2 December 2020
Equity Research
Asia Pacific | Australia

CREDIT SUISSE

Base Metals Forecasts

Buoyant outlook after surprise 2020 for metals

Diversified Metals & Mining | Sector Forecast

Connections Series

- **Goods production delivered surprisingly resilient base metals demand in 2020,** supported by ex-China fiscal stimulus and China's investment-led drive. 2021 should see growing demand from an ex-China recovery, especially as vaccination begins, while China will seek to expand its recovery beyond manufacturing while avoiding derailing this sector. A long-term structural change to metal demand recently accelerated as Japan and South Korea pledged carbon neutral targets by 2050, and the US may be nudged the same way following the election. Copper and aluminium demand should rise with greater electrification, while nickel depends on prevailing battery technology, which can change rapidly.

Figure 1: Revised base metals and alumina price forecasts

			2020E	1Q-21	2Q-21	3Q-21	4Q-21	2021E	2022E	2023E	2024E	LT (real)
Copper	New	US$/lb	**2.80**	3.20	3.30	3.30	3.20	**3.25**	**3.20**	**3.00**	**3.10**	3.00
	Old	US$/lb	**2.70**	2.80	2.80	2.80	2.80	**2.80**	**2.60**	**2.60**	**2.71**	3.00
	Chg	*%*	***4%***	*14%*	*18%*	*18%*	*14%*	***16%***	***23%***	***15%***	***14%***	*0%*
Aluminium	New	US$/t	**1,713**	1850	1900	1900	1870	**1,880**	**1,900**	**1,900**	**1,900**	2,865
	Old	US$/lb	**1,650**	1,700	1,700	1,700	1,700	1,700	**1,800**	**1,800**	**1,800**	2,865
	Chg	*%*	***3%***	*9%*	*12%*	*12%*	*10%*	***11%***	***6%***	***6%***	***-4%***	*0%*
Alumina	New	US$/t	**268**	280	290	290	300	**290**	**320**	**330**	**330**	400
(spot)	Old	US$/t	**272**	290	290	290	290	**290**	**320**	**330**	**346**	400
	Chg	*%*	***-1%***	*-3%*	*0%*	*0%*	*3%*	***0%***	***0%***	***0%***	***-5%***	*0.00*
Nickel	New	US$/lb	**6.27**	7.00	6.90	6.80	6.70	**6.85**	**6.80**	**6.80**	**7.00**	6.70
	Old	US$/lb	**6.02**	6.20	6.20	6.20	6.20	**6.20**	**6.10**	**6.50**	**6.67**	6.70
	Chg	*%*	***4%***	*13%*	*11%*	*10%*	*8%*	***11%***	***12%***	***5%***	***5%***	*0%*

Source: Credit Suisse estimates

- **We lift our copper price targets above $3/lb across the forecast period** as we no longer believe the copper market is well-supplied over the medium-term. We believe copper is in deficit this year, partly due to buying of perhaps 750kt by China's State Reserve Bureau. With stronger global consumption across the forecast period, we expect a supply deficit of 200kt of copper in 2021 and a tight market in subsequent years to support elevated +$3/lb prices, which should incentivise new mines.
- **We believe the aluminium outlook improved** as rampant demand from China limited the global demand decline. From 2021 we expect demand from ongoing growth in China and industrial recovery in the ROW to outpace supply additions, thereby unwinding the supply surpluses over the forecast period and sustaining prices towards the top of the cost curve. **Alumina prices should advance in line with our previous forecast** as growing alumina demand by aluminium smelters stretches the capacity of China's refineries. **Nickel remains in modest surplus though the forecast period** and we expect no shortfall on class 1 nickel. We raise prices to reflect a more buoyant base metal complex. **Zinc may have overshot in the short term** as there is no refined metal shortfall despite mine outages in Peru and Gamsberg. We lift mid-term prices to $2600/t, below spot.

The Credit Suisse Connections Series leverages our exceptional breadth of macro and micro research to deliver incisive cross-sector and cross-border thematic insights for our clients.

Research Analysts

Matthew Hope
61 2 8205 4669
matthew.hope@credit-suisse.com

Conor Rowley
44 20 7883 9156
conor.rowley@credit-suisse.com

Yang Luo
852 2101 6328
yang.luo@credit-suisse.com

Carsten Riek
44 20 7883 9672
carsten.riek@credit-suisse.com

Sam Webb
61 2 8205 4535
sam.webb@credit-suisse.com

Nick Herbert, CFA
61 3 9280 1754
nick.herbert@credit-suisse.com

Caio Ribeiro
212 325 7804
caio.b.ribeiro@credit-suisse.com

Curt Woodworth, CFA
212 325 5117
curt.woodworth@credit-suisse.com

Fahad Tariq, CPA, CA
416 352 4593
fahad.tariq@credit-suisse.com

Prateek Singh
91 22 6777 3894
prateek.singh@credit-suisse.com

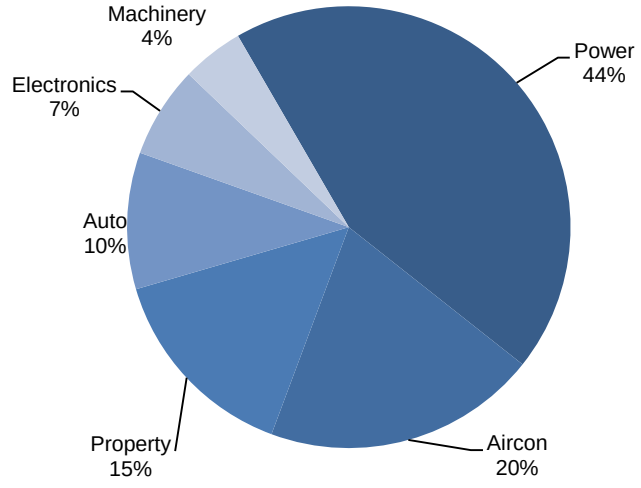
Focus charts and tables

Figure 2: Revised base metal prices

			1Q-20	2Q-20	3Q-20	4Q-20	2020E	1Q-21	2Q-21	3Q-21	4Q-21	2021E	2022E	2023E	2024E	LT (real)
Copper	New	US$/t	5,632	5,366	6,603	7,125	**6,182**	7,060	7,280	7,280	7,060	**7,170**	**7,060**	**6,620**	**6,840**	6,615
	New	US$/lb	2.55	2.43	3.00	3.23	**2.80**	3.20	3.30	3.30	3.20	**3.25**	**3.20**	**3.00**	**3.10**	3.00
	Old	US$/lb	2.55	2.35	3.00	2.80	**2.70**	2.80	2.80	2.80	2.80	**2.80**	**2.60**	**2.60**	**2.71**	3.00
	Chg	*%*	*0%*	*4%*	*0%*	*15%*	***4%***	*14%*	*18%*	*18%*	*14%*	***16%***	***23%***	***15%***	***14%***	*0%*
Aluminium	New	US$/t	1,690	1,501	1,739	1920	**1713**	1850	1900	1900	1870	**1880**	**1,900**	**1,900**	**1,900**	2,865
	New	US$/lb	0.77	0.68	0.79	0.87	**0.78**	0.84	0.86	0.86	0.85	**0.85**	**0.86**	**0.86**	**0.86**	1.30
	Old	US$/lb	0.77	0.68	0.79	0.77	**0.75**	0.77	0.77	0.77	0.77	**0.77**	**0.82**	**0.82**	**0.90**	1.30
	Chg	*%*	*0%*	*0%*	*0%*	*13%*	***3%***	*9%*	*12%*	*12%*	*10%*	***11%***	***6%***	***6%***	***-4%***	*0%*
Alumina (spot)	New	US$/t	284	242	273	275	**268**	280	290	290	300	**290**	**320**	**330**	**330**	400
	Old	US$/t	284	242	273	290	**272**	290	290	290	290	**290**	**320**	**330**	**346**	400
	Chg	*%*	*0%*	*0%*	*0%*	*-5%*	***-1%***	*-3%*	*0%*	*0%*	*3%*	***0%***	***0%***	***0%***	***-5%***	*0.00*
	linkage	*%*	*16.8%*	*16.1%*	*15.7%*	*14.3%*	***15.7%***	*15.1%*	*15.3%*	*15.3%*	*16.0%*	***15.4%***	***16.8%***	***17.4%***	***17.4%***	*14.0%*
Nickel	New	US$/t	12,689	12,254	14,683	15,700	**13,831**	15,440	15,220	15,000	14,780	**15,110**	**15,000**	**15,000**	**15,440**	14,775
	New	US$/lb	5.76	5.56	6.66	7.12	**6.27**	7.00	6.90	6.80	6.70	**6.85**	**6.80**	**6.80**	**7.00**	6.70
	Old	US$/lb	5.76	5.56	6.66	6.10	**6.02**	6.20	6.20	6.20	6.20	**6.20**	**6.10**	**6.50**	**6.67**	6.70
	Chg	*%*	*0%*	*0%*	*0%*	*17%*	***4%***	*13%*	*11%*	*10%*	*8%*	***11%***	***12%***	***5%***	***5%***	*0%*
Zinc	New	US$/t	2,124	1,970	2,424	2,730	**2,312**	2,750	2,650	2,600	2,600	**2,650**	**2,600**	**2,600**	**2,600**	2,400
	New	US$/lb	0.96	0.89	1.10	1.24	**1.05**	1.25	1.20	1.18	1.18	**1.20**	**1.18**	**1.18**	**1.18**	1.09
	Old	US$/lb	0.96	0.89	1.10	1.00	**0.99**	1.00	1.00	1.00	1.00	**1.00**	**1.10**	**1.10**	**1.12**	1.09
	Chg	*%*	*0%*	*0%*	*0%*	*24%*	***6%***	*25%*	*20%*	*18%*	*18%*	***20%***	***7%***	***7%***	***5%***	*0%*
Lead	New	US$/t	1,843	1,679	1,679	1,925	**1,782**	2,145	2,067	2,028	2,028	**2,067**	**2,028**	**2,080**	**2,080**	2,000
	New	US$/lb	0.84	0.76	0.76	0.87	**0.81**	0.97	0.94	0.92	0.92	**0.94**	**0.92**	**0.94**	**0.94**	0.91
	Old	US$/lb	0.84	0.76	0.76	0.84	**0.80**	0.85	0.85	0.85	0.85	**0.85**	**0.90**	**0.92**	**0.94**	0.91
	Chg	*%*	*0%*	*0%*	*0%*	*4%*	***1%***	*14%*	*10%*	*8%*	*8%*	***10%***	***2%***	***3%***	***1%***	*0%*

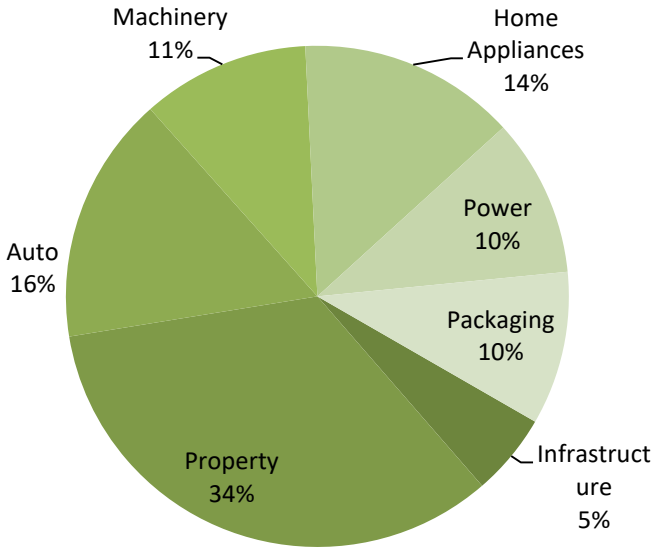
Source: Credit Suisse estimates

Figure 3: China's copper demand break-up by end-use sector



Source: CQi, Credit Suisse estimates

Figure 4: China's aluminium demand break-up by end-use



Source: CQi, Credit Suisse estimates

Table of Contents

Demand environment for metals

Commodities benefitted from the pandemic

Global government financial support flows into goods, driving commodity demand

The COVID-19 recession has borne little resemblance to the recessions of old, other than a rise in unemployment. Globally, governments have opened the cash faucets for welfare spending and fiscal stimulus. With fewer services and travel to attract consumer spending, some of the money has bought goods, especially consumer appliances. And a lot of those goods are manufactured in China, which is seeing high growth in manufactured exports. Base metals demand is being supported by global government stimulus, via China.

China itself has seen stimulus by the Government mainly through infrastructure investment to support its economic performance. Property and infrastructure projects drove construction-related sectors – machinery, steel & cement. Crude steel demand is likely to grow at 7% this year on statistics to October, showing a robust demand response by commodities. The sectors driving steel - construction, machinery, autos and appliances – will have also driven base metals consumption growth.

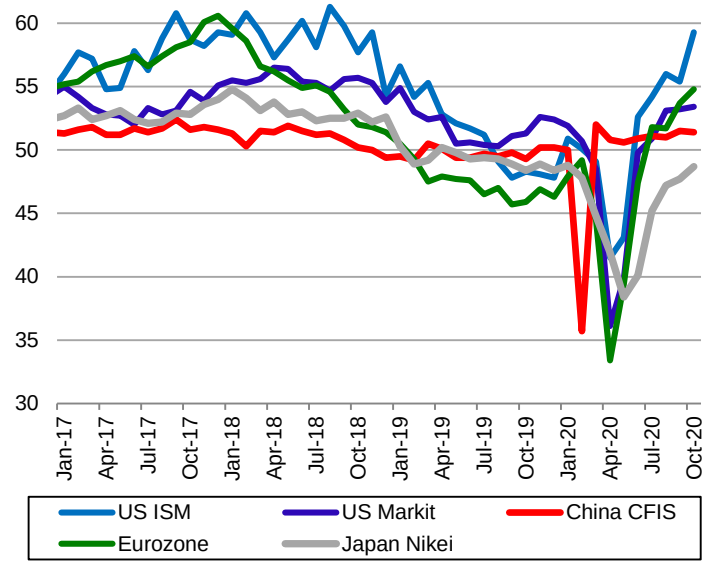
Developed economies manufacturing have picked up

Global manufacturing PMIs for developed countries have all recovered from April lockdowns and, apart from Japan, have entered expansionary territory. The rebound looks, strong, but it is coming from a low base including pent up demand, so statistics may be a bit skewed. On the other hand, as previously noted, a significant amount of the cash being handed out by Governments is being spent on goods rather than services, and appliances are selling strongly, so there is reason to expect manufacturing to be strong.

Autos in particular appear to be recovering more swiftly than expected in Europe and Japan. Automakers have steadily upgraded sales forecasts and blast furnaces that steel makers banked in April in Japan and Europe are being refired. Nippon, JFE and ArcelorMittal have all restarted blast furnaces citing steel demand from the auto sector.

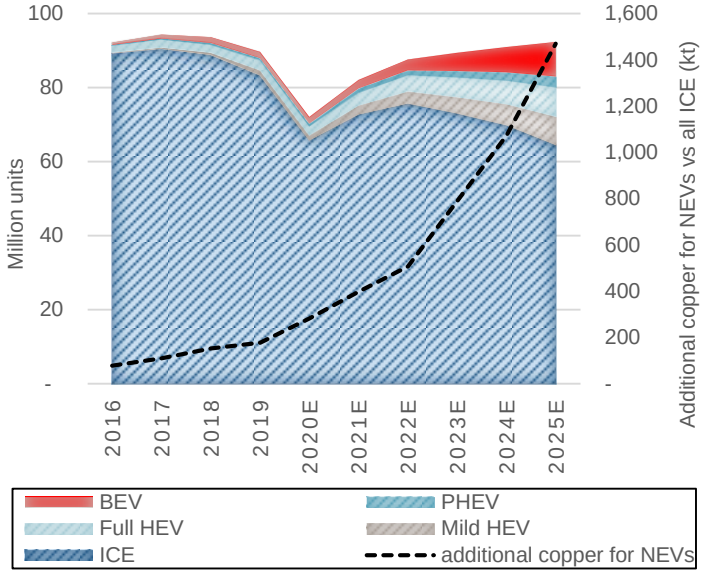
While Europe is entering a second wave of COVID and second lockdown, we expect the impact on production to be less severe than the first wave. And the US has avoided further widespread lockdowns so far, but is bearing the cost as a high rate of COVID-19 infections.

Figure 5: Manufacturing PMIs



Source: the BLOOMBERG PROFESSIONAL™ service, Credit Suisse

Figure 6: Global auto production forecasts



Source: Credit Suisse estimates, IHS

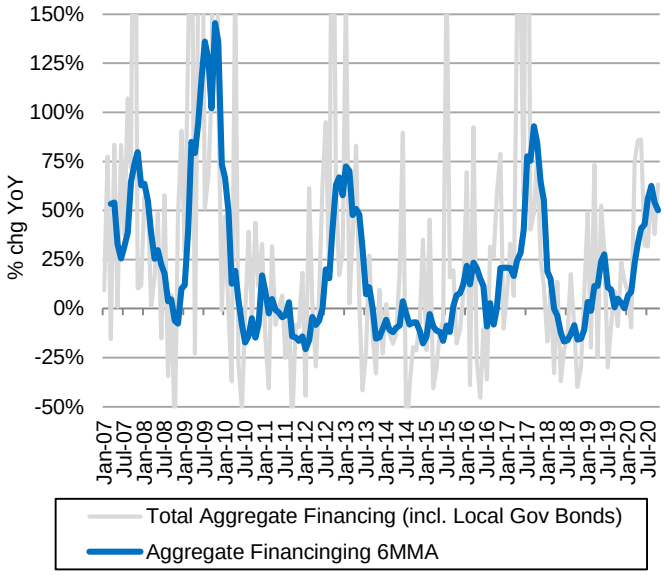
China is the greatest driver of the metal prices rise

The greatest driver of metal price performance has been the demand growth in China. The government issued a range of targeted stimulus measures to restart to the economy after its February-March lockdown. The greatest stimulus was approval of funds targeting infrastructure projects. Once again investment has driven commodity prices.

To fund the stimulus, the Government used a Rmb1.6tn increase in Special Bonds issuance, another Rmb1tn in Special Treasury Bonds, and a projected fiscal deficit of Rmb1tn relative to 2019. The sum of these figures, Rmb3.6tn was 3.6% of GDP according to our China economist and is the total fiscal stimulus available for 2020 relative to 2019. And beyond the Local Government projects, SOCs and major companies were enlisted to invest in 'New Infrastructure' and assist the economy to restart by bringing forward new orders.

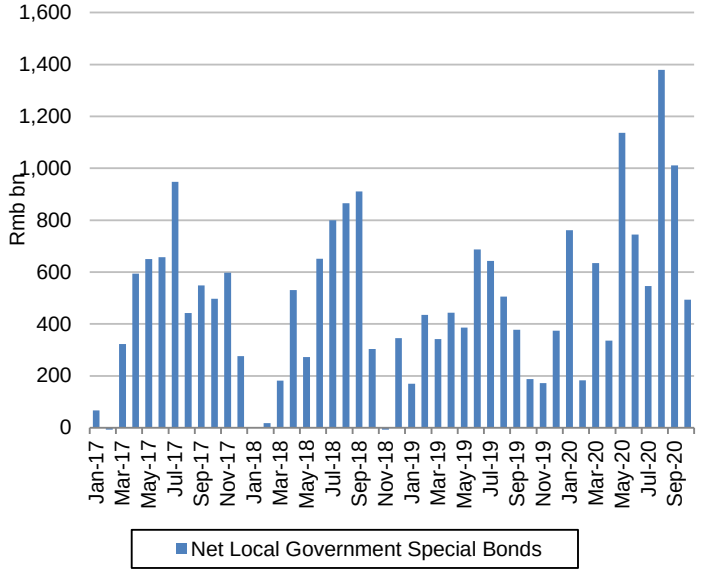
While most of the infrastructure is directed at the same old sectors of road, rail, subways, waterways and airports, the 'New Infrastructure' covers seven areas: 5G networks, industrial internet, inter-city transportation and inner-city rail systems, data centers, artificial intelligence, ultra-high voltage, and new energy vehicle charging stations. Many of these look to be copper and aluminium intensive. The activity has been strong: for instance 500,000 5G base stations were planned for 2020, but the total looks likely to exceed 600,000 now. The result is that China's domestic demand for steel, aluminium and copper have all increased YoY.

Figure 7: China aggregate financing



Source: CEIC, Credit Suisse estimates

Figure 8: Local Government Special Bonds



Source: CEIC, Credit Suisse estimates

Outlook for 2021

Developed world to see growth recovery in 2021, not a rebound

Europe and the US are experiencing a second wave of COVID-19 with more lockdowns, but we still expect economic growth next year. Firstly the world is getting used to the virus. Medical procedures have improved and ventilators are now abundant in developed nations. The shock and fear that accompanied the first wave when hospitals were ill-prepared has passed. Protests in European countries show that populations are less tolerant of further mandatory lockdowns, so another heavy impact to industrial production due to COVID-19 is unlikely. Furthermore, success in vaccine development means the highest priority recipients – likely medical workers – should be administered vaccines in the first half of next year. It will take time to administer sufficient numbers to create herd immunity to the current form of COVD-19, so no bounce-back to pre-COVID-19 travel and social behaviour can be expected in 2021. Nevertheless, industrial activity should gradually recover towards normality, but it will be a recovery, not a bounce-back. Early hopes to put economies in hibernation for the period of the pandemic were

dashed by the duration of the impact. Jobs and wages have been lost, businesses are still failing as Government support rolls off, and economic wealth has been destroyed.

China – likely to moderate investment in 2021, but not cut it off

China will start a new five year plan in 2021, but Beijing has released few details so economists are left to speculate. Investment in 2020 successfully stimulated the basic materials sectors, but service sectors and consumption remained fragile. Now the materials sector is in good health, Credit Suisse' CQi unit suggested the Government would moderate the stimulus to avoid financial risks and overheating. However, Beijing would not want the economy to fall off a financial cliff either, so it suggested infrastructure investment may fall about 15% to Rmb3tn in 2021 from Rmb3.6tn in 2020. Likewise, Mysteel estimated the infrastructure Special Bonds released next year would not be less than Rmb3tn. These pundits expect a decline in investment, which is negative for materials, but CQi believes the normal lag in spending may see the funding released in 2H-20 continue to support infrastructure projects in 1H-21, moderating the impact of the decline on activity.

Once again Beijing tries to cool the housing sector – with some success

The government has also renewed its campaign against housing speculation under the mantra that houses are for living in, not speculation. This time the moves to cool the housing sector are having a greater impact than previous attempts. Under its "Three Red Lines" policy, the government has tightened funding avenues for developers and forced them to deleverage. Property New Starts slowed in 2H-20 and the land area purchased was negative, indicating lower construction next year. This too is a headwind for commodity demand, but again, CQi suggested the government wouldn't want to see a collapse in construction so it may limit the housing decline so New Starts may retreat in low single digits in 2021. But Mysteel also pointed out that not all property has slowed. About 30% of the infrastructure stimulus funding has been allowed to fund shanty town redevelopment, which is property.

Manufacturing and autos may experience strong demand in 2021

On the positive side manufacturing and exports have been very strong this year and may continue. CQi expects materials demand for the auto sector to rise 10% next year. Furthermore, CQi expects property completions may rise in 2021 from the low rates seen in 2020 and that should stimulate downstream demand for base metals and appliances for the fit out. And manufacturing FAI (new factories) may begin to recover from the low rates this year as export–focused manufacturers have experienced a strong year. CQi forecast demand for both copper and aluminium to rise 4-5% next year.

China – new five year plan to involve "Dual Circulation"

While there are few details for policy direction of the next five year plan commencing in 2021, a "Dual Circulation" slogan is becoming prominent. This appears to mean a greater focus on domestic consumption of manufactured products, while retaining the export business, hence the "dual" nature. This would be intended to lighten the current burden on Investment as the driver of GDP. But how greater consumption in China is to be achieved is yet to be seen. Consumption certainly won't change due to a slogan alone; other major changes will be required for households to spend more and save less.

The Government has just unveiled a new subsidy scheme for cars and appliances, particularly focused on the rural sector. While this is likely to bolster demand, based on the experience of previous subsidy schemes, subsidies largely pull forward consumption rather than create it, so it doesn't look like the answer for the entire Dual Circulation policy. And the Government won't want the Consumption segment of GDP to be as reliant on Government funding as the Investment segment is at present.

Impact of macro moves on base metals demand

Copper and aluminium demand in China outperforming in 2020

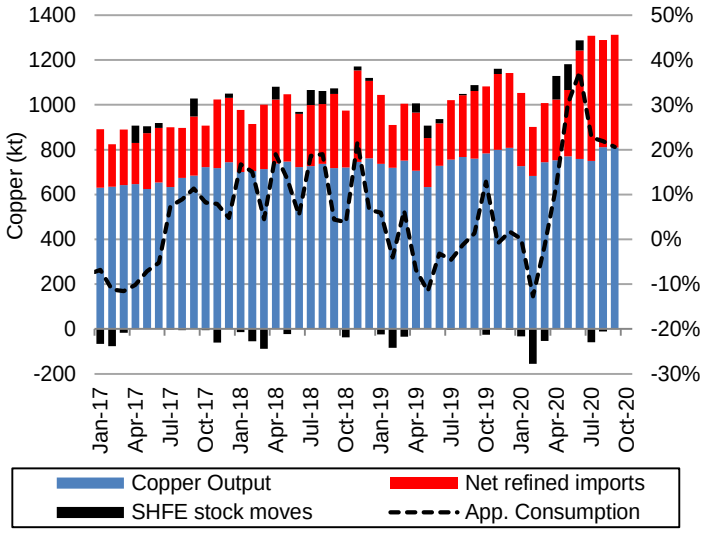
In 3Q, Copper and aluminium demand continued the rapid growth seen since the start of 2Q in China. For the year to September, we now calculate apparent consumption (including inventory movements) of 15% YoY for copper in China, and 10% for aluminium if we include alloy imports and semi exports (Figure 9, Figure 10). The growth in the production of metals in China

has been nowhere close to those rates, just a few percent. The big increase in apparent consumption is caused by heavy imports of metal to China, at the same time as domestic inventory declines. Few believe these high rates of apparent consumption are real; most assume some level of stockpiling metals is occurring in China out of view. But why would prices be so strong, if consumption is modest and inventories are building?

SRB believed to be buying both copper and aluminium in China in 2020

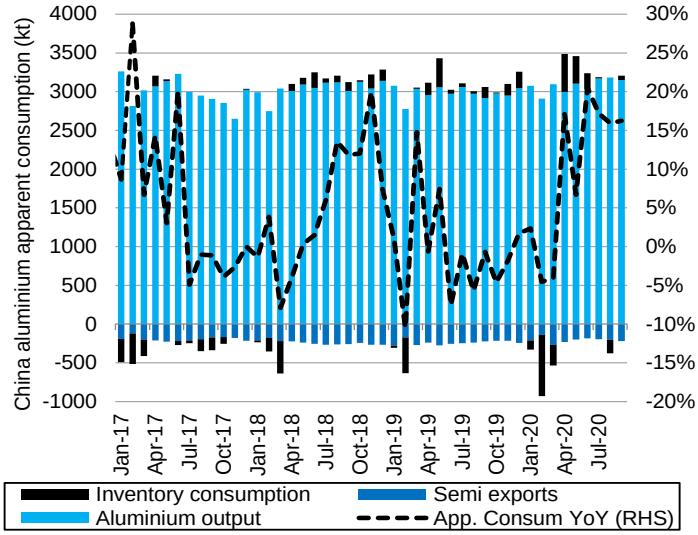
We believe there is stockpiling, but by China's State Reserve Bureau for China's strategic metals reserve rather than commercial traders. The SRB is not a nimble or tactical buyer; it is a government agency. It takes time to gain the approval and funding to increase inventory. The price-insensitive SRB buying is probably a large part of the reason why the China prices are so strong and metal prices are so high.

Figure 9: China copper apparent consumption



Source: SMM, customs data, Credit Suisse estimates

Figure 10: China aluminium apparent consumption

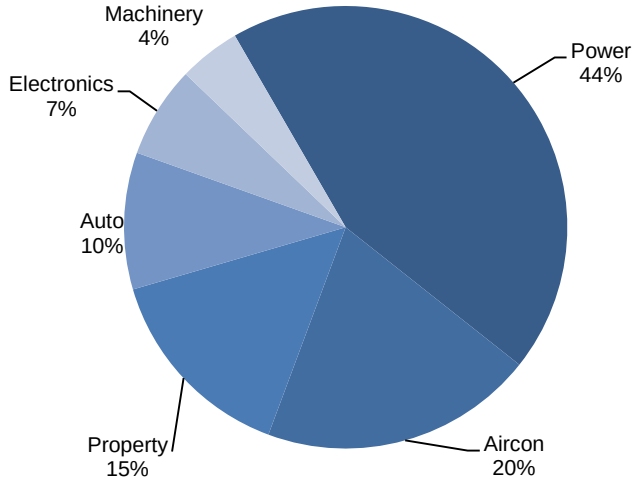


Source: IAI, customs data, SMM, SHFE, Credit Suisse estimates

However, industrial consumption in China also grew in 2020

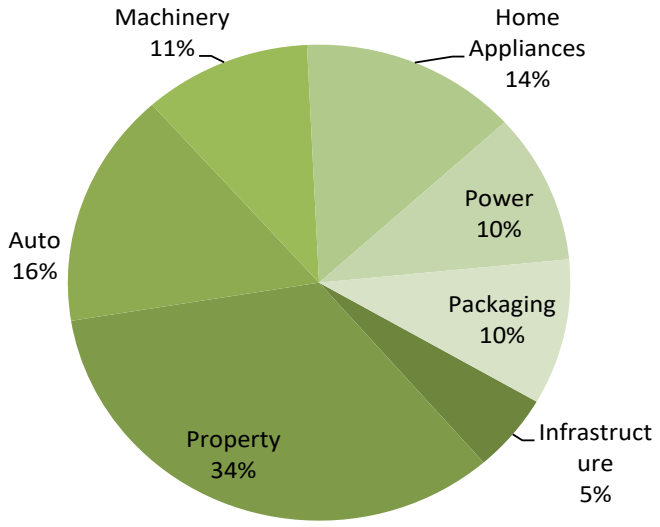
While acknowledging stockpiling had a role in the strength of China's copper and aluminium demand in 2020, we don't believe industrial consumption has shown no growth. China's crude steel apparent demand looks likely to finish the year up 7.3% YoY, including inventory movements, primarily due to strong growth in property construction, infrastructure and machinery production, aided by appliances and autos. Steel has different sector weightings to base metals. For steel, 65% or more goes into construction and machinery, while those sectors are lower for base metals – 46% for aluminium, and only 19% for copper – but they still contribute to demand growth (Figure 11, Figure 12). So we believe there has been demand growth in base metals, but not at the full 10% - 15% apparent consumption rates we calculated to Sep. Those high rates were assisted by SRB restocking.

Figure 11: China copper usage breakdown



Source: CQi Credit Suisse estimates

Figure 12: China aluminium usage breakdown



Source: CQi, Credit Suisse estimates

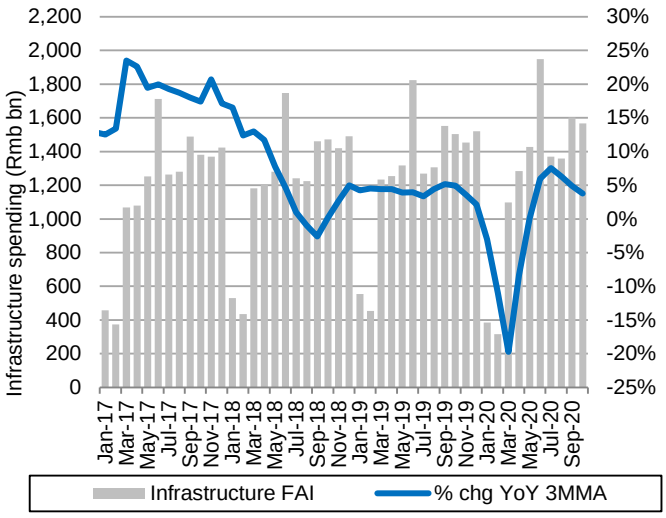
China Details

Infrastructure investment increased

Infrastructure investment has lifted during the year but modestly to only low single digit growth. Nevertheless it achieved the desired effect with solid growth in the construction sector reflected in steel and aluminium demand. CQi and Mysteel expect Beijing will ease back on investment in 2021 to avoid overheating the sector and seek the spread the economic recovery from COVID to service and consumption sectors.

