Planet Tracker

The SKY HIGH cost of deep sea mining

June 2023

Trying to **restore the damage** caused by deep sea mining would **cost** so much that neither companies nor governments would **pay** for it

Financial institutions should therefore **not support** deep sea mining

CONTENTS

EXECUTIVE SUMMARY

Land and sea use change is the leading driver of biodiversity loss globally.[a] Deep sea mining has been proposed as an 'environmentally friendly' alternative to conventional land-based mining. However, research shows that deep sea mining would cause significant permanent damage to deep sea ecosystems and the broader oceans with which they interact.

Deep seas are biodiverse but still under-researched

While only a fraction of the deep sea has been studied, it contains many of the most pristine, biodiverse and evolutionarily remarkable ecosystems on our planet. Deep sea mining risks destroying undiscovered species and impacting the functioning of the global biosphere.

Deep sea mining risks environmental damage on a massive scale

Environmental damage is often measured in two dimensions (e.g., in km^2). This report argues that two more dimensions – **volume and time – need to be considered to evaluate the magnitude of environmental damage**, especially for marine ecosystems. Thinking in 3D is especially important in the ocean, where the volume (in km^3) affected by human impacts can be colossal. **Time is critical** for the recovery of ecosystems: the destruction of a habitat is even worse if it takes millions of years to recover, as opposed to a few decades. Nature loss should therefore be examined in 4D.

Figure 1: Estimated range of the biosphere impacted by mining of nodules in international waters and critical materials for the energy transition on land (min & max volume in million km^3). Source: Planet Tracker.[34]

[a] See for instance UNEP (2022): 5 key drivers of the nature crisis or Jaureguiberry, P., et al. (2022). The direct drivers of recent global anthropogenic biodiversity loss. Science advances, 8(45), eabm9982.

Our analysis estimates that mining minerals critical for the energy transition on land impacts biodiversity across 1–10 million km^3. Deep sea mining would cause impacts on an even larger scale. We estimate the **total biosphere impacted by nodule mining in abyssal plains in international waters alone would be up to 25–75 million km^3, more than the volume of all freshwater in the world**, including ice and snow. The risk of large-scale environmental impacts from deep sea mining is driven by a combination of the enormous spatial scale of mining activity and the spread of mining-related noise and sediment plumes.

On top of this, like crude oil, the polymetallic nodules at the centre of mining interests take tens of millions of years to form, but unlike crude oil, they are an essential habitat for life: over half of the species living in the Pacific abyssal plains depend on nodules. Much of the habitat and biodiversity loss caused by deep sea mining would therefore essentially be permanent.

Deep sea ecosystems are essentially unrestorable

The International Seabed Authority (ISA) and mining companies have suggested that deep sea ecosystem restoration could be used to mitigate these negative environmental impacts. No details have been provided as to what restoration would look like in practice. Current research indicates that the potential for successful passive and active post-mining deep sea ecosystem restoration is extremely low, because of the long timescale and huge spatial impact of environmental damage.

The cost of deep sea restoration would be astronomical

The use of artificial clay nodules is the only deep sea ecosystem restoration technique being investigated in detail. We have estimated the **total cost of artificial nodule-based deep sea ecosystem restoration** at USD 5.3–5.7 million per km^2, which is **more than the revenue a typical company would make from mining**. The cost of restoration would be so high it would be impossible for deep sea mining companies to pay for it and operate at a profit.

Table 1: Impact of restoration costs on deep sea mining profit generation. Source: Planet Tracker, adapted from The Metals Company, 2021.

Item	Value
Annual area mined by a single company in 2030 (km^2)	1,000
% of nodules on the seabed that ends up collected on board carrier vessels	73%
Nodule abundance (wet kg/m^2)	17
2030 estimated revenue (USD million)	**4,379**
2030 estimated OpEx excluding restoration costs (USD million)	2,721
2030 estimated EBIT margin	**38%**
2030 estimated restoration costs (USD million)	5,299
2030 estimated EBIT margin after restoration costs	**(83%)**

However, this does not include the cost of monitoring restoration progress, which could increase this figure significantly given the high cost of transport and remotely operated vehicles needed to access the seabed. In addition, the technology for artificial nodule deployment at scale does not yet exist and if it did, the evidence so far indicates a low chance of successful restoration.

Neither public nor private money would cover that cost

An Environmental Compensation Fund has been proposed to fund ecosystem restoration as a part of the Mining Code being developed by the ISA. Our analysis found that **this Fund cannot be sufficiently capitalized to cover the estimated cost of restoration**. Restoring only 30% of potential deep sea mining concessions in international waters would likely cost more than the entire global defence budget.

There is also **little evidence that the Fund and current draft restoration regulation has considered best-practice from terrestrial mining restoration regulation**, including cost estimates. This could risk governments and tax payers footing the bill, as indicated by examples from terrestrial mining.

The governance of deep sea restoration has been neglected

The current lack of transparency and accountability around the roles and responsibilities of the ISA, sponsoring states and other parties poses a significant risk to the enforcement of post-mining deep sea ecosystem restoration.

There are also **limited opportunities for external scrutiny of deep sea mining impacts and restoration**, given the high costs of transport and remotely operated vehicles. For terrestrial mining, civil society and academia have been important for holding companies and governments to account for managing environmental damage and ecosystem restoration.

CALL TO ACTION

Financial institutions should support a moratorium on deep sea mining

Deep sea mining is **not aligned with global goals to protect and restore nature and could expose financial institutions to significant policy, regulatory and reputational risks**. Deep sea mining is likely to cause significant environmental damage and this report has found that the likelihood of achieving deep sea ecosystem restoration is low, while the cost is prohibitively high. **Financial institutions should therefore support a moratorium on deep sea mining**.

INTRODUCTION

While environmental issues are financially material for the vast majority of companies,[1] stock market prices are rarely directly impacted by nature-related events. Yet, when a video of a deep sea mining trial by The Metals Company surfaced,[2] showing the potential for significant negative environmental impacts, the price of its shares (admittedly volatile) reacted significantly and negatively.[3] This highlights the importance that current and potential investors attribute to environmental issues as they try to forecast the likelihood of commercial deep sea mining becoming a reality.

Proponents of deep sea mining argue that it is less environmentally damaging than conventional land-based mining. However, the broad scientific consensus asserts that deep sea mining would cause significant permanent damage to deep sea ecosystems and the broader ocean ecosystems with which they interact. Deep sea mining has been attracting significant and growing opposition, with companies, investors, national governments, scientists and civil society organizations calling for a Moratorium on deep sea mining.[4,5]

Purpose, methodology and scope of this report

Considering the potential for environmental damage caused by deep sea mining, this report aims to investigate the viability and costs of deep sea ecosystem restoration as a key driver of total costs and risks for deep sea mining. It will also explore the options for funding and governing post-mining deep sea ecosystem restoration and how these compare to learnings from terrestrial mining.

This report focuses on the impact of mining polymetallic nodules in the Clarion-Clipperton Zone (equatorial eastern Pacific), as this has received the most commercial interest to date and is the most likely area to be mined in international waters. Since nodules take millions of years to form, removing them through mining would result in essentially permanent ecosystem destruction. Current deep sea ecosystem restoration experiments indicate a very low chance of full recovery. In addition, the analysis in this report indicates that the cost of deep sea ecosystem restoration would be so expensive it would be impossible for mining companies to pay for it and operate at a profit.

The information and recommendations in this report were developed using a bottom-up approach, grounded in extensive literature review, expert interviews and primary analysis.

Planet Tracker aims to provide a practical working resource for financial institutions to understand and assess their exposure to the environmental risks associated with deep sea mining. This report is aimed at financial institutions with potential exposure to deep sea mining activities and those seeking to support the transition towards a sustainable blue economy. The overall aim is to empower investors to better integrate nature and marine biodiversity into capital allocation decisions.

WHAT IS DEEP SEA MINING?

WHY?

Deep sea mining refers to the extraction of metals and minerals from **the deep seafloor, which covers around 50% of the earth's surface** (360 million km^2), representing **95% of the global biosphere**.[6] There has been a surge of interest in deep sea mining in recent years, driven by the forecast rise in demand for metals for technology and the low-carbon transition and increasing global metal prices.[7]

WHERE?

While the deep sea is technically considered to be below 200 m, most of the mineral deposits currently under exploration are greater than 1,500 m below the sea's surface.[8] Major mineral reserves on the deep seabed have been known about for decades, but no commercial scale deep sea mining has taken place to date within national waters or international waters (the focus of this paper), where rules are currently under negotiation by the International Seabed Authority (ISA)[b].

WHAT?

The most important elements that could be mined from the seabed are: copper, cobalt, manganese, nickel, zinc, silver and gold.[9] Three types of deep sea mineral deposits are of commercial interest: polymetallic nodules, seafloor massive sulphides and cobalt-rich crusts – see Table 2. This report focuses on the impact of mining polymetallic nodules as they have received the most commercial interest to date, particularly in the Clarion-Clipperton Zone (equatorial eastern Pacific).

Table 2: Commercially important deep sea mineral deposit types. Source: United Nations Environment Programme Finance Initiative, 2022.

