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Seabed minerals in Norway

An analysis of conflicts and sustainability issues

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Cover photo: (NTNU, undated)

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Abstract

The increasing demand for metals for use in renewable technologies and electronics has led to a surge in the interest in the minerals found on the seabed. The demand is driven by the need for green technologies to reach climate goals, population growth, and environmental, social, and economic challenges with today's mining methods on land. Deep-sea mining is an industry still in its infancy, and there is currently no commercial exploitation taking place, but several countries are looking to exploit marine minerals either within their jurisdictional zones or in the Area, the common heritage of mankind. There has been significant opposition to the marine minerals industry due to environmental, social, and legal challenges, which led to several countries signing an international moratorium in the fall of 2021. Norway is one of few countries that voted against the moratorium and has initiated an opening process for deep-sea mining on the Norwegian continental shelf.

This thesis analyzes the drivers and motivations for deep-sea mining, how a marine mineral industry aligns with the United Nations Sustainable Development Goals, why Norway has decided to take a different approach to seabed mining than most other countries, and the sustainability issues raised in the impact assessment program related to the opening process on the Norwegian continental shelf. Questions of sustainability, the Precautionary Principle, risk, and decision-making under uncertainty are considered. The study uses both primary and secondary data. The primary data was collected through three semi-structured interviews. The secondary data used for this thesis were public consultation documents, White Papers, UN reports, and peer-reviewed scientific literature. Based on the analysis, the thesis suggests that ultimately, the society must make choices if we are to succeed with both the transition to a low-carbon emission future and in meeting the needs of a growing population. However, making decisions under uncertainty is challenging, deciding how much risk one is willing to take and how much weight to give precautionary measures. This decision is likely to not rely entirely on scientific knowledge, but also on political interests, social values, and technological development.

Keywords: *deep-sea mining, sustainability, the Precautionary Principle, the Sustainable Development Goals, uncertainty, risk*

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1 Introduction

Advances in technology in recent years have made a large part of the ocean more accessible to humans, which has spurred the commercial interest in the ocean. We are gradually starting to understand the importance of the ocean and how it can help address several environmental, economic, and social challenges both today and in the future. By 2050, the world needs to be able to produce enough food, jobs, raw materials, energy, and economic growth to support an estimated population of 9-10 billion people (OECD, 2016). The ocean is considered a vital tool in meeting these needs, but further exploitation of the ocean is challenging. It is already under pressure from pollution, over-exploitation, deteriorating biodiversity, and climate change. Therefore, it is essential to find a balance between the environmental, economic, and social dimensions of sustainable development concerning the oceans. An increasing number of emerging industries are taking advantage of the oceans' resources, such as offshore wind, offshore aquaculture, and seabed mining. Technological innovation and emerging industries often face skepticism and opposition and are often subject to precautionary measures. Sustainability principles and practices such as the Precautionary Principle, the Polluter Pays Principle, Best Environmental Practice, and Best Available Technology often play a central role in both public debates regarding the establishment of new industries and innovations, but also in the policymaking phase. However, as these principles and practices have relatively wide definitions, they can be interpreted differently. In the case of deep-sea mining, an industry in its infancy, there are sustainability arguments on "both sides" of the debate. Both parts refer to the same sustainability principles. It is thus not a black and white case of environmental conservation on one side and economic growth and profits on the other, as those in approval argue that deep-sea mining is necessary in order to succeed with the shift to a low-emission society and reach our climate goals, while others argue that it will lead to significant and non-reversible harm to the marine ecosystems and the climate.

To make the world more sustainable, renewable technologies have seen an increasing popularity. Electrification of society has increased the demand for minerals such as manganese, lithium, cobalt, copper, silver, zinc, nickel, and rare earth minerals (REE). These metals are used in renewable technologies and electronics, such as in batteries, solar panels, wind turbines, and in the electric infrastructure for power distribution (Haugan et al., 2019). As of today, these metals are extracted through land mining. However, there is currently not enough mining taking place in order to meet the increasing demand for these metals. This could cause challenges with

producing more clean-energy technologies, which could potentially lead to a delay in the shift to a renewable energy society and prevent us from reaching the climate goals (Baker, 2021). Thus, both governments, research institutions, and private companies have been rushing to find solutions that can secure necessary mineral supplies. It has been found that the deep seabed is where we find the greatest reserves of some very important metals (Toro et al., 2020). This has spurred the interest in mining the deep sea, which is generally defined as the ocean floor found at depths of more than 200 meters. However, a key issue is the question of whether deep-sea mining can be conducted in a sustainable and profitable manner, or if it should even be done at all. The High Level Panel for a Sustainable Ocean Economy released a Blue Paper in 2019 (Haugan et al., 2019), which warned about the potential negative consequences of the extraction of seabed minerals. The report (Haugan et al., 2019) also questioned whether deep-sea mining was consistent with the definition of a sustainable marine economy and argued that it might be in conflict with the United Nations Sustainability Goal 12 (*Responsible Consumption and Production*), Goal 13 (*Climate Action*) and Goal 14 (*Life Below Water*). On the other side, it was stated in the report (Haugan et al., 2019) that seabed mining may help to achieve Sustainability Goal 1 (*Reduce Poverty*) and Goal 7 (*Affordable and Clean Energy*), which again could "counter climate change" (Goal 13, *Climate Action*). This conflicting view of deep-sea mining and its role toward achieving the Sustainable Development Goals has caused uncertainty for policymakers on what is the correct path forward.

This thesis aims to explore how Norwegian stakeholders such as the Norwegian government, other public agencies, research institutions, and user and interest organizations position themselves with regard to deep-sea mining and what the main lines of conflict are in the debate. Furthermore, this thesis will look into what role sustainability and associated principles and practices, such as the Precautionary Principle, the Polluter Pays Principle, Best Environmental Practice (BEP), and Best Available Technology (BAT), play in the debate regarding the deep-sea mining in Norway. The reason why these principles and practices are chosen and others such as equity and justice are left out is because they are mentioned frequently in both the global debate regarding deep-sea minerals and in the consultation inputs in the opening process in Norway. Environmental sustainability seems to play a more prominent role in this debate than economic and social sustainability. The thesis will look further into the historical development of the terms *sustainability* and *sustainable development*, associated principles, the central role sustainability plays in today's policymaking, and the relationship between uncertainty and risk.

Later in this thesis, this will be seen in connection with the debate of deep-sea mining, with a primary focus on Norway.

1.1 Research questions and methods

In 2020, the Norwegian government initiated an opening process for mineral activities on the Norwegian Continental Shelf. This decision has faced criticism both internationally and nationally and is a debate filled with sustainability arguments on both sides. Thus, this thesis seeks to understand how various Norwegian stakeholders position themselves with regard to deep-sea mining, what the main controversies are, and what role sustainability plays in the debate.

The research questions are:

- *How do various Norwegian actors position themselves with regard to deep-sea mining?*
- *What are the main lines of conflict around deep-sea mining?*
- *What role do sustainability and associated principles play in the debate about deep-sea minerals in Norway?*

Methods

This study has a qualitative approach. The reason for choosing such an approach is to acquire a more detailed insight into the stakeholders' different perceptions regarding deep-sea mining. The research design of the thesis consists of both theory, primary data, and secondary data. The theory used in this thesis is based on peer-reviewed scientific literature on sustainability and associated principles such as the Precautionary Principle, the Polluter Pays Principle, Best Environmental Practice and Best Available Technology, Blue Growth, and the relationship between risk and uncertainty. The primary data was collected through three semi-structured interviews, and the secondary data used for this thesis were public consultation documents, White Papers, UN reports, and peer-reviewed scientific literature.

Document analysis

In order to answer the three research questions, a thorough analysis of the 53 consultation inputs to the program proposal for the impact assessment sat out by the Ministry of Petroleum and Energy was conducted. I decided to analyze of the consultation inputs because it gives an overview of the various perspectives and approaches different Norwegian stakeholders have to the industry of deep-sea mining and the opening process on the Norwegian continental shelf. Instead of selecting only a few inputs, I decided to analyze all of the consultation inputs to get

a broader overview. I started off by dividing the various stakeholders into groups based on what type of organization they are. This way of grouping the actors were based mainly on the Ministry of Petroleum and Energy's division of the stakeholders. However, as they did not group all of them, I decided to place the remaining actors where I felt they fit. The groups I divided them into were:

Table 1.1 Overview of the different stakeholders that made a consultation input to the program proposal

Ministry	**Other public agency**
- The Ministry of Climate and Environment - The Ministry of Transports - The Ministry of Foreign Affairs (*without remarks*) - The Ministry of Agriculture and Food (*without remarks*) - The Ministry of Health and Care Services (*without remarks*) - The Ministry of Justice and Public Security (*without remarks*) - The Ministry of Education and Research (*without remarks*)	- The Norwegian Maritime Authority - Norwegian Biodiversity Information Centre - The Norwegian Mapping Authority - Norway's National Geological Survey - The Norwegian Water Resources and Energy Directorate - The Norwegian Coastal Administration - The Petroleum Safety Authority Norway (PSA) - The Governor of Svalbard - The Directorate of Mining with the Commissioner of Mines at Svalbard - The Norwegian Meteorological Institute - The Norwegian Environment Agency - The Directorate for Radiation Protection and Nuclear Safety (DSA) - The Norwegian Directorate for Cultural Heritage - The Norwegian Directorate of Fisheries
County municipality	**Commercial actors**
- Nordland County Municipality - Møre og Romsdal County Municipality - Kristiansund Municipality	- Adepth Minerals - Allsite Geo AS - Equinor - MHWirth AS

User and interest organization, clusters and employee/employer organizations	**Research and educational institutions**
- Norwegian Forum for Marine Minerals (NMM) - The Norwegian Shipowners' Association - The Norwegian Mineral Industry - Petro Arctic - GCE NODE - GCE Ocean Technology - Nordic Ocean Resources - The Norwegian Confederation of Trade Unions (LO Norway) - The Federation of Norwegian Industries - Norwegian Oil and Gas - Industri Energi - Norwegian Energy Partners - The Future in Our Hands, Greenpeace, Nature and Youth, Friends of the Earth Norway, Sabima and WWF - The Norwegian Fishermen's Association - The Pelagic Association - Fiskebåt	- Norwegian University of Science and Technology (NTNU) - The University of Stavanger - The Institute of Marine Research (IMR) - The Norwegian Polar Institute - NORCE Norwegian Research Centre - Norwegian Institute for Water Research (NIVA) - Centre for Deep Sea Research and the Department of Biological Sciences (BIO), University of Bergen
Private person	**Other**
- Arunima Sen (Nord University)	- Statistics Norway (*without remarks*)

The reason for dividing them into these groups was to easier see whether the actors from the same groups shared opinions regarding the program proposal, as well as what their main arguments were. These were later grouped into "*Positive*", "*Neutral*" or "*Negative/critical*", depending on their approach to the industry of deep-sea mining and the program proposal. As seen in Table 1.1 above, the consultation inputs came from a wide range of actors such as private companies, directorates, departments, research institutions and universities.

Interviews

The reason for conducting interviews in addition to the document analysis was to gain a better understanding of the stakeholders' thoughts and reasoning for how they have positioned themselves with regard to deep-sea mining. As this thesis seeks to gain an understanding of the various attitudes and perceptions of Norwegian actors towards the industry of deep-sea mining and the opening process on the Norwegian continental shelf, the population of interest was individuals who are working for companies/organizations that are involved in the public debate of the opening process. The selection of interviewees was based on a non-probability selection, and the interviewees were chosen based on their level of involvement in the public consultation process and public debate of deep-sea mining in Norway. The stakeholders I decided to interview were the Institute of Marine Research (IMR), Adepth Minerals and the Norwegian Petroleum Directorate (NPD). The IMR is one of the largest marine research institutions in Europe and their main activities are research, advisory work, and monitoring. The IMR is a subordinate to the Ministry of Trade, Industry and Fisheries, and they have been responsible for carrying out one out of six basic reports (about the pelagic ecosystem) that constitutes an important knowledge base for the opening process. Adepth Minerals is a commercial actor built to conduct sustainable exploration and extraction of deep-sea minerals. The NPD was established in 1972 and is an administrative body and a governmental specialist directorate. They report to the Ministry of Petroleum and Energy and hold the responsibility of surveying commercially interesting deposits of minerals on the continental shelf and assess the resource potential. The reason for only selecting three Norwegian actors for the interviews was because I felt that I had gained a solid insight into what various Norwegian stakeholders thought about the opening process and the industry of deep-sea mining through the consultation inputs.

The representatives from both the IMR, the NPD and Adepth Minerals were all contacted through e-mail, and the interviews took place on Microsoft Teams within a few weeks. The interviewees all received an interview guide and an information letter with declaration of consent in advance. The reason for giving out the interview questions beforehand was to let them prepare better and thus hopefully get more detailed answers. The information letter contained information about the thesis, what the material and the personal data would be used for and how it would be stored. The interviews were recorded via the UiO Diktafon App and a mobile device belonging to the University of Tromsø. Thus, everything has been conducted in accordance with the guidelines of the Norwegian Centre for Research Data (NSD).

The interviews were semi-structured in-depth interviews. This type of interview method is based on prepared questions, and it allows to ask follow-up questions. It also gives the interview participants the chance to speak rather freely (Denzin & Lincoln, 2011). Before the interview started, I told the interviewees that if there were any questions they did not wish to answer or felt like they could not answer well, it was possible to skip those questions. This way of conducting the interviews worked well, as it helped me to stay on track and cover the questions I wanted answers to. Furthermore, in this way the interviewee did not feel pressured to answer questions he/she did not want to. The interviews were recorded, which allowed me to give my full attention to the interview subjects and the answers they gave. Conducting the interviews was a nice experience, and the informants seemed interested, gave lengthy and insightful answers, were well prepared and friendly.

The research questions in this thesis are about exploring the different perceptions of Norwegian actors with regard to deep-sea mining, what the main line of conflicts are and what role sustainability and associated principles play in the debate. The interview questions were therefore formed to give more detailed explanations to these questions. The interview questions were also adjusted to reflect each of the actor's consultation inputs to the program proposal for the impact assessment, in addition to other statements they made in the media or on their own websites. The interview questions can be found in Appendix 1, Appendix 2 and Appendix 3. The names of the interviewees will not be used in the thesis, but rather referred to as 'a representative from X'. The interviews lasted between 30 to 40 minutes.

Analysis of the data

The length of the consultation inputs ranged from 1 to 27 pages, and it thus seemed time-consuming to write down each of the 53 stakeholders' arguments. Therefore, I decided to firstly colour code the various arguments in the consultation inputs, which means that if two or more stakeholders came up with the same arguments, then these were highlighted in the same colour. When this was done, I could clearly see what comments that recurred, which gave an indication of what the main lines of conflicts could be. The most recurring arguments where written down, as well as which stakeholders that had made these comments.

The interviews were transcribed within 1-2 days after they had been conducted. This was done in order to code the interviews in a similar way as with the consultation inputs, i.e., the interviewees were asked what they perceive to be the main lines of conflicts, and their answers would then be coded in the same colours as for the consultation inputs. This was done in order

to link the consultation inputs with the interviews and to easier draw lines between the two types of data collection methods.

1.2 Limitations and challenges

There are also limitations and challenges that should be addressed. The first research question deals with how different Norwegian stakeholders position themselves in the debate of deep-sea mining in Norway. I have interpreted the position the stakeholders have taken based on their consultation input to the program proposal by the Ministry of Petroleum and Energy. Some of the inputs contained information that made it difficult to establish whether they were positive or negative/critical to the program proposal and a marine minerals industry. These were thus put in the "*Neutral*" group. It is also important to emphasize that the groupings are made from my point of view and from how I interpreted the consultation inputs. Others may have grouped these differently.

I made the decision to only interview three stakeholders, and one of the consequences of doing so is that the data acquired cannot be generalized in the same way as if I had interviewed more stakeholders. Due to the few interviewees, they had to be carefully selected, and thus, I had to read through the consultation inputs thoroughly before I made the decision to interview the Institute of Marine Research, the Norwegian Petroleum Directorate and Adepth Minerals. The reason for choosing the Norwegian Petroleum Directorate instead of the Ministry of Petroleum and Energy and was because they were in charge of undertaking the professional review of the consultation inputs, and I believed that they were therefore a better fit for the questions that I had prepared. The representative from the Norwegian Petroleum Directorate gave detailed answers to the interview questions, but mentioned several times that the question should be addressed to the Ministry of Petroleum and Energy rather than the Norwegian Petroleum Directorate. I could have reached out to the Ministry, but due to limited time for this thesis, I did not manage to include another interview in my research. However, this could have given some additional insights into why the Norwegian government has decided to take a different approach to the industry of deep-sea mining than most other countries. Apart from that, I am content with the data collected from the interviews as they added insights on how knowledge acquisition related to the opening process should be collected and how the Precautionary Principle can be interpreted in different ways, which became a central element of the results and the discussion of this thesis. The interviews thus gave a valuable contribution to the thesis.

