Circular Economy Business Support

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Final Report

Confidential

Contents

Inspiring change for Scotland's resource economy

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1 Introduction

1.1 Summary and Context setting

Zero Waste Scotland aims to stimulate innovation amongst Scottish businesses to help them adopt more circular business practices, which treat all resources as assets – keeping them in use for as long as possible to extract the maximum value from them.

The oil and gas sector is a large user of materials and a major economic force in Scotland[1]. To date, it has operated largely as a traditional, linear model, but it's a sector which offers significant opportunities to adopt more circular economic practices. In a general context, a circular economy assumes reuse of resources, minimisation of waste and efficient use of assets.

Much of the mature oil and gas producing infrastructure within the UK continental shelf (UKCS) basin is nearing the end of its economic life. Many of these assets have been producing oil and gas for over 40 years and are due to be decommissioned over the coming decades. Estimates of costs vary but latest figures from Oil & Gas UK forecast £17 billion will be spent on UKCS decommissioning between now and 2025[2].

At present, the total infrastructure estimated to require decommissioning from the UKCS consists of over 260 installations, 300 production systems, over 3000 pipelines and around 5000 wells[3]. Currently, the majority of the materials and equipment from these platforms is recycled, with very little re-use or remanufacturing[4]. Here lies the opportunity; the potential benefits of adopting circular economy principles within the decommissioning sector are vast, environmental impacts would be reduced, cost savings could be achieved and new market opportunities would be created.

Making available European Regional Development Funds, Zero Waste Scotland (ZWS) is aiming to stimulate new business activity to identify, develop and bring to market new circular economy products and services. The support delivered and presented in this report falls under the energy infrastructure grant call and in particular the priority sector of oil & gas decommissioning.

1.2 Businesses Supported

This report sets out the key findings and recommendations identified through the business support framework offered to the five Small and Medium sized Enterprises (SMEs) operating in the Oil and Gas (O&G) decommissioning industry to facilitate greater circular economy activity.

These business are summarised below:

Oilfield Machinery Ltd. (Oil Mac)

Oil Mac is an SME based in the Port of Dundee who specialise in buying, selling and brokering surplus O&G equipment to maximise the reuse and recovery value in order to reduce the amount of functional equipment that is destined for recycling / scrap. Oil Mac have the capability to service various types of equipment in order to maximise the value for buyers and sellers as well as reuse opportunities.

The circular economy objective for Oil Mac is as follows:

[1] Benton, D 2015 http://www.green-alliance.org.uk/resources/Circular%20economy%20Scotland.pdf
[2] Decommissioning Insight Report 2017 https://oilandgasuk.co.uk/wp-content/uploads/2017/11/Decommissioning-Report-2017-27-Nov-final.pdf
[3] Royal Academy of Engineering: https://www.raeng.org.uk/publications/reports/decommissioning-in-the-north-sea
[4] RSA 2015 https://www.thersa.org/globalassets/pdfs/reports/rsa-great-recovery---north-sea-oil-and-gas-report.pdf

Extending the operational life of O&G equipment by servicing and reselling equipment to buyers who have a use for it as opposed to scrapping it for parts. As much of the equipment is not near the end of its usable life, it is a waste from an economic and environmental perspective to break it up for scrap when it could be redeployed and provide better value for buyers and sellers.

Provide a straightforward process for buyers and sellers to source and trade equipment they use to maximise reuse opportunities and reduce the manufacture of new equipment.

The Louisville Consultancy (Louisville)

The Louisville Consultancy is an SME based in Aberdeen whose main business offers supply chain management consultancy services to the upstream O&G industry. The company is currently developing a web based supply chain management tool. Part of the development exercise will focus on deploying the tool to the O&G decommissioning industry to increase circular economy opportunities in the supply chain and it is this tool that forms the focus of the business support project.

The circular economy objective for Louisville is as follows:

Explore the potential functionality of a tool that will increase the visibility of O&G equipment from operators that is surplus to requirements to highlight items that could be refurbished and be resold by SMEs for deployment within O&G and outside the industry. The target market for the equipment stems from the apparent need for the SMEs supplying equipment to include refurbishment in their resale services. The overall objective is to have a tool that facilitates greater refurbishment and redeployment of decommissioned O&G equipment as opposed to recycling / scrap.

ReFlex Subsea (ReFlex)

ReFlex Subsea is an SME based in Aberdeen who specialise in buying and selling new and used flexible pipe, umbilicals and subsea production systems. ReFlex offer repair and testing services to give buyers confidence that products will work effectively and reliably. They will also recertify equipment for safe redeployment.