Deposit type	Key metals/minerals	Description
Polymetallic (Manganese) Nodules	Manganese, nickel, copper, cobalt, molybdenum, rare earth metals, iron	Concentrations of iron and manganese hydroxides (5-10cm in diameter) occurring in the abyssal plains at depths of 2,000-6,500m. Nodule fields of commercial interest have been found in parts of the Clarion-Clipperton Zone (equatorial eastern Pacific), the Cook Islands (south west Pacific) and an area of the Central Indian Ocean Basin.
Seafloor Massive Sulphides / Polymetallic Sulphides	Copper, gold, zinc, lead, barium, silver, sulphides	Metallic sulphide bodies are found at both active and dormant hydrothermal vents where hydrothermal fluid (at over >350°C) are/have been emitted. Deposits have been found in all the world's oceanic plate boundaries.
Cobalt-rich (Ferromanganese) Crusts	Manganese, iron, cobalt, copper, nickel, platinum	Precipitation of manganese and iron from cold seawater forms crusts up to 25cm thick on hard rock surfaces on seamount flanks, ridges and plateaus at depths of 400–7,000m. Crusts of commercial interest are found at depths of 800–2,500m on the flat tops of guyots in the western Pacific.

HOW?

Currently polymetallic nodule mining is envisaged to use remotely operated vehicles[10] to collect nodules from the sea floor and pump them via a vertical riser pipe to a support vessel (boat) before being transported to land for processing.[6]

[b] The ISA is a small autonomous UN body, established in 1982 under the United Nations Convention on the Law of the Sea (UNCLOS).

ENVIRONMENTAL IMPACTS OF DEEP SEA MINING

There are over 100 papers exploring the direct and indirect impacts of deep sea mining, most of which focus on the impact of nodule mining on the sea floor, although studies on other deposits are underway.[11] From this research has emerged the broad scientific consensus that deep sea mining vehicles and sediment plumes would cause significant damage to deep sea ecosystems and the broader ocean ecosystems with which they interact.[12]

Yet the reality could be worse, since many of the effects of deep sea mining remain unstudied and their scale is largely unknown.[13] This section provides an overview of the key direct and indirect environmental impacts of deep sea mining – see Figure 2.

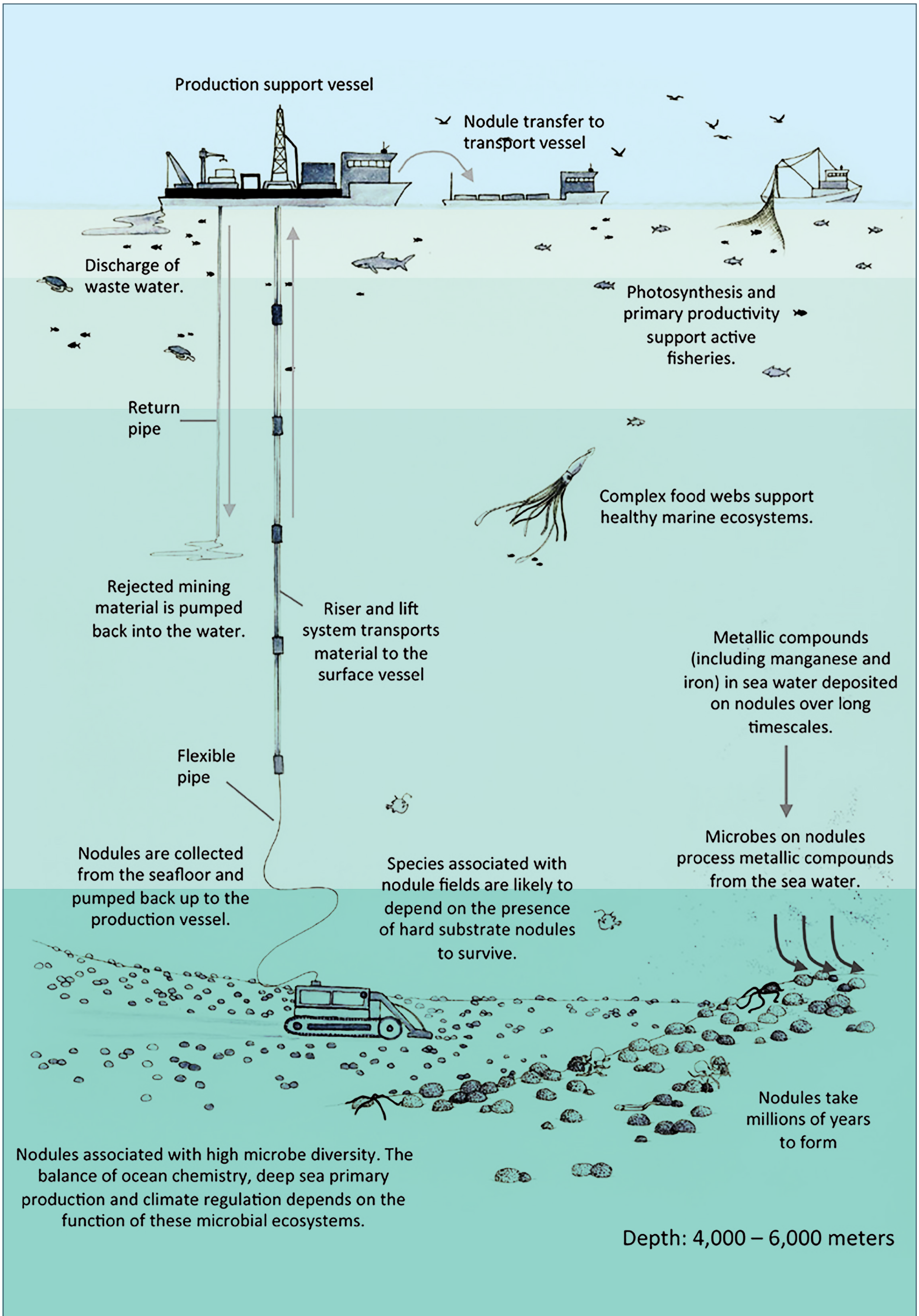


Figure 2: Potential risks and impacts of mining polymetallic nodules on abyssal plains (not to scale). Source: Fauna & Flora International 2021.

A biodiverse, under-researched, highly sensitive biome

The argument that deep sea mining is more 'environmentally friendly' often hinges on the false assumption that the deep sea is largely devoid of life. While only a fraction of the deep sea has been scientifically studied, it contains many of the most pristine, biodiverse[14] and evolutionarily remarkable ecosystems on our planet.[15] Serious concerns have been raised about the potential of deep sea mining to disturb undiscovered organisms.[6] For instance, a recent study found that from a total of 5,578 species recorded in the Clarion-Clipperton Zone (equatorial eastern Pacific), **92% were new to science**.[16]

In addition, recently discovered deep sea species have generally been found to be highly specialized, relatively slow growing and long-lived. This makes them particularly sensitive to physical disturbance, including the impacts of deep sea mining.

Deep sea ecosystems are also known to provide the full range of ecosystem services and are highly interconnected with broader ocean ecosystems – see Figure 3. However, the connections between deep sea habitats and wider global functioning are poorly understood,[17] raising concerns about the potential unknown broader impacts of deep sea mining.

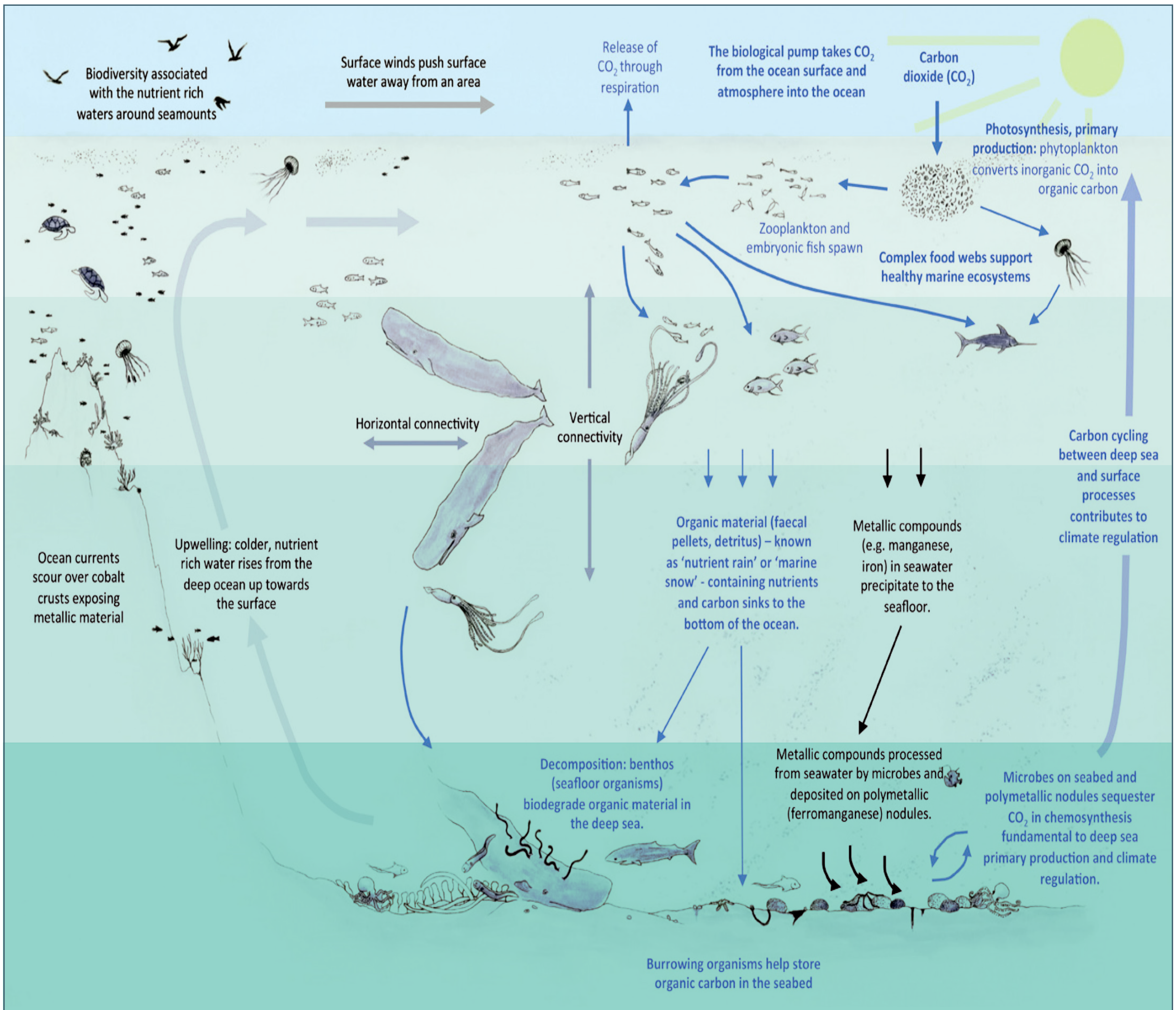


Figure 3: Illustration of oceanic processes including primary productivity and the biological pump, and connectivity (not to scale). Source: Fauna & Flora International 2021.