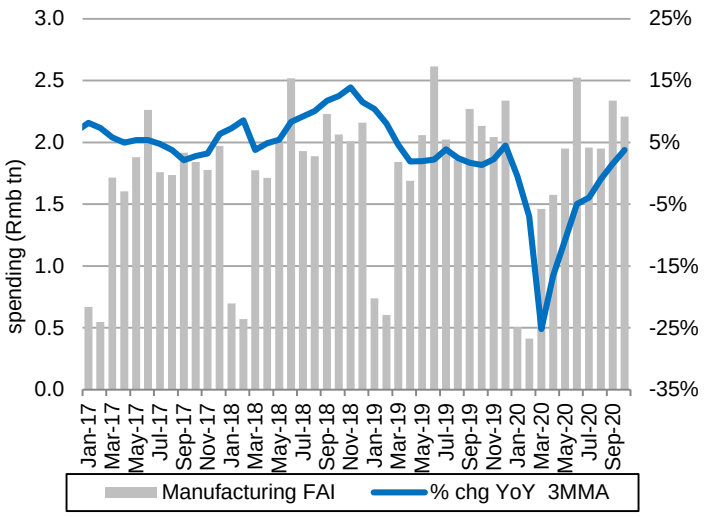
Manufacturing FAI has been a drag on construction this year, down 5.3% by Oct due to a poor 1Q in China and by macro uncertainties. However, since August, manufacturing investment has been positive YoY as industrial production and exports have improved (Figure 14). A CQi survey in Oct found that 30% of SMEs with an export business said they would expand capex. Businesses with a domestic focus were more cautious. Overall we expect the factory investment segment of FAI should return to positive growth in 2021, but may not be strong.

Figure 13: China infrastructure investment eases to 4% YoY



Source: CEIC, Credit Suisse estimates

Figure 14: China manufacturing FAI turned positive in Aug



Source: CEIC, Credit Suisse estimates

Power sector demand supported by power plants, not the Grid

The power sector is critically important for copper demand in China, comprising 44% of demand and 10% of aluminium usage. China's State Grid budgeted an FAI spend of Rmb460bn in 2020, below the spend of Rmb485bn last year. 37% was be allocated to UHV lines (aluminium transmission cables), with four new UHV projects to begin construction in 2H-20. The State Grid front-end loaded its orders for copper cables in 2Q this year to accelerate economic recovery, so orders to copper fabricators were sluggish later in the year according to CQi surveys.

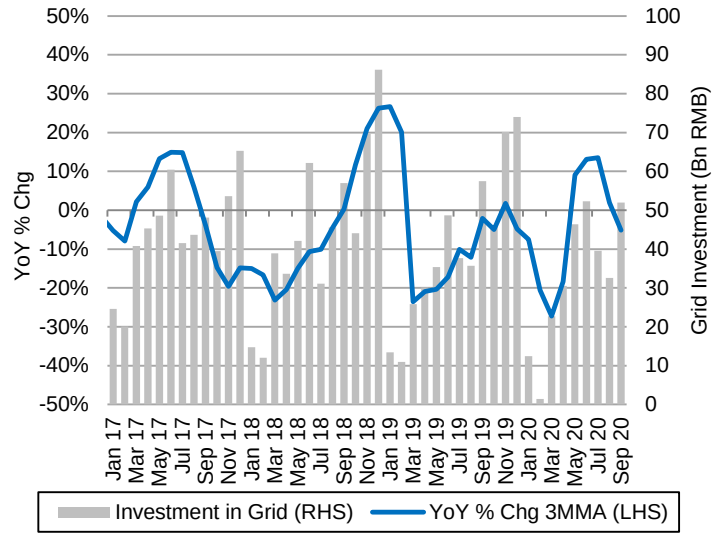
However, China's investment in power plants rose strongly in the first nine months of the year, up 72% by Sep (Figure 16), and unusually has exceeded the spend on the grid by Rmb18bn. Part of that may have been contributed by solar projects. 434 PV projects worth 26GW of capacity were to be subsidized in 2H, 14% above 2019. All of the projects must be finished by the end of 2020 so the spending in 2H remained strong even after a powerful 1H. Overall PV capacity-added in 2020 may be somewhere between 36-49GW according to Lilan Consulting, higher than 30GW constructed in 2019.

Adding together the spending on the Grid and power plant investment, investment in the electrical sector rose 26% in the year to Sep.

Demand also accentuated by new infrastructure

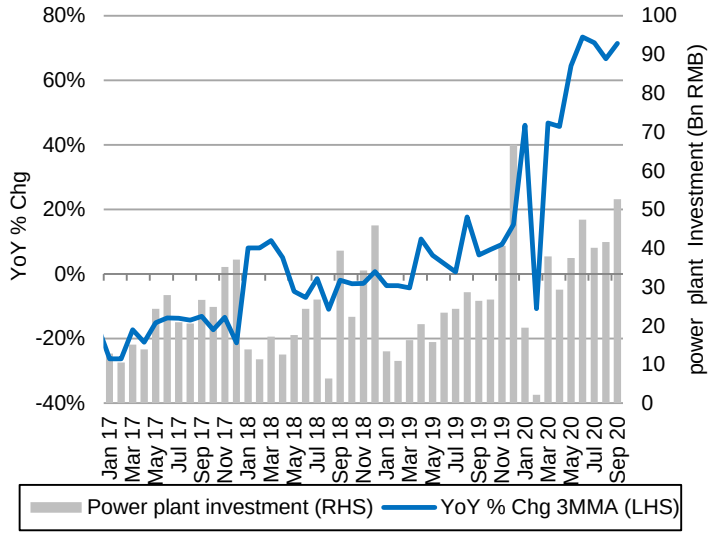
China targeted construction of 200,000 EV charging stations and 500,000 5G base station in 2020. Late in the year we noted that the State Grid was beginning work on 78,000 EV charging piles. By Sep 600,000 5G base stations were installed beating the target. The stations are built by China Mobile, China Unicom and China Telecom and are not captured in State Grid spending statistics.

Figure 15: China's spend on electrical grid was -1.8% to Sep



Source: CEIC, Credit Suisse estimates

Figure 16: China's spend on power generation +72% to Sep



Source: CEIC, Credit Suisse estimates

2021 outlook for power sector is uncertain

For 2021, we don't yet know the spending target for the grid or power sector. However, with China's commitment to decarbonise by 2060, its existing power capacity of 2130GW (and growing by over 100GW/year) will need to migrate from 70% coal-based to renewables, so we expect the solar and wind spend to continue accelerating in future years. CQi reported that the capacity of China's solar sector is projected to increase 587% from 2020 to 2060, and over the next three years, they are expecting double digit CAGR.

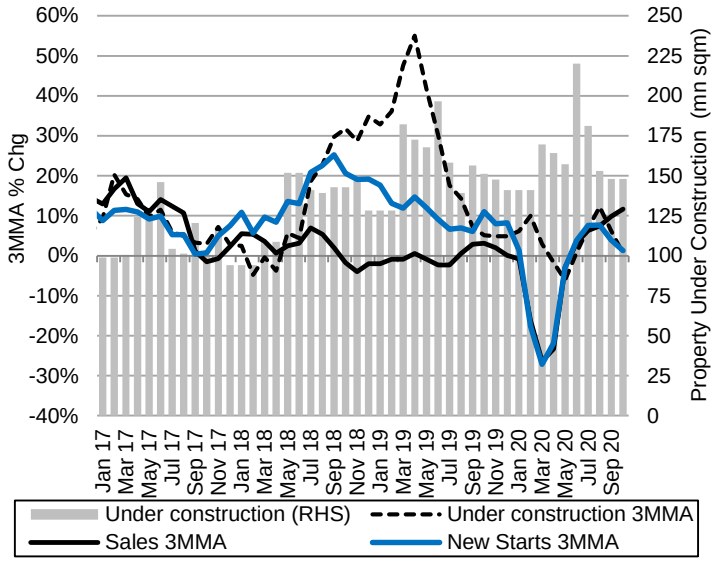
The increase in renewables is positive for base metals. As these facilities use 4-5x the copper use of a thermal power station, the increase should maintain positive copper demand growth. Solar cells may be even more positive for aluminium which provides the module frames for solar

panels. In fact the World Bank believes the energy transition will require an extra six million tonnes of aluminium every year by 2050 for solar panels.

Property sector

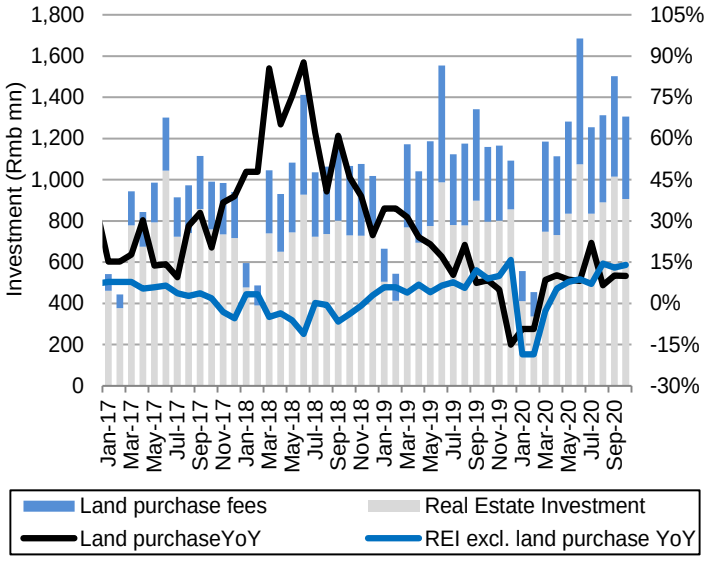
The Government has maintained attempts to cool the housing sector and its "Three Red Lines" policy seems to be having more success at cooling construction than previous measures. Floor space of new starts faded towards the end of the year to low single digits, and given a poor 1Q, should finish the year with a decline of perhaps 2% YoY (Figure 17). However, sales remain strong, so a decline in supply may drive housing prices upwards, a negative result from the Government's perspective.

Figure 17: China property new starts fading towards end year



Source: CEIC, Credit Suisse estimates

Figure 18: China real estate investment ex land +14% in Oct



Source: CEIC Credit Suisse estimates

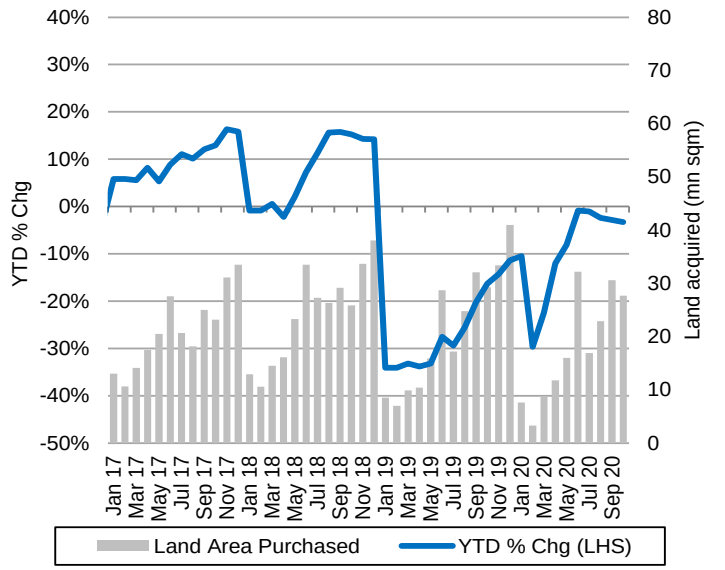
A negative indicator for housing construction in 2021 is the fall in Land Area purchased of 3.3% across the year to October (Figure 19). This again looks to be the result of the Government-organized funding squeeze for developers.

However, Mysteel has pointed out that not all property construction has stalled. About 30% of the Special Purpose Bonds targeted for infrastructure funding has been allowed to fund urban renewal, which is property construction. So while commercial property used by speculators is likely to slow, Mysteel believes low-income urban renewal is accelerating, forming an offset. So far there has been little sign of a drop in real estate funding, with growth running at 14% in recent months (Figure 18).

Overall, the Government wants construction of unoccupied housing for investment to cease, but it would not want the property construction sector to become a major drag on the economy, so the extent of the downfall should be limited. CQi believes new starts in 2021 will fall at low single digits, repeating the outcome of 2020.

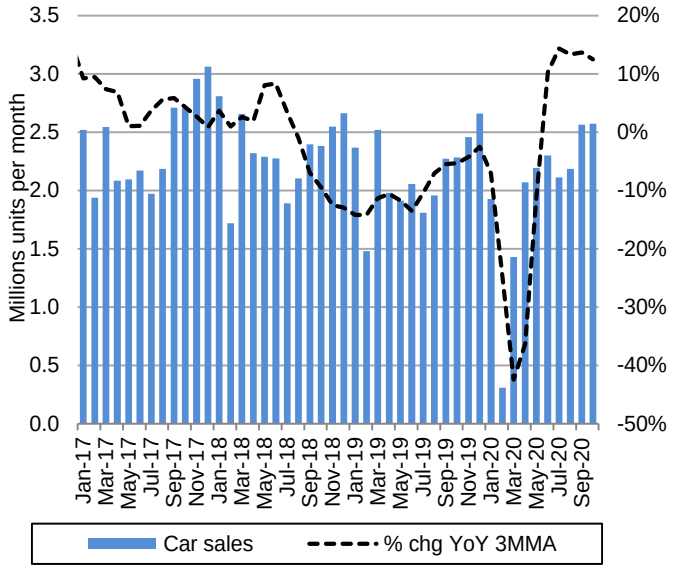
On a more positive note for base metals demand, CQi expects housing completions to rise in 2021 as they were low in 2020. Completions are positive for demand in downstream sectors like appliances.

Figure 19: Land area purchased



Source: Company data, Credit Suisse estimates

Figure 20: China car sales down 4.7% YoY by Oct



Source: Company data, Credit Suisse estimates

Autos and appliances turn upwards

Auto sales have turned up sharply, growing at about 12% YoY in 2Q and 3Q (Figure 20). Overall auto sales should still decline by low single digits across the year, but that's caused entirely by the absence of sales in 1Q due to China's COVID-19 lockdown. Other than 1Q, the auto sector turned up in 2020, a strongly positive result for aluminium in particular. We expect continued growth in 2021.

Another bullish sector which should support commodity demand in 2021 should be appliances. Export orders grew +50% during the second wave of COVID-19 as overseas producers could not fulfill orders (Figure 21). And demand may be sustained now by domestic demand in 2021.

Beijing stimulates auto and appliance sales for 2021

China's Premier Li Keqiang stated at a meeting of the State Council on November 18, that China will continue to expand domestic demand and release the consumption power of the country's rural areas, according to Mysteel. The sectors he mentioned specifically included auto-manufacturing and white goods. "At present, the prominent restraint on economic development lies in consumption, as the main growth engine was seriously affected by the COVID-19 pandemic earlier this year," Li said.

To stabilize and expand auto consumption, Li stated that Beijing is encouraging local governments to ease and optimize the buying restrictions on passenger vehicles, and to release more quotas for the issuance of license plates. China will also launch a new promotional campaign to lift auto sales in rural areas, the meeting agreed. The proposal envisages encouraging rural residents to buy trucks below 3.5 tonnes and automobiles with engines no bigger than 1.6 litres, and offers citizens who buy new cars subsidies to replace their old vehicles. The central government also intends to step up the building of charging units for electric vehicles and parking lots.

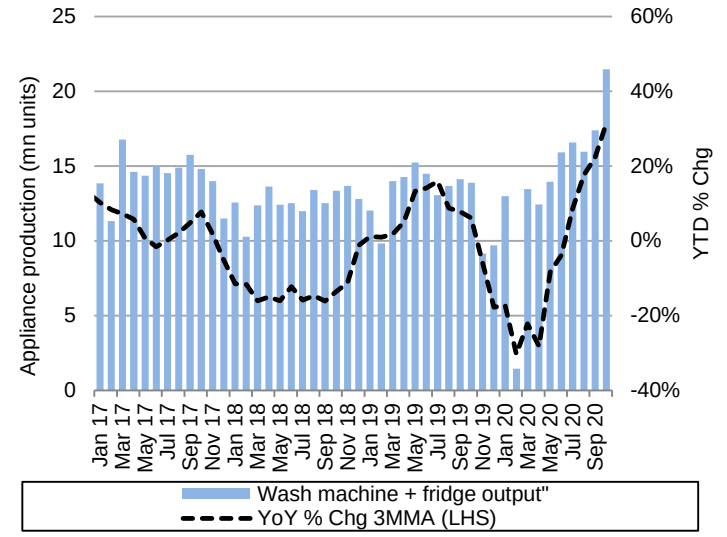
The meeting also restated the government's commitment to promoting consumption of home appliances and furniture, along with boosting services in other areas such as tourism.

Mysteel reported the response of upstream sectors: "There is good news all round, and steelmakers with sheet rolling and coating facilities are going crazy," an official from a steel mill based in North China's Hebei commented. Most of his company's products are used in the auto and white goods industries. "Our sales of cold-rolled products are pretty good. In fact, our order book for the rest of this year is full and now we are taking orders for January," he said.

The strong orders for flat steel should be repeated for all the base metals fabricators. The recovery of the auto sector is particularly important for aluminium, as it comprises 16% of demand in China. The initiative to add EV chargers should stimulate sales in this sector. EV's use 4x the copper of an ICE.

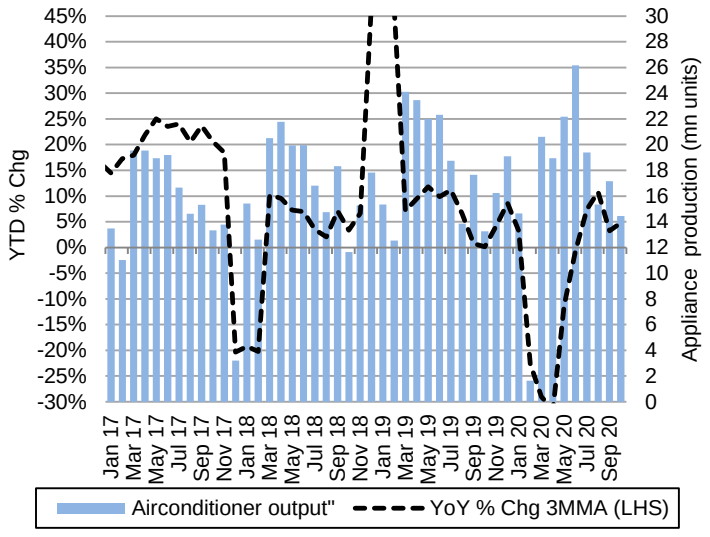
White goods stimulus is also positive for stainless steel fabricators (washing machine cylinders, dishwashers), and copper fabricators for wiring and motors. Beijing's stimulus should add to the natural demand caused by elevated housing completions that CQi expects in 2021.

Figure 21: China washing machine & fridge production



Source: CEIC, Credit Suisse estimates

Figure 22: China air conditioner production

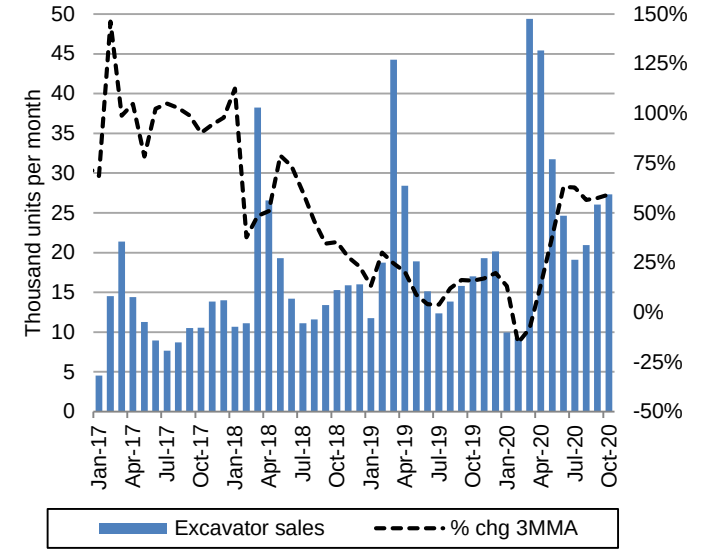


Source: CEIC, Credit Suisse estimates

Machinery sector uncertain for 2021

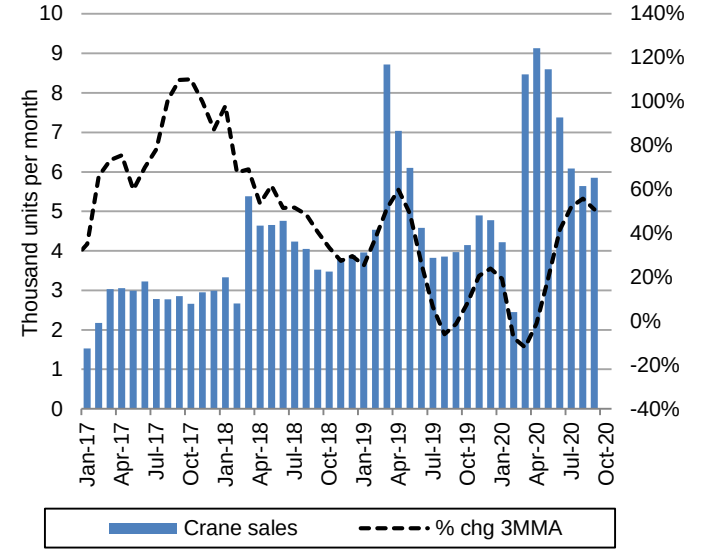
Machinery sales have been elevated for two years, with the sustained sales this year likely a response to the Governments infrastructure projects (Figure 23, Figure 24). In 2021 the infrastructure stimulus may continue, but be 15% less than 2020, and the building area of property new starts may be down by single digits too. Nevertheless the continuation of construction stimulus may see high sales sustained.

Figure 23: Excavator sales



Source: CEIC, Credit Suisse estimates

Figure 24: Crane sales



Source: CEIC, Credit Suisse estimates

Copper forecast

More bullish outlook for demand

We have revised up our copper prices above $3/lb across the forecast period. Previously we had maintained lower mid-term copper forecasts of $2.50-$2.80/lb as the copper price in a well-supplied market hovers around the 90th percentile of the all-in cost curve. But we no longer believe the copper market is well supplied mid-term. China demand has been strong this year and there is now a global push for decarbonisation with investment due in our forecast horizon.

Revised prices higher

The copper price surged above $3.30/lb in Nov, probably for investment expressing a buoyant view of global growth after a flurry of positive COVID-19 vaccine results. Investment demand for copper is fickle, but looking at real consumption, we forecast a supply deficit of 200kt of copper in 2021, and a price of $3.25/lb across the year. In subsequent years we expect a balanced but tight market supporting elevated+$3/lb prices.

Figure 25: Revised copper price forecast

		1Q-20	2Q-20	3Q-20	4Q-20	2020E	1Q-21	2Q-21	3Q-21	4Q-21	2021E	2022E	2023E	2024E	LT (real)
New	US$/t	5,632	5,366	6,603	7125	**6,182**	7,060	7,280	7,280	7,060	**7,170**	**7,060**	**6,620**	**6,840**	6,615
New	US$/lb	2.55	2.43	3.00	3.23	**2.80**	3.20	3.30	3.30	3.20	**3.25**	**3.20**	**3.00**	**3.10**	3.00
Old	US$/lb	2.55	2.35	3.00	2.80	**2.70**	2.80	2.80	2.80	2.80	**2.80**	**2.60**	**2.60**	**2.71**	3.00
Chg	*%*	*0%*	*4%*	*0%*	*15%*	***4%***	*14%*	*18%*	*18%*	*14%*	***16%***	***23%***	***15%***	***14%***	*0%*

Source:, Credit Suisse estimates

Stronger China demand but substantial copper taken in restock by SRB

We estimate copper concentrate is in deficit this year after COVID-19 trimmed mine supply by 1.4%, while low scrap increased smelter demand for virgin metal. Spot TC/RCs are the lowest since 2012 for Asia and China, indicating tight supply. In addition, we believe refined copper is also in deficit this year due to record imports of refined copper by China. It is unlikely all the copper was consumed; we estimate 750kt was stockpiled, probably by China's secretive State Reserve Bureau. Nevertheless, the SRB is not a trader and is unlikely to release the metal again, so its buying represents one-off additional copper demand. Compounding growth on stronger 2020 global consumption than we previously estimated has unraveled former modest surpluses to a broadly balanced but tight copper market across the forecast period (Figure 26).

Figure 26: Global copper supply & demand summary

	2016	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
World mine supply (kt)	20,215	20,158	20,708	20,837	20,549	20,829	21,837	22,881	23,493
Chg YoY	*5.1%*	*-0.3%*	*2.7%*	*0.6%*	*-1.4%*	*1.4%*	*4.8%*	*4.8%*	*2.7%*
included disruption (kt)		-	-	-	(86)	(1,096)	(1,149)	(1,204)	(1,236)
Concentrate supply (kt)	16,343	16,455	17,088	17,265	16,995	17,542	18,569	19,655	20,498
SX/EW copper (kt)	3,857	3,687	3,606	3,557	3,539	3,273	3,255	3,214	2,984
Smelter production (kt)	17,960	18,276	18,926	19,050	19,005	19,591	20,735	21,872	22,800
smelting scrap supply (kt)	2077	2227	2322	2514	2376	2527	2671	2752	2861
Demand for concentrate (kt)	16,395	16,561	17,134	17,070	17,095	17,542	18,569	19,655	20,498
Concentrate surplus/(deficit) (kt)	**(53)**	**(106)**	**(47)**	**195**	**(100)**	**-**	**-**	**-**	**-**
refining scrap supply (kt)	1,372	1,391	1,149	1,014	979	1,026	1,056	1,076	1,076
Electro-refined copper production (kt)	18,908	19,336	20,075	20,064	19,984	20,617	21,791	22,948	23,877
Total refined copper supply (kt)	22,765	23,023	23,681	23,621	23,523	23,890	25,046	26,162	26,860
World Copper consumption (kt)	22,515	23,082	23,689	23,832	22,868	24,106	25,026	26,059	26,978
Chg YoY	*3.7%*	*2.5%*	*2.6%*	*0.6%*	*-4.0%*	*5.4%*	*3.8%*	*4.1%*	*3.5%*
China consumption Chg YoY	*6.3%*	*4.4%*	*6.1%*	*2.8%*	*4.3%*	*3.3%*	*1.2%*	*3.5%*	*2.8%*
China restocking demand					**750**				
World Copper balance (kt)	**250**	**(59)**	**(8)**	**(211)**	**(95)**	**(217)**	**20**	**102**	**(118)**

Source: Wood Mackenzie, Lilan Consulting, Company data, Credit Suisse estimates

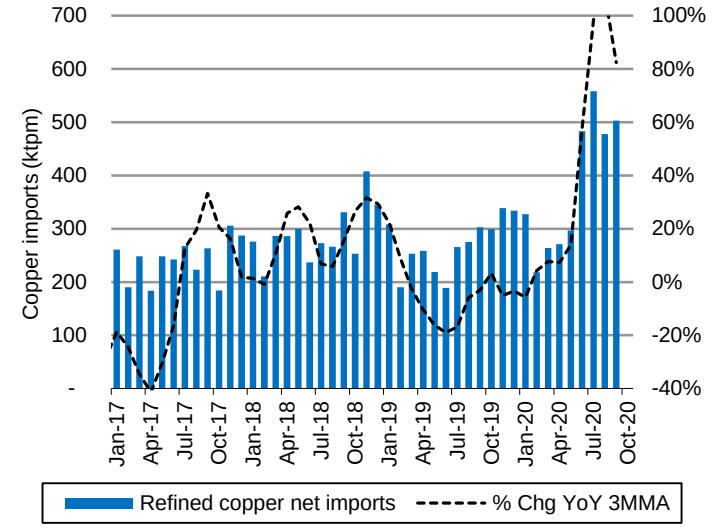
China's demand drove the copper market in 2020

China copper apparent consumption headline of 15.2% to Sep on record imports

China has been the sole growth engine for copper across the world this year. While developed countries have steep falls in copper demand resulting from industry lockdowns for COVID-19, China demand surged from 2Q. China's copper production did not change greatly, limited by concentrate availability, so demand growth was satisfied by imports (Figure 27, Figure 28).

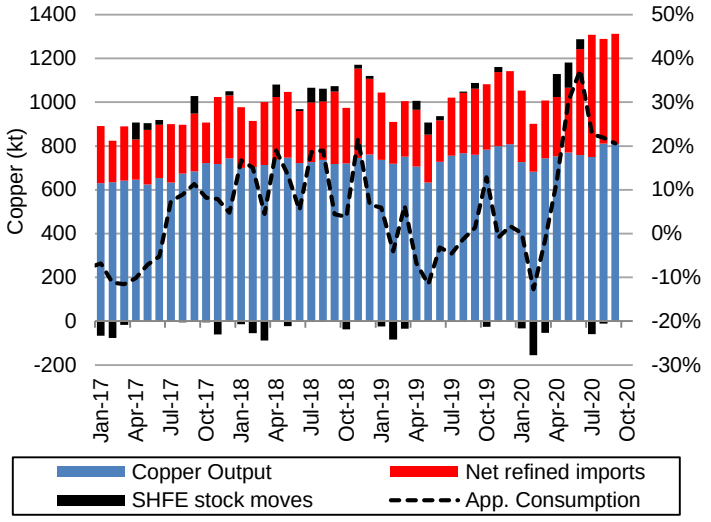
China imports were up 57% YoY through to September, with the surge beginning in June. Adding imports to production (using SMM estimates) and accounting for visible stocks changes, we estimated apparent demand growth in China of 15.2% YoY for the first nine months.

Figure 27: China's imports of refined copper



Source: Customs data, Credit Suisse estimates

Figure 28: China apparent consumption of refined copper



Source: SMM, SHFE, Customs data, Credit Suisse estimates

SRB buying large amounts of copper is one-off demand

Looking at demand by sectors, 15.2% demand growth does not seem a credible reflection of true consumption. We take into account lower direct use scrap supply which would increase demand for refined supply but still find it hard to fathom. The power sector accounts for 44% of China's copper demand, and the State Grid accounts for a large segment of that. But the grid spend may slide a little this year. Other sectors, including power generation, appliance manufacturing and autos have been strong, but still are unlikely to equate to 15% growth, including 1Q. Instead we – like others – believe there has been a large hidden stock build in China. At the extreme end of estimates, Lilan Consulting attributed all the demand growth this year to stock accumulation of 1.2Mt, and estimated consumption growth of only 0.4% YoY. We estimate 4.3% growth in refined copper consumption – aided by low direct use scrap – and a stock build of 750kt.

Other than the SHFE, we have little visibility of copper stocks in China. However, there has been widespread talk in China that the State Reserve Bureau has been buying copper this year. Credit Suisse's CQi unit reported traders saying that the SRB may have bought 300-500kt, but the true figure will never be known. A notable point about the SRB is that its metal stocks represents the Government's strategic reserve of metals. It does not trade metals. Whatever copper stocks it has accumulated this year have probably been permanently lost from the market and will not be released at a later date.

Our copper demand estimates relative to others

We are more positive towards copper demand in China than independent consultants Wood Mackenzie and Lilan Consulting (Figure 29). Our reasons include the apparent consumption calculations pointing to a big number, but also comparison with steel and aluminium. For steel in particular, it is reasonably clear now that China's crude steel production will finish the year at

about 1050Mt and demand will rise by about 7% YoY, including inventory movements. Much of the steel demand will be driven by property, infrastructure and machinery. These end uses are much smaller segments of copper demand, but combined with other positive sectors such as appliances and power generation, we believe there is a good case to expect demand has increased like other metals, not flat-lined. Going forward we expect consumption growth in China to continue at a few percent a year as China will seek to maintain appliance and auto demand while not letting construction collapse, and investment in renewable power will need to expand rapidly. Our estimates for refined copper consumption growth slowing to 1.2% in 2022 is largely a result of direct use scrap supply rebounding in our estimates after 2020 and resuming its share of final copper demand.

We are not able to calculate apparent consumption for ex-China, so our estimate of ROW demand is less certain. Given the global industrial production outages for COVID-19 lockdowns, without any bounce back as seen in China, and second wave infections, we believe demand has been hard hit. To support to our view, we note that the heavy flow of copper imported to China (4.6Mt by Sep, up 1.7Mt YoY) has barely shrunk exchange stocks (Figure 34), so the copper flows were probably the excess available in ROW due to lower consumption. Our estimate of a contraction of 12.8%in 2020 represents a reduction in ex-China demand of 1.5Mt YoY. Our forecast growth rates would see ex-China copper demand recover to 2019 levels by 2022.

