

Transition Investing

Matter over mind? AI's 10 secret ingredients

Investment Strategy

This is a redaction of a 39-page report published on June 16, 2026. Please reach out to your BofA Securities representative or Merrill Global Wealth Management financial advisor for more information.

Semis? Energy? Datacenters? Just try to run AI without:

1) Helium and 2) Neon keep fabs running, while 3) High-Purity Quartz underpins wafer production. 4) Ajinomoto Build-up Film substrates connect chips to boards, with advanced GPUs requiring up to 18x more than CPUs. 5) Gallium and 6) Germanium enable efficient power, RF and photonics, while 7) Tungsten and 8) Antimony support thermal stability under extreme loads. Finally, 9) Graphite and 10) Rare-earth magnets increasingly constrain scaling via power, cooling and energy storage.

The Silicon of tomorrow: 10 inputs that gate it all...

The next phase of AI deployment will depend on securing scarce elements and scaling them fast. Building on our Data centers primer, we identify 10 hard-to-replace chokepoints across every layer of the AI stack. Most are critical minerals, but also noble gases and specialized materials, all characterized by concentrated supply, limited substitution, and rising policy risk. AI demand shock is overwhelming systems, translating into structural scarcity, buildout disruption and price inflation.

Substitution not keeping up = structural price inflation

Stockpiling of these critical inputs is accelerating, while recycling remains below 15% in some markets, limiting near-term relief. Recovery gains in rare-earth, graphite and semiconductor materials are emerging, but scale is still constrained. AI is improving efficiency and accelerating substitution, including screening >67,000 rare-earth-free magnet compounds. However, this remains a medium-term lever. Currently, demand continues to outpace both recycling and supply growth, reflected in the strong performance of rare earths and strategic metals, +140% YoY.

It's a national security issue – global supply is at stake

Supply tightness reflects extreme concentration. China controls 70-98% of supply across several minerals, making export controls a direct constraint on availability. Elsewhere, helium outages tied to Qatar have disrupted about a third of global supply, while HPQ is >70% concentrated in Spruce Pine (US), so a failure there could ripple worldwide.

\$1.5tn+ opportunity across 22 critical upstream enablers

Metals & Mining represent just 2.5% of MSCI ACWI, despite being the AI revolution's gatekeepers. At the same time, demand from AI, electrification and defense is converging on the same materials base, tightening supply buffers and pushing correlations between AI and transition-metal names to +65%. Our full note identifies 22 companies with \$1.5tn market cap across the 10 materials which offer exposure to this theme.

Trading ideas and investment strategies discussed herein may give rise to significant risk and are not suitable for all investors. Investors should have experience in relevant markets and the financial resources to absorb any losses arising from applying these ideas or strategies.

>> Employed by a non-US affiliate of BofAS and is not registered/qualified as a research analyst under the FINRA rules.

Refer to "Other Important Disclosures" for information on certain BofA Securities entities that take responsibility for the information herein in particular jurisdictions.

BofA Securities does and seeks to do business with issuers covered in its research reports. As a result, investors should be aware that the firm may have a conflict of interest that could affect the objectivity of this report. Investors should consider this report as only a single factor in making their investment decision.

Refer to important disclosures on page 13 to 14.

12986323

Timestamp: 23 June 2026 09:42AM EDT

23 June 2026











Equity
Transition Investing

Menka Bajaj >>
Equity Strategist
MLI (UK)

Haim Israel >>
Equity Strategist
Merrill Lynch (Israel)

Exhibit 1: AI's 10 secret ingredients

Spanning noble gases, specialty materials, and strategic minerals

	Helium
	Neon
	High-purity quartz
	ABF Substrate
	Gallium
	Tungsten
	Rare Earth & Magnets
	Germanium
	Graphite
	Antimony

Source: BofA Global Research

BofA GLOBAL RESEARCH

HPQ: High-Purity Quartz

ABF: Ajinomoto Build-up Film

GPU: Graphics Processing Unit

RF: Radio-frequency

*Note: MLAPASC and MLAPASH baskets are proprietary baskets that are structured and maintained by BofA Securities trading desk.

Contents

The strategic inputs squeeze	3
AI scaling hits materials limits	3
Three forces, one pool: defense–energy–AI	3
Hidden enablers of the AI buildout	5
Did you know	6
10 building blocks, One constraint: Supply	7
Helium: the invisible fab dependency	7
Neon: the lithography off-switch	9
High-purity quartz: the silicon starting line	11



The strategic inputs squeeze

Strategic materials demand is transitioning from cyclical to structural, underpinned by the rebuilding of energy systems and digital infrastructure. Electrification, grid expansion and industrial policy are driving sustained demand for copper, aluminum and alloying metals, while deglobalization and strategic stockpiling are tightening supply. At the same time, production remains highly concentrated and slow to scale, elevating bottleneck risk.

Resilience and supply security have become central policy priorities, yet market positioning has not caught up: the Metals & Mining sector represents 2.5% of the MSCI ACWI, near multi-decade lows, underscoring the gap between the sector's rising strategic importance and investor allocation.

Exhibit 2: Metals & Mining sector is just 2.5% of MSCI ACWI

Metals & Mining as a % of MSCI ACWI market cap, as of 05/30/26

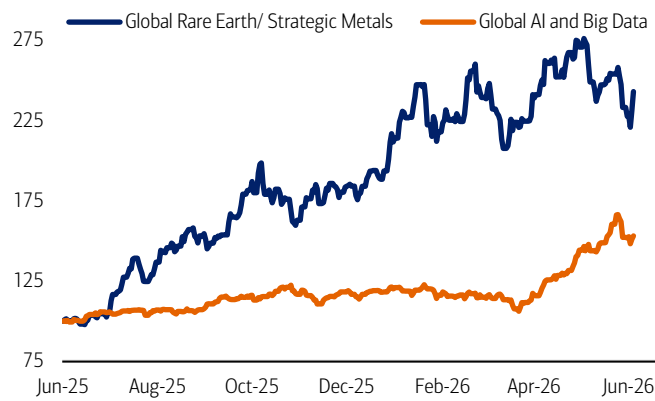


Source: BofA Global Research, Bloomberg

BofA GLOBAL RESEARCH

Exhibit 3: Global Rare Earth/Strategic Metals outperformed YoY: +140% vs +53% for AI & Big Data

YoY Performance of NYBIG Index vs MVREMX Index, as of 06/12/26



Source: BofA Global Research, Bloomberg.

BofA GLOBAL RESEARCH

Three forces, one pool: defense-energy-AI

A critical overlay is competition. Defense, electrification and AI are now drawing on the same constrained metals base, turning previously separate demand drivers into a single, synchronized pull. Correlations between energy-transition and AI-linked metals demand have risen above 65% from 40% last year, signaling growing synchronization across end-markets and reducing diversification across demand drivers. The result is a more fragile system, where shortages ripple across sectors, raising volatility and increasing the premium on secure supply.

