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Copper Long View: Three misconceptions around data centers and copper

Bob Brackett, Ph.D.
+1 917 344 8422
bob.brackett@bernsteinsg.com

Andrianto Guntoro, CFA
+44 20 7676 6825
andrianto.guntoro@bernsteinsg.com

We update our long term view on copper here in depth. Our models are available to clients. We organize in four sections as follows: we summarize our call in a few charts. We then review what's new & improved in this current outlook. Finally, we provide the complete details. We wait for a better entry point into a future copper market we expect to tighten.

On demand, our updated data center (DC) work highlights three areas where expectations appear overstated. First, while DC capacity continues to scale, approaching ~200 GW by 2030, copper intensity is expected to fall meaningfully (Exhibit 10). The shift toward 800 VDC architecture, particularly in AI training facilities, reduces copper requirements by as much as 45%, with a more gradual impact in inferencing.

Second, the read-through to T&D capex and copper demand within grids is less direct than headline growth implies. Interconnection delays across the U.S. and Europe are pushing more operators toward behind-the-meter (BTM) solutions, with up to ~33–44% of demand potentially met on-site (Exhibit 21). This dampens near-term grid build-out intensity. However, given that BTM is still viewed as a bridge rather than a substitute, we still expect grid investment to catch up over time. Accordingly, we lift our T&D capex base case by ~$50–80bn per annum over 2030–2050 (Exhibit 22).

By contrast, energy storage systems (ESS) emerge as a more robust source of copper demand than data centers. Capacity is set to scale from ~550 GWh in 2025 to ~1,500 GWh by 2030 (Exhibit 26), driven by rising renewable penetration and the need for system flexibility. Unlike data centers, we do not see a meaningful near-term decline in copper intensity here, with any shift to lower-copper intensity chemistries, such as sodium-ion, likely to scale in the 2030s.

On the supply side, we revisit key projects and adjust our conviction levels (Exhibit 23). We upgrade BHP's Escondida OGP2 and First Quantum's Cobre Panama to "Going Ahead," reflecting improved visibility on execution. Conversely, we take a more cautious view on Barrick's Reko Diq, downgrading it to "Probable." We also refresh the status of several other projects, including Elang, Coroccohuayco, Copperwood, Nifty Restart, Cascabel, and Gunnison SX-EW.

In terms of investment ideas:

We see copper price currently elevated with reasonably skewed risk to the downside. We see copper-focused equities mostly reflecting optimism on copper as they trade at meaningful premium to their 5-year average multiples (Exhibit 46). For example, Lundin and Southern Copper are trading at more than +2 standard deviations above their respective 5-year averages. In comparison, ANTO (Market-Perform) and FCX (Market-Perform) are trading at approximately +1.7 and +0.6 standard deviations above their 5-year averages. With 2027 consensus at c.$12,500/t, valuations imply expectations for > $13,500/t copper price. **We reiterate our Market-Perform rating on our copper pure plays ANTO and FCX.**

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BERNSTEIN TICKER TABLE

			9 Jun 2026		TTM		Adjusted EPS			Adjusted P/E (x)		
			Closing	Price	Rel.							
Ticker	Rating	Cur	Price	Target	Perf.	Cur	2025A	2026E	2027E	2025A	2026E	2027E
AAL.LN (Anglo American)	M	GBp	3,768.00	2,350.00	59.7%	USD	0.54	1.54	1.56	93.3	32.8	32.3
ANTO.LN (Antofagasta)	M	GBp	3,846.00	**2,800.00**	91.1%	USD	1.29	**1.75**	**1.51**	39.8	29.5	34.1
OLD				2,600.00				1.51	1.39			
B (Barrick Mining)	O	USD	39.15	66.00	69.8%	USD	2.43	3.27	4.24	16.1	12.0	9.2
ABX.CN (Barrick Mining)	O	CAD	55.06	91.00	73.2%	USD	2.43	3.27	4.24	16.2	12.1	9.3
BHP.AU (BHP Group)	M	AUD	60.08	39.50	16.5%	USD	2.00	2.59	1.56	21.1	16.3	27.0
BHP (BHP Group)	M	USD	84.73	56.50	45.9%	USD	2.00	2.59	1.56	42.3	32.8	54.2
BHP.LN (BHP Group)	M	GBp	3,115.00	2,100.00	56.9%	USD	2.00	2.59	1.56	20.8	16.1	26.7
BOL.SS (Boliden)	M	SEK	515.60	580.00	58.2%	SEK	33.41	33.89	42.02	15.4	15.2	12.3
FCX (Freeport-McMoRan)	M	USD	64.25	**58.50**	28.8%	USD	1.53	**2.10**	**2.81**	42.1	30.6	22.9
OLD				53.50				1.74	2.61			
GLEN.LN (Glencore)	M	GBp	569.20	455.00	88.3%	USD	0.20	0.58	0.37	38.1	13.0	20.5
NEM (Newmont)	O	USD	98.54	157.00	62.0%	USD	6.39	10.46	12.73	15.4	9.4	7.7
RIO.LN (Rio Tinto)	O	GBp	7,469.00	6,200.00	59.3%	USD	6.69	8.41	7.19	14.9	11.9	13.9
RIO (Rio Tinto)	O	USD	101.42	83.50	48.0%	USD	6.69	8.41	7.19	15.2	12.1	14.1
RIO.AU (Rio Tinto)	O	AUD	181.23	141.00	26.5%	USD	6.69	8.41	7.19	19.0	15.1	17.7
VALE (Vale)	M	USD	15.14	14.80	35.0%	USD	0.66	1.32	1.41	22.8	11.4	10.7
VALE3.BZ (Vale)	M	BRL	78.07	75.00	8.9%	USD	0.66	1.32	1.41	22.7	11.4	10.7
EDME			1,533.88									
SPX			7,386.65									
ASIAX			1,964.02									
EM			1,823.05									

PRICE TARGET CHANGE / ESTIMATE CHANGE IN BOLD

O - Outperform, M - Market-Perform, U - Underperform, NR - Not Rated, CS - Coverage Suspended

FCX, NEM estimate is Reported EPS; FCX, NEM valuation is Reported P/E (x);

Source: Bloomberg, Bernstein estimates and analysis.

INVESTMENT IMPLICATIONS

We have Outperform ratings on ABX, NEM and RIO. We have Market-Perform ratings on AAL, ANTO, BHP, BOL, FCX, GLEN and VALE.

ANTO (Market-Perform)

We raise our price target from GBP 26.00 to GBP 28.00 to reflect our latest commodity price deck and exchange rate estimates. We use an unchanged 25/75 combination of DCF and an EV/EBITDA multiple of 8.0x against our forward 2027 EBITDA estimate.

FCX (Market-Perform)

We raise our price target from USD 53.50 to USD 58.50 to reflect our latest commodity price deck, and exchange rate estimates. We continue to use EV/EBITDA multiple of 6.50x against our forward 2027 EBITDA estimate.

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DETAILS

A BRIEF SUMMARY OF OUR COPPER OUTLOOK

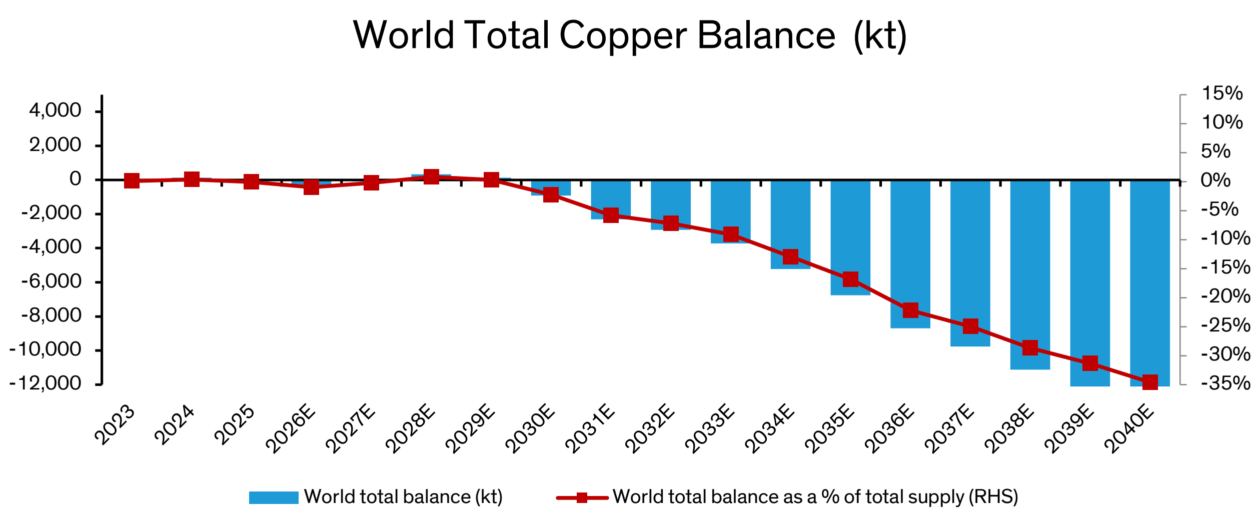
In this note, we revisit our supply projects database and update our conviction on some major copper projects. We become more positive on BHPs 'Escondida OGP 2 (organic growth program) and First Quantum's Cobre Panama project and assign "Going Ahead" status for both projects (previously probable and highly probable, respectively). We lower the likelihood of Barrick's Reko Diq to progress, and assign "Probable" status (previously Going Ahead). We also update the status of other projects like Elang, Coroccohuayco, Copperwood, Nifty Restart, Cascabel and Gunnison Restart SxEw in Exhibit 23.

We also update our demand estimates from data center and batteries (ESS and EVs). We continue to see copper demand from data center capacity growth to be offset by declining copper intensity. As a result, we see demand to stay around 400-500ktpa in the next few years, before declining to 200-300ktpa in 2030s.

Demand for batteries, especially ESS, is notably more consequential to copper. ESS capacity is expected to grow rapidly in the next few years, from 550 GWh in 2025 to 1,500 GWh by 2030. As solar and wind penetration rises, the power system requires more flexibility to manage intermittency, curtailment, peak shifting and ancillary services. More importantly, we don't foresee declining copper intensity in ESS battery in the short-term. The shift from LFP to Sodium-ion technology, which has c.30% less copper intensity, would take time and might impact copper demand in the 2030s when we already expect widening deficit.

Overall, we still see an overall deficit in 2026 (responsible for a portion but not the entirety of copper price run up), and a finely balanced market between 2027 and 2029, followed by widening deficit from 2030 onward (Exhibit 1).

EXHIBIT 1: **We might see a deficit market this year, followed by finely balanced market from 2027 to 2029. It is likely that a significant supply deficit begins to open up and grow from 2030 onwards as supply growth fails to keep up with demand from electrification.**

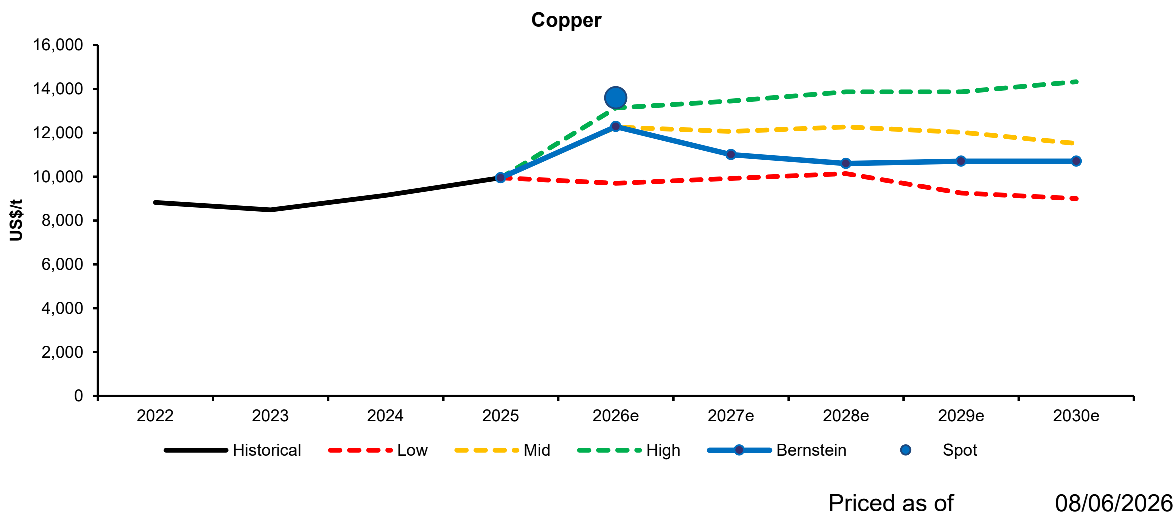


Source: WoodMac, Bernstein analysis and estimates

We revise our H2 2026 price estimates higher to $11,500/t (Exhibit 2) as we continue to expect no tariffs on refined copper import to the US will be introduced this month (Global Metals & Mining: Copper Taco, Part Deux - U.S. policy is distorting copper price). As a result, the unwind of excess copper inventory in Comex warehouses might pressure prices toward long-term margin.

EXHIBIT 2: **Copper price forecasts - consensus and Bernstein Research estimates**

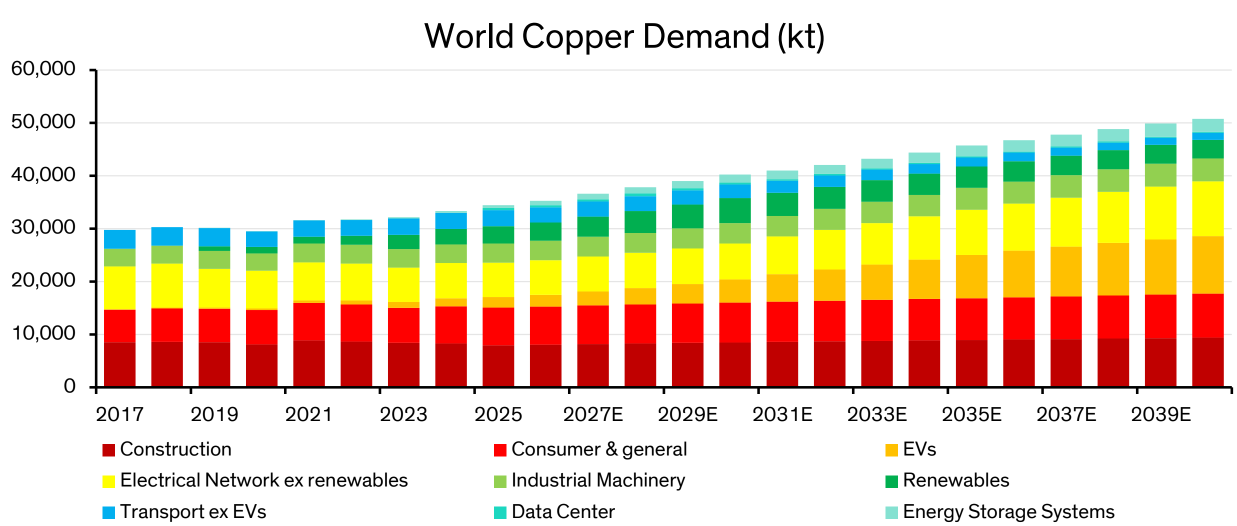
Copper	2022	2023	2024	2025	2026e	2027e	2028e	2029e	2030e
Historical	8,822	8,484	9,150	9,947					
Low				9,947	9,697	9,918	10,138	9,257	8,998
Mid				9,947	12,253	12,058	12,266	12,026	11,519
High				9,947	13,136	13,444	13,863	13,863	14,326
Bernstein				9,947	12,281	11,000	10,600	10,700	10,700
Spot					13,592				



Source: Bloomberg, S&P Global, Bernstein analysis and estimates

We see a growth in copper demand from ~34 Mt (2025 actual) by a 2.7% CAGR to ~40 MT in 2030 then decelerating towards ~51 MT in 2040 (a CAGR of 2.4%). An overall 2.7% CAGR (sub-GDP) is consistent with historic trends and a global economy moving from agriculture & industry towards services.

EXHIBIT 3: **Copper demand is expected to grow steadily to 2040. EVs and renewables are two important growth book ends in the story and significant grid expansion is required to connect the two.**



Source: WoodMac, Bernstein analysis and estimates

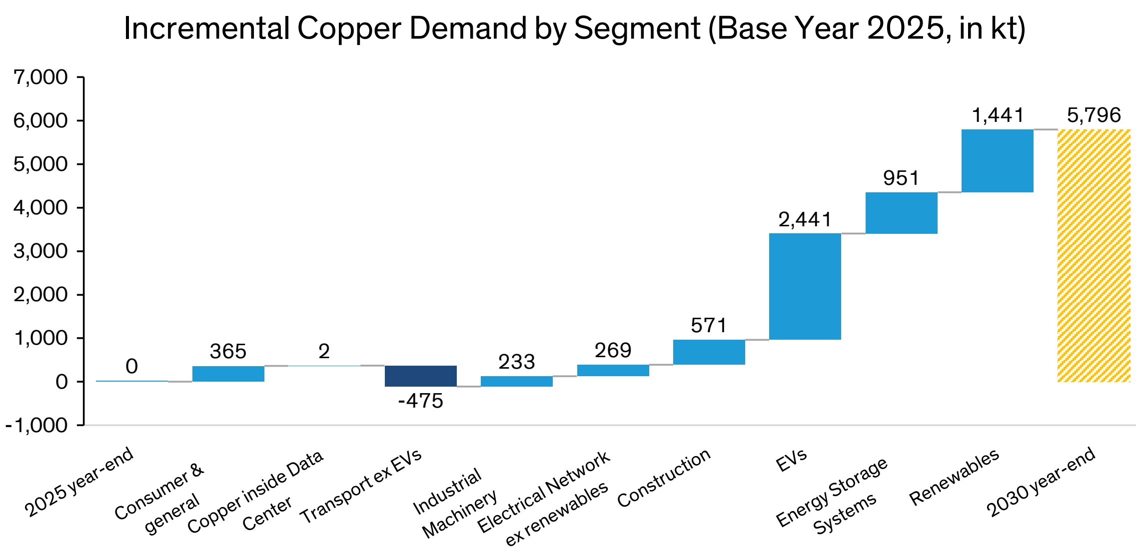
The changes in demand between 2025 and 2030 are shown as follows. New uses of electricity (EVs) and new sources of electricity (renewables such as wind and solar) are still the fastest growing segments.

The grid (electrical network ex renewables) must grow to balance this transition as do battery storage (energy storage systems).

Contrary to the prevailing narrative that data centers will emerge as a major structural driver of copper demand, their contribution remains comparatively modest, with estimated annual consumption in the range of ~350–450kt (c.1% global demand). We expect demand from data centers to remain broadly flat over 2025–2030, as ongoing structural capacity expansion is largely offset by declining copper intensity. We discuss the details in the following section.

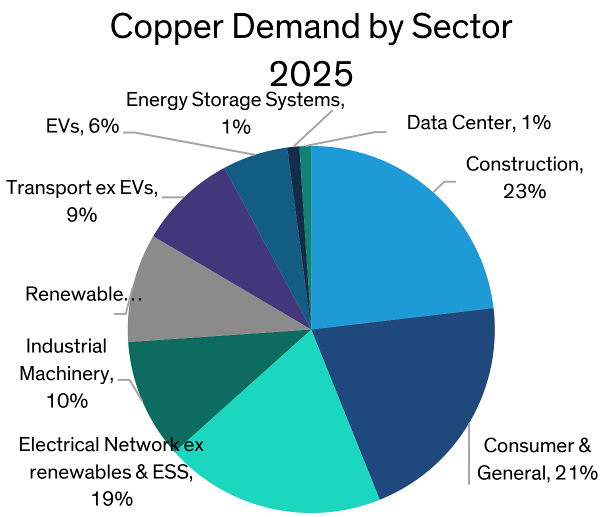
Traditional uses of copper grow less than 2% (from higher current bases) and copper demand into non-EV transport actually falls.

EXHIBIT 4: **Growth in EVs and renewables energy is expected to drive bulk of copper demand growth. Data center growth, on the other hand, is not expected to materially impact copper demand as copper intensity falls, especially after the introduction of the VDC 800.**



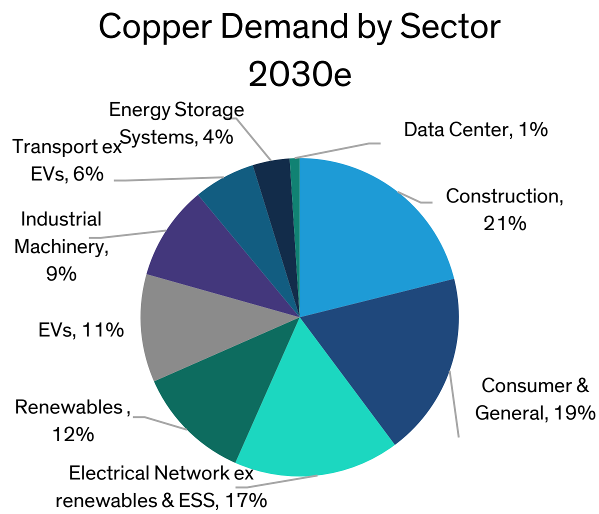
*the declining copper intensity inside data centers is due to the growing use of fiber optic cables instead of copper cables, as higher data speeds are required. Further, using 800 V busways and switching from 415 VAC to 800 VDC in electrical distribution enables 85% more power to be transmitted through the same conductor size. This happens because higher voltage reduces current demand, lowering resistive losses and making power transfer more efficient. With lower current, thinner conductors can handle the same load, reducing copper requirements by 45%.
Source: WoodMac, Bernstein analysis and estimates

EXHIBIT 5: **Green demand (EV & renewables) made up 16% of total demand in 2025...**



Source: WoodMac, Bernstein analysis

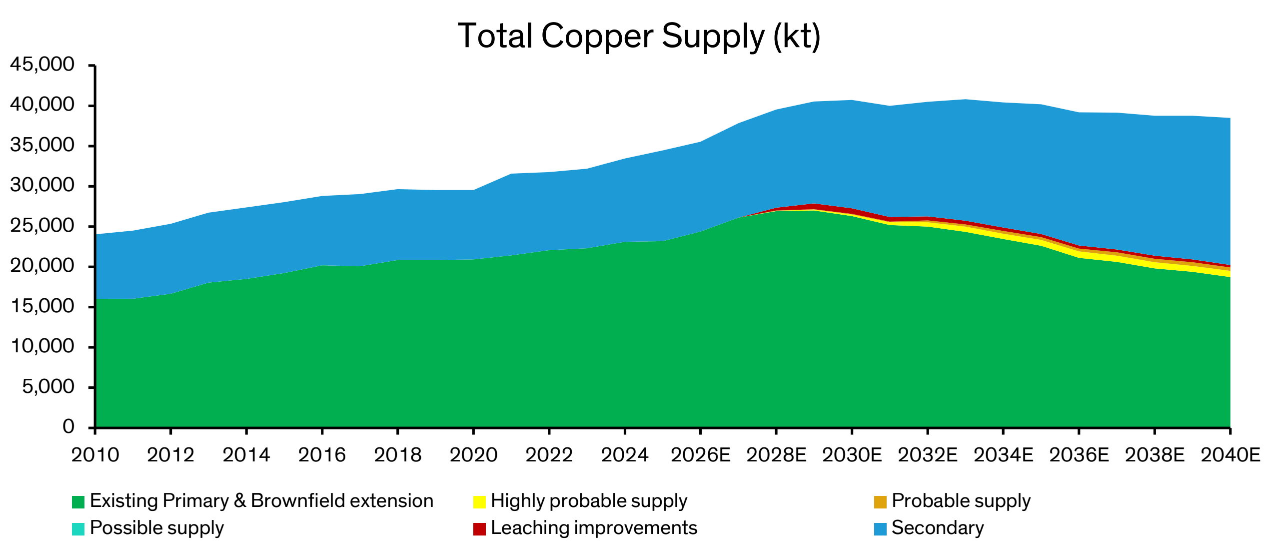
EXHIBIT 6: **...and is expected to grow to 23% by 2030. Copper will still be largely driven by industrial activities.**



Source: WoodMac, Bernstein analysis and estimates

We show a copper deficit beginning in 2030 which is a function of the demand shown above and the supply outlook below. We highlight that a lack of sanctioning of new greenfield copper projects has occurred and the cycle time for copper mines is measured in scales of 5-10 years and so a deficit 4 years out seems increasingly hard to close at today's copper price (see mental frame above obviously).

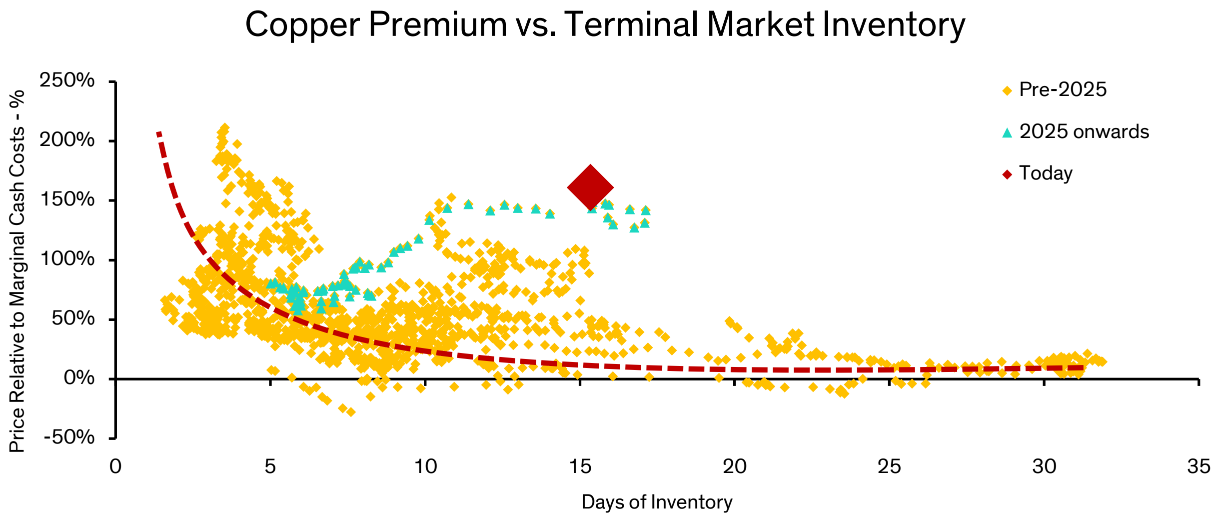
EXHIBIT 7: **Supply is likely to peak in 2030, with the majority of supply increase coming from brownfield extensions, supported by rising secondary supply (direct use of scrap)**



Source: WoodMac, Bernstein analysis and estimates

A combination of our supply/demand imbalance, our long term view of copper EBITDA margin and our correlation of copper price against inventories (below) drives our copper price deck.

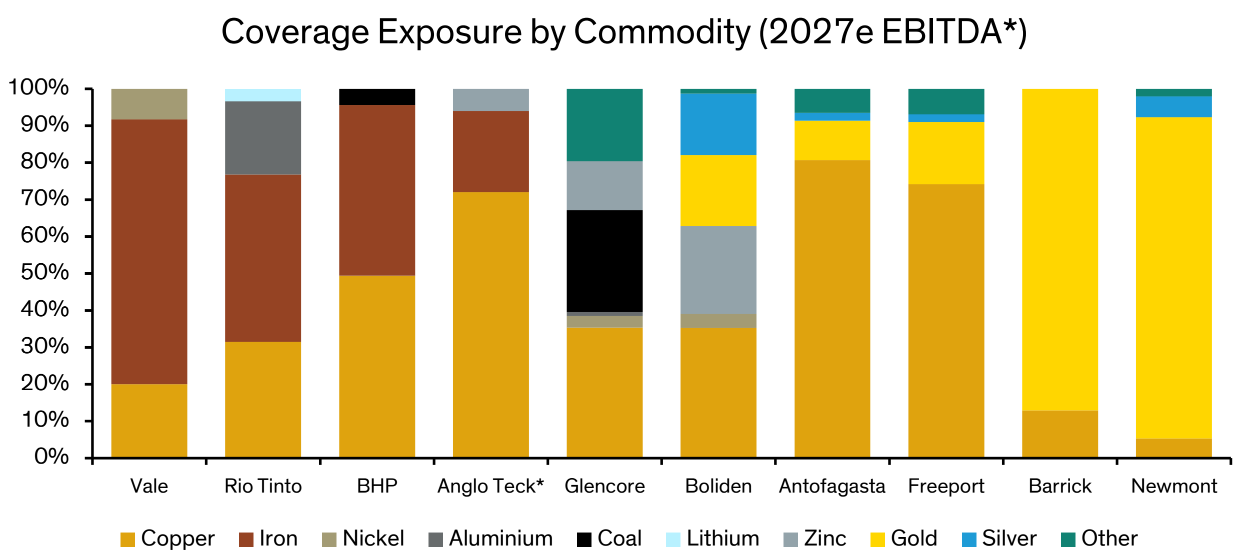
EXHIBIT 8: **At current inventory levels (~15 days of cover), copper prices look elevated.**



Source: WoodMac, Bloomberg, Bernstein analysis and estimates

All of the names in our mining coverage have exposure to copper with Antofagasta, Freeport, and Anglo Teck (pro forma) being the highest.

EXHIBIT 9: **Coverage Exposure by Commodity**



We use revenue (instead of EBITDA) for BOL, ANTO, FCX, NEM and ABX

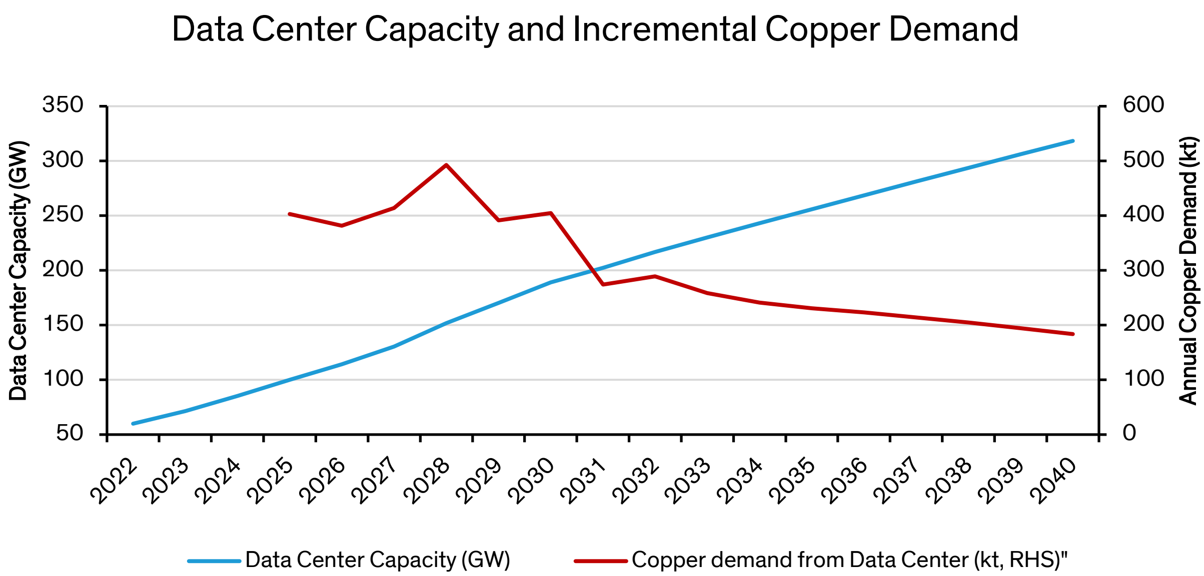
*AngloTeck proforma EBITDA
Source: Company reports, Bernstein analysis and estimates

WHAT'S NEW

WHAT'S NEW - INTEGRATING 800VDC ARCHITECTURE INTO OUR DATA CENTER COPPER DEMAND MODEL

Copper demand from data centre build-out is unlikely to be as significant as current market expectations imply (Exhibit 10). We estimate demand to reach 500Mtpa in 2028, before start declining to reach c.200ktpa by 2040, *despite rising capacity*.

EXHIBIT 10: **Data center capacity is expected to grow rapidly, but declining copper intensity means annual copper demand is likely to peak when 800 VDC architecture is introduced.**

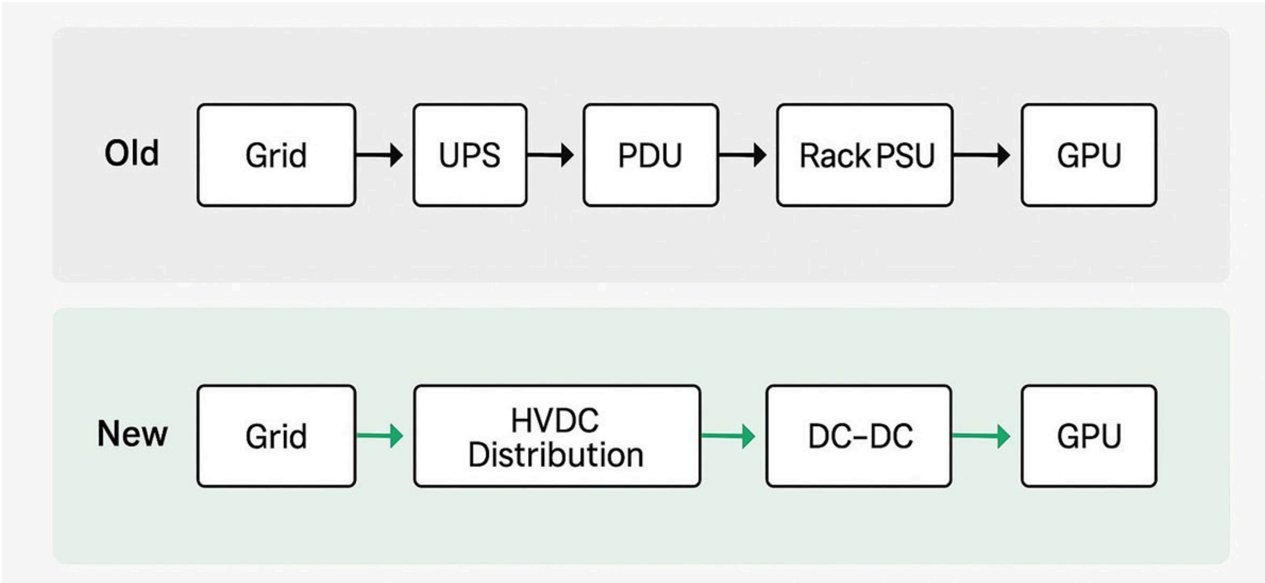


Source: IEA, McKinsey, BCG, Datacenter Knowledge, Bernstein analysis and estimates

We continue to believe that copper intensity in data center would decline as the industry experience technological changes which result in efficiency gains (Exhibit 13). One of major technological changes we anticipate is the introduction of 800 VDC architecture.

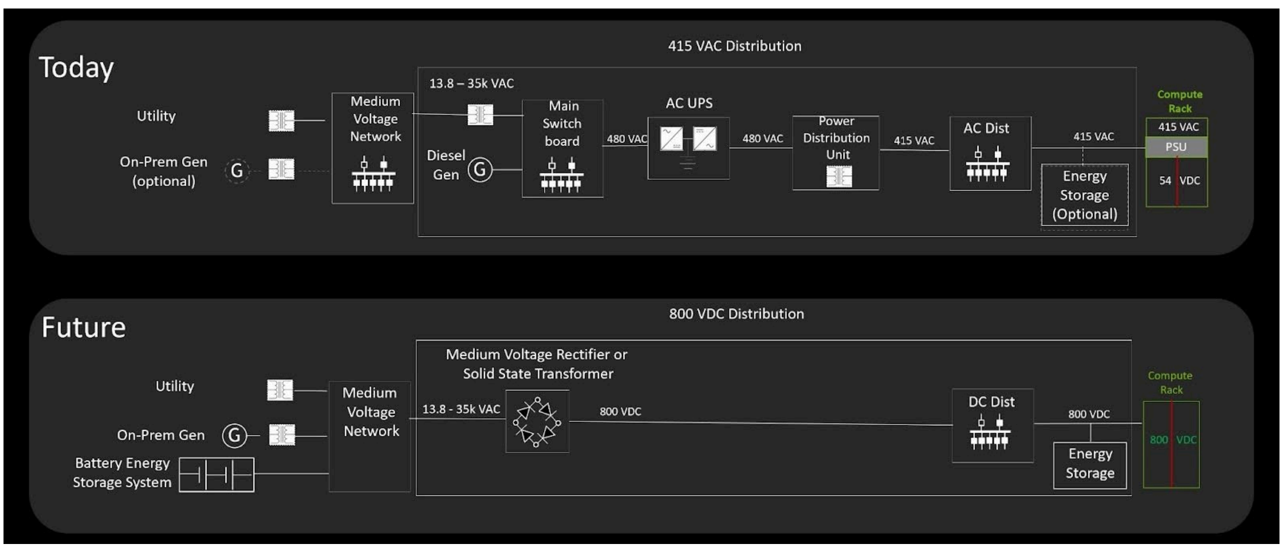
What is 800 VDC architecture? At a high level, **800 VDC architecture in a data centre** refers to a shift in how electricity is delivered internally - from a traditional, multi-step alternating current (AC) system to a **high-voltage direct current (DC) distribution model operating at ~800 volts**. Data centres ultimately run on DC power: chips, GPUs, and servers all require DC to operate.

EXHIBIT 11: **The new 800 VDC is simpler than current infrastructure which requires multiple conversion stages, and inherently has higher power loss (i.e., lower efficiency).**



Source: Company reports, Bernstein analysis

EXHIBIT 12: **NVIDIA gives us comparison between 415 VAC (top) and 800 VDC power distribution (bottom)**



Source: Company reports, Bernstein analysis

Why does the world need 800 VDC? In short, traditional 54 V in-rack power distribution—designed for kilowatt-scale loads—is not structurally suited to support the megawatt-scale power requirements emerging in modern AI data centres.

Legacy infrastructure delivers electricity as AC, meaning power must be converted multiple times before it reaches the compute load. Each conversion step introduces: energy loss, heat generation, and additional equipment and complexity. This architecture was workable when racks consumed ~10 kW. It becomes structurally inefficient as rack power scales toward 100 kW to 1 MW in AI workloads. For example, NVIDIA's latest platforms have already lifted requirements from ~50 kW/rack to 120 to 180 kW, with next-gen systems targeting >3-5x further increases. At these levels, traditional 48 VDC architectures face binding constraints, including elevated current losses, space limitations, and rising copper intensity.

In response, the industry is pivoting toward 800 VDC architectures (e.g., NVIDIA, Mount Diablo consortium), aimed at alleviating these bottlenecks and enabling the next phase of data center scaling.

For more context around 800 VDC, you may to the following Bernstein notes:

AI Value Chain: How much does a GW of data center capacity actually cost, and what goes into it?

Powering AI: Deep diving the 800 VDC shift - quantifying the impact on electricals content and growth

How does 800 VDC impact copper intensity? Higher voltage (V) means lower current (A) needed to deliver the same amount of power (W). NVIDIA estimates that lower current means thinner conductors can handle the same load, reducing copper requirements by c.45%.

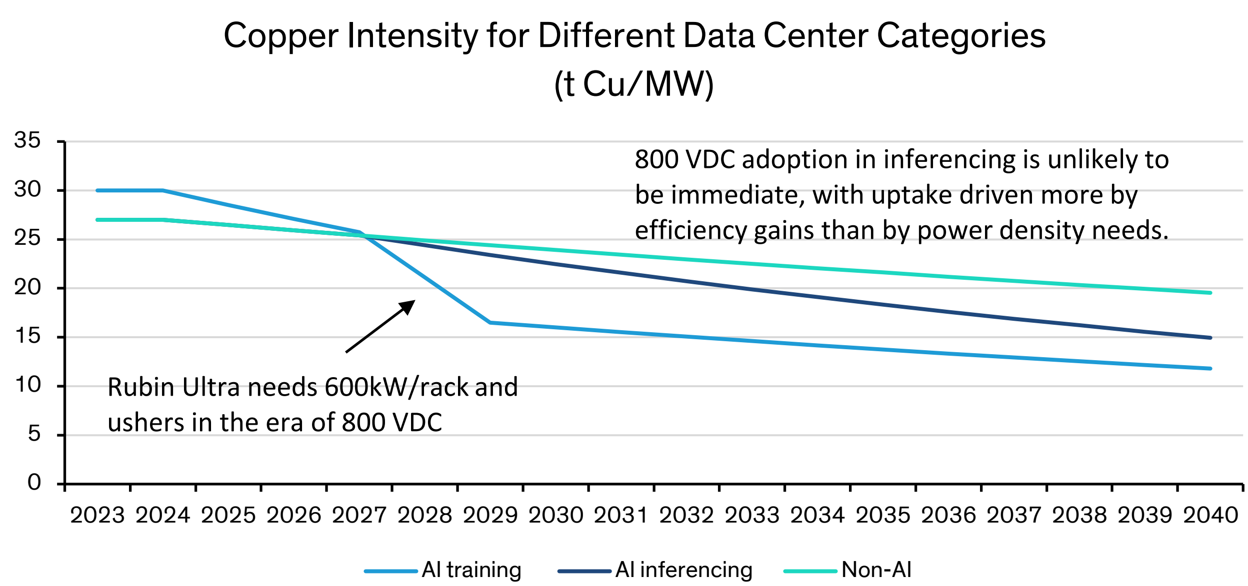
However, not all data centre capacity is dedicated to AI training and inference. As a result, copper intensity outcomes are different across categories, reflecting varying adoption trajectories for 800 VDC architecture.

AI training is anchored on frontier GPU deployments and is therefore expected to lead in adoption. With platforms such as Rubin Ultra, which requires 800 VDC, anticipated from H2 2027, the transition is likely to be front-loaded. We consequently model a sharp decline in copper intensity between 2027 and 2029, falling from ~30 t Cu/MW today to ~17 t Cu/MW by 2029.

By contrast, AI inferencing does not uniformly rely on frontier-class hardware and is therefore less immediately constrained to adopt 800 VDC. Nonetheless, the efficiency benefits remain compelling. Adoption is thus expected to be progressive rather than step-change, driving a steady, incremental reduction in copper intensity over time.

A similar dynamic applies to non-AI data centres. Immediate adoption of 800 VDC is unlikely, given lower power density requirements. However, efficiency gains still provide a structural incentive for transition. As such, uptake is expected to be gradual, with copper intensity trending lower over time, albeit at a slower pace relative to AI inferencing.