The circular economy objective for ReFlex Subsea is as follows:

Encourage the reuse of subsea material, in particular: flexible pipes, umbilicals and subsea furniture which is particularly effective for development of marginal fields. Reuse of equipment could result in significant waste reduction and usage of raw materials, as well as the associated cost saving.

Scour Prevention Systems Ltd (SPSL)

SPSL is an SME based in Lowestoft and was established in 2009 to develop, test and commercialise a unique approach to combatting scour around offshore structures. SPSL has developed an innovative, cost-effective solution to combat the problems of scour occurring around piles, foundations and subsea cabling using recycled car tyres linked together (known as mattresses) and laid on the seabed. SPSL have extensively and successfully trialled the mattresses at a windfarm and on pipeline crossing units installed on projects in the North Sea. The trials identified the opportunity for deployment of the mattresses in the O&G decommissioning industry for covering redundant pipelines that are to be left in situ.

The circular economy objective for SPSL is as follows:

To provide an alternative method for protecting subsea equipment from the hydrodynamic forces (scour) of the sea and make safe exposed sections of decommissioned pipeline left in situ from trawling damage, vessel anchoring and other hazards. They intend to do this by providing a sustainable

alternative to traditional methods by reusing waste tyres, diverting them from landfill and propose commencing a trial in the North Sea to demonstrate their suitability.

Wireless for Subsea Technologies Ltd (WFS)

WFS is an SME based in Livingstone who specialise in the design and manufacture of products and services that utilise wireless radio communication subsea. Traditional subsea communication uses through-water acoustics, soundwaves, which unlike radio waves are unable to pass through barriers such as air-water interface, the seabed or through steel. Acoustic communication also uses substantial amounts of power, meaning operation is limited by battery performance. Wireless radio communication uses less power, resulting in far superior battery life. WFS offer the ability to utilise wireless subsea communication as well as having the ability in combination with sensor technology, to assess and monitor the condition of subsea equipment in a more cost-effective way than other monitoring methods.

The circular economy objective for WFS is as follows:

To extract as much value from equipment before it reaches the end of its usable life and is selected for decommissioning. Utilising technology in asset inspection to make it safer, easier, cheaper and more accurate will help to extend the operational life of equipment such as pipelines and storage tanks which will minimise waste produced from decommissioning and the need for new manufacturing. Evidence suggests that equipment is being decommissioning before the end of its usable life to avoid inspection and certification costs. Having better data on equipment condition could facilitate reuse opportunities as opposed to recycling / scrap.

2 Key Findings and Lessons Learnt

2.1 Common Themes

The following issues were encountered by the teams across the businesses supported:

- Lack of interaction across the supply chain particularly between operators and reseller/brokers
- Cost of adopting versus benefits (financial) – sector is financially driven up to a point but financial benefits of recovery-resale are dwarfed by decommissioning costs overall and therefore not a priority.
- Lack of visibility of items becoming available, condition and complete records of operations and maintenance
- Concern over recovery methods (relating to the point above concerning condition) in that equipment is mishandled / damaged during subsea recovery
- Need for bespoke design / specification – both within O&G sector and other industries limiting opportunities to redeploy parts and equipment
- Certification and liability –certification standards are stringent and O&G industry is very risk averse

2.2 Stakeholder Receptiveness

Table 4 summarises the general findings with regards to the receptiveness of certain stakeholder groups in the O&G industry to the circular economy.

Table 4: Stakeholder analysis

Stakeholder	RAG (Red Amber Green)	Commentary on Status
Operators	**Red**	Survey undertaken on behalf of Oil Mac generated a low response rate (5 out of 26 or 19%) from operators and a lack of engagement in the CE opportunities during decommissioning. General responses indicate that benefits are not seen to outweigh costs and that decommissioning is a contractor issue. No operators were available to attend workshop organised on behalf of Louisville although this was due to late changes to plans. Lack of representation by operators at the workshop was a key gap to develop full supply chain feedback on tool.
Decommissioning contractor	**Amber**	General response indicates that the push is needed from both operators (front end) and the demand market (end user) in order for decommissioning contractors to fully engage.
Waste management contractors Asset Re-sellers	**Green**	There is considerable interest from waste management contractors / asset re-sellers demonstrated by the fact that three of the five businesses targeted for support (Oil Mac, Reflex Subsea, and SPSL) broadly fit into this category. However, there is insufficient evidence of an established or potential supply/demand market to induce confidence.
Oil and Gas Regulators (BEIS. OGA, SEPA)	**Green**	General response indicates that regulators are responsive and understand the benefits of CE solutions; however, the regulations and certification standards are stringent. Initial responses indicate that the regulatory bodies are willing to enter into constructive dialogues.
Oil and Gas Industry and Innovation Bodies (OGIC, OGTC, DNS)	**Green**	Industry bodies are eager to promote reuse initiatives in the industry. OGTC and OGIC have open calls for innovation. OGTC are particularly active in this field. Decom North Sea is taking an active role in facilitating active cooperation between operators and the decommissioning supply chain.
Other sector stakeholders	**Amber**	Representatives from other sectors/markets (e.g. water industry) were generally responsive; however, more evidence is needed that issues around cross-sector certification standards and equipment compatibility can be overcome.

