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However, satisfying the demand for lithium will not be a trivial problem. Despite COVID-19"s impact on the automotive sector, electric vehicle (EV) sales grew by around 50 percent in 2020 and doubled to approximately seven million units in 2021. At the same time, surging EV demand has seen lithium prices skyrocket by around 550 percent in a year: by the beginning of March 2022, the lithium carbonate price had passed $75,000 per metric ton and lithium hydroxide prices had exceeded $65,000 per metric ton (compared with a five-year average of around $14,500 per metric ton).

Direct lithium extraction and direct lithium to product offer significant promise of increasing lithium supply, reducing the industry"s environmental, social, and governance footprint, and lowering costs.

So will there be enough lithium to cover the needs of a new electrified world? As discussed in our recent article, "The raw-materials challenge: How the metals and mining sector will be at the core of enabling the energy transition," arriving at a considered answer and understanding the entire supply-and-demand context will be crucialfor every player along the value chain--mining companies, refiners, battery manufacturers, and automotive OEMs.

Over the next decade, McKinsey forecasts continued growth of Li-ion batteries at an annual compound rate of approximately 30 percent. By 2030, EVs, along with energy-storage systems, e-bikes, electrification of tools, and other battery-intensive applications, could account for 4,000 to 4,500 gigawatt-hours of Li-ion demand (Exhibit 1).

Not long ago, in 2015, less than 30 percent of lithium demand was for batteries; the bulk of demand was split between ceramics and glasses (35 percent) and greases, metallurgical powders, polymers, and other industrial uses (35-plus percent). By 2030, batteries are expected to account for 95 percent of lithium demand, and total needs will grow annually by 25 to 26 percent to reach 3.3 million to 3.8 million metric tons LCE depending on the scenarios outlined in Exhibit 2.

Currently, almost all lithium mining occurs in Australia, Latin America, and China (accounting for a combined 98 percent of production in 2020). An announced pipeline of projects will likely introduce new players and geographies to the lithium-mining map, including Western and Eastern Europe, Russia, and other members of the Commonwealth of Independent States (CIS). This reported capacity base should be enough for supply to grow at a 20 percent annual rate to reach over 2.7 million metric tons of LCE by 2030 (Exhibit 3).

Additionally, projects in North America are focused on extracting lithium from oil-field wastewaters. Although usually low-grade, this can be an additional resource base if the right technology is forthcoming.

For geothermal or oilfield brines to succeed as a source of lithium supply, a proven process for DLE will be required. There are a number of companies testing various DLE approaches. While their ideas differ, the concept remains the same: letting the brine flow through a lithium-bonding material using adsorption, ion-exchange, membrane-separation, or solvent-extraction processes, followed by a polishing solution to obtain lithium carbonate or lithium hydroxide.

Promising DLE technology is currently being considered not only by unconventional players but also by companies that traditionally develop "typical" brine assets. DLE has several potential benefits, including:

To date only adsorption DLE has been used on a commercial scale, in Argentina and China. If DLE can be scaled up and spread across brine assets, it will boost existing capacities via increased recoveries and lower operating costs, whilealso improving the sustainability aspects of operations (Exhibit 6).

Similar to DLE, DLP technology looks to contain only the lithium metal in a polymer, and then for the lithium to be removed to an electrolyzer tube and made into a final lithium product. If successful, this potential process for lithium production could have a significant impact on supply.

Another question that arises is whether lithium can be substituted. Most grid storage applications have a queue of more or less developed technologies that could do the task: vanadium redox flow, zinc air, sodium sulphur, sodium nickel, and so on. However, there is currently no substitute for lithium to meet the demands of the mobility sector. The only potential alternative is sodium ion, which, when fully ready for use, will only be able to tackle low-performing applications. Given the foregoing, there is little risk of lithium demand decreasing by 2030.