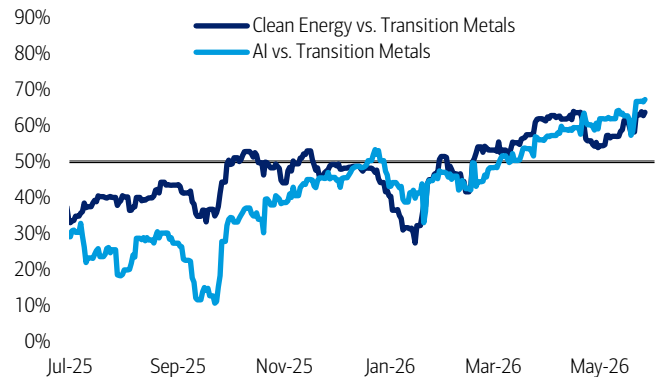
AI scaling hits materials limits

AI is no longer just a demand tailwind; it is reshaping the entire metals value chain. Demand is now driven by engineering constraints like power density, cooling and uptime rather than capex or footprint. As adoption accelerates, metals & mining is central to enabling scale.

As discussed in our Data centers primer, AI infrastructure is much more resource-intensive than traditional cloud, requiring 60-75 tons of metals per MW, largely in power and cooling systems. This pushes metals onto the critical path. While only a low single-digit share of project cost (<5% of data center capex), they anchor key components like transformers and cabling where constraints are already visible, with power equipment lead times now 3-5 years. Hence, Metals are rate-limiters for AI deployment, determining how quickly capacity comes online.

Exhibit 4: AI -transition metals correlation jumped to +65% in 2026

3m rolling correlation between Transition metal vs. AI & Clean energy indices

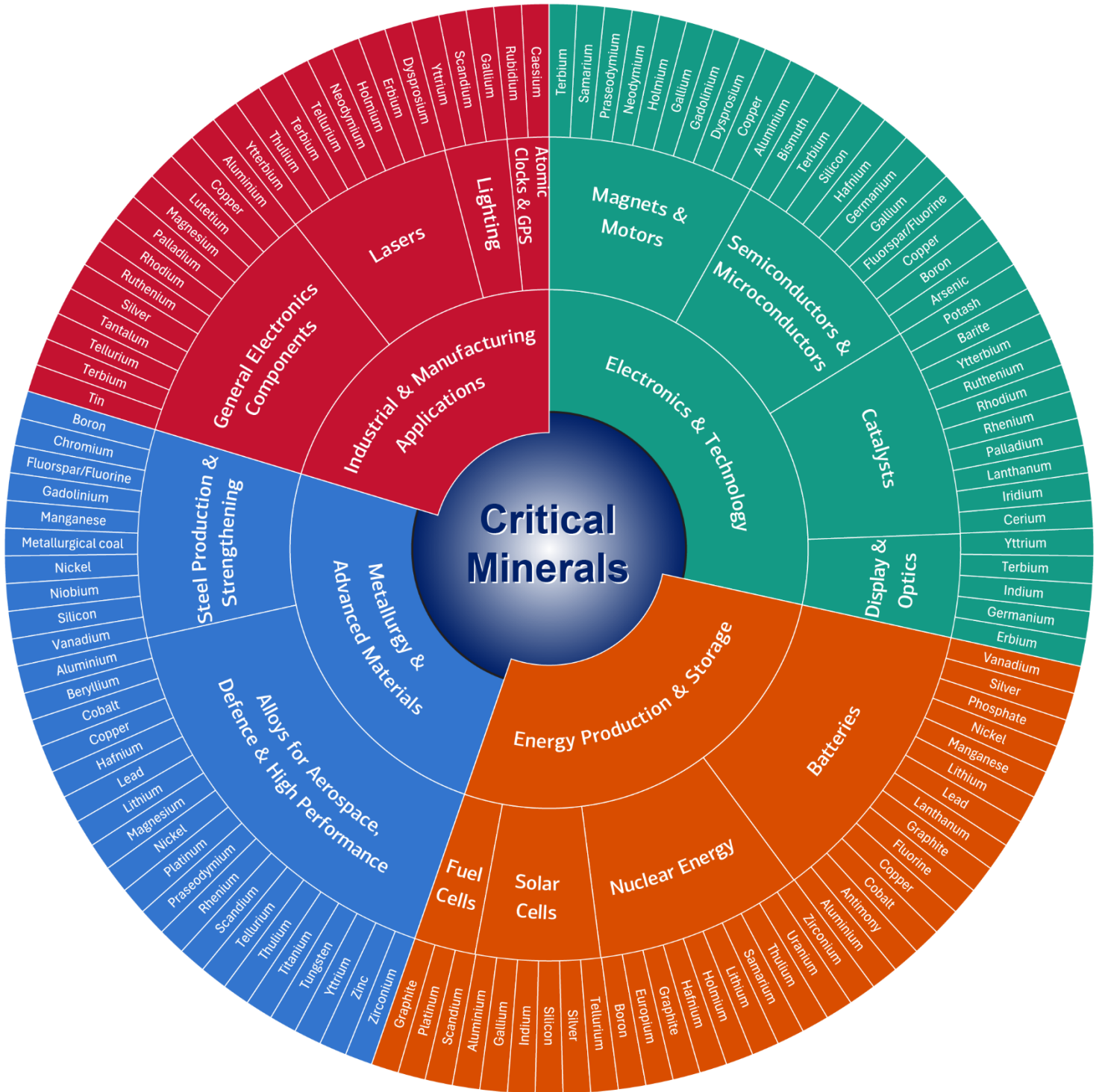


Source: BofA Global Research, Bloomberg. Indices used, MVIS Global Clean-Tech Metals and Nasdaq Global Artificial Intelligence and Big Data Index(NYBIG), S&P Global Clean Energy

BofA GLOBAL RESEARCH



Exhibit 5: The critical minerals in a multi-demand squeeze
 List of over 60 critical minerals by sector exposure



Source: BofA Global Research, U.S. Department of Energy (DOE), U.S Geological Survey (USGS)