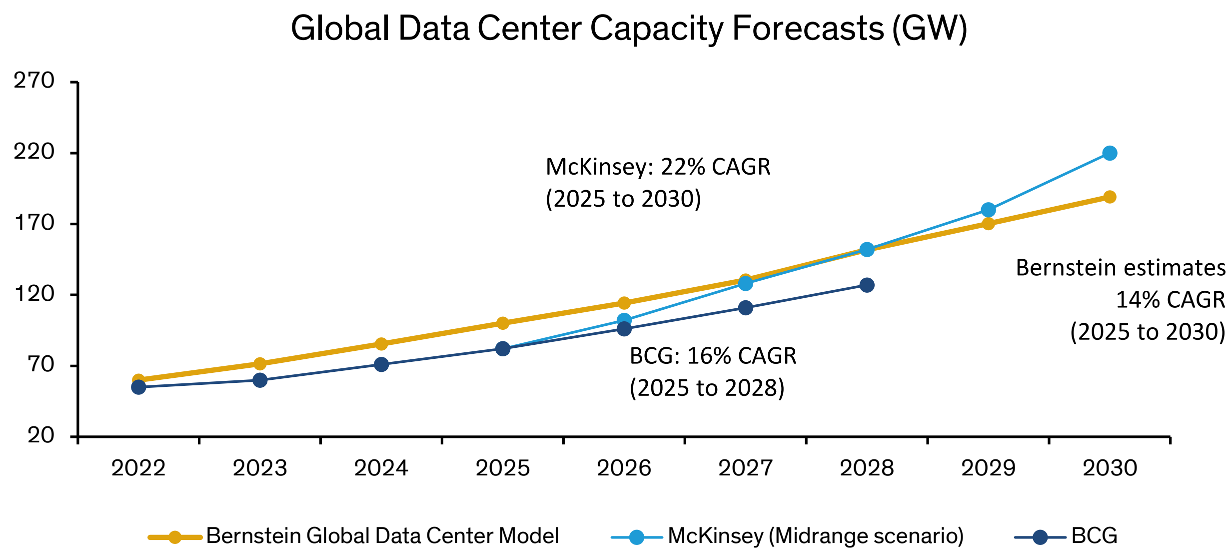
EXHIBIT 13: **NVIDIA expects 800 VDC architecture to use less copper as lower current enables thinner conductors for the same load, reducing copper intensity by ~45%.**



https://developer.nvidia.com/blog/nvidia-800-v-hvdc-architecture-will-power-the-next-generation-of-ai-factories/
Source: Company reports, Bernstein analysis and estimates

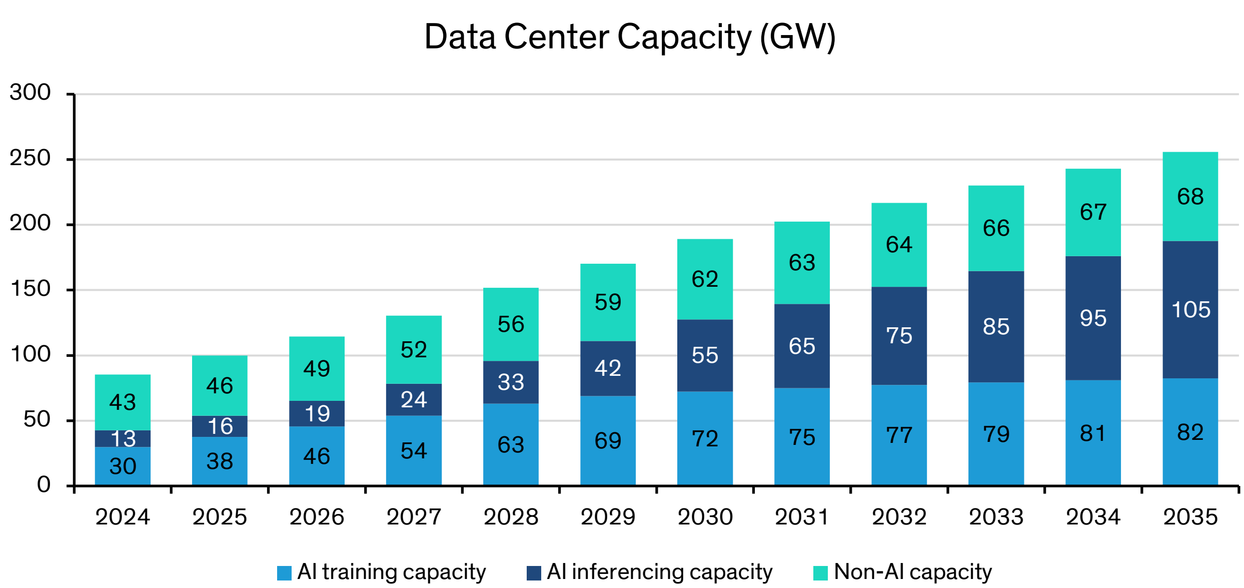
How about data center capacity? In our previous model, we use the average of BCG and McKinsey estimates to inform our data center capacity estimates. Our current model adopts estimates from Bernstein's global data center model, which is slightly higher than our previous estimates (Exhibit 14). We expect cumulative data center capacity to reach 189 GW and 256 GW by 2030 and 2035 (Exhibit 15), with bulk of the addition coming from AI inferencing (Exhibit 16).

EXHIBIT 14: **Global data center supply is expected to almost reach 200GW by 2030, implying 15-20GW annual capacity addition in the next few years.**



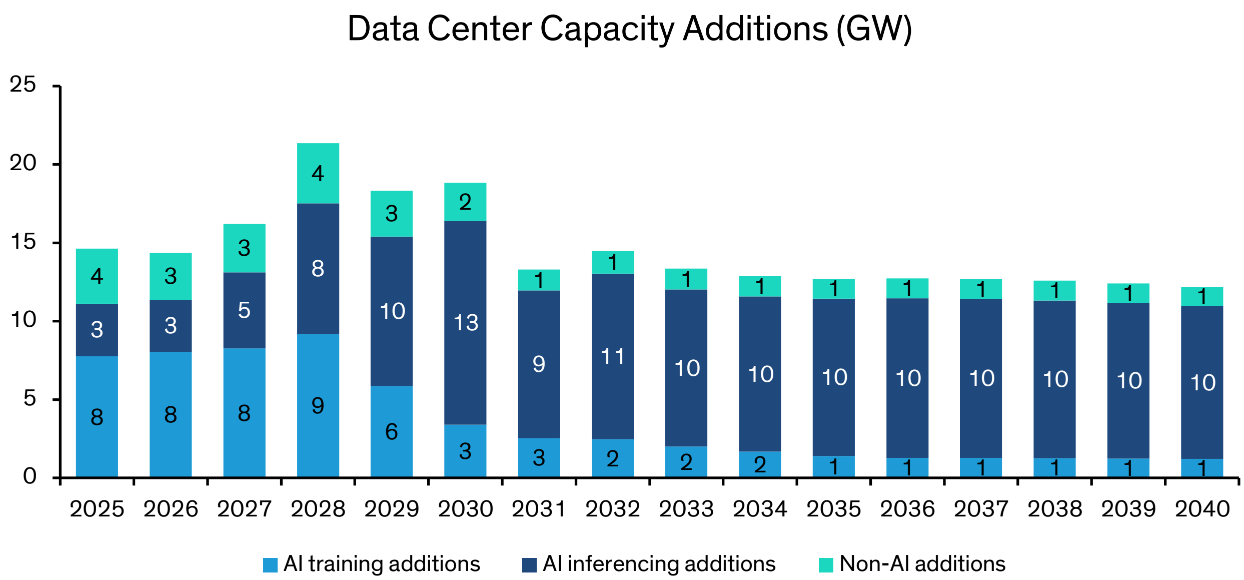
Source: McKinsey, BCG, IDC, Gartner, Omdia, Bernstein Global Data Center Model, Bernstein Analysis and Estimates

EXHIBIT 15: **Data center capacity by end-use type**



Source: IDC, Gartner, Omdia, Bernstein Global Data Center Model, Bernstein Analysis and Estimates

EXHIBIT 16: **Data center capacity annual addition by end-use type**

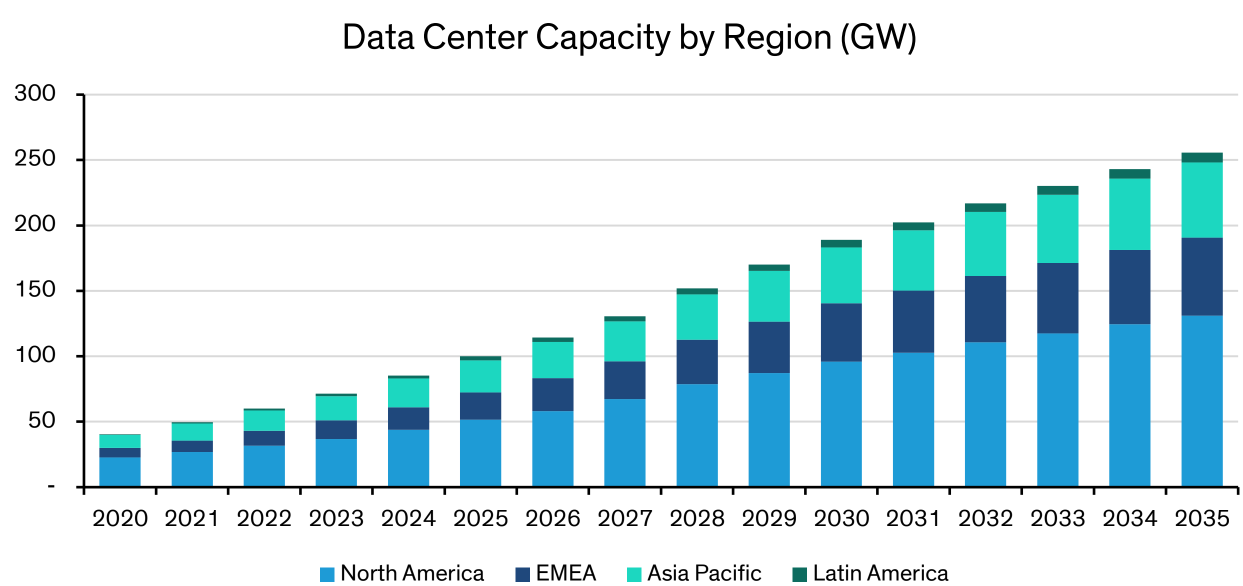


Source: IDC, Gartner, Omdia, Bernstein Global Data Center Model, Bernstein Analysis and Estimates

What about the extra copper needed to build grid (T&D)? We expect a portion of data center electricity needs will be fulfilled by behind-the-meter (BTM) solutions (a.k.a. onsite generation). **Hence, T&D capex growth due to data center, which translates to copper demand, might not be a 1:1 with data center capacity growth.**

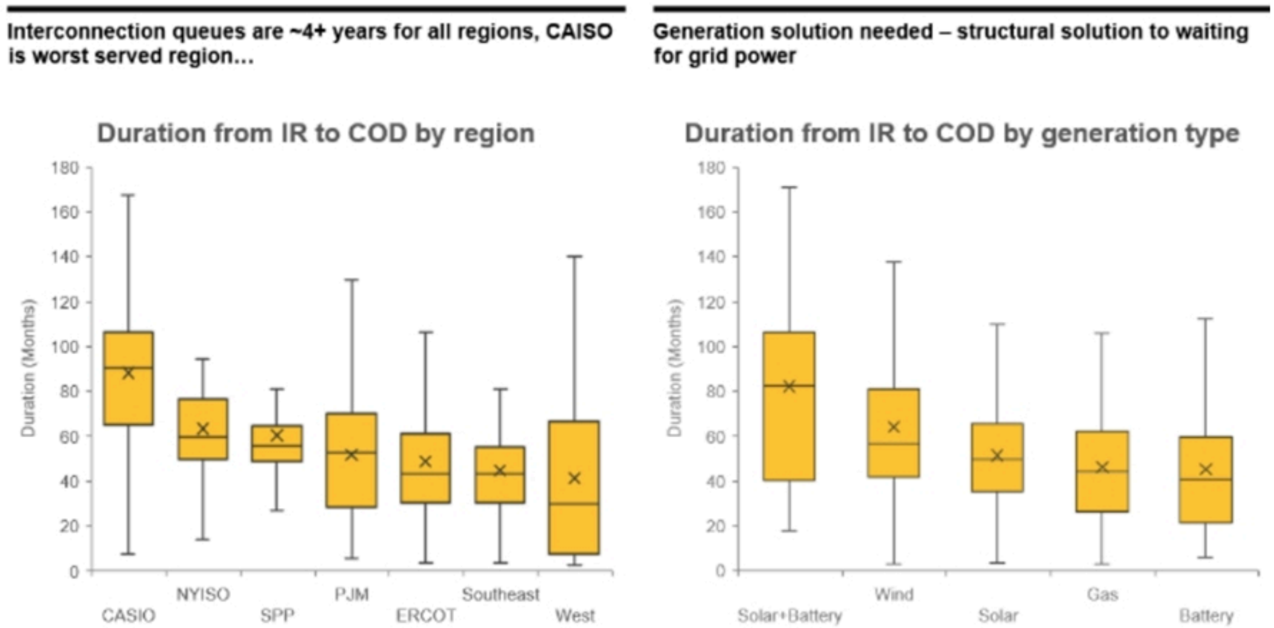
Since the US accounts for c.50% of global data center capacity (Exhibit 17), we highlight long interconnect queues, which explain why data center operators use BTM solutions to fulfill partial or all of their electricity needs (Exhibit 18). Currently, there are 8,188 active generation requests in the US with a combined capacity of 1.76 TW (Exhibit 19).

EXHIBIT 17: **North America is expected to dominate data center supply at c.50% global capacity**



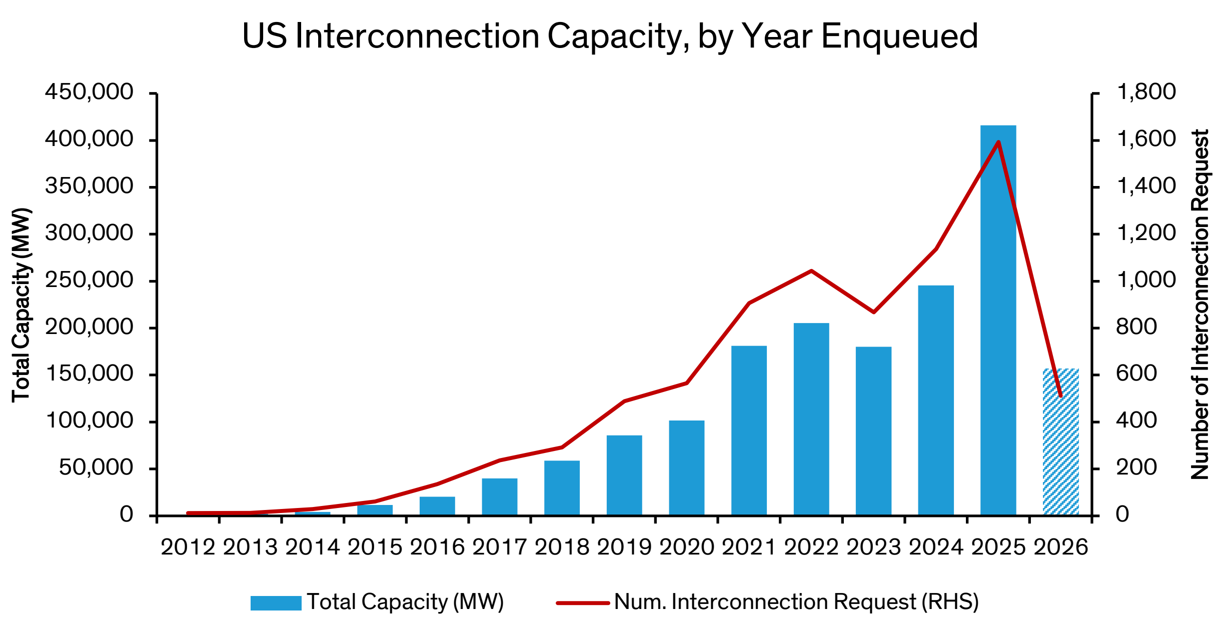
Source: IDC, Gartner, Omdia, Bernstein Global Data Center Model, Bernstein Analysis and Estimates

EXHIBIT 18: **Interconnection queues in the US remain structurally constrained, with timelines from interconnection request (IR) to commercial operations date (COD) typically exceeding four years, on average.**



Source: Company websites, Bernstein analysis

EXHIBIT 19: **Currently, there are 8,188 active generation requests in the US with a combined capacity of 1.76TW**

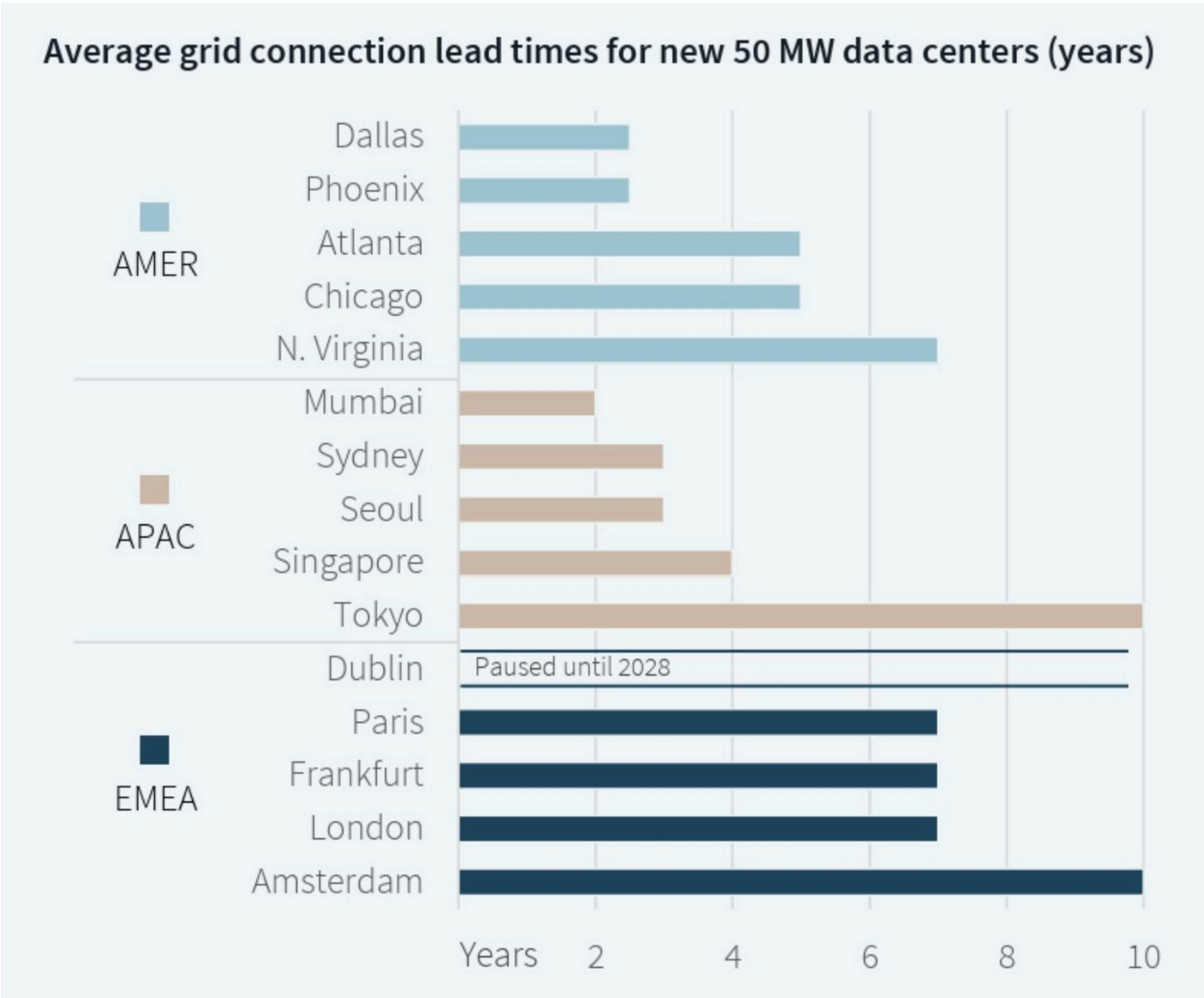


The 2026 figure reflects a year-to-date value and is not annualised.
Source: Interconnection fyi, Bernstein analysis

Long interconnection queues aren't just a US specific issue, they're also present in other regions, particularly in Europe (Exhibit 20). In many cases, European grids are older and less flexible than those in parts of Asia, which tends to make bottlenecks around new connections more pronounced.

Given that backdrop, it's reasonable to expect data center operators in Europe to lean more on behind-the-meter (BTM) solutions. Much like in the US, these act as a practical workaround to help bring capacity online despite grid delays, while utilities take the longer path of upgrading and expanding infrastructure.

EXHIBIT 20: **Grid bottlenecks are increasingly acting as a binding constraint, prompting data centre developers to pivot toward self-generation, power purchase agreements (PPAs), and private wire arrangements as a means of accelerating project timelines.**



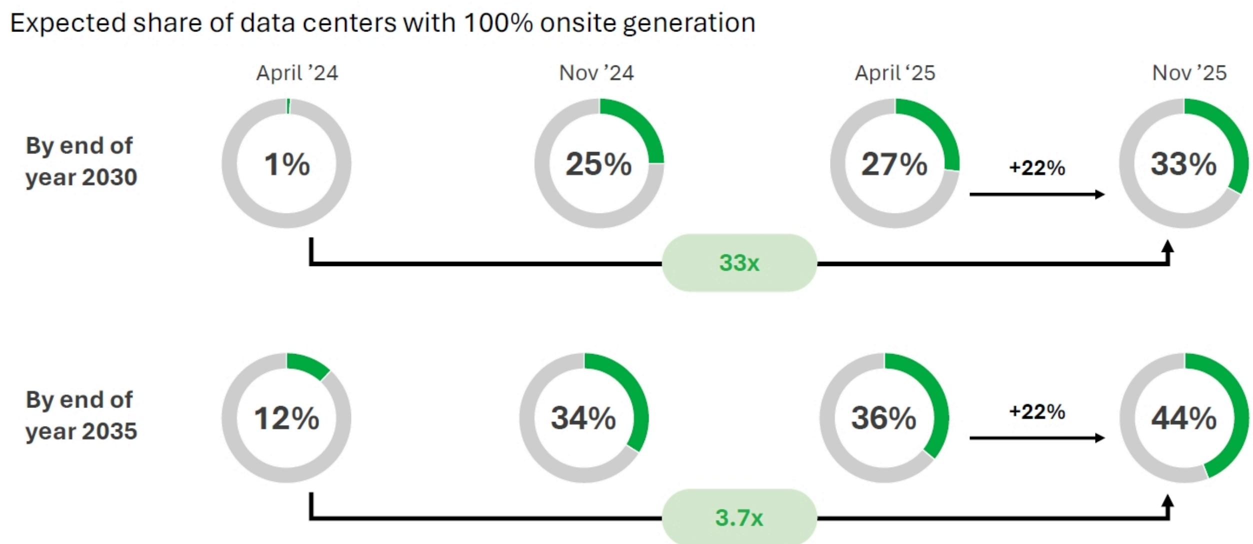
Source: Company reports, Bernstein analysis

Survey results in Exhibit 21 shows that up to 33% and 44% of data centers electricity demand will be met by 100% onsite generation. However, data center operators like Equinix and Digital Realty (both covered by US Communication Infrastructure team) mention that **BTM is a practical bridge, not a long-term replacement for the grid.**

Digital Realty's management still views the utility grid as the backbone of its power strategy. The grid brings built-in advantages, such as scale, redundancy, and shared infrastructure that are difficult and expensive to replicate on a standalone basis. Importantly, DLR doesn't expect a future where data centers broadly go off-grid, especially since hyperscale customers continue to prefer traditional utility power. In that context, BTM solutions are used more tactically: they help get capacity online faster while utilities catch up on transmission and distribution upgrades.

Equinix uses on-site generation, like fuel cells or gas turbines, to fill gaps when grid access is delayed or constrained. The goal isn't to replace the grid, but to keep projects moving and avoid bottlenecks. Once utility power becomes available, that remains the long-term solution.

EXHIBIT 21: **BloomEnergy surveys reveal that 33% and 44% of data centers might use 100% onsite (behind-the-meter) generation by 2030 and 2035, respectively. BTM solutions are much less copper intensive due to location proximity.**

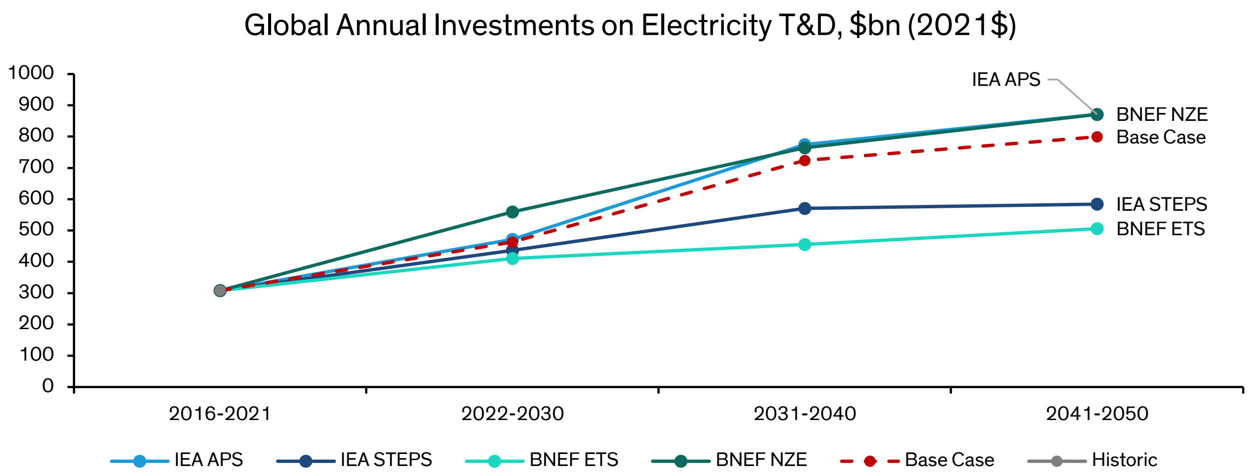


Source: Company reports, Bernstein analysis

As a result, we revise our base case for transmission and distribution (T&D) capex to reflect the incremental load from data center expansion. Previously, our framework anchored on a mid-point between the IEA's STEPS and APS scenarios, consistent with the view that actual investment would likely meet stated policies but fall short of full policy ambition. However, the addition of structurally higher demand from data centers shifts this balance. Grid infrastructure will need to scale more aggressively to accommodate this load.

As a result, we now see T&D capex tracking closer to the APS scenario. The incremental demand from data centers effectively pulls forward investment requirements, increasing the likelihood that realized spending will converge toward the upper end of the IEA framework rather than the midpoint (Exhibit 22).

EXHIBIT 22: **Global T&D investment is set to step up structurally, driven by incremental AI-linked grid capex. We therefore shift our base case from a STEPS/APS midpoint toward the APS trajectory to capture this uplift.**



Source: IEA, Bernstein analysis and estimates

Bob Brackett, Ph.D. +1 917 344 8422 bob.brackett@bernsteinsg.com

WHAT'S NEW - UPDATING OUR SUPPLY/PROJECT DATABASE

EXHIBIT 23: **Some notable changes in the outlook of copper projects.**

Project Name	Country	Mill/SxEw	Brownfield / Greenfield	Previous Probability	Current Probability	Note	2027	2028	2029	2030	2035	2040
Escondida OGP 2	Chile	Mill	Brownfield	Probable	Going Ahead	BHP is aggressively advancing its growth program to offset declining grades at Escondida, having submitted the Environmental Impact Declaration for a new concentrator in March 2026. The new concentrator project, requiring an estimated $4.4 billion to $5.9 billion, is targeting an FID in 2027 or 2028, with first production anticipated between 2031 and 2032.	0	0	0	0	240	240
Elang	Indonesia	Mill	Brownfield	Probable	Highly Probable	PT Amman Mineral completed the DFS for this deposit in 2025. The project will utilize the existing Batu Hijau infrastructure. Development and operations are scheduled to scale up as the current Batu Hijau mine approaches its end of life around 2030.	0	0	0	0	190	165
Cobre Panama Restart	Panama	Mill	Brownfield	Highly Probable	Going Ahead	President Mulino's acknowledgment that "the slate is now clean" suggests a political opening not previously available. The question is when not if. First Quantum restarted the site's power plant and expects this stockpile to yield roughly 70,000 tonnes of copper through 2027. A complete resumption of greenfield mining will require a broader, long-term political resolution.	45	300	376	335	403	350
Coroccohuayco	Peru	Mill	Brownfield	Probable	Highly Probable	Glencore is targeting an FID in the second half of 2026 for this critical expansion within the Antapaccay district. First production is scheduled for late 2029, which is expected to extend the regional mine life by over 40 years.	0	0	50	90	148	148
Reko Diq	Pakistan	Mill	Greenfield	Going Ahead	Probable	Barrick Gold completed an updated feasibility study in late 2024, outlining a massive phased development capable of producing up to 460,000 tonnes of copper annually in Phase 2. However, following the escalation of security incidents in Balochistan in early 2026, Barrick has slowed development activity and initiated a comprehensive review of the project's security, capital requirements, and timeline.	0	0	0	0	230	430
Copperwood	United States	Mill	Greenfield	Probable	Highly Probable	Highland Copper has positioned Copperwood as one of the most advanced near-term domestic copper developers, having secured all necessary permits and completed a Feasibility Study in 2023. To focus entirely on advancing Copperwood to an H2 2026 construction decision, the company divested its interest in the White Pine project for $30.1 million in early 2026. The project targets 2029 production of approximately 30,000 tonnes per annum.	0	0	0	31	29	0
Nifty Restart	Australia	Mill	Brownfield	Possible	Going Ahead	NIFTY COPPER COMPLEX – PHASE 1 COPPER CATHODE RESTART: On 20 November 2025, the Cyprium Board of Directors approved the Cathode Project restart plan, authorising significant expenditures to maintain project schedule for expected first production of copper cathode in Q3 2026.	12	34	46	35	41	43
Cascabel	Ecuador	Mill	Greenfield	Possible	Probable	The project was significantly de-risked following Jiangxi Copper's completed takeover of SolGold in March 2026. The new ownership is targeting early development of the Tandayama-América open pit, with initial production slated to begin in 2028. However, Ecuador gov't plans to renegotiate Cascabel mine contract	0	0	0	0	111	125
Gunnison Restart SxEw	United States	SxEw	Brownfield	Possible	Highly Probable	Gunnison Copper Corp has achieved commercial milestones, transitioning from run-of-mine oxide material into sulfide leach production using Rio Tinto's Nuton technology in late 2025. The priority for 2026 is scaling the operation up to its full SX/EW nameplate capacity.	0	0	0	0	79	79

We assign different weights to different probability categories. Projects we see as likely to proceed receive a full 100% weighting; highly probable, probable, and possible projects receive 50%, 15%, and 0% weightings, respectively.

Source: Company reports, WoodMac, Bernstein analysis and estimates

We update the list of copper projects in our model and refresh our supply forecast given a number of headlines. We assign different weights to different probability categories. For example, projects we see as likely to proceed receive a full 100% weighting; highly probable, probable, and possible projects receive 50%, 15%, and 0% weightings, respectively.

Overall, we gain more confidence in several projects, such as Escondida OGP (organic growth project) 2, which aims to build a new concentrator with 125ktpd capacity to replace Los Colorados. BHP (Market-Perform) announced that it already submitted DIA (simplified environmental impact statement) to the Chilean regulator in March 2026. Considering that DIA is a much simpler process than EIA, we upgrade the project status from "probable" to "going ahead".

EXHIBIT 24: **Escondida OGP 2 is subject only to DIA submission, which was completed in March. Given the relatively streamlined permitting pathway and the strategic importance of the project to BHP, we upgrade our assessment of the project to "going ahead."**

	DIA (simplified environmental impact statement)	EIA (full environmental impact study)
Timing (submission to award)	Legal timing: 90 days Effective timing: 9 to 12 months	Legal timing: 180 days Effective timing: 24 months+
Environmental impacts	The project doesn't cause significant environmental impacts	Project generates significant environmental and social impacts. People's health, natural resources, protected areas, cultural heritage, indigenous communities, etc.
Additional measures	No, but needs compliance with general regulations	Yes. Mitigation and compensation measures to address significant environmental and/or social impact
Public participation	Not mandatory (upon request)	Yes, always. Led by SEA (Environmental Assessment Service, a public body)
Indigenous consultation	No, if there're no significant impacts	Yes. If the project causes impacts to indigenous communities. Led by SEA.

Source: Company reports, Bernstein analysis

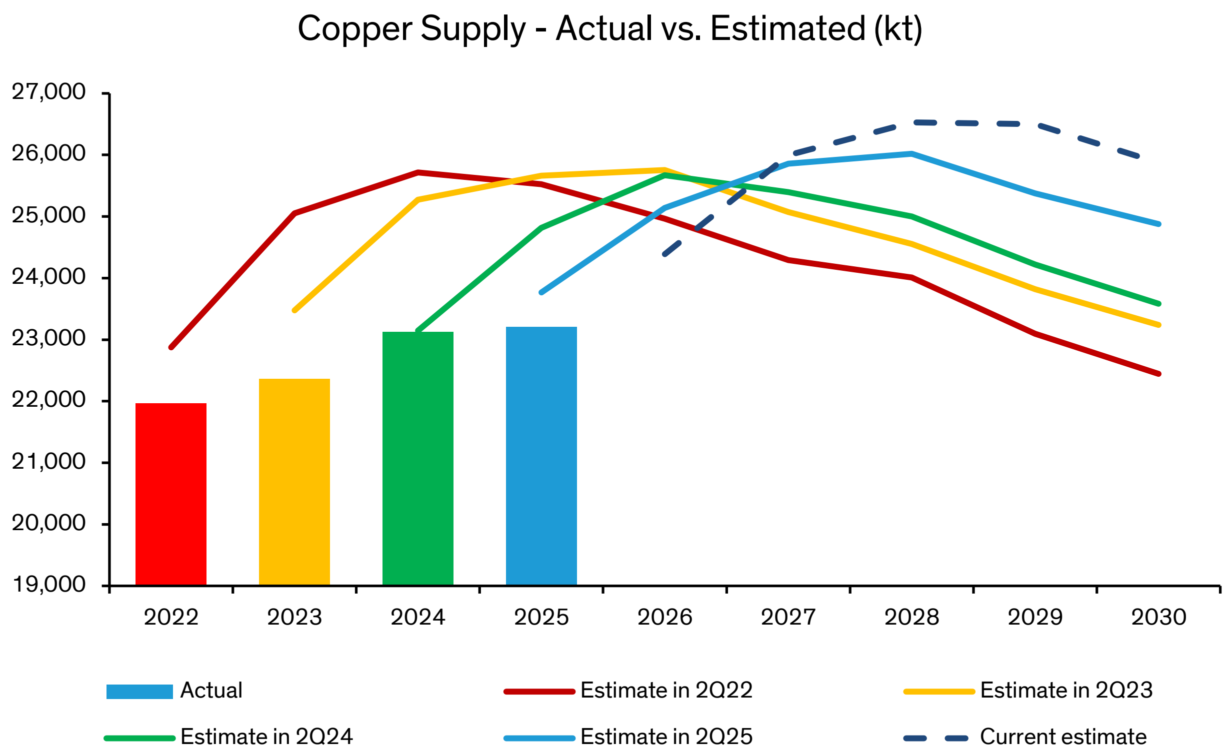
We upgrade the Cobre Panama project from "highly probable" to "going ahead," reflecting de-escalating tensions between the Government of Panama and First Quantum, besides a shift in domestic sentiment toward a more supportive stance on the project. For example, in April 2026, the Government of Panama has formally approved the removal, processing and export of stockpiled ore at Cobre Panamá that was extracted prior to the suspension of operations. Further, Panama's President has formed an inter-agency task force to evaluate the future of First Quantum's suspended copper mine, with a decision on a potential restart expected by mid-year. The review will cover technical, legal, economic and environmental factors. A restart would be economically meaningful for both Panama and First Quantum, while adding supply to a tightening copper market. Lastly, a Cid Gallup poll released in April found that 61% of Panamanians viewed reopening the mine positively.

We also upgrade Coroccohuayco project from "probable" to "highly probable" as we get more clarity on the timeline and potential capex and production from Glencore during its CMD in December.

We only downgrade 1 major project, Reko Diq, from "going ahead" to "probable". In February 2026, Barrick announced a comprehensive review of the project following a deterioration in the security environment and a rise in security-related incidents. This was followed by an April 2026 update indicating a slowdown in development activity, with the review now expected to continue through to mid-2027.
Barrick also flagged potential material increases to both the project's capital intensity and timeline. Previously disclosed estimates pointed to a Phase 1 capital cost of $5.6–6.0 billion (100% basis) and Phase 2 of $3.3–3.6 billion (100% basis), with first production targeted by end-2028.

On absolute terms, copper primary supply has grown by 2.5% CAGR since 2022, from 22Mt to (potentially) 23.7Mt in 2025. However, the growth rate in recent years has been much below expectations (Exhibit 25).

EXHIBIT 25: **The mine's 'capacity' and the miner's 'desire' are offset by underlying under-estimated structural issues, often leading to persistent overestimation of production capacity.**



Source: WoodMac, Bernstein analysis

WHAT'S NEW - UPDATING DEMAND FROM ENERGY STORAGE SYSTEMS (ESS)

Energy storage is an important piece of the puzzle in the electrification of the world. It is an enabling technology that improves the reliability of renewable energy sources, which can be unreliable on their own. As demand for solar and wind power grows, we will need even more batteries for energy storage. ESS demand is expected to reach c.1.4TWh by 2030, similar to what CATL's called in its prospectus in mid-2025. Previously we estimated demand to "only" grow to 983 GWh as we were cautious on the "s-shaped" adoption curve. However, a very robust 2025 shipment/demand shows that the adoption curve has inflected higher and is likely to exceed our previous estimates.

Exhibit 26 shows our calculation to reach our new estimates. We drive our model by assuming that 1GW in 4GW of net added solar and wind capacity will be equipped with ESS. It drives our assumption that ESS capacity will be at 17% of global solar and wind capacity by 2030 (our previous estimate was 12% by 2030).

EXHIBIT 26: **As solar and wind capacity grows, the demand for ESS will follow accordingly. Most of ESS will utilize LFP technology with copper intensity of ~1.02 kg/KWh. We see c.1.5Mt incremental copper demand in year 2030 from ESS.**

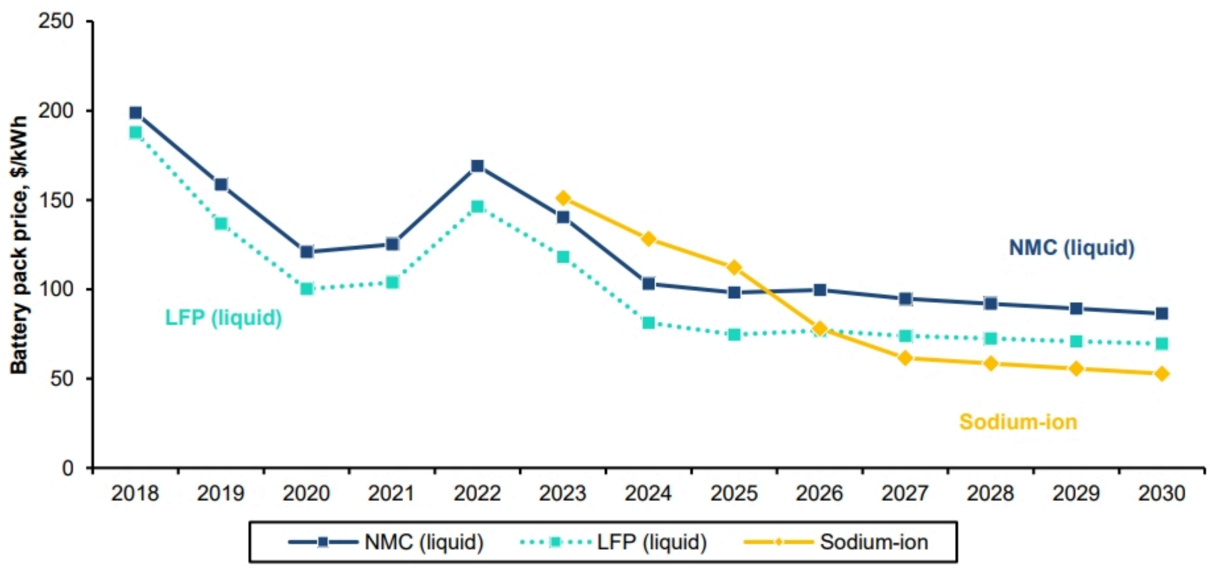
	Unit/Year	2020	2021	2022	2023	2024	2025	2026E	2027E	2028E	2029E	2030E
Global battery storage capacity												
Global Energy Storage team forecast												
Total power capacity	GW	7,690	8,053	8,495	9,160	9,973	10,812	11,755	12,799	13,887	15,012	16,170
YoY (%)	%	*5%*	*5%*	*5%*	*8%*	*9%*	*8%*	*9%*	*9%*	*9%*	*8%*	*8%*
Total solar and wind capacity	GW	1,531	1,802	2,127	2,686	3,399	4,144	4,978	5,877	6,861	7,878	8,920
Share of solar and wind	%	*20%*	*22%*	*25%*	*29%*	*34%*	*38%*	*42%*	*46%*	*49%*	*52%*	*55%*
Net added solar and wind capacity	GW	262	271	324	560	713	745	834	898	984	1,017	1,042
YoY (%)	%	*49%*	*3%*	*20%*	*73%*	*27%*	*4%*	*12%*	*8%*	*10%*	*3%*	*2%*
Cumulative ESS capacity	GW	18	27	45	90	165	281	489	714	960	1,214	1,475
As of total capacity	%	*0%*	*0%*	*1%*	*1%*	*2%*	*3%*	*4%*	*6%*	*7%*	*8%*	*9%*
As of solar and wind capacity	%	*1%*	*2%*	*2%*	*3%*	*5%*	*7%*	*10%*	*12%*	*14%*	*15%*	*17%*
Net added ESS capacity	**GW**	**6**	**10**	**18**	**45**	**75**	**116**	**209**	**225**	**246**	**254**	**261**
YoY (%)	%	*75%*	*63%*	*82%*	*154%*	*68%*	*55%*	*80%*	*8%*	*10%*	*3%*	*2%*
As % of Net added solar and wind capacity	%	2%	4%	5%	8%	11%	16%	25%	25%	25%	25%	25%
Duration	hours	2.0	2.1	2.1	2.1	2.3	2.5	2.6	2.8	3.1	3.3	3.4
Cumulative ESS capacity	**GWh**	**36**	**58**	**95**	**191**	**375**	**700**	**1,280**	**2,032**	**2,977**	**3,985**	**5,060**
Scrappage rate	%							*2%*	*3%*	*4%*	*5%*	*5%*
Annual battery installation	**GWh**	**12.2**	**21.7**	**37**	**96**	**184**	**325**	**594**	**790**	**1,016**	**1,142**	**1,275**
YoY (%)	%	*61%*	*78%*	*71%*	*159%*	*91%*	*77%*	*83%*	*33%*	*29%*	*12%*	*12%*
Annual ESS battery shipment/demand	**GWh**	**21**	**44**	**121**	**185**	**301**	**550**	**798**	**1,027**	**1,153**	**1,287**	**1,479**
YoY (%)	%	*73%*	*114%*	*175%*	*53%*	*63%*	*83%*	*45%*	*29%*	*12%*	*12%*	*15%*
Summary												
LFP battery cell energy density	Wh/kg	180	180	180	180	180	180	180	180	180	180	180
LFP battery cell energy density	kg/KWh	5.56	5.56	5.56	5.56	5.56	5.56	5.56	5.56	5.56	5.56	5.56
Copper energy density in LFP battery	kg/KWh	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Copper demand from ESS battery	**kt**	**21**	**45**	**124**	**189**	**308**	**563**	**816**	**1,050**	**1,180**	**1,317**	**1,513**

We assume a 10-15-year lifecycle for ESS batteries. Consequently, in the long term, 7% of the battery capacity must be retired each year to maintain a stable state (i.e., scrappage rate will reach 7% by early-2030s)
Source: IEA, BNEF, SNE Research, Bernstein analysis and estimates

Bernstein's Global Energy Storage team has recently turned bullish on sodium-ion batteries (Global Energy Storage: Sodium-ion batteries to disrupt the LFP market). Sodium-ion batteries (SIB) saw a step-change in 2025 cost competitiveness, with China-based component data indicating ~50% cost deflation over the year. At current trajectories, SIB is converging with NMC and is on track to reach LFP parity by end-2026, potentially undercutting it by $15 to 20/kWh, supported by rising lithium carbonate prices (Exhibit 27). With Li-ion costs expected to rise in 2026, the team expects an inflection in SIB commercialization, shifting the chemistry from a niche product to play a more complementary mainstream solution with growing market share driven by its structural cost advantage.

ESS is one of interesting end-use markets for SIB, where cost and cycle life are the primary value drivers. Performance has improved materially, with SIB cells now delivering up to ~10,000 cycles (vs. ~2,000–3,000 three years ago), exceeding LFP and significantly above ~1,000 cycles for some NMC chemistries. As durability continues to scale, SIB might capture an increasing share of the ESS market.

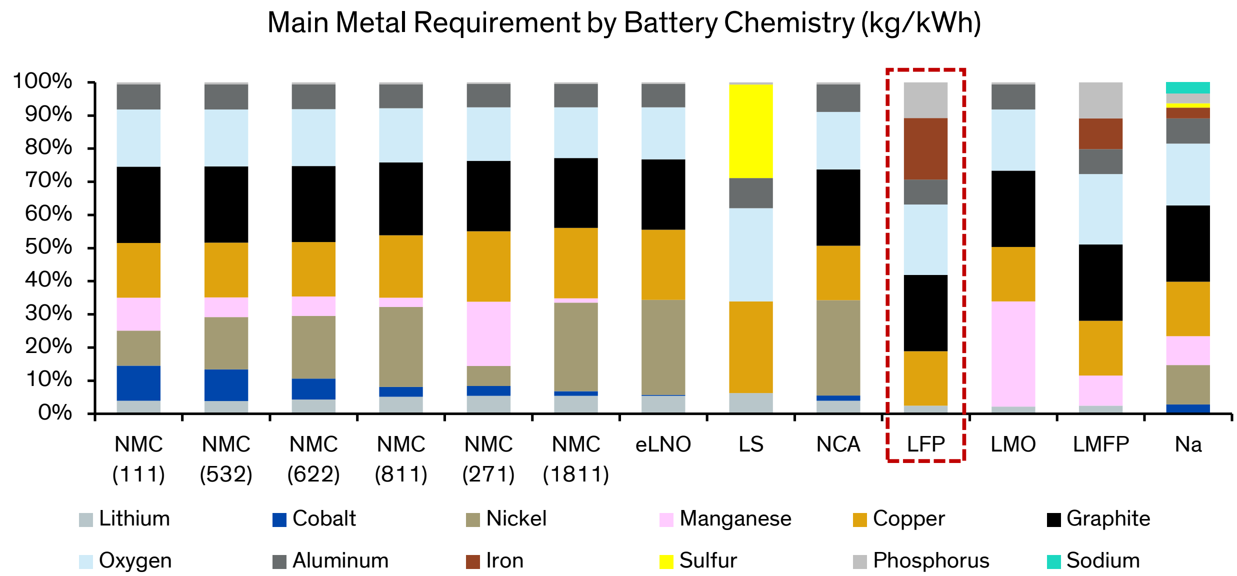
EXHIBIT 27: **We expect sodium-ion battery prices to match LFP by 2026 and then gain a cost advantage thereafter**



Estimated for 2026-2030
Source: Bloomberg, Baiinfo, Bernstein analysis and estimates

Nevertheless, currently we haven't factored in SIB in our model as we are still gauging how the battery players are ramping up SIB technology for ESS. We highlight that SIB has c.30% lower copper intensity than LFP technology (Exhibit 28).

