Circular Oil & Gas Decommissioning: The social, economic, technical and environmental values of North Sea oil & gas decommissioning for local communities and companies.

Technical Report · December 2020

CITATIONS
0

READS
51

1 author:

Anne Velenturf
University of Leeds
64 PUBLICATIONS **441** CITATIONS

SEE PROFILE

Circular Oil & Gas Decommissioning

The social, economic, technical and environmental values of North Sea oil & gas decommissioning for local communities and companies

Project report

December 2020

Dr Anne P.M. Velenturf

Abstract

This project investigated the social, economic, technical and environmental values of North Sea oil & gas decommissioning for local communities and companies with the Complex Value Optimisation for Resource Recovery (CVORR) approach. This report introduces circular economy and presents an adapted CVORR approach aiming to transparently involve stakeholders in the sustainability assessment of future circular economy scenarios. An initial systems assessment for NOG decommissioning provides essential background information covering the political-economic system, insight into common decommissioning practices, current circular economy performance and insight into the social network boundaries of the system. NOG stakeholders were engaged to 1) Analyse the social, economic, technical and environmental values that stakeholders associate with decommissioning of NOG and 2) Analyse the barriers and enablers for embedding circular economy into future NOG decommissioning. The report concludes with reflections on the value system of NOG in comparison to circular economy and makes recommendations to embed sustainable decommissioning practices in NOG, using circular economy approaches to accelerate the energy transition.

Acknowledgements

This project was funded by the Economic and Social Research Council impact acceleration account to the University of Leeds, grant code ES/T501955/1. I am grateful to Profs Naomi Brookes, Phil Purnell and Dr Charlotte Stamper and Scott Bryant who helped to secure the funds and supported the project delivery. My sincere thanks go to the University of Leeds co-investigator team and the core stakeholder group who offered expert input and a sounding board during various project activities, and the stakeholders who participated via informal conversations to give a unique insight into the NOG sector. A special thanks to the Aberdeen & Grampian Chamber of Commerce who co-organised the final project event with Zero Waste Scotland, University of Leeds and an excellent range of speakers and engaged audience.

Disclaimer

Please cite this report as: Velenturf, A.P.M. (2020) Circular Oil & Gas Decommissioning: The social, economic, technical and environmental values of North Sea oil & gas decommissioning for local communities and companies. University of Leeds. https://www.researchgate.net/publication/347530402_Circular_Oil_Gas_Decommissioning_The_social_economic_technical_and_environmental_values_of_North_Sea_oil_gas_decommissioning_for_local_communities_and_companies

Contents

1. Introduction

1.1 Background

UK government and various industries have the ambition to realise a circular economy that makes better use of resources (Chapter 2). This will increase resource efficiency, limit carbon emissions, promote the use of renewable materials and energy, and boost low-carbon development through innovative business opportunities that create jobs in disadvantaged regions. Implementing circular economy proves challenging, not least because collective action is required from government, industry and the general public (Chapter 3).

Circular economy is intertwined with the challenge of adopting more low-carbon energy systems. While the UK ups its renewables targets, North Sea oil & gas (NOG) will be decommissioned. Decommissioning of NOG infrastructure presents both a challenge and opportunity for the sector, with 600 installations set to be decommissioned over the next 30-40 years in the UK. This corresponds to the recovery of 840,000 tonnes of materials in the next decade alone [2]. NAO [3] reports an estimated total decommissioning cost of £45-77Bn and 2017 was the first year that NOG has been a net drain on the public purse (Chapter 3).

A lack of forward planning has led to technical, environmental, and collaborative challenges with high and variable costs as a result. With the UK taxpayer likely to foot 50%-70% of the decommissioning bill due to tax relief available to many operators, there is an urgent need to have a discussion on the most economic, social and environmentally beneficial decommissioning route(s) for the general public and the UK as a whole.

The current 'business as usual' is to scrap the infrastructure and ship it overseas for processing. Although recycling rates are said to be high at 95%, the materials are exported into low value recycling applications. Higher value circular economy solutions such as reuse and remanufacturing of components and equipment are hardly used. Circular decommissioning is anticipated to create more opportunities for local business, thereby maintaining viable communities in Scotland and the UK.

1.2 Project aims and objectives

This project was initiated by the University of Leeds and Zero Waste Scotland. It was funded with an ESRC-funded Impact Acceleration Account project titled: The social, economic, technical and environmental values of North Sea oil & gas decommissioning for local communities and companies[1].

The project takes a systems approach to analyse the economic, technical, social and environmental values of North Sea oil & gas (NOG) decommissioning applying the Complex Value Optimisation for Resource Recovery approach, engaging stakeholders in NOG to:

1. Analyse the social, economic, technical and environmental values that stakeholders associate with decommissioning of NOG through a case study of a decommissioned oil & gas platform.
2. Analyse the barriers and enablers for embedding circular economy principles into future NOG decommissioning.

[1] The social, economic, technical and environmental values of North Sea oil & gas decommissioning for local communities and companies part of grant ES/T501955/1

2. Circular economy

A circular economy can be understood as the opposite of a linear economy is which we take resources from the natural environment, turn them into materials, components and products that are generally used for a short period of time, before they are disposed of in oft-unsustainable ways.

Circular economy has been defined in hundreds of different ways (see e.g. [4]) and the only common denominator is the striving to make better use of materials, components and products when compared to a linear economy. “Better” involves the minimising of materials extracted from the natural environment, the maximising of waste prevention, and the optimising of environmental, technical, social and economic costs and benefits throughout the consecutive lifecycles of materials, components and products.

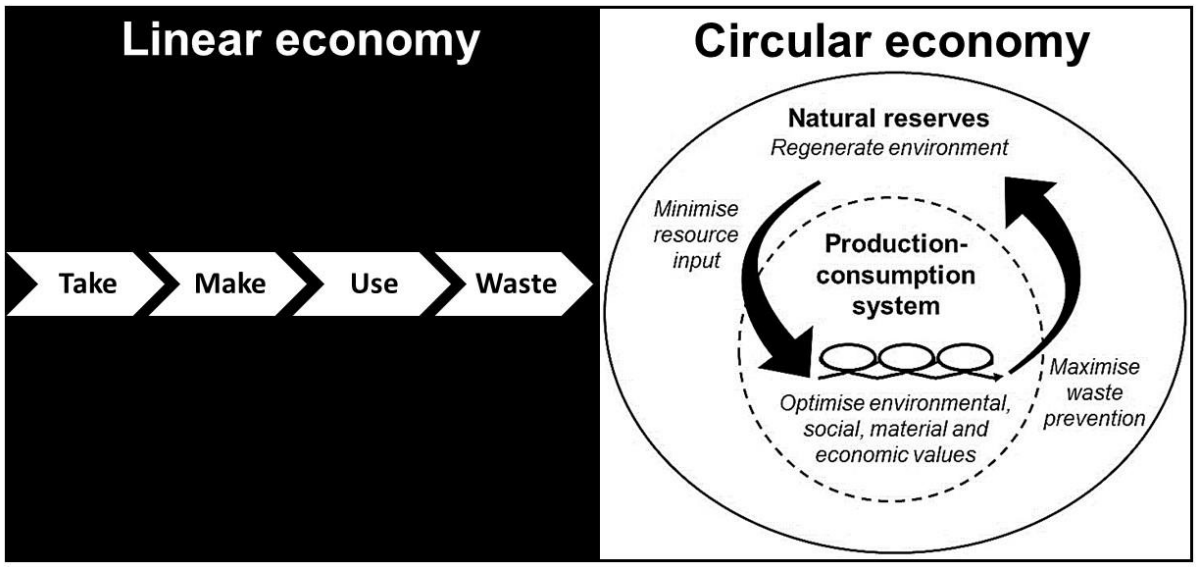

Figure 1: The difference between a linear wasteful economy and a circular economy in which materials, component and products are used more effectively and efficiently (image credit: author produced for The Conversation [5] and the Offshore Renewable Energy Catapult [6].

2.1 Values of a sustainable circular economy

The purpose of the optimisation of costs and benefits within a circular economy centres on three core values that are closely related to sustainable development (Figure 2). A sustainable circular society is an equitable society that improves or maintains environmental quality and economic prosperity for current and future generations [7]:

- Social and individual well-being: Create conditions that offer equity in realising quality of life that at least meets human rights standards for all.
- Environmental quality: Using resources within planetary boundaries, enhancing natural capital within and across generations.
- Economic prosperity: Collective organisation of fair access to resources within and across generations to enable social and individual well-being and enhance environmental quality.

Circular economy has gained a lot of momentum because of its ability to reduce environmental impacts while opening new business opportunities which can create jobs and other social benefits. For example, circular economy can reduce greenhouse gas emissions by 63% by

2050 [8]. Evidence suggests that it is impossible to reach climate targets without realising a transformative circular economy [9]. Environmental benefits stretch further than carbon emission reductions alone and further than net-zero given that absolute improvements to a diverse set of environmental aspects is to be formally aimed for (see e.g. [10, 11]). However, arguably it has been the envisaged economic benefits that have made circular economy attractive for governments and businesses around the world [12], with forecasts of $25 trillion in new business opportunities globally by 2050 [13] and a potential 8 million jobs created in the EU by 2030 (calculated based on [14].

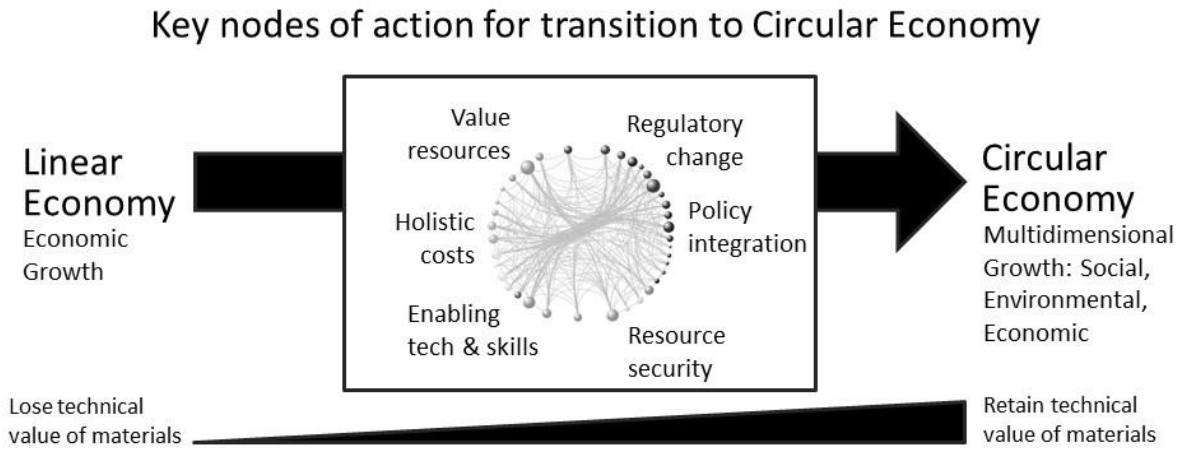

Figure 2: The purpose of a circular economy changes from a focus on short-term economic growth to a long-term focus on social, environmental and economic progress (image credit: Graphical abstract from [15].

2.2 Circular economy strategies

Circular economy can be implemented with a variety of strategies under four main categories, in order of priority [16, 17]:

- Narrowing resource flows to reduce the amount of materials going around in the economy (e.g. dematerialisation, waste reduction);
- Slowing the flow of resources between the point of manufacturing and disposal (e.g. repair and maintenance, lifetime extension, component reuse and refurbishing, remanufacture, disassembly);
- Closing the loop of resource flows (e.g. decommissioning, recycling);
- Safely integrating material flows back into natural processes (e.g. controlled storage in landfills, rigs-to-reefs, re-mining).

Specifically, the strategies might entail (overview with explanations in [18]):

1. Design for circularity: proactive design to maximise the sustainability potential of a circular economy – in the case of NOG, designed for an as swift as possible energy transition – with a balanced mix of the strategies listed:
2. Dematerialise: reduced resource use through, for example, shape optimisation and using alternative materials for infrastructure components.
3. Prevent waste: eliminate waste from production through design or by putting wastes and by-products to use through industrial symbiosis.
4. Repair and maintain: preventative, planned or ad hoc inspection/ servicing tasks, which may involve repairs to restore a component to a good working condition.

5. Extend lifetime: keeping (infra)structures in use beyond their designed service life, converting them as part of the energy transition to move away from fossil fuels.
6. Component repurposing and refurbishing: components are used again for similar functions in more sustainable infrastructures such as for offshore wind, energy storage or carbon capture and storage, as part of the energy transition. Components/ parts can also be repurposed for applications other than energy/ related infrastructure.
7. Remanufacture: components are sorted, selected, disassembled, cleaned, inspected and repaired/ replaced before being reassembled and tested to function as good as new or better.
8. Disassemble: a key step to take components apart to enable repair, repurpose, remanufacturing and recycling, ideally considered at the first design stage.
9. Data and information: offering insight into the volumes, technical characteristics and accompanying social, environmental and economic values of materials, components and infrastructure throughout their consecutive lifecycles.
10. Recertify: offering assurances about the characteristics of materials, components and infrastructure.
11. Decommission: dismantle and remove some or all parts of energy infrastructure, followed by site restoration and monitoring.
12. Site recovery: returning a site to a similar state as before the development.
13. Recycle materials: the collection and preparation of wastes into materials that can re-enter production, and the reprocessing of recyclates into new components.
14. Landfill and controlled storage: storage and compaction of components and materials into defined cells that prevent pollutants from entering the surrounding environment, often combined with resource and energy recovery.
15. Re-mine: recovery of materials from "Anthropogenic Ores" such as the industrial, municipal, metallurgical, and mining wastes that people have entrusted into geological storage.
16. Energy recovery: recovery of the energetic input invested into the preparation of materials and components.

Circular economy requires a whole system approach in which the full lifecycle of materials, components and products are considered proactively within their social-cultural, political-economic, legal, technical and environmental contexts – explained further in the next section.

2.3 Adapting the Complex Value Optimisation for Resource Recovery approach

One approach to collaboratively implement a circular economy is the Complex Value Optimisation for Resource Recovery (CVORR) framework [19]. CVORR was developed at the University of Leeds as an alternative to mono-dimensional value evaluations that are focused on either environmental or economic aspects alone, which collapse diverse types of values, if considered at all, onto one aggregate value such as monetary or carbon emission equivalents [20]. Examples of such mono-dimensional approaches are cost-benefit analysis, (some forms of) natural capital accounting and life-cycle assessment. CVORR offers an alternative that enables the assessment of economic, social, technical and environmental costs and benefits that are created, transferred, destroyed and distributed through (circular) supply chains [19]. Costs and benefits are incorporated into the analysis in their original units of analyses resulting in an integrated assessment of e.g. money, job potential, structural strength of a material, and carbon emissions; avoiding the subjective conversion of values, often lacking transparency, into a singular unit. The basis of the approach is material flow analysis embedded in a systems of systems approach. CVORR offers a whole-system approach to assess multi-dimensional values of supply chain scenarios that are under consideration in decision-making.

