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Promoting a regulatory toolkit to assess the decommissioning of offshore energy infrastructures in the circular economy

Dr Andrea Miglionico
SUPERVISOR

Dr Andrea Parziale
CO-SUPERVISOR

Carlotta Giacché - 719771
CANDIDATE

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Chapter 1

Introduction

1.1 *Background of the thesis*

Offshore drilling facilities have a limited lifespan ranging between 20 and 30 years after which they become unproductive and terminate operations. The standard popular approach is to proceed with the decommissioning of infrastructures, which implies the plugging of wells, cleaning and removal of pipelines, and removal of the production equipment and the overall structure. Total removal of platforms is generally justified by two main reasons. The first being that platforms can interfere with shipping and represent a threat or obstacle to ships during navigation. The second reason lies in the general perception that, once platforms cease to operate, the conditions of the surrounding environment should be restored as they were originally, prior the instalment of platforms.

The dismissal of offshore energy infrastructures is a delicate process, which entails high technical challenges and environmental risks; it is also a very costly operation with a significant environmental impact, as it involves the use of explosives that can lead to the destruction of the seabed and forms of life which originated around the facility. More sustainable alternatives exist – such as conversion to artificial reefs – that could considerably decrease costs and avoid damages on the surrounding environment, and others could be developed thanks to new engineering and technological progress. However, the current regulatory framework at international level is outdated with respect to the notable awareness about sustainability that is being built globally. Decommissioning operations as they are handled nowadays pose several issues in terms of economic sustainability, as they require extraordinary expenses that could be reduced with alternative methods; environmental sustainability, given the damages provoked to the seabed, as well as the surrounding ecosystem, as an effect of chemicals and oil spills; and social sustainability, as any impact on the environment is reflected over other maritime sectors, as well as the livelihoods of the people inhabiting the coasts.

A more coherent regulatory approach is needed at international and national scale to ensure that economic costs as well as environmental and social externalities are addressed and minimised. Regulatory initiatives could help frame the behaviour of participants in the sector, guiding their actions through clear legal requirements, and modelling their incentives through a set of supporting policies.

1.2 *Literature review*

The matter of decommissioning has only started to attract attention recently: as first-generation infrastructures were mostly built in the 50s and 60s, first decommissioning operations were only carried out at the beginning of the new century. The amount of empirical evidence drawn from the past is still relatively poor and no certain assessment can be made about the efficacy of given regulations yet; although the issue of regulating decommissioning has only been discussed to a limited extent in the literature, some attempts have been made to realise a broad picture of the most important pieces of legislation in the field.

Invernizzi et al.[1] review the major technical challenges associated with decommissioning and suggest the need to develop ad hoc energy policies to handle decommissioning safely and effectively. The authors also underline how decommissioning challenges are exacerbated by an overall lack of harmonised recycling policies and end-of-life waste management regulations. Hamzah carries out a comparison between major international treaties on decommissioning and underlines the urgency of re-examining the practicality of the current legal regime, to ensure that high standards of environmental protection are also guaranteed in Third world countries.[2] In fact, while developed countries already display some measures for ensuring accountability and promoting good practices in decommissioning, the matter is almost completely disregarded in developing ones. This results in low standards of environmental protection in those regions, and at the same time it creates a situation of regulatory arbitrage whereby companies might move operations in countries where they face lower regulatory requirements, undermining the efforts of those with stricter standards. Trevisanut highlights the regional characterisation of the existing legal regime, pointing out that such geographical fragmentation represents an obstacle to the creation of solid guarantees for environmental safeguard.[3] These scholarly contributions will provide the theoretical foundations for the first section of Chapter 4, which aims at refining the arguments in support for some level of regional and international legal harmonisation and policy coordination. The case of South-East Asia is also analysed to provide a practical example of how the lack of regional coordination can lead to direct negative externalities over the environment in the form of transnational pollution.[4]

[1] D. C. Invernizzi, G. Locatelli, A. Velenturf, P. Love, P. Purnell, N. J. Brookes, 'Developing policies for the end-of-life of energy infrastructure: coming to terms with the challenges of decommissioning' (2020) *Energy Policy*.

[2] B.A. Hamzah, 'International rules on decommissioning of offshore installations: some observations' (2003), *Marine Policy*.

[3] S. Trevisanut, 'Decommissioning of Offshore Installations: a Fragmented and Ineffective International Regulatory Framework' in Catherine Banet (ed), *The Law of the Seabed: Access, Uses, and Protection of Seabed Resources* (Brill Nijhoff 2020).

[4] Y. Lyons, 'Transboundary pollution from offshore oil and gas activities in the seas of Southeast Asia, Centre for International Law (2012).

Specific aspects have also been analysed in terms of disposal of disused platforms. As far as ex-ante planning is concerned, Manfra et al. compare data pertaining to six countries in the region of the Adriatic Sea, and propose a framework for legal harmonisation at regional level of Environmental Impact Assessment procedures, monitoring and decommissioning. [5] This contribution will form the basis for section 4.2.1, which emphasises the relevance of ex-ante planning and the establishment of standard procedures and common indicators for impartial environmental monitoring and impact assessment. Section 4.2.2 focuses more specifically on ex-ante planning for the sake of platforms' reuse and draws on the work from Techera and Chandler.[6] The authors illustrate the existing legal framework, pointing especially to its current inadequacy to sustain the development and diffusion of more sustainable alternatives to decommissioning such as rigs-to-reef programs. Even though they recognise the need to assess decommissioning processes on a case-by-case basis, they emphasise the role of regulation in fostering transferability of rigs-to-reef programs outside the US to test its feasibility in other realities with different morphological conditions. The case of the US framework for rigs-to-reef programs has been analysed in detail by Hall,[7] whose work provides the basis for section 4.2.3, proposing the US case as a virtuous example for incentivising sustainable practices of platforms' reconversion at the end of productive life.

Financial assurance to sustain the cost of decommissioning is also a theme which has received considerable attention in the literature. The work from Holland[8] highlights how changing external circumstances – in this specific case, increases in oil prices – can lead to disputes among economic operators as an effect of decreasing security to cover decommissioning liabilities, especially where no precise framework for financial assurance is defined. This scholar contribution is included in section 4.3.2, as a case study about viable alternatives to create solid mechanisms of financial assurance. The second case study revolves around the Norwegian taxation example, on the basis of the seminal work of Osmundsen and Tveterås, who explore international economic and regulatory issues concerning the reuse of installations.[9] In particular, Norwegian decommissioning policies are analysed: as it possesses many of the largest drilling facilities in the world and has a record for high

[5] L. Manfra, C. Virno Lamberti, S. Ceracchi, G. Giorgi, D. Berto, M. Lipizer, M. Giani, O. Bajt, M. Fafandel, M. Cara, S. Matievic, M. Mitric, S. Papazisimou, M. Poje, C. Zeri, B Trabucco, 'Challenges in Harmonized Environmental Impact Assessment (EIA), Monitoring and Decommissioning Procedures of Offshore Platforms in Adriatic-Ionian (ADRION) Regions' (2020) *Water.*

[6] E.J. Techera, J. Chandler, 'Offshore installations, decommissioning and artificial reefs: Do current legal frameworks best serve the marine environment?' (2015) *Marine Policy.*

[7] K. B. Hall, 'Decommissioning of Offshore Oil and Gas Facilities in the United States' (2020), *Louisiana State University Law Digital Commons*.

[8] B. Holland, 'Decommissioning in the United Kingdom Continental Shelf: Decommissioning Security Disputes' (2016), *Denning Law Journal*.

[9] P. Osmundsen, R. Tveterås, 'Decommissioning of petroleum installations – major policy issues' (2003), *Energy Policy.*

environmental standards, Norway might provide valid inspiration for good practices in the decommissioning field.

These scholarly views critically contributed to building knowledge about decommissioning regulations. However, the existing literature on decommissioning lacks a comprehensive picture of how regulation both at national and international level can tackle its different aspects to ensure sustainability of operations and help defining it in the context of the circular economy.

1.3 *Methodology of the research*

The research adopts a qualitative methodology. This will be based on the re-elaboration of the existing literature on the Blue Economy and sustainability of the maritime sector; the methodology reviews the current legislative framework on decommissioning, considering its pillars at international level, as well as major regional agreements. Practical cases are analysed to provide a material description of the main challenges that need to be addressed in the context of offshore extractive activities; finally, proposals for reform are advanced, based on the evidence derived from the sources taken under consideration – past experiences in the field and the existing literature.

The thesis is therefore structured in three main blocks. Chapter 2 aims to contextualise the management of offshore platforms in the realm of the Blue Economy. An overview of the concept of sustainability is provided, as well as its application in the maritime sector, followed by a description of the different interpretations of the Blue Economy. Then, the matter of decommissioning is introduced, as well as how it is generally managed. Chapter 3 frames the regulatory discourse on decommissioning, listing the economic and environmental rationales for regulating the field, and reviewing main existing international and regional agreements with a focus on the European framework. Accordingly, the main regulatory gaps are identified and discussed. Chapter 4 draws on previous scholarly work and punctual case analyses in order to address four major challenges in regulating decommissioning – namely, achieving legal harmonisation at international level, performing appropriate ex-ante assessment, guaranteeing companies' financial assurance to comply with their decommissioning liabilities, and addressing reputational risks. As mentioned in section 1.2, each section in Chapter 4 is backed by material evidence derived from relevant case studies. The core cases analysed are the decommissioning legal regime in South-East Asia, the US framework for platforms disposal, the UK decommissioning security dispute mechanism and the Norwegian taxation system. Section 4.5 focuses on events that were particularly resounding in the public opinion and shed light over important challenges that should be kept in mind when regulating decommissioning. The first concerns the blowout of the Deepwater Horizon Platform, which raised public awareness over the criticality of monitoring extractive operations closely. The second addresses the disputes that emerged with respect to the Brent Spar decommissioning, emphasising how reputational risks should be taken into consideration in the definition of incentives directed to economic operators.

Chapter 5 also extensively draws from case analyses to elaborate some proposals for the creation of a regulatory toolkit that can help ensure and emphasise sustainability of decommissioning operations. In particular, the EU framework is displayed in section 5.2 as a notable outset for defining collateral initiatives that can support the development of a sustainable decommissioning industry, besides the development of a solid regulatory framework. Similarly, the marine knowledge 2020 Strategy is reported as a valid initiative for fostering data integration in the maritime field, which could be adapted to the necessities of the extractive sector. Moreover, new trends in autonomous environmental monitoring[10] are analysed as evidence of recent progresses in data collection and management, which should be fostered and exploited for guaranteeing environmental protection. Several experiences and emerging studies concerning the reuse of platforms are then presented in section 5.3. In particular, conversion to artificial reefs is described as the most advanced method used until now, thanks to the extensive experience accumulated in the Gulf of Mexico; also new options are proposed which are currently under examination for finding innovative solutions of rehabilitation. Finally, Chapter 6 offers a summary of the main elements of the research, as well as its principal conclusions.

1.4 *Aim of the thesis*

The existing literature on decommissioning lacks a comprehensive view of the several aspects of decommissioning and how the current regulatory landscape fails to guarantee their sustainability under environmental and economic terms. Furthermore, their scope is generally limited to identifying given regulatory deficiencies, while they do not provide suggestions for improvement. This elaborate is meant to fill this gap by proposing a more comprehensive view of decommissioning, which does not treat removal of platforms in isolation, but addresses economic, environmental and social concerns at once. Acquiring an integrative view of all these aspects is necessary in order to adopt a sustainable view to decommissioning, one that ensures that present generations take care of the interests of future ones preventively. Besides, it also attempts to propose a set of actions that could help make regulations on decommissioning more efficient.

The main contribution is provided by creating a specific focus on long-term planning of decommissioning and introducing an integrated view of several components. It is not in the scope

[10] D.O.B. Jones, A.R. Gates, V.A.I. Huvenne, A.B. Phillips, B.J. Bett, 'Autonomous marine environmental monitoring: Application in decommissioned oil fields' (2019) *Science of the Total Environment.*

of this work to analyse in detail the legal technicalities of decommissioning regulation, but rather to address its gap with respect to three main elements. The first concerns international cooperation, which is here intended not only with respect to regulatory harmonisation, but also in terms of coordinating policies and initiatives for data integration and research. The second regards ex-ante planning and impact assessment. While these activities are usually performed on a case-by-case basis and considered in isolation compared to the other phases of platforms life, a different perspective is proposed. This includes the development of common procedures, parameters and indicators at regional level to ensure common standards of environmental protection; but also, that this sort of evaluations is already performed in initial considerations about platforms' instalment, so that their structure can be designed with a view towards making decommissioning as efficient as possible. Thirdly, while existing scholarly work focuses on the description of current regulatory requirements to ensure safety of decommissioning operations, it is here proposed that authorities also design a policy framework for incentivising the development of a decommissioning industry. This would be enabled by a set of initiatives aimed at incentivising research and development, in order to introduce advanced technologies and find innovative alternatives to traditional decommissioning methods.

An innovative framework is advanced to consider all aspects of decommissioning in integration. The aim of the thesis is to address the regulatory gap in the decommissioning field, explore regulatory challenges and provide plausible alternatives to face them effectively. The final objective is to propose a regulatory toolkit that does not focus exclusively on regulating platforms' removal rather to propose a set of key enabling actions that would allow to inscribe the disposal of disused platforms in the circular economy.

Chapter 2

Offshore platforms and the Blue Economy

2.1 *Overview of the Blue Economy: economic and environmental aspects*

The notion of Blue Economy refers to all economic activities that are generally based on the seas and their natural resources. It is a broad concept in the maritime economic sector, and it should be contextualised in the larger arena of sustainable development. According to the United Nations, the Blue Economy aims at the 'improvement of human well-being and social equity, while significantly reducing environmental risks and ecological scarcities'.[11] This concept describes a renewed framework where ecosystem services are protected and preserved so as to actively contribute to the creation of economic value. It represents an integrated and dynamic vision addressing issues of economic, social and environmental character, aimed at improving overall welfare and increasing value for current and future generations. In other words, the Blue Economy seeks to embrace the opportunities related to the oceans and their resources, while also addressing their threats to make sure that the impact of human activity does not compromise their potential.

The Blue Economy is a rather fluid notion: different actors tend to offer different interpretations[12], which provide a rather complete overview of the facets that compose this complex realm. Each of these interpretations significantly sheds light over a different aspect which is relevant from either an economic or an environmental perspective, suggesting the spectrum of rationales calling for a protection of marine ecosystems. The interpretation of 'oceans as natural capital' tends to underline the two parallel axes of sustainable development and human wellbeing, connecting environmental objectives with broader economic narratives, as well as those concerning improvements in livelihoods and wellbeing; in this sense, the valuation of ecosystem services serves as means to identify both social and economic benefits associated with healthy marine ecosystems.

The notion of 'oceans as livelihoods' is rather related to the practical application of the Blue Economy in developing countries, and therefore acquires a context-specific character. This view focuses on fostering improvements in management and community returns from existing economic sectors in the maritime environment, and at the same time identifying new sources of growth. Thirdly, industry groups provide an interpretation of 'oceans as good business' whereby the encouragement of the Blue Economy serves as incentive for greater engagement of the private

[11] UNCTAD 'United Nations Conference on Trade and Development, The Ocean Economy: Opportunities and Challenges for Small Island Developing States' (2014) *Concept Paper*, 2

[12] M.A. Voyer, G. Quirk, A. McIlgorm, K. Azmi 'Shades of blue: what do competing interpretations of the Blue Economy mean for oceans governance?' (2018) *Journal of Environmental Policy and Planning*, 21-22.

sector in the sustainable development of oceans as a new form of economic growth. Finally, the notion of 'oceans as drivers of innovation' emphasises the need to nurture research and development to favour the continued and sustained growth of the Blue Economy. This vision especially focuses on fostering partnerships between research institutes and the industry, for the development of technological advances that might allow a new and more efficient use of marine resources. For example, the European vision of Blue Growth[13] heavily emphasises the role of research and development, which is also central in the Australian approach[14] to the Blue Economy. Even though these competing interpretations might result in various consequences on matters of oceans governance, they all agree on the following points: (1) the Blue Economy is a marine-based economy that provides social and economic benefits for both current and future generations; (2) one that restores and protects the diversity and intrinsic value of marine ecosystems; and (3) it is mostly based on clean technologies, renewable energy and circular material flows.

The maritime economy includes a broad spectrum of activities, each of them affecting natural habitats in distinct ways and to varying degrees, the most impactful generally relating to the traditional ocean economy. For instance, oil and gas exploration and extraction often produce accidental oil spills or releases hazardous substances which are highly polluting; another significant source of pollution is represented by carbon emissions deriving from shipping. Remarkable damages also emerge from overfishing and the scaling up of aquaculture production provoked by the growing global seafood need, as well as disruptive coastal tourism and harm to the seafloor caused by telecommunications cables. Even though new sectors are being developed in the attempt to move away from destructive, extraction-focused business and towards more sustainable solutions, these novel alternatives themselves do not entirely come without a damaging potential.

The main innovative activities in the Blue Economy include renewable energies, seabed mining, remediation and restoration of ecosystem services, blue biotechnology for the production and use of marine molecules, blue carbon allowing carbon storage in marine and coastal ecosystems, and blue technology providing data infrastructures; however, a set of controversies is also associated to these new operations. Oceans are being increasingly used to host infrastructures to produce renewable energy, such as offshore wind farms: although these infrastructures represent the future to address climate change through the development of alternatives to fossil fuel sourced energy, they inevitably determine an external pressure on marine natural habitats. Exploiting renewable energy capacity of the seas should be balanced against the risk that potentially represents to their

[13] European Commission, 'Blue Growth', available at https://ec.europa.eu/maritimeaffairs/policy/blue_growth_en, (accessed 21 March 2021).
[14] National Marine Science Committee, 'Australian National Marine Science Plan' (2015), available at https://www.marinescience.net.au/nationalmarinescienceplan/ (accessed 24 March 2021).

ecosystems. Mining the seabed may offer a valid alternative to terrestrial mining, but it might as well embody both a threat to the seabed biomass and a source of water pollution; similarly, blue biotechnology carries the risk of accidentally withdrawing some marine species, and such risk is even more real given the sketchy regulation in this realm.[15]

The controversy in the context of the marine economy arises from the characterisation of oceans as common property which creates several issues making their regulation even more complicated. Oceans are often affected by incentives for overuse which may lead to reckless exploitation of natural resources, undermining their availability in the long-term. Moreover, some activities in one sector can affect the quality and disposal of resources for other sectors – for example, waste dilution determining higher pollution of waters and therefore reducing the number of marine species available for fishing. Further, given the absence of a clear system of resource allocation, when multiple actors are interested in the same resource a tension emerges as to whom that specific resource should be allocated. In addition, the extent to which marine resources are affected by the cumulative impacts of oceans-related activities remains largely uncertain or even disregarded, as a centralised and integrated control of resource use is lacking. As a result, the enactment of the marine-based economy and the operationalization of its sustainable management are made quite contentious by the general lack of established frameworks and an integrative set of guidelines which are an essential toolkit for determining baseline objectives, action plans, projects assessment and monitoring. In this regard, recent trends emphasise the necessity to ensure more efficient and reasoned decision-making and tend to suggest a shift towards stricter planning of the ocean economy.

