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## There's a Global Race to Control Batteries—and China Is Winning

Chinese companies dominate the cobalt supply chain that begins at mines in Congo



Miners pushing their cobalt-laden bicycles through a mine near Kolwezi, Congo, last June. They often sell to Chinese wholesalers. PHOTO: DIANA ZEYNEB ALHINDAWI FOR THE WALL STREET JOURNAL

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## There's a Global Race to Control Batteries—and China Is Winning

KOLWEZI, Democratic Republic of Congo—Miners push bicycles piled high with bags of a grayish-blue ore along a dusty road to a makeshift market. There, they line up at wholesalers with nicknames such as Crazy Jack and Boss Lee.

Most of the buyers are Chinese. Those buyers then sell to Chinese companies that ship the bags, filled with cobalt, to China for processing into rechargeable, lithium-ion batteries that power laptops and smartphones and electric cars.

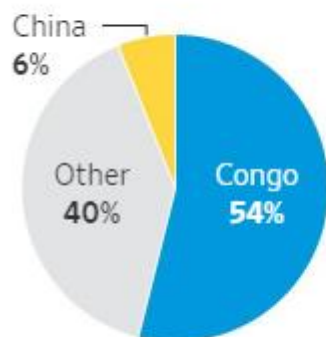
There is a world-wide race to lock up the supply chain for cobalt, which will likely be in [even greater demand](#) as electric-car production rises. So far, China is way ahead. Chinese imports of cobalt from Congo, the world's biggest producer of cobalt, totaled \$1.2 billion in the first nine months of 2017, compared with just \$3.2 million by India, the second-largest importer, government data show.

“We’re realizing that the Congo is to [electric vehicles] what Saudi Arabia is to the internal combustion engine,” says Trent Mell, chief executive of exploration company [First Cobalt Corp.](#), based in Toronto. Chinese firms are keenly aware of Congo’s importance to electric vehicles, he says, and “trying to control the whole ecosystem...from cobalt mining to battery production.”

## From Congo to China

Congo produces more than half of the global supply of cobalt.

**Percentage of raw cobalt production, by country**



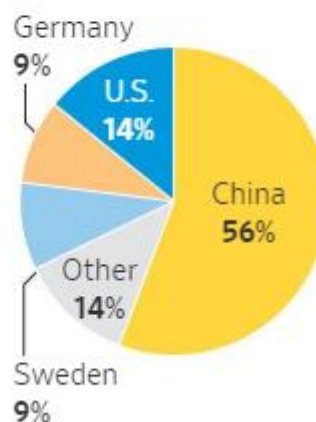
Much of Congo’s cobalt winds up in processed cobalt sulfate.

**Percentage of world-wide cobalt sulfate production**



Lithium-ion battery production is concentrated in four countries.

**Percentage of global production capacity\***



China already is the [world’s largest electric-car market](#). In 2011, Beijing listed electric vehicles as one of seven “strategic emerging industries.” Developing a homegrown battery industry became a vital part of the government-sponsored push. The Chinese government provides subsidies to domestic battery makers, essentially [locking out foreign companies](#).

Companies from China now dominate the first steps in the lithium-ion battery production process. Such firms produce about 77% of refined cobalt chemicals, up from 67% in 2012, according to commodities researcher [CRU Group](#). George Heppel, a consultant at CRU, says Chinese companies could soon have more than 90% of the market. About 54% of the global cobalt supply comes from Congo. Chinese companies dominate the network of middlemen who buy cobalt from freelance miners such as those lining up at the market in Kolwezi.



The freelancers are known as *creuseurs*, the French word for diggers. They unearth cobalt with picks and shovels, earning about roughly \$300 per ton of ore, up from \$200 a year ago. U.S. and European companies have grown wary of cobalt suppliers who buy from creuseurs, partly because some of the miners are children. They rarely wear masks or other safety equipment. Crippling injuries are common.

“A stone fell on me,” says Jean Kayombo Asani, 20 years old, pointing to a big gash on his forehead. He has been a cobalt miner since he was 15. “There are enormous risks, like landslides. One can fall and die,” he adds.