Figure 29: Consumption growth rate forecasts – independent consultants vs CS

	2016	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
China Consumption									
Wood Mackenzie	4.9%	3.4%	5.7%	1.8%	2.7%	0.0%	0.8%	0.6%	0.6%
Lilan Consulting	6.3%	4.4%	6.1%	2.8%	0.4%	4.5%	0.5%	1.4%	0.6%
Credit Cuisse	6.3%	4.4%	6.1%	2.8%	4.3%	3.3%	1.2%	3.5%	2.8%
World ex-China Consumption									
Wood Mackenzie	1.5%	0.8%	-0.6%	-1.6%	-9.5%	6.2%	6.9%	4.9%	4.1%
Credit Cuisse	1.5%	0.8%	-0.6%	-1.6%	-12.8%	8.1%	6.9%	4.8%	4.3%
Global consumption									
Wood Mackenzie	3.1%	2.1%	2.5%	0.1%	-3.3%	2.8%	3.7%	2.7%	2.4%
Credit Cuisse	3.7%	2.5%	2.6%	0.6%	-4.0%	5.4%	3.8%	4.1%	3.5%

Source: Wood Mackenzie, Lilan Consulting, Credit Suisse estimates

Decarbonisation demand may impact in 2023-24

In the latter years of our forecast horizon, we expect that the drive towards decarbonisation may begin to impact copper. With the Democrats' win in the US, all the world's major industrial nations have committed to some form of decarbonisation; EU, Japan and South Korea to be carbon neutral by 2050, and China by 2060. In the US, the Democrats' election platform committed to decarbonise the power sector by 2035 and encourage NEVs including building 500,000 rechargers, but whether that will be supported by legislators remains to be seen. It may be watered down, but at least some moves are likely. The EU has the most ambitious plans with a rapid expansion of the grid, and huge investment in renewable power, not just to decarbonise the power sector, but also to generate green hydrogen for industrial use. The EU plans to have 6GW of green hydrogen facilities built by 2024, within our forecast horizon. Solar and wind power is 4-5X as copper intensive as conventional power, so we expect to see elevated ROW copper demand in 2023-24, where we forecast +4% pa.

Copper price lifted by China

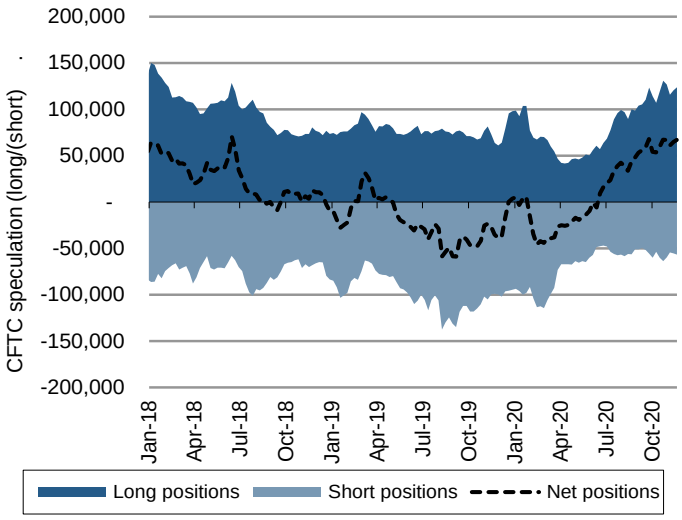
The lift in the copper price this year was achieved by China's imports. The copper price lifted in China on strong demand and tight supply, and that price was exported via the import arbitrage. Subsequently, the LME copper price has lifted on its own, closing the import arbitrage.

Copper speculators remain bullish

Speculators remain net long copper on the COMEX (Figure 30). Copper has long been used as a way for investors to express a view about global growth, rather than just to invest in copper fundamentals. In this instance there are a number of positive factors for copper – falling stocks,

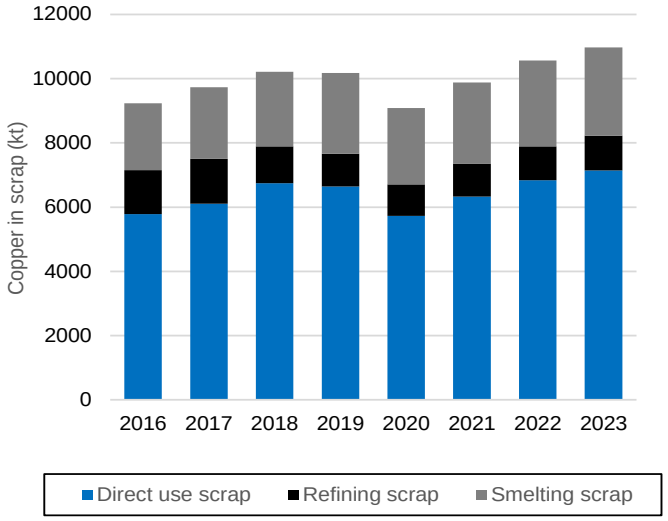
US election with winners having a copper-heavy platform, and numerous countries pledging carbon neutrality by 2050 meaning heavy investment in renewables and hydrogen. In our opinion these form a positive backdrop, but it is probably the announcement of positive trial results for three COVID-19 vaccines that have drove the latest copper price surge, as it reinforces the potential for global industrial recovery from the COVID-19 recession in 2021.

Figure 30: COMEX speculators remain net long copper



Source: COMEX, Credit Suisse estimates

Figure 31: Scrap estimates in our supply & demand model

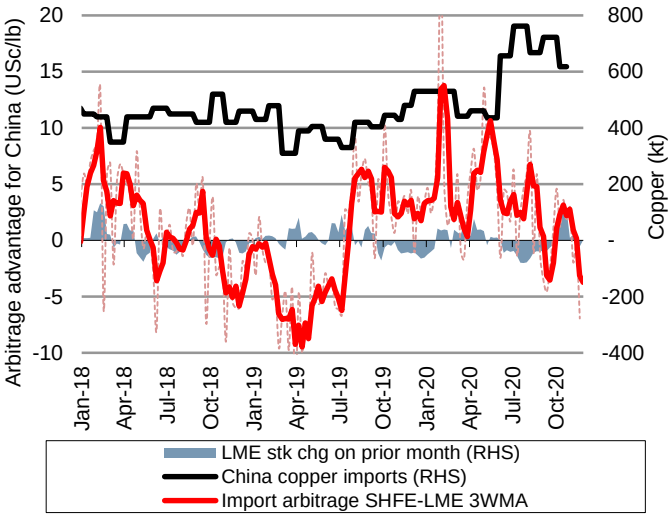


Source: Wood Mackenzie, Lilan consulting , Credit Suisse estimates

Copper import arbitrage firmly closed in Nov

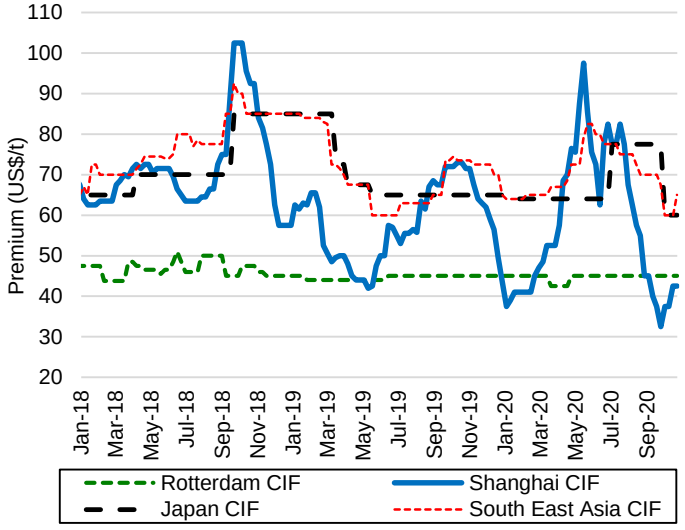
The China import arbitrage for copper has fluctuated though the year but was largely open from March until August (Figure 32). Elevated imports continued to arrive after this date but the arbitrage is now closed, reinforced by a steep fall in Shanghai copper premiums. We expect China's copper imports to subside at least until next spring.

Figure 32: Copper arbitrage for China shipments closed in Nov



Source: LME, SHFE, customs data, Credit Suisse estimates

Figure 33: Asia copper premiums sag as demand fulfilled

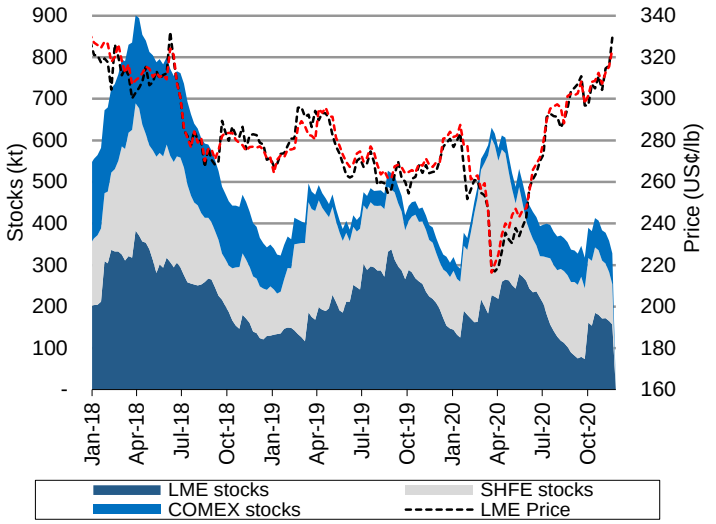


Source: Fastmarkets, Credit Suisse estimates

Shanghai bonded warehouse stocks build with arbitrage closed

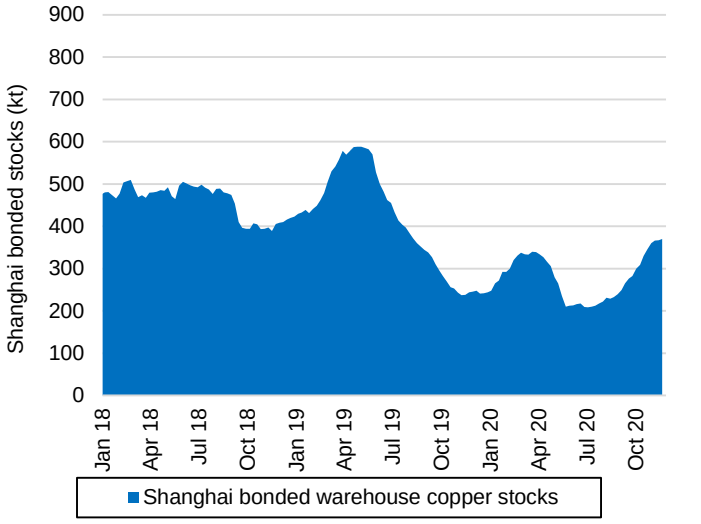
Globally copper exchange stocks are declining, offset by some sporadic large additions on speculators moves. SHFE stocks declined through the year, but stocks in bonded warehouses have accumulated since August as the negative arbitrage makes importing into China though customs unprofitable.

Figure 34: Global exchange copper stocks



Source: LME, SHFE, customs data, Credit Suisse estimates

Figure 35: Shanghai bonded warehouse copper stocks

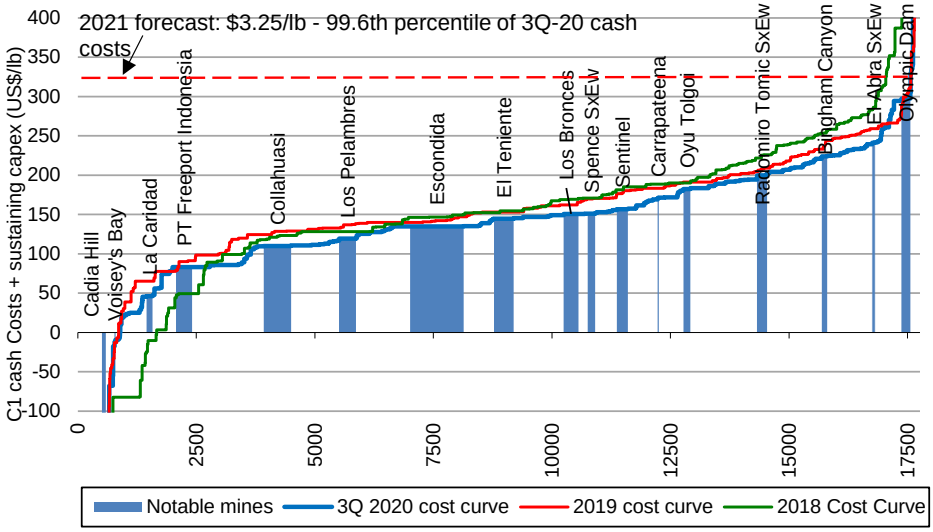


Source: SMM, Credit Suisse estimates

Price to remain strong

Given our forecast of a copper supply deficit this year and in 2021, we believe copper will be able to sustain a high price next year, of $3.25/lb, at the top of the cost curve making all mines profitable (Figure 36). After 2021, we expect the copper market to remain broadly balanced but tight through to the end of our forecast horizon, so elevated prices over $3/lb are justified to incentivise new mine supply beyond the several large new operations already in construction.

Figure 36: C1 cash + sustaining capex cost curves – notable mines highlighted



Source: Wood Mackenzie, Credit Suisse estimates

Mid-term & long-term pricing

Our longer term copper price view uses a 40 year cost curve

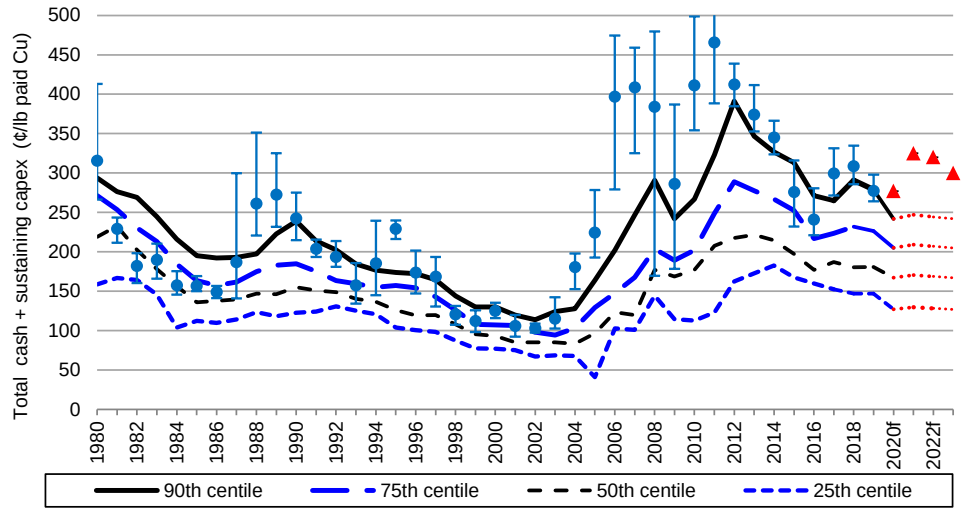
Our mid-term price forecasts are informed by a 40 year cost curve (Figure 37). In normal times when the market is sufficiently supplied, we believe the price should lie around the 90th percentile as it did in overall from 1990 to 2004, broadly since 2012 and exactly in 2019, profitable for most mines on an all-in basis, but putting pressure on the worst performing mines to become more efficient.

The average price has climbed well above the 90th percentile when supply is tight and new mines need to be incentivised. That occurred during the China super-cycle extending from 2004 to 2014, when China copper demand was growing at a CAGR of 11%.

We are now forecasting similar prices well above the cost curve for 2020-24 on a view that copper supply will barely meet demand. And the tightness may continue beyond 2024 as the world progresses towards decarbonisation. The plans for carbon neutrality are essentially to electrify everything where it is possible, needing copper demand. Copper may also see additional demand for its heat conduction properties, as heat pumps (reverse cycle air conditioners) are seen as the global answer for heating and cooling, moving away from direct use of coal, gas or oil. These devices use copper in external radiators to move heat in or out of houses.

Figure 37: 40 years total cash + sustaining capex cost curve percentiles and Cu prices

Real 2020 terms



Source: Wood Mackenzie, Credit Suisse estimates

Uncertainty whether Long term copper price needs to rise for decarbonisation

The most recent construction starts of large mines (Quelleveco and QB2) were approved on a view that the long-term copper prices would be $3/lb, which provided these projects with IRRs of 10-15%. The decarbonisation plans point to further mine approvals being needed. While there are a long list of possible new mines and mine expansions possible, the price needed to incentivise them is unclear. $3/lb was demonstrably a good call for the past but with the recent acceleration towards decarbonisation – and stronger copper demand, a higher price might be needed. However we are not yet convinced that is the case, so retain our current $3/lb long term price.

Figure 38: China supply & demand summary

	2016	2017	2018	2019f	2020f	2021f	2022f	2023f	2024f
China mine supply (kt)	1420	1460	1480	1515	1525	1590	1680	1810	1865
Chg YoY	*-6.5%*	*3.4%*	*1.0%*	*1.3%*	*0.6%*	*4.1%*	*6.1%*	*7.4%*	*3.2%*
Concentrate imports	4,311	4,413	4,986	5,561	5,589	5,866	6,250	6,450	6,540
Concentrate supply (kt)	5,731	5,873	6,466	7,076	7,114	7,456	7,930	8,260	8,405
SX/EW copper (kt)	70	80	75	60	60	60	70	70	75
Smelter production (kt)	6258	6,522	7,204	7,869	7,891	8,340	9,022	9,424	9,675
smelting scrap supply (kt)	750	880	1,050	1,120	970	1,160	1,290	1,370	1,480
Demand for concentrate (kt)	5651	5789	6316	6926	7099	7366	7930	8260	8405
Concentrate surplus/(deficit) (kt)	**80**	**84**	**150**	**150**	**15**	**90**	**-**	**-**	**-**
refining scrap supply (kt)	830	898	650	490	390	420	430	450	450
imports blister anode (kt)	704	798	901	755	940	920	840	900	970
Electro-refined copper production (kt)	7792	8218	8755	9114	9221	9680	10292	10774	11095
Total refined copper supply (kt)	7,862	8,298	8,830	9,174	9,281	9,740	10,362	10,844	11,170
China Copper consumption (kt)	10726	11194	11872	12209	12737	13155	13317	13785	14174
Chg YoY	*6.3%*	*4.4%*	*6.1%*	*2.8%*	*4.3%*	*3.3%*	*1.2%*	*3.5%*	*2.8%*
Restocking demand	345	10	430	200	750	0	0	0	0
Copper balance (kt)	**(3,209)**	**(2,906)**	**(3,472)**	**(3,235)**	**(4,206)**	**(3,416)**	**(2,955)**	**(2,941)**	**(3,005)**

Source: Lilan Consulting, Wood Mackenzie, Company data, Credit Suisse estimates

Figure 39: World ex-China supply & demand summary

	2016	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
ROW mine supply (kt)	18,795	18,698	19,228	19,322	19,024	19,239	20,157	21,071	21,628
Chg YoY	*6.0%*	*-0.5%*	*2.8%*	*0.5%*	*-1.5%*	*1.1%*	*4.8%*	*4.5%*	*2.6%*
Concentrate exports to China	(4,311)	(4,413)	(4,986)	(5,561)	(5,589)	(5,866)	(6,250)	(6,450)	(6,540)
Concentrate supply (kt)	10,612	10,582	10,622	10,189	9,881	10,086	10,639	11,395	12,093
SX/EW copper (kt)	3,787	3,607	3,531	3,497	3,479	3,213	3,185	3,144	2,909
Smelter production (kt)	11,702	11,754	11,722	11,181	11,114	11,252	11,713	12,448	13,126
Smelting scrap supply (kt)	1,327	1,347	1,272	1,394	1,406	1,367	1,381	1,382	1,381
Demand for concentrate (kt)	10,744	10,772	10,818	10,144	9,996	10,176	10,639	11,395	12,093
Concentrate surplus/(deficit) (kt)	**(133)**	**(190)**	**(197)**	**45**	**(115)**	**(90)**	**-**	**-**	**-**
Refining scrap supply (kt)	542	493	499	524	589	606	626	626	626
Electro-refined copper production (kt)	11,116	11,118	11,320	10,950	10,763	10,937	11,499	12,174	12,782
Total refined copper supply (kt)	14,904	14,725	14,851	14,447	14,241	14,150	14,684	15,318	15,691
ROW Copper consumption (kt)	11,789	11,888	11,817	11,623	10,131	10,951	11,709	12,275	12,804
Chg YoY	*1.5%*	*0.8%*	*-0.6%*	*-1.6%*	*-12.8%*	*8.1%*	*6.9%*	*4.8%*	*4.3%*
Copper balance (kt)	**2,769**	**2,827**	**2,604**	**2,624**	**3,360**	**3,199**	**2,975**	**3,044**	**2,887**

Source: Wood Mackenzie, Company data, Credit Suisse estimates

Mine supply reduced in future years by COVID-19

Concentrate imports grew only 2%

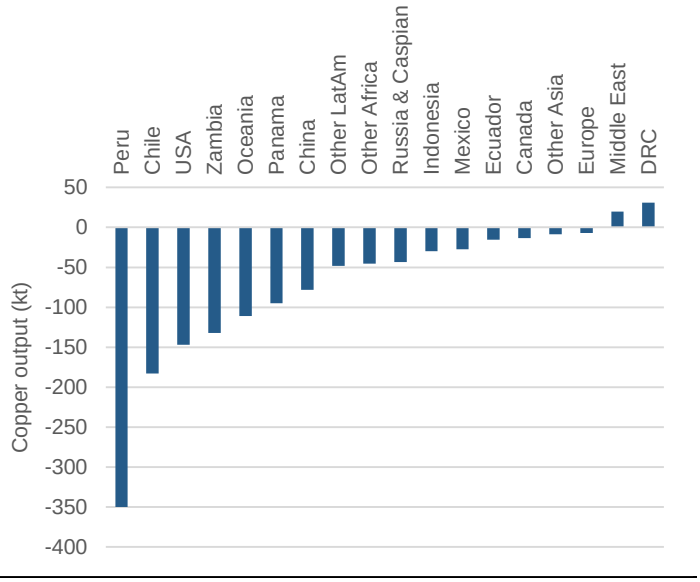
The impact of COVID-19 on South American copper mines was significant. If we compare copper mine output estimated so far to our expectations in Dec 2019, the mine supply is down by 1.3Mt or 6.2% of planned output. We adjust planned production down by 5% each year to account for strikes/accidents and other production misses, so COVID-19 has increased disruption above that expected by about 240kt. The production losses were headed by Peru at 350kt, followed by Chile -183kt and USA and Zambia, 132kt–147kt (Figure 40).

Another way to view this is to compare this year's production relative to last year and adjust for disruption factors. This does not fully measure disruption as some mines such as Grasberg were always expected to increase. Nevertheless, the production loss comes to about 344kt, again led by Peru at over 300kt and followed by Chile at 125kt.

Major concern now is new Chilean constitution and whether it affects mine supply

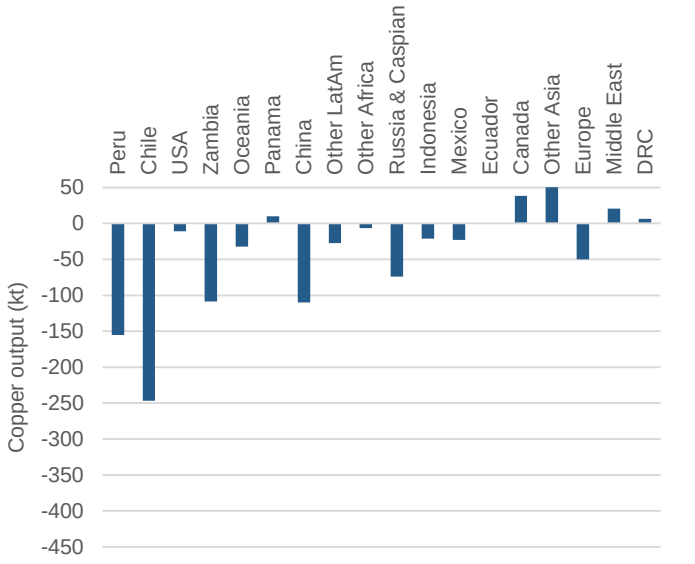
The impact on mine supply from COVID-19 will extend into future years. While Chilean mines produced solidly this year on reduced workforces, many have cut back on stripping so are storing up production difficulties for the future. BHP confirmed as much in its 2020 production reports, pointing out that FY22 output at Escondida will be impacted as stripping falls behind schedule on the reduced workforce on site. MMG's Las Bambas in Peru also noted a shortage of staff during the pandemic peak led to stripping being curtailed, so the mine plan needs revision and it dropped guidance.

Figure 40: 2020 mine production reduction vs 2019 estimate



Source: Wood Mackenzie, Company data, Credit Suisse estimates

Figure 41: 2021 mine production reduction vs 2019 estimate



Source: Wood Mackenzie, Company data, Credit Suisse estimates

Peru impact from COVID-19

We assess Peru as having experienced the greatest negative impact to copper mine supply so far. The world's second largest copper producing nation imposed its lock-down on 16 March and extended the period to May. While some mines saw little impact, such as those of Southern Copper, other major operations were heavily impacted. Antamina was closed for two months. Las Bambas did not cease, but a shortage of staff saw it abandon stripping, mine whatever ore was exposed, so the mine plan was abandoned, and grade was reduced. Relative to our pre-pandemic forecast, we assess Peru will lose 350kt of mine supply.

Chile impact from COVID-19

Chile as the world's largest copper producing nation comes second in mine supply reductions in our estimate. Chile did not closed mines, declaring them essential industries and actually saw solid production. However, relative to our pre-pandemic forecast, we assess Chile's output as being down by 185kt, but some of this may be related to other issues such as drought rather than just the pandemic.

Mining unions have noted that the reduced workforces being used at many mines is storing up mining problems for the future, which BHP has confirmed for Escondida. The bigger impact may be ahead. We assess a loss of 250kt in 2021 (Figure 41), and 350kt in 2022 relative to our 2019 estimate for this period, but some of this may be due to a slow-down in growth – especially the QB2 mine and Quelleveco projects.

Zambia

In other notable regions, Glencore announced the idling of Mopani, but incurred an immediate reaction from the Zambian Government, which threatened to strip the mine from Glencore. Glencore backtracked and now says it is operating the mine, but is still negotiating with the Government. In November, Zambia state-owned ZCCM Investments said it would buy the mine

and operate it, but it is unclear how the Government would fund the purchase. The jump in the copper price should now make Mopani look attractive again.

US impact

Freeport idled production at its Chino mine in the US after a worker was infected with COVID-19, although the mine has now restarted. Freeport also adjusted production plans at all its US operations to reduce costs and capex plans. While overall production appears to have been resilient, output is still 150kt below our pre-COVID-19 expectations.

Growth mines

COVID-19 will impact future years copper mine supply

We expect COVID-19 will delay some of the new mine supply growth. The annual additions we expect are now 200-300kt less than previously. Construction halted earlier this year at Quelleveco in Peru and QB2 in Chile, two of the big new ca.300ktpa porphyry copper deposits scheduled for 2022, but activity is now cautiously restarting in 3Q. Teck confirmed a six month delay for the QB2, indicating a start-up in 2H-22, rather than late 2021. Anglo indicates that Quelleveco is still expected to start in 2022, but it has been set back. Slowing these two projects has taken 170kt from our forecasts for 2022.

BHP also just set back the start-up date of Spence Hypogene to 1H-21 from Dec-Mar saying COVID-19 mitigation caused delays and we also expect a slow down at Mina Justa. Cobre Panama which recently started and was ramping up is producing strongly, but guidance was cut after it was shut for a quarter due to COVID-19. We expect Mopani operating at low rates this year as Glencore was still intent on idling the operation. But we have the mine accelerating next year irrespective of ownership on the assumption that the operation looks attractive at a +$3/lb copper price (Figure 42).

Figure 42: Growth mine projects in our forecasts

Mine	Country	Owner	2020	2021	2022	2023	2024	2020-24
Kamoa-Kakula	DRC	CNMC	0	50	250	350	385	385
Mopani	Zambia	Glencore	21	70	100	105	105	84
Timok	Serbia	Nevsun	0	20	135	145	129	129
Oyu Tolgoi	Mongolia	Rio Tinto	158	188	267	453	586	428
Chuqcamata	Chile	Codelco	99	193	298	388	418	319
Spence Sx/EW	Chile	BHP	150	145	135	115	52	-98
Spence Hypogene	Chile	BHP	0	90	160	190	190	190
Quebrada Blanca	Chile	Teck	0	0	40	200	290	290
Quellaveco	Peru	Anglo American	0	0	20	180	380	380
Mina Justa	Peru	Minsur	0	90	98	90	85	85
Mina Justa SXEW	Peru	Minsur	0	50	55	58	58	58
Tia Maria	Peru	SCC	0	0	0	0	45	45
Cobre Panama	Panama	First Quantum	190	310	325	425	401	211
Lone Star	US	Freeport	18	40	55	70	90	72
Carrapateena	Australia	Oz Mineral	23	80	76	70	65	43
PT Freeport	Indonesia	Freeport	350	661	750	802	760	410
Batu Hijau	Indonesia	PT Amman MN Teng.	108	161	161	161	161	53
Total			**1116**	**2148**	**2926**	**3802**	**4200**	3083
Annual increment			**235**	**1032**	**778**	**875**	**398**	

Source: Wood Mackenzie, Company data, Credit Suisse estimates

Supply: China refined output increased weakly

China's production growth while demand is strong points to problems for smelters.

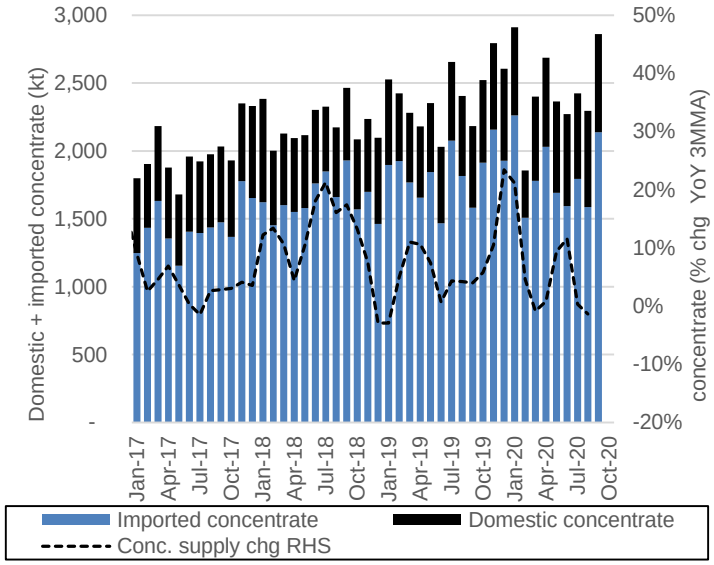
China's refined output as estimated by SMM was up 3.6% YoY for the first nine months. It was broadly flat since March at about 750kt per month, until Aug when if climbed past 800kt per month, despite solid demand growth (Figure 43). We suspect the reasons for the slow growth

was a lack of raw materials, particularly smelting and refining scrap, and a lack of a profit incentive.

Concentrate imports grew only 2%

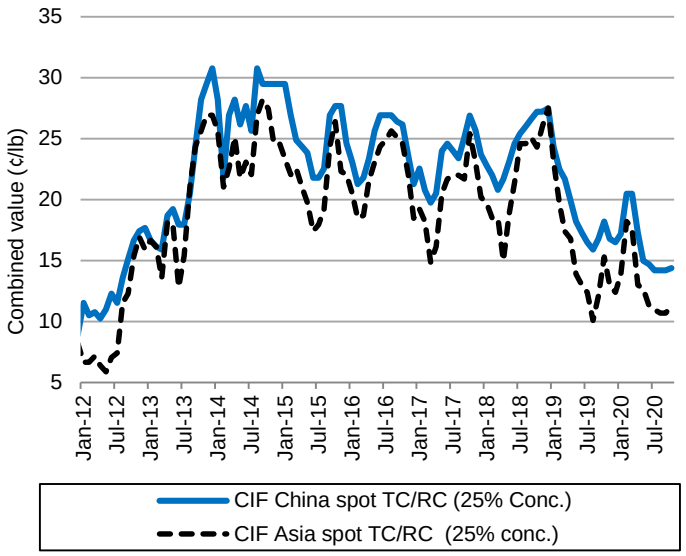
The impact of COVID-19 on South American copper mines is well known and may have played a factor in China's subdued copper output despite rampant demand. Certainly falling spot TC/RCs indicate that supply is tight (Figure 44), therefore it is not surprising that China's imports of copper concentrate over the first nine months were up a meager 2.2% (Figure 43).

Figure 43: China concentrate supply



Source: Customs data, CEIC, Credit Suisse estimates

Figure 44: Asia & China spot TC/RCs (¢/lb combined for 25%)



Source: Wood Mackenzie, Credit Suisse estimates

Domestic concentrate output looks strong

Domestic mine supply is a different story. Production figures are not available for the first two months, but judging from subsequent output reported by China's Nonferrous Metals Industry Association, domestic supply may be up around 8% YoY in the first nine months. Overall, it appears that mine supply for China is up YoY (Figure 43), so lack of concentrate may not be the overall reason for soft smelter output growth.

