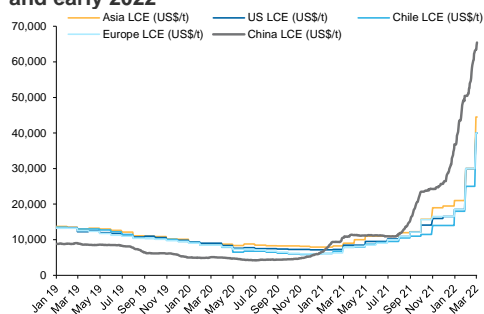


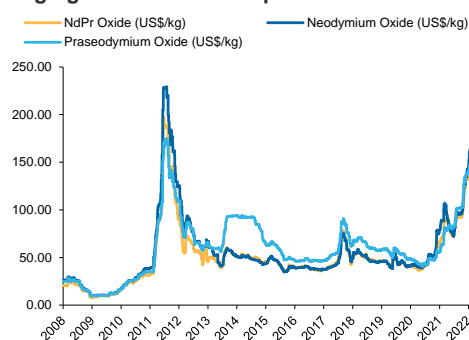
EQUITIES

Chinese spot lithium prices surged in late 2021 and early 2022



Source: Bloomberg, Macquarie Research, March 2022

Neodymium and Praseodymium prices are edging close to the 2011 peak



Source: Bloomberg, Macquarie Research, March 2022

Lithium and Rare Earths Market Outlook Supply outpaced by demand growth

Key points

- ▶ Production guidance from major lithium producers have fallen short of our expectations and we upgrade our price outlook to reflect the tighter market.
- ▶ Spot lithium prices in China already exceed US\$60,000/t and we now expect spodumene prices to peak at US\$4,000/t.
- ▶ Rare earth prices have also risen strongly, and we upgrade our NdPr prices by 12-24% for CY22-CY24.

Event

- We are upgrading our lithium and rare earths price outlook to reflect further tightening in supply/demand fundamentals and strength in spot prices.

Spot price rise continues amid market deficits

- **EV sales growth update:** Macquarie Global EV tracker reported strong YoY sales in January despite the on-going production disruption (semiconductor related) and a decline in subsidies. The MoM decline is mainly due to seasonality and global automakers' strong year-end push last month. January sales implied EV penetration rates of 20% for Europe, 19% in China and 6% in the US.
- **Supply side response outpaced by demand growth:** Lithium production growth was outpaced by strong demand expansion over the last 12 months. Guidance from major incumbent producers has fallen short of our expectations and is expected to keep the lithium market tight in 2022. Rare earth market fundamentals also remained tight despite higher YoY quotas from China.

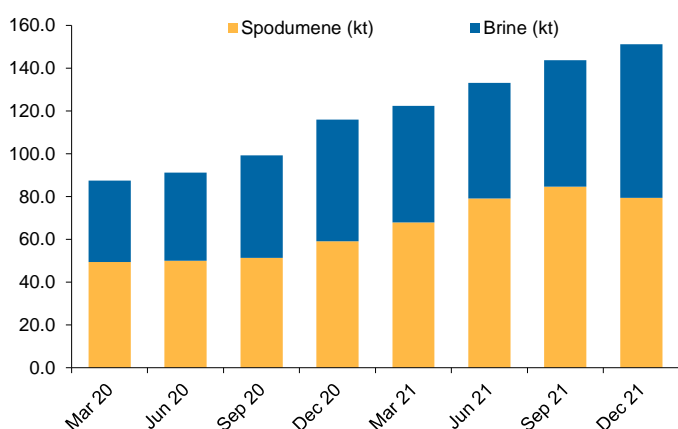
Upgrading lithium and rare earths price outlook

- **Chinese prices surging higher:** Domestic Chinese lithium carbonate prices are trading at significant premiums to regional lithium carbonate prices. We have upgraded our CY22 and CY23 Chinese battery grade lithium carbonate prices by ~105% and ~80% to reflect current strength in spot prices and lack of supply response. Our CY24-CY26 forecasts rise 10-40%.
- **Regional price lag expected to close:** We have linked regional lithium carbonate and hydroxide prices to the China price with a three month lag for CY22 and CY23 before all prices normalise in CY24. This drives upgrades of 132-148% for CY22 regional carbonate prices and increases of 104-110% for CY23 and 35-51% for CY23-CY24.
- **Spodumene price peak increased to US\$4,000/t:** We upgrade our short and medium-term spodumene price forecasts by 18-50% to reflect the weaker production outlook and larger market deficit in CY22. We do not see material volume from new spodumene producers until CY24. We lift our peak price assumption by 60% to US\$4,000/t and upgrade annual prices by 49% for CY22 and 18-28% for CY23-CY25.
- **Upgrading NdPr and Tb price outlook:** Rare earth market fundamentals remain tight following the recent inventory drawdown in China. We are upgrading our NdPr price forecasts by 12-24% reflecting the tightening supply/demand fundamentals. We also increase our peak price assumptions for Terbium, Holmium and Gadolinium forecasts by 20-40%, while maintaining longer-term price forecasts for other rare earth elements.

Supply response outpaced by demand growth for both lithium and rare earths

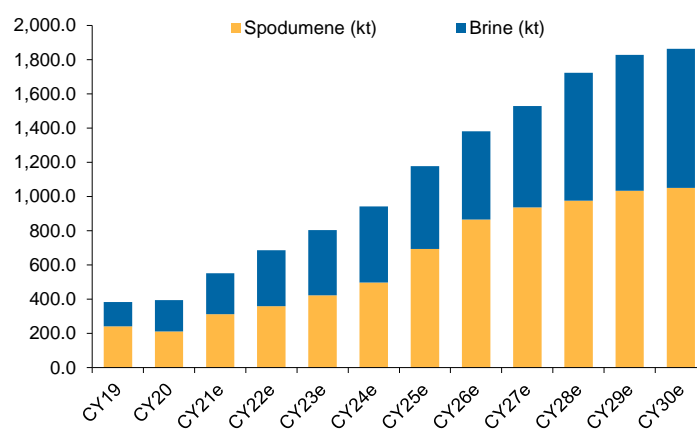
- Lithium production growth rates have maintained the upward trajectory since the start of 2020, with solid increases from spodumene producers in Western Australia and rising production from South America. In the December quarter, lithium production reported diverging performance between Spodumene and Brine streams, with higher brine production more than offset by lower spodumene volumes. We note the sequential decline in spodumene production was mainly driven by labour shortages in Western Australia. International lithium producers Livent (LTHM, Not Rated), Albemarle (ALB US, Not Rated) and SQM (SQM US, Not Rated) have increased brine production over the last 12 months.
- We continue to expect significant supply growth over the next 2-3 years despite the near term operational challenges. We believe the majority of the additional supply is from the incumbent producers, including ALB's Salar de Atacama expansion in Chile, growth from SQM, and the ramp up of the Kemerton and Kwinana lithium hydroxide plants at Greenbushes.

Fig 1 Spodumene and brine supply has responded to rising prices since the beginning of 2020 (LCE Equ.)



Source: Company data, Macquarie Research, March 2022

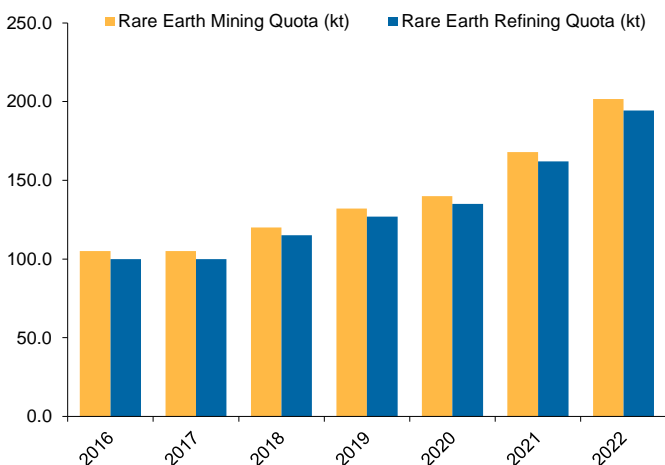
Fig 2 We expect spodumene to dominate supply growth over the next five years (LCE Equ.)



Source: Company data, Macquarie Research, March 2022

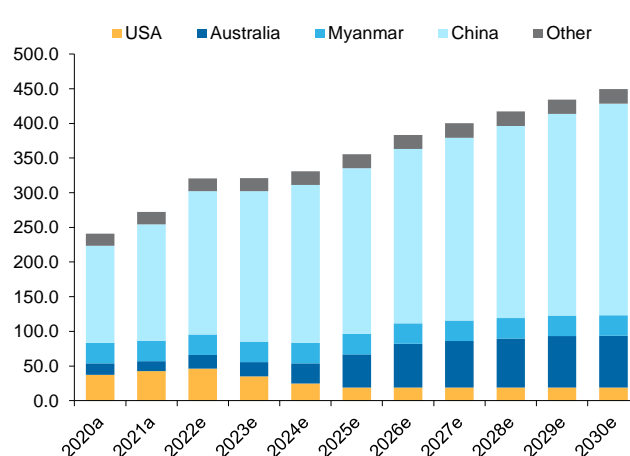
- In early January, China's Ministry of Industry and Information Technology (MIIT) formally announced the first batch of rare-earth production quotas for 2022. The mining and refining quotas have been set at 100.8kt and 97.2kt, respectively. The quotas are up 20% YoY for both mining and refining. In Australia, LYC produced 4,209t of REO (Rare Earth Oxides) in the 2QFY22, with a total REO sales of 3,753t. Over the medium term, we expect material supply to come from Australia as development projects are brought online.