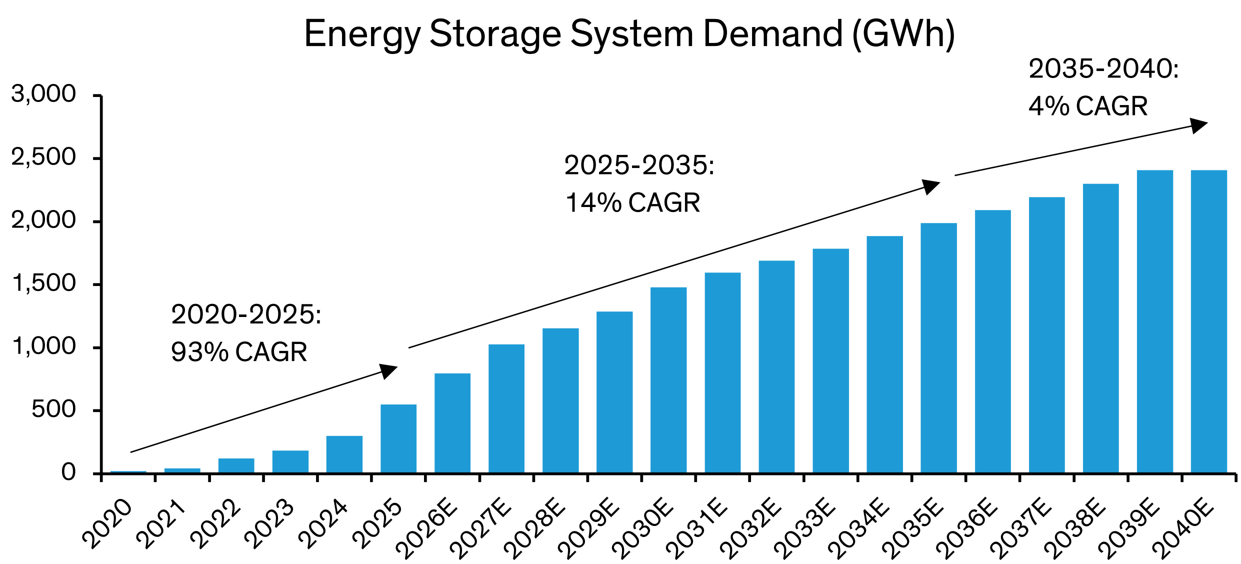
EXHIBIT 28: **LFP batteries currently capture the majority of market share in the ESS sector. SIB may gain share as it becomes more cost-competitive. SIB also has approximately 30% lower copper intensity than LFP.**



Source: Bernstein analysis and estimates

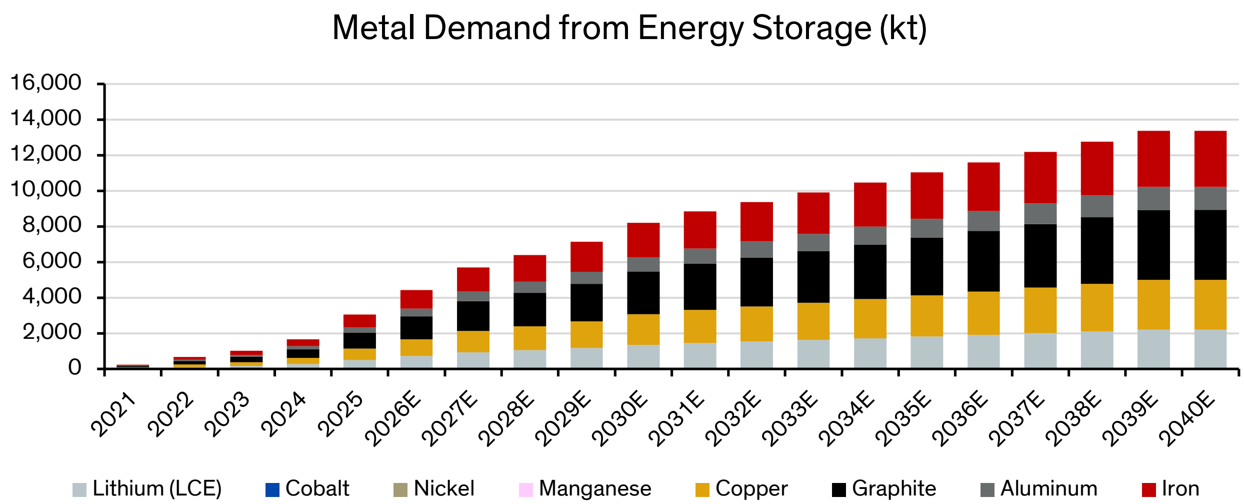
Applying our view of stationary ESS demand (Exhibit 29) and metal components in LFP batteries (Exhibit 28), we get the total copper required for ESS, other metals are shown for context (Exhibit 30).

EXHIBIT 29: **Demand for stationary energy storage system is expected to grow by 14% CAGR in the next decade. There is a potential upside to this scenario if demand for renewables grows higher than expected.**



Source: SNE Research, IHS, BNEF, Bernstein analysis and estimates

EXHIBIT 30: **Annual metals demand for stationary energy storage**



Source: Company reports, SNE Research, IHS, Bernstein analysis and estimates

FULL DETAILS

SUPPLY INTRODUCTION

Despite the newly added projects, the supply deficit is still expected this year, followed by finely balanced market until 2029 and widening deficit from 2030. The primary supply (excluding recycling) is also expected to peak in 2030. Supply is tight and will get tighter due to 7 main reasons (Exhibit 31) - which we discuss in depth in the Appendix section. **1)** Copper is geologically relatively scarce. **2)** Ore grades of copper fall over time. **3)** We are finding less and less copper. **4)** Few substantial copper projects are coming online, **5)** Scrap can't make up for primary weakness. **6)** Geopolitical risks. **7)** New technologies aren't transformational (at the moment).

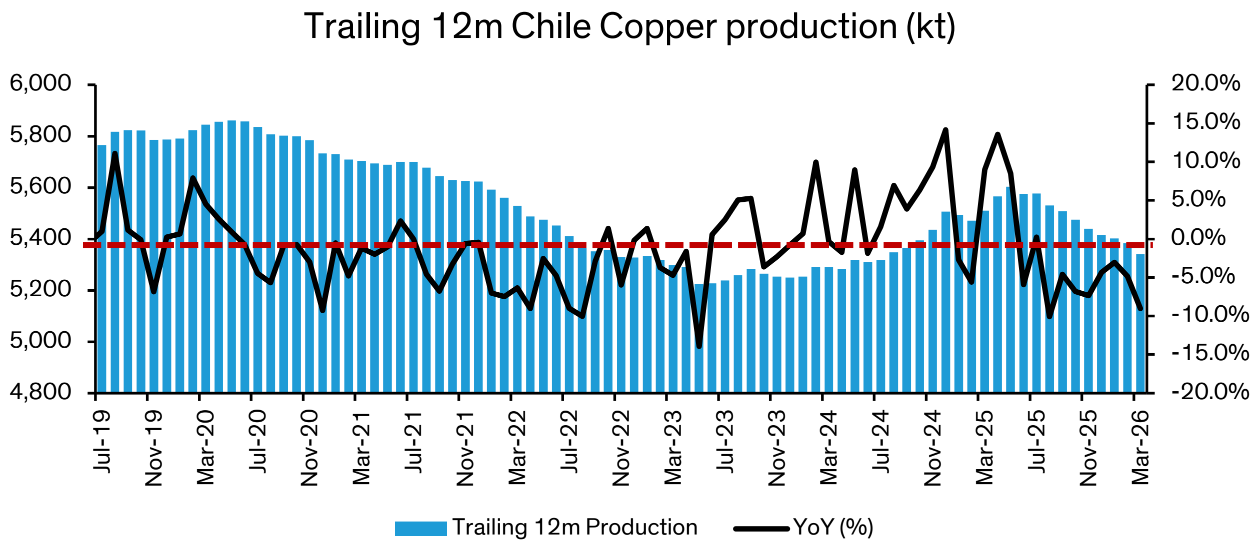
EXHIBIT 31: **Copper mining is facing multiple structural challenges that will increase both opex and capex intensity, resulting in structurally higher copper prices.**

Challenges in (Copper) Mining	Structural	Cyclical
Ore Hardness	✓	✗
Lower Grade	✓	✗
Increasing Depth to Mineralization	✓	✗
Seismic Activity	✓	✗
Regulation/Permitting	✓	✗
Geopolitical Risks	✓	✓
Strikes	✗	✓
Water Availability	✗	✓

Source: Bernstein analysis

The world's biggest copper producer, Chile, saw declining copper production from 2020 to 2023. It had been able to increase production until mid-2025(Exhibit 32), before subsequently slipping back to 2024 levels. In Q1 2026, on YoY basis, we see declining production in a number of key mines, such as El Teniente, Escondida, El Abra and Spence.

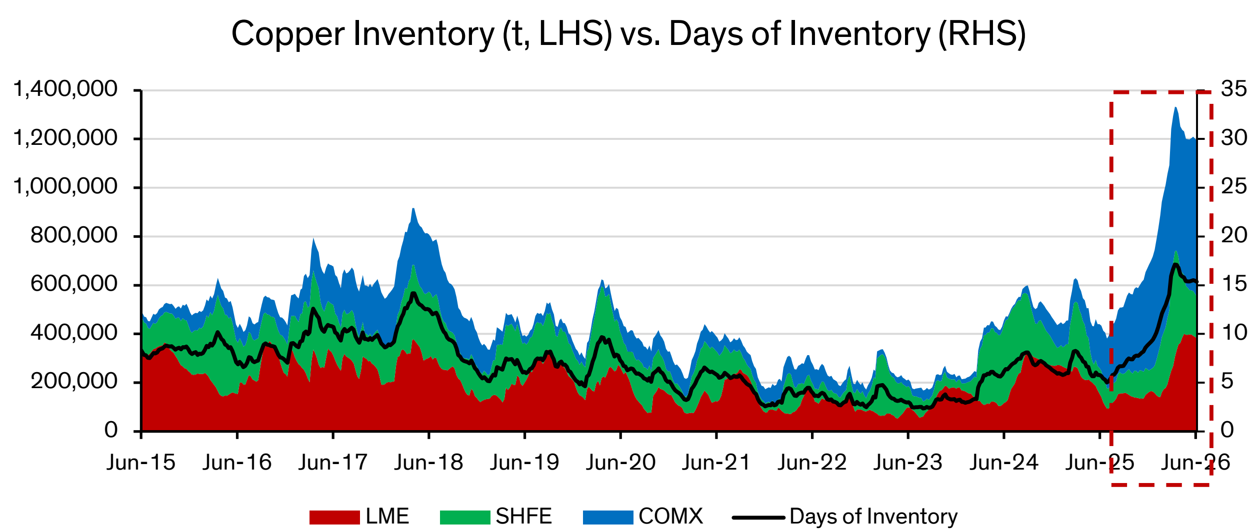
EXHIBIT 32: **Chile reported modest production growth in 1H 2025, with output peaking in the summer months. However, momentum has since softened, with Q1 2026 production at El Teniente, Escondida, El Abra, and Spence declining on a year-on-year basis.**



Source: Cochilco, Bernstein analysis

Copper inventories have risen relentlessly since summer last year (Exhibit 32), especially Comex inventories as the market anticipates potential 15% tariffs on refined copper (due to be announced this month). We continue to believe that the US will not implement tariffs on refined copper (Global Metals & Mining: Copper Taco, Part Deux - U.S. policy is distorting copper price).

EXHIBIT 33: **Since summer 2025, copper inventories on Comex have risen steadily, reaching 642 kt last week, the highest level since 2000. SHFE and LME inventories has slightly declined over the past month. Exchange inventories now total almost 1.2 Mt (15 day inventory).**



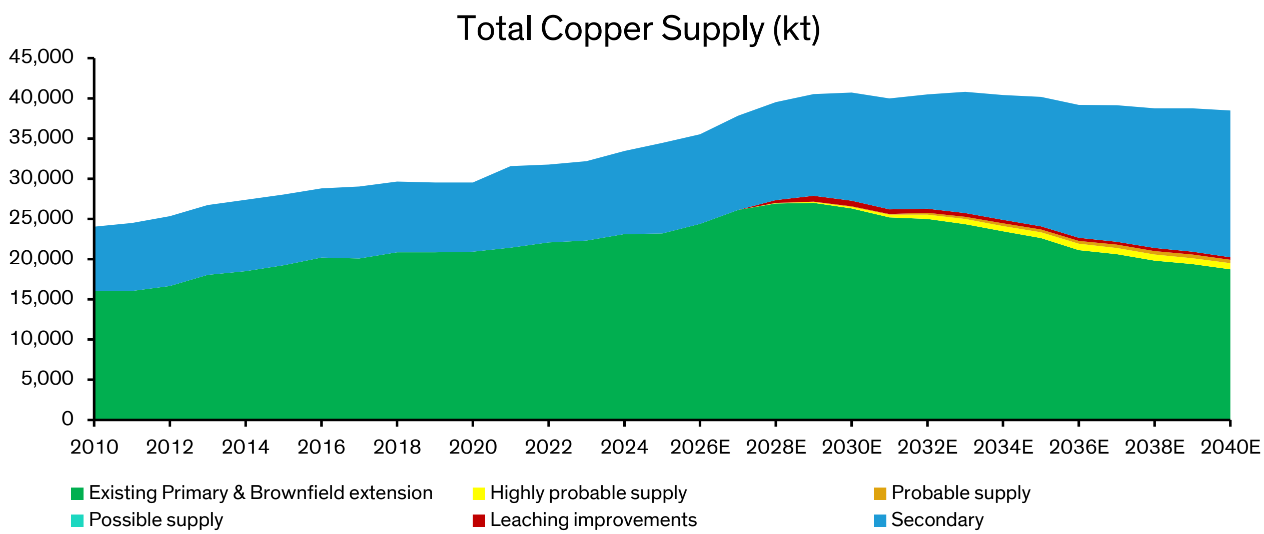
https://www.whitehouse.gov/presidential-actions/2025/07/adjusting-imports-of-copper-into-the-united-states/
Source: Bloomberg, Bernstein analysis

SUPPLY FORECAST

The above-mentioned factors have led to slow total supply growth - mined supply increased at a CAGR of 2.7% from 2010-2024, and scrap supply increase at a CAGR of 1.5%.

In our base case, we expect future supply to peak by 2030 and then slightly decline until 2040 (Exhibit 34) driven by lower primary supply, but offset by higher secondary supply. We estimate that primary supply will decline at a CAGR of -3.5% in 2030s. In contrast, secondary supply is expected to grow at a CAGR of 3.1% over the same period. Overall, this results in a total copper supply CAGR of -0.6% for the decade, which is lower than the 2.3% CAGR projected for copper demand.

EXHIBIT 34: **Supply is likely to peak in 2030, with the majority of supply increase coming from brownfield extensions, supported by rising secondary supply (direct use of scrap)**



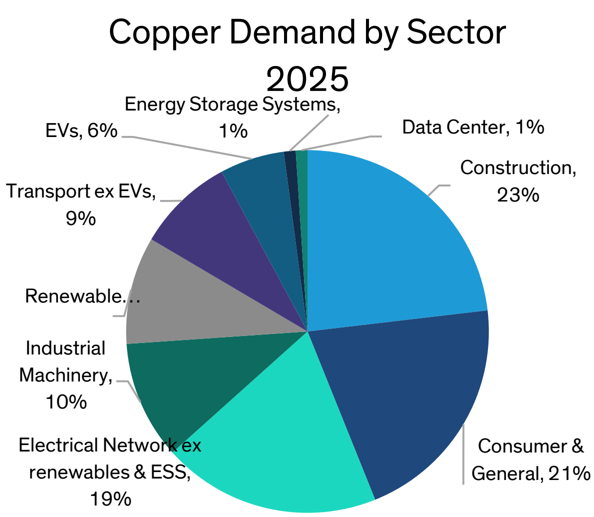
Source: WoodMac, Bernstein analysis and estimates

DEMAND

We are moving away from hydrocarbons as an energy source and towards electrons. The uses of the electricity are still relatively varied but the one thing we do know is that almost all applications will need copper due to its excellent electrical conductivity and physical properties. In this section we discuss the current demand of copper and the areas where there will be significant demand growth.

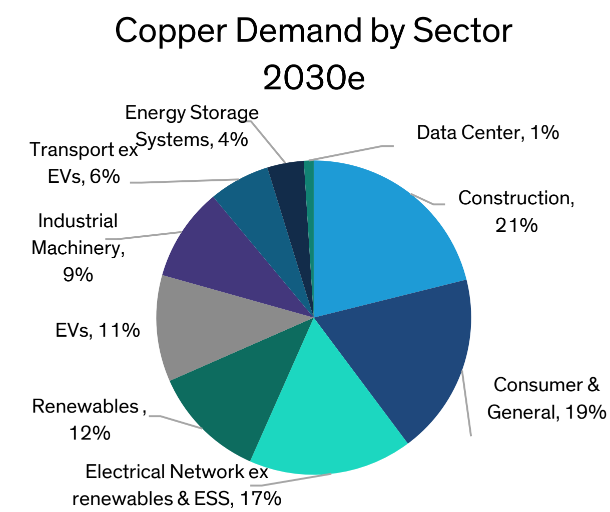
Currently, the biggest driver of copper demand are construction and consumer, followed by electrical network (Exhibit 35 and Exhibit 36). China is the biggest consumer of copper, so traditionally the area to focus on for copper demand is Chinese economy. However, we note that copper demand growth in the coming years will mostly come from EVs and renewable segments (Exhibit 37). We estimate that demand from EVs will grow from 2.0Mt in 2025 to 4.4Mt in 2030, while renewable might grow from 3.3Mtpa to 4.7Mtpa within the same period.

EXHIBIT 35: **Green demand (EV & renewables) made up 16% of total demand in 2025...**



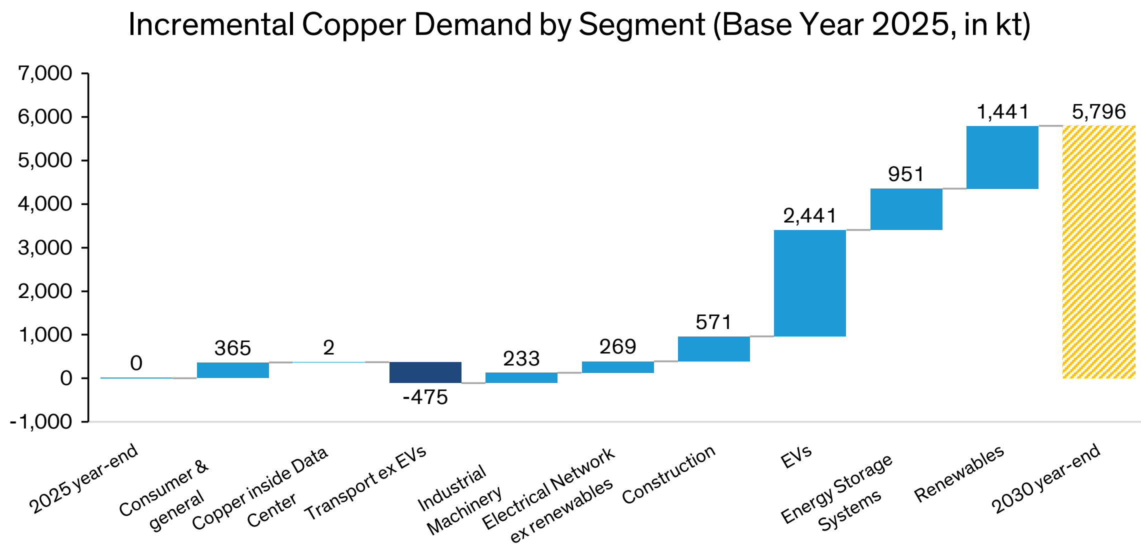
Source: WoodMac, Bernstein analysis

EXHIBIT 36: **...and is expected to grow to 23% by 2030. Copper will still be largely driven by industrial activities.**



Source: WoodMac, Bernstein analysis and estimates

EXHIBIT 37: **Growth in EVs and renewables energy is expected to drive bulk of copper demand growth. Data center growth, on the other hand, is not expected to materially impact copper demand as copper intensity falls, especially after the introduction of the VDC 800.**



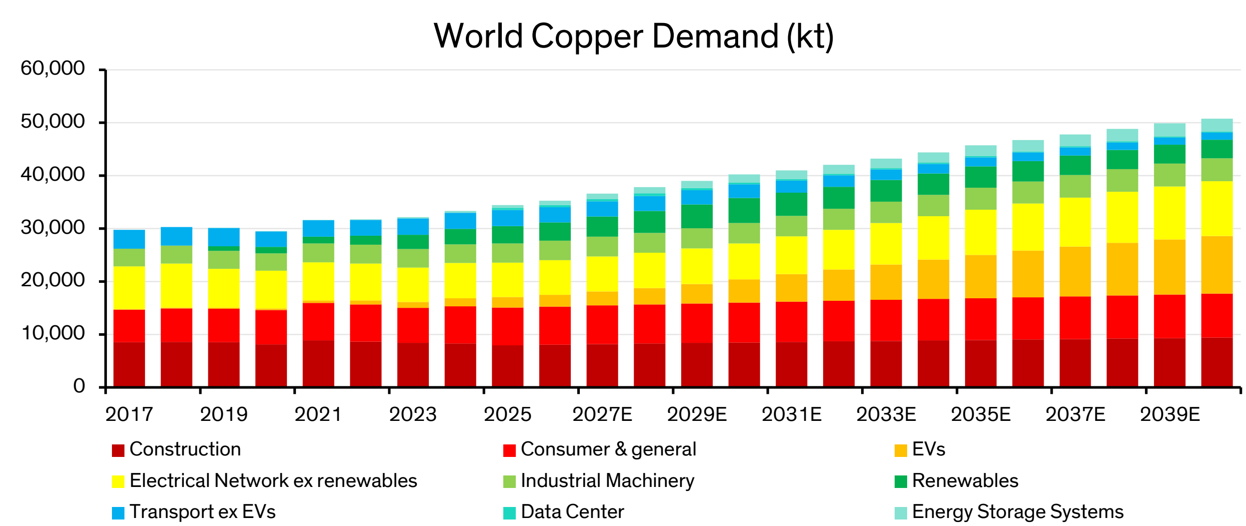
*the declining copper intensity inside data centers is due to the growing use of fiber optic cables instead of copper cables, as higher data speeds are required. Further, using 800 V busways and switching from 415 VAC to 800 VDC in electrical distribution enables 85% more power to be transmitted through the same conductor size. This happens because higher voltage reduces current demand, lowering resistive losses and making power transfer more efficient. With lower current, thinner conductors can handle the same load, reducing copper requirements by 45%.

Source: WoodMac, Bernstein analysis and estimates

DEMAND FORECAST

Bringing all of these sectors together gets us to our copper demand forecasts (Exhibit 38).

EXHIBIT 38: **Copper demand is expected to grow steadily to 2040. EVs and renewables are two important growth book ends in the story and significant grid expansion is required to connect the two.**

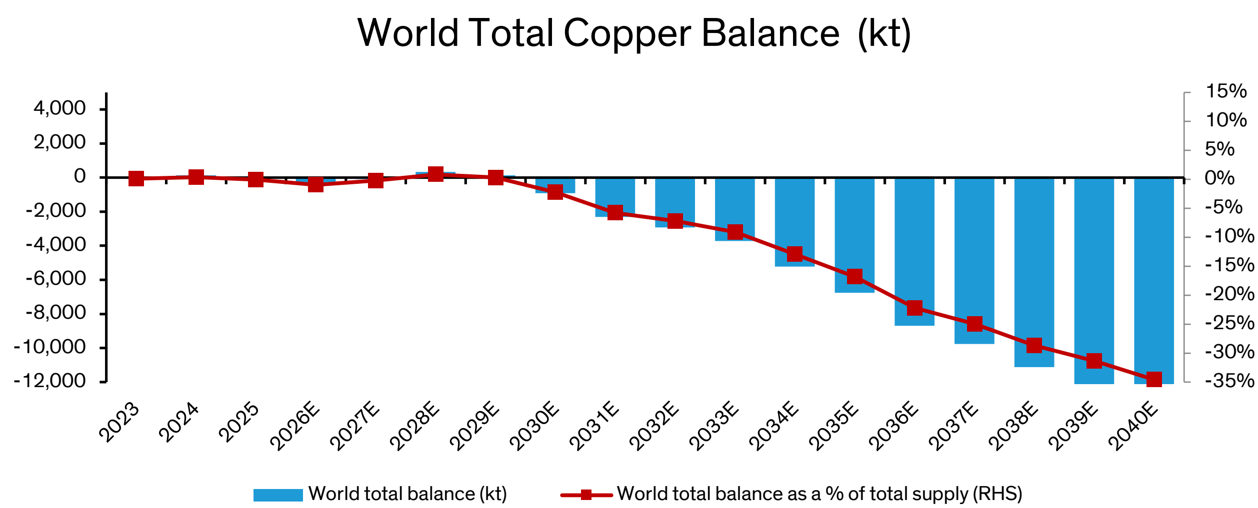


Source: WoodMac, Bernstein analysis and estimates

MARKET BALANCE

Combining our supply and demand views gets us to our overall market balance. Typically, just over 5% of global supply is disrupted each year from events such as weather, conflicts, technical issues, or pandemics. Exhibit 39 shows our disruption adjusted market balance.

EXHIBIT 39: **We might see a deficit market this year, followed by finely balanced market from 2027 to 2029. It is likely that a significant supply deficit begins to open up and grow from 2030 onwards as supply growth fails to keep up with demand from electrification.**



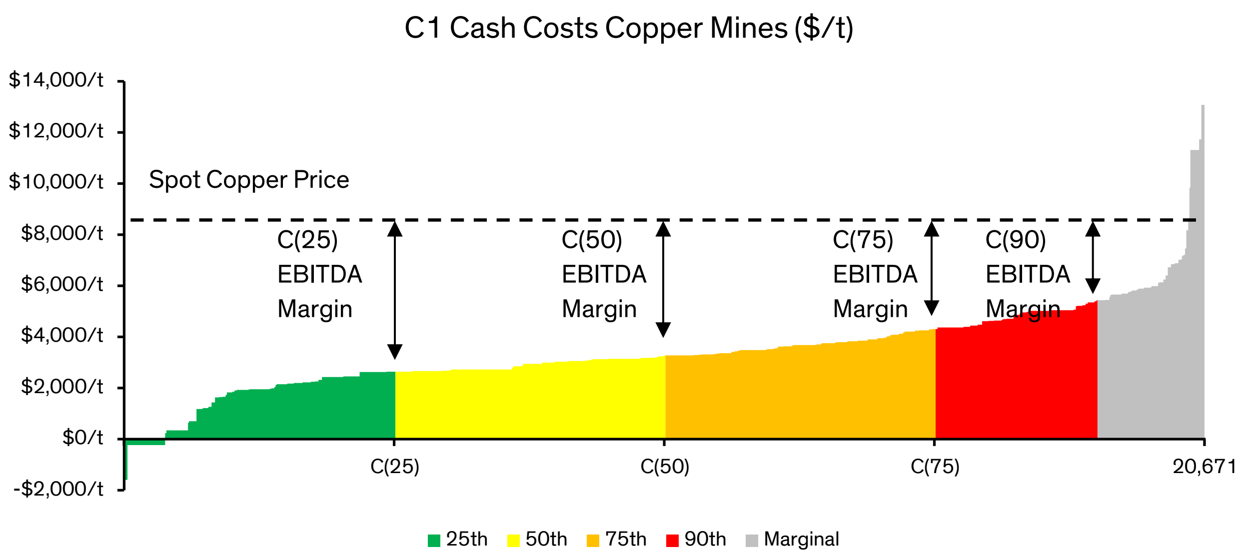
Source: WoodMac, Bernstein analysis and estimates

PRICING COPPER

We believe in two fundamental principles: (1) industry margins revert to a long term average, and (2) the cost curve provides price support and acts as a floor (how strong that floor is varies from commodity to commodity).

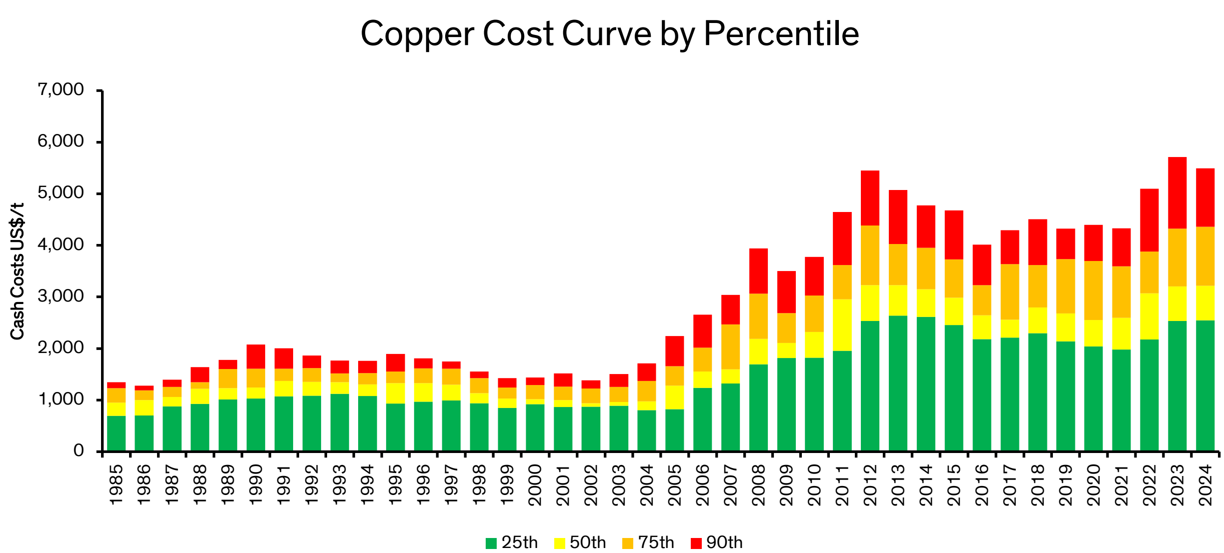
Firstly, let's define what we mean by industry margin (Exhibit 40)

EXHIBIT 40: **Using the average of the C(25), C(50), C(75), and C(90) EBITDA margin we get to the industry EBITDA margin**



Source: WoodMac, Bloomberg, Bernstein analysis and estimates

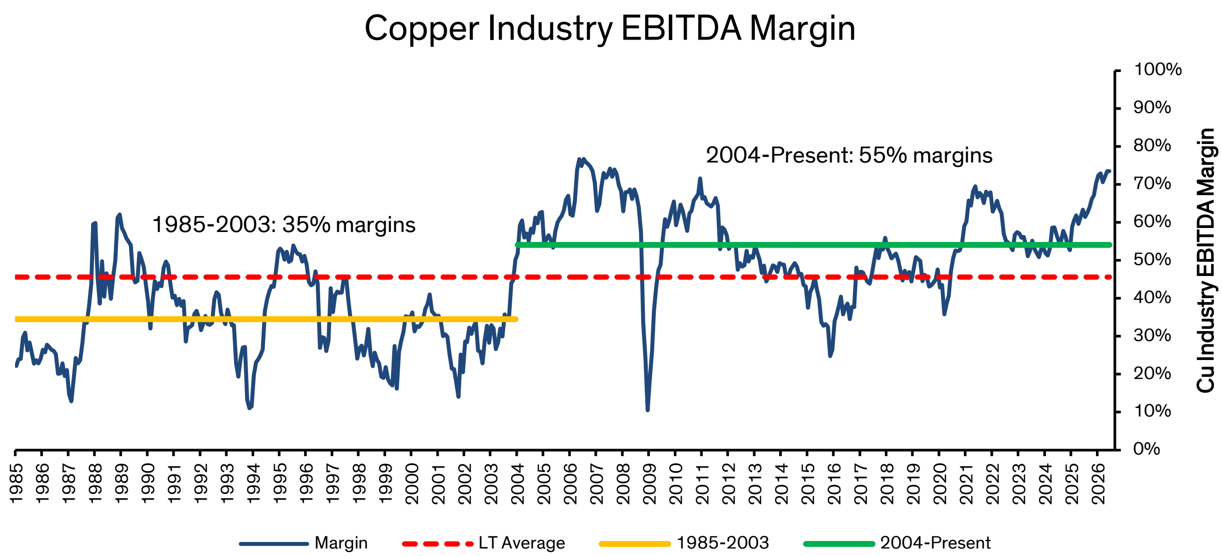
EXHIBIT 41: **We can combine data going back to 1985 to get the cost curve profile evolution**



Source: WoodMac, Bernstein analysis

And finally, using copper price we can work out the EBITDA margin of the copper industry going back to 1985 (Exhibit 42). For most commodities we see a long term margin reversion, but for copper we argue there are two distinct periods with different margins: pre-and post-China.

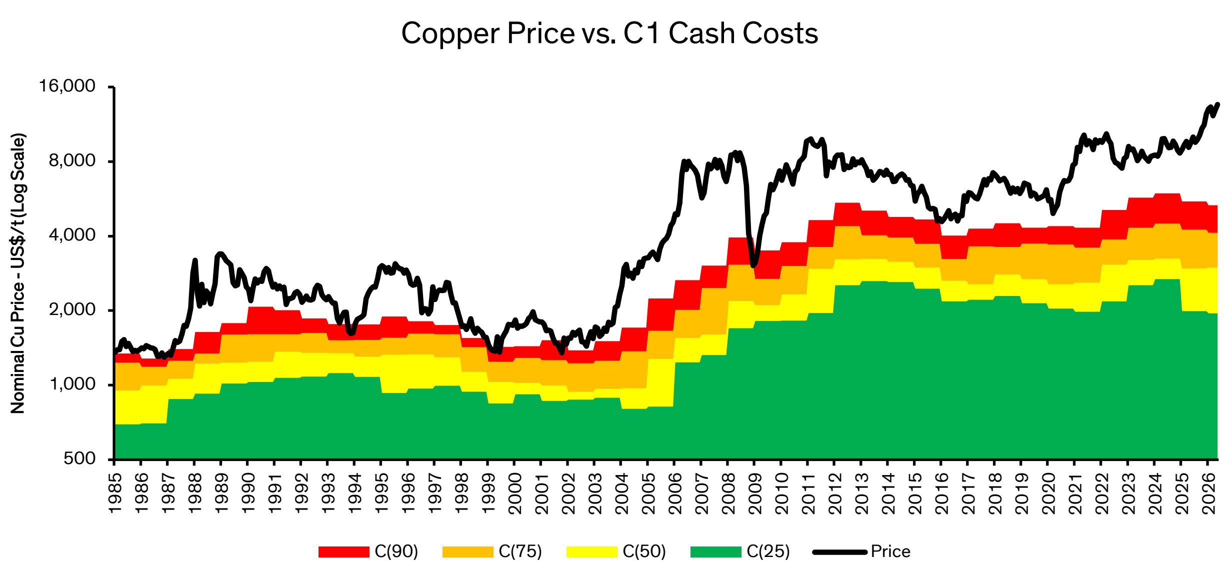
EXHIBIT 42: **Copper industry EBITDA margin now stands at 74%, significantly above the LT average of 55%.**



Source: Bloomberg, WoodMac, Bernstein analysis

The analysis above makes it easy to prove that the C1 cash cost curve sets the floor of copper price (Exhibit 43).

EXHIBIT 43: **Copper price vs. C1 cash costs**



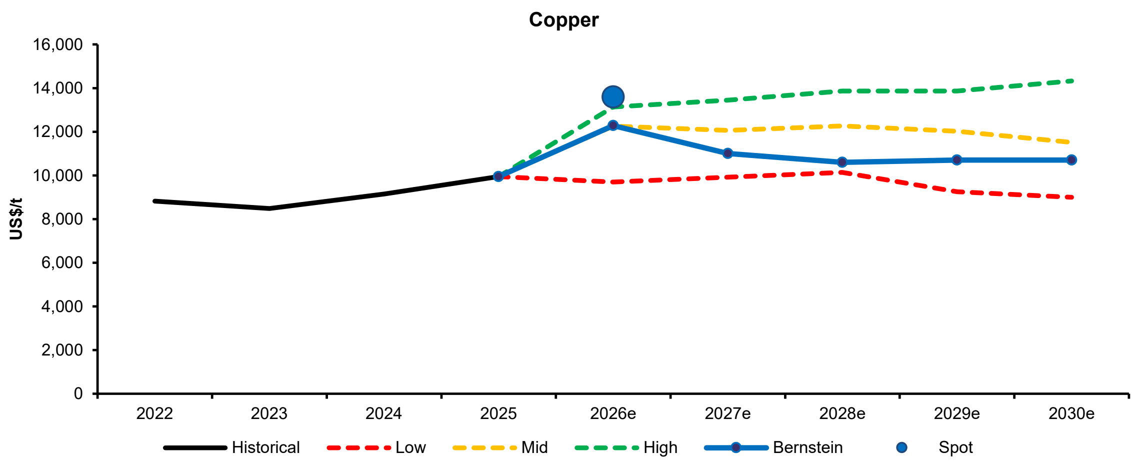
Source: Bloomberg, WoodMac, Bernstein analysis and estimates

For our long term copper price forecast we start with the 2030 cost curve in nominal terms. We only have visibility on the costs of 21.4Mt out of the 27.2Mt of mine supply expected in 2030. The mines for which we don't have visibility are likely to be (a) small, and (b) high cost (we would know about a mine if it was >100ktpa and sat in the bottom quartile of the cost curve...)

So, we add the missing 3.5Mt of production in between the 75th and 95th percentile. We then use the resulting C(25), C(50), C(75), and C(90) costs along with the post-China margin of 55% to get to a long term copper price of $10,700/t (Exhibit 44).

EXHIBIT 44: **Copper price forecasts - consensus and Bernstein Research estimates**

Copper									
	2022	**2023**	**2024**	**2025**	**2026e**	**2027e**	**2028e**	**2029e**	**2030e**
Historical	8,822	8,484	9,150	9,947					
Low				9,947	9,697	9,918	10,138	9,257	8,998
Mid				9,947	12,253	12,058	12,266	12,026	11,519
High				9,947	13,136	13,444	13,863	13,863	14,326
Bernstein				9,947	12,281	11,000	10,600	10,700	10,700
Spot					13,592				



Priced as of 08/06/2026

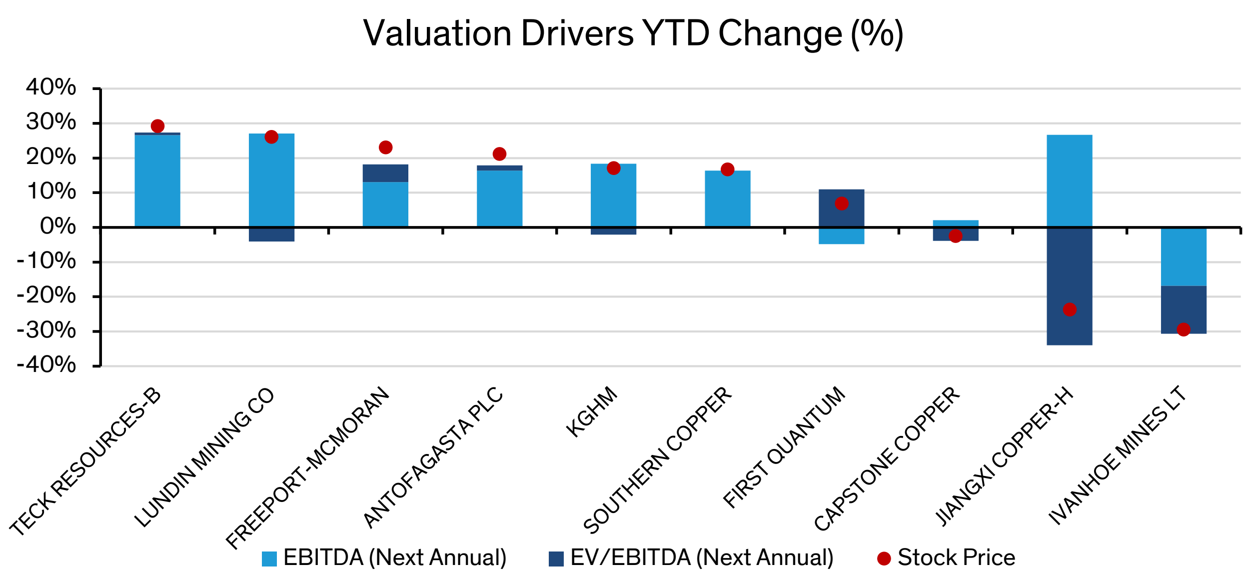
Source: Bloomberg, S&P Global, Bernstein analysis and estimates

COPPER THESIS - HOW MUCH IS ALREADY PRICED-IN?

We started this year with copper price at $12,500/t. As copper prices have risen to $13,000/t to 14,000/t, EBITDA estimates have been revised higher for most copper miners (Exhibit 45). Ivanhoe experienced large negative revision due to Kamoa-Kakula disruption.

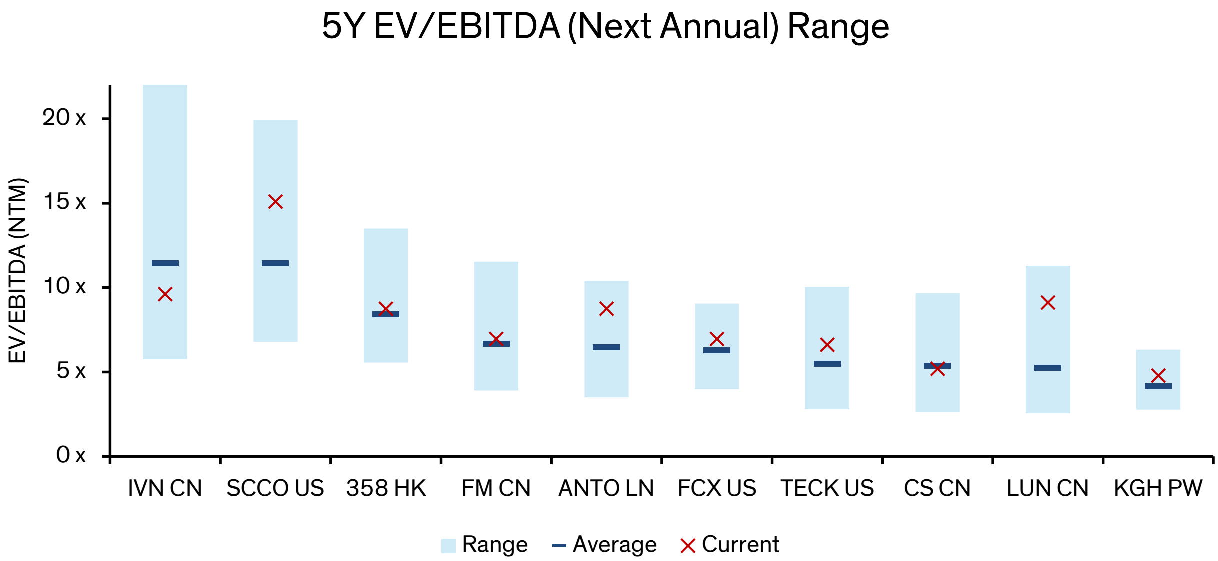
There's minimal multiple re-rating this year, as copper stocks typically trade at or above their 5-year and 10-year average (Exhibit 46 and Exhibit 47). Looking ahead, the driver for stock prices would be up/downward revisions to EBITDA, as analysts adjust their estimates to reflect the potential for higher/lower copper prices. A sector-wide re-rating appears unjustified at current levels, although selective de-rating risk is emerging across certain names. For example, Lundin and Southern Copper are trading at more than +2 standard deviations above their respective 5-year averages. In comparison, ANTO (Market-Perform) and FCX (Market-Perform) remain elevated but less extreme, at approximately +1.7 and +0.6 standard deviations above their 5-year average.