1.3 The structure of the thesis

The next chapter will cover the theoretical framework for the thesis, while Chapter 3 contains various aspects of the industry of deep-sea mining, such as the legal and institutional framework for marine minerals, the drivers and the controversies that are unfolding. An additional focus is placed on how the Norwegian government facilitates for a marine minerals industry in Norway through the Subsea Minerals Act and the launch of an opening process on the Norwegian Continental Shelf. The main findings are presented in Chapter 4, and further discussed in Chapter 5, where the findings are seen in connection with the theoretical framework. Lastly, Chapter 6 provides a summary and a reflection of the main findings of the thesis.

2 Theoretical Framework

2.1 Sustainability – historical development

'*Sustainability*' as a term was first used in German forestry circles in 1713 in *Sylvicultura Oeconomica* by Hans Carl von Carlowitz (Du Pisani, 2006). He proposed sustainable use (*nachhaltende Nutzung*) of forest resources and the importance of balancing the harvest of old trees and safeguarding enough young trees to replace the old ones. Later in the 18th century, concerns about population growth related to resource consumption started to appear. In 1798, Thomas Robert Malthus published the "*Essay on the principle of population as it affects the future improvement of society,*" where he argued that the population growth had to be restricted as it threatened to exceed the food production. After this, human impact on nature and overexploitation of natural resources has been a recurring theme (Du Pisani, 2006). In 1972, the same year as the Roma Club published the report "*The Limits to Growth,*" the UN Conference on the Human Environment was held in Stockholm. The Stockholm Declaration made environmental issues a major international subject.

The term '*sustainable development'* was first used in the International Union for the Conservation of Nature's "*World Conservation Strategy*" in 1980. Then, in 1987, the World Commission of Environment and Development (WCED), also known as the Brundtland Commission, submitted their report "*Our Common Future,*" containing long-term environmental strategies for the global society to the United Nations. The report focused principally on human interests and needs and how to assure global justice for the next generations by reallocating society's resources to the more impoverished nations in order to support their economic growth and ensure the coverage of basic needs for everyone (Du Pisani, 2006). The Brundtland Report defined sustainable development as:

> *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."*
>
> (WCED, 1987)

The report further described the term with three co-equal elements, thus environment, economy, and equity. The authors argued that sustainable development could only be accomplished by upholding economic growth and development, protect the environment, and promote equity simultaneously (WCED, 1987). The realization of one of the three elements neither can nor

should be accomplished by sacrificing one of the other. That is to say, the idea of sustainability as a policy discards the notion that there is essentially a tradeoff between e.g., environmental protection and economic growth, or equity and economic growth. The only way to achieve sustainable development is when environmental protection, economic growth, and equity coincide. Thus, sustainability initiatives are not, in its original notion, actually anti-growth, it is more about finding a balanced "*state so that the earth can support the human population and economic growth without ultimately threatening the health of humans, animals or plants*" (WCED, 1987).

Sustainability is about the perseverance of resources throughout generations, which means that as a government, a corporation or a private person, one must continuously consider whether one's activities and behaviours will help to achieve all three dimensions of sustainability, namely economic, environmental and social (Purvis et al., 2018). The three pillars are interlinked and are often portrayed through two different models. One of them is in the shape of an interconnecting circle/Venn diagram where the three pillars overlap each other and holds equal importance to achieving sustainable development (*Figure 2.1*). The other is a hierarchical pyramid where environmental sustainability holds the fundamental importance and is considered a precondition for social and economic sustainability (*Figure 2.2*). There is also a relationship of dependency between the social and the economic pillar, where the former mentioned lays the basis for the latter to be achieved.

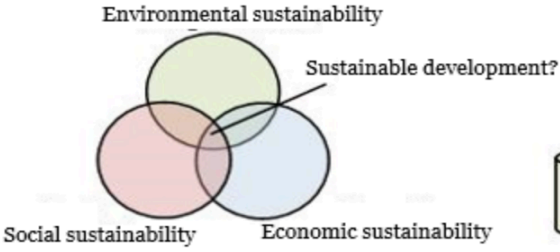

Figure 2.1 Venn diagram portraying the link between environmental, social and economic sustainability (KTH Royal Institute of Technology, 2021)

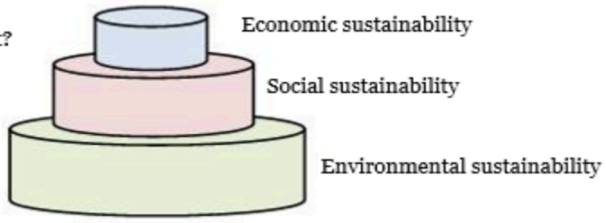

Figure 2.2 Hierarchical pyramid of the three sustainability pillars (KTH Royal Institute of Technology, 2021)

Based on the report that the Brundtland Commission released in 1987, sustainable development was put on the agenda of the Earth Summit in Rio de Janeiro in 1992. Then, in 2000, the Millennium Development Goals (MDGs) were adopted, with the main goal of reducing extreme poverty within 2015. The follow-up of the MDGs confirmed the global commitment to eradicate hunger and poverty, and for the first time, this goal seemed achievable (Meld. St. 40.

2020-2021). Then, in 2012, at the UN Conference on Sustainable Development in Rio de Janeiro, the Member States launched a process of developing the Sustainable Development Goals based on the MDGs. This was seen as the starting point for a comprehensive involvement process, and millions of voices from around the world gave input to the negotiations on the 2030 agenda, which eventually resulted in the 2030 Agenda for Sustainable Development, launched at the UN Sustainable Development Summit in September 2015. The agenda consisted of 17 SDGs, ranging from achieving good health and wellbeing, zero hunger, and no poverty to conserving the oceans and ensuring sustainable cities and communities. It also emphasizes that the SDGs cannot be achieved one by one in isolation, as the goals are mutually dependent. Several other large agreements took place in 2015, such as the Paris Agreement on Climate Change, the action plan from the Addis Ababa Summit for Financing for Development, and the Sendai Framework for Disaster Prevention.

Each Member State has a responsibility to work toward the SDGs, but the European Commission implemented a binding framework for EU countries through the launch of the EU Green Deal in December 2019. The deal is the European Commission's strategy to implement the UN's 2030 Agenda and reach the SDGs. The overarching objective is to make Europe the first climate-neutral continent by 2050 with improved protection of health and environment, increased life quality, less pollution, safe and clean food and energy, healthy ecosystems, and conservation of biological diversity (Miljødirektoratet, 2021). The deal is a comprehensive strategy that seeks to solve climate and environmental challenges across policy areas, and the idea is that a green transition will give European industry and business a competitive advantage and help to create new and green jobs (Schjødt, 2021; Miljødirektoratet, 2021). Various instruments are being used in order to accomplish the objectives, such as policy and regulatory development, investments, research, innovation, standardization, supervision, and monitoring (The European Commission, undated; Miljødirektoratet, 2021). The deal sees climate, business policy, and innovation as a whole and recognizes that we can only solve the climate challenge by cooperating with and setting requirements for the business community (Melandsø, 2021; Schjødt, 2021). The EU will fund both research and innovation that are able to build green technology.

Norway is not part of the European Union (EU), but part of the European Economic Area (EEA) and will thus still be affected by the changes in the framework conditions of the Green Deal. New legal acts will include several regulatory changes and new requirements for standardization, which will have an effect on a great number of sectors, markets, and

technologies. A majority of these regulatory changes will be incorporated into Norwegian law through the EEA Agreement (Melandsø, 2021). A significant part of the EU's programs and budgets will be geared towards the Green Deal, and there will therefore be specific guidelines for both funding and investments in areas such as infrastructure, research and innovation. Making regulatory and financing changes in the system means that many companies will have to reconsider investment plans, modify their business strategies, clean up supply chains, and increase their level of transparency (Melandsø, 2021).

Even though all member states are working towards the 17 SDGs, it has been emphasized that each country needs to adapt the goals to its own level of development and economy. Norway has thus released its own action plan on how to reach the SDGs by 2030. The plan is called *Mål med mening: Hvordan Norge skal nå bærekraftsmålene* (St.Meld.40. 2020-2021). The plan takes on how Norway is contributing to the 17 SDGs. The 2030 agenda emphasizes that a sustainable society presupposes economic growth and value creation, and therefore, the Norwegian Government's main strategies for achieving the SDGs by 2030 are to create more jobs, involve more citizens in the working life, and ensure economic growth in the coming years (St.Meld.40. 2020-2021). By seeing the potential in thinking sustainably, an increasing number of companies are now basing their business strategies, investments, and day-to-day working life on the sustainability goals (Schjødt, 2021; Melandsø, 2021). The Norwegian Government aims to facilitate a market in which it pays to think sustainably and plans to do so by setting both regulations and requirements that can safeguard sustainable development, as well as foster green and sustainable solutions.

2.2 Blue Economy / Blue Growth

Advances in technology in the past decades have made most parts of the ocean accessible, which has led to an increased commercial interest in the ocean. The ocean covers more than two-thirds of the Earth's surface and has thus become a new economic frontier (Jouffray et al., 2019). Governance of marine resource use is increasingly facilitated around the rather new term and concept, "*Blue Growth.*" The rhetoric of a blue economy that would combine economic growth with sustainable use is increasingly finding its way into national and international policy documents. However, there have been raised concerns over conflicting interpretations of what the term '*Blue Economy'* and '*Blue Growth'* actually entail, which has led to different actors interpreting the terms to fit their viewpoints (Brent et al., 2020).

The United Nations has offered a general definition of a '*Blue Economy'* as "*an ocean economy that aims at the improvement of human well-being and social equity, while significantly reducing environmental risks and ecological scarcities*" (United Nations, 2014). The definition is wide and has led to different stakeholders favouring particular interpretations of the definition to best meet their own purposes. The term Blue Economy "sits in two competing ways" – opportunities of economic growth and development, and vulnerable and threatened species and habitats needing protection. Naturally, these different preferences and interests lead to potential problems and conflicts (Lee et al., 2020).

The UN SDGs highlight the importance of balancing the environmental, social, and economic dimensions of sustainable development concerning the oceans. This key component of the Blue Economy is that the economic development needs to be both environmentally sound and socially inclusive. The UN has declared 2021 to 2030 as the '*Decade of Ocean Science for Sustainable Development.*' The aim is to encourage and support the work towards improved ocean health and congregate a common framework for all ocean stakeholders, and improve the knowledge about the ocean so that countries have the best possible scientific support when trying to balance the three dimensions of sustainable development (United Nations, 2014; Lee et al., 2020). However, it has been difficult to link 'Blue Economy' to the SDGs when there are potential conflicts between industries and countries, e.g., fossil fuel-based carbon emission reductions and energy provision, or protecting the deep-sea ecosystem and the need for minerals in renewable technologies (Lee et al., 2020). The term thus poses some important conflicts of interest.

2.3 Practices and principles

Sustainability has become a common norm and rule of action that everyone must follow. It has been increasingly incorporated into governmental and corporate strategies, and the everyday person is also trying to reduce their environmental footprint. Sustainability is on everyone's agenda and has laid the foundation for many decisions regarding new infrastructure, financing, emerging industries, food, etc. However, sustainability, in similarity to blue growth and blue economy, is a vague concept that allows for many different interpretations, which has led to different stakeholders favouring particular interpretations of the definition to best meet their own purposes (Weingart, 1999). It has therefore become difficult to state what exactly is the correct interpretation in different situations, and in many debates, e.g., the one of deep-sea

mining, there are sustainability arguments on both sides. It is therefore no longer that simple to make a decision based on sustainability.

Decisions must often be taken under some level of uncertainty, and ever since sustainable development was first put on the agenda, policymakers have used concepts such as the Precautionary Principle, the Polluter Pays Principle, Best Available Technology (BAT), and Best Environmental Practice (BEP) as a foundation for decision-making regarding the protection of both the environment and human health (van Asselt & Vos, 2006).

2.3.1 The Precautionary Principle

The Precautionary Principle has often been used in situations of uncertainty were taking a particular course of action could potentially cause harm, and there is a lack of conclusive evidence (Dovers & Handmer, 1995; Balzacq, 2015). The principle also works as a "*reversal of the burden of proof*" (van Dyke & Broder, 2015) as those wanting to conduct possible harmful actions need to demonstrate that the type of activity will not cause any harm, instead of the other side having to show scientific evidence that it does cause harm (van Dyke and Broder, 2015). It also emphasizes the importance of exploring alternative technologies and options. The Precautionary Principle is closely linked to sustainable development, as both focus on the importance of meeting current needs without compromising future generations to meet theirs. The principle is enshrined in international environmental agreements and legislations. It was first introduced in German national environmental law in the 1970s and 80s (McIntyre & Mosedale, 1997), and the *Vorsorgeprinzip* was implemented to justify regulatory interference to constrain what could be possibly detrimental discharges into the marine environment even without evidence of environmental harm (Knol, 2011). The principle has become a common instrument in environmental policies to tackle uncertainty, and there are various definitions and versions that have been used, but one of the most common formulations of the principle is in the Principle 15 of the 1992 Rio Declaration: "*Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.*" The more common understanding of this definition is that in situations of scientific uncertainty, it is the environment that gets the benefit of the doubt (Knol, 2011). The approach is based on an understanding of the vulnerability of the environment and the limitations of science in terms of accurately predicting potential threats to the environment (McIntyre & Mosedale, 1997).

There is a general agreement that uncertainty and risk are core concepts in the Precautionary Principle, and that the principle should thus help to address uncertain risks (van Asselt & Vos, 2006). De Sadeeler (1999) defines uncertain risks as situations with "*serious suspicions of danger, although scientific evidence is lacking.*" Nowotny et al. (2001) argue that innovations e.g., new ideas, products, and concepts, cause uncertainty and thus also uncertain risks. Innovations challenge and change already conventional ways of doing things, and thus, uncertainty is produced through change (van Asselt & Vos, 2006). Uncertain risks may result in effects that are considered negative or even unacceptable by one or more actors of the society. Human intervention in the environment is a typical example of a situation involving uncertain risks, as there are uncertainties regarding the complex multi-causal relationships in an ecosystem (McIntyre & Mosedale, 1997; van Asselt & Vos, 2006). Uncertainty can be reduced through research and monitoring, but more knowledge does not necessarily lead to less uncertainty. New knowledge can sometimes increase the level of uncertainty as it may pinpoint a presence of uncertainties that were unknown before or perhaps underestimated (van Asselt & Vos, 2006). New information can make us realise that the deep-water ecosystem was more complex than originally thought, or our understanding was more inadequate than initially thought.

