



SUT/MASTS Decom & Wreck Removal Workshop
Technology & Innovation Centre, Glasgow
5th and 6th October 2017

Thursday 05/10/2017

Open - 13:50

Welcoming remarks from **Karen Seath – SUT Co-Chair Decom & Wreck Removal Sub-Committee**

Aim of workshop – to bring expertise together from across disciplines to build shared understanding and opportunities.

Setting the Scene – **Moya Crawford – SUT International Salvage and Decom Committee Chair**

- Overview of the Salvage and Decommissioning committee –way of tackling fragmented understanding and bringing together knowledge on the topic.
- Introduces 3 subcommittees - Decommissioning and wreck removal subcommittee, Salvage and emergency response, technology and innovation.
- Commends the excellent technology being developed which is able to simulate decommissioning process including impacts and expresses we should all explore and share this new information.

Session 1: Environmental Perceptions of Jacket Decommissioning Scenarios

Dr Sally Rouse, SAMS – Environmental perceptions of jacket decommissioning scenarios

MASTS Oil and Gas research forum – work in the North Sea to ask if there is a marine environmental case to challenge OSPAR decision 98/3

Current regulations state that oil platforms must be removed. Debate has been raised with academics if the disused platforms should be decommissioned?

She presents workshop carried out in May 2017 – fuelled by 2016 MASTS ASM decommissioning workshop.

- list all plausible interactions if platforms left in, partially or fully removed.
- Stakeholders to rank interactions.
- Take interactions in order of priority and list in temporal and spatial scales.
- Pull out where key knowledge gaps.
- Pick one of decommissioning options....

This workshop will provide the context for today's work which will be informed by this earlier process.



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How data is used – submit peer review paper by end of year.

- Collate public perspectives on environment.

Presents work by a similar group - North Sea Futures – Danish independent company conducted similar collaborative workshop collating response from 40 experts.

Sally presented interaction results of the 2017 ASM workshop

Many more in favour of using current state as baseline for decommissioning – especially the academics and industry members.

Sally collects opinions.

Group discussion session

David Paterson - Are we in danger of being too simplistic with this approach? (referring to opinion choices we voted on). Appreciates that we need to simplify the arguments to specify a best available overview of opinions. We partition things too far – need to step beyond science and listen to opinions. We do need to restrict decision to form collective opinion.

Comment that it is surprising that academics and industry and agree on leaving the structures in place.

David Paterson countered that this is an example of it being too simplified, the argument needs to be considered on case by case basis – taking them all out or leaving all in place isn't the right answer. Scientists want to base methods on evidence and the problem lies with the lack of evidence. Points out the lack of representation from the fishers - they will obviously be less keen on leaving the structures in place as it will restrict fishing in the area

Sally Rouse - Academics often challenge OSPAR on evidence base to suggest it may be less detrimental to the environment. There seems to be a growing evidence base for this challenge.

Question from unknown - How do the scientists expect to balance the environmental damage caused by removing the rigs with the potential damage which could be caused by navigational errors around structures left in place resulting in a greater risk?

Sally responds that she doesn't have all the answers and that the point of this workshop is to get people sharing the knowledge they have



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Moya – worked on drillings for 10 years - need to move forward. Expresses desire to leave structures in place with exclusion zone – need to understand particular impacts of uptake of pollutants.

Mike Elliot Now we have a much better idea about how resilient systems are and their assimilative capacity. We are also more concerned n the overall impacts on a system – e.g. the long term effects and energy budget.

Becky Hitchin - picked up on feeling that this is a simplistic outlook on complicated problem. JNCC are trying to compartmentalise the issue North, South, West of Shetland. Marathon oil undertook very large study into infrastructure and came up with issues on whole range of conditions and came up with solutions to individual issues.

John commented on mega fauna attraction to platforms – patterns of seals around platforms however lots of data showing they forage elsewhere. Do the platforms change the pattern on a population scale.

Unknown - Decommissioning has been taking place for a while – how much data have we been collecting and adding to our knowledge. Do we have the systems in place to gather data where decom is happening? We simply do not know cost of removing bio- fouled platforms.

Sally - We need to think about the impacts of leaving platforms on ecosystem scales and long terms.

Unknown - Thousands of pounds are being spent on decommissioning but how much is being spent on building our knowledge of its impacts?

David Paterson – one of the problems is that the decom process is not focused around understanding the environment, it is about acquiring consent. Would be useful to pair these ideas together.

