

Next Generation EV Batteries Eliminate the Need for Deep Sea Mining

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Abstract

Advances in electric vehicle (EV) battery technology, and the accelerating adoption of these technologies, are leading to the replacement of EV batteries dependent on cobalt, nickel, and manganese. As a result, the deep sea mining of these metals is neither necessary, economically advantageous, or environmentally advisable. In fact, efforts to promote the mining of these metals in the deep ocean now serve neither manufacturers nor consumers, but only enterprises that have been established for the express purpose of deep sea mining. Typically, companies and consumers are asked to make sacrifices for the good of conservation and the environment. Now, happily, what is good for both enterprise and the end consumer, also serves the need to protect and preserve our oceans, and the life that resides within.

Authors

Jeanne Everett
Daniel Kammen
Stan Rowland

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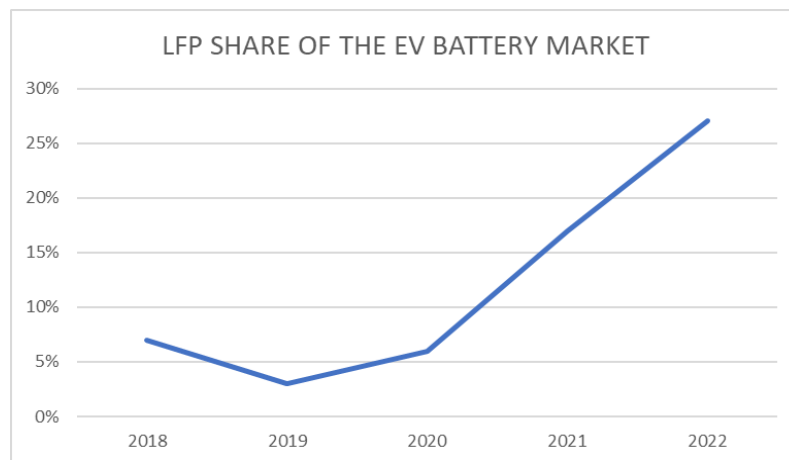
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Advances in electric vehicle (EV) battery technologies over the last several years have led to the widespread use of EV batteries that don't use cobalt, nickel or manganese – the primary metals that mining companies seek to mine from the deep sea. The popularity and rapidly increasing market share of these next generation batteries, which now represent a third of the global EV battery market, have undermined mining company arguments that deep sea mining (DSM) is necessary to support the growing EV market and have made the financial viability of DSM even more dubious. These next generation batteries make it easy for regulators to make decisions to protect the ocean from the risks of DSM.

Rapidly expanding sales of Lithium Iron Phosphate (LFP) and other EV batteries that don't use metals sought to be mined from the deep sea have eliminated the purported need for DSM to meet the growing demand for EVs.

Mining companies have been seeking to mine the Pacific Ocean's Clarion Clipperton Zone ("CCZ"), an area as wide as the continental United States, for polymetallic nodules that contain cobalt, nickel, manganese and copper (referred to herein as "Deep Sea Metals"). Three of these Deep Sea Metals - cobalt, nickel and manganese - have historically been heavily used in EV batteries. Based on this historical usage and the growing demand for EVs, mining companies have argued that DSM is necessary to obtain these metals to meet the growing demand for EVs.

In recent years, however, several batteries that don't use these Deep Sea Metals have rapidly gained momentum in the marketplace, the most notable of which is the LFP battery. LFP batteries are popular due to lower cost, high stability,¹ availability of raw materials, better resilience to price shocks, fewer ESG concerns, and safety benefits.²



Source: International Energy Agency, Paris³

As indicated in the above chart, the LFP market share has been growing quickly,⁴ from 7% of the global EV battery market in 2018 to 27% in 2022⁵ and even higher in late 2022.⁶ A 2023 market research report projects the global LFP battery market size to double in the next 5 years from \$17.7 billion in 2023 to \$35.5 billion in 2028.⁷ LFP batteries are now estimated to represent over 60% of the EV battery market in China, having grown from 18% in just three years.⁸ In early 2022, half of the new Teslas coming off the production line globally were using LFP technology.⁹ Several automakers including Volkswagen,¹⁰ Ford,¹¹ and Rivian¹² have announced they plan to start offering EV models with LFP batteries starting in 2023-2024.

