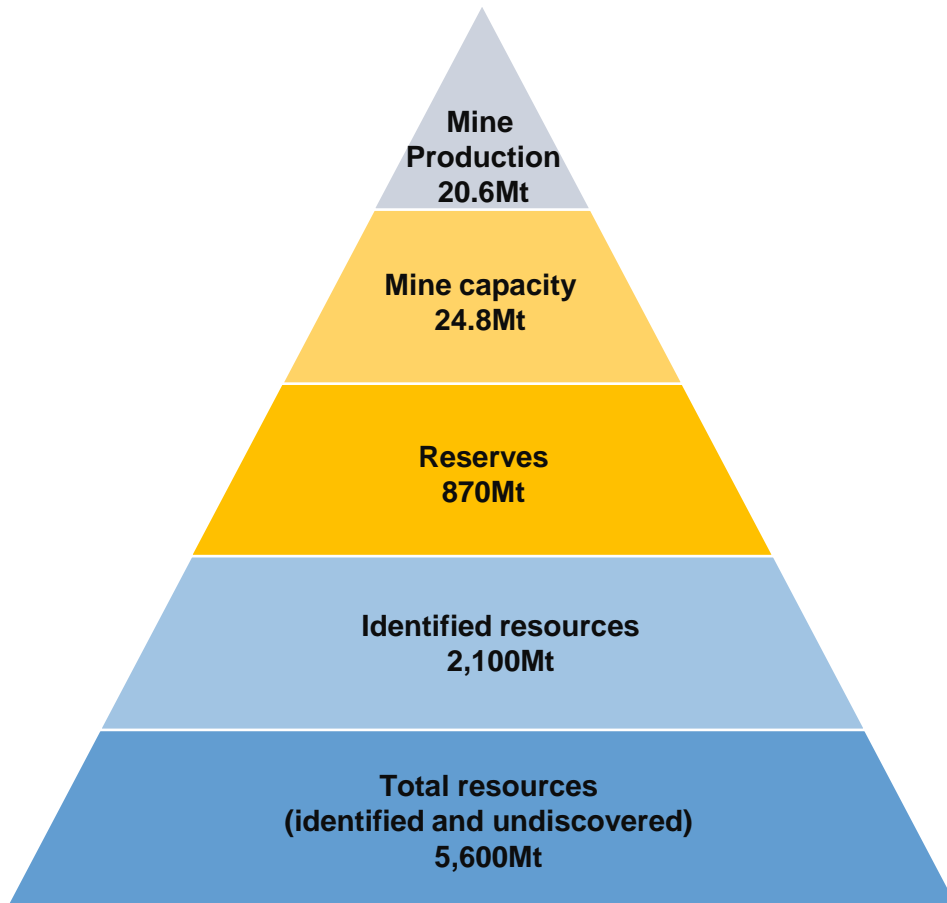




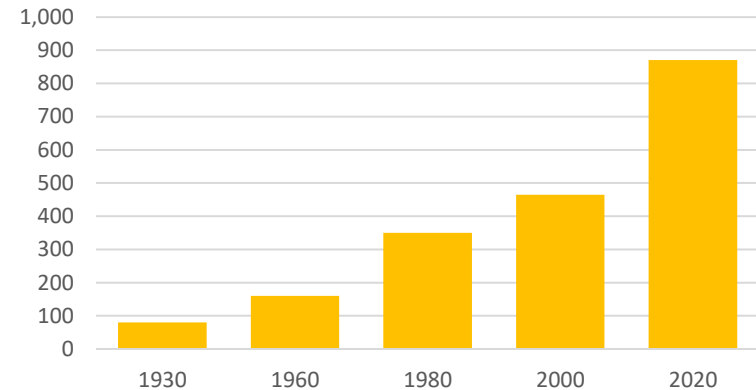
Global Copper Market: “A Long-Term Play”

Global copper reserves have consistently stay at 38 years-level since 1960, it is highly improbable that copper supply will run out

World Copper Reserves & Mine Production, 2020, mln tons (Mt)



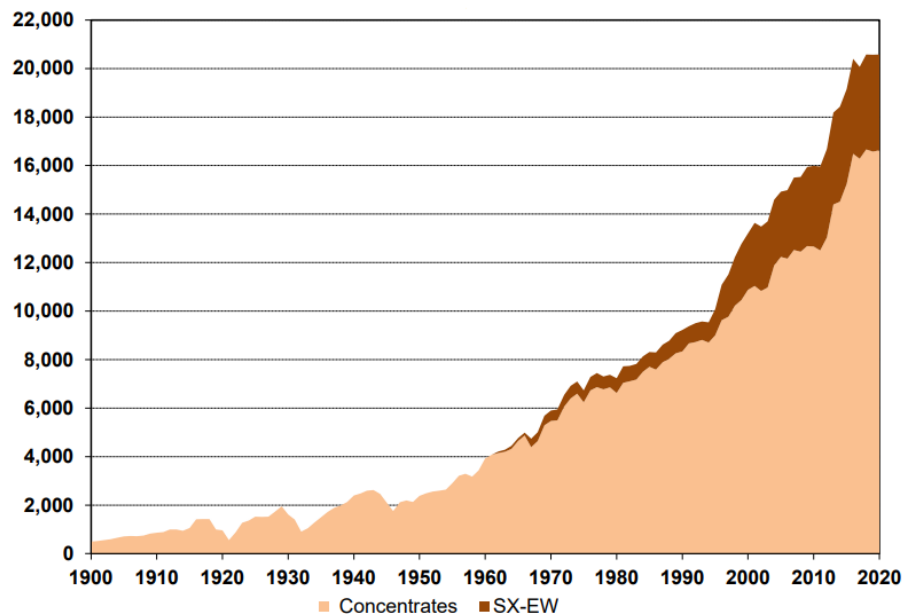
USGS Reported World Copper Reserves, mln tons



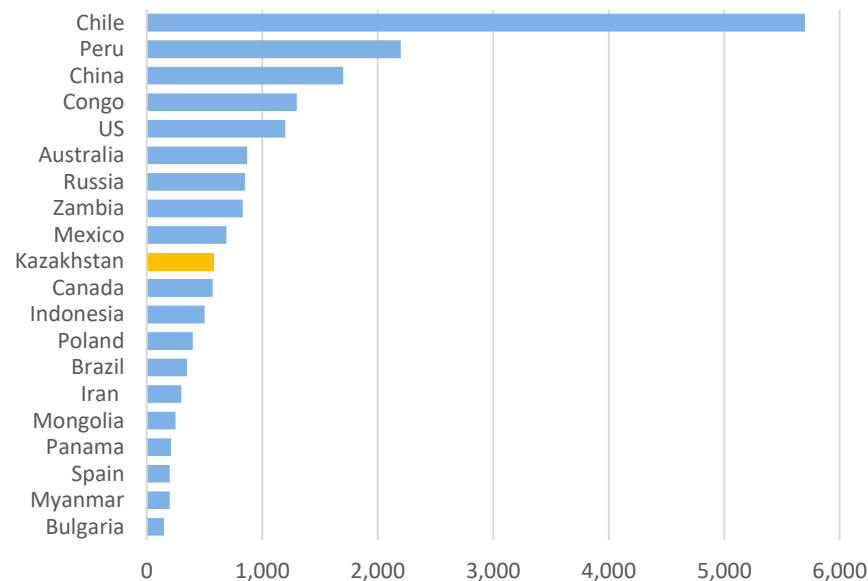
- ✓ It is highly improbable that copper supply will run out. Since 1960, there has always been **38 years of global copper reserves on average**.
- ✓ During 2010-2020, 207Mt of copper have been mined. Concurrently, **reserves have grown by 240Mt to 870Mt** copper in the same period.
- ✓ **Identified and undiscovered copper resources are estimated at around 2,100Mt and 3,500Mt, respectively.**
- ✓ **Copper is one of the few raw materials which can be recycled repeatedly without any loss of performance.** Recycling, innovation and mining exploration continue to contribute to the long-term availability of copper.