Moya Crawford - Holistic approach needs to be applied to OSPAR – are we better leaving the platforms and using money saved to tackle terrestrial issue which cause greater impacts.

Joe Ferris - As TAX payer feels resentful paying for decommissioning infrastructure that oil companies have made huge profits.

Mike Elliot - We start thinking about scales of environmental problems (energy budget, emissions) from decommissioning will dwarf those from leaving platforms.

Unknown - Recommendation to spread the results from today as there are decisions currently being made that will be influenced by these results.



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Unknown - Not only about collaborating process but also about academia coming up with best solutions for industry and environment.

Becky Hitchin - Worry that by do we know the scale of challenging OSPAR? Understanding of this process is required.

Sally Rouse - This workshop is not about forming a challenge to OSPAR but about identifying if there is a case to build a challenge around.

Session 2: Salvage and Emergency Response (16:00)

Tom Walters, HFW – Rapid Response – using LOF in offshore projects

Explains the effectiveness and limitations of LOF contracts. Lessons can be learned from salvage in decommissioning.

What is LOF contract – Simple contract / process – easy to agree on / very flexible

- Effort made to minimize impacts on environment.
- Contractors entitled to a proportion of the overall salvage profit
- LOF can circumvent a lot of issues involved with salvage.

Operators do not want to be associated with environmental damage.

Gives examples illustrating effectiveness of LOF - Thunderhorse damaged by hurricane and time became critical when worries that another hurricane would further damage. Consortiums of salvors were able to use LOF mechanism to step outside of the health and safety regime and use their experience to effectively and safely salvage the ship.

LOFS have led to effective and organised salvage operations at many locations LOF being used as bridging contract until further contracts can be established e.g. wreck removal contract.

Field specific issues to consider before LOF is employed

LOF is not clear about where liability lies and some contractors are not relaxed about working under them.

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Planning detail – Salvors can plan quickly whereas the Offshore Industry used to more thorough planning process.

Who pays for the insurance?

High level of expertise can be carried over from salvage to decommissioning to drive down costs.

Jim Elliot, T&T Salvage Marine – Salvage and Marine Firefighting regulatory Frameworks

Gives comparison of UK and USA response models – in both, Salvage is time critical

- After the best methods have been employed and everything is done correctly after a spill, only 10% of oil can be cleaned.
- Need communication with public after incident – often companies want to keep quiet about spillages.
- When 100s of companies were assessed on vessel response plans - only 4 were deemed “adequate”
- Point reiterated that knowing other users helps increase effectivity of salvage operations. Introducing Salvors to decommissioners and scientists is invaluable and can lead to great improvements in efficiency of practices for everyone

Nigel James, Waves Group - Similarities & Differences: Closing the gap between decommissioning and wreck removal

Discusses the situation after salvage has failed – wreck removal. Discusses many of the aspects and various challenges of wreck removal.

Location is absolutely vital

- Similarity to decommissioning is that you are not immediately considering removal process of installation when installing infrastructure.
- When structural integrity of ships is compromised operational challenges can interfere with salvage operation - weather plays important role can change plans of salvage.
- Operators are particularly concerned about their reputation when undertaking salvage operation.



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- Problem occurs when numerous contractors are involved but may not have the particular skills required.
- Often particular offshore companies do not have the protocols for salvage operations.
- No conversations for the discussion of whether to prioritise salvage of vessels or oil well heads.
- Needs to be discussion between salvors and offshore companies. E.g. certain operations left active on platforms.
- Offshore companies know the installation best – useful to have them on site for salvage operations.

Fiona Murray - Not all abandoned platforms will become habitats for biota. Much of it will not survive under changes in pressure changes of cutting up platforms.

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Session 3: Technology & Innovation (08:45)

Welcome back from **Don Orr, SUT Decom & Wreck Removal Sub-Committee Chairman** – Good to see the diversity of people present from all around the country and internationally but also representing a range of stakeholders from different sectors.

Great afternoon yesterday:

In Sally's session it was interesting to see the alignment amounts the academics that she had been working with. Also the frustration over the evidence (or lack of) and a real call for the tangible facts that could be used to formally justify the positions of different sectors.

Salvage and emergency response piece we could see a fast moving and effective industry even when dealing with regulations.

Don invited the Executive Director of MASTS, Professor David Patterson to say a few words.

Professor David Paterson - The first of these meeting was an attempt to integrate from the academic 'pool' (consortium of expertise) to the industrial zone and some of the commercial activities that we (academia) felt we didn't understand or support very well.

