

BATTERY METALS INSIGHT

January 2020

THE NICKEL MARKET POST INDONESIAN BAN: POTENTIAL IMPLICATIONS FOR THE LI-ION BATTERY INDUSTRY

Quarterly pricing wrap: Indonesian nickel export ban increases price volatility

London Metal Exchange (LME) nickel prices were extremely volatile in the second half of 2019, especially during the fourth quarter, largely due to the speculation and fallout from Indonesia's decision to implement its nickel ore ban on January 1, 2020 — two years earlier than originally planned.

The LME three-month nickel price surged to a five-year high of \$18,850/metric ton on September 2, after Indonesia confirmed implementation of the ban. This triggered a surge in shipments to China, leading the Indonesian government to announce on October 28 the immediate ban on nickel ore exports.

By October 30, the government reversed this decision and maintained its plan to impose its nickel ore export ban in 2020.

This reversal, combined with negative comments from US President Donald Trump regarding a trade deal with China,

caused the nickel price to drop significantly throughout November on widespread selling pressure.

The price eventually fell to \$13,120/mt on December 4, its lowest level in more than four months. It then rebounded to \$14,200/mt on December 16 after the announcement of a phase one trade deal between the US and China three days earlier.

This rebound came despite LME nickel stocks increasing by nearly 61,000 mt between December 6 and December 16 to reach 130,224 mt.

Despite the recent volatility, the current fundamentals are mostly bullish for nickel in the near future, analysts said.

“Once demand sentiment improves from currently bleak levels, we expect prices will rise to incentivize a large global supply response to the Indonesian ore ban,” Citi Research said

in a report issued in early December. The bank forecast an average price of \$16,750/mt for 2020.

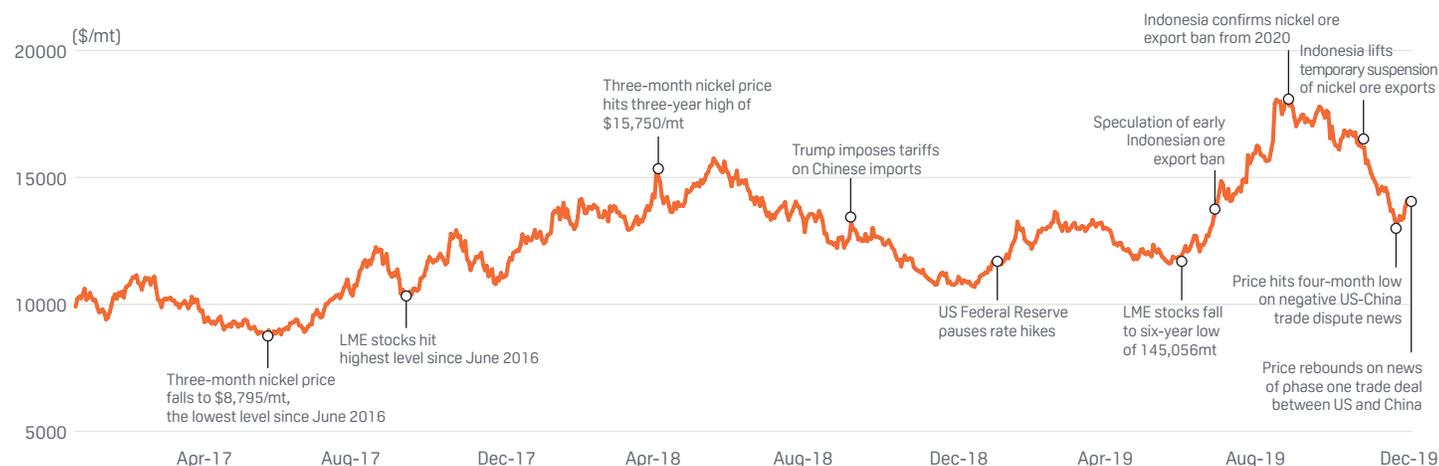
“In our base case for demand, we find that without an additional supply response via higher prices, nickel stocks could draw to nil over the next 3-4 years,” said Citi, which expects the market to become aware of the potential for “stock-out” “as ore stocks draw in the first half of 2020 and refined stocks begin to draw in H2.”