EXHIBIT 45: **We began this year with copper at $12,500/t. As copper prices have risen to reach $14,000/t, EBITDA estimates have been revised higher for nearly all miners.**



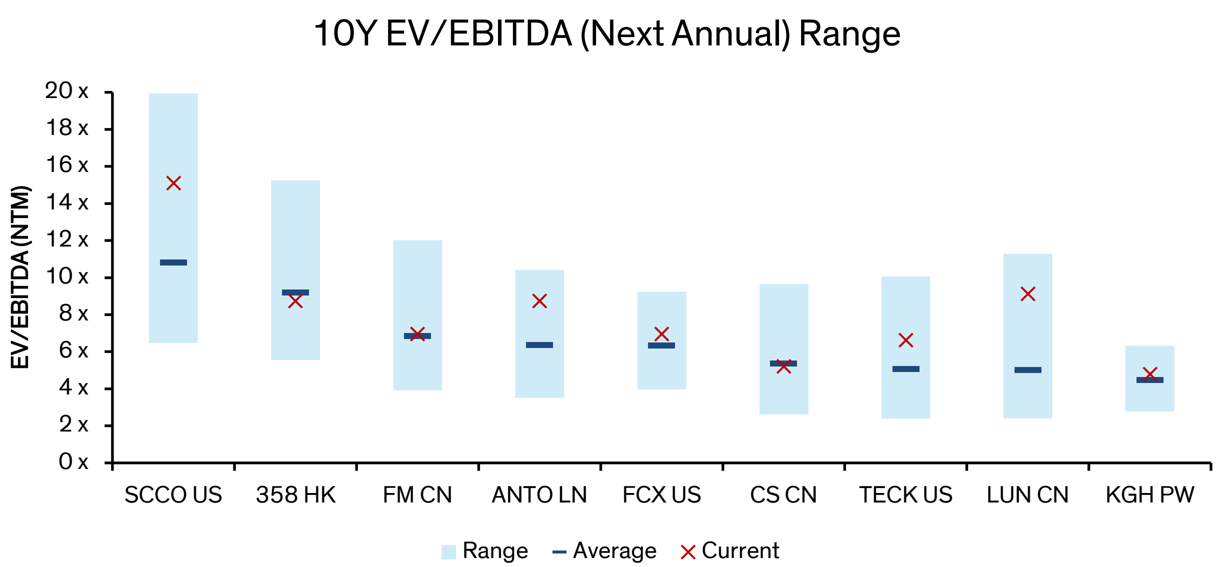
We use Next Annual as we want to use "normalised EBITDA" to increase comparability. This is especially true for FCX which will see "one-off" lower production from Grasberg in 2026.
Source: Bloomberg, Bernstein analysis

EXHIBIT 46: **Most copper equities trade at or above their 5-year average multiples, reflecting strong conviction in the copper narrative. With 2027 consensus at c.$12,500/t, valuations imply expectations for >$13,500/t copper price.**



Source: Bloomberg, Bernstein analysis

EXHIBIT 47: **Again, most copper equities are also trading at or above their 10-year average valuation...**

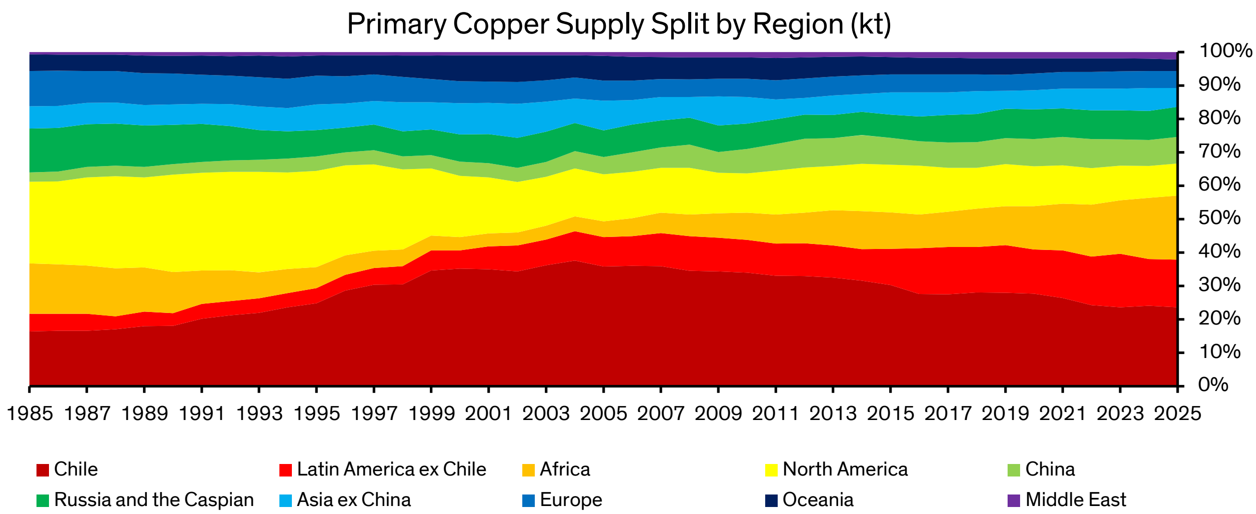


Source: Bloomberg, Bernstein analysis

APPENDIX

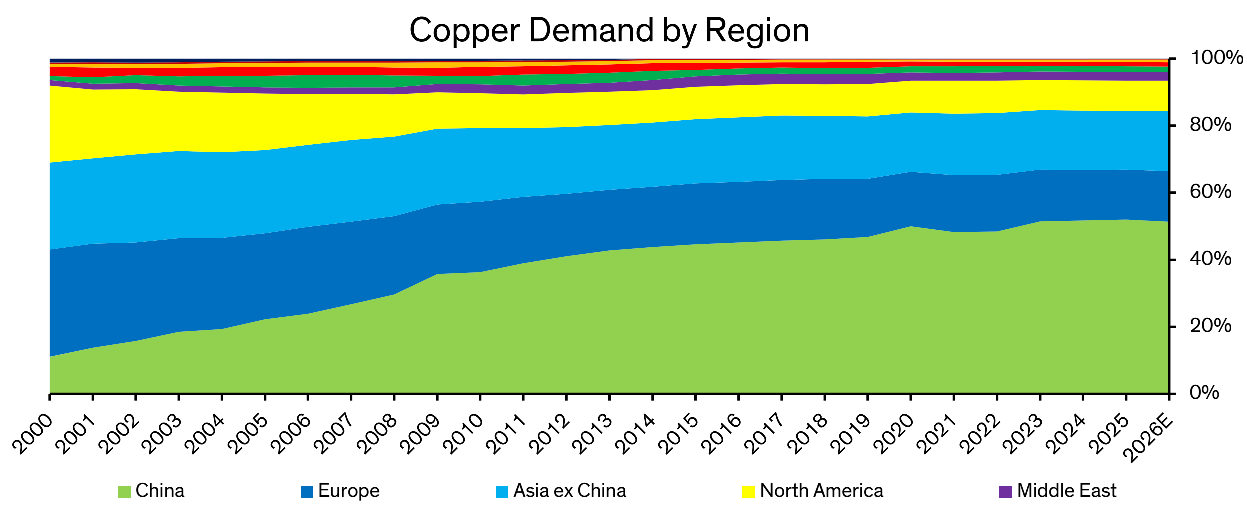
COPPER LONG-TERM CHARTS

EXHIBIT 48: **Primary supply is fragmented, Chile is the biggest supplier with over 20% of global production**



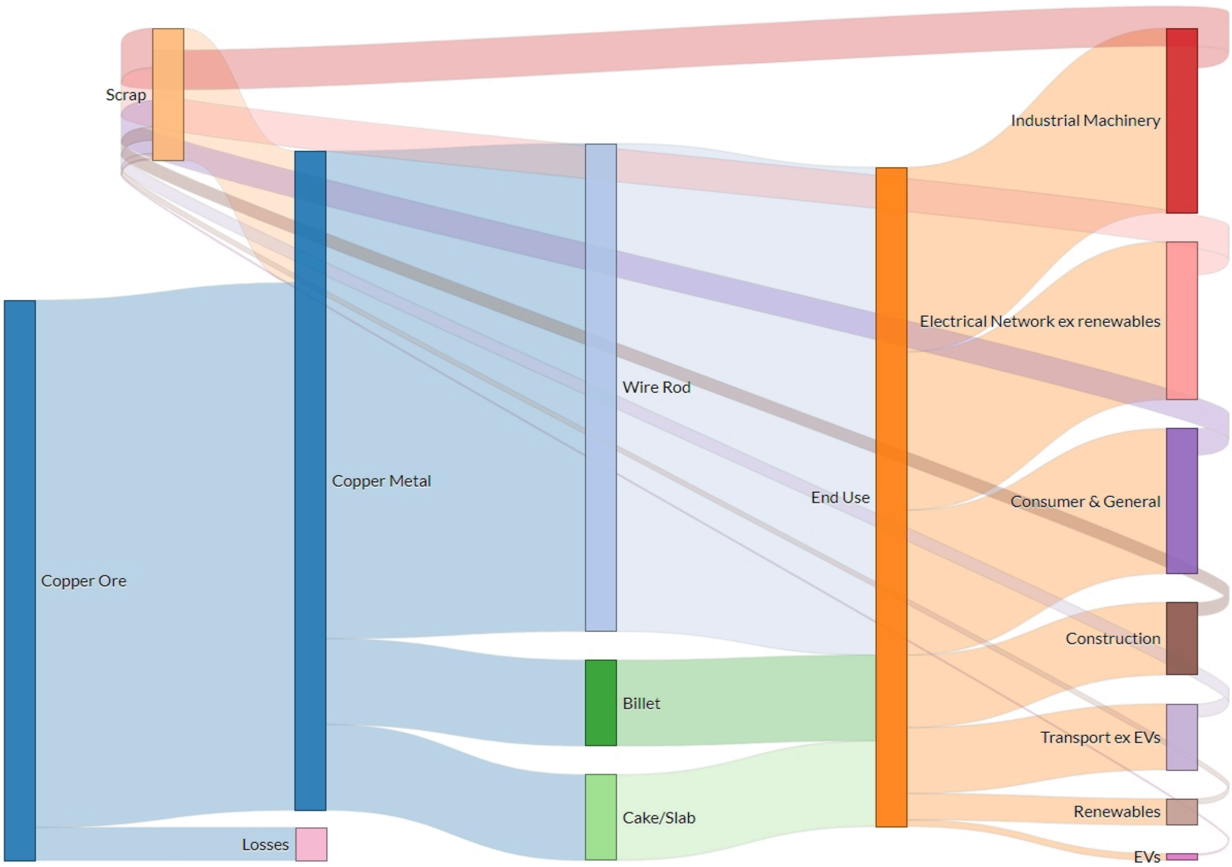
Source: WoodMac, Bernstein analysis and estimates

EXHIBIT 49: **China's copper demand has grown significantly over the past couple of decades...**



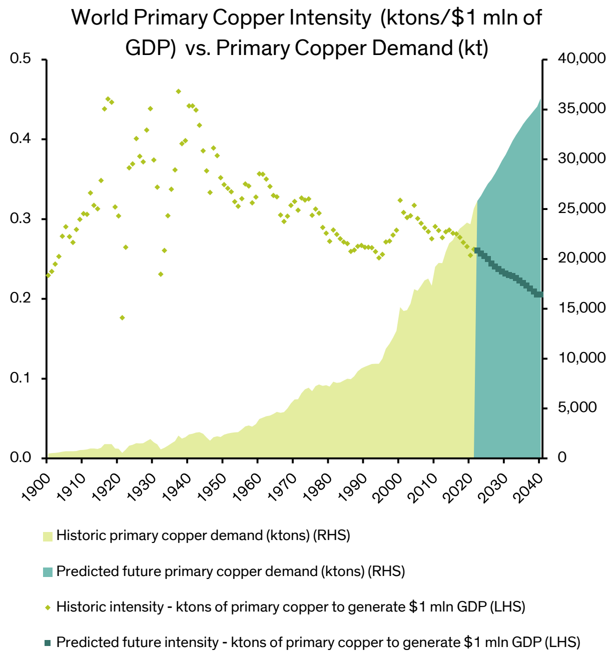
Source: WoodMac, Bernstein analysis

EXHIBIT 50: **Flow of copper**



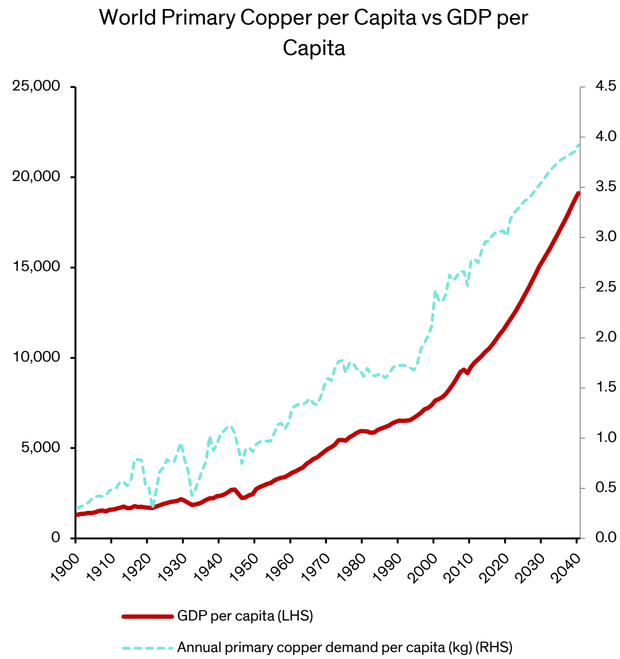
The chart is not drawn to scale
Source: WoodMac, Bernstein analysis

EXHIBIT 51: **Primary copper demand grows with time whilst intensity drops**



Source: USGS, OECD, World Bank, IMF, WoodMac, Bernstein analysis and estimates

EXHIBIT 52: **Total future demand growing at a similar pace to GDP**

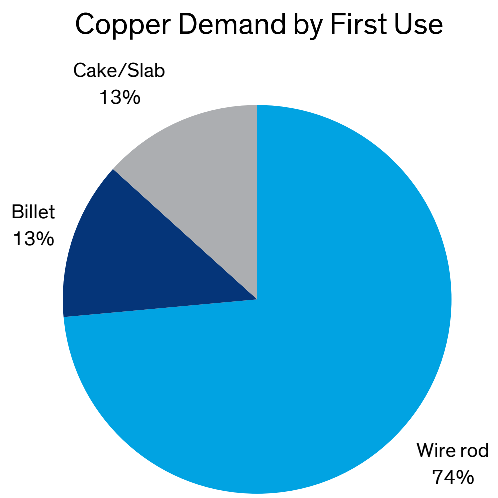


Source: USGS, OECD, World Bank, IMF, WoodMac, Bernstein analysis and estimates

COPPER DEMAND BY SECTOR

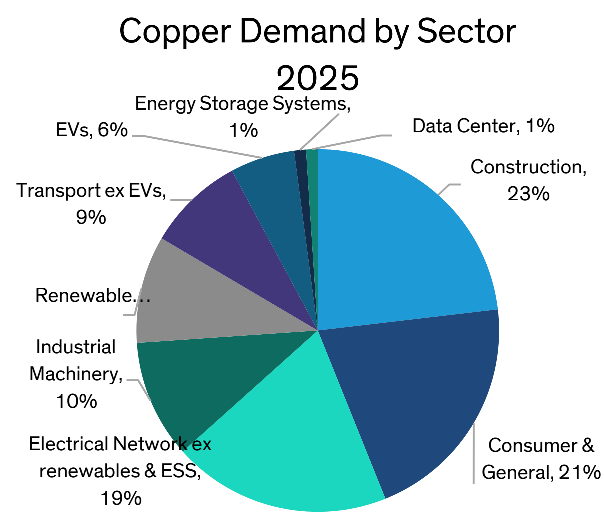
Copper's malleability allows it to be in many different forms, but wire dominates first use with nearly three quarters of all copper demand in wire form (Exhibit 53). In terms of end uses, it is much more diverse – copper is used in many different applications, but construction and the electrical network dominate (Exhibit 54).

EXHIBIT 53: **Most copper is made in wire form**



Source: WoodMac, Bernstein analysis

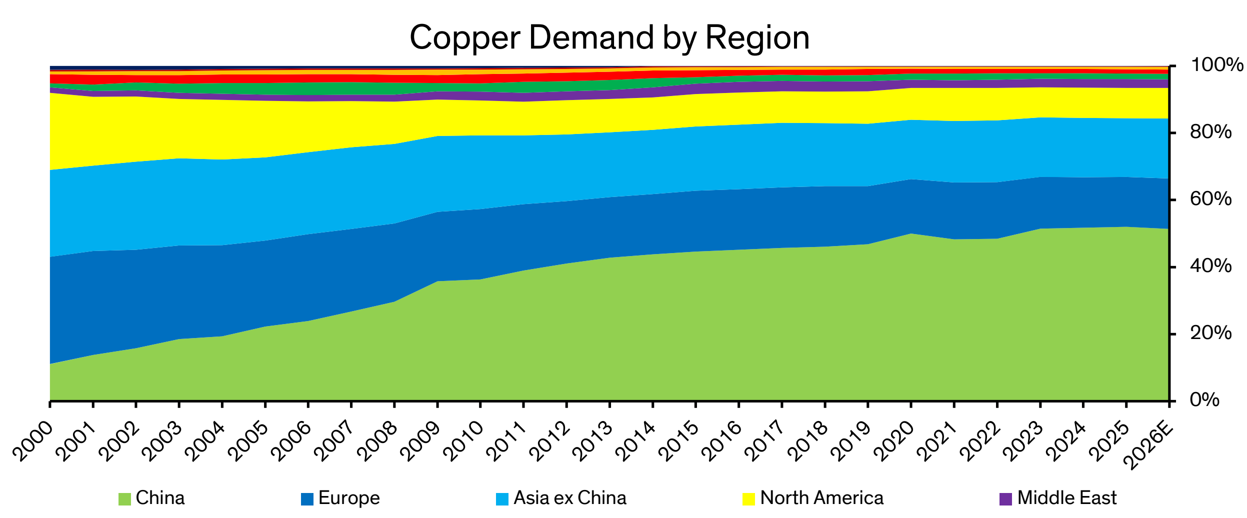
EXHIBIT 54: **Green demand (EV & renewables) made up 16% of total demand in 2025...**



Source: WoodMac, Bernstein analysis

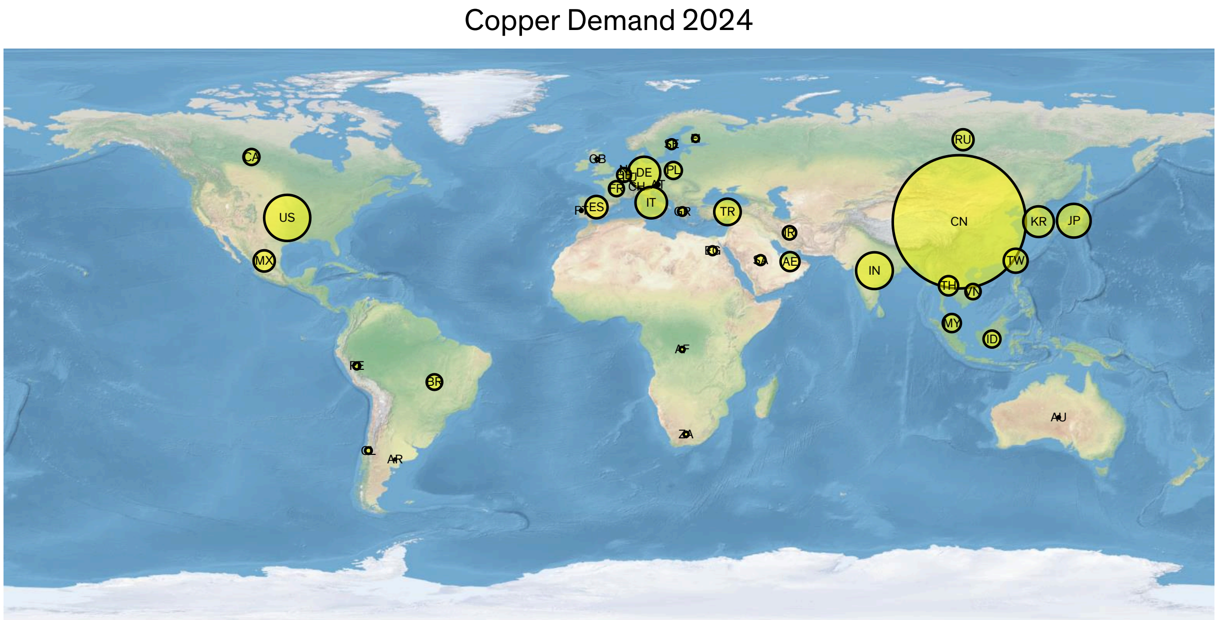
As with most metals, China consumes the most copper(Exhibit 55 and Exhibit 56).

EXHIBIT 55: **China's copper demand has grown significantly over the past couple of decades...**



Source: WoodMac, Bernstein analysis

EXHIBIT 56: **...it now dominates global demand**



Source: WoodMac, Bernstein analysis

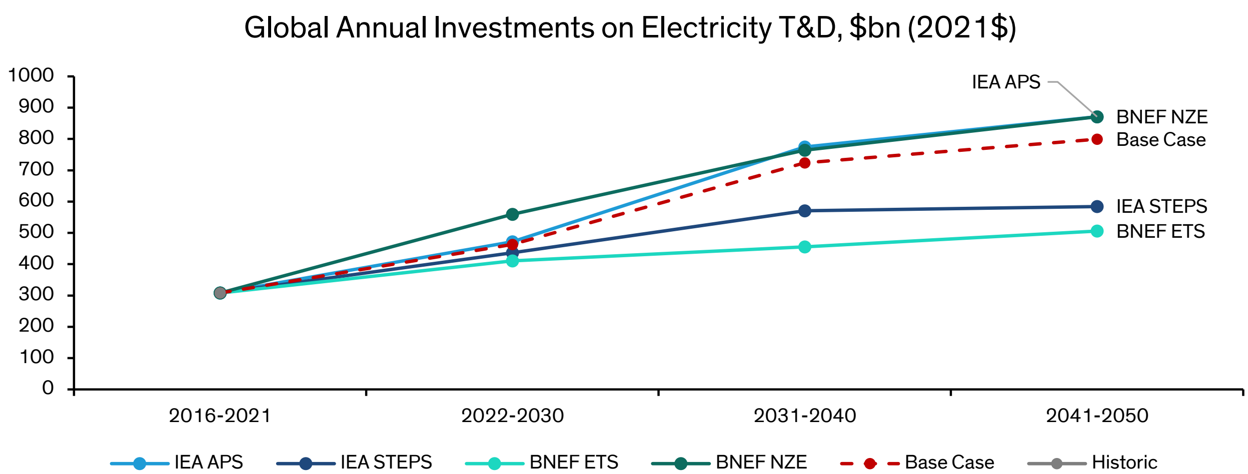
Electrical Network

Electrical network/grid is expected to be the third-largest source of copper demand, ranking just behind construction and consumer end-markets.

Exhibit 57 shows the IEA's forecast of investment into electricity and transmission. In the announced pledges scenario (APS), investment is expected to scale up 4.5x by 2050 to reach net zero. The IEA APS is an ideal scenario, but it's difficult to achieve due to the significant policy changes required. Bureaucracy is slow, especially when it involves governments. However, politicians will eventually have to step up investments beyond their stated policies, which are captured in the IEA STEPS scenario.

In this note, we revise our base case for transmission and distribution (T&D) capex to reflect the incremental load from data center expansion. Previously, our framework anchored on a mid-point between the IEA's STEPS and APS scenarios, consistent with the view that actual investment would likely meet stated policies but fall short of full policy ambition. However, the addition of structurally higher demand from data centers shifts this balance. Grid infrastructure will need to scale more aggressively to accommodate this load. As a result, we now see T&D capex tracking closer to the APS scenario (Exhibit 57). The incremental demand from data centers effectively pulls forward investment requirements, increasing the likelihood that realized spending will converge toward the upper end of the IEA framework rather than the midpoint (Exhibit 57.

EXHIBIT 57: **Global T&D investment is set to step up structurally, driven by incremental AI-linked grid capex. We therefore shift our base case from a STEPS/APS midpoint toward the APS trajectory to capture this uplift.**



Source: IEA, Bernstein analysis and estimates

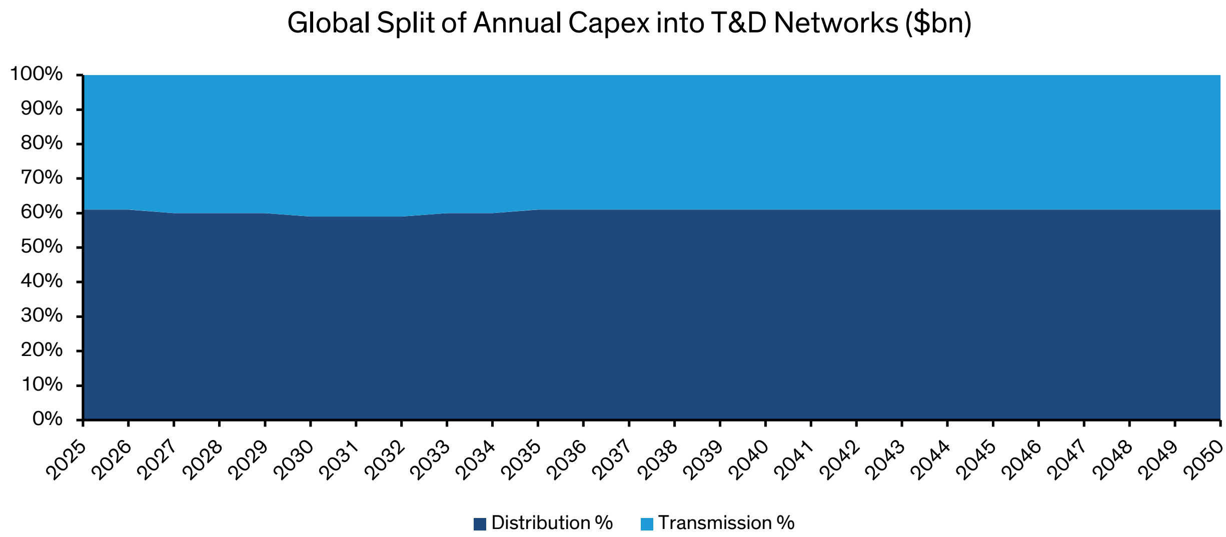
We can translate this dollar spend into future metal requirements. 20% of T&D (transmission and distribution) spend is copper and aluminium. The split of the 20% between aluminium and copper is unclear, we lay out our logic below to estimate the split.

Aluminium is sometimes used as a substitute for copper in T&D infrastructure, especially in transmission sector (e.g., high-voltage overhead lines), due to its lower cost and weight. However, it has higher maintenance needs and lower electrical conductivity than copper, which leads to larger cables and corrosion issues. Hence, copper is still preferred for underground and subsea lines and transformers due to technical specifications and maintenance requirements. Additionally, aluminum production is more carbon-intensive than copper production (on average).

To refine our analysis, we divide the T&D into two categories: transmission and distribution (Exhibit 58). Distribution lines have a higher copper intensity and is expected to drive copper demand in power T&D. Hence, we assume 90% of “distribution lines” capex and 20% of “transmission lines“ capex will go to copper (i.e., 80% of transmission capex goes to aluminum) to estimate copper demand. To address the potential of copper substitution with aluminium in distribution lines, we adjust our copper component in distribution lines from 90% to 85% in mid-2030s and further to 80% in 2040s.

If you are interested in learning more about future investments in electricity grid, our European Utilities and Clean Energy team wrote an excellent primer: Renewable Primer Series: Electricity grid opportunities amount to >$20 trillion of investments if bottle-necks can be resolved.

EXHIBIT 58: **We currently spend 60% on distribution, which mostly use copper, and 40% on transmission, which often use Aluminum. We assume this trend will hold until 2050.**



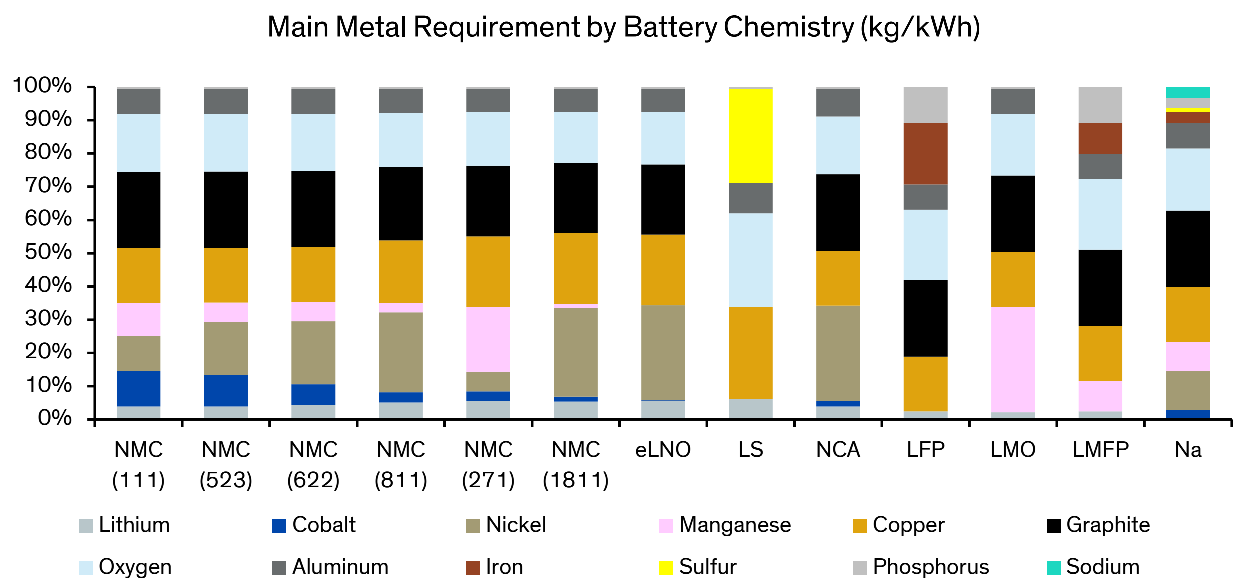
Source: BNEF Net Zero Scenario, Bernstein analysis

EVs

Moving from cars running on hydrocarbons to cars running on electrons requires a lot of copper. The copper in an EV can be split (broadly) into two area: in the battery and out of the battery.

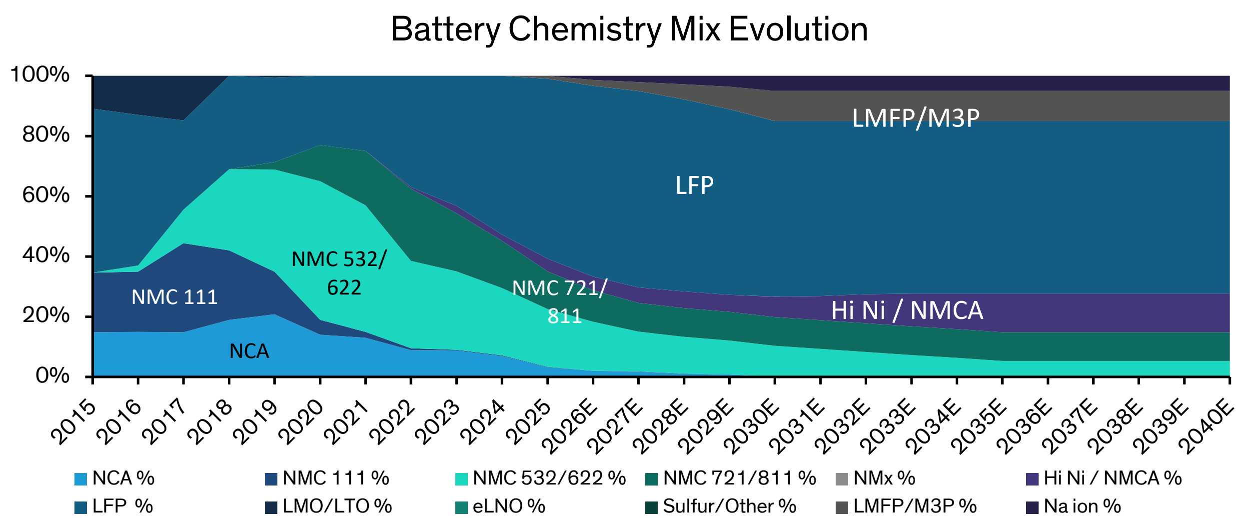
One of the big unknowns for EVs is which battery chemistries will be used, this makes predicting demand for metals which are used only in some batteries more difficult. However, it's much easier with copper as it is used across all battery chemistries (Exhibit 59). So copper will be used extensively in EV batteries whichever chemistry ends up being the most popular. Exhibit 60 shows our latest expectations on battery chemistry mix, which gravitates toward LFP. **Few years ago, the consensus view was NMC would win the race with over 60% market share. However, as LFP technologies have continued to improve, we currently expect LFP to gain market share over time (58% share by early 2030s).**

EXHIBIT 59: **Different battery chemistries imply different raw material requirements per unit of energy capacity**



Source: Bernstein analysis and estimates

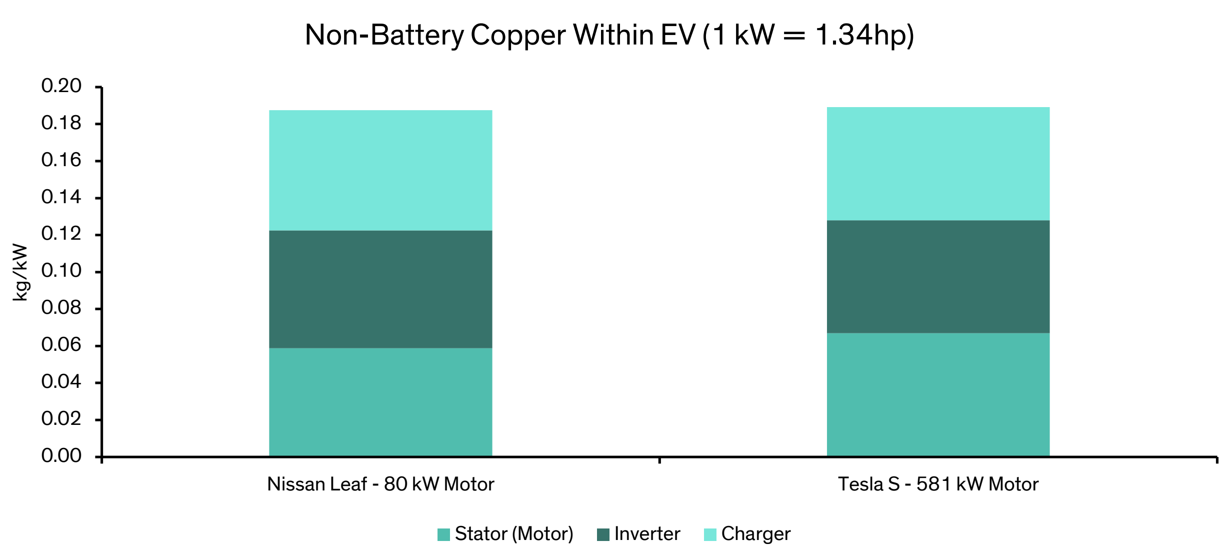
EXHIBIT 60: **LFP technology (including LMFP) is expected to consolidate its dominance, reaching c.67% market share by 2040. While sodium-ion may gain incremental share given its cost competitiveness, its LT trajectory remains uncertain at this stage**



Source: Rho Motion, SNE Research, Bernstein analysis and estimates

Outside the battery, copper is used in the motor, the inverter/converter and internal charging requirement, as well as wiring all of the components together. Outside the car you need copper for the external charging of EVs, as well as investment in the grid (we don't double count the grid in T&D and EVs).

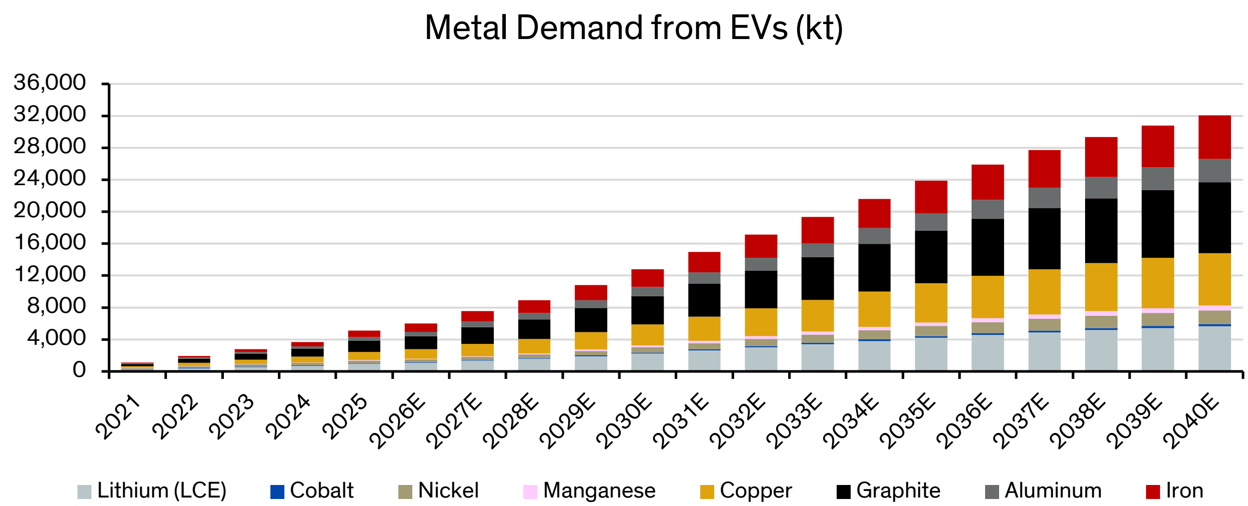
EXHIBIT 61: **Copper is not just used in the batteries, it is also used extensively in the charger, inverter, and stator**



Source: Bernstein analysis and estimates

Applying our in-house view of battery mix shifts and EV motor size progression we get the total copper required per EV, which we can combine with our EV forecast to get the total copper demand from EVs, other metals are shown for context (Exhibit 62).

EXHIBIT 62: **Annual metals demand for EVs**



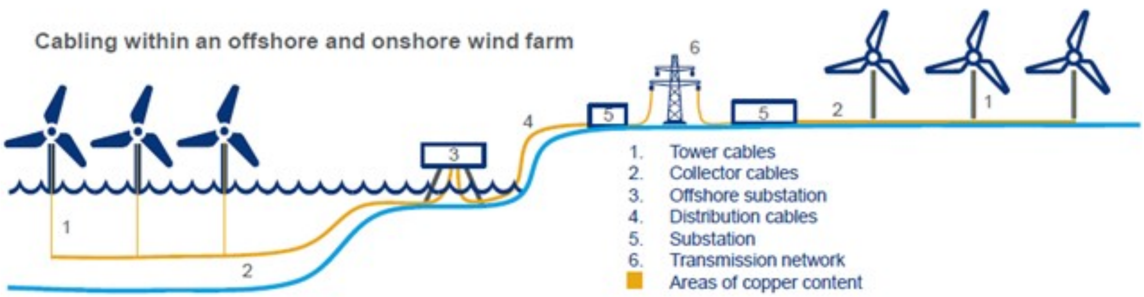
Source: Company reports, SNE Research, IHS, Bernstein analysis and estimates

However, there are a few risks that may affect copper demand from EVs, such as a move towards a centralised computer/control system, more aluminium wiring harness for weight reduction, the use of compact batteries that don't require wired modules, thinner copper foil in battery cells, and a shift towards higher voltage systems (12V to 48V).

Renewables

One of the clearest instances of the role played by copper in reducing CO2 emissions is in the energy mix and the copper intensity of low-emission fuel sources. Renewable energy assets require 3-15 times as much copper as conventional power generation per unit of installed capacity. If we examine wind and solar energy facilities (these tend to use the most copper per unit power capacity), a large amount of cabling is needed to connect the many wind turbines, solar cells, and energy storage systems over a large area (Exhibit 63). Moreover, many of the major electrical components which these assets require are copper-intensive (such as generators, inverters and transformers). Offshore wind, for instance, is far more copper-intense than onshore, primarily due to the greater need for cabling to transfer power, but also due to the copper content of generators and transformers (Exhibit 64 and Exhibit 65).

EXHIBIT 63: **The move to renewable energy generation will require a considerable amount of copper**



Source: WoodMac

EXHIBIT 64: **The draw from wind energy is considerable, as seen below for onshore farms...**

Copper Intensity in Wind Farms	
	Onshore
Component	*tonnes Cu / MW*
Generator	0.4
Transformer	1.0
Tower cables	0.3
Gearbox	0.1
Collector cables	2.6
Substation	0.5
Distribution cables	0.5
Total	**5.4**

The total figure excludes distribution cables line, which is already included in the electrical grid demand model
Source: WoodMac, Bernstein analysis

EXHIBIT 65: **...though offshore farms require even more copper per unit of energy**

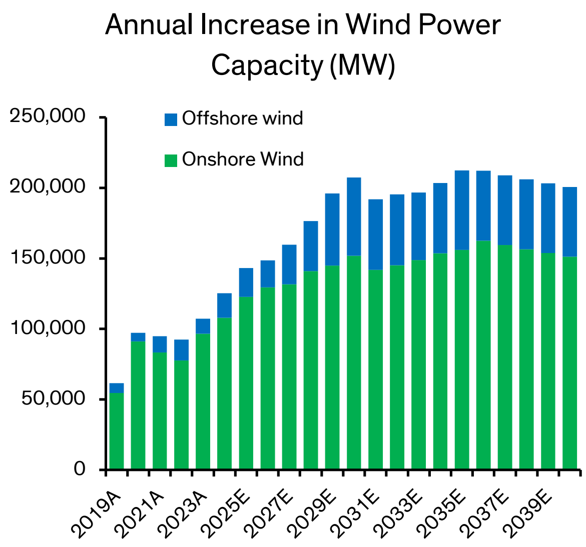
Copper Intensity in Wind Farms	
	Offshore
Component	*tonnes Cu / MW*
Generator	3.2
Transformer	1.4
Tower cables	0.6
Gearbox	-
Collector cables	5.1
Substation	1.1
Distribution cables	3.9
Total	**15.3**

The total figure excludes distribution cables line, which is already included in the electrical grid demand model
Source: WoodMac, Bernstein analysis

The Bernstein Renewables team has updated their renewable capacity model, and forecasted higher solar and wind power capacity. Applying the copper intensities to the new forecasted power capacity gets us the annual copper demand from wind and solar (Exhibit 66 to Exhibit 67).

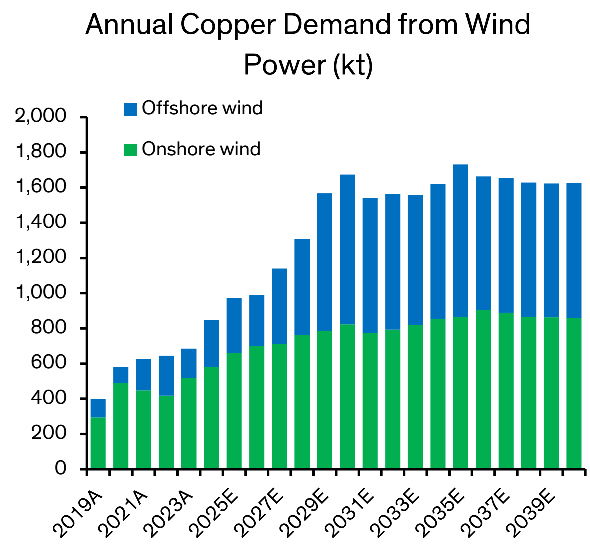
Copper is also needed to upgrade existing renewables, as well as make repairs.