Industry researcher [Darton Commodities](#) estimates that creuseurs produce as much as 14% of the cobalt output in the central African nation.

[Tesla](#) Inc. said last year its cobalt supplier in Congo is “very reputable,” without identifying the supplier. The auto maker sent a team to the country to make sure its supply chain doesn’t include child labor or cobalt mined by creuseurs. Tesla hasn’t said if it made any changes as a result.

For years, traders who bought cobalt from freelance miners often sold it to Congo DongFang International Mining, a unit of Chinese giant [Zhejiang Huayou Cobalt](#) Co. , according to human-rights group Amnesty International and other people familiar with Congo’s cobalt market.

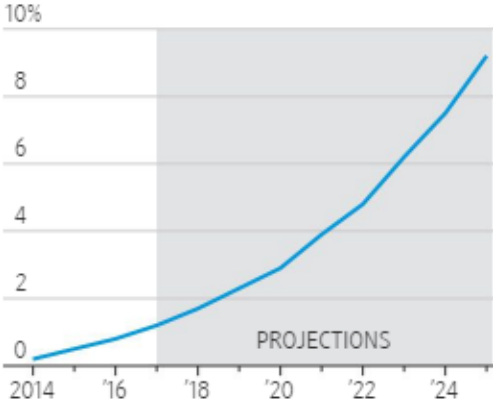
A Zhejiang Huayou spokesman says it stopped buying last April from wholesalers who cater to creuseurs and is trying to buy more from industrial miners that have greater control over the production process. The company is making the changes with help from a nongovernmental organization called Pact, the Zhejiang Huayou spokesman adds.



Few commodities have had more dramatic increases in demand than cobalt, primarily a byproduct of copper and nickel mining. Global cobalt production has quadrupled since 2000 to about 123,000 metric tons a year, according to the U.S. Geological Survey.

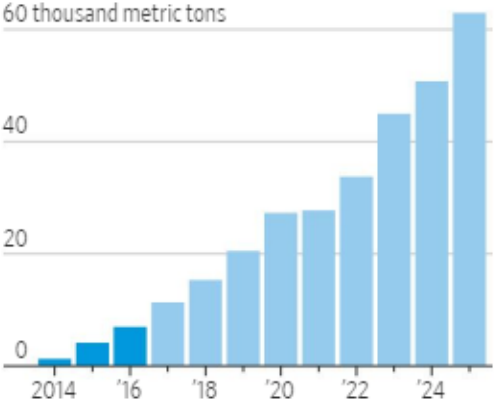
With the projected rise in electric vehicle sales...

**Electric vehicles as a percentage of all vehicles sales**



...the amount of cobalt used in their batteries is projected to skyrocket.

**Cobalt used in electric and hybrid vehicles**



Demand is growing even faster and is expected to reach more than 200,000 tons by 2025, according to researcher Wood Mackenzie. Electric cars are a big reason why. About 1,300 metric tons of cobalt were used in electric vehicles in 2014, Morgan Stanley estimates. The total is expected to rise to 11,320 tons this year and 62,940 tons by 2025.

Such expectations have caused cobalt prices to more than double in the past year in London trading. Cobalt prices are [up more than 230%](#) since the end of 2015, according to Thomson Reuters.

“If our projections for electric vehicles are anywhere near close, there are going to be some serious issues in the cobalt market” after 2020, says Jack Bedder, an analyst who follows cobalt for the London market-intelligence firm Roskill. Tight supply would give China yet another advantage because of its strength in the cobalt supply chain.

Swiss miner [Glencore](#) PLC is the world’s largest cobalt producer, including 27,400 tons from Congo last year. Glencore expects its output to more than double in the next few years.

Much of the remaining 30,000 tons to 40,000 tons of Congolese cobalt comes from creuseurs, Chinese companies such as China Molybdenum Co. and Zhejiang Huayou, and small industrial producers, according to traders.

China Molybdenum last year purchased a giant copper and cobalt mine in Congo from U.S. mining giant [Freeport-McMoRan](#) Inc. The mine supplies a Freeport facility in Finland that produces about 20% of the processed cobalt sulfate used to make batteries. Analysts say the rest of global cobalt sulfate production is done in China.

