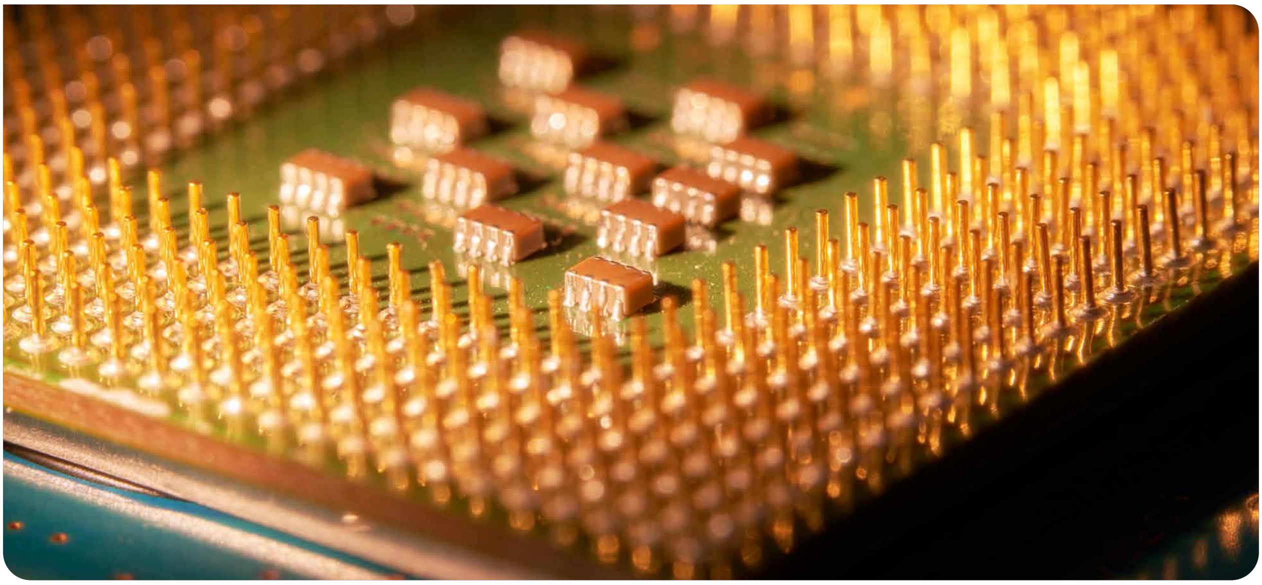
Four innovations stand out: chemical fingerprinting, big data and analytics, blockchain-based traceability and real-time monitoring.

Gold fingerprinting

Fingerprinting applies chemical and isotopic analysis to gold to identify its geographic origin. These techniques rely on trace elements or isotope ratios that are characteristic of the ore body where the gold was mined. Once captured, signatures can be catalogued and referenced against samples further down the supply chain. Fingerprinting thereby strengthens due diligence, allowing independent validation of supplier claims and supporting compliance with conflict-free sourcing and responsible gold principles. To scale this technology in a commercially-viable way, the World Gold Council is working with partners to trial this technology at artisanal mine sites and processing plants. This will allow aggregators and refiners to source gold from ASGM sites with greater confidence and certainty as to its origin, diverting legitimate flows from irresponsible actors.

Other technologies rely on tagging or marking material at the mine site. For example, the partnership between Swiss refiner Argor-Heraeus and traceability specialist Haelixa utilises DNA-based tagging to trace

32. https://www.gold.org/the-london-principles
33. https://www.gold.org/news-and-events/press-releases/asgm-report-2022-press-release



the physical origin of gold from Latin America. Gold is marked at the mine with a microscopic DNA tracer and its presence is later verified at the refinery, providing proof of origin and chain-of-custody integrity, while offering a non-invasive and tamper-proof alternative to traditional documentation systems.

Both approaches help secure the primary supply chain but once the gold is refined to investment grade these unique identifiers are lost. Many refiners have developed their own security features to authenticate their bars. These rely on high resolution image analysis, topical applications to the bar, or micro attachments such as secure holograms.

Going forward, a combination of pre- and post-refining traceability systems will be required to secure the gold supply chain, and for the primary leg (mine site to refiner) using the natural chemical footprint of a mine site as the basis for traceability could have a significant impact on the ability to source ASGM, in particular, with confidence.

Big data and analytics: detecting anomalies across the chain

Data is increasingly available across the gold supply chain – covering production volumes, shipping logs, export records, refining yields and financial transactions. This information can provide a powerful toolset for detecting suspicious patterns of behaviour and validating compliance.

Global consultancy Tech Mahindra has developed advanced analytics systems for the mining and metals sector, which can be applied to gold trading. These systems use data from mines, transporters and refiners to identify inefficiencies, discrepancies or potential red flags. Aiming to enable real-time monitoring of physical flows and financial signals, the technology could have a material impact on supply chain governance.

Environmental data is increasingly integrated into traceability systems too. Some refiners and asset managers have already begun to embed carbon intensity, water usage and waste metrics into their reporting frameworks to differentiate their product offerings from peers. These technologies can also support ESG performance tracking, feeding into audit frameworks to enhance confidence among downstream buyers and institutional investors.

Real-time monitoring

Real-time, public-facing monitoring is the benchmark in environmental impact accountability, empowering communities with information on a mine's performance in dust, noise or water quality measures. While some operations are unable to deploy the hardware that enables this kind of information flow, increasing segments of the industry are adopting these tools, as equipment is replaced and connectivity is enabled.