Spalding pointed the need for a new international collaboration based on a common definition of the Blue Economy that can promote economic benefits, while facilitating sustainable changes in the management and use of ocean resources.[16] On this view three key priorities emerge: building a common set of categories, methodologies and defined geographies, shifting subsidies away from environmentally harmful activities and engaging citizens and consumers to become real actors of a 'new' Blue Economy.

The Blue Economy is growing as a new governance tool with an instrumental role for the articulation of appropriate resource use within oceans, and in this sense two major guiding lines have been traced. The first concerns data gathering, aimed at generating quantifications in terms of baseline data to measure ecological functions and assess environmental impacts, and to be used by policy makers during planning of maritime activities. In this regard, a prominent example is

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[15] M. J. Spalding, 'The New Blue Economy: The Future of Sustainability' (2016) *Journal of Ocean and Coastal Economics*, 9.
[16] Ibid., 16.

represented by the BlueMed Strategic Research and Innovation Agenda, an initiative supported by the European Commission in the context of the Blue Growth Strategy[17] with the objective of identifying the key challenges for the Mediterranean area and addressing the main knowledge gaps in the field. Targeting relevant research and innovation players, as well as public and private actors of the blue economy, the BlueMed initiative fosters knowledge creation and sharing of best practices through the creation of a thematic debate platform, with the ultimate goal of coordinating the various stakeholders involved. This project has the potential to provide a critical contribution for the creation of a comprehensive attitude towards the Blue Economy, as data collection and stakeholders' consultations are essential for, respectively, ensuring the conscious deployment of resources and raising the necessary support for sustainable practices from all the interested parties.

BlueMed's 2020 Implementation Plan presents the shared priority goals for research and innovation, therefore identifying the thematic and structuring actions to be developed so as to trigger a transformative process at Mediterranean level. The second set of proposals regards the idea of determining a change in the scope and scale of ocean governance by establishing a system of comprehensive ocean zoning, to be achieved through planning, the division in dominant-use zones and the allocation of user rights. It has been argued that planning and use-priority management would help increase the prospects of conservation and incentivise more efficient use of marine resources, while the establishment of user rights would shape an evolution in users' incentives towards collective choices and spontaneous group organization.[18] Three main motives underlie the argument for ocean zoning.

Firstly, comprehensive planning is necessary to replace the current normative patchwork that regulates the maritime environment and generate a more coherent and coordinated framework. An alternative regulatory option is the 'private ordering' a form of allocation of well-defined property rights, in which individuals would have an incentive to resolve conflicts privately rather than recurring to government regulation, creating a system of automatic adjustment of externalities.

Secondly, a system based on priority use would provide a flexible and decentralised mechanism for favouring the realignment between rights and resources. Allocating well-defined spaces and the resources embedded within them to given classes of actors – through rights, leases or concessions – could represent a valid alternative to reduce uncertainty over resource use, offer an impetus for self-organisation and provide environmental incentives, since deterioration of the ecosystem would result into a loss of economic profitability for the user in charge of the area.

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[17] BlueMed, 'Research and Innovation for blue jobs and growth in the Mediterranean area', available at: http://www.bluemed-initiative.eu (accessed 24 March 2021).

[18] J. N. Sanchirico, J. Eagle, S. Palumbi, B.H. Thampson Jr, 'Comprehensive Planning, Dominant-Use-Zones, and User Rights: a New Era in Ocean Governance' (2010) 86 *Bulletin of Marine Science* 273.

Finally, ocean zoning would lay down the basis for engaging in a structural reform of ocean governance, moving beyond the traditional view of managing each sector separately, where current ocean-management institutions control single resources over large geographical spaces and therefore leave space for regulated industries to exert pressure over the activities of management agencies. Planning, use-priority management and allocation rights in the context of a framework based on ocean zoning would represent a useful contribution to the protection of marine habitats and the thoughtful and more efficient use of their natural assets.

2.2 *Management and decommissioning of offshore energy assets*

The presence of offshore energy assets, both in terms of management during their life and decommissioning at the end, poses challenges through several perspectives. Offshore infrastructures can represent a threat to navigation safety, and their installation can become a source of disturbance for marine ecosystems; moreover, drilling platforms often provoke chemical spills having a polluting effect over the oceans. The oil and gas supply chain are articulated into, respectively, an upstream level identifying the phase of design and planning of the infrastructure, and a downstream level concerning crude procurement as well as supply, logistics and storage.

A similar phenomenon which raises a considerable amount of concern is the one of produced water[19]: oil and gas production processes imply large amounts of liquid waste which has been treated with different physical, chemical and biological methods, whereby the resulting liquid being dispersed in the seas presents a number of oil particles and dissolved elements which can be poisonous for aquatic species. Therefore, the occurrence of oil spills and the release of chemicals resulting from the activity of drilling facilities does not only determine a damaging effect on the marine environment, but also potentially compromises the activity of other sectors drawing from the variety of resources or the cleanness of water, such as fishing and coastal tourism. The environmental and economic costs borne as a result of oil spills and produced water in terms of pollution and deterioration of ecosystems raise the issue of redesigning diffused practices and the way the sector operates in general, as well as a revision of the relevant normative in this realm.

From this perspective, most attention will be placed on the ultimate stage of installations' life, namely the decommissioning phase corresponding to their withdrawing from service. Decommissioning oil and gas platforms implies the plugging of wells, cleaning and removal of pipelines, and removal of the production equipment and the overall structure. The deconstruction is generally justified by reasons of navigation and environmental safety to ensure that the

[19] Ahmadun, A. Pendashteh, L. C. Abdullah, D. R. A. Biak, S. S. Madaeni, Z. Z. Abidin, 'Review of technologies for oil and gas produced water treatment' (2009), *Journal of Hazardous Materials* 532.

abandonment of structures does not represent a danger for ships nor a source of pollution for the water. Several options are available for decommissioning energy assets, each of these methodologies being associated with distinct environmental costs and benefits. Complete removal requires the use of explosives to disconnect the well conductors, pilings and support legs five meters below the seafloor, such that the structure can be dragged to the shore and scrapped. In the case of partial removal, the structure is mechanically cut in two portions so as to only remove the upper part and reduce the overall height; the top portion can then be placed on the seafloor as additional reef habitat. Finally, toppling implies explosives to be detonated to undermine only three supports of the platform, such that the whole structure is bent over horizontally on the seafloor and left as reef habitat.

The process of decommissioning inevitably involves several risks.[20] The major challenge is inherently technical and emerges with respect to both the management of radioactive, toxic and hazardous materials resulting from decommissioning, and dealing with transportation and recycling of large components. Moreover, the remoteness of infrastructures creates further difficulties for mobilising equipment and resources. Besides the paramount monetary costs involved, also social challenges arise as the workforce operating on the platforms is left unemployed: both the economic and social costs incurred inevitably provoke controversies and public debates that can hinder the progress of decommissioning.

Most importantly, dismantling drilling infrastructures entails a great deal of environmental challenges connected to the use of explosives on the seafloor, restoring decommissioned infrastructure sites or prepare them for subsequent use, and ensuring that modules, components and materials can contribute to the circular economy by being reused or recycled in order to reduce the impact of waste. It has been argued that under certain circumstances decommissioning might not even be the best option for the environment at all.[21] Offshore infrastructures often end up altering the marine ecosystem in the area to such a profound degree, that restoration of the initial conditions becomes extremely hard or even harmful for the ecosystem itself. This is because platforms eventually provide significant ecological value by turning into artificial reefs and hosting various forms of marine life, and hence instituting by all effects a truly novel ecosystem. Therefore, transplanting some platforms may be detrimental to the extent that it removes the pivot of the newly developed ecosystem. The attempt to recognise the ecological services delivered by offshore platforms is at the base of 'Rigs-to-Reefs' programs promoted in some countries, whereby the

[20] D. C. Invernizzi, G. Locatelli, A. Velenturf, P. Love, P. Purnell, N. J. Brookes, 'Developing policies for the end-of-life of energy infrastructure: coming to terms with the challenges of decommissioning' (2020), *Energy Policy*, 2-4.
[21] S. van Elden, J. J. Meeuwig, R. J. Hobbs, J. M. Hemmi, 'Offshore Oil and Gas Platforms as Novel Ecosystems: A Global Perspective' (2019), *Frontiers in Marine Science*, 6.

obsolete infrastructures are repurposed as artificial reefs instead of being removed and scrapped. This type of initiatives has been particularly successful in the Gulf of Mexico, where around 530 structures have been reorganised as artificial reefs;[22] the experiences of structures turned into reefs has proven beneficial not only to the marine habitat, but also to other human activities, as they displayed incremental fishing biomass resulting into the emergence of enhanced fishing zones.

2.3 *The sustainable Blue Economy*

The experience of Rigs to Reefs programs shows that decommissioning may not always be the best option from an environmental point of view, and therefore sheds light over its highly contextual nature. The choice of whether to dismantle drilling platforms or not, and the methodology applicable, carries different consequences depending on the specific characteristics of the ecosystem involved, and requires an integrative understanding of safety, environmental, social, technological and economic effects. Nevertheless, the overall lack of empirical evidence about the long-term impacts of decommissioning, and the need to select the most appropriate option from a safety and sustainability point of view, call for the development of evidence-based approaches and tools that allow decision-making to be based on a comprehensive assessment of the peculiarities of the area in question. This is the fundamental consideration underlying the several decision support system methodologies that are growingly being explored and proposed. Among them, the Multi-Criteria Analysis approach[23] represents a framework for identifying a single more preferred option, by evaluating and comparing the performance of various alternatives. It therefore offers a well-defined method including the selection of objectives as well as the respective criteria defining them, the identification of the suitable options for the structure in question, a performance evaluation for each of the defined criteria according to their respective weights, the combination of criteria evaluations in an overall assessment for each option and the final selection of the best alternative.

Another innovative, evidence-based instrument for decision-making support is the SPIDA framework, a comprehensive database tool for gathering and screening all relevant information for obtaining a clear picture of the environment under consideration.[24] The SPIDA method would draw from a number of underlying data tables reporting on potential decommissioning methods, the pressures they would exert on the ecosystem and the sensitivity of the ecosystem itself to the said

[22] Invernizzi et al. (n 20), 3.
[23] S. Grandi, D. Airoldi, I. Antoncecchi, S. Camporeale, A. Danelli, W. Da Riz, M. de Nigris, P. Girardi, V. Martinotti, N. Santocchi, 'Planning for a safe and sustainable decommissioning of offshore hydrocarbon platforms: complexity and decision-support systems. Preliminary consideration' (2017) *Geoingegneria Ambientale e Mineraria*, 104.
[24] D. Burdon, S. Barnard, S. J. Boyes, M. Elliott, 'Oil and gas infrastructure decommissioning in marine protected areas: system complexities, analysis and challenges' (2019), *Institute of Estuarine & Coastal Studies*, 8.

pressures.[25] A wider approach has also been developed, not exclusively referring to the final stage of dismantling, but to the whole lifetime of installations and the range of activities involved.[26] On this view, the oil and gas industry seems to lack a satisfying framework for sustainable supply chain management: the risks associated with the oil and gas chain would decline and higher sustainability would be ensured through an improvement in the overall logistic system. Such improvement would be granted by developing a multidimensional contextualisation of both macro-economic and organizational-related elements exerting an influence over the industry, the companies operating within, and the functional areas involved in the supply chain. A sustainable supply chain management of the oil and gas industry would ensure that all managerial decisions are aimed towards efficient performance under economic, environmental and social perspectives.

This underlines the significant relevance of the Blue Economy to ensure an adequate sustainable development, through a comprehensive approach integrating economic, social and environmental dimensions, as the maritime industry is one that impacts the world economy and contributes significantly to the creation of value. A revision of the regulatory framework would provide the necessary guidelines to adopt more efficient and sustainable practices. Moreover, it would create the premises for a system of incentives to set up extensive data gathering structures to allow the design of tailor-made approaches on a case-by-case basis, so as to tackle decommissioning based on the specific conditions of the ecosystem involved; finally, it would foster the development of new technologies for discovering more sustainable alternatives to decommissioning within the logic of circular economy.

[25] The information outlined would then be presented in a standardised format and according to a flexible, modular structure so as to allow a clear and user-friendly source.

[26] N. K. W. Ahmad, M. P. de Brito, J. Rezaei, A. Tavasszy, 'An integrative framework for sustainable supply chain management practices in the oil and gas industry' (2017), *Journal of Environmental Planning and Management,* 581-594.

Chapter 3

The regulatory framework

3.1 *The economic and environmental rationales for regulating decommissioning*

The need for regulating the decommissioning of offshore energy assets lies in the significant economic and environmental costs associated to this type of activity. Generally, the normative framework provides a key instrument for directing stakeholders' behaviours towards socially desired outcomes namely, assuring minimal costs from both economic and environmental perspectives. The rationales for regulating decommissioning operations can be grouped into three categories.

First, regulatory requirements for detailed cost estimation can drive notable reductions in the monetary costs disbursed for decommissioning. Demanding cost estimation is critical to evaluate the validity of the proposed projects before granting permission and for encouraging extensive programming of decommissioning. For instance, data drawn from a cost summary on a few projects in the North Sea show that the actual cost is on average 76% higher than originally estimated, and decommissioning projects in some cases exceeded budgets by 189%.[27] Therefore, sustained monitoring over the correspondence between estimated and actual costs would act as an incentive to realise higher cost efficiency and explore cheaper alternatives.

Second, obligations concerning ex-ante impact assessment ensure that an estimate is elaborated about the potential effects of decommissioning on the environment and on other sectors. Determining in advance this type of consequences allows to benchmark the different options that can be pursued when the platform is no longer profitable. It provides a useful tool to inscribe decommissioning programmes in a macro-economic perspective and an integrative attitude which is more aware of the specific surrounding circumstances. Increased consciousness is vital not only for ensuring the minimisation of the environmental impact, but also for reducing the damaging risk vis-à-vis other human activities contributing to the creation of economic value.

The third rationale is related to information disclosure which only regulatory authorities can enforce. Decommissioning requires a disbursement either on the side of the company or the host state. If the allocation of costs falls upon the company, they arise at a moment when the platform is not profitable anymore. This entails the risk that, if the company has not adequately considered the cost of decommissioning in advance, it will not be able to pay for the restoration of the damage

[27] Y. Tan, H. X. Li, J. C. P. Cheng, J. Wang, B. Jiang, Y. Song, X. Wang, 'Cost and environmental impact estimation methodology and potential impact factors in offshore oil and gas platform decommissioning: a review' (2020), *Environmental Impact Assessment Review*, 2.

provoked once it cannot rely on incoming revenues anymore. Therefore, taxpayers will have to bear the burden of liability for restoration. Regular disclosure of financial information can facilitate the monitoring of this risk and ensure that adequate funds are set aside. It is also convenient for assessing compliance with the estimated costs on a regular base, and inspiring more timely and accurate interventions or corrections if deviations occur. If, on the other hand, costs are allocated to the host state since the beginning, it is important to know in advance how much it will weight on the government's budget. In either case, information disclosure can create the incentives for elaborating cheaper decommissioning solutions, which are financially beneficial to both the host country and the oil company. Decommissioning is a controversial issue which raises questions in terms of accountability, third-party liability and good practices in the oil industry. Regulating decommissioning serves as a means for enhancing potential benefits by encouraging research for innovative and cheaper alternatives.

3.2 The international regulatory framework

3.2.1 *The Geneva Convention and UN Law of the Sea Convention*

First generation structures built between the 1950s and 1960s were designed without consideration of their eventual removal; when the first step towards the establishment of an international regulatory framework was realised through the Geneva Convention of 1958, awareness about the issue of decommissioning was still limited, as it only started to become a source of concern in the late 80s. The Geneva Convention on the Continental Shelf, based on the Truman Declaration, laid down the basis for management of offshore installations, establishing the exclusive right for coastal states to explore the continental shelf and dispose of its resources. As far as decommissioning is concerned, the Convention clearly stated the obligation of full removal of any abandoned or disused installation.

The provisions contained in the Geneva Convention were subsequently incorporated to a large extent in the UN Law of the Sea Convention (UNCLOS) of 1982, establishing a comprehensive international treaty on ocean governance. Both the Geneva Convention and UNCLOS favour removal of structures rather than their abandonment; on the one hand, the Geneva Convention favours removal only for the sake of navigation safety, while on the other UNCLOS also introduces wider attention towards the development of a sustainable marine environment and the protection of other productive activities such as fishing. This is demonstrated by Article 206 of the UNCLOS, which sets out that States must evaluate the potential effects of planned activities on the environment and communicate the results of their assessments when they have reasons to believe that significant pollution or damages might result from the planned activity. Article 208 of the

UNCLOS also requires States to adopt regulations to control and reduce the pollution and damage associated with seabed activities. Article 210 regulates pollution connected with dumping, defined as the 'placement or disposal at sea of wastes or other materials'. In this sense, UNCLOS allows more flexibility compared to the previous framework, as Article 60 encourages removal without establishing an absolute obligation to remove the structure in its entirety.[28]

The UNCLOS framework displays some areas of progress, but some criticisms still need to be resolved in order to extensively address the environmental impact of decommissioning. Despite increased attention towards environmental concerns under UNCLOS, dismantling remains mandatory only when matters of navigation safety are at stake, while fishing and the protection of natural habitats do not represent self-sustaining grounds for removal; hence, both the Geneva Convention and UNCLOS mostly focus on matters of navigation rather than sustainability. The question arises as to where priority will be placed in the eventuality where matters of environmental protection and navigational safety are in contrast. For instance, full removal might be preferable for the sake of ships' safety, but it might represent a major threat to the marine ecosystem due to the damages provoked by explosives during the process of decommissioning. In cases where a similar controversy emerges, UNCLOS does not provide a clear framework to indicate what factors should be taken into account to define priority in a reasoned way, while it almost automatically attributes more relevance to navigation at the expense of the environment. Moreover, even though article 206 prescribes the ex-ante assessment of planned activities, it does not define specific and common standards for carrying out evaluations, which leaves room for a high degree of discretion to coastal states and does not ensure objectivity of the results.

The Geneva Convention also largely disregards the eventuality of installations disposal and is very rigid on establishing full removal as the only available option. Some progress can be highlighted under UNCLOS provisions on dumping (Article 210): the abandonment of installations or their parts could be considered as dumping, and therefore the UN framework seems to envision the possibility of partial removal – in contrast with the Geneva Convention, which prescribed entire removal at any time. However, UNCLOS does not present any explicit reference to structures disposal, be it for rehabilitation or abandonment. This leaves a considerable gap for what concerns substituting decommissioning with less impactful solutions and reflects a lost opportunity for encouraging the development of more sustainable and cost-effective alternatives. Taking everything into account, even though UNCLOS contributes to a partial progress compared to the Geneva

[28] E.J. Techera, J. Chandler, 'Offshore installations, decommissioning and artificial reefs: Do current legal frameworks best serve the marine environment?' (2015) *Marine Policy,* 55-56.