China's refining and smelting scrap supply heavily impacted by lockdowns

Copper smelters also use scrap as a raw material, and that supply has declined. Smelting scrap is used in the converters of primary copper smelters to absorb free heat and the subsequent refined copper is a combination of virgin copper and scrap units. Refining scrap is treated by specialist secondary smelters that profit from the price spread between scrap and refined copper.

China's imports of scrap dropped by an estimated 46% in terms of contained copper in nine months to Sep (Figure 45). We estimate that amounts to a fall in copper content of 490kt. The fall was partly due to COVID-19 lockdowns in southeastern Asian dissembling yards in 1H, as well as uncertainties about the implementation of China's new import standards.

China's domestic scrap was also low in 1H, according to Lilan Consulting, but loosened after May with improved collection and higher copper prices encouraging scrap dealers to destock inventory. Despite the stronger copper price, and dissemblers reporting EOL electrical appliances volumes soaring in 2Q, Lilan Consulting believes domestic scrap collection might drop 10.5% or 180kt given the low operating rate in 1Q.

Putting these two amounts together 490+180kt it is evident that the scrap shortfall in China is large at over 670kt of contained copper. Most of this old scrap would be lower grade products that need refining, rather than clean scrap used directly by fabricators.

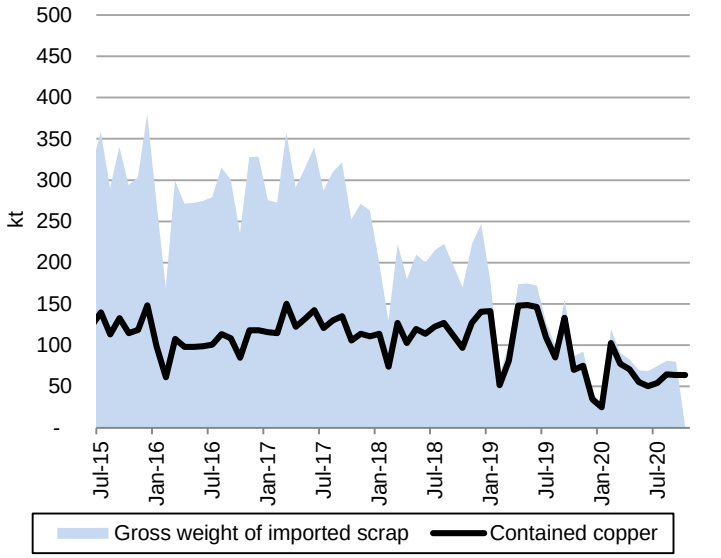
Copper output may be low on the scrap shortfall

So it is possible that China's refined copper output growth was slowed by a scarcity of scrap raw materials. Secondary smelters were not operating in IH and concentrate tightness did not fully alleviate the scrap-gap.

Profits low on TC/RC and weak scrap discounts

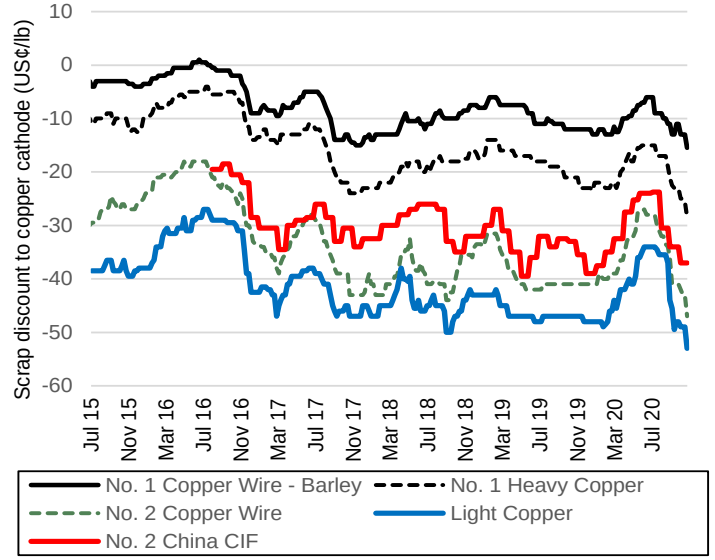
Equally, copper smelters may not be inclined to ramp up production aggressively due to weak profitability. TC/RCs are low on concentrate tightness - spot TC/RCs are now the lowest in China since the super cycle growth year of 2012 (Figure 44), and term contracts are not much higher, with the large China Smelter Purchase Team accepting a TC/RC floor of $53/5.3¢ for 3Q, a drop from $67/6.7¢ in 2Q.

Figure 45: China imported copper scrap – Cu declined



Source: Customs data, Lilan Consulting, Credit Suisse estimates

Figure 46: Copper scrap discounts to refined copper price



Source: Fastmarkets, Credit Suisse estimates

Scrap supply improved in 2H but not imports

In 2H scrap supply and usage has improved. Some Chinese-owned disassembling yards and casting mills in Southeastern Asia have resumed production, thus improving scrap supply. Scrap spreads widened on improved supply which encouraged usage by fabricators and secondary smelters (Figure 46).

Imports of scrap to China under the new standards that classified it as a raw material rather than waste were delayed as HS codes for import were not initially released. The HS codes came out in 3Q, and in theory imports under the new high grade standards should have been free of restriction from 1 Nov, with no need for import quotas. However, Refinitiv reported that Chinese scrap suppliers remain hesitant to import given some confusion over inspection requirements and whether US cargoes are subject to a 25% trade war tariff.

Figure 47: Copper supply and demand

	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
MINE PRODUCTION								
Chile	5,552	5,866	5,842	5,716	5,651	5,688	5,907	6,105
China	1,540	1,555	1,575	1,585	1,650	1,750	1,880	1,940
Russia/Caspian	1,652	1,750	1,835	1,806	1,791	1,900	1,995	2,044
Peru	2,406	2,397	2,419	2,101	2,468	2,521	2,656	2,751
Oceania	1,003	955	1,003	906	990	1,038	942	914
USA	1,313	1,279	1,308	1,279	1,410	1,409	1,345	1,380
DRC	1,152	1,338	1,445	1,544	1,574	1,888	2,026	2,004
Zambia	789	865	829	912	1,000	1,068	1,030	1,026
RoW	4,751	4,703	4,581	4,779	5,341	5,584	5,984	5,970
World Mine Production (unadj.)	**20,158**	**20,708**	**20,837**	**20,628**	**21,875**	**22,846**	**23,765**	**24,133**
Probable Growth	-	-	-	7	47	*106*	170	290
Price-driven closures					**-**	**-**	**-**	**-**
Mine Disruption (5.0%)	-	-	-	(86)	(1,096)	(1,149)	(1,204)	(1,236)
SxEw (adjusted)	3,687	3,606	3,557	3,539	3,273	3,255	3,214	2,984
Concentrate (adjusted)	16,470	17,103	17,280	17,010	17,556	18,582	19,667	20,509
World Mined Copper	**20,158**	**20,708**	**20,837**	**20,549**	**20,829**	**21,837**	**22,881**	**23,493**
% Change	*-0.3%*	*2.7%*	*0.6%*	*-1.4%*	*1.4%*	*4.8%*	*4.8%*	*2.7%*
Available Supply of Conc.	**16,455**	**17,088**	**17,265**	**16,995**	**17,542**	**18,569**	**19,655**	**20,498**
Smelter Capacity	22,281	23,788	24,327	24,827	25,236	25,658	25,551	25,551
Smelter Production	18,276	18,926	19,050	19,005	19,591	20,735	21,872	22,800
Scrap addition (ex resmelted blister)	2,227	2,322	2,514	2,376	2,527	2,671	2,752	2,861
Smelter losses	512	530	533	532	549	581	612	638
Primary Feed Requirement	**16,561**	**17,134**	**17,070**	**17,095**	**17,542**	**18,569**	**19,655**	**20,498**
CONC. SURPLUS/(DEFICIT)	**(106)**	**(47)**	**195**	**(100)**	**0**	**0**	**0**	**0**
REFINED COPPER PRODUCTION								
Africa	1,263	1,474	1,454	1,618	1,794	1,995	2,016	1,983
Asia	12,029	12,344	12,480	12,665	13,299	13,943	14,391	14,736
Europe	2,942	2,891	2,833	2,957	3,016	3,016	3,021	3,061
Latin America	2,953	2,998	2,792	2,859	2,970	2,892	2,784	2,675
North America	1,800	1,814	1,779	1,711	1,959	1,969	1,980	1,954
Oceania	390	374	421	484	505	525	542	566
Other	1,647	1,786	1,862	1,916	1,889	1,917	1,976	1,989
Required Adjustment	-	-	-	(688)	(1,543)	(1,212)	(549)	(105)
Scrap/Blister	1,391	1,149	1,014	979	1,026	1,056	1,076	1,076
Electro Refined	19,336	20,075	20,064	19,984	20,617	21,791	22,948	23,877
Net SxEw	3,687	3,606	3,557	3,539	3,273	3,255	3,214	2,984
World Refined Production	**23,023**	**23,681**	**23,621**	**23,523**	**23,890**	**25,046**	**26,162**	**26,860**
% Change	*1.1%*	*2.9%*	*-0.3%*	*-0.4%*	*1.6%*	*4.8%*	*4.5%*	*2.7%*
of which China	8,299	8,830	9,175	9,256	9,790	10,362	10,844	11,170
% Change	*5.6%*	*6.4%*	*3.9%*	*0.9%*	*5.8%*	*5.8%*	*4.7%*	*3.0%*

	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
STOCKS (year end)								
LME+Comex	393	232	179	-	-	-	-	-
SHFE	150	119	124	-	-	-	-	-
Total Exchange Stocks	543	351	303	-	-	-	-	-
Weeks Consumption	1.2	0.8	0.7	-	-	-	-	-
PRICE								
Price (US$/t)	**6,170**	**6,532**	**6,010**	**6,100**	**7,160**	**7,060**	**6,620**	**6,840**
Price (US$/lb)	**2.80**	**2.96**	**2.73**	**2.77**	**3.25**	**3.20**	**3.00**	**3.10**
TC (US$/t)	93	82	81	62	90	100	100	100
RC (c/lb)	9.3	8.2	8.1	6.2	9.0	10.0	10.0	10.0
Smelter utilisation	*82%*	*80%*	*78%*	*77%*	*78%*	*81%*	*86%*	*89%*
REFINED COPPER CONSUMPTION ("First Use")								
Africa	209	208	182	171	188	202	211	223
Asia	15,078	15,602	15,930	16,091	16,616	17,012	17,657	18,192
Europe	3,745	3,797	3,629	3,003	3,380	3,644	3,843	4,046
Latin America	422	420	414	369	401	432	457	480
North America	2,366	2,414	2,453	2,166	2,398	2,538	2,629	2,731
Middle East	808	790	798	698	730	779	829	861
Oceania	11	11	11	10	11	11	11	11
Russia/Caspian	444	448	415	359	382	407	422	434
World Consumption	**23,082**	**23,689**	**23,832**	**22,868**	**24,106**	**25,026**	**26,059**	**26,978**
% Change	*2.5%*	*2.6%*	*0.6%*	*-4.0%*	*5.4%*	*3.8%*	*4.1%*	*3.5%*
of which China	11,194	11,872	12,209	12,737	13,155	13,317	13,785	14,174
China	*4.4%*	*6.1%*	*2.8%*	*4.3%*	*3.3%*	*1.2%*	*3.5%*	*2.8%*
World Excl. China	*0.8%*	*-0.6%*	*-1.6%*	*-12.8%*	*8.1%*	*6.9%*	*4.8%*	*4.3%*
- Including China stock build	-	-	-	750	-	-	-	-
SURPLUS/(DEFICIT)	**(59)**	**(8)**	**(211)**	**(95)**	**(217)**	**20**	**102**	**(118)**
- including price-induced mine closures			**-**	**-**	**-**	**-**	**-**	**-**
CHINA MARKET BALANCES								
Total Mine Supply	**1,460**	**1,480**	**1,515**	**1,525**	**1,590**	**1,680**	**1,810**	**1,865**
Conc. Imports	4,413	4,986	5,561	5,589	5,866	6,250	6,450	6,540
Other Raw Material Imports	920	1,065	1,140	990	1,180	1,310	1,390	1,500
Smelter Production	6,522	7,204	7,869	7,891	8,340	9,022	9,424	9,675
Refinery Scrap	898	650	490	390	420	430	450	450
Refined Production	**8,298**	**8,830**	**9,174**	**9,281**	**9,740**	**10,362**	**10,844**	**11,170**
Refined Copper Imports	3,243	3,323	3,550	4,425	3,325	2,910	2,629	2,417
Refined Copper Exports	338	281	316	220	330	400	420	450
Refined Consumption	**11,194**	**11,872**	**12,209**	**12,737**	**13,155**	**13,317**	**13,785**	**14,174**
Direct Use of Scrap	1,365	1,268	1,275	1,071	1,155	1,291	1,365	1,453
Semis Production	**12,559**	**13,140**	**13,484**	**13,808**	**14,310**	**14,608**	**15,150**	**15,627**
% Change	5.4%	4.6%	2.6%	2.4%	3.6%	2.1%	3.7%	3.2%

Source: Wood Mackenzie, Lilan Consulting, SMM, Company data, Credit Suisse estimates

Aluminium forecast

Growth to outpace supply, unwinding surpluses

The outlook for aluminium has further improved, in our opinion. While global aluminium consumption in 2020 deteriorated under the global COVID-19 recession, prices soared in the second half of the year as rampant demand in China consumed domestic stocks, then imported from the rest of the world, exporting its price. Aluminium prospects continue to look upbeat in 2021 as ROW should see industrial production recovery, while China should support construction and manufacturing as it works to revive other facets of its economy. Further forward, the accelerating moves towards decarbonisation benefit aluminium through necessary expansions of electricity grids, and frames for solar panels.

Revised aluminium prices upwards on tightening outlook

An acceleration of construction demand in China in Nov saw the price surge, nearing $2000/t. We expect the price to ease with construction demand over winter, but lift once more with demand from 2Q-21. We expect ongoing growth in China and industrial recovery in the ROW to outpace supply additions, tightening prices across the forecast period, and delivering a price towards the top of the cost curve. We do not rule out prices exceeding $2000/t for periods, but do not have confidence that such a price can be sustained, given large global stockpiles and the detrimental impact on production rationalisation such prices would have.

Figure 48: Revised aluminium price forecast

		1Q-20	2Q-20	3Q-20	4Q-20	2020E	1Q-21	2Q-21	3Q-21	4Q-21	2021E	2022E	2023E	2024E	LT (real)
New	US$/t	1,690	1,501	1,739	1920	**1713**	1850	1900	1900	1870	**1880**	**1,900**	**1,900**	**1,900**	2,865
New	US$/lb	0.77	0.68	0.79	0.87	**0.78**	0.84	0.86	0.86	0.85	**0.85**	**0.86**	**0.86**	**0.86**	1.30
Old	US$/lb	0.77	0.68	0.79	0.77	**0.75**	0.77	0.77	0.77	0.77	**0.77**	**0.82**	**0.82**	**0.90**	1.30
Chg	*%*	*0%*	*0%*	*0%*	*13%*	***3%***	*9%*	*12%*	*12%*	*10%*	***11%***	***6%***	***6%***	***-4%***	*0%*

Source: Credit Suisse estimates

Aluminium long-standing surplus moves towards supply balance by 2023

We estimate the COVID-19 recession has caused global aluminium consumption to decline by 0.7%in 2020, and we expect the global surplus will be 2.6Mt. However, by 2023 we expect the market to be approaching balance, as global demand recovers while production additions slowdown as China's smelter builds are tightly restricted under China's 45Mt capacity cap. We forecast global demand growth of 6.3% in 2021 due to demand recovery of 9.1% in world ex-China, and 4.1% growth in China. In 2020, we believe China's consumption growth was 7.0%, but supply – production, imports and stock reductions – was greater, pointing to a non-visible stock build. We understand from our China analyst's contacts that the China's secretive State Reserve Bureau has bought aluminium and we estimate the volume to be 850kt.

Figure 49: Global aluminium supply & demand summary

	2015	2016	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
Global capacity	64,520	66,320	70,700	75,520	76,280	77,500	78,380	79,520	80,500	81,240
Global production (kt)	57,807	59,457	63,124	64,093	63,710	65,530	69,375	71,730	73,090	74,680
Disruption allowance (kt)						*-129*	*-1,570*	*-1,590*	*-1,610*	*-1,620*
Forecast output (kt)	**57,810**	**59,460**	**63,120**	**64,090**	**63,710**	**65,400**	**67,810**	**70,140**	**71,480**	**73,060**
Chg YoY	*6.8%*	*2.9%*	*6.2%*	*1.5%*	*-0.6%*	*2.7%*	*3.7%*	*3.4%*	*1.9%*	*2.2%*
Capacity utilisation (%)	*89.6%*	*89.7%*	*89.3%*	*84.9%*	*83.5%*	*84.4%*	*86.5%*	*88.2%*	*88.8%*	*89.9%*
Global Al consumption (kt)	**55,920**	**58,180**	**60,640**	**62,270**	**62,058**	**61,600**	**65,450**	**68,350**	**70,900**	**73,150**
Chg YoY	*5.9%*	*4.0%*	*4.2%*	*2.7%*	*-0.3%*	*-0.7%*	*6.3%*	*4.4%*	*3.7%*	*3.2%*
SRB Restocking						850				
Global demand	55,920	58,180	60,640	62,270	62,058	62,450	65,450	68,350	70,900	73,150
Global surplus/(deficit) (kt)	**1,890**	**1,280**	**2,480**	**1,820**	**1,652**	**2,950**	**2,360**	**1,790**	**580**	**(90)**

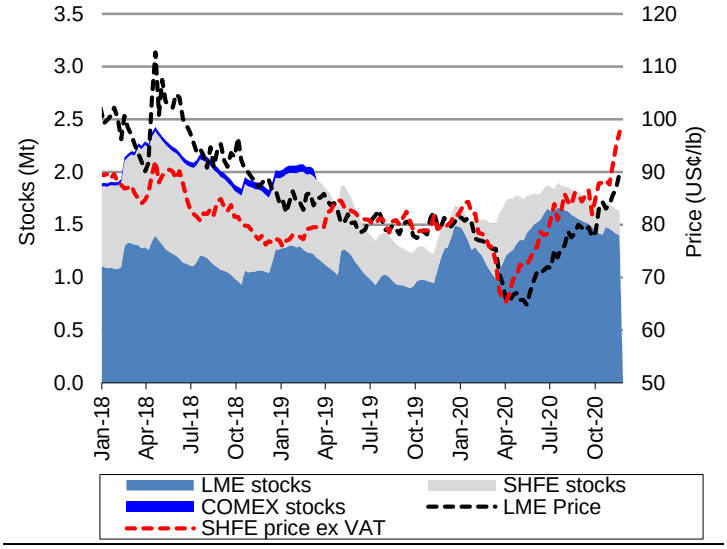
Source: IAI, Wood Mackenzie, Customs data, SMM, Credit Suisse estimates

China aluminium demand carried the world in 2020

Chinese imports surged from June, lifting global prices

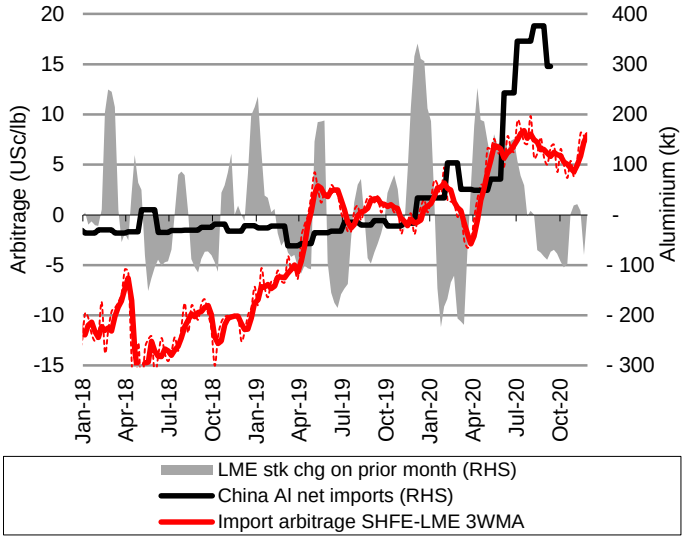
Beginning in April, China's aluminium demand recovered from a very weak start to the year, and began to deplete domestic stocks. By June, China started to import 200-400kt per month of unwrought aluminium, exceeding net semi exports. The call on global aluminium to meet China's rampant demand dragged up LME prices to narrow the arbitrage against China's strong price and depleted visible aluminium stocks in LME warehouses from July (Figure 50, Figure 51). From the end of October, China prices surged in line with steel, probably in response to accelerating construction demand, as projects raced to beat the onset of the winter freeze. With the lift in China's price, the import arbitrage remains wide open at present, so imports are liable to continue to the end of the year.

Figure 50: Global exchange stocks & prices



Source: LME, SHFE, COMEX, Credit Suisse estimates

Figure 51: China import arbitrage, imports & LME stock chg



Source: LME, SHFE, customs data, Credit Suisse estimates

Apparent demand and imports surged from June

Based on IAI aluminium production, customs and SMM inventory data, for eight Chinese cities, we estimate China's aluminium apparent consumption at 10.1% YoY over the nine months to September, with the strongest monthly rates since June (Figure 52, Figure 53). Clearly aluminium lifted sharply at the end of the China lockdowns, but really took off from mid-year, which broadly correlates with the trajectory of car sales, infrastructure, appliances and power generation. The last may seem anomalous, but may reflect an acceleration of solar power projects (36-40GW). Aluminium alloy is used for the solar panel frames.

We forecast 7% consumption growth and 850kt of SRB stocks for 2020

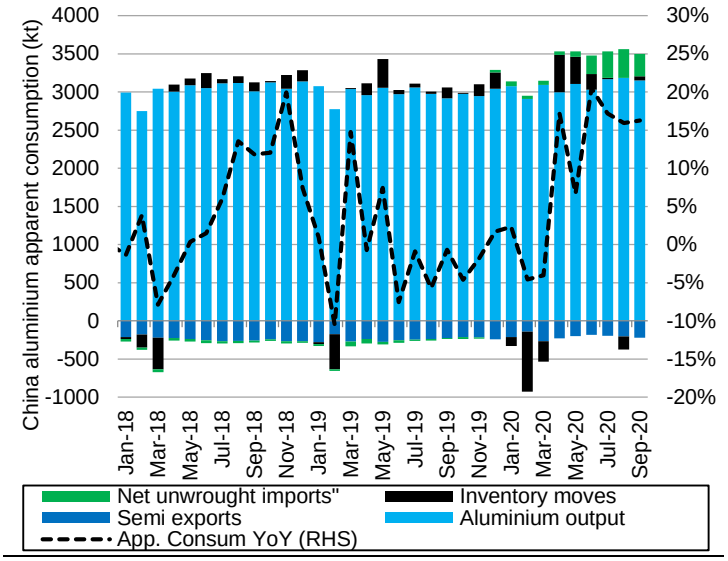
While we can account for much of the demand from China manufacturing, 10% YTD growth achieved in six months reversing a negative first quarter is extraordinary. We forecast consumption growth this year will actually be 7% YoY, the same as China's steel demand. This rate is a lot higher than consultant Wood Mackenzie, which estimates China's primary aluminium consumption fell 1.1% this year, but we find it inconceivable that Chinese aluminium demand could be falling while steel demand has clearly grown 7% this year. The demand sectors are the same between the two metals albeit with different weightings.

If consumption growth really is 7% as we estimate, and the IAI China production figure is reliable (questionable), then there is perhaps 800-900kt of aluminium supply to China needing to be accounted for.

There are three possible explanations for the missing 800-900kt of aluminium in China:

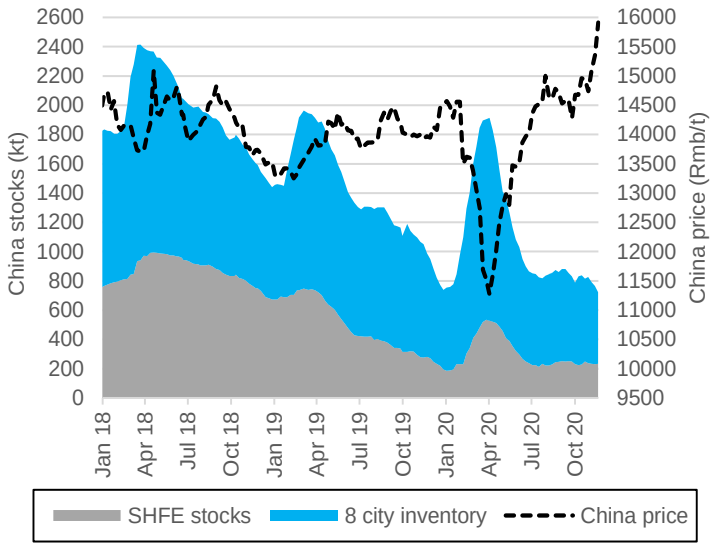
- The excess of ~850kt of supply may be in commercial stocks not captured in SMMs report;
- The stocks might be in the form of semi-fabricated product stockpiles rather than ingots, where stockpiles are harder to monitor. Wood Mackenzie believes this is the case, as about two thirds of smelters sell liquid metal directly to fabricators, and may lack a cast house to produce ingots. It explains the high price for ingots as a shortage of metal in that form rather than an overall aluminium shortage. However, we see little evidence to suggest this is the case. SMM monitors inventories of 6065 alloy billet in five consumption areas of China, but there was little evidence of an inventory build after the 1Q inventory bulge was worked down.
- China State Reserve Bureau buying aluminium. Our China analyst's contacts indicated the SRB was buying aluminium for its warehouse in Henan. The SRB is secretive so we will never have confirmation on whether the SRB did buy or how much. But as the SRB is a strategic reserve, not a trader, whatever it may have bought is unlikely to be released and so has permanently exited the market. This is the explanation we use for our model, with an 850kt build in China stocks.

Figure 52: China's apparent consumption of aluminium



Source: IAI, customs data, SMM, Credit Suisse estimates

Figure 53: China's 8 city aluminium ingot inventory



Source: SMM, SHFE, Credit Suisse estimates

China's 2021 demand

We expect 4.1% consumption growth in 2021 with all sectors positive

CQi notes aluminium demand in China in 2020 benefited from the power sector, property and infrastructure, and the auto sector, home appliances, and packaging sectors, all having improved markedly late in the year.

In 2021, we forecast China's primary aluminium demand will grow 4.1%. We expect all sectors to remain positive, and auto demand should accelerate. However, growth in construction may slow, with property new starts easing and the infrastructure investment spend may fall. Any slowdown may be countered by higher property completions adding to demand for the fit-out. The investment in renewable power may continue to rise, supporting aluminium demand for the solar and wind facilities, as well as overhead transmission lines.

Figure 54: China supply & demand summary

	2015	2016	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
Al Capacity	35,200	37,700	39,000	41,000	43,000	44,200	45,000	45,000	45,000	45,000
Chg YoY	*14.3%*	*7.1%*	*3.4%*	*5.1%*	*4.9%*	*2.8%*	*1.8%*	*0.0%*	*0.0%*	*0.0%*
Disruption allowance (kt)						*-70*	*-900*	*-900*	*-900*	*-900*
Al Production (kt)	**31,520**	**32,640**	**35,910**	**36,490**	**35,800**	**37,210**	**38,710**	**39,810**	**41,310**	**42,810**
Chg YoY	*11.3%*	*3.6%*	*10.0%*	*1.6%*	*-1.9%*	*3.9%*	*4.0%*	*2.8%*	*3.8%*	*3.6%*
Capacity utilisation	*90%*	*87%*	*92%*	*89%*	*83%*	*84%*	*86%*	*88%*	*92%*	*95%*
Al Consumption (kt)	**28,590**	**30,200**	**31,990**	**33,379**	**33,336**	**35,680**	**37,160**	**38,830**	**40,510**	**41,960**
SRB restocking						850				
Chg YoY	*9.2%*	*5.6%*	*5.9%*	*4.3%*	*-0.1%*	*7.0%*	*4.1%*	*4.5%*	*4.3%*	*3.6%*
China aluminium balance	**2,930**	**2,440**	**3,920**	**3,111**	**2,464**	**680**	**1,550**	**980**	**800**	**850**
Al unwrought imports/(exports)	-380	-267	-402	-389	-224	2,050	2,000	2,000	2,300	2,400
Al in Semi exports	2,208	2,008	2,059	2,986	2,956	2,588	2,746	2,870	2,995	3,114
China net balance	**342**	**165**	**1,459**	**(264)**	**(716)**	**142**	**804**	**110**	**105**	**136**

Source: IAI, customs data, SMM, Credit Suisse estimates

ROW aluminium demand to recover

We forecast a 10% fall: Autos were a drag in 2020, but are the accelerator for 2021

We forecast ROW aluminium demand fell almost 10% this year, dragged down by a number of sectors, but particularly autos, where car industries in Europe, the US and Japan were impacted by lockdowns and weak sales. However, late in the year, the auto industry across all these regions was picking up faster than expected, causing the refiring of curtailed blast furnaces at steel mills. By November, HRC mills in many regions, particularly the US were stretched to meet orders from auto plants. This bodes well for a strong pick-up in auto demand in 2021.

Another sector that was very strong late in 2021 was demand from appliances and machinery. These orders were being filled in China, with its export orders up 50% in Oct. This may have been caused by stage 2 COVID-19 lockdowns in Europe impacting production, so only Chinese models could be sold.

Led by a rebound in these sectors, and contributions from others, we expect ROW aluminium demand to rebound by 9.1% in 2021, and follow that with 4.3% in 2022, taking aluminium consumption above 2019 levels (Figure 55).

Figure 55: Ex-China aluminium supply and demand summary

	2015	2016	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
Capacity	29,320	28,620	31,700	34,520	33,280	33,300	33,380	34,520	35,500	36,240
YoY	*2.8%*	*-2.4%*	*10.8%*	*8.9%*	*-3.6%*	*0.1%*	*0.2%*	*3.4%*	*2.8%*	*2.1%*
Disruption allowance (kt)						*-59*	*-670*	*-690*	*-710*	*-720*
Production (kt)	**26,290**	**26,820**	**27,210**	**27,600**	**27,910**	**28,190**	**29,100**	**30,330**	**30,170**	**30,250**
Chg YoY	*1.9%*	*2.0%*	*1.5%*	*1.4%*	*1.1%*	*1.0%*	*3.2%*	*4.2%*	*-0.5%*	*0.3%*
Capacity utilisation	*90%*	*94%*	*86%*	*80%*	*84%*	*85%*	*87%*	*88%*	*85%*	*83%*
Consumption (kt)	**27,330**	**27,980**	**28,650**	**28,891**	**28,722**	**25,920**	**28,290**	**29,520**	**30,390**	**31,190**
Chg YoY	*2.7%*	*2.4%*	*2.4%*	*0.8%*	*-0.6%*	*-9.8%*	*9.1%*	*4.3%*	*2.9%*	*2.6%*
ROW aluminium balance	**(1,040)**	**(1,160)**	**(1,440)**	**(1,291)**	**(812)**	**2,270**	**810**	**810**	**(220)**	**(940)**
Al unwrought imports/(exports)	380	267	402	389	224	(2,050)	(2,000)	(2,000)	(2,300)	(2,400)
Al in Semi imports	2,208	2,008	2,059	2,986	2,956	2,588	2,746	2,870	2,995	3,114
ROW net balance	**1,548**	**1,115**	**1,021**	**2,084**	**2,368**	**2,808**	**1,556**	**1,680**	**475**	**(226)**

Source: Wood Mackenzie, IAI, customs data, Credit Suisse estimates

Decarbonisation to enhance aluminium demand late in the forecast period

Further out we expect aluminium demand to be relatively buoyant as it will be a key contributor to decarbonisation and renewable energy, both for the frame around solar panels, and also transmission, as grids relying on intermittent renewable energy will need to be greatly expanded to balance supply and demand. The EU plans to expand its grid not only between the 27

members, but also the rest of Europe. The decarbonisation demand may become noticeable in 2023 and 2024, so we maintain consumption forecasts in the mid-high 2% due to demand for electrical infrastructure.

Supply analysis

China's smelter additions should end within the forecast period as 45Mt cap nears
SMM assessed China's built smelting capacity at the end of October as 44.18Mtpa, although not all is operational due to curtailments. On SMM's estimates, the operational rate was 87.5% during the month. SMM also assessed new smelter capacity additions as 2.5Mt in 2019, 2.9Mtpa due to be added this year and 3.2Mt to be added in 2021. The nominal smelter capacity cap in China is about 45Mtpa, so we assume that some of the built smelters will be permanently shut down and demolished as the new smelter capacity is added.