What Sally's session showed us is that when we talk about these subjects and we use an evidence base for our views, we come to similar conclusions. When we talk to each other more effectively we can



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produce so much more from these opportunities - when you are putting kit and high tech together into the sea, there is so much opportunity for us to add value to the situation.

Nobody wants to destroy the environment - we have to use it within sensible limits.

Interesting to see that pollution came out as this groups top priority Need to discuss this in more detail to see why pollution is not such a big deal (as David sees it) and other issues are of more importance.

This integration between stakeholders is crucial for progress. Thanks to the organisers for providing this opportunity to speak together and to see that the different sectors aren't very far apart in opinions and could likely come together more.

Don Orr continues his welcome:

Main objective is to explore the difficulty of producing new innovative technology.

Don's own experience relating to the subject was as part of the technical consulting group that was supporting the MPU heavy lifter - an innovation by Norwegians in response to a technical call by Total and Philips relating to the decom of 2 big Norwegian fields - the Total Frigg field and the Philips Ecofisk field - both reaching end of usable lives of the facilities. The call was for single piece removal. Rather than reverse installing them, they could be removed in larger chunks - more efficient as no need to preserve.

Lots of energy and response from different businesses to the call. However the story got sad after that as a lot of the businesses went bankrupt after that. MPU heavy lifter had invested 75-100 million into the enterprise and design work then realised that the market wasn't developed enough to support the work.

Were some successes -

Acer? with buoyancy tanks were used for a decom project.

Pioneering Spirit has been built and used for two projects.

Although a few successes overall it wasn't an efficient or constructive way to engage the innovators to bring forward these ideas.



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These are larger scale examples but there are numerous smaller scale examples which in many cases have also struggled.

Arup talked to the decommissioning industry - the operators, the technology providers and regulators trying to understand what could be done to make the decom process more efficient. It was also done in order to educate these stakeholders in order to guide them on the process.

Welcome **Elliot Wishlade, ARUP.**

Will draw from some innovations from an in-house product design group at Arup.

Adequate effort needs to be paid to each component of the technology innovation process.

Upfront work needs to be done to really understand the needs is crucial. Technologists tend to focus on what they think the needs exist or the capability of their equipment.

Another important part is capturing the needs in a 'brief' - the best work is when this is written almost as a third party document - talking about the functional requirements not giving many details description about the innovations. This process can be managed in a structured way which helps guides the required development over time.

Encourages engagement between innovators and end users at an early stage before “polished” product. This responsibility lies with the innovators before product is finalised but also with the producer - there is a tendency to not want to engage until a product is ready to be deployed. Feedback from market is vital and the earlier this happens the better.

Useful to understand size and scale of market the innovation will be deployed into, in addition to the barriers that may arise. Needs to be good market and product analysis - this should happen at early stage which allows a map for development to be established which understands business requirements.

Execution - formalise partnerships in legal agreements - will help to establish confirmed costings.

Lots of legal work and other formalities need to be conducted in parallel with the technology development to allow for effective administration of products.

Readiness levels help the developers to understand progress and allow them to allocate subsequent effort appropriately. Allows informing of other stakeholders on progress.

Key recommendations from study are presented.



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Tendency in North Sea to move towards tried and tested technologies and to steer away from innovation.

Breakout Sessions

To be led by **Brian Nixon** from The Oil & Gas Technology Centre (OGTC) and **Stuart Bradley** from the Energy Technologies Institute (ETI).

Don Orr - The reason for these organisations existence is to try to take innovations and turn them into something real - good opportunity to get for the stakeholders to get to know Brian and Stuart and possibly some of these ideas to be taken forward.

1. Offshore Asset Decommissioning

Brian Nixon with the decom team from OGTC - Glad for opportunity to engage with many sectors and hope some experiences and ideas will influence forward strategy.

Daniel Warrick, Maersk - presented progress of Janice decommissioning 80% of subsea infrastructure removed.

Alisdair Baghurst, Maersk - presented some of the challenges of decommissioning -

Numerous technical challenges trailed different methodologies for recovering of 'debris' (inactive parts left within 500m safety zone)

Maersk are used to constructing installations not in taking them apart collaboration with salvors would have been appropriate.

Break into 6 groups to address 3 questions:

- Is the oil and gas industry doing enough? Is it doing too much? Should they be doing more?
- Are there things from your area which you feel the oil industry could and should be using in decommissioning?
- Are there things the oil and gas industry should be doing in the way of new technology?