EXHIBIT 66: **Wind power is set to grow rapidly...**



Source: Bernstein analysis and estimates

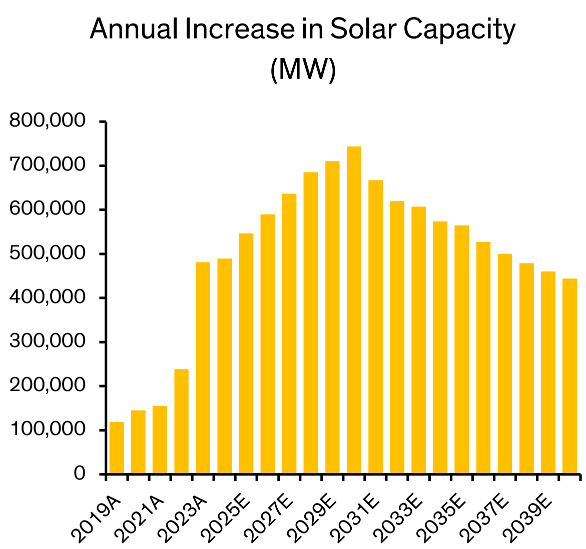
EXHIBIT 67: **...requiring a lot of copper**



Source: WoodMac, Bernstein analysis and estimates

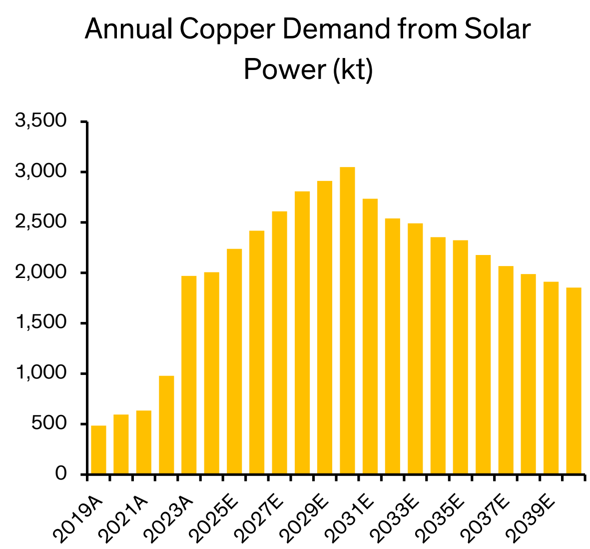
Solar uses 4.1kgCu/kW and is set to grow even more than wind (Exhibit 68 and Exhibit 69).

EXHIBIT 68: **Solar power is also set to grow rapidly...**



Source: Bernstein analysis and estimates

EXHIBIT 69: **...requiring a lot of copper**

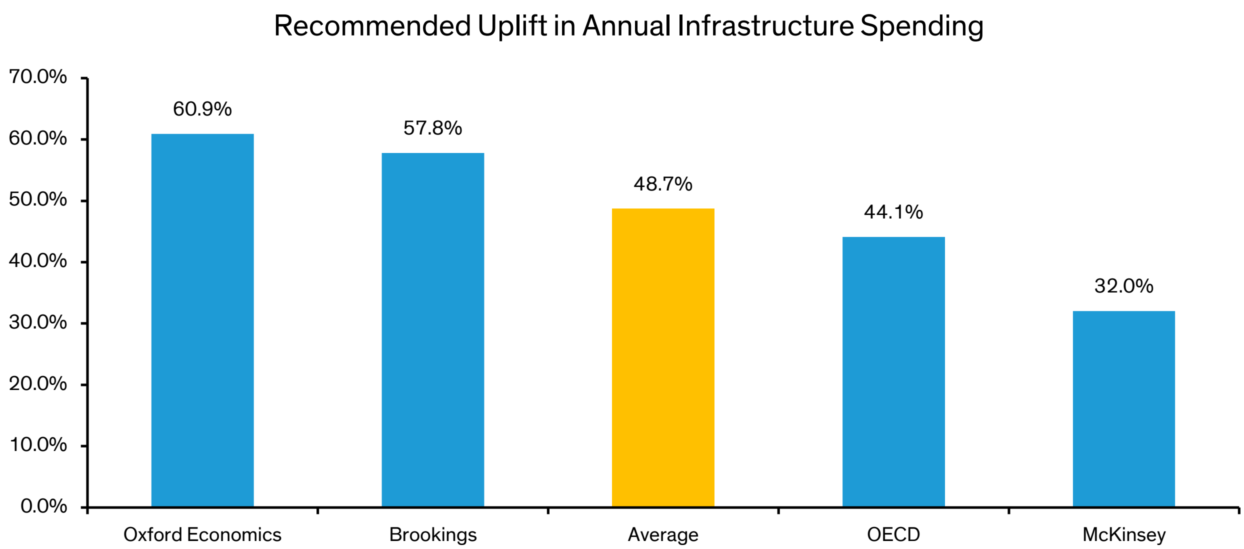


Source: Bernstein analysis and estimates

Infrastructure

Infrastructure spending is well below required levels in both developing and developed countries. Emerging markets continue their march towards the creation of wealthier societies; infrastructure is a critical enabler of this. The trend of urbanization doesn't show signs of slowing, and again this requires substantial infrastructure spending. Developed markets, on the other hand, are waking up to the fact that their infrastructure needs repair.

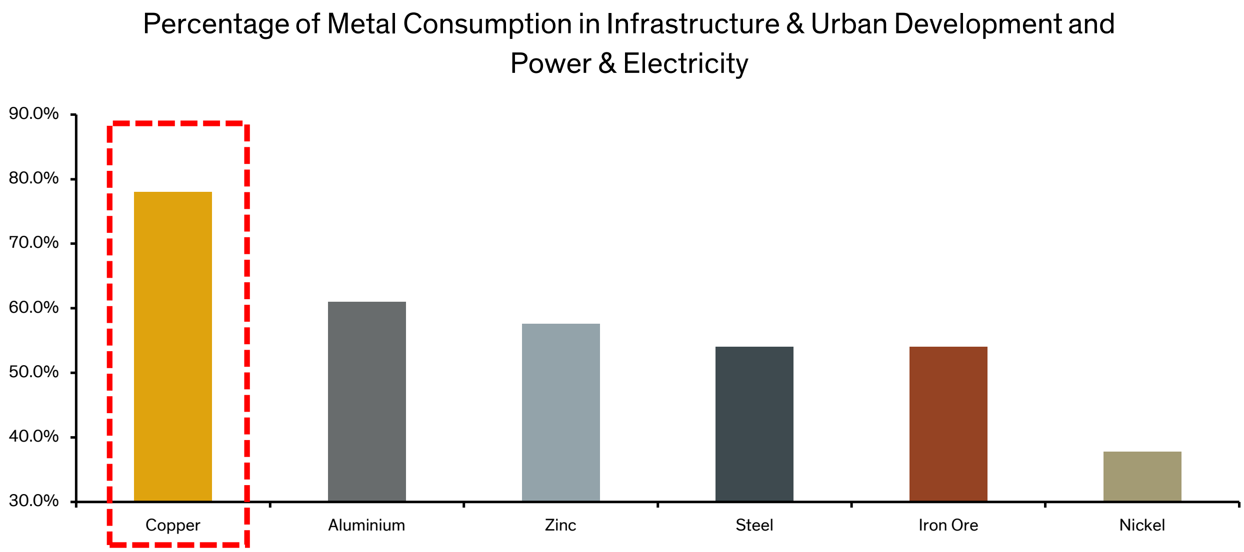
EXHIBIT 70: **Major studies recommend an average of ~50% uplift in infrastructure investment over the next 15 years will be required (excluding investment in the "green" economy)**



Source: Bernstein, Brookings: "Delivering on Sustainable Infrastructure for Better Development and Better Climate", OECD: "Investing in Climate, Investing in Growth", Oxford Economics for the Global Infrastructure Hub: "Global Infrastructure Outlook", McKinsey: "

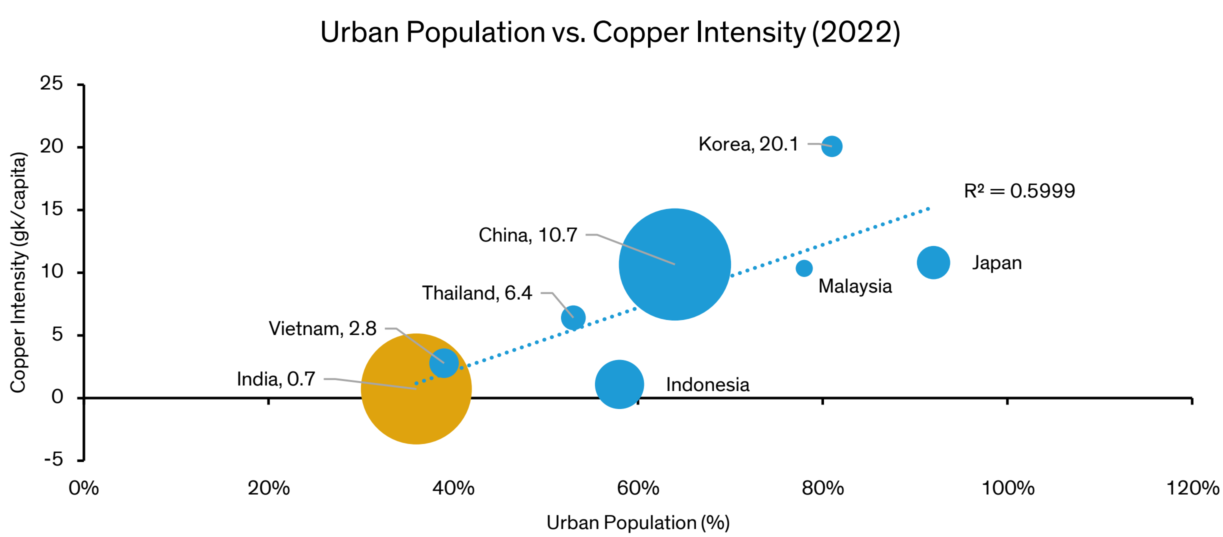
Copper is the main beneficiary of increased infrastructure spending (Exhibit 71) as it is used extensively in wiring, plumbing, appliances, telecommunications links, and heating and cooling systems. In our copper demand model we have three buckets which are linked to infrastructure: construction, industrial machinery, and the electrical network ex renewables.

EXHIBIT 71: **More than any other metal, copper benefits substantially from the development of infrastructure**



Source: UN, Bernstein analysis

EXHIBIT 72: **India's ongoing reforms could lead to increased urbanization, resulting in a higher per capita demand for copper. Given its status as the world's second most populous country, this can be significant.**

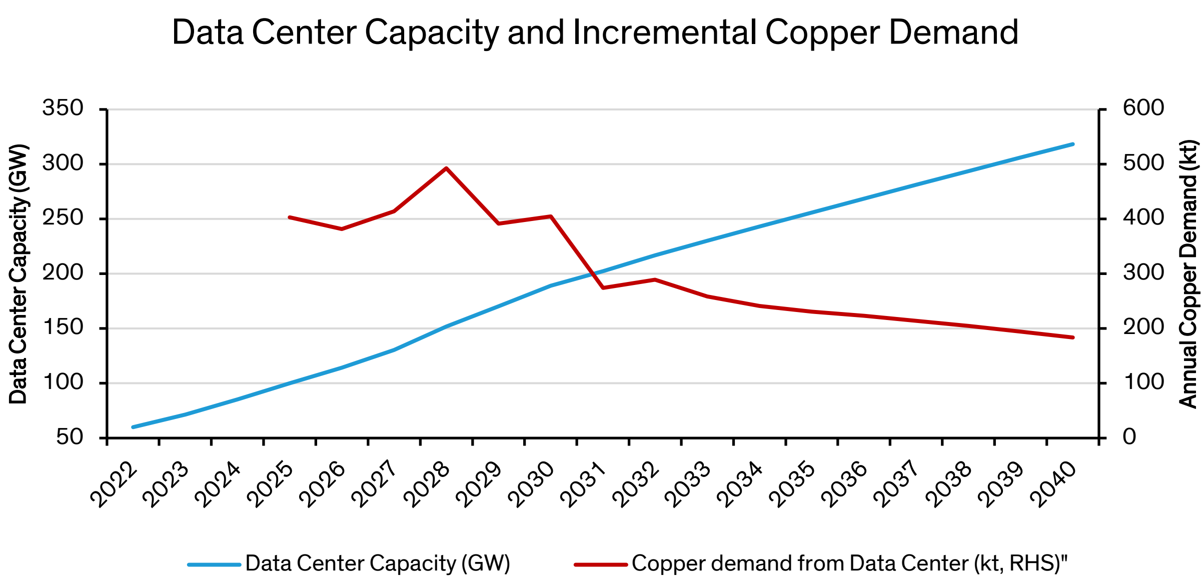


*Bubble size indicates total population
Source: WoodMac, World Bank, Bernstein analysis

Data center

Copper demand from data centre build-out is unlikely to be as significant as current market expectations imply (Exhibit 73). We estimate demand to reach 500Mtpa in 2028, before start declining to reach c.200ktpa by 2040, *despite rising capacity*.

EXHIBIT 73: **Data center capacity is expected to grow rapidly, but declining copper intensity means annual copper demand is likely to peak when 800 VDC architecture is introduced.**

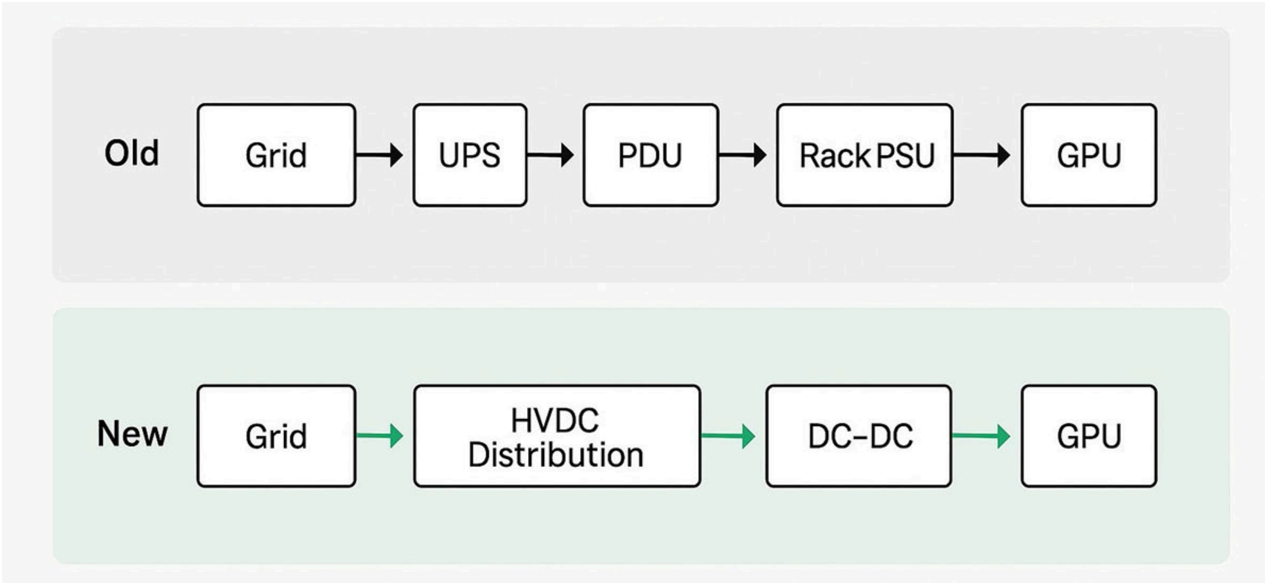


Source: IEA, McKinsey, BCG, Datacenter Knowledge, Bernstein analysis and estimates

We continue to believe that copper intensity in data center would decline as the industry experience technological changes which result in efficiency gains (Exhibit 74). One of major technological changes we anticipate is the introduction of 800 VDC architecture.

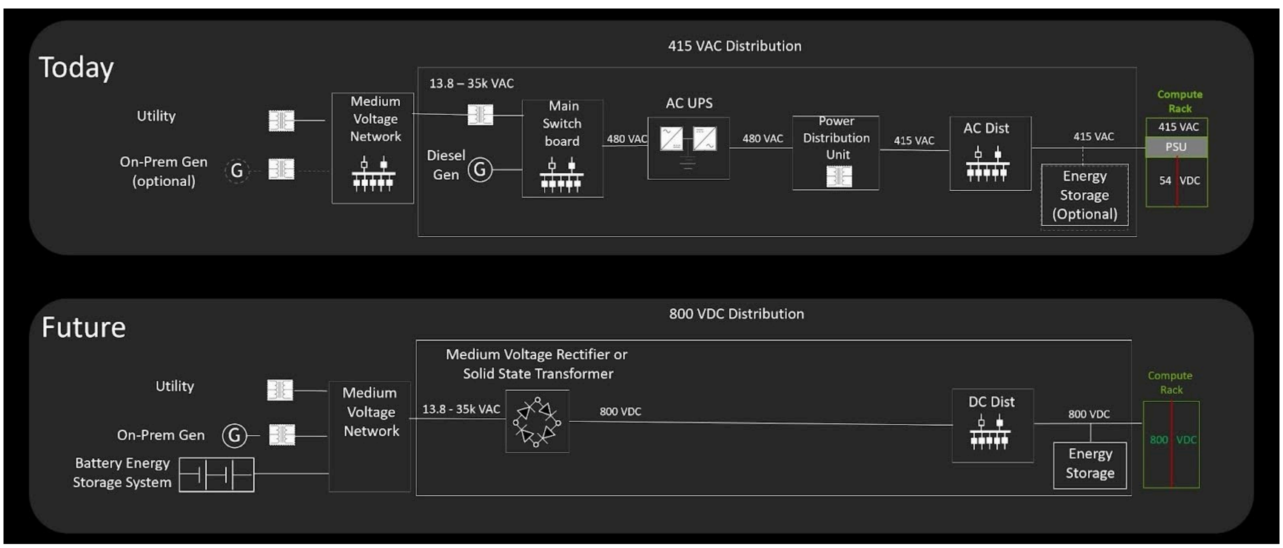
What is 800 VDC architecture? At a high level, **800 VDC architecture in a data centre** refers to a shift in how electricity is delivered internally - from a traditional, multi-step alternating current (AC) system to a **high-voltage direct current (DC) distribution model operating at ~800 volts**. Data centres ultimately run on DC power: chips, GPUs, and servers all require DC to operate.

EXHIBIT 74: **The new 800 VDC is simpler than current infrastructure which requires multiple conversion stages, and inherently has higher power loss (i.e., lower efficiency).**



Source: Company reports, Bernstein analysis

EXHIBIT 75: **NVIDIA gives us comparison between 415 VAC (top) and 800 VDC power distribution (bottom)**



Source: Company reports, Bernstein analysis

Why does the world need 800 VDC? In short, traditional 54 V in-rack power distribution—designed for kilowatt-scale loads—is not structurally suited to support the megawatt-scale power requirements emerging in modern AI data centres.

Legacy infrastructure delivers electricity as AC, meaning power must be converted multiple times before it reaches the compute load. Each conversion step introduces: energy loss, heat generation, and additional equipment and complexity. This architecture was workable when racks consumed ~10 kW. It becomes structurally inefficient as rack power scales toward 100 kW to 1 MW in AI workloads. For example, NVIDIA's latest platforms have already lifted requirements from ~50 kW/rack to 120 to 180 kW, with next-gen systems targeting >3-5x further increases. At these levels, traditional 48 VDC architectures face binding constraints, including elevated current losses, space limitations, and rising copper intensity.

In response, the industry is pivoting toward 800 VDC architectures (e.g., NVIDIA, Mount Diablo consortium), aimed at alleviating these bottlenecks and enabling the next phase of data center scaling.

For more context around 800 VDC, you may to the following Bernstein notes:

AI Value Chain: How much does a GW of data center capacity actually cost, and what goes into it?

Powering AI: Deep diving the 800 VDC shift - quantifying the impact on electricals content and growth

How does 800 VDC impact copper intensity? Higher voltage (V) means lower current (A) needed to deliver the same amount of power (W). NVIDIA estimates that lower current means thinner conductors can handle the same load, reducing copper requirements by c.45%.

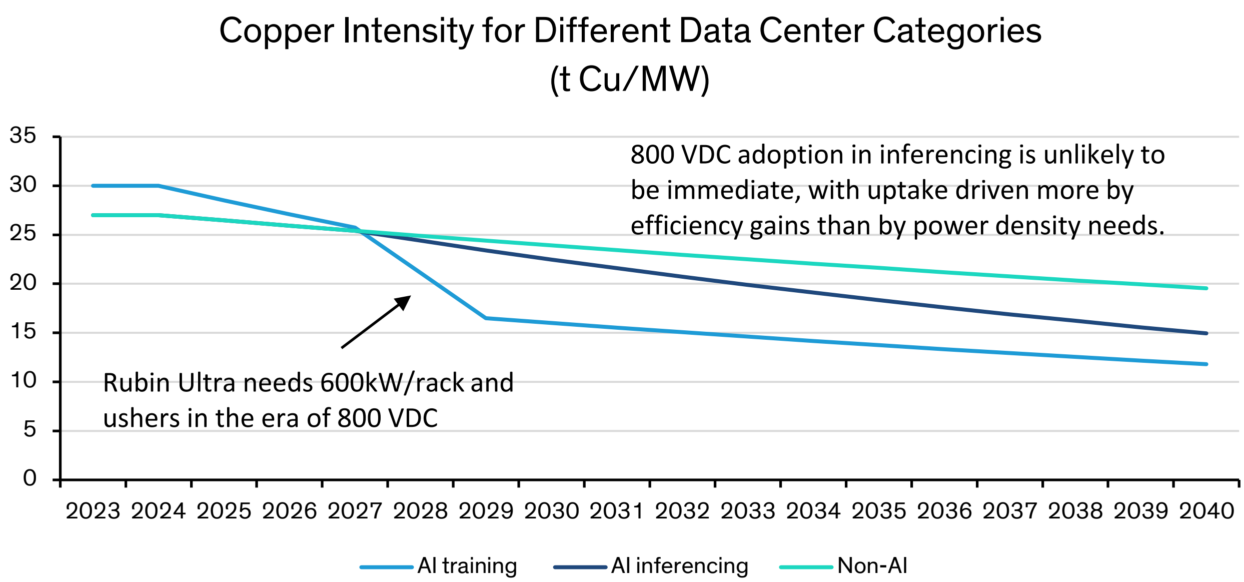
However, not all data centre capacity is dedicated to AI training and inference. As a result, copper intensity outcomes are different across categories, reflecting varying adoption trajectories for 800 VDC architecture.

AI training is anchored on frontier GPU deployments and is therefore expected to lead in adoption. With platforms such as Rubin Ultra, which requires 800 VDC, anticipated from H2 2027, the transition is likely to be front-loaded. We consequently model a sharp decline in copper intensity between 2027 and 2029, falling from ~30 t Cu/MW today to ~17 t Cu/MW by 2029.

By contrast, AI inferencing does not uniformly rely on frontier-class hardware and is therefore less immediately constrained to adopt 800 VDC. Nonetheless, the efficiency benefits remain compelling. Adoption is thus expected to be progressive rather than step-change, driving a steady, incremental reduction in copper intensity over time.

A similar dynamic applies to non-AI data centres. Immediate adoption of 800 VDC is unlikely, given lower power density requirements. However, efficiency gains still provide a structural incentive for transition. As such, uptake is expected to be gradual, with copper intensity trending lower over time, albeit at a slower pace relative to AI inferencing.

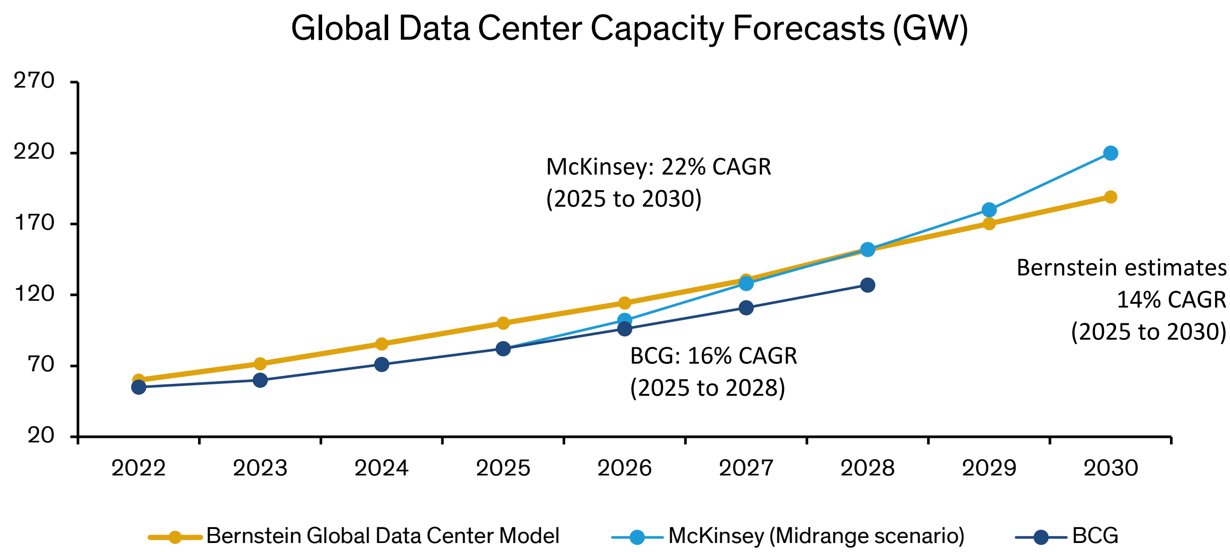
EXHIBIT 76: **NVIDIA expects 800 VDC architecture to use less copper as lower current enables thinner conductors for the same load, reducing copper intensity by ~45%.**



https://developer.nvidia.com/blog/nvidia-800-v-hvdc-architecture-will-power-the-next-generation-of-ai-factories/
Source: Company reports, Bernstein analysis and estimates

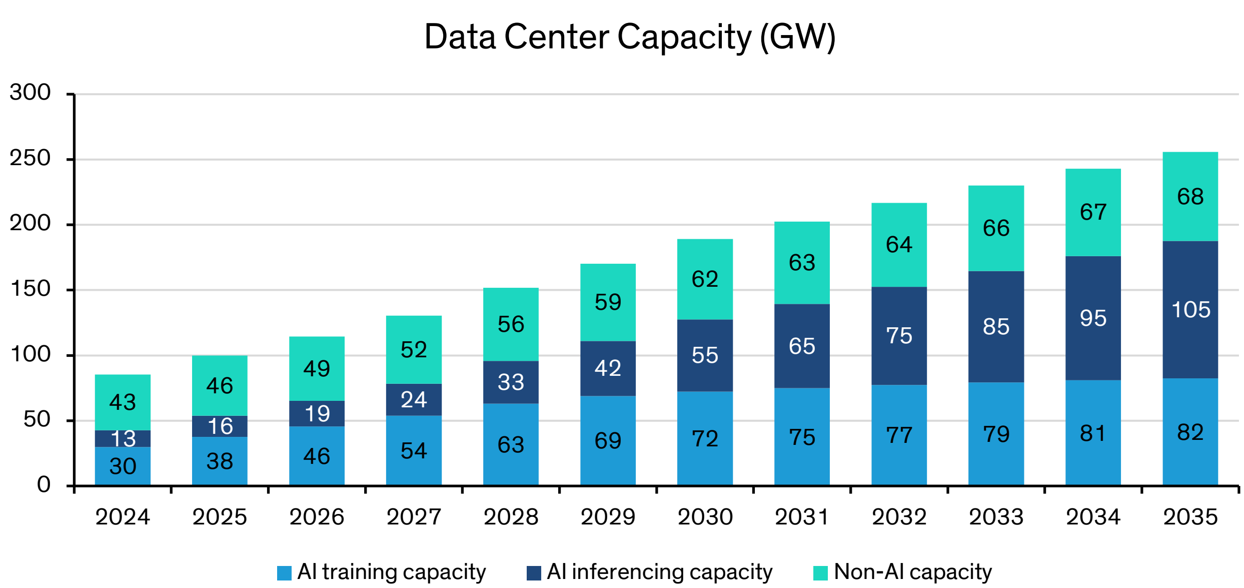
How about data center capacity? In our previous model, we use the average of BCG and McKinsey estimates to inform our data center capacity estimates. Our current model adopts estimates from Bernstein's global data center model, which is slightly higher than our previous estimates (Exhibit 77). We expect cumulative data center capacity to reach 189 GW and 256 GW by 2030 and 2035 (Exhibit 78), with bulk of the addition coming from AI inferencing (Exhibit 79).

EXHIBIT 77: **Global data center supply is expected to almost reach 200GW by 2030, implying 15-20GW annual capacity addition in the next few years.**



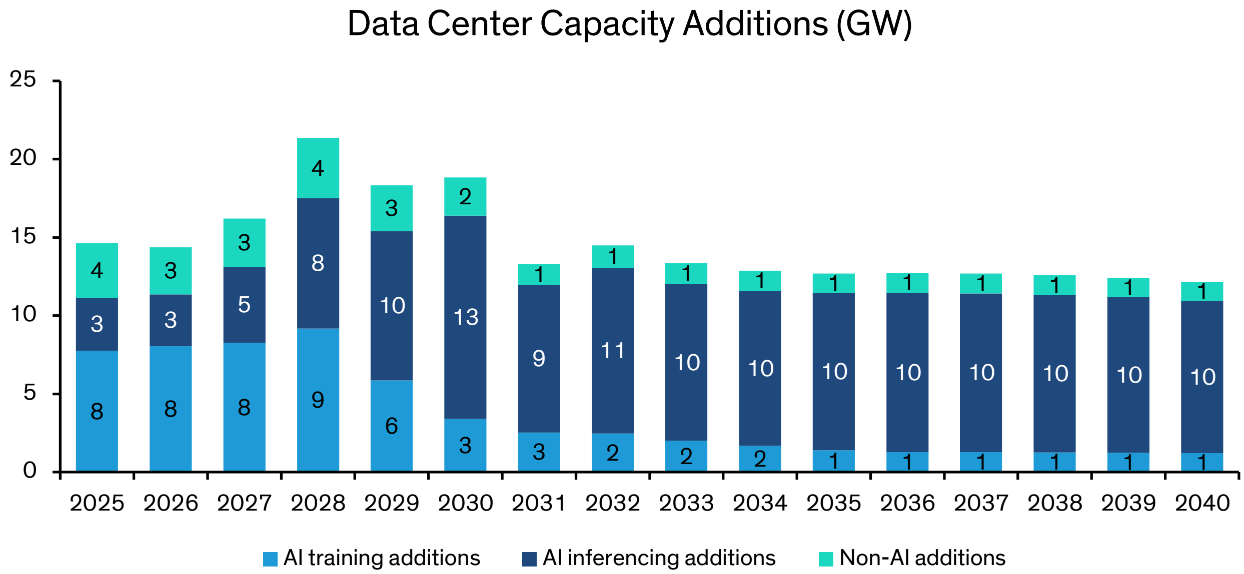
Source: McKinsey, BCG, IDC, Gartner, Omdia, Bernstein Global Data Center Model, Bernstein Analysis and Estimates

EXHIBIT 78: **Data center capacity by end-use type**



Source: IDC, Gartner, Omdia, Bernstein Global Data Center Model, Bernstein Analysis and Estimates

EXHIBIT 79: **Data center capacity annual addition by end-use type**

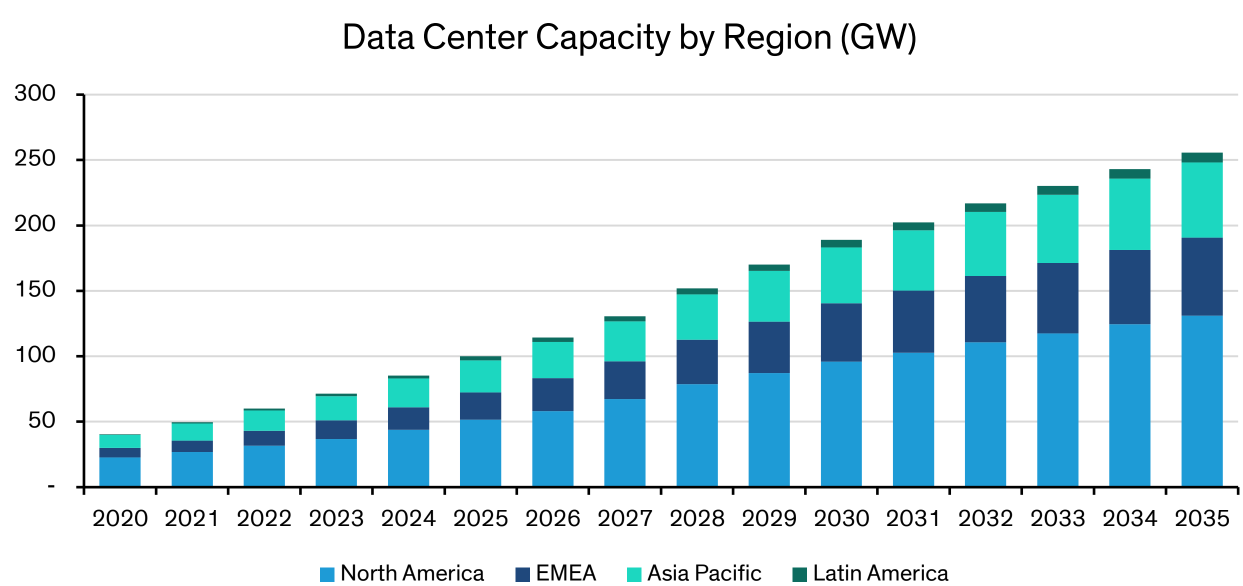


Source: IDC, Gartner, Omdia, Bernstein Global Data Center Model, Bernstein Analysis and Estimates

What about the extra copper needed to build grid (T&D)? We expect a portion of data center electricity needs will be fulfilled by behind-the-meter (BTM) solutions (a.k.a. onsite generation). **Hence, T&D capex growth due to data center, which translates to copper demand, might not be a 1:1 with data center capacity growth.**

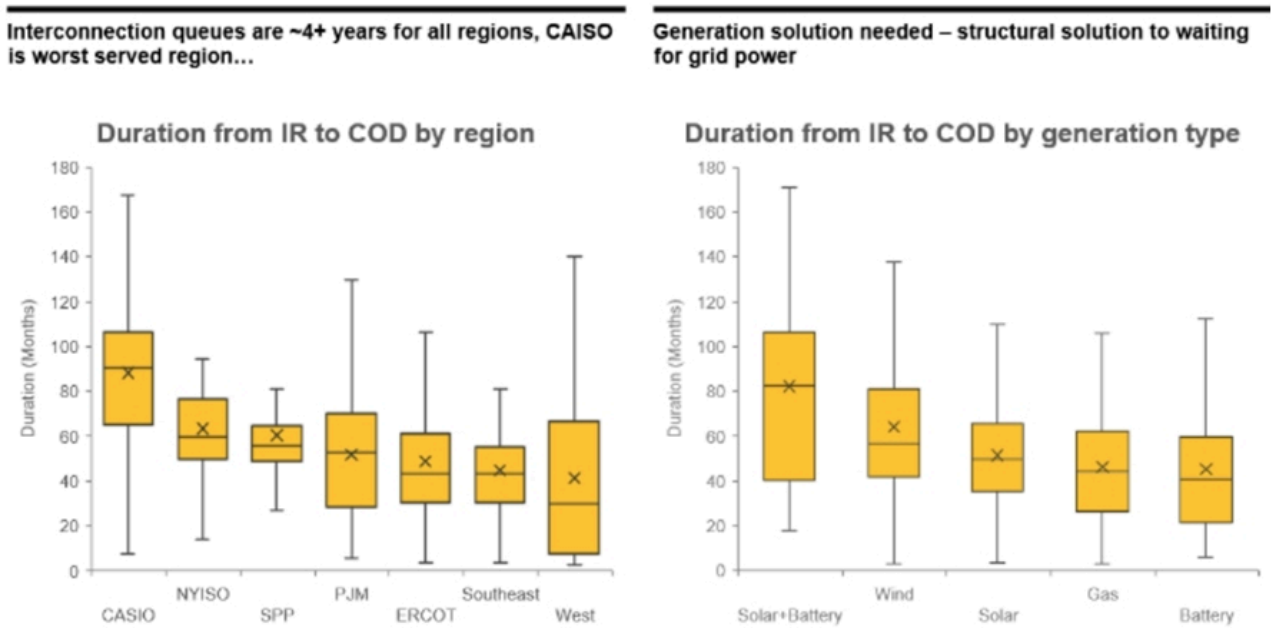
Since the US accounts for c.50% of global data center capacity (Exhibit 80), we highlight long interconnect queues, which explain why data center operators use BTM solutions to fulfill partial or all of their electricity needs (Exhibit 81). Currently, there are 8,188 active generation requests in the US with a combined capacity of 1.76 TW (Exhibit 82).

EXHIBIT 80: **North America is expected to dominate data center supply at c.50% global capacity**



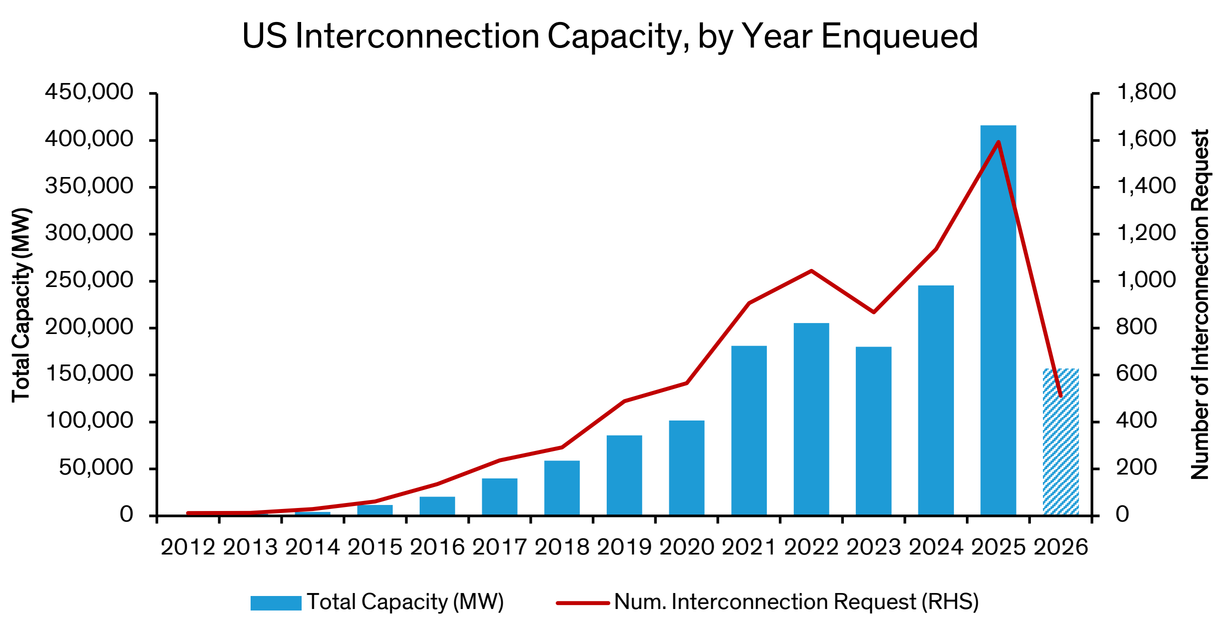
Source: IDC, Gartner, Omdia, Bernstein Global Data Center Model, Bernstein Analysis and Estimates

EXHIBIT 81: **Interconnection queues in the US remain structurally constrained, with timelines from interconnection request (IR) to commercial operations date (COD) typically exceeding four years, on average.**



Source: Company websites, Bernstein analysis

EXHIBIT 82: **Currently, there are 8,188 active generation requests in the US with a combined capacity of 1.76TW**

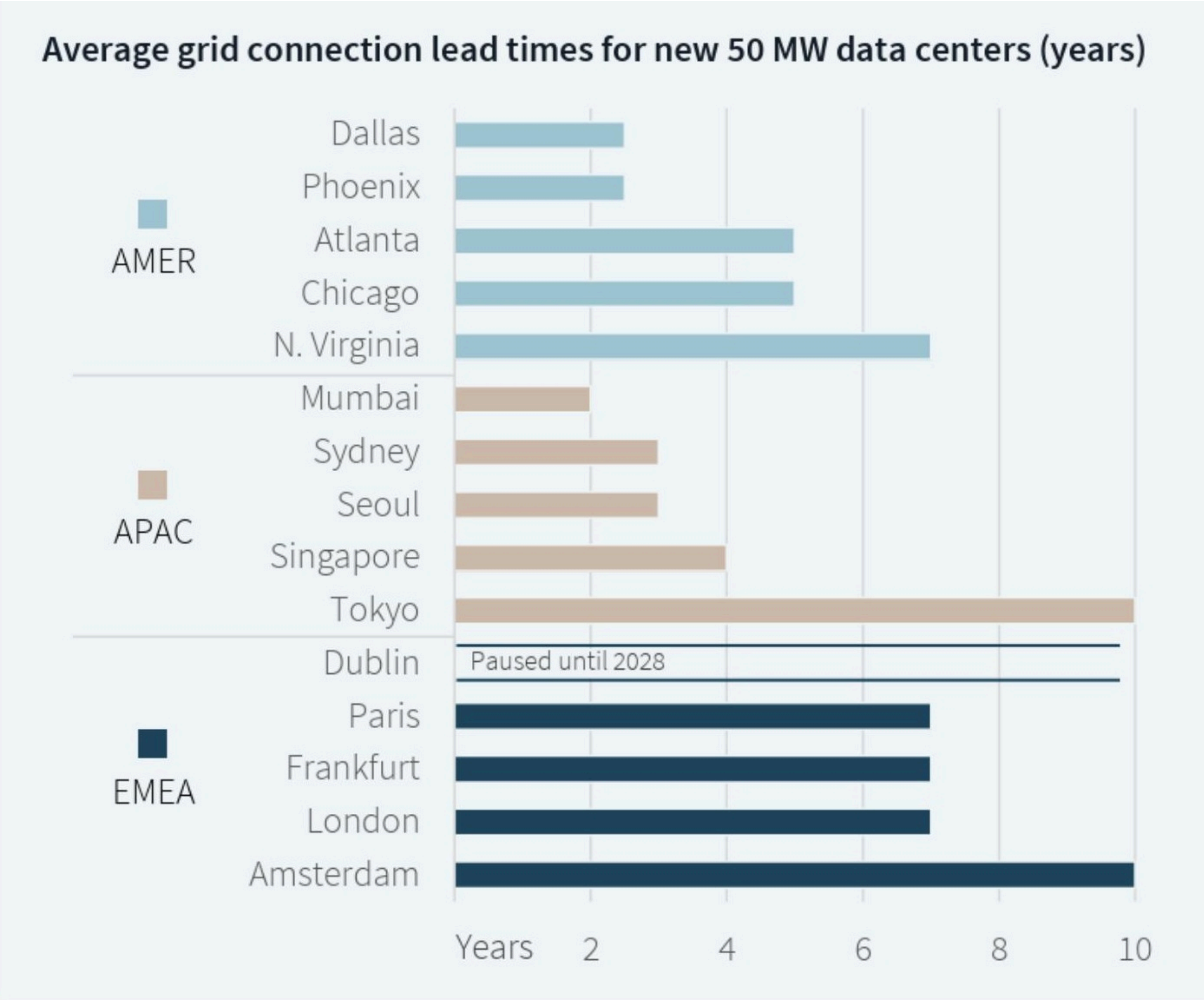


The 2026 figure reflects a year-to-date value and is not annualised.
Source: Interconnection fyi, Bernstein analysis

Long interconnection queues aren't just a US specific issue, they're also present in other regions, particularly in Europe (Exhibit 83). In many cases, European grids are older and less flexible than those in parts of Asia, which tends to make bottlenecks around new connections more pronounced.

Given that backdrop, it's reasonable to expect data center operators in Europe to lean more on behind-the-meter (BTM) solutions. Much like in the US, these act as a practical workaround to help bring capacity online despite grid delays, while utilities take the longer path of upgrading and expanding infrastructure.

EXHIBIT 83: **Grid bottlenecks are increasingly acting as a binding constraint, prompting data centre developers to pivot toward self-generation, power purchase agreements (PPAs), and private wire arrangements as a means of accelerating project timelines.**



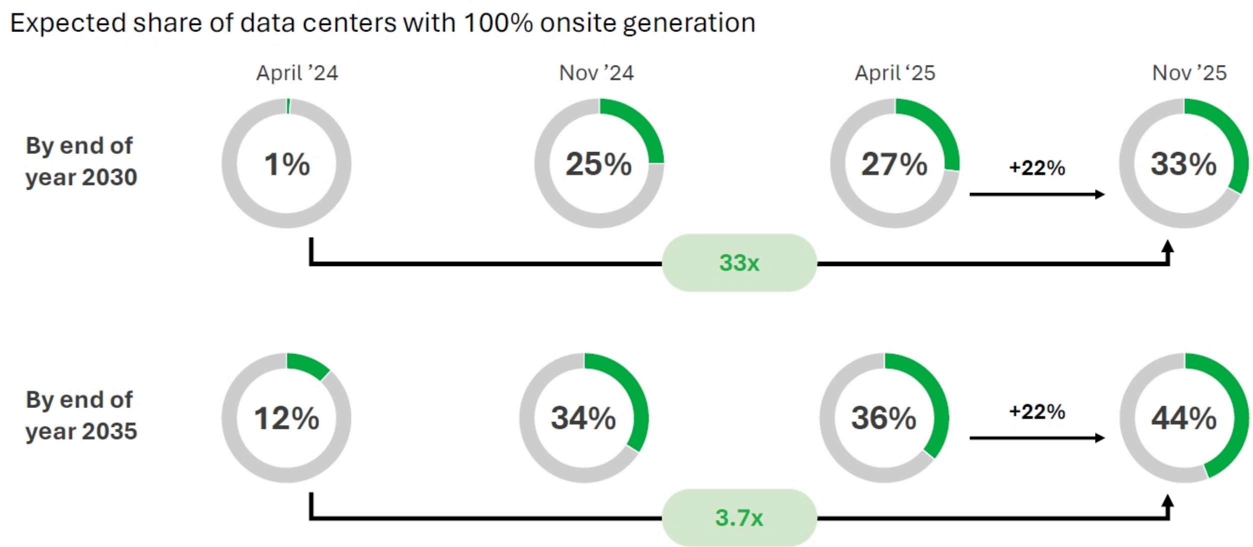
Source: Company reports, Bernstein analysis

Surveys results in Exhibit 84 shows that up to 33% and 44% of data centers electricity demand will be met by 100% onsite generation. However, data center operators like Equinix and Digital Realty (both covered by US Communication Infrastructure team) mention that **BTM is a practical bridge, not a long-term replacement for the grid.**

Digital Realty's management still views the utility grid as the backbone of its power strategy. The grid brings built-in advantages, such as scale, redundancy, and shared infrastructure that are difficult and expensive to replicate on a standalone basis. Importantly, DLR doesn't expect a future where data centers broadly go off-grid, especially since hyperscale customers continue to prefer traditional utility power. In that context, BTM solutions are used more tactically: they help get capacity online faster while utilities catch up on transmission and distribution upgrades.