Fig 3 Annual China rare earth quotas are up 20% in the first half of 2022



Source: MIIT, Macquarie research, March 2022

Fig 4 We expect spodumene to dominate supply growth over the next five years (LCE Equ.)



Source: Company data, Macquarie Research, March 2022

EV sales have remained strong through the 2HCY21

- Macquarie Global EV tracker reported strong YoY sales in January despite the on-going production disruption (semiconductor related) and a decline in subsidies. The MoM decline is mainly due to seasonality and global automakers' strong year-end push last month. January sales implied EV penetration rates of 20% for Europe, 19% in China and 6% in the US.

Fig 5 Global plug-in sales in key markets

(units, %)		Jan 2022	Jan 2021	YoY (%)	Dec 2021	MoM (%)	1M22	1M21	YoY (%)
US	Total plug-in sales	56,610	34,974	61.9%	69,762	-18.9%	56,610	34,974	61.9%
	% penetration	5.6%	3.2%	2.5%p	5.7%	-0.1%p	5.6%	3.2%	2.5%p
	BEV	49,592	29,665	67.2%	58,663	-15.5%	49,592	29,665	67.2%
	PHEV	7,018	5,309	32.2%	11,099	-36.8%	7,018	5,309	32.2%
China	Total plug-in Sales	419,000	172,000	143.6%	498,000	-15.9%	419,000	172,000	143.6%
	% penetration	19.2%	8.4%	10.8%p	20.6%	-1.4%p	19.2%	8.4%	10.8%p
	BEV	335,000	172,000	94.8%	416,000	-19.5%	335,000	172,000	94.8%
	PHEV	85,000	28,000	203.6%	82,000	3.7%	85,000	28,000	203.6%
Europe*	Total plug-in sales	109,922	86,036	27.8%	203,878	-46.1%	109,922	86,036	27.8%
	% penetration	19.3%	14.6%	4.6%p	30.4%	-11.1%p	19.3%	14.6%	4.6%p
	BEV	60,354	38,633	56.2%	130,231	-53.7%	60,354	38,633	56.2%
	PHEV	49,568	47,403	4.6%	73,647	-32.7%	49,568	47,403	4.6%

*Sales in France, Germany, UK, Italy, Norway, and Sweden comprise around 80% of the total for Europe.

Source: Autodata, CAAM, KBA, CCFA, OFV, Macquarie Research, March 2022

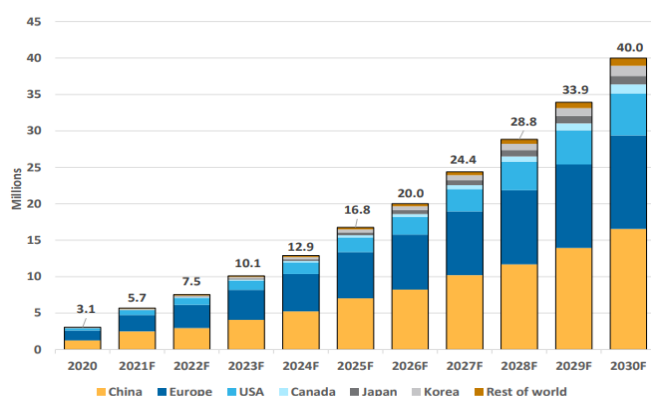
Fig 6 Global electric vehicle sales market penetration assumptions

('000 units)	2015	2016	2017	2018	2019	2020	2021	2022E	2023E	2024E	2025E
Global light vehicle sales	89,165	93,990	96,448	95,544	91,988	80,466	80,865	90,638	94,797	97,423	100,073
YoY growth (%)	2.1%	5.4%	2.6%	-0.9%	-3.7%	-12.5%	0.5%	12.1%	4.6%	2.8%	2.7%
BEV	326	471	778	1,276	1,675	2,268	4,451	6,108	8,293	10,777	13,555
PHEV	226	296	429	634	589	1,069	1,913	3,354	4,431	5,281	6,175
HEV	1,705	1,751	1,989	2,240	2,494	3,004	3,620	4,809	5,659	6,709	7,509
MHEV (48V)	0	0	4	130	1,113	2,494	4,226	6,002	7,634	9,189	11,222
ICE	86,908	91,472	93,249	91,263	86,117	71,631	66,656	70,365	68,780	65,468	61,611
(% penetration)											
BEV	0.4%	0.5%	0.8%	1.3%	1.8%	2.8%	5.5%	6.7%	8.7%	11.1%	13.5%
PHEV	0.3%	0.3%	0.4%	0.7%	0.6%	1.3%	2.4%	3.7%	4.7%	5.4%	6.2%
HEV	1.9%	1.9%	2.1%	2.3%	2.7%	3.7%	4.5%	5.3%	6.0%	6.9%	7.5%
MHEV (48V)	0.0%	0.0%	0.0%	0.1%	1.2%	3.1%	5.2%	6.6%	8.1%	9.4%	11.2%
ICE	97.5%	97.3%	96.7%	95.5%	93.6%	89.0%	82.4%	77.6%	72.6%	67.2%	61.6%

Source: Autodata, CAAM, KBA, CCFA, OFV, Macquarie Research, March 2022

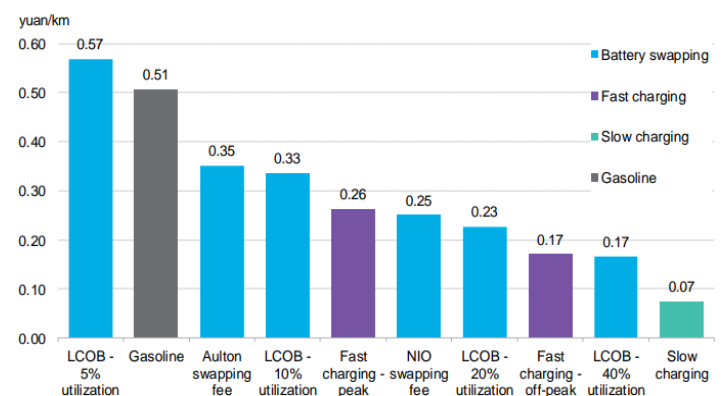
- Our demand forecasts are unchanged and assume global EV market penetration rates rise to 22% by CY22 and 38% by CY25. We estimate current market penetration rates are 18% globally, led by the European and Chinese market. Per Everett Rogers' S adoption curve, plug-in adoption in China and Europe is at an inflection, expanding beyond early adopters to early majority. In addition, US plug-in adoption should be a tailwind in 2022. In addition, Battery swapping could double battery demand esp. for ternary batteries.

Fig 7 Global electric vehicle sales forecast



Source: Rho Motion, Macquarie Research, March 2022

Fig 8 Battery swapping is at similar costs vs. fast charging



Source: Bloomberg NEF, Macquarie Research, March 2022

Permanent magnets demand the key driver for NdPr

- Neodymium and Praseodymium (NdPr) are the dominant force in the rare earths markets. While NdPr accounts for just over 30% of total Rare Earth Oxide (REO) demand, it accounts for around 80% of market value based on current spot prices. We estimate the global demand for NdPr was ~57kt in CY20 and has grown to ~69kt in CY21.

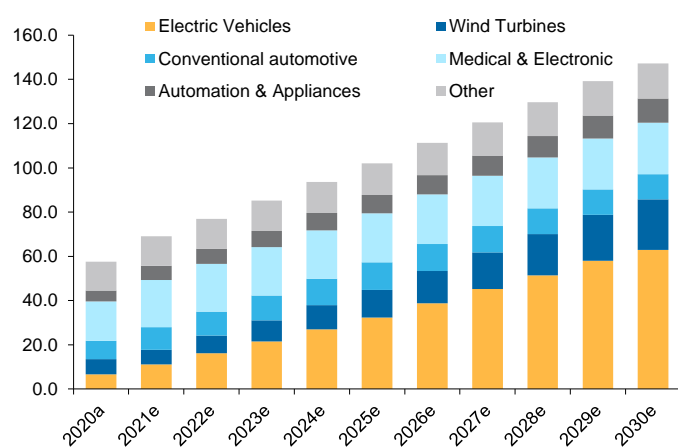
Fig 9 Rare Earth Elements have a wide range of end-uses

Demand	Light REE	Medium and heavy REE	Application
Magnetics	Nd, Pr	Tb, Dy	Disk Drive Motors, Automotive parts, Power generation, Communication system, MRI, etc
Metal Alloys	Nd, La, Ce, Pr	Y	NiMH Batteries, Fuel cells, Super alloys, etc
Glass & Polishing	Nd, La, Ce, Pr	Gd, Er, Ho,	Polishing compounds, Pigments and coatings, Photo-optical glass, X-ray imaging
Catalysts	Nd, La, Ce, Pr		Petroleum refining, Catalytic converter, Chemical processing, Air pollution Controls
Phosphors	Nd, Ce, Pr	Eu, Tb, Y, Er, Gd	Display phosphors, LCD, Fluorescents, Medical imaging, Lasers, Fibre Optics
Ceramics	Nd, La, Ce, Pr	Y, Eu, Dy, Lu, Gd	Capacitors, Sensors, Colorants, Scintillators, Refractories
Defense	Nd, Pr, La	Eu, Tb, Dy, Y, Lu, Sm	Satellite communication, Guidance System, Aircraft structures, Smart missiles