The Precautionary Principle has received a fair amount of criticism. Even though the principle is applied in marine policies for various activities, e.g., shipping and fisheries, there is a lack of operational standards or guidelines that can be followed in order to implement the principle (Knol, 2011). Initially, the principle was intended to be limited to specific activities and situations that could pose high risks to the environment (McIntyre & Mosedale, 1997), but as the principle has been implemented in various international agreements together with its wide formulation in the Rio Declaration, it has turned into a general guiding principle for protection of the environment. As a result of this, the principle has appeared in many different forms and has become a principle open for interpretation. Its means of application is therefore perceived as challenging. Giddens (2000) argues that it has become increasingly more difficult with time to calculate risk in human actions in the nature. This increasing difficulty with calculating risk and the rapid development of new technologies have made it even more important to embrace the Precautionary Principle than before (Welsh & Ervin, 2006). Nevertheless, Giddens (2000) claims that the principle is too '*extreme and counterproductive*' as it might restrain new and desirable innovation. Similarly, Wildavsky (2000) argues that the Precautionary Principle is an "*anathema to technology development and the process of social learning*", because if regulatory

groups prevent the commercialization of innovative technologies because of possible, but yet undocumented, harm to the environment, they cut short the learning process through the trial-and-error method. He further questions if we are to reject anything that is not risk-free and what effects these reductions in innovation will have on society (Welsh & Ervin, 2006). Furthermore, Wildavsky (2000) argues that throughout history, safe technologies have been developed through the process of introducing new technologies and techniques that has made it possible to make necessary adjustments along the way (Welsh & Ervin, 2006). Wildavsky (2000) ends by stating that the "*Precautionary Principle will essentially cause more harm to the society because it restrains the process of developing safe technologies through the process of trial and error.*"

2.3.2 The Polluter Pays Principle

The Polluter Pays Principle is another fundamental concept in environmental law. The principle was first introduced in 1972 by The Organisation for Economic Co-operation and Development (OECD) and was announced as one of several 'guiding principles' that concerned the economic features of environmental policies (Lindhout & van den Broek, 2014). The idea of the principle is that those who "cause the pollution" are the ones who should pay for the harm that they impose on others. This is also known as the internalization of external costs, which can take the shape of e.g., emission allowances (cap and trade), taxes, and command or control measures. The latter mentioned can be installation of avoidance and abatement devices, restrictions related to levels of activity, or prohibitions (Schmidtchen et al., 2020). The intention behind the principle is to incentivize actors to reduce pollution and produce new and more sustainable products and technologies (Lindhout & van den Broek, 2014). The principle takes place in various jurisdictions and exists in Principle 16 in the Rio Declaration on Environment and Development (1992) and Article 191(2) of the Treaty of the Functioning of the European Union. It has become a foundation of EU environmental policy and is included in the Single European Act and referred to in several European Directives.

The principle's core is simple to understand, but in similarity to the Precautionary Principle, there are difficulties with applying it in practice (Lindhout & van den Broek, 2014). Pollution is considered to be harmful, but it is not generally prohibited. Most often, pollution is a negative side-effect of an otherwise valuable and anticipated activity, as someone often depends on this activity in terms of employment and income or needs the products/services that it provides (Bugge, 2009, p. 415). Preventing pollution can be costly, which can lead to e.g., closing of the

activity, ending with many people losing their jobs and thus their income. It can be difficult to state whether the consequences are just. One rather common example of this is a factory that forms the economic foundation of a local community (Bugge, 2009, p. 415). The families' livelihood is dependent on the factory as this is where their salary comes from. The factory emits substances that contribute to both local and global pollution, and in order to reduce the national emission reduction targets, the factory needs to reduce their emissions. However, pollution prevention is costly, and the factory cannot afford to reduce it and thus have to close down and lay off all workers. This has serious social consequences for most families in the small community, and it is thus questionable whether it is fair that it is the local community that has to bear such a burden. Simultaneously, it is important to reduce both local and global pollution. A possible solution here would be that the authorities cover a large part of the pollution prevention costs or give the factory an exception from the restriction.

2.3.3 Best Available Technologies (BAT) and Best Environmental Practice (BEP)

Other central sustainability practices are Best Available Technologies (BAT) and Best Environmental Practice (BEP). A rising number of countries are applying both the BAT and the BEP in efforts to prevent marine pollution (OSPAR Commission, 2022). BAT is used as an instrument to form "*evidence-based environmental permit conditions for industrial installations"* (OECD, 2022) and typically means to take use of the most recent developments within technology, either in the form of facilities, processes, or methods of operation, that are most suitable for limiting emissions, waste, and discharges (OSPAR Commission, 2022). When talking about Best Environmental Practice, we refer to the use of the most suitable combination of plans that consider the criteria established by a specific regulator and environmental control measures, thus the most generally accepted standards of both environmental and risk management (Gerber & Grogan, 2020). It is, however, challenging to conceptualize these operational practices in a new, emerging industry because of the high levels of uncertainty related to what the best methods for operation are, the effects of various technological solutions on the environment, and the regulatory framework (Gerber & Grogan, 2020).

2.3.4 Dealing with risk and uncertainty

Both the Precautionary Principle, the Polluter Pays Principle, Best Available Technologies, and Best Environmental Practice are considered guiding principles and practices in policymaking. Policymakers often need to make decisions under high levels of uncertainty, and it has become rather common to lean on these principles and practices when managing uncertainty. However,

as there are different types of uncertainty, it is important to be aware of what type of uncertainty that must be dealt with in a given situation. Generally, uncertainty can be defined as "*limited knowledge about the future, past, or current events*" (Walker et al., 2013). Knight (1921) emphasized the importance of making a distinction between uncertainty and risk. He defined risk as something calculable and thus also the controllable part of the unknowable. The residual part, what Knight calls *uncertainty*, is both incalculable and uncontrollable. It is essential to distinguish between the two and to keep in mind that with respect to policymaking, the level of uncertainty often involves subjectivity. The extent of uncertainty is related to approval of the current level of knowledge, which again is related to the perspectives and values of the policymaker (Walker et al., 2013).

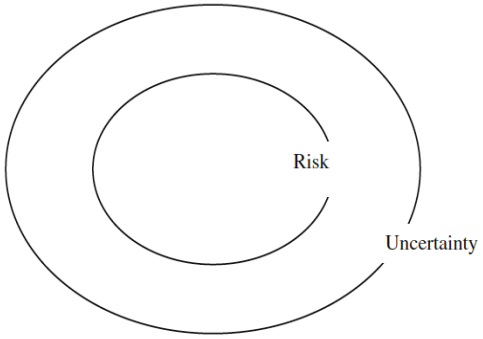

Figure 2.3 Risk and uncertainty (Walker et al., 2013)

However, relying on these principles and practices can be difficult when stakeholders with different views on an activity both use sustainability arguments and refer to the SDGs. The case of deep-sea mining is such a case. There is a significant debate on whether or not this type of mining is in line with sustainable development and the Precautionary Principle. There are different ways in which the Precautionary Principle can be interpreted in deep-sea mining, and it is important to achieve more clarity about these different possible interpretations. In the next section of the thesis, the industry of deep-sea mining will be introduced. The next chapter focuses on what deep-sea mining is, the legal and institutional framework both in international waters and in Norway, as well as the main arguments in the debate that is now unfolding.

3 Deep-sea mining

3.1 Marine minerals

When referring to marine minerals, we distinguish between polymetallic nodules, ferromanganese crusts, and seafloor massive sulphide deposits. Polymetallic nodules mostly consist of manganese and iron hydroxides (Cuyvers et al., 2018), but also nickel, cobalt, and copper. It also consists of smaller amounts of rare earth elements (REE), lithium, and molybdenum. They can be found at all depths and over large areas in all oceans, but is most common between 4000-6000 meters, where they are found buried in sediments and appear like round rocks (Cuyvers et al., 2018). Polymetallic crusts, also known as ferromanganese crusts, contain large amounts of manganese, iron hydroxides, cobalt, nickel, and copper, as well as smaller traces of REE and other metals. These crusts are found at depths between 400 and 7000 meters through all oceans, and form on the summits and slopes of ridges, seamounts, and plateaus (Miller et al., 2018; Cuyvers et al., 2018). The third type of marine minerals, seafloor massive sulphides (SMS), consists of zinc, copper, lead, arsenic, cobalt, gold, silver, and smaller concentrations of other metals. SMS are normally found between 800 and 5000 meters around oceanic ridges, in association with island arc systems and volcanic island sites.

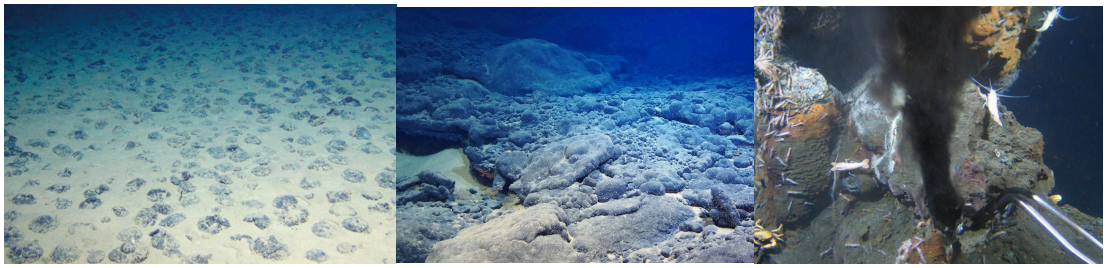

Figure 3.1 Types of mineral deposits: From left; polymetallic nodules, polymetallic crusts and seafloor massive sulphides (Miller et al., 2018)

3.2 Deep-sea mining

Deep-sea mining is the activity of retrieving deposits of minerals from the ocean floor in the deep sea (Cuyvers et al., 2018). Deep-sea mining is also often referred to as seabed mining, deep seabed mining, or extraction of minerals from the deep sea, and these will be used interchangeably in this thesis. The process consists of two phases, exploration and exploitation. Exploration is the first part of the process and is the procedure of searching for the resources and involves techniques for locating deposits of minerals. The exploitation phase involves the

process of extracting the minerals. There has been no large-scale exploitation on the deep seabed yet (Cuyvers et al., 2018; Hallgren & Hansson, 2021; Miller et al., 2018).

The great depths combined with great environmental conditions present challenges for the mining operations. Thus, deep-sea mining is conducted using remote technology. As mentioned previously, there are three types of marine minerals, and the mining process varies slightly depending on the type of marine mineral that is being targeted. The processes are based on the concept of using a seabed resource collector, a lifting system, usually in the form of an air pump, and support vessels on the water surface (Miller et al., 2018). This can be seen in Figure 3.2 below.

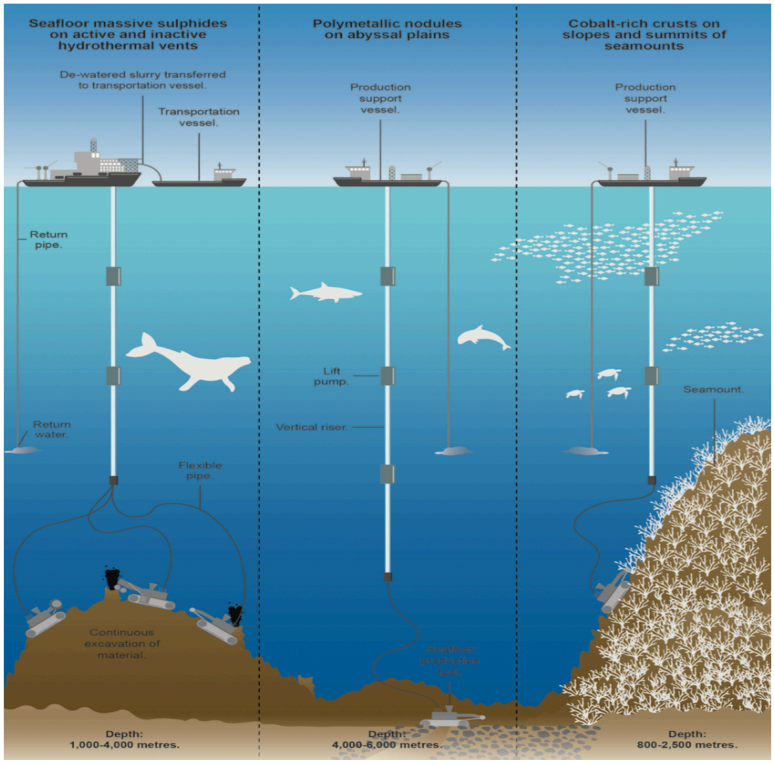

Figure 3.2 Processes for the main types of deep-sea mineral deposits (Miller et al., 2018)

3.3 The International Governance Regime

The legal framework governing activity in the ocean depends on the distance from land. According to the 1982 United Nations Convention on the Law of the Sea (UNCLOS), a coastal state's territorial sea stretches to 12 nautical miles from its coastline, including the water body to the seabed, the air space, and the subsoil. All coastal nations hold the right to exploit the water column and the seabed within its Exclusive Economic Zone (EEZ), thus from its baseline out to 200 nautical miles. Some coastal states have an "extended" continental shelf (ECS) that

extends further than the EEZ (out to 350 nm), in which they hold sovereign rights of the seabed and its resources, but not above the water column (*Figure 3.3)*

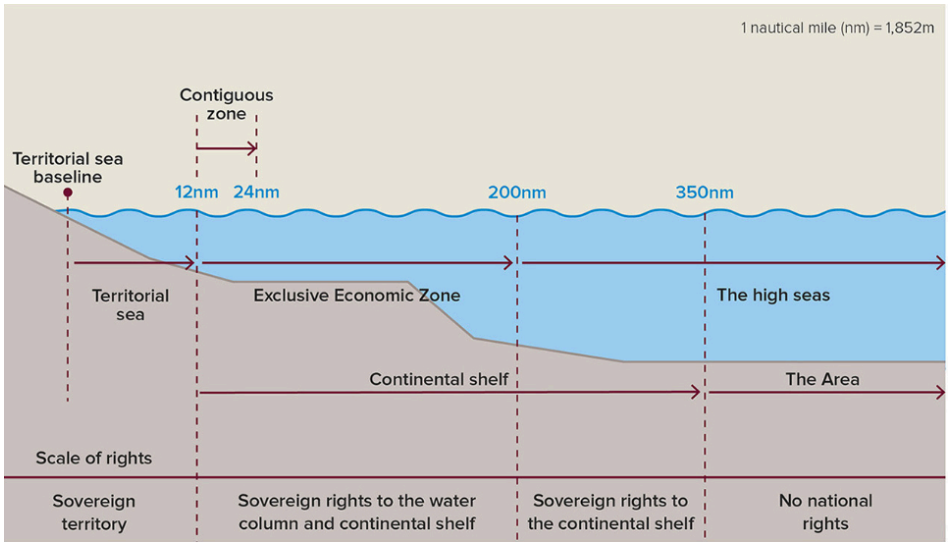

Figure 3.3 Jurisdictional zones from a nation's coast (Millet et al., 2018)

In the Area, the sea outside of national jurisdiction, it is the International Seabed Authority (ISA) that is the responsible body for governance and regulation. The ISA was recognized as the governing body under the United Nations Convention on the Law of the Sea (UNCLOS) in 1982, and has the conclusive authority on all cases concerning the governance of the deep-sea (Miller et al., 2018) This could be regarding reviews of environmental impact assessments (EIA), exploration and exploitation licenses, and safeguarding satisfactory monitoring of all activities related to mining in the Area. According to UNCLOS Article 136, "*the Area and its resources are the common heritage of mankind*", and is not subject to direct claims by sovereign states (Wedding et al., 2015). If any member state causes damage to the seabed or the marine biodiversity, the ISA can limit withdrawal rights according to Article 75, the Rules of Procedure of the ISA Council.

Mining, sand and gravel dredging are taking place in various countries in shallower waters, but so far, no commercial-scale deep-sea mining has taken place. What was expected to be the first commercial project within deep-sea mining was the Solwara 1 Project in Papua New Guinea led by the company Nautilus Minerals, is currently shelved due to the company going bankrupt in 2019 (Doherty, 2019). Nevertheless, this does not imply low interest in mining the deep-sea. The International Seabed Authority (ISA) has received numerous applications for mining the deep-sea in the Area, and has so far granted thirty-one exploration contracts with twenty-one contractors (Hallgren & Hansson, 2021). The permits establish specific rights as well as

obligations to a company undertaking the activity. In order for the company to sign a permit/contract, it needs to have the support of an ISA member state where the company have to be of that nationality. The state then acts as a sponsor and is responsible for ensuring necessary and appropriate measures, that they are in line with the ISA regulations, as well as they ensure to protect human life and the marine environment (Zhou, 2019). Furthermore, if they fail to meet those requirements or any damages occur, the sponsoring state may be held liable. The contracts have been given to various countries, such as Russia, Japan, China, France, the United Kingdom, Germany and Brazil. When granting such a contract, it is initially contracted for fifteen years, however, those of which have already terminated have been renewed for five additional years. More than half of the contractors have applied for mining after polymetallic nodules, while the residual is for ferromanganese crusts and seafloor massive sulphides (Haugan et al., 2019; Miller et al., 2018). A large part of the contracts related to polymetallic nodules takes place in the Clarion-Clipperton Zone in the Eastern Pacific Ocean. The contracts for ferromanganese crusts and seafloor massive sulphides primarily occur on the Southwest Indian Ridge, the Central Indian Ocean West Pacific Seamounts and the Rio Grande Rise (off Brazil) and the Mid-Atlantic Ridge (Haugan et al., 2019). So far, no contracts for exploitation of deep-sea minerals have been permitted by the ISA, but they are currently working on designing regulations for exploitation.