Convention concerning environmental issues, it still fails to define a mature and coherent vision to address sustainability of decommissioning in the long-term.

3.2.2 *IMO Guidelines*

In 1989 the International Maritime Organization asserted its competence over the treatment of disused installations, adopting a Resolution on Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone. UNCLOS now refers to the guidelines established by the IMO, and States enjoy a high degree of flexibility as long as they remain compliant with international standards. The Resolution defined removal of disused installations as the general approach, but it leaves room for a case-by-case decision on whether to proceed with removal or not, based on empirical evidence. Exceptions are allowed under the circumstances where removal is technically unfeasible or would entail an extreme damage or a significant risk to the personnel and the environment; in such case, coastal states are expected to ensure that any remaining structure does not represent a threat to navigation.[29]

What is innovative about the IMO Guidelines is the notion of 'new use', which can determine a reasonable justification for leaving the platform in place or removing it only in part. The Resolution innovatively allows for re-use of installations or even conversion to artificial reefs, provided that they do not interfere with customary traffic lanes. This interestingly sheds light over IMO's awareness that the objectives of environmental protection can sometimes be in contradiction with the obligation to remove installations, either because the use of explosives used for dismantlement can provoke substantial damages to the seabed, or because the installation itself has become a new habitat for natural resources. An environmental provision is also included, stating that the means used to remove the platforms should not cause any major damage to the marine ecosystem; wide discretion is left to coastal states as to what constitutes an adverse effect on the environment.

The primary purpose of IMO Guidelines is to provide a set of minimum standards to be used by coastal states with wide discretion; furthermore, the guidelines are only binding for state parties who are also signatories of the UNCLOS Convention, which creates a regulatory gap for those not being part of it. Another major deficiency lies in the fact that the environmental concern remains insufficiently addressed, as the guidelines do not provide any standard procedure to be adopted for carrying out environmental impact assessments. Even though the appropriateness of removal is to be determined on a case-by-case basis, a standard and harmonised procedure is crucial to ensure efficiency and objectivity of impact assessment. In this sense, IMO Guidelines do not provide any

[29] B.A. Hamzah, 'International rules on decommissioning of offshore installations: some observations' (2003), *Marine Policy,* 345-346.

further contribution compared to the UNCLOS framework, as they only prescribe the necessity to perform environmental assessments, but they do not specify a set of common rules for guiding the evaluations. On the other hand, it should be recognised that the IMO made indeed a step forward for what concerns alternatives to decommissioning; by introducing the concept of 'new use', IMO Guidelines offer a new perspective which welcomes the re-adaptation of platforms as an opportunity to save on the costs of decommissioning, while at the same time preserving marine ecosystems and even foster their development.

3.2.3 *The London Convention and 1996 Protocol*

The 1972 London Convention – also referred to as 'Dumping Convention' – replaced by its 1996 Protocol, deals with the issue of platform disposal in more detail. The abandonment of disused structures is considered as dumping, and as such it falls under the scope of this legal framework. The London Convention as amended by the 1996 Protocol introduces a stricter framework compared to UNCLOS, as it encourages states to envision any opportunity to avoid dumping in favour of environmentally preferable alternatives. Full removal is generally considered the standard procedure and dumping should be foreseen only in exceptional circumstances, provided that any polluting material has been removed.

The London Convention does not establish an absolute prohibition on the abandonment of installations, but a licensing system shall grant explicit permission, based on a list of materials whose dumping is allowed. A considerable step forward is represented by the request for applicants to submit an environmental impact assessment in advance to obtain the authorisation. Not only applicants must attain to the listed materials for dumping to be allowed, but they also have to submit a previous assessment of the potential effects that the materials in question could have on the marine environment. In general, the Convention applies the precautionary principle and demands coastal states to adopt the highest degree of precaution and responsibility when deciding on platforms' decommissioning; however, wide discretion is left to the single states as to what approach they should adopt when deciding. Therefore, also in this case the Convention fails to foster a coherent approach common to all signatories and disregards the necessity to ensure objectivity of ex-ante impact assessment through the establishment of harmonised procedures. Another major criticism lies in the fact that a Convention focused on dumping could be rightly expected to treat the subject of platforms' disposal. Instead, the London Convention completely ignores the discussion concerning rehabilitation or re-adaptation of platforms; just as in the case of UNCLOS, this framework does not recognise the opportunity for new uses of drilling platforms to represent a valid alternative to removal useful to favour sustainability.

3.2.4 *Regional agreements*[30]

Even though UNCLOS sets out some general obligations for the protection of the marine environment, it does not establish a uniform and overarching legal framework, which is developed following a model based on regionalism. The regulation of offshore oil and gas operations is rather formulated through a range of regional agreements whose scope is limited to the signatory parties.

The Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean of 1976 is composed of two protocols: the Protocol for the Prevention of Pollution in the Mediterranean Sea by Dumping from Ships and Aircraft and the Protocol for the Protection of the Mediterranean Sea against Pollution resulting from Exploration and Exploitation of the Continental Shelf and the Seabed and its Subsoil. The former follows the same rationale as the London Convention whereby dumping is prohibited in general, but exceptions can occur only when explicitly permitted by the competent authorities. The second applies more specifically to drilling platforms and is quite detailed in covering the whole lifecycle of offshore operations. It sets mandatory requirements to be followed during the authorization procedure, both on the side of industries and institutional authorities, including an environmental impact assessment of the planned activity and regular monitoring. Two significant elements included in the Offshore Protocol concern: (1) plans for removal of the structure shall be included by the operator in the overall project submitted to obtain approval to set up the platforms (2) the obligation upon coastal states to take measures against operators who refuse to comply with the requirements. Nevertheless, the Barcelona Convention establishes an obligation to present environmental impact assessments and plans of removal in advance, but it does not set out a standard format to be respected, which risks undermining the objectivity of evaluation. The Mediterranean Offshore Action Plan complements the framework of the Barcelona Offshore Protocol, emphasising the need to develop further and more coherent measures at regional level, as well as to adopt common standards and procedures for removal.

The 1989 Offshore Protocol to the Kuwait Regional Convention for Co-operation on the Protection of the Marine Environment from Pollution provides a relatively flexible framework, allowing for partial removal instead of total removal when matters of navigational safety or fishing are at stake. While guidelines for decommissioning of installations have not been elaborated, the

[30] S. Trevisanut, 'Decommissioning of Offshore Installations: a Fragmented and Ineffective International Regulatory Framework' in Catherine Banet (ed), *The Law of the Seabed: Access, Uses, and Protection of Seabed Resources* (Brill Nijhoff 2020) 445-451.

Marine Emergency Mutual Aid Centre [31] has defined 'Guidelines on Requirements for the Conduct of Environmental Impact Survey and the Production of Environmental Impact System'. These guidelines are relevant to the extent that they fill the gap left by the Protocol in terms of environmental impact assessment; on the other hand, they do not set standards for the development of impact surveys, while the competent authority requiring the assessment has a wide margin to select the terms of references which it considers necessary.

The Helsinki Convention for the protection of the Marine Environment of the Baltic Sea Area, which entered into force in 2000, defines a stricter approach with respect to platforms removal compared to other regional agreements. It imposes an obligation for entire removal, which shall be carried out under the responsibility of the private operator owning the structure; at the same time, it is less rigid than the Barcelona Convention, in that it does not address coastal states with a requirement to take actions against non-compliant operators. Even though the Convention establishes that offshore installations in general should not be abandoned at sea after the end of extraction operations, it does not determine an absolute prohibition; contracting parties can issue a permit for dumping certain materials, only when it represents an alternative that minimizes the risk of damage to human or marine life. In this, the agreement ratified in Helsinki appears similar to the 1996 Protocol, as dumping is only foreseen when no preferable alternative solution is available.

The Helsinki Convention, similarly to the other regional agreements, shows a lack guidelines on how proof of the inevitability of dumping should be determined and considered valid. By the same token, no reference is made with respect to environmental impact assessments or ex-ante plans for removal to be submitted prior to platforms' construction.

The 1992 OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic represents the combination of two previous agreements: the 1972 Oslo Convention for the Prevention of Marine Pollution by Dumping and the 1974 Paris Convention for the Prevention of Marine Pollution from Land-Based Sources. It probably represents the stricter piece of legislation in the realm of decommissioning, as it institutes an absolute prohibition on dumping of wastes as well as other materials derived from offshore installations. No disused structures shall be left on the seabed without explicit permission, issued by the competent authority on a case-by-case basis; and no permit shall be granted if the structure contains any substances representing a risk of damage to the surrounding marine habitat. Even stricter measures entered in place with Decision 98/3,[32] introducing a prohibition to leave wholly or partially in place any structure, except when significant

[31] Created in 1982 by the Protocol concerning Regional Co-operation in Combating Pollution by Oil and other Harmful Substances in Case of Emergency to the Kuwait Convention.
[32] Ministerial Meeting of the OSPAR Commission, OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations, 15.

reasons exist to justify alternative disposal as a preferable option; in that case, the competent authority shall consider the possibility to issue a permit for allowing an exception. Therefore, the OSPAR Convention clearly creates a presumption in favour of an obligation for total removal; nor does it differ from other regional agreements in terms of regulatory shortcomings, as it lacks a consistent approach towards impact assessment and specific guidelines concerning what exactly should constitute a valid reason for leaving installations in place.

With these considerations in mind, it might be concluded that both international and regional agreements tend to display the same criticisms concerning two fundamental elements. First, the lack of commonly established procedures in order to guide impact assessments, which is critical in order to ensure objective evaluations concerning the appropriateness of decommissioning. Prescribing assessments is insufficient unless they are carried out based on a common format that allows systematic evaluation and comparison across alternatives. Second, the existing legal frameworks generally overlook the possibility of finding sustainable alternatives to decommissioning; more specifically, they largely disregard the possibility of leaving infrastructures in place or dismantling them only partially, and re-habilitating them as new sites of marine life. The agreements that are currently in place do not take into account new empirical evidence concerning the impact of decommissioning on the environment and therefore do not sufficiently address new frontiers for making the final stage of platforms' life more sustainable.

3.3 Focus on the European framework

3.3.1 *The 2013 'Offshore Directive'*

The so-called 'Offshore Directive',[33] amending Directive 2004/35/EU, represents a higher degree of advancement and completeness compared to its foreign counterparts. The main objective of the Directive is to design a set of rules aimed at the prevention of accidents and ensuring efficient responses when those occur, to allocate specific responsibilities to both operators and individual countries and promote sharing of best practices across Member States. According to the Directive, companies possess full liability for environmental damages caused by their activities and national authorities are responsible for verifying safety provisions, environmental protection measures and emergency preparedness. Permission to begin exploration and production will depend upon the granting of licenses, based on a range of preventive evaluations. Companies shall prepare a 'Report on Major Hazards' containing a risk assessment and an emergency response plan in case accidents occur; competent authorities shall also ensure that companies have the necessary technical expertise

[33] Directive 2013/30/EU of the European Parliament and of the Council on 12 June 2013 on safety of offshore oil and gas operations and amending Directive 2004/35/EU.

to deal with the correct and safe management of operations and dispose of sufficient back-up resources to respond to potential emergencies. Independent verification of technical solutions which are critical for the safety of operators shall also be guaranteed prior the beginning of operations. National authorities shall assess safety of extractive and productive activities for their whole duration, and countries are entitled to impose sanctions or other corrective actions – including halting production – where companies fail to respect minimum standards. Countries and companies are also required to publicly disclose information on how they handle and ensure safety of drilling platforms, and citizens have the right to express opinions and comments on the environmental effects of planned operations.

Under Directive 2013/30/EU Member States were required to transpose it into their national legal regimes by July 2015, with transitional periods for industries extending to July 2018. In general, the European Commission observed a satisfactory level of completeness in terms of individual Member States' implementation, even though the integrity and quality of results achieved by single countries varies significantly, due to the different approaches adopted.[34] The request to submit risk assessments prior installations become operative, monitoring on the side of authorities on a regular base and openness to public participation surely represent notable aspects of the EU Offshore Directive. The greatest advancement is given by the Report of Major Hazards, under two respects. First, in taking into account all relevant stages of platforms' lifecycle and providing a comprehensive anticipation of all foreseeable situations, the RoMH shall include anticipations on how decommissioning will be carried out. This implies that the competent authority will have to evaluate plans for decommissioning before granting authorisation for starting production, and therefore displays increasing awareness that finding optimal solutions for decommissioning requires consideration on a preventive basis. Second, a Virtual Centre of Offshore Safety Expertise (ViCOS) was instituted by the Joint Research Centre, under appointment of the European Commission's Directorate General for Energy, with the aim of assisting national competent authorities to perform assessments of RoMH. Competent authorities were provided with training and a set of guidelines[35] for developing the necessary capabilities to perform appropriate and objective assessment of the reports provided by applicants before granting licenses for operations.

[34] Report from the Commission to the European Parliament, the Council and the European Economic and Social Committee assessing the implementation of Directive 2013/30/EU of the European Parliament and of the Council of 12 June 2013 on the safety of offshore oil and gas operations and amending Directive 2004/35/EC.

[35] S. Walker, M. Konstantinidou, S. Contini, E. Zhovtyak, S. Tarantola, 'Guidelines for the Assessment of Reports on Major Hazards based on the requirements of Directive 2013/30/EU – Summary and highlights of the JRC training course under the Virtual Centre of Offshore Safety Expertise' (2017) *JRC Conference and Workshop Reports*.

Given its relatively recent application, it can be observed that the EU Offshore Directive probably displays the most comprehensive and up-to-date legal framework concerning the management of offshore oil and gas extraction and production. Some fundamental gaps still need to be addressed. Even though decommissioning is subject to the approval of authorities, the Directive's scope is limited to possible safety aspects related to the end-of-life stage of platforms, while it does not include environmental concerns arising after decommissioning; moreover, no mention is made about more sustainable alternatives that could result into lower environmental impact compared to decommissioning. Therefore, EU legislation does not provide specifications concerning how removal should be handled, while it relies on the OSPAR Convention to provide a reference on how authorities should approach dismantling of platforms. Finally, despite the advancements displayed in terms of risk assessment through the imposition of the RoMH, guidelines are only provided to competent authorities when evaluating the reports, while no standard format has been designed for the operators to follow when drafting RoMHs.

3.3.2 *The Mediterranean Action Plan and the Blue Growth Strategy*

The Mediterranean Action Plan was established in 1975 by Contracting Parties to the Barcelona Convention and the European Union as a multilateral agreement in the context of the Regional Seas Programme of the United Nations. It defines a unique institutional, legal and implementing framework for cooperation in addressing common challenges of marine environmental degradation and integrating essential building blocks for sustainability in the Mediterranean. It is guided by a six-years medium-term strategy and implemented through two-years programmes organised around thematic regional strategies and action plans, with a view to underpinning the implementation of the Barcelona Convention and its Protocols.[36]

The Mediterranean Offshore Action Plan[37] refers to offshore exploration activities and aims to outline measures to be applied at regional level to ensure the safety of offshore activities and reduce their potential impact on the marine ecosystem. The main objectives of the Action Plan are the creation of a governance framework to support the adoption and enforcement of regional standards and procedures, as well as the development of a commonly agreed reporting and monitoring system based on a set of relevant indicators.[38] It represents an extremely comprehensive architecture

[36] UN environment programme, 'Mediterranean Action Plan, Barcelona Convention', available at https://www.unep.org/unepmap/ (Accessed 3 April 2021).
[37] UNEP Decision IG.22/3 'Mediterranean Offshore Action Plan in the framework of the Protocol for the Protection of the Mediterranean Sea against Pollution resulting from Exploration and Exploitation of the Continental Shelf and the Seabed and its Subsoil' (2016).
[38] UN environment, Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea, 'Mediterranean Offshore Action Plan', available at https://www.rempec.org/en/about-us/strategies-and-actions-plans/mediterranean-offshore-action-plan (Accessed 3 April 2021).

including technical cooperation, regional transfer of technology, capacity building programmes and the mobilisation of resources for the pursuit of the Action Plan. Setting an implementation timeframe from March 2016 to December 2024, the Offshore Action Plan represents a significant step forward towards the achievement of common long-term objectives, based on a uniform approach to be applied at regional level; most notably, it finally recognises the importance of strengthening decision-making due to the application of an empirical approach based on consistent indicators.

'Blue Growth' is another significant initiative in the landscape of the Blue Economy, setting up a long-term strategy[39] to support sustainable growth in the maritime sectors at European level and being defined through a detailed roadmap for action.[40] The Blue Growth strategy aims at exploiting the full potential of the marine sector as driver of growth and innovation of the European economy, as well as supporting its recovery and resilience after the pandemic crisis. It is a rather exhaustive package covering a wide range of aspects of the Blue Economy however, it completely disregards the oil and gas sector especially the potential for ensuring its sustainability. The absence of offshore extractive activities from the Blue Growth strategy represents a missed opportunity for inscribing the sustainability of platforms' lifecycle and decommissioning in an overarching and integrative framework to be applied at European level.

[39] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions, 'Initiative for the sustainable development of the blue economy in the western Mediterranean' (2017).
[40] Commission Staff Working Document, 'Framework for action', accompanying the document 'Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions, Initiative for the sustainable development of the blue economy in the western Mediterranean' (2017).

Chapter 4

Issues in the regulatory framework on decommissioning

4.1 Creating an overarching and harmonised framework at the international level[41]

4.1.1 *Fragmentation across and within regions*

Decommissioning is mostly regulated under regional agreements with a limited geographical scope. As different approaches and requirements are prescribed over distinct areas, the first issue is the high level of fragmentation of the existing regulatory framework. For the time being, the only normative sources at the international level concerning seabed activities are found in the United Nations and the International Maritime Organization. UNCLOS creates a general obligation for coastal states to adopt national laws in order to guarantee environmental preservation, but it grants coastal states the exclusive right to dispose of their continental shelves to exploit natural resources.[42] The IMO has adopted non-binding guidelines applying to offshore activities; moreover, even though the IMO contributes to the regulation of offshore activities, pollution associated specifically with extraction has been declared outside of its mandate.[43] As a result, there is no international framework clearly establishing rights and obligations with respect to environmental standards of extractive activities.

Regulatory requirements are not only differentiated on the basis of regional clusters, but even individual countries within the same region have the possibility to adopt extremely different approaches. Current regional agreements are characterised by extreme flexibility: signatory states are free to establish the premises to authorise projects, the procedures to perform extractive activities, and how the ending life of structures should be handled. Provisions contained in the existing examples of regional agreements generally refer to ‘environmental damage’, but do not provide an agreed definition of what actually represents an environmental damage and what can be considered a tolerable level of risk. As a result, single states establish the acceptable options based on their subjective judgement, defining when decommissioning is necessary and how it should be carried out or, on the contrary, which circumstances might justify the abandonment of platforms.