Source: National Energy Technology Laboratory, Macquarie research, March 2022

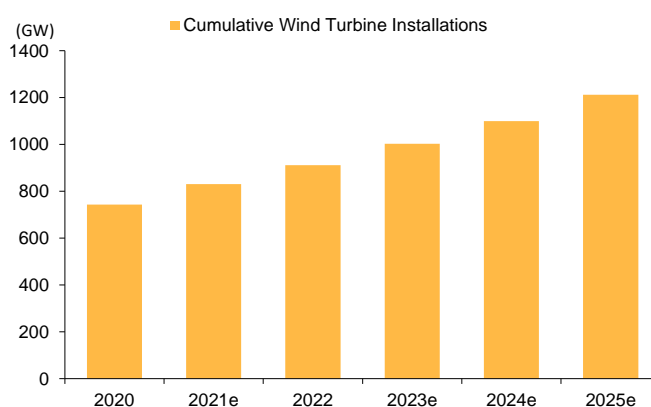
- Rising global sales of electric vehicles (EV) underpins the strong demand outlook for NdPr, with increasing capacity expansion of offshore windfarms also a key contributor. We forecast five year demand CAGRs for NdPr of 29% from EVs and 17% for Wind turbines. This combined with lower growth rates from other key sectors should see NdPr demand grow on average at 10% per year for the next five years.
- We estimate that 80% of the EVs used motors that contained rare earths, while 100% of PHEV used motors that contained rare earths. Our demand forecasts for rare earths assume one standard passenger PHEV consumes 4-6kg of rare earth magnets while a pure EV uses 5-10kg of rare earth magnets for its motors.
- The demand for rare earth magnets would be supported by growth in accelerating offshore wind power capacity installation and higher penetration of inverter air conditioners, as the world is moving towards its climate change goals. We have forecast rare earth magnets intensity of 0.67 tons per MW for direct drive wind turbines and 0.1kg per unit for inverter air conditioners.

Fig 10 NdPr demand underpinned by growth in EV and wind turbines



Source: MIIT, Macquarie research, March 2022

Fig 11 Total wind turbine capacity forecasts a key driver of NdPr demand

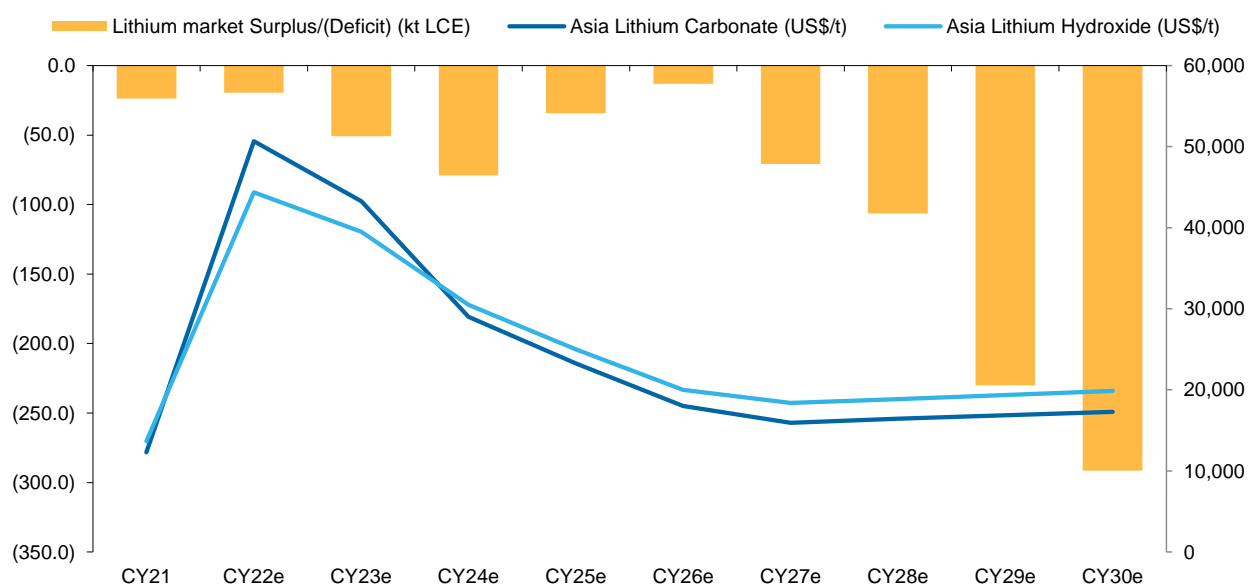


Source: GWEC, Macquarie Research, March 2022

Lithium market remains in deficit

- The surging lithium raw material prices indicated a clear deficit market in 2021. The supply response has been limited to date, with producer guidance for 2022 for Pilbara Minerals and SQM lower than we had assumed in our lithium supply model.
- The strong price move has started to encourage new entrants into the market. Several incumbent producers have either announced further capacity expansion projects or accelerated development plans. However, we do not expect material additions to volume until CY23 at the earliest.
- Despite the accelerating supply growth, we continue to believe that the strong demand from the growing electric vehicle market could more than offset the rise in spodumene and brine supply. In addition, a slower than expected production ramp-up, which we have already experienced in 4QCY21, presents further price upside in the very near term.

Fig 12 We believe the lithium market is now likely to remain in deficit



Source: Bloomberg, Company data, Macquarie Research, March 2022

- A widening deficit remains our base case in the medium-term, with the speed at which new entrants can enter the market presenting a key risk to our base case. In the longer-term the market deficit starts to widen significantly from 2027, suggesting that more new sources of supply will be required to meet the shortfall.

Fig 13 Macquarie global lithium market supply/demand outlook

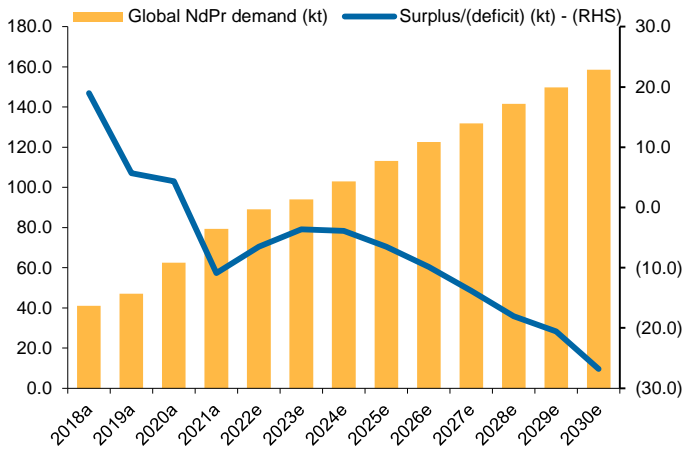
Y/E December	CY21	CY22e	CY23e	CY24e	CY25e	CY26e	CY27e	CY28e	CY29e	CY30e
Supply (kt)										
Spodumene	310.9	357.8	422.7	496.7	693.3	864.7	935.1	974.2	1,032.9	1,049.4
Brine /Clay	239.5	328.2	380.0	444.1	482.7	526.4	612.9	769.3	815.1	833.4
Recycling	0.0	0.0	0.0	0.0	0.0	26.0	42.0	58.0	74.0	90.0
Total Supply	550.4	686.0	802.7	940.8	1,176.0	1,417.1	1,590.0	1,801.5	1,922.0	1,972.7
Demand (kt)										
Chemical/industrial	147.5	154.9	162.7	170.8	179.3	188.3	197.7	207.6	218.0	228.9
EV battery	295.3	395.7	518.3	658.3	822.9	1,012.1	1,214.6	1,433.2	1,648.2	1,730.6
Consumer battery	60.2	62.3	65.0	67.8	70.7	72.6	74.5	76.6	78.7	80.9
ESS (fixed) battery	45.7	66.6	80.8	95.8	109.7	129.1	145.2	161.3	177.4	193.5
Other	25.5	26.0	26.6	27.1	27.6	28.2	28.7	29.3	29.9	30.5
Total demand	574.3	705.5	853.4	1,019.8	1,210.3	1,430.3	1,660.7	1,907.9	2,152.1	2,264.3
Balance										
Surplus/(Deficit) (kt)	(23.8)	(19.5)	(50.7)	(79.0)	(34.2)	(13.2)	(70.8)	(106.5)	(230.1)	(291.5)

Source: Bloomberg, Company data, Macquarie Research, March 2022

Select rare earths remain in deficit

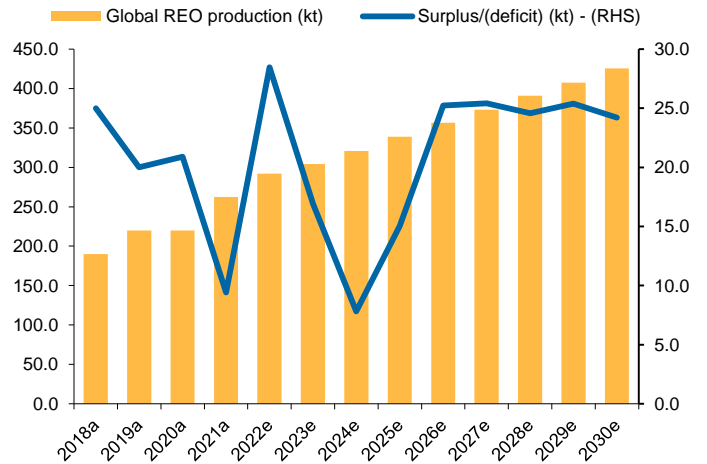
- We estimate the market share for NdPr demand for Electric Vehicles has grown from ~18% in 2020 to 23% in 2021 and we forecast further growth to 27% in 2022. Offshore wind turbine capacity growth is the other key driver of global demand for NdPr.