Equinix uses on-site generation, like fuel cells or gas turbines, to fill gaps when grid access is delayed or constrained. The goal isn't to replace the grid, but to keep projects moving and avoid bottlenecks. Once utility power becomes available, that remains the long-term solution.

EXHIBIT 84: **BloomEnergy surveys reveal that 33% and 44% of data centers might use 100% onsite (behind-the-meter) generation by 2030 and 2035, respectively. BTM solutions are much less copper intensive due to location proximity.**



Source: Company reports, Bernstein analysis

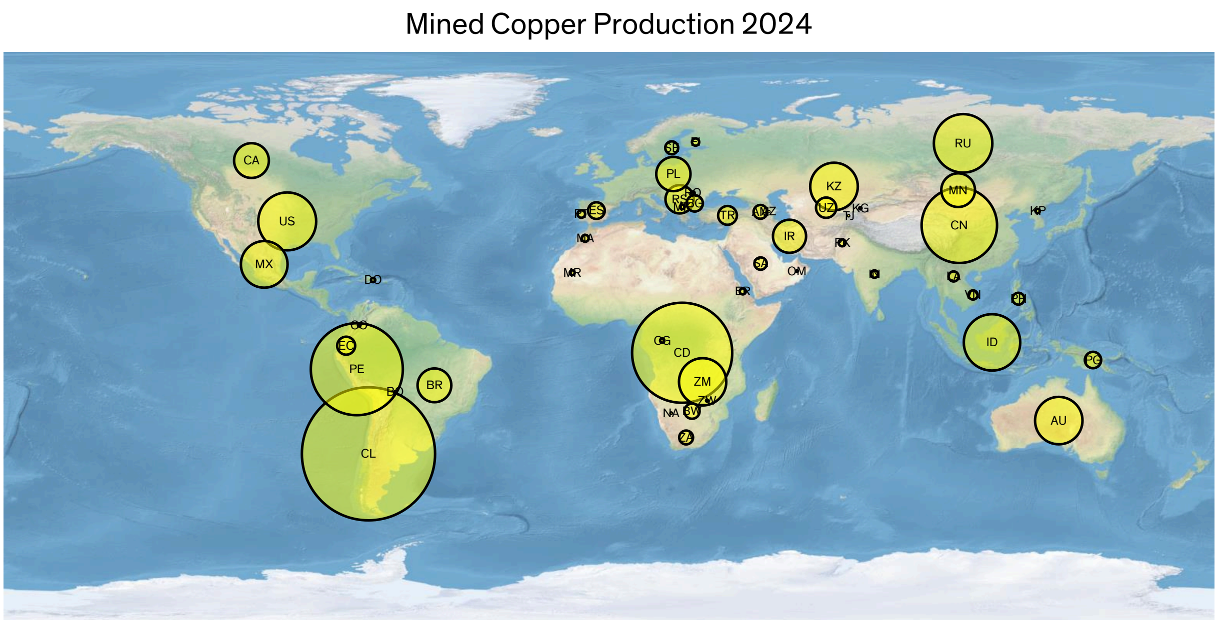
As a result, we revise our base case for transmission and distribution (T&D) capex to reflect the incremental load from data center expansion. Previously, our framework anchored on a mid-point between the IEA's STEPS and APS scenarios, consistent with the view that actual investment would likely meet stated policies but fall short of full policy ambition. However, the addition of structurally higher demand from data centers shifts this balance. Grid infrastructure will need to scale more aggressively to accommodate this load.
As a result, we now see T&D capex tracking closer to the APS scenario. The incremental demand from data centers effectively pulls forward investment requirements, increasing the likelihood that realized spending will converge toward the upper end of the IEA framework rather than the midpoint (Exhibit 57).

FACTORS CAUSING TIGHT(ER) COPPER SUPPLY

Copper is Geologically Relatively Scarce

Looking at the world map of copper production it would seem that copper is everywhere (Exhibit 85).

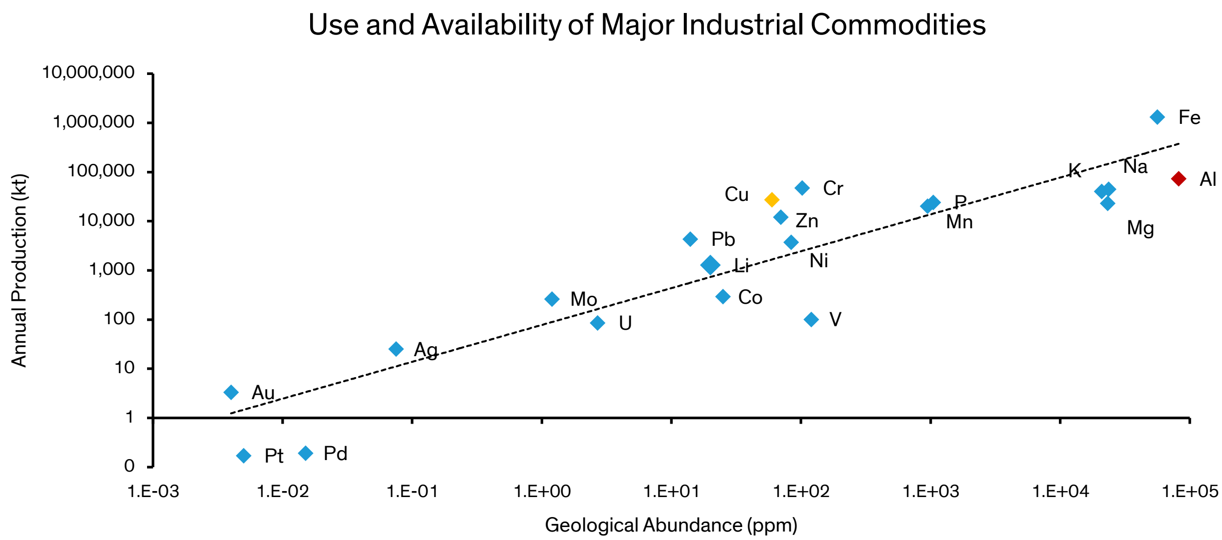
EXHIBIT 85: **South America produces a large chunk of the world's copper**



Source: WoodMac, Bernstein analysis and estimates

Although there are copper mines across the globe, copper is considered a geologically scarce metal in relation to its demand. We observe that the consumption of commodities correlates with their geologic abundance (Exhibit 86).

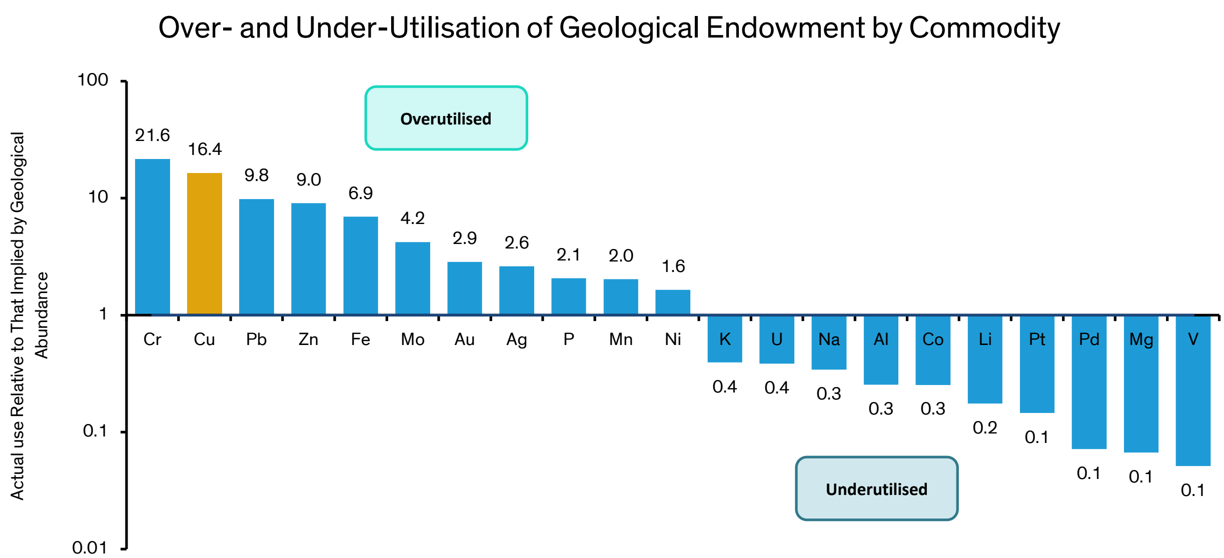
EXHIBIT 86: **Consumption of commodities correlates with geological abundance**



Source: USGS, Bernstein analysis

And relative to its consumption, copper is over-utilized (Exhibit 87). So, **copper is relatively scarce.**

EXHIBIT 87: **Copper is amongst the most over-used for its endowment**

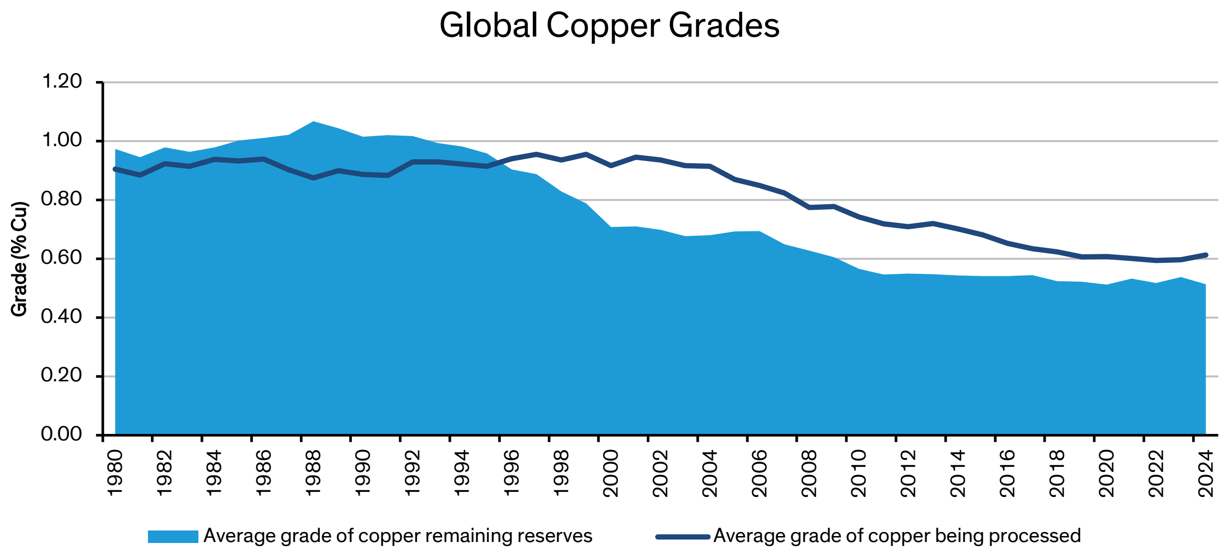


Source: USGS, Bernstein analysis and estimates

Ore Grades of Copper Fall over Time

The average grade of copper reserves (source of future production) is falling over time (Exhibit 88). Importantly, if ore falls from 1% copper grade to 0.5% copper grade, then twice as much ore must be mined and milled – a doubling of effort (and costs). Second, in the late 1990s a cross-over point was reached from an era in which the copper to come (reserves) was higher grade than the copper of the day (production), to the opposite.

EXHIBIT 88: **Global copper reserves grades have been falling sharply since the mid-1990s. As we continue to mine above reserves grade, production grade will inevitably fall in the future.**

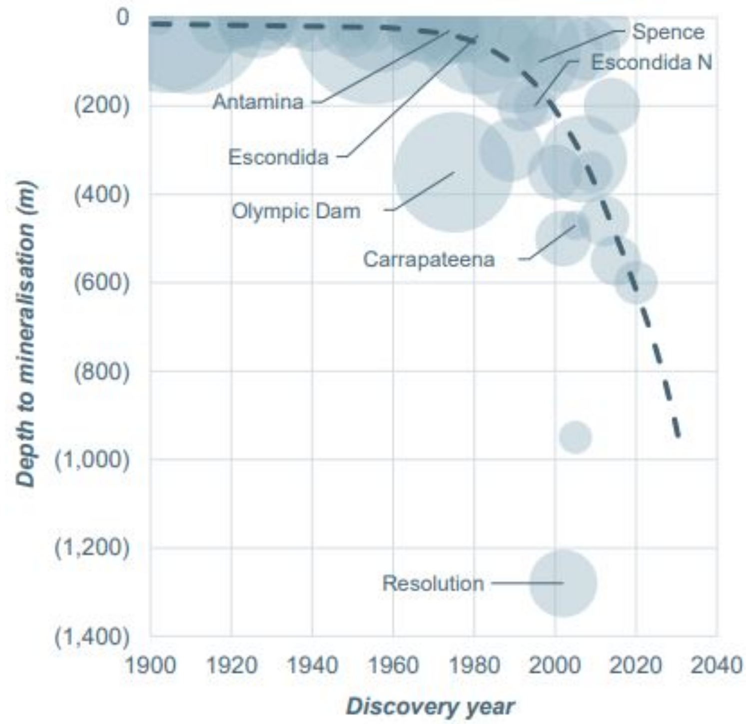


Source: WoodMac, Bernstein analysis and estimates

We are Finding Less and Less Copper

Major copper mines are increasingly harder to find and getting deeper (Exhibit 89), which suggests a structural shift (higher) in cash costs.

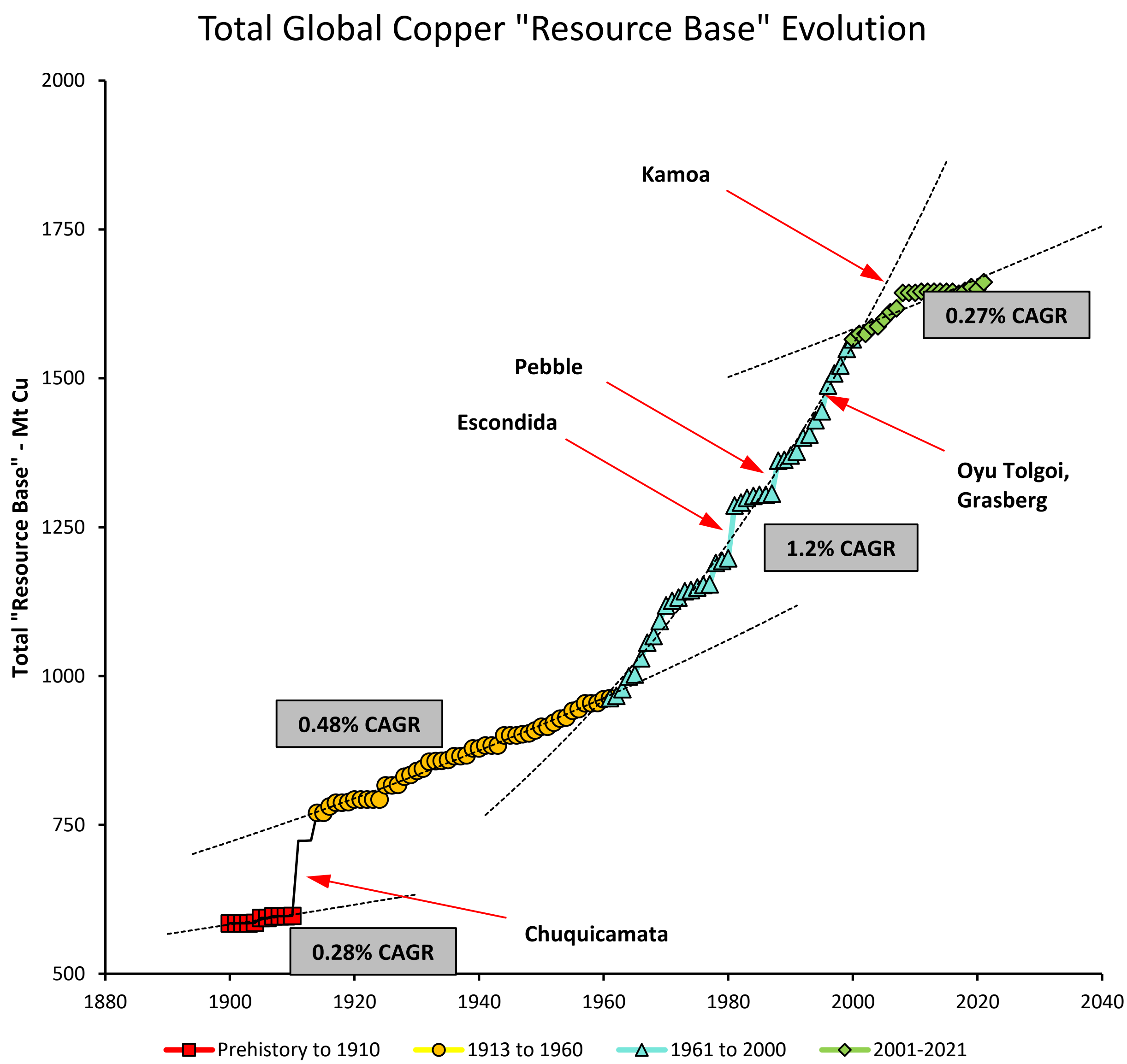
EXHIBIT 89: **Major copper discoveries are getting deeper..**



Source: BHP

The copper resource base grows when discovered volumes exceed extractions. Exhibit 90 shows that the current era has trivial growth in the resource base (certainly compared to past eras). A recent notable significant discovery of the Winu deposit by Rio Tinto was 503 Mt copper equivalent at a 0.45% ore grade.

EXHIBIT 90: **The world is not growing the copper resource base**

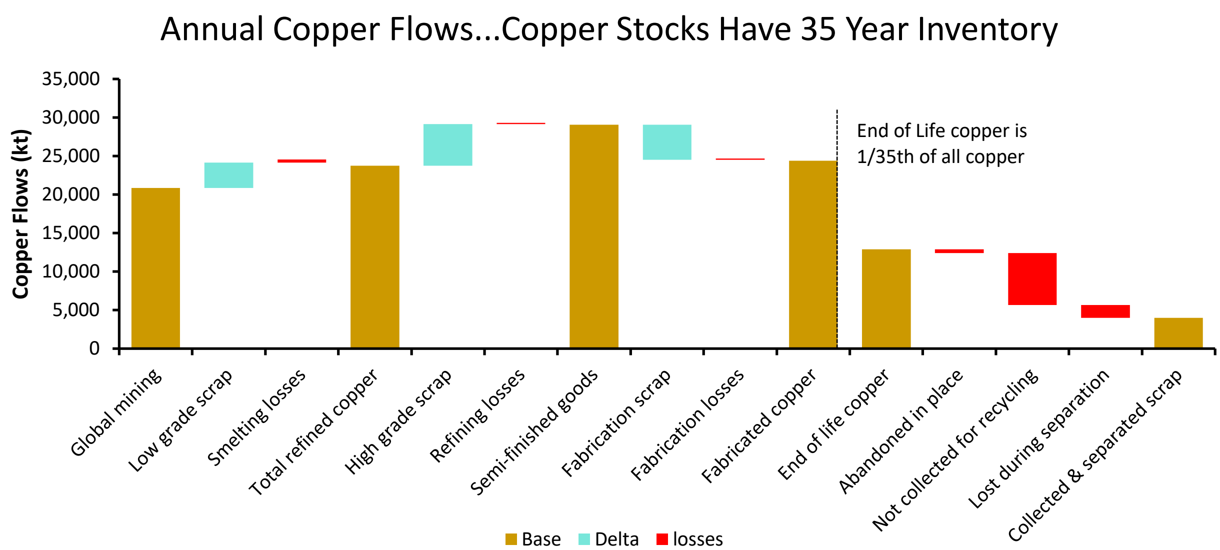


Source: USGS, WoodMac, Corporate reports, Bernstein estimates and analysis

Scrap can't Make Up for Primary Weaknesses

Clearly significant amounts of copper get recycled. However, it is and will not be enough to offset declining primary supply. Exhibit 91 shows the flow of copper and importantly that copper tends to have a life of 35 years (in other words on average it takes 35 years for copper to be available for recycling). Of the copper reaching its end of life only 44% of it is collected and separated.

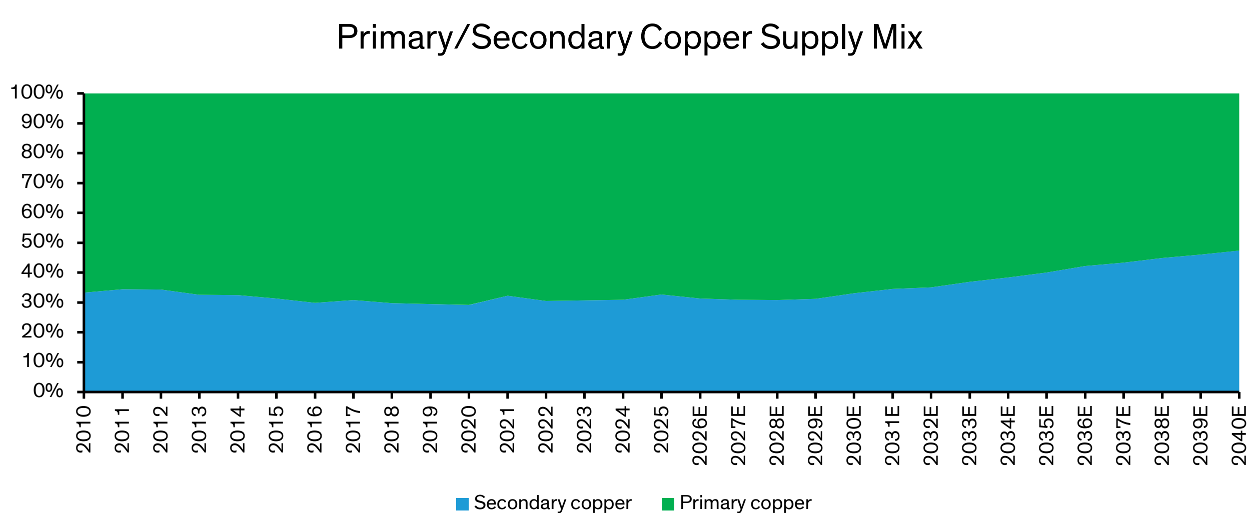
EXHIBIT 91: **Flow of copper supply, demand, and recycling**



Source: Fraunhofer Institute for Systems and Innovation Research ISI for ICA, Bernstein analysis

We assume the average lifetime of copper remains at 35 years and the collection/separation rate increases from 44% to 55% due to recycling innovated and/or government incentives and mandates. We expect recycled copper production to increase from 10.0Mt in 2022 to 18.2Mt in 2040 (Exhibit 92).

EXHIBIT 92: **Secondary copper's share is expected to rise to ~40% by 2035, up from ~31% currently.**



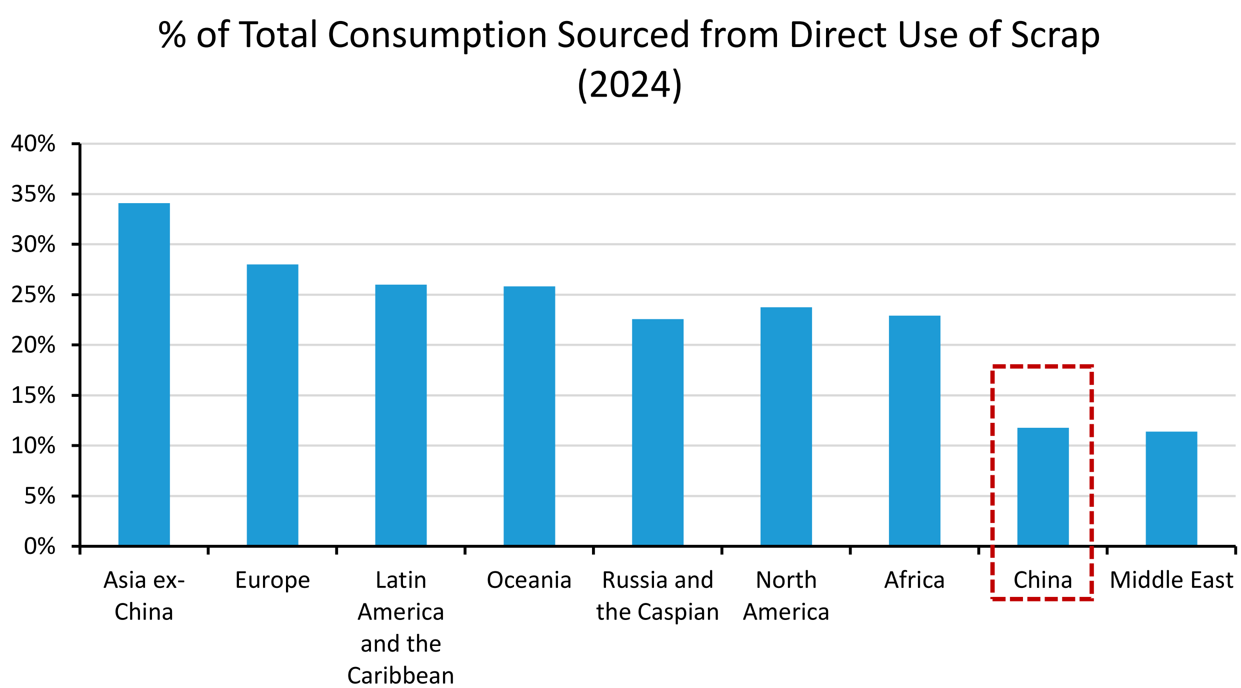
Source: WoodMac, Bernstein analysis and estimates

China has lots of room to grow in using recycled copper (Exhibit 93), we expect it to be a key growth area in recycling copper.

In February 2024, China announced that it aims to achieve a 15% increase in the volume of recycled disused or old home appliances and furniture by 2025 (vs. 2023 level). The circular issued by nine government departments, including the Ministry of Commerce, said that efforts will be made in four main areas: improving the country's recycling network, nurturing big recycling businesses, innovating recycling models, and standardizing recycling practices. The Chinese government expects these efforts to drive the growth of new home appliance consumption. We think the growth will only help to offset the sluggish Chinese consumer spending. Thus, we keep our demand forecast for “consumer & general” category intact.

Higher supply from scrap will narrow the potential deficit, but cannot make up for primary supply weakness. We will still see deficit in 2026 and 2027, followed by finely balanced market between 2027 and 2029, then deficit from 2030 onwards.

EXHIBIT 93: **China is lagging behind in using recycled copper. We expect the gap to narrow with Chinese government looking to grow the national recycling industry that targets disused or old home applicances & furniture.**



Source: WoodMac, Bernstein analysis

Geopolitical Risks

Geopolitics has always had a large impact on commodity prices. The most recent example is the Ukraine war. The sanctions and expected sanctions led palladium (of which Russia makes up almost 40% of global supply) increasing to as high as $3400/t in March 2022. Nickel increased even more, reaching $100,000/t (!) before the LME halted trading, despite Russia only producing ~10% of the world's supply (although Russian nickel is in general high quality, so Russia produces almost 20% of the world's high quality nickel). This large spike was largely due to short positions being squeezed, but the message still holds: geopolitics has had and will have a large impact on commodity prices.

Geopolitical risks do not only come from wars and coups — over the past two years a big topic has been Chile raising their royalty rates. A leftist government was elected at the end of 2021 and the country has passed an increase in mining royalties this year. Starting in 2024, mining royalties will increase to a range of 8% to 26% of operating margin (from 5% to 14%) and a 1% ad-valorem tax based on sales will be applied. Chile's Mining Council forecasts that the new royalties scheme will boost the average tax rate to 44.7%, with a maximum potential tax burden set at 46.5%.

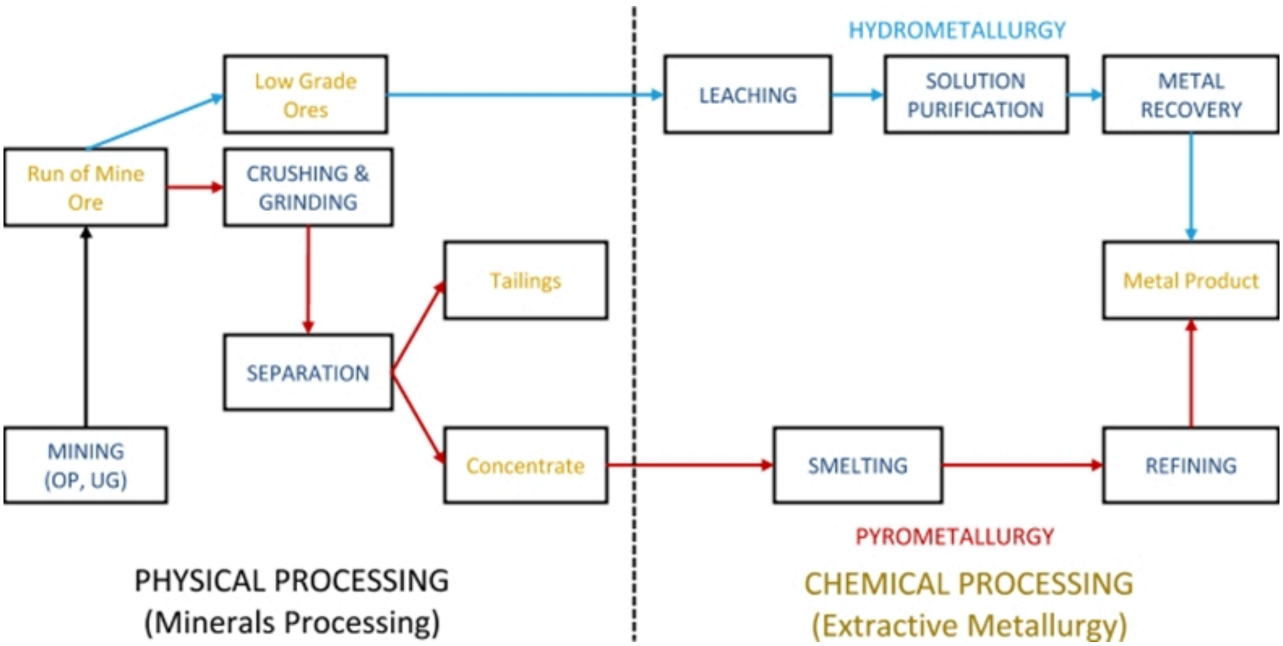
Geopolitics offers a lot of upside risk to copper price - either by limiting supply (coups, wars, embargoes), or by raising costs (royalty hikes, windfall taxes).

New Technologies are not Transformational (at the moment)

Currently, there are two main methods to process copper ore for metal production. The most widely used method (and the most conventional) is the pyrometallurgical method which consists of crushing, grinding, flotation, smelting-refine and electrorefining. It is applied to sulphide flotation concentrates rather than ores and is used for high grade ore. Meanwhile, oxides and lower grade sulfides favor leaching/ hydrometallurgical/SxEw, which consists of crushing, leaching, Solvent extraction and Electrowinning. The advantage of this method is that it can be used to extract copper from low grade ore which would not be economical to process through pyrometallurgy. Exhibit 94 highlights both methods.

We explore hydrometallurgy further in one of our best-read notes: Global Metals & Mining Primer: The coming hydrometallurgy revolution and Global Metals & Mining Primer: The emerging copper leaching revolution.

EXHIBIT 94: **Metalliferous ores, including copper, are processed by pyrometallurgy or hydrometallurgy. Recent advances in copper leaching are noteworthy, as they may enable extraction from low-grade primary sulfide ores.**

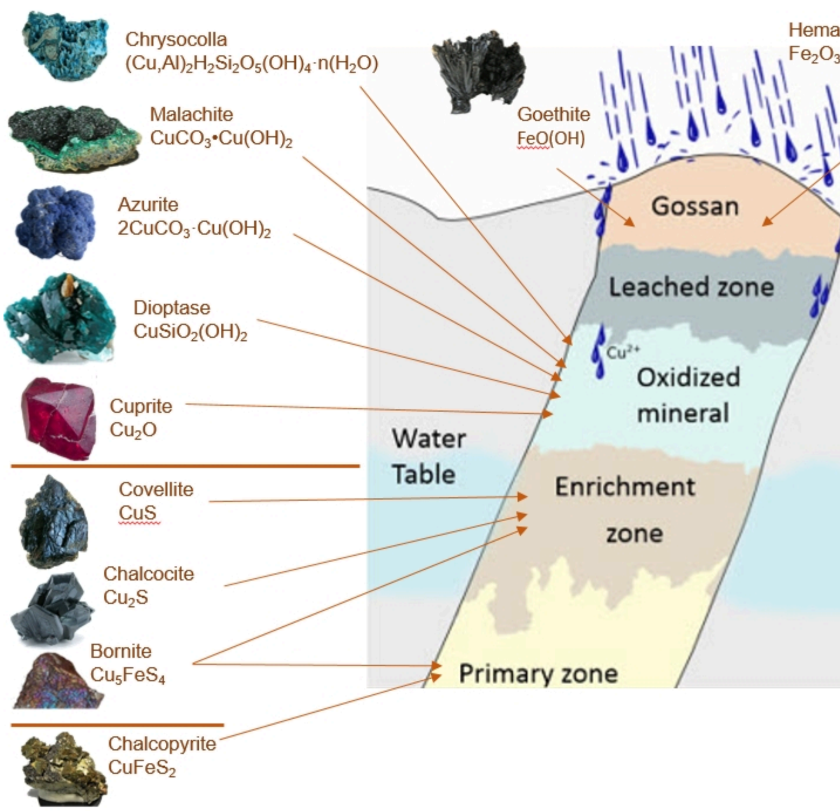


Source: Company reports, Bernstein analysis

Leaching is generally effective for extracting copper from oxide ore and secondary sulfide ore (Exhibit 95), which together account for about ~30% of global copper resources. The remaining 70% is locked in low-grade primary sulfide ore, which have remained largely untapped because neither of the standard extraction routes (Exhibit 1) has been economically viable. The operative phrase here is "economically viable". This means, extracting copper from hypogene sulfide is not impossible, it's just not profitable yet. Hence, if copper price stay high for an extended period of time (think above $11,000/t), extracting copper from low-grade primary sulfides might yield attractive IRR and, it could significantly alleviate the widely projected copper shortage expected from the 2030s onward. In the following sections, we discuss two potential pathways that may lead to more low-grade primary sulfide leaching: (1) leaching innovations evolution and (2) traditional leaching revolution.

EXHIBIT 95: **A roadmap for matching ore and metallurgy**

Supergene processes (“super” meaning above, or near the surface) relate to secondary minerals



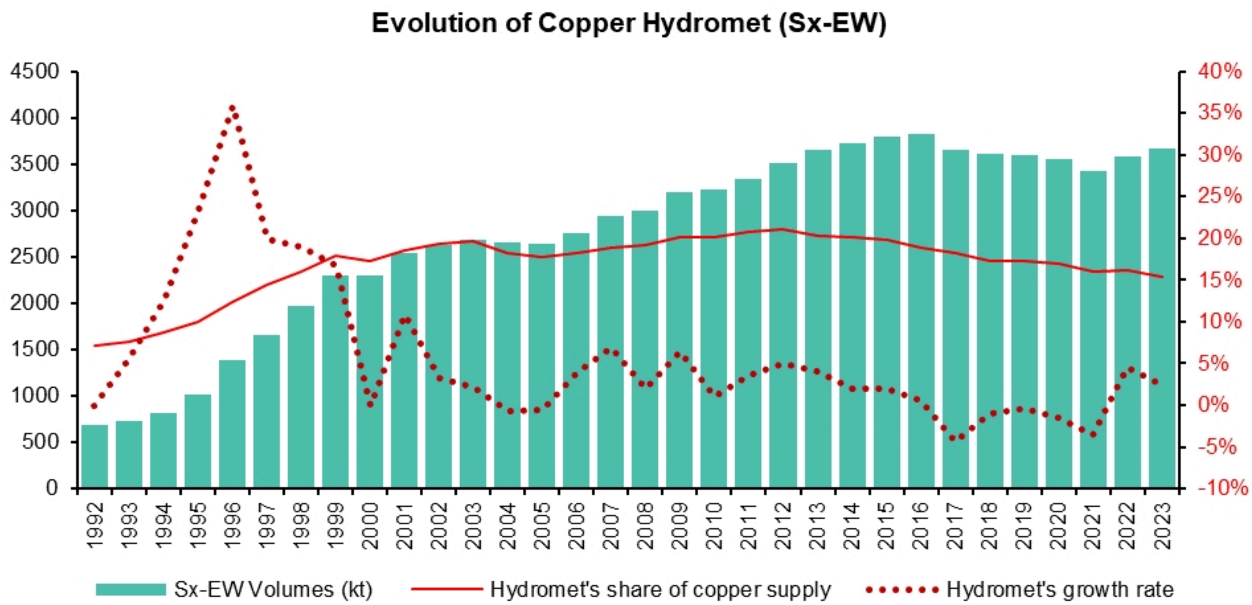
	High grade	Low grade
Oxides	Pressure/ Vat leaching	Heap leaching
Secondary sulfides	Concentration/ **smelting** or bioleaching	Bioheap leaching
Primary sulfides	Concentration/ **smelting** or bioleaching	**R&D**

Hypogene processes (“hypo” meaning under, or deep below surface) relate to primary minerals

Source: CRU, USGS, Wikimedia commons, Bernstein analysis

Exhibit 96 shows the role that hydromet has played in copper, going back to 1992. In 1992, hydromet's share of copper supply was perhaps 10%, and it grew to >20% a decade ago and has since lost share. It grew as fast as 30+% at its peak. It now bounces around a zero growth rate. The first generation of the hydromet revolution seems mostly over.

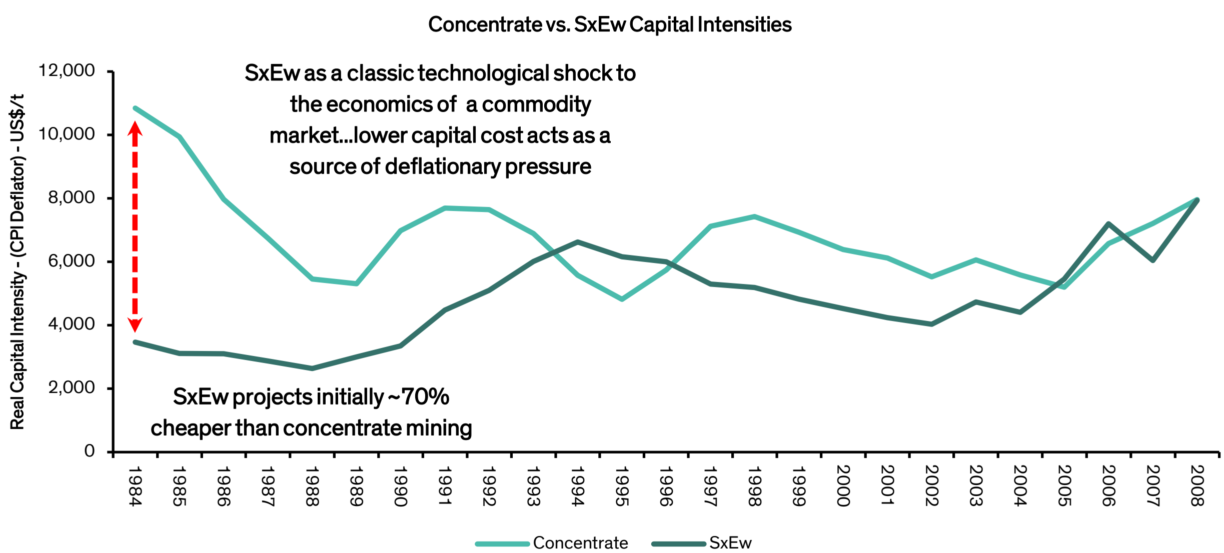
EXHIBIT 96: **Hydromet's disruption of copper mining muted...**



Source: WoodMac, Bernstein analysis

Why is the first revolution over? Exhibit 97 shows that the initial hydromet projects were significantly cheaper. One of our themes is hydromet "works" when the right process hits the right ore - you need both halves of the Venn Diagram to overlap. That's exemplified below. Over time the match between hydromet technology and ore body fell and thus the competitiveness with conventional (concentrate smelting) projects normalized. **Capital intensity was an important factor for the initial rapid growth, and then stagnation of SxEw supply.**

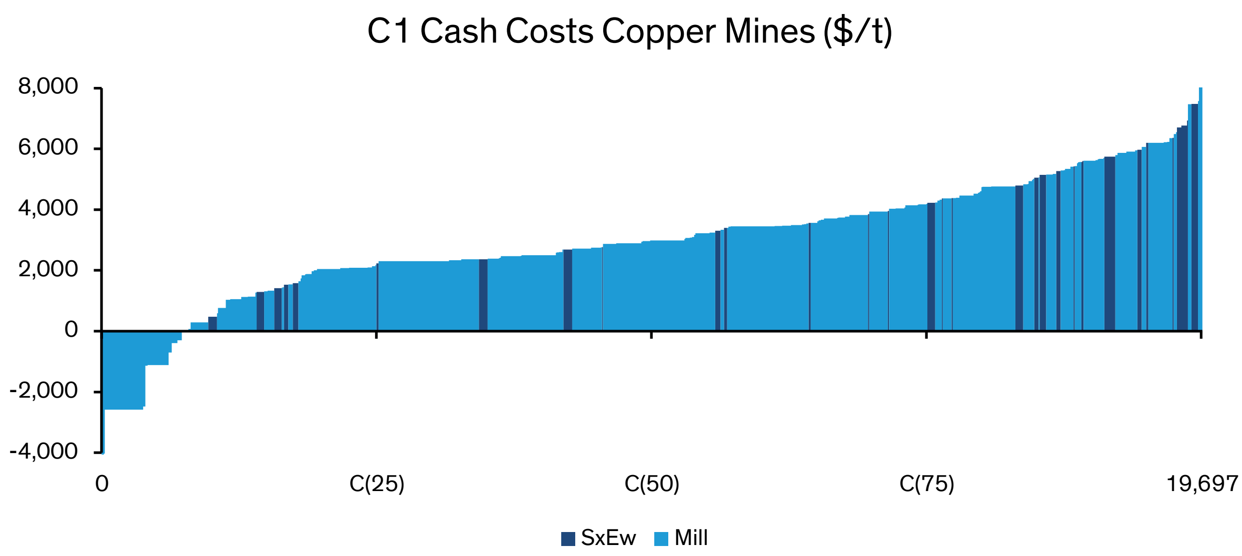
EXHIBIT 97: **The revolution around milling 'shock' (from concentrate to SxEw) has played out**



Source: WoodMac, Bernstein analysis and estimates

Standalone SxEw/leaching operations generally have lower capex requirements but are more expensive to run (per ton of paid Cu) than mill operations, as shown in Exhibit 98. However, leaching can be introduced in existing mill operations to lower cost, Freeport is planning to lower costs at some of its US operations using leaching.