See Annex 1 for output.

2. Monitoring and Inspection

Led by **Dr Stuart Bradley** from the Energy Technologies Institute (ETI)



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See Annex 2 for output.

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Session 4: Changing Landscapes, Changing Subsea-scapes

Opening remarks from **Professor Mike Elliot, University of Hull** – when putting together the workshop structure, the organisers wanted to have interactive elements and to try show the way which different groups of stakeholders can interact on the same sort of problems. Yesterday was more about the larger structures – rigs, jackets etc., today is more about the parts of the structures pipelines and mattresses etc. Going to present some ways to tackle problems of decommissioning these parts and also the solutions adopted to address them.

Before breakout sessions there will be introductory talks focused on the how decommissioning will affect ecology, society (mainly fishing) and economics.

Carole Barbone, O&G Decom Consultant - Pipelines, Umbilicals, Bundles: Decommissioning Requirements

Talk covers:

- Current rules regarding decommissioning guidance and context of where rules come from.
- Overview of the particular kit
- Guidance of decommissioning and thoughts for future.

Range in types of infrastructure, expectations - remove small and simple infrastructure;

Regulations are aimed at achieving a balanced understanding of the available options.

Need to take into the long term costs of monitoring infrastructure which is left on the seabed.

Very important to consider the effects this kit will have on other stakeholders of seas. A large effort is made to communicate with groups like the SFF.

What are the mitigations in place to minimize impacts interactions between users and infrastructure left in place?



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Comment by **Mike Elliot** from breakout sessions – many stakeholder groups have their own terminology / languages and these sessions are effective at getting people talking the same language.

Dr Becky Hitchin, JNCC - Changing Subsea-scapes: Scenarios for the environment

Gives four infrastructure scenarios and provides JNCC principles regarding ideal situation for decommissioning and then where there can be some compromise “in practice”.

The potential benefits from leaving infrastructure in place is of secondary value to the features of a designation – e.g. an oil rig in “sandbank” designation may have diverse epibiota attached but what is of main concern is the sandbank community and how that is being influenced.

With surface structures the ideal case would be for full removal but where there may be some flexibility is if the removal causes release of toxicants. There is also current discussions taking place about when there are protected species growing on infrastructure e.g. at the moment CITES can allow removal of substrate that is habitat for *Lophelia* reefs.

Buried pipelines for many stakeholders would be best left in place but concern lies with the future degradation and monitoring.

Partially buried - need to have discussion about what is the best practice

- Need to understand how current legislation deals with mobile sediments and scale of impacts if the features are moving around
- With mattresses - adopt a case by case basis e.g. assess ecosystem services provided by habitat when infrastructure is left in place vs removed.
- SEPA are concerned there is not enough capacity to process continued removal of mattresses in Scotland over the next 30 years.

Finishes with questions JNCC have regarding decommissioning

Dr Peter Hayes, Marine Scotland – Triple win: Pipeline and cable decommissioning for Society removal

Initial reminder for breakout sessions that it is not only commercial fisheries that interact with Oil and Gas sector - fisheries just one user but has highest profile



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Gives overview of Pipelines and demersal fisheries which are most likely to interact with them. Many demersal fishers will fish along pipelines as they act as FADs.

Able to use VMS data from demersal vessels and information known about pipeline locations to show areas of interaction. The challenge - that they do not know the level of interaction at these locations as they do not know where exactly the pipelines lie on the surface, are partially or fully buried. Information about how pipelines are installed would significantly help to know the condition of infrastructure and what effects decommissioning will have on the environment. The solution – industry collaboration with information sharing about the details of particular installation conditions to give a strategic understanding on how decommissioning can influence commercial fishing.

Another problem is with the current data on fishing activity may not reflect how it is in the future.

Talks through slides on where decommissioning is today and its future.

Mike Tholen, OGUK – Scenarios for the Economy

Gives overview of decom from the industry perspective and how it will be paid for

Oil and Gas UK represent whole oil and gas industry and industry through the whole operating process from conception to decommissioning.

How much will decommissioning cost and how will it be funded? Often not considered fully as it lies so far in the future. Much effort has been made to estimate costs of decom but large variations occur

Challenge for industry to work within OSPAR remit to conduct decommissioning responsibly, effectively and cost effectively.

Countries want to spend money to conduct decommissioning correctly to prevent any future requirements from the infrastructure.

Comment from **Mike Elliot** - Moral decision of committing to costs of decommissioning for which the bill will be footed by future generations.