There is massive planned growth in LFP battery manufacturing capacity in the US as Chinese patents on the technology expire. In February 2023, Ford announced it is building a \$3.5 billion LFP battery plant in Michigan.¹³ In March 2023, LG Energy Solutions, the leading global

manufacturer of EV batteries after CATL,¹⁴ announced that it was dedicating \$2.3 billion of a \$5.5 billion¹⁵ battery manufacturing plant investment in Arizona towards LFP manufacturing for energy storage systems. In August 2023, chemicals company ICL broke ground on a \$400 million plant in St. Louis, Missouri which will produce 30,000 tonnes a year of LFP cathodes.¹⁶ Also in the US, American Battery Factory is planning on rolling out a number of gigafactories solely dedicated to LFP starting with a first \$1.2 billion investment in Arizona.¹⁷ Other LFP players gaining momentum in the US market include Gotion.¹⁸

LFP batteries are not the only batteries now being developed and commercialized that are designed to avoid some, if not all, Deep Sea Metals. Others include sodium-ion¹⁹ (already incorporated into production by CATL,^{20,21} BYD²² and Sihao, a joint venture of VW²³), and certain solid-state batteries such as Solid Power.²⁴ Other cobalt, nickel and copper free options are attracting attention such as sodium sulfur,²⁵ lithium-sulfur²⁶ and certain lithium silicon batteries.^{27,28}

The fact that the widespread popularity and market growth of these next generation batteries allows us to avoid DSM is gaining global recognition.²⁹ Will some EV batteries continue to use Deep Sea Metals, either as a primary component or minor additive? Undoubtedly. But these proven alternatives that don't rely on Deep Sea Metals remove any need for DSM and provide the opportunity for a precautionary and thoughtful approach rather than an urgent rush into DSM.

Without the claimed need for DSM to obtain metals for EV batteries, there is no need for DSM.

In the past, most of the projected growth in demand for three of the Deep Sea Metals - cobalt, nickel, and manganese - was driven by the anticipated demand for these metals in EV batteries. One analysis estimated that, without higher LFP battery use, *“Demand for EV batteries will account for 80% to 90% of demand for cobalt, 75% to 85% for nickel, and 45% to 65% for manganese in 2050.”*^{30,31} But with reduced demand for these Deep Sea Metals for EV batteries, the overall demand for these metals drops significantly. This same report concluded that *“with higher LFP [battery use] the demand for cobalt, nickel and manganese would fall below 50% of the [business as usual] scenario by 2030.”*³²

Already these metals are not high supply risks. A 2020 study by the European Union looking at both 2030 and 2050 horizons³³ shows that three of the Deep Sea Metals targeted for DSM (manganese, copper, and nickel) were considered to be of “very low” supply risk, while cobalt was considered “moderate.” This estimate was made even before some of the new batteries that don't use these metals were developed and commercialized, which has further significantly reduced projected demand and supply risk.

Although there is significant demand for manganese for uses other than EV batteries, such as for steel, manganese is not rare.³⁴ Global terrestrial manganese reserves are vast, in the order of 1700 million tonnes or 85 times the 2022 global annual production of 20 million tons.³⁵ In

comparison, current estimated world reserves for nickel and cobalt are 44 and 30 times, respectively, their 2022 production.³⁶

The fourth of the Deep Sea Metals, copper, is in broad demand for applications such as electrical wiring. But as important as copper is for a variety of applications, it is not in critical supply. A May 2023 letter to US lawmakers from USGS Director David Applegate confirmed that the current supply of copper does not warrant a reclassification of copper into the critical minerals category.³⁷ But more important to the DSM issue is the fact that polymetallic nodules have low concentrations of copper. So even massive DSM operations in the CCZ would not contribute significantly to the global supply of copper. Based on current estimates, even if all 17 areas of the CCZ licensed by the ISA for mining exploration, covering an enormous 492,000 square miles (1.3 million km²), were mined, they would produce only 2.4% of today's 22 billion ton global copper market.³⁸ So mining the CCZ for copper would not have a significant impact on the global supply, while imposing a heavy cost in terms of environmental damage.

In sum, without the claimed need for Deep Sea Metals for EV batteries, there is no need for DSM - even without taking into account alternative strategies for meeting projected demand such as more robust recycling programs.

EV battery recycling is now beginning to come online which, with more recycling generally and the movement towards a more circular economy, will further reduce the demand for Deep Sea Metals and other metals used in EV batteries.