Blockchain and digital traceability: immutable records for assurance

Blockchain technology can facilitate the creation of a shared ledger of gold transactions that is tamper-resistant and transparent to permissioned participants. Once data is added to the blockchain – such as mine of origin, refining details, or chain of custody – it becomes immutable, providing a permanent audit trail. Blockchain does not eliminate the need for physical validation or regulatory oversight, but it does increase trust in digital records and reduces reliance on paper-based systems that are easier to falsify.

Several gold industry participants are actively exploring blockchain-based systems:

- The Gold Bar Integrity Programme is a blockchain initiative designed to digitally track gold bars from mine to vault. Launched by the LBMA and World Gold Council, it aims to prevent illicit metal from entering the legitimate market and enable bar-level provenance verification.
- Technology specialist Unicsoft has developed a blockchain-backed gold supply chain management platform for a refiner, allowing users to verify every step from mining through delivery, including quality control and client verification.
- The Responsible Gold Supply Chain Application uses blockchain to track doré from mines to finished products. The system ensures that every point in the journey is digitally recorded, reducing the risk of fraud and increasing confidence in responsible sourcing claims.

Building customer trust, layer by layer

Taken together, these technologies have the potential to form a multilayered system for risk mitigation and trust-building:

- Fingerprinting confirms geographical origin;
- Big data analytics detect outliers and support performance monitoring;
- Real-time environmental monitoring provides state-of-the-art accountability;
- Blockchain ensures transaction integrity and traceability.

Each tool adds a layer of verification. Together, they can catalyse change along the value chain. For the gold industry, these technologies can protect market integrity and reputational status. For regulators, they offer solid proof that the industry can move from a compliance-driven approach to a model based around trust-by-design. And for investors and consumers, the tools will provide clear proof of responsible sourcing, allowing them to assess and value gold not just by weight and purity, but by its environmental, social and ethical credentials too.

Gold as a sustainable and transparent asset

As investors, regulators and downstream industries demand stronger environmental and social performance, producers and refiners who lead in transparency and sustainability initiatives should benefit from better access to premium markets, creating incentives for the broader industry to adopt more transparent and sustainable operations. Several initiatives across the gold value chain highlight ways in which responsible production and traceable supply can become commercial differentiators:

- Valcambi, a major Swiss refiner, has issued Green Gold products since 2008, offering gold that is fully traceable from mine to client. The programme uses segregated supply chains and rigorous documentation to meet demand from ESG-conscious investors and brands.
- Apple, through its annual Conflict Minerals Report, has confirmed that all gold refiners in its supply chain are certified by third-party programmes, including the LBMA and the Responsible Minerals Initiative. The company is also shifting toward 100% recycled gold in its products.
- Tiffany & Co. publicly discloses its sourcing policies, sourcing all rough diamonds and gold from known, responsibly managed mines or suppliers committed to traceability and ethical practices.

Retail Gold Investment Principles

Work is also being undertaken to foster best practice amongst gold retailers and thereby instil trust among consumers and individual investors. Global research suggests that trust is a major barrier for buyers and investors to the gold market. The World Gold Council's Retail Gold Investment Principles (RGIPs)[34] are designed to address this issue, providing a voluntary code of conduct for both jewellers and bar and coin dealers. Broadly-based, the RGIPs cover fairness and integrity, transparency, protection of client assets, responsible gold sourcing, regulatory compliance, commercial prudence and operational professionalism.

Created to bolster trust and confidence in the retail space, the Principles aim to reassure consumers that they are being dealt with fairly and that retailers adhere to the highest standards of best practice. The RGIPs have already been launched in India and Singapore, and work is ongoing to launch versions in Australia, Germany, Malaysia, the UAE and the US.

Key takeaways:

- The gold industry makes a significant contribution to socioeconomic growth and financial stability. But there are challenges to address around trust and transparency.
- Technology can play a central role in overcoming these challenges across the gold supply chain.
- Several initiatives are already underway, including blockchain-backed traceability and real-time environmental monitoring.
- With commitment, coordination and a willingness to embrace innovation, there is a real opportunity to deliver positive change across the gold industry, benefiting stakeholders from mine to market.

Conclusion

The gold industry is at a critical point. Demand for gold is at record highs, driven by interest across geographies, socioeconomic groups and investor communities. At the same time, gold miners and the entire supply chain are under pressure from regulators, institutional investors and consumers. These stakeholders are calling for improved environmental outcomes, stronger engagement with host communities, a rooting out of illicit trade and greater transparency from mine to market.

The challenges are many and varied. But they are far from insurmountable. Today, new technologies, advanced data systems, digital traceability and improved governance models can help the industry to meet and exceed stakeholder demands.

The opportunity is clear: gold that can prove its origin, integrity and sustainability will strengthen its position as a credible, resilient asset in a changing financial landscape. This will require more than mere compliance. It demands active collaboration across the value chain.

Working together, mining companies, refiners, financial institutions, policymakers and technology providers can embed transparency, traceability and ESG performance into the gold market.

Gold's status as a trusted and transparent asset is within reach. But it will depend on aligning technical innovation with clear governance and credible assurance. Those who lead will shape the next era of gold – where responsible production and verified provenance are not optional but expected.

A new era for gold is in sight. The time to act is now.

34. https://www.gold.org/gold-standards/retail-gold-investment-principles

Clareo is a global team of experts helping mining companies and suppliers solve industry-disrupting challenges posed by the dynamic and rapidly changing demand for energy.

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World Gold Council

We are a membership organisation that champions the role gold plays as a strategic asset, shaping the future of a responsible and accessible gold supply chain. Our team of experts builds understanding of the use case and possibilities of gold through trusted research, analysis, commentary, and insights. We drive industry progress, shaping policy and setting standards for a perpetual and sustainable gold market.

You can follow the World Gold Council on X (Twitter) at **@goldcouncil** and LinkedIn.

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