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The benefit sharing regime of the International Seabed Authority

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Kurzbeschreibung

Die Mitgliedstaaten der Internationalen Meeresbodenbehörde verhandeln derzeit über einen umfassenden Kodex für den Abbau mineralischer Rohstoffe wie Manganknollen, Massivsulfide und kobaltreicher Krusten im Meeresbodengebiet jenseits der Grenzen nationalen Rechts, dem Gemeinsamen Erbe der Menschheit. Diese Studie zielt darauf ab, die anstehenden Probleme des im Seerecht vorgesehenen gerechten Ausgleichs der möglicherweise entstehenden wirtschaftlichen und finanziellen Vorteile auf ganzheitliche Weise anzugehen. Wir stellen zunächst die rechtlichen Vorgaben vor und betrachten ergänzend die umfassenden ethischen Überlegungen und Entwicklungen, welche zu der heute global als notwendig erachteten Transformation hin zu nachhaltigem Wirtschaften und Leben, ausgedrückt in der Agenda 2030 und den Zielen für nachhaltige Entwicklung, geführt haben. Dies ist der Rahmen für unsere Empfehlungen zu einem umfassenden Vorteilsausgleichsregime.

Was genau ist unter Vorteil zu verstehen? Bezieht das auch Nachteile mit ein? Gestützt auf das Konzept des Naturkapitals und damit auf einen umweltökonomischen Ansatz, der darauf abzielt, alle Formen des Kapitals fair zu berücksichtigen, analysieren wir im nächsten Kapitel die Vorteilsproblematik von Rohstoffabbau vor den speziellen Anforderungen des gemeinsamen Erbes der Menschheit. Die von der Tiefsee erbrachten Ökosystemdienstleistungen müssen als messbarer Nutzen in die Kalkulation einbezogen werden und ebenso ihre etwaige Beschädigung auch Bergbau als anrechenbare Kosten.

Der bislang verhandelte Ansatz zum Zahlungsmechanismus wird vorgestellt und gegen ein dem Gemeinsamen Erbe gerechteren System zur Aufteilung des Nutzens abgewogen. Es muss zudem auch auf integrierte und umfassende Weise ein gemeinsames Bild der Zukunft entworfen werden, damit die Entscheidungen als gerecht und fair akzeptiert werden. Ein möglicher Mechanismus hierzu ist die Szenario Analyse, in welche im letzten Kapitel eingeführt wird.

Abstract

Member states of the International Seabed Authority are working to adopt a comprehensive Mining Code this study aims to address the issues around benefits in relation to mining the Area in a holistic way. The initial chapter summarises the legal framework of the benefit sharing regime in the context of the Common Heritage of (Hu)mankind. Having established the legal basis, we look at the broader ethical considerations and developments which have led to the global commitment for "Transforming our World" towards sustainable development and economies, enshrined in the Agenda 2030 and the Sustainable Development Goals. This provides a framework for policy recommendations on an inclusive benefit sharing regime that take also the precautionary principle fully into account.

The next chapter provides a comprehensive economic analysis of mining in the Area in relation to benefits that may or may not accrue for distribution to mankind. The analysis is based on the concept of natural capital and thus an environmental economics approach that aims to fairly consider all forms of capital and the ecosystem services provided by the deep ocean. This offers a way to assess benefits and losses. By developing the idea of a net benefit for humanity as a precondition for mining, this approach allows decisions based on adequate criteria for the benefit sharing regime.

The financial payment mechanism chapter looks at the work undertaken to date by the ISA through workshops and third-party contracts to deliver the payment mechanism for contractors to compensate mankind for losses in the Area. This chapter critically assesses the approach taken and proposes alternatives. To deliver a meaningful benefit sharing regime that is acceptable to a broad range of stakeholders requires not only that it reflects legal, societal, environmental and economic concerns but it also needs to be debated in an integrated and comprehensive way so that the results seem equitable and fair. The final chapter provides an introduction into scenario analysis as a mechanism that could be considered to get to such a common agreement.

Inhaltsverzeichnis

Abkürzungsverzeichnis

BBNJ	Biological Diversity in Areas Beyond National Jurisdiction
CAPEX	Capital Expenditure
CBA	Cost-Benefit Analysis
CCZ	Clarion-Clipperton Zone
CEO	Chief Executive Officer
CHM	Common Heritage of (Hu)Mankind
DSM	Deep Seabed Mining
EBM	Ecosystem-Based Management
EEA	European Environment Agency
EGS	Ecosystem Goods and Services
EIA	Environmental Impact Assessment
EMM	Environmental Management and Monitoring Plan
EPC	Economic Planning Commission
EU	European Union
GDP	Gross Domestic Product
GRR	Global Risks Report
HELCOM	Kommission zum Schutz der Meeresumwelt im Ostseeraum (Convention on the Protection of the Marine Environment of the Baltic Sea Area)
IMF	International Monetary Fund
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
ISA	International Seabed Authority
IUCN	The International Union for Conservation of Nature
LTC	Legal and Technical Commission
MIT	Massachusetts Institute of Technology
NCC	Natural Capital Committee
NGO	Non-Governmental Organisation
NPPF	National Planning Policy Framework
OEWG	Open –Ended Informal Working Group of the Council
OPEX	Operational Expenditures
SDG	Sustainable Development Goal
SMS	Seafloor Massive Sulfide
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea

Zusammenfassung

Das internationale Seerecht weist einen Teil des Ozeans als Gemeinsames Erbe der Menschheit aus. Dies betrifft den Meeresboden, einschließlich der dortigen mineralhaltigen Substrate, in Gebieten jenseits aller nationalen Ansprüche der Küstenstaaten, im sogenannten "Gebiet". Alle Aktivitäten, die mit der Förderung dieser mineralischen Vorkommen zusammenhängen sollen so durchgeführt werden, dass sie im Sinne und zum Wohl der gesamten Menschheit sind. Stellvertretend für die Menschheit entscheidet die globale Staatengemeinschaft unter dem Dach der Internationalen Meeresbodenbehörde über die Bedingungen für die kommerzielle Förderung von mineralischen Rohstoffen, die Verwirklichung eines effektiven Schutzes der Meeresumwelt vor den Folgen dieser Förderung, sowie über ein gerechtes Regime zur Kompensation der Menschheit für den materiellen und immateriellen Wertverlust des Gemeinsamen Erbes heute und in der Zukunft.

Parallel zu den aktuell geführten Verhandlungen über die rechtlichen Rahmenbedingungen für den kommerziellen Bergbau am internationalen Tiefseeboden wird ein Abgabensystem diskutiert. Der hierfür bisher gewählte Ansatz baut auf gängigen Industriekonzepten auf, bei denen die Umweltkosten nicht eingerechnet werden, und der voraussichtliche Gewinn für das Gemeinsame Erbe gering ist. Auch die Frage der sozialen Akzeptanz des Tiefseebergbaus, im Kontext eines stetig steigenden Umweltbewusstseins in der Gesellschaft findet wenig Beachtung. Was in der heutigen Zeit und vor dem Hintergrund der Nachhaltigkeitsziele, einen echten Gewinn für die Menschheit darstellt bleibt in der internationalen Debatte weitgehend undiskutiert.

Ziel der vorliegenden Studie ist es, diesen Ansatz kritisch zu hinterfragen und alternativ ein ökonomisch und ökologisch konsistentes Modell vorzustellen, dass, wie im Seerecht vorgesehen, auch einen intra- und intergenerationell gerechten Vorteilsausgleichs beschriebt.

Dazu stellen wir zunächst die rechtlichen Grundlagen des vorgesehenen Vorteilsausgleichsregime vor (2.2) und erörtern das Konzept des "Gemeinsamen Erbes der Menschheit" im Kontext der globalen Nachhaltigkeitsagenda und deren historischer Entwicklung parallel zu den Verhandlungen über das Seerecht in den Vereinten Nationen (2.3). Daraus wird eine Verpflichtung zu einer Überprüfung von durch Aktivitäten im Gebiet entstehenden Kosten und Vorteilen durch eine Kosten-Nutzen Analyse (2.2.3), und eine Leitfunktion der Nachhaltigkeitsagenda für die Umsetzung von Tiefseebergbau im Rahmen des Prinzips Gemeinsames Erbe der Menschheit abgeleitet. Kapitel 3 stellt das Konzept des Naturkapitals vor, welches unter Internalisierung aller Kosten, die theoretische und praktische Grundlage für die Umsetzung einer Kosten-Nutzen-Analyse liefert. In Kapitel 4 wird das derzeit bei der Meeresbodenbehörde diskutierte Abgaben-Modell analysiert und insbesondere daraufhin untersucht, ob es den Anforderungen an den Umgang mit dem Gemeinsamen Erbe entspricht. Alternative Ansätze werden vorgestellt. Die Ausweisung des Gebietes als Gemeinsames Erbe der Menschheit erfordert insbesondere Transparenz und die Herstellung eines gesellschaftlichen Konsenses darüber was in der heutigen Zeit und in der Zukunft ein wünschenswerter Vorteil aus dem Gemeinsamen Erbe wäre. Kapitel 5 zeigt Möglichkeiten auf, wie ein solcher Konsens praktisch erarbeitet werden kann.

Viele durch menschliche Aktivitäten hervorgerufene Umweltveränderungen gefährden die Ökosysteme des Planeten. Falls dennoch die Weichen für eine weitere industrielle Aktivität im bislang unberührten tiefen Ozean gestellt werden sollen ist es für die Ermittlung der Konsequenzen erforderlich ein ganzheitliches Buchhaltungssystem zu führen, welches die Auswirkungen von Aktivitäten auf die menschliche Umwelt in Bezug zur natürlichen Resilienz der Ökosysteme erfasst. Es ist bekannt, dass bei Überschreitung bestimmter natürlicher Grenzen Ökosysteme durch menschliche Einwirkungen irreversibel in neue Zustände kippen können, wobei sie ihre bisherigen (für Menschen wichtigen) "Dienstleistungen" verlieren. Die Verwendung von Methoden der wirtschaftlichen Bewertung von Gewinn und Verlust von Ökosystemgütern und -Dienstleistungen hat eine starke Grundlage in der Wirtschaftstheorie und eine wachsende Evidenzbasis. Sie erlaubt es Gewinn und Verlust mit derselben

"Währung" auszudrücken, wenn auch die Bezifferung der Ökosystemverluste wegen der großen Kenntnislücken ungenau ist. Zur Vermeidung unkontrollierten Verlustes müssen daher die voraussichtlich irreversiblen, großskaligen und umfassenden ökologischen Auswirkungen des Tiefseebergbaus zunächst korrekt bewertet werden, einschließlich möglicher Auswirkungen auf das Naturkapital der Ozeane.

Die moderne Ressourcenökonomie geht davon aus, dass nicht erneuerbare Ressourcen begrenzt sind und daher jede Nutzung optimiert werden muss. Vorschriften, einschließlich Zahlungsmechanismen, sollten so strukturiert sein, dass die Betreiber die besten Anreize für eine effiziente Nutzung der Prozesse erhalten. Relevante Ziele sind, Mineralien für die Zukunft im Boden zu halten, Innovationen zu fördern und bessere, effektivere Bergbauprozesse zu entwickeln und Erträge aus der Gewinnung produktiv wieder zu investieren. Es wurden detaillierte Wirtschaftsmodelle entwickelt, um den Ansatz zur Berechnung des Wohlstands zu berechnen. Wir müssen die Einnahmen aus dem unvermeidlichen Verbrauch endlicher Ressourcen in andere Kapitalformen reinvestieren, beispielsweise durch die Wiederherstellung des Naturkapitals oder durch den Aufbau von Wissen und Humankapital.

Das Konzept des Naturkapitals

Das Konzept des Naturkapitals wird seit den 1990er Jahren häufig verwendet, um natürliche Zwänge in das Wirtschaftslexikon aufzunehmen. Für eine nachhaltige Entwicklung muss den Bedürfnissen sowohl der heutigen wie zukünftiger Generationen Rechnung getragen werden. Dies schließt auch das Recht auf eine natürliche Umwelt ein. Naturkapital ist eine von mehreren Arten von Kapital, die als Produktionsfaktoren verwendet werden. Es ist natürlich, weil es nicht von der Menschheit produziert wird. Die Natur stellt kostenlos erneuerbare Ressourcen zur Verfügung, sofern diese nicht überbeansprucht werden, während nicht erneuerbare Ressourcen nur einmal beschafft werden können. Sowohl erneuerbare als auch nicht erneuerbare Ressourcen (und damit zugrundeliegende Vermögenswerte) können bewertet werden. Neben der Bereitstellung physischer Produkte (und Dienstleistungen) bietet die Natur auch natürliche Schönheit sowie spirituelle und ästhetische Werte.

Eines der Werkzeuge ist die Anlage von Vermögenskonten, mit welchen Länder eine Bestandsaufnahme durchführen können, um die Nachhaltigkeit von wirtschaftlicher und gesellschaftlicher Entwicklung zu überwachen. Für nicht erneuerbare natürliche Kapitalanlagen muss die Gesellschaft eine Entscheidung treffen, ob wir sie jetzt konsumieren oder sie bewahren, sodass möglicherweise zukünftige Generationen mit potenziell wichtigeren Bedürfnissen und geeigneteren Technologien diese nichterneuerbaren Güter konsumieren kann. Wenn heute Vermögenswerte verwendet werden, müssen andere Vermögenswerte beiseitegelegt werden, um zu kompensieren, was diese Generation verbraucht hat.

Seit den 1970er Jahren, angefangen mit dem berühmten Bericht des Club of Rome (Meadows et al., 1972), wird Systemdenken angewendet, um zu verstehen, wie komplexe Systeme in der öffentlichen Politikgestaltung effektiver verändert werden können. Es wird zunehmend zur Modellierung von Interaktionen zwischen anthropogenen und natürlichen Systemen verwendet, um die Wahl zwischen alternativen Szenarien für Maßnahmen oder politische Interventionen zu erleichtern.

Die Bewertung des direkten und indirekten Nutzens von marinen Ökosystemleistungen kann die langfristige Nachhaltigkeit unterstützen, Indikatoren und Entscheidungsinstrumente bereitstellen und transdisziplinäre Ansätze verbessern. Der wirtschaftliche Gesamtwert umfasst sowohl Gebrauchs- als auch Nichtnutzungswerte. Naturkapital zusammen mit wirtschaftlichem und sozialem Kapital sorgen für integrativen Wohlstand als bestes Maß für Wohlstand. Aber während heute immaterielles, soziales, Kapital möglicherweise wächst, ist das natürliche Kapital erschöpft, was schwerwiegende Folgen für das menschliche Wohl hat.

Ökosystemdienstleistungen spielen eine zentrale Rolle im Rahmen der Ökosystembuchhaltung, da sie die Verbindung zwischen Ökosystemvermögen (alle biotischen und abiotischen Komponenten sowie deren Interaktion) einerseits und den Vorteilen für die Gesellschaft andererseits herstellen.

Ökosystemleistungen, die zum Wohlbefinden des Menschen beitragen, können klassifiziert werden in:

- Bereitstellungsdienstleistungen - Produkte wie: Lebensmittel (Fisch); Wasser; Faser (Holz); und Kraftstoff
- Regulierung von Dienstleistungen - Vorteile wie: Wasseraufbereitung; Klimaregulierung; Reduzierung von Lärm und Luftverschmutzung sowie Reduzierung der Hochwassergefahr
- Kulturelle Dienstleistungen - immaterielle Vorteile, zum Beispiel: durch kulturelles Erbe; Erholung oder ästhetische Erfahrung
- Unterstützende Dienstleistungen - wie z.B. Nährstoffkreislauf, Sedimentbildung, Bereitstellung des Habitats und Biodiversität

Die Summe dieser Komponenten untermauert nicht nur alle wirtschaftlichen Aktivitäten, sondern auch das Leben auf der Erde an sich. Bei angemessener Nutzung kann das Naturkapital die Ökosystemleistungen und -vorteile weiterhin auf unbestimmte Zeit erbringen. Die Bereitstellungsdienste werden von Regulierungsdiensten gefördert, die viele für den Menschen wesentliche Funktionen mariner Ökosysteme unterstützen. Diese Dienstleistungen umfassen unter anderem die Bereitstellung von Nahrungsmitteln für Organismen, den Nährstoffkreislauf und die Kohlenstoffbindung.

Ohne Kenntnis der Funktionsweise mariner Ökosysteme im Zusammenhang mit Mineralvorkommen können Änderungen des Zustands eines Ökosystems nach Änderung der Umwelt nicht eingeschätzt werden. Die Ermittlung der von Meeresbodenökosystemen erbrachten Dienstleistungen, einschließlich ihrer Lebensdauer und ihres Rhythmus, ist daher für die Abschätzung der Auswirkungen zukünftigen Tiefseebergbaus von entscheidender Bedeutung.

Die Weltbank hat einen solchen Ansatz der vorsorglichen Bewirtschaftung von Tiefseemineralien für den Pazifik skizziert (World Bank 2017b), bei dem eine detaillierte Untersuchung der Kosten und des Nutzens des Tiefseeabbaus durchgeführt und Anstrengungen unternommen wurden, um den Wert des intakten Ozeans für die Menschen zu bewerten.

Kein Nettoverlust

Das Prinzip „kein Nettoverlust“ der biologischen Vielfalt ("no net loss of biodiversity") wurde von Regierungen, Unternehmen und Finanzinstituten international vereinbart und als Ziel übernommen. Ökosysteme können nur bis zu einer bestimmten Schwelle Belastungen kompensieren. Jenseits dieser Schwelle kann ein schrittweiser Anstieg des menschlichen Drucks zu einer großen, oft abrupten Änderung der Struktur und Funktion eines Ökosystems führen. Solche abrupten Regimewechsel sind in der Regel irreversibel bzw. wenn überhaupt kostenintensiv rückgängig zu machen und können für die menschliche Umwelt zutiefst negative ökologische, wirtschaftliche und soziale Folgen haben. Es wird erwartet, dass diese Schwellenwerte in den kommenden Jahrzehnten in marinen, aquatischen und terrestrischen Ökosystemen häufiger überschritten werden, aufgrund weiter zunehmender Handlungsintensität und deren kombinierten und oft synergistischen Wirkungen. Die komplexe nichtlineare Dynamik von Ökosystemen und ihre Wechselwirkungen mit menschlichen Systemen machen es schwierig vorherzusagen, wo Schwellenwerte liegen, wann sie überschritten werden und wie groß die Auswirkungen sein werden. Angesichts dieser Unsicherheit und der möglichen Auswirkungen von Regimewechseln ist es ratsam, vorsorglich vorzugehen und Störungen weit unter den wahrscheinlichen Schwellenwerten zu halten. Das Konzept des „Nettogewinns“ zielt darauf ab, einige dieser Herausforderungen anzugehen. Ein Beispiel für die Verwendung des Konzepts findet sich im britischen Ansatz auf der Grundlage des Natural Capital Committee (NCC) an die Regierung vom Mai 2019.

Um das Konzept des positiven Nettonutzens auf den Abbau von mineralhaltigem Substrat im Gebiet anzuwenden, sind eine Basisbewertung und klare Überwachungs-, Verifizierungs- und Qualitätssicherungsprozesse erforderlich, die von benannten zuständigen Stellen durchgeführt werden. Dadurch wird es ermöglicht potenzielle externe (Umwelt-)Kosten von Aktivitäten zu berücksichtigen. Voraussetzung ist, dass die Bilanzierung sowohl während der Explorationsphase als auch auf Tiefsee-Bergbaukonzessionen während der Nutzungsphase angewendet wird. Alle Auswirkungen sind in einer Umweltverträglichkeitsprüfung vollständig zu berücksichtigen. Umweltverträglichkeitsprüfungen müssen vom Regulierer im Lichte des Vorsorgeprinzips und des CHM überprüft und für akzeptabel eingeordnet werden. Für das Gebiet muss diese Form der Akzeptanz von allen Beteiligten kommen. Dazu gehören auch nichtstaatliche Akteure wie Umweltgruppen, Befürworter:innen anderer menschlicher Aktivitäten (z. B. Fischerei, Tourismus, Schifffahrt oder Tiefseekabelindustrie) und die Öffentlichkeit, sowie Wissenschaftler:innen und andere Expert:innen.

Ökologische Kosten

Die hohe Unsicherheit über die ökologischen Kosten im Zusammenhang mit dem Abbau des Meeresbodens verschärft die Schwierigkeiten bei einer Kosten-Nutzen-Analyse. Die Weltbank empfiehlt, das Vorsorgeprinzip anzuwenden und fundierte Kosten-Nutzen-Analysen der vorgeschlagenen-Projekte durchzuführen, bevor sie umgesetzt werden.

Das allgemeine Funktionieren der Tiefsee als Ökosystem ist von hoher wirtschaftlicher Bedeutung. Die hohen Summen, die für die gesamten Ökosystemleistungen angegeben wurden, unterstreichen die Notwendigkeit, unser Verständnis darüber zu verbessern, wie die Tiefsee als Ökosystem einen wirtschaftlichen Wert für die menschlichen Gesellschaften erzeugt. Der Erhalt der biologischen Vielfalt ist der Schlüssel zum Erhalt gesellschaftlich relevanter Werte und sollte zu ihrem Schutz führen. Indem wir den Standard für neue Aktivitäten danach festlegen, ob diese umfassend zur Erzielung eines positiven Nettonutzens unter Abwertung aller Vorteile und Kosten beitragen können, können wir sicherstellen, dass Fortschritte in diese Richtung erzielt werden können.

In Europa wird der Schwerpunkt zunehmend auf Konzepte wie Kreislaufwirtschaft, grüne Wirtschaft, grüne Infrastruktur, Naturkapital und naturbasierte Lösungen gelegt. Entsprechend relevant sind Argumente für den Umweltschutz auch unter verstärkter Verwendung wirtschaftlicher und monetärer Argumente.

Der tiefe Ozean ist kaum untersucht und daher braucht es dringend weiterer Forschung, um seine Ökosystemfunktionen vollständig zu verstehen. Auf der Ebene der potenziellen Knollenabbaugebiete weist die östliche Clarion-Clipperton Zone, CCZ, eine extrem hohe biologische Vielfalt auf und bringt den Nachweis, dass der Meeresboden ein wichtiger Lebensraum u.a. für Wale ist. Die Existenz verschiedener Bakterien und Archaeen Gemeinschaften deutet darauf hin, dass eine breite Palette von funktionellen Arten mit signifikanten Ökosystemleistungen vom Tiefseebergbau betroffen sein könnte. Es kann davon ausgegangen werden, dass es im Falle des Abbaus zu einem messbaren Nettoverlust der (ansässigen) biologischen Vielfalt kommen würde.

Die Auswirkungen langfristigen und großräumigen Biodiversitätsverlustes können von der Veränderung der Festlegungsraten von organischem Kohlenstoff bis hin zu veränderten mikrobiellen Umsetzungsraten reichen, und sich potenziell auf das Nachwachsen von Knollen (durch höhere Partikeldichte/Sedimentation) auswirken. Das durch Anpassungsstrategien an extreme Lebensräume entstandene und potenziell für den Menschen wertvolle biologische Material könnte insbesondere durch Bergbau an Hydrothermalquellen gefährdet werden.

Zeitgleich mit der Erarbeitung des Mining Code durch die ISA wird derzeit bei den Vereinten Nationen ein spezifischer Schutz- und ein BBNJ-Vorteilsausgleichsregime für die biologischen Schätze des Meeres, einschließlich des Gebietes ausgehandelt. Infolgedessen muss jeder zusätzliche Stressor in der Tiefsee, wie z. B. der Tiefseebodenabbau, sorgfältig auf seine wirtschaftlichen Kosten hin untersucht

werden. Wie Deepwater Horizon gezeigt hat, können die Auswirkungen menschlicher Aktivitäten in der Tiefsee massive Kosten verursachen. Dazu gehören nicht nur quantifizierbare lokale Auswirkungen, beispielsweise durch die Entfernung endemischer Arten, die sich direkt auf oder um Knollen befinden, sondern auch potenzielle kumulierte Auswirkungen wie zum Beispiel auf die Klimafolgen im Ozean sowie das Potenzial, zu Wendepunkten und Systemänderungen beizutragen.

Die wirtschaftliche Kosten-Nutzen-Rechnung

Wirtschaftswissenschaftler: innen haben eine Reihe von Ansätzen entwickelt, um den Wert des Schutzes der biologischen Vielfalt in der Tiefsee zu bewerten und die Kosten eines erhöhten Risikos und der Volatilität der Ergebnisse zu quantifizieren, auch an abgelegenen Orten und in komplexen marinen Wertschöpfungsketten. Die Ergebnisse zeigen, dass die Methode der bedingten Bewertung ("contingent valuation") wirtschaftliche Schätzungen der Auswirkungen kommerzieller Aktivitäten auf Ökosystemleistungen zur Verwendung bei der Kosten-Nutzen-Analyse liefern kann. In einem kürzlich veröffentlichten IUCN-Bericht werden die finanziellen und gesellschaftlichen Kosten von DSM sowie die potenziellen wirtschaftlichen und gesellschaftlichen Vorteile erörtert.

Eine relevante Debatte betrifft den Metallbedarf in der Weltwirtschaft. So wird von Befürwortern des Tiefseebergbaus argumentiert, dass zusätzlicher Abbau erforderlich ist, um einer zusätzlichen Nachfrage von Metallen gerecht zu werden, die sich z.B. aus dem Ausbau erneuerbarer Energien (Elektrobatterien etc.) möglicherweise ergibt. Andererseits deuten die prognostizierten Verbrauchsmuster von Kupfer, Aluminium, Zement und Stahl darauf hin, dass die künftige Nachfrage nach Ressourcen geringer sein könnte als erwartet, da die Länder ein Stadium erreichen, in dem der Verbrauch eine Sättigung erreicht (Kapitel 3). Teske et al. (2016) haben berechnet, dass die Metallnachfrage im Zusammenhang mit erneuerbaren Technologien auch bei ehrgeizigen zukünftigen Energieszenarien keinen Abbau am Meeresboden erfordert.

Ein wirtschaftlicher Kostenfaktor für DSM, der ebenfalls berücksichtigt werden muss, ist seine Auswirkung auf das globale Kohlenstoffbudget. Zusätzlich zu den Treibhausgasemissionen beim Bau der Ausrüstung, beim Versand und bei der Verarbeitung der Materialien, die teilweise durch eine umfassende Kohlenstoffabgabe angegangen werden könnten, könnte DSM weitere Auswirkungen auf die Kapazität des Ozeans haben, Kohlenstoff in lebende Materie umzuwandeln und zu speichern. Derzeit nimmt die Bedeutung der CO_2-Preisgestaltung im privaten Sektor zu, da immer mehr Unternehmen interne CO_2-Preise verwenden, um klimarelevante Risiken aktiv zu steuern. Es wäre hilfreich zu sehen, ob ISA-Vertragsnehmer:innen für den kommerziellen Abbau im Gebiet die Bewertung ihrer CO_2-Auswirkungen veröffentlichen und wie sie beabsichtigen, diese auszugleichen.

Ein wichtiger Schlüsselbegriff zur Einschätzung der im Finanzmechanismus für den Tiefseebergbau vorgesehenen Zahlungen ist der Begriff der Unsicherheit. Wenn eine zukünftige Zahlung durch die Kontraktor:innen nicht sicher sind, stellt sich die Frage, ob die Empfänger:innen das Risiko eingehen müssen, nicht bezahlt zu werden, oder ob er dieses Risiko auf eine andere Partei wie eine Versicherung oder einen Bürgen übertragen kann, der die Zahlung übernimmt. Ebenso kann die Volatilität potenzieller Ergebnisse das Finanzmodell belasten und unterschiedliche Anreize für Handelsunternehmen schaffen. Angesichts der Vielzahl von Unsicherheiten bei der Durchführung eines erfolgreichen Projekts und der hohen Volatilität der Metallpreise und damit der potenziellen Renditen ist es entscheidend, Regulierungsmechanismen und Risikominderungsinstrumente wie Versicherungen nicht nur so zu strukturieren, dass sie unter allen Umständen robust sind. Sie müssen auch sicherstellen, dass die Betreiber:innen daran gehindert werden, das System zu „spielen", z. B. indem sie zu einem bestimmten Zeitpunkt des Prozesses in Konkurs gehen oder Zahlungen und Transaktionen in verschiedenen Formaten zeitlich festlegen, um die Zahlungen für das CHM zu minimieren. Eine Grundannahme zur Optimierung solcher Zahlungen muss sein, sicherzustellen, dass der "Löwenanteil" aller finanziellen Vorteile, die sich aus Aktivitäten in der Region ergeben, dem CHM zukommen. Eine Umkehr der Beweislast zulasten der Kontraktor:innen kann zudem einen Beitrag zur Umsetzung des

Vorsorgeprinzips leisten. Dies erfordert ein solides Regulierungssystem, das dieses Ergebnis unter verschiedenen Szenarien erzielen kann.

Um die für das CHM zur Verfügung stehende Summe zu optimieren, gilt es, die Kosten für den Abbau zu minimieren. Dies gilt sowohl für die anfänglichen Investitionen als auch auf die Betriebskosten. Wenn es beispielsweise möglich ist, dass eine neue Technik in Zukunft auf den Markt kommt, die eine günstigere und effizientere Tiefseebergbau-Lösung ermöglichen würde, wäre es finanziell sinnvoll, zu warten und erst später zu investieren, um die Zahlungen zu optimieren. Ebenso sind die Finanzierungskosten eine wichtige Komponente eines großen Infrastrukturprojektes. Kreditkosten spiegeln das wahrgenommene Risiko wider. Wenn Risiken reduziert werden können trägt dies zur Optimierung der Zahlungen bei.

Ein gerechter Zahlungsmechanismus für das Gemeinsame Erbe

Der Zahlungsmechanismus muss angemessen und im Einklang mit den Vorschriften von UNCLOS sein. Das heißt, die ISA hat die Aufgabe, die finanziellen und sonstigen wirtschaftlichen Vorteile, die sich aus den Aktivitäten in der Region ergeben, durch einen geeigneten Mechanismus auf nichtdiskriminierender Basis gerecht zu verteilen, wobei insbesondere die Bedürfnisse und Interessen von Entwicklungsländern und Völkern zu berücksichtigen sind oder sonstigen Selbstverwaltungsstatus haben (Artikel 140 Absatz 2 und Artikel 160 Absatz 2 Buchstabe f Ziffer i). Zu diesem Zweck sollen Regeln, Vorschriften und Verfahren entwickelt werden (Art. 162 Abs. 2 Buchst. O i), wobei eine Reihe von Grundsätzen zu berücksichtigen sind, die in Abschnitt 8 des Anhangs der Durchführungsvereinbarung von 1994 dargelegt sind.

Aus rechtlicher Sicht gibt UNCLOS und das Umsetzungsabkommen von 1994 der ISA klare Anforderungen und Mechanismen vor. Am wichtigsten ist, dass das Prinzip des gemeinsamen Erbes der Menschheit neben der Forderung, dass Aktivitäten in der Region zum Wohle der gesamten Menschheit durchgeführt werden müssen, in der die Gestaltung eines gerechten Mechanismus zur Aufteilung der Vorteile voll zum Ausdruck kommen muss. Wenn Aktivitäten in der Region nicht in der Lage sind, der Menschheit einen positiven Nettonutzen zu bringen, wäre folglich die Existenz eines Mechanismus zur Aufteilung der Vorteile funktionsunfähig, und die Durchführung von Aktivitäten in der Region unter solchen Umständen sollte in Frage gestellt werden.

Während der Schwerpunkt auf finanziellen Vorteilen liegt, müssen auch andere nicht monetäre Vorteile geteilt werden. Dies beinhaltet den Austausch von Wissen, Know-how und Know-how, das durch Erfahrung gewonnen wurde. Wege, die den Technologietransfer und den Kapazitätsaufbau erleichtern, sollten gefördert werden. Ebenso sollte die Verbesserung unseres wissenschaftlichen Verständnisses der Tiefsee, was eindeutig der Menschheit zugutekommt, und das aktive Streben nach mehr Daten und Informationen zur Schließung von Wissenslücken gefördert werden.

Abgesehen davon müssen der Begriff der Verteilungsgerechtigkeit und die Interessen der zukünftigen Generationen auch bei der Gestaltung eines geeigneten Mechanismus berücksichtigt werden. Neue Normen wie die nachhaltige Entwicklung und das Verursacherprinzip sollten ebenfalls eine herausragende Rolle spielen. Alle externen Kosten, insbesondere die Umweltkosten, müssen vollständig berücksichtigt und internalisiert werden. Schließlich sind die Operationalisierung des “Enterprise” und die verstärkte Beteiligung der Entwicklungsländer an Aktivitäten in der Region wichtige Bestandteile eines geeigneten Mechanismus, der die Vorteile für die Menschheit und eine gerechte Aufteilung der Vorteile sicherstellt.

Es gibt eine Reihe von Systemen, die weltweit angewendet werden, um potenzielle gesellschaftliche Einnahmen zu optimieren und finanzielle Gewinne zu erzielen. Diese müssen insbesondere die Konzepte des Risikos und des Zeitwerts des Geldes widerspiegeln. Begünstigte bevorzugen sichere CHM-Zahlungen gegenüber dem Risiko, überhaupt keine Gelder zu erhalten. Letzteres könnte

beispielsweise eintreten, wenn die Vertragspartei vor Fälligkeit der Zahlungen beschließt, nicht mit dem Projekt fortzufahren. Das attraktivste Ergebnis wäre daher ein Vorauszahlungsmechanismus.

Ein anderer üblicher Weg, um solche Vorteile zu erfassen, besteht darin, die Gewinne der Aktivitäten zu betrachten und sie entsprechend zu besteuern, im Allgemeinen mit einem progressiven Satz. Dies bedeutet aber, dass die Zahlung nur erfolgt, wenn tatsächlich Gewinne erzielt werden. Ein solches Regime erfordert ein wirksames Rechnungsführungssystem, um Gewinne zu ermitteln. Entscheidungen darüber, welche Abzüge (z. B. für Finanzierungskosten) zulässig sind und zu welchem Zeitpunkt diese Zahlungen fällig sind, müssen im Voraus getroffen werden. Bei Anwendung auf potenzielle Tiefseeunternehmen würde ein solches gewinn-orientiertes Steuersystem angesichts der anfänglichen Anlaufkosten möglicherweise erst Jahrzehnte nach Beginn des Abbaus zu Zahlungen, diese könnten dann jedoch erheblich sein.