CVORR is an interactive approach involving stakeholders throughout the sustainability assessment. It is crucial to be transparent about the stakeholders involvement in the process to maintain the approach's unique benefit compared to alternatives such as LCA. Tools for sustainability assessment can be understood as 'value articulating institutions' which describe and enforce a certain worldview [21]. A stakeholder could select a tool that aligns with their worldview, thereby introducing a bias in the assessment process in favour of their interests and preferred outcome. In principle, CVORR is a value agnostic tool i.e. it does not prescribe a particular worldview other than considering sustainability and the assessment of multi-dimensional value as important. The value framework for the assessment is derived from the system description, including for example the policies and regulations that must be adhered to, and shaped by aspects that stakeholders consider important. In other words, CVORR enables the articulation of value frameworks anew for each system under investigation. This flexibility enables adaptive governance, but also risks stakeholders articulating a value framework that is most likely to result in the outcome that matches their interests and this may not be for the greater good of long-term sustainable development for all. The CVORR approach must transparently link all stages of the assessment, explaining which stakeholders were involved when and why, which of their views were or were not taken on board and why, and show any 'bias' caused by the underlying value framework and show how the outcomes of the assessment would change if the value framework is adapted.

Herein an adapted CVORR approach is proposed aiming to increase transparency of the stakeholder involvement, adding steps on stakeholder analysis and articulating a value framework as well as on process evaluation (Figure 3). Adaptations in some of the other steps are also proposed given that each stage is shaped around stakeholder involvement. The CVORR approach is implemented through a series of iterative steps.

Here we offer a brief overview, with a more detailed description in preparation for peer-reviewed publication:

2.3.1 System analysis

System selection and the iterative delivery of the stakeholder analysis, system dynamics analysis, material flow analysis and development of a value framework

- **System selection:** Define the system and sketch the system boundaries – based on geographic location and social network – which would be detailed further later, and collectively agree upon the problem and objectives for the assessment process.
- **Stakeholder analysis:** Identify the stakeholders in the system and their roles, interests and relations.
- **System dynamics analysis:** The system under investigation is part of a wider set of dynamic systems that are affecting each other. The wider set of systems can be analysed using the well-established PESTEL approach to identify dynamics, drivers and constraints, covering the political and legal, economic, social-cultural, technological and ecological systems.
- **Material flow analysis:** System boundaries are specified (in conjunction with geographic and social boundaries), and processes within the system boundaries, inflows, intermediate flows, outflows and stocks are described and then quantified in volumes of materials.
- **Develop value framework:** Articulate a value framework – consisting of principles about how the system is believed to work and values which define what is considered to be important, desirable and just – based upon the other steps in the system analysis and completed with input from stakeholders.

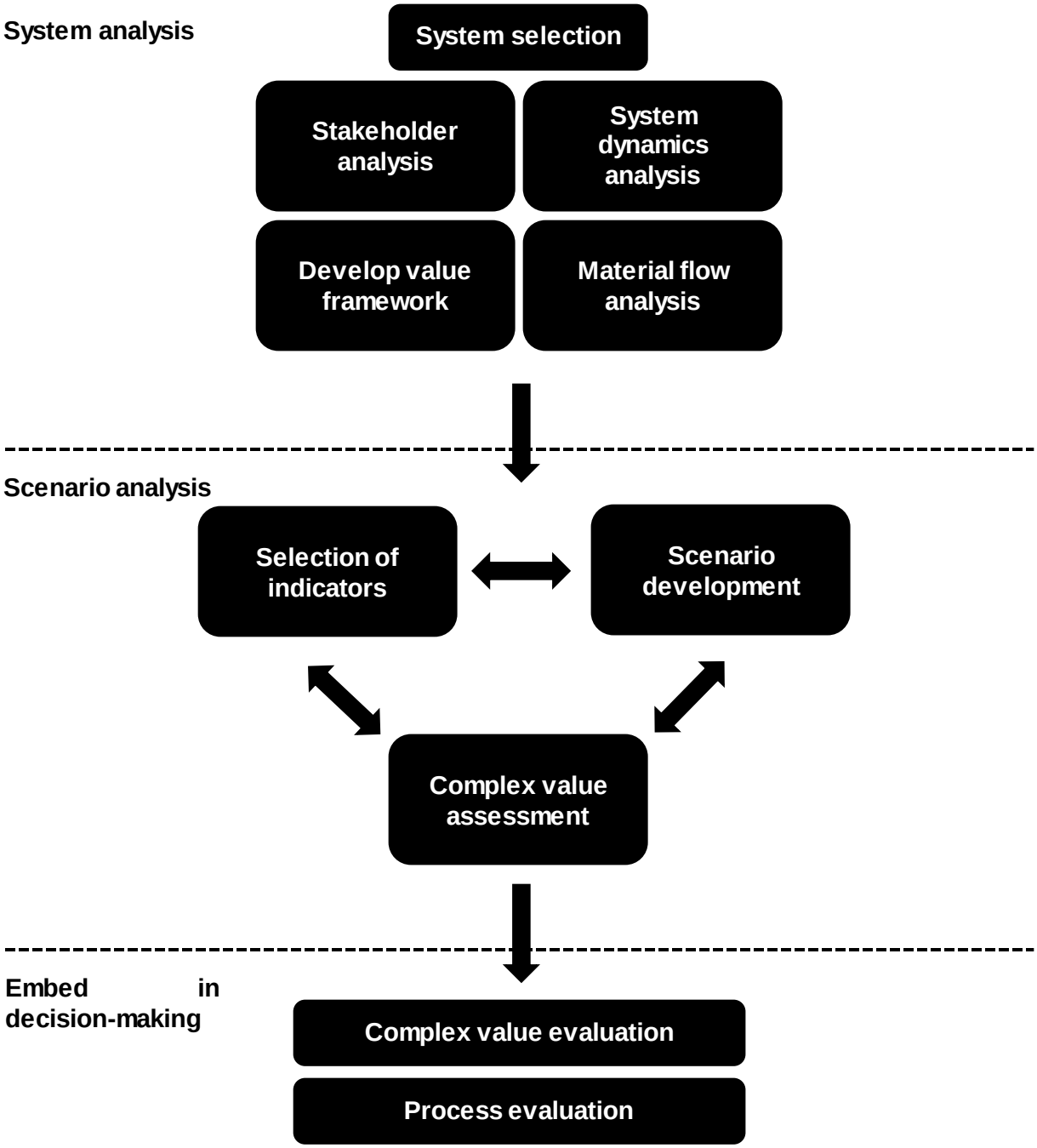

Figure 3: Complex Value Optimisation for Resource Recovery approach adapted and expanded from the approach published by Iacovidou, Millward-Hopkins [19].

2.3.2 Scenario analysis

Selection of indicators, scenario development, and complex value assessment, starting with an outline of indicators and scenarios and consecutively delivered iteratively and repeated as required to refine the scenario analysis.

- **Selection of indicators:** Indicators are selected from a long-list with input from stakeholders, each explaining which indicators they feel should be included and why. The short-list of indicators should be sufficient to reflect the value changes that are considered important. Indicators can vary between scenarios, because different metrics can become relevant under different conditions.

- **Scenario development:** Scenarios are developed to assess the impacts and benefits of the business as usual, if available, and analyse how these values change under alternative scenario(s) or when a change in the wider systems would be introduced.
- **Complex value assessment:** Data are collected for the selected indicators and then prepared and entered into a model to assess how costs and benefits are created, transformed, destructed and distributed in the system.

2.3.3 Embed in decision-making

- **Complex value evaluation:** The assessment results are handed over to a decision-making process, supporting decision-makers in the use of the results including 1) an overview of the costs and benefits under the various scenarios of the investigated system, 2) the interactions with the wider system of systems which can give insights into the necessary changes in e.g. policy or markets to enable or constrain scenarios that are preferred or less favourable respectively; 3) an evaluation that compares the final results to the value framework.
- **Process evaluation:** Evaluate the quality of the process based upon the transparency, reliability, accuracy and validity of the assessment results, and possibly expand with commonly used principles for sustainability assessments such as impartiality, independence, credibility and usefulness.

3. Background of North Sea oil & gas decommissioning

This chapter offers vital background information about North Sea oil & gas (NOG) decommissioning, covering the political-economic system, insight into common decommissioning practices, current circular economy performance and insight into the social network boundaries of the system. A broad range of grey literature was identified (Appendix A) and used as a basis for this study, which in a follow-up study could be complemented with a review of scientific publications.

3.1 Political-economic system

3.1.1 Governance system

The direction of travel in the UK is for clean growth and a circular economy [22]. Energy, infrastructure and circular economy generally persist in policy siloes within the governance system [23]: Energy is handled by BEIS; infrastructure is part of the portfolio of the Treasury's Infrastructure and Projects Authority; and resources and circular economy are with DEFRA. Nevertheless, growing concerns over climate change are driving integration in the governance system and this has implications for NOG extraction and decommissioning.

Governance for NOG decommissioning is driven and influenced by several government bodies [3]. BEIS carries overall responsibility for NOG exploration and decommissioning. OPRED, located within BEIS, is "responsible for ensuring that decommissioning is delivered in a safe, efficient and cost-effective way while minimising the risk to the environment. It does this through approving and monitoring operators' decommissioning plans". The Oil & Gas Authority (OGA) was established in 2015 to deliver the Maximising Economic Recovery strategy to continue oil & gas extraction in the most cost effective manner, helped by targets to reduce decommissioning costs. Decommissioning costs are in part funded through the HM Treasury, who sets tax rules for operators and reliefs for decommissioning, and HMRC who brings taxation plans into practice. Further complexity is added by governance being partially devolved to the Scottish (and Welsh) administrations. Due to some powers being reserved by the central Government for the UK, it can be challenging for devolved administrations to take a different course.

The UK government wants operators to maximise the potential economic value of remaining NOG reserves. It is primarily a commercial decision for operators as to whether they continue to extract oil and gas using existing assets or invest in constructing new assets to extract from new reserves. The government is committed to supporting the industry to maximise extraction due to its role in the economy, supplying energy and providing employment. Since 2013, the government has introduced a series of measures aimed at making it more commercially viable for operators to continue investing in the UK. This includes reducing taxes on oil and gas production, introducing investment allowances to encourage capital investment, providing certainty about tax reliefs for decommissioning, and establishing the OGA to work with the industry to reduce costs and find efficiencies. The OGA has sanction powers (including the ability to revoke licences) if it judges operators not to be fulfilling their obligations for extracting economically viable oil and gas. Government strategy aims to give operators the incentives, and investors the confidence, to develop new assets and to keep assets in use for longer. Reduced decommissioning costs will make more money available for new investment in NOG extraction.

Government strategy for maximising NOG extraction clearly goes directly against the strategy for clean growth and the net-zero target as well as environmental strategy aiming to leave the

environment in a better state for the next generation. Maximising exploitation of NOG – a finite resource that upon use brings existential environmental crisis upon people – is also not in line with the realisation of a more circular economy.

The implementation of NOG decommissioning policy and regulation is generally considered complex due to the high number of diverse government bodies involved (Figure 4).

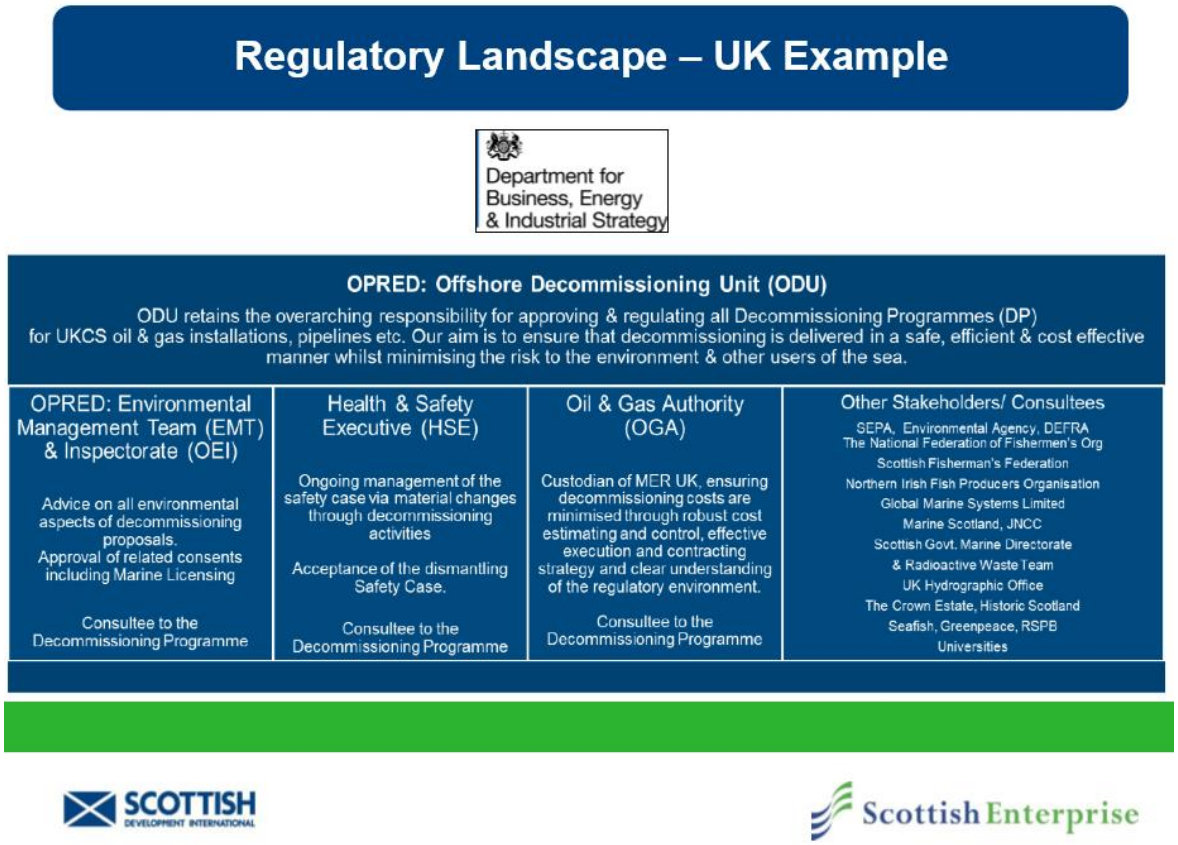

Figure 4: Regulatory landscape overview [24].

3.1.2 Decommissioning costs

Oil & gas still is a key industry for Scotland [25]. The sector is directed by global oil prices. Costs of decommissioning are escalating and as a result the importance of cost reductions and efficiency increases in decommissioning have risen on agendas.