In 2025, the first wave of EV batteries, which generally last up to eight years, will begin to be recycled.³⁹ The battery recycling market is expected to grow six-fold by 2030,⁴⁰ and within this, the market for recycled Li-ion batteries alone is expected to reach nearly \$20 billion by 2030.⁴¹ In parallel, recycling processes and technologies are improving, enabling recyclers to more effectively dissolve the metals and separate them from waste.⁴²

Almost 40 companies pursuing the EV battery recycling market are referenced in the Volta Foundation Battery Report.⁴³ Redwood Materials,⁴⁴ created by a Tesla co-founder and backed by Ford among others, is establishing a \$3.5 billion battery recycling facility in Nevada⁴⁵ and is expected to be able to supply the battery equivalent of 1 million electric vehicles by 2025.⁴⁶ In 2022, Aquametals announced \$3.1 billion in funding for battery manufacturing and recycling.⁴⁷ Swedish battery manufacturer Northvolt, backed by Goldman Sachs, Volkswagen and others, announced in 2021 that it produced the first-ever lithium-ion battery cell with 100% recycled nickel, manganese, and cobalt.⁴⁸ It aims to increase recycling capacity to 300,000 ton battery pack in 2030 through its joint venture Hydrovolt in Norway.⁴⁹ Other notable companies making progress in recycling EV batteries and attracting investors include Li-Cycle, Solvay,⁵⁰ Nth Cycle, Posh, Umicore,⁵¹ Posco⁵² and ESS. At the same time, auto manufacturers are making major investment decisions in the same direction. In 2023 Mercedes-Benz started building a 2,500 ton battery recycling plant in Germany⁵³. In 2025 CATL will begin construction of a EV battery recycling factory with \$5 billion in planned investment.⁵⁴

There is growing recognition that recycling provides one of the best opportunities to obtain required metals at reduced cost and with less impact on the environment. The opportunities are enormous to expand recycling and make it a more important source of metals - and fortunately many companies are moving into that space.⁵⁵

The financial viability of DSM - already questionable based on high costs, technological challenges and regulatory hurdles - has been further undermined by these new batteries that don't use Deep Sea Metals.

In its 2022 Annual Report, The Metals Company admitted that LFP batteries and other batteries that don't use Deep Sea Metals could impact the demand for Deep Sea Metals and could have a material adverse effect on its proposed DSM business and its financial condition:

“Technology changes rapidly in the industries and end markets that utilize our materials. If these industries shift to new technologies or products such as lithium iron phosphate (LFP) batteries that no longer require or use less of the metals that we intend to collect and process, or if suitable substitutes become available, it could result in a decline in demand for our metal products...and a material adverse effect on our business and the results of our operations and financial condition.”⁵⁶

Elsewhere in the same report, The Metals Company noted:

“strong prices also create economic pressure to identify or create new sources of supply and alternate technologies requiring consumption of metals that ultimately could depress future long-term demand for nickel, cobalt, copper and related products.”⁵⁷

In fact, LFP batteries are already impacting current and projected demand for Deep Sea Metals and, with it, the financial prospects and viability of DSM (which has already been called into question).⁵⁸

Statements by mining interests and others have distorted much of the public's perception of the need for DSM, resulting in a false correlation between DSM, EV production, and a green transition.

Statements by mining interests need to be carefully considered to ensure one has a balanced view. As recently as October 2023, The Metals Company stated on its website:

“An electric vehicle with a 75 kWh battery pack and NMC 811 chemistry needs 56 kg of nickel, 7 kg of manganese, and 7 kg of cobalt, plus 85 kg of copper for electric wiring. One billion EVs—the equivalent of the world's entire passenger fleet—would require 56 million tons of nickel, 7 million tons of manganese, 7 million tons of cobalt, and 85 million tons of copper—exponentially more than destructive mines produce now. Producing these*

battery metals from polymetallic nodules is the best way to ensure we can meet the challenges of the climate crisis with the lightest environmental and social impacts.”

Perhaps the estimated demand for Deep Sea Metals is correct based on the statement’s convenient assumption that one billion EVs would all use a particular EV battery that uses large amounts of Deep Sea Metals. But, if those same one billion EVs instead used standard LFP batteries that don’t use Deep Sea Metals, these EV batteries would require 0 tons of nickel, 0 tons of manganese, and 0 tons of cobalt. Also, unlike the implication in the above statement, DSM would not contribute significantly to the global supply of copper required for wiring in these EVs.

The press has echoed the assertion of mining interests that increasing EV production relies on DSM. The public often sees headlines such as *“Green Transportation Depends on the Success of Deep-Sea Mining,”*⁵⁹ *“Deep-Sea Mining Vital To Climate Action, Deadly To Oceans,”*⁶⁰ or *“The Double-Edged Sword Of Deep-Sea Mining - We Need Deep-Sea Mining To Ramp Up Electric Vehicle Production. It Comes With Potentially Devastating Environmental Costs.”*⁶¹ These articles have led a large segment of the public into believing that DSM is necessary for increased EV production and climate action. Hopefully soon the press will catch up with developments in the EV battery industry over the past several years that allow us to eliminate the use of Deep Sea Metals in EV batteries.