Impacts on the li-ion battery industry

Although the battery making industry accounts for only 5% of the world's nickel consumption, according to the Nickel Institute, versus 70% from the stainless steel industry, the li-ion supply chain was also affected by the recent uncertainties regarding nickel prices.

Targeting increased driving ranges of electric vehicles (EVs), the industry has

NICKEL PRICES EXTREMELY VOLATILE ON INDONESIAN ORE BAN DEVELOPMENTS



Source: S&P Global Market Intelligence, London Metal Exchange

Data as of 17 December 2019

[\(continued on page 2\)](#)

been progressively focusing on batteries powered by nickel-rich cathodes, such as NCA (composed of nickel, cobalt and aluminum oxide, frequent in Tesla's models) and NMC (nickel, manganese and cobalt).

"The recent nickel price surge impacted the battery industry favoring, for example, the resurgence of LFP [lithium iron phosphate] cathodes in China," BMO Capital Markets analyst Colin Hamilton told Platts. He expects "\$14,000-15,000/mt should be a good balance price for [LME nickel in] the medium term, next 2-3 years."

Nickel is used in batteries in the form of sulfate, which is normally processed from class one nickel, which has higher purity than class two material.

Other raw materials such as lithium carbonate and hydroxide, as well as cobalt sulfate and nickel sulfate prices, slid throughout 2019 due to the slower-than-expected growth in demand from EVs. In the case of nickel, delays in the industry adoption of NMC 811 (which contains eight parts of nickel for one part of cobalt and manganese each) due to technology constraints also added to the bearish outlook.

Even the surge in the LME nickel price at the beginning of the fourth quarter failed to provide momentum to nickel sulfate prices. The most recent indications heard by Platts were at Yuan 26,000/mt for battery-grade nickel sulfate on a DDP China basis. In early January 2020, prices were hovering near Yuan 30,000/mt on the same basis.

Indonesia's export ban could indirectly hit availability of battery-grade nickel: sources

Nickel demand is expected to increase faster than supply in the coming years -- and this is also true for the specific battery-grade nickel, according to industry participants. The tightening of the nickel market shouldn't have an immediate effect in the lithium-ion battery industry, but the sector may face problems in the future, sources said.