The mining companies are thus waiting for an international framework for exploitation to be established, and have strongly signaled that they think the process is moving too slow. As an attempt to accelerate the formation of rules and supervision standards, wealthy ISA member nations wanted a two-year rule that could be invoked by any country. If a country decides to use the two-year rule, the ISA is given 24 months to establish an international framework for exploitation of marine minerals (Singh, 2021). In June 2021, the island state Nauru took the rule to use and noticed ISA that they want to conduct deep-sea mining within two years (Reid, 2021). It is a subsidiary of the Canadian corporation The Metals Company (TMC) (more recently known as Deep Green Resources) that will be responsible for the operation on behalf of Nauru. The subsidiary is called Nauru Ocean Resources Inc (Nori) and seeks to conduct mining operations in the North Pacific, more specifically between Mexico and Hawaii (the Clarion-Clipperton zone). In ISA, Nauru is the guarantee for TMC, and they have together kickstarted a commercial rush towards exploiting the resources at the deep sea (Reid, 2021).

If the ISA is unable to complete the regulations of exploitation within July 2023, countries and mining operators can still submit exploitation applications, which ISA has to consider

regardless of no finalized regulations (Singh, 2021). This is perceived as challenging as there are still several legal uncertainties and other outstanding matters. If the ISA is unable to finalize these regulations, then Nauru and TMC can conduct mining operations without a full legal framework. This has caused global concern as Nauru is known to have overexploited and exhausted the majority of its natural resources. Nauru used to be considered an idyllic place, but the island state has suffered from the upper soil layer being depleted of phosphate and never fully restored (Connell, 2006). This has led to unexpected issues in the local climate such as drought, several plant species are in danger of disappearing, which again has affected local food production. After the economy collapsed, the authorities tried to establish themselves as tax havens and the island state has thus become a place for money laundering and corruption (Connell, 2006). It seems as though Nauru has been focusing, and still is, on meeting their current needs, and not so much about whether or not this compromises future generations to meet theirs. It seems as though there is no application of the precautionary principle, which has led to unstainable practices and exacerbated environmental risks, which are no good prospects for future seabed mining practices in Nauru.

3.4 Main points of global discussion

The debate regarding deep-sea mining is filled with controversy and sustainability arguments. While some claim that the marine minerals mined from the deep seabed is crucial for a low carbon future and reaching our climate goals, others argue that mining the seabed will cause non-reversible and substantial damage to our ecosystems, thus making it more difficult to succeed with the transition to the green shift. Minerals such as cobalt, copper, manganese, nickel and rare earth elements (REE) are vital components in today's electronics and renewable technologies, such as wind turbines, solar panels, batteries, and the electric infrastructure for power distribution (Haugan et al., 2019; Miller et al., 2018). These technologies are considered vital to achieve the transition to a low-emission society, and the demand for the relevant minerals is expected to significantly increase in the coming years. As it is well documented that there are large amounts of minerals on the seabed in the deep oceans, there is now a growing interest in seabed mining. However, due to the lack of knowledge regarding the deep sea, marine mining has also become a highly contentious issue.

After developments in the mining technology in the 1960s, mining of the seabed became a topic of interest (Jaeckel et al., 2015). The enlarged interest is due to several factors. One of the major

concerns of today is global warming, which is a result of human activities, predominantly fossil-fuel burning (NASA, 2022). The emission of greenhouse gases is considered as one of the major threats to the climate. With an increased understanding of the effect of the emission of greenhouse gases, scientists, governments and corporations are looking for solutions to reduce the damage. It has been found that in order to succeed with the conversion to a greener, low-emission society, it is necessary to find and use new energy sources. Additionally, there is a need to make production, consumption and transportation more sustainable (Toro et al., 2020). As a result, there has been an increased use of metals as they can be used in renewable technologies. These metals have thus become a crucial element in reaching the climate goals and generally a greener society. However, it is estimated that the mining of metals such as lithium and cobalt have to quadruple by 2040 in order to meet the estimated future use of these metals (Green, 2021). The demand for these metals is already high which has led to the prices skyrocketing. For example, between 2000 and 2018, the price of zinc and copper have increased by respectively 359% and 360% (Jouffray et al., 2019). Not only is there not enough mining taking place to meet estimated future demand, but the current production happening on land has faced increased environmental, economic and social challenges.

Some of the environmental concerns have been destruction of natural habitats, discharge of toxic waste and land grabbing (Jouffray et al., 2019). Other challenges are violation of land rights, slavery practice, child labour and dislocation of communities (Haugan et al., 2019). It has become increasingly difficult to find available land for mining and high-grade ores, something that has led to mining at greater depths than in the past in more distant areas. The mining companies thus seek to exploit areas where there are other interests, such as possible areas for housing (Hallgren & Hansson, 2021). There are also geopolitical concerns regarding the present mineral supply side. As of today, China is producing and supplying more than 90% of the world's rare earth elements (REE). REE is a group of 17 metal elements in the periodic table that are significant to various high technology industries, e.g., renewable energy (Morrison & Tang, 2012). Both the US, Japan and the European Union are major importers of REE, and as they do not produce enough themselves, they have become profoundly reliant on Chinese exports. Their heavy dependence on China has created distresses in times of sudden significant price increases or in times of partial/full stops in the REE export, e.g., in 2010 when China stopped all REE exports as they needed to sustain domestic supply (Morrison & Tang, 2012). In 2019, China also considered using REE as leverage against the US (Zhang, 2012). There is a similar dependency when it comes to the production of cobalt, as it is the Democratic

Republic of Congo that is the main producer of cobalt. They produce around 60% of the world's cobalt (Rystad Energy, 2020). The Democratic Republic of Congo struggles with a fragile and corrupt government, which makes it difficult for the countries and companies that rely on this metal.

Due to the uncertainty related to the exports of both REE and cobalt and the critical situation of Europe's supply situation for minerals, governments are seeking to diversify and secure their future supply side. This has led to the EU launching an action plan for critical raw materials in the autumn of 2020. Furthermore, the recent situation with Russia's invasion of Ukraine has highlighted the issue of geopolitics and reliance on metals from other countries. On the 24th of February 2022, Russia invaded Ukraine and the invasion sparked strong sanctions from Western countries against Russia, and following the invasion, the price for several metals such as gold and nickel have seen a significant increase (Tan, 2022). Both countries are large suppliers of metals. Russia supplies about 10% of the nickel that the world needs, and is also a top producer of gold, copper, cobalt, rare earth elements, lithium, zinc and iron ore. Ukraine is a large producer of manganese, iron ore and REE (Gronholt-Pedersen, 2022). Several of these metals are critical for infrastructure, military uses and clean energy (Burke, 2022). On the same day as Russia's invasion of Ukraine, the Biden administration announced new measures, which aimed to strengthen the US' supply chain of metals. In addition to diversifying which countries they source metals from, the administration aims to develop domestic reserves of lithium, nickel, rare earth elements, as well as promoting recycling of metals.

A commonly proposed solution to the need for more metals is recycling, mainly due to its infinite recovery, which allows the metals to be reused over and over again. The World Economic Forum (WEF) stated in its year-end report of 2019 that merely about 20% of global metals are recycled from electronic waste and scrap (Hallgren & Hansson, 2021). There is thus a significant potential to meet some of the metals demand through recycling. However, as of the research conducted so far, recycling will not be sufficient to meet the anticipated demand growth of various metals in the coming years (Rystad Energy, 2020), but it is anticipated that on a more longer-term basis, perhaps around 2060, recycling is more likely to play a somewhat greater part in meeting the demand of metals. Månberger & Stenqvist (2018) conducted a study on several metal demand scenarios, and discovered that recycling has the potential to reduce the demand of cobalt, copper and lithium between 5%-35% within 2060. Yet, as of now, the process of recycling is not advanced enough to meet the quickly increasing demand for metals (Hallgren & Hansson, 2021).

These challenges have led to people looking elsewhere for solutions, and one of the possibilities that stands out is to extract minerals from the deep seabed. It has been considered to be a good possibility as it has been found that the deep-sea holds the greatest reserve of manganese, cobalt, nickel, rare earth elements on earth (Pak et al., 2019; Toro et al., 2020). However, 80% of the deep-sea is unexplored, which leaves us with significant knowledge gaps. Additionally, there is uncertainty about how deep-sea mining will affect the marine ecosystems and the overall environment. There is a growing pile of scientific evidence that shows that the seabed retains rich biodiversity (Hallgren & Hansson, 2021). The deep seas are stably cold ecosystems, which means that the biological processes are slow, and thus, physical impacts on these ecosystems will have a long recovery time (van der Meeren et al., 2021). From the experimental mining conducted so far, scientists are questioning whether full recovery of the ecosystem is possible after the extraction of marine minerals. There have been conducted several mining exploratory operations for polymetallic nodules in the Clarion-Clipperton fracture zone (CCZ), an area in the Pacific Ocean with depths between 4000-6000 meters. The CCZ seabed area is roughly six million km^2 and it has been found to hold substantial deposits of polymetallic nodules. Since the late 1960s, it has been conducted a significant amount of scientific research and exploration in the CCZ (Lodge et al., 2014). The research found that the mining for polymetallic nodules left clear signs of mining twenty-six years after the operations had taken place. The density of nematodes, the biomass and the diversity of species were noticeably lower in the area of mining than the surrounding area (Miljutin et al., 2011). Furthermore, the epifauna in the same fracture zone was found to have entirely vanished thirty-seven years after the mining took place. Mining on hydrothermal vents for massive seafloor sulphides has been found to cause serious and permanent changes in the seabed topography. Regarding mining for ferromanganese crusts from seamounts, there is a lack of experimental data that can help to establish the effects of this type of mining.

There is disagreement in terms of the technological methods used for deep-sea mining and its effect on the seabed. In a debate post in a Norwegian newspaper called Klassekampen on the 8th of May 2021 with the title "*Vi må grave etter kunnskap*", the CEOs of Adepth Minerals and Loke Minerals and the head of exploration and chief geoscientist at Green Minerals state that *«the deep sea of the world covers huge areas. ... However, compared with the size of the deep sea, the activity could be regarded as small surgical interventions on delimited areas and on inactive deposits. By using a closed production system, one will prevent the spread of sediments to the surrounding seabed…».* (Tvedt et al., 2021). From this statement, it seems as though the

mining operations will be a rather careful and simple process. However, on the other side, deep-sea mining has been linked to seabed trawling, which is universally known to have a damaging impact on both the biodiversity, the abundance and the substrata (Sala et al., 2021; Blue Ventures, 2021; Clark et al., 2012). Bottom trawling is known to have a significant carbon footprint, as well as lots of fuel is needed to drag the nets across the seabed, which has made bottom-trawled seafood one of the most emission-intensive food we can eat. Additionally, seabed trawling releases carbon from marine sediments, and the seabed is the largest carbon storage in the world (Sala et al., 2021; Blue Ventures, 2021; McVeigh, 2021). The trawling thus leads to discharge of CO_2 back into the ocean. As all states are trying to reduce their carbon footprint to meet CO_2 targets, trawling causes an additional challenge for the states engaging in this type of fishery. Deep-sea mining is an industry in its infancy, and the technological development has thus not come that far. As with all new industries, there is a need for a development of methods and technology of how to extract the minerals from the seabed to make this as sustainable as possible.

In 2019, the High Level Panel for a Sustainable Ocean Economy released a Blue Paper (Haugan et al., 2019) that emphasized that mining at the deep seabed may be contrary to a sustainable marine economy. The Blue Paper contained rather clear recommendations as to how we can succeed to reach the SDGs, and it emphasized that many of the solutions lay in the ocean and its resources. Nevertheless, deep-sea mining was not considered as one of the solutions in the report (Haugan et al., 2019), mostly because there is a too big knowledge gap regarding the deep seabed ecosystems, the species living there and the probable consequences of mining these grounds. Furthermore, the report (Haugan et al., 2019) highlights that deep-sea mining raises both environmental and legal issues that may be contrary to the SDGs.

3.5 Global moratorium

A temporary ban on extraction of deep-sea mining from 2020-2030, also known as a moratorium, was first initiated in 2019 by the World Wildlife Fund and Fiji, a coastal state with significant deposits of marine minerals at the deep seabed (WWF, 2020). At the International Union for Conservation of Nature (IUCN) conference on deep-sea mining in September 2021, the moratorium was put to vote among member states. Eighty-one countries voted for the global temporary ban aiming for no exploration contracts being given to any countries before more research has been conducted and it exists evidence proving that the ecosystems can be protected (Kapoor, 2021). The moratorium was also supported by several larger corporations such as the

Volkswagen Group, Samsung, Philips, Google, Volvo Group, BMW Group and Patagonia. By supporting the temporary ban, these corporations guarantee to not source deep-sea minerals, use the minerals extracted in their supply chains or be involved in the financing of deep seabed activities between 2020 and 2030 (WWF, 2020). The ban calls for more transparent and thorough impact assessments being carried out, an increased understanding of the economic, social and cultural consequences, and the "*protection of the marine environment being ensured*" (Kapoor, 2021; WWF, 2020; WWF, 2021). Norway, Belgium, China and Japan were four of the eighteen countries that voted against the moratorium. Twenty-eight countries abstained from voting.

A vote against deep-sea mining at the IUCN conference is not binding, but the wide opposition says something about the broad unrest that surrounds the industry. The moratorium is a clear example of how the Precautionary Principle can be interpreted on a global scale and put into real-world scenarios. There is significant uncertainty related to not only the environmental effects of the mining operations, but also prices, costs, technological developments, and environmental requirements. Precautionary measures are almost always taken in cases of uncertainty, and it is thus not a surprise that those voting for the moratorium refer to the Precautionary Principle and want to give the environment the benefit of the doubt. The principle also emphasizes the importance of exploring alternative technologies and options, which is also what the critics of deep-sea mining are doing. One of the arguments against the industry is that the models that estimate very high need for e.g., cobalt in the future do not take into consideration the high speed of technological development or innovative business models (WWF, 2020). These proponents argue that we can focus on recycling and technological alternatives.

4 Deep-sea mining in Norway

4.1 Historical background – from the 1990s to today

In Norway, the exploration of mineral compositions on the seabed across the Norwegian part of the Mid-Atlantic Ridge started in the late 1990s. The first annual research cruise started in 1999 by the University of Bergen (UiB), and in 2005, the first finding of hydrothermal sulphides occurred at the southern part of the Mohns ridge. From 2011, UiB and the Norwegian Petroleum Directorate (NPD) started collaborative scientific research cruises on a yearly basis. In 2016, NTNU started with their own cruises, and in 2020, NPD and the University of Tromsø started joint scientific research cruises. The explorations have found seafloor massive sulphide deposits and ferromanganese crusts along the Mid-Atlantic ridge, which can be seen in Figure 4.1, and these consisted of metals such as copper, cobalt, zinc, manganese, rare earth elements (REE), as well as smaller amounts of other critical metals (Brekke et al., 2021). Polymetallic nodules have not been found on the Norwegian continental shelf (Brekke et al., 2021). The Norwegian territorial spreading ridge is roughly 1300 km long, and the distance from the mid part of the spreading ridge to the Norwegian mainland is about 380 nautical miles (700 km) (Rystad Energy, 2020). The ridge is located between Jan Mayen and Svalbard, with the Mohns Ridge in the south and the Knipovich Ridge in the north (Rystad Energy, 2020). The depth of the waters along the majority of the ridge is between 2000 to 3000 meters, but on the southern part of the Mohns Ridge and the northern part of the Knipovich Ridge, the depths are 1000-2000 meters.