Deep sea mining risks large-scale direct environmental impacts

The biggest direct impact of deep sea mining of nodules would be habitat and biodiversity loss, as nodules are removed along with the organisms that grow on them, many of which, including corals and sponges, cannot grow anywhere else[18] – see Figure 4.

Figure 4: Sponge of the species Hyalonema obtusum with anemones attached to its stalk. The sponge is attached by the stalk to a polymetallic nodule. Source: GEOMAR, ROV-Team.

These organisms have been identified as key structural species, supporting a huge range of fauna and playing a critical role in the food web[19] – see Figure 5. **Nodules take tens of millions of years to form, so the habitat and biodiversity loss caused by deep sea mining would essentially be permanent**.[14] Over half of the species living in the Pacific abyssal plains depend on nodules.[19]

Figure 5: A deep sea cusk eel (Bassozetus nasus) in the nodule fields of the Clarion-Clipperton Zone. Source: Diva Amon and Craig Smith/University of Hawai'i.

The sediment that makes up the deep sea floor would also be compacted, removed and redeposited by deep sea mining machinery. Sediments may take centuries to recover along with the microbes they host, which all life on the abyssal plain depends on,[13] as the natural sedimentation rate in the Clarion-Clipperton Zone is less than 1cm per thousand years.[21]

Deep sea mining has the potential to be particularly damaging because of the enormous spatial scale of mining activity and its direct environmental impact. Over 1.5 million km^2 of international seabed has been set aside for deep sea mining exploration.[22] This is about the size of Mongolia, or **more than the total area of sea trawled by bottom trawlers**.[23] In addition, many countries have also awarded hundreds of thousands of km^2 of seabed concessions for potential mining. Norway, for instance, has granted 232,000 km^2 of seabed concessions for mineral exploration.[24] Forecasts suggest that several hundred[15] to a thousand[25] km^2 of seabed could be disturbed each year by a single polymetallic nodule mining operation.

In comparison, terrestrial mining is currently estimated to cover 57,000–66,000 km^2 of land, which is about the size of Latvia or a thousand Manhattans.[27] Therefore, **even if only 5% of deep sea concessions in international waters was mined (75,000km^2), it would still be larger than the total area mined on land today**.

Deep sea mining therefore risks directly causing habitat loss and damage to sensitive marine ecosystems on an enormous scale, with a much larger land (or seabed) footprint than terrestrial mining. Many of these impacts could be essentially permanent, particularly with the loss of nodules which take millions of years to form.

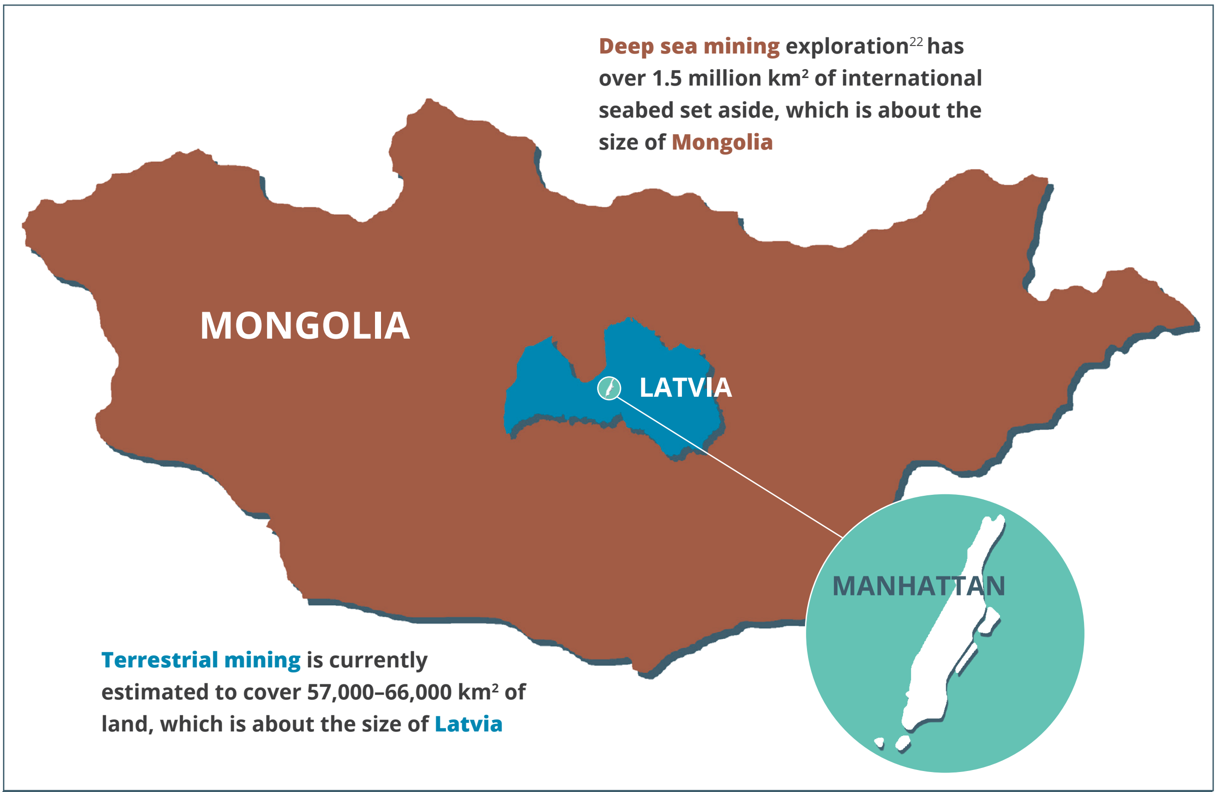


Figure 6: Comparing the area of Terrestrial mining with Deep Sea mining. Source: Tang & Werner (2023), Planet Tracker.

Sediment plumes and noise amplify DSM impacts

The main indirect impacts of deep sea mining are associated with the sediment plumes and noise created by mining activity which could have far-reaching impacts on ocean ecosystems. For example, seabed communities could be smothered,[28] toxic metals may be released,[29] deep sea fisheries could be contaminated[30] and nutrients could be introduced into otherwise nutrient-poor ecosystems.[30] While these impacts are relatively under studied, existing research indicates they are likely to be very difficult to control and contain due to the highly interconnected and dynamic nature of the ocean.

Estimates for the total area of ocean that would be impacted by deep sea mining vary widely. However, scientists agree that noise and sediment plumes from equipment disturbing the seabed and surface de-watering processes[6,32] could have far-reaching effects on broader ocean ecosystems.[30] Sediment plumes alone could spread hundreds to thousands of km in the water column,[33] so the overall area affected by deep sea mining would be at least two to four times larger[15] than the area mined.

Research has also shown that in gentle weather conditions, **the sound from a single nodule mining operation could travel up to 500km**.[31]

Within a 4–6 km radius, the sound would be above 120db, the threshold that denotes the possibility of behavioural impacts on marine mammals. A total area of 5.5 million km^2 would be impacted by noise louder than ambient sound levels experienced in gentle weather conditions.[31]

We estimate the total area of biodiversity impacted by nodule mining in abyssal plains in international waters alone would be up to 12.4 million km^2 – see Figure 7. This is assuming impacts would extend within a 500 km radius of operations, accounting for sediment plumes and noise generated by deep sea mining. This is an enormous area – **if it was a country, it would be the second largest, behind Russia and ahead of China**.