Global copper mine production grew by 3.2% p.a. since 1900, with Chile, Peru and China being the largest copper producers

Global Copper Mine Production, '000 tons



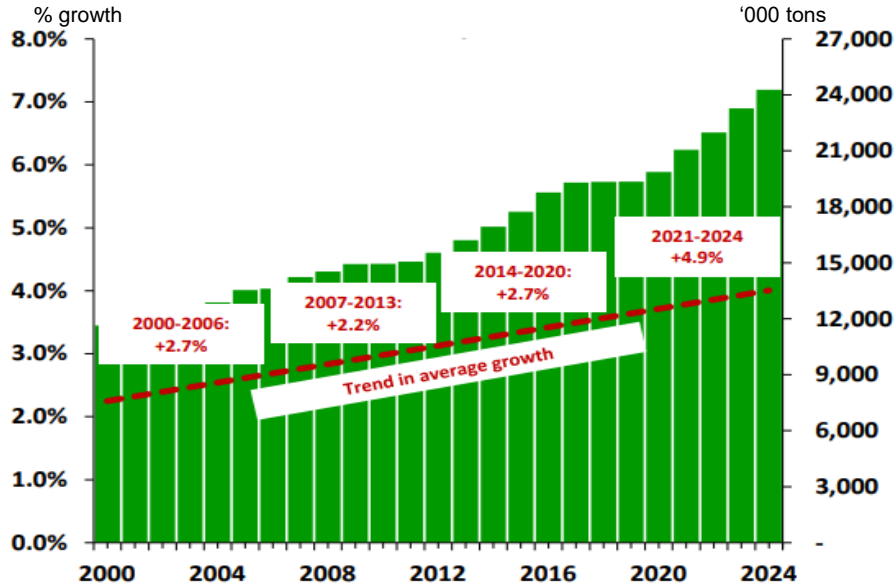
Global Copper Mine Production by Top 20 Countries, '000 tons



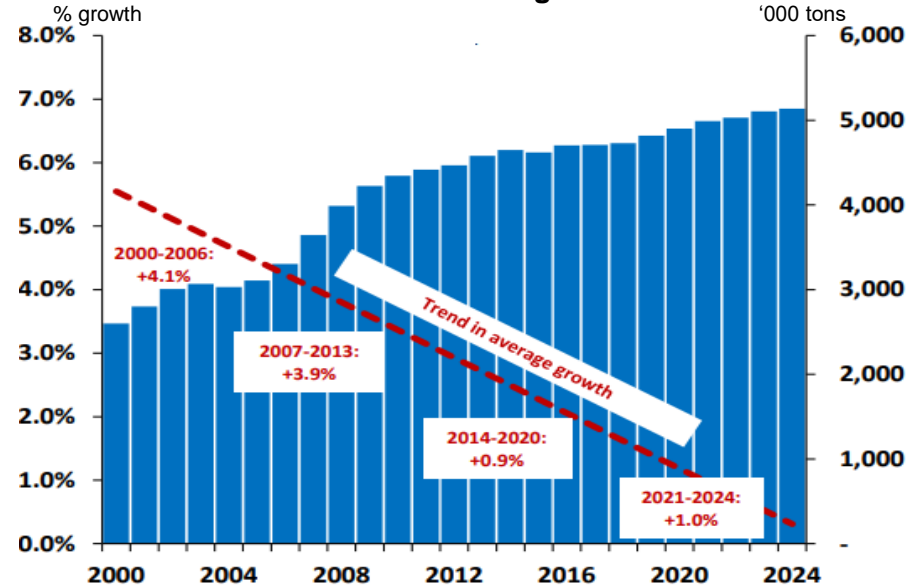
- ✓ **Since 1900, global copper mine production has grown by 3.2% per annum to 20.6Mt in 2020.** Solvent extraction and electrowinning (SX-EW) production which was non-existent before the 1960s, stood at 3.9Mt or 18.9% of total mine production in 2020.
- ✓ From <750,000 tons copper in 1960, copper mine production in Latin America has increased to 8.5Mt in 2020, representing 41% of the global copper mine production. Asia has also registered strong growth, the region's share of global production increased from a 6% to 16% over the same period. In contrast, North America's share of global production declined from 36% to 12%.
- ✓ **Chile contributed to almost one-third of the world copper mine production** in 2020 producing 5.7Mt copper. This was followed by **Peru 10%, China 8.3%, Congo 6.3% and US 5.8%**. Kazakhstan is the world's 10th largest copper mine producer.

Global copper mining capacity is expected to grow at 4.9% per year to reach 29.4Mt by 2024

Copper Mining Capacity, Concentrates



Copper Mining Capacity, Solvent-Extracting & Electrowinning



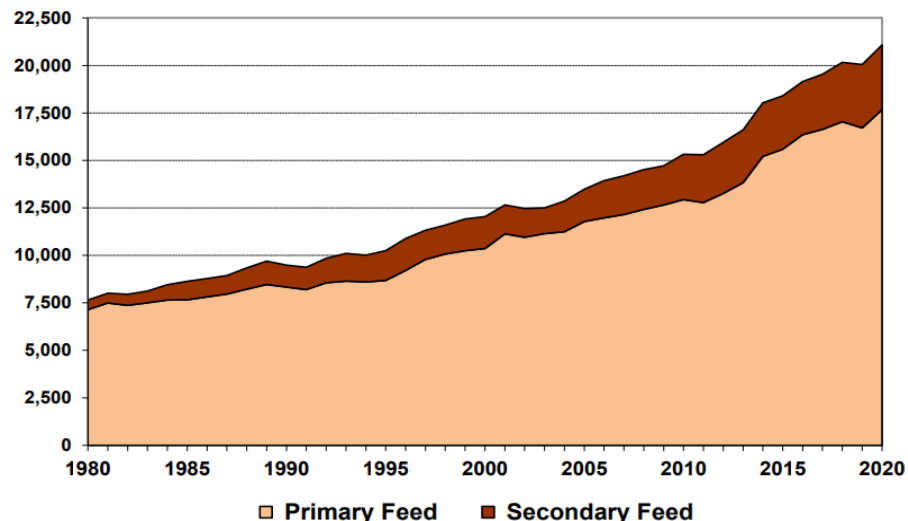
- ✓ The ICSG projects that **global copper mining capacity to reach 29.4Mt by 2024**, with 17% being SX-EW production. This compared to global capacity of 24.8Mt copper recorded in 2020.
- ✓ **Growth in copper mine capacity is expected to average 4.9% per year** going forward as new capacity is added at existing and some new operations.
- ✓ The global mine capacity utilization rate was at ~83% in 2020.