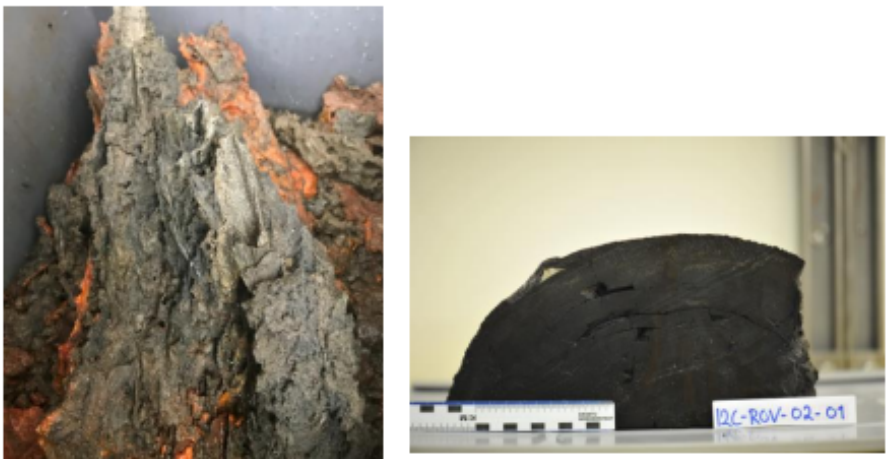

Figure 4.1 Polymetallic sulphides and ferromanganese crusts (Brekke et al., 2021)

4.2 The Subsea Minerals Act

In order to facilitate exploration and extraction of mineral deposits on the Norwegian Continental Shelf, the Subsea Minerals Act entered into force in Norway on the 1st of July 2019. The Purpose of the Act (§ 1-1) is to *"facilitate the exploration and extraction of mineral deposits on the continental shelf in accordance with societal objectives, so that consideration for value creation, the environment, safety of the business, other business activities and other interests are taken into account" (The Subsea Minerals Act, Purpose of the Act,* § 1-1). The geographical scope of the Act applies to mineral deposits in Norway's inland waters, Norway's sea territory and the Norwegian continental shelf. The Act also sets out *Requirements for sound mineral activities* (§ 1-7), where it is emphasized that mineral activities should be conducted responsibly and ensure the safety of personnel, the environment and economic values that facilities and vessels represent. Furthermore, it specifies that the mineral activities should not unnecessarily or unreasonably hinder or impede other maritime industries such as fishing, shipping, aviation or other activities. Additionally, mineral activities should not cause risk of damage or damage to pipelines, cables or other subsea facilities. Reasonable action must be taken to avoid pollution and littering, and avoid causing harm to the biodiversity in the ocean.

In May 2020, the Norwegian government started an opening process for the exploitation of seabed minerals on the Norwegian continental shelf by initiating the process towards an impact assessment. Before any activity and granting of permits to commercial actors can take place, impact assessments must be conducted in accordance with the Subsea Minerals Act (§ 2-1). The aim of the impact assessment process is to shed light on the effects that a possible opening may have on the environment as well as economic and social effects (The Ministry of Petroleum and Energy, 2021a), and to involve stakeholders and provide as much comprehensive and up-to-date knowledge as possible. The Ministry of Petroleum and Energy has the administrative responsibility and is in charge of the opening process, while the Norwegian Petroleum Directorate holds the responsibility of surveying commercially interesting deposits of minerals on the continental shelf and assess the resource potential.

In January 2021, the Ministry of Petroleum and Energy presented a program proposal for an impact assessment. The program proposal covers a wide range of topics, such as legislation and framework conditions, organization of work, implementation and schedule, study area and knowledge base, a detailed activity description and challenges for further study. When preparing the program proposal, The Norwegian Petroleum Directorate consulted with other

relevant professional bodies to ensure broad knowledge of natural resources, the environment and business activities, as well as possible effects on these. As part of the work with the impact assessment, professional sub-studies of relevant academic environments, be it state institutes and universities or private actors, was carried out based on tender competitions where this was required. The six (basic) reports that were prepared constitutes an important knowledge base for the completion of the study. These basic studies cover natural and environmental conditions, business activities (fishing and sea transport) and technologies for exploration and extraction of seabed minerals. The Coastal Administration has prepared the basic study for shipping, the Norwegian Directorate of Fisheries for fishery activity in the study area, the Norwegian Polar Institute for seabirds, DNV for technology, the Institute of Marine Research for pelagic ecosystems in Nordic oceans, and University of Bergen for landscape, nature types and benthic ecosystems.

The suggested study area covers the Norwegian part of the Mid-Atlantic spreading ridge. The area is approx. 592 500 km^2. The depths vary between 100 to 4000 meters, but is generally deeper than 1500 meters (Skaar et al., 2021). The shallower parts can be found in the area of Jan Mayen. There is a 12 nm zone around Jan Mayen, which is protected and is thus not a part of the study area. The study area can be seen in Figure 4.2.

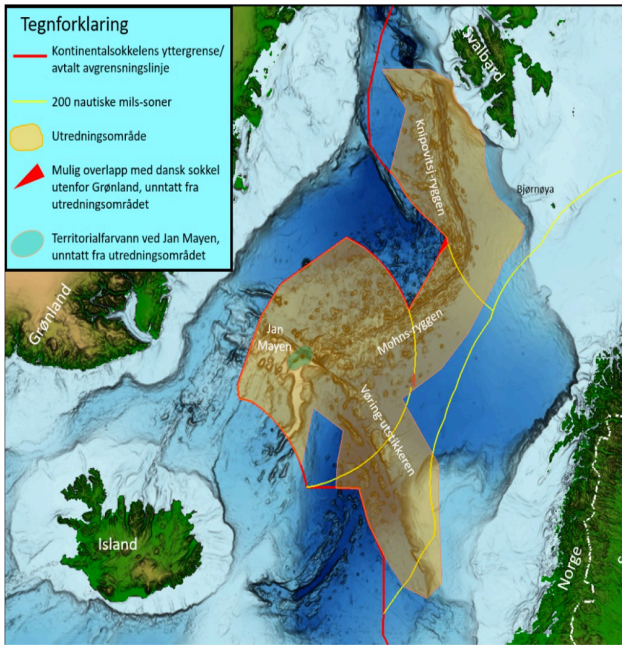

Figure 4.2 Map showing the assessment area for the impact assessment (marked in brown) (The Ministry of Petroleum and Energy, 2021a)

The deadline for giving input to the program proposal was three months, and when the response deadline had passed, the program for the impact assessment could be determined and the

assessment phase could begin. The Ministry of Petroleum and Energy received 53 consultation inputs from a wide range of actors, such as private companies, directorates, departments, research institutions and universities. The inputs were then reviewed by the Norwegian Petroleum Directorate, which eventually determined the final program for the impact assessment on the 10th of September 2021 (The Ministry of Petroleum and Energy, 2021b). The following phase is the assessment phase, with completion of different studies, which is supposed to last to the second quarter of 2022. Then, the reporting phase is planned to take place in the Q3 and Q4 2022, and the final decision phase is set for Q2 2023. A plan regarding the decision to open a new area for mineral activities will be presented, which again has to be re-consulted. Henceforth, after the opening of a new area, private actors can apply for exploration permits (The Ministry of Petroleum and Energy, 2021b). In similarity to the Norwegian Petroleum Act, the Subsea Minerals Act offers a non-exclusive exploration permit and an exclusive production permit with a work obligation. An overview of the different phases within both exploration and extraction of deep-sea minerals as well as where impact assessments are to be carried out is presented in Figure 4.3.

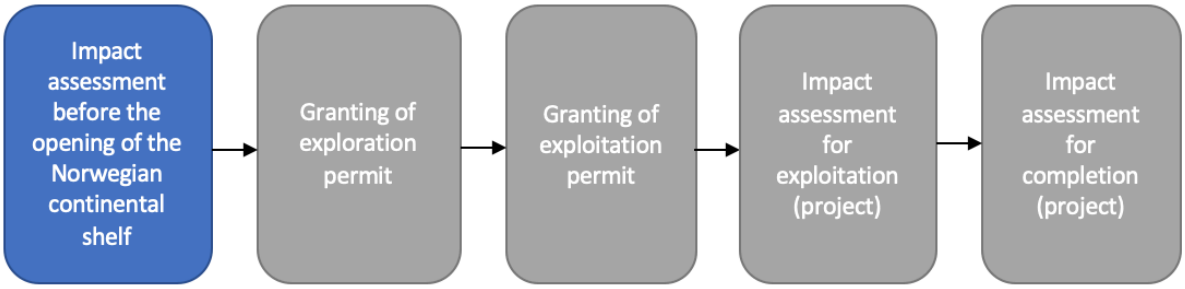

Figure 4.3 Impact assessment (EIA) before opening in relation to processes for granting permits and later project-specific impact assessments (The Ministry of Petroleum and Energy, 2021a)

There are several corporations that have signaled their interest and are preparing for exploration and extraction of deep-sea minerals in the near future. Norway has both fundamental knowledge and experience about offshore technology, mainly gained from the oil and gas sector (Rystad Energy, 2020). It is considered to overlap well with the technology and actual operations for deep-sea mining. This means that Norway already has a strong supply industry and professional communities within offshore operations. In order to advance the industrial development of deep-sea minerals in Norway, industrial clusters named the Norwegian Forum for Marine Minerals (NMM), GCE Ocean Technology and GCE NODE have gathered private companies, public agencies, research institutions, universities, financial institutions and entrepreneurs. The

aim is to strengthen and improve the knowledge and find the best solutions and collaborations to make the marine minerals industry a sustainable industry (GCE Ocean Technology, 2021). Green Minerals, Adepth Minerals and Loke Marine Minerals are some of the private companies that are seeking to conduct deep-sea mining in Norway.

There are also several companies involved in a competence building project, which examines whether deep-sea mining can be conducted sustainably on the Mid-Atlantic ridge. The project is named Eco-Safe Ridge Mining and is led by University of Bergen. Project partners are NORCE, the University of Stavanger, Equinor, GCE Ocean Technology, the Royal Netherlands Institute for Sea Research (NIOZ), the Norwegian Oil and Gas Association, Loke Marine Minerals, Adepth Minerals and Aanderaa Data Instruments. It is a three-year competence project with a total budget of 18 million NOK. The aim of the project is to fill knowledge gaps to increase the understanding of environmental risks and detect suitable mitigation actions (GCE Ocean Technology, 2021). Other research projects are *Secure European Critical Rare Earth Elements,* which is led by SINTEF, with several companies participating, such as Yara International and REETEC. NTNU coordinates the project *Global material flows and demand-supply forecasting for mineral strategies* (Forskningsrådet, 2019), and is also a part of the project *Blue nodules*, which is a project aiming to develop technology and methods for extracting manganese nodules at depths of 6000 meters.

4.3 Technology

As mentioned in Section 3.2, the mining method will depend on what type of minerals that are being extracted. As for Norway, the type of minerals that will be extracted (*in terms of what has been discovered on the Norwegian continental shelf*) are polymetallic sulphides and manganese crusts. There is a need to develop technologies not only for the extraction part of the operations, but from the establishment of the operating area and installation of equipment for transport to land (DNV, 2021). As extraction of deep-sea minerals is a very new industry, both in Norway and globally, technologies for the extraction of sea minerals are under development, but there are currently no fully developed technologies. However, there is a significant development of technology, particularly with regard to the subsea operations at great depths.

DNV, in cooperation with NTNU and other international experts, conducted a study in 2021 on request from the Ministry of Petroleum and Energy and the Norwegian Petroleum Directorate as part of the opening process on the Norwegian continental shelf. DNV states in their report

that there are several technologies under development that could be relevant for the area on the NCS. The various solutions for extraction of deep-sea minerals are considered to have a relatively low level of technological maturity (TRL) (DNV, 2021). Technological Readiness Level (TRL) is a method developed by NASA in the 1970s to estimate the maturity of technologies, and in 2010, the European Commission advised EU-funded research and innovation projects to use the NASA method. The TRL method consists of 9 levels: 1 is the lowest (basic principles observed) and 9 the highest (actual system detected in operating environment) (DNV, 2021). The currently available technological solutions in Norway have been considered to have a TRL between 2 and 6, and this is because most of them still are at the lab level/concept level. Several of the extraction solutions for mining is based on technologies and similar equipment of what is currently used in offshore oil and gas operations, and it is expected that the already existing knowledge Norway has from oil and gas will be an advantage in the operationalization of extraction of deep-sea minerals on the NCS (DNV, 2021). It is thus not the traditional mining industry on land that is now interested in the extraction of seabed minerals. Instead, there are companies with a background in and expertise from subsea operations related to the oil and gas industry.

5 The different positions

In this chapter, the main findings from the analysis of the various consultation inputs and the interviews are presented. The chapter is arranged in a logical order based on the research questions.

5.1 How do various Norwegian actors position themselves with regard to deep-sea mining?

5.1.1 The Norwegian government

As previously mentioned in this thesis, Norway is one of few countries that voted against the international moratorium on deep-sea mining at the International Union for Conservation of Nature (IUCN) conference on the 8th of September 2021. This voting took place under Norway's previous prime minister, Erna Solberg, representing the Conservative Party (H). In the parliamentary election on the 13th of September, there was a change of government with a new prime minister, Jonas Gahr Støre, representing the Labour Party (A). However, this has not affected the Norwegian government's approach to deep-sea mining nationally or internationally. One of the first arguments in the program proposal for the opening process is that the need for various metals will increase in the future, mainly due to population growth and economic growth outside the OECD countries and especially in countries such as Brazil, India, and China. The Ministry of Petroleum and Energy further mentions that the increased need for metals is because they are a prerequisite for producing e.g., wind turbines, solar panels, and batteries, which again is essential for reducing greenhouse gas emissions. The increasing need for metals can only be partially met by material recycling, and the extraction of seabed minerals can thus be a solution (The Ministry of Petroleum and Energy, 2021a).

The Norwegian government also emphasizes that Norway holds fundamental knowledge and experience about offshore technology, mainly gained from the oil and gas sector, which is considered to overlap well with the technology and the actual operations for deep-sea mining (The Ministry of Petroleum and Energy, 2021a; Persen, 2021; Rystad Energy, 2020). Norway already has a strong supply industry and professional communities within offshore operations, which is considered a great advantage as the expertise gained and the technology can be passed on to the marine minerals industry (Rystad Energy, 2021). The close collaboration between the Norwegian authorities, the scientific communities, and commercial actors is a significant

advantage. A proof of this is the several clusters that have been established, such as the Norwegian Forum for Marine Minerals (NMM), GCE Ocean Technology, and GCE NODE. These clusters have gathered private companies, public agencies, research institutions, universities, financial institutions, and entrepreneurs to strengthen and improve the knowledge and find the best solutions and collaborations to make marine minerals a sustainable industry in Norway. The technologies for the extraction of seabed minerals are primarily based on solutions from the oil and gas industry (DNV, 2021).

It is the Norwegian government's position that Norway should be a pioneer in the marine minerals industry due to Norway's strict regulations on the Norwegian continental shelf (NCS). This has pushed the oil and gas companies' operations to be world-leading in low environmental impact operations (Rystad Energy, 2020). By being a front-runner, Norway can set an example of how this type of operations should be carried out in an environmental-friendly way. Both the Ministry of Petroleum and Energy and the Norwegian Petroleum Directorate believe that if a considerable emphasis is put on the environmental consequences of the mining operations from the very beginning, then Norway can become a sustainable mineral supplier (Rystad Energy, 2020). This argument has become even more critical after Nauru invoked the ISA two-year rule in the summer of 2021 and is now a front-runner in the race to the bottom. Nauru is known for destroying most of its natural resources, struggling with money laundering, corruption, and an unstable political economy (Connell, 2006). If the ISA does not develop a regulatory framework for the exploitation of marine minerals in the Area within the summer of 2023, then Nauru will conduct the exploitation based on the current framework, which is considered weak and unfinished. Norway, on the other hand, has a legislation for mineral activities in place and follows a type of impact assessment that represents an internationally recognized tool for, among other things, ensuring that various relevant considerations are accounted for in the decisions related to public plans and programs (The Ministry of Petroleum and Energy, 2021a).

In recent years, the Norwegian authorities have focused on the potential for a new Norwegian industry related to deep-sea mineral extraction (DNV, 2021). The industry is considered to be an excellent opportunity for restructuring of the oil industry. As a result, several Norwegian companies have been established that focus on deep-sea mineral extraction as a future activity, such as Adepth Minerals, Loke Marine Minerals, and Green Minerals. Norway is a rich country, mainly due to oil and gas findings within jurisdictional zones since the late 1960s. However, as the oil and gas industry are facing criticism for its adverse effects on the climate and

environment both internationally and nationally, the activity is expected to decrease in the coming years (Rystad Energy, 2020). An expected effect of the decline in activity will be lower revenues to the Norwegian state, and thousands of people working in the industry will lose their jobs. Therefore, the Norwegian government is looking for other and hopefully profitable industries that may substitute the oil and gas industry, and deep-sea mining and offshore wind are expected to be the most promising alternatives (Rystad Energy, 2020). If Norway manages to commercialize the marine minerals industry, this will lead to approx. 21.000 new jobs and can create revenues of about 20 billion USD by 2050 (DNV, 2021; Rystad Energy, 2020).