BofA GLOBAL RESEARCH



Hidden enablers of the AI buildout

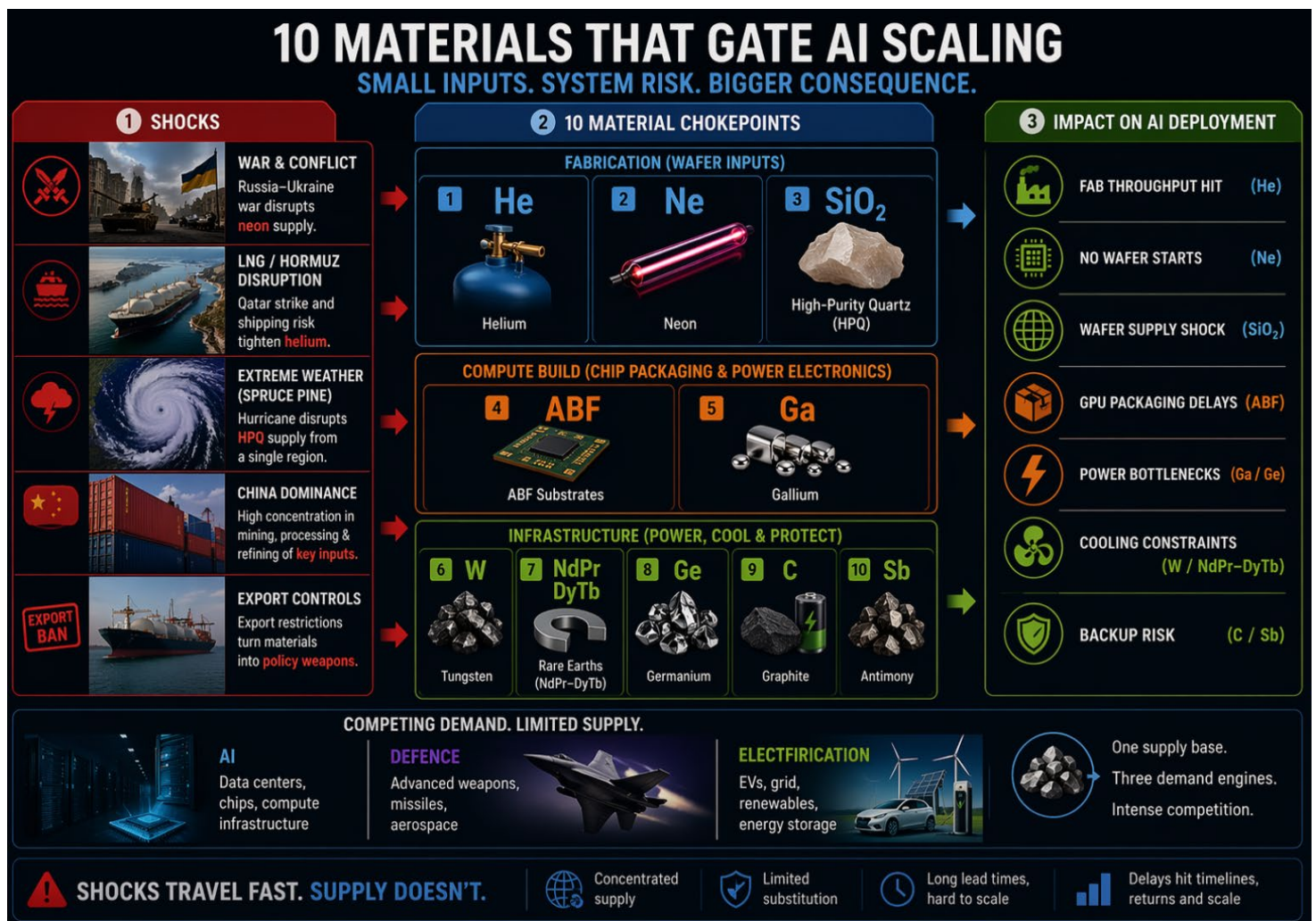
Building on our recent Data-center work, we analyze the metals intensity of the AI supply chain, focusing on overlooked but essential upstream inputs that enable scaling. Beyond headline materials, key choke points include industrial gases (helium, neon), advanced packaging (ABF substrates), rare earths (NdPr, DyTb), high-purity quartz for silicon, graphite, and other binding materials such as antimony, tungsten, gallium and germanium. These are core to chips, photonics, interconnects and power electronics, yet remain underrepresented in AI narratives despite their critical role.

Geopolitics meets scarcity

Export restrictions have increased more than fivefold since 2009, with c.16% of global critical-materials trade facing at least one restriction in 2022–24 (OECD) and significantly higher exposure in key inputs. Recent shocks including Middle East helium disruptions (>30% supply offline), China’s tightening export controls (gallium, germanium, graphite), Russia–Ukraine exposure in gases (neon), and Hurricane Helene risks to HPQ highlight a common pattern: high concentration, low substitutability and slow recovery. While near-term shocks may drive volatility, they reinforce a structural trend - supply remains constrained and policy-driven as AI, energy and defense continue to push demand higher.

Exhibit 6: AI Supply Chain: 10 Critical Chokepoints

Key choke points are concentrated upstream, spanning industrial gases (helium, neon), advanced packaging (ABF substrates), rare earth magnets (NdPr, DyTb), high-purity quartz, graphite, and less visible but critical inputs such as antimony, tungsten, gallium and germanium.



Source: BofA Global Research Note: The infographic is provided for illustrative purposes only and is intended as a high-level overview rather than a comprehensive or exhaustive representation



Did you know

- There were 3x more critical raw-material export restrictions in 2025 vs. 2024.¹
- Military strikes on Ras Laffan cut off 1/3rd of global helium supply in 2026.²
- Tungsten melts at 3.4k°C; gallium at 29°C, one is 3-5x hotter than lava, the other liquefies in your hand.³
- In power electronics, GaN can make magnetics up to 60% smaller.⁴
- Graphite sheets cut weight by 90% vs. copper, without compromising cooling capabilities.⁵
- Solar panel waste could contain up to 20kt of antimony by 2030.⁶
- China exported 57kt of RE magnets in 2025, enough for 6.7k AIDCs.⁷
- Permanent magnets account for around 95% of rare earth demand by value.⁷
- One site, Spruce Pine (US), supplies 70-90% of the HPQ used in semis.⁸
- AIDCs require c.36x more fiber-optic cable than traditional CPU racks.⁹
- AI chips use >10x more Ajinomoto Build-up Film (ABF) than PC CPUs.¹⁰
- AI accelerates materials innovation: RE-free magnet discovery is 200x faster, with 70% lower CO₂ and 80% lower cost.¹¹
- Globally about 8/10 mines exist within a 50km radius of key biodiversity areas.¹²
- The top 40 mining companies generate more revenue than the annual GDP of a G20 economy.¹³
- Americans consume ~38k lbs of new materials a year, about 10 cars' weight.¹⁴
- A 2°C pathway to 2050 requires 3bn t of minerals, equal to 300k Eiffel Towers.¹⁵
- The US graduated >35k lawyers vs 350 mining engineers in 2025...¹⁶
- ...while China trains at scale with ~40k students at a dedicated mining university.¹⁶

Sources: ¹GlobalTradeAlert, ²International Union of Marine Insurance, ³Britannica, University of Toledo, ⁴Texas Instruments, ⁵10.1021/acsami.1c00319, ⁶Smart Energy Council, ⁷IEA, ⁸Vince Beiser, ⁹STL, ¹⁰Ajinomoto, ¹¹Materials Nexus, ¹²WWF, ¹³Statista, Trading Economics ¹⁴Minerals Education Coalition, ¹⁵World Bank, TourEiffel, ¹⁶Amanda Lacaze, Bloomberg, China Admissions



10 building blocks, One constraint: Supply

Helium: the invisible fab dependency


Exhibit 7: Helium: AI Supply Chain Snapshot


Disruptions at Qatar's Ras Laffan complex, the world's largest helium hub, have removed one-third of global supply following missile strikes and LNG shutdowns


HELIUM


THE INVISIBLE FAB DEPENDENCY


Helium is critical to semiconductor manufacturing. It stabilizes operating conditions and prevents contamination in advanced fab processes, particularly in lithography and etch.




 **COOLING**

 **PURGING**


 **LEAK CHECKS**

 **STABLE CONDITIONS. CLEAN PROCESSES. MAXIMUM UPTIME.**
Helium protects yield and keeps fabs running.

RUSSIA CONTROLS + QATAR SHOCK = ALLOCATION RISK

 **RUSSIA EXPORT CONTROLS**


In April 2026, Russia imposed temporary export controls outside the EEU (Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia) till December 2027.

 **QATAR SUPPLY SHOCK**


Disruptions at Qatar's Ras Laffan complex, the world's largest helium hub—have removed one-third of global supply following missile strikes and LNG shutdowns.

MITIGATION: INVENTORY, ALLOCATION, PARTIAL RECYCLING


There is no viable substitute for helium in critical semiconductor processes.

 **INVENTORY MANAGEMENT**


Build and manage multi-month inventories to bridge near-term disruptions.

 **ALLOCATION TO PRIORITY SECTORS**


Helium is allocated to essential sectors (chips, healthcare, etc.) during tightness.


 **PARTIAL RECYCLING**

Recycling systems can only partially recover supply due to their limited scale.