The NAO [3] report drew together information to support parliament in assessing whether taxpayer's interests are effectively being protected by the various government departments involved in oil & gas decommissioning. Future costs of decommissioning were estimated at £45-77Bn to operators, and based on the cost estimates for the operators the government estimated its contribution to be £24Bn via tax reliefs (paid from previously collected taxes and through relief on current taxable profits). Cost estimates are highly uncertain and taking on board the error margins could see costs increasing to ca. 145Bn over the full lifetime of the sector, compared to a receipt of £334Bn in tax so far since 1970-71. The OGA expects that cost estimates will become more precise in the future with the growing experience in decommissioning.

Decommissioning costs have been rising. Since 2014 operators spent more than £1Bn every year. The OGA set a target for operators to achieve 35% reduction in decommissioning costs by 2022. Operators can recover a part of the costs via tax reliefs on current profits and also claim back tax that was paid in earlier years. This includes decommissioning tax relief deeds and historic tax transfers to give assurances to operators and motivate their continued investment and extraction of oil & gas. 2016-17 was the first year that government paid out more to operators than it received in tax and licences, resulting in a net tax income of -£290M. In 2017-18 the balance recovered to +1.2Bn, and the Office for Budget Responsibility forecasted net positive balances up to 2022-23.

Tax income from oil & gas has been declining in the past decade. The recent lows in 2016-17 were due to low oil & gas prices combined with high deductible costs. While government has the objective to maximise economic value from remaining reserves, current systems are unable to offer a full insight into the costs and thus make it impossible to assess whether tax reliefs are delivering value for money[2]. Moreover, it is unclear whether tax reliefs are indeed reinvested in the UK and hence it is not possible to substantiate the effectiveness of the Government strategy.

Government monitors the financial health of operators. In case of doubt whether an operator can cover the decommissioning costs, they can be obliged to set aside funds. This has happened so far for 9 operators, setting aside a total of £844M i.e. about 2% of the minimum decommissioning cost estimates [26]. Government has not disclosed a quantified risk, currently described as "an unquantifiable remote contingent liability". Government generally considers the risk that the state has to act as 'decommissioner of last resort' to be low because 80% of assets is or has been owned by large operators who are primarily liable for the decommissioning costs.

Operators have to reduce decommissioning costs by 35% by 2022, compared to the estimated costs of £60Bn in 2017. Key priority areas to reduce costs, and develop solutions that are ideally exportable, are:

1. Increasing certainty about costs
2. Developing supply chain capability
3. Clarifying regulatory requirements

The most important cause of the high costs and the uncertainties, is the limited experience with NOG decommissioning (further explored in next section).

The cost profile for decommissioning, according to OGUK, is as follows: Project management 8%; Post-CoP running costs 9%; Well decommissioning 45%; Facilities and pipelines permanent isolation and cleaning 4%; Topsides preparation 4%; Topsides removal 10%; Substructure removal 8%; Topsides and substructure onshore disposal 2%; Subsea infrastructure 9%; Site remediation 1%; and Post decommissioning monitoring 1%.

3.2 Decommissioning approaches

There are currently 320 fixed installations for oil & gas extraction, which are mainly located in the North Sea [3]. Since 1970-71 about 44Bn barrels have been extracted and estimates are that there are 10-20Bn barrels left. Given that it took ca. 50 years to extract the former, it may take another ca. 20 years to extract the remaining NOG – if that offers the best value for the

[2] HMRC is due to publish plans to improve reporting on tax reliefs and their contributions to achieving government objectives.

UK, bearing in mind for example costs of climate change mitigation and adaptation. Currently the objective of the government is to enable operators *"to maximise the potential economic value that remaining oil and gas reserves have in supplying energy, creating employment and contributing more generally to the economy"* (p8, NAO 2019). At the same time, government is aiming for an energy transition in the light of net-zero by 2050. BEIS forecasts that electricity generation from natural gas will reduce 63% during 2017-2035, pending availability of cleaner energy sources. Particularly in transport and heating more efforts are required. The dependency on oil may persist for longer. In the view of government, decommissioning costs have to be lowered to enable continued extraction.

There are three commonly defined approaches to decommissioning of NOG [25]:

1. Piece small: Removal of the platform is small parts of less than 20 tonnes. Limits the potential for reuse and repurposing of components but enables more reuse of equipment. This method can be used for topsides but not the steel or concrete jackets.
2. Piece large: Reverse installation methods and modularisation for the removal of a platform in parts of up to 5,000 tonnes. Increases potential for reuse and repurposing of whole components. This method can be used for topsides and jackets.
3. Single lift: Removal of topside in one piece and jacket in whole as well, up to 48,000 tonnes at once. Ability to use this method depends on structural integrity of the topside or significant preparations ahead of the lift. Also suitable for steel jackets but generally not for concrete jackets. Potential for reuse of whole topside or to dismantle whole modules onshore for reuse. Risk of damage to equipment limits potential for reuse and repurposing.
4. Refloating: Potential for steel jackets to be floated into sheltered waters for cutting into sections for further processing. Unlikely to be suitable for concrete jackets.
5. Leave in place

Selection of the removal methods is based on the stage, size and type of asset i.e. the nature of the platform structure as well as the availability of money and overall costs. Single lift is the most commonly used to date. Most installations removed are relatively light ones from the southern North Sea. DNS, ZWS [25] list 21 fixed installations that have been removed, of which of the topsides ca. 14% was removed with a mix of piece small and large, ca. 4% by piece large, ca. 78% by single lift, and ca. 4% was refloated; and of the jackets ca. 4% was removed with piece large methods, ca. 78% by single lift (all of which were small steel), ca. 4% were refloated (gravity-based steel), and ca. 14% were left in place (all of which were concrete jackets).

Most decommissioning and dismantling approaches are based on reverse engineering [25]. Currently reuse, repurposing, and remanufacturing are limited, and instead the majority of installations that are removed are said to be recycled. Assets are cleaned and once considered free from hydro-carbons they are being processed using standard demolition techniques followed by material segregation and further processing for recycling. The techniques used offer certainty of costs and high safety standards. However, installations removed via single lift can only be landed and processed in a limited number of ports in the UK, and this increases the risk that installations have to be exported with limited benefits to the UK. With that in mind, piece small or large, or planning ahead more to remove reusable equipment at an earlier stage, could offer better value for the UK. Late life extensions of NOG installations can be made more economic by accessing redundant parts of installations that are about to cease production. Previous comparative assessments have indicated the viability of all the three main removal methods, but more assurances regarding the feasibility of piece small and large are required. Operators were surveyed about barriers to piece small and large, the greatest of which were:

- Financial viability
- Knowledge of contractors
- Health and safety management
- Environmental management
- Technical feasibility

Operators were particularly uncertain about contractual agreements (new contractual formats are required), managing risks of reuse and resale, financial viability, knowledge of contractors, and the methodology employed for piece small and large [25]. Moving forward, challenges were seen to include:

- Scale of the number and weight of installations reaching end-of-use
- Safety and security
- Demand for new solutions for alternative removal methods
- Complexity and technical challenge of removal
- Inhospitable offshore environment
- Understanding the end-of-use options
- Reducing costs
- Potential for reuse to lower costs
- Potential for reuse to increase sustainability of decommissioning

Moreover, increasing reuse and repurposing would require to plan ahead more, before ceasing production, to find outlets for reuse and ensure such equipment and components are preserved. Some companies have recently started to offer such services[3].

Structures that are to be decommissioned are [25]:

- Subsea equipment (56 installations in UK)
- Pipelines
- Matrasses
- Jackets (in UK total 227 steel and 12 concrete jackets in place)
- Topsides

Moreover, floating production storage and offloading are also in use which will require decommissioning in time. None of these structural components were designed for decommissioning and removal when being commissioned, limiting their potential for sustainable decommissioning and integration with a more circular economy.

Conversely, various assets were identified by specialists to be potentially suitable for reuse or repurposing [25], including:

- Power generation equipment
- Standalone process modules
- Glycol regeneration, desalination etc.
- Rotating equipment
- High value or long lead time fixed items
- Tubulars e.g. for piling

Information about equipment – such as design details and specifications, maintenance information and modifications – is important in enabling reuse or repurposing. In the absence of such information, recertification becomes critical.

[3] See for example the business pitches at the Creating value with sustainable decommissioning event https://www.agcc.co.uk/circular-north-east/circular-economy-resources

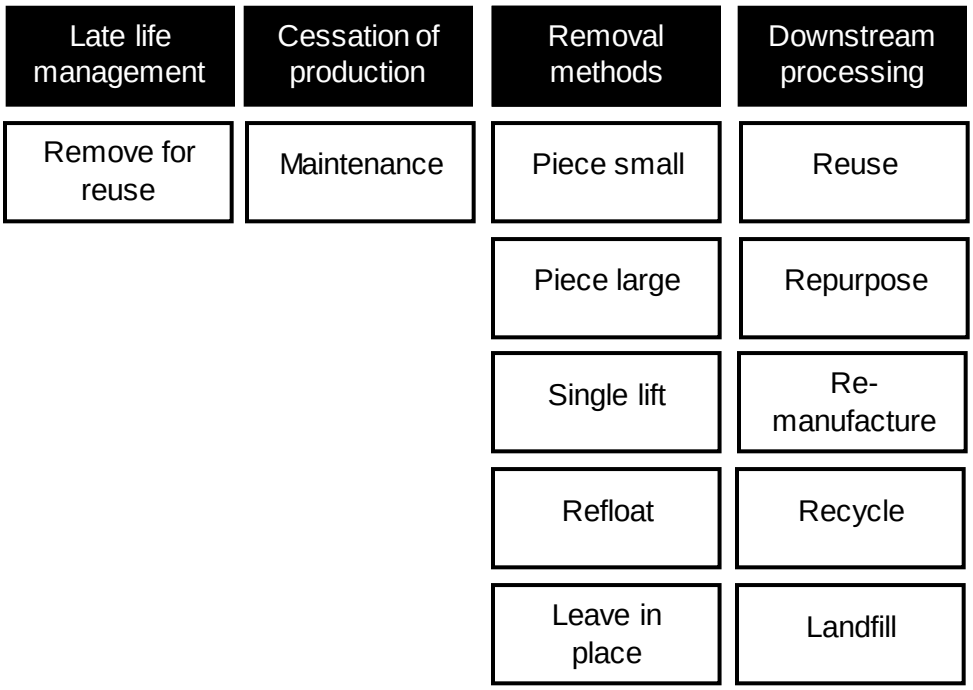

Figure 5: Overview of end of use strategies for NOG decommissioning.

Piece small and large can increase potential for reuse and repurposing of equipment and components, but is subject to more cost uncertainties which mainly pertain to [25]:

- Offshore labour costs
- Labour productivity and impact of offshore conditions
- Vessel hire costs for offshore demolition
- Transport costs of labour and accommodation
- Vessel use to power platform
- Decontamination costs
- Platform preparations for use of alternative technologies
- Use of new technologies

The costs of new technologies are currently estimated by adding the extra costs of offshore labour and working in the challenging offshore environment to the normal onshore demolition costs [25]. It is unclear whether this includes the additional value of contractors who are trained to work in hazardous environments. Moreover, at a sectoral level an investment into training of contractors in hazardous environments may be required, taking on board lessons learned in the nuclear and chemicals industries. These contractors would then need to gain practical experience. The potential to reduce costs for NOG decommissioning is high, but there is a potential trade off of greater health and safety risks which impacts on the outcome of the comparative assessment through which the removal method is determined. The risk to environment is considered lower because contractors are already used to work to high environmental standards onshore.

Costs could decrease with growing experience, benchmarking and learning, and if the number of offshore contractors would increase and strengthen competition. Costs could be further reduced with new techniques that are required during preparations for heavy lifts, the cost effectiveness of heavy lifts, and module separation, by demolition contractors, marine engineers, port facilities and global asset resale specialists.

3.3 NOG circular economy performance

The NOG sector reports a high recycling performance of ca 95%. However, as can be derived from Chapter 2, circular economy goes well beyond the recovery of resources. Moreover, the current recycling performance can be challenged, grounded in governance practice and industry reporting.

Arguably the waste hierarchy is applied in the decommissioning of NOG infrastructure. The waste hierarchy falls firmly within the domain of resources and waste management, the governance of which is led by DEFRA. The waste hierarchy prioritises waste prevention, the preparation of components for reuse, the recycling of materials, the recovery of elements and/or energy, and disposal – in that order [27]. However, the decommissioning guidance for NOG, falling in the remit of BEIS, appears to turn the waste hierarchy upside down (Figure 6). Waste prevention seems absent, reuse of components is not to be commonly considered and is clustered with the apparent institutionalised preference for recycling. Giving due consideration of the waste hierarchy is a legal obligation but BEIS deviates from this within the proposed procedures for NOG decommissioning.

Moreover, the NOG decommissioning performance against the waste hierarchy is not consistently measured in the close out reports. The 95% recycling performance is based upon the weight of materials brought ashore. However, building on the analysis by Marques, Bititci [28], close out reports suggest that large tonnages of materials are left in the marine environment, ranging from 23%-92% based on the numbers provided. However, two of the four reports analysed appear to have large tonnages of materials (to the tune of ca. 36-39%) that are not accounted for i.e. there is a mismatch between the total tonnage and the sum of tonnages reportedly left at sea and shored for further processing. This is a matter that requires further investigation and, herein, explicitly no conclusive statements are being made.

Recalculating the percentages based on the total tonnage, rather than just the tonnage brought ashore, results in a dramatically different picture: 0%-17% reuse and repurposing, 8%-28% recycled, and 0%-1% incinerated or landfilled. Bearing in mind, however, that the performance could yet be different given the tonnages for which the end of use pathway could not be traced.

Guidance and regulation on end of use management of decommissioned equipment, components and materials has to be integrated so that government bodies speak with one clear voice. In addition, reporting guidelines must be standardised and become more transparent, to avoid reports that do not clearly explain how all equipment, components and materials has been processed. In particular, situations in which “verifiers concluded that all items were removed from the seabed, but there is insufficient evidence to prove that all items were handed over to the waste management contractors” [29] are wholly unacceptable and bring the NOG sector and the UK Government into disrepute.

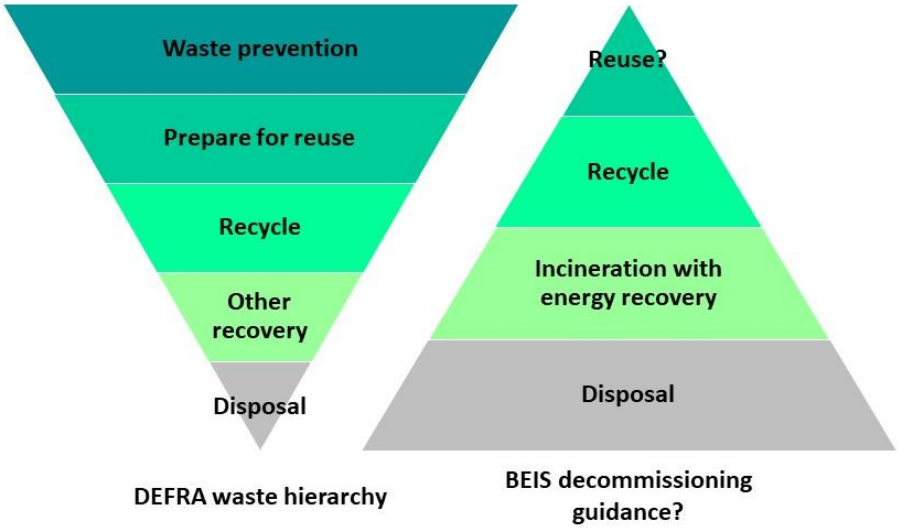

Figure 6: Waste hierarchy according to DEFRA and as proposed to be implemented in NOG decommissioning via BEIS guidance [27, 30].