5.1.2 The stakeholders

The consultation inputs show that Norwegian actors have different views regarding the opening process and the industry of deep-sea mining. While some express a positive attitude, others are more critical. In order to clarify the different consultation bodies' approaches to the consultation process and deep-sea mining, I have used the set-up from *Table 1.1 Overview of the different stakeholders that made a consultation input to the program proposal.* The stakeholders have been divided into three different categories, depending on their approach to the opening process and the deep-sea mining industry.

The categories have the following criteria:

Positive = Perceived to support the opening process and the deep-sea mining industry.
Neutral = The stakeholders' comments are perceived to have a neutral tone, that it only provides information or that the consultation input is without remarks.
Negative/critical = Stakeholders that appear critical or express concern related to specific aspects e.g., radiation protection or impact on fisheries.

Table 5.1 Overview of how the consultation bodies view the opening process and the industry of deep-sea mining

Ministry	**Other public agency**
Positive:	**Positive:**
Neutral:	- The Norwegian Maritime Authority
- The Ministry of Transports	**Neutral:**
- The Ministry of Foreign Affairs (*without remarks*)	- Norwegian Biodiversity Information Centre
- The Ministry of Agriculture and Food (*without remarks*)	- The Norwegian Mapping Authority
- The Ministry of Health and Care Services (*without remarks*)	- Norway's National Geological Survey
	- The Norwegian Water Resources and Energy Directorate

- The Ministry of Justice and Public Security (*without remarks*) - The Ministry of Education and Research (*without remarks*) **Negative/critical:** - The Ministry of Climate and Environment	- The Norwegian Coastal Administration - The Petroleum Safety Authority Norway (PSA) - The Governor of Svalbard - The Directorate of Mining with the Commissioner of Mines at Svalbard - Norwegian Meteorological Institute - The Norwegian Directorate of Fisheries **Negative/critical:** - The Norwegian Environment Agency - Directorate for Radiation Protection and Nuclear Safety (DSA) - The Norwegian Directorate for Cultural Heritage
County municipality **Positive:** - Nordland County Municipality **Neutral:** - Møre og Romsdal County Municipality - Kristiansund Municipality **Negative/critical:**	**Commercial actors** **Positive:** - Adepth Minerals - Allsite Geo AS - Equinor **Neutral:** - MHWirth AS **Negative/critical:**
User and interest organization, clusters and employee/employer organizations **Positive:** - Norwegian Forum for Marine Minerals (NMM) - The Norwegian Shipowners' Association - The Norwegian Mineral Industry - Petro Arctic - GCE NODE - GCE Ocean Technology - Nordic Ocean Resources	**Research and educational institutions** **Positive:** - Norwegian University of Science and Technology (NTNU) **Neutral:** - The University of Stavanger **Negative/critical:** - The Institute of Marine Research (IMR) - The Norwegian Polar Institute - NORCE Norwegian Research Centre - Norwegian Institute for Water Research

- The Norwegian Confederation of Trade Unions (LO Norway) - The Federation of Norwegian Industries - Norwegian Oil and Gas - Industri Energi - Norwegian Energy Partners **Neutral:** **Negative/critical:** - The Future in Our Hands, Greenpeace, Nature and Youth, Friends of the Earth Norway, Sabima and WWF - The Norwegian Fishermen's Association - The Pelagic Association - Fiskebåt	(NIVA) - Centre for Deep Sea Research and the Department of Biological Sciences (BIO), University of Bergen
Private person **Positive:** **Neutral:** - Arunima Sen (Nord University) **Negative/critical:**	**Other** **Positive:** **Neutral:** - Statistics Norway (*without remarks*) **Negative/critical:**

As seen in Table 5.1, it is primarily stakeholders from the groups: "*User and interest organizations, clusters and employee/employer organizations*" and "*Commercial actors,*" which have a positive approach to the program proposal and the deep-sea mining industry. In terms of the formerly mentioned group, these stakeholders are either clusters that have gathered a range of companies and institutions to find the best solutions and collaborations to make marine minerals a commercial industry in Norway or user or interest organizations where their members can benefit from a deep-sea mining industry in Norway e.g., through transmissions of technology from the oil and gas industry to the marine minerals industry. The commercial actors are perceived as satisfied with the Norwegian government's decision to initiate an opening process on the Norwegian continental shelf. These companies are developing technology for the exploration and exploitation of deep-sea mining and are content with Norway trying to be a pioneer in this industry as it provides large export opportunities of

technology and services to other parts of the world with similar resource potentials. Furthermore, the opening process creates predictability, and it gives an incentive to the commercial actors to develop technologies for the marine minerals industry.

The stakeholders in the group "*Ministries*" are mostly considered neutral. This was because the majority of them were without remarks. The Ministry of Climate and Environment was considered highly critical to the ongoing opening process and the program proposal. They express concern related to the low levels of knowledge about the ecosystems in the deep sea and the potential effects this type of activity will have on the marine environment, and that the timetable sat out does not enable enough time to form a sound basis for decision-making. The majority of the stakeholders in the group "*Other public agency,*" were also considered neutral, mainly because their inputs provide information that does not seem to favour or disfavour the program proposal or the deep-sea mining industry. Still, some stakeholders in this group were perceived as negative/critical. The Directorate for Radiation Protection and Nuclear Safety (DSA) and The Norwegian Directorate for Cultural Heritage expressed concerns about emissions of radioactive substances and damage to cultural heritage. The Norwegian Environment Agency shares many of the same concerns as the Ministry of Climate and Environment, and is thus perceived as negative/critical.

The majority of the stakeholders in the group "*Research and educational institutions*" are perceived to have a critical approach. The Institute of Marine Research, the Polar Institute, NORCE, the Norwegian Institute for Water Resources (NIVA), and the University of Bergen emphasize the significant knowledge gaps related to the effects of deep-sea mining on the marine ecosystem. They also emphasize that the timeline set out is too short to be able to collect the necessary data to make a sound decision by 2023. There are also stakeholders perceived to be critical in the group "*User and interest organizations, clusters and employee/employer organizations.*" The Norwegian Fishermen's Association, the Pelagic Association, and Fiskebåt express their concerns regarding the impacts of deep-sea mining on fisheries. In this group, we also find what could perhaps be considered the most negative/critical stakeholders overall, namely the environmental organizations The Future in Our Hands, Greenpeace, Nature and Youth, Friends of the Earth Norway, Sabima, and WWF. They have have written a common consultation input where they demand that the Norwegian government stops the current opening process of mineral activities on the Norwegian continental shelf.

5.2 What are the main lines of conflict in the debate of deep-sea mining in Norway?

The consultation process shows that deep-sea mining is a controversial topic also in Norway. The most addressed concern in the consultation inputs is the lack of knowledge about the environmental conditions in the study area and thus the need for more mapping. Furthermore, it is mentioned that the time horizon and the schedule is too tight to gather sufficient knowledge about the environmental conditions in the study area to make a sound decision regarding the opening of the Norwegian continental shelf. This concern is addressed by consultation bodies such as the Institute of Marine Research, the Polar Institute, NORCE, the University of Bergen, the Ministry of Climate and Environment, the Norwegian Environment Agency, Fiskebåt, the Future in Our Hands, Greenpeace, Nature and Youth, Friends of the Earth Norway, Sabima, WWF, and the Norwegian Institute for Water Research (NIVA).

All three interviewees were asked about what they perceived as the main lines of conflict in the debate on deep-sea mining. The three representatives also emphasized the lack of knowledge and the pace of the process. More specifically, the representative from the Institute of Marine Research emphasized the effect of extraction on biological diversity and the ecosystems, including waste, in the perspective of the lack of knowledge. The representative from the Norwegian Petroleum Directorate stated that the most critical argument coming from the NGOs is the pace of the process combined with the lack of knowledge. The representative from Adepth Minerals also emphasized the lack of knowledge and data collection, but also mentioned the ongoing situation in Ukraine, which has led to the lines of conflict being shifted from mainly a focus on the climate and the environment to becoming more about geopolitical challenges.

It seems as though there is a general agreement as to what the main line of conflict is, but that the stakeholders have different ideas about how to solve the situation with the current knowledge gaps. The representative from IMR emphasizes that knowledge acquisition is essential but that it should be done independently of an impact assessment that has a specific timeline and schedule. The representative from IMR further argues that the current knowledge acquisition in relation to the opening process is not about acquiring new knowledge but more about gathering already available information to understand the current knowledge gaps better. He/she explains that there has been a collection of knowledge for years related to the deep seabed on the Atlantic ridge on the Norwegian continental shelf, but that this knowledge acquisition has been more about wanting to understand the ecosystems, but that we are not yet at the stage where we can truly understand them.

In the interviews, both the Norwegian Petroleum Directorate and Adepth Minerals stated that they believe the opening process will lead to a more effective and quicker knowledge acquisition. The representative from Adepth Minerals underlines how the opening process helps gather more knowledge and gives an incentive to industry actors to conduct further research and find innovative solutions. The representative further mentions that they want to help find out whether deep-sea mining is a better alternative than today's land-based mining, and further emphasizes that if the Norwegian continental shelf is not opened now, it will mainly be academia that will conduct the research. This process will unfortunately be too slow because they do not get enough funding for their projects. Once the industry comes to the fore, there will be an increased focus on deep-sea mining and necessary research, and we can then easier find out whether deep-sea mining is a better solution than the alternative of land-based mining. The representative further explains that they intend to use the same methodology that research institutions use today and that they do not envisage that they will cause any more damage to the environment through exploration than what is done through research to find out what the deep seabed actually looks like.

The Ministry of Petroleum and Energy and the Norwegian Petroleum Directorate address the concerns related to the knowledge gap and the timeline in their "*Assessment of consultation inputs"* (The Ministry of Petroleum and Energy, 2021c). They argue that it is through the impact assessment process that we gather an up-to-date and comprehensive knowledge base related to deep-sea mining on the Norwegian continental shelf. They further argue that the impact assessments' purpose is to (together with the consultation input and resource mapping) provide the Norwegian authorities with a knowledge base for deciding whether or not to open areas for seabed mineral activities. In order to gain more details on this explanation, the representative from NPD explains that:

> "*There will always be some lack of knowledge in everything we do. It is important to remember that this impact assessment is an impact assessment for an opening, not for a field-specific development. And after an opening, then there will be a process of deciding whether to award the project, followed by a new impact assessment for the project in question, which then has to be granted a license to extract seabed minerals. This will not happen tomorrow. It will take many years before anyone will be granted licenses and a project comes into place. The knowledge gaps will slowly be filled over time" (Interview, Representative NPD)*

5.3 What role do sustainability and associated principles play in the debate about deep-sea minerals in Norway?

Several sustainability issues are raised in the program proposal for the impact assessment, newspaper articles, the consultation inputs, and in the interviews conducted for this thesis. Perhaps the most addressed sustainability issues relate to the environmental pillar, but social and economic sustainability are also addressed. Associated principles and practices such as the Precautionary Principle, the Polluter Pays Principle, Best Environmental Practice (BEP), and Best Available Technology (BAT) are also addressed in the debate, as well as the United Nation's Sustainable Development Goals. Regardless of the actors' attitude towards the case of deep-sea mining, they refer to sustainability challenges and the SDGs to argue for their point of view.

Firstly, in the program proposal prepared by the Ministry of Petroleum and Energy, they state that the UN Sustainable Development Goals lay the foundation for the political framework for the Norwegian government's work both on a national and an international level, and the governments' environmental goals. Thus, the SDGs form the basis for the work with the opening process on the Norwegian continental shelf. It is also mentioned in the program proposal that in accordance with the Subsea Minerals Act, mineral activities should take place in a responsible way and safeguard the environment. Furthermore, any mineral activities may also be subject to permits in accordance with the Pollution Control Act. The report made by the High Level Panel for a Sustainable Marine Economy (Haugan et al., 2019) is also mentioned in the program proposal, where they specifically mention the part of the report that discusses the need for critical metals in order to reach the climate goals. Increased supply of metals can lead to lower prices for the companies dependent on these in their supply chains. This can again increase the chances of establishing more technologies and innovations based on renewable energy, which again can contribute to reaching the climate goals. Furthermore, the program proposal refers to the World Bank's initiative *Climate Smart Mining*, which also emphasizes the importance of minerals to reach the climate goals, particularly in regard to renewable energy sources such as wind and solar technology.

5.3.1 Environmental sustainability

One of the most recurrent statements from both the consultation comments and the interviews conducted is the need for more knowledge before any marine mineral exploitation takes place. A majority of the consultation bodies, such as the Institute of Marine Research, the Polar

Institute, NORCE, the University of Bergen, the Ministry of Climate and Environment, and the Norwegian Environment Agency, argue that there is too little knowledge about the ecosystems in the study area, both in the water masses and in the bottom areas (van der Meeren et al., 2021). They argue that these areas may contain a number of new and undiscovered species, which may be of more considerable importance than what is currently known, e.g., for use in future vaccines and other medicines. Additionally, they are afraid of damaging/removing species before there is knowledge about the value they add to the ecosystems. The Institute of Marine Research particularly mentions the unknown effect of extraction on biological diversity and the ecosystems in the perspective of the lack of knowledge.

In this context, the same consultation bodies also mention in their inputs that the time horizon is not realistic due to the size of the study area and how long it takes to identify species. The Ministry of Climate and Environment warns its own government against the current process and explains in their consultation comment that due to low knowledge levels about the environmental conditions and the resources in the study area, it is essential to collect significant amounts of knowledge to ensure a sound basis for knowledge-based decision-making. The timeline that is proposed in the impact assessment program does not allow a wholesome enough knowledge acquisition for the entire study area. NORCE also mentions that due to the significant knowledge gaps, the scientific foundation by Q2 2023 will not be satisfactory enough to make a comprehensive decision about deep-sea mining to satisfy the same strict requirements for sustainability as for the other maritime industries in Norway. According to several of the consultation bodies, there is also a lack of knowledge and experience regarding the technical operations of deep-sea mining, which makes it challenging to establish the risks associated with different technological methods.

The Norwegian Environment Agency mentions in their consultation input that the process and the timeline that has been set up so far bear the mark of urgency and that the process is set up in a way that does not assess nor safeguard environmental considerations in accordance with international best practice. They further emphasize that Norway is a party to the OSPAR Convention, which seeks the protection of the marine environment in the Northeast Atlantic. OSPAR involves several regulations aimed at protecting the marine environment in the Northeast Atlantic, and are legally binding on all member states. The OSPAR Commission promotes implementing an ecosystem approach within the framework of the Biodiversity Convention (CBD), and is based on the Precautionary Principle, the Polluter Pays Principle, the use of Best Environmental Practice (BEP), and Best Environmental Technology (BAT). They

also refer to the fact that Norway is subject to the United Nations Convention on the Law of the Sea and thus also to the rules set out by the International Seabed Authority (ISA). The ISA has established regulations aiming to protect the marine environment, which obliges member states to follow the Precautionary Principle and Best Environmental Practice. The Norwegian Environment Agency refers explicitly to Article 208 of the Convention on the Law of the Sea, which obliges Norway to implement regulations that cannot "*be less effective than international standards and recommended methods and procedures.*"

Several of the consultation inputs contain comments about the importance of emphasizing an ecosystem approach and the Precautionary Principle in the situation of deep-sea mining due to the severe knowledge gaps (NIVA, IMR, the Norwegian Polar Institute, the Ministry of Climate and Environment, Equinor, Fiskebåt, Kristiansund County Municipality, the Pelagic Association, the University of Bergen). It is mainly the stakeholders considered to be negative/critical that mention the Precautionary Principle in their consultation inputs. The interviewees were asked how they perceive the Precautionary Principle in the case of deep-sea mining. The representative from IMR emphasizes that the Precautionary Principle is enshrined in international and national environmental legislation to protect nature and people when the knowledge base is deficient. However, it is often a problem to objectively define what is considered "*lack of knowledge"* in this context because it depends on the motivation of the person assessing the knowledge. The representative from IMR further explains that by looking at environmental impact assessments conducted in the past, the conclusion for those in favour of development is that they have gathered enough knowledge to make a decision. However, this is often not the case if you look at it from a more biological-professional side, as there will often be things that biologists would like to shed better light on. There may be a lack of understanding regarding the exact connection in question, how different parts of the ecosystem work together and what kind of impact the measure will have on the ecosystems in question. He further emphasizes that it is common in decision-making processes that information is not considered because an opinion has been made in advance, and the decision-makers lean on the scientific reports that support their view.