Production increases lag capacity additions – we expect 1.5Mtpa
The actual production increase has been slower than the capacity additions. Through to September, China's production was growing at 3.3% YoY according to IAI stats and we expect the output for the year to rise 1.4Mt, only about half the capacity addition. We expect another 1.5Mt to start up in 2021 and most subsequent years, with production reaching 42.8Mtpa by 2024, a 95% capacity utilisation of the 45Mtpa capacity cap. That is probably as high as can be sustainably reached.

We expect China will continue to export semi-fabricated products at an elevated and growing rate through the forecast period, as that is the metal form its aluminium industry is set up to produce. Many smelters are located adjacent to the fabricators and supply liquid aluminium, saving on energy costs. SMM estimated 69% of primary aluminium supply was in a liquefied form in October. Conversely, many other countries have come to rely on China for semi-fabricated products and probably do not have the facilities to produce their own.

China's 45Mtpa capacity cap was devised as the appropriate production to supply its own domestic needs. However, if part of that production is being exported as semis, additional imports of raw aluminium will be needed to support domestic needs. We expect China will need to import at least 2Mt of contained aluminium as unwrought and alloy products to sustain the semi exports if production rates increase at about 1.5Mtpa through the forecast period as we estimate.

Few ex-China smelter additions
Ex-China additions are adding about 1Mtpa to production in 2021 and 2022 as ramp-ups in Russia (Taishet), India (Jharsuguda), Iran (SALCO), and Canada (Becancour restart) rise towards capacity. However from 2023, ex-China production is likely to flatten out at roughly 30.25Mt as current projects reach capacity (Figure 55). Beyond that, new smelter additions will be needed.

There are potential new additions after -2025 (a cumulative 765Kt in 2026 and growing) but these additions are speculative. There are a wide range of possible projects – additions to smelters in the Gulf and India, new ASIAN smelters in Indonesia or Vietnam, some facilities in the "Stans" of Central Asia.

Smelter outages may be delayed on high prices
We previously believed about 3Mt of aluminium smelting capacity outside of China could be closed in the next few years. These potentially included the smelters in Australia, which Alcoa and Rio Tinto have flagged as under review. This year we have seen Rio Tinto move to close Tiwai Point in New Zealand, and Alcoa to close San Ciprian in Spain. But since these announcements, the LME aluminium price has spiked, moving into the mid- $1900s per tonne, so even these older inefficient units might be in the money. We expect Tiwai Point and San Ciprian will close as planned, but the other smelters under review may have a stay of execution as owners will want to assess whether current high prices could be sustained.

LT where will decarbonized aluminium come from?
With global commitments towards a decarbonized world in 2050, it raises the question of where the world's green aluminium supplies will come from.

The smaller problem will be to remove carbon from the anodes in aluminium pots which contributes 10% of the CO2 emissions from aluminium production. That problem is being worked on by a Rio Tinto and Alcoa JV, as well as Actus Metals in Iceland using an inert anode. The bigger problem is where to get Green power supply, as electricity contributes over 70% of aluminium's CO2 emissions.

There is, of course, significant smelter capacity supported by hydro power, notably in Canada, Norway, Siberia, Malaysia, Paraguay, and China's Yunnan Province. But there are limited new localities for dams and the proportion of smelters powered by hydro has dropped from 46% in 2000 to 26% in 2018. Most of the regions that have increased aluminium capacity in recent years have low power prices due to gas and coal–fired power stations, notably the Gulf States, and north and western China, including the growing region of Inner Mongolia. Coal is estimated to power 61% of aluminium production, largely due to China's capacity.

We believe there will be insufficient hydro resources on the planet to support the volume of aluminium that will need to free itself from carbon-power, so in a truly decarbonized world, many smelters may need to be connected to an extensive renewable power grid. But with the electricity demand of aluminium sitting at about 12,500kWh per tonne for most-efficient modern designs, the electricity demand on the grid would be intense. Some modern designs are being adapted to cope with variable electricity supply to prevent pots from freezing when supplies are low and continue reduction when supply is high. And it is believed that such large-scale variable demand could help stabilise renewable energy grids. But that wouldn't seem to solve all the issues.

China is set to produce about 42Mtpa of aluminium in a few years' time and may need power supply of 60GW to meet the demand, which may mean renewable capacity of 2-3x that figure to sustain that supply. And even so, at sunset there could be a major power shortage issue in China, especially in winter.

Aluminium looks to be another large problem for decarbonisation, as most of the new smelters starting and due to start at the moment are heavy users of carbon power.

Decarbonisation concerns may delay new smelter builds near term

The acceleration of the moves towards decarbonisation and activist pressure may delay new aluminium smelter builds, thereby tightening supplies and lifting prices. Most companies investing in a new smelter would expect the facility to operate for at least 30 years and hopefully 50. But building a new smelter now is problematical unless it's connected to hydro power. Without that, the operator may soon see community activism to close the power plants that supply the electricity. Likewise, there has been a move to reward and pay a premium for "green" aluminium, which may soon spread to become a penalty for "dirty" aluminium. In the worst case, some years out, non-green aluminium might be banned from import by some jurisdictions. These are potential risks on the horizon for new smelters, and may well act as a disincentive to aluminium investment in the current low cost jurisdictions like the Gulf.

Aluminium pricing – looking sustainably stronger

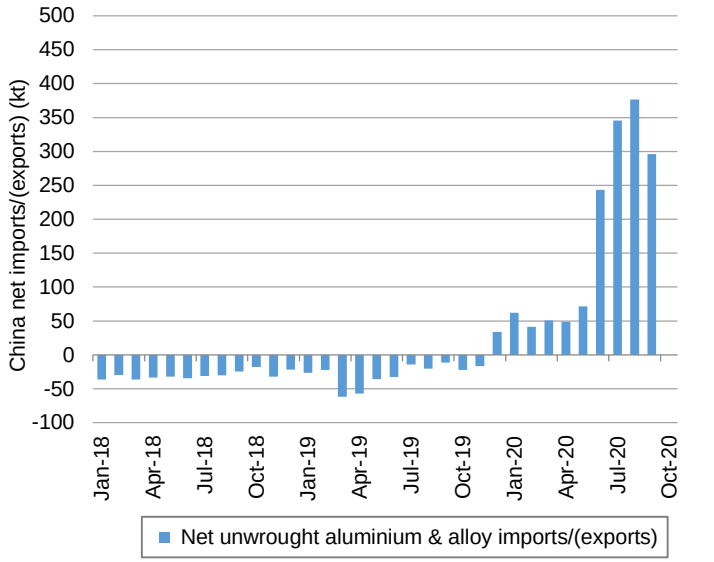
Bullish SHFE price caused arbitrage and LME aluminium flowed to China

The Chinese aluminium market has been buoyant since 1Q on positive demand fundamentals, while ex-China saw slumping demand. However, a price discrepancy was hard to sustain with the China price higher as an arbitrage opportunity of 5-8¢/lb opened from May as the LME fell behind the surging SHFE price. Unwrought aluminium and alloy exports reversed to imports, and exceeded the gross volume of semi exports in June and July (Figure 56, Figure 57). China buying has lifted the LME price towards the China price, although it has not yet caught up and the arbitrage remains open.

The arbitrage mechanism is not as efficient when the China price is lower than LME due to China's export tax on ingot sales. This discourages exports so China tends to export semi-fabricated products which can avoid the tax. Net semi exports from China reached 4.8Mt in 2018 and 2019. However, they fell 16% in the nine months to Sep as ex-China industrial demand evaporated, and the lower LME price was not conducive for exports.

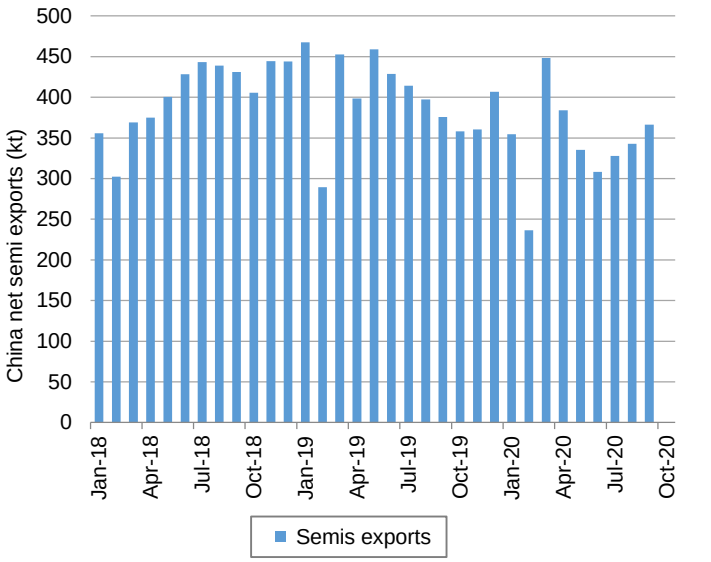
Our price forecasts are constructed on the basis that SHFE and aluminium prices should be similar.

Figure 56: China net aluminium & alloy imports/exports



Source: Customs data, Credit Suisse estimates

Figure 57: China's semi exports



Source: Customs data, Credit Suisse estimates

Assessing price forecasts

We forecast prices on the basis of fundamentals - supply balances and cost curves.

Shrinking global supply balances

Looking first at the global supply balance, it looks elevated this year and next, but then declines swiftly to near balance in 2023 on our estimates, which is positive for pricing. We expect consumption to grow, but globally there are limited smelter additions and many countries may be reticent to commit to new smelters, as the regions that have low cost electricity are generally reliant on carbon-based power.

High China capacity utilisation

We believe China's smelter capacity utilisation is running at about 84% this year, but should climb to 92% by 2022 (Figure 58). For manufacturing industries, a capacity utilisation over 90% is regarded as tight with little flexibility, and delivers pricing power to producers. Aluminium supply in China appears to be heading into this regime where smelters dictate the price.

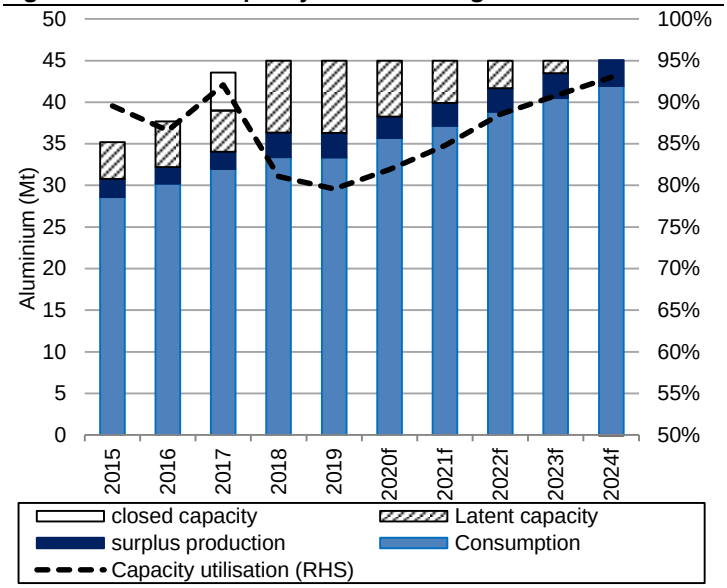
China should export its tighter price via ongoing imports

We believe China's tighter balances and higher price will be transmitted to the rest of the world via sustained aluminium imports of 2Mtpa or more.

As previously discussed, we expect China will continue to export semi-fabricated products at an elevated rate through the forecast period (we assumed 3.1Mt of contained Al in semis in 2024). To sustain such export of semi-fabricates, China may need to continue high levels of net imports of unwrought aluminium and aluminium alloys in future years to balance supply. We estimate the flow will be substantial at 2Mtpa, and as we have seen this year, flows of these size can lift the global price towards China's.

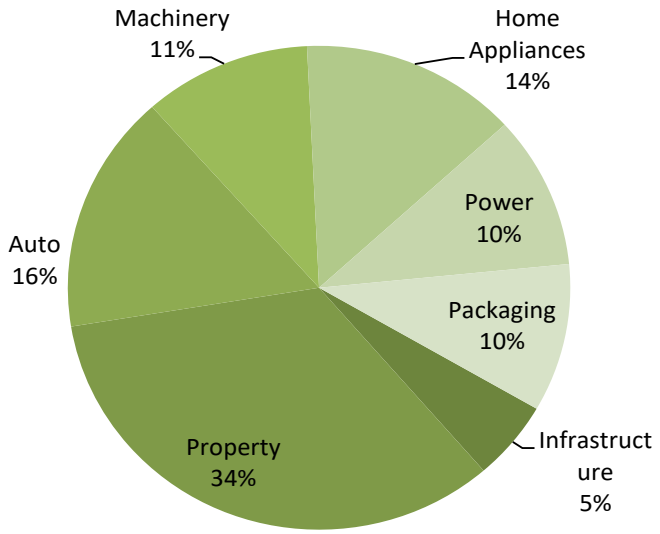
The aluminium industry is looking fundamentally different in the future when capacity is capped from the previous China with slack demand, flooding the world with low priced metal in the form of semis. China's supply is tightening, and its imports will shape the global price.

Figure 58: China's capacity utilisation begins to recover



Source: IAI, customs data, Wood Mackenzie, Credit Suisse estimates

Figure 59: Aluminium consumption sectors in China



Source: CQi, Credit Suisse estimates

Cost curve sense check on our price forecasts

The supply factors we have discussed support stronger aluminium prices. But until the world finally moves into a sustained supply deficit, we need to assess forecast prices in light of the global cost curve. A price hovering above the cost curve makes all global operations profitable and incentivises new starts of smelters. But it may also entice owners of aluminium stocks to release metal into the high prices, so elevated prices are difficult to sustain without a true deficit.

We view global aluminium supply as being in surplus for the next few years, but moving towards a balanced market in 2023. It is possible a deficit may open in 2024, but it is a bit distant and uncertain to be baked into our price forecasts.

We expect brief price forays to high levels are likely within the forecast period, but we see no reason the price would be sustained above the cost curve if there is no aluminium deficit. So we use the cost curve to limit the upside of our price forecasts.

2Q-2020 cost curve is unsustainably low, 2021 costs should be more like 1Q-2020

For the cost curve analysis, we need to choose a useful cost curve. We believe the most recent 3Q-2020 cost curve is not appropriate as it is excessively low (Figure 60).

The two major inputs into aluminium production are alumina and electricity. Both of these input costs have been depressed in 2Q and 3Q, on low gas and oil prices, compressing coal prices. Likewise, the alumina price has been capped at about $280/t on excess capacity. We expect the 3Q-2020 aluminium cost curve will prove to be too low for the medium-term and the 1Q aluminium cost curve will prove to be closer to realised costs in 2021.

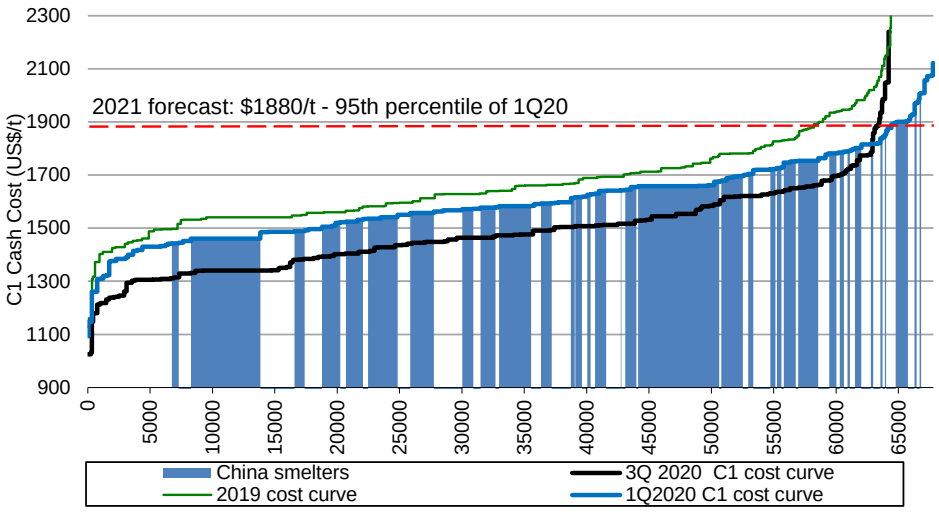
2021 forecast of $1880/t is the 95th percentile

Our 2021 price forecast of $1880/t is the 95th percentile of the 1Q-2020 cost curve. While this is a high percentile, the C1 cash cost does not include sustaining capex, so the true percentile should be a little lower.

The 2022 price could rise to $1900/t as the surplus shrinks

As the capacity utilisation in China rises, and global metal surpluses shrink, we expect the price will climb to $1900/t. We cap our mid-term prices at this level as we are not convinced the price should climb above the cost curve in the mid-term until there is a definite metal deficit.

Figure 60: Aluminium C1 cash cost curve – Chinese smelters highlighted



Source: Wood Mackenzie, Credit Suisse estimates

Figure 61: Aluminium supply and demand

	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
ALUMINA PRODUCTION								
North America	3.03	2.87	2.96	2.82	2.74	2.78	2.78	2.78
Europe	8.49	8.54	8.74	8.62	8.80	8.88	8.96	9.00
Russia & Caspian region	4.32	4.24	4.16	4.28	4.40	4.64	4.64	4.84
China	70.70	71.55	71.28	69.50	77.00	81.75	84.00	86.00
India	6.15	6.43	6.68	6.34	7.56	8.14	8.92	9.42
Other Asia	2.15	2.25	2.42	2.48	3.66	4.64	5.52	5.66
Australia	20.86	20.42	20.54	21.10	20.84	20.90	20.92	21.00
Africa & Middle East	1.73	2.19	3.34	4.30	4.66	4.76	4.76	4.76
Jamaica	1.78	2.48	2.18	1.64	1.76	1.86	1.86	2.00
Brazil	11.06	8.25	9.22	10.30	11.12	11.22	11.22	11.24
Other Latin America	0.26	-	0.02	-	-	-	-	-
Disruption Allowance	-	-	-	*(0.2)*	*(5.7)*	*(6.0)*	*(6.1)*	*(6.3)*
Required addn/(cuts)	-	-	-	2.5	2.5	1.0	-	-
World Alumina Production	**130.5**	**129.2**	**131.5**	**133.7**	**139.3**	**144.6**	**147.4**	**150.4**
% Change	*8.7%*	*-1.0%*	*1.8%*	*1.6%*	*4.2%*	*3.8%*	*2.0%*	*2.0%*
NMA Consumption	7.73	8.38	9.39	8.92	9.28	9.74	10.12	10.52
% Change	*7.3%*	*8.5%*	*12.0%*	*-5.0%*	*4.0%*	*5.0%*	*4.0%*	*4.0%*
SGA Available	122.80	120.83	122.16	124.74	130.06	134.85	137.32	139.91
SGA Requirement	121.19	123.05	122.32	125.57	130.20	134.67	137.24	140.28
SURPLUS/(DEFICIT) SGA	**1.6**	**(2.2)**	**(0.2)**	**(0.8)**	**(0.1)**	**0.2**	**0.1**	**(0.4)**
ALUMINIUM PRODUCTION								
North America	3.93	3.82	3.98	4.16	4.26	4.30	4.30	4.30
Europe	4.50	4.47	4.26	4.22	4.44	4.56	4.72	4.76
Russia & Caspian region	4.14	4.18	4.30	4.34	4.50	4.82	4.86	4.88
China	35.91	36.49	35.80	37.28	39.61	40.71	42.21	43.71
Other Asia & Oceania	6.06	6.61	6.61	6.62	7.04	7.68	7.32	7.34
Middle East	5.53	5.70	6.04	6.30	6.64	6.68	6.70	6.70
Africa	1.68	1.67	1.64	1.61	1.69	1.74	1.74	1.75
Latin America (ex Mexico)	1.38	1.16	1.09	1.00	1.20	1.24	1.24	1.24
Disruption Allowance	-	-	-	*(0.13)*	*(1.57)*	*(1.59)*	*(1.61)*	*(1.62)*
Price induced cuts	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
World Production	**63.1**	**64.1**	**63.7**	**65.4**	**67.8**	**70.1**	**71.5**	**73.1**
% Change (World) incl cuts	*6.2%*	*1.5%*	*-0.6%*	*2.7%*	*3.7%*	*3.4%*	*1.9%*	*2.2%*
% Change (China) incl cuts	*10.0%*	*1.6%*	*-1.9%*	*3.9%*	*4.0%*	*2.8%*	*3.8%*	*3.6%*
Capacity Utilisation (%)	*89.3%*	*84.9%*	*83.5%*	*84.6%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*
World Consumption	**60.6**	**62.3**	**62.1**	**61.6**	**65.5**	**68.4**	**70.9**	**73.2**
SURPLUS/(DEFICIT) ALUMINIUM	**2.48**	**1.82**	**1.65**	**2.95**	**2.36**	**1.79**	**0.58**	**(0.09)**
incl. price induced cuts	-	-	-	-	-	-	-	-

	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
STOCKS								
LME + COMEX	1.13	1.28	1.49					
SHFE	0.75	0.67	0.19					
Exchange stocks	**1.89**	**1.95**	**1.68**					
Other stocks	2.71	2.54	2.24					
Total visible stocks	**4.60**	**4.49**	**3.91**					
Weeks Consumption	*3.9*	*3.7*	*3.3*					
Est Total stocks	**16.86**	**18.68**	**20.33**	**23.28**	**25.64**	**27.43**	**28.01**	**27.92**
Al Price (US$/t)	**1,969**	**2,110**	**1,791**	**1,700**	**1,850**	**1,900**	**1,900**	**1,900**
Alumina Linkage	18.0%	22.5%	18.5%	16.1%	15.7%	16.8%	17.4%	17.4%
Alumina Price (US$/t)	354	474	332	274	290	320	330	331
ALUMINIUM CONSUMPTION BY REGION								
North America	6.46	6.45	6.39	6.08	6.65	6.92	7.09	7.24
Europe	9.34	9.56	9.57	8.47	9.31	9.73	10.00	10.21
Russia & Caspian region	0.94	0.93	0.97	0.84	0.93	0.97	1.00	1.02
China	31.99	33.38	33.34	35.68	37.16	38.83	40.51	41.96
India	2.24	2.21	2.21	1.83	2.07	2.24	2.40	2.53
Japan	2.15	2.12	2.03	1.91	2.03	2.07	2.11	2.14
Other Asia	3.92	4.02	4.03	3.67	3.87	4.00	4.10	4.18
Oceania	0.29	0.28	0.29	0.26	0.28	0.29	0.30	0.31
Africa & ME	2.00	2.04	2.00	1.76	1.93	2.04	2.09	2.18
Latin America (ex Mexico)	1.31	1.27	1.23	1.12	1.21	1.27	1.32	1.37
China restocking demand				0.85				
World Consumption	**60.6**	**62.3**	**62.1**	**62.5**	**65.5**	**68.4**	**70.9**	**73.2**
% Change (World)	*4.2%*	*2.7%*	*-0.3%*	*0.6%*	*4.8%*	*4.4%*	*3.7%*	*3.2%*
% Change (China)	*5.9%*	*4.3%*	*-0.1%*	*7.0%*	*4.1%*	*4.5%*	*4.3%*	*3.6%*
% Change (ROW)	*2.4%*	*0.8%*	*-0.6%*	*-9.8%*	*9.1%*	*4.3%*	*2.9%*	*2.6%*
ALUMINIUM CONSUMPTION BY SECTOR								
Building & Construction	15867	16889	17570	18255	19274	20141	20849	21421
% Share	*21.2%*	*21.9%*	*22.6%*	*24.0%*	*23.7%*	*23.7%*	*23.7%*	*23.5%*
Transport	25818	26450	26351	23604	26354	27990	29353	30623
% Share	*34.5%*	*34.3%*	*33.9%*	*31.0%*	*32.5%*	*33.0%*	*33.3%*	*33.6%*
Electrical	7505	7963	7384	7400	7681	7979	8281	8591
% Share	*9.7%*	*9.5%*	*9.4%*	*9.4%*	*9.4%*	*9.5%*	*9.6%*	*9.4%*
Packaging	10184	10551	10828	11116	11474	11779	12093	12364
% Share	*14.6%*	*14.1%*	*13.9%*	*13.7%*	*13.6%*	*13.3%*	*13.2%*	*13.0%*
Consumer Goods	3118	3101	3099	3084	3227	3355	3485	3606
% Share	*4.1%*	*4.0%*	*4.0%*	*4.0%*	*4.0%*	*4.0%*	*4.0%*	*4.0%*
Machinery & Equipment	5367	5387	5359	5230	5477	5645	5840	6033
% Share	*7.2%*	*7.0%*	*6.9%*	*6.9%*	*6.7%*	*6.7%*	*6.6%*	*6.6%*
Other	7029	6878	7087	7410	7705	7935	8150	8400
% Share	*9.4%*	*8.9%*	*9.1%*	*9.7%*	*9.5%*	*9.4%*	*9.3%*	*9.2%*

Source: IAI, customs data, SMM, Wood Mackenzie, Credit Suisse estimates

Alumina forecast

Set to climb beyond price cap with aluminium demand

Alumina demand depends on aluminium output, so our stronger aluminium outlook should improve alumina prices. Demand was not sufficient to lift alumina from a range bound price in 2020, but should do so in 2021.

Revised alumina price upwards on demand growth

We have not lifted our alumina price forecasts despite our more bullish aluminium expectations as our previous forecast proved optimistic. We maintain the previous prices, but with a more nuanced view of the quarterly price movements in 2021.

The alumina price has largely been range-bound in 3Q, unable to pass $280/t due to surplus Chinese refining capacity at that price point. However, this Chinese capacity is finite and we expect alumina demand growth of 3.7% in 2021 which should stretch China's supply, allowing the price to advance to $300/t by 4Q. Further +3% supply growth in 2022, and likely cost increases for energy and caustic inputs should allow alumina to advance back into its old trading range of $320-330/t in 2022-23.

Figure 62: Revised alumina price forecast

		1Q-20	2Q-20	3Q-20	4Q-20	2020E	1Q-21	2Q-21	3Q-21	4Q-21	2021E	2022E	2023E	2024E	LT (real)
New	US$/t	284	242	273	275	**268**	280	290	290	300	**290**	**320**	**330**	**330**	400
Old	US$/lb	284	242	273	290	**272**	290	290	290	290	**290**	**320**	**330**	**346**	400
Chg	US$/lb	*0%*	*0%*	*0%*	*-5%*	***-1%***	*-3%*	*0%*	*0%*	*3%*	***0%***	***0%***	***0%***	***-5%***	*0%*
Linkage	%	*16.8%*	*16.1%*	*15.7%*	*14.7%*	***15.8%***	*15.1%*	*15.3%*	*15.3%*	*16.0%*	***15.4%***	***16.8%***	***17.4%***	***17.4%***	*14.0%*

Source: Credit Suisse estimates

Demand growth to stretch Chinese production capacity to higher price point

For 2020, we forecast a global 2.7% increase in aluminium production, corresponding to an increase in Smelter Grade Alumina (SGA) demand of the same magnitude. The demand increase has occurred in China, so SGA exports to China have been high (3.9Mt) to support the rising demand. The IAI statistics would imply a global deficit of SGA in 2020, but anecdotally that is not correct, with China having ample supply capacity which has capped prices in 2020.

From 2021, we expect SGA demand to increase 3.7%, but more Chinese alumina capacity may be available to meet the demand, so exports should ease. Nevertheless, demand growth of 9Mt over the next two years should stretch supply and lead to stronger pricing outcomes.

Figure 63: Global alumina supply & demand

	2015	2016	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
China alumina production	58,979	60,827	70,699	71,547	71,284	70,500	75,271	78,582	80,642	82,559
less NMA	(1,962)	(2,535)	(3,032)	(3,440)	(4,180)	(3,680)	(3,820)	(3,940)	(4,080)	(4,140)
China SGA production	57,017	58,292	67,667	68,107	67,104	66,820	71,451	74,642	76,562	78,419
China imports/(exports)	4,658	3,029	2,809	(976)	1,375	3,880	2,800	2,000	2,800	3,000
China demand	60,515	62,671	68,938	70,051	68,726	71,445	74,328	76,436	79,314	82,200
China balance	**1,161**	**(1,350)**	**1,539**	**(2,920)**	**(247)**	**(745)**	**(77)**	**205**	**48**	**(781)**
ROW production	59,739	59,205	59,827	57,665	60,260	63,161	64,069	66,008	66,798	67,871
less NMA	(4,737)	(4,663)	(4,694)	(4,942)	(5,207)	(5,240)	(5,460)	(5,800)	(6,040)	(6,380)
ROW SGA production	55,002	54,543	55,132	52,723	55,053	57,921	58,609	60,208	60,758	61,491
ROW imports/ (exports)	(4,658)	(3,029)	(2,809)	976	(1,375)	(3,880)	(2,800)	(2,000)	(2,800)	(3,000)
ROW demand	50,485	51,489	52,252	52,999	53,594	54,125	55,872	58,234	57,926	58,080
ROW balance	**(142)**	**25**	**71**	**700**	**84**	**(84)**	**(63)**	**(25)**	**32**	**411**
Global SGA production	112,019	112,834	122,800	120,830	122,157	124,741	130,060	134,850	137,320	139,910
Global SGA demand	111,000	114,160	121,190	123,050	122,320	125,570	130,200	134,670	137,240	140,280
Global balance	**1,019**	**(1,326)**	**1,610**	**(2,220)**	**(163)**	**(829)**	**(140)**	**180**	**80**	**(370)**

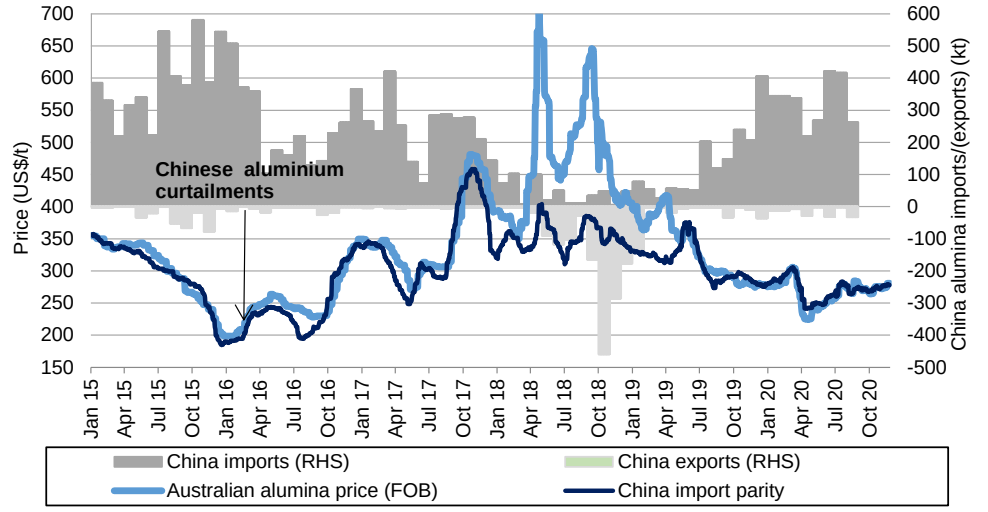
Source: Wood Mackenzie, IAI, customs data, SMM, Credit Suisse estimates

Greater aluminium output should lift alumina price

Lack of a terminal market creates a volatile price

The alumina price is volatile, as there is no terminal market to buffer demand and supply. Without buyers of last resort for any excess, and no stockpiles to draw down in a shortage, refinery production must flex to balance aluminium smelters' needs, and the price move must be sufficiently dramatic to incentivise costly action. The price has slumped to a low of $198/t, soared to highs of $700/t, dived again in April and now recovered, all in the space of four years (Figure 64). There are no trading stocks because alumina is a bulky, inconvenient powder that must be stored under cover, but has low value. No trader wants to hold it as there are more valuable and less troublesome options.

Figure 64: Seaborne & China alumina prices in parity terms + imports



Source: Fastmarkets, customs data, Credit Suisse estimates

SGA demand to remain stable with aluminium production

Aluminium production is the demand side for smelter grade alumina (SGA), so the 3.7% lift in global aluminium production in 2021 should increase SGA demand by about the same amount. In 2022, we forecast SGA demand to grow another 3.4%. Together these increases should raise global SGA demand by almost 9Mtpa over two years, from 126Mt in 2020 to 135Mt in 2022. That is a strong rise, and while we expect global supply will adequately meet the demand from excess and new capacity in China, we expect it should stretch capacity and lift prices up the cost curve to higher cost operations.

Weak prices started with SGA demand decline in 2019

The strong demand growth we forecast is a major change from the situation in 2019, when China aluminium demand and production declined and global SGA demand fell with it. As new Chinese refineries started-up in the face of sliding demand, prices unraveled, as also occurred in 1H-20. We believe that negative demand environment has now passed, and prices are set to rise.