Top 20 Copper Mines by Capacity (2021), '000 tonnes copper

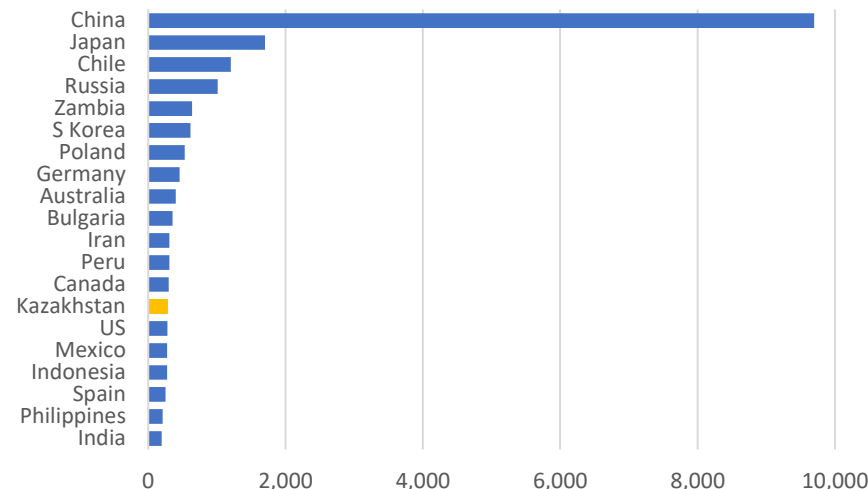
Rank	Mine	Country	Owner (s)	Source	Capacity
1	Escondida	Chile	BHP Billiton 57.5%, Rio Tinto Corp 30%, Japan Escondida 12.5%	Concs & SX-EW	1,510
2	Grasberg	Indonesia	PT Freeport Indonesia (PT Inalum & provincial/regional govt 51.2%, Freeport-McMoRan Inc 48.8%	Concs	700
3	Collahuasi	Chile	Anglo American 44%, Glencore plc 44%, Mitsui 8.4%, JX Holdings 3.6%	Concs & SX-EW	610
4	Buenavista del Cobre	Mexico	Grupo Mexico	Concs & SX-EW	525
5	Morenci	US	Freeport-McMoRan Inc 72%, affiliates of Sumitomo Corp 28%	Concs & SX-EW	520
6	Cerro Verde II (Sulphide)	Peru	Freeport-McMoRan Copper & Gold Inc 54%, Compania de Minas Buenaventura 19.58%, Sumitomo 21%	Concentrates	500
7	Polar Division (Norilsk/Talnakh Mills)	Russia	Norilsk Nickel	Concentrates	450
7	Antamina	Peru	BHP Billiton 33.75%, Teck 22.5%, Glencore Plc 33.75%, Mitsubishi Corp 10%	Concentrates	450
7	Las Bambas	Peru	MMG 62.5%, Guoxin International Investment Corp Ltd 22.5%, CITIC Metal Co Ltd 15%	Concentrates	400
10	El Teniente	Chile	Codelco	Concs & SX-EW	399
11	Los Pelambres	Chile	Antofagasta Plc 60%, Nippon Mining 25%, Mitsubishi Materials 15%	Concentrates	370
12	Chuquibambilla	Chile	Codelco	Concs & SX-EW	360
13	Cobre Panama	Panama	First Quantum Minerals Ltd 90%, Korea Panama Mining Corp (LS-Nikko Copper Inc and Korean Resources) 10%	Concentrate	350
14	Kansanshi	Zambia	First Quantum Minerals 80%, ZCCM 20%	Concs & SX-EW	340
14	Los Bronces	Chile	Anglo American 50.1%, Mitsubishi Corp 20.4%, Codelco 20%, Mitsui 9.5%	Concs & SX-EW	340
14	Radomiro Tomic	Chile	Codelco	Concs & SX-EW	340
17	Kamoto	Congo	Katanga Mining Ltd 75%, Gecamines 25%	SX-EW	300
17	Sentinel	Zambia	First Quantum Minerals Ltd	Concentrates	300
17	Toromocho	Peru	Chinalco	Concentrates	300
20	Bingham Canyon	US	Kennecott	Concentrates	280

Asia's share of global copper smelter production surged to 64% in 2020, driven by rapid expansion smelter production in China

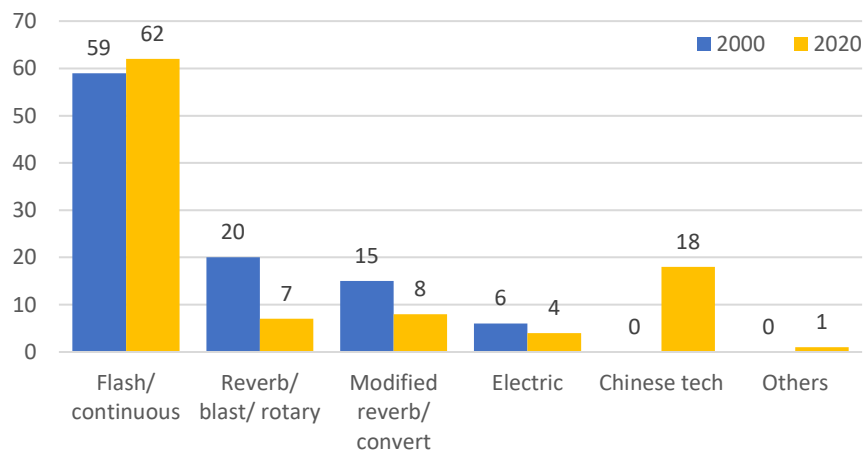
Global Copper Smelter Production, '000 tons



Copper Smelter Production by Top 20 Countries, '000 tons



Global Copper Smelter Capacity by Technology Type, %



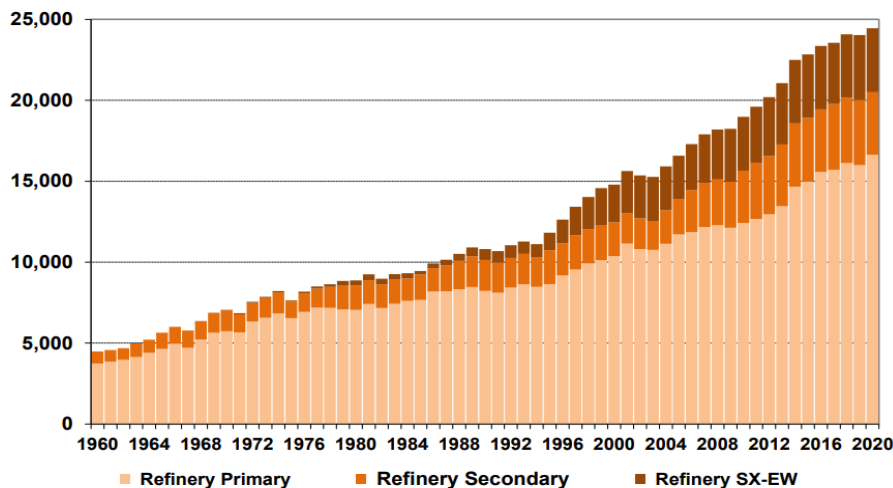
- ✓ Global copper smelter production stood at 21.2Mt in 2020. Asia's share of global copper smelter output surged to 64% in 2020 vs. 27% in 1990, driven by rapid expansion of smelter production in China.
- ✓ China accounted for close to 50% of global copper smelter production, followed by Japan 8%, Chile 6% and Russia 5%.
- ✓ The use of Flash/Continuous technology accounted for 65% of global copper smelting capacity in 2020 (2000: 59%). There has also been a rapid expansion of Chinese technology at 18% of global copper smelting capacity in 2020.