Ein alternativer Ansatz, der in einer Reihe von Gerichtsbarkeiten angewendet wird, verwendet Lizenzgebühren, d.h. einen festgelegten Prozentsatz des Umsatzes, der zum Zeitpunkt des Verkaufs zu zahlen ist. Dies erfordert klare Definitionen darüber, woran genau die Lizenzgebühr bemessen wird. Ein solcher Ansatz führt wahrscheinlich zu früheren Zahlungen als eine Gewinn-orientierte Steuer. Für die Behörde besteht weiterhin das Risiko, dass Auftragnehmer:innen mit der Ausübung von Tätigkeiten beginnen, sich jedoch vor dem Verkauf zurückziehen. In diesem Fall würden keine Lizenzgebühren gezahlt. Es kann auch sein, dass der letztendlich gezahlte Gesamtbetrag erheblich geringer sein kann als bei einer Gewinnsteuer oder einem Auktionssystem.

Eine Reihe von Ländern wendet daher in ihren Vorschriften für den terrestrischen Bergbau einen hybriden Ansatz an, bei dem Lizenzgebühren mit Gewinnsteuern kombiniert werden. Ein wirksames Steuersystem für den Tiefseeabbau umfasst eine Mischung aus „Pay-as-you-Produce“ (Lizenzgebühren) und gewinnorientierten Instrumenten, wobei letztere sowohl Körperschaftssteuern als auch Ressourcensteuern umfassen können. Die auf den Cookinseln und in Tonga erhobene zusätzliche Gewinnsteuer ist ein Beispiel für eine auf zweckgebundener Basis erhobene Ressourcensteuer, die für DSM gelten kann.

Das zweite Treffen der informellen, offenen Arbeitsgruppe zum Finanzmodell fand vom 11. bis 12. Juli 2019 in Kingston, Jamaika, statt. Der Vorsitzende der offenen Arbeitsgruppe für das Finanzmodell hob unter anderem hervor: Es bestehen weiter Divergenzen in der Einschätzung der drei vom Bericht des Massachusetts Institute of Technology (MIT) vorgeschlagenen Zahlungsoptionen, nämlich einem Mechanismus für Lizenzgebühren mit festem Zinssatz, der nur als *Ad-Valorem* gilt, Lizenzgebühren und ein kombiniertes gewinnorientiertes System; sowie bei den Optionen für die Einrichtung eines Umweltfonds. Die offene Arbeitsgruppe empfahl dem Rat: (a) eine dritte Sitzung der Arbeitsgruppe einzuberufen, um unter anderem die Arbeit am Zahlungsmechanismus für polymetallische Knollen voranzutreiben und, soweit möglich, mit der Arbeit an anderen Bodenschätzen zu beginnen; und (b) ein entsprechendes neues Modell zu entwickeln, was eine progressive *Ad-Valorem*-Lizenzgebühr beinhaltet. Auf der Tagung des Rates legte die Afrikanische Gruppe eine ausführliche Stellungnahme zum Zahlungsregime vor und kam unter anderem zu dem Schluss, dass der Tiefseeabbau nur erfolgen sollte, wenn er nachweislich für die Menschheit von Vorteil ist. Sie schlug außerdem vor, dass mindestens 40% der Gewinne aus dem Tiefseeabbau von der ISA erhalten werden sollten. Bei dem dritten Treffen der OEWG im Februar 2020 trug das MIT ein Modell mit einer progressiven *Ad-Valorem*-Lizenzgebühr vor. Das frühe Stadium des Verordnungsentwurfs und der indikative Charakter des Modells bedeuteten, dass divergierende Positionen diskutiert und dann auch schriftlich zum neuen Termin vom 23 März eingereicht wurden. Eine vierte Sitzung des OEWG soll nun vor der nächsten Ratssitzung stattfinden.

Empfehlungen

Angesichts der erheblichen Lücken und Probleme des bisherigen MIIT-Ansatzes ist ein Umdenken und gegebenenfalls ein Neuanfang erforderlich, um einen Zahlungsmechanismus zu entwickeln, der mehr im Einklang mit UNCLOS (Kapitel 2.2) und der Notwendigkeit steht, die ökonomischen Vorteile zu optimieren (Kapitel 3). Sollten die Mitgliedstaaten es vorziehen, auf der MIT-Arbeit aufzubauen, wäre es notwendig, diesen auf Kontraktor:in-Interessen basierenden Ansatz durch einige notwendige weitere Komponenten zu ergänzen, insbesondere:

1. Eine Analyse der finanziellen und wirtschaftlichen Auswirkungen des vorgeschlagenen gesamten Mineralienkodex („Mining Code“), nämlich ob die rechtlichen und finanziellen Verpflichtungen (Gebühren, Vorauszahlungen in Fonds, Rentabilitäts- und Versicherungsanforderungen usw.) eine ausreichende Robustheit bieten, um sicherzustellen, dass keine Risiken bei der ISA bestehen bleiben
2. Eine breitere wirtschaftliche Bewertung der potenziellen Kosten von Bergbauaktivitäten für die Tiefsee, um sicherzustellen, dass diese vollständig in die Entscheidungsfindung einbezogen werden, um den positiven Nettonutzen aller durchgeführten Aktivitäten zu gewährleisten (3) über die Wirtschaftlichkeit der Bergbauaktivitäten
3. Ein klarer Entwicklungspfad für die Internationale Meeresbodenbehörde unter Berücksichtigung der Rolle des “Enterprise” und hybrider Modelle, um alternativen wirtschaftliche Vorteile sicherstellen, die über rein finanzielle Zahlungen, die in Kapitel 4 kommentiert sind, hinausgehen.

Eine gesellschaftliche Bewertung des Gesamtnutzens, der Abläufe und der Transparenz ist ebenfalls erforderlich, das Kapitel 5 liefert hierzu Ideen, wie ein Szenario-Ansatz es erleichtern kann, derartige Entscheidungen zu begründen.

Summary

International law identifies part of the ocean as a common heritage of humanity. The seabed, including the mineral deposits thereof, beyond national jurisdiction of the coastal states is defined as the “Area” and should be managed in the interest and for the benefit of all mankind. The international community under the umbrella of the International Seabed Authority decides on the conditions for the commercial extraction of mineral raw materials, the implementation of effective protection of the marine environment from the consequences of this extraction, as well as on a just regime to compensate humanity for the loss of value to the Common heritage today and in the future.

In parallel to the current negotiations of a legal framework for commercial mining on the international deep seabed, a payment mechanism is being discussed. The approach chosen so far is based on commercial concepts and does not take environmental costs into account. The social acceptance of deep seabed mining is not also evaluated in the light of sustainable development.

The aim of the present study is to critically question this approach and, alternatively to present an economically and ecologically consistent model that, as provided for in the law of the sea, also ad-dresses intra- and intergenerationally equitable sharing of benefits.

For this purpose, we first present the legal basis of the envisaged benefit sharing regime (2.2) and put the concept of a "Common Heritage of (Hu)Mankind" into the context of the global sustainability agenda and its historical development parallel to the negotiations of the law of the sea in the United Nations (2.3). An obligation to review the costs and benefits of activities in the Area results and requires a cost-benefit analysis (2.2.3) and the guiding function of the sustainability agenda for implementing benefit sharing under the common heritage principle. Chapter 3 presents the concept of natural capital, which provides the theoretical and practical basis for the implementation, with internalization of all costs. Chapter 4 analyses the payment model currently being discussed by the International Seabed Authority and in particular examines whether it meets the requirements of the common heritage principles. Alternative approaches are also presented. As there is also a need to establish a social consensus on the sharing of benefits, Chapter 5 shows options for how such a consensus can be worked out in practice.

Detrimental environmental change caused by human activities is putting the ecosystems of the planet at risk, thus requiring a holistic accounting and measurement system that captures human environmental impacts from business and other activities on the resilience of natural ecosystems. Resilience is key for keeping ecosystems from reaching tipping points. The use of economic valuation of ecosystem goods and services methods have a strong foundation in economic theory and offer a rapidly growing evidence base, improving ability to evaluate a broad range of ecosystem goods and services. Given that the deep-sea provides a wide range of benefits to humanity, the impacts, economic benefits and costs of proposed deep-sea economic activities such as deep- sea mining need to be assessed to prevent loss, including from the potential impacts of such activities on deep-sea natural capital.

Modern resource economics starts from the premise that non-renewable resources are limited, therefore any exploitation needs to be optimised. Regulations, including payment mechanisms, should be structured to provide operators with the best incentives to use processes efficiently. Relevant goals include keeping minerals in the ground for the future, encouraging innovation and the development of better, more effective mining processes and re-investing returns from extraction productively. Detailed economic models have been developed to calculate the approach that optimises welfare. We need to re-invest the income gained from consuming finite resources into other forms of capital, such as by restoring natural capital or by building up knowledge and human capital.

The concept of natural capital

The concept of natural capital is widely used since the 1990s to incorporate natural constraints into the economic lexicon. Sustainable development means that the needs of present and future generations have to be taken into account. This includes the right to the natural environment. Natural capital is one of several types of capital used as factors of production. It is natural because it is not produced by mankind. Nature keeps on providing renewable asset for free, provided it is not over-exploited, whereas non-renewable resources can only be sourced once. Both renewable and non-renewable resources (and hence underlying assets) are capable of being valued. Apart from providing tangible products (and services), nature also provides benefits such as natural beauty with spiritual and aesthetic values.

One tool is wealth accounting as it allows countries to take stock of their assets to monitor the sustainability of development. For non-renewable natural capital assets there is a choice to be made by society, should we consume them now or leave them, to be potentially consumed later by future generations with potentially more important needs and more appropriate and sustainable technologies. If assets are used now, then other assets need to be set aside to compensate for what this generation has used up.

Beginning with the famous Club of Rome report of 1972, system thinking has been applied to understand how to change systems more effectively in public policy making and is used increasingly in modelling interactions between anthropogenic and natural systems to aid in choosing between alternative scenarios for actions or policy interventions.

Valuation of the direct and indirect benefits stemming from marine ecosystem services can support long-term sustainability, provide indicators and decision-making tools and enhance trans-disciplinary approaches. Total economic value includes both use and non-use values. Natural capital together with economic and social capital provide for inclusive wealth as the best measure of prosperity, whereas intangible social capital may be growing natural capital that has been depleting, with grave consequences for wellbeing. Ecosystem services are central in the ecosystem accounting framework since they provide the link between ecosystem assets on the one hand and the benefits received by society on the other.

Ecosystem services that contribute to human well-being can be classified into:

- Provisioning services – products such as: food (fish), water, fibre (timber); and fuel;
- Regulating services – benefits such as: water purification, climate regulation, noise and air pollution reduction and flood hazard reduction;
- Cultural services - non-material benefits, for example: through cultural heritage, recreation or aesthetic experience;
- Supporting services – such as nutrient cycling, sediment formation, habitat provision and biodiversity.

The sum of these components underpins not only all economic activity but life on earth itself. If properly managed, the living aspects of natural capital can continue to provide the ecosystem services and benefits indefinitely. Provisioning services are maintained by regulatory services that support many essential functions for the health of marine ecosystems. These services include, but are not limited to, food provisioning for organisms, nutrient cycling, and carbon sequestration.

Without in-depth knowledge of the functioning of marine ecosystems associated with mineral deposits, changes in the state of an ecosystem after human modification of the environment cannot be measured. Identifying the services provided by seabed ecosystems, including their life spans and rhythms, is therefore essential for estimating the adverse impacts of mining on the marine environment and its ecosystems.

The World Bank has outlined such an approach of precautionary management of deep-sea minerals for the Pacific where a detailed study of deep seabed mining costs and benefits was undertaken and efforts have been made to assess the value of the ocean to the people.

No net loss

The principle of "no net loss" of biodiversity has been embraced by governments, corporations and financial institutions. Ecosystems can only absorb pressure up to a certain threshold. Beyond this threshold, an incremental increase in human pressure can lead to a large, often abrupt, change in an ecosystem's structure and function. Such abrupt regime shifts tend to be persistent and irreversible (or costly to reverse), and can have profoundly negative environmental, economic and social consequences. Thresholds are expected to be crossed more frequently in the coming decades in marine, aquatic and terrestrial ecosystems owing to the increasing intensity of pressures, and their combined and often synergistic effects. The complex non-linear dynamics of ecosystems and their interactions with human systems make it difficult to predict where such thresholds lie, when they will be crossed, and what will be the scale of impact. Given this uncertainty and the potential impact of regime shifts, it is prudent to take a precautionary approach and keep disturbance well below likely thresholds. The concept of "net gain" aims to address some of these challenges. An example of the use of the concept can be found in the UK approach based on the advice of the Natural Capital Committee (NCC) to government on net environmental gain of May 2019.

To apply the concept of positive net benefit on deep seabed mining in the Area, baseline assessment and robust monitoring, verification and quality assurance processes carried out by designated competent bodies are required. The concept of net positive benefit allows us to take potential external costs of activities into account and needs to be applied to deep seabed mining concessions. This applies to both during the exploration phase, where the role of science and access to knowledge and its sharing is al-ready considered, and during the exploitation phase, prior to which all impacts need to fully considered in an environmental impact assessment. EIAs need to be comprehensively reviewed and deemed acceptable in light of the precautionary principle and CHM. For the Area, this form of acceptance needs to come from all stakeholders, which include "non-state actors" such as environmental groups, proponents of other human activities (e.g., fishing, tourism, shipping or cables), civil society and the "public", as well as scientists and other experts.

Ecological cost

The high level of uncertainty associated with the ecological cost of seabed mining compounds the difficulties in conducting a cost–benefit analysis exercise. The World Bank recommends that the precautionary principle be applied and that sound cost-benefit analyses of proposed DSM projects be undertaken before they proceed.

The overall functioning of the deep-sea as an ecosystem is of high economic importance. The high values reported for total ecosystem services emphasize the need for furthering our understanding of how the deep-sea as an ecosystem generates economic value for human societies. Valuing biodiversity is key to its protection. By setting the standard for new activities as to pre-ascertaining whether they can comprehensively contribute to achieving net positive benefits, we can ensure that progress is made in this direction.

In Europe, there has been growing emphasis on concepts such as the Circular Economy, Green Economy, green infrastructure, natural capital, and nature-based solutions, and a corresponding shift in language and arguments for environmental protection, with greater use of economic and monetary arguments for raising awareness and tracking performance.

The deep ocean is greatly understudied and we need urgent further research to fully understand its ecosystem functions. At the potential nodule mining area level, the eastern Clarion-Clipperton Zone (CCZ) shows high megafaunal diversity, patterns of whale interaction and diverse communities of

bacteria and archaea, suggesting that a wide range of functional species with significant ecosystem services values could be affected, thereby resulting in a measurable net loss of biodiversity from mining.

These losses of biodiversity over vast areas and a long term can range from impacts to organic carbon sequestration to microbial ecosystem services impacts, including potentially on nodule regrowth given sedimentations and particle density.). Marine genetic resources may also be affected.

This is pertinent at a time where their value is increasingly being recognised and a dedicated international regime (including benefit-sharing) for them is presently being negotiated at the United Nations. Consequently, any additional stressor on the deep ocean such as deep-seabed mining needs to be carefully assessed as to its economic cost. As the Deepwater Horizon incident demonstrated, impacts of human activities in the deep ocean can reach massive costs. These include not only any quantifiable local impacts, such as through the removal of endemic species directly located on or around nodules, but also its potential contributions to the cumulative cost of ongoing ocean change as well as its potential to contribute to tipping points and systems change, taking into account the precautionary principle.

An economic cost-benefit calculation

Economists have developed a number of approaches to assess the value of protecting deep-sea biodiversity and quantifying the costs of increased risk and volatility of outcomes, including in remote locations and complex marine value chains. Results show that the Contingent Valuation method can provide economic estimates of impacts on ecosystem services from commercial activities for use in cost-benefit-analysis. A recent IUCN report discusses the financial and societal cost of DSM as well as the potential economic and societal benefits.

One emerging debate is around global metals needs in the future world economy. Supporters of deep seabed mining have suggested that mining is needed to meet future demand. However, consumption patterns of copper, aluminium, cement and steel projected over the 21st century suggest that future demand for resources could be lower than expected as countries reach a stage at which consumption reaches saturation. Teske et al. (2016) have calculated that even with ambitious future energy scenarios, metal demand associated with renewable technologies will not require seabed mining.

One economic cost of DSM that will also need to be considered is its impact on the global carbon budget. In addition to the greenhouse gas emissions of building the equipment, shipping and processing the materials, which could partially be addressed through a comprehensive carbon levy, DSM may well have further impacts on the ocean's ability to cycle and store carbon, which would need to be fully assessed. Momentum is also building for carbon pricing in the private sector, where an increasing number of companies are using internal carbon pricing to actively manage climate-related risks. It would be helpful to see DSM contractors publish the assessment of their CO_2 impacts and how they intend to use carbon pricing to offset those.

Uncertainty is another key financial term; in order to assess payment rules for deep sea mining. If a future payment is not certain, the question arises whether the recipient will have to take the risk of not being paid or can off-load this risk to another party, such as insurance or a guarantor who takes the risk. Likewise, volatility in potential outcomes can put stresses on the financial model, creating different incentives for commercial companies. Given the range of uncertainties of delivery of a successful project and the high volatility in metal prices and thus in potential returns, it is critical to structure regulatory mechanisms and risk reduction instruments such as insurance not only in such a way that they are robust under any different scenarios, but also in such ways as to prevent operators from "gaming the system" (such as by "walking away" at some point in the process or by timing payments and transactions in various formats so as to minimise the ultimate benefits that may accrue to CHM). One key concept to optimise payments will be to guarantee that the majority of financial benefits of activities in the Area are provided to the CHM. A reversal of the burden of proof could also considered

to be applied to Contractor activities as a particular measure to implement precaution in the specific context of DSM. This requires also solid regulatory system.

A comprehensive economic assessment will be required to address these challenges. The interaction between different SDGs and in particular the goals for SDG14 directly put constraints on the creation of additional ocean stressors. Deep-sea science is rapidly adding to our knowledge of the complex deep-sea ecosystems and warning us about the potential impacts of human activities.

An effective mechanism needs to be put in place to ensure that an appropriate overall level of returns is delivered to the resource owner, which is, in the case of the "Area", the ISA as steward of the Common Heritage of Humankind. The first component of an equitable sharing mechanism will be the payment regime. Deep seabed mining revenues need to managed for the public good - ensuring transparency and distribution equity. A basic assumption to optimise such payments will need to be that the ISA makes sure that it will receive the "lion's share" of any financial benefits that accrue from activities in the Area, so that a substantial and significant financial compensation is delivered to humankind. This requires a robust regulatory regime that is able to deliver this outcome under the different range of developments. This cannot be circumvented; it needs to operate without loopholes and leakages.

Another basic aspect of optimising payments requires an assessment of the financial model as a whole, in order to see what the best timing and cost structure for the venture would be. This will need to relate both to initial capital expenditures and to operating cost. To take one example, if a new technique that would allow a much cheaper solution is likely to appear in the market at a certain date, it would make financial sense to wait with incurring costs today and rather invest later, thereby allowing payments to be optimised. Likewise, any venue with a large financing cost component such as big infrastructure will be affected by borrowing costs, which generally reflect perceived risk. If risks can be reduced, for instance through better science, prior to any expenditure this would mean lower cost and again help to optimise payments.

A fair payment mechanism for the Common Heritage

The deep seabed mining payment mechanism needs to be specific, "fit for purpose" and in line with the prescriptions of UNCLOS. The ISA is tasked with the equitable sharing of financial and other economic benefits derived from activities in the Area through any appropriate mechanism on a non-discriminatory basis taking into particular consideration the needs and interests of developing States and peoples who have not attained full independence or other self-governing status (Arts 140(2) and 160 (2)(f)(i)). It is to develop rules, regulations and procedures for this purpose (Art 162(2)(o)i) taking into account a number of principles set out in Section 8 of the Annex to the 1994 Implementation Agreement.

From a legal perspective, UNCLOS and the 1994 Implementation Agreement prescribes the mandate of determining the appropriate mechanism to the ISA with several clear requirements. Most importantly, the Common Heritage of Humankind principle, alongside the requirement that activities in the Area must be carried out for the benefit of humankind as a whole, are to be fully reflected in the design of an equitable benefit-sharing mechanism. Consequently, if activities in the Area are unable to deliver net positive benefits to humankind, the existence of any form of benefit-sharing mechanism would be dysfunctional and the conduct of activities in the Area under such circumstances should be called into question.

Furthermore, while emphasis is placed on financial benefits, other non-monetary benefits should also be shared. This includes the sharing of knowledge, know-how and expertise gained through experience. Avenues that facilitate the transfer of technology and capacity building should be promoted. Likewise, improving our scientific understanding of the deep sea, which clearly benefits humankind, and the active pursuit for more data and information to close knowledge gaps should be encouraged.

Apart from that, the notion of distributive justice and the interests of future generation must also be attended to in the design of an appropriate mechanism. Emerging norms, such as sustainable development and the polluter pays principle ought to feature prominently as well. All external costs, especially environmental costs in particular, must be fully accounted for and internalised. Lastly, the operationalisation of the Enterprise and increasing the participation of developing states in activities in the Area are also key ingredients of an appropriate mechanism that underlines benefits to humankind and equitable benefit-sharing.

There are a number of systems generally applied the world over to optimise potential societal revenues and capture financial gain. These need to reflect in particular the concepts of risk and of time value of money. Beneficiaries under the CHM principle will prefer certain returns over the risk of not receiving any monies at all, for instance if the contractor party decides at some stage, before payments are due, not to proceed. The most attractive outcome is therefore an upfront payment mechanism.

Another common way to capture such benefits would be to look at the profits of the activities, and to tax them accordingly, generally at a progressive rate. This means that payment is taken only as profits are actually made. Such a regime requires an effective accounting system to identify profits. Decisions as to which deductions (such as for financing cost) are permitted and at what point these payments are due will need to be made in advance. In practice, applied to potential deep seabed mining ventures given the initial start-up cost, any such profit-based tax regime is likely to lead to payments only quite far in the future, possibly only in decades after mining commences, yet they may be significant amounts at that stage.

An alternative approach applied in a number of jurisdictions uses royalties, that is a predetermined percentage of turnover, to be paid at the time of sale. This requires clear definitions around what exactly the royalty is measured on. Such an approach is likely to lead to earlier payments than a profit-based tax. There remains a risk for the Authority that a contractor starts to engage in activities but pulls out before any sale is made, in which case there will have been no royalty payments. It may also be that the total amount ultimately paid could be significantly less than under a profit-tax or an auction regime.

A number of countries therefore apply a hybrid approach in their terrestrial mining regulations, combining royalty payments with profit taxes. An effective fiscal regime for the deep seabed mining sector involves a mix of both "pay-as-you-produce" (royalty) and profit-based instruments, whereby the latter can include both corporate income taxes and resource rent taxes. The additional profits tax imposed in the Cook Islands and Tonga is an example of a resource rent tax imposed on a ring-fenced basis that can apply to DSM.

At the second meeting on 11-12 July 2019 in Kingston, Jamaica the Chair of the open-ended Working Group on the financial model highlighted, *inter alia*: divergence on the three options for payment mechanism proposed by the Massachusetts Institute of Technology (MIT) report, namely a fixed rate royalty mechanism, an *ad-valorem* only royalty, and a combined profit-based system; and options for setting up an environment fund. At the Council session in July 2019 the African Group made a detailed submission on the payment regime and concluded, *inter alia*, that deep seabed mining should only occur if it is demonstrably beneficial to humankind. It also suggested that at least 40% of the profits from deep seabed mining should be received by the ISA. The open-ended working group convened for a third meeting in February 2020 of the working group to advance work on a new model that included a progressive *ad-valorem* royalty presented by the MIT.

The early stage of the draft regulations and the indicative nature of the model meant that a number of participants had divergent opinions which were either raised in the OEWG or submitted in writing by a new deadline of 23 March 2020. A fourth session of the OEWG is due to take place ahead of the next Council session, possibly in 2021.

Recommendations

However, significant gaps and problems have been identified with the approach presented thus far by the MIT. Therefore, we suggest that a rethink, and if necessary, a fresh start needs to be made in order to design a payment mechanism that is in line with UNCLOS and the need to optimise benefits to CHM. Should member states nevertheless continue to build on the MIT work, it would be desirable to at least complement this contractor-based approach with some necessary further components, in particular:

1. an analysis of the financial and economic implications of the overall Mining Code proposed, for instance as to whether the legal and financial obligations (fees, pre-payments into funds, viability and insure requirements etc.) provide sufficient robustness as to ensure that no risks remain with the Authority
2. a broader economic assessment in particular as to the potential costs to the deep-sea environment of mining activities so as to ensure that these are fully integrated into the decision-making to guarantee that there will be net positive benefits of any activities undertaken (see the discussion in chapter 3 of the economics of the deep-sea floor)
3. a clear pathway for impact, which may include the Enterprise as well as hybrid models that help deliver alternatives for economic benefits beyond the financial payments is discussed in chapter 4.

A societal and stakeholder assessment as to overall benefits, processes and transparency will also be required, the scenario approach undertaken in chapter 5 offers some suggestions.

1 Introduction

The international seabed is not only a vast, complex natural habitat, it also delivers significant ecosystem services benefits to humankind. This Area is described in Art. 136 of UNCLOS as Common Heritage of (Hu)Mankind.[1] Additional economic benefits can arise from deep-sea science and exploration, in particular if these activities lead to new knowledge, skills, technologies and understanding and if this capacity is shared globally, fairly and comprehensively. According to Art. 140 of UNCLOS activities shall be carried out for the benefit of humankind as a whole. The International Seabed Authority is charged with a fair distribution of any benefits that may arise. At present, there is no assessment mechanism in place to show that potential mining activities can deliver such a benefit. The code also needs to provide for the equitable distribution of any financial benefits. The purpose of any payment regime will be to optimise such payments. This study discusses the broader context of benefit sharing, both legally and in terms of global sustainability. It then develops a comprehensive economic analysis, taking into account the concept of natural capital and the net benefit for Humanity. The proposed financial payment mechanism is reviewed in this framework. The paper concludes with the development of a methodology to assess deep seabed mining activities win the Area that applies scenario analysis to deliver a broader, holistic approach that is in keeping with the high standards of equity, transparency and precaution that is appropriate for dealing with the largest global common on Earth, the international seabed Area as Common Heritage of Humankind.

[1] From here on, the Common Heritage of (Hu)Mankind principle will be referred to as the Common Heritage of Humankind.

2 The legal and ethical background to the benefit sharing concept

2.1 Introduction

Benefit-sharing under the Common Heritage of Humankind principle needs to be based on a solid legal and ethical foundation to ensure transparency and distribution equity, in particular taking into account the concerns of the developing world. The following sections address the legal framework and economic concepts relevant to identify financial and other economic benefits. In the light of these concepts the proposed financial payment mechanisms are discussed and an alternative methodology based on a scenario analysis approach is discussed. Further background can be found in a summary from a recent international expert workshop (Thiele et al., 2019).

Under Section 2.2, the legal aspects on benefit sharing will be examined. Section 2.2.1 starts off with a succinct elaboration on the historical development of benefit sharing under UNCLOS, before proceeding to discuss the provisions that are relevant to benefit sharing under UNCLOS and the 1994 Implementing Agreement, both of which essentially provides the regulatory framework for the sharing of benefits. This is important, because ongoing and future discussions at the ISA on the payment regime and an appropriate mechanism for benefit sharing must adhere to the fundamental requirements that are laid down in both instruments. Section 2.2.2 then briefly turns to consider the applicable provisions in the Exploration Regulations and the current version of the Draft Exploitation Regulations, with a view to ascertain how payments and benefit sharing are considered thereunder. Thereafter, section 2.2.3 elucidates on the need for a thorough cost-benefit analysis of deep seabed mining activities, in particular to account for environmental degradation, in order to ensure that such activities adhere to the Common Heritage of Humankind principle and sets out to deliver a net benefit to humankind. This is followed by some concluding remarks and initial recommendations under section 2.2.4. To round up the view on benefit sharing in context with the Area, as a common good under the common heritage of humankind, chapters 2.3 and 2.4 review the evolution of the sustainable development concept which occurred in parallel and mutually supporting in philosophy. Therefore, the 2030 Agenda comes as a natural context for interpreting the benefit sharing regime under the common heritage of humankind.

2.2 Analysis of legal aspects pf benefit sharing

2.2.1 UNCLOS and the 1994 Implementing Agreement

2.2.1.1 Developments prior to the adoption of UNCLOS in respect to sharing of benefits

In order to better understand the legal position of benefit-sharing under UNCLOS (adopted in 1982) and the subsequent 1994 Implementing Agreement, which finally paved the way for UNCLOS to come into force in 1994, it is important to comprehend the developments that took place prior to 1982.[2] While numerous other factors formed the background to the development of UNCLOS (e.g. the emergence of newly independent states post-colonization, increased development of maritime technology, the unilateral declarations of continental shelfs and exclusive economic zones of up to 200 nautical miles), this sub-section will be kept brief to focus on the designation of the international seabed as the 'Area' and the declaration of the Area and its mineral resources as the 'Common Heritage of Humankind'. While mineral resources of the deep seabed were first discovered in the 1870s through the voyage of the HMS Challenger and the recovery of manganese nodules, it was only in the 1960s when actual interest in the mineral resources of the deep seabed really surfaced. This is mainly attributed to

[2] For a thorough discussion on this sub-section on historical developments, see e.g., White, M., 1982. The Common Heritage of Mankind: An Assessment. Case Western Reserve Journal of International Law 14:3 509-542; Wolfrum R., 1983. The Principle of the Common Heritage of Mankind. MPIPIL, https://www.zaoerv.de/43_1983/43_1983_2_a_312_337.pdf; Wood, M.,1999. International Seabed Authority: The First Four Years. Max Planck UNYB 3 174-241.

John Mero's publication of 'The Mineral Resources of the Sea' in 1965, which suggested the availability of abundant resources with high economic potential. As interests in exploitation grew, Maltese Ambassador Arvid Pardo addressed the First Committee of the United Nations in 1967 and posited that the deep seabed and its mineral resources be declared as the 'Common Heritage of Humankind'. One of the main concerns then was that the status quo (i.e. freedom of the high seas) of an open access deep seabed (that would only be accessible to technologically advanced developed states) would create the imminent possibility of a tragedy of the common's scenario, and this was to be avoided.

Shortly after Ambassador Pardo's speech, a UN General Assembly declaration in 1970 endorsed the designation of the Area and its mineral resources as the Common Heritage of Humankind.[3] This provided the pathway to extended negotiations on the deep seabed, wherein an agreement on how to regulate the access to the resources, and how to share the ensuing benefits from its exploitation, was to be ascertained. Ultimately, as reflected in Part XI of UNCLOS, it was agreed that access to the resources would be regulated by an international organization (i.e. the International Seabed Authority or ISA), that activities in the Area will be carried out for the benefit of humankind as a whole, that an independent entrepreneurial arm (i.e. the Enterprise) would be established, and that all benefits arising from the conduct of activities in the Area will be shared and distributed equitably through a mechanism that was to be determined through the ISA process. Hence, the Common Heritage of Humankind principle can be seen as a jurisdictional principle, embedding two essential components: first, that there can be no assertion of sovereignty or territorial appropriation, and second, that the resources are to be governed by an international organization that authorizes mining activities and establishes a regime for the equitable sharing of benefits (Feichtner, 2019). Premised on this understanding, albeit among many others, UNCLOS was adopted in 1982.

At the outset, it is important to note that while Part XI is dedicated to the international seabed (or Area) and mining activities that occur there, there are also other parts of UNCLOS that are applicable to the regime currently being developed at the ISA. In particular, certain provisions under Part XII (on the protection and preservation of the marine environment) and Part XIII (on marine scientific research) are also relevant to some extent when considering the regime under Part XI. Underpinning the regime under Part XI, just like all other human activities that are associated with the marine environment that fall within the ambit of UNCLOS, is the concept of sustainable development. Indeed, this is confirmed in the 2012 high level global declaration on 'The Future We Want' via following terms: "We recognize the importance of [UNCLOS] to advancing sustainable development […]."[4]

Finally, two further points are relevant. First, while UNCLOS preempts the establishment of a suitable mechanism to provide for the equitable sharing of benefits, it left the task of designing such an appropriate system to be determined under the ISA process. Second, while UNCLOS was adopted in 1982, it was not well-received by many States, particularly among developed States and States that had a prior interest in deep seabed mining. Indeed, there was some dissatisfaction about certain provisions under Part XI of UNCLOS (such as the transfer of technology, providing assistance to the Enterprise, financial aspects, and decision-making processes). This necessitated in the need for further negotiations and the conclusion of an "Implementing Agreement" in 1994, which eventually paved the path for UNCLOS to come into effect.

[3] UNGA Resolution 2749 (XXV), Declaration of Principles Governing the Seabed and the Ocean Floor, and the Subsoil thereof, beyond the Limits of National Jurisdiction, adopted on 17 December 1970.

[4] United Nations, "The Future We Want", Outcome Document of the United Nations Conference on Sustainable Development (Rio+20), Rio de Janeiro, 20-22 June 2012, at paragraph 159, available at: https://sustainabledevelopment.un.org/content/documents/733FutureWeWant.pdf.