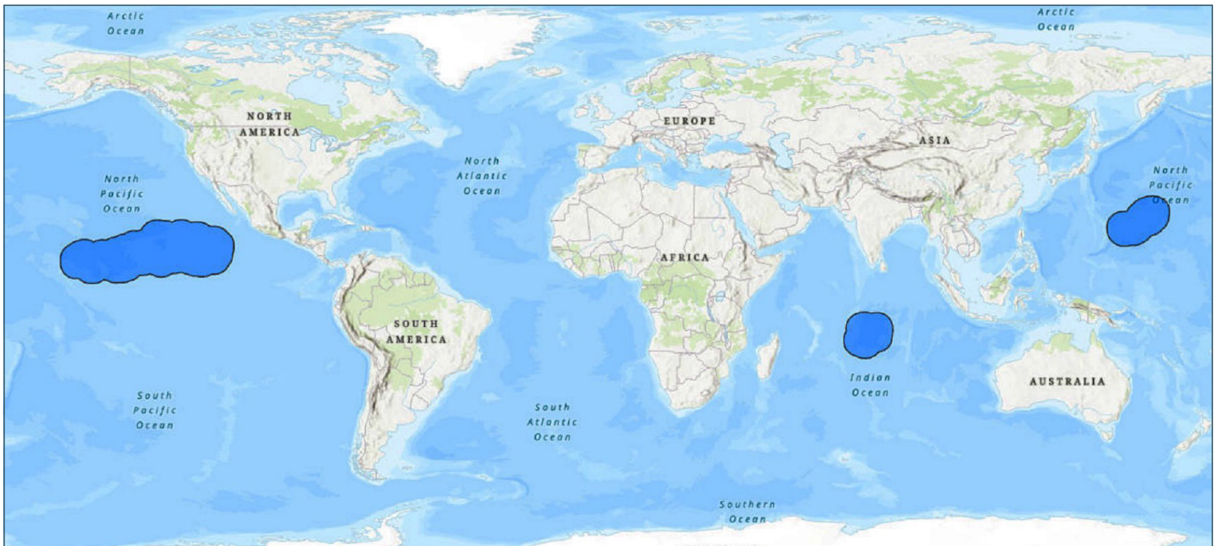


Figure 7: Illustrative example of the area whose biodiversity would be impacted by the mining of nodules in international waters, assuming a 500km radius. Source: Planet Tracker map based on ISA data.

Importantly, given how sound and sediment plumes travel, **biodiversity impacts for deep sea mining have to be measured in km³ rather than km²**.

Using the estimated area above, we calculate that the total biosphere[c] potentially impacted by nodule mining in international waters could be up to 25–75 million km^3 – more than all the freshwater in the world, including ice and snow (24 million km^3).[38] This assumes average vertical distances (through the water column) of up to 2 to 6 km (nodules typically occur 4 to 6 km below the ocean surface).[19]

In comparison, we estimate that the biosphere impacted by the mining of minerals critical for the energy transition on land is unlikely to be larger than 1 to 10 million km^3. This is based on existing research estimating the area directly impacted at 25.4 million km^2,[36] and assuming terrestrial mine impacts travel vertically between 55 m and 400m on average over the area impacted (underground and above ground, due to dust and other forms of air pollution) – see Figure 8.

Figure 8: Estimated range of the biosphere impacted by mining of nodules in international waters and critical materials for the energy transition on land (min & max volume in million km^3). Source: Planet Tracker.[34]

[c] Life in the air, on land including soil, and in water.

Deep sea mining would barely reduce mining-related deforestation

Supporters of deep sea mining also often point to the damage caused by nickel mining in the rainforests of Indonesia as an issue that could be mitigated by mining the deep sea. But would deep sea mining reduce deforestation?

Mining is the fourth largest driver of deforestation, behind agriculture, infrastructure and urban expansion, and mining-related deforestation has almost doubled in the 2010s compared to the previous decade. However, 71% of the deforestation caused by mining is linked to just two commodities: gold and coal – see Figure 9. These two commodities were responsible for a combined total of 6,877 km^2 of forest loss between 2001 and 2019.

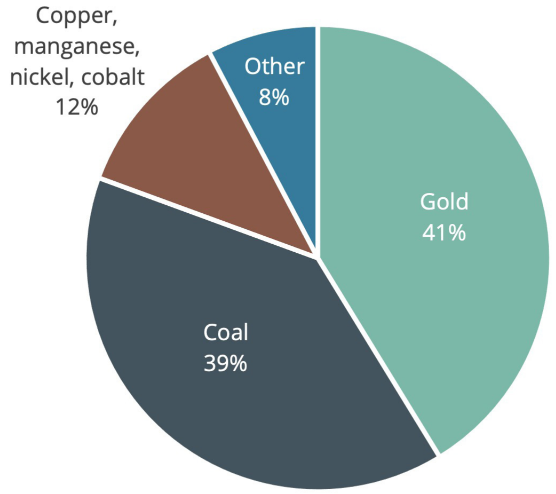


Figure 9: Breakdown of mining-related deforestation (in km^2) over the 2001-2019 period by metal.[37] Source: Planet Tracker, WWF.

In comparison, the mining of copper, cobalt, nickel and manganese (the metals present in deep sea nodules) led to 997 km^2 of forest loss over the same period, or 12% of all mining-related deforestation.[37]

Just one contractor in one area of international waters (The Metals Company) forecasts to mine about 1,000 km^2 of seabed a year in 2030,[25] about twenty times the annual area of mining-related deforestation by all mining companies globally for cobalt, copper, nickel and manganese (52 km^2 a year).

Mining the seabed is therefore unlikely to significantly reduce terrestrial mining-related deforestation, because only a fraction (if at all) of the metals mined from the seabed would replace those mined on land.[38] In addition, there is no indication that deep sea mining would displace terrestrial mining; the sectors would instead become competitors in a larger minerals market.[39]

DEEP SEA MINING IS NOT ALIGNED WITH GLOBAL GOALS TO PROTECT AND RESTORE NATURE

The environmental damage expected from deep sea mining detailed in the previous section is not aligned with intergovernmental and national policy agendas, which aim to halt biodiversity loss and promote nature restoration.

At the global level, UN Member States have committed to building synergies between existing freshwater, marine and terrestrial ecosystem conservation and restoration commitments and initiatives. This includes the UN Decade on Ecosystem Restoration, the UN Sustainable Development Goals, and the Kunming-Montreal Global Biodiversity Framework, adopted by Parties to the Convention on Biological Diversity in December 2022. A summary of relevant legal frameworks can be found in Appendix 1: A summary of legal frameworks. **Deep sea mining even seems to contradict the ISA's own mandate to ensure the 'effective protection' of the marine environment** and to ensure mining activities are carried out for the 'benefit of (hu) mankind'.

More generally, Net Zero and 'nature positive' have become common expressions defining the ambition of many organisations and jurisdictions to tackle the climate and biodiversity crises[d]. Deep sea mining companies have attempted to tap into this narrative with claims that deep sea mining is more 'environmentally friendly' than terrestrial mining. However, this does not match the mounting evidence that deep sea mining is likely to cause significant damage to oceanic ecosystems. Even recent research funded by The Metals Company acknowledges the enormous difficulty of comparing the worth of different ecosystems.[40]

This leaves companies and potential **investors involved in deep sea mining exposed to potential policy and reputational risks, including greenwashing**[e].

[d] Google searches for Net Zero and 'nature positive' have respectively almost quadrupled and tripled between 2018 and 2023, based on Google Trends.

[e] For an overview of Greenwashing see Planet Tracker's report: The Greenwashing Hydra

DEEP SEA ECOSYSTEM RESTORATION POST MINING IS AN ILLUSION

The ISA and deep sea mining companies have indicated that deep sea ecosystem restoration could provide a way of mitigating the significant negative environmental impacts and associated risks detailed in the previous sections.

The Society of Ecological Restoration defines ecological restoration as the process of ***"assisting the recovery of ecosystems that have been degraded, damaged or destroyed"***.[41] The aim of ecosystem recovery is to create a self-supporting habitat similar to the 'original' habitat before impact took place, or similar to a reference ecosystem. In comparison, ecosystem rehabilitation is less ambitious, aiming to replace structural or functional characteristics that have been damaged and enhancing the ecological, social and economic value of the new ecosystem.[42,43]

Current research indicates that achieving successful deep sea habitat restoration (and even rehabilitation) is extremely unlikely and our analysis shows the cost of proposed restoration techniques would make deep sea mining financially unviable.

The narrative around deep sea restoration also ignores a key issue: the lack of detailed understanding of deep sea ecosystems and their relationship with wider ocean ecosystems indicates that no robust, precautionary approach exists to protect the ocean against the negative impacts of deep sea mining.[7] Ecosystem restoration should only be undertaken after everything has been done to avoid and minimize any negative impacts in the first place.[14] This is indicated by the mitigation hierarchy, which is usually used to manage environmental risks on land and in coastal areas – see Figure 10.

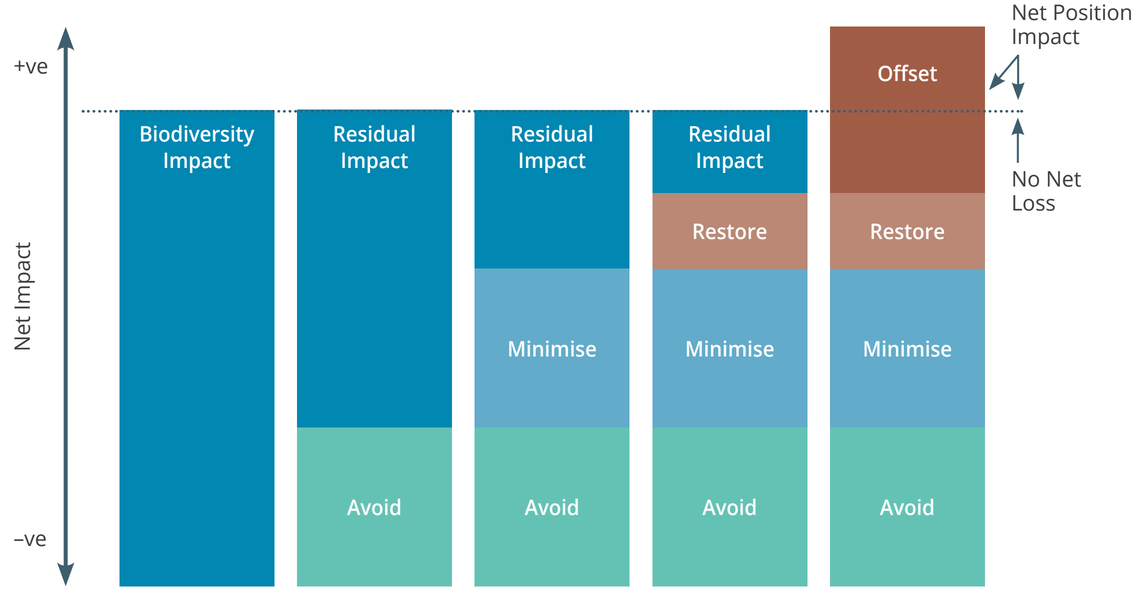


Figure 10: The biodiversity mitigation hierarchy.[44] Source: UNEP FI.