3.4 Social network boundaries

Exploring the social network boundaries for the NOG decommissioning system, the following stakeholder types were identified:

1. Operators
2. Engineering companies and consultancies
3. Removal contractors
4. Port/ yard operators
5. Disposal contractors, waste management
6. Re-use and repurposing solution providers
7. Equipment suppliers
8. Material suppliers
9. End-users reused/ repurposed equipment, recycled materials
10. Third party (network) organisations
11. Professional bodies
12. Business support
13. Government bodies – policy makers and regulators
14. Funders
15. Environmental NGOs
16. Local communities
17. Research and innovation
18. Media and event owners

The Oil & Gas Sector Decommissioning Plan [1] includes a work breakdown overview (copied in Figure 7) that can be used to give direction to the types of stakeholders to involve in NOG decommissioning projects. Adding to stakeholders associated with each decommissioning stage in Figure 7, for circular economy the social boundaries should be extended to sectors offering circular economy solutions such as reuse, repurpose, remanufacture and higher value recycling as well as end-users of equipment and materials.

New installations are still being commissioned in the North Sea but only at a small scale, offering some opportunities for reusing, repurposing and recycling of equipment and materials within the NOG sector itself[4]. It is more likely, however, that new users of equipment and

[4] NOG involves equipment suppliers mainly of: Tubular steel, Steel Sections from the deck, Pipelines, Valves, Vessels and tanks, Compressors, Drilling packages, Engines, Generators, Hydraulic pumps, Lifting Equipment, Process equipment, Cement pumps, Water pumps, Winches, Accommodation block, Anchor chains, Helideck, Concrete mattress, Christmas tree, Subsea Wellhead, Power cables, Platform piles, and Floating production storage & offloading.

materials are located in other sectors such as the car industry and shipping [31], and the agriculture, aquaculture, chemical, civils, construction, energy, health, marine, transport and utilities sectors [32]. Depending on the scenarios explored it may be important to include organisations that recertify equipment. The supply chain for removal and disassembly can benefit from extension with stakeholders from the onshore demolition sector and global asset resale specialists [25].

It should also be noted that the inclusion of stakeholders for reuse, repurpose etc. does not imply that these solutions offer the most optimal combination of environmental, social, technical and economic values from a whole system perspective; this should be subject to scenario analysis (as outlined in Section 2). Moreover, circular economy generally aims to restore and regenerate the environment while decreasing economic costs. Therefore, if circular economy is the aim, then a solution in which parts of installations are removed and other parts are left in place could be the preferred solution; again, pending provision of the evidence base and an assessment from a whole-system perspective.

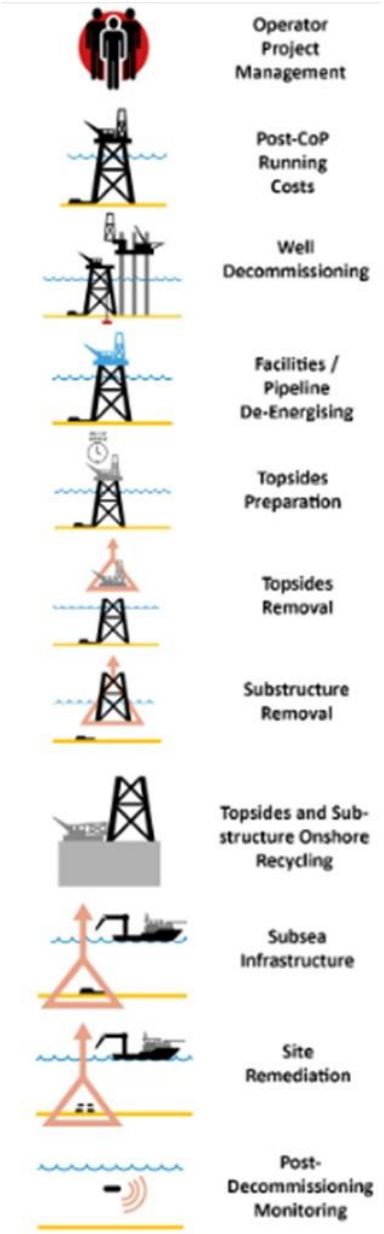

Figure 7: Overview of work breakdown structure NOG decommissioning (copy from [1].

4. Methods to explore value systems in NOG, decommissioning and circular economy

4.1 Stakeholder conversations

Conversations were held with key stakeholders (Section 4.2) in the period January – March 2020 to elucidate their value system and to understand the drivers and barriers for adopting more circular economy practices. In informal conversations of about one hour the following subjects were covered:

PART 1: What stakeholders consider important about circular economy, oil & gas, and the decommissioning sector in general.

1. Professional life in general including their role in the oil and gas sector and what they consider important about their work
2. Oil & gas sector including the most important benefits that the oil & gas sector has created and any adverse impacts that may have been generated
3. Circular economy including why the oil & gas sector started to look into circular economy and the extent to which circular economy approaches have been integrated
4. Decommissioning including views in general, most important considerations and when decommissioning is considered successful

PART 2: A case study to discuss when the decommissioning of an installation is considered successful, the parameters based on which stakeholders would decide when a project is successful, and the wider benefits, consequences and trade-offs of this success (see case study selection in Section 4.3).

5. Based upon the case study, what was good and less great about the decommissioning plans
6. Economic, social, environmental and technical costs and benefits associated with the decommissioning of the case study example
7. Synergies and trade-offs between the identified values, and the wider system implications of decommissioning NOG
8. Reflection whether the costs and benefits identified for the case study were in line with the values discussed in the first part of the conversation

Generally speaking Part I was fully covered in the conversations, but point 4 tended to be based on the case study already. There was little time for point 6-8 and these were often covered briefly only.

Conversations were not recorded. Notes were taken during the conversations, and these were anonymised and thematically analysed afterwards to draw out commonalities and differences, presented in narrative form in Chapters 5-6.

4.2 Stakeholder selection

A stakeholder analysis was carried out for the purpose of identifying key stakeholders to engage via one-to-one conversations about system change to embed more circular economy practices into NOG decommissioning.

Data from the initial stakeholder engagement in the preparation and opening stages of this project and in the system selection, and the start of the system dynamics analysis and material flow analysis, identified a longlist of 218 stakeholders (data and documents used in this process have been listed in Appendix A). A group of ca 20 project stakeholders was first asked

to check whether any important organisations were missing and to complement the list accordingly.

The most influential stakeholders, i.e. those who have the most control over the NOG decommissioning system, were selected by asking the members of the key stakeholder group to cast 22 votes each. The number of votes per stakeholder were summed up (companies in the oil & gas, port, removal and waste management were grouped) and the top 10% with the most votes were considered the most influential stakeholders in the NOG system – in alphabetical order rather than in order of votes received:

1. BEIS
2. Decommissioning Regulatory Hub
3. Decom North Sea
4. Environment Agency
5. Health & Safety Executive
6. Marine Scotland
7. OGA – Decommissioning Task Force / MER UK
8. Oil & gas operators
9. Oil & Gas Technology Centre
10. Oil & Gas UK
11. OPRED – Offshore Decommissioning Unit
12. OSPAR
13. Port operators
14. Removal and waste management companies
15. Scottish Enterprise
16. Scottish Environmental Protection Agency
17. Scottish Fisherman's Federation
18. Scottish Government
19. Society of Underwater Technology
20. Zero Waste Scotland

This is an interesting outcome in terms of key influencers because of those that are missing from the top 10%. SEPA's Oil & Gas Sector Decommissioning Plan [1] identified for example Defra, the Crown Estate and the NGO community in general as key influencers as well.

4.3 Case study selection

During the project initiation it was repeated several times that decommissioning strategies had to be determined on a case-by-case basis. Moreover, using an example can help to take conversations out of the abstract and make it more concrete.

A case study was selected following a structured approach. Core stakeholders suggested four potential installations that had been or were about to be decommissioned. These were assessed against a number of criteria which can be found in Table 1. Following the assessment process Goldeneye was selected as a case study for this project (Figure 8).

Table 1: Case study assessment.

	Goldeneye	Leadon North Towhead	Viking / Loggs
Located in the Central North Sea, assuming that this increases likelihood that a reuse/ repurpose scenario is realistic when compared to an installation in the Northern North Sea Central = 3; Southern = 2; Northern = 1	Central North Sea (gas condensate) 3	Northern North Sea (oil) 1	Southern North Sea (gas) 2
Potential criterion: (to be) landed in Scotland Scotland = 3; Elsewhere UK = 2; Abroad = 1	Unknown 1?	Lerwick 3	Great Yarmouth 2
Preference for an already decommissioned installation, but can focus on an installation that is to be decommissioned shortly Already decommissioned = 3; In progress = 2; Forthcoming = 1	To be decom shortly 1	In progress 2	To start soon/ in progress 2
Steel jacket structure preferred to increase potential for transferability of assessment outcomes to other installations (Table 2) Steel jacket = 2; Other structures = 1	Steel jacket 2	Subsea – FPSO combination? Mostly carbon steel 1	Steel jacket Field consists of satellite platforms and hubs. 2
Inventory of materials and equipment is available Yes = 2; No =1	Yes 2	Yes 2	Yes 2
Insight into forecasted and actual economic costs, assessment made to meet regulatory requirements, and news messages, blogs, reports or other documents about the public perception of the decommissioning operation would strongly benefit the assessment Data availability high = 3; medium = 2; low =1	Partly (comparative assessment available + news messages) 3	No comparative assessment. Some material available online. 1	Partly (comparative assessments plus additional info available) 3
Total scores	12	10	13

Table 2: Type, location, number and size of North Sea oil and gas installations (copied from [25].

Country	Steel Jacket	Concrete Substructure	Subsea	FPSO	Total	Tonnes
UK	227	12	56	17	312	2290
Norway	69	13	54	9	145	1750
Netherlands	118	2	7	0	127	340
Denmark	39	0	0	0	39	114
Germany	1	1	0	0	2	0

Source - KIMO International

Shell submits Goldeneye decommissioning plan

Shell submits plans to decommission one of the North Sea's youngest platforms.

9 November 2018 / Practice, UK

Anglo-Dutch oil and gas firm Shell has submitted its draft decommissioning programme for its North Sea Goldeneye platform to the Department for Business, Energy and Industrial Strategy. Shell plans to remove all of the topsides and jackets and take them to a shore yard for dismantling and recycling.

The Goldeneye platform is a four-leg piled steel jacket weighing in at 3,500t, anchored to the seabed 120m down using eight piles totalling 2,500t. The platform itself is located 100km east north-east Peterhead, Scotland and was installed in 2004. After only operating for seven years the platform is now being decommissioned.

A decommissioning programme, environmental appraisal report and comparative assessment has been submitted for the project, with stakeholders now able to comment on the draft plans. No derogation from the general OSPAR Decision 98/3 is being sought.

Figure 8: Article published by the Environment-Analyst, which was used to introduce the case study during the stakeholder conversations.

5. Values held by North Sea oil & gas actors

Values can be understood as the matters that people find important. The values described in this section are the views from the project participants with whom conversations were held in the period January-March 2020. Anonymised notes from conversations were thematically analysed and turned into one coherent overarching narrative presented herein.

5.1 Economic

The major economic benefit from NOG that was unanimously mentioned by all stakeholders was wealth generation. However, concerns were raised about the destination of the wealth. Funds disappeared "into the wrong pockets" and the balance between wealth generation for the country and for companies was insufficiently discussed over the lifetime of the sector.

Wealth for shareholders is still understood as one of the major determinants of business success. These matters may be changing though because for oil & gas to attract investment, companies increasingly have to show that they are "energy companies" with diversification into renewables, hydrogen and carbon capture and storage. In other words, to continue with the core business in oil & gas, companies must join the energy transition (further covered in Environment).

NOG is part of a heavily globalised industry. While this global industry has brought economic prosperity with better living conditions for communities in Scotland, there are now more calls for community-embedded businesses with greater social value. This is particularly visible in discussions focused on decommissioning, with calls to bring platforms and components ashore in Scotland or the UK, to generate economic activity and jobs domestically. Indeed, the decommissioning costs to NOG offer an economic development opportunity for other industries (further covered in Social).

Such perspectives on local and regional benefits were, however, found to be at tension with the government target to minimise decommissioning costs. Local and more circular solutions such as reuse are more costly than exporting the decommissioned infrastructure for dismantling and processing abroad. While "decommissioning has to be as cheap as possible within social and environmental boundaries", environmental and human rights concerns have been raised around rigs exported to for example India and Bangladesh.

Cost reductions are also considered essential for attracting investment. Nevertheless, investment in decommissioning should be promising in any case, given the anticipated market development. Industry has identified decommissioning as a new export market but, within the conversations held, it was not made clear what exactly was to be exported i.e. the decommissioning infrastructure itself or newly developing decommissioning technology and expertise.

Export and globalisation have been a core part of the industry's vocabulary. Oil & gas lowered energy prices and this enabled a strong growth in the current economic system based on cheap products and global supply chains. High material consumption enabled by cheap energy has had hugely detrimental effects on our environment. While demand for oil & gas products continues to be high, resulting in the climate emergency and environmental decline, the industry does not consider it to be part of their responsibility to drive a reduction in the consumption of their products. This is understandable from a business continuity perspective and indicates a role for Government and other societal actors to step in. It remains a

reputational risk, however, whether the general public will recognise this as the industry doing "*everything we can"* (Tim Eggar, 15 January 2020) to contribute to net-zero targets.

The belief in on-going demand for oil & gas products is exacerbated by doubt from within the industry about the reliability and feasibility of an energy system entirely based on renewables. The effects of the energy crises now nearly 50 years ago are deeply ingrained in long-held beliefs that oil & gas are still essential for energy security and self-sufficiency.

The oil & gas industry appears primarily concerned with securing short-term economic benefits. The success of the MER, for example, should be measured in more than monetary terms to deliver decommissioning in the most cost-efficient manner. This will require change to the OGA strategy to fully embed the implications of contributing to the net-zero transition (also see response to OGA strategy consultation in Appendix B). Success of a decommissioning operation is largely determined by delivery within budget – environmental and social performance take a second rank. As noted by project participants, the success of a more sustainable low-carbon economy is determined over longer periods of time to safeguard a healthy environment on which economic activity depends.