2.2.1.2 Benefit sharing under UNCLOS and the 1994 Implementing Agreement

UNCLOS provides the foundation for the development of an appropriate benefit sharing mechanism to distribute the benefits arising from the exploitation of seabed mineral resources in an equitable manner. However, as noted above, UNCLOS does not elaborate much on how this mechanism is to be implemented; instead, it simply delivers an overarching framework and mandates the Authority to prescribe for this (Harrison, 2011). More importantly, as Part XI of UNCLOS endured substantially modifications via the Agreement Relating to the Implementation of Part XI of UNCLOS 1994 (or the 1994 Implementing Agreement), provisions in the latter (notably, pertaining to the financial terms of exploitation contracts) shall prevail over UNCLOS in the event of conflict.[5]

UNCLOS designates the international seabed (i.e. 'Area') and its mineral resources as the 'Common Heritage of Humankind'.[6] Here, cross reference with the Preamble of UNCLOS, which (in referring to the 'Common Heritage of Humankind') states that the "exploration and exploitation of which shall be carried out for the benefit of mankind as a whole", is especially pertinent.[7] The integral nature of the 'Common Heritage of Humankind' within the frame of UNCLOS is evident, in that "States Parties agree that there shall be no amendments to the basic principle relating to the Common Heritage of Mankind set forth in article 136 and that they shall not be party to any agreement in derogation thereof."[8]

UNCLOS further reiterates the pertinence of benefit of humankind in the following terms: "activities in the Area shall, as specifically provided for in this Part, be carried out for the benefit of humankind as a whole, irrespective of the geographical location of States, whether coastal or land-locked, and taking into particular consideration the interests and needs of developing States […]".[9] Consequently, UNCLOS instructs the ISA to "provide for the equitable sharing of financial and other economic benefits derived from activities in the Area through any appropriate mechanism, on a non-discriminatory basis".[10] Thus, Article 140(2) squarely captures the ISA's mandate to establish an appropriate mechanism to cater for the equitable sharing of benefits derived from seabed mining.

"Common heritage of Humankind" and "for the benefit of humankind as a whole" in UNCLOS

- Article 136 UNCLOS: "The Area and its resources are the common heritage of mankind."
- Article 137 (2) UNCLOS: "All rights in the resources of the Area are vested in mankind as a whole, on whose behalf the Authority shall act."
- Article 140 UNCLOS: "1. Activities in the Area shall, as specifically provided for in this Part, be carried out for the benefit of mankind as a whole, irrespective of the geographical location of States, whether coastal or land-locked, and taking into particular consideration the interests and needs of developing States… 2. The Authority shall provide for the equitable sharing of financial and other economic benefits derived from activities in the Area through any appropriate mechanism…"

Further, UNCLOS also associates the pursuit of marine scientific research with the "benefit of mankind as a whole". For instance, one provision provides that "Marine scientific research in the Area shall be carried out exclusively for peaceful purposes and for the benefit of mankind as a whole, in accordance with Part XII [of UNCLOS]",[11] while another stipulates that the ISA "shall promote and encourage the

[5] Article 2(1) of the 1994 Implementing Agreement.
[6] Article 136 of UNCLOS.
[7] Preamble of UNCLOS.
[8] Article 311(6) of UNCLOS.
[9] Article 140(1) of UNCLOS.
[10] Article 140(2) of UNCLOS.
[11] Article 143(1) of UNCLOS.

conduct of marine scientific research in the Area, and shall coordinate and disseminate the results of such research and analysis when available".[12]

Another critical theme that relates to "benefits" and "sharing" is the transfer of technology and capacity building. In this regard, UNCLOS prescribes that the ISA shall take measures to "acquire technology and scientific knowledge in relation to activities in the Area, and to promote and encourage the transfer to developing States of such technology and scientific knowledge so that all State Parties benefit therefrom".[13] This also applies to the Enterprise, the entrepreneurial arm of the ISA, and includes references to the provision of training opportunities for the Enterprise and developing States "in marine science and technology" primarily to ensure their "full participation in activities in the Area".[14] It should be noted that Article 144 should be read in line with the 1994 Implementing Agreement on Part XI of UNCLOS, which subjects the transfer of technology to meet "fair and reasonable commercial terms and conditions, consistent with the effective protection of intellectual property rights", either via the open market or through joint-venture agreements.[15] While the Enterprise is established under Article 170 and Annex IV of UNCLOS; however, the current status of the Enterprise must be considered in the light of the modifications brought about by the 1994 Implementing Agreement.

The UNCLOS provision in Part XI which is dedicated to the protection of the marine environment is another integral provision to the benefit sharing discourse, even though the word "benefit" is not mentioned therein.[16] It affirms the principal importance of ensuring that necessary measures are taken "to ensure effective protection for the marine environment from harmful effects which may arise from such activities". As will be discussed later, this provision gives the underlying credence to the argument that any appraisal of whether activities in the Area are, in fact, providing any "benefit to mankind as a whole" must include an assessment of its potential detrimental effects to the marine environment. Moreover, in line with the precautionary approach, which requires the exercise of greater circumspection when the potential impacts of an activity are unknown and involves numerous environmental uncertainties, it is indeed arguable that the need to ensure that the deep seabed mining activities do not come at too high a price (e.g. unjustifiable degradation to the marine environment). On this premise, it is necessary to impose a high economic value on preserving the marine environment and the ecosystem services that are provided by the deep ocean.

Moreover, while the above provisions of UNCLOS lay down the underlying principles for the Part XI regime, such as the mineral resources being the Common Heritage of Humankind, that activities in the Area is to be carried out for the benefit of humankind as a whole, and that the protection of the marine environment from the harmful effects of mining must be given utmost attention, the overarching policies relating to activities in the Area are provided for in Article 150 of UNCLOS.

Policies relating to "activities in the Area", as defined in UNCLOS

The 'Policies relating to activities in the Area' are stipulated in Article 150 of UNCLOS, which provides as follows:
"Activities in the Area shall, as specifically provided for in this Part, be carried out in such a manner as to foster healthy development of the world economy and balanced growth of international trade, and to promote international cooperation for the over-all development of all countries, especially developing States, and with a view to ensuring:

a) the development of the resources of the Area;

[12] Article 143(2) of UNCLOS.
[13] Article 144(1) of UNCLOS.
[14] Article 144(2) of UNCLOS.
[15] Section 5 of the Annex to the 1994 Implementing Agreement.
[16] Article 145 of UNCLOS.

b) orderly, safe and rational management of the resources of the Area, including the efficient conduct of activities in the Area and, in accordance with sound principles of conservation, the avoidance of unnecessary waste;
c) the expansion of opportunities for participation in such activities consistent in particular with articles 144 and 148;
d) participation in revenues by the Authority and the transfer of technology to the Enterprise and developing States as provided for in this Convention;
e) increased availability of the minerals derived from the Area as needed in conjunction with minerals derived from other sources, to ensure supplies to consumers of such minerals;
f) the promotion of just and stable prices remunerative to producers and fair to consumers for minerals derived both from the Area and from other sources, and the promotion of long-term equilibrium between supply and demand;
g) the enhancement of opportunities for all States Parties, irrespective of their social and economic systems or geographical location, to participate in the development of the resources of the Area and the prevention of monopolization of activities in the Area;
h) the protection of developing countries from adverse effects on their economies or on their export earnings resulting from a reduction in the price of an affected mineral, or in the volume of exports of that mineral, to the extent that such reduction is caused by activities in the Area, as provided in article 151;
i) the development of the common heritage for the benefit of mankind as a whole; and conditions of access to markets for the imports of minerals produced from the resources of the Area and for imports of commodities produced from such minerals shall not be more favourable than the most favourable applied to imports from other sources." [17]

Article 150 raises a few points for discussion. First, it should be noted that Article 150 comes under Section 3 of Part XI and is entitled "Policies relating to activities in the Area"; whereas Articles 136 to 149, some of which have been referred to above, come under Section 2 of Part XI with the title "Principles governing the Area". It is a clear rule of interpretation that principles take precedence over policies, and as such, Article 150 must be interpreted in the light of the provisions under Section 2 of Part XI. Second, the opening paragraphs recognizes the main purpose of conducting activities in the Area as "to foster healthy development of the world economy" and to promote the "overall development of all countries", but especially developing States in particular. This gives rise to the possible interpretation that activities in the Area should only be pursued if this promise can be attained.

Third, it should be noted that as Article 150 does not mention that paragraphs (a)-(j) are listed in the order of priority, there is no reason to treat any paragraph as being more superior to another. Fourth, premised on the use of the word "and" before the final paragraph (i.e. after paragraph (i) and before (j)), all of the said paragraphs are to be read conjunctively and not disjunctively. As such, activities in the Area shall be carried out with a view to ensure congruence with each of the said paragraphs (a)-(j).

Fifth and finally, Article 150 also presents a few other foundational factors that require further interrogation. On the one hand, it emphasizes on "sound principles of conservation", "the expansions of opportunities for participation", and "participation in revenues by the [ISA] and the transfer of technology". The "development of the common heritage of mankind for the benefit of mankind as a whole" is also mentioned; as well as the importance of protecting the economies of developing countries that are producers of land-based minerals, which may face adverse effects as a consequence of activities in the Area.[18] On the other hand, the said provision also acknowledges that activities in the Area could

[17] Article 150 of UNCLOS.

[18] The latter is important, given the fact that it has been singled out to be given special attention, as provided by Section 1(5)(e) of the Annex to the 1994 Implementing Agreement, and is to be studied as a matter of priority before any

ensure "increased availability of minerals", and promote "just and stable prices" in the commodities market. These factors present some additional consideration when evaluating the actual purpose of (and pressing need for) carrying out activities in the Area.

Two key components feeding into benefit sharing are the production policies of the ISA and the financial terms that are attached to the individual plans of work submitted to and approve by the ISA. UNCLOS provides some critical provisions on this;[19] however, these provisions were substantially modified and largely replaced by the 1994 Implementation Agreement.[20] In what remains of Article 13 of Annex III, paragraph (1), the following is stipulated:

"In adopting rules, regulations and procedures concerning the financial terms of a contract between the Authority and the entities referred to in article 153, paragraph 2(b), and in negotiating those financial terms in accordance with Part XI and those rules, regulations and procedures, the Authority shall be guided by the following objectives:

a) to ensure optimum revenues for the Authority from the proceeds of commercial production;
b) to attract investments and technology to the exploration and exploitation of the Area;
c) to ensure equality of financial treatment and comparable financial obligations for contractors;
d) to provide incentives on a uniform and non-discriminatory basis for contractors to undertake joint arrangements with the Enterprise and developing States or their nationals, to stimulate the transfer of technology thereto, and to train the personnel of the Authority and of developing States;
e) to enable the Enterprise to engage in seabed mining effectively at the same time as the entities referred to in article 153, paragraph 2(b); and
f) to ensure that, as a result of the financial incentives provided to contractors under paragraph 14, under the terms of contracts reviewed in accordance with article 19 of this Annex or under the provisions of article 11 of this Annex with respect to joint ventures, contractors are not subsidized so as to be given an artificial competitive advantage with respect to land-based miners."

The 1994 Implementing Agreement restates the production policy of the ISA, stating that the production policy shall be based on the following tenets:

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exploitation activity commences. UNCLOS envisions an economic assistance fund to address this, as provided for in Section 7(1) of the Annex to the 1994 Implementing Agreement as follows:

> "The policy of the Authority of assisting developing countries which suffer serious adverse effects on their export earnings or economies resulting from a reduction in the price of an affected mineral or in the volume of exports of that mineral, to the extent that such reduction is caused by activities in the Area, shall be based on the following principles:
>
> (a) The Authority shall establish an economic assistance fund from a portion of the funds of the Authority which exceeds those necessary to cover the administrative expenses of the Authority. The amount set aside for this purpose shall be determined by the Council from time to time, upon the recommendation of the Finance Committee. Only funds from payments received from contractors, including the Enterprise, and voluntary contributions shall be used for the establishment of the economic assistance fund;
>
> (b) Developing land-based producer States whose economies have been determined to be seriously affected by the production of minerals from the deep-seabed shall be assisted from the economic assistance fund of the Authority;
>
> (c) The Authority shall provide assistance from the fund to affected developing land-based producer States, where appropriate, in cooperation with existing global or regional development institutions which have the infrastructure and expertise to carry out such assistance programmes;
>
> (d) The extent and period of such assistance shall be determined on a case-by-case basis. In doing so, due consideration shall be given to the nature and magnitude of the problems encountered by affected developing land-based producer States."

[19] Article 151, and Article 13 of Annex III, of UNCLOS.

[20] See section 8(2) of the Annex to the 1994 Implementing Agreement.

a) "Development of the resources of the Area shall take place in accordance with sound commercial principles;
b) The provisions of the General Agreement on Tariffs and Trade, its relevant codes and successor or superseding agreements shall apply with respect to activities in the Area;
c) In particular, there shall be no subsidization of activities in the Area except as may be permitted under the agreements referred to in subparagraph (b). Subsidization for the purpose of these principles shall be defined in terms of the agreements referred to in subparagraph (b);
d) There shall be no discrimination between minerals derived from the Area and from other sources. There shall be no preferential access to markets for such minerals or for imports of commodities produced from such minerals, in particular:
    (i) By the use of tariff or non-tariff barriers; and
    (ii) Given by States Parties to such minerals or commodities produced by their state enterprises or by natural or juridical persons which possess their nationality or are controlled by them or their nationals;
e) The plan of work for exploitation approved by the Authority in respect of each mining area shall indicate an anticipated production schedule which shall include the estimated maximum amounts of minerals that would be produced per year under the plan of work; […]"[21]

In further elaborating underlying principles pertaining to the financial terms of contracts, Section 8(1) of Annex to the 1994 Implementing Agreement enunciates that the "following principles shall provide the basis for establishing rules, regulations and procedures for financial terms of contracts:

a) The system of payments to the Authority shall be fair both to the contractor and to the Authority and shall provide adequate means of determining compliance by the contractor with such system;
b) The rates of payments under the system shall be within the range of those prevailing in respect of land-based mining of the same or similar minerals in order to avoid giving deep-seabed miners an artificial competitive advantage or imposing on them a competitive disadvantage;
c) The system should not be complicated and should not impose major administrative costs on the Authority or on a contractor. Consideration should be given to the adoption of a royalty system or a combination of a royalty and profit-sharing system. If alternative systems are decided upon, the contractor has the right to choose the system applicable to its contract. Any subsequent change in choice between alternative systems, however, shall be made by agreement between the Authority and the contractor;
d) An annual fixed fee shall be payable from the date of commencement of commercial production. This fee may be credited against other payments due under the system adopted in accordance with subparagraph (c). The amount of the fee shall be established by the Council;
e) The system of payments may be revised periodically in the light of changing circumstances. Any changes shall be applied in a non-discriminatory manner. Such changes may apply to existing contracts only at the election of the contractor. Any subsequent change in choice between alternative systems shall be made by agreement between the Authority and the contractor;

[21] Section 6(1) of the Annex to the 1994 Agreement.

f) Disputes concerning the interpretation or application of the rules and regulations based on these principles shall be subject to the dispute settlement procedures set out in the Convention."[22]

With respect to payment for the administrative cost or processing fee of an application for a plan of work, UNCLOS had initially prescribed this amount as USD $500,000.[23] The 1994 Implementing Agreement subsequently reduced this to USD $250,000.[24] However, as this sum was found to be insufficient for the administrative cost of processing a plan of work, the Exploration Regulations increased this sum back to USD $500,000.[25]

In terms of developing the regulatory framework, UNCLOS also clarifies the roles and responsibilities within the ISA with respect to the development of rules, regulations and procedures, and in the present case, specifically those that relate to benefit sharing. In this respect, the Assembly of the ISA is given the main responsibility "to decide upon the equitable sharing of financial and other economic benefits derived from activities in the Area", and "to consider and approve, upon the recommendation of the Council, the rules, regulations and procedures on the equitable sharing of financial and other economic benefits derived from activities in the Area".[26] The Assembly is also tasked to "establish, upon the recommendation of the Council, on the basis of advice from the Economic Planning Commission a system of compensation or other measures of economic adjustment assistance" to alleviate the adverse effects on the economies of land-based mineral producing developing countries that arise as a result of activities in the Area.[27] As is clearly stated in Article 162, the Assembly receives recommendations in this respect from the Council on these matters,[28] which in turn relies on recommendation from its relevant subsidiary advisory body.[29] The Economic Planning Commission (EPC) is established as a subsidiary organ to the Council,[30] and its responsibilities are mainly to provide advice to the Council on technical matters specifically relating to the ISA's production policies, such as reviewing the trends of metal supply, demand and prices, as well as adverse effects on the economies of land-based mineral producing developing countries.[31] It is pertinent to note, however, that the EPC has not yet been operationalized. As prescribed under the 1994 Implementing Agreement, all "functions of the Economic Planning Commission shall be performed by the Legal and Technical Commission until such time as the Council decides otherwise or until the approval of the first plan of work for exploitation."[32] As the Council has not yet decided to formalize the EPC, the Legal and Technical Commission (LTC) is shouldering the weight of the EPC.

With respect to the regulatory design of the financial terms, while the Assembly still mains supervisory oversight over the matter, the Council has a more instrumental role. Here, the Council has the power to adopt and apply provisionally, pending approval by the Assembly, the rules, regulations and procedures of the Authority, and any amendments thereto, taking into account the recommendations

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[22] Section 8(1) of Annex to the 1994 Implementing Agreement

[23] Article 13(2), Annex III of UNCLOS

[24] Section 8(3) to the Annex of the 1994 Implementing Agreement

[25] Regulation 21(1) of the Regulations on Prospecting and Exploration for Cobalt-rich Ferromanganese Crusts in the Area (2012), Regulation 21(1)(a) of the Regulations on Prospecting and Exploration for Polymetallic Sulphides in the Area (2010), and Regulation 19 of the Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area (2000, amended 2013).

[26] See Articles 160(2)(f)(i) and 160(2)(g).

[27] Article 160(2)(l), to be read together with Section 7 of the Annex to the 1994 Implementing Agreement.

[28] Articles 162(m), (n), and (o)(i).

[29] Which in this case refers to the Economic Planning Commission

[30] Article 163(1) of UNCLOS

[31] Article 164 of UNCLOS.

[32] Section 1(4) to the Annex of the 1994 Implementing Agreement.

of the Legal and Technical Commission or other subordinate organ concerned. These rules, regulations and procedures shall relate to prospecting, exploration and exploitation in the Area and the financial management and internal administration of the Authority. […] All rules, regulations and procedures shall remain in effect on a provisional basis until approved by the Assembly or until amended by the Council in the light of any views expressed by the Assembly".[33] Here, the Council acts on the advice of the LTC, who is tasked to provide such recommendations pursuant to Article 165(2)(f). The role of the Assembly here is to consider and adopt the rules, regulations or procedures that already have been adopted by the Council and provisionally applied.[34]

Intermediate conclusion

Thus, from the above, it is demonstrable that the determination of benefit sharing is treated on a different footing as the determination of financial terms. While the Council plays a more influential role in determining the latter, and may already apply such rules, regulations and procedures provisionally, the Assembly plays a more dominant role in deciding on the equitable sharing of financial and other economic benefits derived from activities in the Area. Another noteworthy provision states that: "Decisions on questions of substance arising under the following provisions shall be taken by consensus: article 162, paragraph 2(m) and (o); adoption of amendments to Part XI" at the Council. [35]

As noted earlier, Article 162(m) is on protecting the economies of land-based mineral producing developing countries that suffer adverse effects as a result of activities in the Area, whereas Article 162(o) is on the adoption of rules, regulations and procedures for the: (i) equitable sharing of financial and other economic benefits derived from the Area; and (ii) prospecting, exploration and exploitation in the Area. In this regard, Section 3 of the Annex to the 1994 Implementing Agreement, while making numerous modifications to the decision-making procedures of the Council, does not alter Article 161(8)(d) and the three instances in which decisions shall be taken by consensus. Lastly, it is important to point out here that "consensus" here means the absence of any formal objection, and not mutual agreement.[36]

With respect to payments received by the ISA, UNCLOS does provide some direction as to how the funds are to be utilized. UNCLOS considers all payments received through the conduct of activities in the Area as "funds of the Authority".[37] Other sources of income include assessed contributions made by member States, funds that are borrowed, and voluntary contributions. As the ISA does not receive any significant amount from the conduct of exploration activities, the ISA is at present heavily reliant on the assessed contributions made by member States to cover its administrative expenses. Not surprisingly, it stipulates that "the administrative expenses of the Authority shall be a first call upon the funds of the Authority".[38] Thereafter, any remaining funds (with the exception of assessed contributions made by member States) may be allocated for equitable benefit sharing, to finance the Enterprise, and to compensate land-based mineral producing developing States.

Finally, as regards to dispute settlement, UNCLOS provides that the Seabed Disputes Chamber of the International Tribunal for the Law of the Sea "shall not pronounce itself on the question of whether any rules, regulations and procedures of the Authority are in conformity with this Convention, nor declare invalid any such rules, regulations and procedures".[39] In other words, the determination of rules,

[33] Article 162(2)(o)(ii) of UNCLOS.
[34] Article 160(2)(f)(ii) of UNCLOS.
[35] Article 161(8)(d) of UNCLOS
[36] Article 161(8)(e) of UNCLOS.
[37] Article 171 of UNCLOS.
[38] Article 173(2) of UNCLOS.
[39] Article 189 of UNCLOS.

regulations and procedures by the ISA are discretionary powers and are non-justiciable (i.e. cannot be reviewed). Thus, the jurisdiction of the Seabed Disputes Chambers is "confined to deciding claims that the application of any rules, regulations and procedures of the Authority in individual cases would be in conflict with the contractual obligations of the parties to the dispute or their obligations under this Convention […]".[40] Furthermore, it is useful to recall that Section 8(1) to the Annex of the 1994 Implementing Agreement, which deals with the financial terms of contracts, clearly stipulates in paragraph (f) therein, that "disputes concerning the interpretation or application of the rules and regulations based on these principles [i.e. paragraphs (a)-(e)] shall be subject to the dispute settlement procedures set out in the Convention".

2.2.2 Exploration and draft exploitation regulations – In particular with regard to potential benefit during exploration

The Exploration Regulations[41] do not explicitly make any references to potential benefits arising from the exploration stage. In particular, financial gains are not expected at this stage as revenues obtained from fees are fully absorbed as operational costs of the ISA. Nevertheless, the exploration stage entails some priceless non-monetary benefits in the form of knowledge and data that are acquired during exploration activities (Jaeckel et al., 2016). Apart from that, expertise and know-how that come about through exploratory cruises, scientific studies and the development and deployment of technology are also amongst the important non-monetary benefits that do in fact arise from this stage (Bourrel et al., 2016). In this regard, the transfer of technology and capacity building are among critical areas which UNCLOS and the 1994 Implementing Agreement makes reference to. Finally, another potential form of benefit or benefit-sharing that could arise during the exploration stage is the participation of developing states through the 'parallel system' as seen in the Nodules Exploration Regulations, whereby an applicant nominates two sites of equal estimated economic value. If successful, the applicant receives an exploration contract over one site and the other site becomes a reserved area held by the ISA. The ISA can then allocate the reserved area to the Enterprise or a developing state. This measure substantially reduces the initial expenses to locate a site of economic value, thereby lowering the threshold to participate in activities in the Area, which may be seen as a benefit to the developing states. However, this framework has been altered in recent years, as reflected in both the Sulphides and Crusts Exploration Regulations, whereby applicants are given the choice between allocating a reserved area or by offering an equity interest in a joint venture with the Enterprise. A high percentage of applicants have elected the latter alternative. Seeing that financial gains are not expected during the exploration stage, and any financial benefit directed to the Enterprise would be equitably distributed to all states, this alternative to the parallel system may be seen as a removal of a potential benefit (i.e. the participation of developing states).[42]

Akin to the Exploration Regulations, the Draft Exploitation Regulations also do not make any explicit reference to potential benefits that arise from exploitation activities. However, it does emphasize under Draft Regulation 3 (Duty to cooperate and exchange of information), paragraph (f), that the following are essential;

(i) "Sharing, exchanging and assessing environmental data and information for the Area;
(ii) Identifying gaps in scientific knowledge and developing targeted and focused research programs to address such gaps;

[40] Article 189 of UNCLOS.

[41] Exploitation Regulations here refer to the three separate sets of regulations governing the exploration of polymetallic nodules, polymetallic sulphides and cobalt rich ferromanganese crusts referred to above.

[42] For a thorough discussion on this topic, see Jaeckel, A., Ardron, J., Gjerde, K., 2016. Sharing benefits of the common heritage of mankind – Is the deep seabed mining regime ready? Marine Policy 70 198-204.

(iii) Collaborating with the scientific community to identify and develop best practices and improve existing standards and protocols with regard to the collection, sampling, standardization, assessment and management of data and information;
(iv) Undertaking educational awareness programs for Stakeholders relating to activities in the Area;
(v) Promoting the advancement of marine scientific research in the Area for the benefit of mankind as a whole; and
(vi) Developing incentive structures, including market-based instruments, to support and enhance the environmental performance of Contractors beyond the legal requirements, including through technology development and innovation."

Intermediate conclusion

Accordingly, it can be surmised that the sharing of information and experience, as well as increasing awareness and insights, technical know-how, and scientific knowledge, are among the non-monetary benefits that the exploitation stage also anticipates. Moreover, given that financial gains are expected at this stage, the current version of the Draft Exploitation Regulations includes a dedicated section under Part VII on the "Financial terms of an exploitation contract" (see Annex I to this report) as well as an appendix (Appendix IV) on the "Determination of royalty liability" (see Annex II to this report).

2.2.3 The need for cost-benefit analysis

Due to the use of the term "benefit" in UNCLOS, it can be argued that cost-benefit analysis would be a central tool for implementing the decision-making process. Cost-benefit analysis is an important economic tool for weighing alternatives, however, requires that all elements are monetarized. Because the benefit-sharing mechanism to be established by the ISA as part of the realization of the principle of the Common Heritage of Humankind concerns "financial and other economic benefits" defined to a great degree in Art. 150 UNCLOS, the elements on the "benefit" side of the equation can be relatively easily defined and would include:

- Financial resources for funding the benefit-sharing mechanism;
- Availability of an additional source of minerals;
- Competitive market prices for minerals;
- Marine scientific research;
- Technology development;
- Technology transfer;
- Research funding;
- Economic growth.

In contrast, the "cost" side of the equation poses a number of problems. First, any assessment of the costs of environmental damage would first require their monetarization (e.g. though the valuation of ecosystem services and natural capital) which poses a number of challenges and has significant ethical implications. Second, the costs involved in benefit-sharing are highly variable, depend on both internal and external factors and cannot be predicted in advance. Elements that would need to be included on the "cost" side include:

- Environmental damage, destruction of ecosystems;
- Depletion of mineral reserves;
- Costs that reduce the funds available for benefit-sharing, including:
    a) Reimbursement of investment costs,
    b) Low market prices for minerals,
    c) Compensation for land-based mineral producers (depends on market behaviour),
    d) Administrative costs at the ISA.

While a cost-benefit analysis can provide initial input to sup-port decision-making, it is not designed to address complex environmental or social issues with entirely different planning trajectories. Furthermore, it may also fail to adequately address the concerns of States as beneficiaries. From an institutional standpoint, although a cost-benefit analysis would address key issues for implementation by the ISA, the ISA is poorly equipped to conduct such an analysis. In particular, the organ that would logically be competent to conduct a cost-benefit analysis according to Art. 164 (2) UNCLOS – the Economic Planning Commission – has not yet been operationalized. As explained earlier, the Legal and Technical Commission is currently shouldering the responsibilities of the Economic Planning Commission. In any event, it does not appear that the Legal and Technical Commission would be able to conduct such an ongoing and dynamic cost-benefit analysis exercise, mainly due to a lack of expertise.

Having set out the legal basis for conducting a cost-benefit analysis for the implementation of the principle of the Common Heritage of Humankind and a cost-effectiveness analysis for the implementation of the precautionary principle in regard to activities in the Area and noting the particular contribution of cost-effectiveness analysis for the consideration of environmental issues, the question must now be addressed how such a cost-effectiveness analysis would be designed.

General questions

Some questions can be raised to begin this process:

- Would significant limitations on activities in the Area due to environmental protection measures so significantly reduce the financial and economic benefits that a benefit-sharing mechanism would be threatened?
- Would activities serve to improve or worsen resource efficiency?
- Is deep seabed mining necessary for the realization of the SDGs?
- Would the financial distributions from the benefit-sharing mechanism be invested into sustainable development?
- Would deep-seabed mining lead to a reduced overall environmental impact when compared to terrestrial mining?
- Would innovation, the development and transfer of technology lead to an overall improvement in technological capacity in all countries, reducing overall environmental impacts?

2.2.4 Conclusions

Premised on the analysis above, it is necessary to outline several additional observations. It is clear that the deep seabed mining regime is subjected to the Common Heritage of Humankind, and that activities in the Area are to be carried out for the benefit of humankind as a whole. The latter, referred to as a principle in one recent publication (Van Nijen et al., 2019), is a necessary pre-requisite for any equitable benefit-sharing mechanism that is to be established. First, while environmental considerations were not of the paramount at the time of inception of the Common Heritage of Humankind principle, it is widely accepted that the protection of the marine environment is an integral component of it (Jaeckel et al., 2017). Under this presupposition, natural services provided by the deep-sea ecosystems must be seen as a pre-existing provision of benefit that will likely suffer impairment as a result of activities in the Area. As such, it is necessary for the benefit-sharing mechanism to fully internalize all external costs (including environmental costs such as loss of natural capital, see chapter 3). Second, it is also evidently clear that the deep seabed mining regime is also subject to overarching themes such as sustainable development, distributive justice, as well as intra- and intergenerational equity. Therefore, the rights and interests of future generations in the deep seabed and for them to stand to benefit from it also deserve protection from the conduct of current activities (Thiele et al., 2019). Third, a fully-functional Enterprise is perceived as one of the indispensable elements of operationalizing the conduct of activities in the Area for the benefit of humankind as a whole aspect of the deep seabed mining regime and the Common Heritage of Humankind. As recently underlined by the African Group,

the foundation of the Enterprise was premised on the contention that as owners of the resources, mankind should participate directly in its administration and management (Algeria, 2018). Fourth, greater attention must be paid towards increasing scientific knowledge of the deep seabed. Indeed, as elucidated above, the pursuance of improving scientific understanding is to be recognized as a benefit and measures to actively promote this should be adopted (Ginzky et al., 2020). Likewise, options to ensure the transfer of technology and capacity building should be promoted. Finally, while measures can be taken to design an appropriate mechanism to enable equitable benefit sharing if there is sufficient political will, there is also a need to ensure compliance by contractors – in particular with respect to reporting and declaring their activities. As such, the establishment of an inspectorate to verify contractor reporting is an indispensable component of a robust benefit-sharing mechanism.

Initial Recommendations

When weighing the potential benefits to be shared against the costs incurred by activities or no activities in the Area, the ISA as a trustee for humankind as the beneficiary should first

- operationalize the Economic Planning Commission and the Enterprise as a matter of urgency;
- establish a body of inspectors to ensure compliance by contractors, particularly with respect to verifying reporting and declaring of activities;
- initialise a debate and decision-making on how best benefits can be generated for this and future generations;
- define what has to be considered a financial or other economic benefit;
- ascertain the potential impacts of deep seabed mining on the economies of developing states that rely on terrestrial mining as a source of income;
- design a revenue mechanism which allows ISA a significant share;
- carry out a comprehensive cost-benefit and cost-effectiveness analysis offsetting potential revenues with potential costs associated with seabed mining in the Area as a whole and for each operation, which must necessarily include environmental costs and costs to other users of the sea;
- design an equitable sharing mechanism which corresponds to the framework set by UNCLOS, i.e. to prioritize the needs of developing states.

2.3 Benefit sharing under the common heritage of humankind from ethical and development perspective

2.3.1 The common heritage as a common good

The oceans used to be a global common, until a strong increase in technological options for its exploitation also far from land led to an increasing appropriation by coastal states. The Area and the high seas are therefore what remained of the shared space. The idea of the Common Heritage of Humankind is an ethical and legal concept which dates back to the draft World Constitution of 1948 which saw humankind as an integral part of nature and proposed Earth and its resources to become a common good. Importantly, humankind as a whole should be responsible for maintaining and protecting the health of the environment for this and future generations (Taylor, 2018). Taylor (2018) describes the objective of the founders of the concept, Elisabeth Mann-Borgese and Avid Pardo, as being to ensure "*ocean's plentitude continued to sustain present and future generation and that its uses contribute to peace, security, and the equitable development of peoples*" based on the holistic understanding of the oceans as a complex, integrated ecological system. She quotes Avid Pardo who initiated the new legal principle of the Common Heritage of Humankind as

In ocean space, ... the time has come to recognise as a basic principle of international law the overriding common interest of mankind in the preservation of the quality of the

marine environment and in the rational and equitable development of the resources lying beyond national jurisdiction (Pardo, 1975).

Not national interest, but the interest of humankind should be the driver for activities in this common space with the ultimate goal to achieve sustainable development of common spaces and resources in an ethic of care. UNCLOS in the end limited the common heritage concept to the Area, the seafloor beyond the limits of national jurisdiction, and left the high seas as a free-for-all leading to the current overexploitation. The Area and its resources, on the other hand, are in some way a global common subject to a common management system with commonly agreed rules for access, use, and exploitation – an ideal precondition for securing the values of the Area.

However, the understanding driving the development of the rules for exploitation of the Area is still dominated by national interests, the understanding that contract areas determine a kind of long-term ownership and no common vision exists.[43] This is not compatible with the more traditional understanding of how and to what purpose a commonly shared good is administered: In the more traditional commons management, as the founders of the common heritage principle had in mind, no part of the common good can be "owned", but rather a community of trustees feels collectively responsible for handing out to future generations what was inherited from the ancestors (Borgese, 1998). The implication is that the overall value, including the utilisation value, does not diminish over time, but should at least be maintained or improved through the generations. This is consistent with what is commonly referred to as «strong sustainability» (Neumann et al., 2017). Support for this understanding can also be found in, for example, African customary law, Eastern religious thinking, and the Islamic economic culture (Borgese, 1998; Taylor, 2017), and it extends in particular to the environment, including all waters, the atmosphere, and land being considered a commonly governed good.

2.3.2 Development of global understanding

It is "Our Common Future", as aptly framed by the World Commission on Environment and Development (1987) that we are talking about. Building on the achievements of the 1972 Stockholm Declaration, the wake-up call from the Club of Rome "Limits of Growth" report, the 1982 Nairobi Declaration and other international conventions, the Commission charted a comprehensive agenda for common action to make our children's fundamental right to a healthy, life-enhancing environment come real. The realisation of humanity's inability to fit its activities to the scale of our planetary systems has caused fundamental change of the life supporting ecosystems already. The Commission stated that they assume human survival and well-being to depend on the success in elevating sustainable development to a global ethic. For the sake of human development, security and peace, this requires common action by all nations and States to accommodate our needs with long-term health of earth's ecosystems: benefits have to be understood in their context in the very long-term. Sustainable development has to be seen as a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs and involves painful choices and most of all political will.