If, on the one hand, higher flexibility allows to address decommissioning on a case-by-case depending on the specificities of the natural habitat involved, on the other it entails high environmental risks. The first issue is that, as countries display varying sensitivity to environmental matters, some of them might disregard the harmful impacts of decommissioning and be more

[41] Y. Lyons, ‘Transboundary pollution from offshore oil and gas activities in the seas of Southeast Asia, Centre for International Law (2012).
[42] UNCLOS, art. 77(1).
[43] Ibid, 12.

permissive when considering decommissioning projects, leading to regulatory arbitrage whereby companies tend to operate in places where legislation is more relaxed. Such a fragmented framework at the international level does not ensure high standards of environmental protection to be uniformly applied, and therefore does not allow to properly address the danger of ecosystem deterioration in countries where environmental concern is still superficial. Secondly, ambiguity of legislative provisions inevitably compromises objectivity of evaluations, preventing effective control over pollution of the water and seabed disruption. Overall, the granularity of legislation on decommissioning – both in terms of fragmentation across and within regions – results in a high degree of opacity, with detrimental effects on the predictability of environmental consequences and the accountability of operators in this respect. Expecting the same standards of environmental protection on the side of companies operating in different countries and regions would not only be beneficial for the preservation of marine ecosystems but would also have positive effects on the international competitiveness of oil and gas enterprises. Facing the same strictness of legal requirements, companies would compete in a level playing field despite operating in different areas, and the extractive sector would be characterised by increased competitiveness. Operators in the sector would receive higher encouragement to innovate and find more sustainable alternatives to manage decommissioning, and market dynamics would shift the focus of competition on sustainability, as it is already happening in other productive sectors. Benefits would materialise in terms of innovation, technological advancements and digitalisation to guarantee the development of sustainable decommissioning.

4.1.2 *Inscribing decommissioning in an integrative, environment-focused framework*

Besides the high level of international fragmentation, existing regulatory requirements on decommissioning also seem quite dispersive and disjointed within regions. Even at regional level, provisions on decommissioning are dispersed across different pieces of legislation and, for the time being, there is no example of a complete framework addressing the issue of safety and sustainability of decommissioning with an integrative approach. A clear case of the inconsistent character of current decommissioning provisions is given by the division of competences between UNCLOS and IMO Guidelines. Instead of creating a unique and comprehensive framework, competences are distributed across the two distinct entities, the UN dealing in general with pollution by seabed activities and dumping, and IMO Guidelines treating disused installations more specifically. This is representative of the current absence of an overarching framework being able to provide a big picture of decommissioning, as distinct regulations tend to tackle individual aspects of the matter instead of linking them with an all-embracing outlook.

In order to achieve completeness of legislation on decommissioning, two main aspects need consideration. The first remedy concerns the dispersion of provisions about the environmental implications of decommissioning; given the growing awareness about the dangers represented by decommissioning from an environmental perspective, an appropriate level of care and attention should be devoted to the matter. Taking action requires grouping the risks of water pollution and deterioration of natural habitats resulting from the disruption of the seabed in an accurate and detailed framework, that focuses specifically on the prevention of such risks and the preservation of marine ecosystems. Second, dismantling of platforms needs to be inscribed in a more integrative perspective that addresses the different stages of platforms' life as a continuum and not as separated moments. Decommissioning is often considered in isolation compared to the other phases of extractive activities and even disregarded as having secondary importance, while it is one of the most delicate moments in terms of environmental impact. A more comprehensive framework embracing all aspects and stages of extractive activities would be especially helpful to address the design of infrastructures with a long-term view towards what will happen once platforms cease to operate.

It is important to find a fair equilibrium between fixed international standards for environmental protection and, at the same time, allowing the necessary flexibility to face each case of decommissioning with a specific view to its contingent characteristics. Drilling infrastructures are placed in locations distinguished by different physical and natural characteristics, and a decommissioning option which is optimal in one case might not be the best alternative for another structure; for this reason, it is vital to avoid a one-size-fits-all approach and address decommissioning case-by-case. This, however, does not imply the impossibility to establish some simple and uniform guidelines, rules and procedures as well as common control mechanisms internationally to guarantee appropriate caution towards the environment. A regulatory framework centred around the environmental risks of decommissioning would serve three main purposes. It would promote more conscious and responsible attitudes on the side of member states; it would represent the opportunity to face the matter effectively through a more integrative and complete approach; and it would create agreement about the implementation of best practices for ensuring environmental protection in the maritime sector.

4.1.3 *Southeast Asia: how ocean governance can affect marine pollution*

The case of Southeast Asia is emblematic of the practical consequences that the lack of regulatory coherence can determine on environmental conditions. The seas of Southeast Asia are densely populated by extractive activities, hosting about 1390 platforms[44] especially concentrated among Indonesia, Thailand and Malaysia. Given the wide presence of drilling platforms, the necessity to regulate their pollutant impacts and their decommissioning process becomes imperative. Even more so, the morphologic conformation of these seas, which appear as semi-closed basins shared among several coastal states, is particularly conducive to transboundary pollution, originating in one state's area of competence and expanding in the surrounding areas. However, drilling activities in general are merely regulated on the basis of bilateral or multilateral agreements ratified by individual countries, or by private contracts stipulated by economic operators in the sector.

The lack of consistent regional regulation concerning extractive activities in South-east Asia has frequently been the source of heated disputes among coastal states. For instance, promising sedimentary basins located in the area of the Spartly Archipelago were claimed by up to six coastal states – China, Taiwan, Philippines, Brunei Darussalam, Malaysia and Vietnam. Specifically, contentions between China and the Philippines revolved around the Sampaguita gas field, as drilling operations carried out by the Philippines were interrupted by Chinese threats and interventions several times. As a result, even though management of operations in the field were to follow Philippines' rules on environmental law, the greatest deal of attention was devoted to security issues created by the tensions with China, and monitoring of platforms was seldom performed.

Another controversy emerged when China took the prerogative of granting the Wan'an Bei 21 Block, located off the Vietnamise coasts, to a US oil and gas company; the company eventually gave up the opportunity specifically for the political risks that the tension between China and Vietnam posed, but the area was later exploited by several companies receiving concessions from both countries. Therefore, distinct agents operating in the same area were subject to different rules, procedures and monitoring, arguably leading to confusion about what national environmental standards and requirements companies should comply with.

Disputes also concerned Indonesia and Malaysia with respect to the Ambalat block in the South of Ligitan and Sipadan islands. Although the International Court of Justice finally established the Malaysian control over the area in 2002, Indonesia never fully gave up its claims over oil resources there, even leading to military clashes in the upcoming years.

Continuous and unresolved issues among different coastal states, claiming their prerogative over oil resources in the seas off Southeast Asia, potentially materialises in higher environmental risk under several aspects. First, as mentioned in relation to the disputes between Philippines and China, the necessity to manage diplomatic relations and deal with delicate political equilibrium

[44] Ibid, 4.

inevitably diverts attention away from environmental concerns, resulting in lower levels of monitoring; on the contrary, competition among states might as well result in a race for resources, creating incentives for overuse. Besides, the question of pollution created by extractive activities specifically in Southeast Asia is emphasised by a prominent issue of multiple and conflicting uses. These seas are characterised by incredibly diverse ecosystems and massive trade volumes; the populations of the coastal states involved heavily rely on fishing as well as coastal tourism. In this context, the relative environmental damage that may arise from drilling and decommissioning is even more worrying, as it would negatively impact all other activities that revolve around marine resources, and which represent the primary source of income for local populations. These considerations acquire further importance in light of the fact that ASEAN countries are experiencing considerable economic growth, whereby their energy demand is expected to increase exponentially – while requirements for environmental protection continue to be quite lax as they are perceived as an obstacle to recover the development gap.

4.2 Performing adequate ex-ante planning

4.2.1 *Environmental Impact Assessment* [45]

Environmental Impact Assessments (EIAs) are analyses performed on a preventive basis to evaluate the potential effects of given activities over the surrounding ecosystem and the environment as a whole. EIAs serve two main objectives: (1) create the conditions for making reasoned decisions about planned activities, and assess their feasibility by weighting their benefits against the environmental costs they could potentially imply; (2) increase predictability in the management of operations and improve readiness to respond to potential accidents. EIAs are critical parts of ex-ante planning to ensure the smooth functioning of operations and reduce the likelihood of environmental harm.

Existing regulatory frameworks are arguably lagging in defining EIAs procedures in the offshore oil and gas sector. Not every regional agreement prescribes ex-ante assessments of environmental risks to be carried out as a necessary condition to obtain authorisation for proposed projects; where this obligation exists, provisions are still very vague and do not clearly specify how EIAs should be structured and performed in order to grant their validity. For example, neither the Helsinki nor the OSPAR Conventions contain obligations to conduct preventive assessments of potential damages to the environment. Article 206 of UNCLOS merely sets out that States should

[45] L. Manfra, C. Virno Lamberti, S. Ceracchi, G. Giorgi, D. Berto, M. Lipizer, M. Giani, O. Bajt, M. Fafandel, M. Cara, S. Matievic, M. Mitric, S. Papazisimou, M. Poje, C. Zeri, B Trabucco, 'Challenges in Harmonized Environmental Impact Assessment (EIA), Monitoring and Decommissioning Procedures of Offshore Platforms in Adriatic-Ionian (ADRION) Regions' (2020) *Water.*

evaluate the potential effects of planned activities on the environment and communicate the results of their assessments when they have reasons to believe that significant pollution or damages might result from the planned activity. The London Convention simply adopts the precautionary principle, invoking the highest degree of precaution and responsibility on the side of coastal states when deciding about decommissioning; a list is provided naming the materials whose dumping is allowed, and applicants must submit a previous assessment of the potential effects that the materials in question could have on the marine environment. The Barcelona Convention requires that plans for removal of the structure are preventively included in the overall project besides environmental impact assessments; the Kuwait Protocol[46] is slightly more specific in providing annexed guidelines for the conduct of Environmental Impact Surveys. The Report on Major Hazards (RoMH)[47] foreseen by the EU Offshore Directive as a necessary condition to start operations probably represents the most advanced example in this respect; the RoMH shall include both risk assessments and an emergency response plan, and it is accompanied by a set of guidelines to support competent authorities in the development of capabilities required to appropriately assess the reports provided by applicants before granting licenses.

Where regulations require the performance of ex-ante assessments, they all display a fundamental gap – namely, in no case they provide a standard format to be followed as a reference for Environmental Impact Assessments, which leaves individual states full discretion to decide what should be included in the analysis and how it should be interpreted. First of all, there is no guidance as to how EIAs should be performed and structured. This might concern what kind of information should be included and what factors should represent the subject of the analysis. Also, what direct or indirect indicators can be considered representative of the factors under study and how they should be developed, as well as recommended parameters to be monitored. It would also be relevant to determine what data should be gathered and how it should be collected to ensure reliability of results. Guidance should be provided as to how statistical data should be interpreted in order to gain trustworthy and significant insights about the conditions of the surrounding environment, and the risks implied by the planned activity. Secondly, there is no established agreement on what results should be observed to justify the authorisation of operations. Regulators should agree on what represents a tangible risk of environmental damage, as well as what is the level of risk which is considered acceptable in order to start operations. Preventive considerations on how to reduce environmental risk could be carried out in order to provide a useful basis for companies to structure

[46] Protocol Concerning Marine Pollution Resulting from Exploration and Exploitation of the Continental Shelf, 2065 UNTS 68.
[47] Directive 2013/30/EU of the European Parliament and of the Council of 12 June 2013 on safety of offshore oil and gas operations and amending Directive 2004/35/EU.

their preliminary analysis. In general, it is necessary to lay down the premises that need to be respected in order to grant licenses and the type of projects that should be accepted. As a result of the current lack of such elements, individual countries enjoy discretion when evaluating the results presented by companies and cannot compare their results against fixed benchmarks or targets to make independent decisions.

The absence of precise guidelines on how EIAs should be structured and interpreted prevents the possibility to make reasoned decisions about decommissioning based on full awareness of its environmental impact. An agreed definition of environmental damage and of the acceptable level of risk is needed to ensure that the same standards of safety and protection are ensured everywhere, and preservation of marine ecosystems is not left to the subjective judgement and sensitivity of the single competent authorities involved. Authorisation of operations should be guided, instead, by clearly defined criteria on the basis of objectivity that only an empirical approach can guarantee.

The absence of baseline parameters and indicators does not enable a transparent and independent assessment of the dangers involved, increasing the unpredictability of operations and potentially provoking inadequate risk management. A more systematic and objective approach would also facilitate monitoring of the actual environmental effects provoked over the whole lifetime of the platform, enabling higher responsiveness to the changing conditions of the natural habitat under consideration. In general, well-defined EIAs have the potential to play a crucial role in guiding both the daily management of operations, and the correct definition of ex-ante planning with a long-term outlook.

4.2.2 *Guidelines on platforms' disposal as an incentive for innovation*

Another major controversy of the current regulatory framework on decommissioning is that it displays a rather restricted vision of what alternatives should be considered once platforms reach the ending stage of their lifecycle. All existing regulations share the same limitation in this respect: they vaguely prescribe the removal of infrastructures for the sake of navigational safety, or at best allow for their partial abandonment when removal is too costly or might provoke serious damages to the seabed; policy makers in this respect fail to adopt a proactive approach in addressing the issue of what could be done to avoid decommissioning and maybe aim towards the recovery of structures. Current regulations do not provide sufficient guidelines on how decommissioning should be carried out in the way to minimise the risk of environmental damage and they do not foresee potential reuse or recycling of platforms, which is rather left to the voluntary effort of individual companies. As a result, operators in the sector arguably face almost inexistent legal incentives to address the ending stage of operations with an innovative and sustainable perspective. Competent authorities are in the position to create the right regulatory environment conducive to more visionary and responsible attitudes on the side of extractive companies to ensure the sustainability of their operations. In this respect, there are three main elements that policy-makers could consider to complement existing regulatory requirements in a way that can provide operators with the means and right level of motivation to become more environment-focused.

The first element concerns empowering companies with the legal possibility to choose among different options without restricting their margin of operation. All regulations now only foresee the possibility of full or partial removal, while it would be necessary to expand the set of possible options that companies can contemplate when deciding about the future of disused platforms, without restricting their field of action to the most obvious and yet most damaging solution – full removal. To this end, operators should also be provided with the intellectual means to distinguish across a set of available options and select the course of action which is most appropriate for their specific case. International cooperation among public and private actors on the matter would allow to raise a considerable pool of financial and intellectual resources to carry out extensive research on the matter; this would allow the development of a set of conventional parameters and common technical guidelines to support companies in developing the capabilities to: (1) make informed decisions about the preferable option that guarantees the lowest environmental risk and highest cost efficiency and (2) materially operationalize the selected alternative.

The second step consists in integrating ex-ante planning with preventive considerations about decommissioning prior the settlement of the platform. For the time being, only the Mediterranean area presents legal requirements of this sort. The Offshore Protocol to the Barcelona Convention demands that plans for removal of the structure are included in the initial phase of submission to obtain approval to set up the platforms. The RoMH in the context of the EU Offshore Directive shall also include anticipations on how decommissioning will be carried out, meaning that the competent authority will have to evaluate plans for decommissioning before granting authorisation to start production. Requesting plans for decommissioning even before settlement of platforms is critical to ensure a long-term outlook. Decommissioning has long been considered an issue to be addressed by future generations, while planning how to dismantle platforms during their very design would ensure more immediate and efficient operations. The way platforms are currently dismantled greatly depends on how they were designed in the first place. In other words, platforms were installed without consideration of their future decommissioning, and only once they became inoperative the issue of their removal was raised, and specific approaches were designed case-by-case. New drilling platforms, on the other hand, should be designed keeping in mind the necessity to make their dismissal as easy, cost-efficient and environmental-friendly as possible. Instead of performing decommissioning based on the design of platforms, platforms should be designed in a way that can facilitate their eventual removal or guarantee their recycling. Ex-ante planning of decommissioning would allow to: (1) ensure that planned activities will not result in major environmental hazards or damages; (2) preventively assess what would be the major difficulties of removal in a given area, and design the platform in way that can decrease the level of risk and difficulty; (3) know in advance how much removal will cost and save the financial resources needed to that end; (4) establish possible ways to reuse components of the structure and choose the materials employed accordingly; (5) know in advance the steps to be taken once the platform ceases to operate, allowing companies to act more promptly, and possibly exploring new ways to reinvest in the infrastructure and generate new sources of revenue. Regulatory requirements are vital to completely reverse the premises of decommissioning and enable the said change in perspective.

Thirdly, a complete regulatory framework is also instrumental to elaborate a reasoned and targeted set of incentives for research, innovation and digitalisation. It is important that regulators try to limit the detrimental effects of traditional decommissioning techniques, but that they also actively create the premises for encouraging research and development in the field. Regulatory authorities are the very first actors that can promote international cooperation to carry out extensive research about sustainable alternatives to decommissioning. International cooperation would enable pooling of knowledge and resources, exchange of ideas and perspectives, and sharing of best practices. This could increase the likelihood to spread both growing awareness of the environmental risks associated with decommissioning, and innovative approaches to address them, and it would support the development of a decommissioning industry. Transnational cooperation could also take place in the form of a system of common subsidies with the aim of fostering competitiveness in the sector and encourage the development of new technologies to facilitate the green transition of decommissioning.

4.2.3 *Platforms' disposal in the U.S: incentives for rehabilitation* [48]

The extensive experience that the United States acquired throughout the years, exploiting oil reserves in the Gulf of Mexico, provide it with one of the most advanced decommissioning regulatory frameworks around the World. Only in the period between 2017 and 2002, the U.S. engaged in the removal of around 2750 structures devoted to extractive activities.[49] Although the United States are not a party to the UNCLOS, which poses serious issues in terms of international

[48] K. B. Hall, 'Decommissioning of Offshore Oil and Gas Facilities in the United States' (2020), *Louisiana State University Law Digital Commons*.

[49] 'Statistics for Decommissioned Platforms on the OCS', page of the Bureau of Safety and Environmental Enforcement website, https://www.bsee.gov/what-we-do/environmental-focuses/decommissioning/decommissioning-statistics (Accessed 7 May 2021).

cooperation over maritime pollution, it presents a comprehensive legal regime that governs platforms' management over their whole lifecycle quite in detail; while international law contributes to a relatively small extent, the industry is regulated under both state and federal law, depending on platforms' distance from the continental shelf.[50]

The conditions applying to Leasing Programs are outlined in the US Outer Continental Shelf Act, which establishes five-year plans for holding leases to operate in a given portion of federal offshore waters.[51] The Bureau of Ocean Management, Regulation and Enforcement (BOEMRE) is the general agency responsible for the monitoring of extractive activities in federal waters, but duties relating to environmental protection and safety are delegated to a specific agency, the Bureau of Safety and Environmental Enforcement (BSEE). Federal law defines decommissioning as a contractual obligation, included in the lease text, which implies joint and several liability of all operators involved.[52] The obligations establish liability to sustain the cost of decommissioning, expressively determine the time at which removal should be performed, [53] and its modalities to ensure proper platforms' disposal.[54] The decommissioning process is closely monitored by the BSEE, which shall scrutinize the company's work plan for removal and provide its approval before the process for unplugging the well begins,[55] as well as a final written report submitted by the company within 30 days of completing the removal.[56] Financial assurance requirements are also foreseen to make sure that the company will actually be able to sustain its decommissioning obligations once the platform ceases to operate, and federal law meticulously explores the different alternatives available to oil and gas companies to satisfy financial assurance requirements. It also defines monitoring activities to be carried out regularly in order to check the company's solvency, based on a set of standard financial indicators.[57]

In addition to its relative degree of advancement compared to other existing normative frameworks, the US system presents a valuable specificity – namely, its wide focus on ex-ante planning of decommissioning and platforms' disposal. Its uniqueness lies in the fact that US federal

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[50] Federal law applies when the drill is located in *federal waters,* more than three nautical miles offshore; for drills which are located within the three nautical miles, the state law of the nearest state applies).