3 Circular Economy Business Support (CEBS) Monitoring Summary

3.1 Barriers

Table 7: PESTLE analysis of business influences in the circular economy of O&G decommissioning

Factor	Barriers	Suggested Actions and for who (e.g. ZWS, Individual Business, Government, Enterprise and Innovation Agencies, Trade Bodies)
Political	• Decommissioning is a politically sensitive issue, and it could be argued that the lack of top-down legislation driving decommissioning/reuse in the sector is not providing any 'push' for the operators to engage fully. High costs to the industry and the UK taxpayer may prevent this from being addressed in the short to medium term.	ZWS and Industry Bodies to engage Scottish and UK Government to report findings of business support project, including results of operator survey.
Economic	• Long-term storage of equipment is costly and it can be difficult to forecast future demand. • Equipment inspection can be costly and require a halt in production which is unacceptable. • Due to the large costs associated with decommissioning programmes, the comparatively small value saving from considering reuse is perceived as low priority to operators that have influence over supply chain behaviour. • SMEs do not always have the financial means to offer solutions to insurances, re-certification and perceived liability to encourage reuse.	• Further conversation between relevant SMEs and the finance sector to explore hire leasing options for O&G equipment. • Innovation agencies and industry bodies to recommend that operators look at contractual/procurement models that incentivise reuse (i.e., shared pain/gain model).
Social	• Operators don't prioritise maintenance on near end of life equipment. • Operator mentality tends to see sourcing new equipment as less risky and complicated than procuring second hand. • Operators claim to support reuse initiatives but do not tend to back this up with action. • Short term thinking for investing in new monitoring equipment. • There is low engagement across the operators for considering reuse. Preference would appear to be to pass responsibility for reuse further down the supply chain to decommissioning contractors and onshore waste management contractors.	• Thorough consideration should be given to by ZWS to deliver a targeted sector wide engagement campaign for raising the environmental and economic benefits of circular economy. • ZWS liaison with Scottish and UK Government to determine what measures could be taken to drive a 'top down' approach to reuse in decommissioning. • Industry bodies, ZWS and Oil Mac to encourage operators to think about reuse opportunities at a

Factor	Barriers	Suggested Actions and for who (e.g. ZWS, Individual Business, Government, Enterprise and Innovation Agencies, Trade Bodies)
		component level as opposed to just high-value equipment.
Technological	• The age of equipment now being decommissioned predates digital records resulting in much of the paperwork for older assets being difficult to trace and verify. This makes operators reluctant to procure equipment where comprehensive condition and maintenance record information is not available. • Incomplete landing records in decommissioning programmes makes it difficult to accurately assess the quality and suitability for reusability of equipment that is being made available from offshore platforms. • Expired equipment warranties lessens operator confidence. • Technology to recover the largest and most complex equipment does not yet exist to allow for removal within acceptable levels of risk. • In some instances, equipment is made to bespoke specifications and once redundant is obsolete. • Incomplete and inaccurate inventories negatively affect the visibility of equipment and make forecasts on potential costs and savings unreliable. • Indicative design life for used equipment may prevent reuse if it has been operating for several years. • Water/waste water equipment is required to achieve MCERTS certification, which is not standardised with O&G sector certification. Preventing deployment of equipment to other sectors	• The Oil & Gas Technology Centre (OGTC) could support an Innovation Call to identify digital solutions for a standardised testing and certification process for recovered equipment. For example, DNV GL is a global quality assurance and risk management consultancy who have identified the need for greater digitisation to address technical, organisational and cultural barriers across the supply chain and in data management. • ZWS and industry bodies to lobby government to consider research into level of equivalency to calibration certifications to determine the level of information to be made available by suppliers.
Legal	• The party holding liability for repurposed/reused equipment was a reoccurring theme identified throughout the business support. The nature of the industry means that accidents have potential to have significant repercussions economically, environmentally and reputationally for operators with the obvious example being the fallout from the Deepwater Horizon explosion and oil spill in the Gulf of Mexico caused by equipment failure. SMEs do not have the financial means to offer the substantial liabilities likely required for equipment sold to operators.	• ZWS and industry bodies to recommend that operators are legally required to maintain centralised equipment inventories and clear audit trails to avoid uncertainty over age and usage. • Some issues of liability are perceived, not legal. The perception is that the poor publicity related to an environmental incident from third party use of reconditioned equipment is too great a risk to take. An initial communications and engagement campaign led