The Brundtland Commission set the starting point for an increased recognition that "environment" as well as "development" are neither unrelated problems nor can they be addressed in isolation, but require a new understanding for the root-causes of the problems and coordinated global measures to readjust humankind's footprint on earth. Finally, at the 1992 Rio Earth Summit conference, States committed to strive for "living in harmony with nature" (1992) followed up 20 years later by the

[43] Also other important aspects of the common heritage principle are currently not elaborated or fit for purpose (Jaeckel et al., 2016)

declaration to guard Mother Earth in “The Future We Want” (Convention on Biological Diversity, 2012). In particular the 1992 declaration has become a "*legal concept of sustainable development as well as of the main principles of international environmental law underpinning treaties, treaty negotiations, domestic legislation, and a now substantial body of domestic and international jurisprudence*", which can be considered to be the "most emblematic set of principles guiding our relationship with the environment" (Viñuales, 2015).

As such, the Rio Convention encapsulates a comprehensive set of 27 pre-existing and new legal principles and policy guidelines (Kiss 1994 in Viñuales, 2015) which can be clustered around the keywords "Balancing", "Integration", "Cooperation" and "Partnership" (Sanwal 1993 in Viñuales, 2015) or ‘backbone’, ‘environment set’, ‘development set’, ‘differentiation set’, ‘avoiding conflict’ (Viñuales, 2015). These principles should all be the foundation for ISA´s work to create benefit for humankind from the Area and its resources because in their entirety, they address the tensions of ISA´s work between the "development of the resource" and effective protection of the environment.

The inextricable bond between human well-being, a healthy environment and peace is expressed in Principle 1 and 25, which can be achieved only once "environmental protection constitutes an integral part of the development process" (Principle 4), and effective environmental legislation and standards are enacted (Principle 11). Among the "environment set" of principles in the Rio Declaration, Principle 2, the prevention principle is seen as the foundational principle of the Rio Declaration, as "the ‘prevention’ [of transboundary and ABNJ harm] dimension brings together the intergenerational equity aspect of Principle 3 and the integration principle stated in Principle 4" (Viñuales, 2015). This duty of "prevention" of harm is also at the basis of all environmental provisions of UNCLOS.

These principles, in particular also Principle 15 on a precautionary approach still guide the norms and conduct of governance, and should guide considerations of what consists an actual benefit to humankind. Principle 6 on the special needs of developing and least developed countries is part of the benefit-sharing concept of UNCLOS (). Principle 7, which calls for global cooperation towards the common task to protect ecosystems, but differentiated responsibilities, was subject to an Advisory Opinion of the Seabed Chamber of the International Tribunal for the Law of the Sea, ITLOS (2011), which weighed the need for control of Sponsoring States over deep seabed mining operations higher than the eventually limited capacities of developing States to do so. However, developmental concerns may be relevant for the actual implementation of Principle 15, the precautionary approach (Viñuales, 2015).

Also, the "Polluter-pays" Principle 16 relates to the prevention of environmental harm by placing the cost of environmental degradation on the polluter. This principle should be a crucial element of the benefit-sharing concept of the Common Heritage of Humankind[44] which would require to a) quantify the value of environmental losses in the Area due to deep seabed mining, and b) make exploitation contractors compensate humankind for these losses, in addition to the losses that humankind incurred in terms of minerals value. The latter chapters in this report discuss the current debate at the International Seabed Authority in this regard (chapters 3 and 4). One mechanism to determine the likely scale and extent of environmental losses is a prior Environmental Impact Assessment, EIA, legally required under UNCLOS a.o. for deep seabed mining (ITLOS, 2011) and whenever an activity is ‘likely to have a significant adverse impact on the environment’ (Principle 17 in domestic context). However, EIAs normally do not include the valuation of environmental cost.

Principle 8 brings to mind that the planet has only finite resources - a thought which should also guide the current run for deep seabed resources:

[44] the polluter-pays principle was added to the principles named in the ISA draft exploitation regulations in 2019 only.

to achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies

Principle 8 has its roots already in the 1987 Brundtland Commission report which pointed to the limits of growth long before the planetary boundaries concept has been given actual indicators and thresholds (Rockström et al., 2009a; Steffen et al., 2015). As the Commission (1987) stated, global development requires that "those who are more affluent adopt life-styles within the planet's ecological means - in their use of energy, for example". This is one way of benefit-sharing which, though highlighted by civil society groups, is currently not a prominent focus of the sustainability debate in those societies which have the highest *per capita* consumption of raw materials. For example, this leads to projections for electrification of the entire global car fleet, and additional growth due to global population development and increase in average standard of living by 2050 with related exponential increase in new mineral demand for batteries. The argument is made that given the enormous social and environmental problems of land mines it was environmentally and socially more sustainable to exploit these minerals from the deep seabed.[45] Such a view does not even consider that an overall ethical change in mindset is required to enable humankind to continue to live on this planet - so far there is no planet B, and the resources from the seafloor will last only so long while the environmental degradation will last forever. As the report rightly says, the problem has to be viewed holistically, but also for the long future.

The management concept which would enable a comprehensive approach to the problem of weighing different development options and their long-term consequences is an ecosystem approach to management (Ecosystem-based management, EBM). The 2002 World Summit on Sustainable Development among others committed to an ecosystem approach to management to help the implementation of the global commitments towards more sustainable governance and economies, later confirmed and defined in the 2012 Rio+20 summit, which also lay the foundation for the 2030 Agenda "Transforming our World" (UN General Assembly, 2015). This Agenda for Sustainable Development embraces also the goals of newly emerged treaties since the 1990, such as the UN Framework Convention on Climate Change ('UNFCCC')[46] and its Kyoto Protocol,[47] the Fish Stocks Agreement,[48] the Rotterdam Convention on Prior Informed Consent ('PIC Convention')[49] and the Aarhus Convention (1998).

The integrated whole of the 17 Sustainable Development Goals, SDGs, and 169 associated targets, which are the main action-oriented outcome of the 2030 Agenda, provide important stimuli for overall benefit sharing if taken as a benchmark (see further chapter 2.4). *Vice versa*, a responsible management of the Common Heritage for the benefit of humankind as a whole can contribute to both environmental and social sustainable development goals (Christiansen et al., 2019).

Therefore, both the SDGs and the common heritage principle have as a central element the benefits to humanity, interconnected with economic sustainability and the protection of the natural resource

45 e.g. confidential report for DeepGreen: Paulikas, D., Katona, S., Ilves, E., Stone, G. O´Sullivan, A. Where should metals for the green transisiton come from? Comparing Environmental, Social, and Economic Impacts of Supplying Base Metals from Land Ores and Seafloor Polymetallic Nodules. December 2019, 170 pp.

46 United Nations Framework Convention on Climate Change, 9 May 1992, 31 ILM 849 ('UNFCCC')

47 Kyoto Protocol to the United Nations Framework Convention on Climate Change, Kyoto, 11 December 1997, 2303 UNTS 148 ('Kyoto Protocol').

48 Agreement for the Implementation of the Provisions of the United Nations Conventions on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, 4 August 1995, 2167 UNTS 88 ('Fish Stocks Agreement')

49 Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, 10 September 1998, 2244 UNTS 337 ('PIC Convention' or 'Rotterdam Convention')

base. If addressed in this balanced way, the common heritage of humankind could make a meaningful contribution to the achievement of the 2030 Agenda and its SDGs, while *vice versa*, the holistic framework of the SDGs sets out the direction of a desirable management of the common heritage in light of the globally accepted «interests» (see further chapter 2.4).

Therefore, all tools are available for a resource governance in direction to the world projected in "The Future we want", including the understanding of the need for a transition towards sustainability, the government commitments and treaties, and the legal basis. Nonetheless, ever since, the state of the environment overall has decreased, the effects of climate change have strengthened and the observed changes in ocean chemistry and ecosystems have multiplied (Diaz et al., 2019; EEA, 2019; Independent Group of Scientists appointed by the Secretary-General, 2019; IPCC, 2019 in press; UN Environment, 2019). The calls for better safeguarding the natural resources of the planet became ever more explicit (MEA, 2005).

As emphasised in (Diaz et al., 2019), man is degrading the very basis of his life, the

> *"biosphere, upon which humanity as a whole depends, [which] is being altered to an unparalleled degree across all spatial scales. Biodiversity – the diversity within species, between species and of ecosystems – is declining faster than at any time in human history", a.o. because "Economic incentives generally have favoured expanding economic activity, and often environmental harm, over conservation or restoration (B5 and "Nature managed by indigenous peoples and local communities is under increasing pressure) (B6)".*

For the oceans, this means: Over 40% of ocean area was strongly affected by multiple drivers in 2008, and 66% was experiencing increasing cumulative impacts in 2014. Only 3% of the ocean was described as free from human pressure in 2014 (Diaz et al., 2019). The living planet index for marine populations showed a decline of 49 percent from 1970 to 2012, based on more than 5800 vertebrate species, deep-sea fish populations in the North Atlantic alone declining on average 72 % over 40 years (WWF, 2015). This increasingly puts coastal populations at risk.

Deep seabed mining may provide more risks than benefits in the end, even if the future benefit sharing mechanism of the ISA eventually provides some compensation to coastal States, in particular developing nations: the far-field effects of deep seabed mining are as yet unknown. Modelling studies in the Indian Ocean indicate the likelihood that the prevailing winds and currents may very well lead to a quick drift of mining related pollution and sediment plumes to coastal waters (Popova et al., 2019). This would mean that the most vulnerable parts of the developing states´ populations, those dependent on the ocean for a living, will suffer from yet another threat on the ecosystems they rely on.

As the Rio Declaration emphasises, development, peace and environmental health are interdependent and inseparable. Considering also the pressure on coastal and other ecosystems from climate change, enhancing food security, health and well-being must have precedent over exploiting the last mineral resources of the planet for the decarbonisation of energy provision and the stabilisation of consumption patterns in high-income countries. Deep seabed mining cannot be considered part of the blue economy (Voyer et al., 2018), now being promoted as a new economic pillar for coastal and island nations. Deep seabed mining neither will provide new jobs (Rademaekers et al., 2015), nor will it lead to significant economic return, on the contrary, it may impair those sectors which depend on intact ecosystems (Folkersen et al., 2018a).

Given the uncertainties and environmental risks from mining, the preservation of nature, the natural capital we have, should be a priority for the Area, in particular as long as the deep sea is not only

largely pristine still, but provides ecosystem services to humankind to a so far little-known extent (Le et al., 2017; Orcutt et al., 2018; Thurber et al., 2014). The problem of ecosystem degradation and the immense task to succeed in transiting to sustainable societies has its very deep roots in the ethics of our economic actions and a side-lining of all traditional and modern commons-oriented society systems (Beckenkamp, 2012; Edenhofer et al., 2012; Taylor, 2012).

In his encyclica "*Laudato Si*", pope Francis recapitulates the long history of concern over the "*structural causes of the dysfunctions of the world economy and correcting models of growth which have proved incapable of ensuring respect for the environment*", expressed already by Benedict XVI, who also recognised the link to unsocial behaviour and a misinterpretation of human power. Pope Francis puts environmental degradation in a desperately needed ethical context, reminding us that man and nature are an integrated whole and the sustainability goals need to be addressed altogether. The ethical and spiritual roots of environmental problems require that we look for solutions not only in technology but in a reorientation of humanity towards the principles of the equity. As the United States bishops have said, greater attention must be given to “the needs of the poor, the weak and the vulnerable, in a debate often dominated by more powerful interests (Vatican, 2015). Otherwise, unprecedented economic losses may impact even stronger on the disadvantaged and significantly perturb world economy (Johnson et al., 2020).

2.3.3 Intergenerational justice and the common heritage of humankind

At its core, the common heritage principle is driven by a vision of intra- and intergenerational equity for all people in relation to the Area and its resources. Equity means "justice through fairness" (White, 2004/5 in Bourrel et al., 2016), which means in the context of the common heritage fairness to the financial, economic and other needs of developing States, and civil society at large today and in the future. This vision is very much compatible with the normative core of Agenda 2030 and the SDGs: that “no one will be left behind” and Principle 3 of the Rio Declaration "[t]he right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations". In the idealistic vision of the common heritage in the UNCLOS, non-monetary transfer of knowledge should aid present-day capacity building for science and technology, and provide equal opportunities to participate the Area´s governance processes. Financial and other economic benefits from activities in the Area, including through the "Enterprise", should lead to financial transfers which would enable the developing states to catch up developing in their social and economic systems.

As this report demonstrates, the benefit-sharing of the common heritage within, but particularly across generations is at risk: the current practice along the "business as usual" trajectory will lead to resource exploitation without substantial compensation to humankind (chapter 4) at the cost of irreversible environmental degradation (Niner et al., 2018). This resource exploitation is currently not embedded in an overall strategy to ensure resource use also for the purposes of future generations - not only in the next 100, but 1000 years and more from now. The 2030 Agenda and its roots theoretically show the path to sustainable livelihoods and equity - but are we on track?

The problems of environmental degradation and lack of opportunities for human development are closely linked. For example, should deep seabed mining directly or indirectly contribute to limit the ocean´s capacity to absorb heat and greenhouse gases (see chapter 3.4), or impact on coastal ecosystems (Popova et al., 2019) and reduce fishing opportunities (Rademaekers et al., 2015), this will aggravate the problems of the most vulnerable parts of the world population. Therefore, the aspect of intergenerational equity in the benefit-sharing concept of the Common Heritage of Humankind is of utmost importance.

Not only across generations, also in present generations different needs exist, calling for effective and all-inclusive participation of all societal groups, in particular also the youth, in determining the future of the Common Heritage of Humankind. As Bourrel et al. (2016) formulate:

The successful implementation of the CHM principle in a DSM mining context requires that a mechanism be established to ensure that the common heritage itself is properly protected and that an equitable sharing mechanism of the benefits derived from the exploration and exploitation of the Area for current and future generations is established. By this logic, equitable sharing will only be achieved if there is equitable utilisation of the resources of the Area, understood as requiring a balancing of interests and considerations at stake including for conservation of these resources.

Nevertheless, neither has the scope of "humankind" been defined (but see Christiansen et al., 2019), the kind of benefit expected from the common heritage determined, nor does an equity concept nor a distribution mechanism exist. In essence, there is currently no shared understanding among State parties of the implications of the equity provision inherent in the Common Heritage of Humankind. Developing a common vision on the equity concept of the Common Heritage of Humankind should be the first step prior to developing rules and regulations to exploit it (Christiansen et al., 2019).

2.3.4 Natural science perspective

From a natural science perspective sustainability means to use ecosystems like those in the ocean only to the extent that the systems and their components can replace any loss incurred while maintaining the complex interactions leading to the ecosystem services enjoyed by humankind. In this sense, the exploitation of non-renewable, biodiversity-relevant structure in a largely unknown environment at a so far unclear scale is definitively irresponsible. In addition, when looking at the contribution that the Area in its entirety can have on the achievement of SDG 14, it is quite evident that only an ecologically functional and unaltered deep sea can provide the necessary stability to the otherwise widely industrialised oceans (Halpern et al., 2015; Stojanovic and Farmer, 2013) where the level of stress needs to be reduced rather than to be increased to come close to the aspirations of SDG 14.

Earth systems thinking which is required to overlook the multitude of changes has started with the report to the Club of Rome (Meadows et al., 1972), which drew the attention of the world to the "limits of growth" due to the finite nature of the five basic factors that determine and limit growth on this planet: population, agricultural production, natural resources, industrial production and pollution. Building on this early thinking, new tools for decision-making are being developed, such as integrated management and assessment frameworks that incorporate ecosystem services, environmental footprints, planetary boundaries and human-nature connections to help to increase the understanding of the socioeconomic and environmental interdependencies and to create sustainability solutions (MEA, 2005). The planetary boundaries concept (Rockström et al., 2009b; Steffen et al., 2015) illustrates particularly clearly the limits of the so-called “safe operating space for humanity", or in other words the limits of desirable human impacts on the biophysical setting of the Earth system to prevent abrupt global environmental change. Although the definition of thresholds on a global scale is a critical issue, the proposed boundaries indicate where the natural stability of the Earth system as observed throughout the Holocene is expected to come to an end and serve as a warning to not continue with “business-as-usual”. Two core boundaries were identified, climate change and biosphere integrity, which both could drive the Earth system into a new state - and both have been transgressed significantly already (Liu et al., 2015).

Under this view, the minerals of the Area should be kept as an asset, rather than used as a resource, and considered as foundational part of ecosystems essential to the natural life-support system already under pressure. This vision of the common heritage will support efforts to respect planetary boundaries and the rights of all people to a fair share of humankind's resources while keeping the natural environment in such a state as to provide sufficient opportunities for future generations (Taylor, 2014, 2018).

2.3.5 Conclusions

The question remains which route will be the more beneficial one for humankind in the long term: exploitation or conservation? This question cannot be answered without also considering aspects far beyond this report, e.g. the broader aspects of resource governance, including consumption patterns, industrial development, and innovation, its intrinsic importance for both scientific discovery and enhanced environmental protection, and the preservation of its resources and vital ecosystem functions. The Area has much to offer apart from the commercialisation of its mineral resources.

Currently, the ISA process towards exploitation seems to be like an express train moving in one direction only. But, taking all UNCLOS obligations together, there should also be processes and criteria for considering whether mining is [un-]acceptable at all, e.g.

- in the case that deep seabed mining cannot take place without breaching the obligations to protect the marine environment from harm caused by mining activities;
- in the case that the mining of the mineral resources of the Area does not lead to significant financial and other economic benefits of humankind, in particular in the Global South.

A process which determines the net benefit for humankind could take the form of a Strategic Assessment of the ISA policies and the developing regulations, where social, economic and environmental considerations are assembled and valued in a transparent and inclusive process. It is important to also take account of the different expectations of States and civil society in all regions of the world, constituting humankind, of the long-term benefit of the Area and its mineral-containing seafloor structure (Christiansen et al., 2019).

2.4 Using the SDGs as a practical decision-making tool concerning deep seabed mining and its implications for sustainable development

2.4.1 Background

The Sustainable Development Goals (SDGs) provide a normative structure for the implementation and realization of the Agenda 2030 for sustainable development adopted by the United Nations General Assembly in 2015. They consist of an integrated package of 17 overarching goals, 169 targets and 230 indicators to monitor progress toward achieving those goals. While the 169 official targets supplemented by 230 indicators identify priority areas of action and examples of measurable outcomes on the road to achieving a set of 17 overarching goals. This means that the successful implementation of the Agenda 2030 requires the successful implementation of all goals collectively taking into account potential interactions, trade-offs and conflicts between the goals[50]. This holistic approach is intended to achieve an acceptable balance between all three pillars of sustainable development: economic, social and environmental.

The 17 SDGs can be grouped along four main achievements to be reached until 2030, with the individual goals interacting in various ways with each other (International Council for Science, 2017; Singh et al., 2017):

- Maintaining the natural capital: SDG13 (climate), 14 (oceans);
- Inspiring social equity: SDG4 (science, education, capacity building), 9 (innovation, knowledge), 17 (partnerships);
- Supporting sustainable livelihoods: SDG 7 (energy), 9 (infrastructure), 11 (cities, communities), 12 (consumption), + small scale fishing in SDG14;

[50] https://unstats.un.org/sdgs/report/2018/interlinkages/; https://unstats.un.org/sdgs/files/meetings/iaeg-sdgs-meeting-08/5a_Cara%20Williams_Canada_Interlinkages_Report_SlideDoc.pdf

- Demanding economic fairness, enabling access, benefit sharing within and across generations: SDG 1 (no poverty), 2 (no hunger), 3 (health, well-being), 5 (gender equality), 16 (peace and justice).

A unique feature of the SDGs, in contrast to previous international action plans and goals for sustainable development such as the Millennium Development Goals, is their focus not just on issues facing developing countries but also developed countries and the understanding that economies, societies and ecologies are interdependent. The SDGs were also notably conceived from the very beginning through a much more collaborative process than typical of international policymaking, bringing in extensive contributions from civil society actors, NGOs and industry to augment the contributions of the different countries. This approach is also intended to continue dynamically over the entire course of Agenda 2030, making the SDGs the most broadly participative and inclusive international policy instrument for sustainable development adopted to date.

Given the broad global consensus supporting the realization of the SDGs, there are many good reasons to use this normative framework as a decision-making tool to address development challenges that are not explicitly mentioned in the SDGs but could nonetheless endanger the realization of sustainable development as a whole – for example, deep seabed mining.

Building on the legal provisions in UNCLOS (Article 140, see chapter 2.2.1.2) some basic assumptions, requirements and unresolved issues surrounding the "benefit to mankind", as to be derived from activities in the Area can be identified:

- The entire legal regime for deep seabed mining in the Area is based on the premise and presumption that a benefit will be produced.
- Activities in the Area must produce a net benefit for humankind. A net benefit for humankind would encompass both present and future generations in accordance with the substance of the principle of common heritage and therefore a much broader time span than merely that of exploration and exploitation contracts.
- The overarching "benefit" in question is not limited to the "financial and other economic benefits" to be distributed through the benefit-sharing mechanism and therefore requires broader reflection and methodologies for accounting for natural capital and intrinsic value.
- "Mankind as a whole" is not defined and therefore there is currently no specific beneficiary for whom the existence of a net benefit from activities in the Area can be judged.
- The interests and needs of developing States are to be explicitly taken into account not just when sharing "financial and other economic benefits" but also in determining what the overarching definition of "benefit" constitutes.
- There are no objective criteria for determining what those "interests and needs" are, nor even for determining which States would constitute "developing States" for this purpose.
- Objective criteria for ensuring "equitable sharing" of financial and other economic benefits do not exist.

In order to use the Sustainable Development Goals to help determine the benefit to humankind, there must be agreement on three further fundamental assumptions:

- The pursuit and achievement of sustainable development represents a benefit for all humankind.
- The broadly inclusive, participatory process used to formulate and adopt the SDGs is a reasonable proxy for "mankind as a whole".
- The SDGs, for lack of a better alternative, provide a widely accepted statement of the "interests and needs" of both developing and developed countries while also taking the concerns of industry and civil society into account.

It is critically important that the issue of deep seabed mining is approached from multiple perspectives, not just as an ocean protection issue but also as a potential industrial process, as its implications for sustainable development are broad. A provisional analysis of the various implications of mining minerals in the Area is provided in Annex III of this report. While the SDGs provide Goal 14 – Life Under Water as a standalone ocean goal and a reasonable starting point for discussion, deep seabed mining is not merely an issue of ocean protection. Treating it as such in the context of the SDGs would fail to take into account the holistic approach to sustainable development intended by the goals collectively.

2.4.2 The interlinkage of the sustainable development goals with the benefit sharing of the common heritage

As shown above, there are multiple interactions between the principle goals of the Common Heritage of Humankind, and the 2030 Agenda´s overarching goals, and in many ways the implementations of the SDGs will at the same time provide the benefit to humankind, as envisioned by the common heritage principle. In particular, Wolfrum (2009) considers sustainable development an important part of the intertemporal dimension of the common heritage principle.

In order to reflect on the SDGs, some general questions might be asked:

General questions

- Would deep seabed mining support or hinder sustainable development? Who decides? According to which criteria?
- Could deep seabed mining operations be conducted sustainably? How?
- Which fields of action toward sustainable development should be prioritized for financial and economic distributions from a benefit-sharing mechanism to ensure maximum benefit for humankind? Should benefits be “earmarked” for broad development issues such as poverty eradication or be directed toward more directly related thematic areas such as natural re-source management or technology transfer?

Such considerations provide a crucial context for implementing the mission of the International Seabed Authority (as stated in its Strategic Plan 2019-2023)[51], "*the organization through which States parties organize and control activities in the Area, which is the common heritage of mankind, to promote the orderly, safe and responsible management and development of the resources of the Area for the benefit of mankind as a whole, including by ensuring the effective protection of the marine environment in accordance with sound principles of conservation and contributing to agreed international objectives and principles, including the Sustainable Development Goals*". In particular, Strategic direction 1.1. specifically calls for the alignment of its "*programmes and initiatives towards the realization of those Sustainable Development Goals which are relevant to its mandate*".

In the Annex to the Strategic Plan (ISBA/24/A/10, Annex I, see Annex 2 of this study), the ISA identifies SDGs 1, 4, 5, 8, 9, 12, 13, 14, 16, 17 as areas where contributions can be made by the ISA, which at first glance seems positive. However, with a second look it is immediately apparent that the focus is exclusively on “*financial and other economic benefits”* in the strict sense, to be derived from mining the minerals while those SDGs or aspects of deep seabed mining which could potentially restrict activities in the Area are ignored. Furthermore, the ISA also ignored the fact that the SDGs are intended as an integrated package and not as a “pick-and-choose” list confined to a small, conveniently self-selected,

[51] International Seabed Authority, 2018. Decision of the Assembly of the International Seabed Authority relating to the strategic plan of the Authority for the period 2019–2023. ISBA/24/A/10

mandate. Perhaps the most egregious omissions concern SDG 14, where the ISA fails to make a single reference to the protection of ecosystems.

In a preliminary analysis, of the 17 SDGs, we identify thirteen goals which one way or another interact with the benefit sharing regime governing the mineral exploitation in the Area through deep seabed mining. These are SDG 1, 2, 4, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17. As further specified in table B in Annex 3 the benefit derived from the Area with and without mineral exploitation has to be considered. Both scenarios interact with the SDGs in different ways. For example, with respect to Goal 1 "*End poverty in all its forms everywhere*", the promise of the common heritage regime is that the mining of minerals in the Area will generate funds for redistribution to humankind, with a particular consideration of the needs of developing countries. This was intended to enhance equity in economic and social development across the globe. To date, it seems questionable whether substantial funds would be generated with the currently purported payment regime (see chapter 4). In addition, mining could be counterproductive to achieving Goal 1 if mining would significantly impact on the access to fishing opportunities and/or the quality of fish for local communities and Small Island States, if pollution would deteriorate coastal waters, or if land processing further deteriorates living conditions for people in the neighbourhood. At a larger scale, this negative effect might become mineral market. The no-mining scenario on the other hand, would not derive any direct monetary benefits but provide for undisturbed deep-sea ecosystems delivering a range of ecosystem functions and services which are needed in times of biodiversity decline and climate change, the value of which may far exceed the value effective in economies depending on mineral export, if minerals from the deep sea change the global generated by mining the mineral-containing basis for benthic ecosystems (see chapter 3).

2.4.3 Conclusions

Times have changed, and the world of 1982 and 1994 when UNCLOS was signed and the Implementation Agreement finally brought UNCLOS into force has become one of an increasing urgency for resolving a biodiversity and climate crisis while the social and economic divide between north and south still remains to some extent. The 2030 Agenda and its Sustainable Development Goals, though far from being overambitious, collectively can be used as a benchmark for reconsidering the contributions that the extraction of mineral substrates from the Area will make to the achievement of the envisaged transition to a socially just, environmentally sustainable and economically fair future. A more in-depth study of the interlinkages of the Common Heritage provisions in general and the social, ecological and economic impacts of deep seabed mining in particular is worth the effort as it could lead the way to determining whether deep seabed mining in the Area could ever get a "social licence to operate".

3 The concepts of natural capital and net benefit: an economic analysis of the common heritage of humankind

3.1 Introduction

In order to approach the idea of sharing of the benefits of the Area from an economic perspective we first need to get a sense of how the Area could be described in terms of economics. This chapter explains how the concept of natural capital provides such an approach. Unlike human, physical and knowledge capital, natural capital – which provides the building blocks of all other forms of capital – is globally in decline. The Area is a critical natural capital asset for the planet and key to the functioning of the ocean systems. Yet human activities are already causing detrimental environmental change that is putting the global ecosystems at risk. Over the past 50 years ecosystems have declined in size and condition by an average of 47% globally compared to estimated natural baselines (World Economic Forum, 2020). A comprehensive, holistic accounting and measurement system is required that captures human environmental impacts from business and other activities (Jones, 2010). Such an accounting system does not only need to take be able to take into account the gradual changes that a specific activity may affect but it also needs to reflect the necessity to is keep ecosystems from reaching tipping points (Folke et al., 2004) which could cause irreversible change. The World Economic Forum's 2020 Global Risks Report (GRR) ranks biodiversity loss and ecosystem collapse as one of the top five risks in terms of likelihood and impact in the coming 10 years, so it is critical that any economic analysis reflects these risks. Wealth accounts, which take these aspects into account, is therefore required to inform strategic decision making to addressing challenges such as climate change, environmental tipping points, and transition risks (Zenghelis et al., 2020) and thus needs to be applied to the Area. Any loss of nature and its functions is material to businesses in all industry sectors and nature-related risks need to be identified, assessed and disclosed by business (World Economic Forum, 2020). The use of the natural capital approach and of an economic valuation of ecosystem goods and services has a solid foundation in economic theory though there remain theoretical and practical limitations that need to be understood and kept in mind when interpreting results (Tinch et al., 2019).

As the evidence base is growing the ability to evaluate the impact of a new activity such as deep seabed mining on a broad range of ecosystem goods and services is improving. Part of such an assessment includes the consideration of alternatives. A promising avenue could for instance be an emphasis on circular economy concepts (European Environment Agency, 2019a) that require fewer raw materials. Circular material use may bring economic and environmental co-benefits from having less impact on natural capital and is therefore a promising tool for sustainable development. A recent OECD report refers to this as going "beyond growth" (OECD, 2019). In recent years numerous 'sustainability schemes' and 'sustainable mining' initiatives have been developed, with differing requirements and types of responsible sourcing to which they apply (van den Brink et al., 2019). Preliminary evidence suggests that such circular approaches may for instance lead to significant reductions in greenhouse gas emissions. Applying this to deep seabed mining activities suggest that a holistic approach that encompasses the concept of 'cradle-to-grave' analysis will be required, such as an assessment of the entire life cycle from exploration and extraction to restoration and/or remediation (Hein et al., 2020). We already know that seabed habitats are under pressure, as a recent report (Vaughan et al., 2019) notes. The EEA assessment of pressures and their effects in Europe's seas estimated that at least 14 % of European seabed is already affected by physical disturbance. In the North-East Atlantic, almost the entire shelf area is disturbed according to the benthic indicators (OSPAR, 2018). The deep sea provides a wide range of benefits to humanity, the impacts, economic benefits and costs of proposed deep-sea economic activities such as deep seabed mining (Hoagland et al., 2010) need to be assessed, including potential impacts (Yamazaki, 2011) on deep-sea natural capital (Thiele, 2019). Because commercial DSM has not yet commenced, despite long running arguments about its potential contribution to the delivery of raw materials including potentially rare earth elements to the economy (Dingwall,

2020), the exact nature and effects of such broad-scale stressors on deep- sea ecology are not yet known (Dover et al., 2017), however, there have been an increasing number of scientific studies that suggest effects will be long-lasting and widespread (Stratmann et al., 2018). The International Seabed Authority has an obligation to prevent, reduce and control deleterious effects arising from DSM, before serious harm occurs.[52] The two principal organs which establish the ISA's policies and govern its work are the Assembly, in which all States Parties are represented; and the 36-member Council elected by the Assembly, which functions as the ISA's executive organ.[53] The total area of deep seabed which the ISA has approved for exploration now surpasses 1.3 million square kilometres. UNCLOS encourages nation states to avoid interference with the ecological balance of the marine environment (Ardron et al., 2019). The International Seabed Authority does not only have a preferential role concerning the protection of the environment in respect of activities in the Area, but has also been allocated the task to make a leading contribution to the implementation of the pre- cautionary principle in ocean and environmental governance (Scheiber and Paik, 2013).

Scientists have recently called for a "precautionary pause" on deep seabed mining to allow time to gain sufficient knowledge and understanding to support informed decisions and effective management (Laffoley et al., 2019) and the European Parliament supported calls for a moratorium (2018) made by a wide range of eNGOs (Conservation International, 2020). Economic approaches are one of the ways of developing the necessary understanding that can help to reach such an informed decision. The ongoing degradation of marine environments resulting from the inadequate management of cumulative effects has led to the degradation or loss of resources (Foley et al., 2017) and created uncertainty for investors (Davies et al., 2018), so a recent study suggests how to deal with data scarcity and uncertainty, and how to promote comprehensive and inclusive management of marine areas (Davies et al., 2020). A number of countries and observers have raised the issue of environmental costs in meetings of the ISA Council. On 18 Feb, 2020, Germany, with Italy, highlighted the need for more consideration of environmental costs in the models (IISD, 2020a). The African Group expressed concern that the consultants from MIT had not considered his group's submissions. It suggested that the payment regime rates should ensure that deep sea mining only occurs if it is demonstrably beneficial to humankind (IISD, 2020b). This paper argues that such demonstration can only be made once the economic cost of damage to the deep-sea environment is fully reflected in the model. This chapter looks at the concept of natural capital and the emerging notion of net benefit to see how modern economics can contribute to the decision-making on the licensing of activities in the deep sea by providing a way to quantify costs and benefits.

3.2 Natural capital concept and accounts

The concept of natural capital is widely used since the 1990s to incorporate natural constraints into the economic lexicon (Missemer, 2018). Natural capital is one of several types of capital used as factors of production (NCFA, 2020). It is natural because it is not produced. Nature keeps on providing renewable asset for free, provided it is not over-exploited, whereas non-renewable resources can only be removed once but may have multiple uses. An example on how to consider natural capital in public decision-making is provided by the United Kingdom. The UK Green Book (HM Treasury, 2018) incorporates natural capital, ecosystem services and the value of associated goods and services into government appraisals. In its 2020 Annual Report the UK Natural Capital Committee suggested that the Government should develop measures "...to value of benefits delivered by change in natural capital and the ecosystem services it delivers". These measures should be compatible with the Green Book guidance

[52] United Nations Convention on the Law of the Sea [UNCLOS], (1982). Opened for signature 10 Dec 1982 and entered into force 16 Nov 1994; 1833 UNTS 397. Montego Bay: UNCLOS

[53] UNCLOS, Arts 158(1), 159–162

regarding the incorporation of environmental improvements within economic assessments of government spending and investment decisions (NCC, 2020). The Green Book guidance also incorporates recent scientific research recognising the potential for abrupt collapse in some forms of natural capital in response to increased pressures upon stocks caused by a project or by the cumulative effect of multiple projects. "Non-marginal effects such as reaching ecological tipping points* might lead to dramatic or irreversible loss in the asset under consideration. This would result in a loss of environmental services and welfare. Cumulative effects of multiple investment decisions upon the underpinning stocks of natural capital should also be considered." (HM Treasury, 2018). Both renewable and non-renewable resources (and hence underlying assets) can be valued. As well as providing physical products (and services) nature also provides benefits such natural beauty with spiritual and aesthetic values. However, even these can be valued using revealed preference or contingent valuation estimations. If no such price is applied for accessing a resource and access is freely available, an asset is likely to be over-exploited, such as has happened with fish stocks. Another example is found in climate change. Absent a carbon price to compensate for negative greenhouse gas effects, CO_2 is released into the atmosphere at large quantities and damages the environment. So there is a strong case to think about nature through the lens of economics - and in thinking economically about nature. If nature is viewed as a set of assets it can be valued economically and valued assets are better looked after, something humanity has failed to do sufficiently for the ocean.