Given the focus on economic aspects, the major driver for looking into circular economy was stated to be in the interest of reducing costs. Circular economy solution providers also stated other motivations, such as a desire to reduce waste. There is a contradiction in the position of operators: On the one hand the onshore handling of decommissioned rigs and components is relatively low compared to the total cost of decommissioning, and this offers little incentive to reduce costs/ generate a positive monetary value from the further processing of components and materials. On the other hand there appears to be an aversion to solutions such as reuse because it could increase the decommissioning costs, and this fits well into the MER to minimise all decommissioning costs. However, if costs were low already, then the effect of such measures should be limited in the grander scheme of the operation. While more openness to circular economy would cost the industry little in monetary terms, the benefits for themselves and local communities are anticipated to be substantial.

5.2 Social

The most voiced social benefit of NOG is the creation of jobs. Working in oil & gas was perceived as prestigious, although this may have changed with the growing awareness of climate change. Jobs and social benefits are considered more important than doing what is best for the environment. The Scottish economy has a long-term heritage of relying on the marine environment for employment, such as fishing and oil & gas. There is a sense of pride and emotional ties to these industries and this influences policy, even if it creates perverse incentives with regards to the health of the marine environment upon which livelihoods depend.

The embeddedness of NOG, via the jobs provided to people, in local communities poses challenges and opportunities for radical change. It is difficult to be against something, or be more in favour of something else, if it is still an important part of your livelihood. It was suggested that NOG has become such an important employer in Scotland that it has created too much of a dependency on this sector. Within this context, statements in the importance of democracy and making sure that Scotland has a voice in NOG activities take on extra meaning. Even more so when considering the view that too much of the wealth generated disappears to Westminster while it was felt that the Scottish government is left without sufficient resources to deliver on the energy transition.

Within the governance environment the MER policy, which reinforces the single value focus on money described in the preceding section, offers a “safety blanket” for ongoing oil & gas extraction. But public opinion is changing with the public now expecting companies to go beyond compliance and to do everything that is possible against climate change. It was suggested that it is public perception and government’s understanding of it that is setting the rate of change for industry. NOG has to act upon public opinion in order to maintain a social license to operate.

While some industry bodies emphasise the importance of, in their view, maintaining a collective voice, industry responds with a range of messages to the dynamic social and economic environment. It is considered important that NOG now does what they promised to do in relation to net zero. There is an underlying concern that it is more PR and not really about driving radical change. This is also the case for the uptake of circular economy practices in decommissioning. First because of very public cases in which rigs were exported abroad for dismantling to save costs but under deeply concerning social and environmental conditions, arguably breaking waste regulations via a network for international crime. This damages reputation and the credibility of the whole industry in doing what is right. Second because of the inclusion of circular economy practices in CSR policies, the contents of which apparently unfamiliar to operators. Uptake of circular economy appears driven by CSR and environmental considerations in times of economic instability. In times of economic crisis the emphasis shifts to financial considerations. This is a notion that requires further investigation.

Building relations with other actors on the health of the environment was considered important, especially given that the marine space becomes ever busier, with regular liaising to be able to note and solve issues proactively. The success of decommissioning is also measured by the opinion of stakeholders, with the reputational liability of decommissioning considered resolved if stakeholder expectations have been met. In practice, this most commonly means that decommissioning is signed of successfully if everything is removed and then trawled over by the fishing industry without incidents.

The other major tenet of social value revolves around safety within the industry. In the first place this is about safety of those delivering the decommissioning operations, with the offshore part of the operations considered to have higher safety standards while the onshore dismantling and waste management is subject to lower safety standards. It is also about making the environment safe again for other users of the sea after decommissioning. Risk perception is holding back the reuse of components and equipment out of concerns for liability claims if anything does go wrong, making recertification a necessary step. Arguably the focus of NOG is on risk minimisation to people and environment, and the industry is characterised as risk averse. It is then ironic that the same industry has ignored the precautionary principle with regards to climate change resulting from the use of fossil fuels, thereby putting the safety of the entire human population and the stability of our planetary system at risk.

5.3 Environment

The most important new environmental value appearing in NOG is that of contributing to net zero, following a long legacy of climate change denial. It has become impossible to deny climate change any longer due to the frequent climate change related environmental disasters. Despite this positive step, it is received with scepticism and the communications of the NOG industry are considered superficial. This has much to do with the narrow system boundaries drawn around the industry, only taking responsibility for the production of fossil fuel products but not for their usage.

The argument that oil & gas industry cannot change the use of their products, and that it is acceptable to continue extraction because demand for products persists, does not align with the public's expectations. The expectation is that the industry will do what is best for the environment, no matter what. The line of expectation is that of one planet prosperity, in which resource use is brought back to a scale of one planet only, without compromising the economic viability of a country and individual companies. For companies in NOG this will mean a complete change of business activities.

Environmental considerations go beyond climate change and extend to natural capital and waste. There was some ambivalence in terms of project participants stating that environmental impacts at sea are less visible to people and thus less of a concern, while at the same time noting close relations to the marine environment via jobs and communities. Environmental impacts should be minimised and – during decommissioning – all pollutants should be removed. There is a growing movement against waste and pollution, such as reflected in the discussion on flaring.

Circular economy is often narrowly perceived as being about waste management and not the wider system change such as described in Section 2. It is considered in terms of the waste hierarchy, and arguably via the duty of care and right waste, right place. Decommissioning success is when end of waste is achieved, with maximum materials recovery and minimal disposal.

Comparative assessment should point out whether the sourcing of new raw materials and manufacturing is better or worse than reuse and/or recycling. In other words, whether it is better to decommission all assets or whether it is better to leave some in-situ. The increasingly short lifespan of oil & gas fields is an incentive for more circular economy practices, making operations more affordable through the reuse of components and equipment. Reuse and remanufacturing services can also meet demand for replacement parts faster and cheaper than OEMs. This creates the perverse incentive, however, that circular economy enables continued extraction of NOG. In this manner, from a whole system perspective, NOG decommissioning is unlikely to become fully part of a circular economy. There is scope to align NOG with a more sustainable circular economy at a whole system level if the aim becomes the repurposing of infrastructure for hydrogen, CCS and/or renewables. There are concerns with such repurposing that ownership models will be complex resulting in lack of clarity regarding who is responsible to remove infrastructure later on.

Circular economy approaches for NOG can also contribute to sustainability via rigs-to-reefs. An underrepresented, and arguably controversial, area of circular economy is the acceptance that zero waste is not technically, environmentally and economically feasible or desirable and hence circular economy must include solutions on the reintegration of materials into natural biogeochemical cycles. Within circular economy this offers space for the rigs-to-reefs discussion.

Proponents of rigs-to-reefs argue that leaving infrastructure in-situ is safer because most safety incidents happen during the onshore dismantling and waste management, that the energy cost of decommissioning is high and that repurposing for CCS/ hydrogen reduces energy use, that there is a lack of natural habitat left in the North Sea and that rigs offer environmental value, and that the infrastructure uses a relatively small surface of the marine space which results in a limited impact.

This latter argument in particular, however, flies into the face of opponents of rigs-to-reefs, fuelling the perception that the industry tries to get away with doing the minimum required instead of what is right. It is seen as a display of lack of moral desire to clean everything up.

The acceptance of some but small amounts of pollution and slow leakage into the environment over time are in line with that of an incremental circular economy, rather than the transformative changes that are required for sustainability[5]. The public opinion is generally not thought to be in favour of rigs-to-reefs. Similarly, the general line in international legislation is to restore the seabed to conditions similar to that before the development and in practice is often perceived as acting upon the best solution from social and environmental perspective.

To resolve the differences between proponents and opponents there has to be openness to discuss decommissioning options, and more transparency about the assessment and decision-making about the decommissioning approach taken and about the performance of decommissioning operations. There is consensus across NOG stakeholders that decisions on decommissioning approaches, including rigs-to-reefs, should be made on a case by case basis. There is no agreement yet about the exact criteria based on which such assessments should be made – as opposed to the current processes in place – but it should at least include social and environmental indicators and a risk assessment. Economic considerations may best be left out of the equation altogether, to remove any suggestion that decisions are made for the monetary benefit of NOG. This discussion would be aided by a stronger evidence base, enabled by greater collaboration between NOG and researchers and open data, which is currently considered IP or commercially sensitive, and not available for the purpose of environmental protection.

5.4 Technical

Most valued in technical terms is the high standard of engineering and skills that has developed within the industry. This has resulted in a "huge crop of talent" both in the UK and globally, with people moving all over the world with export, income and reputational benefits. NOG has also brought advances in other areas of expertise, such as geographical surveys, understanding the geographic and oceanographic conditions, etc (but note data restrictions mentioned above).

Decommissioning is another opportunity to transfer people and skills from NOG into a new market. Decommissioning is seen as a new industry – raising the question whether it needs specific support as many new industries do – requiring new skills, technologies and expertise. Notably the psychological drivers for decommissioning are different. There is interest to move into this new sector and to make the UK a centre of excellence in decommissioning.

Currently, circular economy is not integrated yet with decommissioning. Decommissioning is considered a linear process with limited closing of loops of material flows within the industry itself (which may not be a bad thing when phasing out an industry). Circular economy has to be made easier. In part this can be enabled by greater proactivity in industry itself, anchored in regulation and guidelines, to recover reusable components and equipment before the cease of production. There were complexities highlighted here regarding the procedural assessment in the engineering processes which need to be clarified further. The risk averse character of the industry has to be brought into line with circular economy practices, for example with new procedures and recertification. This would also help to rebut concerns about low quality/ durability of reused, repurposed and remanufactured components and equipment.

[5] For the difference between these different types of circular economy, see 33. Reike, D., W.J.V. Vermeulen, and S. Witjes, *The circular economy: New or Refurbished as CE 3.0? — Exploring Controversies in the Conceptualization of the Circular Economy through a Focus on History and Resource Value Retention Options.* Resources, Conservation and Recycling, 2018. **135**: p. 246-264.

6. Drivers and barriers for a more circular economy in North Sea oil & gas decommissioning

Project participants identified numerous drivers and barriers for a more circular economy in NOG decommissioning.

6.1 Barriers

Barriers appeared in terms of:

- Relations in companies, the private sphere and the governance system
- Lack of circular economy knowledge and understanding of actions to take
- Poorly integrated policy and regulation
- Lack of decommissioning infrastructure
- Knowledge gaps and coordination across academia
- Risk averse and procedural manner of working
- Limited valuing of nature compared to monetary gain

Relational barriers were identified in the private, social sphere with friends and family commonly working in NOG. More direct barriers occur within companies, where decision makers, decommissioning operations and engineers are too distant from each other, thereby failing to realise the circular economy potential. Change, it was felt, has to be driven from the top of a company – this idea is indeed also reflected in the drivers for change. Across the sector there is a lack of cooperation (project level) and collaboration (strategic level).

Disjointed governance poses major barriers. This can be seen right from the point of the MER which is poorly aligned with for example clean growth and resource management policy. Overall, the lack of an overarching vision for the marine environment constrains for example the reuse potential of NOG infrastructure for CCS and hydrogen. Moreover, the Scottish and UK government are not integrated which drives mismatches in the available resources to deliver on the energy transition. Finally, regulation is misaligned across organisations with NOG and decommissioning being subject to multiple regulators. There is demand for a whole system approach across the governance landscape.

While the technical expertise for energy transition is present, delivery is considered challenging because of competition for investment and the limited availability of infrastructure to switch fully to renewables while energy demand continues to be high.

Moving to the uptake of circular economy practices in particular, for the NOG industry there is no clear impetus to take up circular economy. Decision making in favour of circular economy, outside of the usual financial considerations, is challenging because valuing nature is quite literally considered a joke. Decisions are profit and shareholder driven – but note how this may have to change given the climate concerns of major investors.

Circular economy is often perceived as too complex and risky with too limited benefits. It is difficult for the NOG industry to understand what the right thing to do is. The solution is being sought in the provision of new procedures, to replace the bureaucracy and procedures that are currently holding back circular economy practices.

Understanding of the best circular economy solutions is further held back by poor quality material inventories and uncertain commercial values of recovered materials. This poses challenges for decommissioning contracts and holds back investment. Equipment is also often bespoke and unique approaches are commonplace, both of which make the development of

circular economy solutions more challenging. Equipment and component design are not normally completed with decommissioning in mind.

Examples of circular economy practices are few and far between but, if they were available, could really help uptake. That would create a portfolio of ideas for reuse, remanufacturing, etc. Overall, more opportunities for knowledge exchange would help to gather more circular economy examples. Movement of people around different organisations would also aid the development of a whole system understanding which is an essential part of circular economy expertise.

6.2 Drivers

NOG has changed direction and is now aiming to support net-zero and the energy transition. The mind-set is changing due to various reasons, including:

- Oil & gas running low
- Public opinion on climate change
- Crises: economic, social, environmental
- Education and communication
- Regulation

Crises have historically proven to be keystone moments for change. The Piper Alpha disaster was a transformative moment for HSE practices. The economic crisis in 2008 forced diversification of NOG to reduce costs. The current multi-layered – economic, social and environmental – crisis can be another moment of transformation for NOG, possibly for the wide uptake of circular economy. Such transformations have to be accompanied by extensive education, training and development of new skills and expertise, combined with broad media coverage on the subject repeating the crisis and demand for change.

The changing public opinion and government's understanding of it is driving change. NOG is a regulation driven industry – they do what they must. Government interventions such as net zero policy are considered crucial for driving change and could include: tax breaks; stop new permits for extraction; more ambitious targets to process wastes in UK. This is an industry that appears to operate in a relatively hierarchical manner, which is also visible in organisational structures within companies – the belief that change must be driven from the top – and the sector as a whole – the belief that change is driven by a few offering thought leadership.

Decommissioning is driven by low oil & gas prices. Circular economy is driven for different reasons depending on economic conditions, but it times of crisis it tends to be pursued for the reduction of costs. As outlined in the values section, there is a perverse incentive to adopt circular economy to reduce costs and thereby enable continued extraction. Moreover, circular economy practices can contribute to the social license to operate, being seen as doing the right thing. Within the net-zero transition, there is a further driver in the sense of repurposing NOG infrastructure for CCS and hydrogen.

So far, uptake of circular economy has been reliant on the existence of networks within the sector, which has offered an entrance to make the case for circular economy solutions that go beyond recycling. This relational approach can also be observed in the practice of regulators, which aim to build up positive relations to enable circular economy and coach to compliance rather than taking the enforcement route.

Good and memorable examples are also important tools to drive change. For example, the Brent case led to such poor publicity that it cost Shell in sales. The subsequent repurposing of components in a dock is seen as a successful example. Sharing of good examples is a

driver that can be used more than it currently is. There must be circular economy solutions for operators to choose from.

There are companies providing circular economy solutions to NOG. Lighter and easier regulation was proposed as one way to enable more of such business activity, and this requires coordination across the diverse regulators involved. Financial drivers could also be applied, on the one hand to make solutions such as reuse, remanufacturing and recertification more affordable via tax breaks and on the other hand by making practices such as landfill and export more expensive.