Evidence of the lack of need for DSM and the dubious financial feasibility and future of DSM is also coming directly from the business and financial communities.

A strong signal that DSM is unnecessary comes from the very sector purported to need a surge in DSM and Deep Sea Metals. EV manufacturers such as BMW, Volvo, Volkswagen, Renault, Rivian and Scania,^{62, 63} have all committed not to use Deep Sea Metals in their production chain and have stated their support for a DSM moratorium.

Outside the automotive industry, numerous businesses and financial institutions have also either committed to exclude Deep Sea Metals from their supply chains or expressed their support for a DSM moratorium.⁶⁴ These include tech companies (e.g., Microsoft,⁶⁵ Google, Samsung⁶⁶ and Philips⁶⁷); banks and financial institutions (e.g., ABN AMRO,⁶⁸ BBVA,⁶⁹ Cooperative Bank,⁷⁰ EIB⁷¹, Credit Suisse,⁷² Standard Chartered Bank,⁷³ and Triodos Bank⁷⁴), and consumer goods companies (e.g., Patagonia⁷⁵).

Major investors have also recently divested from DSM mining companies. In March 2023, Lockheed Martin sent a strong signal to the market by announcing it sold its DSM subsidiary UK Seabed Resources to Norway’s Loke Marine Metals.⁷⁶ In May 2023, Maersk sold its 9% stake in The Metals Company.⁷⁷

By stopping DSM before it starts, we will avoid major irreversible harm to our ocean.

Deep concern over the environmental impact of DSM and the lack of knowledge about its impact have led to a global call for a DSM moratorium. Over 750 marine science and policy experts from over 44 countries⁷⁸ called for a pause on DSM “until sufficient and robust scientific information has been obtained to make informed decisions as to whether deep-sea mining can be authorized without significant damage to the marine environment...” They noted that DSM would result in “the loss of biodiversity and ecosystem functioning that would be irreversible on multi-generational timescales” and cited several specific concerns including:

- Direct loss of unique and ecologically important species, many before they have been discovered;
- Large sediment plumes damaging seafloor and midwater species and ecosystems;
- Interruption of important ecological processes connecting midwater and benthic ecosystems;
- Release of sediment, metals and toxins into the water column detrimental to marine life, including the potential for contamination of commercial food fish such as tuna;
- Noise pollution; and
- Potential impact on carbon sequestration dynamics and deep-ocean carbon storage.

More recent research has also found that alpha radiation present on manganese nodules will trigger health risks to handlers and the environment.⁷⁹

The environmental damage and unknown risks of DSM have led to a global call for a DSM moratorium. Joining this call for a moratorium are 22 countries (including Brazil, Canada, Chile, Ecuador, Fiji, France, Germany, Panama, New Zealand, Samoa, Spain and Switzerland), inter-governmental organizations (including the European Parliament and the Pacific Parliamentarians Alliance), over 100 non-profit organizations, indigenous leaders from over 70 groups from more than 50 countries, fishing organizations, and major corporations and financial institutions (as noted above)⁸⁰.

In conclusion, we can celebrate that these next generation batteries provide practical and market-proven alternatives to DSM that render DSM an unnecessary and gratuitous environmental threat.

In June 2023, the European Academies Science Advisory Council stated: “The argument that deep-sea mining is essential to meet the demands for critical materials is contested and does not support the urgency with which exploitation of deep-sea minerals is being pursued..... There remains much potential ... to minimize continued dependence on the linear economy’s focus on extracting virgin materials from nature .”⁸¹

With the current widespread availability and accelerating popularity of EV batteries that don’t use Deep Sea Metals, DSM has become folly. The DSM industry may collapse before it starts, but it would be prudent for the world to unite around a DSM moratorium before irreversible environmental damage is done.

AUTHORS

Jeanne Everett, Director of Programs and Operations, Blue Climate Initiative.

<https://orcid.org/0000-0003-1398-4232>

Daniel Kammen, James and Katherine Lau Distinguished Professor of Sustainability, Renewable and Appropriate Energy Laboratory (RAEL), Energy and Resources Group (ERG), University of California Berkeley.

<https://orcid.org/0000-0003-2984-7777>

Stan Rowland, CEO Blue Climate Initiative; Chairman, Tetiaroa Society.

<https://orcid.org/0009-0007-6089-4295>

For comments and questions: please email to jeanne@blueclimateinitiative.org

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