Breakout sessions facilitated by Professor Ben Wilson, SAMS, and Dr Paul Fernandes, University of Aberdeen

Give opinions on pro- and cons- of removing infrastructure or leaving installed on:

Economy, Environment, Society, and possible solutions



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Questions after session:

Is the financial impact from different scales of economy understood? Has financial modelling or other analysis been carried out?

The Scottish government is carrying out industrial strategy as to how they will deal with decommissioning.

Man from Winthorpe oil - Feels decommissioning won't have such severe negative effects on the UK economy as some people are worried about, it will be job transferring from operating rigs to decommissioning.

Mike Elliot - there is a struggle to get industry to share the data that they acquire and make it useful

Don Orr - Decom North Sea has put together a web based framework seeking to capture and share the different lessons learning from decommissioning to date. They are hoping a range of stakeholders will share and utilize the framework

Brian Nixon - consulting with industry to identify the key topics to reach 35% cost reduction target in - one of those is knowledge exchange - challenge is that many groups of stakeholders agree that this process is required but not all of them are as willing to take part in it.

Another speaker points out Xodus group are also facilitating a project from knowledge exchange.

Structural engineer - raises the point that although producers would like to do it correct first time, feedback is required about effectiveness.

Confidentiality is a concern regarding sharing of cost effectiveness.

Transfer of knowledge is important - ownership of intellectual property is a concern.

Knowledge exchange is encouraged by operators but few companies conduct this practice - progress will be made when this exchange will happen

Point made by operator - If we remove the pipelines (or critical elements of them) because an operator wants to be rid of its liability then that will reduce the capability of other companies to exploit the oil and gas fields available to us resulting in more having to be imported.



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Answered by a point that a conversations are currently underway with the oil and gas authority and other companies (can't make out which) into what is the best practice for not "sterilizing" an area by removing infrastructure and hampering future prospects in that location.

Question - is this this consideration extended to CO2 transport?

Answer - Very often the current pipelines are not adequate for Carbon capture. CO2 is highly corrosive when mixed with water so in many cases, pipelines that were designed for other purposes it would require re-plumbing the existing infrastructure.

Final points

Results were shared by **Paul Fernandes**

Close - Moya Crawford - Two themes she highlights from the workshop - Society and Alliance

Commending the outputs of this workshop (particularly MASTS / SUT) and the format by which different sectors have come together and exchanged knowledge. Feedback about the workshop will be important.

There are key points in decommissioning which require more clarification e.g. liability - was good to have salvors present who are good at working with insurers and PI clubs (Protection and Indemnity) to get better figures on liability. It is a point that she will take back to the SUT - to push forward with the liability issue.

Something raised by the group sessions was the question, are we short of technology? Unequivocally yes and she recommends the encouragement of more engineers to attend next year to provide advice for this issue.

The 'intellectual and environmental knowledge' is one of the great things to have come out of decommissioning. We need to think about how each of us can build and develop this knowledge through cooperation

Wreck removal and salvage need to be congratulated for bringing together workshop effectively.

Close.

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Annex 1: Session 1 – Environmental Perceptions of Jacket Decommissioning Scenarios – Results Summary

Seventy-two participants attended the workshop with representatives from academia (35%), oil and gas operators or contractors (28%), other marine industries (15%), regulators and government advisors (8%) and environmental consultants (6%), with the remaining participants identifying as ‘other’.

The participants were asked to consider their own opinion (with their industry/sector experience) for 3 outlined tasks, the results of which are presented below.

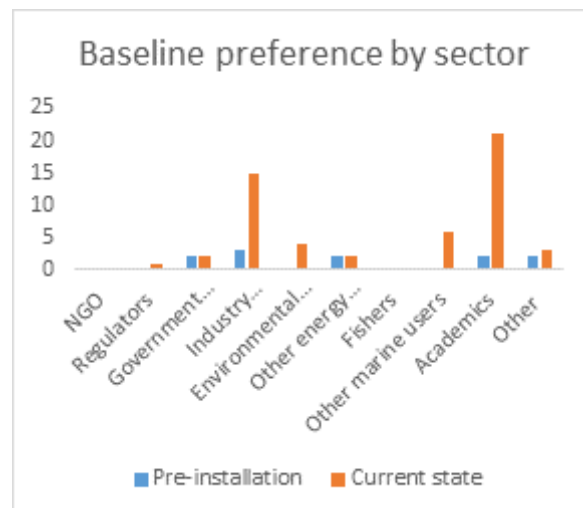
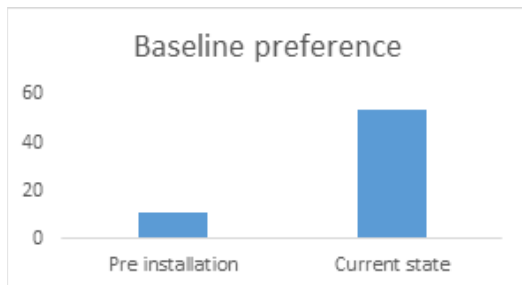
Please note, the participants were only asked to consider the marine environment (not including any safety, technical or cost aspects) and that they were not asked what their preference or opinions were for changing any decommissioning policies.