Fig 14 NdPr market remains in deficit despite production quota increase



Source: Company data, Bloomberg, Macquarie Research, March 2022

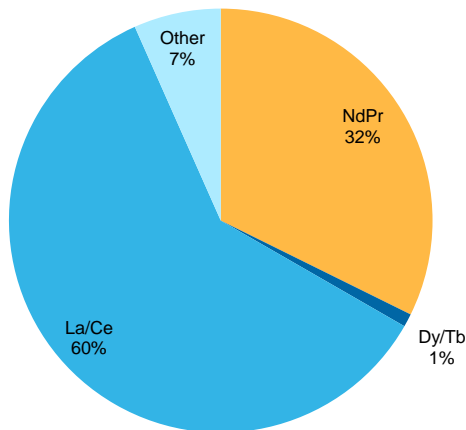
Fig 15 Other light rare earths remain in surplus, particularly lanthanum and cerium



Source: Company data, Bloomberg, Macquarie Research, March 2022

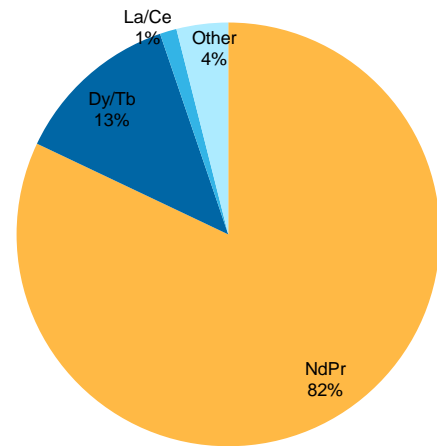
- The total rare earth market, which is dominated by lanthanum and cerium, which combined account for ~60% of total volume, are likely to remain, which is reflected in our base case rare earth forecasts. We note that NdPr accounts for around one third of global rare earth demand by volume but over 80% by value at current spot prices.

Fig 16 Global rare earth demand by volume (kt)



Source: Company data, Bloomberg, Macquarie Research, March 2022

Fig 17 Global rare earth demand by value (US\$)

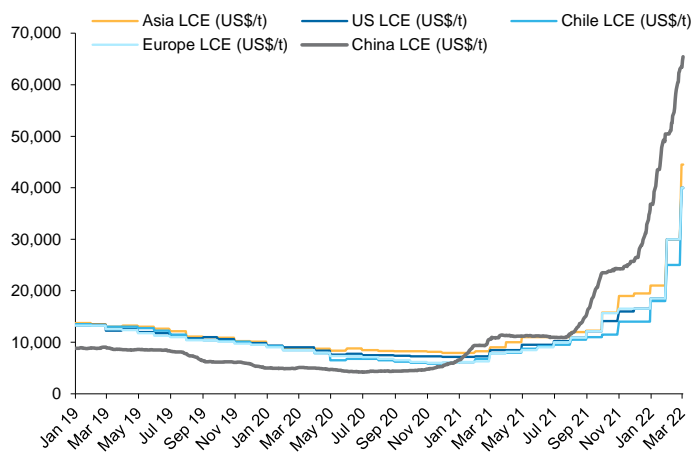


Source: Company data, Bloomberg, Macquarie Research, March 2022

Lithium spot prices continue to surge, led by LCE prices in China

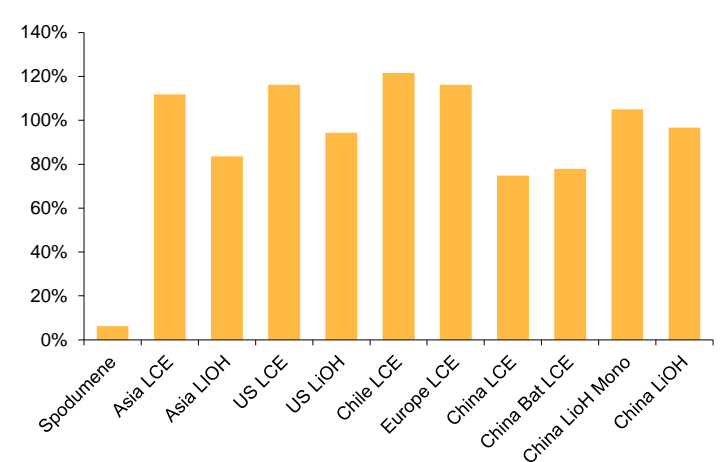
- Spot lithium carbonate prices in China have soared since late 2021. After a brief consolidation in October, the spot China lithium carbonate prices increased to over Rmb250,000/t by the end of 2021 and have risen further in the first part of 2022 to over Rmb490,000/t. This translates to an increase of ~80% in battery grade lithium carbonate prices in China in CY22.
- A re-stock by Chinese downstream battery manufacturers is expected in as plants lift output post the Chinese New Year. The anticipated restock was a key driver in the recent surge in spot prices in China. Regional prices have started to move higher, with a lag around three months. Most regional lithium prices are up +100% in CY22, and given the lag to Chinese prices, we expect further increases to occur over the next few months.

Fig 18 Chinese spot lithium prices roared in late 2021 and early 2022



Source: Bloomberg, Macquarie Research, March 2022

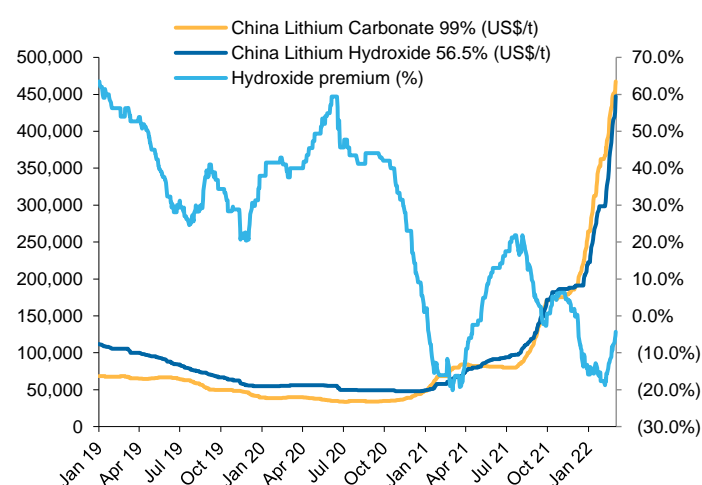
Fig 19 Significant price increase in the first two months of 2022 for regional lithium prices



Source: Bloomberg, Macquarie Research, March 2022

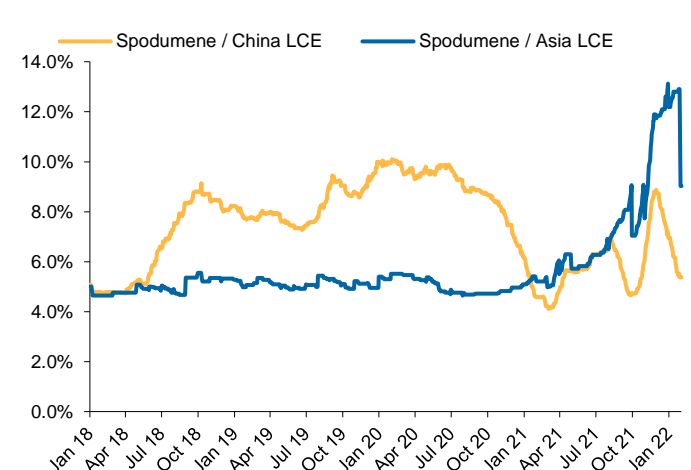
- Spodumene prices have tracked closely to the Chinese domestic prices, rising over 500% in CY21. Prices have risen only 6% in CY22, however the look through to Chinese prices suggests there is material near-term upside for realised spodumene prices. We note that spodumene prices have traded around ~6% of the China lithium carbonate price over the past two years.
- Lithium hydroxide price performance in China has been mixed in 2021 compared to carbonate prices. The hydroxide discount to carbonate has resumed in mid-October 2021, with a discount rate of ~85%.