EXHIBIT 98: **SxEw mines are concentrated above the 50th percentile of the C1 cash costs curve...although leaching can be used in older mill operations to lower costs (e.g. Freeport)**

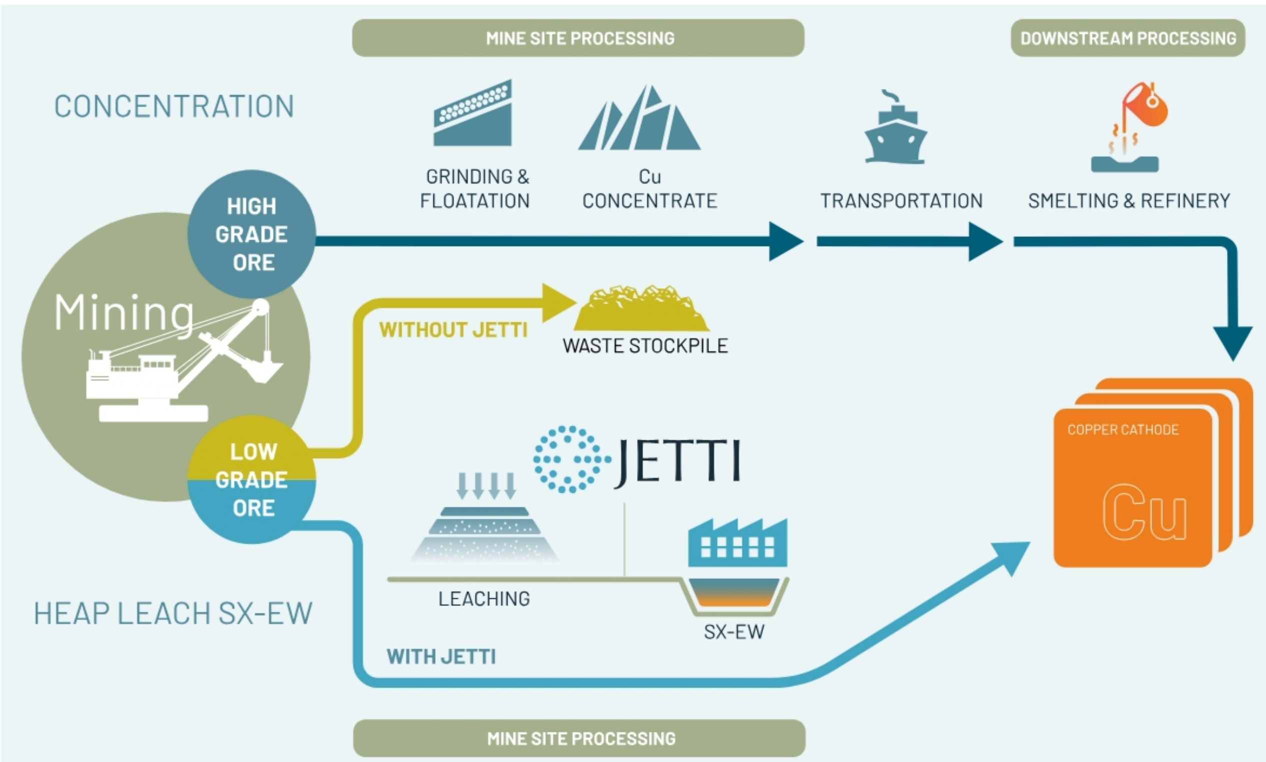


Data as of Aug 2025
Source: WoodMac, Bernstein analysis

However, another key reason why SxEw production is stagnating is because the low-grade copper ore being leached is subjected to a passivation layer, which essentially blocks the solvent to leach the copper. Historically high temperatures or oxidizing agents have been used to break down this passivation layer, both of which are expensive making it commercially unsuccessful. A catalyst, created by Jetti Resources and backed by big names such as BHP, Teck, and Freeport-McMoran, could solve this issue. The catalyst breaks down the passivation layer, allows leaching to continue and enabling extraction of copper from low-grade primary sulphides, such as chalcopyrite, the most abundant copper ore.

Nevertheless, several major miners have made meaningful progress in leaching chalcopyrite (a.k.a. hypogene sulfides, or low-grade primary sulfides). These advancements matter because they lift copper recovery rates to levels that start to look economically viable-given that traditional recovery rate from primary sulfide leaching has been notoriously low, around 10-30% versus ~65% in typical leach operations. The core challenge with primary sulfides is the formation of a "passivation layer," which effectively blocks the continued extraction of copper and limits overall recovery. BHP and Freeport have partnered with Jetti Resources to deploy tailored processes for extracting copper from lowgrade primary sulfide ore (which can be found in waste-ore stockpiles) (Exhibit 99).

EXHIBIT 99: **About 70% of copper resources lie in low-grade primary sulphide ores, which are too low-grade to makepyrometallurgical processing economical. Bioleaching has to date proven ineffective because these minerals forma "passivation layer" that blocks further copper extraction.**



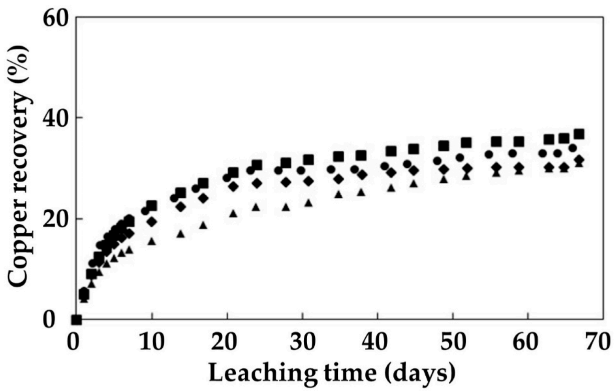
Source: Company reports, Bernstein analysis

One example of recent studies on chalcopyrite leaching (Yévenes et al., 2022) shows that:

"Intermittent irrigation enhanced the dissolution of the chalcopyrite ore, but excessively long rest periods negatively affected chemical and bacterial activity due to a shortage of acid and/or nutrients for the microorganisms. The recovery of low-grade chalcopyrite ore was enhanced by increasing the microbial cell density."

Exhibit 100 and Exhibit 101 show that copper recovery can exceed 30% after 30–40 days of leaching. However, it is important to note that the leaching columns used in this study were only 1 meter in height. In real operations, leach pads can be tens of meters tall. Hence, commercial leaching times will be longer - could be a multiple of those observed in small-scale pilot tests.

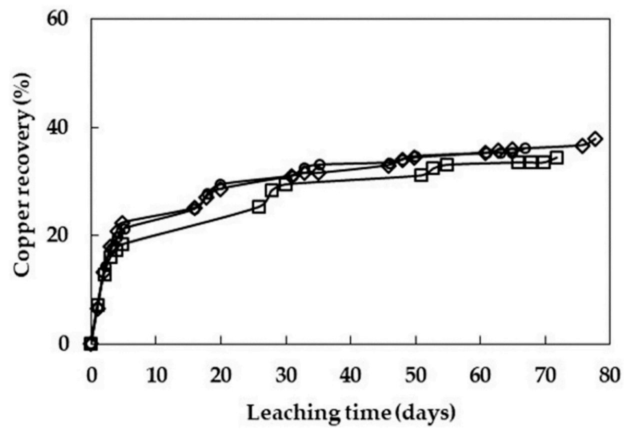
EXHIBIT 100: **Bioleaching in Columns 1.0 m in Height with Continuous Irrigation**



Copper dissolution of chalcopyrite ore with continuous irrigation in 0.5 g/L copper (II) at ambient temperature with the addition of ▲ 3.0 g/L of acid, 1.0 g/L total iron and 107 cells/mL, ■ 3.0 g/L of acid, 1.0 g/L total iron and 5.0 × 107 cells/mL, ♦ pH-controlled at 2.0, 1.0 g/L of total iron and 5.0 × 107 M cells/mL and ● pH-controlled at 1.5, 1.0 g/L of total iron and 5.0 × 107 M cells/mL.

Source: (Yévenes et al, 2022), Bernstein analysis

EXHIBIT 101: **Bioleaching in Columns 1.0 m in Height with Intermittent Irrigation**



Copper dissolution of chalcopyrite ore with continuous irrigation in 12 g/L of acid, 0.5 g/L copper (II), 1.0 g/L total iron, and 5.0 × 107 cells/mL at ambient temperature with three intermittent irrigation cycles of: 5/10 days; ◇ 5/10 days (duplicate); and ☐ 5/20 days.

Source: (Yevenes et al, 2002), Bernstein analysis

Taken together, these developments show that the industry is gradually moving toward economically viable recovery of copper from low-grade primary sulfide ores (Exhibit 102), potentially within the next 3 to 5 years. However, the technologies continue to evolve, and the additional copper expected from these leaching innovations is still modest compared with the potential supply gap projected for the 2030s. In short, leaching progress seems to be an evolution-not a revolutionwith gradual improvement expected in the future. This could be part of the solutions to solve the upcoming copper deficit.

EXHIBIT 102: **Morenci Engineered Heaps (MEH) are ROM leach pads where air is injected to enhance sulfide leaching, improving copper recovery up to 3× for hypogene ores like chalcopyrite. Could FCX's leaching innovations drive recovery even higher?**

	Copper Recovery by Process (%)					
Ore Type Description	MFL	S-ROM	X-ROM	Low-Grade	MEH	Leaching Innovations
Leached Cap	61.1	53	53	35	53	
Mixed Oxide-Sulfide	82.6	59	59	40	59	
Supergene Sulfide	79.6	57	57	35	57	
Hypogene Sulfide	13	13	13	10	30	>>30?
Acid Soluble Oxide	86.7	65	70	50	65	
Acid Insoluble Oxide	61.1	53	53	35	53	
Mixed Hypogene Sulfide	30.6	27	27	19	30	
Mixed Supergene Sulfide	51.6	37	37	25	45	

Source: Company reports, Bernstein analysis

Leaching is an important aspect of running the world's largest copper mines. The Exhibit 103 below shows the top 20 mines globally and highlights the source of copper — concentrates (smelting), SX-EW (hydromet) or a combination. 9 of the world's largest mines are a combination of concentrates and SX-EW. Two of the top 20 - Tenke Fungurume and Kamoto - are purely SX-EW. So half of the top 20 mines in the world leverage "conventional" hydromet. We'll use some examples of these mines to further grow our intuition for hydomet. But intuitively, big resources get bigger with time and any breakthrough in technology can use these large mines as a working laboratory given the level of investment spent on them.

EXHIBIT 103: **World's top 20 copper mines (2025)**

Rank	Mine	Country	Owners	Source	Capacity
1	Escondida	Chile	BHP (57.5%), Rio Tinto Corp. (30%), Japan Escondida (12.5%)	Concs & SxEw	1,350
2	Grasberg	Indonesia	PT Freeport Indonesia (PT Inalum and the provincial/regional government 51.2% and Freeport-McMoRan Inc 48.8%)	Concentrates	800
3	Collahuasi	Chile	Anglo American (44%), Glencore plc (44%), Mitsui (8.4%), JX Holdings (3.6%)	Concentrates	600
4	Kamoa-Kakula	DRC	Ivanhoe Mines (39.6%), Zijin Mining Group (39.6%), Crystal River Global Limited (0.8%), Government of the DRC (20%)	Concentrates	600
5	Morenci	United States	Freeport-McMoRan Inc 72%, 28% affiliates of Sumitomo Corporation	Concs & SxEw	570
5	Cerro Verde	Peru	Freeport-McMoRan Copper & Gold Inc. 53.56%, Compañia de Minas Buenaventura 19.58%, Sumitomo 21%	Concs & SxEw	550
7	Buenavista del Cobre (former Cananea)	Mexico	Grupo Mexico	Concs & SxEw	535
8	Antamina	Peru	BHP (33.75%), Teck (22.5%), Glencore plc (33.75%), Mitsubishi Corp. (10%)	Concentrates	450
8	Tenke Fungurume	DRC	China Molybdenum Co., Ltd 56%, affiliate of BHR Partners (Chinese private equity firm) 24%, Gecamines 20%	SxEW	450
10	El Teniente	Chile	Codelco	Concs & SxEw	401
11	Cobre Panama (in C&M)	Panama	First Quantum Minerals Ltd 90%, Korea Panama Mining Corp. (LS-Nikko Copper Inc. and Korean Resources Corporation) 10%	Concentrates	400
11	Las Bambas	Peru	MMG (62.5%), Guoxin International Investment Corporation Limited (22.5%), CITIC Metal Co., Ltd. (15%)	Concentrates	400
11	Los Pelambres	Chile	Antofagasta Plc (60%), Nippon Mining (25%), Mitsubishi Materials (15%)	Concentrates	400
11	Polar Division (Norilsk/Talnakh Mills)	Russia	Norilsk Nickel	Concentrates	400
15	Chuquicamata	Chile	Codelco	Concs & SxEw	370
16	Oyu Tolgoi	Mongolia	66% Rio Tinto, 34% Government of Mongolia	Concentrates	350
17	Quellaveco	Peru	Anglo American 60%, Mitsubishi Corp. 40%	Concentrates	340
18	Spence	Chile	BHP	Concs & SxEw	315
19	Bingham Canyon	United States	Kennecott (Rio Tinto)	Concentrates	310
20	Kamoto	Congo	Katanga Mining Ltd (86.33% Glencore plc) 75%, Gecamines 25%	SxEW	300
20	Quebrada Blanca	Chile	Teck 60%, Sumitomo 30%, Codelco 10%	Concentrates	300
20	Toromocho	Peru	Chinalco	Concentrates	300

Source: ICSG, Bernstein analysis

We think it's prudent to factor in some of incremental supply from leaching technologies as it may extend mines' life-of-mine or improve production yields. Hence, we assume 20% yield improvements from leaching operations from 2029 onward.

Traditional Leaching Revolution?
We start with a simple hypothesis: higher copper prices could make it economical to leach low-grade ores at 30% recovery rate, even without innovations.

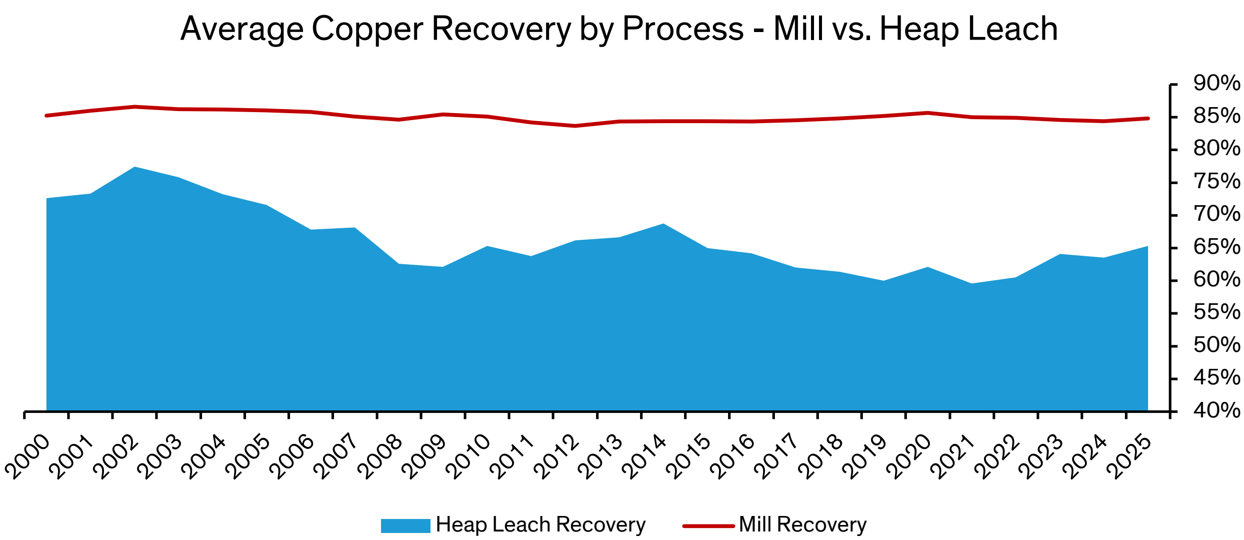
Without innovations - such as applying heat, pressure and proprietary lixiviant - recovery rate for hypogene sulfides leaching can be very low-in some cases as low as 10% at Morenci (Exhibit 102). This is why chalcopyrite leaching without such innovations is almost unheard of.

Because output is directly proportional to recovery, lower recovery directly reduces production. For example, if recovery falls from 60% to 30%, the same fixed operating cost would produce only half as much copper. In other words, halving recovery effectively double unit costs.

Global average recovery rate for copper leaching was about 75% in the early 2000s but has since declined to around 65% (Exhibit 7). Typical leaching operations have C1 cash costs of roughly $5,000/t (Exhibit 8), with about 70% of those costs tied to processing and G&A (Exhibit 9).

If miners consider leaching hypogene sulfide ores already sitting in waste dumps-thus incurring no mining costs-and expect recoveries of only about 30% (i.e., without technological improvements), unit costs could rise to roughly $7,000/t [5,000 × 70% × (60% / 30%)]. At that level, the project would sit near the top of today's cost curve.

EXHIBIT 104: **Average copper recovery in milling process has remained relatively stable at about 85% over the past 25 years. In contrast, average recovery from leaching has declined slightly since the early 2000s and now sits at around 65%.**



Source: WoodMac, Bernstein analysis

Miners would also consider capital charge/capital intensity to build new SxEw facility. Building a new concentrate-leach facility requires relatively modest investment. Hudbay, for example, reported capital costs of $367 million for an 85 ktpa operation (Exhibit 10 and Exhibit 11), implying a capex intensity of roughly $4,400 per annual tonne of copper. This aligns with recent financial data showing fixed capital requirements of $4,948–$6,980 per annual tonne of copper cathode for hydrometallurgical plants with capacities of 3,000–7,000 tpa (Mokmeli, 2020). While this is very low compared to capex intensity to build a new concentrator, consider that the "mine life" of waste stockpile leaching project could be short. Assuming a 5-year mine life, it means there's an additional $880/t capital charge.

Taken together, operating costs plus the capital charge total about $7,880/t-an unattractive level given that average copper prices in 2024 and 2025 were $9,145/t and $9,940/t, respectively. However, this also implies that once copper prices stay above $10,000/t, waste-stockpile (chalcopyrite) leaching project could start to look economically viable. This will add supply and avert the second coming of a copper "supercycle".

EXHIBIT 105: **Hudbay spent $367 mln to build c.85ktpa Cu concentrate leach capacity, which implies $4,400/tpa Cu capex intensity.**

HUDBAY

2023 Copper World - PFS
Form 43-101F1 Technical Report

Thes economics demonstrate the project is robust, providing Hudbay with full flexibility to optimize the Project in the future through funding the addition of the concentrate leach facility with operating cash flows.

Key valuation, production, and cost details from the PFS are summarized in Table 1-10.

TABLE 1-10: SUMMARY OF PROJECT KEY VALUATION METRICS AT $3.75/LB. CU

Summary of Key Metrics (at $3.75/lb Cu)				
Valuation Metrics (Unlevered)[1,2]	**Unit**	**Phase I**		
Net Present Value @ 8% (after-tax)	$ millions	$1,100		
Net Present Value @ 10% (after-tax)	$ millions	$771		
Internal Rate of Return (after-tax)	%	19.2		
Payback Period	# years	5.9		
Project Metrics	**Unit**	**Phase I**		
Growth Capital – Concentrator Process Plant	$ millions	$1,323		
Construction Length – Concentrator Process Plant	# years	2.6		
Growth Capital – Concentrate Leach Facility (Year 4)	$ millions	$367		
Construction Length – Concentrate Leach Facility	# years	1.0		
Operating Metrics	**Unit**	**Year 1-10**	**Year 11-20**	**Phase I**
Copper Production (annual avg.)[3]	000 tonnes	92.3	77.5	**85.3**
EBITDA (annual avg.)[4]	$ millions	$404	$339	**$372**
Sustaining Capital (annual avg.)	$ millions	$33.9	$19.4	**$27.1**
Cash Cost[5]	$/lb. Cu	$1.53	$1.39	**$1.47**
Sustaining Cash Cost[5]	$/lb. Cu	$1.95	$1.62	**$1.81**

Source: Company reports, Bernstein analysis

EXHIBIT 106: **Hudbay's EPCM cost details**

TABLE 21-2: GROWTH CAPITAL EPCM COSTS DETAILS

Metric	Unit	Concentrator Process Plant	Concentrate Leach Facility	Total
Sitewide	$M	$22	$0	$22
Mining	$M	$34	$0	$34
Primary Crushing	$M	$31	$0	$31
Sulfide Plant	$M	$270	$0	$270
Molybdenum Plant	$M	$21	$0	$21
Reagents	$M	$10	$3	$14
Plant Services	$M	$12	$0	$12
Acid Plant	$M	$0	$79	$79
Concentrate Leach SXEW	$M	$0	$28	$28
Precious Metal	$M	$0	$7	$7
Leach Plant (Albion)	$M	$0	$140	$140
Site Services and Utilities	$M	$4	$0	$4
Internal Infrastructure	$M	$52	$0	$52
External Infrastructure	$M	$112	$0	$112
Common Construction	$M	$33	$13	$46
Other	$M	$98	$37	$134
Contingency	$M	$134	$57	$191
Total	**$M**	**$833**	**$364**	**$1,197**

Source: Company reports, Bernstein analysis

COPPER WALL OF SUPPLY

We previously looked across various metals that could contribute future supply and focus on pre-FID assets (Global Metals & Mining: Walls of Supply 2024 edition). Here we compare copper's pipeline to other metals.
We are concerned with potential supply (as opposed to expected supply) and as such we focus on pre-FID assets (Exhibit 107) although we do include some mines in which construction has started to some degree but a final FID is in the future (for example, in the case of iron ore, the Simandou project).

EXHIBIT 107: **We are most concerned with the middle projects...projects well enough defined to matter but not yet guaranteed to arrive...**

ValueChain	Early Exploration	Late Exploration	Early Development	Late Development	Production
Stage	**Early Stage**	**Late Stage**	**Pre-production**	**Pre-production + funded**	**Operating**
sub-stage	*Grassroots*	*Feasibility*	*Construction planned*	*Construction started*	*Satellite*
	Exploration Target Outline	*Reserves development*		*Commissioning*	*Expansion*

Source: SNL, Bernstein analysis

We begin with our summary of conclusions but describe our complete methodology in the first section below (for diamonds).

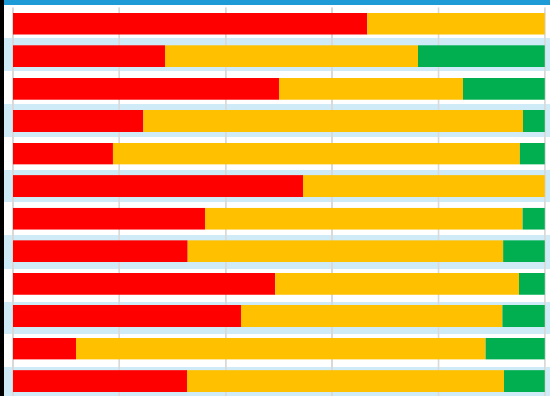
We rank (Exhibit 108) from 'least impactful' ("most scarce") to most impactful ("most abundant") walls of supply.

For each commodity we estimate the number of world-scale large projects that could enter the market and the increase in global supply if all were executed. That comprises our "wall of supply" in terms of quality or scale. We also show the total number of projects in the pipeline (the long tail moving towards trivial scale) and the supply if all the projects currently imagined were executed (a statistical and financial impossibility). Finally, we show how concentrated the supply potential is. A high percentage indicates that watching the mega-projects is most appropriate while a small percentage suggests significant volumes "hiding" among the long tail of projects.

Diamonds and gold rank as having the fewest projects in the pipeline and even if those projects were achieved the least impact to global supply. At the other extreme would be potash and lithium.

EXHIBIT 108: **2026 Commodity walls of supply summary**

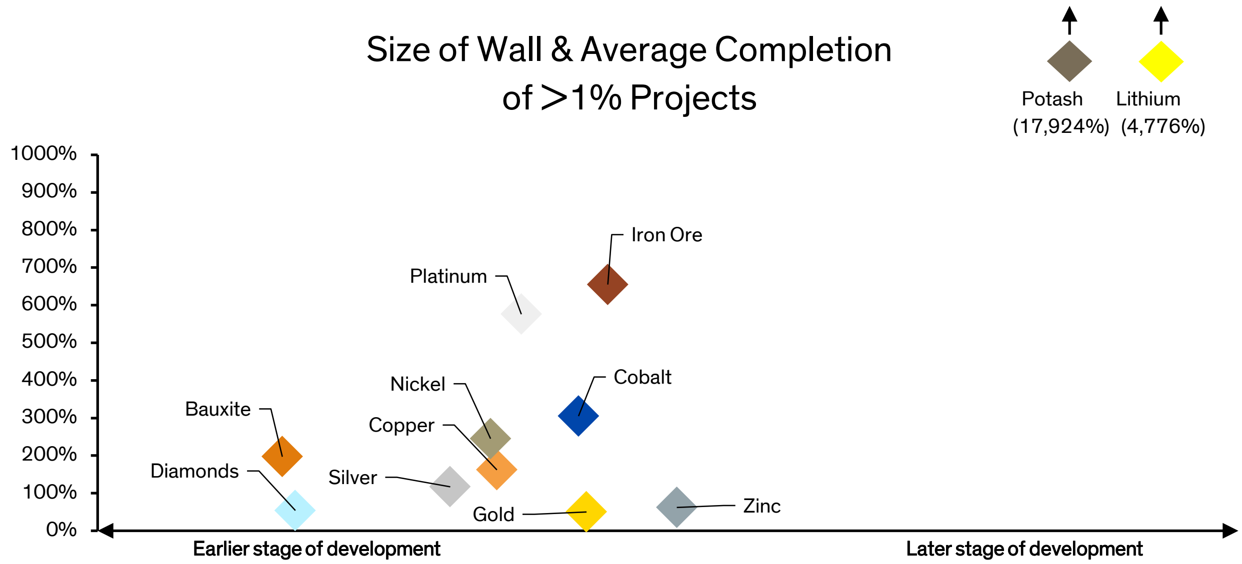
Commodity	# of projects with scale >1% of demand	Increase in global supply if all done	"Traffic light" of likelihood (red="stop" --> green ="go")
Diamonds	15	54%	
Gold	21	50%	
Zinc	26	62%	
Silver	49	117%	
Copper	64	162%	
Bauxite	22	197%	
Nickel	72	245%	
Cobalt	64	305%	
Iron Ore	144	655%	
Platinum	63	576%	
Lithium	135	4776%	
Potash	52	17924%	



Source: S&P Global, USGS, WoodMac, Company reports, Bernstein analysis

The X-axis below shows the average stage of project development (bauxite the most immature and lithium most mature) against the scale of impact (new diamond projects least likely to disrupt while a flood if all lithium projects move forward).

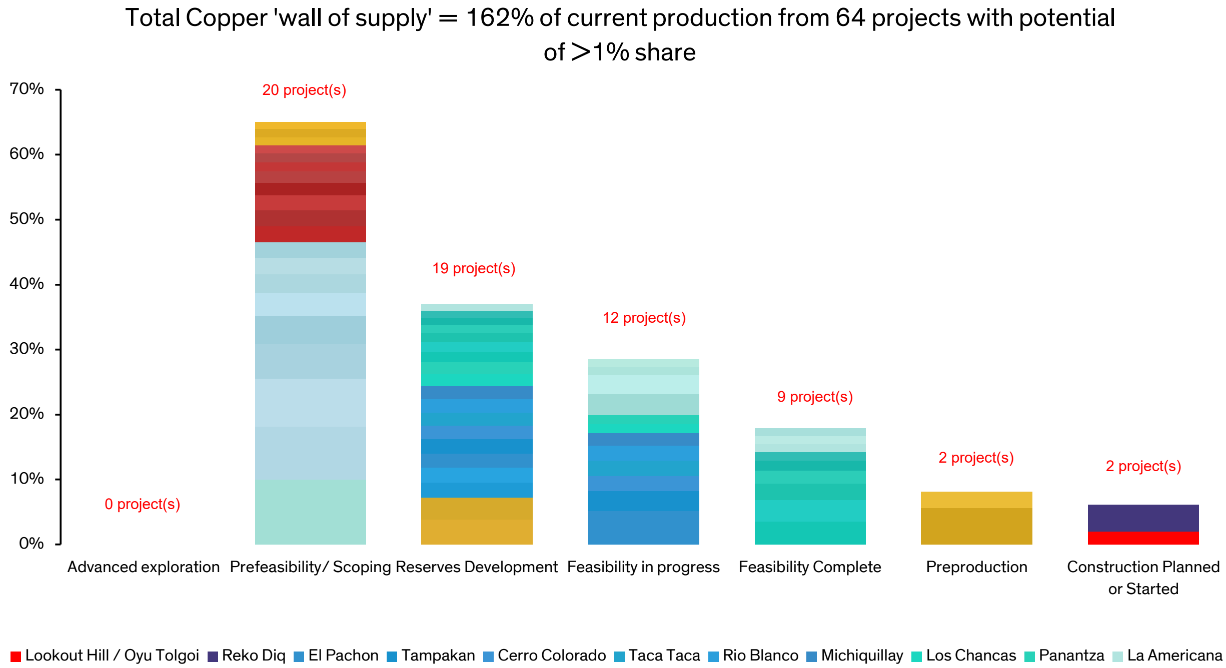
EXHIBIT 109: **We contrast maturity (x-axis) with scale (y-axis) which shows diamonds, copper, and gold are 'scarce and young' and potash and lithium potentially the opposite**



Source: S&P Global; USGS; WoodMac; Company reports; Bernstein analysis

64 projects are of the scale to contribute 1% or more to global copper supply. If all were achieved it would add 162% to current production. The strong majority of projects are pre-feasibility/scoping.

EXHIBIT 110: **Copper wall of supply**



Source: S&P Global, USGS, WoodMac, Company reports, Bernstein analysis

EXHIBIT 111: **Copper projects (1)**

Traffic Light	Property	Owner(s)	Status	Country	Share of current production if 20 year mine life
Yellow	Los Bronces Underground	Anglo American plc, Mitsubishi Corp., Corporación Nacional del Cobre, Mitsui & Co. Ltd.	Los Bronces UG is likely to be developed later as AAL signed MOU with Codelco to develop a joint mine plan for Los Bronces and Andina	Chile	10.0%
Yellow	Filo del Sol	BHP Group, Lundin Mining Corp.	An integrated technical study for the Vicuña Project, including an updated Mineral Resource estimate, was published in Feb 2026.	Argentina	8.1%
Red	Pebble	Northern Dynasty Minerals Ltd.	The Pebble Project remains blocked under EPA's 2023 Clean Water Act veto, and ongoing litigation continues: US DOJ defending EPA veto in federal court and summary judgment reply briefs due April 2026.	USA	7.4%
Yellow	Resolution	Rio Tinto Group, BHP Group	USFS republished the Final EIS and draft Record of Decision in June 2025, but the congressionally mandated land exchange was enjoined by the Ninth Circuit Court of Appeals in August 2025. Oral arguments in the Ninth Circuit Court of Appeals were completed on January 7, 2026, with a decision anticipated in 2026.	USA	5.7%
Yellow	KSM	Seabridge Gold Inc.	The KSM Project has successfully completed a joint harmonized environmental assessment review as outlined by the British Columbia Environmental Assessment Act, the Canadian Environmental Assessment Act and the Nisga'a Final Agreement. Now looking for JV partner(s).	Canada	5.3%
Yellow	El Pachon	Glencore plc	RIGI application submitted in Aug 2025, currently in feasibility stage with environmental permits in 2029, and first production in 2034.	Argentina	5.1%
Yellow	La Granja	First Quantum Minerals Ltd., Rio Tinto Group	Feasibility study completion targeted for 2028. Ongoing drilling, environmental and socio-technical studies.	Peru	4.4%
Green	Reko Diq	Barrick Mining Corp., Government of Balochistan, Pakistan Petroleum Ltd., Oil & Gas Dev. Co., Gvt Hldgs (Pvt) Ltd	ESIA approved, IFC/IDA financiang approved (2025) but Barrick is reviewing budget and timeline due to security incidents, creating uncertainty over prior targets (construction in 2025, production in 2028).	Pakistan	4.2%
Red	Toqui Cluster	Corporación Nacional del Cobre	Reserves Development / Inactive	Chile	3.8%
Red	El Arco	Southern Copper Corp.	42 years in development; power issues; lack of government support	Mexico	3.6%
Yellow	Onto	Vale S.A., PT Aneka Tambang Tbk	Pre-feasibility stage. PT Sumbawa Timur Mining (80% Vale) targets production start in 2030 pending feasibility completion (expected 2028). Won the Thayer Lindsley Award (PDAC 2025) for major discovery significance.	Indonesia	3.5%
Yellow	Junin	Empresa Nacional Minera ENAMI (Ecuador)	Enami now plans an international tender in 2026 for a new partner to develop Junin/Llurimagua (c. US$3bn capex, ~210 ktpa Cu over 27 years).	Ecuador	3.4%
Yellow	NuevaUnion	Teck Resources Ltd., Newmont Corp.	All actions related to the MIA-R (Environmental Impact Assessment) and ETJ (Land Use Change) permits are complete, with a regulatory decision anticipated in the first half of 2026. Engagement with government authorities and stakeholders is ongoing to support the review of both permits.	Chile	3.3%
Yellow	Los Azules	McEwen Inc., Stellantis N.V., Private Interest, Nuton LLC	Feasibility Study completed in Oct 2025	Argentina	3.2%
Yellow	Tampakan	Alcantara Group	The project continues to face legal challenges, community opposition, and delays. A renewed petition questions the constitutionality of the FTAA extensions; hearings continued into March 2026. Meanwhile, Sagittarius Mines seeks a strategic partner, and production is now expected to start in 2028 (delayed from 2026).	Philippines	3.1%
Yellow	Altar	Aldebaran Resources Inc., Sibanye Stillwater Ltd.	Reserves Development. PEA underway; PFS targeted for 2026.	Argentina	2.9%
Yellow	Cascabel	SolGold Plc	SolGold is advancing Cascabel with geotechnical drilling, team build-out, and key permits secured. A revised mine plan targets first copper in 2028, accelerating development with open-pit + underground sequencing.	Ecuador	2.9%
Yellow	Frieda River	PanAust Ltd.	Local landowners and PNG authorities support the project; it is in permitting and feasibility stages, with government backing as of 2025–2026.	Papua New Guinea	2.5%
Yellow	Warintza	Solaris Resources Inc.	Warintza is transitioning from exploration to development, backed by major resource and reserve upgrades. PFS published in Nov 2025; major decision is expected end-2026. Strategic funding package from Royal Gold supports development.	Ecuador	2.5%

Source: S&P Global, USGS, WoodMac, Company reports, Bernstein analysis

EXHIBIT 112: **Copper projects (2)**

Aynak	Metallurgical Corp. of CN Ltd., Jiangxi Copper Co. Ltd.	Taliban government supportive. As of late 2025, Taliban officials and Afghan media report only preparatory works: access roads, site preparation, and planning for power supply to the mine; substantial construction of the mine, concentrator, smelter, rail, and power infrastructure is still not evident on the ground.	Afghanistan	2.5%
Sunrise	Glencore plc, Teck Resources Ltd.	Army Corps revokes key permit in 2023. Teck/Glen is doing a new studies which are designed to meet all permitting requirements. Proposed changes may be subject to supplemental environmental review and permitting, and will include multiple opportunities for public comment and feedback.	USA	2.4%
Vizcachitas	Los Andes Copper Ltd.	Company news (Mar 2026) includes measures to settle debt obligations through share issuance while maintaining focus on approvals and partnerships.	Chile	2.4%
Los Helados	NGEx Minerals Ltd., JX Advanced Metals Corp., Lundin	Lundin acquired 31% interest in Los Helados in March 2026. It's c.17 km to the south from Lundin's Caserones mine, located within the emerging Vicuña District. Possible synergies include scenarios to potentially truck or convey mineralization from Los Helados to Caserones, offsetting lower grade material with higher grade mineralization from Los Helados.	Chile	2.4%
Cerro Colorado		Unlikely given current Cobre Panama concerns. To be clear, this is different from BHP's Cerro Colorado (in C&M now).	Panama	2.4%
Maturi	Antofagasta plc, Beaver Bay JV	Mining leases cancelled by government	USA	2.3%
Taca Taca	First Quantum Minerals Ltd., Unnamed Owner	Feasibility / Active. FM is preparing its presentation to the RIGI. Estimated total investment $5.25 bln.	Argentina	2.3%
Elang	Nusa Tenggara Partnership B.V., PT Bumi Sumberdaya Semesta, PT Pukuafu Indah, Pt Indonesia Masbaga Investama	AMMAN and Indonesian government disclosures indicate Elang production is expected to start after completion of Phase 8 at Batu Hijau around 2030	Indonesia	2.3%
Rio Blanco	Zijin Mining Group Co. Ltd., Tongling Nonferrous Metals Grp	Feasibility / Under Litigation	Peru	2.3%
Baihe	Zijin Mining Group Co. Ltd., Unnamed Owner	Reserves Development / Active, but no recent announcement of construction start, detailed capex, or a firm commissioning date. Possibly 2030+ option.	Peru	2.3%
Oroyek	Rosnedra	Reserves Development / Inactive	Russia	2.2%
Nowa Sol	Lumina Metals Corp.	In April 2025 Poland's Ministry of Climate and Environment approved the geological documentation for Nowa Sól (C1 category), which enables Lumina to start preparing a formal mine development plan.	Poland	2.2%
Valeriano	ATEX Resources Inc.	In November 2025 ATEX filed an updated NI 43-101 technical report and mineral resource estimate for the Valeriano Cu-Au project in Chile's Atacama Region, significantly upgrading resource confidence and size.	Chile	2.1%
Los Bronces Sur	Anglo American plc, Mitsubishi Corp., Corporación Nacional del Cobre, Mitsui & Co. Ltd.	Reserves Development / Active. Los Bronces Sur, in this context, is effectively folded into this integrated Los Bronces/Andina district strategy rather than being advanced as a siloed Codelco project.	Chile	2.1%
West Wall	Glencore plc, Anglo American plc	Reserves Development / Active. However, no disclosure of a construction decision or definitive timetable for West Wall; it remains in the resource/project pipeline rather than development.	Chile	2.0%
Baimskaya	Trianon Ltd.	Transferred from KAZ Minerals due to sanctions. Russia is investing US$13.4B (2025) to fully develop the Baimskaya copper project, including a 70 Mtpa processing plant and 428 km road.	Russia	2.0%
Los Volcanes	Antofagasta plc, Luksic Group	Not specifically named in portfolio projects currently. Last mentioned in 2015 resource report.	Chile	2.0%
Michiquillay	Southern Copper Corp.	In April 2025, SCCO agreed with Peruvian authorities to extend the preoperational period for the Michiquillay Project by 3 years. SCCO expects to continue with hydrological, hydrogeological, and geotechnical studies in 2026 and initiate mineral reserve estimation and mine plan studies. Company is targeting 2032 start.	Peru	2.0%
Lookout Hill / Oyu Tolgoi	Rio Tinto Group, Mongolia, Entrée Resources Ltd.	In June 2025 RIO announced an "alternative mine plan" that pauses development in Panel 1 where the Entrée JV ore sits, and reallocates development to Panel 2 South, which lies outside the Entrée JV area. RIO stated that development in the Entrée JV area is on hold until the Mongolian government processes the transfer of the Shivee Tolgoi/Javhlant licences from Entrée's Mongolian subsidiary to OT LLC.	Mongolia	1.9%
NORI	TMC the metals Co.	ISA has until 2025 to finalize deep sea mining regulations	Nauru	1.9%
Western Foreland	Ivanhoe Mines Ltd., Dem. Rep. Congo, Private Interest	Ivanhoe continues to frame Western Foreland as a district-scale exploration and resource growth story around Kamoa-Kakula, with work focused on Makoko, Kiala and newer discoveries.	Dem. Rep. Congo	1.9%
Oak Dam	BHP Group	BHP reported maiden mineral resource estimate in August 2024. Oak Dam remains in the exploration/evaluation phase as a potential future mine, with no published PFS/FS or FID timing.	Australia	1.8%

Source: S&P Global, USGS, WoodMac, Company reports, Bernstein analysis

EXHIBIT 113: **Copper projects (3)**

TOML	TMC the metals Co.	ISA has until 2025 to finalize deep sea mining regulations	Tonga	1.8%
Paulo Afonso	Vale S.A.	Within Vale's broader Novo Carajás program to expand copper in the Carajás province. Currently at PFS stage.	Brazil	1.7%
Wafi-Golpu	Newmont Corp., Harmony Gold Mining Co. Ltd.	The PNG government aims to increase benefits from extractive projects, which could involve policy changes such as a new production sharing regime, amendments to the Mining Act of 1992, domestic processing requirements, changes in local equity participation, and new taxation regimes. It is subject to potential legal challenges from PNG provincial governments, landowner groups, and civil society organizations, including ongoing judicial reviews concerning the environmental permit granted in December 2020.	Papua New Guinea	1.6%
Limamayo		Reserves Development / Inactive	Peru	1.5%
Los Chancas	Southern Copper Corp.	SCCO continued to implement environmental and social programs in the communities, but the presence of illegal miners within the project area has prevented the project from advancing, and the company continues to take actions with the relevant authorities to regain control of the project area. In 2026, expects to restart the EIA for the Los Chancas project, carry out a 40,000-meter diamond drilling campaign, and conduct hydrogeological and geotechnical studies.	Peru	1.4%
Ann Mason	Hudbay Minerals Inc., Tether Invts S.A. De C.V.	PFS stage, expected to be completed in late 2026. A deeper permitting process will be required following the PFS, indicating that a construction decision is not anticipated until the early 2030s. First production from Mason is expected to follow Copper World and Cactus.	USA	1.4%
Cerro Negro		Reserves Development / Inactive	Chile	1.4%
Namosi	Newmont Corp., Mitsubishi Materials Corp., Nittetsu Mining Co. Ltd.	Fiji government states no mining will proceed until the Mining Act is renewed; SPL 1420 has been on hold since 2023. The project copper resources has been removed from Newmont's resources.	Fiji	1.3%
Panantza	Tongling Nonferrous Metals Grp, China Railway Construction Cor	Feasibility / Inactive. Remains suspended due to social conflict and legal rulings.	Ecuador	1.3%
Canariaco Norte	Fortescue	In October 2024, Alta Copper received approval for its Declaración de Impacto Ambiental drill permit application from the Ministry of Energy and Mines of Peru for 42,400 meters of drilling. A significant risk to the development of Canariaco is the lack of community approval for access agreements with the San Juan Canaris Community, which has prevented drilling since 2013.	Peru	1.3%
Santa Cruz	Ivanhoe Electric Inc.	A June 2025 PFS confirms a high-grade underground copper mine in Arizona with construction targeted for 2026 and first cathode production in 2028. Land acquisition payments completed Nov 2025 cleared the way for early construction.	USA	1.3%
Haquira	First Quantum Minerals Ltd.	The exploration permit for Haquira was amended with the third amendment filed in November 2023 and approved by Peru's Ministry of Energy and Mines in early February 2025, extending the permit's term by seven years to allow for future drilling.	Peru	1.3%
Norte Abierto	Barrick Mining Corp., Newmont Corp.	Drilling ongoing. Total project capital cost, exclusive of capitalized stripping, is expected to be $2 billion based on the approved feasibility study.	Chile	1.3%
MARA	Glencore plc	Glencore anticipates receiving RIGI approval for MARA in the first half of 2026, with El Pachon to follow. The MARA project is currently in the pre-feasibility phase, with environmental permit applications targeted for submission by the end of 2026, leading to FID in 2027.	Argentina	1.2%
Galore Creek	Newmont Corp., Teck Resources Ltd.	The decision to approve and commence construction is contingent on the results of a PFS, which is currently underway, and a feasibility study that has not yet occurred.	Canada	1.2%
Josemaria	BHP Group, Lundin Mining Corp.	An integrated technical study for the Vicuña Project, including an updated Mineral Resource estimate, was published in Feb 2026.	Argentina	1.2%
Copper World	Hudbay Minerals Inc., Mitsubishi Corp.	Copper World is fully permitted (air + aquifer permits) and in final feasibility stage. In 2026, Hudbay launched a US$1.48B acquisition of Arizona Sonoran, integrating the Cactus project to create one of North America's largest copper districts.	USA	1.2%
Aidarly	Kazakhmys	Recent Kazakh government and company commentary point to Aidarly as a strategic project with construction of a 50 Mtpa concentrator targeting start-up around 2026–2028 and full GOK launch by 2027,	Kazakhstan	1.2%
Cactus	Hudbay Minerals, Rio Tinto Group	Hudbay Minerals consolidates Cactus with Copper World, forming one of the largest copper districts in North America. Targeted FID in 2026, early cathode potential by late decade.	USA	1.2%
Malmyzh	Russian Copper Co.	Reserves Development / Active. A 2025 article referencing Russian projects indicated "the first phase of Russia's Malmyzh mine" was expected to start around 2025 with copper capacity of about 150 ktpa, but without confirming that this schedule was actually achieved. Timeline likely has slipped.	Russia	1.1%
Polo Sur	Antofagasta plc	Polo Sur is one of satellite deposits in the Centinela dsitrict. It is being advanced as an alternative within the district for cathode production, with good progress being made.	Chile	1.1%
La Americana	Corporación Nacional del Cobre	Reserves Development / Active, but not mentioned in recent project and budget reporting for 2024–2026 core structural projects	Chile	1.1%
Panguna	Bougainville Copper Ltd.	BCL holds a five-year exploration licence (EL01), granted in 2024, which is the legal basis for progressing pre-feasibility and feasibility work at Panguna.	Papua New Guinea	1.1%

Source: S&P Global, USGS, WoodMac, Company reports, Bernstein analysis

COPPER SUPPLY CALCULATION METHODOLOGY

If we are highly confident that a project is going ahead, we give the project a 100% probability of going ahead.