The following section will detail the potential for deep sea ecosystem restoration and lessons from terrestrial mining.

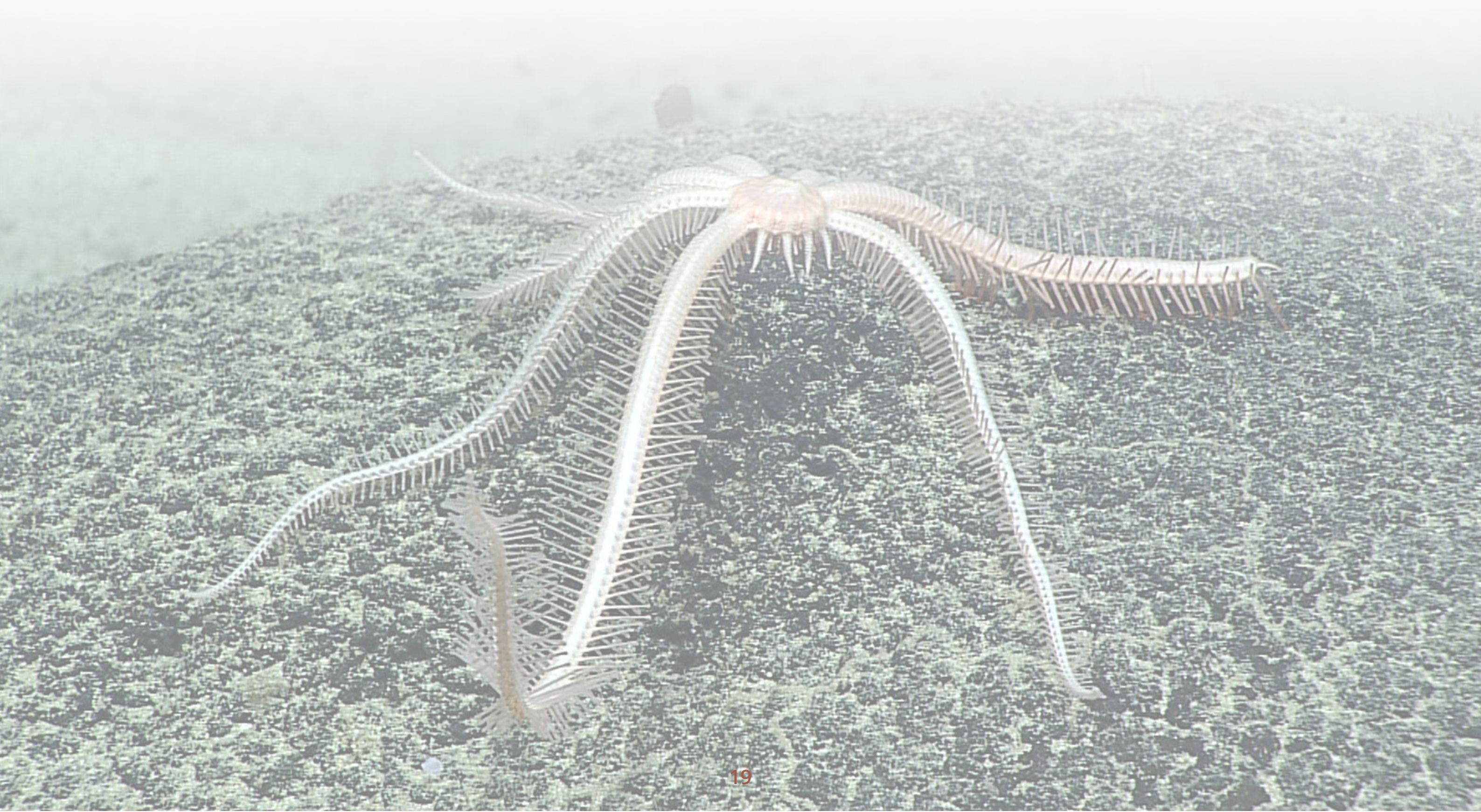
Deep sea ecosystem restoration potential: very limited

By removing nodules and compacting, removing and redepositing sediments deep sea mining will cause habitat and biodiversity loss, some of which could last tens of millions of years, as described in the previous sections. The potential for successful passive or active restoration of deep sea ecosystems damaged and destroyed by deep sea mining is therefore extremely low.[13,20] In one experiment looking at passive restoration, the density and diversity of megafauna (greater than 1 cm) in an area disturbed to simulate the effect of a nodule collector vehicle were still significantly lower than reference areas after 26 years.[28]

Even if these habitats were not destroyed or damaged by deep sea mining, ecosystem recovery depends on organisms returning to a site, but this cannot happen if source populations are destroyed by further mining, or are too far away because of the huge scale of mining activity.[45] In addition, many organisms cannot travel across the vast and varied abyssal plain habitats and for those which can, sediment plumes may also act as a physical barrier to recolonizing areas affected by deep sea mining.

Replacing nodules with artificial nodules?

There is little research about the specific active restoration techniques that would be used after abyssal plains were mined to extract nodules. One restoration technique explored in detail is experiments with the use of artificial clay nodules, which began in 2021.[20] These nodules are made on land, transported on boats, then loaded onto remotely operated vehicles to the deep seabed – a deep sea mining operation in reverse, where nodules are deposited rather than mined, where the nodules will be studied for their suitability as a replacement for polymetallic nodules. This restoration technique is the focus of the following sections exploring the potential cost of deep sea restoration.



Learning from technical challenges in terrestrial mine rehabilitation

The restoration of ecosystems impacted by deep sea mining appears to be partly inspired restoration and rehabilitation for mining on land. The ecological restoration of degraded mine sites should, in theory, facilitate a level of native ecosystem recovery, including the restoration of biodiversity, as well as ecosystem structure, functioning and services.

However, many mine sites create such radical landscape change **that rehabilitation is a more likely outcome**, resulting in a new or hybrid ecosystem with both native and non-native species. Current best practice aims for progressive rehabilitation that starts when mines are in operation, rehabilitating areas of the site no longer in use as new areas are opened up.

Despite growing demand, achieving successful mine restoration or rehabilitation faces major technical challenges. These include: selecting, propagating and re-establishing species; controlling invasive species and; monitoring the progress of rehabilitation.

In practice, terrestrial mine restoration and rehabilitation is often a process of trial-and-error, due to the lack of systematic knowledge of how ecosystems function.[46]

Selecting the right species to include in degraded mine sites requires detailed information on each species' ecological niches. This is particularly important in the early stages of rehabilitation where 'nurse species' are needed to attract pollinators as well as organisms that disperse seeds and those that attract new species into the ecosystem. **Considering the limited understanding of deep sea species, ecosystem structure, functioning and services, it is currently unlikely that deep sea ecosystems could be restored or even rehabilitated effectively.**

Monitoring terrestrial mine rehabilitation is key to understanding whether ecosystems have been successfully restored, and is a legal requirement in many countries.[47] Yet monitoring faces significant challenges. Field-based monitoring, with rehabilitation staff physically visiting mine sites, is still the most common approach for assessing ecosystem rehabilitation globally,[48] but it is labour intensive, time-consuming and expensive, especially with mines often located in remote areas. As a result, **monitoring is often insufficient or non-existent**. Monitoring deep sea ecosystem recovery is likely to face similar challenges, given the technical difficulty in accessing deep sea environments, as well as the cost (discussed in the next section).

Remote sense monitoring, which has been used to monitor terrestrial mine restoration and rehabilitation since the 1970s, is increasingly providing opportunities to reduce the cost and effort of monitoring. It also provides an opportunity for public scrutiny, from academic studies to civil society groups tracking the environmental impact of mines remotely. This is important for holding mine operators to account in the context of poor monitoring. Similar levels of **external scrutiny for deep sea ecosystem restoration would be extremely limited** given the current limited access and high cost associated with transport and remotely operated vehicles.

THE ASTRONOMICAL COST OF RESTORING DEEP SEA ECOSYSTEMS

There are very few estimates of the costs of active deep sea ecosystem restoration for polymetallic nodule fields, despite the significant commercial interest they have garnered. Assuming deep sea restoration costs would be similar to those of coastal ecosystems, Amon et al.[44] conservatively estimate USD 50 billion would be required to restore just 10% of 500,000 km^2 of abyssal seafloor and *"would probably still be inadequate to prevent substantial species extinctions"*.

However, other research has pointed out that deep sea ecosystem restoration is likely to be three to four times more expensive than for shallow water habitats,[49] with coastal ecosystem restoration costs ranging from USD 80 to 160 million per km^2.[50] The ships and remotely operated vehicles required for deep sea ecosystem restoration are extremely expensive and are estimated to account for 80% of restoration costs.[51] In addition, the deeper the seabed, the more expensive it is to access it – see Figure 11.