Fig 20 Hydroxide now at a discount to carbonate in China, but has started to close the gap



Source: Bloomberg, Macquarie Research, March 2022

Fig 21 Realised spodumene price has lagged the recent move in carbonate prices

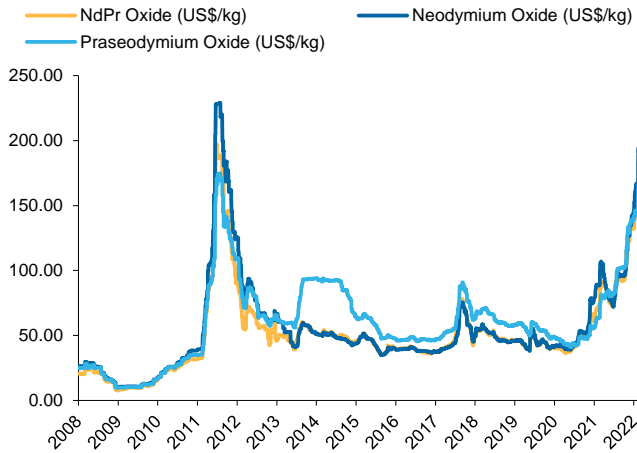


Source: Bloomberg, Macquarie Research, March 2022

Mixed rare earth price performance

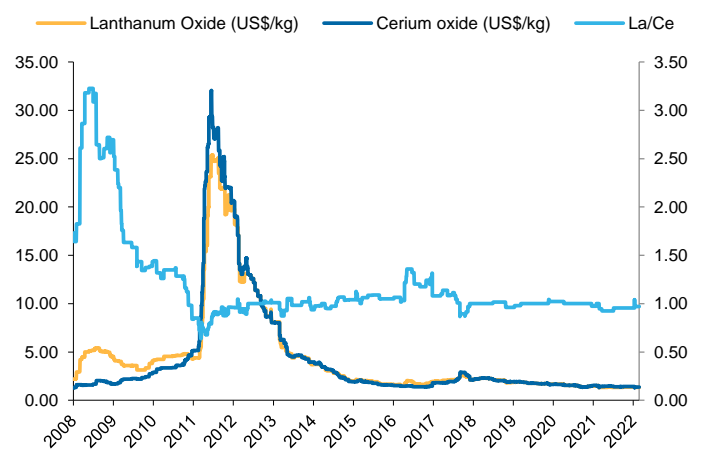
- NdPr (Neodymium / Praseodymium) prices have continued to rise in 2022 and are up ~30% this year and over 100% in the past twelve months. Heavy rare earth prices have also been strong in 2022. Terbium spot prices are up 38% in 2022 while Dysprosium prices are up 9% over the same period. Holmium prices have been the strongest, rising 50% in 2022 YTD.

Fig 22 Neodymium and Praseodymium prices are edging close to the 2011 peak



Source: Bloomberg, Macquarie Research, March 2022

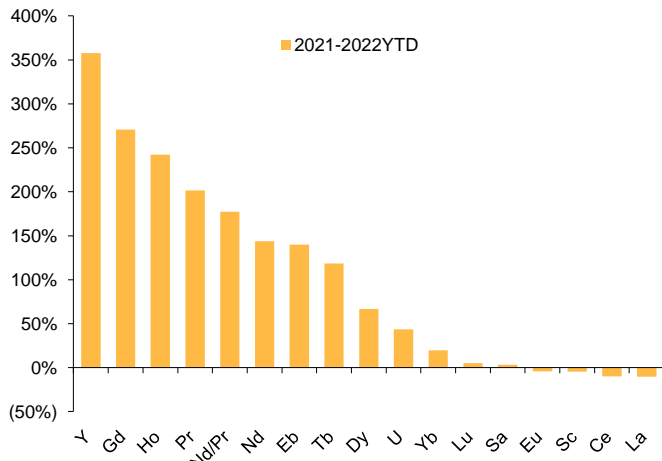
Fig 23 La and Ce prices have been depressed since 2015 and continue to weaken



Source: Bloomberg, Macquarie Research, March 2022

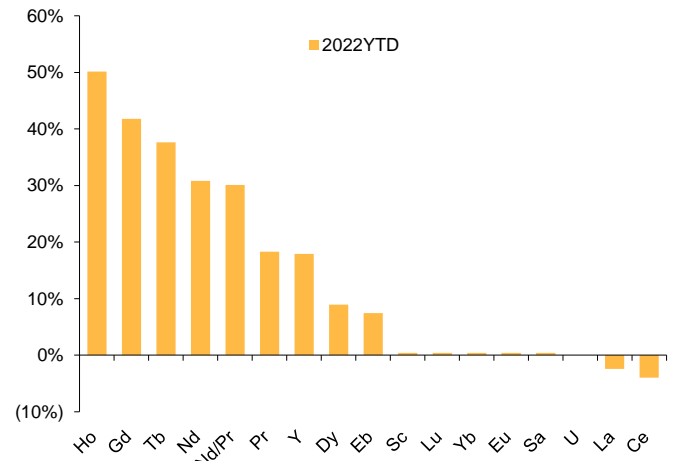
- We note that rare earth prices for Lanthanum and Cerium have fallen 2% and 4% so far in 2022, supporting our thesis that markets for these light rare earths remain in oversupply.

Fig 24 Neodymium and Praseodymium prices have increased by over 150% since the start of 2021



Source: Bloomberg, Macquarie Research, March 2022

Fig 25 Only La and Ce prices have declined since the start of 2022



Source: Bloomberg, Macquarie Research, March 2022

Upgrading Chinese lithium carbonate and hydroxide price outlook

- Domestic Chinese lithium carbonate prices are trading at significant premiums to regional lithium carbonate prices. We have upgraded our CY22 and CY23 Chinese battery grade lithium carbonate prices by 105% and 79% to reflect current strength in spot prices and lack of supply response. Our CY24, CY25 and CY26 forecasts rise 44%, 30% and 13% to reflect the higher current pricing.

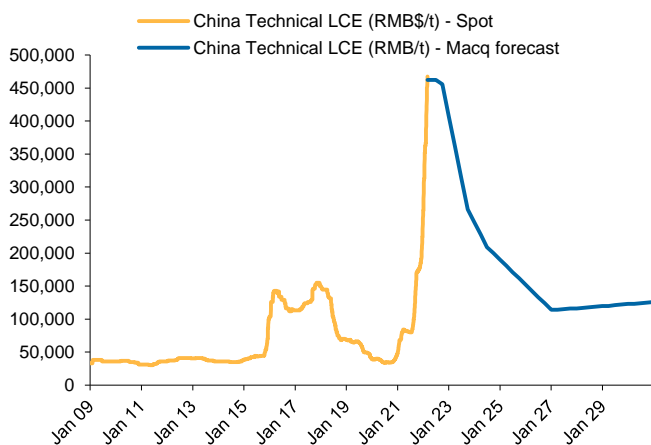
Fig 26 Strong spot prices underpin near-term upgrades to Chinese domestic lithium prices

Y/E December	CY22e	CY23e	CY24e	CY25e	CY26e	CY27e	Long-term
Old forecasts (RMB/t)							
China Lithium Carbonate 99%	211,000	160,000	143,500	128,750	114,750	111,500	97,000
China Lithium Carbonate 99.5%	222,000	175,000	151,000	135,000	120,000	117,000	102,000
China Lithium Hydroxide Mono 56.5%	208,250	168,000	151,000	135,000	120,000	117,000	102,000
China Lithium Hydroxide 56.5%	213,500	176,000	158,000	141,500	126,000	122,500	107,000
New forecasts (RMB/t)							
China Lithium Carbonate 99%	430,675	297,000	206,750	166,500	128,500	115,250	101,000
China Lithium Carbonate 99.5%	454,775	312,500	217,500	175,000	135,000	120,000	105,000
China Lithium Hydroxide Mono 56.5%	396,500	292,000	226,250	186,250	147,500	124,500	109,000
China Lithium Hydroxide 56.5%	380,075	276,500	237,500	200,250	162,000	130,250	114,000
Change (%)							
China Lithium Carbonate 99%	104%	86%	44%	29%	12%	3%	4%
China Lithium Carbonate 99.5%	105%	79%	44%	30%	13%	3%	3%
China Lithium Hydroxide Mono 56.5%	90%	74%	50%	38%	23%	6%	7%
China Lithium Hydroxide 56.5%	78%	57%	50%	42%	29%	6%	7%

Source: Bloomberg, Macquarie Research, March 2022 *Prices are not adjusted for VAT

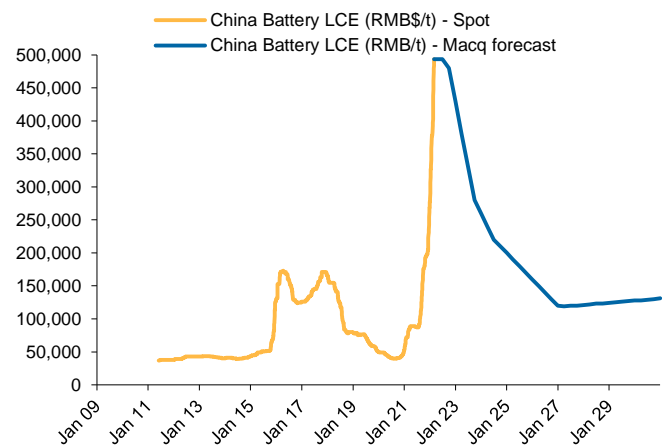
- We make only minor adjustments to our lithium hydroxide premiums for China, with the Hydroxide premium now only expected to return in CY24. Our longer-term prices see only minor adjustments of 3-4% for carbonate and 7% for Hydroxide.
- For hydroxide monohydrate prices, we lift our forecasts by 90% for CY22, 74% for CY23 and 50% for CY24. Standard hydroxide price forecasts rise 78% for CY22, 57% for CY23 and 50% for CY24. We also adjust our longer-term standard hydroxide premium in China to reflect the likely tighter spodumene market.