LITHIUM CARBONATE AND HYDROXIDE SPREADS



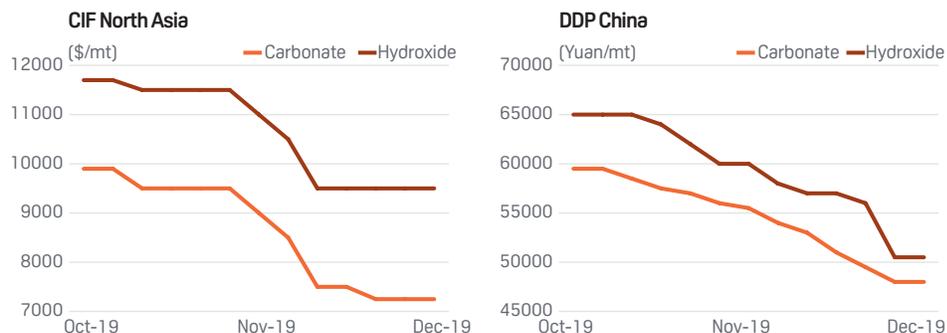
Source: S&P Global Platts

SPODUMENE CONCENTRATE 6% PRICING



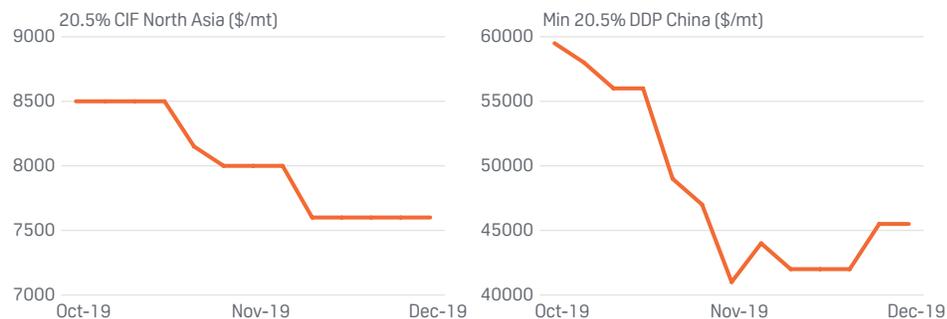
Source: S&P Global Platts

LITHIUM CARBONATE AND HYDROXIDE PRICING



Source: S&P Global Platts

COBALT SULFATE PRICING



Source: S&P Global Platts

LME-deliverable class one nickel that can be processed into nickel sulfate, which will ultimately feed NCA (nickel-cobalt-aluminum oxide) and NCM (nickel-cobalt-manganese) cathodes for lithium-ion batteries, represents slightly less than half the global nickel supply. However, most of it is consumed by Chinese-based stainless steel producers, who may be forced to increase their appetite for battery-grade nickel as Indonesian class two material won't be available anymore due to the government's ban on exports, effective January 2020.

"Class one should be the last option of the Chinese. They will prefer ferronickel instead of it, and then the new Indonesian additional NPI capacity," BMO Capital Markets analyst Colin Hamilton told S&P Global Platts.

But Alex Schmitt, Anglo American's executive head of marketing-base and special metals, told Platts that "China is a 600,000 metric tons/year nickel pig iron (NPI) market, so they will need more class one to cover the shortfall in the short term -- Indonesia accounts for one-third of the nickel [ore] consumed in the Chinese NPI production."

Schmitt estimated that around 40,000 mt/y of class one nickel currently goes to batteries.

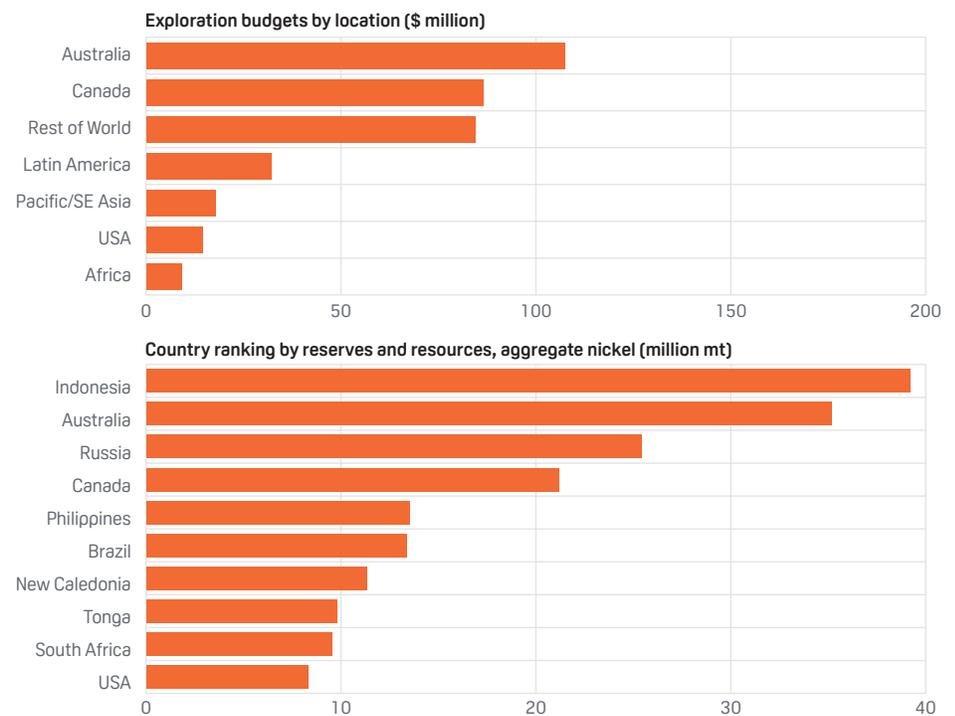
"This market will increase to 400,000-700,000 mt/y until 2030 depending on the study that you look at," he said, adding that "more class one will be required by the battery industry, but stainless steel will also grow a lot, supplying a lot of segments, such as the food industry, oil and gas, solar panels."

