Deep-sea mining: what are the alternatives?

Deep-sea mining is out of step with the direction the world is taking as leaders across both public and private sectors seek nature-based solutions to the climate and biodiversity crises. Set within a circular economic model, this approach is in line with the United Nations (UN) Sustainable Development Goal (SDG) 12 – to ensure responsible consumption and production – and the UN’s designated decades of ocean science and habitat restoration.

Deep-sea mining prospectors claim we have no choice but to open the ocean to mining in order to power the shift to renewable energy. This is because the minerals they are targeting – manganese, cobalt and nickel – are frequently used to build batteries for renewable technologies. However, alternatives to deep-sea mining are within reach providing we continue to invest in three main areas: innovation in battery technology; increased reuse and recycling capacities; and the continued extraction of metals from terrestrial sources under greatly improved environmental and social governance (ESG) frameworks.

### Innovation in battery technology

Ensuring clean and green battery supply chains has been identified as a requirement for business and government energy strategies in order to shape an energy transition that does not repeat the mistakes of the fossil fuel-based economy. Since Apple announced its goal to “stop mining the earth altogether” in 2017, battery technology has advanced rapidly. Investment in innovation means that the next generation of longer-lived batteries that reuse metals – or do not use deep-sea minerals at all – are already entering the market. A joint study by the International Energy Agency (IEA) and the European Patent Office underlines the key role that battery innovation is playing in the transition to clean energy technologies. It revealed that between 2005 and 2018, patenting activity in batteries and other electricity storage technologies grew at an average annual rate of 14% worldwide, four times faster than the average of all technology fields.

Experts anticipate that new technologies will unlock additional applications sooner than expected and create a “seismic shift” in how we power our lives and organize energy systems as early as 2030. They warn investors that change will be rapid, with timelines that “may not align with traditional venture capital criteria.”

“As early as 2025, and no later than 2030, RMI expects non-Li-ion battery technologies to have made significant commercialization steps... Regulators and policymakers must look ahead to understand just how quickly lower-cost batteries will accelerate the transition to zero-carbon grids and open new pathways for mobility electrification.” RMI, 2020.

Some foresee companies moving away from the use of nickel altogether, due to its cost. Solid-state batteries, that require no nickel or cobalt, can be lighter and provide more range at a lower cost than today’s electric vehicles (EVs) that use lithium-ion batteries. They also have faster charging times and do not contain flammable electrolytes. This may explain why solid-state battery technology is predicted to massively disrupt the battery industry in the near future, and...
why Ford and BMW are leading a $130 million funding round in a solid-state battery start-up, Solid Power, with hopes of integrating next-generation batteries into its electric vehicles by the end of this decade. In addition, lithium-ion phosphate (LFP) batteries, also cheaper than nickel and cobalt batteries, have seen success over the past year. Although they currently tend to hold less power and have a shorter range than ‘conventional’ lithium ion batteries, their overall share of the global battery market rose to 18.5% in January 2021, compared to just 1% in January 2020. In March 2021, Volkswagen announced its intention to employ LFP batteries in its own models. This upward trend is forecast to increase to 25% during 2021.

In April 2021, China’s BYD announced that it is going all-in on LFP and removing cobalt, nickel and manganese from its vehicle batteries entirely, enabling it to produce vehicles at a lower cost to consumers and with a lower fire risk. Overall, the installation of LFP batteries in EVs in China is reported to have increased by around 21% in 2020 and Tesla’s move to LFP batteries in its Model 3 cars has proved to be a success.

Other recent innovations include:

- In November 2021, Swedish battery manufacturer, Northvolt, produced the first-ever lithium-ion battery cell with 100% recycled nickel, manganese, and cobalt.
- In June 2021, a Bioleaching Research Group at Coventry University reported that all metals present in EV batteries can be recovered using bioleaching, allowing them to be “recycled indefinitely into multiple supply chains.”
- In May 2021, the world’s biggest truck makers – Volvo and Daimler – bought into a joint hydrogen venture for large vehicles, predicting that hydrogen will “take off” as the future of long-distance transport between 2027 and 2030 before going “steeply up.”
- In April 2021, IBM Research reported progress in testing a new battery chemistry that is free from any heavy metals, such as nickel and cobalt.
- In February 2021, UK government-funded tests successfully developed a cobalt and nickel-free solid-state battery system which, they say, costs half that of lithium-ion.
- In January 2021, Guoxuan High-tech launched its new generation LFP cell.
- In September 2020, SAIC Motors produced the first high end hydrogen cell vehicles. It aims to roll out at least 10 models and produce 10,000 hydrogen vehicles by 2025.
- In May 2020, Chinese automotive battery cell manufacturer, SVOLT, launched a cobalt-free battery.
- In April 2020, Honda announced it will use solid state battery technology by the late 2020s.
- Mercedes is exploring advances in battery technology from lithium-sulphur to solid state, and even lithium-air or organic batteries, describing solid state battery technology as a “step change” for battery technology.