 **LOGISTICS OPTIMIZATION**


Rerouting and efficiency improvements help manage flows, not expand supply.

 **As a byproduct of natural gas/LNG, supply is inherently inflexible.**


 At a system level, helium sits in the "uptime layer". It does not improve chip performance, but it protects yield and maintains throughput across fabs.


FEW PLANTS, FEW COUNTRIES CREATE A STRUCTURAL CHOKEPOINT


Helium supply is highly concentrated (15–20 liquefaction plants) and located in a small number of LNG-linked regions, creating exposure to geopolitics and physical bottlenecks.




The US and Qatar accounts for c. 75% of global supply. This makes the system structurally fragile.


 South Korea chip manufacturers remain highly exposed (65% reliance on Qatari supply).


 Spot prices have surged >100% in places (albeit from a low base).


 By late May 2026, the typical 60–90 day safety buffers held by East Asian semiconductor players were largely depleted*.

 Near term, fabs remain partially insulated given multi-month inventories and helium's relatively small, pass-through cost. However, if tightness persists, allocation is likely to favor higher-margin AI chips over consumer semiconductors.

POTENTIAL CASCADE EFFECTS

 Extended lead times

 Constraints in helium filled HDD supply for data centres

 Drag on physical expansion of global cloud storage capacity

Source: BofA Global Research. Note: The infographic is provided for illustrative purposes only and is intended as a high-level overview rather than a comprehensive or exhaustive representation

Where it bites in AI: uptime, cooling, purge & leak control

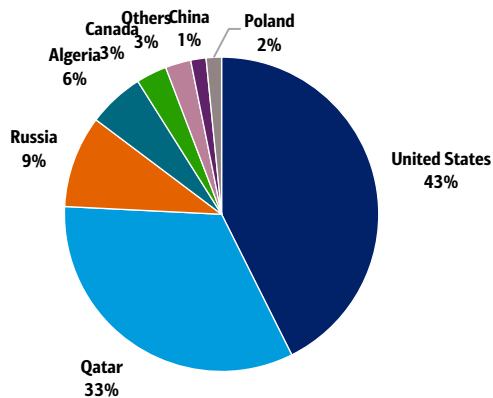
Helium is critical to semiconductor manufacturing, used across cooling, purging, and leak detection in high-precision tools. It stabilizes operating conditions and prevents contamination in advanced fab processes, particularly in lithography and etch. At a system level, helium sits in the “uptime layer”, it does not improve chip performance, but it protects yield and maintains throughput across fabs.

Few plants, few countries create a structural chokepoint

Helium supply is highly concentrated (15-20 liquefaction plants) and located in a small number of LNG-linked regions, creating exposure to geopolitics and physical bottlenecks. The US and Qatar accounts for c.70% of global supply. This makes the system structurally fragile, disruptions in one hub can cascade globally despite helium’s minimal cost share, and elevate it to a system-critical input for semiconductors.

Exhibit 8: Global helium supply is dominated by the US (43%) and Qatar (33%)

Global Helium production, 2025E



Source: BofA Global Research, U.S. Geological Survey, Mineral Commodity Summaries, Feb 2026
BofA GLOBAL RESEARCH

Russia controls + Qatar shock = allocation risk

In April 2026, Russia imposed temporary export controls outside the EEU (Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia) until December 2027. Any helium exported will require authorization, as Russia is prioritizing strategic domestic uses such as fiber optics (including defense applications).

This comes as disruptions at Qatar’s Ras Laffan complex, the world’s largest helium hub, have removed one-third of global supply following missile strikes and LNG shutdowns. Force majeure declarations and logistics constraints through the Strait of Hormuz have amplified the impact, with full recovery likely to take several years.

South Korea chip manufacturers remain highly exposed (65% reliance on Qatari supply), while spot prices have surged (>100% in places, albeit from a low base). By late May 2026, the typical 60–90 day safety buffers held by East Asian semiconductor players were largely depleted. Near term, fabs remain partially insulated given multi-month inventories and helium’s relatively small, pass-through cost. However, if tightness persists, allocation is likely to favour higher-margin AI chips over consumer semiconductors. This risks cascading effects: extended lead times, constraints in helium-filled HDD supply for data centers, and a potential drag on the physical expansion of global cloud storage capacity (BIS, June 2026),

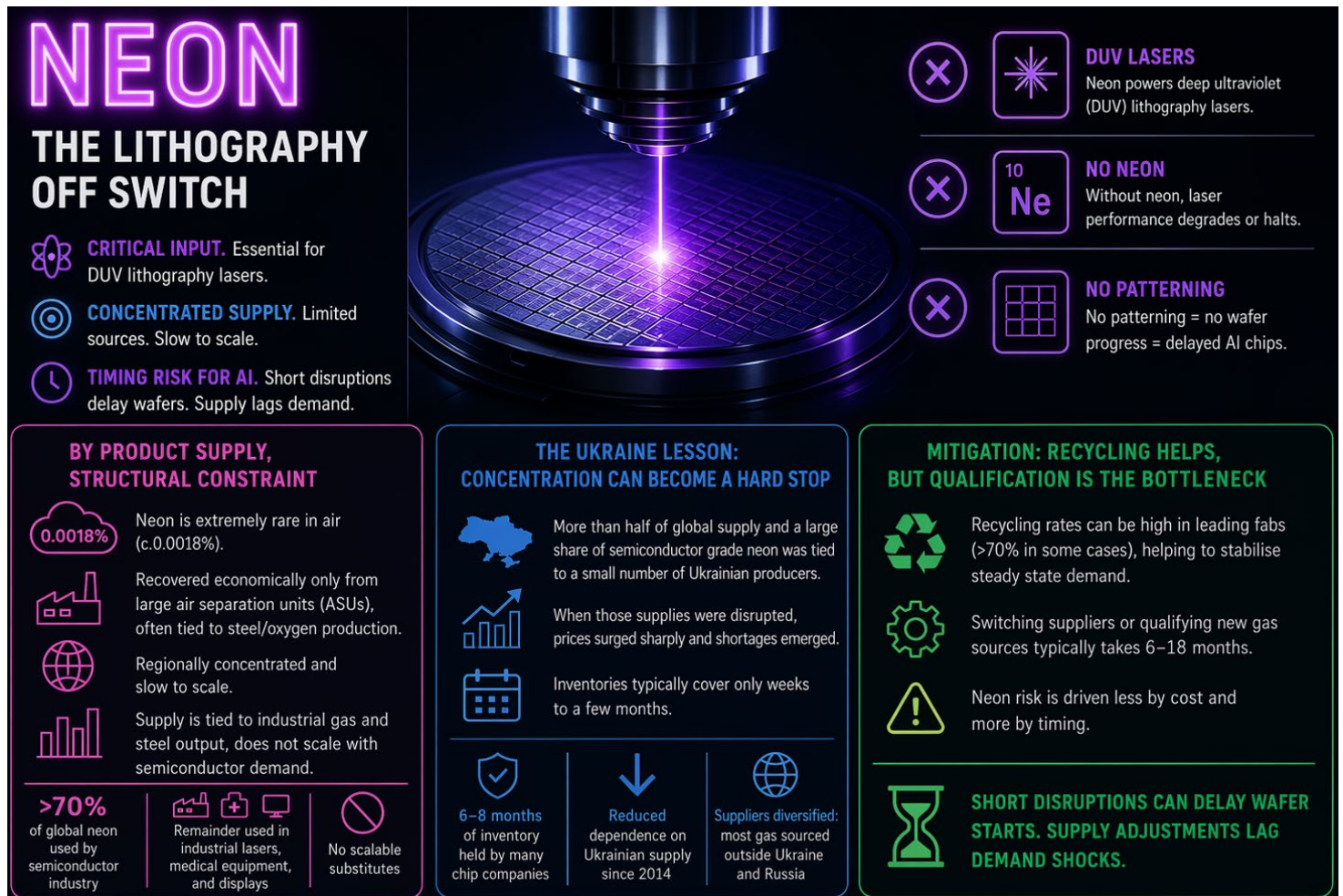
Mitigation: inventory, allocation, partial recycling

There is no viable substitute for helium in critical semiconductor processes. As a byproduct of natural gas/LNG, supply is inherently inflexible, so mitigation is limited to inventory management and allocation to priority sectors (chips, healthcare); recycling systems, which can only partially recover supply due to their limited scale; and logistics optimization, rather than true supply expansion.