But Schmitt doesn't expect the battery industry to be undersupplied in the future since "Indonesian product doesn't find its way into the battery industry."

Hamilton also doesn't expect a big short-term impact.

"Maybe some people will rethink going to NCM 811 [which is composed by eight parts of nickel for one part of cobalt and manganese each], but the market will rebalance, and there'll be no need of additional capacity," he said.

ANNUAL EXPLORATION BUDGETS: NICKEL



Source: S&P Global Market Intelligence

These doubts could vanish soon as the Indonesian government is promoting the construction of high pressure acid leach (HPAL) plants, which would allow the class two nickel ore extracted in the country to be processed into battery-grade nickel sulfate. Jakarta's goal is to ultimately have lithium-ion battery plants operating in the country through partnerships with industry majors.

In early December, Vale's executive director of base metals, Mark Travers, emphasized the importance of the HPAL process in order to convert nickel laterite ore for battery makers. Vale considers the electric vehicle industry an important growth opportunity as the increased use of nickel in batteries is needed to "enable the mass adoption of electric vehicles," he said.

However, the economic feasibility of having these HPAL plants in Indonesia, which concentrates a significant portion of the laterite ore supply, is still not clear. Moreover, there are still concerns about how fast these facilities would come online, as well as about the country's environmental legislation.

"For me, the big question is how will the market respond to concerns on the sustainability of Indonesian nickel?" an OEM source told Platts. "There will be a lot of concern about how Indonesia will handle their tailings. The industry will wake up soon about this," the source added, stressing that it will be a challenge for automakers to track its sustainability.

The uncertainties over Indonesia's plan to become a major battery-grade nickel supplier may not be easily overcome as the global nickel supply in general is not expected to grow in tandem with demand in the coming years.

On average, nickel projects take around 10 years to go online from the exploration stage, or five years from a pre-feasibility study stage.

"A lot of OEMs are focused on lithium. The industry doesn't realize how difficult it is to bring new nickel supply online," the OEM source said, adding that nickel projects are capital intensive upfront. "People think nickel is a very liquid market, but it can be a significant constraint going forward."

DEMAND SIDE: THE VIEW FROM PLATTS ANALYTICS

Nickel emerging as latest key metal risk to EV battery prices as Indonesia imposes export ban

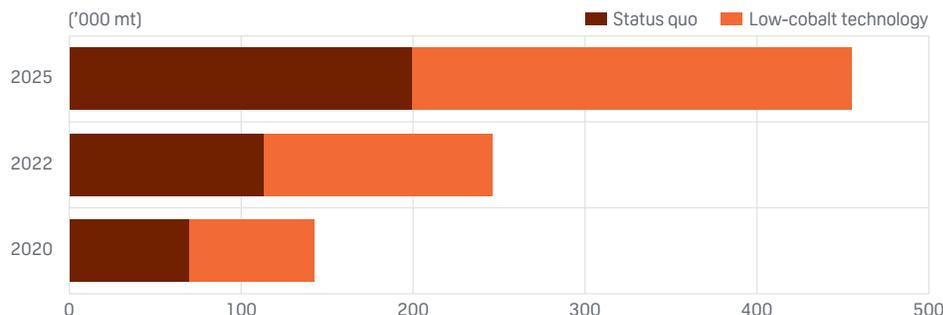
A doubling of nickel prices could translate to an increase of around 7% in electric vehicle (EV) battery prices – even as many expectations of EV uptake presume continuing declines from economies of scale and learning, according to S&P Global Platts Analytics.

In late August, nickel prices surged by 8% as Indonesia — the world’s largest producer with about 24% of global 2018 production (according to the US Geological Survey) — announced the export ban. Nickel along with lithium and cobalt are key metal constituents in modern lithium-ion batteries used in plug-in electric vehicles (PEVs). The Indonesian government brought forward its plan to ban nickel ore exports up to January 2020 from January 2022 as originally planned, due to limited nickel resources in the country.