If we have reason to believe the project will not go ahead, we give the project a 0% probability of going ahead.

If we are not thoroughly convinced either way, we apply a preset probability based on project category

- Highly Probable, Probable* and Possible** category receive a 50%, 15% and 0% probability respectively. The default probabilities assigned to each project category are based on our study of project sanctioning in the past decade. However, you have the flexibility to adjust the category probability as you see fit in our supply/demand model. We also delay the start date of possible projects by 3 years, as they usually run into issues around licensing, financing, or permitting.

To arrive at the total copper supply, we sum the product of the probability and production capacity of all projects. For instance, a 100ktpa mine under the probable category contributes 15ktpa to our total copper supply. This sounds over punishing, but most projects don't make it to production, and those that do are often delayed.

* Probable projects are those that are not considered sufficiently imminent and advanced to include in the highly probable category. Projects generally fall into two categories; those owned by established producers and those owned by aspirant smaller companies. The attributes of the projects owned by the established producers tend to be those of larger scale projects and are often higher quality. Where an aspirant company owns a single project that appears finance-able (i.e. appears technically and economically sufficiently robust) and management is plausible, the project will be included as probable. In most instances projects are at least in the process of having a bankable feasibility study conducted on them, if this has not been completed.
** Possible projects comprise two principal groups. Firstly, projects owned by the established producers that appear low in their project development portfolios, regardless of the perceived quality of the asset. Secondly, projects owned by the aspirant companies that may be at scoping or pre-feasibility stage or show marginal economics at current price levels following completion of bankable feasibility studies. In general projects in this category have greater risks associated with their development that result in longer lead times.

THE TOP COPPER COMPANIES AND RECENT PERFORMANCE

A recent analysis (Global Metals & Mining State of the Business 2H25: Mining engine was humming to end 2025...2026 has started hotter but can it last?) combined 68 companies from both MSCI Global Metals &Mining Producers ETF and MSCI Global Gold Miners ETF. However, we note that the various sectors have significantly different business models and metrics

Exhibit 114 shows the companies considered in the analysis.

EXHIBIT 114: **Summary of companies considered in state of the business**

No.	Bloomberg Ticker	Company	Classification	EV ($ bn)	Market Cap ($ bn)	Revenues ($ bn)	EBITDA ($ bn)	EV/ EBITDA	EBITDA Margin	ROCE	FCF ($ bn)	P/E	Dividend Yield	Total Assets ($ bn)	Current Liabilities ($ bn)
1	BHP AU EQUITY	BHP Group Ltd	Diversified	240	220	54	29	8x	53%	16%	9.9	21x	5%	109	16
2	RIO LN EQUITY	Rio Tinto Ltd	Diversified	199	179	58	22	9x	37%	14%	4.5	17x	4%	128	15
3	SCCO US EQUITY	Southern Copper Corp	Copper	150	148	15	9	17x	61%	31%	4.3	31x	2%	21	2
4	GLEN LN EQUITY	Glencore PLC	Diversified	123	90	248	10	12x	4%	2%	0.4	211x	2%	142	63
5	NEM US Equity	Newmont Corp	Gold	114	117	25	16	7x	63%	22%	9.2	13x	1%	57	6
6	FCX US EQUITY	Freeport-McMoRan Inc	Copper	110	91	26	10	11x	37%	10%	1.8	38x	1%	58	6
7	GMEXICOB MM EQUITY	Grupo Mexico SAB de CV	Copper	94	91	20	11	9x	56%	22%	3.4	17x	3%	42	3
8	AEM CN Equity	Agnico Eagle Mines Ltd	Gold	89	91	14	10	9x	72%	22%	4.5	19x	1%	34	2
9	VALE3 BZ EQUITY	Vale SA	Iron Ore	84	69	39	10	9x	24%	7%	3.4	23x	1%	86	16
10	ABX CN Equity	Barrick Gold Corp	Gold	75	69	19	13	6x	66%	26%	5.4	17x	2%	52	3
11	AAL LN EQUITY	Anglo American PLC	Diversified	75	60	19	4	21x	20%	-9%	1.5		0%	56	7
12	MAADEN AB EQUITY	Saudi Arabian Mining Co	Other	74	66	10	4	18x	39%	12%	1.1	34x		32	4
13	ANTO LN EQUITY	Antofagasta PLC	Copper	57	50	9	5	11x	59%	12%	-0.4	38x	1%	26	2
14	WPM CN Equity	Wheaton Precious Metals Corp	Gold	57	59	3	2	25x	83%	22%	1.0	36x	1%	9	0
15	MT NA EQUITY	ArcelorMittal SA	Steel	58	47	62	7	9x	11%		0.5	16x	1%	98	23
16	3993 HK EQUITY	China Molybdenum Co Ltd	Diversified	57	58	32	6	10x	18%	35%	2.8	15x	1%	29	10
17	NUE US EQUITY	Nucor Corp	Steel	57	52	34	5	12x	14%	12%	0.5	21x	1%	35	4
18	ANG SJ Equity	AngloGold Ashanti Ltd	Gold	48	47	10	5	9x	55%	30%	3.4		5%	15	2
19	FMG AU EQUITY	Fortescue Metals Group Ltd	Iron Ore	51	50	16	9	6x	52%	15%	4.0	13x	8%	31	3
20	5401 JP EQUITY	Nippon Steel Corp	Steel	51	19	67	5	11x	7%	1%	-1.0	171x	4%	92	19
21	JSTL IN EQUITY	JSW Steel Ltd	Steel	39	33	21	3	12x	16%	21%	0.3	14x	1%	29	7
22	GFI SJ Equity	Gold Fields Ltd	Gold	38	36	9	6	6x	69%	37%	3.1	10x	4%	15	2
23	005490 KS EQUITY	POSCO	Steel	40	25	49	4	9x	9%	2%	-1.2	43x	2%	73	16
24	TTST LI EQUITY	Tata Steel Ltd	Steel	37	28	26	3	12x	11%	4%	0.0		2%	33	10
25	STLD US EQUITY	Steel Dynamics Inc	Steel	37	33	19	2	16x	12%	11%	0.7	25x	1%	16	2
26	K CN Equity	Kinross Gold Corp	Gold	33	34	8	5	6x	65%	30%	3.0	13x	1%	12	1
27	TECK/B CN EQUITY	Teck Resources Ltd	Diversified	30	30	9	4	8x	42%	5%	0.0	28x	1%	33	3
28	HNDL IN EQUITY	Hindalco Industries Ltd	Aluminium	31	25	28	4	8x	13%	14%	0.1	15x	0%	31	8
29	358 HK EQUITY	Jiangxi Copper Co Ltd	Copper	30	21	81	2	15x	2%	15%	-1.2	14x	2%	31	16
30	1772 HK EQUITY	Ganfeng Lithium Co Ltd	Lithium	28	23	4	1	38	0	15%	-0.3	35x	0%	16	5
31	FM CN EQUITY	First Quantum Minerals Ltd	Copper	27	21	5	2	16x	31%	-3%	1.2			25	3
32	LUN CN EQUITY	Lundin Mining Corp	Copper	26	24	4	2	11x	57%		0.9	20x	0%	11	1
33	NHY NO EQUITY	Norsk Hydro ASA	Aluminium	25	22	20	2	11x	11%	7%	0.6	33x	3%	21	5
34	5713 JP EQUITY	Sumitomo Metal Mining Co Ltd	Diversified	24	19	12	2	15x	14%	10%	0.1	16x	2%	22	5
35	VAL SJ EQUITY	Anglo American Platinum Ltd	Platinum	21	22	7	2	12x	26%	18%	0.8	22x	2%	10	3
36	010130 KS EQUITY	Korea Zinc Co Ltd	Other	21	20	13	1	19x	8%	10%	-1.1	28x	0%	14	4
37	KGH PW EQUITY	KGHM Polska Miedz SA	Copper	20	18	11	3	7x	25%	23%	-0.3	10x	0%	16	3
38	RS US EQUITY	Reliance Steel & Aluminum Co	Steel	20	18	15	1	14x	10%	14%	0.6	23x	1%	10	1
39	PMAH MK EQUITY	Press Metal Aluminium Holdings	Aluminium	19	19	4	1	25x	21%	23%	0.4	35x	1%	5	1
40	9696 HK EQUITY	Tianqi Lithium	Lithium	19	17	2	1	29	0	18%	-0.2	36x		10	1
41	5411 JP EQUITY	JFE Holdings Inc	Steel	18	7	30	2	8x	7%	3%	0.4	15x	5%	37	9
42	BOL SS EQUITY	Boliden AB	Diversified	17	16	11	3	6x	25%	12%	-0.6	13x	2%	16	3
43	AA US EQUITY	Alcoa Corp	Aluminium	16	16	13	1	12x	10%		0.0	16x	1%	16	4
44	2002 TT EQUITY	China Steel Corp	Steel	17	9	10	1	20x	8%		0.7		1%	21	4
45	VEDL IN EQUITY	Vedanta Ltd	Diversified	17	13	9	3	5x	37%	31%	1.3	15x	3%	25	15
46	EDV CN Equity	Endeavour Mining Corp	Gold	15	15	5	3	6x	55%	26%	1.4	16x	2%	6	1
47	IMP SJ EQUITY	Impala Platinum Holdings Ltd	Platinum	13	13	6	1	10x	21%	9%	0.5	27x	3%	8	1
48	PLS AU EQUITY	Pilbara Minerals	Lithium	14	14	1	0	92x	24%		-0.1			3	0
49	S32 AU EQUITY	South32 Ltd	Aluminium	14	14	5	1	15x	17%	4%	0.4	36x	3%	14	2
50	CLF US EQUITY	Cleveland-Cliffs Inc	Steel	14	6	19	0	-405x	0%		-1.0			20	3
51	MIN AU EQUITY	Mineral Resources Ltd	Diversified	13	9	3	2	8x	47%	12%	-0.1	32x		8	1
52	IVN CN EQUITY	Ivanhoe Mines Ltd	Copper	12	12	1	0	79x	30%	5%	-0.5	112x		8	1
53	LYC AU EQUITY	Lynas Rare Earths Ltd	Other	12	13	0	0	95x	28%	3%	-0.1	213x		2	0
54	VOE AV EQUITY	Voestalpine AG	Steel	11	9	17	2	7x	10%	4%	0.9	34x	1%	17	6
55	SSW SJ Equity	Sibanye Stillwater Ltd	Gold	10	9	7	2	5x	30%		0.1	21x	3%	9	2
56	GGBR4 BZ EQUITY	Gerdau SA	Steel	11	9	13	1	7x	11%	5%	0.5	29x	3%	15	2
57	BSL AU EQUITY	BlueScope Steel Ltd	Steel	10	9	11	1	12x	8%	4%	0.2	46x	3%	10	2
58	NPH SJ EQUITY	Northam Platinum Ltd	Platinum	8	8	2	1	15x	24%	21%	0.2	18x	3%	3	0
59	004020 KS EQUITY	Hyundai Steel Co	Steel	8	4	16	1	6x	9%		0.4	864x	1%	24	5
60	SSABB SS EQUITY	SSAB AB	Steel	8	9	10	1	7x	11%		-0.3	16x	2%	12	3
61	5711 JP EQUITY	Mitsubishi Materials Corp	Diversified	8	4	12	1	11x	6%	9%	-0.1	17x	2%	19	12
62	SSRM CN Equity	SSR Mining Inc	Gold	7	7	2	1	12x	30%	8%	0.2	13x		6	1
63	BTO CN Equity	B2Gold Corp	Gold	7	7	4	3	3x	68%	16%	0.3	13x	2%	6	1
64	EREGL TI EQUITY	Eregli Demir ve Celik Fabrikal	Steel	7	6	5	1	13x	10%	1%	1.0	584x	1%	13	3
65	KIO SJ EQUITY	Kumba Iron Ore Ltd	Iron Ore	6	6	4	2	3x	46%	25%	1.0	7x	10%	6	1
66	ACX SM EQUITY	Acerinox SA	Steel	6	4	7	0	14x	6%		-0.1		4%	7	2
67	IGO AU EQUITY	IGO Ltd	Diversified	4	5	0	0	686x	2%		0.0			2	0
68	BRAP4 BZ EQUITY	Bradespar SA	Diversified	2	2	0					0.1	11x	1%	1	0

Source: Bloomberg, Company reports, Bernstein analysis

DEFINITIONS

Before proceeding, we introduce definitions of the terms discussed through the report.

Reported Group Revenues are the product of a company's production for the period times the realized price of their product.

Opex are the operating expenses which includes all the cash costs incurred in the production process of metals, petroleum products and production taxes along with the exploration expenses and selling, general and administrative costs which includes overhead expenses along with employee compensation costs.

EBITDA stands for Earnings Before Interest, Tax and Depreciation and Amortization. It's calculated as group reported revenues less opex.

D&A is Depreciation and amortization as reported by the companies.

Impairment losses / other items are non-cash charges to reflect the decline in the value of an asset below historical cost including other non-recurring items or one-offs and is derived as the difference between EBITDA, D&A and EBIT.

EBIT is EBITDA less the D&A and Impairment losses / other items.

Net Interest is the interest payments on debt borrowed net of interest received.

Others are the non-operating items derived from balancing out the difference between EBIT, Net Interest from EBT.

EBT/PBT is the company reported earnings before tax and extraordinary items which comprises of minorities and discontinued operations.

Taxes are tax expenses reported by the companies.

Underlying Net Income is the amount of profit the company made after paying all its expenses.

Net Operating Cash flows is the cash generated by the operating activities of the business.

Capex / Organic Capex is the capital expenditure incurred on exploration and development assets which includes both maintenance as well growth capital expenditure.

Enterprise Value is the sum of market capitalization, preferred equity, minority interest, total debt less cash and equivalents.

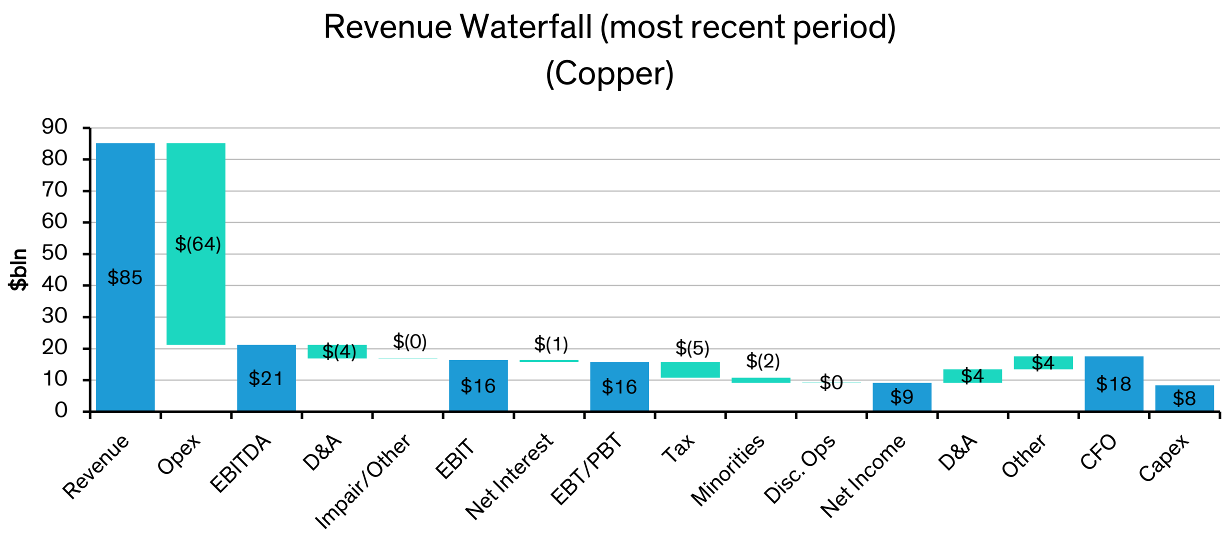
Dividend Yield is the sum of net dividend per share that have gone ex-dividend over the prior 12 months, divided by the current stock price.

FCF Yield is calculated as trailing 12-month free cash flow per share divided by last price.

Capital Employed is Total Assets less Current Liabilities.

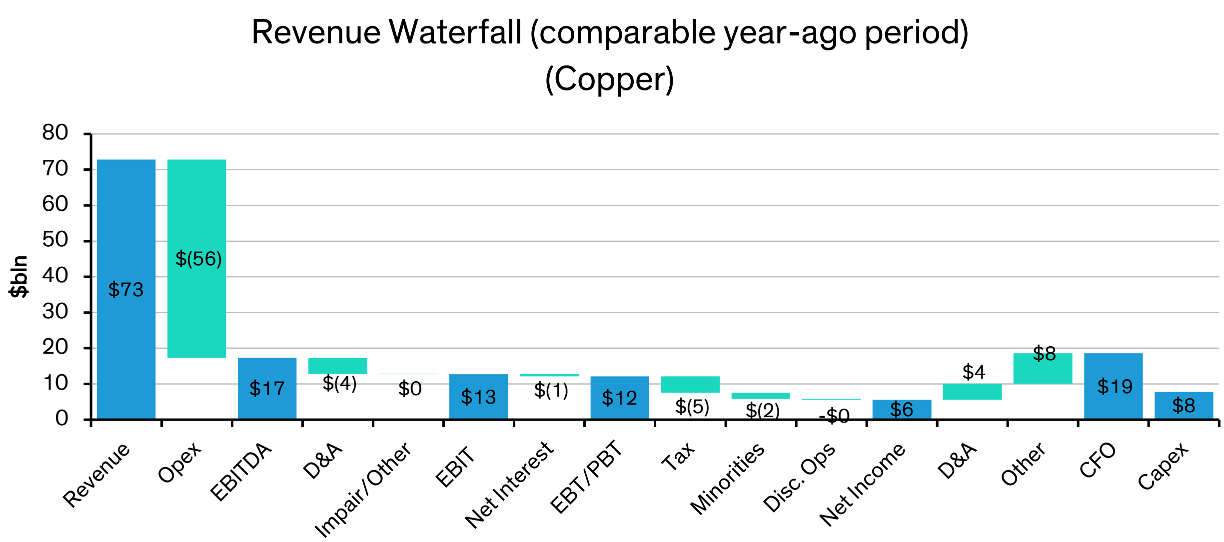
ROCE is EBIT divided by Capital Employed

EXHIBIT 115: **Copper**



Source: Bloomberg, Company reports, Bernstein analysis and estimates

EXHIBIT 116: **Copper**



Source: Bloomberg, Company reports, Bernstein analysis and estimates

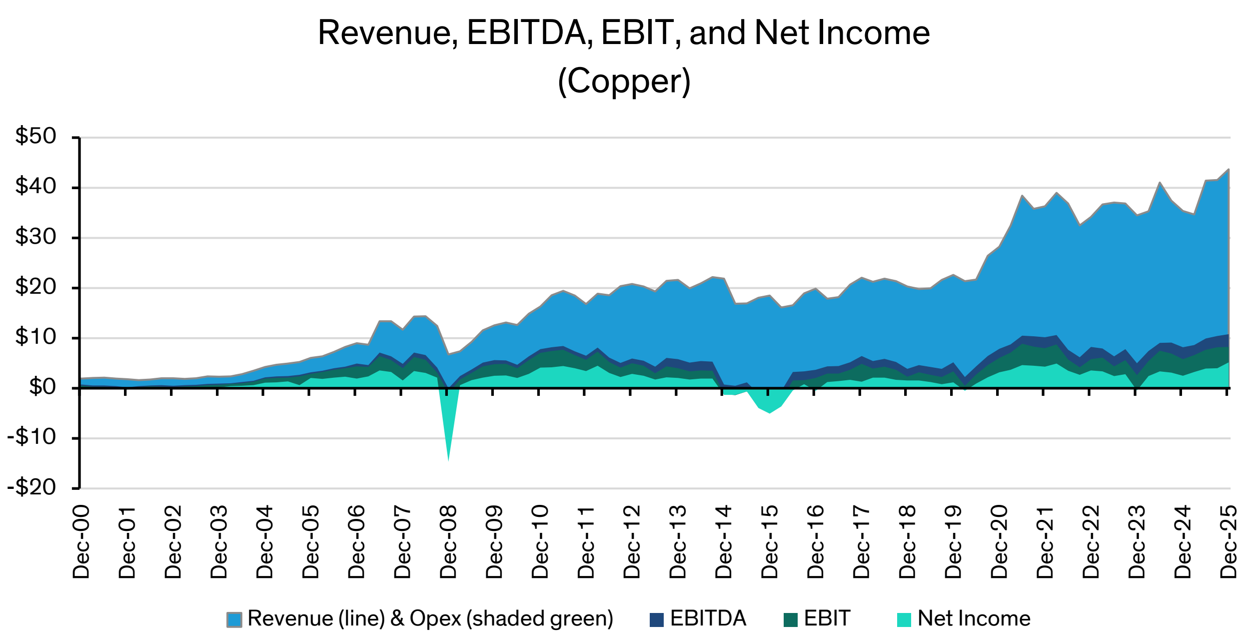
EXHIBIT 117: **Copper**

Consolidated Copper Producers Cash Flow Waterfall ($bln) [current period]

	Current Period		Year Ago Period		Change (y-o-y)
Revenues	$	85.2	$	72.8	*17%*
Opex	$	(64.0)	$	(55.5)	*15%*
EBITDA	$	21.2	$	17.3	*23%*
EBITDA Margin		*24.89%*		*23.76%*	
DA	$	(4.3)	$	(4.5)	
Impairment losses/other items	$	(0.1)	$	0.0	
EBIT	$	16.4	$	12.7	*29%*
EBIT Margin		*19%*		*17%*	
Net Interest	$	(0.6)	$	(0.6)	
EBT/PBT	$	15.8	$	12.1	
Tax	$	(5.0)	$	(4.6)	
Minorities	$	(1.6)	$	(1.7)	
Discontinued operations	$	0.1	$	(0.2)	
Underlying Net Income	$	9.2	$	5.6	*63%*
EV ($bn)	$	454.5	$	276.6	*64%*
EV/EBITDA		11.4x		8.2x	*3.2x*
EV/EBIT		14.8x		10.8x	*4.0x*
Dividend Yield (%)		1%		2%	*(53) bp*
FCF Yield (%)		0%		0%	*(45) bp*
Capital Employed	$	188.3	$	168.0	*12%*
ROCE		11%		10%	*128 bp*

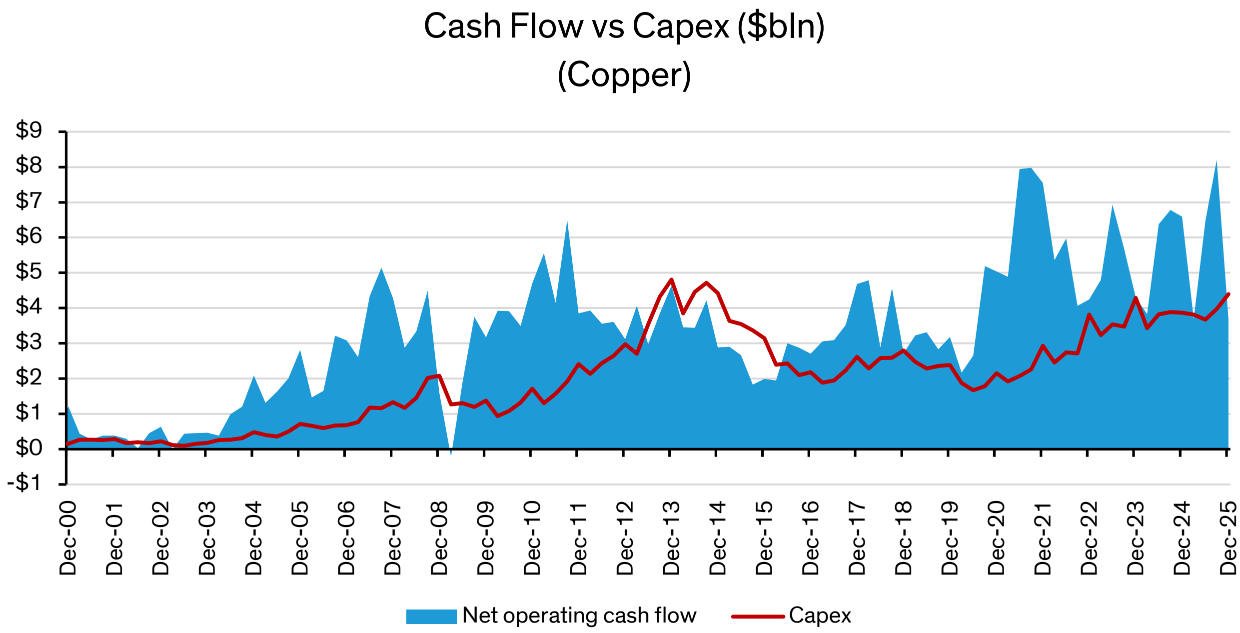
Source: Bloomberg, Company reports, Bernstein analysis and estimates

EXHIBIT 118: **Copper**



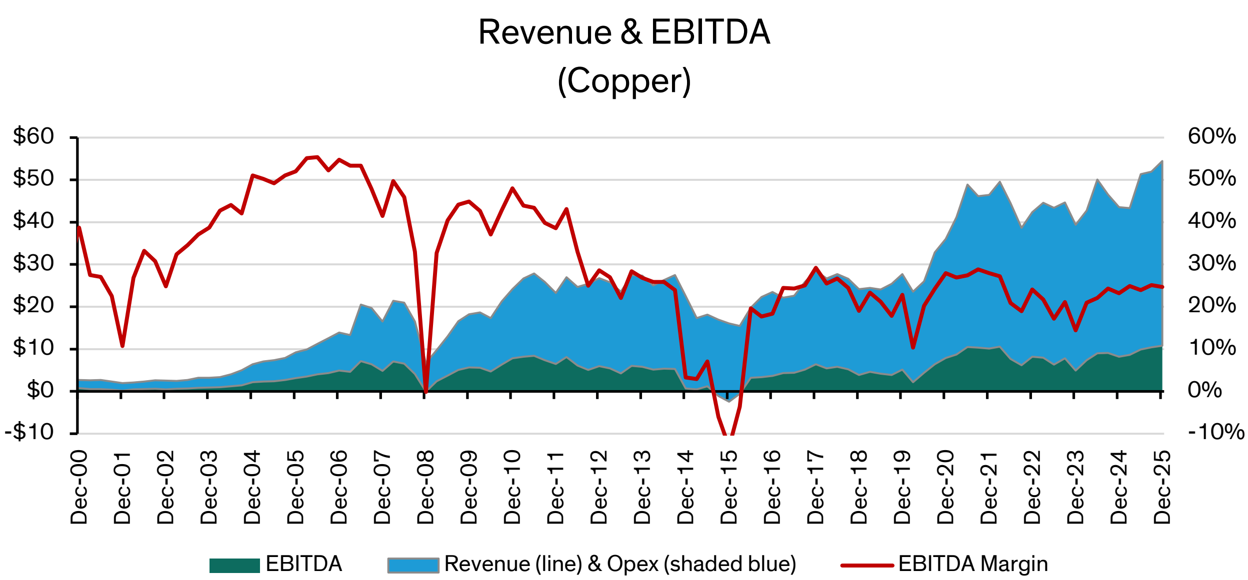
Source: Bloomberg, Company reports, Bernstein analysis and estimates

EXHIBIT 119: **Copper**



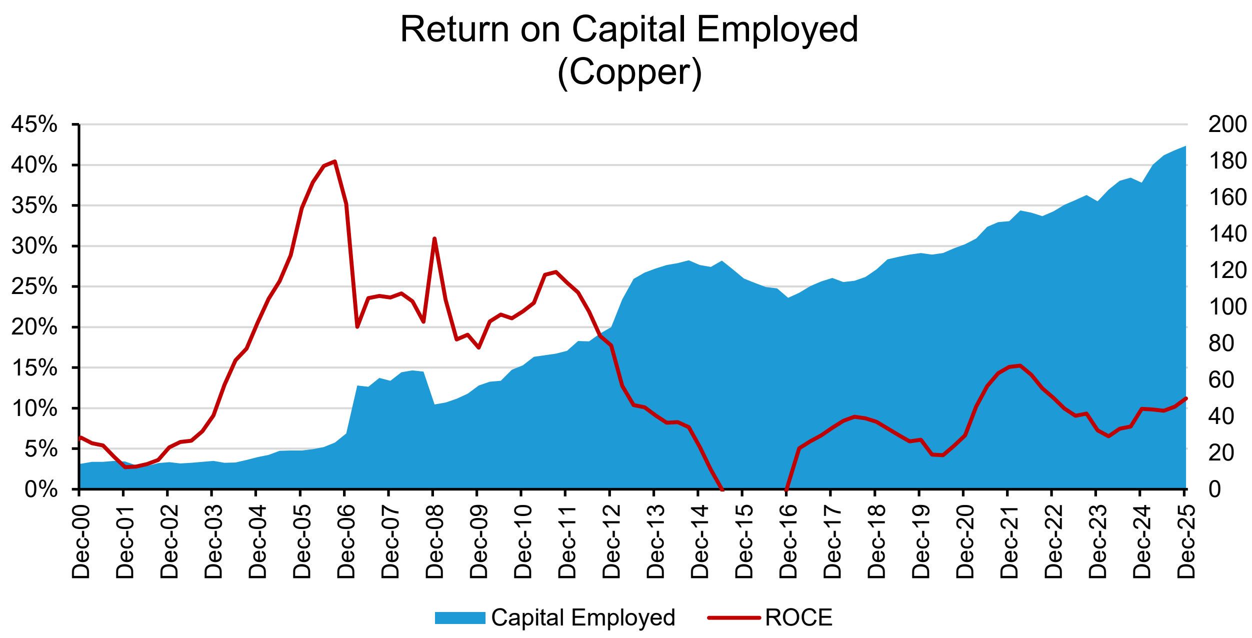
Source: Bloomberg, Company reports, Bernstein analysis and estimates

EXHIBIT 120: **Copper**



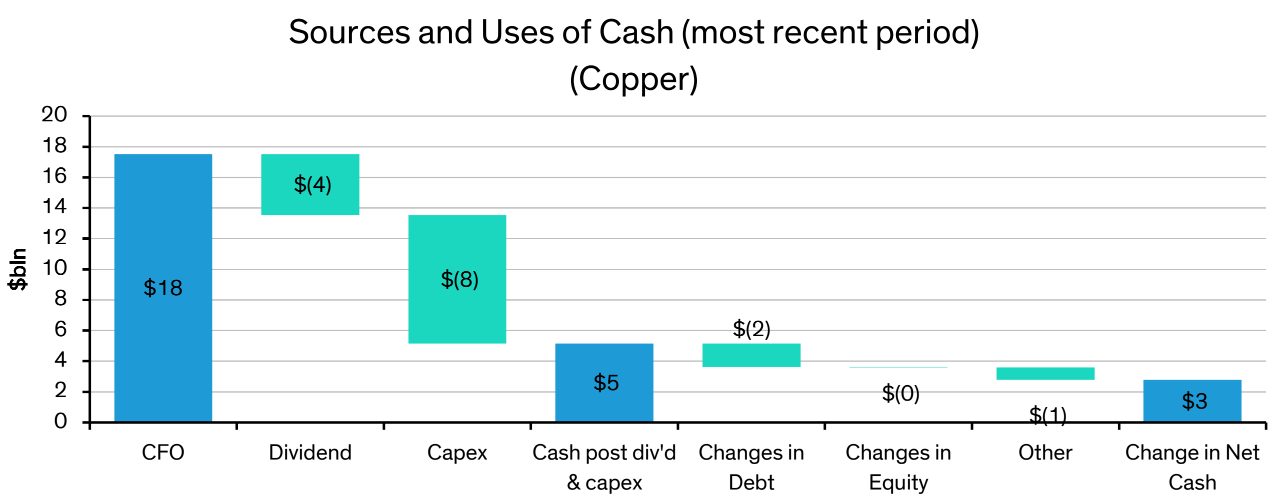
Source: Bloomberg, Company reports, Bernstein analysis and estimates

EXHIBIT 121: **Copper**



Source: Bloomberg, Company reports, Bernstein analysis and estimates

EXHIBIT 122: **Copper**



Source: Bloomberg, Company reports, Bernstein analysis and estimates

APPENDIX - FINANCIAL FORECASTS

ANTOFAGASTA

EXHIBIT 123: Antofagasta - Valuation and TP basis

Antofagasta plc

NPV (as at Dec-27)	USDm	GBP/sh
Los Pelambres	7,696	5.85
Centinela	11,517	8.76
Antucoya	910	0.69
Zaldívar - attr.	269	0.20
Twin Metals	0	0.00
Buenaventura - attr.	1,581	1.20
Railway and transport	415	0.32
Corporate costs and other	-1,487	-1.13
Attr. net debt / (cash)	863	0.66
Equity Value	**20,038**	**15.24**
NPV multiple	1.0	1.0
NPV valuation	**20,038**	**15.24**

EBITDA (12m to Dec-27)	USDm	share	GBP/sh
Los Pelambres	3,131	60%	2.38
Centinela	2,235	70%	1.70
Antucoya	324	70%	0.25
Zaldívar - attr.	99	50%	0.08
Railway and transport	91	100%	0.07
Buenaventura - attr.	294	19%	0.22
Corporate / Exploration	-110	100%	-0.08
EBITDA	**6,063**		**4.61**
EV at 8.0x	**48,505**		**36.88**
Non-controlling interest	5,529		4.20
Attr. net debt / (cash)	863		0.66
Equity Value	**42,113**		**32.02**
Price Target	**36,594**		**28.00**
Dividend	808		0.61
Upside / (downside)			-28.1%

Note: Priced as of 8th June 2026

Source: Company reports, Bloomberg, Bernstein analysis and estimates

EXHIBIT 124: Antofagasta Summary

Antofagasta

		2025A	2026E	2027E	2028E	2029E
Financials						
Revenues	**USDm**	**8,620**	**9,427**	**9,362**	**10,487**	**11,046**
EBITDA (incl JVs)	**USDm**	**5,202**	**6,059**	**5,769**	**6,537**	**6,830**
Depreciation	USDm	-1,695	-1,660	-1,842	-2,111	-2,200
Operating profit	**USDm**	**3,374**	**4,218**	**3,781**	**4,248**	**4,473**
Equity acc. profit / (loss)	USDm	53	142	136	128	84
Net interest / FX	USDm	-267	23	-21	-90	-190
PBT	**USDm**	**3,160**	**4,384**	**3,897**	**4,286**	**4,368**
Tax	USDm	-1,088	-1,633	-1,483	-1,600	-1,649
Underlying profit	**USDm**	2,017	2,751	2,414	2,685	2,719
Underlying EPS	**USD/sh**	1.29	1.75	1.51	1.68	1.67
DPS	USD/sh	0.65	0.87	0.75	0.84	0.83
Sustaining Capex	USDm	-2,004	-1,720	-1,811	-1,487	-1,324
Expansionary Capex	USDm	-1,680	-1,615	-620	-318	-326
Capex	**USDm**	**-3,685**	**-3,335**	**-2,431**	**-1,805**	**-1,651**
PP&E	USDm	16,653	18,327	18,916	18,610	18,060
Non-current assets	**USDm**	**19,271**	**21,088**	**21,813**	**21,635**	**21,170**
Cash and equivalents	USDm	2,717	2,912	3,370	4,547	5,752
Current assets	**USDm**	**7,147**	**7,343**	**7,800**	**8,977**	**10,183**
Total assets	**USDm**	**26,418**	**28,431**	**29,612**	**30,612**	**31,352**
Retained earnings	USDm	10,085	11,026	11,704	12,597	13,401
Total equity	**USDm**	**14,430**	**16,205**	**17,518**	**18,984**	**20,358**
Long term debt	USDm	7,158	7,396	7,265	6,798	6,165
Non-current liabilities	**USDm**	**9,525**	**9,762**	**9,631**	**9,165**	**8,531**
Short term debt	USDm	501	501	501	501	501
Current liabilities	USDm	2,463	2,463	2,463	2,463	2,463
Equity and liabilities	**USDm**	**26,418**	**28,431**	**29,613**	**30,612**	**31,353**
Net debt / (cash)	**USDm**	**2,750**	**2,791**	**2,203**	**559**	**-1,280**
ND:EBITDA	x	**0.3**	**0.3**	**0.2**	**0.0**	**-0.1**
Attr. net debt / (cash)	**USDm**	**3,397**	**2,730**	**2,152**	**-143**	**-3,046**
Free cash flow	USDm	-508	584	1,246	2,368	2,740
CFO before int / tax	USDm	4,253	5,878	5,624	6,359	6,673
Net CFO	**USDm**	**3,072**	**3,935**	**3,824**	**4,451**	**4,739**
CFI	**USDm**	**-3,450**	**-3,001**	**-2,135**	**-1,588**	**-1,555**
CFF	**USDm**	**913**	**-739**	**-1,232**	**-1,686**	**-1,978**
Inc/(dec) in cash	USDm	534	196	457	1,177	1,206

		2025A	2026E	2027E	2028E	2029E
Commodity and FX assumptions						
Copper	USD/t	9,947	12,281	11,000	10,600	10,700
Moly	USD/t	48,733	51,290	41,888	40,053	33,069
Gold	USD/oz	3,440	4,818	5,200	5,500	5,800
Production and operational overview						
Copper production	**kt**	**654**	**669**	**702**	**790**	**829**
Los Pelambres	kt	295	339	357	352	351
Centinela Cathodes	kt	66	55	68	67	67
Centinela Concentrates	kt	174	153	167	262	304
Antucoya	kt	81	87	76	76	76
Zaldivar (attr.)	kt	37	35	33	33	31
Copper sales	**kt**	**666**	**662**	**701**	**789**	**828**
Gold sales	**koz**	**212**	**210**	**226**	**283**	**308**
Los Pelambres	koz	53	61	61	60	60
Centinela	koz	159	150	165	223	248
Moly sales	**kt**	**15.3**	**13.6**	**13.8**	**15.1**	**16.1**
Gross cash costs	USD/lb	2.38	2.44	2.41	2.35	2.36
Net cash costs	USD/lb	1.19	1.12	1.18	0.99	0.96
Market valuation						
EV/EBITDA - consolidated	x	9.7	8.3	8.7	7.7	7.4
P/NPV	x	3.4	3.1	2.8	2.6	2.5
Dividend yield	%	1.2%	1.6%	1.4%	1.6%	1.6%
FCF yield	%	-1.0%	1.0%	2.1%	4.0%	4.6%
ROIC	%	9.5%	10.6%	9.0%	9.8%	9.9%

Valuation - PT based on 25% 1.0x NPV and 75% 8.0x EV/EBITDA

NPV (as at Dec-27)	GBP/sh	EBITDA (12m to Dec-27)	GBP/sh
Los Pelambres	5.85	Los Pelambres	2.38
Centinela	8.76	Centinela	1.70
Antucoya	0.69	Antucoya	0.25
Zaldívar - attr.	0.20	Zaldívar - attr.	0.08
Railway and transport	0.32	Corporate / Exploration	-0.08
Attr. net debt / (cash)	0.66	EBITDA	4.61
Equity Value	15.24	EV at 8.0x	36.88
NPV multiple	1.00	Attr. net debt / (cash)	0.66
NPV valuation	15.24	Equity Value	32.02
		Price Target (GBP/sh)	**28.00**

Note: Priced as of 8th June 2026

Source: Company reports, Bloomberg, Bernstein analysis and estimates

FREEPORT

EXHIBIT 125: **Target price determination**

Freeport-McMoRan Inc.		
EBITDA (12m to Dec-27)	**USDm**	**15,181**
EV at 7.0x	**USDm**	**106,267**
+ Cash & Equivalents	USDm	8,352
- Non-Controlling Interest	USDm	16,245
- Total Debt/Obligations	USDm	15,364
Equity Value	**USDm**	**83,010**
Shares outstanding - diluted	mn	1,421
Price Target	**$/sh**	**58.50**
Current Price	$/sh	62.42
Upside / (downside)	%	-6%
Expected Dividend (12m to Dec-27)	$/sh	0.60
Expected dividend yield	%	1.0%

Note: Priced as of 8th June 2026

Source: Bloomberg, Bernstein analysis

EXHIBIT 126: **Freeport financial summary**

Freeport-McMoRan Inc.

		2025A	2026E	2027E	2028E
Financials					
Revenues	**USDm**	**25,915**	**28,983**	**32,005**	**33,227**
EBITDA	**USDm**	**9,942**	**12,882**	**15,181**	**15,689**
D&A	USDm	2,244	2,250	2,466	2,595
Operating profit	**USDm**	**6,518**	**9,961**	**12,515**	**12,894**
Net interest	USDm	-369	-474	-480	-480
PBT	**USDm**	**6,372**	**8,604**	**12,035**	**12,414**
Tax	USDm	-2,221	-3,052	-4,092	-4,469
Underlying profit	USDm	2,204	3,020	4,008	3,558
Diluted EPS	**USD/sh**	**1.53**	**2.10**	**2.81**	**2.52**
DPS	USD/sh	0.60	0.60	0.60	0.60
Sustaining Capex	USDm	1,594	1,316	1,518	1,647
Expansionary Capex	USDm	2,900	3,000	2,980	2,900
Capex	**USDm**	**4,494**	**4,316**	**4,498**	**4,547**
PP&E	USDm	40,736	42,707	44,739	46,691
Non-current assets	**USDm**	**44,377**	**46,354**	**48,386**	**50,338**
Cash and equivalents	USDm	4,054	5,050	8,352	10,692
Current assets	**USDm**	**13,790**	**15,389**	**18,694**	**22,094**
Total assets	**USDm**	**58,167**	**61,743**	**67,080**	**72,432**
Retained earnings	USDm	1,385	4,248	7,409	10,129
Total equity	**USDm**	**30,766**	**34,400**	**39,719**	**45,054**
Long term debt	USDm	8,913	8,914	8,914	8,914
Non-current liabilities	**USDm**	**21,382**	**21,437**	**21,457**	**21,477**
Short term debt	USDm	466	500	500	500
Current liabilities	USDm	6,019	5,906	5,904	5,902
Equity and liabilities	**USDm**	**58,167**	**61,743**	**67,080**	**72,432**
Net (debt) / cash	**USDm**	**5,325**	**4,364**	**1,062**	**-1,278**
ND:EBITDA	x	**0.5x**	**0.3x**	**0.1x**	**-0.1x**
Free cash flow	USDm	1,116	3,546	5,940	4,964
Net CFO	**USDm**	**5,610**	**7,862**	**10,438**	**9,511**
CFI	**USDm**	**-4,472**	**-4,328**	**-4,498**	**-4,547**
CFF	**USDm**	**-1,876**	**-2,525**	**-2,638**	**-2,624**
Inc/(dec) in cash	USDm	-738	1,009	3,302	2,340

		2025A	2026E	2027E	2028E
Commodity and FX assumptions					
Copper	USD/t	9,921	12,281	11,000	10,600
Moly	USD/lb	22.52	23.27	19.00	18.17
Gold	USD/oz	3,444	4,818	5,200	5,500
Production and operational overview					
Copper sales	**mlb**	**3,574**	**3,138**	**3,794**	**4,119**
Gold sales	koz	1,066	656	1,050	1,300
Moly sales	mlb	83	90	90	95
Unit Net Cash Costs	**$/lb Cu**	**1.65**	**1.97**	**1.30**	**0.91**
Site Production & Delivery	$/lb Cu	2.75	3.16	2.73	2.57
By-product Credits	$/lb Cu	-1.42	-1.48	-1.72	-1.98
Treatment Charges	$/lb Cu	0.13	0.18	0.17	0.19
Royalties & Export Duties	$/lb Cu	0.19	0.10	0.12	0.14
SG&A	$/lb Cu	0.15	0.17	0.13	0.13
Exploration and research	$/lb Cu	0.05	0.05	0.04	0.04
Environmental obligations	$/lb Cu	0.02	0.03	0.03	0.03
Market valuation					
EV/EBITDA	x	9.3x	8.4x	7.1x	6.9x
Dividend yield	%	1.2%	1.0%	1.0%	1.0%
FCF yield	%	1.2%	3.3%	5.5%	4.6%
ROIC	%	9.6%	14.3%	15.7%	14.3%
Valuation - PT based on 7.0x EV/EBITDA					
EBITDA (12m to Dec-27)	**USDm**	**15,181**			
EV at 7.0x	**USDm**	**106,267**			
+ Cash & Equivalents	USDm	8,352			
- Total Debt/Obligations	USDm	15,364			
Equity Value	**USDm**	**83,010**			
Shares outstanding - diluted	mn	1,421			
Price Target	**$/sh**	**58.50**			

Note: Priced as of 8th June 2026

Source: Company reports, Bernstein analysis and estimates

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