7. Reflections and recommendations

In a sustainable circular economy the core values are the maintaining or improving of environmental quality and social well-being, enabled by an economy that offers economic prosperity (Section 2). Section 5 showed how within NOG the generation of wealth and short term economic success is considered the most important/ pertinent. This also transpires into the sole focus of the MER UK whose success is measured in monetary cost reductions, trumping community considerations for circular economy measures that would add relatively limited costs to the NOG industry (given the low percentage of decommissioning costs going to waste management) but could potentially generate much greater social benefits in the UK. The social considerations in turn trump environmental concerns, expressed by the acceptance of small amounts of pollution and, more importantly, the risk that continued extraction and use of fossil fuel present to the living conditions for people on our planet. The circular economy and NOG worldviews could not be farther apart (Figure 9).

The second major difference between circular economy and NOG pertains to systems thinking. A sustainable circular economy requires a whole system approach, considering the effects of changing one part of the system on another part of the system. For example, when a manufacturing industry produces something then the resources sector will eventually have to clean it and have the infrastructure to do so. In a circular economy the effects of changed practices are considered proactively with a view to optimise the costs and benefits across the environmental, social, technical and economic domains of value. In NOG, systems approaches are not embedded yet. For example, in the striving for net zero the system boundaries are drawn narrowly around the extractive industry while washing their hands clean of the environmental destruction that fossil fuel usage brings. In operations there seems to be a low awareness of decommissioned equipment and components that could be safely reused in combination with recertification. And while arguably a risk averse industry, in decommissioning this seemingly goes overboard by exporting infrastructure for dismantling and processing abroad, risking great human rights concerns and environment pollution.

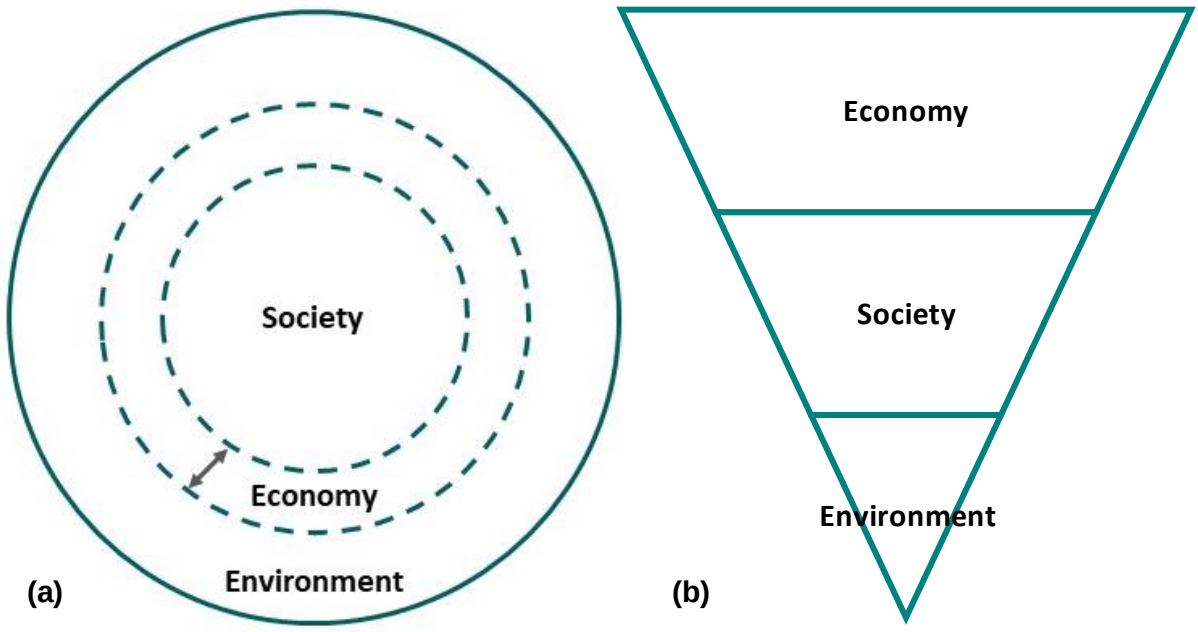

Figure 9: Difference in value systems for a) sustainable circular economy and b) in NOG.

Circular economy approaches should not be used for the purpose of affordable continued NOG extraction. The use of non-renewable and polluting fossil fuels can never be in line with a sustainable circular economy, and hence neither can their extraction. Adopting circular economy approaches in NOG must be for the purpose of accelerating the energy transition, repurposing NOG infrastructure for carbon capture and storage and hydrogen integrated with renewables.

Managing and designing NOG infrastructure in a manner that enables sustainable decommissioning and circular economy is not the norm yet. This is a problem because it increases the cost and risk to industry and Government. It also contradicts a host of Government strategies such as the Clean Growth Strategy, Resources and Waste Strategy, 25 Year Environment Plan, etc. Public perception has also notably changed in recent years with grave concerns regarding climate change, and the direction of travel is clearly in favour of accelerating a low-carbon economy particularly supported by more renewable energy.

Implementing a circular economy can bring crucial benefits to NOG, more value (in all of its forms) generated throughout the lifecycle of energy infrastructure, high potential to develop new industries that can benefit the UK economy, contribute to achieving Government strategies for a more sustainable economy, continue to attract investment that relies on NOG industry joining the energy transition, and supporting a more positive image in the public eye.

The management and decommissioning of NOG infrastructure for circular economy, and thus for the energy transition, must be embedded in the decommissioning programme guidance and OGA strategy accordingly, and build into permitting processes with proposed "decommissioning" programmes submitted earlier to enable revisions in the design of oil & gas infrastructure. This kind of proactive decommissioning planning requires new collaborations across the energy sector and carbon capture and storage but also involving the resources and environmental sectors earlier on. There are a host of new circular economy companies emerging within the energy and decommissioning sectors, with expertise to repair equipment and components for safe – certified – reuse, repurposing and/or remanufacturing. The resources and new circular economy companies within energy and decommissioning have the expertise to advice on valuable end of use pathways for equipment, components and materials. Crucially, such advisory conversations must be had early on, well before the cease of production and ideally even at the design stage of newly developed infrastructure. At these stages the equipment and components have not become a waste yet and this offers far more flexibility in end of use destinations with greater value.

The drivers and barriers suggest that the best way to embed greater proactivity in decommissioning and circular economy is via a relational approach in which regulators coach for compliance, good examples of new business practices are shared and operators become engaged in a more circular economy. Nevertheless, evidence also suggests that the industry works by the minimum required as expressed in regulation, and as such effective means to drive change can include a) Higher ambitions for managing wastes from offshore energy infrastructure in the UK set out in Government regulation and b) Making export more expensive/ difficult via permitting procedures.

Recommendations to policy makers and government have been summarised in Table 3. Separate recommendations were formed in response to the questions in the OGA Strategy (consultation response in Appendix B).

Table 3: Overview of policy recommendations.

Adapt OGA strategy to include targets that first and foremost measure progress in terms of social and environmental performance in the energy transition and circular economy.
Adapt OGA strategy to incorporate circular economy approaches in NOG for the purpose of accelerating the energy transition, repurposing NOG infrastructure for carbon capture and storage and hydrogen integrated with renewables as soon as possible, aligning the OGA strategy with the Clean Growth Strategy .
Incorporate the management and decommissioning of NOG infrastructure for circular economy, and thus for the energy transition, into permitting processes with proposed "decommissioning" programmes submitted earlier to enable revisions in the design of oil & gas infrastructure.
Adopt a whole system approach to proactively assess environmental, social, technical and economic costs and benefits in assessments and decision-making for NOG decommissioning.
Adapt decommissioning guidance to involve stakeholders representative of the whole system earlier on in the process, additionally covering the wider energy sector, carbon capture and storage, and the resources and environmental sectors.
Identify – before the cease of production – opportunities for component and equipment reuse, repurposing and remanufacturing, together with innovative circular economy companies and the resources sector.
Ensure that regulators have sufficient resources in terms of skilled staff, money, time and procedures to collaborate, and to coach operators to compliance.
Share best practice in circular economy approaches in NOG decommissioning.
Enable better circular economy performance in NOG decommissioning by a) Higher ambitions for managing wastes from offshore energy infrastructure in the UK set out in Government regulation and b) Making export more expensive/ difficult via permitting procedures.
Summarised recommendations from OGA Strategy consultation (Appendix B):
The sector as a whole must take a whole system approach with the purpose of fully supporting the transition towards a low carbon economy within the sector and beyond, by the means of: 1. Building a collaborative culture to ensure that the oil & gas sector has the credibility to play an active role in the energy transition and the pathways to become an energy actor. 2. Adopting criteria for sustainable investment in line with the Government's Green Finance Strategy and the ambition to leave our environment in a better state for future generations. 3. Removing punitive action against actors that want to reduce oil & gas extraction when evidence shows continuing higher production rates are suboptimal from a balanced economic, social and environmental perspective.

References

1. SEPA, S.E.P.A., *Oil and Gas Decommissioning Sector Plan*. Undated.
2. OGUK, O.G.U., *2017 Decommissioning Insight*. 2017.
3. NAO, N.A.O., *Oil and gas in the UK – offshore decommissioning*. 2019.
4. Kirchherr, J., D. Reike, and M. Hekkert, *Conceptualizing the circular economy: An analysis of 114 definitions.* Resources, Conservation and Recycling, 2017. **127**: p. 221-232.
5. Velenturf, A.P.M. and P. Purnell, *What a sustainable circular economy would look like.* The Conversation, 2020.
6. Velenturf, A., *Circular economy strategies for more sustainable wind energy*, O.R.E. Catapult, Editor. 2020.
7. Velenturf, A.P.M. and P. Purnell, *Principles for a Sustainable Circular Economy.* Sustainable Production and Consumption, 2021. **27**: p. 1437-1457.
8. Circle Economy, C., *Circularity Gap Report 2019*. 2019.
9. Green Alliance, G., *Less in, more out: using resource efficiency to cut carbon and benefit the economy*. 2018.
10. UN, U.N., *Transforming our world: the 2030 Agenda for Sustainable Development*. 2015.
11. DEFRA, D.f.E., Food and Rural Affairs, *Environment Bill 2020.* 2020.
12. Purnell, P., A.P.M. Velenturf, and R. Marshall, *Chapter 16: New Governance for Circular Economy: Policy, Regulation and Market Contexts for Resource Recovery from Waste*, in *RSC Green Chemistry*. 2020. p. 395-422.
13. Lacy, P. and J. Rutqvist, *Waste to wealth: The circular economy advantage*. Waste to Wealth: The Circular Economy Advantage. 2016. 1-264.
14. Stahel, W.R., *The circular economy.* Nature, 2016. **531**(7595): p. 435-438.
15. Velenturf, A.P.M. and J.S. Jopson, *Making the business case for resource recovery.* Science of the Total Environment, 2019. **648**: p. 1031-1041.
16. Bocken, N.M.P., et al., *Product design and business model strategies for a circular economy.* Journal of Industrial and Production Engineering, 2016. **33**(5): p. 308-320.
17. Velenturf, A.P.M., et al., *Circular economy and the matter of integrated resources.* Science of the Total Environment, 2019. **689**: p. 963-969.
18. Velenturf, A.P.M., *A framework and baseline for the integration of a sustainable circular economy in offshore wind.* Under review.
19. Iacovidou, E., et al., *A pathway to circular economy: Developing a conceptual framework for complex value assessment of resources recovered from waste.* Journal of Cleaner Production, 2017. **168**: p. 1279-1288.
20. Coronado, M., et al., *Complex Value Optimization for Resource Recovery (CVORR): A Tool for an Evidence-based Pathway to Circular Economy*, in *WASCON 2015: 9th International Conference on the environmental and technical implications of Construction with Alternative Materials*. 2015.
21. Gasparatos, A., *Embedded value systems in sustainability assessment tools and their implications.* Journal of Environmental Management, 2010. **91**(8): p. 1613-1622.
22. HM Government, H., *Industrial Strategy*. 2017.
23. Mignacca, B., G. Locatelli, and A. Velenturf, *Modularisation as enabler of circular economy in energy infrastructure.* Energy Policy, 2020. **139**.
24. Enterprise, S., *Regulatory Landscape: UK Example*. undated.
25. DNS, D.N.S., Z.W.S. ZWS, and ABB, *Offshore Oil and Gas Decommissioning: Platform Removal Methods, Inventory Characterisation and Re-use Solutions*. 2015.
26. Mackie, C. and A.P.M. Velenturf, *Financial security for decommissioing offshore renewable energy installations in UK waters: trouble on the horizon.* Under review.
27. DEFRA, D.f.E., Food and Rural Affairs, *Guidance on applying the Waste Hierarchy* 2011.

28. Marques, M., et al., *Reusing and recycling decommissioned materials: Is the glass half full or half empty?*, D.N. Sea, Editor. 2021.
29. Jee and BP, *North West Hutton Decommissioning Programme: Close-out Report* 2014.
30. BEIS, D.f.B., Energy and Industrial Strategy, *Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines*. 2018.
31. Green Alliance, G., *Circular Economy Scotland*. 2015.
32. RSA, R.S.o.A., *North sea oil and gas rig decommissioning & re-use opportunity report*. 2015.
33. Reike, D., W.J.V. Vermeulen, and S. Witjes, *The circular economy: New or Refurbished as CE 3.0? — Exploring Controversies in the Conceptualization of the Circular Economy through a Focus on History and Resource Value Retention Options.* Resources, Conservation and Recycling, 2018. **135**: p. 246-264.

Appendix A: Bibliography for Circular Oil & Gas Decommissioning project

Coproduced bibliography with NOG stakeholders, last updated January 2020.