The definition of natural capital (Daily, 1997) has been adapted over time in line with contemporary scientific development to include all the wider services provided by ecosystems. Such ecological capital is therefore an important component of natural capital (Barbier, 2017; Daily, 1997). Costanza et al. (1997) published a much cited article which looked the 17 types of ecosystem services provided by 16 biomes. According to this paper, marine biomes in total provided ecosystem services of an estimated US$28.9 trillion, which compared to US$17.0 trillion from terrestrial biomes. The paper included US$2.3 trillion from tidal marshes and mangroves in the terrestrial numbers.

The study was updated in 2011 (de Groot et al., 2012) with increased unit values and adjustments, some in part due to environmental degradation. Marine biomes were then estimated to provide US$49.7 trillion and terrestrial biomes US$75.1 trillion (including $24.8 trillion from tidal marshes and mangroves). Also, of note was a significant jump in the value of services provided by coral reefs, which had halved in area but jumped fortyfold in estimated unit value. In comparison to the 1997 total ecosystem services valuation of US$45.9 trillion, world GDP was US$45.2 trillion at the time. By 2011 world GDP had risen to $68.6 trillion compared to a total ecosystem's valuation of $125 trillion. Whatever the merits of trying to calculate the precise valuations, it is clear that ecosystem services provided by nature are very substantial and that marine biomes are significant part of that. As Costanza concludes "these estimates are useful to raise awareness about the magnitude of these services relative to other services provided by human-built capital".

Wealth accounts allow countries to take stock of their assets to monitor the sustainability of development, an urgent concern today for all countries. Natural capital together with economic and social capital provide for inclusive wealth as the best measure of prosperity, but whereas intangible social capital may be growing natural capital has been depleting, with grave consequences for wellbeing (Zenghelis, 2019). The Changing Wealth Report (World Bank, 2018) covers national wealth for 141 countries over 20 years (1995–2014) as the sum of produced capital and includes 19 types of natural capital. It discusses net foreign assets and human capital overall as well as by gender and type of employment. Great progress has been made in estimating wealth since the first volume in 2006. Based on a broad concept of human-made and natural capital stocks, the inclusive wealth framework permits a coherent operationalisation of SDG targets (Dasgupta, 2008). New data substantially improve estimates of natural capital, yet elements of natural capital that are not yet fully incorporated in the wealth accounts include air pollution, marine fisheries, and ecosystems.

For non-renewable natural capital assets there is a choice to be made by society, should we consume them now or leave them, to be potentially consumed later by future generations. Such future generation may potentially have more important needs, better use processes and more appropriate extraction technologies. However, if we still decide to go ahead and use assets now then at a minimum other assets need to be set aside for future generation so as to compensate them for what this generation has used up. This may be achieved through an explicit financial fund that protect for future generations the value created or it may be through building up man-made or human capital.

Thus, the Chair of the UK Natural Capital Committee D. Helm (2015) suggests that under a strong aggregate natural capital rule the stock of renewable natural capital should be kept at least constant and the value of economic rents from the depletion of non-renewable natural capital should be reinvested in renewable natural capital.

Natural capital remains the largest share of wealth for many low-income countries today. In 10 of the 24 low-income countries, natural capital accounts for more than 50% of their wealth. The fact that the share of natural capital in total wealth decreases in higher-income groups means that countries do not have to liquidate natural assets to grow. Instead, it points to the need to manage natural capital so that it increases in value for future generations. This is reflected in the wealth composition of high-income countries, where the value of natural capital is three times that of low-income countries.

Natural capital accounts offer a consistent way of looking at the significance of nature. They can help identify drivers of ecosystem change within wider economy and society and they can help understand whether stocks of natural capital are being used sustainably. The application of the System of National Accounts to classify and account for ecosystem services (Eigenraam and Obst, 2018) supports the application of a range of other accounting concepts such as investment, depreciation and degradation. In accounting terms natural capital can be defined as the stock of ecosystems and biodiversity that yield a flow of valuable ecosystem services (WBCSD, 2009). The concept of natural capital accounting has been applied by Office of National Statistics to develop UK natural capital estimates using wealth accounting approaches, these estimates will be incorporated into the UK Environmental Accounts. It also is a key tool for financial institutions (Nordheim et al., 2018). The Natural Capital Protocol is a private sector initiative to implement this thinking across businesses (Natural Capital Coalition, 2018). System thinking is a related effort that has been applied to understanding how to change systems more effectively in public policy making and is used increasingly in modelling interactions between anthropogenic and natural systems to aid in choosing between alternative scenarios for actions or policy interventions. Some effort has been devoted to applying these concepts to natural capital and Chapter 5 of this volume discusses the links between system thinking and scenario analysis and how it could be applied in the context of deep seabed mining in more detail.

3.3 Natural capital of the marine environment

Valuation of the direct and indirect benefits stemming from marine eco-system services can support long-term sustainability, provide indicators and decision-making tools and enhance trans-disciplinary approaches (Austen et al., 2019). Total economic value includes both use and non-use values. Use values in the marine space include direct values (such as from seaweed extraction), indirect (such as nutrient and calcium carbonate cycling (Macreadie et al., 2017), the value of habitat provision and climate regulation) and so-called option values (Armstrong et al., 2011). Non-use values can be separated into existence value (the value we give to the fact that a feature exists) and bequest value, that is the value we leave for future generations. Global public goods such as features of the deep ocean ecosystems can be valued through willingness-to-pay approaches, even with distant beneficiaries (Navrud and Strand, 2018). Studies have shown that people consider changes in the deep ocean affecting them personally. The recognition of deep-sea changes having personal effects appears to be reflected in the public's ecocentric attitude toward the marine environment (Ankamah-Yeboah et al., 2020). Cultural

values can play an important part in this assessment (Hynes et al., 2018) and will vary across ocean basins, with a particularly strong affiliation with the ocean found in indigenous people in the Pacific.

Ocean accounts are being developed though the Ocean Accounts Partnership for Asa and in other places. They need to reflect the complexity of the three-dimensional ocean (Sayre et al., 2017) and integrate materials flow accounting approaches (Krausmann et al., 2017). The National Ocean Strategy of Portugal for example includes a satellite account for the sea. The European Union aims to achieve comprehensive blue growth through delivery of the sustainable development goal 14. A recent study (Rickels et al., 2019) used 18 indicators to assess progress by 15 EU coastal states and identified a lack of science-based decision-making as a key hurdle to achieving sustainability.

To conclude, a robust assessment of the marine environment based in marine science and common standards of accounting need to be the basis for any decision on future activities as they need to provide the framework for any valuation of potential impacts.

3.4 Ecosystem services and valuation approaches

Ecosystem services are central in the ecosystem accounting framework since they provide the link between ecosystem assets on the one hand and the benefits received by society on the other. Ecosystem services have been defined (Daily, 1997) as the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life. The focus on monetary valuation and payment schemes has contributed to attract political support for conservation (Gómez-Baggethun et al., 2010). In particular, the publication of the Millennium Ecosystem Assessment (TEEB, 2009) spurred a much greater awareness of the links between ecosystem services and human wellbeing. Ecosystem services that contribute to human wellbeing (Tinch et al., 2019) can be classified into:

- Provisioning services – products such as: food (fish), water, fibre (timber), and fuel;
- Regulating services – benefits such as: water purification, climate regulation, noise and air pollution reduction and flood hazard reduction;
- Cultural services - non-material benefits, for example: through cultural heritage; recreation or aesthetic experience
- Supporting services – such as biodiversity, function.

The sum of these components underpins not only all economic activity but life on earth itself. If properly managed, the living aspects of natural capital can continue to provide the ecosystem services and benefits in-definitely.

According to Chapter 2.1. of the recent IPBES report (Diaz et al., 2019) "*nature has been degraded by the aggregated impacts of myriad actions (well established). Today, humans extract more from the earth than ever before (~60 billion tons of renewable and non-renewable resources) 40% of the marine environment, and 50% of streams manifest severe impacts of degradation {2.1.12}. Nearly 75% of the major marine fish stocks are currently depleted, or overexploited*".

3.5 Ecosystem services and the marine environment

Marine ecosystems support high biological productivity and supply some of the most important needs of humankind (Barbier, 2012). They produce a wide range of goods and services, such as wild biotic stocks, transport and relaxation options, and potential new biological and genetic resources supported by a variety of ecosystem services (Armstrong et al., 2012).

Ocean acidification drives loss in coastal and marine ecosystem services. The pH value of the ocean has fallen more than 30% since the industrial revolution, with a massive threat to marine biodiversity (Hoegh-Guldberg and Bruno, 2010), leading to changes in the structure of marine ecosystems that create increasing risks and vulnerabilities to food and income security (Hoegh-Guldberg et al., 2017). The

threats of increasing ocean warming and deoxynation are likely to have cumulative and synergistic effects that will need to be considered.

Without knowledge of the functioning of marine ecosystems associated with mineral deposits, changes in the state of an ecosystem after modification of the environment cannot be adequately assessed. The potential impacts of mining on ecosystem services in the deep sea may vary substantially, including even at microbial level (Orcutt et al., 2020). Identifying the services provided by seabed ecosystems, including their life spans and rhythms (Carreiro-Silva et al., 2013) is therefore essential for estimating the impacts of mining. Not all impacts on ecosystems will be directly detectable in the outputs and products obtained from the marine environment, and natural systems can have ecosystem services of their own and not linked to produced goods, so a comprehensive economic modelling of ecosystem services is required (Bassi et al., 2016). One area where such modelling will need to take place is in the environmental impact assessment that will need to be undertaken by deep seabed mining contractors. Integrating ecosystem services into the environmental impact assessment would enable comparison of the profits from the extraction activity with the loss of ecosystem societal benefits. Ecosystem valuation could then be applied to demonstrate the changes in intermediate ecosystem services, habitat abundance, or in management practices (Armstrong et al., 2012).

The World Bank has outlined such an approach of precautionary management of deep-sea minerals for the Pacific (World Bank, 2017a) where a detailed study of deep seabed mining costs and benefits was undertaken (Secretariat of the Pacific Community, 2016) and efforts have been made to assess the value of the ocean to the people (Seidel and Lal, 2010). Other scientists have called for an ecosystem-based deep ocean strategy (Danovaro et al., 2017). Whilst such monetary arguments for recognising the relative importance of different forms of natural capital and processes may not be to everyone's taste, this framing can be useful to compare different options and convincing for some decision makers.

3.6 From "no net loss" to "net benefit"

The principle of "no net loss" of biodiversity has been embraced by governments, corporations and financial institutions (Bull et al., 2016) yet there remains a lack of clarity and convergence around the terms deployed. The European Union Biodiversity Strategy aims to halt the loss of biodiversity and ecosystem services in the EU and to help stop global biodiversity loss by 2020. The Strategy aims to ensure "no net loss of biodiversity and ecosystem services" (Action 7, Target 2).

Ecosystems can only absorb pressure up to a certain threshold. Beyond this threshold, an incremental increase in human pressure can lead to a large, often abrupt, change in an ecosystem's structure and function. Such abrupt regime shifts tend to be persistent and irreversible (or costly to reverse), and can have profoundly negative environmental, economic and social consequences. Thresholds are expected to be crossed more frequently in the coming decades in marine, aquatic and terrestrial ecosystems owing to the in-creasing intensity of pressures, and their combined and often synergistic effects. The complex non-linear dynamics of ecosystems and their interactions with human systems make it difficult to predict where thresholds lie, when they will be crossed, and what will be the scale of impact. Given this uncertainty and the potential impact of regime shifts, it is prudent to take a precautionary approach and keep disturbance well below likely thresholds. Maintaining or restoring biodiversity can make ecosystems more resilient, reducing the likelihood of regime shifts (OECD, 2019).

The concept of "net gain" aims to address some of these challenges. An example of the use of the concept can be found in the UK approach based on the advice of the Natural Capital Committee (NCC) to government on net environmental gain of May 2019 (Natural Capital Committee, 2019). The National Planning Policy Framework (NPPF) produced in 2018 already contained the narrower concept of net biodiversity gain (Great Britain and Ministry of Housing, 2019). The revised NPPF introduced net environmental gain language and a reference to natural capital enhancement. The NCC states that a net

environmental gain approach considers first and foremost key natural capital assets, should be developed as a priority and then introduced as soon as practicable. The approach should include an assessment of the losses of all the benefits provided by the natural environment and should present the individual benefits and losses – it should not be reduced to a single netted off figure. Whilst there has been significant research into benefits from resources (Baker et al., 2016) we know less about the costs of such activities to society and the environment.

Baseline assessment and clear monitoring, verification and quality assurance processes carried out by designated competent bodies are required. Baseline data on the biological, physical and chemical environment are a prerequisite for this effort (Washburn et al., 2019).

The concept of net positive benefit allows us to take potential external costs of activities into account. It needs to be applied to deep seabed mining concessions both during the exploration phase, where the role of science and access to knowledge and its sharing is already considered, and during the exploitation phase, prior to which all impacts need to fully considered in an environmental impact assessment (Thiele et al., 2019). EIAs need to be reviewed and found acceptable in light of the precautionary principle and CHM. For the Area, this form of acceptance needs to come from all stakeholders, which are to include "non-state actors" such as environ-mental groups, proponents of other human activities (e.g., fishing, tourism, shipping or cables), and the "public" as well as scientists and other experts (Durden et al., 2018).

Ardron et al. (2018) suggest that accountability could be improved by giving the public and non-government organizations (NGOs) greater access to information and that seabed mining management could be improved through more effective reporting of activities, quality assurance, compliance and an independent panel to review decisions. A social cost–benefit analysis could assess a proposed mining activity in relation to the environment, economy and local and global communities (Wakefield and Myers, 2016). The precautionary approach, adaptive management and best environmental practices are essential to the development of a poly-metallic nodule resource (Hein et al., 2020). The high level of uncertainty associated with seabed mining compounds the difficulties in a cost–benefit analysis. The World Bank (2017a) recommends that the precautionary principle be applied and that sound cost-benefit analyses of proposed DSM projects be undertaken before they proceed. Unfortunately, there are large information gaps that make undertaking a cost-benefit analysis very difficult. One critical gap is a lack of understanding of the value (in monetary terms) of the ecosystem services provided by the deep sea in its current state – it is this value that is potentially at risk from DSM (Folkersen et al., 2018b). Based on a meta-review screening 489 research papers, with special attention given to studies that investigate the relationship between the environmental goods and services of the deep sea and economic outputs, e.g. cost, revenue, net benefits, etc. Folkersen et al.(2018a) looked at studies that specifically investigated an economic value- aspect of the deep seas. The results indicate that the overall functioning of the deep sea as an ecosystem is of high economic importance due to the high coefficient and statistical significance for this variable. the meta-analysis indicates that the functioning of the deep sea as an ecosystem significantly influences the economic value that it provides to society. The limited number of studies identified, along with the broad variety in their methods, scope, valuation perspective and purpose, emphasises the need for future research into economic value-aspects of the deep sea.

The high values reported for total ecosystem services emphasise the need for furthering our understanding of how the deep-sea as an eco-system generates economic value for human societies (Folkersen et al., 2018b).The findings of recent willingness-to-pay studies support the conservation of cold-water corals and more generally of ocean environments that provide habitat for fish, which the current deep sea governance systems are not adequately designed or sufficiently well-structured to secure (Armstrong et al., 2019). As a recent report that surveyed public perceptions in six countries confirmed, people across all six countries see the condition of the ocean as important to their country's

economy (94% to 96%) (Kantar, 2020). Valuing biodiversity is key to its protection" (Atkinson et al., 2014). By setting the standard for new activities as to whether they can comprehensively contribute to achieving net positive benefits we can ensure that progress can be made in this direction. In Europe, there has been growing emphasis on concepts such as the Circular Economy, Green Economy, green infrastructure, natural capital, and nature-based solutions, and a corresponding shift in language and arguments for environmental protection, with greater use of economic and monetary arguments for raising awareness and tracking performance. At the launch of the 2020 biodiversity strategy, the European Parliament rapporteur stated 'each year we lose 3% of GDP due to the loss of biodiversity. That costs the EU €450 billion year after year (Tinch et al., 2019). As the progress at the Convention on Biological Diversity discussions shows, these threats are now taken seriously by member states in that forum and likewise need to be integrated in other fora, including the ISA (CBD, 2019).

3.7 Economics of the deep ocean

The deep ocean is understudied, and we need urgent further research to fully understand its ecosystem functions (Rogers et al., 2015) if we want to assess the impacts of future human activities such as DSM. The deep sea plays a critical role in global climate regulation through uptake and storage of heat and carbon dioxide (Morato et al., 2020). The activity of epibenthic megafauna as recently been identified as the most likely mechanism for nodule sustention, that is for keeping nodules on the surface of the ocean floor (Dutkiewicz et al., 2020). The economics of the deep ocean have to be based on an understanding of the value of ecosystem services provided and the potential impacts of DSM on such values. The proposed first nodule mining area, the Eastern-Clarion-Clipperton Zone in the Pacific, shows high megafaunal diversity (Amon et al., 2016), patterns of whale interaction (Marsh et al., 2018) and diverse communities of bacteria and archaea (Woodall et al., 2018), suggesting that a wide range of functional species with significant ecosystem services values. All these could be affected, resulting in a measurable net loss of biodiversity from mining (Niner et al., 2018).

Deep seabed mining will have impacts on organic carbon sequestration to microbial ecosystem services impacts, including potentially on nodule regrowth. Decisions to allow activities in the deep need to take potential impacts on these ecosystems into account (Worm et al., 2006) and provide for the protection of habitats and the reduction and elimination of pollution (Rogers et al., 2015). Marine genetic resources may also be affected at a time where their value is increasingly recognized (Arrieta et al., 2010) and a specific protection and BBNJ benefit sharing regime for them is presently being negotiated at the United Nations (Harden-Davies, 2016).

Aspects that need to be considered do not include only quantifiable local impacts, such as from the removal of endemic species directly located on or around nodules but also potential contributions to the cumulative cost of ongoing ocean change. These have the potential to lead to tipping points and systems change, making it paramount to apply the precautionary principle (Jaeckel and van Doorn, 2018). As a consequence, any additional stressor on the deep ocean such as deep seabed mining needs to be carefully assessed as to its economic cost (ECORYS, 2014). As the Deepwater Horizon incident showed impacts of human activities in the deep ocean can reach massive costs (Bousso, 2018).

Economists have developed a number of approaches to assess the value of protecting deep-sea biodiversity and quantifying the costs of in-creased risk and volatility of outcomes, including in remote locations and complex marine value chains (Drakou et al., 2017). One emerging approach looks at public preferences for the protection of deep-sea eco-systems through choice experiments and contingent valuation methods(Christie et al., 2006), both in relation to the existence value of deep-sea species and as option value for future medical products (Jobstvogt et al., 2014). These reports showed that people allocated significant values to the deep-sea. A meta-analysis on the economic value of the deep-sea showed the interaction with human behaviour provided the key cost or benefit in economic terms (Folkersen et al., 2018b). Stated preference theory (Barkmann et al., 2008) and discrete choice experiments (Hoyos, 2010) are ways to calculate and value specific outcomes, for instance to award damages

where specific ecosystems have been affected. Results show that the Contingent Valuation method can provide economic estimates of impacts on ecosystem services from commercial activities for use in cost-benefit-analysis (Navrud, 2018; in: Thiele et al. 2019). A recent IUCN report discusses the financial and societal cost of DSM as well as the potential economic and societal benefit (Cuyvers et al., 2018). Other studies calculate the DSM environmental impacts based on a DSM environmental impact framework selected through a systematic literature review and deliver numerical calculations focussed on the initial DSM disturbances and plume sources, species disturbance, sediment plume and tailings (Ma et al., 2019). However, the microscopic spectrum of seafloor life and the services that this life provides in the deep sea are rarely considered explicitly yet potential impacts of mining on microbial ecosystem services in the deep sea is likely to vary substantially (Orcutt et al., 2020).

One emerging debate is around overall metals needs in the future world economy. Bleischwitz et al. (2018) analysed consumption patterns of copper, aluminium, cement and steel projected over the coming century and suggest that future demand for resources could be lower than expectedly others, as countries reach a stage at which consumption reaches saturation. Teske et al. (2016) have calculated that even with ambitious future energy scenarios metal demand associated with renewable technologies will not require seabed mining. Contractors will need to provide a full impact-weighted financial statement analysis (Serafeim et al., 2020) metrics to evaluate the impact of products once they come to market.

One other economic cost of DSM that will also need to be considered is its impact on the global carbon budget. In addition to the greenhouse gas emissions of building the equipment, shipping and processing the materials, which could partially be addressed through a comprehensive carbon levy, DSM may well have further impacts on the ocean's ability to cycle and store carbon, which would need to be fully assessed. From the former, there has been continued progress on carbon pricing initiatives in recent years at the regional, national and subnational levels. Accelerating the pace of action on these priorities in the coming years will be important for achieving a reduction in GHG emissions in line with the 2°C objective. According to a fence World Bank study (World Bank, 2017b) price levels that are consistent with achieving the temperature goal of the Paris Agreement, need to be in the range of US$40–80/t$CO_2$e by 2020. Momentum is also building for carbon pricing in the private sector, where an increasing number of companies are using internal carbon pricing to actively manage climate-related risks. It would be helpful to see DSM contractors publish their assessment of their CO_2 impacts and how they intend to use carbon pricing to offset those.

3.8 Economic and financial concepts that are important for structuring the financial mechanism

Modern resource economics starts from the premise that non-renewable resources are limited, therefore any exploitation strategy has to be optimised. Regulations, including payment mechanisms, should be structured to provide operators with the best incentives to use processes efficiently. Goals may include keeping minerals in the ground for the future, encouraging innovation and the development of better, more effective mining processes and re-investing returns from extraction productively. Detailed economic models have been developed to calculate the approach that optimises welfare. The so-called Solow-Hartwick rule proscribes the conditions under which these resources can be used, which include the need to re-invest the income gained from consuming finite resources into other forms of capital, such as by restoring natural capital or by building up knowledge and human capital.

A key concept of finance is the idea of discounting. Simply put, money today is worth more than the same cash amount in the future since the holder is, at least in theory, always expected to be able to invest this money at the "risk-free" rate. As recent experience with negative interest rates however shows in practice these investment opportunities may not always exist or an investor may prefer a certain future payment to the risk of holding cash. Similarly, any borrower will need to pay interest on a loan, which will reflect the sum of the risk-free rate, a risk premium and transaction cost of the

transaction. Applying these economic concepts to any payment potentially received from deep sea mining operators means that potential future payments need to be "discounted" back to the present to correctly compare different potential cash flow streams. This calculation allows the comparison of any financial arrangement on an equal basis, provided of course that the risks that may occur in the future (and may make repayment less likely or impossible), are fully assessed and calculated correctly.

In order to set the discount rate that will be appropriate for the calculation there are a wide range of determinants that will need to be considered. A particular subject of economic debate is around so-called "social discount rates", which aims to apply the discounting concept to wider society. A low social discount rate reflects the idea that future cash flows will arise to future generations and are therefore still valuable; a higher rate can be a reflection of shorter time horizons of poorer populations. It is therefore important to appropriately assess each context when using the concept of social discount rates to compare different alternatives. An emerging consensus towards schedules of declining social discount rates has been identified but closer scrutiny of individual cases will be required (Freeman and Groom, 2015). Perhaps the most significant development is the contribution of climate economics in its response to the challenge of appraising policy actions to mitigate (or adapt to) climate change. Work in this area has increased the focus on how to value costs and benefits that occur far into the future, particularly by showing how conventional procedures for establishing the social discount rate become highly problematic in this intergenerational context and what new approaches might be needed. Climate economics has contributed to describing the role of uncertainty in Cost- Benefit-Analysis, especially where uncertain outcomes might be associated with large adverse impacts (OECD, 2018). Nature risks equal financial risks (Bassen et al., 2019). Uncertainty is key financial concept, if a future payment is not certain, the question arises whether the recipient will have to take the risk of not being paid or can off-load this risk to another party, such as insurance or a guarantor who takes the risk. In case of the DSM payment mechanism these issues are explored further in Chapter 4.

Likewise, volatility in potential outcomes can put stresses on the financial model, creating different incentives for commercial companies. Given the range of uncertainties of delivery of a successful project and the high volatility in metal prices and thus in potential returns, it is critical to structure regulatory mechanisms and risk reduction instruments such as insurance not only in such a way that they are robust under any different scenarios but also in such a ways as to prevent operators from "gaming the system", such as by "walking away" at some point in the process or by timing payments and transactions in various formats so as to minimise the ultimate benefits that may accrue to CHM. A reversal of the burden of proof could therefore considered be applied as a particular measure to implement precaution in the specific context of DSM (Jaeckel, 2017).

3.9 Conclusions

Reconciling seabed mining with the United Nations Sustainable Development Goals discussed under chapter 2.4 above has to be a crucial ambition, yet this will be difficult because minerals extraction will have irreversible consequences that could lead to the loss of habitats, species and ecosystems services. A comprehensive economic assessment will be required to address these issues. This requires a thoughtful analysis at a time where, as was put so aptly in a recent paper by Duncan Austin (2020) the "financial system is operating on a 'before ecological and social depreciation and amortisation' basis". The interaction between different SDGs (Singh et al., 2017) and in particular the goals for SDG14 directly put constraints on the creation of additional ocean stressors. Deep-sea science is rapidly adding to our knowledge of the complex deep-sea ecosystems and warning us that currently no reliable prediction of potential ecological consequences is possible (Boetius and Haeckel, 2018).

Kim (2017a) suggests that it is time to question the assumption that commercializing the Area will benefit all humankind. Under a 'Towards sustainability' scenario as described in the IRP Global Resources Outlook 2060 it is suggested deep sea mining will not be needed (International Resource Panel, 2018). A recent report based a systematic impact and risk assessment based on a Strategic

Environmental Assessment framework comes to the conclusion that a moratorium on deep seabed mining (>200 meters depth) is strongly recommended (Howard et al., 2020). The necessary environmental impact assessments (Ahnert et al., 2000) of individual projects therefore should be required to fully analyse the economic as well as the environmental implications of any proposed deep seabed mining project (Kaikkonen et al., 2018). Furthermore, any decision to commence deep seabed exploitation under the mandate of the International Seabed Authority requires, in addition to all the other factors that need to be considered in advance, a comprehensive economic analysis if the equity principle that underline the Common Heritage of Humankind (Bourrel et al., 2016) is to be properly reflected. Given the differences in the three resources involved, that is polymetallic nodules, crusts and vents, both environmentally and economically (Martino and Parson, 2012), these need to be analysed separately. Likewise, the different metal resources have a wide range of market uses, supply issues (van den Brink et al., 2020) and demand forecasts. This also means that following such independent comprehensive economic assessments for each different regulatory regime will be required to be put in place.

Drawing from the above, the following recommendations are made:

Recommendations

- Describe the ecosystem services of the deep ocean and undertake an economic assessment and valuation before proceeding to deep sea mineral exploitation;
- Strengthen the capacity of the International Seabed Authority in environmental economics, for in-stance by including such expertise in the LTC;
- Require contractors to include in their plan of work for a potential mining exploitation an economic valuation that clearly quantifies potential environmental cost.

4 The payment mechanism

4.1 Introduction

The payment mechanism can be defined as the terms under which financial contributions are to be made based on certain outcomes so that monetary flows arrive with the International Seabed Authority.

The history of the payment mechanism discussion can be traced to a ISA technical study published in 2013 (ISA, 2013) leading to an initial working paper, which was presented for consideration to the Members of the Legal and Technical Commission of the International Seabed Authority in February 2014 (ISA, 2014). On 166 pages, it covers payment mechanisms based on a comparative study and key financial obligations including environmental management obligations. It suggested that the system should not be "complicated" in terms of administrative burden as well as "fair" to the ISA and the Contractor, with rates of payment "within range" of land-based mining for same minerals. It also asked how to capture environmental concerns / biodiversity loss in financial terms and suggested that other obligations with financial impact needed to be considered since any fiscal model must support commercially sound practices and promote environmental objectives. Subsequent to a stakeholder survey in 2014, a discussion paper was issued in 2015, which reflects the stakeholder input and discusses the issue of a "fair return" to the Common Heritage of Mankind within a first general framework for the development of an ISA payment mechanism (ISA, 2015).

In May 2016 Deep Seabed Mining Payment Regime Workshop #1 convened a limited number of representatives from industry, academic and civil society communities, national governments, and international organizations at the Scripps Institution of Oceanography, University of California San Diego to discuss a number of foundational issues in the design of a payment regime for deep seabed mining (DSM) activities in the area beyond national jurisdiction (the Area). The primary focus of the workshop was to contribute towards the further development of a deep seabed mining payment regime for the International Seabed Authority (SIO, 2016). This was the first of three workshops on the topic. At the second workshop, cost components for a potential model were presented and several contractor participants provided presentations on topics such as CAPEX and other modelling aspects (RESOLVE, 2016). The third and final workshop developed these aspects further (RESOLVE, 2017).

The next phase in progressing this work began with the first meeting of an open-ended informal working group of the Council in respect of the development and negotiation of the financial terms of a contract under article 13, paragraph 1 of Annex III to UNCLOS and under section 8 of the Annex to the Agreement relating to the implementation of Part XI of UNCLOS held in Kingston, 21-22 February 2018, followed by a second meeting on 11-12 July 2019 (ISA, 2019a) and a third meeting on 13 February 2020 - 14 February 2020. As of January 2021, the date for a fourth session is not confirmed and it is uncertain how this process will be concluded.

The payment mechanism is a critical and still outstanding aspect of the Minerals Code of the International Seabed Authority. Without a detailed understanding of the implications of the payment mechanism a full assessment of the draft text seems unachievable. The Secretariat stated in its note ISBA/25/C/2, distributed Dec 4, 2018 ahead of the most recent 25th Council session: "*5. The present note does not address points raised by stakeholders in connection with the development of the economic model and the financial terms of contracts.*" The same sentiment is reflected in ISBA/25/C/17/Add.1, following the summer session of the Council in 2019: "*9. The Council also considered the report of the Chair of the open-ended informal working group on the outcome of the second meeting of that working group, which was held on 11 and 12 July 2019 (ISBA/25/C/32). The Council welcomed the progress made by the working group but recognized that further work still needed to be done. Therefore, the Council decided that the informal working group should convene its third meeting in 2020.*" (ISBA/25/C/17/Add.1).

Indeed, as per ISBA/25/C/37, the Council: "*10. Requests the Commission to consider, as appropriate, the submissions received in the context of its work since the twenty-fourth session, including on the draft regulations from: Algeria, on behalf of the African Group,* "Submission on the ISA payment regime for deep seabed mining in the Area "Submission of two payment regimes for consideration by the Council of the International Seabed Authority".

Therefore, this discussion of the financial mechanism comes at a crucial point in the deliberations of the ISA Minerals Code. It aims to look at the financial payment mechanism discussions in a more comprehensive way and in light of the preceding chapters, keeping in mind that the payment mechanism will be the principal route as to which financial benefits could accrue which would then be available for distribution under the Common Heritage of Humankind approach.

The starting point for any payment mechanism therefore needs to be the ownership of humankind of the mineral resources of the Area (Oude Elferink, 2007). These non-renewable natural resources deplete with exploitation, so a fair share of any exploitation needs to be delivered to the International Seabed Authority of steward of the Area. The economic rent arising from the scarcity of deep-seabed minerals (Mullins and Burns, 2018) require that an effective mechanism needs to be put in place to ensure that an appropriate overall level of returns are delivered to the resource owner. The first component of an equitable sharing mechanism will therefore be provided by the payment regime (Lodge et al., 2017). All resulting deep seabed mining revenues need be managed for the public good - ensuing transparency and distribution equity (Ovesen et al., 2017).

A basic assumption to optimise such payments would be for the ISA to be sure that it will receive a clearly understood proportion, such as the majority, the "lion's share", of any financial benefits that accrue from activities in the Area. As the submission of the African Group shows, which suggests a share of at least 40% in line with land-based mining, the idea of a relevant overall share seems immediately intuitive. This paper argues that agreeing on a clear approach of "at least 50%" does not only appear most equitable but is also more likely to be able to ensure that a substantial and significant financial compensation is delivered to humankind. It is however by no means guaranteed that even at such a level deep seabed mining is delivering net benefits overall.

It is intuitively obvious that under a profit-based system a marginally profitable mining operation that is not clearly ring fenced to ensure that project accounting is adequate may well deliver low payments. It should be noted that even under a royalties regime, as will be discussed below, the overall financial outcome for the ISA is uncertain as the royalties are linked to the overall amount of notional revenues. It is for instance at least misleading that the MIT briefing note in the Table in para 12 refers to an "effective tax rate" of 49% based on adding a variety of costs and payments at different points in time and to different bodies, without any guarantees of prevention of transfer pricing and other mechanisms.

Therefore, under all circumstances a robust regulatory and accounting regime is required and is presently missing from the proposals, it needs to operate without loopholes and leakages. It thus remains the case that the deep seabed mining regime is not yet ready to effectively share the benefits derived from the Common Heritage of Humankind (Jaeckel et al., 2016). Such a regime would aim to implement a comprehensive fiscal regime for deep seabed mining comprising pay-as-you-produce and profit-based instruments (Mullins and Burns, 2018).