[51] Ibid. 440.

[52] Sections 1 and 22 of the standard offshore lease for federal waters.

[53] Structures shall be removed within one year after the lease terminates, but regulators are entitled to require to plug a well earlier 'if the well poses a hazard to safety or the environment, or if the well is no longer capable of producing oil or gas in paying quantities' (30 C.F.R. § 1711).

[54] Federal law specifies that 'the well must be permanently plugged, and the plug must provide downhole isolation of hydrocarbon zones, protect freshwater acquifers and prevent migration of formation fluids within the well bore or the seafloor' (30 C.F.R. § 250.1714).

[55] 30 C.F.R. § 250.1712.

[56] 30 C.F.R. § 250.1729.

[57] NTL 2016-N01 sets out that the BOEM shall determine the amount of self-insurance an operator is allowed to use, based on an analysis of its financial capacity, projected strength, business stability reliability and record of compliance with federal OCS obligations.

law is, for the time being, the sole legal source providing for rehabilitation of drilling facilities rather than their removal. While other regulations worldwide set removal as the standard approach and only allow for partial removal – or at best, abandonment – in exceptional circumstances, companies operating in the Gulf of Mexico enjoy an additional possibility. The re-use of equipment under the Rigs-to-Reef program, for which federal law has created a detailed framework of implementation. Rigs-to-Reef programs represent an exception to the standard requirement for removal, whereby the facilities are donated to a coastal state for re-use as an artificial reef, rather than being dismantled and brought to shore. Not all platforms qualify for being turned into artificial reefs, and the conditions for activating the procedure are set out under BSEE decommissioning regulations;[58] if the facility qualifies for the program and obtains the permit from the US Army Corps of Engineers, it is donated to the coastal state for rehabilitation, which implies that the original owner ceases to have liability over its monitoring. This condition indeed creates an incentive for operators to apply for Rigs-to-Reef programs, as by donating the infrastructure they give up their decommissioning obligations, with considerable cost savings. Therefore, US decommissioning regulation does not only allow for more sustainable alternatives to full removal of facilities through the development of Rigs-to-Reef programs; it also creates economic and legal incentives for its implementation, as donators cease to be responsible for the correct management and preservation of facilities and save considerable costs on decommissioning.

4.4 Sustaining the cost of decommissioning

4.4.1 *Addressing companies' financial distress* [59]

On August 2012, ATP Oil and Gas Corporation filed for bankruptcy for its Gomez Properties in the Gulf of Mexico, claiming that the decrease in oil prices and the complications created in the area as a consequence of the Deep Horizon blowout had provoked disastrous effects on the company's revenues. The Gomez properties consisted of a floating offshore platform with a combined network of wells and gathering facilities; as ATP's business mainly concerned the ownership and operation of such platform, filing for bankruptcy could potentially allow the company to abandon the structure and give up its decommissioning obligations. The first option contemplated in order to deal with ATP's bankruptcy was the sale of its assets in order to gather the necessary financial resources to provide for decommissioning. The US Department of Interior (DOI) initially intervened in the bankruptcy proceedings against this option, arguing that the sale would not raise sufficient funds to cover the company's decommissioning obligations. However, this objection was

[58] 30 C.F.R. § 250.1725 and 250.1730

[59] E. Ripley, E. Roché, 'Offshore Decommissioning Liability and Bankruptcy' (2017), *Law360*.

eventually withdrawn when Bennu Oil & Gas LLC became the ultimate purchaser, committing $44.25 million in a trust devoted to sustaining ATP's decommissioning costs and administered by the Bureau of Ocean Energy Management. The sale of ATP's assets continued to be opposed by Fortune Natural Resources Corporation, one of ATP's co-lessees, based on the argument that the sale would only cover obligations in which ATP was solely liable, while it would not account for its decommissioning obligations to other co-lessees. The Bankruptcy Court, however, overruled Fortune's objection and proceeded with the sale.

ATP's experience shows that insolvency is a tangible threat to companies' capacity to sustain the costs of decommissioning, especially in a situation of decreasing oil prices. The main source of this controversy in the offshore oil and gas sector is given by the finite lifespan of drilling platforms. As reservoirs are limited in the amount of resources they can provide, the standard productive capacity of extractive facilities ranges between 20 to 30 years, after which they cease to operate and need to be removed. As a consequence, while companies in other sectors normally only incur fixed set up costs with negative cash flows at the beginning of their activity, oil and gas companies also need to take into account a final fixed cost for decommissioning, which will also occur at a time when they will not enjoy positive revenue streams anymore. The main rationale for regulating financial disclosure in the oil industry is represented by the necessity to develop adequate control mechanisms to prevent, or at least reduce, financial risks associated with extractive activities.

Risks inherent to the oil and gas sector include the fact that drilling platforms involve a long-term investment spread over two or three decades, which determines a higher potential that changing external circumstances will have an impact on operations; moreover, oil prices are particularly sensitive to geopolitical conditions, provoking continuous price fluctuations. In the worst-case scenario, the possibility exists that an operator incurs financial difficulties during the management of the business and becomes insolvent. Therefore, it is necessary to foresee a bankruptcy scenario and determine the course of action in that case. Even when companies are in healthy financial conditions, regulators should take appropriate steps to ensure that sufficient monetary resources are saved while positive cash flows are still being generated, and that will be used to sustain the final cost of decommissioning.

Guaranteeing the financial stability of operators demands careful consideration in terms of financial disclosure requirements. Regulators need to determine what financial information should be supplied by companies and what indicators are relevant in order to regularly assess their future capacity to deal with decommissioning obligations. Second, regulators need to establish the most effective system for providing sufficient funds to be set apart in preparation for decommissioning.

At the same time, however, performing financial disclosure can become a costly and time-consuming activity, whereby disclosure requirements should be envisioned in a way that does not constitute an overwhelming burden on companies. The following sections report the examples of two countries that dealt with the issue of decommissioning financial assurance extensively – namely, the UK and Norway.

4.4.2 *Example 1: Decommissioning Security Process in the UK*[60]

Decommissioning in the United Kingdom is regulated by the Petroleum Act of 1998, amended by the 2008 Act, which establishes that all former and current co-licensees should be jointly and severally liable for decommissioning costs. In order to manage the overlapping liability that the Petroleum Act requirements create, the industry has developed Dispute Security Agreements (DSA),[61] whereby each co-licensee commits to regularly deposit a given amount of money or security into a trust devoted to sustaining the cost of decommissioning once the platforms cease to operate. The trust is also meant to cover the obligation of a party in the eventuality where it incurs financial distress at any time during the management of the business, which would otherwise prevent it to participate to the cost of decommissioning in the absence of the trust.

Oil and Gas UK, the leading representative body for the offshore oil and gas industry in the United Kingdom, also created a standard format for DSAs as well as guidance notes to establish common industry practices. The standard format takes the name of JOA and is based on the conditions that: (1) parties enter the DSA before they submit the plan for development of the field, and (2) each of them will commit to pay a security to a fund, held until the moment of decommissioning. The share that each participant should pay every year, as determined by the standard DSA, is calculated as the best estimated costs of performing all decommissioning activities – also taking into account a risk factor – minus the expected net receipts from the field and the amount of security already provided by the participant. [62]

Standard DSAs represent a valuable form of support for addressing decommissioning financial assurance and creating a coherent system for its management. They provide assurance that the financial resources to address decommissioning exist, decreasing the risk that operators will not be able to sustain the cost once they do not enjoy positive revenue streams anymore. They also provide a form of assurance for participants themselves, that they will not have to sustain the costs of other co-lessees' decommissioning obligations, as the calculation of each participant's contribution takes

[60] B. Holland, 'Decommissioning in the United Kingdom Continental Shelf: Decommissioning Security Disputes' (2016), *Denning Law Journal*.
[61] Ibid. 20.
[62] Ibid. 23.

into consideration their financial stability. Nevertheless, disputes still arise as to how the estimated costs, as well as participants' net cost and value used for the evaluation of fund securities should be calculated. For example, as oil prices fall, larger participants may require additional security from financially weaker partners to ensure that they will actually be able to provide for their part of funding; to that end, they might aim to review the way decommissioning costs are estimated. Smaller participants, on the other hand, may not always be in the conditions to provide additional securities, especially at a time when they are already experiencing financial distress as a result of falling oil prices. One way in which the U.K. has tried to solve the issue of co-lessees' diverging incentives is through expert determination: in that case, when the operator submits the proposed plan for approval under JOA, the highlighted disputes may be subjected to review by an expert, who will also be engaged with independent assessment of the cost estimation provided by the operator.

4.4.3 *Example 2: Norwegian decommissioning tax treatment* [63]

The US and UK, whose cases were analysed in the previous sections, share a similar approach to decommissioning cost, in that they foresee full liability of operators to sustain its payment. The Norwegian experience can provide an interesting addition to the analysis, as it offers a different perspective. The Norwegian government, in fact, generally contributes to decommissioning costs to a large extent. Other reasons why it might be worth diving deeper in this case include Norwegian authorities' records for high environmental standards, as well as the fact that Norway possesses many of the largest drilling infrastructures in the world – implying more complex and expensive decommissioning procedures.

In general, the procedures for decommissioning largely reflect the ones diffused in other countries. Operators are required to prepare a detailed decommissioning plan to examine and evaluate different options, and eventually come up with a preferred alternative. The plan is then submitted to the government, reviewed by the Ministry of Petroleum and Energy, and circulated to environmental and fisheries organisations to receive their views. The ultimate decision will reflect the views of all stakeholders involved, and will probably establish a solution which lies between their different interests. What is peculiar about the Norwegian approach, however, is the treatment of decommissioning costs. Probably as a compensatory measure to balance the severe tax regime that companies have to sustain for the whole duration of activities – the oil and gas industry is subject to a marginal corporate income tax of 78 per cent – the Norwegian government provides for the payment of a large share of costs incurred in the phase of installations' removal. In particular,

[63] P. Osmundsen, R. Tveterås, 'Decommissioning of petroleum installations – major policy issues' (2003), *Energy Policy*, 1582-1584.

the state's share of contribution to removal costs will be paid directly to companies when the moment for decommissioning comes; the state's contribution is evaluated on a case-by-case basis and equals the average effective corporate income tax rate that the company has paid on the net incomes from the field during the management of operations. This implies that if the company has been in a good financial condition for the entire period of operation, and has thus been able to regularly pay taxes all along, the state's share will amount to up to 78 per cent. Exceptions are also foreseen to this cost-sharing rule, whereby if the estimated state share is unreasonably low, the operator may apply for its revision in order to increase it; in this case, the company's future tax position is taken into consideration in order to proceed with the calculation of the revised state share.

The point might be raised that state support to sustain the cost of decommissioning might represent a negative incentive towards more hazardous behaviour on the side of operators; knowing that the government will provide financial resources to pay for removal anyway might create a moral hazard for companies and discourage them from saving the appropriate funds for their portion of costs. However, given that the share provided by the state depends upon tax contributions committed by the company during the whole duration of activities, this scenario is quite unlikely, as operators will need to maintain a good financial position anyway in order to regularly pay taxes. Besides, there are several advantages related to the Norwegian cost-sharing rule for decommissioning. First, this approach helps cushion the risk of insolvency of operating companies and ensures that appropriate financial resources are set aside to provide for its payment. Second, it avoids distortion in companies' behaviour, which might result from incentives to shut down production early, while they are still experiencing positive incomes, in prevision of removal costs. Third, as the government contributes to a large portion of decommissioning costs, removal might be carried out with more attention towards preservation of the environment rather than just trying to find the cheapest alternative. Therefore, the cost-sharing rule between companies and the state might be a valid alternative to provide an approach which allows higher absorption of financial risks and, at the same time, provides a more environment-centric perspective.

4.5 Key lessons from resounding cases in the public opinion

4.5.1 *Monitoring challenges: the Deepwater Horizon accident*

The Deepwater Horizon blowout which occurred in April 2010 is remembered as the most severe accident ever occurred in the offshore oil and gas sector: an explosion which provoked 11 fatalities, 17 injuries and disastrous consequences on the surrounding environment that can still be observed today. The Deepwater Horizon Rig was situated in the Macondo oil prospect off the Mississipi

Canyon coasts; at the time of the accident, it was owned and operated by the offshore oil-drilling company Transocean and leased by the oil company BP. It was an exploratory well meant to assess the presence of extractable hydrocarbons and associated reservoir structures in the area; although it was originally planned for a total depth of 19,650 feet, drilling was eventually halted at a total depth of 18,360 feet, as it was decided to temporarily abandon the well and maintain it for future oil and gas production. In order to prepare the well for temporary abandonment, a concrete core was installed to seal the facility for later use: on the night of April 20, a surge of natural gas blasted through the concrete core, provoking the explosion of the well. The fire continued to be fed by the hydrocarbons spilling from the well for 36 hours until the rig eventually sunk, but hydrocarbons continued to flow from the reservoir for 87 days, causing the largest oil spill in human history.[64]

Temporary abandonment of a well is a standard practice in order to provide the operator with the time to install the infrastructure needed for production; at this stage, sealing the well properly is critical to prevent the occurrence of hydrocarbon flows during the time of temporary abandonment, and is usually done through cement liners as well as additional cement or mechanical plugs that provide multiple barriers to hydrocarbon flows. Leaked documents later on revealed that BP had already experienced a similar accident on a rig in the Caspian sea in 2008: similarly to the Macondo case, the cement used for the sealing cores was too weak to withstand hydrocarbons' pressure, being composed of a concrete mixture where nitrogen gas was used to accelerate the process.[65] Forensic analysis completed in the following years revealed serious weaknesses all along the process, both before the explosion and during emergency procedures. The studies carried out after the accident highlighted: (1) the weak cement design of the sealing system, as well as its inappropriate testing, quality assurance and risk assessment; (2) the delayed and inappropriate intervention when the fallacy was detected, revealing insufficient and superficial planning of emergency procedures; (3) the malfunctioning of the Blowout Preventer (BOP) mechanism designed to prevent oil spills, which was supposed to close the channel through which oil is drawn.[66]

The Macondo well explosion caused both a human and environmental disaster. Eleven people working on board of the platform lost their lives, and about 4 million barrels of crude oil spilled into the ocean for three consecutive months, leaving a 100 miles wide oil layer on the surface of the ocean. The surrounding ecosystem was irremediably damaged, with both marine and coastal species

[64] National Academy of Engineering and National Research Council, 'Macondo Well Deepwater Horizon Blowout: lessons for Improving Offshore Drilling Safety' (2012), *The National Academy Press*.
[65] R. Pallardy, 'Deepwater Horizon oil spill natural disaster, Gulf of Mexico' (2020), *Britannica.com,* https://www.britannica.com/event/Deepwater-Horizon-oil-spill (Accessed 8 May 2021).
[66] Incident investigation team, 'Deepwater Horizon Investigation Report' (2010), *Deepwater Horizon*.

being affected by the oil spill.[67] Besides the huge ecosystem deterioration, the spill also had disastrous consequences over the fishing and tourism sectors – with an overall loss of around $700 million – and on the extractive sector itself, where about three-thousand people lost their jobs as a result of the 6 months standstill period imposed on offshore drilling activities during investigations.[68]

The Deepwater Horizon accident is a manifest demonstration of how delicate operations around drilling facilities can be, and of the dramatic effects that can result if these operations are not carried out with an appropriate level of care. In fact, the accident shed light over a certain amount of negligence concerning both safety assessments of the well's conditions, and inadequate planning of emergency mechanisms and procedures. One of the main challenges in the offshore extractive sector hence implies development of efficient and strict monitoring systems, that can ensure proper maintenance of safe conditions around drilling facilities in order to avoid that similar human and environmental disasters will repeat in the future.

4.5.2 *Addressing reputational risks: the Brent Spar experience* [69]

The management of offshore drilling facilities often attracts a great deal of public attention, as an effect of the relevant environmental and safety concerns involved. Decommissioning and disposal of exhausted platforms is no exception in this respect. Important safety issues are at stake, as decommissioning processes imply the manipulation of delicate components with consistent explosive dangers; besides, the selection of the most appropriate course of action will also need to take into account environmental concerns. For instance, environmental associations generally tend to defend their position that, at the end of a platform's life, the conditions of the surrounding ecosystem should be restored as they were prior to the settlement of the installation. All these factors require careful consideration because of the critical consequences they might have on the reputation of the company involved.

The Brent Spar experience is a prominent demonstration of how reputational risks belong to the set of challenges that need to be addressed in the context of the redefinition of decommissioning regulation. The Brent Spar installation was taken out of operation in 1991 after about 15 years of activity in the Shell/Esso Brant field in the North Sea. After the halt of production, several studies

[67] 'Environmental Impact of the Deepwater Horizon Oil Spill', *National Environmental Trainers,* https://www.natlenvtrainers.com/blog/article/the-environmental-impact-of-the-deepwater-horizon-oil-spill (Accessed 8 May 2021).
[68] V. Neri, 'Il disastro della Deepwater Horizon. Cosa è successo, le cause e i responsabili' (2019), *Lifegate.it,* https://www.lifegate.it/deepwater-horizon-disastro-ambientale#animali (Accessed 8 May).
[69] Shell United Kingdom, 'Brent Spar Dossier', https://www.shell.co.uk/sustainability/decommissioning/brent-spar-dossier/_jcr_content/par/textimage.stream/1426853000847/32a2d94fa77c57684b3cad7d06bf6c7b65473faa/brent-spar-dossier.pdf (Accessed 8 May).

were undertaken in order to determine the most correct alternative for the platform's disposal. The analyses underlined a low toxic impact of the facility, whereby the Best Practicable Environmental Option (BPEO) would be its deep-water disposal at a site in the Northern Atlantic; Shell argued that deep-water disposal would have negligible impacts over the environment, while the safety risks associated to its onshore disposal were calculated to be up to six times higher. The BPEO was publicly approved by the UK Government in February 1995, and both the European Union and the twelve signatory states to the Oslo Convention for the protection of the environment were informed of the decision. Nevertheless, the decision was followed by exceptional public demonstrations, as the idea of infrastructures' dumping at sea was perceived by some environmentalist groups as a further element of disturbance for the marine environment. Although the proposed BPEO had received the official approval of both the UK government and international institutions, its involvement in public disputes was having damaging effects over Shell's reputation; this is why the company decided to change its approach in a way that would allow them to gain public support. Shell UK launched an initiative called 'Our Way Forward', meant to find an alternative solution through wide engagement and consultation of the public. A bid was organised to find the BPEO, and the project was eventually awarded to the British-Norwegian consortium Wood-GMC. As Stavanger Port Authorities were already planning to build a quay extension at Mekjarvik, cut and cleaned ring sections of the Brent Spar's buoy's hull were recycled to form the base of this new quay.