Fig 27 We expect lithium carbonate prices in China are close to a peak



Source: Bloomberg, Macquarie Research, March 2022

Fig 28 We assume a modest premium for battery grade lithium carbonate over technical grade

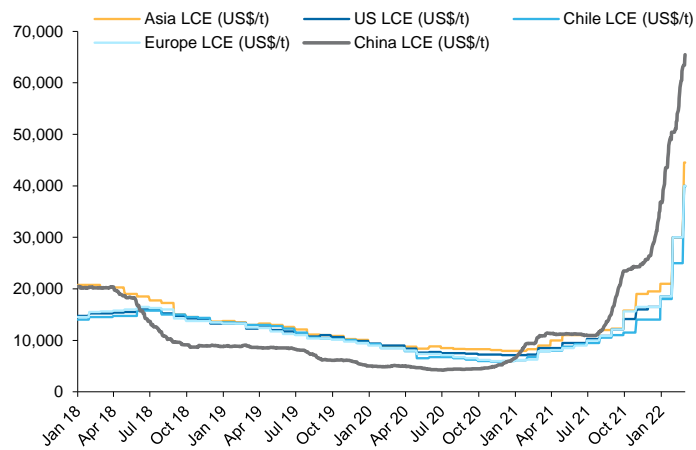


Source: Bloomberg, Macquarie Research, March 2022

Regional price lag now three months

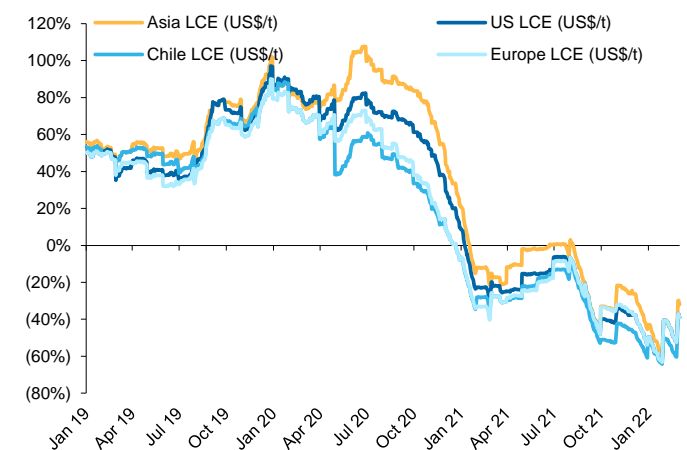
- Spot prices for key regional markets in Asia, South America, North America, and Europe continue to lag movements in Chinese domestic prices, with gap widening in late 2021 and early 2022. We now shift our regional pricing model to lag our China lithium price forecasts by three months for CY22 to CY24, with price differentials normalising by 2024.

Fig 29 Regional carbonate prices have lagged the China carbonate price (VAT adjusted)



Source: Bloomberg, Macquarie Research, March 2022

Fig 30 Regional prices have swung to discounts vs China prices in 2021



Source: Bloomberg, Macquarie Research, March 2022

- We have upgraded our short-term lithium prices to reflect the current strength in spot prices, with the lag for regional prices closing to three months. We upgrade our CY22 forecasts by 132% for the Asia lithium carbonate price with other regional prices rising 142-148%. Our CY23 forecasts rise 104-110% for the four regional prices, reflecting the higher CY22 price forecast.
- In CY23 and CY24 the continued emergence of a spot market is likely to see most lithium contracts being priced on shorter term periods, which we expect will remove the variability between regional prices over time.
- We have equalised our regional lithium carbonate prices from the end of CY24 as we believe the spot market emergence will see regional prices trade broadly in line. Given the rising capital cost for new entrants we lift our long-term price 8% from US\$13,000/t to US\$14,000/t.

Fig 31 Upgrading regional lithium prices and equalising regional prices by the end of CY24

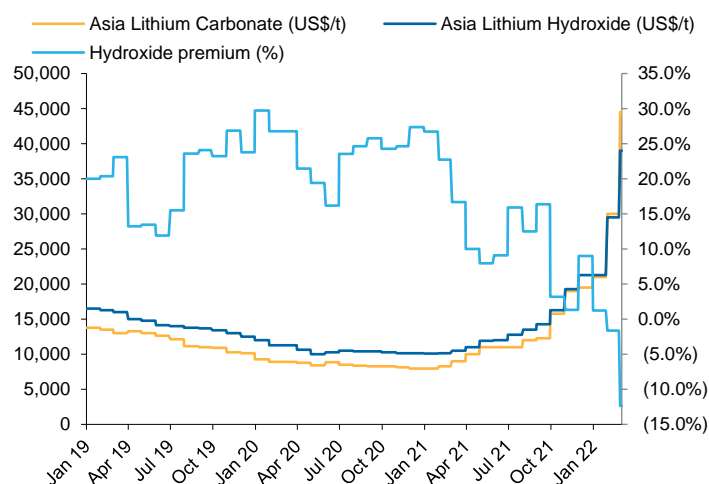
Y/E December	CY22e	CY23e	CY24e	CY25e	CY26e	CY27e	Long-term
Old forecasts (US\$/t)							
Asia Lithium Carbonate	21,875	21,250	19,250	17,250	15,375	14,943	13,000
North America Lithium Carbonate	18,933	19,750	19,150	17,250	15,375	14,943	13,000
South America Lithium Carbonate	17,988	19,750	19,150	17,250	15,375	14,943	13,000
Europe Lithium Carbonate	18,933	19,750	19,150	17,250	15,375	14,943	13,000
New forecasts (US\$/t)							
Asia Lithium Carbonate	50,650	43,250	29,000	23,250	18,000	15,950	14,000
North America Lithium Carbonate	45,800	40,750	29,000	23,250	18,000	15,950	14,000
South America Lithium Carbonate	44,600	40,250	29,000	23,250	18,000	15,950	14,000
Europe Lithium Carbonate	46,050	41,500	29,000	23,250	18,000	15,950	14,000
Change							
Asia Lithium Carbonate	132%	104%	51%	35%	17%	7%	8%
North America Lithium Carbonate	142%	106%	51%	35%	17%	7%	8%
South America Lithium Carbonate	148%	104%	51%	35%	17%	7%	8%
Europe Lithium Carbonate	143%	110%	51%	35%	17%	7%	8%

Source: Bloomberg, Macquarie Research, March 2022

Upgrading regional hydroxide price outlook

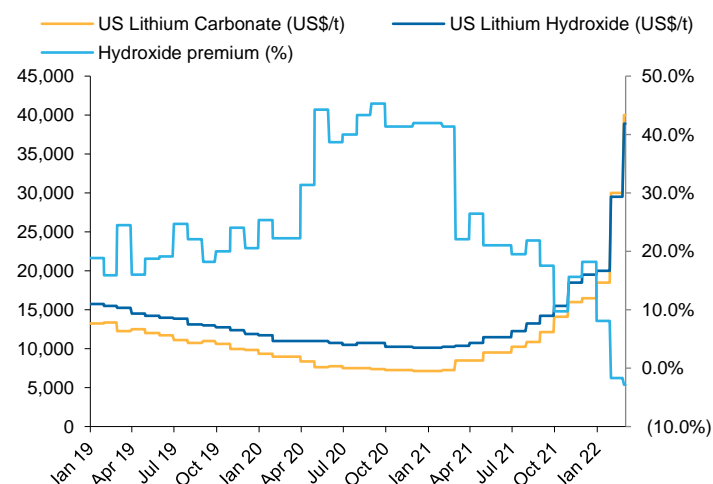
- Regional lithium hydroxide prices have been mixed in 2021. Asia hydroxide prices have outperformed the North American (US) price, due to longer-term pricing contracts which tends to result in a lag for North American prices.
- Despite the outperformance Asia hydroxide premiums have declined as the hydroxide price has underperformed the Asia carbonate in 2021. Hydroxide premiums have fallen to 0% in Asia while North American Hydroxide prices are below Carbonate.

Fig 32 Asia Hydroxide prices have lagged carbonate prices and are now trading at a discount



Source: Bloomberg, Macquarie Research, March 2022

Fig 33 North American hydroxide prices have also lagged carbonate and trade at a slight discount



Source: Bloomberg, Macquarie Research, March 2022

- The upgrades to our regional lithium hydroxide prices have largely matched the changes to our regional lithium carbonate prices. Our forecasts for CY22, CY23 and CY24 rise 84%, 65% and 38% for Asian regional hydroxide prices while North American regional hydroxide prices rise 103%, 77% and 42% for CY22, CY23 and CY24, respectively. Our long-term price assumptions rise 3%, reflecting a slight reduction in the assumed premium compared to carbonate.

Fig 34 Near-term upgrades to hydroxide price outlook reflect carbonate increases

Y/E December	CY22e	CY23e	CY24e	CY25e	CY26e	CY27e	Long-term
Old forecasts (US\$/t)							
Asia Lithium Hydroxide	24,178	23,905	22,085	20,435	18,450	17,932	15,600
US Lithium Hydroxide	21,773	22,713	22,070	20,435	18,450	17,933	15,600
New forecasts (US\$/t)							
Asia Lithium Hydroxide	44,375	39,500	30,500	25,000	20,000	18,375	16,100
US Lithium Hydroxide	44,250	40,250	31,250	26,750	20,750	18,375	16,100
Change							
Asia Lithium Hydroxide	84%	65%	38%	22%	8%	2%	3%
North America Lithium Hydroxide	103%	77%	42%	31%	12%	2%	3%

Source: Bloomberg, Macquarie Research, March 2022

Upgrading spodumene price outlook to a peak of US\$4,000/t

- We upgrade our short and medium-term spodumene price forecasts by 18-50% to reflect the weaker production outlook and larger market deficit in CY22. We do not see material volume from new spodumene producers until CY24. We lift our peak price assumption by 60% to US\$4,000/t and upgrade annual prices by 49% for CY22 and 28%, 23% and 18% for CY23, CY24 and CY25, respectively.
- Our CY26 and CY27 prices rise 7% and 5%, respectively, largely due to the higher peak price and expected delays as new entrants enter the market. Our longer-term price is upgraded 4% from US\$910/t to US\$950/t as we continue to expect spodumene prices to trade slightly above historic long-term averages compared to regional lithium carbonate prices. We note that our long-term spodumene price is equivalent to 6.8% of our China and regional Lithium Carbonate prices.
- Several spodumene projects are now assessing the potential to be developed as fully integrated operations, constructing lithium sulphate or lithium hydroxide conversion plants in conjunction with the spodumene mine. This is likely to limit the amount of potential third party volumes that could become available, particularly in the short to medium-term.