Recycling and re-use

The International Resource Panel Global Resources Outlook has emphasized that rapid growth and inefficient use of natural resources will continue to create unsustainable pressures on the environment. It stresses that the decoupling of natural resource use and environmental impacts from economic activity and human well-being is an essential element in the transition to a sustainable future.

Now is the time to invest in recycling plants for rare earth elements and other non-renewable natural resources used in renewable energy systems, in tandem with these market shifts. Research into ‘urban mining’ – making better and smarter use of the metals we have already taken – is already underway. As one of the fastest global waste streams – one that threatens to grow into a global problem of unmanageable proportions – the recovery of
electronic waste can play a significant role in reducing the need for virgin-mined metals to meet future demand. It also has the potential to be more cost-effective. Research has shown that it is technologically possible to recover and recycle upwards of 95% of lithium, nickel, cobalt and copper in batteries, and that significant reductions in demand for virgin mining are feasible in the nearer term. Moreover, large amounts of nickel, copper and cobalt that have been used in other manufacturing processes, products and applications besides batteries are already being recycled and are available on the market. For example, around 50% of the nickel, 38% of the copper and 29% of the cobalt on the US market in 2020 consisted of recycled metal, or metal recovered from scrap.

In 2021, Earthworks analyzed and quantified the recycled content from general end-markets and the recycling of end-of-life EV lithium-ion batteries, as well as demand reduction driven by improved recovery rates. On comparing the results with total metal demand, it found that: “Effective recycling of end of life batteries has the potential to reduce global demand by 2040 by 55% for copper, 25% for lithium and 35% for cobalt and nickel – creating an opportunity to significantly reduce the demand for new mining.”

“0If the market steers away from cathodes containing cobalt to an LFP-dominated market, cobalt, manganese, and nickel become less relevant and reach circularity before 2040.”

The IEA has also confirmed that recycling end of life Li-ion batteries could “relieve a proportion of the burden from mining them from virgin ores”, highlighting that “contributions from recycled minerals could be even more prominent in EV batteries, has stated that battery recycling should be baked into battery designs rather than thought of at the end of the life cycle. Manufacturers should also provide detailed information to facilitate battery recycling. Many governments have, or are developing, policy or regulatory instruments to encourage the recycling, reuse or refurbishment of consumer electronics and industrial batteries. The ReCell Center, the US Department of Energy’s Li-ion battery recycling Research and Development center, has been running since December 2017 with the goal of making recycling competitive and profitable. More recently, the US Battery Supply Chain Review called for more research into “alternates to critical minerals” and measures to enable “end-of-life reuse and critical materials recycling at scale.” Meanwhile, the proposed EU Batteries Regulation aims to ensure that batteries placed in the EU market are sustainable and safe throughout their entire life cycle. It requires manufacturers to use a minimum amount of recycled cobalt, lithium, nickel and lead from 2030 and to provide information that facilitates recycling at end-of-life. This would also affect manufacturers outside the EU if they intend to sell their products within the bloc.

“The sustainability of batteries has to grow hand in hand with their increasing numbers on the EU market.” Virginijus Sinkevičius, EU commissioner for environment, oceans and fisheries

Above: methane bubbles rising above a cold seep site. Quill worms, anemones, patches of bacterial mat, pandalid shrimp, and a large red crab (Chaceon quinquedens) along the periphery of the seepage area.
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Conclusion

Assessments of deep-sea mining should not only consider the significant risks it poses to biodiversity and humanity but also the risks for investors; minerals from the deep may come too late to compete with rapid advances in alternatives that underpin a circular economy and a genuinely green transition.

“The economic viability of exploration and extraction in the deep sea as of 2030 must be carefully evaluated in light of advances in battery and other technology as well as circular economy benefits. More research is required to thoroughly consider the environmental implications before increasing the exploitation of these resources”

The World Economic Forum

About the DSCC

The Deep Sea Conservation Coalition (DSCC) was founded in 2004 to address the need to prevent damage to deep-sea ecosystems and the depletion of deep-sea species on the high seas from bottom trawling and other forms of deep-sea fishing. The DSCC is made up of over 90 non-governmental organizations (NGOs), fishers organizations and law and policy institutes, all committed to protecting the deep sea.

For further information: info@savethehighseas.org
www.savethehighseas.org
@DeepSeaConserve

Endnotes

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