Neon: the lithography off-switch

Exhibit 9: Neon: AI Supply Chain Snapshot
The chip industry uses >70% of global neon



Source: BofA Global Research. Note: The infographic is provided for illustrative purposes only and is intended as a high-level overview rather than a comprehensive or exhaustive representation

BofA GLOBAL RESEARCH

Where it bites in AI: DUV lasers, no neon, no patterning

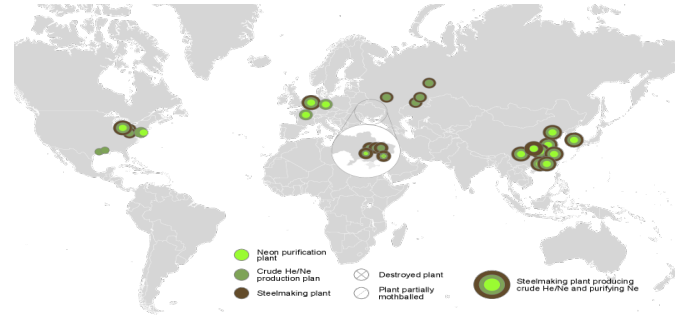
Neon is a critical input for deep ultraviolet (DUV) lithography lasers used in semiconductor manufacturing. These lasers remain essential across multiple steps, even for advanced AI chips, enabling the precise patterning of silicon wafers. Without sufficient neon, laser performance degrades or halts, disrupting key stages of wafer production. The semiconductor lithography accounts for >70% of global neon demand (as per SFA Oxford), with intensity rising for AI chips due to higher layer counts and complexity. The remainder is used in industrial lasers, medical equipment, and display manufacturing.

By-product supply, structural constraint

Neon is extremely rare in air (c.0.0018%) and is typically recovered economically only from large air-separation units (ASUs) often tied to steel/oxygen production. That makes supply both regionally concentrated and slow to scale. Its dependence on a limited number of feedstock sources and cross-border logistics creates exposure to conflict, industrial cycles, and trade disruption. Because supply is tied to industrial gas and steel output, it does not scale with semiconductor demand, amplifying cyclical tightness. With no scalable substitutes, disruptions translate directly into timing risk delaying wafer starts and constraining AI capacity ramp.

Exhibit 10: Just 18 plants worldwide produce semiconductor-grade neon

Non-exhaustive map of neon purification plants in relation to (unpurified) helium–neon gas mixture production plants and steelmaking plants



Source: Purer than pure: how purity reshapes the upstream materiality of the semiconductor industry, arXiv:2509.18768

BofA GLOBAL RESEARCH

Mitigation: recycling helps, but qualification is the bottleneck

Despite these adjustments, structural constraints remain. Supply depends on a limited number of specialized purification facilities, and new capacity requires time to build and qualify, leaving the system more resilient, but still exposed to disruption. Recycling rates can be high in leading fabs (>70% in some cases), helping to stabilize steady-state demand. However, switching suppliers or qualifying new gas sources typically takes 6–18 months, limiting flexibility. As a result, neon risk is driven less by cost and more by timing: short disruptions can delay wafer starts, while supply adjustments lag demand shocks.

High-purity quartz: the silicon starting line


Exhibit 11: High Purity Quartz: AI Supply Chain Snapshot

A large majority of the ultra-high-purity natural quartz used for semiconductor-grade crucibles comes from a single area: Spruce Pine, North Carolina (US)


HIGH-PURITY QUARTZ

THE SILICON STARTING LINE

High-purity quartz (HPQ) is used to manufacture quartz crucibles, which are essential for growing single-crystal silicon ingots, the starting point for semiconductor wafers. These wafers underpin all chips, including AI accelerators.




THE SILICON JOURNEY STARTS WITH QUARTZ



SINGLE-REGION GEOLOGICAL DEPENDENCE: CONCENTRATED AND FRAGILE

A large majority (70–80%) of ultra-high-purity natural quartz used for semiconductor-grade crucibles comes from a single area:



→ SPRUCE PINE, NORTH CAROLINA (US)

Mainly operated by: Quartz Corp and Sibelco (Belgium)

- Other countries (Norway, Brazil, Russia, China, Australia) have quartz deposits, but very few meet the purity levels needed for advanced chips.
- Synthetic alternatives exist (e.g., Japan Super Quartz), but they are more expensive and not yet a full replacement at scale.
- HPQ is best thought of as a geological bottleneck, not a normal commodity – where disruption in a single region can transmit across global semiconductor supply chains.

PHYSICAL DISRUPTION RISK NOW VISIBLE

In 2024, extreme weather events, including severe flooding from Hurricane Helene, disrupted mining and logistics operations in the Spruce Pine region, exposing a critical upstream vulnerability in semiconductor supply chains.

Quartz crucibles are consumed and replaced regularly in silicon growth. Disruptions can flow relatively quickly into wafer production.

During periods of tightness, quartz crucible delivery times can extend to several months, reflecting limited supplier capacity and high replacement frequency, with wafer manufacturers facing constraints well before chip fabs feel the impact.

MITIGATION: DIVERSIFICATION IS SLOW; SYNTHETIC IS COSTLY

- LIMITED SUBSTITUTION**
Synthetic and alternative quartz exist, but are more expensive and not yet scalable replacements.
- INVENTORY BUFFER**
Wafer makers and crucible suppliers hold inventories, but only for a limited duration.
- DIVERSIFICATION**
New sources and suppliers require long qualification and ramp-up timelines. In June 2026, new HPQ resources were identified in Tibet (Dinggye), with potential very high purity levels.

Source: BofA Global Research. Note: The infographic is provided for illustrative purposes only and is intended as a high-level overview rather than a comprehensive or exhaustive representation

BofA GLOBAL RESEARCH

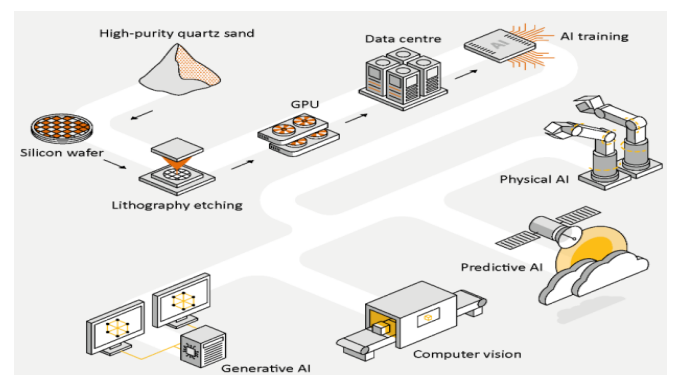
Where it bites in AI: crucibles, wafers, all chips

High-purity quartz (HPQ) is used to manufacture quartz crucibles, which are essential for growing single-crystal silicon ingots, the starting point for semiconductor wafers. These wafers underpin all chips, including AI accelerators. This makes HPQ an essential upstream input: disruptions hit wafer supply first and only later feed into fab utilization and chip output. The impact is therefore delayed but system-wide, with supply shocks initially muted but capable of cascading across the entire semiconductor stack if prolonged.