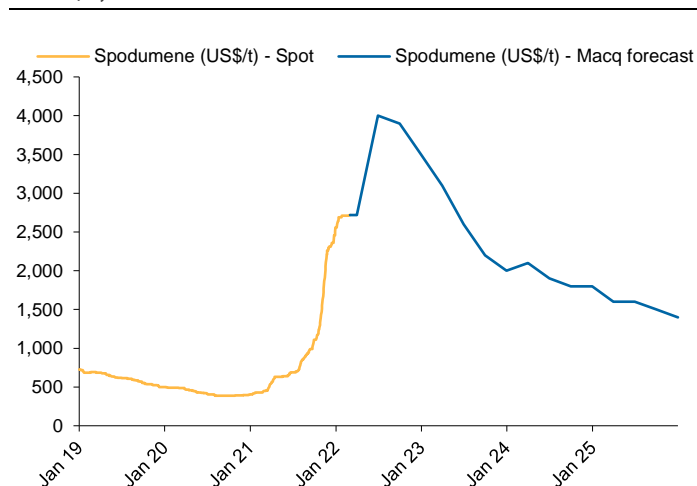
Fig 35 Upgrading price outlook for spodumene

Y/E December	CY22e	CY23e	CY24e	CY25e	CY26e	CY27e	Long-term
Old forecasts (US\$/t) – CFR	2,363	1,940	1,540	1,295	1,078	1,046	910
New forecasts (US\$/t) - CFR	3,525	2,475	1,900	1,525	1,150	1,100	950
Change	49%	28%	23%	18%	7%	5%	4%

Source: Bloomberg, Macquarie Research, March 2022

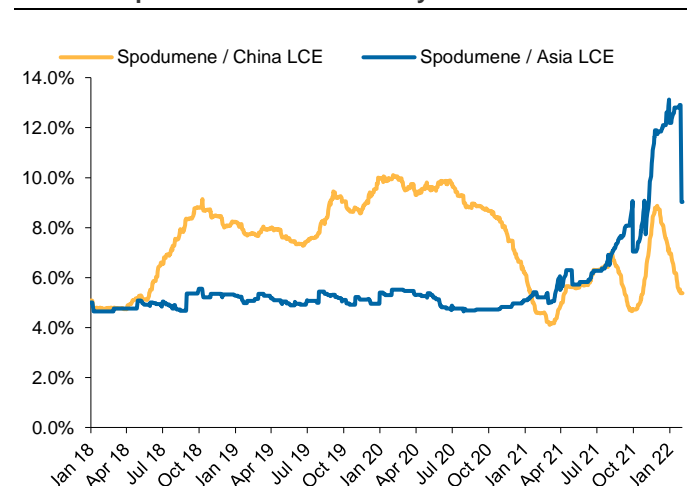
- The decoupling of spodumene compared to lithium carbonate as spot price volumes increase should enable spodumene to hit a new quarterly average peak of US\$2,500/t in the 2QCY22. We note that our peak price assumption is lower than the recent third spot sale completed by PLS but in our view is more reflective of average realised prices likely to be achieved over a three month period.
- We believe this partially reflects the lag that regional lithium carbonate prices see compared to Chinese domestic prices. Our long-term regional lithium carbonate prices are in line with the Chinese domestic prices after adjusting for VAT, hence our long-term spodumene ratio is 6.8% for both regional and Chinese domestic carbonate prices.

Fig 36 We now expect spodumene prices to hit a new peak of US\$4,000/t in mid 2022



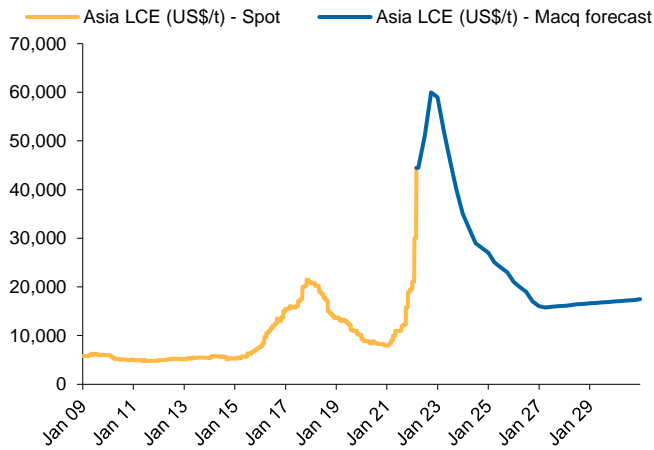
Source: Bloomberg, Macquarie Research, March 2022

Fig 37 We expect spodumene prices to outperform carbonate prices over the next two years



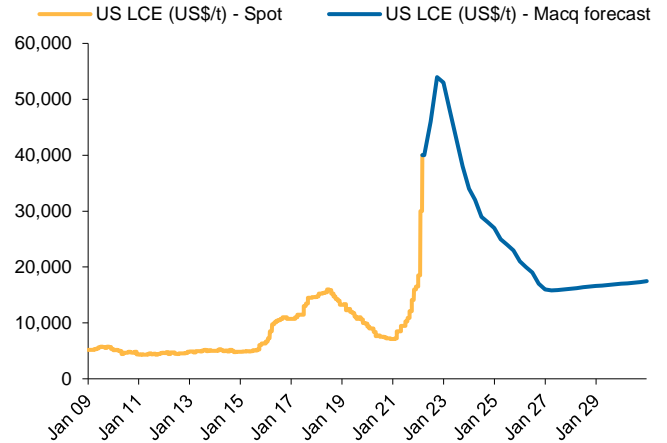
Source: Bloomberg, Macquarie Research, March 2022

Fig 38 Long-term Asia Lithium Carbonate price expected to move above previous peak



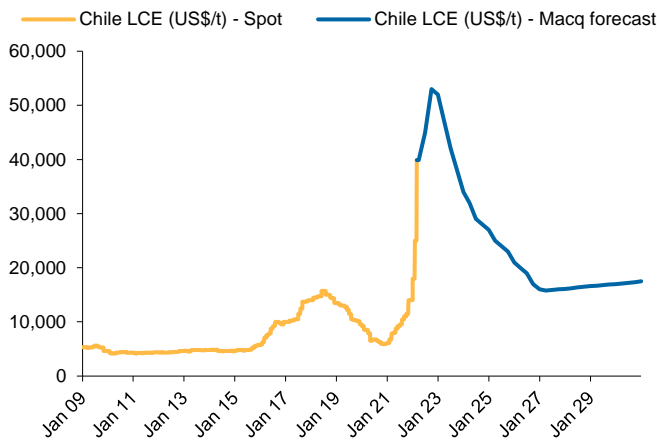
Source: Bloomberg, Macquarie Research, March 2022

Fig 39 Long-term North America Lithium Carbonate price outlook



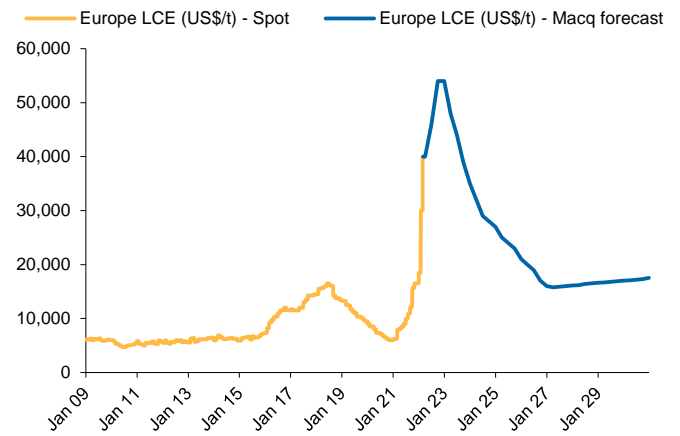
Source: Bloomberg, Macquarie Research, March 2022

Fig 40 Long-term South America Lithium Carbonate price outlook



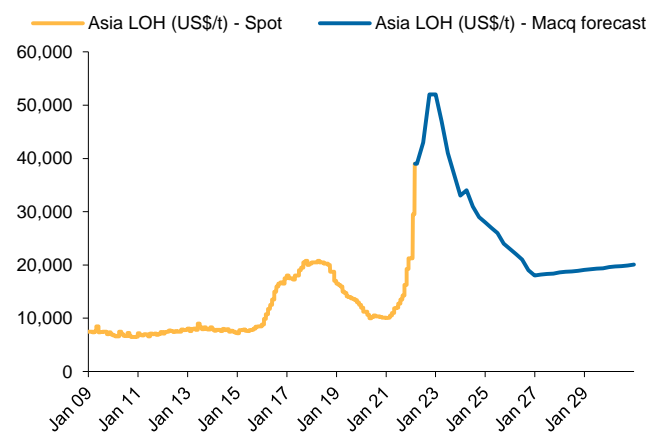
Source: Bloomberg, Macquarie Research, March 2022