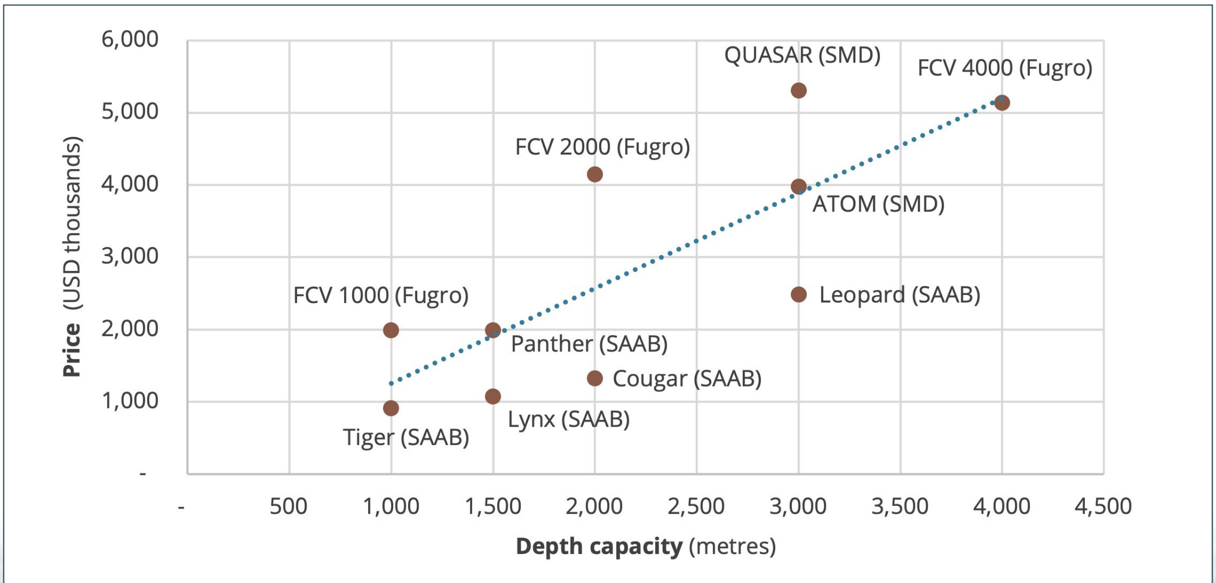


Figure 11: Price of various remotely operated vehicle models (manufacturers in brackets) in relation to the maximum depth each model can access.[52] Source: Planet Tracker, based on Teague, Allen and Scott (2017).

Costing the replacement of polymetallic nodules with artificial clay nodules

The current cost of producing artificial clay nodules is estimated to be USD 0.10 per artificial nodule.[20] We have estimated the total cost of artificial nodule-based deep sea restoration at USD 5.3–5.7 million per km^2, based on the following assumptions:

Table 3: Assumptions retained to estimate the total cost of replacing nodules with artificial nodules. Source: Planet Tracker, based on sources listed below.

Item	Value	Unit	Source/comment
Average artificial nodule weight	180	grams per artificial nodule	Reference[20]
Targeted spatial distribution of artificial nodules	52	nodules/m^2	Assuming 1:1 replacement of existing nodules, using The Metals Company's NORI area as a representative example, based on The Metals Company's estimates of resource recovery, area processed and moisture content[53]
Deployment cost of artificial nodules	0.25	USD million/km^2	Based on The Metals Company's estimated offshore operating cost[52]
Average tonnage of dry carriers used for the transport of artificial nodules	70,000	tonnes	Note: TMC's TOML Technical Report assumed that chartered vessels with 35,000 to 100,000 tonne deadweight capacity would be used to transport the dewatered nodules
Operating cost of a single dry carrier vessel	9	USD million per year	Assuming that the margins charged on shipping costs would be minimal[54]

The cost of deploying the artificial nodules at scale is based on The Metals Company's estimate for the cost of nodule extraction. This assumes that the remotely operated vehicles and other equipment used to extract the nodules could be operated in reverse: artificial nodules lowered onto the seabed, rather than existing nodules being extracted from the sea floor. However, this technology does not currently exist.[55] Alternatives including using remotely operated vehicles to drop artificial nodules from a few meters above the seabed would mean the cost of the restoration would sky rocket to astronomical values.

The cost of monitoring restoration has not been included in these calculations because there is currently no consensus on the exact resources and equipment needed and how frequently it would occur. Currently, monitoring would almost certainly require the use of remotely operated vehicles, significantly increasing the total cost of restoration, based on the evidence above.

Overall, **using artificial nodules to restore abyssal plains impacted by deep sea mining is likely to cost between USD 5.3–5.7 million per km^2**, depending on whether artificial nodules are deployed at the same time or after polymetallic nodule extraction. If artificial nodules are deployed at the same time as polymetallic nodules are extracted, savings would be generated on remotely operated vehicles and transport costs.

Deep sea mining companies cannot afford the cost of restoration

If the cost of restoration had to be borne by mining companies, it would severely impact their profitability. Combining the forecasts and estimates from The Metals Company's SEC filing, we calculate that a company collecting nodules over 1,000 km^2 of abyssal plain in 2030 could potentially generate revenues of USD 4.379 billion with operational expenditures of at least USD 2.721 billion. This would mean a 38% operational margin, excluding other costs such as stock-options[f]. **Per km^2, the restoration cost we computed (USD 5.3–5.7 million) is higher than the revenue made from the sale of nodules (USD 4.4 million), and about twice as high as the cost of mining them (USD 2.7 million).**

Adding the restoration costs as cash costs would turn that 38% margin into a large loss equivalent to 83% of revenue – see Table 4. Considering the cost of restoration monitoring has been excluded from our estimates, the loss could be significantly larger.

Table 4: Impact of restoration costs on deep sea mining profit generation. Source: Planet Tracker, adapted from The Metals Company, 2021.

Item	Value	Comment/source
Area mined (km^2)	1,000	In line with The Metals Company's 2030 forecasts for its NORI area
% of nodules on the seabed that ends up collected on board carrier vessels	73%	In line with The Metals Company's 'resource recovery factor'
Nodule abundance (wet kg/m^2)	17	In line with The Metals Company's NORI Area D
Nodules moisture content (%)	24%	In line with The Metals Company's NORI Area
Average Nickel grade (%)	1.32%	The proportion of each mineral contained in a dry nodule, in line with the average in The Metals Company's NORI area
Average Copper grade (%)	1.08%	
Average Cobalt grade (%)	0.18%	
Average Manganese grade (%)	29.41%	
Nickel price (USD per tonne)	16,472	Prices assumed by The Metals Company
Copper price (USD per tonne)	6,872	
Cobalt price (USD per tonne)	46,333	
Manganese price (USD per dry metric ton unit)	4.5	A unit is 10kg[56]
2030 estimated revenue (USD million)	**4,379**	
Average offshore operating cost (USD million/km^2)	0.25	The Metals Company estimate
Transport, processing, and SG&A costs (USD per dry tonne)	229	The Metals Company estimate
Royalties to ISA and states (USD per dry tonne)	33	The Metals Company estimate
2030 estimated OpEx excluding restoration costs (USD million)	2,721	
2030 estimated EBIT margin	**38%**	
2030 estimated restoration costs (USD million)	5,299	Assuming restoration occurs during exploitation
2030 estimated EBIT margin after restoration costs	**(83%)**	

[f] We do not endorse this revenue forecast but use it as a basis to estimate the revenue generated by a company similar to TMC based on all the assumptions it retained.

Alternatively, the costs of restoration could be booked as liabilities upfront, as can be the case in terrestrial mining. However, evidence from terrestrial mine restoration indicates that this would create multiple issues, as discussed in the following sections.

Cost of terrestrial mining rehabilitation

There are a variety of different types of terrestrial mine closure estimates (including, mine rehabilitation among other activities) used today to meet companies' internal requirements and those of investors, regulators and others. A detailed description of each type of closure cost estimate is provided in the International Council for Mining & Metal's (ICMM's) Financial Concepts for Mine Closure,[57] a summary of which is available in Appendix 2: A summary of terrestrial mine closure estimate types.

How well are terrestrial mine rehabilitation costs estimated?

Experts and regulators have highlighted that terrestrial mine rehabilitations costs are often grossly underestimated. This is in part due to the myth that limited monitoring and maintenance is required after mine closure, an assumption that is implied in most rehabilitation cost calculation tools used by industry and regulators.[58,59] It appears that deep sea mining cost estimates face a similar issue, with very little attention paid to the technicalities and cost of monitoring.

Evidence from the US and Australia, leading jurisdictions in the terrestrial mine rehabilitation space, highlights that financial assurance is frequently significantly underestimated. For example, in 2008, the US Government Accountability Office found that the financial assurances provided for 52 hard rock[g] mining sites in operation at the time were around USD 61 million less than what was required to fully cover reclamation costs.[58]

Regulators in some jurisdictions are beginning to recognise these risk and have begun reviews and reforms in: progressive rehabilitation (while a site is still in operation), closure planning, risk assessment, residual risk calculation for risks that remain after mine closure and financial provisioning for closure.[57]

Despite the wealth of information available on restoration cost estimates for terrestrial mining, the ISA and deep sea mining companies have provided very little to no detail on how deep sea restoration costs would be calculated. Considering concerns of transparency and accountability, there is also the question of whether the ISA would have the incentive or capacity to amend deep sea rehabilitation cost calculations or regulations if they prove ineffective.

