Kiev lithium-ion battery technology

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The batteries propelling electric vehicles have quickly become the most crucial component, and expense, for a new generation of cars and trucks. They represent not only the potential for cleaner transportation but also broad shifts in geopolitical power, industrial dominance, and environmental protection.

According to recent predictions, EVs will make up just over half of new passenger car sales in the US by 2030. One estimate suggests that the potential growth of the global battery market could require 90 more facilities the size of the Tesla Gigafactory to be built over the next decade.

Lithium-ion batteries, also found in smartphones, power the vast majority of electric vehicles. Lithium is very reactive, and batteries made with it can hold high voltage and exceptional charge, making for an efficient, dense form of energy storage. These batteries are expected to remain dominant in EVs for the foreseeable future thanks to plunging costs and improvements in performance.

Right now, electric-car batteries typically weigh around 1,000 pounds, cost around $15,000 to manufacture, and have enough power to run a typical home for a few days. While their charging capacity degrades over time, they should last 10 to 20 years.

Each battery is a densely packed collection of hundreds, even thousands, of slightly mushy lithium-ion electrochemical cells, usually shaped like cylinders or pouches. Each cell consists of a positive cathode (which typically contains metal oxides made from nickel, manganese, and cobalt); a negative, graphite--based anode; and a liquid solution in the middle, called an electrolyte.

This is where lithium"s reactivity comes into play; its loosely held outer electron can easily be split off, leaving a lithium ion (the atom sans its outer electron). The cell basically works by ping-ponging these ions and electrons back and forth.

EV expansion has created voracious demand for the minerals required to make batteries. The price of lithium carbonate, the compound from which lithium is extracted, stayed relatively steady between 2010 and 2020 but shot up nearly tenfold between 2020 and 2022, spurring new investments across the globe. More than a dozen battery plants and numerous potential mining projects are in development in the US alone.

The vast majority of cobalt, a common cathode component, comes from the Democratic Republic of the Congo, infamous for child and forced labor. Much of the US supply of raw materials is on tribal lands. Chile, a key producer of lithium, wants to wrest control of production from multinationals. Meanwhile, mining companies and entrepreneurs have plans to mine the seabed for minerals, which could damage a fragile, poorly understood ecosystem (Chile is pushing a moratorium on such ocean mining).

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As demand soars, the rollout promises huge rewards. Global lithium ion battery revenues will grow to $700bn a year by 2035, according to consultancy Benchmark Mineral Intelligence, by which time $730bn will have to be poured into battery plants, mines and processing facilities to meet the need not just for lithium but for other ingredients including nickel and cobalt.

With two principal branches of lithium-ion technology vying for supremacy, winners and losers will be decided in the coming years as companies race to supply the world, from carmakers including Tesla, Volkswagen and BYD, and battery makers CATL and LG Energy Solution, to mining companies such as Glencore and BHP.

Invented in the 1970s by US-based scientists and commercialised in 1991 by Japan"s Sony to power its Handycam video cameras, lithium-ion cells pack far more punch in smaller and lighter units than the lead acid or nickel cadmium units that previously dominated the rechargeable battery market.

Having helped give birth to the portable electronics industry, lithium-ion batteries have fought off competing technologies to become the dominant force in electric cars after a 90 per cent drop in cost over the past decade. Total global deployment of the technology could top 1 terawatt-hours this year, equivalent to 17mn average-sized electric cars, according to London-based battery consultancy Rho Motion.