Top 20 copper smelters capacity (2021), '000 tonnes copper

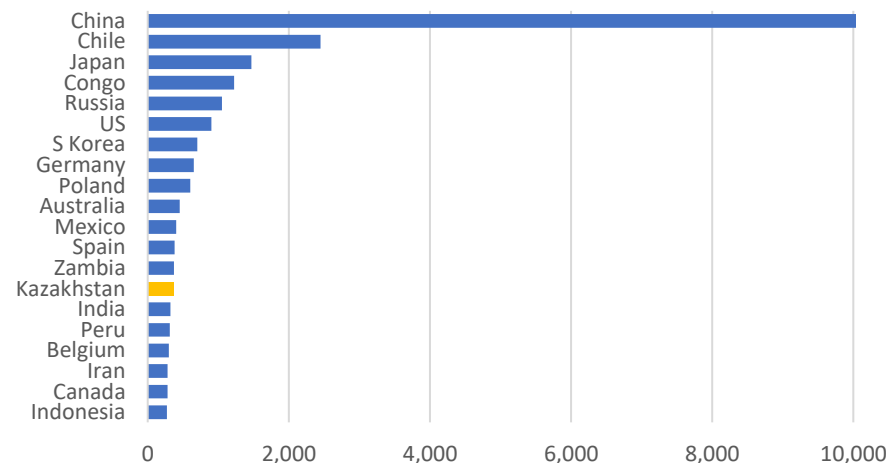
Rank	Smelter	Country	Operator/ Owner (s)	Process	Capacity
1	Guixi (smelter)	China	Jiangxi Copper Corp	Outokumpu Flash	600
2	Birla Copper (Dahej)	India	Birla Group (Hidalco)	Outokumpu Flash, Ausmelt, Mitsubishi Continuous	500
3	Chuquicamata (smelter)	Chile	Codelco	Outokumpu/ Teniente Converter	450
3	Jinchuan (Fangchenggang smelter)	China	Jinchuan Non-Ferrous Metal Co	Flash smelter	450
3	Hamburg	Germany	Aurubis	Outokumpu, Contimelt, Electric	450
3	Besshi/ Ehime (Toyo)	Japan	Sumitomo Metal Mining Co Ltd	Outokumpu Flash	450
3	Saganoseki/ Ooita (smelter)	Japan	JX Nippon Mining & Metals Co Ltd	Outokumpu Flash	450
8	El Teniente (Caletones)	Chile	Codelco	Reverberatory/ Teniente Conv.	400
8	Chifeng	China	Chifeng Jinfeng (Yunnan Copper 45%, Tasheng 45%, Jinfeng Copper 10%)	Side-Blown	400
8	Chinalco Southeast Copper	China	Chinalco	Flash Smelter	400
8	Jinguan (smelter)	China	Tongling Non-Ferrous Metals Group	Flash Smelter	400
8	Xiangguang copper (smelter)	China	Yanggu Xiangguang Copper Co	Outokumpu Flash	400
8	Sterlite Smelter (Tuticorin)	India	Vedanta	Isasmelt PProcess	400
8	Norilsk (Nikeley, Medny)	Russia	Norilsk Nickle	Reverb, Electric, Vanyukov	400
15	Pirdop (smelter)	Bulgaria	Aurubis (99.77%)	Outokumpu Flash	360
15	Ilo Smelter	Peru	Southern Copper Corp (Grupo Mexico 88.9%, international investment community 11.1%)	Isasmelt Process	360
17	Onahama/ Fukushima	Japan	Mitsubishi Materials Corp 55.715%, Dowa Metals & Mining Co 31.621%, Furukawa Metals & Resources Co Ltd (12.665%)	Mitsubishi/ Reverb.	354
18	Heding Copper	China	Jiangxi Copper (Zhejiang Jiangtong Fuye Heding Copper Co Ltd)	Side-Blown	350
18	Jinlong (Tongdu)	China	Tongling Nonferrous Metals Corp 57.4%, Sumitomo 35%, Pingguo Aluminium Co	Flash Smelter	350
18	Sarchesme Copper Complex (smelter)	Iran	National Iranian Copper Industry Co	Flash Smelter	350

Global refined copper production was at 24.5Mt in 2020, China accounted for 41% of global production

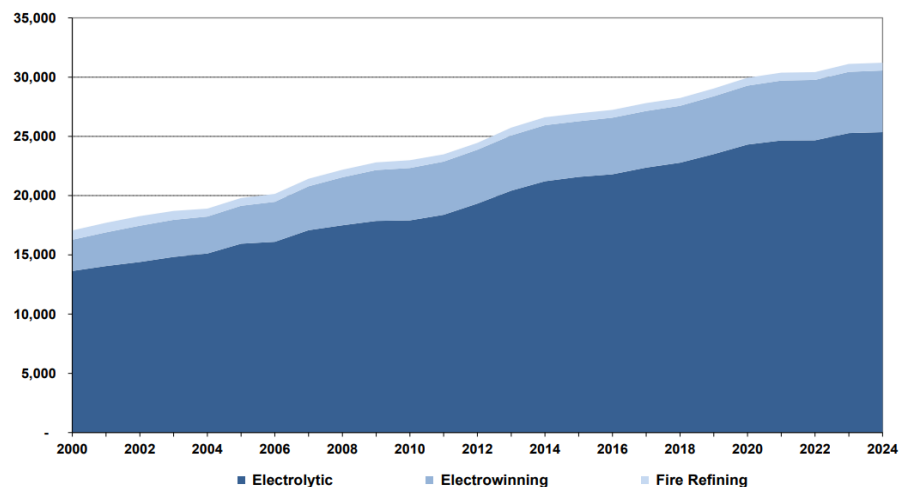
Global Refined Copper Production, '000 tons