Reports and plans:

1. IOGP (2003) Disposal of disused offshore concrete gravity based structures in OSPAR area https://www.iogp.org/bookstore/product-category/decommissioning/

2. CDA (2011) The business value case for data management – a study https://oilandgasuk.co.uk/wp-content/uploads/2019/07/CDA-The-business-value-case-for-data-management-a-study.pdf & roundtable https://oilandgasuk.co.uk/wp-content/uploads/2019/07/CDA-The-business-value-case-for-data-management-a-study-Roundtable.pdf

3. OGUK (2012) Guidance on the management of ageing and life extension for UKCS oil & gas installations

4. OGUK (2013) Guidelines on Well Abandonment Cost Estimation – Issue 1

5. Oil & Gas UK (2013) The Management of Marine Growth during Decommissioning https://oilandgasuk.co.uk/wp-content/uploads/2019/07/The-Management-of-Marine-Growth-during-Decommissioning.pdf

6. OGUK (2013) Guidelines on Decommissioning of Pipelines in the North Sea Region – Issue 1 https://oilandgasuk.co.uk/product/guidelines-decommissioning-of-pipelines-in-the-north-sea-region/

7. Oil & Gas UK (2013) Guidelines on Decommissioning Cost Estimation – Issue 3 https://oilandgasuk.co.uk/product/guidelines-on-decommissioning-cost-estimation/

8. Wood, Ian (2014) UKCS maximising recovery review: final report https://www.ogauthority.co.uk/media/1014/ukcs_maximising_recovery_review.pdf

9. DECC (2014) Government response to Sir Ian Wood's UK Continental Shelf maximising economic recovery review https://www.ogauthority.co.uk/media/1018/wood_review_government_response.pdf

10. IOGP (2014) Options for decommissioning subsea bundles https://www.iogp.org/bookstore/product-category/decommissioning/

11. DecomWorld (2015?) North Sea Decommissioning Strategy Report http://1.decomworld.com/LP=1530

12. RSA Great Recovery and ZWS (2015) North sea oil and gas rig decommissioning & re-use opportunity report https://www.zerowastescotland.org.uk/content/north-sea-oil-and-gas-rig-decommissioning-re-use-opportunity-report-0

13. Green Alliance (2015) Circular Economy Scotland https://www.green-alliance.org.uk/resources/Circular%20economy%20Scotland.pdf

14. OGUK (2015) Adoption of Novel Solutions Report 2015 https://oilandgasuk.co.uk/product/adoption-of-novel-solutions-report-2015/

15. OGUK (2015) Decommissioning Contract Risk Allocation Report 2015 https://oilandgasuk.co.uk/product/decommissioning-contract-risk-allocation-report/

16. OGUK (2015) Guidelines on Late-Life Decommissioning Inspection and Maintenance – Issue 1 https://oilandgasuk.co.uk/product/guidelines-late-life-decommissioning-inspection-maintenance/

17. Decom North Sea, ZWS and ABB (2015) Offshore Oil & Gas Decommissioning: platform removal methods, inventory characterisation and reuse solutions https://library.e.abb.com/public/d689c2f70f0c447586610ac566c9aa7e/ABB-Offshore-Oil-and-Gas-Decommissioning-2015.pdf

18. SEPA (XXXX) Oil & Gas Decommissioning Sector Plan https://sectors.sepa.org.uk/media/1106/oil__gas_sector_plan_final_single_pages_-308143_sct0219532280-002.pdf

19. OGA (2016) Decommissioning Delivery Programme

20. IOGP (2017) Overview of International Offshore Decommissioning Regulations – Volume 1: Facilities https://www.iogp.org/bookstore/product-category/decommissioning/

21. IOGP (2017) Overview of International Offshore Decommissioning Regulations – Volume 2: Wells Plugging and Abandonment https://www.iogp.org/bookstore/product-category/decommissioning/

22. EBN, May 2017, report from Netherlands.

23. Scottish Enterprise and Highlands and Islands Enterprise (2017) Oil & Gas Decommissioning Action Plan https://www.scottish-enterprise-mediacentre.com/resources/deccom-action-plan

24. Bowdren, H. (2017) All at sea? CIWM journal.

25. OGA (2017) UKCS Decommissioning: 2017 Cost Estimate Report https://www.ogauthority.co.uk/media/4742/ukcs-decommissioning-cost-report-v2.pdf

26. Scottish Wildlife Trust (2017) report from rigs to reef study

27. IOGP (2018) Decommissioning of Offshore Concrete Gravity Based Structures (CGBS) in the OSPAR Maritime Area / Other Global Regions https://www.iogp.org/bookstore/product-category/decommissioning/

28. Oil & Gas UK (2018) Decommissioning Insight 2018 https://oilandgasuk.co.uk/wp-content/uploads/2019/03/OGUK-Decommissioning-Insight-Report-2018.pdf [and all preceding reports since 2010]

29. Scottish Enterprise, Highlands and Islands Enterprise and Scottish Development International (2018) Oil & Gas Decommissioning Scottish Capability http://www.evaluationsonline.org.uk/evaluations/Search.do?ui=basic&action=showPromoted&id=640

30. OGA (2018) UKCS Decommissioning: 2018 Cost Estimate Report https://www.ogauthority.co.uk/media/4999/decommissioning-a5-2018-pdf-version.pdf

31. BEIS, OPRED and Offshore Decommissioning Unit (2018) Guidance notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/760560/Decom_Guidance_Notes_November_2018.pdf

32. OGA (2018) Decommissioning Strategy https://www.ogauthority.co.uk/media/1020/oga_decomm_strategy.pdf

33. SEPA (2018) SEPA Guidance WST-G-059: Regulation of Offshore Oil and Gas Waste

34. Decom North Sea (2018) Guidelines: Managing offshore decommissioning waste.

35. Bureau Veritas (2018) Decommissioning on the UK Continental Shelf – an overview of regulations.

36. Scottish Fishermen's Federation (2018) Offshore Oil & Gas Decommissioning Policy https://www.sff.co.uk/wp-content/uploads/2018/08/DecomPolicy_Final_0808_lowres.pdf

37. Scottish Fishermen's Federation (2018) Offshore Oil & Gas Decommissioning Policy – Key Principles https://www.sff.co.uk/wp-content/uploads/2018/08/DecomPolicy_KeyPrinciples_0808_lowres.pdf

38. OGA (2019) UKCS Decommissioning: 2019 Cost Estimate Report https://www.ogauthority.co.uk/media/5906/decommissioning-estimate-cost-report-2019.pdf

39. CRIME report on lessons learned.

40. OPRED (2019) Oil and gas: decommissioning of offshore installations and pipelines - Decommissioning programmes, including dates, locations, installations decommissioned, method of decommissioning and close-out reports where available https://www.gov.uk/guidance/oil-and-gas-decommissioning-of-offshore-installations-and-pipelines

41. NAO (2019) Oil and gas in the UK – offshore decommissioning https://www.nao.org.uk/wp-content/uploads/2019/01/Oil-and-gas-in-the-UK-offshore-decommissioning.pdf

42. Report from CE workshop in Dundee, May 2019

43. NexStep/ EBN reports on reuse/ repurpose

44. Circular Economy Evidence Building Programme – Oil and Gas Sector report produced by AMEC E&I UK ltd

45. Genenis and ABB (undated) JIP: Guidance for UK Safety Case Management during End of Life (EoL), Decommissioning and Dismantling https://oilandgasuk.co.uk/wp-content/uploads/woocommerce_uploads/2017/09/Guidance-for-UK-Safety-Case-Management_.pdf

46. Decom North Sea, Scottish Enterprise, ARUP (undated) Decommissioning in the North Sea – review of decommissioning capacity

Presentations:

47. ZWS (2014) Decommissioning in a circular economy. http://oilandgasuk.co.uk/wp-content/uploads/2015/06/61.pdf

48. ZWS (2016) The benefits of a circular economy approach during decommissioning. https://decomnorthsea.com/uploads/pdfs/events/3_ZWS-Presentation-SUT-MASTS-Decom-Wreck-Removal-Workshop.pdf

49. Construction Scotland Innovation Centre, Scottish Enterprise and ZWS (2018) Oil & Gas Decommissioning for Construction Workshop http://www.cs-ic.org/media/3377/presentations-og-and-construction-workshop-09112018.pdf

50. National Decommissioning Centre, introductory slides

51. Aker Solutions (undated) Decommissioning Contracting

Blogs and news items:

52. ZWS (2014) Leading organisations tell Scottish Parliament that the circular economy is a major opportunity for Scotland's future https://www.zerowastescotland.org.uk/content/leading-organisations-tell-scottish-parliament-circular-economy-major-opportunity-scotland%E2%80%99s

53. The Guardian (2014) Can North Sea installations be recycled, or decommissioned sustainably? https://www.theguardian.com/sustainable-business/2014/dec/01/north-sea-installation-recycle-sustainable-reuse-oil-gas

54. RSA (2015) Decommissioning North Sea Oil and Gas assets; an opportunity for new approaches around the circular economy https://www.thersa.org/discover/publications-and-articles/rsa-blogs/2015/10/north-sea-oil-and-gas-assets-opportunity-circular-economy

55. Olesiewicz and Gomersall (2015) Application of the Circular Economy Business Model to North Sea Decommissioning https://pale-blu.com/2015/02/20/application-of-the-circular-economy-business-model-to-north-sea-decommissioning/

56. Jorgenson (2015) Circular Decommissioning of North Sea Oil & Gas Structures: What Could it Mean and Are We Ready? https://www.linkedin.com/pulse/circular-decommissioning-north-sea-oil-gas-structures-jorgensen/

57. DecomWorld (2015) UK urged to create re-use markets for parts to raise value, create jobs http://decomworld.devpad.co.uk/regulation-and-policy/uk-urged-create-re-use-markets-parts-raise-value-create-jobs

58. OGA (2016) Decommissioning Strategy https://www.ogauthority.co.uk/decommissioning/strategy/

59. Useful Projects (2016) Oil and gas rigs – circular economy https://usefulprojects.co.uk/an-opportunity-for-new-approaches-around-the-circular-economy/

60. Environment Analyst (2016) Market Insight: gearing up for North Sea oil & gas decom https://environment-analyst.com/mis/44551/market-insight-gearing-up-for-north-sea-oil-gas-decom

61. Resource (2017) How sustainable are new oil rig decommissioning projects heading to Norfolk? https://resource.co/article/how-sustainable-are-new-oil-rig-decommissioning-projects-heading-norfolk-11602

62. Energyvoice (2019) From recycling to re-use: News for the Oil & Gas sector https://www.energyvoice.com/oilandgas/decom/189628/from-recycling-to-re-use/

63. Forth Port Group (2019) John Lawrie Group to create Decom Base at The Port of Dundee https://www.forthports.co.uk/media-releases/john-lawrie-group-to-create-decom-base-at-the-port-of-dundee/

64. Scotsman (2019) Oil and gas innovation centre invests £6m https://www.scotsman.com/business/oil-and-gas-innovation-centre-invests-6m-1-4916086

65. RRfW, Petroleum Leeds (2019) New project to apply circular economy to oil and gas decommissioning https://rrfw.org.uk/2019/07/24/apply-circular-economy-to-oil-and-gas-decommissioning/, https://petroleum.leeds.ac.uk/research/new-research/

66. The Guardian (2019) UK facing EU outrage over 'timebomb' of North Sea oil rigs https://www.theguardian.com/business/2019/sep/04/uk-facing-eu-outrage-over-timebomb-of-north-sea-oil-rigs

Databases:

67. OGUK. WBS guideline.

68. East of England Energy Group. Member directory – decommissioning https://www.eeegr.com/members-directory/?sort=sectors&sector=26

69. OPRED (last updated 2019) Decommissioning guidance, and plans under review and approved https://www.gov.uk/guidance/oil-and-gas-decommissioning-of-offshore-installations-and-pipelines#table-of-approved-decommissioning-programmes

70. Decom North Sea (undated) Late Life Planning Portal https://l2p2.net/SitePages/Home.aspx

71. OGA (undated) Decommissioning Learning Portal https://www.ogauthority.co.uk/lessons-learned/

Academic publications:

No specific search for academic literature was performed:

72. Mearns and Hinze (2015) Re-designing a more circular Scottish economy https://strathprints.strath.ac.uk/54778/1/FEC_39_2_2015_MearnsEHinzeD.pdf

73. Terpou (2017) Applying circular economy principles in the oil & gas industry: An LCA study of the decommissioning process of offshore platforms. MSc thesis. http://publications.lib.chalmers.se/records/fulltext/248492/248492.pdf

Other publications:

74. Decom North Sea – newsletter

75. Scottish Government, Decommissioning Challenge Fund - https://www.gov.scot/policies/oil-and-gas/oil-and-gas-decommissioning/

76. AMEC Foster Wheeler (XXXX) Circular economy https://www.amecfw.com/documents/brochures-publications/capability-sheets/amec-foster-wheeler-circular-economy.pdf

77. Veolia (XXXX) Onshore decommissioning & dismantling of redundant oil & gas platforms https://www.campus.veolia.co.uk/case-studies/onshore-decommissioning-dismantling-redundant-oil-gas-platforms

78. OGUK (2013) Decommissioning Cost Estimating - Checklist

79. OGUK (undated) O&M framework for decommissioning

80. Scottish Wildlife Trust (2016) Decommissioning offshore infrastructure - policy https://scottishwildlifetrust.org.uk/wp-content/uploads/2016/09/002_293__decommissioningoffshoreinfrastructure_policy_1386585277.pdf

81. John Lawrie Group (2018) Reusing and recycling North Sea infrastructure https://johnlawrie.com/news/item/184-reusing-and-recycling-north-sea-infrastructure

82. Scottish Energy News – decommissioning http://www.scottishenergynews.com/tag/decommissioning/page/7/ [are there any news items considered particularly important on this site?]

83. Opportunity North East (2018) Opportunity North East and Scottish Enterprise – SME Decommissioning Programme https://opportunitynortheast.com/oil-gas-energy/sme-decommissioning-programme/

84. North Sea Future (2018) Activities & IFOME http://northseafutures.org/events/

85. BEIS (2019) Strengthening the UK's offshore oil & gas decommissioning industry – call for evidence https://www.gov.uk/government/consultations/strengthening-the-uks-offshore-oil-and-gas-decommissioning-industry-call-for-evidence

86. OGA (undated) Case Studies of MER UK in action – decommissioning https://www.ogauthority.co.uk/about-us/performance/case-studies-of-mer-uk-in-action/decommissioning/

87. OGA Decommissioning Roadmap https://www.ogauthority.co.uk/decommissioning/decommissioning-roadmap/

88. OGA (undated) Webpage on decommissioning "Programmes and guidance" https://www.ogauthority.co.uk/decommissioning/programmes-guidance/

Reports behind paywall

Reports not freely accessible but likely to add value, such as – from https://oilandgasuk.co.uk/product-category/decommissioning/:

89. OGUK (2013) Guidelines on Stakeholder Engagement during Decommissioning Activities – Issue 1 https://oilandgasuk.co.uk/product/guidelines-on-stakeholder-engagement-during-decommissioning-activities/

90. OGUK (2014) Guidelines on the Management of Ageing and Life Extension of Offshore Structures – Issue 1 https://oilandgasuk.co.uk/product/guidelines-on-the-management-of-ageing-and-life-extension-of-offshore-structures/

91. OGUK (2016) Guideline on Ageing and Life Extension of Subsea Pipelines and Risers – Issue 1 https://oilandgasuk.co.uk/product/guidelines-ageing-life-extension-subsea-pipeline-risers/

92. OGUK (2017) Decommissioning of Steel Piled Jackets in the North Sea Region – Issue 1 https://oilandgasuk.co.uk/product/guidelines-for-decommissioning-of-steel-piled-jackets-in-the-north-sea-region/

93. OGUK. Guidelines package for the Abandonment of Wells https://oilandgasuk.co.uk/product/guidelines-package-abandonment-of-wells/

Appendix B: Consultation response on proposals to revise the MER UK strategy

29 July 2020

Dear Oil & Gas Authority, dear reader,

RE: Consultation on proposals to revise the MER UK strategy

I would be grateful if you could consider the views provided herein based on the ESRC project titled "The social, economic, technical and environmental values of North Sea oil & gas decommissioning for local communities and companies" which was funded to increase the reach of the outcomes from the Complex Value Optimisation of Resource Recovery project, part of the £7M Resource Recovery from Waste programme (grant NE/L014149/1). I am a Research Impact Fellow in Circular Economy with 8 years of experience applying circular economy approaches to diverse energy sectors including bioenergy, offshore wind and oil & gas. I have a broad knowledge of sustainable transitions and in particular regarding governance, business model innovation and the development of collaborations and networks to enable transformative change.