[g] Gold, silver, copper and other hard rock minerals.

AN ENVIRONMENTAL COMPENSATION FUND TO COVER THE RESTORATION OF DEEP SEA ECOSYSTEMS?

The cost of post-mining deep sea rehabilitation is likely to be prohibitively expensive, as presented in our analysis in the previous section. Another key question is: who would pay?

The current 'Draft regulations on exploitation of mineral resources in the Area', states that an Environmental Compensation Fund would be created for deep sea ecosystems impacted by mining. The Environmental Compensation Fund would finance:[60]

- Measures designed to prevent, limit or remediate any damage to the area;
- The promotion of research into methods of marine mining engineering and practice to reduce environmental damage in the area;
- Education and training programmes;
- Funding of research into best available techniques for the restoration and rehabilitation of the area; and
- The restoration and rehabilitation of the area when technically and economically feasible and supported by best available scientific evidence.

The final point here indicates that **if restoration and rehabilitation are not financially feasible they will not be carried out**. Based on our calculations, it is very unlikely that deep sea restorations will be financed by the ISA's Environmental Compensation Fund.

The Environmental Compensation Fund is not fit for purpose

The Environmental Compensation Fund would be funded from a percentage of royalties and penalties paid to the ISA by deep sea mining operators. Recent research highlights that this funding mix is not adequate since fines and donations are unstable sources of finance and the system of collecting royalties is subpar.[61]

In addition, our calculations show that **the Fund cannot possibly be capitalised enough to fund the restoration and rehabilitation of the areas mined**.

Even if 100% of the royalties collected by the ISA were used to capitalise the Fund (clearly an unrealistic assumption), **the cost of restoring the area damaged by deep sea mining would be around 11 times bigger than the endowment of the fund**. And this is solely for the mining of nodules, not other forms of deep sea mining.

This is based on a royalty rate equal to around 10% of mining revenue[h]; exploitation hypotheses in line with those assumed by The Metals Company and listed in Table 5 below; an average area mined annually of 2,000 km^2 and; an average cost of restoration of USD 5.65 million/km^2. Other research has suggested much lower royalty rates of 2%–6%.[62]

[h] USD 33 per dry tonne (assumption used by The Metals Company), vs. estimated revenue extracted per nodule of USD 328 per dry tonne.

Table 5: Comparing the cost of restoration to the Environmental Compensation Fund capitalisation. Source: Planet Tracker..	
ISA royalties rate (USD per dry tonne)	33
Nodule abundance (wet kg / m²)	17
Resource recovery rate (%)	73%
Nodule moisture content (%)	24%
Km² mined per year	2,000
Nodules extracted (million dry tonnes per year)	18.9
ISA royalties perceived (USD million)	622.5
% of royalties channelled to fund capitalisation	80%
Fund capitalisation after one year (USD million)	498
Length of exploitation (years)	30
Average annual return of fund (%)	3.5%
Fund capitalisation at end of mine life (USD million)	**32,134**
Fund capitalisation (USD million per km²)	0.5
Cost of restoration (USD million per km²)	5.65
Total cost of restoration (USD million)	338,861
Total cost of restoration as % of fund capitalisation at end of mine life	**1,055%**

It is worth noting that assuming that only 2,000 km² would be mined every year is very conservative. It is equivalent to twice the area forecast to be mined by just one company (The Metals Company) in 2030. Yet the associated cost of restoration over 30 years totals USD 339 billion. This is about five times more than the total forecast capital expenditures for the twenty largest terrestrial mining companies globally.[63]

Even if research shows that more adequate payment mechanisms for deep sea mining are possible,[64] this report is the first to argue that no payment mechanism could fully fund the cost of restoration post deep sea mining.

ISA: a lack of transparency and conflicts of interest

More generally, concerns have been raised about the lack of transparency and independent scrutiny in how the ISA operates and conflicts of interest between the ISA and the deep sea mining companies it would regulate.[14] The regulations are also being developed rapidly, largely ignoring the precautionary principle (as already discussed) and with little public debate.[65]

Learning from terrestrial mine restoration regulations

The regulations being proposed for deep sea mining fall far short of current best-practice regulations for terrestrial mining. On land, mine restoration regulations vary across the world, but usually aim to return the mine site to a state that is non-polluting, safe, stable, with a self-sustaining ecosystem and can support an 'agreed' post-mining land use through progressive rehabilitation.[66]

Today, Australia, Canada, Germany and the US state of Nevada are recognised as leading the way in mine restoration and mine closure more generally.[46]

These jurisdictions have established stringent, wide-ranging and effective regulations combining a command-and-control approach with economic incentives to encourage best-practice in the mining sector. Current best practice emphasises:

- Ensuring **mine rehabilitation is integral to life-of-mine planning** from project inception, with a closure plan and cost estimate required as part of the mine permitting process before development begins.
- Developing **well-planned post-mining landscape**, encouraging progressive restoration where possible.
- Regularly **reviewing and adjusting mine closure plans**, cost estimates and financial assurance throughout the life of the mine, using the results of ongoing studies, progressive restoration performance and stakeholder engagement. These are adjusted annually in many jurisdictions and up to five years in others.
- Setting specific, measurable, achievable, realistic and time-bound completion **criteria/targets to demonstrate rehabilitation has been achieved**. These contribute to companies' relinquishing mine-related responsibilities.
- Involving **all stakeholders** in mine closure planning, to build accountability and stewardship for post-mining landscapes.

There is little evidence to suggest that the current regulation around post-mining deep sea ecosystem restoration has learnt from best practice in terrestrial mining. This contradicts the 'environmentally friendly deep sea mining narrative and provides another indication that environmental impacts are not being properly accounted for.

Is terrestrial mine restoration regulation implemented?

Despite significant improvements in regulation in recent decades, there is substantial evidence from across the world that successful terrestrial mine restoration remains 'an unrealised aspiration'.[67]

Terrestrial mines hiding in care and maintenance

In many cases, when mine operators fail to meet rehabilitation requirements, sites go into some form of 'care and maintenance'. Some sites close suddenly because external factors like commodity price changes make a mine unprofitable, but some operators effectively use this as a way of avoiding rehabilitation.[65] This is particularly well documented in Australia[65] where an estimated 75% of mines close prematurely.[68] However, there is often no clear definition or management strategy for care and maintenance sites from regulators. In some jurisdictions, the responsibility for enforcing site management might fall between the government departments responsible for mines and environment. This means sites can remain in this state while departments dispute responsibility.

There is a lack of clarity around the roles and responsibilities of the ISA, sponsoring states and other parties in supervising mining activities and enforcing regulations.[14] This could mean little or no enforcement of any regulations that are developed around post-mining deep sea restoration, considering the lessons above from terrestrial mining.

We could all pay for deep sea restoration through our tax bills

While the ISA recognises that deep sea mining would result in ecosystem destruction, the mechanism proposed to fund the restoration of mined areas is inadequate and falls significantly short of offering a satisfying guarantee that meaningful ecosystem restoration would happen.

Could this be solved by redistributing more deep sea mining revenue towards royalties, to better capitalise the fund? No.

Even if 100% of the revenues generated by deep sea mining companies were allocated to ecosystem restoration (clearly an unrealistic option), it would still not be enough to pay for restoration using artificial nodules. **The cost of restoring deep sea ecosystems after they were mined is so high it is impossible for deep sea mining companies to pay for it and operate at a profit.**

Could governments step in, in a classic case of profits being privatised and 'externalities' picked up by the public? They could, but their pockets would not be deep enough either. For instance, **restoring 30% of the area under a concession for potential deep sea mining** (30% of c1.5 million km^2) would **cost more than the entire global defence budget**[i] - see Figure 12.

[i] Planet Tracker calculations, compared to IISS (2023). Global defence spending – strategic vs economic drivers.

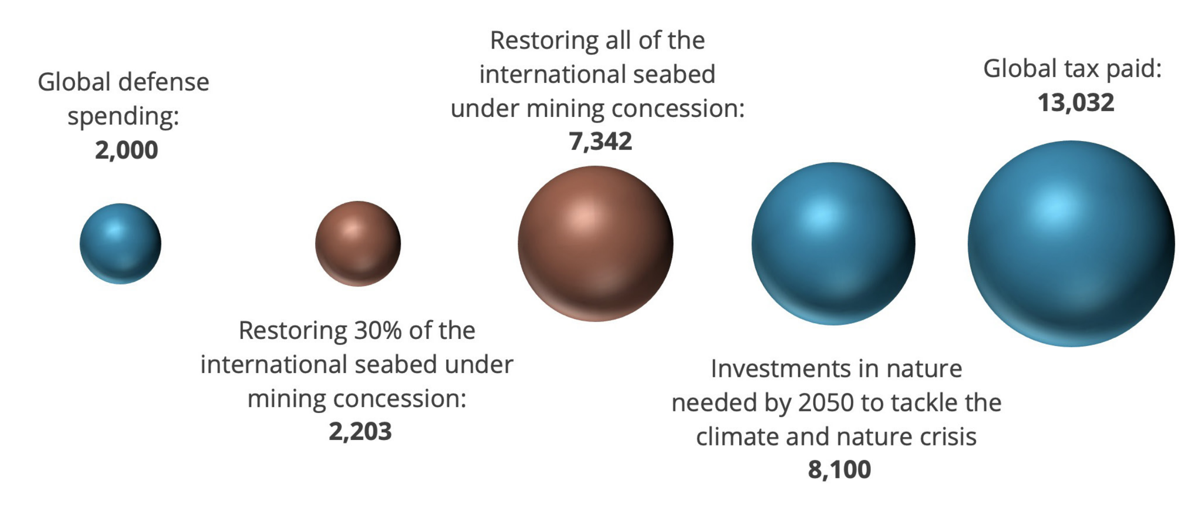


Figure 12: Benchmarking the cost of restoring the international seabed after it was mined (amounts in USD billion). Source: Planet Tracker.