The representative from the Norwegian Petroleum Directorate states in the interview that there is always a lack of knowledge in everything we do, but that the opening process helps gather more knowledge and uncover knowledge gaps. The interviewee further emphasizes that if we have to wait until we have knowledge of everything and take no risk, then we will certainly not

get anywhere. He/she explains that even though the Precautionary Principle has been adopted in Norwegian management, it does not mean that one should refrain from making a decision:

> "*Initiating an opening process does not mean that you initiate a process for extraction without any knowledge. As I interpret the Biodiversity Act, it is not contrary to it (the Precautionary Principle) to initiate an impact assessment. It is clear: a lack of knowledge should not prevent us from making an administrative decision." (Interview, Representative NPD)*

The representative from the Norwegian Petroleum Directorate further explains that Norway is known for taking care of its natural resources, so even though the authorities are preparing an impact assessment, they do not intend to cause damage to the environment.

5.3.2 A marine minerals industry in light of the UN SDGs

University of Bergen, NORCE, the Ministry of Climate and Environment, and the Norwegian Fishermen's Association are among the actors that have taken note of the report from Haugan et al. (2019) on behalf of the High Level Panel for a Sustainable Ocean Economy. The report discusses the marine minerals industry in light of the UN SDGs. The report is briefly referred to in the program proposal by the Ministry of Petroleum and Energy, specifically the part where it mentions that an increased supply of metals can lead to favourable prices, which in turn can increase the possibility of establishing new renewable energy technologies. This can again contribute to achieving the SDGs. NORCE and the Norwegian Fishermen's Association demand more clarity and a more detailed explanation of how mineral extraction activities comply with the UN SDGs before any large-scale opening of mining operations in Norway takes place. University of Bergen (UiB) points out in their consultation comment that it is positive that the program proposal refers to the Haugan et al. (2019) report, but that it is important to also include other findings from the report. UiB specifically refers to the part of the report where the authors propose alternative solutions to meet the growing metals demand, for instance, through more research on alternative technologies, which can help to reduce the use of significant metals that are already under great resource pressure. Furthermore, UiB points out the part of the report where Haugan et al. (2019) emphasize that deep-sea mining should not start before its environmental effects are better understood and more thorough assessments have been completed.

5.3.3 The role of deep-sea mining in the green shift

The Ministry of Petroleum and Energy, Nordland Municipality, the Norwegian Geological Survey (NGU), and the Norwegian Shipowner's Association are some of the actors mentioning the importance of seabed minerals for succeeding with the transition to the green shift. This argument is one of the most frequent arguments in the global discussion regarding deep-sea mining. Access to important metals is crucial for renewable energy production from wind and solar panels, and battery production. Additionally, various metals found on the deep seabed will play a vital part in a number of value chains and products in the future. NGU underlines that the demand for minerals will increase significantly in the next years, but that it is incorrect to state that there are scarce resources (stated in the program proposal). NGU further highlights that seabed minerals can play a role in the long term when the environmental and resource management, and the technological prerequisites are more mature.

In the Future in Our Hands, Greenpeace, Nature and Youth, Friends of the Earth Norway, Sabima, and WWF's common consultation input, they argue that it is entirely possible to achieve the green shift without extracting minerals from the seabed. They highlight that if the material efficiency and the recycling rate are improved through a mineral consumption circular system, then the demand for most metals can be reduced by 60-90%. They further argue that the models that estimate a very high need for cobalt in the future do not consider the high speed of technological development and innovative business models that can change the need for new minerals. Electric vehicles need various metals in their production, but even electric vehicle producers such as Volvo and BMW have signed the international moratorium and thus will not use seabed minerals in their production cycles in the coming years. Manufacturers such as these two car-producing companies are constantly coming up with innovations fitting the policies and trends in the market, and it can thus be expected that new technology will be adjusted to this.

5.3.4 Ecological effects of noise, vibrations and light

Another environmental argument that comes forward is that previous research shows potential damage to the ecosystem. IMR emphasizes previous research on noise, vibrations and use of light and its effect on marine ecosystems. It has been found that human-made noises can interfere with the natural use of sound. This can be either through human-made noise "masking" biologically relevant sounds or triggering false responses. Sound propagation under water can reach very far. Therefore, noise from seabed mining can travel over long distances (van der

Meeren et al., 2021). In 2012, a study was conducted on the effect of underwater cannons, and it was found to cause increased swimming activity combined with decreased eating activity in redfish, blue halibut, and cod. The noise could also have an effect on the reproduction of redfish species, as observations from research cruises found that the redfish can release the larvae prematurely, which they believe is due to high stress levels. There is a lack of information about the hearing abilities of several species, which makes it challenging to evaluate the effects of man-made noise from mining (van der Meeren et al., 2021). Furthermore, artificial light can also have an effect on the fish's behavioral response, particularly deep-water species, since they are adapted to life in the dark. It has been found that artificial light impacts eating and shoal behaviour, migration, spatial distribution, predation risk, and reproduction. Light will attract shoals and larger predator fish that use visualization for hunting, which again can increase the survival of predator species. This can cause an "unnatural "top-down" regulation of fish populations" (van der Meeren et al., 2021).

5.3.5 Social and economic sustainability

The Norwegian Fishermen Association demands that new types of activities, such as deep-sea mining, will not be established at the expense of the marine environment, spawning and rearing areas, wild stocks, seafood safety, or general operating basis and profitability for Norwegian fishermen. They underline that the fishing industry is different from other offshore industries in Norway since fisheries are based on renewable biological production. This makes the industry dependent on clean marine environments. The Pelagic Association, an interest organization for shipping companies that conducts fishing with ocean-going vessels, states that mineral exploitation will have significant consequences for their members both in terms of area conflicts and possible pollution. Suspicion about pollution may result in significant marked oriented consequences for the export of seafood from Norwegian vessels. In terms of area conflicts, the Pelagic Association argues that their fishermen simply need to fish where the fish is and cannot just be allocated to other places. They further refer to p.16 in the program proposal, where the MPE and NPD have written that the areas considered for mining are far away from the coast and thus that the mapping of mineral resources should be able to proceed without significant effects on other activities such as fisheries, shipping, petroleum, and renewable energy production. Contrary to this, the Pelagic Association states that Norwegian fishing vessels are fishing in the whole of the Norwegian Exclusive Economic Zone as long as the fishery is financially sound. Thus, mining at long distances from land does not mean that mining will not be in the way for fisheries. Furthermore, the Pelagic Association mentions that

seabed mining will happen at considerable depths and that traditional fisheries usually take place at <300 meters, and that it then may seem as there will be no conflicts regarding area with the fisheries industry, but in the last 4-5 years, there has been conducted experimental fishing on mesopelagic species where the fishing happens down to 800 meters depth. From the experimental fishing done so far, it seems as mesopelagic fisheries can become a significant fishery. Nordland Municipality also emphasizes in their consultation input the importance of fisheries and aquaculture in the northern part of Norway and that when allocating areas for exploration for and operation of seabed minerals, consideration for these industries must weigh heavily.

GCE Ocean Technology and Norwegian Oil and Gas emphasize that it is vital to consider the access to minerals from a global perspective and refer to the geopolitical and environmental challenges with today's mining industry on land. Adepth Minerals also mentions in their inputs that they would want the impact assessment to further inform about global consequences of *not* conducting mineral activities on the Norwegian continental shelf, related to e.g., geopolitics, health and environment, security, and corruption. In the consultation input, the company does not go into detail on this, but in an interview with Geo365 (Carstens, 2021), a representative from Adepth Minerals emphasizes that today's mining industry makes significant interventions in the nature in Asia, Africa and South America. The extraction process of land-based mining requires extensive water utilization, which has caused pollution of local water sources. Additionally, the land-based mining extraction frequently occurs under tough working conditions with high risks (Carstens, 2021). MHWirth also addresses these challenges in their inputs. They especially emphasize China's dominance in the current supply and demand situation and land-based mining's challenges with child labour and discrimination against women.

In the above-mentioned article "*Vi må grave etter kunnskap*" in Klassekampen, written by the CEOs of Adepth Minerals and Loke Minerals and the head of exploration and chief geoscientist at Green Minerals, they stated that the consequence of saying no to marine minerals extraction in Norway is also a yes to extraction elsewhere. In their article, they refer to current land-based mining in countries that do not have the same strict environmental standards or working conditions as there are in Norway. Tvedt et al. (2021) further argue in their post that the Norwegian industry can extract minerals with a high focus on environmental safety and contribute to local value creation. If we say no to exploration activity before we have the

"enough knowledge", we risk delaying the green shift significantly. The representative from Adepth Minerals mentions in the interview conducted that the idea behind the establishment of Adepth Minerals is that they believe that they can conduct mining in a better way than how it is done today. Furthermore, it is important to have access to mineral resources, including short-distance access to the resources.

A central economic argument mentioned in the inputs is that establishing a new industry could lead to the development of competence and industry (The Norwegian Shipowners Association, Norwegian Energy Partners, Petro Arctic, Adepth Minerals). Norwegian companies have good preconditions for positioning themselves as technology suppliers for the deep-sea minerals industry. The industry has a promising export potential and is thought to create significant value, tax revenues, and jobs (NMM, The Federation of Norwegian Industries, The Norwegian Shipowners Association). Due to Norway's knowledge and management competence of natural resources from relevant industries such as the petroleum and shipping industry, the country is expected to be successful when it comes to deep-sea mining. The reference used in the inputs where this is addressed, is Rystad Energy's report "*Marine Minerals. Norwegian Value Creation Potential*", which was released in November 2020.

Several of the consultation bodies mentioned in their inputs the need to clarify the consequences of deep-sea mining for the society as a whole in the impact assessment. More information is requested about expected profitability and employment. Several of the private companies and clusters, such as GCE NODE and GCE Ocean Technology, request more information about the fiscal regime, tax rates, royalties and expected profitability from operations. More information about the tax regime is requested in order to assess the feasibility of future projects, commitments to expensive exploration, and EIA campaigns. Some of the commercial actors also want more information about whether Norwegian companies will be incentivized to participate in the deep-sea mining business and whether areas would be opened to foreign investors and companies.

5.3.6 Institutional barriers

Further regulatory development and establishment of a management system on deep-sea mining with an emphasis on including environmental authorities in the opening process have been requested from several consultation bodies. The Ministry of Climate and Environment requests closer co-operation between the resource authorities and the environmental authorities. The Norwegian Environmental Agency argues that initiating an opening process for a new industry

before the legal framework is clear is contrary to good administrative practice. The Petroleum Safety Authority Norway (PSA) mentions in their input the importance of not letting businesses develop and start operations without establishing a management system and clear regulations, as this could have unfortunate safety consequences. They suggest developing a national regulatory framework based on experiences from the HSE regulations within the petroleum industry and learning from the experiences of early incidents such as the Bravo blowout in 1977 and the Kielland accident in 1980. The Subsea Minerals Act is similar to the Petroleum Act, and as the two industries have comparable activities and risk factors, the regulatory development should be based on the experience of regulating the petroleum activities.

5.3.7 Consultation response from the MPE and NPD

The Ministry of Petroleum and Energy and the Norwegian Petroleum Directorate have considered and evaluated the consultation inputs. The first pages of the consultation response address the most recurring details from the inputs. In the interview conducted with NPD, the interviewee expressed the importance of the inputs for the impact assessment and that they need to take everything into consideration. The interviewee perceived the most important lines of conflict around the introduction of extraction of seabed minerals to be the significant knowledge gaps and that the whole process is moving too fast. This is in line with what seems to be one of the recurring inputs in the consultation inputs. The Ministry and NPD respond by stating that the impact assessment process is a way of collecting up-to-date and comprehensive knowledge related to deep-sea mining on the Norwegian continental shelf. Another pervasive response from NPD and MPE is that the inputs will be addressed in connection with the future allocation of production licenses or in a project-specific impact assessment as part of the plan for extraction of subsea minerals after areas have been opened for business. Their response to several other comments is that these will be further addressed in the sub-studies that cover natural and environmental conditions, business activities (fishing and sea transport), and technologies for exploration and extraction of seabed minerals. The Norwegian Environment Agency has expressed their dissatisfaction with how the MPE and NPD have treated the various inputs from researchers and environmental authorities, as they find it difficult to see that anything in the original plan has changed. They express that the size of the study area and the schedule are still unchanged (Fjeld, 2021).

6 Discussion

The findings presented in the previous chapter have given insight into how various Norwegian stakeholders have positioned themselves with regard to deep-sea mining and what the main lines of conflict are. The analysis of the consultation inputs found that the main controversy is the lack of knowledge and the timeline decided upon in the opening process. What is also interesting to see from the consultation inputs is that regardless of whether the actors have a positive, neutral, or negative/critical approach to seabed mining and the opening process, they refer to environmental, economic, or social sustainability to argue for their point of view. In the next part of the thesis, the findings from the previous chapter will be seen in connection with the theoretical framework presented in Chapter 2.

6.1 Sustainability issues

Sustainability has been used as a "guide" to make sound decisions and steer both governments and private companies in the "right" direction towards a more sustainable society. However, the 17 SDGs are extensive, which can complicate the establishment of new industries. As mentioned previously in this thesis, deep-sea mining is thought to possibly be a hinder to the United Nations Sustainability Goal 12 (*Responsible Consumption and Production*), Goal 13 (*Climate Action*) and Goal 14 (*Life Below Water*), while it, on the other hand, may help to achieve Sustainability Goal 1 (*Reduce Poverty*) and Goal 7 (*Affordable and Clean Energy*), which again could "counter climate change" (Goal 13, *Climate Action*) (Haugan et al., 2019). This conflicting view of deep-sea mining and its role in achieving the SDGs makes it increasingly difficult for policymakers to navigate.

Sustainability entails both an economic, social, and environmental pillar. The Brundtland report underlined that sustainability could only be accomplished by upholding economic growth and development, protecting the environment, and promoting equity simultaneously (WCED, 1987). The realization of any of the three pillars should not be accomplished by sacrificing one of the other, and sustainable development as a policy rejects the idea that there is essentially a tradeoff between environmental protection, economic growth, and social equity. Robert et al. (2005) describe sustainable development as a compromise between those who value economic development, those who emphasize environmental protection, and those concerned with human condition. It is a way of negotiating and making a compromise that tackles "opposing"

objectives from different interest groups and couple development ambitions with the preservation of the planet.

Nevertheless, in reality, accomplishing agreement on sustainability goals, values and actions are difficult. Due to its wide definition, the term can be redefined and reinterpreted to fit and address almost any situation or challenge. As Robert et al. (2005) emphasize, the interpretations of sustainable development have often been taken to extremes, either "*sustain only*" or "*develop mostly.*" This can make it difficult in practice as it can be used to "*disguise or greenwash socially or environmentally destructive activities*" (Robert et al., 2005), which has also been the case in the Norwegian public debate on deep-sea mining. In the fall of 2021, the Head of Research at SINTEF, one of Europe's largest independent research institutes, claimed that seabed minerals are a sustainable alternative to land-based mining operations (Sørum, 2021). The World Wildlife Foundation Norway has heavily criticized this claim and stated that "*Lars Sørum and Sintef continue a number of myths that simplify, prejudice and greenwash the history of seabed minerals.*" (Andaur, 2021).

One of the most recurrent arguments in the consultation inputs is the lack of knowledge and the high level of uncertainty associated with the effects of deep-sea mining. It is thus essential to ask the following questions: when can we safely say that we know enough to make a sound decision? Is it possible to remove uncertainty through more knowledge? How much knowledge is enough to make sound decisions? One can always diminish uncertainty by acquiring more knowledge, but decision-makers cannot always wait for research to fill these knowledge gaps. Some risks have to be taken, as we will never be able to state that we have complete knowledge, and research cannot do more than produce estimates of what may happen (Tannert et al., 2007). Tannert et al. (2007) explain this challenge in a simple and comprehensible manner: "*Uncertainty challenges the central claim of science: that all problems are presumed to be solvable by research.*" Science is not necessarily about facts but more about odds and increasing the chances of improving those. A common thought is that uncertainty can be reduced through more research, but more knowledge does not necessarily lead to less uncertainty. New knowledge can actually increase the level of uncertainty as it may pinpoint a presence of uncertainties that were unknown before or perhaps underestimated (van Asselt & Vos, 2006). New information can make us realise that the deep-water ecosystem was more complex than originally thought or that our understanding was more inadequate than initially assumed. It is thus vital to accept that there will always be some level of uncertainty.