As noted in the Platts Analytics 2Q 2019 Electric Vehicle Sales and Policy Scorecard, the Indonesian government has expressed interest in expanding PEV manufacturing capacity, a rapidly expanding industry in much of Eastern Asia. Officials aim to attract auto manufacturers through tax incentives while encouraging domestic PEV demand by levying fees on combustion engine purchase and ownership. The nation’s director general of Metal, Machinery and Transportation announced a 2030 manufacturing target of 750,000 PEVs/year, or one-fourth of expected domestic production capacity. Volvo, Renault, Volkswagen and Hyundai have already expressed interest in investing in new factories.

Battery manufacturers are gradually replacing some cobalt with nickel to reduce exposure to cobalt price risk and increase battery energy density, effectively increasing vehicle range. Cobalt prices more than quadrupled last year coupled with concerns around the cobalt supply chain. Battery

NICKEL DEMAND FROM LIGHT-DUTY PASSENGER PEVs IS LIKELY TO MORE THAN QUADRUPLE BY 2025



Source: S&P Global Platts Analytics - scenario planning service: most likely case

S&P Global Platts

GO DEEPER

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Reach out to scenarioanalytics@spglobal.com to get access to the reports, and further analysis.

manufacturers are increasingly moving from the NMC 111 (1 part nickel, 1 part manganese, 1 part cobalt) cathode to the NMC 532 and NMC 622. Assuming this trend continues, nickel demand from light-duty passenger EVs will more than quadruple under the Platts Analytics Most Likely Case. Batteries today remain a small share of the total nickel demand (less than 5%). Platts Analytics estimates that a doubling of prices from the level seen earlier this year (current prices are almost double levels seen in June 2017) could lead to a 7% increase in overall

lithium-ion NMC 622 battery prices.

In an environment where battery cost declines are a key argument underpinning expectations for the continued strong uptake of electric vehicles, even modest price increases could delay the crossing point for the relative costs of buying and owning electric vs. conventional internal combustion engine vehicles. While Platts Analytics’ EV outlook remains unchanged for now, we will continue monitoring battery metals development to determine when forecast updates will be needed.

SUPPLY SIDE: THE VIEW FROM S&P GLOBAL MARKET INTELLIGENCE

Alternative sources unable to replace nickel lost due to Indonesian ore ban

The Indonesian government ban on exports of nickel ore, enforced starting January 1, 2020, should have a substantially negative impact on output from the Chinese nickel pig iron (NPI) sector — the main consumer of Indonesian nickel laterite ore — in 2020 and 2021, according to S&P Global Market Intelligence. We expect that this will result in a much tighter primary market and higher prices in those years.

When the original Indonesian ore export ban was implemented in 2014, the Philippines significantly increased its Chinese nickel ore imports to become China's leading supplier of nickel ore. The market therefore expects the Philippines

to be the main candidate to fill the gap left by Indonesia and provide the missing feedstock to support China's NPI industry during the ban. We believe, however, that the Philippines' ability to do so will be limited by factors such as the country's current moratorium on new mining projects, known as Executive Order Number 79, due to environmental concerns, government-ordered suspensions at some of the country's existing nickel mines, also due to environmental concerns, and the country's rainy season, which usually starts in April and ends in October.

We have incorporated only marginal growth of 4.6% and 3.1% annually in Philippine mine supply in 2020 and 2021, respectively. We forecast Chinese nickel ore imports from the Philippines to rise from 30 million metric tons in 2018 to 35.5 million mt in 2021, not enough to negate the loss of material from Indonesia.

Chinese NPI output will find some support from the lagging arrival of nickel ore exports from Indonesia in the early part of 2020, based on expectations that Indonesian producers would export more material than usual to China ahead of the ban. We also expect that Chinese NPI producers will use nickel ore ports stocks, which stood at 1.34 million mt as of

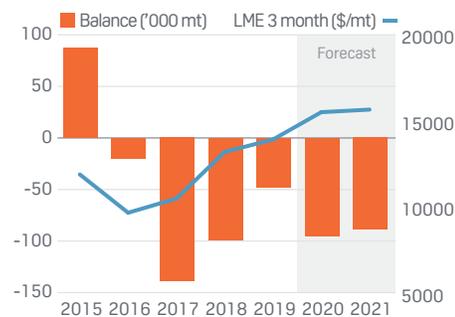
November 22, according to Antaike.