In addition to the very low likelihood of successful restoration, the cost of restoring all the international deep seabed at risk of being mined is so high that **it would require more than half of the tax paid by individuals and companies globally**[j]. This is similar to the total investment needed between 2020 and 2050 to tackle the climate and nature crisis.[69]

Terrestrial mine rehabilitation: forced into government hands

Some terrestrial mine operators avoid paying for rehabilitation or restoration altogether by choosing to forfeit the financial assurance to the state. However, as previously mentioned, the financial assurances required by regulators are not sufficient to cover the real cost of restoration, and these additional costs are left in the hands of the state.

It has been estimated that there are over 10,000 abandoned mines in Canada;[70] over 50,000 abandoned mines in Australia[71] (with an estimated rehabilitation cost of over AUD 1 billion);[72] and over 161,000 abandoned mines in the US.[58] In the US, The Government Accountability Office found that from 1997 to 2008, four federal agencies[k] spent at least USD 2.6 billion of taxpayers money to reclaim abandoned hard rock mines on federal, state, private and Native American lands.[58]

While governments may struggle to meet the cost of mine rehabilitation, in many jurisdictions there is at least some accountability and monitoring of abandoned mine sites. Would the same be true in the case of deep sea mining if operators fail to take care of rehabilitation costs? It is unlikely.

In the unlikely event that governments would pay for the enormous costs of post-mining deep sea ecosystem restoration, **individuals and companies across the world could face significant tax rises**.

To avoid derailing efforts to tackle the climate and biodiversity crises by spending enormous sums of money on the failed restoring deep sea ecosystems, there is an easy solution: **not mining the seabed**.

[j] Planet Tracker calculations, based on World Bank data

[k] The Bureau for Land Management, the Forest Service, EPA and the Office of Surface Mining Reclamation and Enforcement

CONCLUSIONS

This report has found that deep sea mining of polymetallic nodules is likely to cause significant environmental damage on a huge scale and the likelihood of achieving deep sea ecosystem restoration is minimal, while the cost is prohibitively high.

Artificial clay nodules are being investigated for use in the restoration of the deep seabed impacted by mining, with evidence so far indicating a low chance of meaningful ecosystem restoration. We have estimated the total cost of artificial nodule-based deep sea restoration at USD 5.3–5.7 million per km^2 , more than the revenue a typical deep sea mining company would make from mining each km^2. However, this does not include the cost of monitoring restoration progress, which could increase this figure significantly. In addition, the technology for artificial nodule deployment does not yet exist.

It is not clear whether Environmental Compensation Fund put forward by the ISA would fund deep sea ecosystem restoration. There is little evidence that the Fund and current draft restoration regulation has considered best-practice from terrestrial mine restoration cost estimation and regulations. Our analysis also indicates that if the Environmental Compensation Fund did fund ecosystem restoration, it would not be sufficiently capitalized to cover the astronomical costs. This could risk governments footing the bill, as indicated by examples from terrestrial mining.

The current lack of transparency, accountability and clarity around the roles and responsibilities of the ISA, sponsoring states and other parties poses a significant governance risk to the enforcement of post-mining deep sea ecosystem restoration. Opportunities for external scrutiny of both impacts and restoration for deep sea mining would be extremely limited given the current high costs associated with transport and remotely operated vehicles. All of this ignores an important point: restoration should only be undertaken after everything has been done to avoid and minimise negative impacts of deep sea mining, in line with the mitigation hierarchy.

Call to action

Deep sea mining is not aligned with global goals to protect and restore nature and could expose financial institutions to significant policy, regulatory and reputational risks.

Financial institutions should therefore support a moratorium on deep sea mining.

Instead of investing in deep sea mining, financial institutions seeking exposure to a sustainable blue economy could e.g., invest in: seafood traceability[l], greater efficiency of marine protected areas[m], a blue recovery bond to reverse overfishing[n], greater monitoring of fishing fleets[o], sustainable feeds for aquaculture[p], regenerative aquaculture[q], or greater recycling of shipping and fishing vessels[r].

[l] Planet Tracker's report: How to Trace USD 600 Billion.

[m] Planet Tracker's report: Rewarding Conservation Efficiency in Marine Protected Areas.

[n] Planet Tracker's report: Can Blue Bonds Finance a Fish Recovery?

[o] Planet Tracker's report: Bonding with Observers.

[p] Planet Tracker's report: Bonds for Ponds.

[q] Planet Tracker's report: Avoiding Aquafailure.

[r] Planet Tracker's blog: Beached, not Stranded.

APPENDIX 1

A SUMMARY OF LEGAL FRAMEWORKS FOR BIODIVERSITY

Below is a summary of some key international and national legal frameworks for the protection and restoration of biodiversity which relate to marine ecosystems, including those that could be impacted by deep sea mining.

Legally-binding international frameworks

- The Kunming-Montreal Global Biodiversity Framework, adopted by Parties to the CBD in December 2022 commits the global community to restoring degraded ecosystems through clear, measurable goals and targets to address the dangerous loss of biodiversity and safeguarding ecosystem services and functionality, and lead the way to achieving the CBD 2050 Vision of "Living in Harmony with Nature".

Nature restoration at the national and regional level

- The Nature Restoration Law, introduced in June 2022 by the European Commission, would require European Union member states to revive forests, wetlands and other sea- and landscapes marred by human development. If passed, it will require Member States to develop national plans to restore at least 20% of EU land and sea by 2030, and repair all ecosystems in need of restoration by 2050.

- In France, the 'France Nation Verte' initiative details how the concept of ecological planning, promoted by the government. One of its five core goals is the restoration of biodiversity.

- In China, Article XXXII of the 14th Five Year Plan for 2021-2025 states that the country will promote the comprehensive management of ecologically degraded areas and the protection and restoration of ecologically fragile areas.

APPENDIX 2

A SUMMARY OF TERRESTRIAL MINE CLOSURE ESTIMATE TYPES

A summary of terrestrial mine closure estimates adapted from the ICMM's Financial Concepts for Mine Closure.[73]

Table 6: Summary of terrestrial mine closure estimates adapted from the ICMM's Financial Concepts for Mine Closure.[71] Source: ICMM.

Type of mine closure cost estimate	How it is used
Life -of-Asset	• Costs that owners/operators expects to incur at the planned end of the mine's life. • Used internally to estimate the expected total mine closure cost for asset valuation, budgeting and business planning. • Includes cost of preparing for closure (research, trials and progressive reclamation), labour, decommissioning and demolition, post-closure monitoring and relinquishment.
Financial Liability/ Asset Retirement Obligation	• Used to meet public financial reporting requirements to shareholders and stock exchanges based on any legal obligation, liability or compliance as a minimum. • Represents a net present value estimate of closure and reclamation costs of the current disturbed area and mine infrastructure decommissions at the time of reporting (normally annually).
Sudden Closure	• Used internally to evaluate business risk exposure to unforeseen changes in social, physical, political or economic conditions. • Not usually used for regulatory purposes, but some jurisdictions may require a regulatory cost estimate based on assumed unplanned closure at a particular point in time other than the end of mine life.
Regulatory Estimate/ Financial Assurance	• Closure cost estimates required by regulators to establish a financial assurance against sudden unplanned closure. • Financial liability calculated for all phases of the mine lifecycle to exploration to full operation, not discounted by mine asset values. • Based on a third-party, non-government contractor undertaking the work.

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ABOUT PLANET TRACKER

Planet Tracker is a non-profit financial think tank producing analytics and reports to align capital markets with planetary boundaries. Our mission is to create significant and irreversible transformation of global financial activities by 2030. By informing, enabling and mobilising the transformative power of capital markets we aim to deliver a financial system that is fully aligned with a Net Zero, nature-positive economy. Planet Tracker proactively engages with financial institutions to drive change in their investment strategies. We ensure they know exactly what risk is built into their investments and identify opportunities from funding the systems transformations we advocate.

ABOUT THE DEEP SIX PROJECT

This report is the first in a series of six, the 'Deep Six Project', focused on deep sea mining. The goals of the Deep Six Project are to: 1) assess the potential environmental impact of deep sea mining, including in relation to equivalent land-based mining and; 2) for investors to apply six different learnings from the risks and opportunities of deep sea mining to other industries that impact marine ecosystems, focusing on: climate change vs. nature considerations, resource-based valuations vs. natural capital value, restoration potential, circularity, sovereign risk and stranded assets risk.

ACKNOWLEDGEMENTS

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Editor: Dominic Lyle

With thanks to: Bobbi-Jo Dobush, The Ocean Foundation; **Ana Manero**, Crawford School of Public Policy; **Gavin Mudd**, RMIT University; **Torsten Thiele**, Global Ocean Trust; **Adam Weiss**, ClientEarth; **Andy Whitmore**, Deep Sea Mining Campaign; and others that prefer to remain anonymous.

WITH THANKS TO OUR FUNDER

Flotilla FOUNDATION

Suggested citation: Amadi E., Mosnier F., The Sky High Cost of Deep Sea Mining: Planet Tracker (2023).

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