Critically, this is not just an AI issue. HPQ is also a key input in solar photovoltaic manufacturing, where high-purity quartz is used to produce polysilicon and ingots for solar wafers. This creates cross-industry competition for the same upstream resource, particularly during periods of tightness.

Exhibit 12: High-purity quartz is the critical starting point for semiconductor silicon growth and AI Infrastructure

Select AI infrastructure and types of application



Source: IEA

BofA GLOBAL RESEARCH



Single-region geological dependence

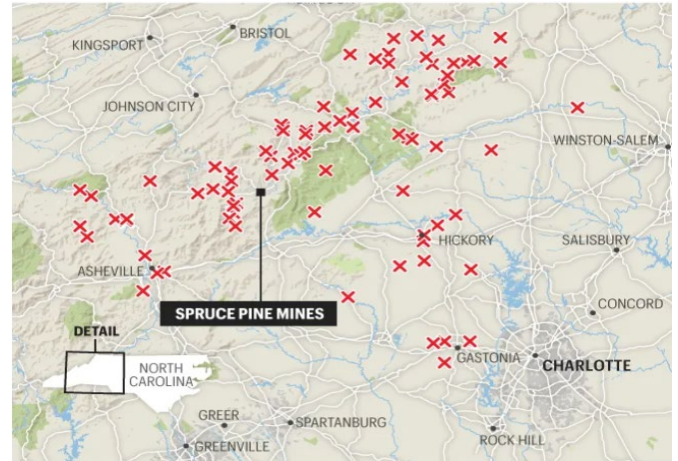
HPQ supply is unusually concentrated. A large majority (>70%) of the ultra-high-purity natural quartz used for semiconductor-grade crucibles comes from a single area: Spruce Pine, North Carolina (US). Other countries, including Norway, Brazil, Russia, China and Australia, also have quartz deposits, but very few meet the purity levels needed for advanced chips. Synthetic alternatives exist, with a few companies such as Japan Super Quartz producing synthetic HPQ, but they are more expensive and not yet a full replacement at scale. As a result, HPQ is best thought of as a geological bottleneck, not a normal commodity, where disruption in a single region can transmit across global semiconductor supply chains.

Physical disruption risk now visible

The fragility of this supply chain has become increasingly visible. In 2024, extreme weather events, including severe flooding from Hurricane Helene, disrupted mining and logistics operations in the Spruce Pine region. The event involved more than 2 feet of rainfall in under a week, forcing both major mines to shut temporarily, exposing a concentrated upstream vulnerability in semiconductor inputs.

Because quartz crucibles are consumed and replaced regularly in silicon crystal growth, disruptions can flow relatively quickly into wafer production. During periods of tightness, quartz crucible delivery times can extend to several months, reflecting limited supplier capacity and high replacement frequency, with wafer manufacturers facing constraints well before chip fabs feel the impact.

Exhibit 13: Hurricane supply shock: Spruce Pine floods shut both mines;
Hundreds of roads closed in North Carolina after damage from Helene



Source: North Carolina Department of Transportation; Open street map

BofA GLOBAL RESEARCH

Mitigation: diversification is slow; synthetic is costly

Substitution remains structurally limited. While synthetic quartz and alternative feedstocks exist, scaling is constrained by high processing costs, purity requirements (>99.99% SiO₂), and long qualification cycles in wafer fabs. Diversification is underway particularly in China. In June 2026, new HPQ resource were identified in Tibet (Dinggye), with potential very high purity levels. However, near-term supply elasticity remains low and HPQ will continue to behave as a geological, processing and qualification bottleneck.

Disclosures

Important Disclosures

Due to the nature of strategic analysis, the issuers or securities recommended or discussed in this report are not continuously followed. Accordingly, investors must regard this report as providing stand-alone analysis and should not expect continuing analysis or additional reports relating to such issuers and/or securities.

BofA Global Research personnel (including the analyst(s) responsible for this report) receive compensation based upon, among other factors, the overall profitability of Bank of America Corporation, including profits derived from investment banking. The analyst(s) responsible for this report may also receive compensation based upon, among other factors, the overall profitability of the Bank's sales and trading businesses relating to the class of securities or financial instruments for which such analyst is responsible.

Other Important Disclosures

From time to time research analysts conduct site visits of covered issuers. BofA Global Research policies prohibit research analysts from accepting payment or reimbursement for travel expenses from the issuer for such visits.

Prices are indicative and for information purposes only. Except as otherwise stated in the report, for any recommendation in relation to an equity security, the price referenced is the publicly traded price of the security as of close of business on the day prior to the date of the report or, if the report is published during intraday trading, the price referenced is indicative of the traded price as of the date and time of the report and in relation to a debt security (including equity preferred and CDS), prices are indicative as of the date and time of the report and are from various sources including BofA Securities trading desks.

The date and time of completion of the production of any recommendation in this report shall be the date and time of dissemination of this report as recorded in the report timestamp.

This report may refer to fixed income securities or other financial instruments that may not be offered or sold in one or more states or jurisdictions, or to certain categories of investors, including retail investors. Readers of this report are advised that any discussion, recommendation or other mention of such instruments is not a solicitation or offer to transact in such instruments. Investors should contact their BofA Securities representative or Merrill Global Wealth Management financial advisor for information relating to such instruments.

Recipients who are not institutional investors or market professionals should seek the advice of their independent financial advisor before considering information in this report in connection with any investment decision, or for a necessary explanation of its contents.

Officers of BofAS or one or more of its affiliates (other than research analysts) may have a financial interest in securities of the issuer(s) or in related investments.

Refer to [BofA Global Research policies relating to conflicts of interest](#).

"BofA Securities" includes BofA Securities, Inc. ("BofAS") and its affiliates. Investors should contact their BofA Securities representative or Merrill Global Wealth Management financial advisor if they have questions concerning this report or concerning the appropriateness of any investment idea described herein for such investor. "BofA Securities" is a global brand for BofA Global Research.