“Some of the biggest American car companies are very pleased about how we manage the supply,” says Kalidas Madhavpeddi, CEO at CMOC International, the overseas operations of China Molybdenum.

Congolese state-run mining company [Gécamines](#) SA and [China Nonferrous Metal Mining Group](#), known as CNMC, are jointly developing a cobalt- and copper-rich mine that likely will also help China. CNMC will build and operate the mine, owning a 51% stake, while Gécamines will own 49% and got a loan of \$870 million from the Chinese company.

China’s State Reserve Bureau has accumulated about 5,000 tons of cobalt, or about 15 days’ global supply, for a reserve stockpile, according to Darton Commodities. In comparison, China has about three days’ global supply of crude oil in its strategic reserve.

“It’s very clear that the Chinese want to be at the center of electric vehicles. There’s no question there’s a laserlike focus,” says Anthony Milewski, chief executive of [Cobalt 27 Capital](#) Corp., which is based in Toronto and owns [about 3,000 tons of cobalt](#), one of the world’s largest stockpiles.

The shift to electric vehicles is happening faster than many experts anticipated just a few years ago, due in part to the rapid evolution of a global supply chain for key components in lithium-ion batteries. That has driven down prices and helped battery makers scale up production.



[Morgan Stanley](#) says the price of a lithium-ion battery today is about \$200 per kilowatt-hour, down from \$1,200 two decades ago. It expects the price to fall to \$100 by the early 2020s. Electric vehicles will account for 34% of global vehicle sales by 2030, [Bank of America](#) analysts forecast.

Battery production and the supply chain behind it remains fragmented, though, complicating efforts by auto makers to ensure supplies. One company mines the minerals, another refines it, a third makes the cells, a fourth combines the cells into a battery module, and a fifth buys the modules to assemble into a battery. Chinese companies are making major investments in each link of the supply chain.

Some companies and battery experts say technological shifts to make rechargeable batteries with less cobalt—or none at all—could make cobalt less important in battery production.

China is lining up behind nickel manganese cobalt batteries. They have a higher energy density than batteries without cobalt, giving cars greater driving range while taking up less space.

Global battery manufacturing capacity is about 110 gigawatt hours a year, mostly for consumer electronics, electric vehicles and electricity storage. In the past year, China has announced plans to add more than 150 gigawatt hours of production in the next three to four years, tripling current capacity. That dwarfs Tesla's ["gigafactory" in the Nevada desert](#), which aims to add 35 gigawatt hours by 2020.

"The Chinese manufacturers have targets set by the government," says Luis Munuera, an analyst with the International Energy Agency. "It is not a market response. It is the amount of battery capacity the government wants to have."

Most Chinese battery production is now focused on low-end, low-density batteries, and many battery makers are relatively small. But the Chinese government has made offers of support contingent on the energy density of the battery. That means more nickel manganese cobalt batteries.

U.S. consumers would benefit if the Chinese cobalt push drives down prices. Lithium-ion batteries "are very quickly becoming a commodity," says Sam Wilkinson, an associate director for solar and energy storage research at IHS Markit.



After the Chinese government helped engineer a big export market in the solar industry, the cost of a residential rooftop solar array has fallen to \$16,000 from \$41,000 in 2010, according to the National Renewable Energy Laboratory. A large, 100-megawatt solar installation that cost \$544 million to build in 2010 can now be built for \$111 million.

About 65% of all solar modules are made in China, and seven of the top 10 module manufacturers are Chinese.

That has caused trade friction with the U.S. Last month, President Donald Trump imposed new tariffs of up to 30% on solar-panel imports after an independent panel concluded that American manufacturers were being unfairly harmed by Chinese rivals.

Some technology experts worry about what could happen as China gains more competitive muscle in the battery industry. They say too much price-cutting could stifle the innovation of better batteries.

“China controls the majority of global production of solar panels, wind turbines and batteries,” says Varun Sivaram, a technology fellow at the Council on Foreign Relations. “Really superior technologies have no chance of breaking in, and that worries me.”