Refined Copper Production by Top 20 Countries, '000 tons



Global Refined Copper Capacity, '000 tons



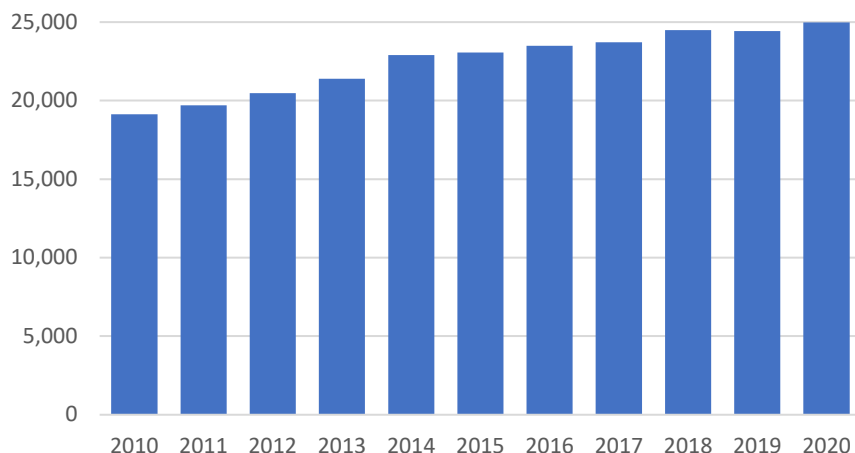
- ✓ Global refined copper production amounted to 24.5Mt in 2020.
- ✓ Refined copper produced from leaching ores rose to 16% of world refined copper production vs. <1% in 1960s, driven by the emergence of SX-EW technology.
- ✓ Global refinery capacity utilization rate was at ~82% in 2020.
- ✓ China contributed to 41% of global refined copper production, followed by Chile 10%, Japan 6%, Congo 5% and Russia 5%.

Top 20 copper refineries capacity (2021), '000 tonnes copper

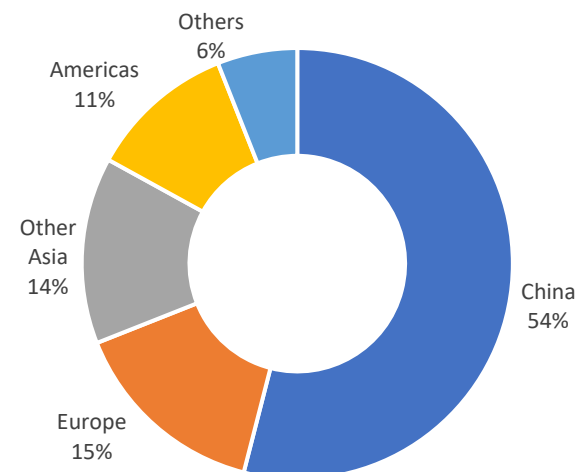
Rank	Refinery	Country	Owner (s)	Process	Capacity
1	Guixi	China	Jiangxi Copper Corporation	Electrolytic	1,100
2	Shandong Fangyuan	China	Dongying, Shandong	Electrolytic	700
3	Daye/ Hubei (refinery)	China	Daye Non-Ferrous Metals Co	Electrolytic	600
3	Jinchuan	China	Jinchuan Non Ferrous Co	Electrolytic	600
5	Yunnan Copper	China	Yunnan Copper Industry Group (64.8%)	Electrolytic	500
5	Birla	India	Birla Group (Hidalgo)	Electrolytic	500
7	Sterlite Refinery	India	Vedanta	Electrolytic	460
7	Pyshma Refinery	Russia	UMMC (Urals Mining & Metallurgical Co)	Electrolytic	460
9	Jinchuan (Fangchenggang)	China	Jinchuan Non-Ferrous Metal Co	Electrolytic	450
9	Toyo/ Hiihama (Besshi)	Japan	Sumitomo Metal Mining Co Ltd	Electrolytic	450
9	Amarillo	US	Grupo Mexico	Electrolytic	450
9	Chuquicamata Refinery	Chile	Codelco	Electrolytic	450
13	Onsan Refinery	S Korea	LS-Nikko Co (LS, Nippon Mining)	Electrolytic	440
14	Hamburg (refinery)	Germany	Aurubis	Electrolytic	416
15	El Paso (refinery)	US	Freeport-McMoRan Copper & Gold Inc	Electrolytic	415
16	Las Ventanas	Chile	Codelco	Electrolytic	410
17	Baiyin	China	Baiyin Nonferrous Metals	Electrolytic	400
17	Jinguan (refinery)	China	Tongling Non-Ferrous Metals Group	Electrolytic	400
17	Jinlong (Tongdu) (refinery)	China	Tongling Non-Ferrous Metals Corp 52%, Sharpline	Electrolytic	400
17	Zijin	China	Zijin Mining Company 50%, Minxi Xinghang 50%	Electrolytic	400

Global refined copper consumption amounted to 25Mt in 2020, with China being the largest consumer of refined copper

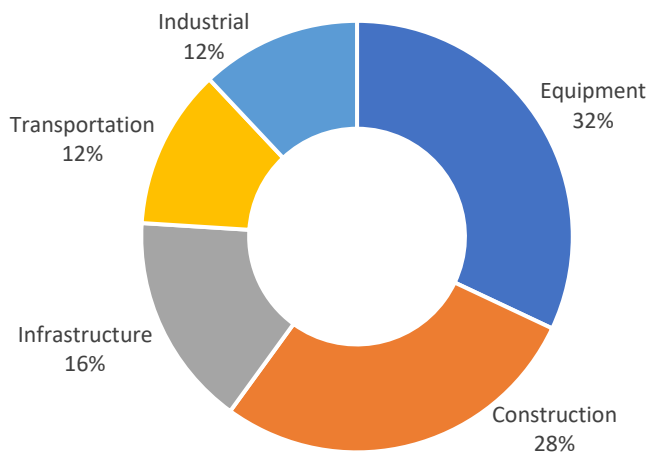
Refined Copper Global Usage, 2020, '000



Refined Copper Global Consumption, 2020, %



Refined Copper by Global End-Use, 2020, %

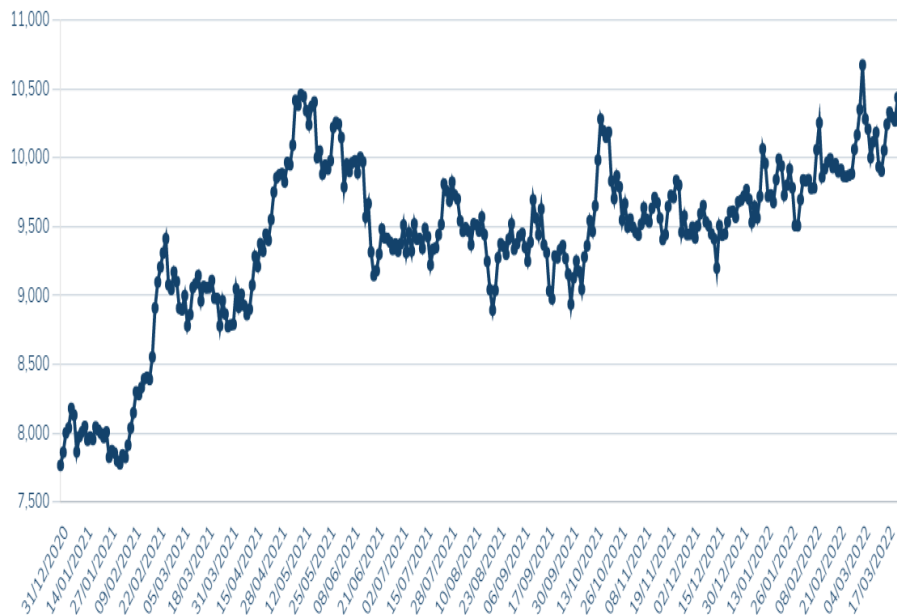


- ✓ Global refined copper consumption was close to 25Mt in 2020, an increase of 2.3% YoY.
- ✓ China is the world's largest refined copper consumer, at 54% of refined copper global consumption, followed by Europe 15%, other Asia 14%, Americas 11%.
- ✓ Refined copper end-use include equipment 32%, construction 28%, infrastructure 16%, transportation 12%, industrial 12%.