Information relating to Non-US affiliates of BofA Securities and Distribution of Affiliate Research Reports:

BofAS and/or Merrill Lynch, Pierce, Fenner & Smith Incorporated ("MLPF&S") may in the future distribute, information of the following non-US affiliates in the US (short name: legal name, regulator): Merrill Lynch (South Africa): Merrill Lynch South Africa (Pty) Ltd., regulated by the Financial Sector Conduct Authority; MLI (UK): Merrill Lynch International, regulated by the Financial Conduct Authority (FCA) and the Prudential Regulation Authority (PRA); BofASE (France): BofA Securities Europe SA is authorized by the Autorité de Contrôle Prudentiel et de Résolution (ACPR) and regulated by the ACPR and the Autorité des Marchés Financiers (AMF). BofA Securities Europe SA ("BofASE") with registered address at 51, rue La Boétie, 75008 Paris is registered under no 842 602 690 RCS Paris. In accordance with the provisions of French Code Monétaire et Financier (Monetary and Financial Code), BofASE is an établissement de crédit et d'investissement (credit and investment institution) that is authorised and supervised by the European Central Bank and the Autorité de Contrôle Prudentiel et de Résolution (ACPR) and regulated by the ACPR and the Autorité des Marchés Financiers. BofASE's share capital can be found at www.bofamli.com/BofASEDisclaimer; BofA Europe (Milan): Bank of America Europe Designated Activity Company, Milan Branch, regulated by the Bank of Italy, the European Central Bank (ECB) and the Central Bank of Ireland (CBI); BofA Europe (Frankfurt): Bank of America Europe Designated Activity Company, Frankfurt Branch regulated by BaFin, the ECB and the CBI; BofA Europe (Zurich): Bank of America Europe Designated Activity Company, Zurich Branch, regulated by the Swiss Financial Market Supervisory Authority FINMA, the ECB and CBI; BofA Europe (Madrid): Bank of America Europe Designated Activity Company, Sucursal en España, regulated by the Bank of Spain, the ECB and the CBI; Merrill Lynch (Australia): Merrill Lynch Equities (Australia) Limited, regulated by the Australian Securities and Investments Commission; Merrill Lynch (Hong Kong): Merrill Lynch (Asia Pacific) Limited, regulated by the Hong Kong Securities and Futures Commission (HKSF); Merrill Lynch (Singapore): Merrill Lynch (Singapore) Pte Ltd, regulated by the Monetary Authority of Singapore (MAS); Merrill Lynch (Canada): Merrill Lynch Canada Inc, regulated by the Canadian Investment Regulatory Organization; Merrill Lynch (Mexico): Merrill Lynch Mexico, SA de CV, Casa de Bolsa, regulated by the Comisión Nacional Bancaria y de Valores; BofAS Japan: BofA Securities Japan Co., Ltd., regulated by the Financial Services Agency; Merrill Lynch (Seoul): Merrill Lynch International, LLC Seoul Branch, regulated by the Financial Supervisory Service; Merrill Lynch (Taiwan): Merrill Lynch Securities (Taiwan) Ltd., regulated by the Securities and Futures Bureau; BofAS India: BofA Securities India Limited, regulated by the Securities and Exchange Board of India (SEBI); Merrill Lynch (Israel): Merrill Lynch Israel Limited, regulated by Israel Securities Authority; Merrill Lynch (DIFC): Merrill Lynch International (DIFC Branch), regulated by the Dubai Financial Services Authority (DFSA); Merrill Lynch (Brazil): Merrill Lynch S.A. Corretora de Títulos e Valores Mobiliários, regulated by Comissão de Valores Mobiliários; Merrill Lynch KSA Company: Merrill Lynch Kingdom of Saudi Arabia Company, regulated by the Capital Market Authority. This information: has been approved for publication and is distributed in the United Kingdom (UK) to professional clients and eligible counterparties (as each is defined in the rules of the FCA and the PRA) by MLI (UK), which is authorized by the PRA and regulated by the FCA and the PRA - details about the extent of our regulation by the FCA and PRA are available from us on request; has been approved for publication and is distributed in the European Economic Area (EEA) by BofASE (France), which is authorized by the ACPR and regulated by the ACPR and the AMF; has been considered and distributed in Japan by BofAS Japan, a registered securities dealer under the Financial Instruments and Exchange Act in Japan, or its permitted affiliates; is issued and distributed in Hong Kong by Merrill Lynch (Hong Kong) which is regulated by HKSF; is issued and distributed in Taiwan by Merrill Lynch (Taiwan); is issued and distributed in India by BofAS India; and is issued and distributed in Singapore to institutional investors and/or accredited investors (each as defined under the Financial Advisers Regulations) by Merrill Lynch (Singapore) (Company Registration No 198602883D). Merrill Lynch (Singapore) is regulated by MAS. Merrill Lynch Equities (Australia) Limited (ABN 65 006 276 795), AFS License 235132 (MLEA) distributes this information in Australia only to 'Wholesale' clients as defined by s.761G of the Corporations Act 2001. With the exception of Bank of America N.A., Australia Branch, neither MLEA nor any of its affiliates involved in preparing this information is an Authorised Deposit-Taking Institution under the Banking Act 1959 nor regulated by the Australian Prudential Regulation Authority. No approval is required for publication or distribution of this information in Brazil and its local distribution is by Merrill Lynch (Brazil) in accordance with applicable regulations. Merrill Lynch (DIFC) is authorized and regulated by the DFSA. Information prepared and issued by Merrill Lynch (DIFC) is done so in accordance with the requirements of the DFSA conduct of business rules. BofA Europe (Frankfurt) distributes this information in Germany and is regulated by BaFin, the ECB and the CBI. BofA Securities entities, including BofA Europe and BofASE (France), may outsource/delegate the marketing and/or provision of certain research services or aspects of research services to other branches or members of the BofA Securities group. You may be contacted by a different BofA Securities entity acting for and on behalf of your service provider where permitted by applicable law. This does not change your service provider. Please refer to the [Electronic Communications Disclaimers](#) for further information.

This information has been prepared and issued by BofAS and/or one or more of its non-US affiliates. The author(s) of this information may not be licensed to carry on regulated activities in your jurisdiction and, if not licensed, do not hold themselves out as being able to do so. BofAS and/or MLPF&S is the distributor of this information in the US and accepts full responsibility for information distributed to BofAS and/or MLPF&S clients in the US by its non-US affiliates. Any US person receiving this information and wishing to effect any transaction in any security discussed herein should do so through BofAS and/or MLPF&S and not such foreign affiliates. Hong Kong recipients of this information should contact Merrill Lynch (Asia Pacific) Limited in respect of any matters relating to dealing in securities or provision of specific advice on securities or any other matters arising from, or in connection with, this information. Singapore recipients of this information should contact Merrill Lynch (Singapore) Pte Ltd in respect of any matters arising from, or in connection with, this information. For clients that are not accredited investors, expert investors or institutional investors Merrill Lynch (Singapore) Pte Ltd accepts full responsibility for the contents of this information distributed to such clients in Singapore.



General Investment Related Disclosures:

Taiwan Readers: Neither the information nor any opinion expressed herein constitutes an offer or a solicitation of an offer to transact in any securities or other financial instrument. No part of this report may be used or reproduced or quoted in any manner whatsoever in Taiwan by the press or any other person without the express written consent of BofA Securities.

This document provides general information only, and has been prepared for, and is intended for general distribution to, BofA Securities clients. Neither the information nor any opinion expressed constitutes an offer or an invitation to make an offer, to buy or sell any securities or other financial instrument or any derivative related to such securities or instruments (e.g., options, futures, warrants, and contracts for differences). This document is not intended to provide personal investment advice and it does not take into account the specific investment objectives, financial situation and the particular needs of, and is not directed to, any specific person(s). This document and its content do not constitute, and should not be considered to constitute, investment advice for purposes of ERISA, the US tax code, the Investment Advisers Act or otherwise. Investors should seek financial advice regarding the appropriateness of investing in financial instruments and implementing investment strategies discussed or recommended in this document and should understand that statements regarding future prospects may not be realized. Any decision to purchase or subscribe for securities in any offering must be based solely on existing public information on such security or the information in the prospectus or other offering document issued in connection with such offering, and not on this document.