Another fundamental aspect of optimising payments requires an assessment of the financial model as a whole, in order to see what the best timing and cost structure for any venture would be. This will need to relate both to initial capital expenditures and operating cost. New techniques that may appear in the market at a future date may allow for cheaper solutions in which case it would make financial sense to wait before costs are incurred. An investment at a later date would be beneficial for CHM under those circumstances, allowing payments to be optimised. However, the same may not hold true for the contractor, who may face different time horizons and business constraints, including potential competitive pressures, and may therefore prefer an earlier starting date even though this may be

suboptimal overall. A particular concern of the international community should be those costs that may not directly be allocated to project but may impact others, such as the cost related to the environment. Assuming that different processes, technologies, timings and business decisions may affect the environment of the deep-sea differently, it will be important to ensure that the payment mechanism proposed does not in any way incentivise contractors to choose suboptimal processes or start with an available technology now if a better technology may become available in the future.

Likewise, any venture with a large financing cost component such as is the case with the big infrastructure required for deep seabed mining will be affected by borrowing costs, which generally reflect perceived risk. If risks can be reduced for instance through better science prior to any expenditure this would mean lower cost and again help to optimise payments. This is an even more important consideration if the project proposal relies on a significant proportion of external debt finance. As prudent resource owner the ISA should therefore ensure that the terms and conditions of any external financing can be fully reviewed by the ISA for any project and that the ISA is in a position as part of the implementation of the payment regime not only to scrutinise these external offers but to set its own standards for such funding. As an example, an increasing group of responsible financial institutions is making sure that there activities are aligned with the Paris Agreement and the SDGs and as the ISA members states are signed up to these international mechanisms they should be in a position to ensure that any proposed mining project likewise fits these standards.

Rather than deriving the payment mechanism purely from first principles of economies this paper proposes that it is appropriate to focus on a "sui genesis" approach to structuring a deep seabed mining payment mechanism that is specific, "fit for purpose" and of course in line with the prescriptions of UNCLOS. Common heritage is a jurisdictional principle that lays the basis for the international allocation and administration of exploitation rights (Feichtner, 2019).

The ISA is tasked with the equitable sharing of financial and other economic benefits derived from activities in the Area through any appropriate mechanism on a non-discriminatory basis, taking into particular consideration the needs and interests of developing States and peoples who have not attained full independence or other self-governing status (Arts 140(2) and 160 (2)(f)(i)). It is to develop rules, regulations and procedures for this purpose (Art 162(2)(o)i) taking into account a number of principles set out in Section 8 of the Annex to the 1994 Implementation Agreement.

Yet we lack knowledge of the deep ocean and its complex ecosystem dynamics, which will hamper a true assessment of the full cost of any activity to the deep ocean. The assessment of Rozemeijer et al. (2015), calculated based on different scenarios with copper, cobalt and nickel prices of 2015 and not including such a full cost assessment, still seems to suggest that profitable exploitation may not be the result of deep seabed mining concessions. This concern seems to be confirmed by research on identification of investors in seabed mining, and their interests – carried out under the EU Maribe-project and reported in van den Burg et al. (2017), suggesting there is low interest of investors in seabed mining. This may also reflect a broader perception that there are ample land-based stocks of economically minable deposits both today and for a period of at least 30 years, and that further large stocks that can be expected in that category in the future (USGS, 2017). Other sources (Hein et al., 2020) have begun to suggest that shifts in the demand patterns of the world economy will result in price rises for marine metals. The purpose of the payment regime mechanism however is not to guess future prices in one or the other way but it needs to be to ensure that the regime adopted is robust under various future price scenarios, is able to deliver the expected returns and ensures that it seeks to minis the external cost.

Another open issue is the question of potential financial consequences of operationalisation of the Enterprise (Egede et al., 2019), both in terms of additional cost for the ISA[54], which may be required to be also paid for by contractors, and in terms of the potential impact of the mining by the Enterprise and its potentially different financial payment mechanism under CHM.

4.2 Mechanisms to capture financial gain

There are a number of finance systems generally applied to optimise potential societal revenues and to capture financial gain. These need to reflect in particular the concepts of risk and of time value of money. Time value of money simply refers to what preference we put on when we receive money, or put in another, how much we value our own well-being over that of our grandchildren. For a business, this calculation is easy, money today can be used in a number of ways, invested for additional return, and is therefore preferable to monies in the future. A hurdle rate can be set as the interest rate at which an investor is indifferent between engaging in a certain project or not. Individuals and nations face a different assessment. At one extreme, a poor individual or country may need to spend all its money on essentials like food today, therefore its unable to wait for funds tomorrow, on the other hand a wealthy nation may want to invest now for instance in infrastructure, education etc. to receive future returns. These differences have led to the contention that a social discount rate approach (Drupp et al., 2015) would be most appropriate. In a previous version, the MIT suggested applying a 10% social discount rate but returned to a 2.27% rate in the latest model. It is open for debate whether presenting an NPV based on such rates in contrast to a 17.3% hurled rate for contractors is appropriate for DSM projects. Despite these differences both ends of this spectrum, and indeed humankind as a whole under the CHM principle, will prefer the certainty of return over the risk of not receiving any monies at all. Such risk could arise for instance if the contractor party decides at some stage, before payments are due, not to proceed.

The most attractive outcome would therefore be for the ISA an upfront payment mechanism. This could be a fixed amount or, from an economist's perspective, the way to secure the highest possible upfront payment is through an auction process. This method has been applied in a number of instances, for instance in the granting of mobile phone spectrum, and led to large payments[55] upfront. This has large benefits to the public owner since the money is received immediately and the risk, be it of technology, roll-out issues and customer acceptance sits fully with the private bidder. If well-designed, auctions have additional benefits, as they provide transparency in giving every potential party access to the process and they can be designed very specifically to address public concerns.

Another common way to capture full economic benefits is to tax the profits of the activities, generally at a progressive rate. This means payment is taken only as profits are actually generated and accounted. Such a regime requires an effective accounting system to identify profits. Decisions as to which deductions (such as for financing cost) are permitted and at what point these payments are due will need to be made in advance. In practice, if applied to potential deep seabed mining ventures, given the initial start-up cost any such profit-based tax regime is likely to lead to payments only quite far in the future, possibly only in decades after mining commences, yet they may be significant amounts at that stage. For DSM, studies have suggested that a project would (potentially) be economically viable and therefore able to show profits if the relevant metals, which are Nickel, Cobalt, Copper and Manganese would trade internationally under moderate and good conditions; that is if prices are to rise significantly beyond today's levels. The financing cost, treatment and refining charges and the annual

[54] The Agreement, Annex, Section 2, paragraph 1 assigned a number of functions of the Enterprise to the Authority, and performance of such functions is to be covered through administrative expenses of the Authority.

[55] Both Germany and the UK raised in the order of US$40billion through auctions of 4G spectrum, which, is an amount of financial benefits equivalent to what was expected at one point to be available from deep seabed mining.

production rate all have potentially an important effect on profitability, as these would offer deduction opportunities in the calculation of profits.

An alternative approach applied in a number of jurisdictions uses royalties, that is a predetermined percentage of turnovers, to be calculated at the time of sale. This requires clear definitions around what exactly the royalty is measured on. This is of particular concern in the case of nodules mining as there is no market today or in the foreseeable future for the nodules themselves, so the proposed system relies on some indirect derivation of nodule prices from metal content. The royalties approach is likely to lead to earlier payments than a profit-based tax. However even then there remains a risk for the Authority that a contractor starts to engage in activities but pulls out before any revenues are generated, in which case there will have been no royalty payments. It may also be that the total amount paid could be significantly lower than under a profit-tax or an auction regime.

A number of countries therefore apply a hybrid approach in their terrestrial mining regulations, combining royalty payments with profit taxes. An effective fiscal regime for the deep seabed mining sector involves a mix of both "pay-as-you-produce" (royalty) and profit-based instruments, whereby the latter can include both corporate income taxes and resource rent taxes. The additional profits tax imposed in the Cook Islands and Tonga is an example of a resource rent tax imposed in a ring-fenced basis that can apply to DSM (Mullins and Burns, 2018).

A specific issue that arises is the definition of the relevant entities that will be liable for payments. Generally, the concept of who controls the underlying entity determines such liability. Companies in which a shareholder (or related shareholders) holds more than 20% but less than 50% of the votes are considered to exercise "effective control", because no transaction is likely to succeed without the assent of that shareholder. Companies in which a significant shareholder (one who controls more than 10% of the votes but less than 20%) or their representative chairs the board of directors and/or a significant shareholder is the CEO or a key executive of the company or if a single shareholder owns sufficient shares to trigger a reporting obligation to the relevant securities commission (10% in Canada; 5% in the United States) can be considered as exercising significant control. Clarity as to which level of control triggers responsibility for payments under the ISA finance mechanism is required in order to assess adequately as to whether contractors will actually be able to meet assumed financial obligations adequately.

4.3 Process to date

The International Seabed Authority commissioned a working paper to prepare a study of comparable extractive industry fiscal regimes for presentation to the Legal and Technical Commission (LTC) of the ISA in February 2014. It made a number of recommendations that go beyond an assessment of national regimes (see table next page) and it also suggested that detailed financial modelling and economic analysis is required. As a next step, three payment regime workshops took place in San Diego (ISA, 2016) and London in 2016 and in Singapore in 2017, followed by discussions at the ISA Council in March 2018, complemented by a presentation made by consultants from the MIT, which was updated and presented at the July 2018 Council session. A first meeting of an open-ended informal working group of the Council in respect of the development and negotiation of the financial terms of a contract under article 13, paragraph 1 of Annex III to the United Nations Convention on the Law of the Sea (UNCLOSC, 1982) and under section 8 of the Annex to the Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 was held 21 – 22 February, 2019 at the Jamaica Conference Center, Kingston, Jamaica. A number of documents were discussed, though the emphasis was on another updated version of the MIT approach. A second such ended informal working group of the Council in respect of the development and negotiation of the financial terms of a contract took place in July 2019. At that time, a written version of the MIT research was available for discussion, which was led by the Chair of open-ended Working Group.

An advance text of the Draft Exploitation Regulations (ISBA/24/LTC/6) was released on May 29, 2018. It contained a number of financial aspects in Part VII DR 60 to DR 81, discussed Fees in Part VIII DR 82 to DR 86 and an indicative royalties determination process is outlined in Appendix IV. However, as the text did not include any numbers (such as royalty rates, fee amounts etc.) the true implications of the payment regime provisions could not be assessed at that time. Unless a separate modelling process is undertaken on an agreed basis that reflects all the points raised by stakeholders and addresses these issues more comprehensively it is not possible for the Authority and its member states to assess whether the ambition of Article 140 II to optimise payments will be achieved.

A new concept of financial incentives was included in DR 61 aimed at Contractors entering into joint arrangements with the Enterprise to stimulate the transfer of technology and the training of personnel of the Authority and of developing States. This raises a number of issues around the acceptability of incentives in general but also as to whether an exploitation contractor is the right party to train the Authority personnel as it raises a number of conflicts of interest issues.

The text seemed to continue to assume a "royalty-only" approach, even though the issue-note 2 suggests it should include royalty and profit share and model different scenarios. A royalty-only approach (as it only pays out once revenues arrive at contractor level) precludes an early payment to CHM (as would be provided by an upfront settlement) and it also means that none of the benefits of a higher late payment to CHM/ future generations (as would be provided by a profit-share in case of a highly profitable operation).

The model presented at the Singapore workshop seemed to assume that all pre-project development costs of contractors would be treated like "risky early stage third-party investments", thus allowing them to be paid back (with a high internal rate of return) before profit. It also assumed that the processing activities would be considered in the calculation (though they sit outside the remit of the ISA). On the other hand, the discount rates applied to any potential payments to CHM in the future was set very low and the upfront cost of non-contractor stakeholders was considered as an equivalent "early stage third-party investment" that should be recouped with interest. It is open for debate as to whether such an approach would be "equitable".

A more recent version of the MIT model has modified these assumptions and seems to suggest a discount rate of 10% (based on World Bank approaches), differing from the investor hurdle rate of 17.5%.

The MIT note of January 2019 looked at a number of models provided for review and identified 21 significant characteristics that vary across the four models discussed. A key difference of the MIT model compared to the other three is that the MIT model assumes that ISA revenue can only derive from activities at the collector. Whilst this seems to be more consistent with the Law of the Sea it leaves open both the exact delineation between the two regimes (should for instance the shipping activities be addressed by the entity that has jurisdiction over the ship rather than the ISA, which does not?) and, importantly, it raises a whole host of potential transfer pricing issues between the different entities.

The second meeting of the informal, open-ended working group on the financial model, under consideration as part of the draft regulations for exploitation of mineral resources in the Area, was held from 11-12 July 2019 in Kingston, Jamaica (ISA, 2019b). The Chair of the open-ended Working Group on the financial model, reported on July 15, 2019 in the ISA Council on the outcomes of the Working Group's second meeting (ISA, 2019c). He highlighted, *inter alia*: divergence of views on the three options for payment mechanism proposed by the Massachusetts Institute of Technology (MIT) report, namely a fixed rate royalty mechanism, an *ad-valorem* only royalty, and a combined profit-based system; and options for setting up an environment fund (IISD, 2019). The open-ended working group recommended that the Council: (a) Convene a third meeting of the working group to advance work on, *inter alia*, the payment mechanism for polymetallic nodules and, to the extent possible, to begin work on other mineral resources; (b) If so decided, to request the Secretariat to develop a new model that

would include a progressive *ad-valorem* royalty for consideration at the following meeting of the working group, to be convened preferably before the following session of the Council, which will be held in 2020 include a progressive *ad-valorem* royalty for consideration at the following meeting of the working group, to be convened preferably before the following session of the Council.

At the Council session, the African Group made a detailed submission on the payment regime, following on from their previous submission dated 5th of July 2019. The African Group concluded, *inter alia*, that deep seabed mining should only occur if it is demonstrably beneficial to humankind. The African Group also suggested that at least 40% of the profits from deep seabed mining should be received by the ISA. On 11 September 2019, the Secretariat issued a Call for a study of the potential impacts of polymetallic nodules production from the Area on the economies of developing land-based producers of those metals which are likely to be most seriously affected. The results of the study will hopefully then be available for a further session of the open-ended working group.

Ahead of the third meeting of the Open-Ended Informal Working Group of the Council in respect of the development and negotiation of the financial terms of a contract under article 13, paragraph 1 of Annex III to the United Nations Convention on the Law of the Sea and under section 8 of the Annex to the Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 held 13-14 February 2020 in Kingston, Jamaica a further Briefing Note was prepared by the Chair of the Open-Ended Informal Working Group of the Council (ISA, 2020). It summarises work undertaken by consultants requested by the Secretariat to refine the model presented earlier to explore variable *ad-valorem* royalty systems. A table was presented to show key results for the three systems presented during the July 2019 session plus two additional progressive ad valorem systems. The rates derived in the earlier blended system were replaced by a system with a 2% *ad-valorem* and a 22% rate on profits in order to provide a similar level of revenue to the Authority as the two-stage *ad-valorem* systems. The variable *ad-valorem* systems provide significantly higher revenues to the Authority if metals prices are higher than forecast However, as the note makes clear, the results of any financial model are dependent on the accuracy of the inputs and their potential variation. The model developed so far is based on inputs such as the duration and cost of the design and build phase, the number of collectors and vessels deployed, the distribution of nodule abundance and the productive mine site area, a price increase for nickel, a substitution theory approach for different types of processed manganese metals prices and various assumptions as to metallurgical recovery rates.

The authors acknowledge that prices chosen to reflect the notional gross metal value of the nodules and not the nodule transfer price which will depend on the development of a future market for nodules. A critical review of the appropriateness of such assumptions and likely consequences of implementing such the proposed payment regime and financial mechanisms still need to be undertaken as it was not part of the work of the consultants and as a consequence not covered adequately by the OEWG.

At the most recent third meeting of the OEWG on February 13, 2020 the MIT consultants provided a new presentation (Roth et al., 2020) entitled "Decision Analysis Framework & Review of Cash Flow Approach". Again, this presentation had not been previously circulated, a fact that was expressly criticised by the African Group and one that meant that only limited feedback was given by participants in the session. This presentation suggested that "To Design an Effective System, We Model & Simulate Each Component of the System" and it therefore covered a variety of commercial activities without distinguishing whether or not they are under the purview of the ISA. The presentation confirmed that "Ideally Royalties Would Be Based On Nodule Price; No Market Exists, So We Must Model It" but rather than attempting to model such a market and its potential actors the approach taken simply builds on costs and metal prices. It also suggests that "Sufficient revenues need to go to collectors to incentivize risky investment". Rather than addressing key concerns of ISA member states the presentation

focused on "System Configurations" of which "Four are Recommended for Further Consideration" who all were set to deliver equivalent 17.3% IRRs to the contractor. Out of the four options presented, namely:

a) One Stage with a Fixed *ad-valorem*
b) Two Stage with a Fixed *ad-valorem*
c) Two Stage with a Variable *ad-valorem*
d) Blended Profit plus Fixed *ad-valorem*

the MIT team suggested b) and c) as being preferable and at the session on February 17, 2020 the Council adopted the recommendation by the Chair of the OEWG that the MIT should further explore these options. At the same time a number of countries signalled their interest in keeping all options open. Written suggestions have been requested to be submitted to the Secretariat by March 23, 2020 and an updated presentation to be distributed at least 2 weeks ahead of OEWG 4.

4.4 The MIT-study

On June 6, 2019, the ISA published on its website a report by Kirchain et al. of the MIT Materials Systems Laboratory entitled: "Report to the International Seabed Authority on the Development of an Economic Model and System of Payments for the Exploitation of Polymetallic Nodules in the Area" (Kirchain et al., 2019).

Sections 1.-6. summarise the report results. Its express focus is on balancing financial return to the ISA and to mining contractors who are solely seen as private, commercial operators. This approach of course does not take into account that most present holders of exploration licences and thus potential candidates for exploitation applications are not private but public entities and that therefore the relevant finance parameters are quite different from those of private companies.

The report also expressly excludes issues of environmental degradation as part of the external costs that a mining venture may have and which a different approach would aim to internalise. The MIT approach therefore differs significantly from the approach described in this text which would focus on achieving optimum outcomes for humankind as a whole from managing the Area based on a comprehensive economic analysis that would take both the public nature of most contractors, including of course the Enterprise, as well as the environmental impacts and their costs fully into account.

The method chosen under sections 7.-10. focusses on a specific private contractor and identifies a minimum attractive rate of return, which is set above that of typical land-based rates (which seems contrary to UNCLOS). MIT then applies a discounted cash flow analysis which is consistent with assuming that all contractors are purely profit-driven private entities. A further, less explicit but important assumptions seems to be that potential applicants have the capacity, size, funding resources and expertise to deliver such a project, as cash flows are then assumed certain to be received over the period considered, which in this case is up to 45 years. As everyone agrees there are significant uncertainties around these projects and it can therefore be argued that a cash flow approach may not be appropriate to discuss all the issues. In any case most of those entities presently holding exploitation contracts do not fit this description of a contractor.

Under section 11. the authors correctly state that no processing plants presently exist to extract the metals from nodules. As they later confirm, the potential processing activities are outside the scope of the regulatory ambit of the ISA. One way to address this conundrum would be to assume that over time a market for nodules may develop, which could then lead to a commercial transaction that establishes market prices competitively. Instead the authors have undertaken to develop cost models for a notional metal processor company and have based them on three different technologies. They estimate that this would require an upfront investment cost of over US$2billion and that based on other market and metal price assumptions it is feasible to calculate a value of the metals content and thus of

the "revenue" of the contractor. This is an interesting and complex endeavour and it is surely open to discussion whether such an approach can assist in any predictable way in developing an ISA payment mechanism or rather needs to be excluded as not being consistent. In fact, none of the national studies taken into consideration by MIT tried to develop such a complex calculation since they just looked at this as an integrated operation, logically from an economic viewpoint but not consistent with UNCLOS. As the authors themselves confirm under section 15. the price that will ultimately be paid in a future nodule market by major processor/ smelter operators, should they ever appear, will depend on negotiating power and a number of other issues, not solely on whatever the assumed cost of investment and operations.

A key contribution of the study is provided by the cash flow model for the nodule operator, suggesting an overall development and construction cost of over $1.6bn, with operating cost of approx. 130 US$ per ton of nodule pa. Other sources have suggested that whilst nodules mining is expected to be more capital intensive than SMS deposit mining due to the larger depths and more widespread distribution over the seafloor, an initial estimated CAPEX of $1,200M seems realistic at the start. A more detailed estimate– as described in EPRS' study (2015) indicates a CAPEX cost of almost $1,800M but includes the investments in a processing facility for almost half of these capital investments. Estimates of nodule mining OPEX range between $85-500/tons, of which costs related to processing form an important component. The authors correctly raise a wide range of risks and uncertainties, which may impact these calculations and of course could delay or otherwise effect deep sea mining. The authors do not assess what financial and technology capacity bidders for contracts would need to have in order to undertake such a venture and thus do not address which uncertainties the ISA is facing in considering contracts with parties that have not shown such capacity.

In section 30. the report describes the goal as "to quantify the economic implications of alternative payment systems" and for the "mechanism to provide optimum revenues to the ISA". The report falls short of this described goal, in part because these concepts are not clearly defined. Furthermore, it is open for debate whether these are indeed the appropriate goals for the ISA.

Section 31. describes the approach taken as one of separate parametric models of the collector, the processor and the markets. Whilst this distinction is important it does not precisely reflect UNCLOS. A more stringent approach would be to clearly define the entity that is under the regulatory purview of the ISA, which indeed is the collector, but not necessarily the shipping function, nor the equipment supplier relationship etc. By correctly separating these entities it would also be possible to identify much more precisely which transactions and other processes of the project entity would need to be strictly monitored to fulfil its obligations to the ISA, and how such monitoring and accounting would facilitate the functioning of the audit and payment mechanism.

The relationship of the "regulated contractor entity" with any other commercial body, such as the processor, is purely a commercial interaction based on future market economics. Any modelling of the latter can't be done appropriately through parametric modelling.

As section 34. correctly states the externality cost of environmental degradation are not considered and need to be compared to the expected net revenues. As described above only if a "positive net benefit" of DSM can be conclusively shown should deep sea mining be allowed to proceed. This key information is, as the authors expressly state, not delivered by their report. In section 35. the authors rightly raise but do not answer the question of what "return would generate sufficient revenue to offer fair compensation to humankind as the resource holder".

In their discussion of royalties, the authors in section 38. work with standard definitions developed by Otto et al. (2006). However, in section 39. they fail to appreciate the particular regulatory context of the ISA, which leads them to repeat, but not substantiate, a common assertion that "profit-based systems are more costly to administer as more information about the paying entity is required, and therefore they are more susceptible to accounting manipulation". Whilst this may well be the case in the

context of international corporations working across multiple businesses and jurisdictions this idea shouldn't be transposed to the ISA. Simply put, the ISA as steward of CHM will need to apply to the contractor, which needs to be solely the project entity under the international regime, a strict administrative accounting regime that will give the ISA full information on physical and financial flows under all circumstances. This is an obligation that directly follows from UNCLOS and is independent of whatever payment regime is implemented.

In section 40. the report correctly considers administrative fees and necessary funds as something that the ISA needs to separately decide and assess. I would add that as these amounts may be significant and need to be fully funded the assumptions used in the model later may not be appropriate and therefore any numbers delivered by the model thus far are highly circumspect.

Section 47.-51. suggest that for the ISA to receive significant revenues requires mining at scale of contractors that receive a threshold rate of return that is higher than land-based mining based on the "technological and operational risk". Whilst this may be a correct description of contractor sentiment today conceptually there are other potential ways to achieve significant ISA revenues, namely those that would have significantly lower technological and operational risk, and I would add, lower financing cost. As an example, if through research and innovation, new technologies can be found that allowed mining at significantly lower cost in the future (including, for instance at lower cost of factors not yet considered, such as the environment and monitoring), and financing structures are put together that lower funding cost to the contracting entity, this scenario, together with potentially increased and more mature demand by then established processing entities for nodules, could deliver enhanced revenues to the ISA whilst being based on a lower threshold to contractors.

Section 52.-62. describe additional consideration of a contractor, with the key point of timing of cashflows identified under Section 62. Section 63.- 69. confirm the point made before that the only relevant revenues are those of the entity under ISA regulation. Having acknowledged in section 69. that there is presently no market for nodules the authors valiantly aim to derive a "nodule transfer price from the metal processor cash flow". As stated previously this approach is conceptually circumspect as nothing is known about the actual cost, regulatory constraints etc of such an entity, so any numbers derived for a processing company are strictly speculation. This is of course different to modelling for the contractor, as the regulatory constraints derive entirely from the ISA Mining Code which will be fully in place before the signing of any exploitation contract).

Section 66. seems to suggest that the ISA payment regime should also take into account the eventual payments due to a sponsoring state. This is misleading. Monies paid to the ISA will always have priority, be it as royalty or as profit share, any taxes paid to sponsoring states and others are calculated after such payments and therefore it is not appropriate to describe this as a split of net revenues. Whilst cash flow analysis as described in section 67. may be an acceptable approach to analysing the regulated entity, the contractor, the same can't be said for other participants in the value chain, be they subcontractors that sell services to the contractor but remain outside the control of the ISA, such as potentially shipping or equipment etc., or be they purchasers of nodules. Those entities sit under various national jurisdictions. The text in section 69. correctly states that there is currently no market for nodules and thus no nodule price, this makes the effort by the authors to artificially create such a price from metal processor cashflows understandable but nonetheless conceptually problematic.

In the same way, the MARR concept outlined in section 76.-77. is a debatable construct. Deep sea mining under the ISA regime is in many ways not comparable to land-based mining, a fact confirmed by the reality that none of the present exploration contractors are actually established land mining companies, therefore to use a risk premium as proposed in section 77. over a different activity may not be appropriate as the two activities are I a number of ways to comparable. The starting point should remain to consider the same hurdle rate. Section 78. uses data received through interviews with contractors which provides thus the view of that group only.

In an effort to calculate a share of net revenues section 79.-84. makes a number of assumptions that need further discussion. Section 80. includes in the revenues the ISA administrative fees, yet these are conceptually simply a method of cost coverage and should therefore not be included. In a similar way, section 82. considers environmental and sustainability funds as part of revenues of the ISA, yet these are in no way revenues that could for instance be used for CHM but rather are insurance-type mechanisms to deal with potential environmental damage. As a consequence, table 2 on page 22 is misleading. Likewise, the OpCost definition for the contractor needs to be scrutinised further. There are in particular three components of such cost that should be considered separately, rather than lumped together. Costs incurred during the exploration phase are economically speaking "sunk cost", therefore whilst relevant for the operator's decision to engage in activities, they should not be included in any calculation of hurdle rates, NOR etc. This is not to say that these are irrelevant, but rather that the contractor should consider recouping them at a much later stage through the value of their equity, long after all necessary project-related payments to the ISA and others have been made. Secondly the application of a uniform WACC seems problematic. To the degree that external debt financing can be provided (which is possibly a large part of the overall funding cost), the cost of the debt will be quite different depending on the type of lender, borrower and the nature of the securities provided. A hurdle rate is thus most appropriately only applied to the relevant equity provided by the investor. It will of course be likely to be significantly higher.

Section 86.-87. contains a further concept that requires scrutiny, which is the application of a uniform social discount rate of 10%. As the authors correctly state this is a key metric to calculate ISA NPV, so this assumption needs to be discussed. The authors are basing their approach on a rate used by leading development banks, and indeed if the report would be discussing choices to be made by such a financing entity their argument would be cogent. The social discount rate would be used to identify the preferences for public investments, for instance into climate change protection measures. As the Stern report rightly assumed, the public sector needs to take the welfare of future generations just as seriously as the economic wellbeing today, therefore an investment for instance against long-term flood risk is justified, which is reflected in a lower social discount rate.

However, this is not the case here, the question is rather whether the ultimate potential recipients of the benefits of the Common Heritage, generally understood to be developing nations (the details of the distribution to be decided by the Finance Committee at the appropriate stage), should have a different time horizon to the contractors. By applying a different, lower rate, this is the assumption the model makes. It seems problematic to make any distinction between the "value of funds over time" to contractors and to CHM. This is notwithstanding the entirely correct statement in section 88. that developed countries typically use much lower discount rates.

The screening analysis in section 92. helpfully looks at the three rates options presently under debate, though by restricting the first phase in section 93. to start with "the beginning of mining" the potentially relevant period from signing of an exploitation contract to "beginning" is not covered. An alternative approach, which would consider the option of an upfront payment at signing would of course deliver funds to the ISA immediately, thus providing both time value of money and greater certainty that the CHM would receive a potentially relevant amount independent of the vagaries of markets, technologies and impacts. A bidding process at that stage would furthermore help to discover the true price a contractor may be willing to pay.

Selection and Monte Carlo Analysis section 94.- 101 applies a financial methodology based on the assumptions described above.

Section 102.-107. identifies the need under ISA jurisdiction to focus on the collector yet as before Figure 4 is still based on a single cumulative cash flow which is, as discussed above, is a problematic approach for this purpose.

Section 108.-112. discusses the cash flows of the metals processor, as mentioned above this is inappropriate as the metals processor is not an existing entity, is not covered under the ISA, prices will result from market forces, not from a theoretical cash flow model. Indeed, this is confirmed by the authors in 109. which correctly states that "prices will be set through the negotiation between the metals processor and the nodule collectors" and will depend on “relative negotiating strength”.

Section 13.-121. discusses metal market price modelling approaches and in 119. The authors rightly identify the “large uncertainty in these forecasts”. There is no way to confirm the numbers delivered in Table 5 under 121. which are given as based on "expert forecast”. As they all seem to suggest significant rises in long-term prices it would have been useful to know whether the experts consulted fully integrated scenario analysis approaches that took on board for instance policy commitments around the Sustainable Development Goals, a circular economy etc. Long-term historical prices (50years may be appropriate as this is the time scale of the projects considered) of such metals show large volatility but not necessarily upward trends.

Consideration of Multiple Manganese Markets, Estimating Metals Processing Costs and Process routes: Section 124.-134. contains an interesting discussion in particular on the processing of a subset of the manganese market (“EMM”), which seems to suggest that the first contractor that addresses this market may have different revenue opportunities to other parties. Section 134. suggests the need for additional work in that area, yet it seems that it will be a processor issue and thus outside the scope of the financial model. Manganese was excluded from the calculations of other studies as it is assumed that for manganese no efficient extraction method is yet available. The manganese residual materials could of course be stored till further developments enable costs effective isolation (Secretariat of the Pacific Community, 2016).

Section 135.-155. contains discussions of technical and cost issues of potential metal processors, though no discussion of their legal, regulatory and operational structure and constraints. As discussed above the information provided is outside the scope of the ISA. Section 153. and 154. describe the problems of the approach chosen to use a calculation of a nodule transfer price.

Section 156. goes back to the logic of a sale of nodules and the following sections and tables make very specific assumptions, the sources for which are not identified. Section 166. clarifies that the technology is in an early stage. It seems debatable whether a payment modelling approach should be based on such uncertain numbers.

Costs Associated with Environmental Baseline: Section 168. suggests that the environmental monitoring section is based on information from contractors, oceanographers and oil platform experts. It seems surprising that experts in environmental issues apparently have not been part of the process.

Section 169.-179. provide a detailed set of assumptions that are difficult to verify.

Costs for Supply and Transport: 1 Section 80.-184. makes a number of further assumptions whilst at the same time stating in Section 181. that shipments may be provided by a third party. As discussed above, the relevant distinction should be the ambit of the ISA, not how a contractor may or may not decide to organise its transport chain.

Nodule Collection Cost Model: Section 185.-187. provides some cost assumptions though 187. refers to environmental monitoring cost during exploration, which seems misleading, since environmental monitoring of the mining process is an activity directly linked to actual mining and therefore due during exploitation, whereas the efforts required to assess the feasibility of environmental monitoring, which may take place during the exploration phase, should be considered general investment assessment costs of the contractor and thus “sunk cost” at the time the decision is made to proceed to bid for an exploitation contract.

Payments to the ISA: Section 189. suggests an administrative annual fixed fee of USD 1million which it then proposes to credit against royalty or other payments. This is erroneous since the administrative fixed fee covers costs of the ISA, they are, as the name says, for administrative cost, and therefore have nothing to do with the payments to CHM.

Extraction-related Payments to the ISA: Section 190.-204. contain the key calculations formula, which is based on "royalty payments on an *ad-valorem* basis using gross metal value of the metals contained in the collected nodules" (Section 191.) and collector profit based on "collector's revenue minus operating cost (including capital carry forward charges) and fees paid to the ISA". Section 196. describes the carry forward as including "all capital expenditures from the start of production" which, as is discussed before, would mean that it is purely left to contractors to decide what Capex to undertake, whether or not such Capex is under the purview of the ISA.

Section 198. suggests a 1% payment of gross metal value into environmental funds, capped at $500 million per mine site without an explanation as to how such a cap is derived and why a cap would be logical. This also means that the fund would only receive monies once production is ongoing, thus the fund would not be fully funded in the critical early years during which the uncertainties are likely to be highest and such a fund might be most required.

Section 200. suggests a 25% sponsoring state income tax level but does not discuss the issue of priority, namely that any ISA payments would always be paid first, meaning any sponsoring state calculations would only affect any remaining amounts.

Section 201.-202. suggests a number of phases. It is not entirely clear but as Section 201. allocates the Design, Build and Operations to the exploitation period, this is to be interpreted that the pre-feasibility and feasibility phase are considered part of the exploration phase. This would imply that these two earlier phases are part of the exploration period and it is not clear why they would be part of the model discussions for the exploitation period.

Section 202. suggests that full operations start in year 13 only, another reminder how far out the period is estimated at which any royalty-type payment would begin to be made. Given that Section 62. helpfully pointed out the key issue of timing of cash flows it needs to be considered carefully whether beginning any payment to CHM at such a date far in the future is in itself appropriately reflecting the CHM principle.

The authors made a number of assumptions to simplify the comparison and then analysed selected systems via a Monte Carlo simulation. As discussed previously, by applying a uniform "social discount rate of 10% to the ISA" but different hurdle rates to the contractor the benefits of the ISA in NPV terms appears larger in comparison. Given this basic feature all the results that follow, in particular in Table 33 under Section 214. etc, are, strictly speaking, not comparable.