The other input into alumina prices are costs. In the early months of 2020, as industry closed down in China and then globally, prices for inputs such as energy and caustic soda plunged, bringing costs of refining down. That situation is now reversing. In China in particular, spot thermal coal prices are rising as supply tightens over winter.

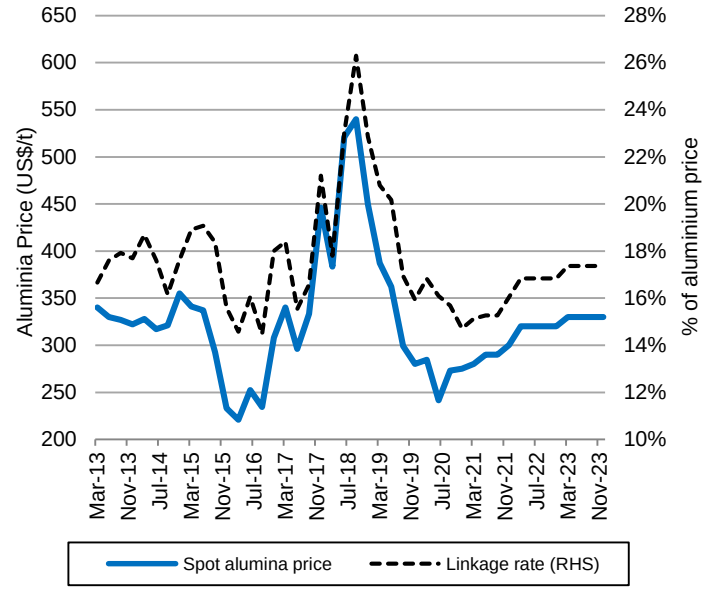
Aluminium price relativity drives our alumina price forecast

We assess forecast prices via the implied linkage to aluminium

Before spot alumina pricing became widely used, alumina was priced as a linkage against aluminium. The implied linkage is still an influence on alumina prices because aluminium

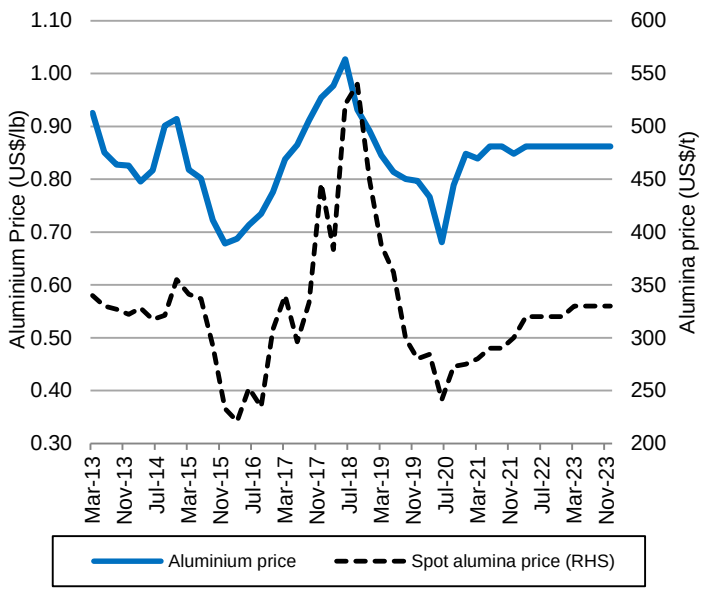
smelters consider the relative prices when buying. We note that implied linkages of spot alumina have occupied a narrow range of 15-19% since 2013 – other than 2018-19 when curtailment of the Alunorte refinery caused an alumina shortfall and the price to soar (Figure 65). Without such a surprise event disrupting supply, it will be difficult for alumina to greatly outperform aluminium. This year, aluminium has outperformed alumina so far but we expect the alumina linkage to catch up over the forecast period. We forecast prices using linkage rates starting at the lower end of the historic range, in the 15%s, but increasing over the forecast period to exceed 17% in 2023 and 2024 (Figure 65).

Figure 65: Alumina linkage to aluminium price – Act & forecast



Source: Fastmarkets, Credit Suisse estimates

Figure 66: Aluminium price vs alumina, actual & forecast



Source: Fastmarkets, LME, Credit Suisse estimates

Alumina price forecast against the cost curve

We test our linkage-derived price forecasts against the alumina cost curve to ensure it makes sense.

Use 1Q-2020 cost curve as 2Q was abnormally low

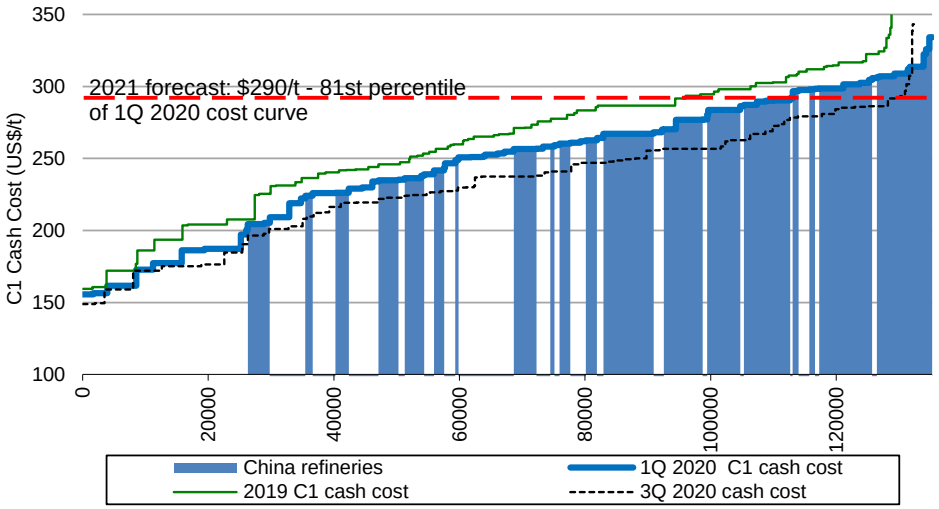
As noted for aluminium, we believe the 3Q-2020 alumina cost curve is abnormally low due to soft demand, especially for energy. As markets recover from lockdowns, the prices for energy and caustic soda should recover, driving alumina costs up to a level closer to 1Q-2020 costs. We use 1Q -2020 as our base assessment to estimate the 2021 cash cost base.

2021 price forecast is the 81st percentile

Our 2021 price forecast is the 81st percentile of the 1Q-2020 cost curve. That seems broadly about right. We perceive demand to be positive, but supply balances are not tight. There remains plenty of production flexibility, especially within China.

In 2022, as demand lifts, a move to higher percentiles may be appropriate. But it would be hard for prices to exceed $330/t as that would lie above the global cost curve, implying an alumina approaching a shortfall. We don't believe that is the case with curtailed capacity in China.

Figure 67: Alumina C1 cash cost curve – Chinese operations highlighted

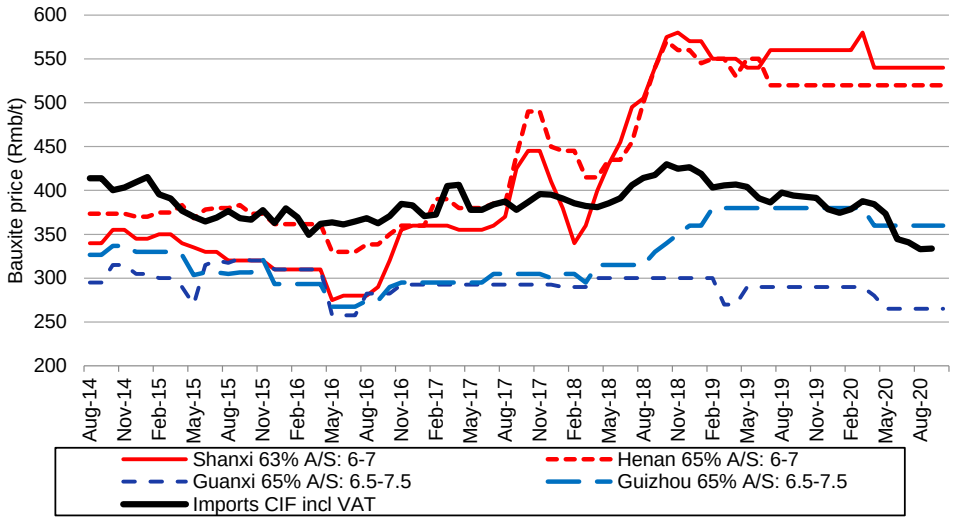


Source: Wood Mackenzie, Credit Suisse estimates

Alumina production flex to come from China

China dominates the top half of the alumina refining cost curve, primarily due to the poor quality and high price of its domestic bauxite (Figure 68). Chinese refineries tend to be quite dynamic, flexing in and out of production to balance demand, as many have thin or no margins to give back if prices ease. The alumina refineries in Australia, Brazil and India, sit in the bottom third of the cost curve and operate at steady levels. But there are few expansions ex-China, so China capacity will inevitably increase to meet its own demand increase.

Figure 68: China domestic bauxite price + China eq. prices of imported bauxite



Source: SMM, customs data, Credit Suisse estimates

In November, SMM noted that alumina plants Shanxi and Henan have kept their operating rates at low levels amid sluggish alumina prices, and the higher-cost capacity is on the verge of closure. Environmental protection and losses have driven production cuts which should ease oversupply concerns. Refineries in this region face challenges around bauxite supply if they are not self-sufficient. Third party bauxite prices remain far higher than those further south due to scarcity. Use of imported bauxite is becoming more common in Shanxi, but it does not lower costs as transport from the coast costs around Rmb200/t. Some of these refineries may also be subject to 50% curtailment on heavy pollution days during the winter heating season.

Nickel forecast

Price lift in line with positive base metal complex

Our view of nickel remains moderately positive, but we consider the near term price is a little overdone, rising on bullish base metals sentiment rather than nickel fundamentals. The nickel market is well-balanced, with rapid Indonesian developments providing new supply for market growth. We continue to expect modest supply surpluses across the forecast period.

Revised prices are higher in-line with base metals complex

We have lifted our nickel price forecasts across the forecast period to align with market moves and our positive view of base metals in general. However, we believe the current spot price of more than $7.00/lb in a surplus market is overdone, and causing the restart of curtailed operations such as Ambatovy. We forecast the price to ease to $6.80/lb in 2021 and 2022.

Figure 69: Revised nickel price forecasts

		1Q-20	2Q-20	3Q-20	4Q-20	2020E	1Q-21	2Q-21	3Q-21	4Q-21	2021E	2022E	2023E	2024E	LT (real)
New	US$/t	12,689	12,254	14,683	15,700	**13,831**	15,440	15,220	15,000	14,780	**15,110**	**15,000**	**15,000**	**15,440**	14,775
New	US$/lb	5.76	5.56	6.66	7.12	**6.27**	7.00	6.90	6.80	6.70	**6.85**	**6.80**	**6.80**	**7.00**	6.70
Old	US$/lb	5.76	5.56	6.66	6.10	**6.02**	6.20	6.20	6.20	6.20	**6.20**	**6.10**	**6.50**	**6.67**	6.70
Chg	*%*	*0%*	*0%*	*0%*	*17%*	***4%***	*13%*	*11%*	*10%*	*8%*	***11%***	***12%***	***5%***	***5%***	*0%*

Source: Credit Suisse estimates

Broadly similar supply-demand balance, despite higher stainless

Our steel team's stainless steel production forecast increased across the forecast period by about 1Mtpa, with most of that in China and adjustments to other regions. We expect global stainless output will decline 7% YoY in 2020, but recover by over 8% in 2021, and about 3% in the two subsequent periods to new highs.

Our demand forecast for nickel in stainless increased, but demand for non-stainless applications decreased, so our global nickel consumption forecast for 2020 is now a fall of 3% versus -5.1% previously. We see similar moves across the forecast period with the net result being nickel surpluses within 50kt of our previous forecast from 2020 to 2022. We forecast the largest surplus to occur this year, then declining as demand recovers while China's NPI output retreats on lower mine supply.

Figure 70: Global nickel supply & demand summary

		2016	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
Mined Nickel	kt	1,965	2,145	2,295	2,501	2,429	2,702	2,911	3,025	3,054
% Chg y-o-y		*-9.2%*	*9.2%*	*7.0%*	*9.0%*	*-2.9%*	*11.2%*	*7.7%*	*3.9%*	*1.0%*
Surplus mine production	kt	(137)	(41)	(14)	(59)	(170)	4	109	130	128
China Ni in NPI		365	421	475	584	480	317	307	314	316
Indonesia Ni in NPI/ferronickel	kt	99	181	264	373	581	783	864	872	872
World Nickel production	**kt**	**2,013**	**2,089**	**2,205**	**2,447**	**2,490**	**2,576**	**2,671**	**2,758**	**2,788**
% Chg y-o-y		*0.5%*	*3.8%*	*5.6%*	*11.0%*	*1.8%*	*3.5%*	*3.7%*	*3.3%*	*1.1%*
Total Nickel consumption	**kt**	**2,082**	**2,196**	**2,306**	**2,465**	**2,392**	**2,539**	**2,629**	**2,736**	**2,886**
% Chg y-o-y		*10.5%*	*5.5%*	*5.0%*	*6.9%*	*-3.0%*	*6.1%*	*3.6%*	*4.0%*	*5.5%*
- China - Nickel consumption	kt	1161	1198	1192	1399	1402	1418	1443	1481	1531
% Chg y-o-y		*13.9%*	*3.2%*	*-0.5%*	*17.4%*	*0.2%*	*1.2%*	*1.8%*	*2.6%*	*3.4%*
Balance nickel	**kt**	**(69)**	**(107)**	**(101)**	**(18)**	**98**	**38**	**41**	**23**	**(97)**
Primary nickel in Stainless	kt	1,427	1,488	1,549	1,672	1,665	1,769	1,810	1,837	1,891
% Chg y-o-y		*13.2%*	*4.3%*	*4.0%*	*8.0%*	*-0.4%*	*6.2%*	*2.4%*	*1.5%*	*2.9%*
Non stainless demand	kt	655	708	757	794	727	770	819	899	994
% Chg y-o-y		*5.2%*	*8.1%*	*7.0%*	*4.8%*	*-8.4%*	*5.9%*	*6.4%*	*9.7%*	*10.6%*

Source: Wood Mackenzie, SMM, Company data, Credit Suisse estimates

Higher China stainless met by Indonesia NPI growth

Minor change to supply surplus – higher China demand nets off against NPI growth

There is no major change to our nickel forecasts. We now have slightly higher nickel demand, mainly due to forecast higher stainless output in China, offset by lower non-stainless. But we also have greater nickel supply as the growth in NPI from Indonesia outpaced our expectations. Netting out these demand and supply additions, we end up with only small changes to our balances with the nickel market remaining in modest surplus to 2023.

Minor price changes reflect a more bullish metal market

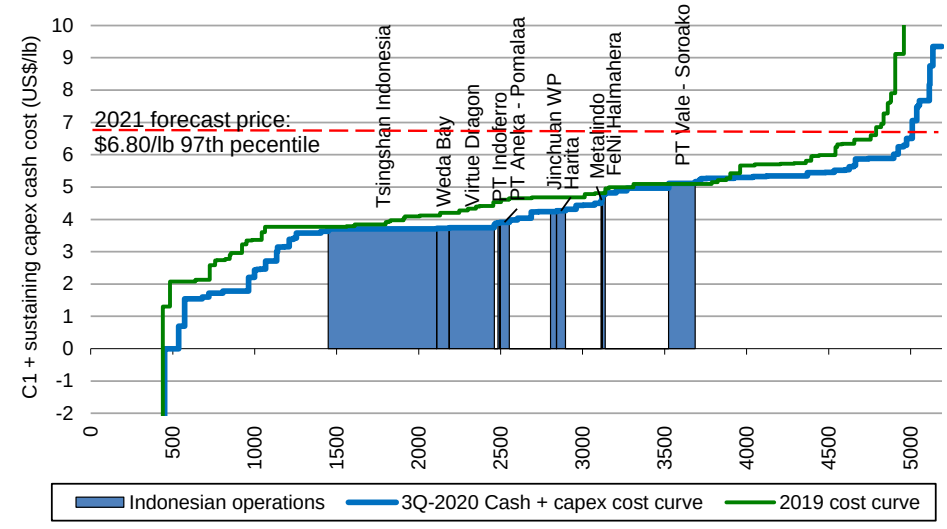
11% price lift in 2021 on positive sentiment to base metals complex

With only minor changes to our supply and demand balances – less than 50kt between 2020 and 2022 – there is little in the nickel fundamentals that changed our view on prices. Instead, the 11% increase in our price forecasts in 2021 and 2022 is based on mark-to-market changes and our overall positive view of the base metals complex. We have increased our prices for copper and aluminium on those metal's fundamental outlook, and those metals tend to lead the complex. It would be unusual for the nickel price to retreat while others remain buoyant.

However, the November price rally to $7.31/lb looks overdone considering the market surplus. This price is not needed to incentivise new projects, those are coming anyway at rapid pace in Indonesia as typical costs are less than $4/lb all-in. Instead the high price is incentivising troubled projects such as Ambatovy to restart, potentially increasing the surplus.

We expect the current price surge to unwind a little as other metal prices cool over the China winter, but we revised our price forecast upwards to ~$6.80/lb from 2021 to 2023. $6.80/lb is the 97th percentile of the cost curve. That percentile seems appropriate as the nickel market looks to be finely balanced to 2023. We increased our price to $7.00/lb in 2024 in line with a forecast deficit, but at this stage we have little conviction on the supply and demand for that distant period.

Figure 71: Nickel: C1 cash + sustaining capex cost curve (Indonesian ops highlighted)



Source: Wood Mackenzie, Credit Suisse estimates

Stainless steel changes

China stainless growth stronger, but ROW weaker than expected

As with other metals, China's has surprised to the upside with its stainless steel output growth. After a severe drop earlier in the year, output in 2H-20 lifted to new highs. We now forecast that global stainless steel output will fall 6.6% this year, not as deep a decline as our previous forecast of a 9.5% fall, largely due to stronger production for China. Our steel team raised their

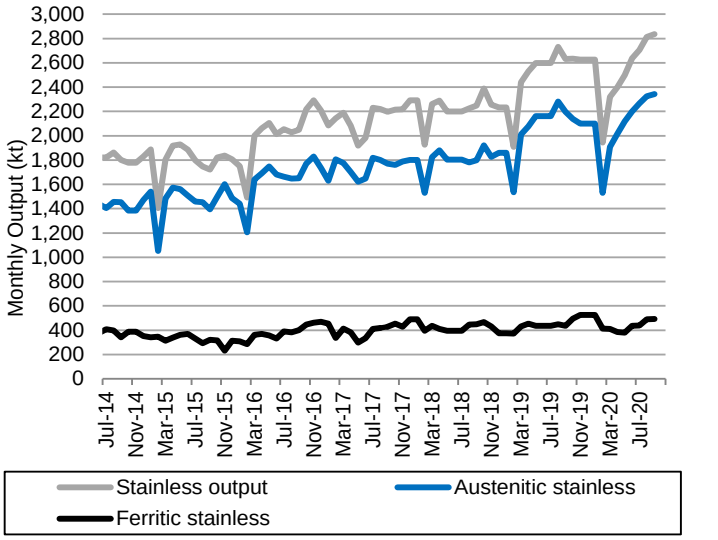
forecast for China stainless output by about 1Mtpa across the forecast period. We now forecast a full recovery in global stainless steel volumes to 2019 levels in 2021 and then ongoing growth to new highs, but with ongoing migration of melting works to China, Indonesian and India ahead of Europe and North America.

Figure 72: Credit Suisse estimated stainless steel output by region

		2016	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
Nth America	kt	2,511	2,789	2,846	2,632	2,245	2,530	2,540	2,595	2,645
Europe	kt	7,369	7,484	7,496	6,711	5,840	6,800	6,980	7,110	7,724
China	kt	24,500	25,660	26,300	30,255	29,620	30,320	30,800	31,430	31,890
Indonesia	kt	25	703	2,203	2,249	2,460	3,040	3,210	3,330	3,593
Japan	kt	3,093	3,168	3,283	3,000	2,430	2,850	3,070	3,160	3,260
Korea	kt	2,273	2,406	2,415	2,360	2,100	2,390	2,570	2,800	2,960
Taiwan	kt	1,263	1,376	1,172	1,000	760	1,040	1,110	1,170	1,210
India	kt	3,324	3,486	3,750	3,900	3,350	3,770	4,100	4,340	4,560
Other World	kt	1,208	1,202	1,135	1,052	828	1,030	1,090	1,130	1,160
Total production	**kt**	**45,567**	**48,275**	**50,599**	**53,159**	**49,633**	**53,770**	**55,470**	**57,065**	**59,002**
%change	*%*	*7.3%*	*5.9%*	*4.8%*	*5.1%*	*-6.6%*	*8.3%*	*3.2%*	*2.9%*	*3.4%*
Of which austenitic	kt	34,828	36,405	37,161	39,527	37,016	39,458	40,439	41,396	42,489
Of which ferritic	kt	10,739	11,869	13,438	13,632	12,617	14,311	15,032	15,669	16,513
Austenitic ratio	*%*	*76.4*	*75.4*	*73.4*	*74.4*	*74.6*	*73.4*	*72.9*	*72.5*	*72.0*

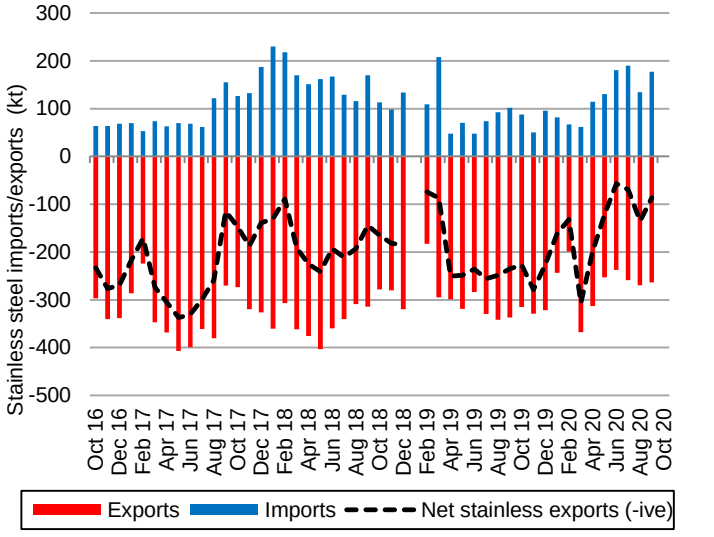
Source: Credit Suisse estimates, World Stainless.org, CRU, Wood Mackenzie

Figure 73: China's stainless steel output



Source: Antaike, Credit Suisse estimates

Figure 74: China's stainless steel imports & exports

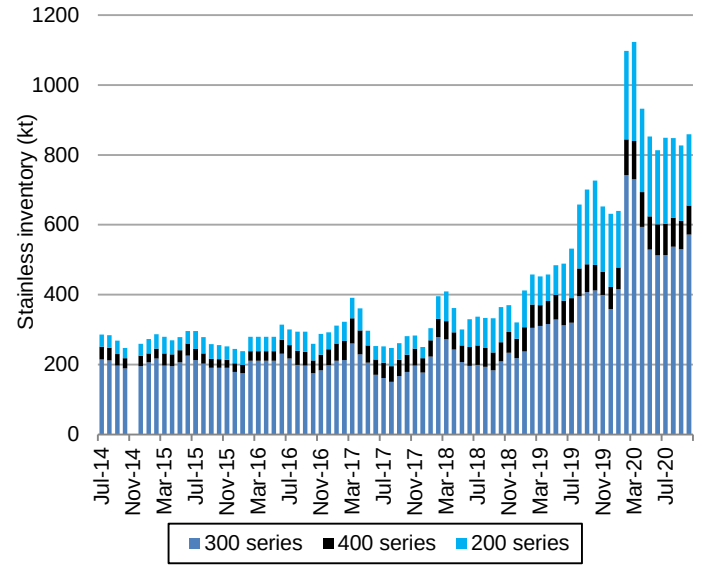


Source: SMM, Credit Suisse estimates

China stainless inventories steady and prices stabilise as 2019 oversupply ended

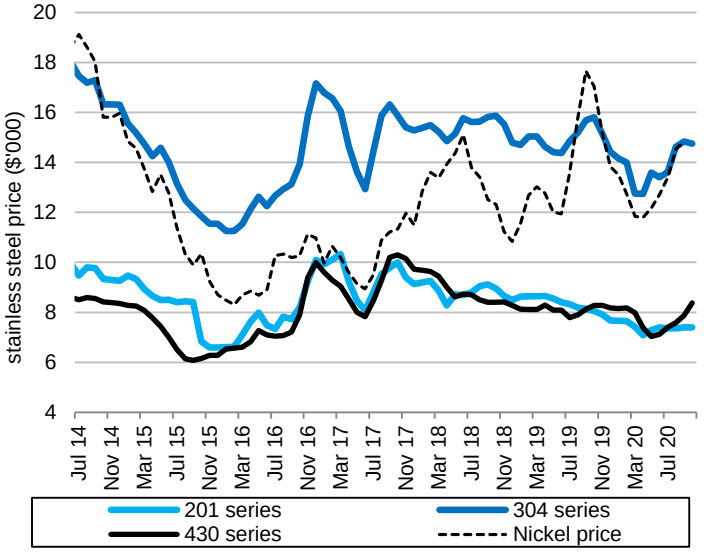
However, China demand growth has not been sufficiently swift to absorb its stainless steel output and also unwind the bulging stainless steel inventories built last year (Figure 75). The inventories have remained flat for the last six months. China stainless steel prices have, nevertheless, steadied from the declines seen last year, with the industry having ceased over-production. (Figure 76).

Figure 75: China's stainless steel inventory unwinding



Source: SMM, Credit Suisse estimates

Figure 76: China stainless prices stabilise as inventory eases



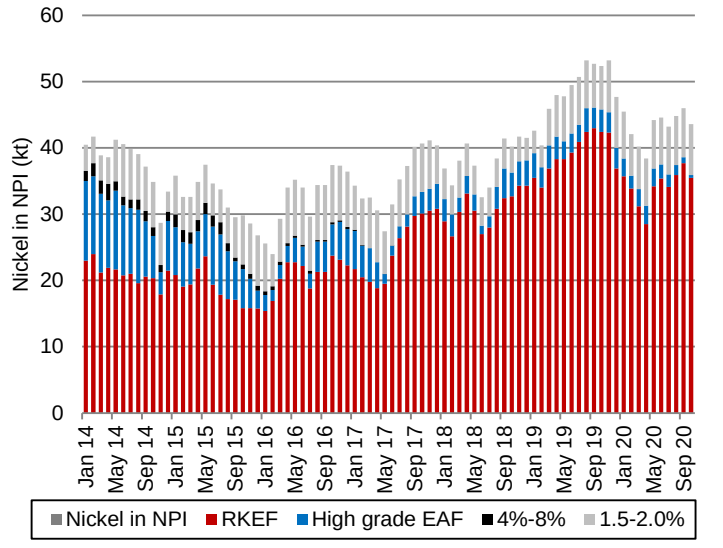
Source: SMM, Credit Suisse estimates

NPI output again beat estimates in China and Indonesia

Indonesian output jumped higher in 2020

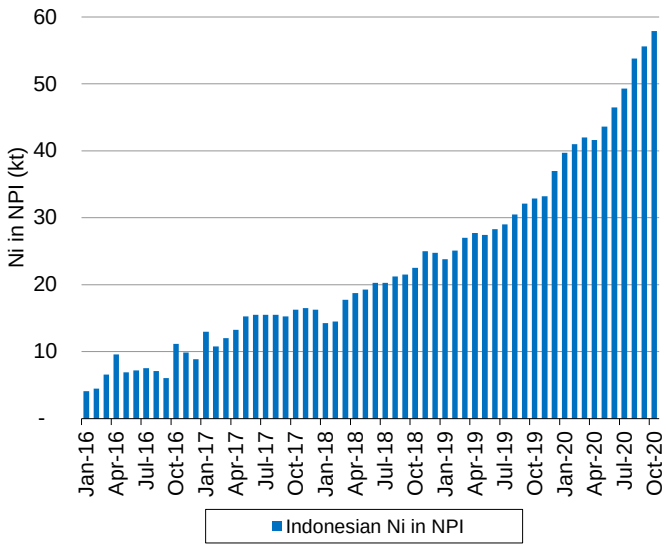
NPI production continued to grow at a ferocious pace, jumping to higher levels at the start of this year. Indonesia NPI production is now greater than China's, having been growing at an exponential pace (Figure 78). The pace of growth was greater than we expected so we increased our forecast to 581kt of nickel in NPI from Indonesia this year, up 14kt compared to our previous forecast, on the way to a 2023 production level of about 900kt.

Figure 77: China NPI output



Source: SMM, Credit Suisse estimates

Figure 78: Indonesian NPI output



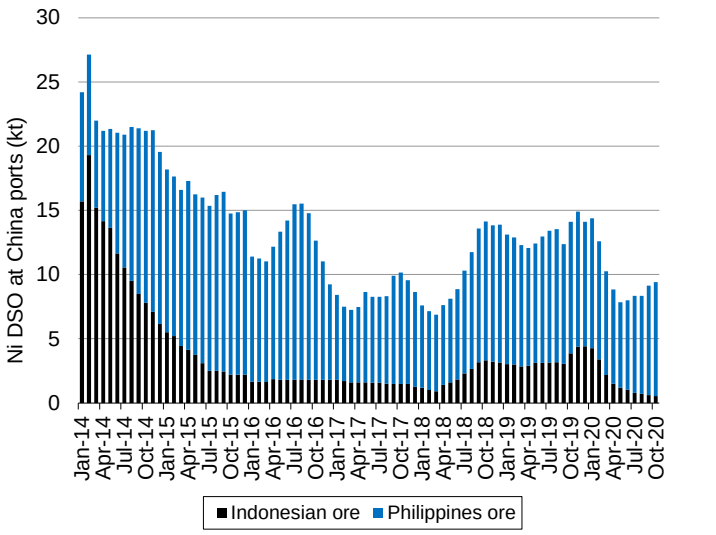
Source: SMM, Credit Suisse estimates

China NPI was more resilient than expected, but ore supplies tightening

China maintained its NPI output at an elevated level, lifting in May and maintaining the level not far off previous highs for six months (Figure 77). We now expect output of 480kt in 2020, similar to the output in 2018 (Figure 81). Ore supplies are tightening for China, seen in ore prices, because production is running ahead of sustainable rates. Port stocks edged up, but imports should soon drop as we've entered the beginning of the traditional monsoon period in

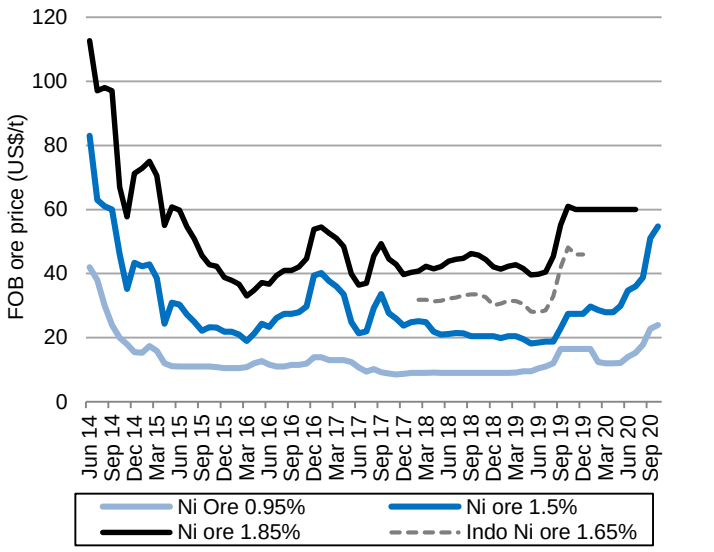
the Philippines. Notably there have been repeated cyclones impacting the country in recent weeks. We expect the long term NPI production rate in China will decline to ~320kt, the rate that could be met with ore sourced from the Philippines and supplemented with lesser amounts from New Caledonia.