These alternative sources are, however, not expected to compensate for the loss of Indonesian nickel ore to China. We expect Chinese primary nickel output to fall from 736,000 mt in 2019 to 646,000 mt in 2021.

We expect that lost Chinese primary output will be partially offset by the continued expansion of Indonesia's own NPI sector as part of the government's long-term aim to produce more value-added products. Market Intelligence expects Indonesian primary nickel output to increase from an expected 368,000 mt in 2019 to 500,000 mt in 2021. Indonesia will nevertheless not be able to offset the reduction in Chinese NPI output in 2020 and 2021.

We forecast the emerging nickel output constraints resulting from the Indonesian export ban will cause global nickel primary supply to rise by a compound average growth rate of just 1.7% per year between 2019 and 2021, versus an expected 2.5% per year increase in global primary nickel demand over the same interval. This will result in wider primary market deficits in 2020 and 2021 compared with 2019, underpinning our expectation that the average LME three-month nickel price will rise from US\$13,908/mt in 2019 to

AVERAGE LME NICKEL PRICES EXPECTED TO RISE ABOVE \$15,000/mt IN 2020 AND 2021



Data as of 17 December 2019

Source: S&P Global Market Intelligence, LME

BATTERY METALS INSIGHT

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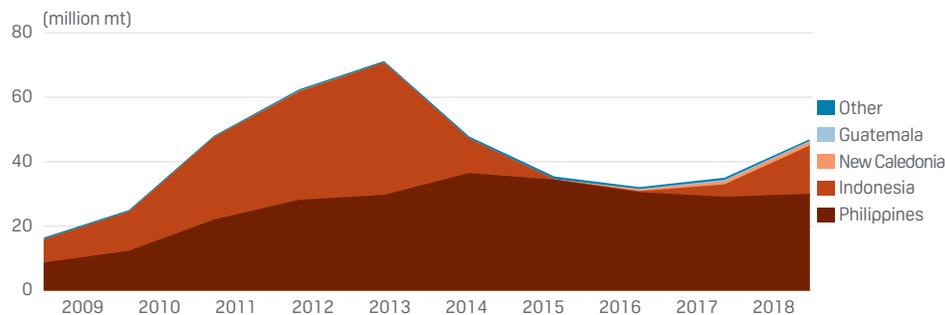
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US\$15,500/mt in 2020 and US\$15,650/mt in 2021.

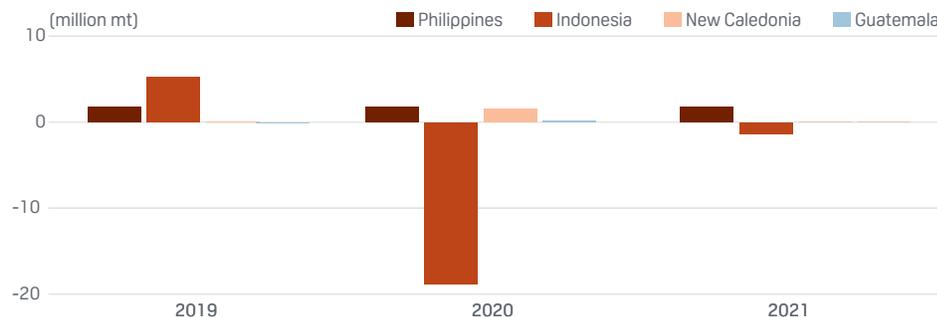
These expectations for a tighter market and higher prices come with risks, mainly on the supply side. These include the possibility that the Indonesia NPI sector could ramp up projects faster than previously forecast to fill the void that will be left by reduced Chinese NPI production, as evidenced by news that Eramet and Tsingshan Holding Group's 30,000 mt/year contained nickel Weda Bay NPI project in Indonesia will now start production six months earlier in the first half of 2020, with Eramet citing the Indonesian nickel ore ban as a reason for the earlier start. This could cause the nickel price to underperform versus our expectations. Conversely, the latest statement from Indonesia's Ministry of Energy and Mineral Resources saying that it expects the country to miss its 2022 smelter construction target highlights the risk that Indonesian primary nickel output could fall short of our expectations. This would lead to a much tighter primary nickel market than we currently expect and therefore higher prices.