The new solution which Shell was forced to undertake as an effect of public contestations raised Brent Spar's total decommissioning costs from an initial estimate of £21.5 million to a final figure of £60 million. Moreover, even though the impact on the local environment was negligible, the second BPEO implied the destruction of the large amount of cold water coral which had formed on the installation itself – a damage which would be avoided with the original plan of deep-water disposal. Shell's experience shows the consistent reputational risks that companies might face at the decommissioning stage; most importantly, this case suggests that widespread beliefs in the public opinion might even force companies into solutions which are not the most cost-effective and beneficial from an environmental point of view. Environmentalist groups that intervened in Brent Spar public contestations, in fact, supported the view that removing the structure would bring the environment back to its original status, but they disregarded the fact that the prolonged presence of facilities often induces a permanent change in the surrounding ecosystem. Platforms often become the support of new ecosystems – for example, the cold water corals that had formed on the Brent Spar structures – which are disrupted once their fulcrum is removed. In this way, the surrounding environment suffers a double pressure: the first, on the original conditions which are disturbed by the instalment of drilling facilities, and the second, on the new equilibrium which has developed around the facilities and which is again affected by their removal. Hence, not only is it unlikely that the original ecosystem actually restores to its original conditions after platforms' removal, but additional damages are caused on the new equilibrium which has developed with their presence.

The Brent Spar experience importantly sheds light over two considerations. The first being that a redefinition of the decommissioning regulatory regime needs to take into account the pressure of reputational risks among the set of incentives that drive companies' decisions. Secondly, in cases where public considerations drive companies' behaviour towards suboptimal solutions, an intervention might be needed on the side of regulators to redefine public perceptions and create higher awareness of what are the actual effects of given solutions. For instance, in the context of Brent Spar contestations, public institutions could have intervened in the debate explaining the reasons that made the first BPEO the optimal alternative, both from an environmental and an economic point of view, establishing a form of support towards Shell to withstand the pressure of reputational risks.

Chapter 5

Proposing a toolkit to promote sustainability of decommissioning processes

5.1 A revised regulatory framework

5.1.1 *An international treaty on decommissioning with an environmental focus*[70]

This section reviews the considerations about the current regulatory landscape in terms of the environmental aspect of decommissioning; it is aimed to provide an integrated analysis of the major gaps and discuss possible alternatives to address them. The negative consequences of water pollution and seabed disruption on marine ecosystems are not simply phenomena confined to specific countries, but diffused challenges at global level. Although platforms might be localised in specific areas, natural habitats work and survive in a complex network where distinct ecosystems and the elements within them interact and influence each other. For this reason, even though drilling and decommissioning activities might directly damage a single ecosystem, their effects might indirectly reflect over other habitats through multiple events with global consequences over the long-term. Moreover, as strictness of regulatory requirements varies across countries and regions, companies might engage in regulatory arbitrage and concentrate in those areas where rules are laxer. For the time being, key international instruments for regulating decommissioning are the UNLCOS and IMO Guidelines. These instruments, however, are only ratified by a minority of oil producing countries and even for their signatories, they only provide soft law mechanisms which are by no means enforceable; besides, they mostly focus on regulating the operative phase of extractive activities, while they largely disregard their end-of-life. The few and dispersed provisions referring to the decommissioning stage mostly refer to matters of navigational safety, while the sustainability character of decommissioning is, at best, mentioned.

A reform proposal would be to develop a unified, comprehensive international treaty on decommissioning with a specific view to its environmental character. An international treaty of this kind should, first of all, delineate an agreed definition of environmental damage and, accordingly, what is the maximum tolerable level of risk that can be accepted at any time. This would enable the definition of minimum safety standards, guaranteeing at least a minimum level of safety and protection to be applied internationally. Minimum regulatory standards already exist under UNCLOS, whereby signatory states are expected to define regulations which are not less strict than international rules; however, international standards are not clearly and explicitly stated and defined. Moreover, once standards are set, an ad-hoc authority should be entitled to actually assess

[70] 'Overview of International Offshore Decommissioning Regulations (2017), International Association of Oil & Gas Producers, Report 584, 26-43.

whether countries display sufficient effort to conform their regulations; enforcement mechanisms should also be expressed in the form of sanctions or commercial retaliation when countries display insufficient commitment to regulate decommissioning in an environment-effective way. Based on the agreed definition of environmental risk, common parameters and indicators should also be developed to create the premises for effective and objective monitoring, therefore supporting the activity of the supranational authority designed for overseeing countries' regulatory effort. Finally, current international provisions seem inadequate to establish favourable conditions for the ideation of sustainable alternatives to decommissioning; current requirements establish platforms' dismissal as the standard procedure to be followed, while full removal in some cases might determine a major damage on the surrounding ecosystem. A further effort is needed in order to create a regulatory environment which does not force companies into removal of installations when it is not the safest and most effective possibility, but is conducive and supportive to the development of creative options for reuse.

Although it might be challenging to establish hard law mechanisms and ensure compliance with standards defined at supranational level, a treaty focused specifically on the matter of sustainability of decommissioning would represent a step forward compared to the current regulatory situation, which appears superficial and piecemeal. It would be especially useful to guide countries' regulatory approaches and reduce the risk of environmental damage by ensuring a minimum level of safety, and it would help foster an international trend towards higher regulation of the sector. Finally, on the one hand it could be an opportunity to create incentives for companies' innovativeness, representing a benefit for the extractive sector in general; on the other, international trends towards sustainability could have positive spillover effects on the other sectors that rely on marine resources.

5.1.2 *Stricter requirements at national level* [71]

Soft law mechanisms and guidelines at international level need to be integrated with exhaustive and detailed hard laws at regional and national level. Given the high safety and environmental risks inherent to extractive activities, national requirements need to address comprehensively the whole oil and gas supply chain, from platforms' installation to their removal. Besides, only national authorities have the right amount of specific knowledge and awareness of environmental conditions of their seas and coasts which is necessary to draft effective regulations. The matters that regulatory authorities at national level need to face mainly concern establishing the allocation of

[71] Ibid. 45-46.

responsibilities for decommissioning and setting up effective systems of monitoring and enforcement. In this respect, the elements that especially require careful consideration are ex-ante planning and financial assurance of decommissioning.

Concerning ex-ante planning, stricter regulatory requirements need to be introduced so that at the time of submitting a project – before the installation of facilities begins – companies already provide an idea of how their platform will be treated once it becomes inoperative. It is true that, given the long lifespan of a platform, operators might adjust their plans based on possible occurring innovations during the years, but it is important that they guarantee minimal environmental damage on a preventive basis anyway. In this respect, it is critical that countries leverage on the parameters and indicators created internationally in order to develop structured Environmental Impact Assessments, that allow to effectively assess decommissioning plans and monitor the procedures that are executed. Moreover, countries located in the same region should make an extra effort to harmonize their procedures and provide homogeneous monitoring over the maintenance of a good environmental status of the basins they share. For instance, the project 'HarmoNIA', carried out in the Adriatic-Ionian area, suggested a methodological proposal to reach a harmonized implementation of procedures of assessment and monitoring of decommissioning impacts.[72] The proposed approach is composed of two main elements: (1) the adoption of a common EIA report template, including indication of the minimum information required, and (2) a common EIA strategy for chemicals discharge, comprehensive of limits of particular pollutants concentrations. The plan should then be subject to continuous monitoring, based on the structured definition of the following factors: survey area, sampling phases, sampling design, matrices and parameters to investigate, and sampling frequency. Continuous monitoring should be articulated in three phases: (1) pre-project survey to define baseline values of environmental conditions, (2) monitoring during the project to identify possible alterations in the surrounding environment, and (3) post-project assessment of trends of possible alterations over a longer time frame. The methodological proposal developed under the HarmoNIA project represents a concrete example of how countries could handle EIAs more effectively and coordinate their actions at regional level to ensure high standards of environmental protection.

The second topic that needs to be addressed is the creation of financial assurance systems for sustaining the costs of decommissioning. As emphasised in section 4.4, there are two main alternatives national authorities can contemplate. The first option is the one currently adopted by most countries and which corresponds to the U.S. and UK example – namely, the owners of the

[72] L. Manfra et al., 'Challenges in Harmonized Environmental Impact Assessment (EIA), Monitoring and Decommissioning Procedures of Offshore Platforms in Adriatic-Ionian (ADRION) Regions' (2020) *Water,* 5-8.

platforms are fully liable for decommissioning operations, and as such they should sustain the costs of it. In this case, the issue of financial disclosure arises: national authorities should regularly monitor the financial situation of operators and ensure that they are in the conditions to sustain decommissioning costs at the end of extractive activities. The second option is represented by the Norwegian example, whereby the state partially contributes to the financing of decommissioning. In this case, assessing the financial wellbeing of operators is less problematic, as the state's contribution is directly proportional to the taxes paid by the company during the years of activity. Given that the issue of financial disclosure mainly concerns the first case, a possible approach to assess financial solidity of companies, and at the same time minimise the effort needed for monitoring, is here proposed. Direct monitoring based on financial disclosure would require considerable effort on the side of both companies and national authorities, while possible solutions for indirect monitoring could be explored. For example, sovereigns could consider the possibility to set up a system similar to the Decommissioning Security Process which is used in the UK, with the distinction that it could be managed by national authorities rather than being left to private contractors. The Decommissioning Security Process in the UK is based on Dispute Security Agreements signed by contracting parties, that agree to save the necessary resources for decommissioning by regularly contributing security deposits to a common fund.[73] This, however, is an optional choice operated by private parties who are jointly liable for the facilities, and that decide to use DSAs as form of assurance that each party will contribute to their share of responsibility. States could adopt a similar mechanism, making the creation of a decommissioning fund mandatory rather than leaving the choice to the discretion of operators; in this way, instead of engaging into costly and time-consuming monitoring of companies' financial performance, national authorities could simply assess on a regular basis whether contractors have deposited their contributions to the fund.

To conclude, a possible reform to create a more effective normative framework would imply synergies between supranational and national systems. The supranational one, implemented through an international treaty and based on soft law mechanisms, would provide minimum standards of environmental protection, supported by the development of common indicators and parameters. Supranational institutions would verify that national regulatory requirements comply with international sustainability standards, and enforcement mechanisms could be contemplated in the form of sanctions or commercial retaliation. On the other hand, national systems should introduce clearer and more structured systems of monitoring and enforcement, especially with respect to ex-ante planning and financial assurance of decommissioning.

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[73] Holland, 20.

5.2 Supporting the development of a decommissioning industry

5.2.1 *Trans-national cooperation to foster development: the EU framework*[74]

Besides redesigning the normative framework at national and supranational level, a variety of initiatives could be promoted in order to inscribe the development of the decommissioning industry in the circular economy. The EU blue growth strategy does not apply directly and specifically to decommissioning, but it might provide a valid inspiration for a trans-national approach applicable to it. The strategy was adopted by the European Commission in 2012 and it represents the current long-term policy to stimulate economic maritime activities. The innovative feature of the EU strategy is that it does not aim at introducing new legislation, but it rather targets a set of key enabling actions to support the development of the maritime sectors.

The first enabler is Maritime Spatial Planning (MSP), a key instrument of Integrated Maritime Policy aimed at managing waters more efficiently and avoiding conflicts between sectors, a necessity which emerged as a result of increased competition for maritime space between different blue maritime sectors. Being regulated by a specific directive,[75] MSP is also supported by a website serving as a platform for exchange of expertise – including projects and practices, as well as solutions for conflict – and a handbook for guiding its implementation on the side of Member States. For instance, growing competition is emerging in the Baltic and North Sea where operators in the fisheries sectors express critical concerns in terms of ship accidents, loss of access to traditional fishing grounds and habitat alteration resulting from the presence of offshore wind facilities. In this respect, possible MSP solutions concern prevention – by considering fisheries prerogatives when planning wind facilities' installation – as well as mitigation – such as, taking into account the fishery season in the construction phase or allowing transit of fishing vessels in the proximity of offshore wind farms. MSP therefore allows a more coherent approach to overall planning of maritime areas, fostering collaboration between sectors and stakeholders as well as cross-sectoral synergies. Furthermore, it is indeed an enabling action that could easily apply to drilling facilities, allowing a more mindful approach with respect to its competing blue sectors.

The second enabler is represented by the institution of marine protected areas, and it is considered the environmental equivalent to the economic pillar of Maritime Spatial Planning. Their determination is specified under the Marine Strategy Framework Directive,[76] which was adopted in 2008 and defines the legal framework for EU action in the field of marine environmental policy.

[74] F. Scholaert, 'The blue economy – Overview and EU policy framework' (2020) *European Parliamentary Research Service,* 2-8.
[75] Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning.
[76] Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive).

The main objective of the Directive is to achieve a good environmental status (GES), whereby Member States are required to assess the initial state of marine waters on the basis of eleven qualitative descriptors, used to determine what can be considered a GES and establish feasible national action plans. For instance, Sweden decided to develop a national warning and response system, that will alert authorities immediately when a new non-indigenous species is identified, triggering immediate response measures for eradication or control. A similar mechanism could be easily adopted for drilling facilities, in order to keep track of the changes that occur in the ecosystem when platforms are built.

The third enabler consists in fostering research and innovation. The 2008 framework includes a strategy for maritime research based on capacity building through new infrastructure and the promotion of research skills, better integration across research disciplines and finding synergies between Member States, regions and industrial sectors. Several projects have received funding through EU research programmes, for a total contribution of around €338 million.[77] Some of the initiatives launched focus specifically on fostering marine research cooperation across regional sea basins, in order to coordinate all marine research and innovation activities and connect the research community, policy makers, the private sector and civil society. Initiatives of this kind have been introduced in the Baltic, Mediterranean and Black Sea; also an Atlantic Ocean Research Alliance has been launched between EU, Canada and the United States. The Horizon Programme has also funded the institution of a European Institute of Innovation and Technology (EIT), an independent body with the aim of reinforcing the innovation capacity of Member States in order to encourage sustainable economic growth. This is realised through knowledge and innovation communities, that are large-scale integrated European partnerships involving innovation stakeholders such as research organisations, educational institutions, public authorities and businesses. Similar knowledge networks specific to the extractive sector could be created, as they would generate solid support for research and innovation in the field of decommissioning, leading to expanding knowledge about more sustainable alternatives.

Finally, a fourth enabler which is set out in the European framework and could also be exploited in the area of decommissioning is integrated maritime surveillance. The objective is to create a common information-sharing environment among Member States; the digitalisation of maritime information sharing can provide authorities involved in maritime surveillance with ways to exchange information and data. In the extractive sector, information sharing would allow to assess the conditions of the marine environment on a real-time basis, enabling prompt reactions in the case where anomalies are detected.

[77] Ibid. 6.

5.2.2 *Data integration to support monitoring and development*

One of the key premises for the correct management of decommissioning operations is the availability of data about the environmental conditions of the interested region. The collection of this sort of data is fundamental for environmental assessment and monitoring; it can provide information about the characteristics of the seabed, which is essential in order to determine the most appropriate approach, and it can help predict ocean flows and weather conditions that could affect operations. Data collection activities are undergoing a process of profound digitalisation; as a result, considerable advancements are being produced, which offer a promising perspective also for the decommissioning industry.

Jones et al.[78] explain the benefits of new trends in autonomous environmental monitoring. Marine autonomous systems consist of unmanned, self-contained systems used to monitor the marine environment, which are experiencing considerable development towards sophisticated particle sensing and capturing instruments. As a result, traditional methods of maritime monitoring are gradually being replaced by automated techniques offering the potential of enhanced data collection and substantial efficiency gains. In fact, it is argued that while traditional methods may remain non-substitutable for some parameters that still require physical sampling, automated data collection offers a valuable alternative for cost-effective, long-term and large-scale monitoring programmes. Marine autonomous systems can provide large quantities of high-quality data using acoustic, visual and oceanographic sensors; besides, given the large dimension of datasets, as well as the variety of data included – not only being of different nature (acoustic, visual, etc.), but also being collected in different moments, with distinct vehicles – quality control is crucial. Rigid systems for assembly, storage, registration, dissemination and permanent archives of data collections are necessary for monitoring data. In this sense, institutions could intervene to promote the development of automated approaches for post-collection quality control of data and establish standard practices for their management. Moreover, operations of automated monitoring tend to be most effective when they combine multiple systems as an observation network to achieve a comprehensive view of the environment;[79] hence, national authorities could also cooperate in order to guarantee large-scale integration of ocean data. A framework has also been proposed to create data support specifically for waste management after decommissioning.[80] Data management is not only essential to support decisions about the most appropriate way to remove platforms, but also to

[78] D.O.B. Jones, A.R. Gates, V.A.I. Huvenne, A.B. Phillips, B.J. Bett, 'Autonomous marine environmental monitoring: Application in decommissioned oil fields' (2019) *Science of the Total Environment,* 835-848.
[79] Ibid. 846.
[80] A.G Akinyemi, M. Sun, A.J.G. Grey, 'Data integration for offshore decommissioning waste management' (2020) *Automation in Construction,* 1-15.

define their reuse: assessment of decommissioned items is necessary to establish how they could be recycled, and hence to advance the oil and gas' industry transition towards the circular economy. This type of assessment relies on data collected over the whole lifetime of facilities, which implies a high degree of heterogeneity. The contribution of the literature in this sense has been to define data management systems that are able to access heterogeneous data sources, manage large quantities of data in a variety of formats, and carry out data analytics. This facilitates the assessment process by providing an integrated set of relevant information that can be used by operators to determine the most convenient course of action; depending on the physical conditions of the decommissioned item, the available set of options will range from material recycling, to components re-use or sub-components repair and re-use.

The European Union has been particularly active in fostering the collection and integration of marine data, and initiatives of this sort are a substantial component at the heart of the marine knowledge 2020 strategy.[81] Based on the premises that effective management of marine data can be critical to stimulate innovation, lead to the development of new services and reduce uncertainty about the state of the seas and the oceans, three main initiatives have been promoted. The first is the new Data Collection Framework,[82] requiring Member States to systematically collect, manage and make available fisheries and aquaculture data to form the basis for best available scientific advice. These include biological data, statistics on fishing activities, as well as economic and social data, compiled by the Joint Research Centre and analysed by the Scientific, Technical and Economic Committee for Fisheries – an advisory body associated to the implementation of the common fisheries policy. Although this program focuses specifically on the fisheries sector, similar initiatives could be promoted with a specific target towards decommissioning. Secondly, the European Marine and Observation Data Network (EMODnet) has been established in order to address integration of heterogeneous data at European level, aiming to collect and process large quantities of data in order to make them freely available. The third component of the new marine knowledge strategy is represented by Copernicus, the EU satellite earth observation programme, which also includes a service related to the marine environment and provides information about dynamics of the oceans and the conditions of marine ecosystems – including data on currents, winds and sea ice. The use of satellites provides a key contribution to improve ship routing services, addressing water pollution, monitor climate change and control fisheries. The significant value delivered by the use of satellite information has been specifically applied to decommissioning

[81] European Commission, 'Green Paper: Marine Knowledge 2020, from seabed mapping to ocean forecasting' (2012), Publications Office of the European Union.