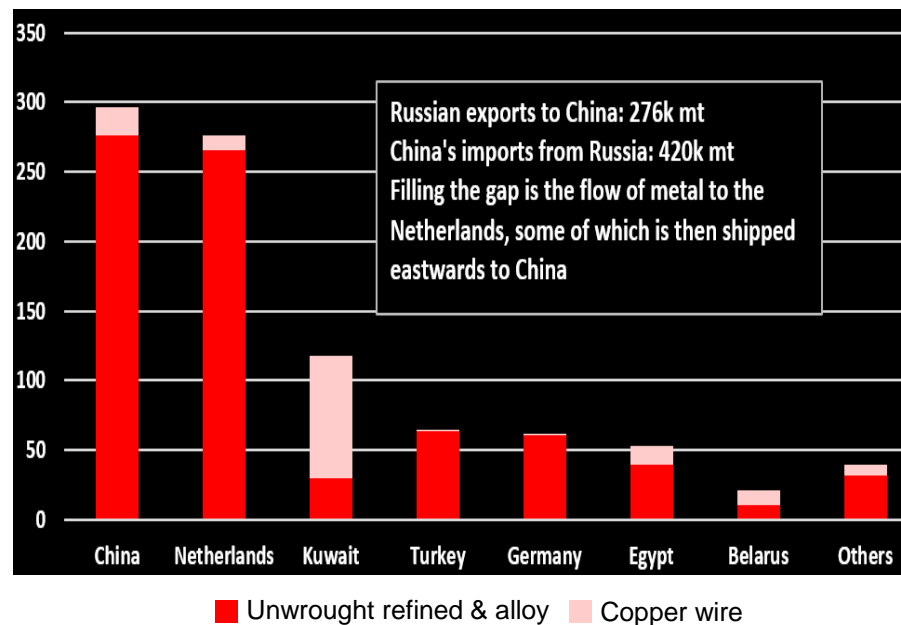


Global copper market is expected to be in a mild deficit of 82,000t in 2022 supported by recovery in global copper demand and ESG agenda