Figure 79: China's nickel ore stocks at ports



Source: SMM, Credit Suisse estimates

Figure 80: Philippines nickel ore prices



Source: SMM, Credit Suisse estimates

Figure 81: China nickel supply & demand summary

		2016	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
China refined output	kt	584	642	693	856	763	634	639	661	669
- of which China NPI	kt	365	421	475	584	480	317	307	314	316
disruption	kt	0	0	0	0	-4	-19	-39	-40	-41
China refined nickel output	kt	584	642	693	856	760	615	601	621	628
China consumption	kt	1161	1198	1192	1399	1402	1418	1443	1481	1531
% Chg YoY	*%*	*13.9%*	*3.2%*	*-0.5%*	*17.4%*	*0.2%*	*1.2%*	*1.8%*	*2.6%*	*3.4%*
China nickel balance	**kt**	**-577**	**-555**	**-499**	**-544**	**-639**	**-784**	**-804**	**-820**	**-862**

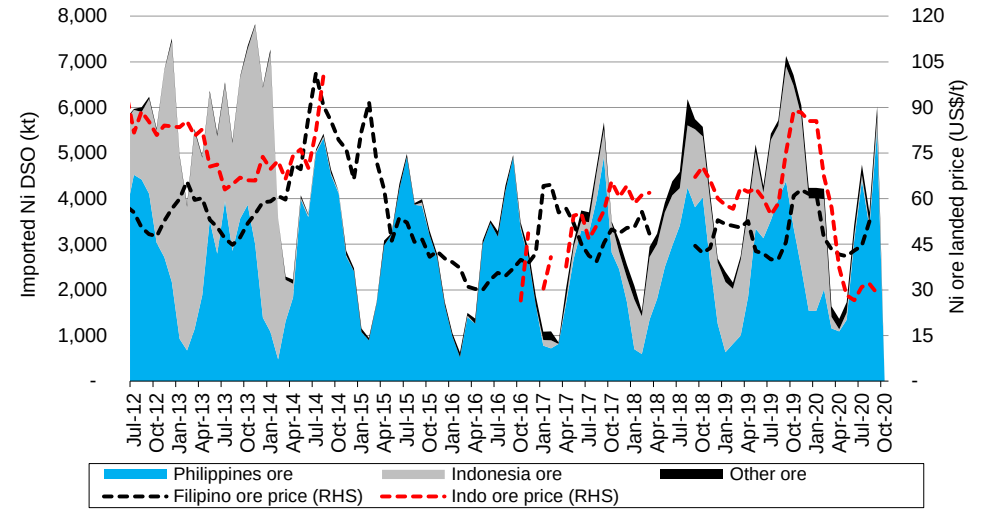
Source: Wood Mackenzie, SMM, Credit Suisse estimates

Weak ore supply raises ore prices for China

Laterite ore prices are rising on tight supply (Figure 80). Shipments to China from the Philippines should decline in the wet season, normally the DecQ and MarQ. The rising price of ore has attracted additional production, with cargoes arriving in China from New Caledonia, Turkey and South Africa, but the supply is not large. The shipments that should arrive from these countries was estimated at 1.2Mt in DecQ by SMM, which may contain about 14kt of nickel.

SMM reported that NPI plants in general have sufficient inventory on hand to maintain current production levels until Jan - Feb 2021. After that, sustaining NPI production will depend on new ore supplies from the Philippines. In 2020, exports had a slow start as certain areas were under lockdown for COVID-19, but ore exports subsequently ramped up quickly and exceeded past years. (Figure 82). But as DecQ and MarQ are monsoon periods, exports will decline significantly.

Figure 82: China's nickel ore imports and landed ore prices

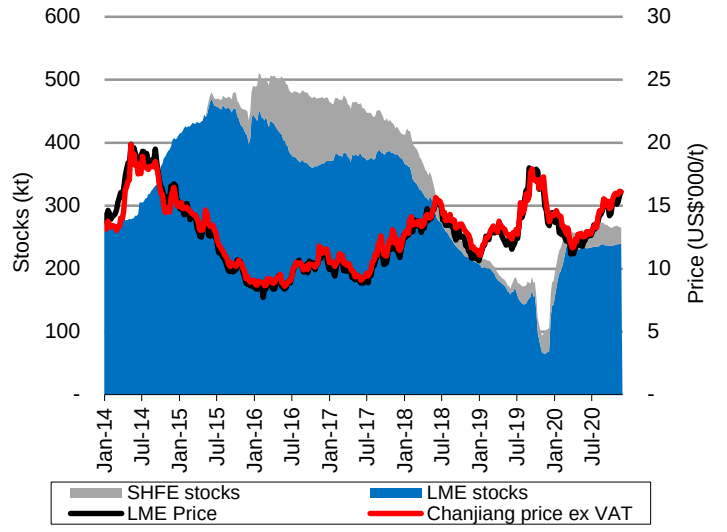


Source: Customs data, Credit Suisse estimates

Hidden nickel reappeared as COVID-19 struck

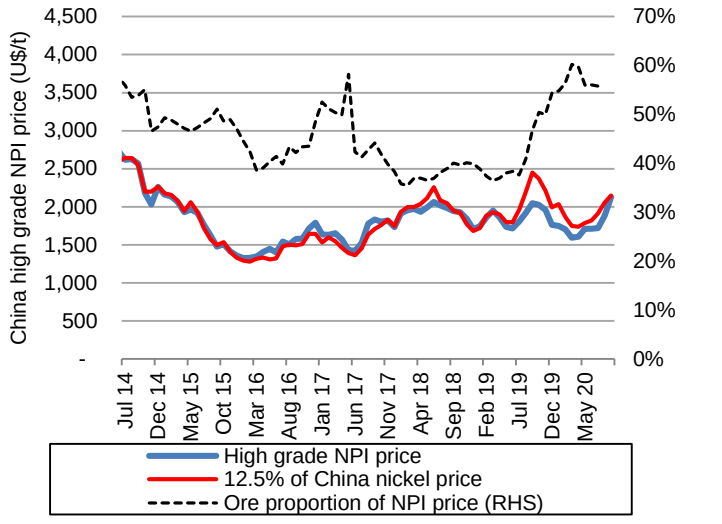
LME nickel stocks leapt at the start of the year as COVID-19 impacted and the world began to expect a global recession (Figure 83). This metal appeared to be hidden inventories coming to light as investors liquidated holdings rather than true inflows from weak demand. But as the world came to grips with the pandemic and East Asia controlled the outbreak, investors have calmed and exchange stocks at warehouses have leveled off.

Figure 83: Global nickel exchange stocks



Source: LME, SHFE, Credit Suisse estimates

Figure 84: China NPI prices



Source: SMM, Credit Suisse estimates

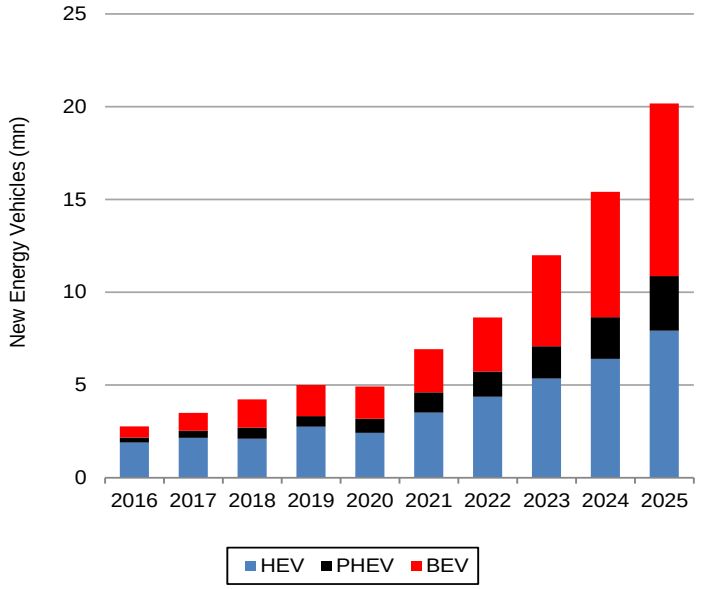
Non stainless demand for nickel

No shortfall in nickel metal for battery cathodes and other non-stainless applications

We have updated our calculations of nickel required by NEVs using estimates by our auto sector and battery sector colleagues in Japan and South Korea respectively for the global growth of NEVs and the associated battery demand. While we expect exponential growth for battery nickel demand (Figure 86), it is coming from a low base and we see no shortfall in the supply of Nickel briquettes or cathode suitable for production of battery materials and other non stainless applications out to 2025 at least (Figure 87).

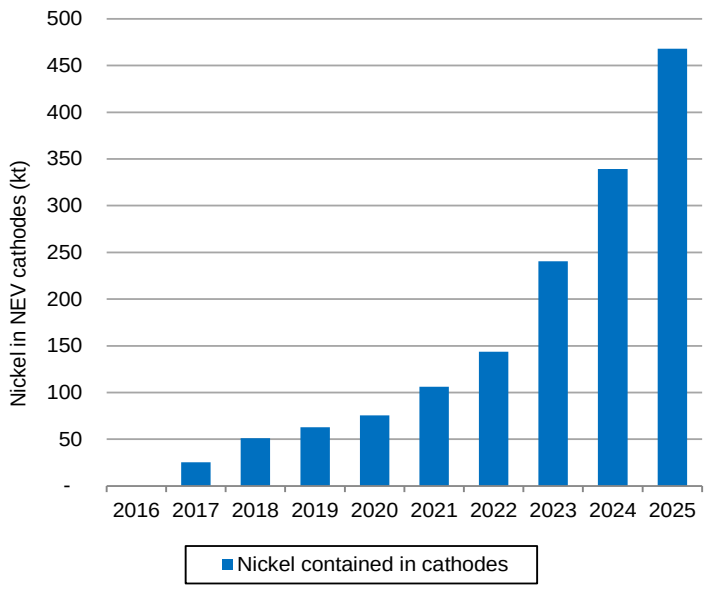
One consideration will be the impact on aircraft deliveries following COVID-19 and the increase in work-from-home and web-based conference calls. If international travel for business falls in future, this will impact the demand for nickel in super alloys used in jet engine turbines.

Figure 85: Credit Suisse estimates of NEV growth



Source: Credit Suisse estimates, IHS

Figure 86: Nickel contained in cathodes



Source: Credit Suisse estimates

Figure 87: Cathode and briquettes supply & demand for non-stainless applications

	2016	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
NEV Ni cathode demand	**18**	**25**	**51**	**63**	**76**	**106**	**144**	**240**	**339**
% change	*55.5%*	*39.8%*	*102.9%*	*22.7%*	*20.7%*	*40.4%*	*35.4%*	*67.2%*	*41.2%*
% total Ni demand	*0.9%*	*1.1%*	*2.2%*	*2.5%*	*3.2%*	*4.2%*	*5.5%*	*8.8%*	*11.8%*
Other alloys, plating, foundry demand	**637**	**683**	**706**	**731**	**651**	**664**	**676**	**658**	**655**
% change	*4.3%*	*7.2%*	*3.5%*	*3.5%*	*-10.9%*	*1.9%*	*1.7%*	*-2.6%*	*-0.5%*
Total non stainless demand	**655**	**708**	**757**	**794**	**727**	**770**	**819**	**899**	**994**
% change	*5.2%*	*8.1%*	*7.0%*	*4.8%*	*-8.4%*	*5.9%*	*6.4%*	*9.7%*	*10.6%*
Proportion of total nickel use	*31.5%*	*32.2%*	*32.8%*	*32.2%*	*30.4%*	*30.3%*	*31.2%*	*32.8%*	*34.5%*
Cathode & briquette production	**1170**	**1094**	**1055**	**1091**	**1065**	**1128**	**1202**	**1263**	**1284**
metal surplus/(shortfall) for non-stainless	**515**	**387**	**298**	**297**	**338**	**358**	**383**	**364**	**289**

Source: Credit Suisse estimates, Wood Mackenzie

Cautious about exponential nickel demand for batteries into the distant future

Another issue with battery demand is that the technology is advancing very rapidly and it's uncertain that the nickel-based cathodes that the batteries are currently relying on will be the technology of choice in five years' time. While we model increasing use of nickel as currently expected for lithium ion battery cathodes, new competing technologies may push nickel aside. We note that no pundits expected Tesla to start using LFP batteries for the Model 3 built in its Chinese Gigafactory. The LFP batteries from CATL's appear to have more compact equipment outside the cell providing overall greater energy density than the same batteries from other suppliers, together with a superior lifespan to current NCM batteries. LFP may not derail nickel, but it is an example of unexpected development diverting demand away from nickel.

Class 1 nickel is not prohibitive from nickel laterite

HPALs don't have to be expensive failures – those run by Nickel Asia work

If new class 1 nickel is needed in future, we see no major constraints. Some of the proposed Indonesian projects use HPALs. While HPALs were problematical at VNC, Ambatovy and Murrin – all complex projects intended to produce finished metal, a pair of simpler HPALs in the

Philippines - owned by Nickel Asia and Japanese partners – produce mixed sulphide products for refining in Japan and were low capex, ramped up swiftly and have had trouble-free lives. Western builders of HPALs probably over-complicated the designs of the projects that have struggled.

Or use RKEFs to make nickel matte for refining to metal as Sorowako does

Furthermore, there is a way to make high-grade nickel matte for refining into class 1 nickel using the RKEF design that the new Indonesian NPI projects use. This process has been used at the Sorowako project in Indonesia since 1978, now owned by Vale. This operation currently produces almost 80ktpa of nickel in matte which is shipped to two refineries in Japan. The matte is converted to nickel oxide sinter for stainless steel-making at Tokyo Nickel's Matsuzaka nickel oxide plant, and electrolytic nickel and cobalt at Sumitomo's Nihama nickel refinery using the matte - chlorine leach - electrowinning process. The all-in cash cost including sustaining capex is estimated at $5.10/lb per tonne of finished nickel, about $1.40/lb higher than the ferronickel produced by Tsingshan and Virtue Dragon (Figure 71). In a nickel presentation two years ago, Glencore previously estimate the Sorowako process adds perhaps $1-$1.50/lb to costs of the standard NPI, but the product can be class 1 nickel.

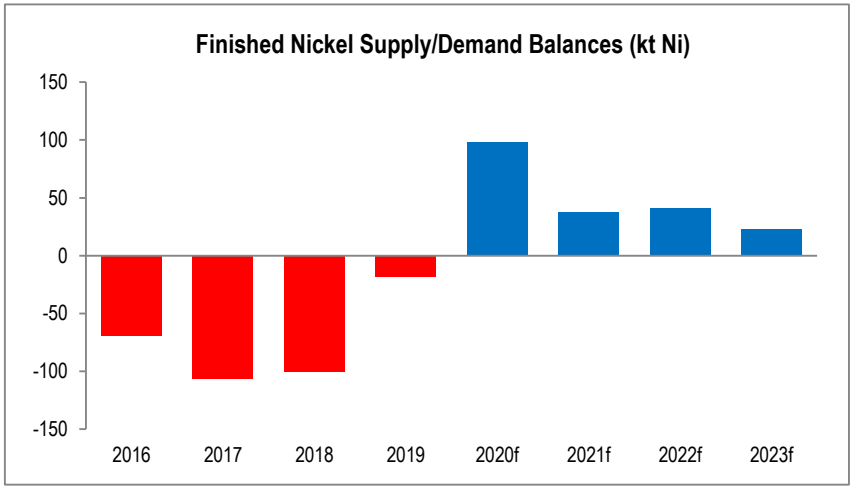
At Sorowako, three ore driers supply five reduction kilns, with calcined ore passed to four electric furnaces for smelting, and the nickel matte is refined in three converters. The major difference between the Sorowako process and traditional ferronickel/NPI RKEF plants is that High Sulphur Fuel Oil is injected into the reduction zone of the rotary kiln. The sulphur combines with iron and nickel in the ore to form iron nickel sulphides. In the electric furnace, the slag and sulphide matte phases separate and matte with 25-28% nickel content is tapped and fed into the converters along with silica flux. Oxygen is injected into the furnace to oxidise the remaining iron, which is then slagged away, upgrading the nickel content of the matte to a nominal 78% Ni, 20% S and 2% Co. Metal recovery is estimated at 86% and the operation is typically paid 78% of the prevailing LME nickel price.

While the metallurgical operation of these plants – including the ore feed chemistry – is complex and tightly controlled, in terms of overall design of the plant, there are only modest changes from the design of the current NPI RKEFs in Indonesia. If additional class 1 nickel is needed, this may be an easier method for pyrometallurgical experts to use than a hydrometallurgical process such as HPAL.

Figure 88: Global nickel supply & demand forecast

	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
Mine Production	2,145	2,295	2,501	2,435	2,786	3,001	3,118	3,148
Disruption Allowance (3%)	0	0	0	(6)	(84)	(90)	(94)	(94)
Laterite stock contribution								
Mine Output	2,145	2,295	2,501	2,429	2,702	2,911	3,025	3,054
REFINED Ni AND FeNi PRODUCTION								
Canada	151	135	125	119	119	122	131	130
Europe	237	250	257	251	279	302	310	312
Russia & Caspian	161	151	154	155	150	150	151	154
Japan	177	165	159	154	155	170	175	176
China	642	693	856	763	634	639	661	669
Australia	112	114	107	114	119	110	108	110
Indonesia	203	289	399	606	814	920	955	962
Other	406	409	392	342	383	416	416	419
Probable Growth	0	0	0	0	3	11	27	35
Disruption Allowance (6%)	0	0	0	(13)	(80)	(170)	(176)	(178)
Total Production	**2,089**	**2,205**	**2,447**	**2,490**	**2,576**	**2,671**	**2,758**	**2,788**
% change	*3.8%*	*5.6%*	*11.0%*	*1.8%*	*3.5%*	*3.7%*	*3.3%*	*1.1%*
Capacity Utilisation %	58%	60%	62%	60%	58%	60%	62%	62%
Briquettes & cathodes	1,094	1,055	1,091	1,065	1,128	1,202	1,263	1,284
China NPI (Ni Content)	421	475	584	480	317	307	314	316
Indonesia NPI (Ni Content)	181	264	373	581	783	864	872	872
CONSUMPTION								
North America	149	150	149	129	139	144	153	166
Europe + Russia	372	363	344	310	346	368	393	437
China	1,198	1,192	1,399	1,402	1,418	1,443	1,481	1,531
Japan	158	178	176	153	168	177	185	193
India	58	58	61	55	59	62	66	70
Indonesia	53	157	154	178	220	233	242	261
Other World	209	208	182	165	189	202	216	228
Total Consumption	**2,196**	**2,306**	**2,465**	**2,392**	**2,539**	**2,629**	**2,736**	**2,886**
% change (World)	*5.5%*	*5.0%*	*6.9%*	*-3.0%*	*6.1%*	*3.6%*	*4.0%*	*5.5%*
% change (China)	*3.2%*	*-0.5%*	*17.4%*	*0.2%*	*1.2%*	*1.8%*	*2.6%*	*3.4%*
% change (Ex-China)	*8.3%*	*11.5%*	*-4.3%*	*-7.1%*	*13.2%*	*5.8%*	*5.8%*	*7.9%*
For Stainless	1,488	1,549	1,672	1,665	1,769	1,810	1,837	1,891
% change	4.3%	4.0%	8.0%	-0.4%	6.2%	2.4%	1.5%	2.9%
For Non-Stainless	708	757	794	727	770	819	899	994
% change	8.1%	7.0%	4.8%	-8.4%	5.9%	6.4%	9.7%	10.6%
- including NEV cathodes	25	51	63	76	106	144	240	339
SURPLUS/(DEFICIT)	**-107**	**-101**	**-18**	**98**	**38**	**41**	**23**	**-97**
LME Stocks	367	206	153					
SHFE stocks	44	15	37					
Total visible stocks	**411**	**310**	**292**	**390**	**427**	**468**	**491**	**394**

	2017	2018	2019	2020f	2021f	2022f	2023f	2024f
Price (US$/t)	10,407	13,130	13,907	13,831	15,110	15,000	15,000	15,440
Price (US$/lb)	4.72	5.96	6.31	6.27	6.85	6.80	6.80	7.00
Stainless Production by Country (kt stainless steel)								
Europe	7,658	7,686	6,891	5,980	7,005	7,195	7,335	7,430
% change	*1%*	*0%*	*-10%*	*-13%*	*17%*	*3%*	*2%*	*1%*
China	25,660	26,300	30,255	29,620	30,320	30,800	31,430	31,890
% change	*4.7%*	*2.5%*	*15.0%*	*-2.1%*	*2.4%*	*1.6%*	*2.0%*	*1.5%*
Japan	3,168	3,283	3,000	2,430	2,850	3,070	3,160	3,260
% change	*2%*	*4%*	*-9%*	*-19%*	*17%*	*8%*	*3%*	*3%*
South Korea	2,406	2,415	2,360	2,100	2,390	2,570	2,800	2,960
% change	*6%*	*0%*	*-2%*	*-11%*	*14%*	*8%*	*9%*	*6%*
Taiwan	1,376	1,172	1,000	760	1,040	1,110	1,170	1,210
% change	*9%*	*-15%*	*-15%*	*-24%*	*37%*	*7%*	*5%*	*3%*
India	3,486	3,750	3,900	3,350	3,770	4,100	4,340	4,560
% change	*5%*	*8%*	*4%*	*-14%*	*13%*	*9%*	*6%*	*5%*
Indonesia	703	2,203	2,249	2,460	3,040	3,210	3,330	3,470
% change		*213%*	*2%*	*9%*	*24%*	*6%*	*4%*	*4%*
USA	2,754	2,808	2,593	2,210	2,490	2,500	2,555	2,605
% change	*11%*	*2%*	*-8%*	*-15%*	*13%*	*0%*	*2%*	*2%*
Other	1,064	983	911	723	865	915	945	960
Total World	**48,275**	**50,599**	**53,159**	**49,633**	**53,770**	**55,470**	**57,065**	**58,345**
% change	*5.9%*	*4.8%*	*5.1%*	*-6.6%*	*8.3%*	*3.2%*	*2.9%*	*2.2%*
Austenitic Ratio	76.9%	77.8%	78.6%	79.5%	79.0%	78.7%	78.4%	78.1%
Scrap Ratio	40.1%	41.2%	37.9%	35.1%	36.7%	37.0%	37.6%	37.9%



Source: Wood Mackenzie, SMM, Company data, Credit Suisse estimates

Zinc Forecasts

Still a surplus market despite mine impacts

Zinc YTD has now enjoyed the greatest price rise. This has been driven by a shortage of concentrate, especially given some recent mine outages such as Gamsberg. However, we doubt this price performance is sustainable given the refined market isn't showing tightness and the concentrate market move into surplus in 2021.

Revised zinc price forecasts

We have lifted the zinc price in line with market moves, but given we expect an oversupply of zinc, we forecast the price will ease to $2600/t in 2H-21 and remain at this level throughout the forecast period. We believe the zinc market still holds concentrate stocks and TCs remain sufficiently elevated to encourage production, which should depress metal prices.

Lead: We have undertaken no supply analysis of lead, but simply set our price forecasts at a typical ratio of the zinc price.

Figure 89: Revised zinc & lead price forecasts

			1Q-20	2Q-20	3Q-20	4Q-20	2020E	1Q-21	2Q-21	3Q-21	4Q-21	2021E	2022E	2023E	2024E	LT (real)
Zinc	New	US$/t	2,124	1,970	2,424	2,730	**2,312**	2,750	2,650	2,600	2,600	**2,650**	**2,600**	**2,600**	**2,600**	2,400
	New	US$/lb	0.96	0.89	1.10	1.24	**1.05**	1.25	1.20	1.18	1.18	**1.20**	**1.18**	**1.18**	**1.18**	1.09
	Old	US$/lb	0.96	0.89	1.10	1.00	**0.99**	1.00	1.00	1.00	1.00	**1.00**	**1.10**	**1.10**	**1.12**	1.09
	Chg	*%*	*0%*	*0%*	*0%*	*24%*	***6%***	*25%*	*20%*	*18%*	*18%*	***20%***	***7%***	***7%***	***5%***	*0%*
Lead	New	US$/t	1,843	1,679	1,679	1,925	**1,782**	2,145	2,067	2,028	2,028	**2,067**	**2,028**	**2,080**	**2,080**	2,000
	New	US$/lb	0.84	0.76	0.76	0.87	**0.81**	0.97	0.94	0.92	0.92	**0.94**	**0.92**	**0.94**	**0.94**	0.91
	Old	US$/lb	0.84	0.76	0.76	0.84	**0.80**	0.85	0.85	0.85	0.85	**0.85**	**0.90**	**0.92**	**0.94**	0.91
	Chg	*%*	*0%*	*0%*	*0%*	*4%*	***1%***	*14%*	*10%*	*8%*	*8%*	***10%***	***2%***	***3%***	***1%***	*0%*

Source: Credit Suisse estimates

Refined zinc supply remains in surplus despite a concentrate shortage in 2020

This year, despite a concentrate deficit and a broadly balanced fundamental supply and demand, the refined market is in surplus. From 2021, we expect mine supply to rebound, ensuring enough concentrate supply and keeping the market in surplus. Zinc mine supply was materially impacted this year especially in parts of South America like Peru. However from the available data, this appeared to rebound quickly through Q3 and so should normalize as we move into 2021.

Figure 90: Zinc supply & demand summary

	2016	2017	2018	2019f	2020f	2021f	2022f	2023f
Mine Output	12,110	12,575	12,886	13,250	12,611	13,027	12,997	13,534
% Change Y-o-Y	*-7.5%*	*3.8%*	*2.5%*	*2.8%*	*-4.8%*	*3.3%*	*-0.2%*	*4.1%*
Of which China	4,693	4,663	4,467	4,691	4,700	4,847	4,910	5,587
% Change Y-o-Y	*-0.8%*	*-0.6%*	*-4.2%*	*5.0%*	*0.2%*	*3.1%*	*1.3%*	*13.8%*
World Refined Production	13,586	13,511	13,239	13,356	13,606	14,099	14,179	14,028
% Change Y-o-Y	*-1.0%*	*-0.5%*	*-2.0%*	*0.9%*	*1.9%*	*3.6%*	*0.6%*	*-1.1%*
Of which China	6,036	6,003	5,636	5,905	6,286	6,473	6,553	6,658
% Change Y-o-Y	*1.8%*	*-0.6%*	*-6.1%*	*4.8%*	*6.5%*	*3.0%*	*1.2%*	*1.6%*
World Concentrate Balance	**(940)**	**(370)**	**330**	**470**	**(483)**	**(86)**	**3**	**(1)**
World Consumption	13,977	14,236	14,184	13,923	13,088	13,588	13,930	14,257
% Change Y-o-Y	*2.2%*	*1.9%*	*-0.4%*	*-1.8%*	*-6.0%*	*3.8%*	*2.5%*	*2.3%*
Of which China consumption	6,673	6,827	6,875	6,954	6,923	7,131	7,273	7,421
% Change Y-o-Y	*3.9%*	*2.3%*	*0.7%*	*1.1%*	*-0.4%*	*3.0%*	*2.0%*	*2.0%*
World Metal market balance	**(391)**	**(725)**	**(945)**	**(567)**	**517**	**511**	**249**	**(229)**
Fundamental Surplus/(deficit) (kt)	**(1,331)**	**(1,095)**	**(616)**	**(97)**	**34**	**425**	**252**	**(230)**

Source: Wood Mackenzie, Credit Suisse estimates

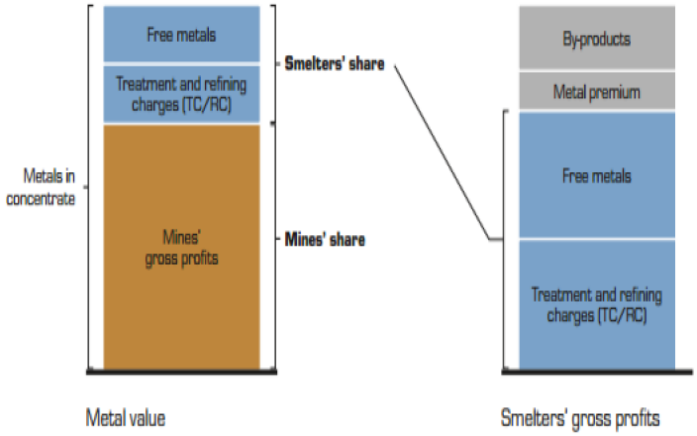
The concentrate vs refined shortage conundrum

The sharp fall in the spot treatment charges has been widely cited as a sign of concentrate market tightness and a shifting balance in favour of the miners. While this is true, the starting point was one of record high TCs (Figure 91) and we see no signs of shortage in the refined market which leads us to think that this stellar rise of the price might be an overshoot relative to the other metals.

Figure 91: China spot TC ($/t)

Source: Wood Mackenzie

Figure 92: Mine vs smelters value breakdown



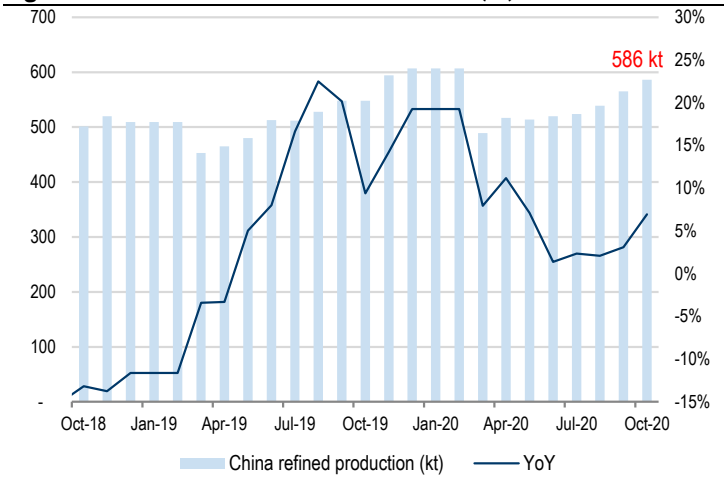
Source: The BLOOMBERG PROFESSIONAL™ service

There is little evidence so far that the impacts to mine supply have constrained the market:

- **Concentrate imports into China remain near record levels despite mine outages**: Concentrate imports into China have been consistently strong all year, assisting concentrate availability within the country (Figure 94).

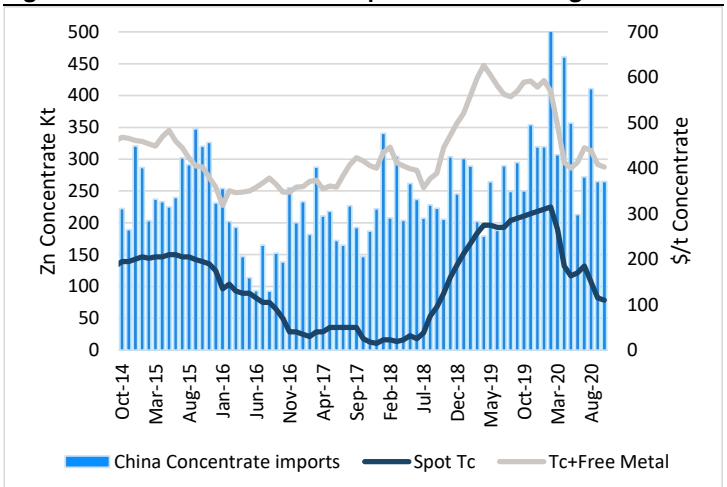
- **Refined production in China remains very strong**: Despite the drop in TCs, refined output is showing no sign of a feed shortage with latest October output up 7% YoY (Figure 93.

Figure 93: China Refined Zinc Production (kt)



Source: The BLOOMBERG PROFESSIONAL™ service

Figure 94: China concentrate imports remain at high levels

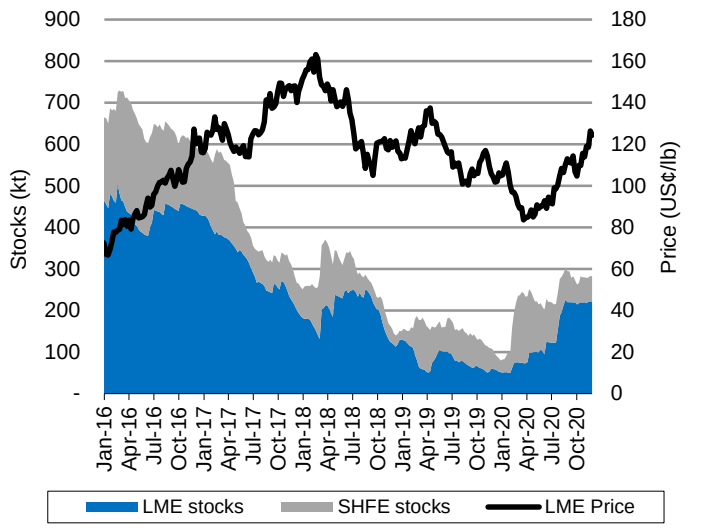


Source: Wood Mackenzie, The BLOOMBERG PROFESSIONAL™ service

- **Inventories have been rising globally (albeit LME offsetting declines in SHFE)**: As we show below, exchange inventories have been on an upward trend despite the mine

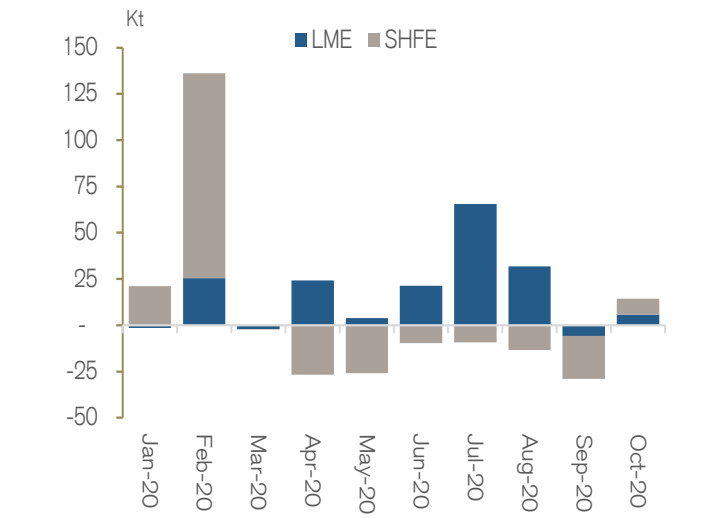
supply outages this year, albeit we've seen different directions in LME and SHFE levels. In October even China saw increases MoM (Figure 95, Figure 96).