[82] Regulation (EU) 2017/1004 of the European Parliament and of the Council of 17 May 2017 on the establishment of a Union framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy and repealing Council Regulation (EC) No 199/2008.

through the initiative recently launched by the European Space Agency.[83] ESA launched an invitation to tender to assess the technical feasibility and commercial viability of satellite-based services in support of decommissioning of energy assets. It supplied funding opportunities for projects that would focus on exploiting satellite data to assist logistics and ensure safety operations, by monitoring environmental impact, supporting waste management processes, and fostering process optimisation through supply chain management.

Data about oceans, ecosystems and the conditions of the seabed can provide critical assistance for the management of decommissioning operations. Data sources of various kinds are already widely available, and new methods for their integration and processing are being searched for in the literature and developed extensively at institutional level – especially in the EU. The new experiences in the field of data integration can be considered quite promising, as its considerable evolutions could provide a fundamental contribution to the development of a decommissioning industry.

5.3 Extending platforms' lives

5.3.1 *Rigs to Reef programs*

A strategic solution to the issue of decommissioning might be represented by the reuse of platforms or their components in order to extend their life. Solutions of this kind are preferable from an environmental point of view for two main reasons. First, because they allow to avoid platforms' removal and all the environmental risks associated with the processes of dismissal. Secondly, they would help inscribe the oil and gas industry in the mind-set of the circular economy, where products do not have a finite, linear life, but rather enter a cyclical process that ideally extends their life indefinitely. The most diffused method for extending platforms' life today is represented by Rigs-to-Reef programs, which imply the re-use of drilling facilities to generate artificial reefs rather than their onshore removal. The United States have particularly focused on this alternative, developing extensive guidelines for state development of artificial reef programs in the Gulf of Mexico. The most active countries in this sense are Louisiana and Texas, whose Rigs to Reef programs are the largest in the world; the Louisiana Artificial Reef Program, established in 1986, has accepted over 120 platforms to create 83 artificial reef sites, while the Texas program established in 1991 has created over 35 reef sites from 73 platforms.[84]

[83] European Space Agency website, https://business.esa.int/funding/invitation-to-tender/decommissioning-energy-assets (Accessed 18 May 2021).
[84] M.J. Kaiser, A.G. Pulsipher, 'Rigs-to-Reef Programs in the Gulf of Mexico' (2005), *Ocean Development and International Law,* 2.

Rigs-to-Reef programs are based on the premises that the presence of platforms often determines a change in the surrounding ecosystem and favours the formation of artificial reefs on the installations themselves. This situation has been referred to in the literature as 'novel ecosystem',[85] whereby platforms determine an irreversible change on the marine ecosystem and encourage the emergence of completely new ones. In that case, platforms' removal could result in substantial damages, as it would provoke the loss of the ecosystem that has developed around them during their lifetime. The transformation of facilities into artificial reefs, on the other hand, provides significant ecosystem services[86] by giving the opportunity to preserve large part of the biological communities that inhibit the surrounding area, contributing to local and regional biological production. In fact, offshore platforms have been shown to provide higher fish biomass and enhanced fishing zones, as they seem to contribute to the overall productivity of the system by increasing species diversity and growth; for this reason, spot fishers and recreational divers generally are among the supporters of Rigs-to-Reef programs, and fishing and diving around offshore platforms is a major source of local tourism industries where it is allowed.[87] Besides, it also allows to save on decommissioning costs – therefore, under certain circumstances it can represent the most efficient option from both economic and environmental perspectives. On the other hand, trawl fishing represents one of the main controversies of maintaining facilities in place. In cases where platforms have become habitats for threatened species, trawl fishing is generally excluded from the area also after the platform becomes inoperative and is turned into an artificial reef; hence, Rigs-to-Reef programs face resistance from some stakeholders, such as operators in the commercial fishing industry. While the prevention of trawling might be detrimental to commercial fisheries, it is critical for the prevention of some endangered species, and social costs should be weighted against benefits in terms of environmental sustainability in order to come to a definitive judgement about rigs conversion to artificial reefs.

The extensive US experience in the Gulf of Mexico has inspired other countries around the world to consider the option of developing national programs for rigs conversion. For example, initiatives of this sort are being taken under scrutiny in Indonesia, where the issue of platforms' decommissioning is becoming pressing: Indonesian seas present more than 500 platforms, of which 70% are approaching the end of productive life.[88] A comparative analysis of various solutions

[85] S. van Elden, J.J. Meeuwig, R.J. Hobbs, J.M. Hemmi, 'Offshore Oil and Gas Platforms as Novel Ecosystems: A Global Perspective' (2019), *Frontiers in Marine Science,* 4.
[86] Ibid. 6.
[87] Ibid. 3.
[88] R.B.A. Nugraha et al, 'Rigs-to-Reef: A new initiative on re-utilization of abandoned oil and gas platforms in Indonesia for marine and fisheries sectors' (2019), *IOP Conference Series: Earth and Environmental Science*, 3.

applicable to dismissal of Indonesian platforms was carried out,[89] based on a set of measurable parameters – discount rate, duration of the program and cost-benefit analysis of economic feasibility. Evidence revealed that Rigs-to-Reef programs would be the preferable option, thanks to significant cost savings and the synergies that would be enabled with other maritime sectors; platforms' conversion to artificial reefs would create areas of fish concentration supportive for fisheries as well as the tourism sector revolving around diving activities. Feasibility studies concerning Rigs-to-Reef programs have instead yielded more pessimistic results for the North Sea.[90]

Due to differing environmental conditions in the North Sea compared to the Gulf of Mexico, converting existing structures into offshore reefs would not be conducive to prominent productivity increases in fisheries. In fact, the North Sea presents lower temperatures, deep waters and an industry which has a lower inshore component; it is estimated that the current presence of oil and gas platforms in the North sea only provides a habitat for approximately 1% of total commercial fish stocks.[91] Any significant socio-economic impact would only be achievable by targeting recreational markets – which is the case in the Gulf of Mexico – meaning that, given the remoteness of North Sea rigs, they should be transferred for significant distances closer to shore, incurring in substantial costs that would dissipate the potential benefits for economic operators. What can be deduced by such contrasting evidence is that productivity of artificial rigs highly depends on punctual morphological conditions; their beneficial effects and feasibility should be assessed on a case-by-case basis, also examining measurable productivity rates per area of inshore constructions against offshore ones.[92]

Despite differing evidence about conversion feasibility, both analyses on Indonesian and North Sea decommissioning agree over a critical point: Rigs-to-Reef initiatives cannot take place without solid regulatory support. In the former case, in the eventuality where the Rigs-to-Reef option is actually pursued, it will need to be inscribed into targeted programs that provide guidelines and a regulatory toolkit to manage operations of conversion. In the absence of policy guidance based on expert advice, the first risk is that operators exploit artificial reefs as a way to justify dumping of their materials, without a correct assessment of rigs proper conditions. Secondly, if the artificial reef site is not chosen correctly and is incompatible with the surrounding morphological characteristics, it might provoke damages to marine life in the vicinity. On the contrary, where artificial reefs end

[89] Ibid., 1.
[90] M. Dj Sayer, M. Baine, 'Rigs to Reef: A Critical Evaluation of the Potential for Reef Development Using Decommissioned Rigs' (2002), *Underwater Technology The International Journal of the Society for Underwater,* Vol. 25 No. 2.
[91] M. Baine, 'Rigs to Reef in the North Sea' (1995), *Proceedings of the International Conference on Ecological Systems Enhancement Technology for Aquatic Environments*, Volume 2, 507-512.
[92] Ibid. 95.

up attracting a considerable fish biomass, it could lead to overfishing if activities in the area are not adequately regulated.[93] As far as the North Sea case is concerned, a program of rigs conversion is quite unlikely to be endorsed in those regions without significant state intervention in terms of financial support and liability replacement.

5.3.2 *Other solutions for conversion*

Besides programs for rigs conversion to artificial reefs, a plethora of ideas is being tested for platforms repurposing or reuse of their components. Most basic proposals concern exploiting platforms with military purposes, with a role in ocean surveillance or as military bases. In particular, the feasibility of turning offshore facilities as points of support for the US Armed Forces helicopters has been assessed,[94] as almost any rig is equipped with helicopter decks which are stressed to accommodate large vehicles, and which are generally used to transport employees or light logistic support. Another possibility has been analysed in the context of the Marine Monitoring, Energy and Environmental Research, Science Education and Training (MMEERSET) project, which consists into converting offshore drilling facilities in the Gulf of Mexico into offshore research, monitoring and technology testing stations.[95] A more creative approach has instead been adopted in the case of the Seaventures Dive Rig off Malaysian coasts, where the oil platform has been redesigned as an offshore hotel and scuba diving platform.[96] Another set of solutions concerns the re-utilization of platforms in the production of renewable energy; these are being especially searched for in the North Sea, where Rigs to Reef programs are mostly unfeasible due to its morphological characteristics.

The first alternative focused on renewable energies is highly incentivized in Scotland, and it consists in diversification of oil and gas companies into offshore wind energy. A high degree of synergy between offshore wind and extractive activities has been detected, which can help companies in the oil and gas sector diversify into the offshore wind business once their platforms cease to operate. On the one hand, reuse of platforms' components to build offshore wind infrastructures would represent a possibility for operators in the extractive sector to reduce decommissioning costs; on the other, the offshore wind industry is open to cooperate with entrants from the oil and gas sector that can deliver the cross-sector expertise and capabilities which are necessary to reduce their set-up and operating costs. Several Scottish firms with an oil and gas

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[93] 'The Pros and Cons of Aritificial Reefs' (2010), https://rushkult.com/eng/scubamagazine/category/top-article/ (Accessed 20 May).

[94] Newport Naval War College, 'Military Use of Offshore Platforms' (1979) 11.

[95] K. Satterlee, S. Watson, E. Danenberger, 'New Opportunities for Offshore Oil and Gas Platforms – Efficient, Effective and Adaptable Facilities for Offshore Research, Monitoring and Technology Testing' (2018), *OCEANS 2018 MTS/IEEE Charleston,* 1.

[96] Seaventures Dive Rig, Seaventures - Dive Sipadan (seaventuresdive.com) (Accessed 21 May).

background are already operating within the offshore wind sector, such as TNEI, Tekmar, Sembmarine SLP, Global Energy Group, Hutchison Engineering, DeepOcean, W3G Marine, FoundOcean and 3Sun. Several initiatives have been implemented in order to support the development of the offshore wind industry through diversification of oil and gas companies. Among them, extensive guidelines have been elaborated[97] that analyse the sector's potential, map and describe available opportunities and define market entry strategies for oil and gas companies to launch their diversification processes. In particular, the guidelines highlight nine areas that represent the greatest opportunities for oil and gas companies. Six among them concern assets and components which are already available and could be recycled in offshore wind installations – array cables, substation structures, turbine foundations, secondary steelwork and cable installations. The remaining three identify existing competences and capabilities companies could leverage on for setting-up and managing wind turbines – project management, installation support services and maintenance and inspection services. These nine areas underline the high degree of synergies between the two sectors, which could provide a way for platforms' reuse for renewable energy production, instead of their removal.

Another solution which is being developed in the North Sea in the field of renewable energy consists in using redundant platforms for geothermal power production. Geothermal energy refers to the heat energy originating from radioactive materials which are stored within the earth subsurface. If the platform's integrity is still good and temperature and flow rate conditions are met, the so-called 'conversion method' can be applied: fluids are pumped into the well, where they're heated by the surrounding rock, and then either piped nearby or used in steam-electricity generation.[98] Since wells tend to be most appropriate for generating heating rather than energy, this option is ideal for abandoned facilities near where there is high heat demand. This approach could be particularly suited to the UK continental shelf, presenting a rather thin earth's crust which gives the wells high bottomhole temperatures.[99] Geothermal power could be used to generate electricity on board of the platforms, and then redirect it into UK national grid through subsea cables. Another possibility would be to exploit waste heat remaining in the fluids to enhance secondary oil recovery and extend the activity of the platform. Greenfield geothermal exploration in the North Sea is currently being performed by the Aquarius North Sea Geothermal Consortium – composed of ZeGen Energy, dCarbonX and Ross DK – in cooperation with North Sea operators, to assess the

[97] Oil and Gas 'Seize the Opportunity' Guides, 'Offshore Wind' (2015), *Scottish Enterprise,* 1-32.
[98] 'How Abandoned Oil Wells Can Be Used For Geothermal Energy' (2021), TriStone Holdings website, How Abandoned Oil Wells Can Be Used For Geothermal Energy (tristoneholdings.com) (Accessed 21 May).
[99] 'Geothermal Power: an alternate role for redundant North Sea platforms?' (2018), Offshore website, Geothermal power: an alternate role for redundant North Sea platforms? | Offshore (offshore-mag.com) (Accessed 21 May).

opportunity of using platforms' produced water for the generation of heat and electricity.[100] The Australian start-up Legacy Global Green Energy also declared its intention to open offices in Aberdeen and London to employ its technology to recondition obsolete drilling platforms in the UK North Sea.[101] The market for geothermal power is taking off, and it offers an incredible potential to provide affordable, clean energy that avoids emission of greenhouse gases; it would make sense for governments to create support for companies to invest in the exploration of this possibility, as it would provide both an effective solution to decommissioning and considerable advantages for the production of clean energy.

Ongoing studies are verifying the feasibility of using inoperative platforms as bulks for hydrogen storage. The main objective is to develop a system of hydrogen generation and supply, by leveraging on existing offshore infrastructures to allow the establishment of several decentralized hydrogen production, storage and distribution solutions. The Hydrogen Offshore Production project[102] has been set up to identify the most appropriate technologies for offshore hydrogen generation with zero and low-carbon approaches; the establishment of an onshore industrial test-site at the Flotta terminal in Orkney is also foreseen. In fact, hydrogen obtained from electrolysis allows production at zero-carbon emissions, but this solution is currently only used onshore for small-scale production, while no electrolysers fit for offshore deployment are available yet. Transitioning this approach offshore would supply zero-carbon hydrogen at large-scale through replication across several assets, while driving a market for improved electrolysis performance.

Moreover, the project is scrutinizing the idea of installing offshore hydrogen electrolysers coupled to wind farms in order to allow greater flexibility: the hydrogen produced could then be exported onshore through existing offshore pipelines. These synergies could be further enhanced by choosing wind farms in the vicinity of existing drilling facilities that need to be decommissioned, as they could be repurposed for house water purification for hydrogen production, or they could provide pipelines for hydrogen transportation to the onshore gas grids. Abandoned installations could also serve as storage tanks for hydrogen gas, especially useful to meet peeks in energy demand. This specific case is being tested at the Flotta terminal, where energy security is a key challenge: if the terminal experienced a power outage, a knock-on effect could reverberate across the Flotta production area; hydrogen produced locally at a test site could be used as an energy

[100] 'Geothermal Energy: A New Life for Old Offshore Oil Wells?' (2021), OE Offshore Engineer website, Geothermal Energy: A New Life for Old Offshore Oil (oedigital.com) (Accessed 21 May).
[101] A. Richter, 'Repurposing North Sea oil platforms for geothermal energy' (2021), Think Geoenergy website, Repurposing North Sea oil platforms for geothermal energy (thinkgeoenergy.com) (Accessed 21 May).
[102] H. Pearson, C. Pearson, L. Corradi, 'Offshore infrastructure reuse contribution to decarbonization' (2019), *The Oil and Gas Technology Centre.*

vector to support energy shutdowns at the test site, and if proven feasible, the solution could then be applied offshore.[103]

Plenty of alternatives to decommissioning are emerging, which regulators need to acknowledge and incentivize if they want to support the development of a more sustainable decommissioning industry. Support on the side of authorities can be provided in through targeted policies and regulations, but also in form of investments in research, development of data integration systems and initiatives for sharing of knowledge and best practices. Focusing on sustainable alternatives, besides regulating decommissioning itself, would yield benefits in environmental terms – avoiding the damaging impact of removal processes – as well as under a financial point of view – as it would be no longer necessary to sustain decommissioning costs; moreover, it would reduce the issue of platforms' waste management, as most of the materials and components would be recycled with a different use. A more proactive approach towards finding better and more efficient alternatives to decommissioning is needed on the side of both private and public stakeholders, in order to address the issue of what will be done with the massive number of platforms that will become inoperative in the upcoming years.

[103] C. Carpenter, 'Offshore Infrastructure Reuse Can Contribute to decarbonization' (2020), *Journal of Petroleum Technology,* Offshore Infrastructure Reuse Can Contribute to Decarbonization (spe.org) (Accessed 21 May).

Chapter 6

Conclusion

The main objective of this study was to promote a regulatory toolkit to address decommissioning in the light of recent trends towards a new Blue Economy, where growth is driven by innovation to ensure sustainability of the maritime sector. Different interpretations of the oceans – as natural capital, livelihoods, good for business and drivers for innovation – emphasise the role that the blue economy displays as a new governance tool to inscribe the marine economy in a sustainable view. Although several traditional and new activities in the maritime sector are associated with considerable environmental risks, the Blue Economy provides social and economic benefits for present and future generations. This, being enabled by the use of clean technologies, renewable energy and circular material flows to restore and protect the diversity and intrinsic value of marine resources. The design of targeted policies is an essential element to tackle issues of pollution effectively, and the European Union presents a developed framework in this respect thanks to its Blue Growth Strategy. One of the latest initiatives has been the introduction of the Directive on single-use plastics,[104] targeting the ten single-use plastic items most commonly found on European beaches. Single-use plastic products are more likely to end in the seas than reusable options, and represent 70% of all marine litter in the EU. According to the Directive 2019/904, the EU aims to reduce the volume and impact on the environment of certain plastic products. Where sustainable alternatives are easily available and affordable, single-use plastic products are completely banned; in other cases, the use of products is being limited through a wide range of measures, including reducing consumption through raising awareness measures, introducing design and labelling requirements, as well as waste management and clean-up obligations for producers. This represents an example of a targeted policy aiming to promote the transition to the circular economy through innovative business models, products and materials, also with the objective of contributing to the efficient functioning of the internal market.

Extractive activities are among those traditional ones in the marine economy that entail high environmental risks, and therefore need a particular focus in order to respect the new vision of blue economy. Phenomena such as oil spills and produced wastewater which release chemicals in the seas require drilling platforms to be carefully monitored during their whole life. The final stage of platforms' removal, however, has arguably received less attention during the recent decades , as it was considered an issue to be handled in the far future. Now that a significant number of platforms is reaching the end of productive life, the issue of decommissioning is becoming pressing, as it

[104] Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment.

affects the marine ecosystems and involves some critical challenges. Technical challenges concern the management of radioactive, toxic and hazardous materials resulting from dismissal, as well as dealing with the transportation of materials and heavy components for long distances towards the shore. On the one hand, the use of explosives to remove installations leads to disruption of the seabed, and therefore losses in the ecosystem; on the other, questions arise on how to reuse platforms' materials in order to reduce waste.