LME 3-Month Copper Closing Price, USD/ton, as at 23rd March 2022

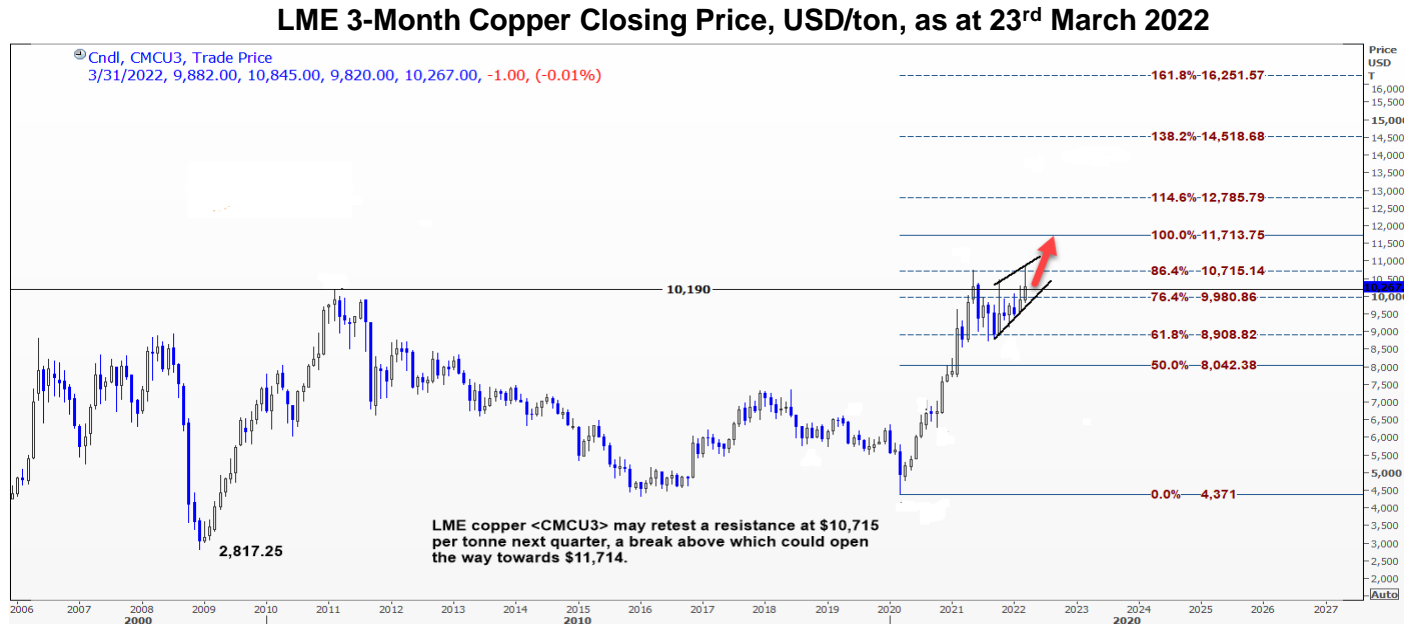


Russia's Copper Exports in 2020, '000 mt



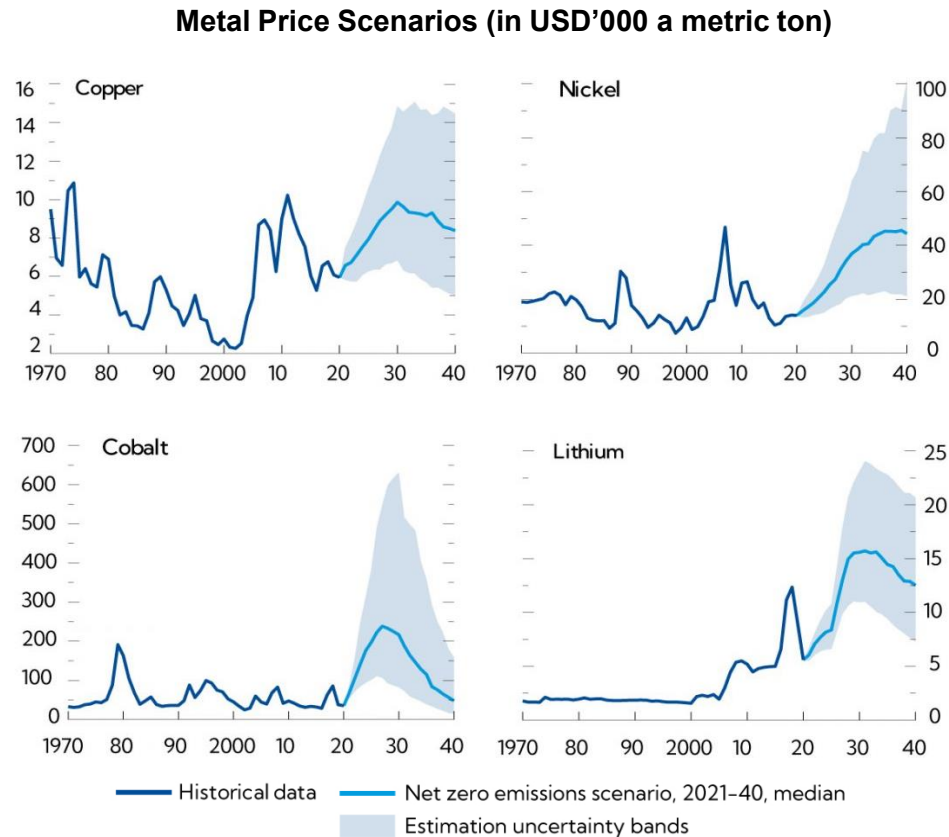
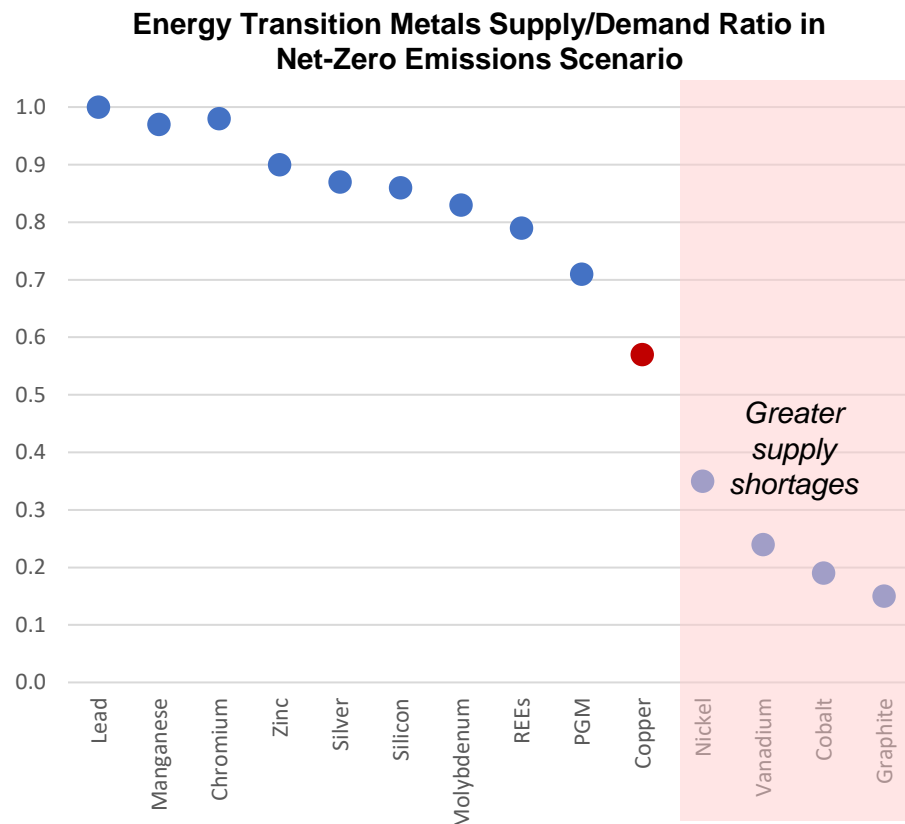
- ✓ **The global copper market is expected to be in a mild deficit of 82,000 tonne in 2022** (or at less than 1% of global copper consumption), supported by the recovery in global copper consumption and increasing investments in renewable energy and transport electrification.
- ✓ In 2022, global copper mine production is expected to increase by 4% to 22.3mln tonne, while refined copper production is anticipated to grow by 2% to 25mln tonne. Global copper consumption is expected to grow by 3% to 25.1mln tonne.

Global copper price may spike up again on low global copper inventory and supply chain disruptions, testing resistance level of USD10,714 per tonne in 2Q22



- ✓ The LME copper market was briefly shaken by the margin meltdown that triggered the suspension of LME nickel market on 8th March, which saw a **short-lived spike up to global copper price to a new all-time high of USD10,845 per tonne**. Since then, the LME 3-month copper price eased and traded range-bound, **last done at USD10,438.5 per tonne as at 23rd March**.
- ✓ Russia is a major refined copper producer, contributes to ~1mln ton per year or 4% of global refined copper production. Russia exports ~400,000 per year of refined copper to China. Approx. 34% of Russia's refined copper to China flow through the Black Sea or via European ports, both shipping routes are becoming increasingly challenging due to geopolitics.
- ✓ Reuters' technical analysis shows that **global copper price may test a resistance of USD10,714 per tonne in 2Q22, a break above could open the way towards USD11,714 per tonne**.
- ✓ Meanwhile, an investment bank expects global copper price to remain elevated at USD12,000 per tonne over a 12-month period.

Clean energy needs may cause years of high prices for copper, nickel, cobalt and lithium under a net-zero emissions scenario



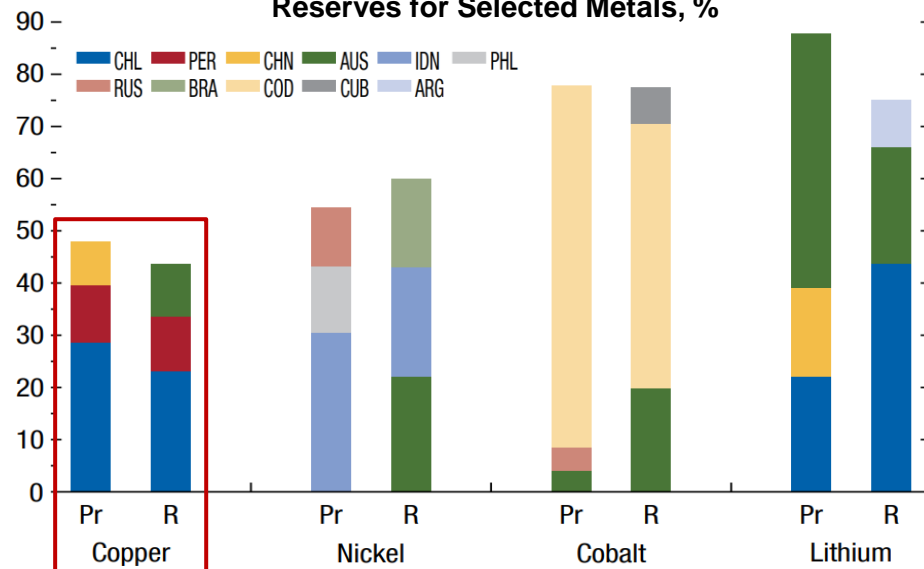
- ✓ The world's historic pivot toward curbing carbon emissions is likely to spur unprecedented demand for some of the most crucial metals used to generate and store renewable energy in a net-zero emissions by 2050 scenario.
- ✓ **IMF analysis shows key metal prices could reach historical peaks for an unprecedented length of time.** Specifically, cobalt, lithium, and nickel prices would rise several hundred percent from 2020 levels and peak around 2030. However, copper is less of a bottleneck as its demand increases are not as steep.