Factor	Barriers	Suggested Actions and for who (e.g. ZWS, Individual Business, Government, Enterprise and Innovation Agencies, Trade Bodies)
	• Concerns over liability of equipment should there be problems, as the owner has a 'duty of care.' • Certification varies across industries which can limit redeployment across sectors in mission-critical roles. • There are waste consents and licensing rules that influence the handling, storage and processing of equipment.	by ZWS and O&G sector industry bodies may create a positive story for operators by engaging in and helping drive the circular economy in Scotland. •
Environmental	• Equipment is exposed to hostile corrosive marine environments for long time periods, decreasing its operational performance and is often contaminated from operational activities. Refurbishment to the required standard is often unviable. • The manufacturing processes of tyre mattresses in particular presented potential issues regarding marine plastic pollution from the deployment of polyethylene rope to secure tyres. • Potential environmental and reputational damage as a result of an incident is too great for operators to take chances on equipment reliability. •	• Innovation industries should have detail about plastic rope degradation in marine environments.

3.2 Enablers

Table 8: PESTLE analysis of business influences in the circular economy of O&G decommissioning

Factor	Enablers	Suggested Actions and for who (e.g. ZWS, Individual Business, Government, Enterprise and Innovation Agencies, Trade Bodies)
Political	• The government give operators significant tax relief on decommissioning costs to reduce costs.	

Factor	Enablers	Suggested Actions and for who (e.g. ZWS, Individual Business, Government, Enterprise and Innovation Agencies, Trade Bodies)
Economic	• Consider the use of specialist hire / leasing companies to facilitate equipment leasing opportunities between SMEs and operators. • Economic opportunities clearly lie several tiers into the decommissioning supply chain, not with the operator. Together with a 'top down' push, the potential supply chain collaboration opportunities are significant.	• Further conversations between relevant SMEs and the finance sector to explore hire leasing options for O&G equipment. • Operators should include incentives in decommissioning programme framework contracts tendered to contractors to require evidence that they consider reuse in their plans. This could create incentives and set positive benchmarks for other contractors to strive to achieve.
Social	• The activities of the SMEs overlap in some cases. For instance, Oil Mac and Louisville could be a good match for facilitating circular economy by mapping and delivering supply chain solutions. Collaboration between industries would also be beneficial to create a centralised database with landed equipment with clear and complete audit trails to aid redeployment. To assist SMEs in the industry, collaboration is also required between tier 2 and 3 operators to give them the opportunity to practice circular economy.	• Thorough consideration should be given to by ZWS to deliver a targeted sector wide engagement campaign for raising the environmental and economic benefits of circular economy. •
Technological	• If unsuitable to be redeployed within O&G, there are good opportunities for redeployment of general pieces of equipment in other industries. • A comprehensive supply chain mapping tool would increase visibility of available equipment. This would require industry collaboration. • Specialist ship yards are being developed with the required capability to extract the highest value parts from landed platforms. • Technological advances in monitoring equipment is enabling thorough testing of equipment to ensure it is not decommissioned before the end of its usable life. • Invest in re-termination engineering of offshore equipment. ReFlex identified the potential for retrofitting flexible pipe with additional components to return it to service either within or out with the O&G sector.	• ZWS to recommend that ReFlex, Oil Mac and Louisville explore the certification and digital services offered by DNV GL. • ZWS to recommend that O&G UK and OGTC look into considering the feasibility of inventory tools used by the aviation industry (aircraft cannibalisation process). • ZWS in collaboration with ReFlex to act as influencers for increasing the application of re-terminated flexible pipe and explore where else re-termination could be utilised. ReFlex state that fulltime research would be required to convince manufacturers and buyers of the performance of re-terminated equipment.