Securities and other financial instruments referred to herein, or recommended, offered or sold by BofA Securities, are not insured by the Federal Deposit Insurance Corporation and are not deposits or other obligations of any insured depository institution (including, Bank of America, N.A.). Investments in general and, derivatives, in particular, involve numerous risks, including, among others, market risk, counterparty default risk and liquidity risk. No security, financial instrument or derivative is suitable for all investors. Digital assets are extremely speculative, volatile and are largely unregulated. In some cases, securities and other financial instruments may be difficult to value or sell and reliable information about the value or risks related to the security or financial instrument may be difficult to obtain. Investors should note that income from such securities and other financial instruments, if any, may fluctuate and that price or value of such securities and instruments may rise or fall and, in some cases, investors may lose their entire principal investment. Past performance is not necessarily a guide to future performance. Levels and basis for taxation may change.

BofA Securities is aware that the implementation of the ideas expressed in this report may depend upon an investor's ability to "short" securities or other financial instruments and that such action may be limited by regulations prohibiting or restricting "shortselling" in many jurisdictions. Investors are urged to seek advice regarding the applicability of such regulations prior to executing any short idea contained in this report.

Foreign currency rates of exchange may adversely affect the value, price or income of any security or financial instrument mentioned herein. Investors in such securities and instruments, including ADRs, effectively assume currency risk.

BofAS or one of its affiliates is a regular issuer of traded financial instruments linked to securities that may have been recommended in this report. BofAS or one of its affiliates may, at any time, hold a trading position (long or short) in the securities and financial instruments discussed in this report.

BofA Securities, through business units other than BofA Global Research, may have issued and may in the future issue trading ideas or recommendations that are inconsistent with, and reach different conclusions from, the information presented herein. Such ideas or recommendations may reflect different time frames, assumptions, views and analytical methods of the persons who prepared them, and BofA Securities is under no obligation to ensure that such other trading ideas or recommendations are brought to the attention of any recipient of this information.

In the event that the recipient received this information pursuant to a contract between the recipient and BofAS for the provision of research services for a separate fee, and in connection therewith BofAS may be deemed to be acting as an investment adviser, such status relates, if at all, solely to the person with whom BofAS has contracted directly and does not extend beyond the delivery of this report (unless otherwise agreed specifically in writing by BofAS). If such recipient uses the services of BofAS in connection with the sale or purchase of a security referred to herein, BofAS may act as principal for its own account or as agent for another person. BofAS is and continues to act solely as a broker-dealer in connection with the execution of any transactions, including transactions in any securities referred to herein.

Copyright and General Information:

Copyright 2026 Bank of America Corporation. All rights reserved. iQDatabase® is a registered service mark of Bank of America Corporation. This information is prepared for the use of BofA Securities clients and may not be redistributed, retransmitted or disclosed, in whole or in part, or in any form or manner, without the express written consent of BofA Securities. This document and its content is provided solely for informational purposes and cannot be used for training or developing artificial intelligence (AI) models or as an input in any AI application (collectively, an AI tool). Any attempt to utilize this document or any of its content in connection with an AI tool without explicit written permission from BofA Global Research is strictly prohibited. BofA Global Research utilizes AI, including machine learning and other technologies, to enhance the services we provide to our clients. These technologies assist our analysts in various aspects of their work, including but not limited to data analysis, content extraction, content creation, data aggregation and summarization and identifying relevant information from diverse sources. All AI-driven processes are subject to review by BofA Global Research employees. BofA Global Research information is distributed simultaneously to internal and client websites and other portals by BofA Securities and is not publicly-available material. Any unauthorized use or disclosure is prohibited. Receipt and review of this information constitutes your agreement not to redistribute, retransmit, or disclose to others the contents, opinions, conclusion, or information contained herein (including any investment recommendations, estimates or price targets) without first obtaining express permission from an authorized officer of BofA Securities.

Materials prepared by BofA Global Research personnel are based on public information. Facts and views presented in this material have not been reviewed by, and may not reflect information known to, professionals in other business areas of BofA Securities, including investment banking personnel. BofA Securities has established information barriers between BofA Global Research and certain business groups. As a result, BofA Securities does not disclose certain client relationships with, or compensation received from, such issuers. To the extent this material discusses any legal proceeding or issues, it has not been prepared as nor is it intended to express any legal conclusion, opinion or advice. Investors should consult their own legal advisers as to issues of law relating to the subject matter of this material. BofA Global Research personnel's knowledge of legal proceedings in which any BofA Securities entity and/or its directors, officers and employees may be plaintiffs, defendants, co-defendants or co-plaintiffs with or involving issuers mentioned in this material is based on public information. Facts and views presented in this material that relate to any such proceedings have not been reviewed by, discussed with, and may not reflect information known to, professionals in other business areas of BofA Securities in connection with the legal proceedings or matters relevant to such proceedings.

This information has been prepared independently of any issuer of securities mentioned herein and not in connection with any proposed offering of securities or as agent of any issuer of any securities. None of BofAS any of its affiliates or their research analysts has any authority whatsoever to make any representation or warranty on behalf of the issuer(s). BofA Global Research policy prohibits research personnel from disclosing a recommendation, investment rating, or investment thesis for review by an issuer prior to the publication of a research report containing such rating, recommendation or investment thesis.

Any information relating to sustainability in this material is limited as discussed herein and is not intended to provide a comprehensive view on any sustainability claim with respect to any issuer or security.

Any information relating to the tax status of financial instruments discussed herein is not intended to provide tax advice or to be used by anyone to provide tax advice. Investors are urged to seek tax advice based on their particular circumstances from an independent tax professional.

The information herein (other than disclosure information relating to BofA Securities and its affiliates) was obtained from various sources and we do not guarantee its accuracy. This information may contain links to third-party websites. BofA Securities is not responsible for the content of any third-party website or any linked content contained in a third-party website. Content contained on such third-party websites is not part of this information and is not incorporated by reference. The inclusion of a link does not imply any endorsement by or any affiliation with BofA Securities. Access to any third-party website is at your own risk, and you should always review the terms and privacy policies at third-party websites before submitting any personal information to them. BofA Securities is not responsible for such terms and privacy policies and expressly disclaims any liability for them.

All opinions, projections and estimates constitute the judgment of the author as of the date of publication and are subject to change without notice. Prices also are subject to change without notice. BofA Securities is under no obligation to update this information and BofA Securities ability to publish information on the subject issuer(s) in the future is subject to applicable quiet periods. You should therefore assume that BofA Securities will not update any fact, circumstance or opinion contained herein.

Certain outstanding reports or investment opinions relating to securities, financial instruments and/or issuers may no longer be current. Always refer to the most recent research report relating to an issuer prior to making an investment decision.

In some cases, an issuer may be classified as Restricted or may be Under Review or Extended Review. In each case, investors should consider any investment opinion relating to such issuer (or its security and/or financial instruments) to be suspended or withdrawn and should not rely on the analyses and investment opinion(s) pertaining to such issuer (or its securities and/or financial instruments) nor should the analyses or opinion(s) be considered a solicitation of any kind. Sales persons and financial advisors affiliated with BofAS or any of its affiliates may not solicit purchases of securities or financial instruments that are Restricted or Under Review and may only solicit securities under Extended Review in accordance with firm policies.

Neither BofA Securities nor any officer or employee of BofA Securities accepts any liability whatsoever for any direct, indirect or consequential damages or losses arising from any use of this information.