Regulating decommissioning is baked by safety, environmental and economic rationales. Safety rationales impose those regulations ensure safety of operations for the people employed in the decommissioning operations, as well as those inhabiting the coasts in proximity of the platform. Environmental rationales demand that regulatory requirements drive the most efficient approach to determine minimum impacts on the surrounding ecosystem. Economic rationales concern the possibility to realise higher cost efficiency through regulatory requirements on detailed cost estimation; the necessity to guarantee financial assurance to sustain the costs of decommissioning through legal requirements of information disclosure; constant monitoring to make sure that economic losses do not arise in other sectors of the marine economy as an effect of decommissioning – for example, oil spills affect the quality of fish in the area and therefore profitability of the fisheries sector.

This analysis has attempted to provide an overview of the existing regulatory landscape, and to underline its major controversies. The two regulatory pillars at international level are the UNCLOS framework and IMO Guidelines. The former relies on soft law mechanisms, requiring signatories to adopt regulations concerning seabed activities, and laying down a general framework to regulate dumping of materials at sea. The second proposes a set of minimum standards for navigational safety and environmental protection. Apart from these very general agreements, decommissioning is mostly regulated on a regional and national basis, which poses questions in terms of fragmentation across and within regions. The absence of a coordinated approach and of a common set of agreed standards creates opacity, undermining objectivity of evaluation and therefore preventing predictability of operations and accountability of actors. Besides, it does not allow uniform standards of environmental protection to be applied everywhere, creating a potential for regulatory arbitrage on the side of oil and gas companies. Moreover, most regional agreements are not up to the considerable challenges posed by decommissioning, and they appear out-dated vis-à-vis new findings elaborated in the field. First, they are mostly concerned with matters of navigational safety rather than presenting a key focus on the preservation of the environment. In order to guarantee minimum interference to navigation, legal requirements generally prescribe full removal as the standard approach, while cheaper and more sustainable solutions exist, allowing to leave installations in place. Second, regional agreements seldom require decommissioning plans to be included in the initial project submission, nor they provide standard parameters and indicators to perform ex-ante impact assessments. In general, the current regulatory landscape does not lay down the premises for handling decommissioning with a long-term approach, nor is it conducive to research for innovative solutions in the field.

As a considerable number of facilities around the world approaches the end of their productive life, it is necessary to define a structured approach to decommissioning that ensures enhanced efficiency and the highest standards of environmental protection. The framework proposed is one that integrates international soft law mechanisms and hard laws at regional and national level. On the one hand, an international treaty focusing on the environmental aspect of decommissioning would establish an agreed definition of environmental risk and its levels of tolerance, develop common parameters and indicators for assessment and monitoring, and promote the institution of an ad-hoc authority entitled to oversee and coordinate countries' regulatory effort. On the other, a consistent degree of harmonisation at regional level is desirable, at least for what concerns standards for projects' approval and monitoring of environmental conditions. At the national scale, single countries should define procedures that allow to tackle decommissioning with a long-term outlook. This implies legal requirements for companies to include plans for decommissioning in the initial project submission, as well as to perform ex-ante environmental impact assessments. National authorities should facilitate and guide economic operators through the process by leveraging on the tools developed internationally, also by elaborating standard EIAs formats. Finally, effective mechanisms for financial assurance need to be put in place at national level to ensure that companies are in the conditions to comply with their decommissioning liabilities. Specifically, it is proposed that national authorities introduce the obligation for operators to contribute regularly to a fund that will be set aside to sustain decommissioning costs; this would represent a valid option to ensure financial solidity of operators, while reducing the monitoring effort needed on the side of authorities, as well as costly and time-consuming activities of financial disclosure on the side of companies.

Besides enforcement through soft and hard law mechanisms, countries could engage in trans-national cooperation in order to design and adopt a set of policies aimed at fostering the development of an innovative and competitive decommissioning industry. This includes, first of all, the elaboration of baseline parameters and common guidelines that can help operators in their evaluations and drive them towards the most effective options. Measures should also be put in place to create new opportunities for investment, as well as incentivise the adoption of new technologies. Another key supporting tool would be represented by the introduction of effective data management systems, that allow real-time monitoring of the environment as well as the integration of information derived from different sources. All these supporting activities can facilitate companies not only to select the best decommissioning option, but also to potentially find innovative ways to reuse platforms. A large variety of ideas has already been proposed – such as converting platforms into artificial reefs, rehabilitating them as military bases, offshore research stations, diving spots and bulks for hydrogen storage, or using their components for the production of wind and geothermal energy – but ideas need to be backed by a robust regulatory framework as well as effective policy instruments. This is necessary in order to shift from a linear to a circular vision of the extractive sector, where the life of obsolete infrastructures is extended such that they acquire a new role in the economy, rather than ending up as waste.

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Thesis Summary

Introduction

Offshore drilling facilities have a limited lifespan ranging between 20 and 30 years, after which they become unproductive and terminate operations. The standard and most popular approach is to proceed with the decommissioning of infrastructures, which implies the plugging of wells, cleaning and removal of pipelines, and removal of the production equipment and the overall structure. Total removal of platforms is generally justified by two main reasons. The first being that platforms can interfere with shipping and represent a threat or obstacle to ships during navigation. The second reason lies in the general perception that, once platforms cease to operate, the conditions of the surrounding environment should be restored as they were originally, prior the instalment of platforms.

The dismissal of offshore energy infrastructures is a delicate process, which entails high technical challenges and environmental risks; it is also a very costly operation with a significant environmental impact, as it involves the use of explosives that can lead to the destruction of the seabed and forms of life which originated around the facility. More sustainable alternatives exist – such as conversion to artificial reefs – that could considerably decrease costs and avoid damages on the surrounding environment, and others could be developed thanks to new engineering and technological progress. However, the current regulatory framework at international level is out-dated with respect to the notable awareness about sustainability that is being built globally. Decommissioning operations as they are handled nowadays pose several issues in terms of economic sustainability, as they require extraordinary expenses that could be reduced with alternative methods; environmental sustainability, given the damages provoked to the seabed, as well as the surrounding ecosystem, as an effect of chemicals and oil spills; and social sustainability, as any impact on the environment is reflected over other maritime sectors, as well as the livelihoods of the people inhabiting the coasts.

The existing literature on decommissioning lacks a comprehensive view of the several aspects of decommissioning and how the current regulatory landscape fails to guarantee their sustainability under environmental and economic terms. This elaborate is meant to fill this gap by proposing a more comprehensive view of decommissioning, which does not treat removal of platforms in isolation, but addresses economic, environmental and social concerns at once. The aim of the thesis is to address the regulatory gap in the decommissioning field, explore regulatory challenges and provide plausible alternatives to face them effectively. The final objective is to propose a regulatory toolkit that does not focus exclusively on legislating over platforms' removal itself. Rather, to also induce a future outlook towards what will happen once platforms become obsolete, and propose a set of key enabling actions that would allow to inscribe the disposal of disused platforms in the circular economy.

Offshore platforms and the Blue Economy

The notion of Blue Economy refers to all economic activities that are generally based on the seas and their natural resources. It is a broad concept in the maritime economic sector, and it should be contextualised in the larger arena of sustainable development. The Blue Economy seeks to embrace the opportunities related to the oceans and their resources, while also addressing their threats to make sure that the impact of human activity does not compromise their potential. Different interpretations of the Blue Economy exist; however, they all agree on the following points: (1) the Blue Economy is a marine-based economy that provides social and economic benefits for both current and future generations; (2) one that restores and protects the diversity and intrinsic value of marine ecosystems; and (3) it is mostly based on clean technologies, renewable energy and circular material flows.

The maritime economy includes a broad spectrum of traditional and new activities, each of them affecting natural habitats in distinct ways and to varying degrees. The controversy in the context of the marine economy arises from the characterisation of oceans as common property, which creates several issues making their regulation even more complicated. First, oceans are often affected by incentives for overuse which may lead to reckless exploitation of natural resources, undermining their availability in the long-term. Moreover, some activities in one sector can affect the quality and disposal of resources for other sectors. Further, given the absence of a clear system of resource allocation, when multiple actors are interested in the same resource a tension emerges as to whom that specific resource should be allocated. Finally, the extent to which marine resources are affected by the cumulative impacts of oceans-related activities remains largely uncertain or even disregarded, as a centralised and integrated control of resource use is lacking. As a result, the enactment of the marine-based economy and the operationalization of its sustainable management are made quite contentious by the general lack of established frameworks and an integrative set of guidelines, which are an essential toolkit for determining baseline objectives, action plans, projects assessment and monitoring. In this regard, the Blue Economy is emerging as a new governance tool with an instrumental role for the articulation of appropriate resource use within oceans, and in this sense two major guiding lines have been traced. The first concerns data gathering, aimed at generating quantifications in terms of baseline data to measure ecological functions and assess environmental impacts, and to be used by policy makers during planning of maritime activities. The second set of proposals regards the idea of determining a change in the scope and scale of ocean governance by establishing a system of comprehensive ocean zoning, to be achieved through planning, the division in dominant-use zones and the allocation of user rights.

The presence of offshore energy assets, both in terms of management during their life and decommissioning at the end, poses several challenges. They can represent a threat to navigation safety, and their installation can become a source of disturbance for marine ecosystems; moreover, drilling platforms often provoke chemical spills having a polluting effect over the oceans. From this perspective, most attention will be placed on the ultimate stage of installations' life, namely the decommissioning phase corresponding to their withdrawing from service. The process of decommissioning inevitably involves several risks. The major challenge is inherently technical and emerges with respect to both the management of radioactive, toxic and hazardous materials resulting from decommissioning, and dealing with transportation and recycling of large components. Moreover, the remoteness of infrastructures creates further difficulties for mobilising equipment and resources. Besides the paramount monetary costs involved, also social challenges arise as the workforce operating on the platforms is left unemployed: both the economic and social costs incurred inevitably provoke controversies and public debates that can hinder the progress of decommissioning. Most importantly, dismantling drilling infrastructures entails a great deal of environmental challenges connected to the use of explosives on the seafloor, restoring decommissioned infrastructure sites or prepare them for subsequent use, and ensuring that modules, components and materials can contribute to the circular economy by being reused or recycled in order to reduce the impact of waste.

Chapter 2 examines these criticalities in detail, assessing the alignment of decommissioning operations with the concept of a sustainable Blue Economy. It is therefore argued that appropriate legal requirements need to be in place, to ensure that operations are carried out safely and that the risks of environmental damage are minimised, so as to define sustainable decommissioning practices.

The regulatory framework and its main controversies

The need for regulating the decommissioning of offshore energy assets lies in the significant economic and environmental costs associated to this type of activity. Generally, the normative framework provides a key instrument for directing stakeholders' behaviours towards socially desired outcomes, assuring minimal costs from both economic and environmental perspectives. The rationales for regulating decommissioning operations can be grouped into three categories: (1) regulatory requirements for detailed cost estimation can drive notable reductions in the monetary costs disbursed for decommissioning; (2) obligations concerning ex-ante impact assessment ensure that an estimate is elaborated about the potential effects of decommissioning on the environment and on other sectors; (3) only regulatory authorities can enforce the type of information disclosure which is needed from companies for financial assurance to sustain their decommissioning liabilities. Chapter 3 examines the current regulatory landscape, reviewing main international treaties and regional agreements; this forms the basis for the critical analysis carried out in Chapter 4, identifying four main challenges in regulating decommissioning.

The first challenge is to create an overarching and harmonised framework at the international level. Decommissioning is mostly regulated under regional agreements with a limited geographical scope: as different approaches and requirements are prescribed over distinct areas, the first issue is the high level of fragmentation of the existing regulatory framework. As countries display varying sensitivity to environmental matters, some of them might disregard the harmful impacts of decommissioning and be more permissive when considering decommissioning projects, leading to regulatory arbitrage whereby companies tend to operate in places where legislation is more relaxed. Secondly, ambiguity of legislative provisions inevitably compromises objectivity of evaluations, preventing effective control over pollution of the water and seabed disruption. The case of Southeast Asia is emblematic of the practical consequences that the lack of regulatory coherence can determine on environmental conditions. The necessity to manage diplomatic relations between ASEAN countries diverts attention away from environmental concerns, resulting in lower levels of monitoring; on the contrary, competition among states often results in a race for resources, creating incentives for overuse.

The second challenge concerns the performance of adequate ex-ante planning through Environmental Impact Assessments and the establishment of guidelines on platforms disposal. Existing regulatory frameworks are arguably lagging in defining EIAs procedures in the offshore oil and gas sector; a more structured approach is needed, including standard procedures and formats, as well as baseline parameters and indicators to carry out impact assessments. The current regulatory framework on decommissioning also displays a rather restricted vision of what alternatives should be considered once platforms reach the ending stage of their lifecycle, as it generally sets removal as the standard procedure. Instead, competent authorities should create a regulatory environment conducive to more visionary and responsible attitudes through three main actions: (1) empower companies with the legal possibility to choose among different options without restricting their margin of operation; (2) integrate ex-ante planning with preventive considerations about decommissioning prior the settlement of the platform; (3) elaborate a reasoned and targeted set of incentives for research, innovation and digitalisation. For instance, U.S. Rigs-to-Reef programs allow companies to give up liability on disused platforms by donating the facilities to the competent state for conversion to artificial reefs. This does not only allow for implementation of more sustainable alternatives to full removal, but it also creates economic and legal incentives for their implementation by giving operators the opportunity to save costs on decommissioning.

The third challenge emerges with respect to providing financial assurance to sustain the costs of decommissioning. Oil and gas companies need to take into account a final fixed cost for decommissioning, which will occur at a time when they will not enjoy positive revenue streams anymore. The main rationale for regulating financial disclosure in the oil industry is therefore represented by the necessity to develop adequate control mechanisms to prevent financial risks associated with extractive activities. Regulators need to determine what financial information should be supplied by companies and what indicators are relevant in order to regularly assess their future capacity to deal with decommissioning obligations. Second, they need to establish the most effective system for providing sufficient funds to be set apart in preparation for decommissioning. In the U.K, the industry has spontaneously developed Dispute Security Agreements whereby each co-licensee commits to regularly deposit a given amount of money or security into a trust devoted to sustain the cost of decommissioning once the platforms ceases to operate. The Norwegian government instead presents an opposite approach, contributing largely to decommissioning costs based on the average effective corporate income tax rate that the company has paid on the net incomes from the field during the management of operations.

The fourth challenge relates to reputational risks incurred by oil and gas companies, and that regulators need to take into consideration in order to design an appropriate set of incentives for fostering more sustainable decommissioning. The first case analysed is the Deepwater Horizon blowout in 2010, which raised considerable concerns about companies' capability to ensure safety of operations and comply with monitoring requirements on the conditions of their facilities. The second case study revolves around the Brent Spar decommissioning experience, which was heavily shaped by reputational concerns: even though the initial decommissioning plan submitted by Shell was approved by competent authorities, the company was eventually forced to opt for a different alternative due to heated public contestations.

Proposing a toolkit to promote sustainability of decommissioning processes

Chapter 5 elaborates a proposal for a revised regulatory framework that would ensure higher standards of environmental protection and promote the development of a sustainable decommissioning industry.

The first idea is to foresee a regulatory framework based on coordinated efforts at national and international level. At international scale, the proposal is to develop a unified, comprehensive international treaty on decommissioning with a specific view to its environmental character. The treaty should delineate an agreed definition of environmental damage and what is the maximum tolerable level of risk that can be accepted at any time. This would enable the definition of minimum safety standards, whose application at country level would be monitored by an ad-hoc authority empowered with enforcement mechanisms in the form of sanctions or commercial retaliation. Common parameters and indicators should also be developed for transparent and objective monitoring, supporting the activity of the supranational authority designed for overseeing countries' regulatory effort. Soft law mechanisms and guidelines at international level would then need to be integrated with exhaustive and detailed hard laws at regional and national level. Countries could leverage on the parameters and indicators created internationally in order to develop structured Environmental Impact Assessments. They should also provide for the creation of financial assurance systems for sustaining the costs of decommissioning. In particular, it is here proposed that states define the obligation for operators to create a decommissioning fund – on the example of U.K. Dispute Security Agreements: this would allow national authorities to ensure that adequate funds are set aside for decommissioning, without engaging into costly and time-consuming monitoring of companies' financial performance.

The second idea is to actively support the development of a sustainable decommissioning industry in the circular economy. This could be enabled through trans-national cooperation along the lines of the EU Blue Growth Strategy, which focuses on a set of key enablers, namely: (1) Maritime Spatial Planning to manage waters more efficiently and avoid conflicts between sectors; (2) the institution of marine protected areas; (3) the definition of a strategy for maritime research and innovation; (4) setting-up a system of integrated maritime surveillance to create a common information-sharing environment. Another critical instrument to support the decommissioning industry consists in mechanisms for effective data collection, management and integration, as data about oceans, ecosystems and the conditions of the seabed can provide critical assistance for the management of decommissioning operations. For instance, new trends in autonomous environmental monitoring are already emerging and could be assisted through targeted policy initiatives.

The third proposal consists into creating the right premises to incentivise research on new, sustainable alternatives to decommissioning. This would include solutions that allow the reuse of platforms or their components in order to extend their life. Solutions of this kind are preferable from an environmental point of view, as they allow to avoid platforms' removal and all the environmental risks associated with the processes of dismissal. Secondly, they would help inscribe the oil and gas industry in the mind-set of the circular economy, where products do not have a finite, linear life, but rather enter a cyclical process that ideally extends their life indefinitely. Even though the most diffused method of platforms' rehabilitation today is their conversion into artificial reefs through Rigs-to-Reef programs – especially in the Gulf of Mexico – research is on-going on other possibilities. Some proposals concern exploiting platforms with military purposes, with a role in ocean surveillance or as military bases. For instance, the feasibility of turning offshore facilities as points of support for the U.S. Armed Forces helicopters has been assessed, as almost any rig is equipped with helicopter decks which are stressed to accommodate large vehicles. Another possibility has been analysed for converting drilling facilities into offshore research, monitoring and technology testing stations. A more creative approach has instead been adopted in the case of the Seaventures Dive Rig off Malaysian coasts, where the oil platform has been redesigned as an offshore hotel and scuba diving platform. Another set of solutions concerns the re-utilization of platforms in the production of renewable energy; these are being especially searched for in the North Sea, where Rigs to Reef programs are mostly unfeasible due to its morphological characteristics. In this respect, researchers are trying to diversify oil and gas companies into offshore wind energy, or use parts of the infrastructure for the production of geothermal power or as bulks for hydrogen storage.

Plenty of alternatives to decommissioning are emerging, which regulators need to acknowledge and incentivise if they want to support the development of a more sustainable decommissioning industry. Support on the side of authorities can be provided through targeted policies and regulations, but also in the form of investments in research, development of data integration systems and initiatives for sharing of knowledge and best practices. Focusing on sustainable alternatives, besides regulating decommissioning itself, would yield benefits in environmental terms – avoiding the damaging impact of removal processes – as well as under a financial point of view – as it would be no longer necessary to sustain decommissioning costs; moreover, it would reduce the issue of platforms' waste management, as most of the materials and components would be recycled with a different use. A more proactive approach towards finding better and more efficient alternatives to decommissioning is needed on the side of both private and public stakeholders, in order to address the issue of what will be done with the massive number of platforms that will become inoperative in the upcoming years.