Factor	Enablers	Suggested Actions and for who (e.g. ZWS, Individual Business, Government, Enterprise and Innovation Agencies, Trade Bodies)
Legal	• Operator survey results reported that procurement is not seen as a barrier to decommissioning, therefore there is an opportunity to influence how operators procure their decommissioning contracts to include incentives for reuse.	• ZWS to consult with academics and legal professionals about to examine the effectiveness of current decommissioning legislation with a view to renewing it in line with recent research findings. • Consider decommissioning programmes on a case-by-case basis as opposed to relying on blanket regulations and processes.
Environmental	• Where equipment has been degraded to a level where redeployment in critical roles is not possible, there is an opportunity to consider other less function-critical roles where it could be used.	• Innovation industries should have detail about plastic rope degradation in marine environments. • Explore viability of other construction materials such as chain as opposed to rope.

4 Summary

4.1 Conclusions

Though the intention of the CEBS Framework was to support the individual businesses, the outcomes have identified recommendations that benefit the industry as a whole as the barriers and enablers that the SMEs face align with those faced by the industry as a whole. The targeted research carried out on behalf of the SMEs, in particular the workshop for Louisville and the operator survey for Oil Mac produced evidential data to support the key barriers and enablers highlighted throughout the individual reports and this report. This has helped form the recommendations listed in section 4.2.

The framework has made progress identifying the issues preventing greater reuse in the industry. The recommendations have highlighted the need to exploit technological innovation throughout the sector to enable reuse. The application of new technologies is relevant to the operations of a number of the SMEs including: equipment inspection carried out by WFS to extend the operational life of equipment; and access to centralised equipment inventories with complete usage and certification documentation, which is the basis of the Louisville supply chain mapping product and would benefit ReFlex and Oil Mac. Engagement across the sector including trade bodies, SMEs and contractors was positive but future studies must be wary of causing stakeholder fatigue and subsequent disconnect.

The process was of value for assessing operators' engagement in considering reuse more critically in their decommissioning programmes. In particular, the low-response rate for the operator survey of 19% highlighted a lack of engagement from the operators in giving adequate consideration to equipment reuse. A general theme identified is that operators tend to pass over the burden of their decommissioning operations to third parties. This itself is not a problem but the industry would benefit economically and environmentally from requiring their contractors to consider reuse when bidding for frameworks, creating a demand-pull incentive. To effectively extract maximum circular economy value from the industry, engaging with operators in a proactive manner is crucial due to the control they have over much of the process, whether this is achieved through financial or legislative instruments.

4.2 Recommendations

Short Term Actions

Sector	Recommendations
Zero Waste Scotland	• Follow up with those companies who responded to the operator survey to discuss their responses – focussing on the challenges around driving a culture change and taking a more active lead on circular economy in the sector. • Real focus and consideration should be given by ZWS towards delivering a targeted sector wide engagement campaign on raising awareness of the environmental and economic benefits that the circular economy can bring. This must be a 'top down' sector wide approach by committee, involving representatives from key industry bodies. Representation at national and international decommissioning conferences was highlighted as a potentially effective platform for reuse discussion and showcasing. • Consider hosting/facilitating an industry 'best practice' session presenting positive case stories with the SMEs involved and other stakeholders. ReFlex highlighted that knowledge exchange through collaboration with other SME organisations in the sector would help drive reuse.
Scottish Government and Agencies	• Engage the Digital Transformation solution centre at the Oil & Gas Technology Centre to explore the viability of a digital solution to keep clear and accurate audit trails for equipment to increase visibility and reduce uncertainty about equipment reliability and condition

O&G Sector	• Focussed discussion with Repsol Sinopec/Veolia to discuss replication of profit share/incentivised decommissioning contractual model. • Engage with sector bodies Oil & Gas UK and Oil & Gas Authority and selected operators in a 'Focus Group' setting to explore mechanisms for operators to influence procurement methods further down the decommissioning supply chains including Tier 2/3 contractors and SMEs. • Explore the viability of introducing specialised hire / leasing companies to facilitate equipment reuse and encourage discussion between operators and SMEs specialising in equipment reuse. Lending criteria for equipment reuse appears to be less onerous than traditional finance streams as long as such transactions are profitable.

Long Term Actions

Sector	Recommendations
Zero Waste Scotland / Resource Efficient Scotland	• Lobby government to consider legislation requiring O&G operators / contactors to perform detailed equipment audits to be stored in centralised databases to ensure clear equipment usage and condition logs are readily accessible.
Scottish Government and Agencies	• Academia and marine specialists to make the case to government about reconsidering the conditions for decommissioning platforms required by OSPAR Decision 98/3.
O&G Sector	• Set out conditions in decommissioning contracts that require contractors to demonstrate how they have considered reuse in their programmes.


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