I have reviewed your proposed revisions with great interest. The inclusion of net zero ambitions in your strategy is certainly a positive step forward. Indeed, *"Public opinion on climate change, and the Government's legally-binding commitment to net zero emissions by 2050 (2045 in Scotland), means that we have to do everything we can to contribute to achieving this"* (Tim Eggar, 15 January 2020). It is my assessment that taking responsibility only to minimise carbon emissions from oil & gas operations is insufficient to meet public concerns about climate change and the role of fossil fuels therein. There is friction between the policy to Maximise Economic Recovery and to promote Clean Growth in that the latter advocates the phasing out of fossil fuels as soon as possible. I agree that the oil & gas sector *"must do more to help solve the challenges of climate change and the drive to net zero"* (ibid), more than what has been proposed in this strategy. The sector must, therefore, take a whole system approach with the purpose of fully supporting the transition towards a low carbon economy within the sector and beyond, by the means of:

1. Building a collaborative culture to ensure that the oil & gas sector has the credibility to play an active role in the energy transition and the pathways to become an energy actor. I expand on this recommendation primarily under Questions 1 and 3.
2. Adopting criteria for sustainable investment in line with the Government's Green Finance Strategy and the ambition to leave our environment in a better state for future generations. I will cover this recommendation mainly under Questions 2, 4 and 5.
3. Removing punitive action against actors that want to reduce oil & gas extraction when evidence shows continuing higher production rates are suboptimal from a balanced economic, social and environmental perspective. I will cover this in Questions 5 and 6.

Q1. Do you have any comments on the proposed changes to the Introduction?

It is a positive step that *"The OGA proposes to re-name the Strategy as "the OGA Strategy", reflecting in part the introduction of the Net Zero Target, and the OGA's view that MER UK should no longer be considered in isolation from such matters"* (Consultation document, point 13). In the eyes of the OGA *"Maximising economic recovery of oil and gas does not need to be in conflict with the transition to net zero. They can and should be fully integrated. The OGA is, therefore, integrating expressly into the Strategy relevant aspects where industry can assist the Secretary of State in meeting the Net Zero Target. This will enable the OGA to take a much greater role in supporting industry to drive the necessary changes."* (Consultation document, point 4). The commitments expressed in the revised strategy, however, are not binding enough *"Although the principles do not in themselves form part of the binding obligations created in the current or revised Strategy, they are intended to be of interpretive effect, helping to clarify the nature of the obligations created by the revised Strategy"* (Consultation document, point 18). The credibility of the otherwise laudable net zero intentions are hardly supported by the repeated references throughout the strategy regarding the attracting of investment, apparently unconstrained by sustainability criteria, for continued exploration and extraction while similar commitments to investment into the energy transition could not be located within the text.

"The OGA is of the view that the oil and gas industry should go considerably faster and farther in reducing its own carbon footprint, or risk losing its social licence to operate" (Consultation document, point 3). This logic is incomplete because it is not only the environmental impact of extracting and processing oil & gas, it is also the use of fossil fuels by the customers of this industry. It is therefore not enough to reduce carbon emissions within the boundaries of the oil & gas sector alone to maintain a social licence to operate. The ambitions of the OGA and the oil & gas industry must be to reduce the direct impacts of extraction and to support the reduction of indirect impacts from the use of fossil fuels by producers and consumers. The oil & gas sector will understand that this cannot be achieved by carbon capture and storage and must involve a rapid reduction of fossil fuel use where possible. In that light the following will not suffice: *"at each stage of their operations, relevant persons should reduce greenhouse gas emissions as far as reasonable in the circumstances and to co-operate with others to achieve this"* (Consultation document, point 5). The strategy fails to specify who these other collaborators may entail, but must certainly go beyond those listed as "relevant persons" – more about this in response to Question 3.

Moreover, the OGA appears to be unaware of the potential to reduce carbon emissions with better decommissioning practice *"it is not intended to duplicate or overlap with the statutory role carried out by the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) with respect to emissions, which is separate"* (Consultation document, point 5). The oil & gas sector uses vast volumes of materials in the form of highly engineered components and equipment, all of which have huge volumes of carbon and other environmental costs invested in them. The poor performance record of the industry to reuse, repair, remanufacture and/or repurpose more components and equipment is therefore a huge missed opportunity to reduce carbon emissions. Achieving net zero emissions for extractive operations requires an integrated approach from all regulators including OGA, OPRED, SEPA/EA and HSE, and a collaborative stance for initiatives that could aid with this such as the DecomRegHub.

While we appreciate the following: *"As the context of this review is already set out in legislation, the scope of this consultation is limited to a revised Strategy that enables the principal objective to be met. Therefore, wider policy considerations, including on energy; carbon capture and storage; climate change mitigation; and oil and gas exploration and production, which are set by the Government, are out of scope of this consultation"* (Consultation

document, point 11), the strategy does have to provide sufficient opportunity to connect to the wider policy considerations. This is also for the benefit of the oil & gas sector because, without sufficient pathways to constructively engage with solution providers and the wider policy developments that will deeply affect the industry, it limits the capability of the sector to determine its own fate and reduces its credibility in playing a role – let alone a leading role – in the energy transition.

Q2. Do you have any comments on the proposed changes to the Central Obligation?

Building on the response to Question 1, the central obligation draws too narrow system boundaries around the oil & gas sector which will prevent it from effectively contributing to the Government's net zero obligation. *"Relevant persons are uniquely placed to assist with matters such as reducing, as far as is reasonable in the circumstances, emissions from sources such as flaring and venting and power generation, and supporting carbon capture and storage projects in the transition to a low carbon economy"* (Consultation document, point 19). The sector can undoubtedly minimise the carbon reductions associated with extractive operations. However, by articulating the obligation in this manner, it would seem that the OGA and the sector have moved from climate denial to the denial of economically unavoidable carbon emissions by the customers of their product. I note that environmental NGOs have also picked up on this observation and it will only be a matter of time before the general public follows suit. This will deepen the distrust against the sector. It will break down the social licence to operate even further and constrain the potential of oil & gas companies to transform themselves into energy companies. The OGA has to show leadership and support the sector to reach out beyond its boundaries and, together with renewable energy suppliers, into sectors that are currently relying on fossil fuels to gain a better understanding of demand and flexibility for the uptake of generation and storage of renewable power, heat, green and blue hydrogen as well as the already identified end of pipe solution in the form of carbon capture and storage.

The central obligation also has to be updated to the current Government ambitions. It is no longer sufficient to minimise impacts such as expressed here: *"relevant persons are uniquely placed to assist with matters such as reducing, as far as is reasonable in the circumstances, emissions from sources such as flaring and venting and power generation"* (Consultation document, point 19), and instead the aim now is to leave the environment in a better state for future generations as articulated in the first sentence of the Clean Growth Strategy: *"This Government is determined to leave our natural environment in a better condition than we found it".* This introduces an obligation to achieve absolute improvements in environmental performance and in particular with regard to the restoration and regeneration of natural capital. The diversity in economic and environmental ambitions and the prolonged timescale necessitate a change in investment criteria.

Q3. Do you have any comments on the proposed changes to the Supporting Obligations to embed the proposed Net Zero limb of the Central Obligation?

The strategy does not give sufficient direction for collaboration to support Government to achieve net zero carbon emissions at a whole system level, for partnerships to ensure that the oil & gas industry can join sustainable opportunities in the energy sector and leave fossil fuel extraction behind when it is possible, for a credible contribution to carbon reductions in society as a result of burning fossil fuels and to maintain a social licence to operate. The definition of relevant persons should be broadened by the integration of additional relevant persons as referred to in point 21 and the respective section in the Petroleum Act, by introducing for the planning and decision making for new developments and the energy transition actors such as:

1) The directorate for energy transformation and clean growth at BEIS to bring the central obligation in step with Government ambitions for the energy transition; 2) Representation from across the energy sector including renewables; 3) Representation from major end user sectors in e.g. manufacturing, transport and housing; and 4) Research and innovation organisations.

I note, moreover, that the proposed strategic points on decommissioning have to be adapted and take a more proactive approach. For existing oil & gas infrastructure, the potential for reuse, repair, remanufacturing and repurposing has to be considered earlier. The current performance of the industry is, frankly, abysmal. My interaction with the oil & gas sector revealed shocking levels of wasted equipment and components which can be valorised to create economic, social and environmental benefits for communities in the UK. Reasons for such high levels of waste are, for example, a lack of communication between those responsible for end of use management and those in charge of commissioning new and maintaining existing infrastructure elsewhere. It is easier to buy new gear and waste the "old". For an industry that wants to be taken seriously in making an effort to decarbonise, wasting equipment and components with a very high embodied carbon contents is no good media contents. An important part of the solution is to consider end of use options, that go beyond material recovery, at an earlier stage and, crucially, before the cessation of production. It is therefore insufficient to state in this strategy that *"the OGA also asks relevant persons, as part of approving any cessation of production plans, to show that they have considered development opportunities, including the carbon capture and storage potential, for any infrastructure. The OGA is a statutory consultee to OPRED, in relation to operators' decommissioning plans, in particular whether re-use opportunities or potential have been considered"* (Consultation document, point 32), because at that point in time it is usually too late to enable reuse, repair and repurposing. Another important barrier are health and safety concerns, and these can be mitigated by the introduction of recertification schemes. The industry should be interested in this, because such emerging "circular economy" solutions are proving to offer faster, more affordable and safe supplies.

For oil & gas infrastructure that is still to be newly deployed, greater consideration should be given to design for reuse and repurposing to accommodate for their application later on for carbon capture and storage and hydrogen. It is unclear why some sections of this strategy do mention hydrogen, while others do not. Greater consistency and proactivity can be embedded in the strategy to minimise carbon emissions for the commissioning of infrastructure while also enabling a faster switch to alternative uses when the time is ripe.

Q4. Do you have any comments on the proposed clarifications to the Supporting Obligations to reflect stewardship and other changes in the United Kingdom Continental Shelf?

The strategy repeatedly refers to continued investment into new oil & gas exploration and extraction. From a public perspective, this may not come across as an industry committed to achieving net zero emissions. It is therefore important that the OGA introduces a requirement for investments to be subject to sustainability criteria. Both national (e.g. Green Finance Strategy) and global (e.g. UNFCCC and UN Sustainable Development Goals) governance offer important starting points to device such criteria. Moreover, the majority of banks in the UK report concerns over the reliability to invest in fossil fuels due to climate change, and continued access to finance may therefore necessitate uptake of sustainable investment criteria. The OGA can show leadership and commit to the preparation of sustainable investment plans, for example as part of the COP26 preparations.

Monetary considerations are also at the heart of reputational risk with regard to oil & gas decommissioning. While it is positive that *"The OGA proposes to make changes to this*

Supporting Obligation to clarify that the cost- effective decommissioning of infrastructure should not prejudice the re-use or re-purposing of all viable options for that infrastructure's continued use" (Consultation document, point 45), this strategy is unlikely to be effective in itself given the low performance currently (1-2% reuse rate). The OGA should strengthen the strategy by putting the environmental and social considerations, in addition to the potential for reusing infrastructure for more sustainable purposes, first. A participant in my study suggested to leave the economic considerations out of the initial assessment altogether, and while this sounds extreme, it may be the only way for the oil & gas sector to gain credibility in decisions made with the best intentions for the environment.

Q5. Do you have any comments on the proposed changes to the Required Actions?

Building on my argument for the design for reuse under Question 3, the following point could be made more explicit *"The OGA proposes to make minor changes to this required action to clarify that all obligations, including any actions, must be complied within a timely fashion"* (Consultation document, point 53) for the purpose of enabling more reuse of infrastructure. For example, the process of preparing decommissioning programmes could include a feedback loop to allow for the revisiting of infrastructure design should there be a greater potential to design for reuse, and accommodating this within the design and commissioning of new infrastructure would likely require a longer development period (which would pay back later with the reuse of infrastructure).

The step to cost efficiency is positive *"The OGA proposes to revise the title of this required action from Cost Reduction to Cost Efficiency. This is a clearer economic term and shifts focus from minimising the baseline costs to a project's overall efficiency and brings in net zero considerations"* (Consultation document, point 53) and should be expanded further to become about optimising the economic, social, technical and environmental costs and benefits throughout the lifecycle of oil & gas infrastructure and its products – in line with the arguments put forward under Questions 1-4. This also pertains to the point that *"The OGA proposes to make revisions to the text in the Strategy to emphasise that the full lifecycle costs include both decommissioning and the re-use and/or re-purposing of infrastructure; that costs should be incurred in the most cost-efficient way; and to clarify that relevant persons should include an assessment of cost efficiency benefits from the re-use and re-purposing of infrastructure, as part of carbon capture and storage project considerations. This clarification does not affect the decommissioning cost reduction target"* (Consultation document, point 54). Such whole system assessments, which are necessary if the OGA wants the industry to lead in the energy transition, may result in outcomes that are at tension with the maximising economic recovery policy. It would be fair on the oil & gas industry to include caveats to allow for relevant persons to stop developments and/or operations if the whole system assessments shows that continuation would not represent an overall positive balance upon consideration of the economic, social, technical and environmental costs and benefits, and there should be no punitive action against this. Moreover, if the anticipated obligation to leave the environment in a better state for future generations does indeed become embedded in legal terms – as currently anticipated by autumn 2020 – then there should be provisions in the strategy the prevent investments being subject to obligation when unlawful environmental degradation as a result of direct or indirect actions is evident.

Q6. Do you have any comments on the proposed changes to the Definitions?

The inclusion of carbon costs into the definition of economically recoverable should be expanded, in order to stay aligned with on-going initiatives in Government, by introducing the inclusion of a broader range of natural capital based costs and benefits. Consideration to novel measures of social value should also be given.

Q7. On what do you base your forecasts of future carbon prices? N/A

Q8. Do you have quantitative evidence of any specific impacts of the proposed revisions to the Strategy that you would like us to consider?

If not planned already, the OGA should invite an independent agency to carry out an ex-ante evaluation to analyse the positive and negative impacts on economic, social and environmental aspects and the likelihood of the strategy to deliver on the central obligation and the transition to net-zero in the UK (i.e. including effects beyond the oil & gas sector).

I hope that you receive my response in good spirits and welcome any further questions and information requests.

Yours sincerely,

Dr Anne Velenturf