To put it in another way, whilst the table correctly shows that given the various assumptions etc. made before a range of hurdle rates for the contractor, chosen here from 17% to 18%, do leave some monies to be shared in some future years with the ISA and that at a later stage sponsoring states will also be receiving funds (though the table 33 does not include a Sponsoring State NPV column, therefore we can't see how, at the some social discount rate, a sponsoring state would fare).

Section 215. shows various likelihoods of outcomes, using a probability density function. These are then used to discuss in particular how under a two-stage system of *ad-valorem* rates different payments may result. Section 243. compares outcomes with the aim to show how different combinations result in variations of ISA NPV.

An overall observation to the results section needs to be that the authors correctly apply various finance techniques with the aim to deliver ways to compare outcomes based on the assumptions chosen. However, as the text itself acknowledges, the critical lesson from finance is "time value of money",

significant contractor cost in the early days and limited percent payments to the ISA in later years will always mean that the value of the payment to CHM is small. Put in a different way, early payments to CHM and reduction of cost of the contractor, be it through innovation and technology progress, through lower finance cost or through strict definitions as to what costs should be included as being of relevance (such as only those strictly under regulatory review of the ISA) will always have the largest impact on the overall results.

Section 245. rightly suggests that the ISA needs to "consider the administrative costs of a profit-based system." As discussed above, the relevant costs are those such a system requires over and above the administrative costs that the ISA will need to incur under any circumstance just to fulfil its legal mandates for correct supervision and administration. Section 247. correctly suggests that a blended system has many attractive features, not the least being that pretty much all mining tax regimes have acknowledged the need to tax at least in some form potential "windfall profits" that may or may not occur at a later stage of the concession.

Section 253.-256. discusses the impact of differing national tax regimes. Given the range of assumptions made it does not seem entirely clear how likely it is that the author's conclusion that lower national tax rate may have positive implications on the amount available to be paid to ISA and/or the contractor. Leaving this abstract debate aside, the authors importantly state in the last sentence of 256.: "the ISA should determine initially a fair return to mankind as resource owner".

Section 257.-264. raises some interesting points from the authors perspective. It starts with "how much return should a contractor expert to generate". It is unclear to me how and why ISA decision makers should adopt this point of view as a starting consideration. UNCLOS is clear that the appropriate rate of return for DSM is that of land-based mining.

Section 260. then refers to fees and fund submissions as aspects under ISA control. Again, it would appear that these need to be set appropriately to cover the full costs and risk, therefore this is not something open to judgement.

Section 261. suggests that the ISA has a trade-off to make between fixed and adjusted rates. This issue arises because the authors compare a cumulative ISA Share total rather than modelling the payment mechanism in line with realistic phasing. In the simplest form, this would need be done as follows:

- an initial phase up to the award of the exploitation contract (contractors take risks and have costs ahead of such an award, none of this need to reflected in the 'project' model but rather in the long-term equity value of the contractor).
- a development phase with significant capital expenditures (contractors provide some equity but also engage with external funders and take on significant risks)
- a first project revenue phase (during which contractors have revenues, which they use to pay royalties, cover operating cost and repay both the interest and the principal of any external funders)
- a second project phase (during which contractors earn revenues, pay royalties, cover operating costs and have sufficient profit to pay a profit tax to ISA as well as deliver a return on their equity invested (on which they pay national tax).

Such a model would be more realistic and show that key financial drivers are timing and cost, in particular interest cost, and that all sides could discuss how best to address these.

Section 264. the authors recommend a two-stage *ad-valorem* only system and Table 39 shows some numbers around this. All caveats mentioned above still apply.

Section 265.-269. suggests that additional work is required around markets and impacts on land-based mining, which is certainly correct. In the last sentence of Section 269. the authors acknowledge what I believe will be key, namely that we need "to understand the economic value of the ecosystem

services that will be impacted by seabed mining". It should be a precondition of any mining that this issue is addressed. Furthermore, as Bleischwitz et al. (2009) note, only a limited number of sectors, both on the production and consumption side, are actually associated with major resource requirements and atmospheric emissions – so synergies between resource conservation and climate protection can be found, which may make any DSM unnecessary.

In the following we look at some of the individual categories included in the model[56]:

Prefeasibility Expenses

The MIT presentation considers these as part of the financial model and thereby imply that they should be integrated into any calculation of what they refer to as "dividing revenues" between contractors and CHM.

Conceptually such cost that relate to identifying new business opportunities are regular course of business and certainly not funded from external debt. Whilst it is correct that these may be significant cost (and that companies will consider them in their decisions) corporations constantly engage in prefeasibility work around the globe in order to decide which business to go into. It is not for CHM to refund them (with significant interest) for them having looked at deep seabed mining as one of the many options for their next investment.

Capital cost and Operating cost

The largest component, 60% of CAPEX and 69% of OPEX relates to the metallurgical plant, even though metallurgy is not part of the deep-seabed regime and its regulations will be entirely national rather than under the ambit of the ISA. It is therefore completely irrelevant as to how the model for assessing the payment mechanism should be constructed. Furthermore, the assumptions taken on e.g. equipment efficiency and costs are very important in the calculations and vary highly between authors (Rozemeijer et al., 2015).

This is not to say that it is not important to contractors, they will of course need to look at various options, whether selling to other smelters, doing it themselves, deciding on which related activities to invest in to complete the value chain, etc. but it entirely is within their remit and not part of the relevant model. To make the point even clearer, if Tesla decided to integrate deep-sea node mining into its value chain, would the ISA be expected to take into account whether or not the electric cars sold would be making sufficient money?

Giving that these costs are over half of the overall cost, they make any results presented on that basis entirely meaningless.

Costs—notably OPEX for fuel, related products, and power—are anticipated to be crucial elements for launching a deep seabed mining project. Given the assumption that these costs might have a share of up to 80% (Kuhn et al. 2011), changes I their prices might be even more decisive. Metal but also fuel or fuel-based prices are subject to strong, often difficult- to-predict fluctuations (Volkmann et al., 2019).

Timing

The length of the process outlined in the proposal shows how important assumptions will be about when payments actually happen. The chart does however only relate to the timing form the perspective of the contractor. For the ISA and its stakeholders, it is likewise critical to decide the correct

[56] The latest version was uploaded to the ISA website on February 14 and can be found via the link provided undo 4. of the OEWG note: https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/files/documents/doclist_0.pdf

timing, taking costs and revenues into account. It may thus be financial advantageous to consider a much later starting date if at that point the potential cost structure be seen as being quite different.

Risk

The MIT generally assumes that due to its novelty, the depth involved, and the technological uncertainty DSM should be considered riskier than land-based mining. On the other hand, the ISA will be providing a clear, upfront legal framework and processes, all endorsed by a community for 168 member nations and the certainty of no alternative claims or local users. Thus, whilst many share the MIIT view, note that Martino and Parson (2012) propose that a lower IRR could be advocated since seabed mining is less risky than onshore mining.

4.5 Comparison with terrestrial mining regimes

Whilst an assessment of national regimes is certainly interesting and indeed required to get for instance a sense of the procedural approaches taken as well as the complexities involved, we need to keep in mind the unique nature of the CHM regime for the area. This principle puts the ISA squarely into the driver's seat and makes it responsible to optimise benefits to humankind. It can be expected to end up with most of the benefits of selling manganese nodule resources, and any proposed regime needs to be judged against this simple threshold. It is not comparable to a government that taxes its citizens. Deep seabed mining and terrestrial mining conditions differ in many other aspects, thus the regulatory regime is also likely to differ.

A table of national comparisons was presented to the ISA in 2014, it differs somewhat compared to another study on royalty rates in terrestrial mining prepared for the World Bank by Otto et al. (2006). Rather than focusing on these differences that arise between countries as to royalty rates chosen and other aspects of the governance regime as a consequence of differences in conditions, policies and processes, it seems helpful to identify similarities that may provide some conclusions.

Thus Figure 3.1 of that study shows that the Effective Tax Rates assessed vs. *per capita* GDP for 24 International Mining Jurisdictions ranges between 25 and 95%, with most countries in the range of 40 to 60%. In fact, as an IMF paper noted, the concern is that the government share of economic rent may become excessively low as counters compete against each other win attacking mineral projects (Sunley and Baunsgaard, 2001). Most stakeholders are therefore likely to expect that the proposed deep-sea financial regime will be at least as beneficial as terrestrial mining regimes, that is structured in a way to ensure that the majority of financial benefits will accrue to the ISA, so that they can be distributed as part of the application of the CHM principle. Any payment regime mechanism would therefore need to show that it delivers on this criterion.

Other lessons that may be drawn from terrestrial mining include the need to consider impacts on communities (Chuhan-Pole et al., 2017) and make certain trade-offs, such as between the efficiency of administration and the ambition of the governance regime to capture all funds, the impacts of other tax and regulatory measures and the effectiveness with which social and environmental ambitions are achieved both during and after the mining process. Thus, Otto et al. (2006) suggest to "give a high priority to strengthening both financial reporting and the institutional capacity of administrative agencies that are responsible for levying and collecting mineral sector taxes." At the same time, it seems clear that also on each of these issues the conditions facing the ISA and the Minerals Code regime differ vastly from those facing terrestrial mining regulators and their governments, and as the focus of this paper is strictly the financial payment mechanism the contention is here that an equitable ISA payment regime will need to be developed "sui genesis" rather than on the back of terrestrial mining experience.

On the other hand, the Implementing Agreement explicitly states that the rates of payment under the system shall be within the range of those prevailing in respect of land-based mining of the same or

similar minerals.[57] As the African Group pointed out in its response to General Question 3 mentioned in the Annex to Document ISBA/23/C/12 this should fairly and sensibly be interpreted to mean that the authority, that is the ISA, would need to receive an equivalent share of the overall amount to that received by a government managing land based mining. The African Group has therefore suggested that an independent study be undertaken of the rates of payment of onshore mining regimes.

4.6 Comparison with other deep-sea extractive regimes, such as for oil and gas

The oil and gas sectors are another relevant example of an area that has a wide range of royalty and similar regimes. Such concessions are primarily awarded via auction processes as they are deemed the most transparent way of allocating rights. A recent Deloitte study (Boeriu, 2018) for Europe concluded that the average royalty rate was approx. 10%, based on a wide spectrum that ranged from 0 to almost 70%. As an IMF paper put it in 2001:

> *"The resource owner has a valuable asset in the ground. This asset can only be exploited once. In order to convert this asset into financial resources, the government must attract capital on terms that ensure it gets the greatest possible value for its resources. Multiple fiscal instruments may be needed to create an identity of interest between the government and the oil and gas companies over the life of the agreement. Production-based instruments, such as royalties, can ensure the government receives at least a minimum payment for its mineral resources. Profit-based instruments allow the government to share in the upside of highly profitable projects." (Sunley and Baunsgaard, 2001).*

Table 2 on page 15 of that paper shows a range of 0-20% royalty rates. The paper underscores the importance of combining a tax on such profits, described as "excess rents" with a number of other measures such as "strict ring fencing" and "thin capitalization" rules. These are mechanisms to ensure that funds are not lost to taxation through internal company transfer pricing.

The complexity of these efforts, the specificity of the sector and of national experiences again suggests that whilst some lessons may certainly be drawn from the oil and gas offshore sector, it would appear simplistic to just apply the financial payment regimes that have evolved for oil and gas to the emerging deep seabed mining discussion. However, countries with expertise in that may be able to bring it to the stakeholder consultation process, for instance in how ring-fencing issues can best be addressed.

4.7 Conclusions for a pragmatic way forward

The early stage of the draft regulations, the indicative nature of the model and the lack of any solid numbers which would need to be based on market transactions of nodules make a full assessment at this point difficult. Whilst the consultants as a consequence of the interactions with the OEWG have changed certain components of the model and consequently are now presenting potentially higher payment amounts to the ISA these entirely depend on uncertain future metal prices. Significant gaps and problems have been identified with the approach taken thus far. Some of these have been also mentioned in a recent briefing note[58] by the Deep-Sea Conservation Coalition, so as:

[57] Section VII, para.1(a) and 1(b) of the Implementing Agreement.

[58] DSCC Briefing 26th ISA February Council Meeting, 14 February 2020

- The approach that is finally agreed must provide for adequate funds to support a robust monitoring and compliance system, appropriate incentives for environmental protection, as well as compensation for environmental damage.
- The regime must meet all UNCLOS requirements, including avoiding subsidising or giving seabed mining in the Area an unfair competitive advantage over terrestrial mining, and setting rates of payment within the range of those prevailing in respect of land-based miners
- The financial model must reflect UNCLOS – this means it should cover the mining or 'collector' aspect and not shipping, processing etc. that are regulated and taxed elsewhere.
- The financial mechanism must deliver an assessment of what the minimum and absolute amounts and the amounts relative to the overall sums delivered will be delivered to the ISA for the common heritage of humankind under the proposed approaches as well as under other potential approaches.

It shows how the ISA's adoption of an individualist stakeholder orientation and its deference to commercial expectations of profitability, in the context of growing political attention to the oceans as a source of economic growth, are further transforming the notion of common heritage and benefit sharing and concomitantly undermine the regime's redistributive ambitions (Feichtner, 2019).

This suggests that a more fundamental rethink is required and, if necessary, a fresh start needs be made in order to design a payment mechanism that is more in line with UNCLOS and the need to optimise benefits to CHM. The proposal by Argentina and 6 other Latin American states to the OEWG of February 14 2020 likewise states: "invite the OEWG to consider if it would be suitable request the Secretariat to make the necessary arrangements for the development of a new financial model"[59]

Such an approach would start with the return to basic agreed principles, with CHM at its core, and would aim to ensure that any activities would only be licensed if it was clear that they would for certain provide net benefits, considering state of the Area as a whole. This requires for instance the establishment of adequate hurdle rates and minimum payment guarantees from contractors before any licence is being considered.

Alternatively, should member states prefer to "build on" the MIT work, it would be desirable to at least complement this contractor-focused approach with some necessary work around setting further minimum components, namely in particular:

- an analysis of the financial and economic implications of the overall Minerals Code proposed, namely as to whether the legal and financial obligations (fees, pre-payments into funds, viability and ensure requirements etc.) provide sufficient robustness as to ensure that no risks remain with the authority,
- a broader economic assessment as to the potential costs to the deep-sea environment of mining activities so as to ensure that these are fully integrated into the decision-making to guarantee net positive benefits of any activities undertaken (see the chapter on the economics of the deep in a previous chapter of this text),
- a clear pathway for impact through the Enterprise and through hybrid models that help deliver alternatives for economic benefits beyond financial payments.

A societal and stakeholder assessment as to overall benefits will also be required. Previous studies have suggested that deep sea mining will in any case only happen if initially subsidised, as was noted

[59] Proposal by Argentina et al in regards to the potential outcomes of the third meeting of an open-ended informal working group, 14 February 2020

for instance in a German study of 2016: "Given the financial risks associated with such a billion-dollar (investment) project, state support and fiscal incentives are seen as a necessary measure to realize DSM".[60] It is at least debatable whether any such subsidisation is permissible under UNCLOS and/ or relevant national legislation.

At this stage, the process chosen separates discussions of the payment mechanism in the Open-Ended Working Group from discussions of benefits in the Finance Committee, whilst the role of the LTC in addressing both topics is unclear. Likewise, as the Latin American paper of Feb 14 2020 also notes, it would require a "draft text proposal on how such model would be reflected in the draft Regulations". All these issues are interconnected, and it remains for the Council to safeguard the broader interests of stakeholders in making sure that the overall outcome is equitable. Further and more comprehensive work in this direction would be welcomed.

The Chair's report to Council from the OEWG dated February 17, 2020 called for a further meeting of the Working Group ahead of the next Council meeting in July, suggests further work around the 2-step royalty options and invites all stakeholders to submit further comments by March 23. These recommendations were adopted by the Council after a wider discussion of the OEWG outcomes during which the African Group and others clearly noted their misgivings on the lack of reflection of the points they had previously raised and Germany and others identified the need to include environmental cost in the financial model calculations. It remains to be seen whether the report requested from the Secretariat in that Chair's report will sufficiently address the wide range of open issues identified above.

Recommendations

- Develop a payments mechanism that delivers the majority of benefits to Common Heritage of Humankind principle; and
- Review the financial mechanism to ensure that it does not encourage activities that are detrimental to the deep ocean environment in any stage of the process;
- Make sure that the development of the payment mechanism fully reflects the need for an open, transparent and inclusive process.

[60] BMWi (2016) Analysis of the economic benefits of developing commercial deep -sea mining operations in regions where Germany has exploration licenses of the international seabed authority, as well as compilation and evaluation of implementation options with a focus on the performance of pilot mining test. Study commissioned by the Federal Ministry for Economic Affairs and Energy division (BMWi) I C 4, Project No 59/15

5 Scenario as a methodology to assess the financial regime of deep seabed mining

5.1 Introduction

The use of scenarios is now widespread in public and private decision-making but has been absent from the development of the payment mechanism. Whilst scenario work originated in a military context and was used for strategic planning and gaming exercises before business took notice, and integrated scenarios into their strategic decision-making processes in the 1960s (Moss et al., 2010). Rather than precise predictions, scenarios are a means to 'manage uncertainties' in that they help construct plausible narratives of how the future might unfold and simultaneously offer a platform to evaluate which strategies are likely to result in desired outcomes across a wide range of possible futures (Fricko et al., 2017; Hughes, 2009). By linking decisions of the present to respective potential future development, scenario development exercises serve the purpose of visualizing how a hypothetical stream of events that ground in the presence generates a plausible future (Hughes, 2009). An integral part of developing scenarios ('scenario planning') is to engage decision-makers in the early-on in the process, to establish understanding and a sense of responsibility for alternative future outcomes (Wack, 1985). Additional goals of scenario planning include knowledge exchange among a diverse stakeholder group with a focus on illuminating potential challenges, risks and opportunities and to ultimately facilitate decision support (Priess and Hauck, 2014). For example, in the 1970s, this technique provided Shell with the tools to grapple with the oil price shock and has since then increasingly been used across business and policy.

In the context of climate change, scenarios are a helpful tool to address how human activities impact the Earth system and shed light on its respective responses. Consequently, it is argued in this chapter that the scenario analysis approach may be particularly useful to deal with complex decisions around deep seabed mining and associated uncertainties.

Despite decade-long research and exploration the idea of facilitating deep seabed mining on a commercial scale is still associated with a high degree of uncertainty and risk (Christiansen et al., 2019). The research community has repeatedly expressed its concerns in regard to potential risks for the marine environment that might occur by putting into practice the endeavour of mining the ocean floor (Hunter et al., 2018). According to Article 150 (j) of UNCLOS all activities in the Area have to be carried out for 'the benefit of mankind as a whole'. To this end, it is important to gather distinct perspectives and knowledge from an ideally many-faceted group of stakeholders and to foster a productive debate amongst diverging interest groups. Currently, the large variety of stakeholders and their diverse, sometimes opposing interests, are not aligned with a common strategy to holistically preserve the deep seabed environment and simultaneously ensure economic benefits to all. By strengthening cooperation across research fields and stakeholder communities the use of scenarios offers a way to engage in the process of navigating the complex political decision-making towards a beneficial, holistic approach in line with the high standards of equity, transparency and precaution that is appropriate for dealing with the largest global common on Earth as the Common Heritage of Humankind.

In the following, we present how this approach was applied at the IASS/UBA international expert workshop on "A Benefit sharing mechanism appropriate for the Common Heritage of (Hu)mankind" in 2018. It describes how the uncertainties surrounding deep seabed mining, the theoretical approach and the implementation of the method can be undertaken.

5.2 Uncertainties and the complex future of deep seabed mining

In light of potential future demand for certain minerals and metals for new technologies and products, and declining terrestrial deposits, a number of parties, though no large mining companies, have shown an interest in developing mining activities on the ocean floor. However, mining the deep seabed for

minerals such as nickel, cobalt, copper and manganese has operational challenges and is associated with a high degree of uncertainty and risk in regard to its potentially harmful effects on the marine environment (Jaeckel, 2020).

Especially in the field of environmental policy complex, often little understood system dynamics and developments covering long time periods and spatial ground, decisions are prone to adherent, unforeseeable and displaced consequences. Strategic decision making in the face of the high level of complexity and uncertainty surrounding the issue of deep seabed mining consequently is a challenging task for the ISA. In order to generate an overarching strategy that is resilient towards a broad spectrum of future trajectories, a high level of engagement from all stakeholders involved is required. In the case of future deep seabed mining, key uncertainties include the legal framework, technical feasibility, economic viability, distributional justice and negative environmental impacts (Christiansen et al., 2019; Ginzky et al., 2020).

According to Thompson et al. (2018) the consensus within the marine scientific community is, that despite knowledge gaps on the exact severity of the impacts 'deep seabed mining will systematically deplete resources, disturb, damage or remove structural elements of ecosystems, cause biodiversity loss and impact ecosystem services.' At the same time, additional climate and anthropogenic stressors (such as climate change, ocean acidification, deoxygenation, pollution and overfishing) are already threatening ocean health and interfering with ecosystem resilience (Ginzky et al., 2020). Keeping in mind the interconnectivity of marine ecosystems and the stressors' cumulative effects on the marine environment, pushing for deep seabed mining on a commercial scale might be leading the ocean system towards reaching a tipping point, unfolding in a cascade of (eco-)system collapses.

Following this argumentation, it remains questionable if potential economic benefits can outweigh the anticipated negative impacts of exploiting the ocean floor for its minerals (Thompson et al., 2018). Kim (2017b) declares: '*The benefits have been consistently assumed and rarely questioned. However, the world has changed drastically. A new set of global goals for humanity have been agreed upon and captured in the 2030 Agenda for Sustainable Development [..]. The meaning of benefit and humankind should be reinterpreted in light of the Sustainable Development Goals. The benefit has so far been defined by the ISA almost exclusively in the economic or financial terms, but social and environmental interests, especially those of future generations, deserve equal consideration […]. It is time to question the assumption that commercializing the Area will benefit all humankind. Is commercial exploitation of non-renewable resources from the ocean floor today really in the interest of humanity?*' This fundamental question should be addressed *a priori* to handing out exploitation rights for contractors.

Currently, respective regulations for industrial mining are being drawn up by the ISA ('Exploitation Regulations'), offering a unique window of opportunity to engage in the process and systematically address existing uncertainties, to facilitate a more open dialogue, involve the public, and create transparency of the process (Christiansen et al., 2019; Ginzky et al., 2020). With the help of scenarios, it might be possible to re-address deep seabed mining as only one trajectory, amongst many, of how to use and develop the ocean floor in the future. Developing narratives of alternative futures can act as a reminder that not allowing mineral exploitation is still a valid option. While the current narrative revolves around the facilitation of mining, a broadened understanding of the ISA as an appointed guardian of the ocean floor habitats might offer additional approaches on how to develop the ocean floor in order to generate the greatest benefits for humanity. For example, the potential inspiration for bionic innovation, a large amount of undiscovered genetic resources with high potential for medical advancement, as well as new opportunities of understanding ecosystem connections and discovering new species all could experience increased prioritisation.

Rethinking the meaning of 'benefits' in light of the sustainable development and intra-and intergenerational justice, as Kim (2017b) proposed, rearranges the background of norms and values against which the decision- making is undertaken. The choice to exploit/ the extend of exploitation of a non-

renewable resource is one that is formed by the level of responsibility felt for a common good, and the concept of ownership inherent to society. While this might change over time, scenario planning can also enable stakeholders with less prominent perspectives to be heard and contribute to shaping the decision makers' thinking patterns.

Momentarily disregarding the environmental concerns and the suggested immanent loss of invaluable ocean ecosystem services benefits (such as food, climate change buffer, recreational use, etc.), it is by no means guaranteed that even from an economic point of view deep seabed mining will be delivering net benefits overall. As mentioned in Chapter 3, a true assessment of the cost of deep seabed mining is not yet possible, due to the lack of knowledge surrounding the deep sea(bed) ecosystems and the economic value of their ecosystem services. Efforts towards optimising payments/ the payment regime by assessing the financial model as a whole and determining the best timing and cost structure, are thus being hampered by uncertainties of future development.

Additional uncertainties include the future global demand, and hence, the prices for marine metals. Whilst some promoters of DSM have predicted significant price rises for the metals in question, based on global demand, thereby leading potentially to financial benefits, others have argued that the transition to a circular economy may mean that prices will remain low and the environmental cost could outweigh the benefits. A recent study by Teske et al. (2016) also seems to suggest that even under an advanced energy revolution scenario, there may be sufficient land-based supply. Developing a sound payment regime that delivers returns under various future price scenarios needs to be robust against potential, unexpected socio-economic developments and price shocks.

5.3 Scenario analysis methodology

Scenarios are a useful tool for envisioning a future, which is not necessarily a prediction, but a form of narrative descriptions following a hypothetical sequence of events that ground in the presence, linking decisions of the present to potential future developments (Hughes, 2009). A scenario hence describes changes, including events and respective consequences, highlighting important drivers of the future and their interrelations (Opdebeeck et al., 2010). Within a scenario, the portrayed future should be illustrated to a point where problems, challenges and opportunities presenting themselves under the described circumstances become visible, and therefore foster critical debate. Uncertainty can be explored through scenario analysis. A variety of scenario analysis approaches currently exist, including quantitative and qualitative approaches, fore- and back-casting studies, descriptive and normative scenario types, and combinations of those, each with its own strengths and weaknesses (Bishop et al., 2007).

While the scenario as a product is very valuable outcome for further planning and decision-making, the process of developing the scenarios can in itself be equally essential (Priess and Hauck, 2014; Volkery and Ribeiro, 2009). Scenario planning should also be further integrated with the process of strategy formation (Wright et al., 2013). A participatory approach to scenario planning helps not only to facilitate knowledge exchange among different research groups and actors, but also to stimulate creative debates around emerging problems and corresponding solutions. By showing how these are interrelated, strategies can be exposed to new inputs and path dependencies (Volkery and Ribeiro, 2009).

5.4 Scenario analysis and climate risk

The consequences of anthropogenic climate change are manifold and vary according to the spatiotemporal extent under consideration. The magnitude of its impact is closely linked to the socioeconomic developments (population dynamics, economic change, technological development, institutional structuring and the implementation of environmental policies), since they determine the degree of climate forcing and level of society's respective adaptation.

Climate scenarios are important especially in regard to consequences on the marine life at the deep-sea. However, deep seabed mining is firmly linked to the demand for metals and minerals, which is highly dependent on our respective consumption. This consumption is susceptible to changing values and beliefs of society. Therefore, including a range of socioeconomic developments is key to identify the actual need for the exploitation, as well as the benefits the extraction has for humanity. Since the ramifications for marine ecosystem structure and functioning are uncertain, the question if DSM really is in the best interest of humankind as a whole has not yet been answered.

Cross-disciplinarily shared scenarios can facilitate integration of concerns and feedbacks between research areas, such as trade-offs between mitigation and adaptation responses, and lead to new integrated research questions (van Vuuren et al., 2014). The multi-functionality of the seascape and the ecological connectivity across different areas of the ocean (cf. Popova et al., 2019 on ABNJs and costal zones) make the cooperation across research fields and stakeholder communities, and thus the implementation of a shared future narrative, of key relevance to the deep seabed mining activities in the Area.

5.5 Shared socioeconomic pathways

A number of distinct Shared Socioeconomic pathways (SSPs) have been proposed by Riahi et al. (2017). By providing a limited number of global narratives, consistency and comparability between study results can be facilitated, i.e. across disciplines (Kriegler et al., 2012). Due to an increasing convergence of the range and scale of future scenarios covered in scientific studies over the last years, the necessity of some shared assumptions and common elements across research disciplines and scales became evident (Absar et al., 2015). To this point, the climate change research community, in a joint effort developed a set of plausible global development narratives, spanning a wide range of potential risks, challenges and opportunities of mitigation and adaptation to climate change (Fricko et al., 2017; Riahi et al., 2017). The Fifths Assessment Report by the IPCC introduced four new Representative Concentration Pathways (RCPs) - different climate scenarios predicting how the climate will change depending on the CO_2 concentration in the atmosphere. Complementary, and more or less in parallel, a set of five Shared Socioeconomic Pathways was designed (Moss et al., 2010). The SSP narratives describe alternative futures of societal development, including qualitive and quantitative descriptions of change in societal aspects such as demographics, economy, technology, social issues, governance and environmental factors (Kriegler et al., 2012) in the absence of climate change policy (van Ruijven et al., 2014). These scenarios enable integrated, multi-disciplinary analysis (O'Neill et al., 2016).

5.6 Application of scenario analysis to deep seabed mining

The discussion of benefits of deep seabed mining lends itself to a scenario approach. There is significant uncertainty around these benefits, but even more importantly, the uncertainties concerning the role of deep seabed mining in the future are even higher. The application of the common heritage principle to the Area will require an equitable assessment of any future mining activities (Bourrel et al., 2016).

Rather than solely debating potential outcomes, the scenario approach invites us to discuss different pathways and assumptions. Not only does this approach allows experts from different disciplines to discuss economic concepts on a more strategic level, it also steers the debate away from proprietary claims and "commercially sensitive" knowledge to a broader social engagement. We used the IASS/UBA international expert workshop on 'A Benefit sharing mechanism appropriate for the Common Heritage (Hu)mankind' to apply the concept practically.

5.7 Scenario experiment at the international expert workshop in November 2019

Participants were randomly allocated to three groups of about 12 persons each and provided with the following text:

"We are in 2030. Your group has been given specific scenario. Please focus in a first step on your common understanding as to what assumptions are consistent with this scenario. What political, legal, economic and societal reality is likely to be reflected in this scenario? What are the key drivers in the world you found? What are its strengths and weaknesses?

In a second step discuss how you see deep seabed mining in the context of this scenario? Knowing what you now know about the world think back to 2018 and discuss the decisions on DSM you would have wanted to have made then to create the optimal framework for DSM in the Area. What regulatory decisions made then would have contributed to delivering most effective benefit-sharing in line with the CHM principle?

In the final ten minutes try to summarise your thoughts. Identify a spokesperson and decide what key outcomes you want to share with the larger group.

Scenarios are an effective way to discuss complex change. They allow you to go beyond the consensus view and address wider dynamics. They have been widely used in business and are increasingly used in science-policy to communicate socio-economic pathways and engage multiple disciplines in a cohesive process."

Results from the groups:

5.7.1 Business-as-usual scenario 2030

The "business-as-usual" scenario group assumed that until 2030 a continued growth of the world population, and increasing inequality would stimulate migration, further enhanced by continued pressure on ocean biodiversity and the effects of climate change which will result in significant sea level rise. Overall, it was expected that faith in legal and multi-lateral institutions could decrease to be replaced by new nationalism, a trend opposite to the ongoing globalisation of corporations and their influence. Metal demand was seen as likely growing despite new technologies and recycling being developed. The driver could be those new technologies, and innovation in the field of renewable energies.

In conclusion, the development of an adaptive and precautionary ISA Mining code was considered to be the most important task at the present time. Collaborative marine scientific research in the deep-sea should be instrumental to a stepwise learning process "learning by doing". In this vein, ISA should take an active role by offering training programs and capacity building opportunities. A good outcome of the BBNJ Agreement negotiations was considered important as was the sustainability of other maritime industries.

5.7.2 Sustainability scenario 2030

The "sustainability" scenario group suggested that by 2030 ambitious climate change mitigation measures could be in place, with more marine protected area and sustainable fisheries and aquaculture, yet oceans warmer and more acid than today. The growth of the renewable energy sector might result in minerals scarcities (for instance cobalt) resulting in price increases. Also, nuclear power might see a revival to curb carbon emissions. A system of carbon pricing could be in place, yet not perfectly implemented. In addition, carbon capture and storage, CCS, was an important tool to reduce carbon emission from coal-based energy provision, used e.g. by China. Also transport emissions would still occur and needed to be compensated, in particular as the change of mobility patterns had not taken place yet. The BBNJ Agreement was supposed to be concluded and enforced, in particular for area-based management tools. As regards deep seabed mining, no commercial scale operations were

expected to exist in the Area by 2030, but rather testing, research and eventually operations in national waters. While a moratorium on deep seabed mining was considered unlikely, it was suggested that it was a matter of metal price not technical feasibility that operations had not started.

5.7.3 Transition scenario 2030

The "transition" scenario group suggested that by 2030 political action and public behaviour was following scientific advice, resulting in widespread environmental awareness, reduced consumption and a phasing out of fossil fuels. While ideally this should be an inclusive process, there was a risk to leave some groups of people behind. This political shift could mean more direct democracy, more democratic power including through social media but also the risk of new eco-totalitarianism. The important point was to move away from path dependencies to leave more opportunities for future generations, e.g. via the energy transition, a successful transformation to a circular economy, including a sharing economy. Other important aspects to mainstreaming environmental considerations would be radically transform sectors such as agriculture. A better quality of life in all countries might reduce migration caused by poverty.

In this scenario, the transition to circular economy is mastered. Need for minerals which cannot be supplied from land-based resources may be supplied from the deep-sea or from asteroids. To understand the oceans better from an earth system point of view, a continued focus on publicly funded deep-sea research was required. Along this line, the benefit of CHM may not stem from minerals mining but rather from scientific discoveries made in the deep ocean. There could be different path on deep seabed mining, including a moratorium, for instance following an unanticipated event such as a result of impacts of DSM activities.

The focus on science and innovation together with a shift in people's attitudes, lifestyles and politics towards a circular and sharing economy could achieve the needed transition, breaking the path dependencies and staying within planetary boundaries, => The group suggested that therefore the world could focus on the benefits of further exploration of the habitats and ecosystems of the deep-sea rather than on DSM.

In the discussions following the presentation of the groups´ ideas about the 2030 scenarios, the comment was made that overall the groups focussed more on the description of the economic paths than on the overall wealth as suggested by the Agenda 2030 SDGs. This might also be due to the short timeframe (only 12 years from now) considered, which may be too short for progress in governance to be fully turned into progress on the ground.

A question was raised as to which decisions today would support a no-mining scenario as suggested in the "Sustainability" scenario. Circular economies may also need some additional supply of new raw materials. One participant suggested that overall mineral demand could be covered from land-based resources.

It was also discussed what sort of unexpected event could trigger a public shift against deep seabed mining.