Clean energy transition implies a long-term play for global metals including copper

Key Indicators for Energy Transition Metals

Metal	Exchange Traded	Energy Transition Usage				Production (2020, \$ billion)
		Renewable	Network	Battery	Hydrogen	
Copper	✓	✓	✓	✓		123.0
Aluminum	✓	✓	✓	✓	✓	107.0
Nickel	✓	✓		✓	✓	28.0
Zinc	✓	✓				28.0
Lead	✓	✓		✓	✓	26.0
Silver	✓	✓				13.0
Manganese	No	✓		✓	✓	25.0
Chromium	Recent	✓				19.0
Silicon	No	✓				14.0
Molybdenum	Recent	✓			✓	5.0
Cobalt	Recent			✓		4.1
Lithium	Recent			✓		1.8
Vanadium	No			✓		1.3
Graphite	No			✓		1.3

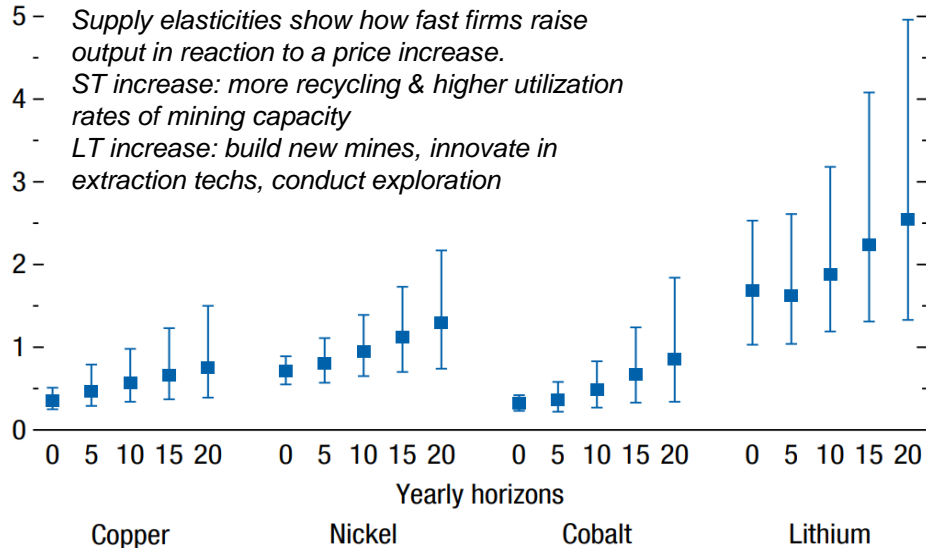
Top 3 Producers by Share of Global Production & Reserves for Selected Metals, %



- ✓ The IMF projects that (i) **global demand/consumption of critical energy transition metals will increase in the long-term (and especially up to 2030s) i.e. lithium and cobalt by a factor of >6x, copper by 2x, nickel by 4x**, (ii) **global demand for metals will be frontloaded between now and 2030**, driven by the need of large initial investments for the switch from fossil fuels to renewables.
- ✓ **The global supply of metals is quite concentrated, implying that a few top producers may stand to benefit** e.g. Congo accounts for 70% of global cobalt output and 50% of reserves. Other countries that stand out in production and reserves include Australia (lithium, cobalt, nickel), Chile (copper, lithium), Peru (copper), Russia (cobalt, nickel), Indonesia (nickel) and South Africa.
- ✓ The economic benefits for higher prices for metal exporters could be substantial. The IMF estimates that **a 15% increase in global metal prices adds an extra 1% to real GDP growth for metal exporters** vs. metal importers.

Global metal supply is more elastic over the long-term in response to a demand-push +ve price shock, revenues from metals production could potentially rival value of oil production

Supply Elasticities for Selected Metals



Projected Cumulated Real Revenue for the Global Production of Selected Metals 2021-2040 (USD bln)

Metals	Historical (1999-2018)	Stated Policies Scenario	Net Zero Scenario
Selected Metals	3,043	4,974	13,007
Copper	2,382	3,456	6,135
Nickel	563	1,225	4,147
Cobalt	80	152	1,556
Lithium	18	141	1,170
Fossil Fuels	70,090	-	19,101
Oil	41,819	-	12,906
Natural Gas	17,587	-	3,297
Coal	10,684	-	2,898

- ✓ A global demand-push **positive price shock of 10%** increases the same-year output of copper by 3.5%, nickel 7.1%, cobalt 3.2%, lithium 16.9%. After 20 years, the same price shock raises the output of copper by 7.5%, nickel 13%, cobalt 8.6%, lithium 25.5%.
- ✓ **Global metal prices are expected to peak in 2030** (i) steep rises in global demand are frontloaded by 2030 due to the need to build infrastructures for clean energy, (ii) price boom induces a global supply reaction, reducing market tightness and potential price pressures after 2030, **implying global metals play up to 2030s.**
- ✓ The IMF estimates that **global demand boom for metals would lead to a 6x increase in the value of global metal production totaling USD12.9tln for the 4 energy transition metals alone.** This would rival the potential value of global oil production over the same period. Risks include technology change, the speed and direction of the energy transition depend on policy decisions.

Global copper market summary

- ✓ It is highly improbable that copper supply will run out. Since 1960, there has always been **38 years of global copper reserves on average**. **During 2010-2020, 207Mt of copper have been mined**. Concurrently, **reserves have grown by 240Mt to 870Mt copper** in the same period. **Identified and undiscovered copper resources are estimated at around 2,100Mt and 3,500Mt, respectively**.
- ✓ **Copper is one of the few raw materials which can be recycled repeatedly without any loss of performance**. Recycling, innovation and mining exploration continue to contribute to the long-term availability of copper.
- ✓ **Since 1900, global copper mine production has grown by 3.2% per annum to 20.6Mt in 2020**. **Chile contributed to almost one-third of the world copper mine production** in 2020, followed by **Peru 10%, China 8.3%, Congo 6.3% and US 5.8%**. Kazakhstan is the world's 10th largest copper mine producer.
- ✓ **Global refined copper consumption was close to 25Mt in 2020**, an increase of 2.3% YoY. **China is the world's largest refined copper consumer, at 54%** of refined copper global consumption, followed by Europe 15%, other Asia 14%, Americas 11%.
- ✓ **The global copper market is expected to be in a mild deficit of 82,000 tonne in 2022** (or at less than 1% of global copper consumption), supported by the recovery in global copper demand and ESG agenda.
- ✓ Reuters' technical analysis shows that **global copper price may test a resistance of USD10,714 per tonne in 2Q22, a break above could open the way towards USD11,714 per tonne**. The LME's three-month contract of global copper price closed at USD10,438.5 per tonne on 23rd March, gained 7.4% year-to-date.
- ✓ The world's pivot toward curbing carbon emissions is likely to spur unprecedented demand for key metals used to generate and store renewable energy in a net-zero emissions by 2050.
- ✓ The IMF projects that (i) **global demand/consumption of critical energy transition metals will increase in the long-term up to 2030s (copper by a factor of 2x)**, (ii) **global demand for metals will be frontloaded between now and 2030**, driven by the need of large initial investments for the switch from fossil fuels to renewables – **implying global metals play up to 2030s**.

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