With clinical trials, testing of new types of genetically modified food, or the implementation of new technologies, there are often dangers and risks associated. Precautionary measures should thus be taken to prevent avoidable risks, but this notion can have a negative effect on decision-making as it may lead to no action (Peterson, 2006). This way of implementing the principle has led to a trade of the somewhat more conventional cost-benefit analyses with a "*more imprecise reasoning that focuses on possible negative effects*." (Peterson, 2006). The most prominent critics of the Precautionary Principle go as far as stating that it is inflexible, anti-growth, and anti-technology. They argue that the principle often prevents new and promising technologies from being established, particularly in emerging industries that carry especially high uncertainty regarding risks. Sunstein (2003) argues that the Precautionary Principle should be rejected, mainly because it leads to no directions, not even bad ones. He further argues that the principle is paralyzing as it offers no guidance and forbids all courses of action.

There is often skepticism towards technological innovations and emerging industries, e.g., oil and gas, aquaculture, offshore wind energy, and deep-sea mining. As a result, emerging industries are almost always subject to precautionary measures. Nonetheless, Tannert et al. (2007) argue that research indicates that applying the Precautionary Principle and precautionary measures may have undesirable side effects as it might decrease public trust by enlarging the perceptions of risk. He further argues that in a situation of uncertainty, applying precautionary measures has to be closely weighed against other possible consequences, *"especially spurious anxieties and fears, and a principal skepticism towards technological innovations"* (Tannert et al., 2007*).* NTNU mention in their consultation comment that mineral extraction is a very controversial topic internationally, and several activists and organizations argue that such activities should not even be considered. NTNU further mentions that there are many strong opinions on this matter also in Norway, but that the opposition is not always equally fact-based, and in order to counteract a polarized debate, it argues that it is important to promote citizen participation and reflection around ethics at an early stage (already for the impact assessment), for example by carrying out stakeholder dialogues.

Several sustainability challenges are raised in the consultation inputs, which makes it challenging for the decision-makers to decide on the "correct" path forward. However, it is clear from the consultation inputs to see that both the Norwegian Environment Agency, the Institute of Marine Research, NORCE, University of Bergen, the Norwegian Polar Institute, and the Ministry of Climate and Environment think the process is moving too quickly and that we hold too little knowledge to open the Norwegian Continental Shelf so soon. Despite the

advice from these institutions, the Ministry of Petroleum and Energy has decided to move forward with the process and refers to research that "supports" their wish to move forward with the opening process. With so much research conducted, policymakers have no difficulties with finding scientific experts that can present evidence that supports their own particular views (Weingart, 1999). Scientific knowledge can thus be used to legitimate different political positions and decisions, and knowledge is thus not necessarily the one-dimensional and non-political truth that many expect lies in the term "scientific advice" (Weingart, 1999). Apparently, scientific knowledge cannot so easily be separated from value judgements, and the relationship between knowledge through science and decision-making is complex. It involves matters such as how problems are framed and what type of knowledge that can be collected, the degree of consent over the available knowledge, how it can be interpreted, but perhaps most importantly, how the available knowledge relates to political interests and social values (Weingart, 1999).

6.2 What way forward?

Baker (2021) argues that the case of deep-sea mining is not a conflict between "*fossil-fuel firms and clean energy proponents, but rather over what ecosystems we are willing to sacrifice*." He receives support from Andrew Sweetman, a marine scientist at the Heriot-Watt University in Edinburgh, who states that at some point, there has to be a trade-off if we are to save the planet from "human-induced warming" (Baker, 2021). Sweetman further underlines that he is neutral to mining from the deep ocean, but that we must eventually understand that in order to continue to have new computers, cell phones, or electric cars, mining for minerals has to take place either in the ocean or on land. Nevertheless, it is essential to obtain the best environmental data possible before the decision to mine is made so that we are more aware of the effects of our actions. "*And then it is up to society to make the decision to go ahead."* (Baker, 2021).

In order to gain more knowledge, it is necessary to conduct research and testing. Exploration and monitoring of impacts can help increase the scientific knowledge regarding the deep seabed that is lacking, and further research can help to expand the understanding of genetic resources and its potential use in pharmaceuticals and biomedical products (Levin et al., 2020). Kris van Nijen, managing director at GSR (Global Sea Mineral Resources), a subsidiary of the DEME Group that focuses on the development of sustainable ocean mineral resources, expressed to The Times that putting a stop to exploration could be counterproductive and that by not conducting any research at the deep seabed, it will remove all chances for the industry. This

will lead to the disappearance of investment resulting in less funding for research. Thus, in about ten years, *"we are in a similar boat as we are today, without a significant advance in knowledge"* (Baker, 2021). He further argues that he does not believe that the ISA will grant any commercial licenses without a full environmental impact assessment, and if the science proves that deep-sea mining is no better than the alternative of land-based mining, then the industry will never become commercialized (Baker, 2021). Lars Sørum, Head of Research at SINTEF, also emphasizes the importance of exploring the possibilities of a marine minerals industry, as the environmental risk can only be identified through research and scientific studies (Sørum, 2021).

Levin et al. (2020) propose an interesting solution to the debate: slow down the process from exploitation to exploration. By doing so, it will allow research time to ensure effective environmental protection and improve the scientific data, which can help to fill the knowledge gaps needed for decision-making and environmental management. As many of the key management and research institutions in Norway have expressed that it is unlikely to be able to gather all the necessary knowledge within Q2 2023, it is not unlikely that the exploration phase of the opening process in Norway will be extended.

The Norwegian government has decided to take a different approach to the industry of deep-sea mining than most other countries and has thus received criticism for ignoring potential negative environmental effects. Nevertheless, there is significant uncertainty regarding these effects, whether or not deep-sea mining is in line with all of the UN SDGs or whether this type of industry belongs in a sustainable marine economy. Something that does not come forward so clearly in the international debate regarding a marine minerals industry is that the majority of the discussions regarding ocean mining are not necessarily about whether to mine or not. Instead, the discussions address how to, when, and where the activity should take place and what the impacts may be (Levin et al., 2020). Even though several countries have voted for a moratorium, they are not voting against deep-sea mining forever but more against the speed of the process in light of how little knowledge there currently is about the potential effects. While most countries have shelved the idea of the industry, the Norwegian government has initiated an opening process within its jurisdictional zones as an attempt to fill these knowledge gaps and improve the scientific data, which can help to improve decision-making and environmental management at a later stage. The opening process has spurred the interest of the industry, which again has led to increased financial investment in both technology development and research projects. However, it is perhaps too soon to state whether deep-sea mining will become a new

growth industry in Norway because of the uncertainty related to prices, costs, technological development, and environmental requirements, where both international and national developments come into play. Therefore, the final decision is likely to rely on a combination of scientific knowledge, political interests and how much risk the authorities are willing to take.

7 Conclusion

Eventually, society must make choices if we are to succeed with both the transition to a low-carbon emission future and meet the needs of a growing population. Both the current mining on land and deep-sea mining involve controversies, but reaching a low-carbon emission future will inevitably have its costs. Thus, trade-offs have to be made at some point. The case of deep-sea mining is filled with strong opinions, but what makes the debate challenging is that it involves several environmental, economic and social sustainability arguments on both sides of the debate. Policymakers can usually lean on sustainability arguments, the United Nation's Sustainable Development Goals, and the Precautionary Principle to make the "correct" decisions, but these principles have perhaps caused more difficulties in the debate on deep-sea mining than they have helped. There is also significant uncertainty related to the effects of deep-sea mining, and making decisions under uncertainty is always challenging. A decision on how much risk to take and how much weight to give precautionary measures must be taken, and this choice is likely going to be affected by political interests and social values.

The Norwegian government has taken a different approach than many other countries in the debate of deep-sea mining but is probably one of the better candidates for being a pioneer in a marine minerals industry than e.g., the Pacific island state of Nauru, which is renowned for overexploiting and exhausting most of its natural resources, its struggle with corruption and its unstable political economy. Norway holds renowned experience from offshore activities such as oil and gas and shipping, and there is a close collaboration between the authorities, research institutions, and the industry, which is at the forefront on low environmental impact operations. In addition, the country is one of the only countries in the world with a marine mineral's legislation in place. Finally, it is the Norwegian authorities that manage the resource and impact studies, which is considered a sign of political will and steadiness. This makes Norway a potential suitable frontrunner, despite the many risks and uncertainties involved.

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9 Appendix

Appendix I

Interview guide: The Norwegian Petroleum Directorate

- Oljedirektoratet bistår departementet i gjennomføringen av konsekvensutredningen og koordinerer det faglige utredningsarbeidet. Dere mener at det er nødvendig å komme i gang med åpningsprosessen for utvinning av havbunnsmineraler. Hva mener dere er de viktigste argumentene for at Norge skal være et foregangsland innen havbunnsmineralutvinning?

- Hva oppfatter dere er de viktigste konfliktlinjene rundt introduksjonen av utvinning av havbunnsmineraler?

- Flere større og sentrale aktører som Havforskningsinstituttet, Klima- og Miljødepartementet, Miljødirektoratet osv hevder at den konsekvensutredningen som nå er startet ikke har tilstrekkelig omfang eller varighet til å fremskaffe nødvendig kunnskap for beslutning om åpning for kommersiell mineralutvinning. De mener at vi kjenner for dårlig til hvordan disse økosystemene fungerer og artene som lever der. Er det riktig å sette i gang en så risikofylt prosess under så stor usikkerhet?

- Er det realistisk å klare å hente inn nødvendig kunnskap innen 2023, slik at vi har et godt nok kunnskapsgrunnlag for beslutninger?

- Flere av aktørene involvert i denne prosessen trekker frem at utvinning av havbunnsmineraler er i strid med føre-var-prinsippet. Hva tenker dere om dette?

- Norge var ett av landene som stemte mot moratoriet på havbunnsmineraler på IUCN konferansen i september 2021. Hvorfor stiller vi oss så ulikt til utvinning av havbunnsmineraler enn mange andre land?

- Dersom Norge skulle følge den foreslåtte tidsplanen, hvordan tror dere at det kan påvirke Norge sitt omdømme rundt bærekraftig forvaltning av naturressurser internasjonalt? Er dere bekymret for at det kan skade Norge sitt omdømme?

- Dere mottok 53 høringsuttalelser på Programforslaget. Hvordan gikk dere videre med de innspillene dere mottok?

- I hvilken grad egner en høringsprosess seg for å ivareta de ulike interessene og uenigheter?

- Hvordan vil høringsprosessen og høringsinnspillene påvirke det videre arbeidet?

- Hvor tror dere at denne næringen er om 10 år?

- Hva mener dere må til for at Norge skal klare å bli et foregangsland i verden for ansvarlig og bærekraftig utvinning av havbunnsmineraler?

Appendix II

Interview guide: The Institute of Marine Research

- Flere aktører innenfor både forskning og næringsliv i Norge mener at det er nødvendig å utvinne havbunnsmineraler og at Norge må lede an fordi vi har forekomster som Europa trenger, at vi kan utvinne det på mer bærekraftig måte enn andre land og dermed kan sette en global standard for hvordan slike operasjoner bør utføres. Dere er jo en av aktørene som mener at den konsekvensutredningen som nå er startet ikke har tilstrekkelig omfang eller varighet til å fremskaffe nødvendig kunnskap for beslutning om åpning for kommersiell mineralutvinning. Hva er deres tanker rundt argumentene for mineralutvinning på norsk kontinentalsokkel?

- I høringsuttalelsen deres så skriver dere at det fortsatt er vesentlig kunnskapsmangel rundt utvinning av havbunnsmineraler. Vil vi noen gang få nok kunnskap?

- Er det ikke viktig å komme i gang med en slik prosess? Nettopp for å få fart på kunnskapsinnhentingen?

- Er det ikke bedre at Norge går frem som et foregangsland og er mer på å utvikle teknologi og sette standarder enn andre land som for eksempel Nauru?

- Hva oppfatter du er de viktigste konfliktlinjene rundt introduksjonen av utvinning av havbunnsmineraler?

- Flere av aktørene involvert i denne prosessen trekker frem føre-var-prinsippet i denne sammenhengen. Hva forstår du med en føre-var-tilnærming?

- Norge var ett av landene som stemte mot moratoriet på havbunnsmineraler på IUCN konferansen i september 2021. Hva tror dere er grunnen for at norske myndigheter stiller seg annerledes til utvinning av havbunnsmineraler enn myndighetene i mange andre land?

- Dersom Norge følger den timeplanen som er satt opp, hvordan tror dere at dette kan påvirke Norges omdømme rundt bærekraftig forvaltning av naturressurser internasjonalt?

- I hvilken grad føler du at deres synspunkter ble ivaretatt i det endelige konsekvensutredningsprogrammet? Føler du at dere hadde noen påvirkning på beslutningene?

- I hvilken grad opplever dere at høringsprosessene er med å løse uenigheter og konflikter mellom ulike aktører?

- Hva fungerer bra i disse prosessene, og hva kan forbedres?

- Hvor står vi om 10 år? Er utvinning av havbunnsmineraler blitt en ny og viktig industri i Norge?

- Hva vil bestemme utfallet?

Appendix III

Interview guide: Adepth Minerals

- Dere er blant de som mener det er viktig at Norge får gjennomført en åpningsprosess og kommet i gang med utvinning av havbunnsmineraler. Hva mener dere er de viktigste argumentene for at Norge skal være et foregangsland innen havbunnsmineralutvinning?

- Hva oppfatter dere er de viktigste konfliktlinjene rundt utvinning av havbunnsmineraler?

- Flere aktører innenfor både forskning og næringsliv i Norge mener at den konsekvensutredningen som nå er startet ikke har tilstrekkelig omfang eller varighet til å fremskaffe nødvendig kunnskap for beslutning om åpning for kommersiell mineralutvinning. De mener at vi kjenner for dårlig til hvordan disse økosystemene fungerer og artene som lever der. Hvordan stiller Adepth Minerals seg til disse argumentene?

- Flere av aktørene involvert i denne prosessen trekker frem føre-var-prinsippet I denne sammenhengen. Hvordan ser dere på dette?

- Når regner dere med at de første lisensene vil kunne tildeles på norsk sokkel?

- Norge var ett av landene som stemte mot moratoriet på havbunnsmineraler på IUCN konferansen i september 2021. Hva tror dere er grunnen for at norske myndigheter stiller seg annerledes til utvinning av havbunnsmineraler enn myndighetene i mange andre land?

- Flere land, men også private selskaper som Samsung, Philips, Patagonia, Volvo Group og BMW Group har stemt for moratoriet. De garanterer dermed å ikke hente ut mineraler på dyphavsbunnen, bruke disse ressursene i sine forsyningskjeder eller finansiere dyphavsaktiviteter før man vet mer om dyphavet og konsekvensene av utvinning. Flere og flere selskaper gjør det samme. Dette kan gjøre markedspotensialet for havbunnsmineraler mindre, og det kan svekke selskapers markedstilgang og konkurranseevne. Hvordan regner dere med at dette vil kunne påvirke dere?

- I tillegg så har kravene til å rapportere på bærekraft og samfunnsansvar blitt strengere og mer omfattende. I 2021 vedtok EU nye rapporteringskrav, og det er varslet om betydelige revideringer også i de kommende årene. I Norge vedtas det to nye lover som vil få stor betydning for innholdet i rapporteringsplikten hos norske selskaper. Hva slags utfordringer tror dere dette kan føre til for deres del?

- Hva anser dere som de største utfordringene for deres del?

- Dersom Norge følger den timeplanen som er satt opp, hvordan tror dere at dette kan påvirke Norges omdømme rundt bærekraftig forvaltning av naturressurser internasjonalt?

- I hvilken grad føler du at deres synspunkter ble ivaretatt i det endelige konsekvensutredningsprogrammet? Føler du at dere hadde noen påvirkning på beslutningene?

- I hvilken grad opplever dere at høringsprosessene har vært med på å løse uenigheter og konflikter mellom aktører?

- Hva har fungert bra i åpningsprosessen til nå, og hvordan kan den eventuelt forbedres?

- Hvor tror du at den norske næringen for havbunnsmineraler er om 10 år?

- Hva mener dere skal til for at Norge skal klare å bli et foregangsland i verden for ansvarlig og bærekraftig utvinning av mineraler?