PHILIPPINES IS MAIN SOURCE OF CHINA'S NICKEL ORE AND CONCENTRATE IMPORTS



Source: S&P Global Market Intelligence, United Nations Comtrade Data as of 17 December 2019

EXPECTED YEAR-ON-YEAR CHANGE IN CHINESE NICKEL ORE IMPORTS FROM MAIN SOURCES



Source: S&P Global Market Intelligence Data as of 17 December 2019

Industry stays on track to increase the adoption of NMC 811

Nickel use in batteries has undergone rapid growth, propelled by global fleet electrification. New electric vehicle car sales experienced a 60% CAGR between 2013 and 2018.

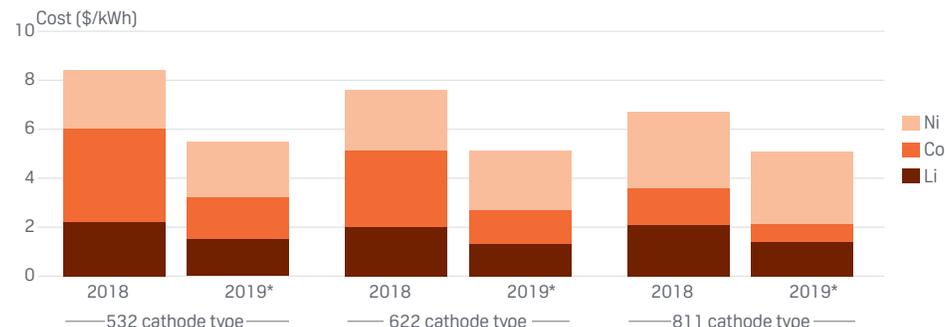
In 2019, China began commercializing NMC 811 cathodes, which contain eight parts nickel to one part cobalt and manganese each. NMC 811 cathodes are known for improved energy density and longer mileage compared with NMC 532 and NMC 622 cathodes but

have previously faced concerns over safety and low cycle life. In March, BMW's X1 plug-in hybrid vehicle, using 811 cathodes from CATL, became available for sale on the Chinese market. CATL's NMC 811 cathodes have since also been used in vehicles including the GAC Trumpchi AION S, SAIC ROEWE Ei5, and FAW-Volkswagen e-BORA and e-GOLF.

The Chinese government's recent efforts to phase out subsidies have removed

pressure for vehicles to meet their battery mileage thresholds and led to concerns of a possible switch back to non-nickel containing LFP cathodes due to their cost-effectiveness. The progress in NMC 811 adoption, however, shows passenger vehicle and battery manufacturers are continuing to improve vehicle performance to compete with internal combustion engines. Other Chinese battery makers are likely to release their NMC 811 cathodes for commercial use in 2020 and beyond.

811 IS STILL THE MOST COST EFFECTIVE NMC CATHODE IN 2019



Data as of 5 November 2019. *Price level reflects the 2019 averages up until Nov 5, 2019. Source: S&P Global Platts, S&P Global Market Intelligence, International Energy Agency, Shanghai Metals Market, Benchmark Minerals

The commercialization of NMC 811 cathodes has happened around a time of low cobalt prices and, until mid-October, high nickel prices. NMC 811 cathodes are cost-competitive as they contain more lower-unit-cost nickel and less higher-cost cobalt.

S&P Global Market Intelligence believes battery technology evolution will continue to search for an even higher combination of energy density and specific energy, which leads to smaller and lighter batteries, respectively. Nickel containing battery cathodes could be replaced by sulfur or air, but such batteries are still far from being commercialized.