Fig 41 Long-term Europe Lithium Carbonate price expected to exceed previous peak



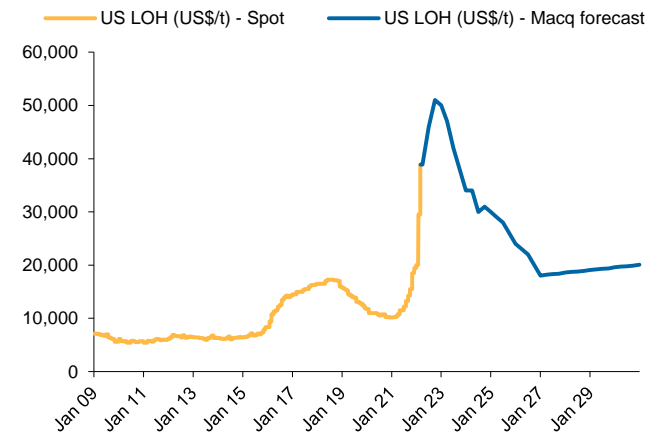
Source: Bloomberg, Macquarie Research, March 2022

Fig 42 Long-term Asia Lithium Hydroxide price expected to remain below previous peak



Source: Bloomberg, Macquarie Research, March 2022

Fig 43 Long-term North America Lithium Hydroxide price outlook

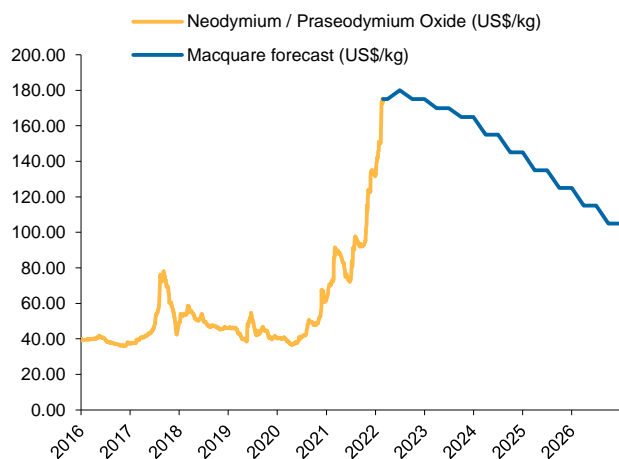


Source: Bloomberg, Macquarie Research, March 2022

Upgrading NdPr and Tb price outlook

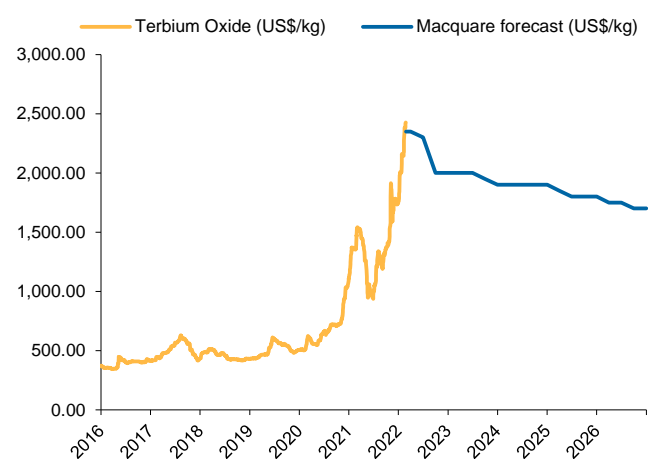
- Rare earth market fundamentals remain tight following the recent inventory drawdown in China. We are upgrading our NdPr price forecasts reflecting the tightening supply/demand fundamentals. We lift our CY22 NdPr price forecast by 24% and raise our CY23 and CY24 forecast by 18% and 12%, respectively. Our longer-term forecasts rise 5-6% to reflect rising capital costs for new entrants.
- We have also increased our short term Terbium, Yttrium, Holmium and Gadolinium price forecasts to reflect current spot prices. Our CY22 forecasts for terbium rise 18% while our holmium and gadolinium price assumptions rise 40% and 42%, respectively. Our CY22 Yttrium price forecast rises 10% with changes to our CY22 estimates for other rare earths move <10%.

Fig 44 NdPr prices have surged to over US\$170/kg (include VAT)



Source: Bloomberg, Macquarie Research, February 2022

Fig 45 Terbium prices are trading above our short and medium-term forecasts



Source: Bloomberg, Macquarie Research, February 2022

Longer-term rare earth prices largely unchanged

- We have not made any material changes to our longer-term forecasts for other rare earths outside of NdPr, which we have increased by 5-6%. Our Gadolinium price forecasts for CY23 and CY25 rise 35% and 13% to reflect the current strength in spot prices, with all other rare earth prices largely unchanged for CY23 and beyond.

Fig 46 Rare Earth Oxide (REO) price forecasts

Y/E December	CY19	CY20	CY21e	CY22e	CY23e	CY24e	CY25e	CY26e	Long-term
Light Rare Earths									
Neodymium / Praseodymium Oxide (US\$/kg)	44.13	45.03	91.90	176.25	167.50	150.00	130.00	110.00	95.00
Neodymium Oxide (US\$/kg)	44.38	48.70	97.70	179.50	168.50	151.00	131.00	111.00	96.00
Praseodymium Oxide (US\$/kg)	54.70	46.73	93.09	176.00	170.50	153.00	133.00	113.00	98.00
Lanthanum Oxide (US\$/kg)	1.79	1.54	1.38	1.28	1.20	1.15	1.10	1.05	0.95
Cerium oxide (US\$/kg)	1.79	1.53	1.45	1.36	1.30	1.35	1.30	1.25	1.10
Medium Rare Earths									
Samarium Oxide (US\$/kg)	1.81	1.81	1.94	1.96	2.00	2.10	2.20	2.20	1.90
Europium Oxide (US\$/kg)	34.33	30.96	30.63	30.00	28.00	26.00	23.00	22.00	20.00
Gadolinium Oxide (US\$/kg)	25.38	26.99	42.90	103.00	87.50	67.50	55.00	60.00	55.00
Heavy Rare Earths									
Terbium Oxide (US\$/kg)	505.7	670.6	1,352.3	2,162.5	1,962.5	1,900.0	1,812.5	1,725.0	1,500.0
Dysprosium Oxide (US\$/kg)	237.36	262.02	410.47	501.25	522.50	510.00	482.50	460.00	400.00
Holmium Oxide (US\$/kg)	50.26	58.32	136.71	275.00	193.75	175.00	180.00	175.00	150.00
Erbium Oxide (US\$/kg)	23.55	22.50	34.49	58.75	62.50	52.50	50.00	45.00	40.00
Ytterbium Oxide (US\$/kg)	15.77	14.64	16.21	17.38	17.50	17.00	16.50	17.00	15.00
Lutetium Oxide (US\$/kg)	603.95	618.67	807.06	860.00	875.00	900.00	950.00	900.00	800.00
Yttrium Oxide (US\$/kg)	2.88	2.83	6.22	10.75	9.25	8.25	7.25	6.50	6.00
Other Rare Earths									
Scandium Oxide (US\$/kg)	1,017	936	892	858	800	850	900	950	850

Source: Bloomberg, Macquarie Research, December 2021

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Recommendation definitions	Volatility index definition*	Financial definitions		
<p>Macquarie – Asia and USA Outperform – expected return >10% Neutral – expected return from -10% to +10% Underperform – expected return <-10%</p> <p>Macquarie – Australia/New Zealand Outperform – expected return >10% Neutral – expected return from 0% to 10% Underperform – expected return <0%</p> <p>Note: expected return is reflective of a Medium Volatility stock and should be assumed to adjust proportionately with volatility risk</p>	<p>Volatility index definition* This is calculated from the volatility of historical price movements.</p> <p>Very high–highest risk – Stock should be expected to move up or down 60–100% in a year – investors should be aware this stock is highly speculative.</p> <p>High – stock should be expected to move up or down at least 40–60% in a year – investors should be aware this stock could be speculative.</p> <p>Medium – stock should be expected to move up or down at least 30–40% in a year.</p> <p>Low–medium – stock should be expected to move up or down at least 25–30% in a year.</p> <p>Low – stock should be expected to move up or down at least 15–25% in a year. * Applicable to select stocks in Asia/Australia/NZ</p> <p>Recommendations – 12 months Note: Quant recommendations may differ from Fundamental Analyst recommendations</p>	<p>Financial definitions All "Adjusted" data items have had the following adjustments made: Added back: goodwill amortisation, provision for catastrophe reserves, IFRS derivatives & hedging, IFRS impairments & IFRS interest expense Excluded: non recurring items, asset revals, property revals, appraisal value uplift, preference dividends & minority interests</p> <p>EPS = adjusted net profit / epowa* ROA = adjusted ebit / average total assets ROA Banks/Insurance = adjusted net profit / average total assets ROE = adjusted net profit / average shareholders funds Gross cashflow = adjusted net profit + depreciation *equivalent fully paid ordinary weighted average number of shares</p> <p>All Reported numbers for Australian/NZ listed stocks are modelled under IFRS (International Financial Reporting Standards).</p>		
Recommendation proportions – For quarter ending 31 Dec 2021				
	AU/NZ	Asia	USA	
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Neutral	27.05%	22.88%	20.43%	(for global coverage by Macquarie, 3.57% of stocks followed are investment banking clients)
Underperform	5.48%	11.44%	1.08%	(for global coverage by Macquarie, 1.06% of stocks followed are investment banking clients)

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