5.8 Lessons from the scenario approach for deep seabed mining assessments

The discussion has shown that a scenario approach has the potential to allow a broader discussion of this complex topic because it opens the floor for wider participation, more clarity about assumptions of different stakeholders and the ability to think through consequences before pathway dependencies are established. It furthermore provides representatives of different backgrounds and disciplines a platform to share ideas and develop a deeper understanding. Concepts such as the benefits of the deep ocean not only require a comprehensive economic analysis, they also need to be supported by a wide range of stakeholders if the goal to optimise the benefits for the Common Heritage of Humankind is to be achieved.

Recommendations

- Use a scenario analysis approach to assess the wider context of the financial mechanism;
- Engage a broad range of stakeholders in this exercise, including in particular those that as of now have been somewhat absent from the payment mechanism debate;
- Ensure that scenarios reflect broader societal commitments, such as those under the SDGs and under the CBD post-2020 targets.

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A Annex

Annex I: Contribution by the International Seabed Authority to the achievement of the Sustainable Development Goals

ISBA/24/A/10

Appendix I

Contribution by the International Seabed Authority to the achievement of the Sustainable Development Goals

Sustainable Development Goal		*Contribution by the International Seabed Authority*
Goal 1	End poverty in all its forms everywhere	Through the distribution of payments received by the Authority in accordance with equitable sharing criteria
Goal 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	Through the promotion of the transfer of skills and knowledge through training programmes and scholarships to least developed countries, small island developing States and African countries
Goal 5	Achieve gender equality and empower all women and girls	Encouragement of gender equality through dedicated efforts to increase opportunities for qualified women from developing States to participate in marine scientific research programmes
Goal 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Through its contribution to: (a) sustainable economic growth and the promotion of access for least developed countries to the Area and its resources; and (b) the protection of labour rights for those engaged in activities in the Area in conjunction with the International Labour Organization
Goal 9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	Through its contribution to improving the technological capabilities of developing countries
Goal 12	Ensure sustainable consumption and production patterns	Through the encouragement of sustainable production practices
Goal 13	Take urgent action to combat climate change and its impacts	Through the development of specific research programmes designed to improve the assessment of essential ecological functions of the deep sea oceans through long-term underwater oceanographic observatories in the Area
Goal 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development	Through its contribution to increasing scientific knowledge, developing research capacity, transferring marine technology and advancing a common and uniform approach, consistent with the Convention and international law, to the sustainable use of ocean resources
Goal 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Through: (a) the promotion of the rule of law; (b) the development of effective, accountable and transparent institutions at all levels; (c) responsive, inclusive, participatory and representative decision-making at all levels; and (d) the broadened and strengthened participation of developing countries in the institutions of global governance
Goal 17	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development	Through fostering strategic partnerships, including with the World Bank and the International Monetary Fund, to enhance the Global Partnership for Sustainable Development and to support the achievement of the Sustainable Development Goals

Annex II: Financial terms of an exploitation contract and draft scheme for determination of a royalty liability as in Draft regulations on exploitation of mineral resources in the Area. ISBA/25/C/WP1

Part VII
Financial terms of an exploitation contract

Section 1
General

Regulation 62
Equality of treatment

The Council shall, based on the recommendations of the Commission, apply the provisions of this Part in a uniform and non-discriminatory manner, and shall ensure equality of financial treatment and comparable financial obligations for Contractors.

Regulation 63
Incentives

1. The Council may, taking into account the recommendations of the Commission, provide for incentives, including financial incentives, on a uniform and non-discriminatory basis, to Contractors to further the objectives set out in article 13 (1) of annex III to the Convention.

2. Furthermore, the Council may provide incentives, including financial incentives, to those Contractors entering into joint arrangements with the Enterprise under article 11 of annex III to the Convention, and developing States or their nationals, to stimulate the transfer of technology thereto and to train the personnel of the Authority and of developing States.

3. The Council shall ensure that, as a result of the incentives provided to Contractors under paragraphs 1 and 2 above, Contractors are not subsidized so as to be given an artificial competitive advantage with respect to land-based miners.

Section 2
Liability for and determination of royalty

Regulation 64
Contractor shall pay royalty

A Contractor, from the date of commencement of Commercial Production, shall pay a royalty in respect of the mineral-bearing ore sold or removed without sale from the Contract Area as determined in appendix IV to these regulations.

Regulation 65
Secretary-General may issue Guidelines

1. The Secretary-General may, from time to time, issue Guidelines in accordance with regulation 95 in respect of the administration and management of royalties prescribed in this Part.

2. The Secretary-General shall consider all requests for the clarification of any Guidelines issued under paragraph 1 above, or on any other matter connected with the administration and management of a royalty and its payment.

Section 3
Royalty returns and payment of royalty

Regulation 66
Form of royalty returns

A royalty return lodged with the Secretary-General shall be in the form prescribed by the Guidelines and signed by the Contractor's designated official.

Regulation 67
Royalty return period

A royalty return period for the purposes of this Part is a half-year return period, from:

(a) 1 January to 30 June; and

(b) 1 July to 31 December.

Regulation 68
Lodging of royalty returns

1. A Contractor shall lodge with the Secretary-General a royalty return for each Mining Area not later than 90 Days after the end of the royalty return period in which the date of commencement of Commercial Production occurs, and thereafter not later than 90 Days after the end of each subsequent royalty return period for the duration of the exploitation contract.

2. In connection with any joint venture arrangement or a consortium of Contractors, one royalty return shall be submitted by the joint venture or consortium.

3. A royalty return may be lodged electronically.

Regulation 69
Error or mistake in royalty return

A Contractor shall notify the Secretary-General promptly of any error in calculation or mistake of fact in connection with a royalty return or payment of a royalty.

Regulation 70
Payment of royalty shown by royalty return

1. A Contractor shall pay the royalty due for a royalty return period on the Day the royalty return is required to be lodged.

2. Payments to the Authority may be made in United States dollars or other foreign currency which is freely convertible.

3. All payments made to the Authority shall be made gross and shall be free of any deductions, transmission fees, levies or other charges.

4. The Council may approve the payment of any royalty due by way of instalment where special circumstances exist that justify payment by instalment.

Regulation 71
Information to be submitted

1. A royalty return shall include the following information for each royalty return period:

(a) The quantity in wet metric tons of mineral-bearing ore recovered from each Mining Area;

(b) The quantity and value by Mineral in wet metric tons of the mineral-bearing ore shipped from the Mining Area;

(c) The value and the basis of the valuation of the mineral-bearing ore sold or removed without sale from the Mining Area, as verified by a suitably qualified person and supported by a representative chemical analysis of the ore by a certified laboratory;

(d) Details of all contracts and sale or exchange agreements relating to the mineral-bearing ore sold or removed without sale from the Contract Area; and

(e) A calculation of the royalty payable in accordance with section 3, including any adjustment made to the prior royalty return period and a declaration signed by a designated official of the Contractor that the royalty return is accurate and correct.

2. In respect of a final royalty return period ending on the date of expiry, surrender or termination of the exploitation contract, the Contractor shall provide:

(a) A final calculation of the royalty payable;

(b) Details of any refund or overpayment of royalty claimed; and

(c) The quantity and value of all closing stocks of the mineral-bearing ore.

3. Within 90 Days from the end of a Calendar Year, the Contractor shall provide the Secretary-General and the sponsoring State or States with a statement from an auditor or certified independent accountant that the royalty calculation for that Calendar Year:

(a) Is based on proper accounts and records properly kept and is in agreement with those accounts and records; and

(b) Complies with these regulations and is accurate and correct.

Regulation 72
Authority may request additional information

The Secretary-General may, by notice to a Contractor who has lodged a royalty return, request the Contractor to provide, by the date stated in the notice, information to support the matters stated in the royalty return.

Regulation 73
Overpayment of royalty

1. Where a royalty return shows any overpayment of royalties, a Contractor may apply to the Secretary-General to request a refund of any such overpayment.

2. Where no such request is received by the Secretary-General within 90 Days of the due date of submission of the relevant royalty return, the Authority shall carry forward any overpayment and credit it against a future royalty amount payable under this Part.

3. Any request to reduce a royalty-related amount payable by a Contractor must be made within five years after the Day the relevant royalty return was lodged with the Authority.

4. Where any final royalty return shows an amount to be refunded, the Secretary-General shall refund such amount provided he or she determines that such refund is properly due. The Secretary-General may request, and the Contractor shall provide,

such additional information or confirmation, as he or she considers necessary to determine that such refund is correct and due to a Contractor.

Section 4
Records, inspection and audit

Regulation 74
Proper books and records to be kept

1. A Contractor shall keep and maintain, at a place agreed by the Contractor and the Secretary-General, complete and accurate records relating to the Minerals recovered in order to verify and support all returns or any other accounting or financial reports required by the Authority in relation to Exploitation.

2. The Contractor shall prepare such records in conformity with internationally accepted accounting principles that verify, in connection with each Mining Area, inter alia:

(a) Details of the quantity and grade of the Minerals recovered from each Mining Area;

(b) Details of sales, shipments, transfers, exchanges and other disposals of the Minerals from the Mining Area, including the time, destination, value and basis of valuation and the quantity and grade of each sale, shipment, transfer, exchange or other disposal;

(c) Details of all eligible capital expenditure and liabilities by category of expenditure and liability incurred in each Mining Area; and

(d) Details of all revenues and operating costs.

3. A Contractor shall supply and file such records at such times as may be required by the Authority under these regulations and within 60 Days of the receipt of any such request from the Secretary-General.

4. A Contractor shall maintain all records and make such records available for inspection and audit under regulation 75.

Regulation 75
Audit and inspection by the Authority

1. The Secretary-General may audit the Contractor's records.

2. Any such audit shall be undertaken at the Authority's sole cost and shall be performed by an Inspector in accordance with Part XI of these regulations.

3. An Inspector may, in connection with a liability for a royalty payment:

(a) Inspect the mining and on-board processing facility with a view to verifying the accuracy of the equipment measuring the quantity of Mineral ore sold or removed without sale from the Contract Area;

(b) Inspect, audit and examine any documents, papers, records and data available at the Contractor's offices or on-board any mining vessel or Installation;

(c) Require any duly authorized representative of the Contractor to answer any questions in connection with the inspection; and

(d) Make and retain copies or extracts of any documents or records relevant to the subject matter of the inspection and provide a Contractor with a list of such copies or extracts.

4. The Contractor shall make available to an Inspector such financial records and information contemplated as reasonably required by the Secretary-General to determine compliance with this Part.

5. Members of the Authority, in particular a sponsoring State or States, shall, to the best of their abilities, cooperate with and assist the Secretary-General and any Inspector in the carrying out of any audit under this regulation, and shall facilitate access to the records of a Contractor by an Inspector and assist in the exchange of information relevant to a Contractor's obligations under this Part.

Regulation 76
Assessment by the Authority

1. Where the Secretary-General determines, following any audit under this Part, or by otherwise becoming aware that any royalty return is not accurate and correct in accordance with this Part, the Secretary-General may, by written notice to a Contractor, request any additional information that the Secretary-General considers reasonable in the circumstances, including the report of an auditor.

2. A Contractor shall provide such information requested by the Secretary-General within 60 Days of the date of such request, together with any further information the Contractor requires the Secretary-General to take into consideration.

3. The Secretary-General may, within 60 Days of the expiry of the period prescribed in paragraph 2 above, and after giving due consideration to any information submitted under paragraph 2, make an assessment of any royalty liability that the Secretary-General considers ought to be levied in accordance with this Part.

4. The Secretary-General shall provide the Contractor with written notice of any proposed assessment under paragraph 3 above. The Contractor may make written representations to the Secretary-General within 60 Days of the date of such written notice. The Secretary-General shall consider such representations and shall confirm or revise the assessment made under paragraph 3 above.

5. The Contractor shall pay any such royalty liability within 30 Days of the date of the determination made by the Secretary-General under paragraph 4.

6. Except in cases of fraud or negligence, no assessment may be made under this regulation after the expiration of 6 years from the date on which the relevant royalty return is lodged.

Section 5
Anti-avoidance measures

Regulation 77
General anti-avoidance rule

1. Where the Secretary-General reasonably considers that a Contractor has entered into any scheme, arrangement or understanding or has undertaken any steps which, directly or indirectly:

(a) Result in the avoidance, postponement or reduction of a liability for payment of a royalty under this Part;

(b) Have not been carried out for bona fide commercial purposes; or

(c) Have been carried out solely or mainly for the purposes of avoiding, postponing or reducing a liability for payment of a royalty; then the Secretary-General shall determine the liability for a royalty as if the avoidance, postponement or

reduction of such liability had not been carried out by the Contractor and in accordance with this Part.

2. The Secretary-General shall provide the Contractor with written notice of any proposed determination under paragraph 1 above. The Contractor may make written representations to the Secretary-General within 60 Days of the date of such written notice. The Secretary-General shall consider such representations and shall determine the liability for a royalty for the original or revised amount.

3. The Contractor shall pay any such royalty liability within 30 Days of the date of the determination made by the Secretary-General under paragraph 2.

Regulation 78
Arm's-length adjustments

1. For the purposes of this regulation:

(a) "Arm's length", in relation to contracts and transactions, means contracts and transactions that are entered into freely and independently by parties that are not related parties; and

(b) "Arm's-length value", in relation to costs, prices and revenues, means the value that a willing buyer and willing seller, who are not related parties, would agree is fair under the circumstances.

2. Where, for the purposes of calculating any amounts due under this Part VII, any costs, prices and revenues have not been charged or determined on an arm's-length basis, pursuant to a contract or transaction between a Contractor and a related party, the Secretary-General may adjust the value of such costs, prices and revenues to reflect an arm's-length value in accordance with internationally accepted principles.

3. The Secretary-General shall provide the Contractor with written notice of any proposed adjustment under paragraph 2 above. The Contractor may make written representations to the Secretary-General within 60 Days of the date of such written notice.

Section 6
Interest and penalties

Regulation 79
Interest on unpaid royalty

Where any royalty or other amount levied under this Part remains unpaid after the date it becomes due and payable, a Contractor shall, in addition to the amount due and payable, pay interest on the amount outstanding, beginning on the date the amount became due and payable, at an annual rate calculated by adding 5 per cent to the special drawing rights interest rate prevailing on the date the amount became due and payable.

Regulation 80
Monetary penalties

Subject to regulation 103 (6), the Council may impose a monetary penalty in respect of a violation under this Part.

Section 7
Review of payment mechanism

Regulation 81
Review of system of payments

1. The system of payments adopted under these regulations and pursuant to paragraph 1 (c) of section 8 of the annex to the Agreement shall be reviewed by the Council five years from the first date of commencement of Commercial Production in the Area and at intervals thereafter as determined by the Council, taking into account the level of maturity and development of Exploitation activities in the Area.

2. The Council, based on the recommendations of the Commission, and in consultation with Contractors, may revise the system of payments in the light of changing circumstances and following any review under paragraph 1 above, save that any revision shall only apply to existing exploitation contracts by agreement between the Authority and the Contractor.

Regulation 82
Review of rates of payments

1. The rates of payments under an existing system of payments shall be reviewed by the Council five years from the first date of commencement of Commercial Production in the Area and at intervals thereafter as determined by the Council, taking into account the Resource category and the level of maturity and development of Exploitation activities in the Area.

2. The Council, based on the recommendations of the Commission and in consultation with Contractors, may adjust the rates of payments in the light of such recommendations and consultation, save that any adjustment to the rates of payments may only apply to existing exploitation contracts from the end of the Second Period of Commercial Production reflected in appendix IV to these regulations.

3. Without limiting the scope of any review by the Council, a review under this regulation may include an adjustment to the Applicable Royalty Rate under appendix IV and the manner and basis of the calculation of a royalty.

Section 8
Payments to the Authority

Regulation 83
Recording in Seabed Mining Register

1. All payments made by the Contractor to the Authority under this Part are non-confidential.

2. All payments received by the Authority from Contractors shall be recorded in the Seabed Mining Register.

Table B: A provisional analysis of the interaction of the Common Heritage of Mankind and the Sustainable Development Goals Supporting ( ), neutral ( ), or limiting ( ) effects of mining minerals in the Area and the achievement of the Sustainable Development Goals.

Achievements	***SDGs***	***Sustainable Development Goals***	***Contribution of the Common Heritage of Mankind*** ***a) mining*** ***b) no mining***	***potential interactions if mining***	***potential inter-actions if no mining***
Enable access, benefit sharing across generations	Goal 1	End poverty in all its forms everywhere	a) The promise of the CHM is that it will generate funds for redistribution to mankind, with a particular consideration of the needs of developing countries. This was intended to enhance equity in economic and social development across the globe. It is questionable whether this goal will be reached. It is questionable whether this will be achieved as deep seabed mining is neither technically nor commercially viable and there is no agreement on a minimum return to ISA for redistribution. In addition, mining could be counterproductive to achieving this goal if mining significantly impacts the access to fishing opportunities and/or the quality of fish, if pollution deteriorates coastal waters or if land processing further deteriorates living conditions for people in the neighbourhood. At a larger scale, this negative effect might become effective in economies depending on mineral export, if deep sea minerals change the global market. b) The no-mining scenario would not derive any monetary benefits but provide for undisturbed deep sea ecosystems delivering a range of ecosystem functions and services which are essential in times of biodiversity decline and climate change, the value of which may far exceed the value generated by mining the mineral-containing basis for benthic ecosystems.		
Enable access, benefit sharing across generations	Goal 2	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture	a) In particular goal 2.1, access by all to safe, nutritious and sufficient food is strongly related to coastal and offshore fisheries with local landings, employment and income generation. Deterioration of fishing opportunities by mining-related pollution and spatial competition will impact on livelihoods of coastal populations concerned, eventually counteracting SDG 1.		

Achievements	***SDGs***	***Sustainable Development Goals***	***Contribution of the Common Heritage of Mankind*** ***a) mining*** ***b) no mining***	***potential interactions if mining***	***potential inter-actions if no mining***
Inspire social capital	Goal 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	The non-monetary benefit sharing mechanisms of ISA need substantial expansion and more permanence for being effective in actually empowering least developed countries and build capacities in the long term. Capacity building should not be limited to issues around mining, but include all ocean topics and environmental governance. ISA could for example be instrumental to setting up an institution comparable to the World Maritime University of IMO.	↑	↑
Support sustainable livelihoods	Goal 7	Ensure access to affordable, reliable, sustainable and modern energy for all	a) The greening of energy production worldwide and ubiquitous electronic devices require a new mix of minerals in so far unknown quantities. Minerals from the deep sea may one day contribute to this rising demand, however, the need for tapping these resources today is questioned. Another line of arguments points out that deep seabed mineral resources may contribute to prevent strong mineral price increases due to scarcity *vis a vis* rising demand - in other words it shall help maintain the current consumption patterns.	↑↓	→
Support sustainable livelihoods	Goal 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	a) Mineral development can be viewed as supporting the concept of sustainable development if the extraction of minerals takes place in a manner that does not lead to irreversible environmental degradation; equitably shares the benefits from the new wealth created; utilizes the capital obtained to provide adequate healthcare, education, and other social services; and reduces the level of waste through recycling and improved technologies to optimize recoveries (Nooten, 2007).The CHM principle aims at all of these elements. However, substantial environmental degradation will be unavoidable, the amount of financial benefits is likely to be modest, and there is a high risk that the mining of minerals in the deep sea, and be it for enabling the transition to renewable energy, will further extend decision-making on measures to reduce raw material consumption to a one earth footprint of mankind. b) If deep seabed mining does not supplement mineral supply and scarcity will increase prices, then this will provide stimulus for developing technologies to globally reduce new mineral consumption, stimulate long and efficient life cycles and further recycling. Blue economy growth can rely on sustainable industries and mining operations would not jeopardise e.g. tourism in island nations.	↑↓	↑

Achievements	*SDGs*	*Sustainable Development Goals*	*Contribution of the Common Heritage of Mankind* *a) mining* *b) no mining*	*potential interactions if mining*	*potential inter-actions if no mining*
Support sustainable livelihoods	Goal 8.4	Improve progressively, through 2030, global **resource efficiency in consumption and production** and endeavour to **decouple economic growth from environmental degradation**, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead	Deep seabed mining will have high ecological costs and cause longterm and large scale environmental degradation. Investing in developing resource efficiency, substitution of critical metals and recycling instead of investment in mining technology could provide solutions in line with SDG 8.4.	↓	↑
Support sustainable livelihoods	Goal 8.5	By 2030, achieve full and productive employment and decent work for all women and men, …	a) Deep seabed mining is not likely to have any substantial employment effect. Therefore, the access given to the Area to all states, may at best have indirect effects on economic growth of least developed countries - should substantial financial benefits be distributed by ISA. Sustainable economic growth and in particular so-called blue growth of maritime industries, should be carefully balanced with coinciding environmental and economic costs and rely on renewable resources to improve the lives of the population directly, rather than through unreliable revenues derived from (eventually foreign) mining.	→	→
Inspire social capital	Goal 9	Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation	a) The technology transfer as originally foreseen in UNCLOS was modified by the Implementing Agreement 1994 to follow commercial principles, including the operation of the Enterprise, which lost its central function of technology development, exploitation and market control. The current capacity building is small scale and not sustainable. It is unlikely that developing countries will benefit of substantial financial transfers in the coming decades for building up local infrastructure.	→	→

Achievements	***SDGs***	***Sustainable Development Goals***	***Contribution of the Common Heritage of Mankind*** ***a) mining*** ***b) no mining***	***potential interactions if mining***	***potential inter-actions if no mining***
Enable access, benefit sharing across generations	Goal 10	Reduce inequality within and among countries	a) One original intention of the Common Heritage of Mankind principle and its rules laid down in UNCLOS was to use the benefits to be derived from the Area for reducing the global inequality. Non-monetary transfer should aid capacity development for science and technology, provide equal opportunities to participate the Area´s governance processes. Financial and other economic benefits from activities in the Area should lead to financial transfers which would enable the developing states to catch up developing in their social and economic systems.These origins have been superseded by the 1994 Implementing Agreement to UNCLOS, limiting substantial components of transfer and equity among UNCLOS parties (see Goal 9). The financial and other economic benefits of mining in the Area will at least in the coming decades not lead to substantial funds for redistribution, in particular to satisfy the needs of developing countries´ economies. Many developing states aim to ensure a share in benefits through becoming Sponsoring States which involves high risks and liabilities. a+b) The reduction of inequality within and among countries can be addressed by international collaboration to facilitate and enhance high standard education, capacity development and scientific research, as required by currently disadvantaged societies (Goal 4).		
Support sustainable livelihoods	Goal 12	Ensure sustainable consumption and production patterns	a) The provision of minerals from deep seabed mining may prolong the period of unsustainable growth and deviate investments which could better contribute to developing step by step a circular economy in developing as well as in developed countries. Circular economy should be seen as a chance to develop new ways of production and cooperation - according to the needs of the different countries. The 10-Year Framework of Programmes on Sustainable Consumption and Production (10YFP) is instrumental to achieving this goal.		
Maintain and restore ecological integrity	Goal 13	Take urgent action to combat climate change and its impacts	a) b) Ocean protection is one aspect of buffering the effects of rising greenhouse gas emissions and their impacts on climate.		
Maintain and restore ecological integrity	Goal 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development	a) Mining the mineral-containing substrates in the deep sea means the irreversible destruction of benthic and pelagic habitats, which will loose their ecological function in ocean processes. b) Ocean protection is the bottleneck for CHM to support Agenda 2030		

Achievements	***SDGs***	***Sustainable Development Goals***	***Contribution of the Common Heritage of Mankind*** ***a) mining*** ***b) no mining***	***potential interactions if mining***	***potential inter-actions if no mining***
Maintain and restore ecological integrity	Goal 14.1	By 2025, prevent and significantly reduce marine pollution of all kinds	This is also required under UNCLOS Part XI (see Article 145 a) and Part XII. So States individually and collectively have to comply with this law. Deep seabed mining will inevitably lead to pollution of various kinds: sediment suspension and discharge, eventually with toxic contaminants, light, noise, releases during the transfer of ore to transport vessels etc. In any case this will be an increase in global ocean pollution with unknown effects.	↓	↑
Maintain and restore ecological integrity	Goal 14.2	By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans.	This is also required under UNCLOS Part XI (see Article 145 b)	↓	↑
Maintain and restore ecological integrity	Goal 14.5	By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on best available scientific information	a) The ISA has designated so-called "Areas of particular environmental interest, APEIs" a non-permanent sectoral closure covering approx. 30 % of the region (International Seabed Authority, 2011; Lodge et al., 2014; Wedding et al., 2013). These areas are located outside the locations of interest to exploration and potential exploitation. Due to a different nodule cover, these APEIs cannot act as reserves in the case of mining (Vanreusel et al., 2016). Therefore, quantitatively, the APEIs may count towards the SDG 14.5 target, however qualitatively they do not meet the criteria of the more elaborate CBD Aichi target 11 (Rees et al., 2018).	↑ ↓	↑
Maintain and restore ecological integrity	Goal 14.7	By 2030 increase the economic benefits to SIDS and LDCs from the <u>sustainable use of marine resources</u>, including through sustainable management of fisheries, aquaculture and tourism	a) Should there be substantial financial and other economic benefits to be equitably shared with particular consideration of the needs of SIDS and LDCs, these funds may support these states economically. However, the resource-dependency and related governance problems may prevent any additional funds to be used substainably. As Sponsoring States, States also have an opportunity to eventually gain access to technical expertise and profit financially of the exploitation of the CHM, however bear high risks and liabilities (see also Goal 8 and 14A).	↑ ↓	↑

Achievements	***SDGs***	***Sustainable Development Goals***	***Contribution of the Common Heritage of Mankind*** ***a) mining*** ***b) no mining***	***potential interactions if mining***	***potential inter-actions if no mining***
Maintain and restore ecological integrity	Goal 14.A	Increase scientific knowledge, develop research capacities and transfer marine technology … in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular SIDS and LDCs	see Goals 4, 9, 10 on CHM non-monetary benefit sharing a) Considerable research and exploration takes place, including on determining the ecological state of the environment. However, there is no automatic publication of knowledge, an unknown fraction of the knowledge falling under the confidentiality agreement of the ISA with contractors. The aim of research is not to improve ocean health but to mine. SIDS and LDCs which are sponsoring States do not normally own the knowledge themselves. b) Funding of deep sea research is likely to decrease if there was no mining in the future. However, then the threat from mining was not imminent and the research focus could be reoriented to ecosystem function in view of climate change		
Maintain and restore ecological integrity	Goal 14.C	Ensure the full implementation of international law, as reflected in UNCLOS for states parties to it, including, where applicable, existing regional and international regimes for the conservation and sustainable use of oceans and their resources by their parties	a) The ISA regulations and procedures for implementing conservation and sustainable use of oceans can be improved to implement the ecosystem approach to management, including in collaboration with the regional and international regimes. b) If no mining, the focus can be on valuation of the CHM in terms of longterm existence value and ecosystem services value.		
Maintain and restore ecological integrity	Goal 15.5	Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species	a) Deep seabed mining will inevitably lead to degradation of large swaths of ocean floor and and unknown volume of deep ocean waters. This will lead to biodiversity loss in the case of nodule mining and in addition to the loss of unique habitats and eventually endemic species in the case of massive sulphide mining at hydrothermal vents and cold deposits. b) No mining will not contribute to a deteriorating state of the oceans but eventually stabilise the ocean ecosystems *vis a vis* climate change effects.		

Achievements	***SDGs***	***Sustainable Development Goals***	***Contribution of the Common Heritage of Mankind*** ***a) mining*** ***b) no mining***	***potential interactions if mining***	***potential inter-actions if no mining***
Enable access, benefit sharing across generations	Goal 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Peaceful use of the CHM is one of the baseline conditions of management of the Area. ISA ensures full participation of all UNCLOS signatories in its organs: in The Assembly one vote per country, in the Council one vote collectively for regional or interest groups. As the Council is the organ taking the decisions, the group representation gives heavy weight to sponsoring states, consumer states, and minerals exporting states.Transparency and accountability to be improved, incorporation of scientific advice not reflected, if done so.		
Inspire social capital	Goal 17	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development			

Appendix IV

Determination of a royalty liability

This appendix sets out the methodology for the calculation of a royalty payable under regulation 64 in respect of the categories of resources. It is indicative and presented for discussion only at this time.

In the present appendix:

Applicable Royalty Rate means the royalty rate shown in the tables below for the applicable Resource category or as determined by a decision of the Council following any review under these regulations.

Average Listed Price means the Average Listed Price for a Relevant Metal, which is a price calculated by averaging the daily prices (in United States dollars)[1] per metric ton listed for the metal in an Official Listing during a royalty return period as specified and published by the Authority.

Average Grade means the average metal content of the Relevant Metal obtained from a range of grades in the Mining Area[2] expressed as the percentage of the metal per ton of the mineral-bearing ore at the Valuation Point and shown under column B in the tables below for the applicable Resource category.

First Period of Commercial Production means a fixed period of [x][3] years following the date of commencement of Commercial Production.

Official Listing means a list of quoted or published prices of metals:

(a) On a recognized international mineral exchange or market;

(b) In a publication recognized for quoting or publishing prices of metals in an international market; or

(c) Where there is no listed price, the Council shall, based on recommendations of the Commission and following consultation with Contractors, determine a formula for the determination of the Average Listed Price for a Relevant Metal.

Relevant Metal means a metal contained in the mineral-bearing ore identified and determined by the Council as relevant for the purposes of calculating the assumed gross value.

Relevant Metal Value(s) means the assumed gross value(s) of a Relevant Metal calculated as the product of its Average Listed Price and Average Grade.

Second Period of Commercial Production means a fixed period of [y][4] years following the end of the First Period of Commercial Production.

Valuation Point is the point of first sale or the first point of transfer of the mineral-bearing ore by delivery onto a vessel transporting the ore from the Contract Area.

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[1] To consider the use of special drawing rights as a unit of account to value the revenue on which a royalty would be based.

[2] An average grade (content) could be determined from resource assessments provided to the Authority in accordance with its resource classification guidelines. A range of acceptable grade parameters could be included in the regulations, with the actual average grade shown in a royalty return, subject where necessary to assay.

[3] To be informed by financial model discussion.

[4] See footnote 3.

Valuation of mineral-bearing ore[5]

1. The value of the mineral-bearing ore shall be an assumed gross value per metric ton at the Valuation Point.

2. The assumed gross value shall reflect the assumed gross value of each Relevant Metal contained in the mineral-bearing ore, calculated under this appendix.

Royalty rate

1. The Applicable Royalty Rate shall be:

   (a) For the First Period of Commercial Production, the percentage(s) shown under column C in the tables below for the applicable Resource category; and

   (b) For the Second Period of Commercial Production, the percentage(s) shown under column D in the tables below for the applicable Resource category.

2. The Applicable Royalty Rate and the manner and basis of its calculation may vary as between a royalty payable in respect of different Relevant Metals and different Resource categories.

Calculation of royalty payable

1. The royalty payable for a royalty return period is the product of the sum of the Relevant Metal Values multiplied by the Applicable Royalty Rate for each Relevant Metal and the quantity (in metric tons) of the mineral-bearing ore sold or transferred at the Valuation Point, thus:

$RP = ((RMV^1 \times ARR^1) + (RMV^2 \times ARR^2) + (RMV^3 \times ARR^3) + \ldots (RMV \times ARR)) \times$ *Total quantity of mineral-bearing ore in metric tons)*

Where:

RP = Royalty Payable

RMV^1 *= the first Relevant Metal Value*

ARR^1 *= the Applicable Royalty Rate applicable to the first Relevant Metal*

RMV^2 *= the second Relevant Metal Value*

ARR^2 *= the Applicable Royalty Rate applicable to the second Relevant Metal, and so on*

RMV^3 *= the third Relevant Metal Value*

ARR^3 *= the Applicable Royalty Rate applicable to the third Relevant Metal, and so on*

2. Where the Council, under columns C and/or D in the tables below for the applicable Resource category, has determined that a composite royalty rate[6] shall be applicable to the assumed gross value of the mineral-bearing ore, the

[5] This approach towards determining a reference value for the metals contained in the ore has been discussed in connection with polymetallic nodules only. Whether this approach is appropriate for other mineral resource categories remains open for discussion. That said, the approach uses international reference prices, and to that extent does not present the Authority with potentially burdensome transfer pricing issues.

[6] In connection with polymetallic nodules, discussions to date have focused on a single royalty rate to be applied to a metal basket value. Other than simplicity in calculation, no detailed discussion has taken place in terms of applying different royalty rates to different metals contained in the basket.

royalty payable for a royalty return period is the product of the sum of the Relevant Metal Values and the quantity (in tons) of the mineral-bearing ore sold or transferred at the Valuation Point multiplied by the composite royalty rate, thus:

RP = (RMV^1 + RMV^2 + RMV^3 + ... RMV) x Total quantity of mineral-bearing ore (in tons) x composite royalty rate

The following tables shall be adopted progressively, from time to time:

Table 1
Polymetallic nodules

A	*B*	*C*	*D*
Relevant Metal	*Average grade (percentage)*	*First Period of Commercial Production: Applicable Royalty Rate (percentage)*	*Second period of commercial production: applicable royalty rate (percentage)*
Metal 1	[x.xx]	[x.xx]	[x.xx]
Metal 2	[x.xx]	[x.xx]	[x.xx]
Metal 3	[x.xx]	[x.xx]	[x.xx]
Metal 4	[x.xx]	[x.xx]	[x.xx]
[Other]			

Table 2
Polymetallic sulphides

A	*B*	*C*	*D*
Relevant Metal	*Average grade (percentage)*	*First Period of Commercial Production: Applicable Royalty Rate (percentage)*	*Second Period of Commercial Production: Applicable Royalty Rate (percentage)*
Metal 1	[x.xx]	[x.xx]	[x.xx]
Metal 2	[x.xx]	[x.xx]	[x.xx]
Metal 3	[x.xx]	[x.xx]	[x.xx]
Metal 4	[x.xx]	[x.xx]	[x.xx]
[Other]			

Table 3
Cobalt-rich ferromanganese crusts

A	*B*	*C*	*D*
Relevant Metal	*Average grade (percentage)*	*First Period of Commercial Production: Applicable Royalty Rate (percentage)*	*Second Period of Commercial Production: Applicable Royalty Rate (percentage)*
Metal 1	[x.xx]	[x.xx]	[x.xx]
Metal 2	[x.xx]	[x.xx]	[x.xx]
Metal 3	[x.xx]	[x.xx]	[x.xx]
Metal 4	[x.xx]	[x.xx]	[x.xx]
[Other]			