Figure 95: LME/SHFE Zinc inventory (t) vs % can. warrants



Source: LME, SHFE, Credit Suisse estimates

Figure 96: LME and SHFE Zinc inventory (t)



Source: The BLOOMBERG PROFESSIONAL™ service, Credit Suisse estimates

Supply and demand outlook – still a surplus market

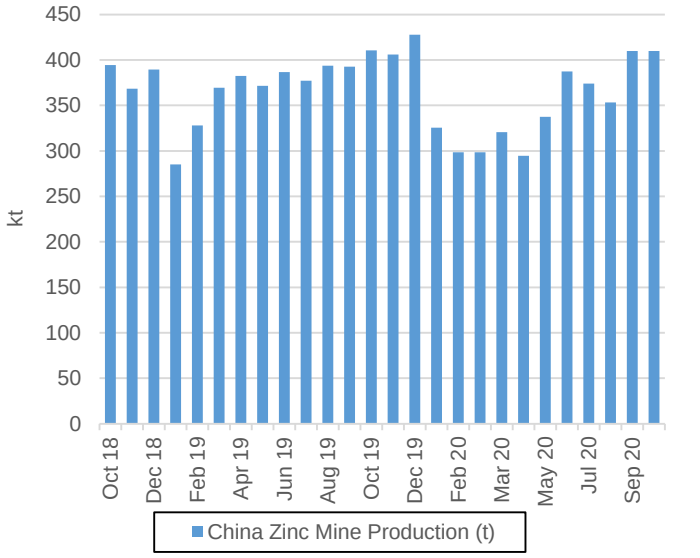
To illustrate the outlook for the zinc market, we think it is important to look at both the refined market balance and the fundamental supply/demand relationship. To do this, we take mine production adjusted for scrap and processing losses and compare it with demand, instead of looking so closely at refined production. This takes out the noise of smelter behaviour and undisclosed concentrate stockpiles, and looks more simply at how much is being produced vs how much is required.

This year, despite a concentrate deficit, and a broadly balanced fundamental supply and demand, the refined market is in surplus. From 2021, we expect mine supply to rebound, ensuring enough concentrate supply and keeping the market in surplus (Figure 90).

Mine supply outages rebounded quickly:
Zinc mine supply was materially impacted this year especially in parts of South America like Peru (Figure 97, Figure 98). However from the available data, this appeared to rebound quickly through Q3 and so should normalize as we move into 2021.

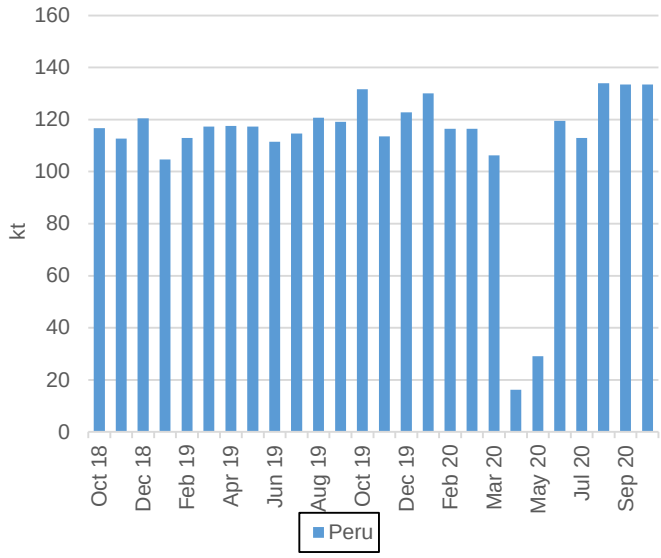
Ex-China mine supply was down ~8% in 2016, with the biggest reductions seen in Australia. We illustrate this below using both WBMS data and our own zinc mine supply proxy, which comprises nine major producers that make up ~30% of global mine supply (or ~50% of supply outside of China).

Figure 97: China mine production (t)



Source: The BLOOMBERG PROFESSIONAL™ service, Credit Suisse estimates

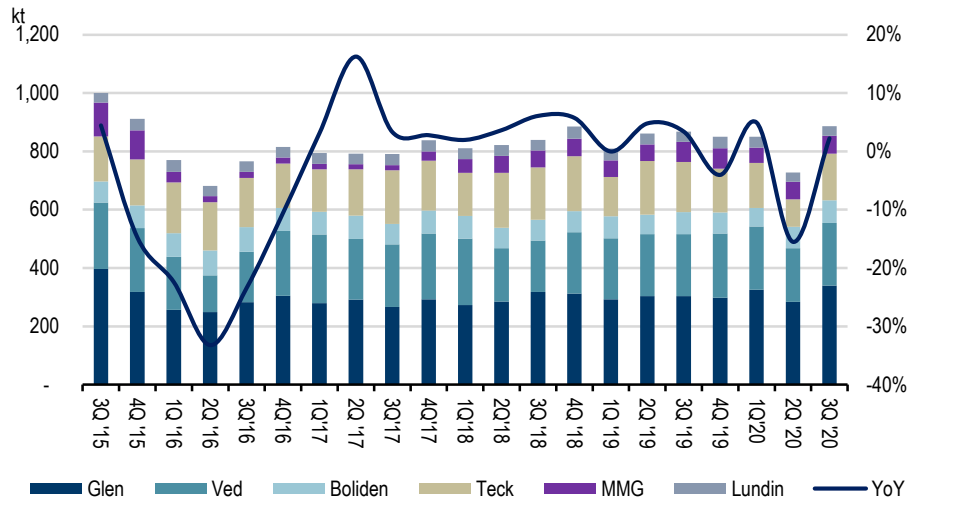
Figure 98: Peru mine production (t)



Source: The BLOOMBERG PROFESSIONAL™ service, Credit Suisse estimates

Our zinc supply proxy consists of nine major zinc producers that combined account for ~30% of global mine supply (~50% ex-China). Production from these companies was severely impacted in Q2 as we saw late 2015/early 2016 too (Figure 99). However this time round the recovery has been sharp and swift with Q3 showing a full return to previous levels.

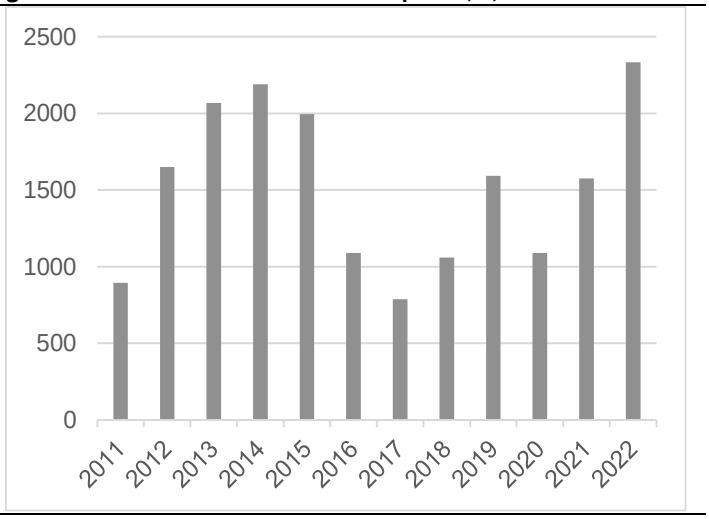
Figure 99: Zinc equity supply proxy (kt)



Source: Company data, Credit Suisse estimates

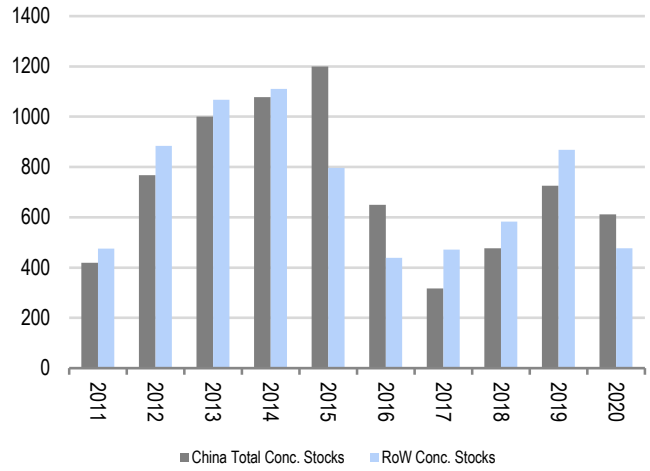
Concentrate stockpiles will have been drawn down, but there is still enough, especially if mine supply rebounds as we expect into 2020. Even after applying a COVID-19 impact, Wood Mackenzie expects 2020 China mine supply to be higher year on year in 2020. In addition, over the past few years there has been a rebuild in concentrate availability, therefore we expect smelters will have access to enough concentrate.

Figure 100: World Concentrate stockpiles (kt)



Source: Wood Mackenzie

Figure 101: Concentrate stockpiles China and ex-China (kt)



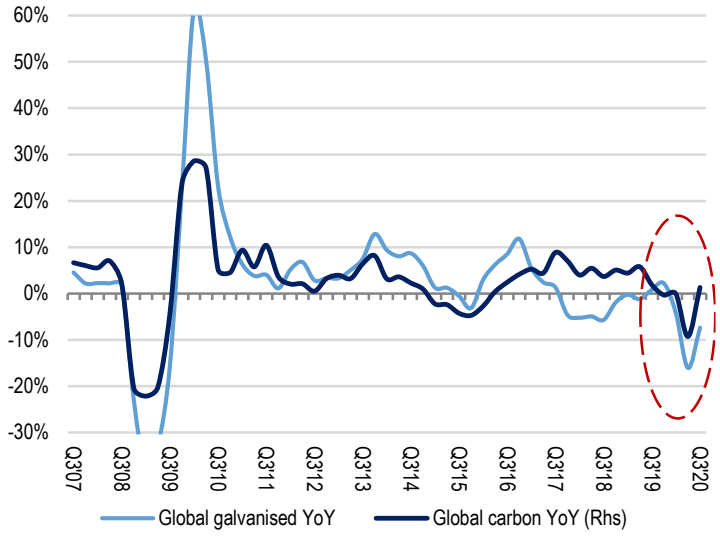
Source: Wood Mackenzie

China the main driver of demand as with other commodities

We have seen galvanized steel rebound strongly this year in China in line with what we have seen in carbon steel. We forecast demand to remain constructive, with China growing ~3% in 2021 and ex-China rebounding 5% next year as it rebounds from a tough 2020.

Figure 102: Global galvanized vs carbon steel YoY%

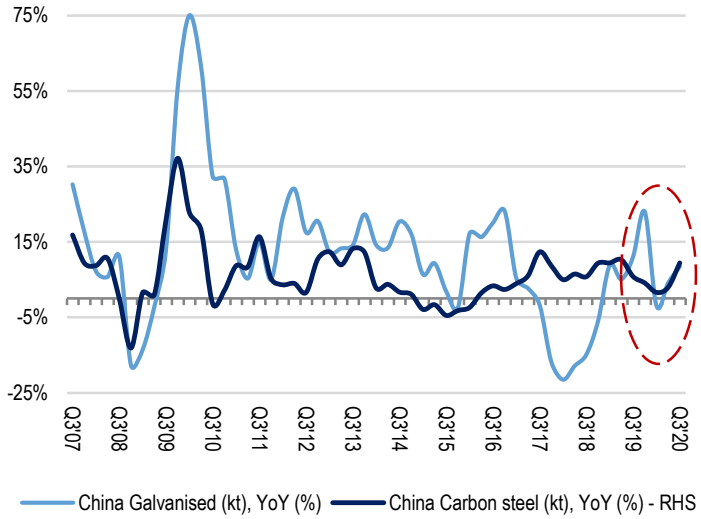
Q3'20 Global galvanized steel output down 7.4% YoY and carbon steel up 1.3% YoY



Source: CRU, WSA, Credit Suisse

Figure 103: China galvanized vs carbon steel YoY%

Q3'20 China galvanized steel output up 8.5% YoY and carbon steel up 9.4% YoY

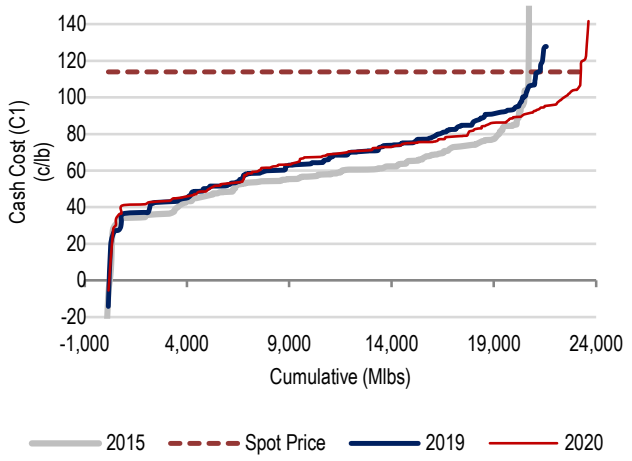


Source: CRU, WSA, Credit Suisse estimates

No cost support for prices

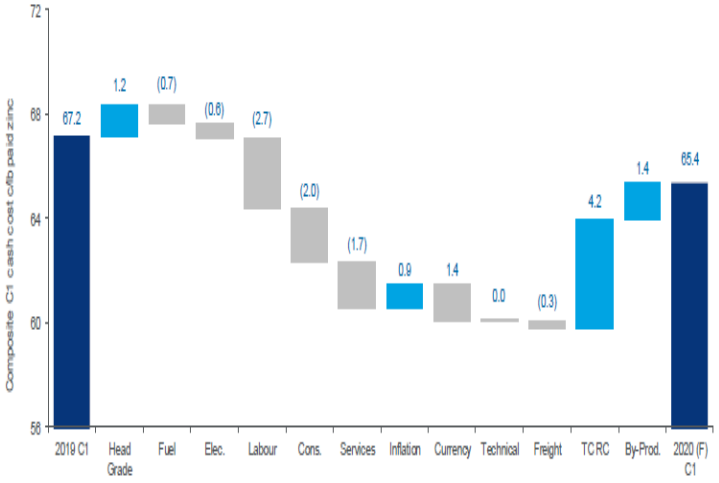
The cost curve is not an accurate predictor of prices, but it can indicate the level of floor support. Prices today are sitting well above the cost curve given the deflationary pressures we have seen as well as the now sharp fall in TCs. We doubt this is sustainable with refined zinc remaining in surplus.

Figure 104: Zinc C1 cash cost curve and spot price



Source: Wood Mackenzie, Credit Suisse estimates

Figure 105: Cost curve comparison 2020 vs 2019



Source: Wood Mackenzie

Figure 106: Zinc supply & demand

	2016	2017	2018	2019	2020f	2021f	2022f	2023f
MINED ZINC SUPPLY								
North America	1,717	1,781	1,838	1,821	1,716	1,839	1,851	1,795
South America (excl. Peru)	750	747	819	816	649	741	754	770
Peru	1,215	1,371	1,360	1,294	1,098	1,361	1,388	1,302
Europe	836	866	947	925	932	943	968	974
CIS	690	761	776	745	797	1,035	1,062	1,068
China	4,693	4,663	4,467	4,691	4,700	4,847	4,910	5,587
India	645	831	749	725	698	788	788	788
Other Asia	208	187	208	237	229	234	249	247
Australia	887	819	1,134	1,318	1,379	1,450	1,474	1,425
Africa	350	432	463	550	481	590	565	381
Middle East	119	117	128	130	132	132	132	132
Probable Projects	-	-	-	-	-	-	2	100
Disruption Allowance	-	-	-	-	(200)	(934)	(1,145)	(1,034)
World Mined Zinc Production	**12,110**	**12,575**	**12,886**	**13,250**	**12,611**	**13,027**	**12,997**	**13,534**
% Change	*-7.5%*	*3.8%*	*2.5%*	*2.8%*	*-4.8%*	*3.3%*	*-0.2%*	*4.1%*
% Change (China)	*-0.8%*	*-0.6%*	*-4.2%*	*5.0%*	*0.2%*	*3.1%*	*1.3%*	*13.8%*
REFINED ZINC SUPPLY	-12%	-5%	2%	5%	-2%	-2%	9%	0%
North America	1,138	1,051	1,105	1,142	1,275	1,355	1,355	1,290
South America (excl. Peru)	274	273	276	284	276	276	276	280
Peru	342	310	334	340	290	335	335	335
Europe	2,181	2,160	2,238	2,192	2,246	2,266	2,266	2,271
CIS	625	649	640	575	580	600	600	600
China (adj.)	6,036	6,003	5,636	5,905	6,286	6,473	6,553	6,658
India	641	828	760	720	698	785	785	785
Japan	534	523	521	529	555	575	575	575
South Korea	1,013	971	989	986	1,020	1,020	1,020	1,020
Other Asia	135	83	65	65	65	65	65	65
Australia	464	459	489	432	485	530	530	530
Africa	94	94	77	78	21	10	10	10
Middle East	109	109	109	109	109	109	109	109
World Refined Production	**13,586**	**13,511**	**13,239**	**13,356**	**13,606**	**14,099**	**14,179**	**14,028**
% Change	*-1.0%*	*-0.5%*	*-2.0%*	*0.9%*	*1.9%*	*3.6%*	*0.6%*	*-1.1%*
% Change (China)	*1.8%*	*-0.6%*	*-6.1%*	*4.8%*	*6.5%*	*3.0%*	*1.2%*	*1.6%*
Incl. Scrap/Secondary	1,202	1,250	1,350	1,250	1,200	1,201	1,202	1,202
Process Losses/Pipeline Stocks	727	743	728	735	748	775	780	772
Required Mined Zinc	13,050	12,944	12,557	12,781	13,094	13,612	13,695	13,535
Concentrate Balance	**(940)**	**(370)**	**330**	**470**	**(483)**	**(86)**	**3**	**(1)**
World Consumption	**13,977**	**14,236**	**14,184**	**13,923**	**13,088**	**13,588**	**13,930**	**14,257**
REFINED SURPLUS/(DEFICIT)	**(391)**	**(725)**	**(945)**	**(567)**	**517**	**511**	**249**	**(229)**

	2016	2017	2018	2019	2020f	2021f	2022f	2023f
STOCKS								
LME	428	182	129	51				
SHFE Stocks	153	69	20	28				
Weeks Cons. (Exch. Stocks)	2.2	0.9	0.5	0.3				
Prod/cons/other Stocks	548	543	480	468				
Reported Stocks	**1,129**	**794**	**629**	**547**				
Weeks Consumption	4.2	2.9	2.3	2.0				
Price (US$/t)	**2,101**	**2,893**	**2,925**	**2,554**	**2,273**	**2,650**	**2,600**	**2,600**
Price (US$/lb)	**0.95**	**1.31**	**1.33**	**1.16**	**1.03**	**1.20**	**1.18**	**1.18**
TC $/t conc.	203	172	147	245	300			
TC realised $/lb Zn	21.2	17.2	14.7	24.1	30.0			
REGIONAL ZINC CONSUMPTION								
North America	1,418	1,375	1,375	1,297	1,143	1,202	1,255	1,294
% Change	*3.6%*	*-3.1%*	*0.0%*	*-5.7%*	*-11.8%*	*5.1%*	*4.4%*	*3.2%*
South America	373	361	364	336	280	280	298	311
% Change	*-2.3%*	*-3.1%*	*0.8%*	*-7.6%*	*-16.7%*	*0.0%*	*6.4%*	*4.2%*
Europe (incl. CIS)	2,574	2,652	2,665	2,533	2,237	2,375	2,409	2,431
% Change	*-0.5%*	*3.0%*	*0.5%*	*-4.9%*	*-11.7%*	*6.2%*	*1.4%*	*0.9%*
Asia (excl. China)	2,520	2,623	2,529	2,458	2,201	2,286	2,370	2,454
% Change	*3.8%*	*4.1%*	*-3.6%*	*-2.8%*	*-10.5%*	*3.9%*	*3.6%*	*3.6%*
China	6,673	6,827	6,875	6,954	6,923	7,131	7,273	7,421
% Change	*3.9%*	*2.3%*	*0.7%*	*1.1%*	*-0.4%*	*3.0%*	*2.0%*	*2.0%*
Australasia	108	94	103	96	89	93	94	96
% Change	*-18.6%*	*-12.7%*	*9.5%*	*-7.4%*	*-7.1%*	*4.7%*	*1.1%*	*1.7%*
Africa	140	143	136	137	112	117	122	133
% Change	*-11.3%*	*2.0%*	*-5.1%*	*0.8%*	*-18.0%*	*3.9%*	*4.6%*	*9.1%*
Middle East	170	162	137	112	103	105	109	117
% Change	*-12.2%*	*-5.0%*	*-15.1%*	*-18.1%*	*-8.1%*	*1.6%*	*4.1%*	*7.0%*
World Consumption	**13,977**	**14,236**	**14,184**	**13,923**	**13,088**	**13,588**	**13,930**	**14,257**
% Change	*2.2%*	*1.9%*	*-0.4%*	*-1.8%*	*-6.0%*	*3.8%*	*2.5%*	*2.3%*
World ex China demand growth	*0.7%*	*1.4%*	*-1.4%*	*-4.6%*	*-11.5%*	*4.7%*	*3.1%*	*2.7%*
World Refining Capacity	16,083	16,253	16,358	16,343	16,343	16,343	16,343	16,343
Capacity Utilisation (%)	84.5%	83.1%	80.9%	81.7%	83.3%	86.3%	86.8%	85.8%

Source: Wood Mackenzie, LME, SHFE, company updates, Credit Suisse estimates

Companies Mentioned *(Price as of 01-Dec-2020)*
Alcoa Corporation (AA.N, $19.9)
Anglo American Plc (AAL.L, 2213.5p)
ArcelorMittal (MT.N, $18.16)
BHP Group Limited (BHP.AX, A$38.56)
BHP Group Limited (BHPB.L, 1698.6p)
CODELCO (Unlisted)
Freeport-McMoRan (FCX.N, $23.39)
Glencore (GLEN.L, 211.85p)
JFE (5411.T, ¥956)
JFE Holdings (5411.OS)
MMG Limited (1208.HK, HK$3.38)
Minsur (MINSURI1.LM, S/.1.7)
NIPPON STEEL (NPSCY.PK, $26.985)
Nevsun Resources (NSU.TO^C19)
OZ Minerals (OZL.AX, A$16.6)
Rio Tinto (RIO.AX, A$102.95)
Rio Tinto (RIO.L, 4834.0p)
Southern Copper Corporation (SCCO.N, $59.37)
Sumitomo Mitsui Trust (8309.T, ¥3,051)
Teck Resources Ltd (TECKb.TO, C$20.52)
Tesla Inc (TSLA.OQ, $567.6)
Vale (VALE.N, $14.56)

Disclosure Appendix

Analyst Certification

I, Matthew Hope, certify that (1) the views expressed in this report accurately reflect my personal views about all of the subject companies and securities and (2) no part of my compensation was, is or will be directly or indirectly related to the specific recommendations or views expressed in this report.

As of December 10, 2012 Analysts' stock rating are defined as follows:

Outperform (O) : The stock's total return is expected to outperform the relevant benchmark* over the next 12 months.
Neutral (N) : The stock's total return is expected to be in line with the relevant benchmark* over the next 12 months.
Underperform (U) : The stock's total return is expected to underperform the relevant benchmark* over the next 12 months.
**Relevant benchmark by region: As of 10th December 2012, Japanese ratings are based on a stock's total return relative to the analyst's coverage universe which consists of all companies covered by the analyst within the relevant sector, with Outperforms representing the most attractive, Neutrals the less attractive, and Underperforms the least attractive investment opportunities. As of 2nd October 2012, U.S. and Canadian as well as European (excluding Turkey) ratings are based on a stock's total return relative to the analyst's coverage universe which consists of all companies covered by the analyst within the relevant sector, with Outperforms representing the most attractive, Neutrals the less attractive, and Underperforms the least attractive investment opportunities. For Latin America, Turkey and Asia (excluding Japan and Australia), stock ratings are based on a stock's total return relative to the average total return of the relevant country or regional benchmark (India - S&P BSE Sensex Index); prior to 2nd October 2012 U.S. and Canadian ratings were based on (1) a stock's absolute total return potential to its current share price and (2) the relative attractiveness of a stock's total return potential within an analyst's coverage universe. For Australian and New Zealand stocks, the expected total return (ETR) calculation includes 12-month rolling dividend yield. An Outperform rating is assigned where an ETR is greater than or equal to 7.5%; Underperform where an ETR less than or equal to 5%. A Neutral may be assigned where the ETR is between -5% and 15%. The overlapping rating range allows analysts to assign a rating that puts ETR in the context of associated risks. Prior to 18 May 2015, ETR ranges for Outperform and Underperform ratings did not overlap with Neutral thresholds between 15% and 7.5%, which was in operation from 7 July 2011.*
Restricted (R) : In certain circumstances, Credit Suisse policy and/or applicable law and regulations preclude certain types of communications, including an investment recommendation, during the course of Credit Suisse's engagement in an investment banking transaction and in certain other circumstances.
Not Rated (NR) : Credit Suisse Equity Research does not have an investment rating or view on the stock or any other securities related to the company at this time.
Not Covered (NC) : Credit Suisse Equity Research does not provide ongoing coverage of the company or offer an investment rating or investment view on the equity security of the company or related products.

Volatility Indicator [V] : A stock is defined as volatile if the stock price has moved up or down by 20% or more in a month in at least 8 of the past 24 months or the analyst expects significant volatility going forward.

Analysts' sector weightings are distinct from analysts' stock ratings and are based on the analyst's expectations for the fundamentals and/or valuation of the sector* relative to the group's historic fundamentals and/or valuation:
Overweight : The analyst's expectation for the sector's fundamentals and/or valuation is favorable over the next 12 months.
Market Weight : The analyst's expectation for the sector's fundamentals and/or valuation is neutral over the next 12 months.
Underweight : The analyst's expectation for the sector's fundamentals and/or valuation is cautious over the next 12 months.
**An analyst's coverage sector consists of all companies covered by the analyst within the relevant sector. An analyst may cover multiple sectors.*

Credit Suisse's distribution of stock ratings (and banking clients) is:

Global Ratings Distribution

Rating	Versus universe (%)	Of which banking clients (%)
Outperform/Buy*	52%	(33% banking clients)
Neutral/Hold*	36%	(28% banking clients)
Underperform/Sell*	11%	(20% banking clients)
Restricted	2%	

Please click here to view the MAR quarterly recommendations and investment services report for fundamental research recommendations.

**For purposes of the NYSE and FINRA ratings distribution disclosure requirements, our stock ratings of Outperform, Neutral, and Underperform most closely correspond to Buy, Hold, and Sell, respectively; however, the meanings are not the same, as our stock ratings are determined on a relative basis. (Please refer to definitions above.) An investor's decision to buy or sell a security should be based on investment objectives, current holdings, and other individual factors.*

Important Global Disclosures

Credit Suisse's research reports are made available to clients through our proprietary research portal on CS PLUS. Credit Suisse research products may also be made available through third-party vendors or alternate electronic means as a convenience. Certain research products are only made available through CS PLUS. The services provided by Credit Suisse's analysts to clients may depend on a specific client's preferences regarding the frequency and manner of receiving communications, the client's risk profile and investment, the size and scope of the overall client relationship with the Firm, as well as legal and regulatory constraints. To access all of Credit Suisse's research that you are entitled to receive in the most timely manner, please contact your sales representative or go to https://plus.credit-suisse.com .

Credit Suisse's policy is to update research reports as it deems appropriate, based on developments with the subject company, the sector or the market that may have a material impact on the research views or opinions stated herein.

Credit Suisse's policy is only to publish investment research that is impartial, independent, clear, fair and not misleading. For more detail please refer to Credit Suisse's Policies for Managing Conflicts of Interest in connection with Investment Research: https://www.credit-suisse.com/sites/disclaimers-ib/en/managing-conflicts.html .

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

Credit Suisse has decided not to enter into business relationships with companies that Credit Suisse has determined to be involved in the development, manufacture, or acquisition of anti-personnel mines and cluster munitions. For Credit Suisse's position on the issue, please see https://www.credit-suisse.com/media/assets/corporate/docs/about-us/responsibility/banking/policy-summaries-en.pdf .

The analyst(s) responsible for preparing this research report received compensation that is based upon various factors including Credit Suisse's total revenues, a portion of which are generated by Credit Suisse's investment banking activities

For date and time of production, dissemination and history of recommendation for the subject company(ies) featured in this report, disseminated within the past 12 months, please refer to the link: https://rave.credit-suisse.com/disclosures/view/report?i=572303&v=1vs1ibr250uk3rtrk2vn0pzmc .

Important Regional Disclosures

Singapore recipients should contact Credit Suisse AG, Singapore Branch for any matters arising from, or in connection with, this research report.

The analyst(s) involved in the preparation of this report may participate in events hosted by the subject company, including site visits. Credit Suisse does not accept or permit analysts to accept payment or reimbursement for travel expenses associated with these events.

For Credit Suisse Securities (Canada), Inc.'s policies and procedures regarding the dissemination of equity research, please visit https://www.credit-suisse.com/sites/disclaimers-ib/en/canada-research-policy.html.

Investors should note that income from such securities and other financial instruments, if any, may fluctuate and that price or value of such securities and instruments may rise or fall and, in some cases, investors may lose their entire principal investment.

Please visit https://www.credit-suisse.com/in/en/legal/research-disclosure.html for additional disclosures required under the Securities And Exchange Board of India (Research Analysts) Regulations, 2014

Credit Suisse Equity Research may make decisions about new and ongoing listed company coverage, including initiation, assumption or termination of coverage, based on various factors including: market capitalisation, trading volume, relevance to our institutional investor-clients, availability of information allowing formation and maintenance of a reasonable investment view, internal resourcing and availability of suitable analysts, or other factors of a regulatory nature as may be encountered from time to time.

In the preparation of Credit Suisse's research reports, Credit Suisse may have had assistance from the company (including but not limited to discussions with management of the company and visits to certain sites of the company).

This research report is authored by:

Credit Suisse (Hong Kong) Limited ..... Yang Luo
Credit Suisse Equities (Australia) Limited ..... Matthew Hope ; Sam Webb ; Nick Herbert, CFA
Credit Suisse Securities (India) Private Limited ..... Prateek Singh
Credit Suisse International ..... Conor Rowley ; Carsten Riek
Credit Suisse Securities (USA) LLC ..... Caio Ribeiro ; Curt Woodworth, CFA
Credit Suisse Securities (Canada), Inc. ..... Fahad Tariq, CPA, CA

To the extent this is a report authored in whole or in part by a non-U.S. analyst and is made available in the U.S., the following are important disclosures regarding any non-U.S. analyst contributors: The non-U.S. research analysts listed below (if any) are not registered/qualified as research analysts with FINRA. The non-U.S. research analysts listed below may not be associated persons of CSSU and therefore may not be

subject to the FINRA 2241 restrictions on communications with a subject company, public appearances and trading securities held by a research analyst account.

Credit Suisse (Hong Kong) Limited ..... Yang Luo
Credit Suisse Equities (Australia) Limited ..... Matthew Hope ; Sam Webb ; Nick Herbert, CFA
Credit Suisse Securities (India) Private Limited ..... Prateek Singh
Credit Suisse International ..... Conor Rowley ; Carsten Riek
Credit Suisse Securities (Canada), Inc. ..... Fahad Tariq, CPA, CA

Important disclosures regarding companies that are the subject of this report are available by calling +1 (877) 291-2683. The same important disclosures, with the exception of valuation methodology and risk discussions, are also available on Credit Suisse's disclosure website at https://rave.credit-suisse.com/disclosures . For valuation methodology and risks associated with any recommendation, price target, or rating referenced in this report, please refer to the disclosures section of the most recent report regarding the subject company.