Task 1: When measuring environmental implications of decommissioning (for multiple scenarios) – what baseline should we measure environmental impacts against?

The participants were asked to identify their preferred environmental baseline state in relation to decommissioning.

1. Pre-installation of Jacket (e.g. undisturbed seabed) or
2. Current state (e.g. as Jacket is installed)

The results shown here showed a preference to use the current environmental state as the baseline.



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Breaking the results down by industry/sector, no sector had a preference for pre-installation baseline. However, Government Advisors and Other Energy Industries were evenly split.

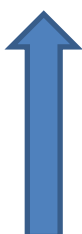
Task 2: What are the most important environmental considerations relevant to decommissioning?

The participants were asked to rank their perceived importance of 8 marine biology topics (as identified by academics at a separate workshop hosted by the MASTS Oil and Gas Environmental Forum in May 2017); in relation to decommissioning of oil and gas installations.

The Topics were:

1. Changes to non-native invasive species presence/abundance
2. Changes to benthic biodiversity, biomass and biogenic habitats - native species
3. Attraction to structures and changes to feeding patterns for megafauna
4. Uptake of pollutants by fish
5. Change in abundance of reef - based fish and shellfish
6. Change in commercially exploited fish stocks
7. Changes in fish population connectivity (larval dispersal, foraging, shelter)
8. Changes in area of seabed exposed to fishing

The ranked importance of the topics by workshop participants is outlined in the table below:

Topic	Perceived Importance	
Changes to benthic biodiversity, biomass and biogenic habitats - native species	1	
Uptake of pollutants by fish	2	
Attraction to structures and changes to feeding patterns for megafauna	3	
Change in abundance of reef - based fish and shellfish	4	
Changes to non-native invasive species presence/abundance	5	
Changes in fish population connectivity (larval dispersal, foraging, shelter)	6	
Change in commercially exploited fish stocks	7	
Changes in area of seabed exposed to fishing	8	

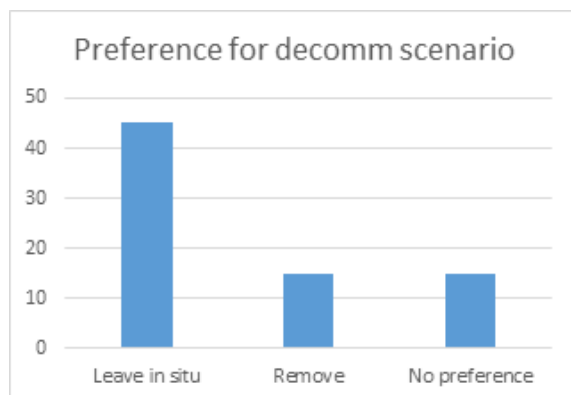
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Unfortunately, it was not possible to separate the perceived importance by industry/sector due to errors in recording the data.

Task 3: Based on the information you are presented with in the matrices, which decommissioning scenario would you select?

Finally, based on information collected during the workshop, the participants were presented with 3 decommissioning scenarios and some environmental evidence in matrix format – illustrating potential positive, negative, neutral, contested or unknown impacts (against the 8 topics outlined in task 2).

Results showed that based on the information presented to them, there was a preference for leaving the structures in-situ. With removal and no preference showing equal results.



Next steps

The results from this workshop, and the workshop held in May 2017 will be compiled into a report that will be made available in due course.

Annex 2: Output from Session 3, Breakout Session 1 - Offshore Asset Decommissioning

Question 1: Is the Oil & Gas industry, decommissioning removal scope considered 'the normal' too much?

- 1 Government / tax payer burden?
- 2 Debris removal? Case by case... costly + time consuming
- 3 Cost review / transparency of contracting models to ensure most effective solutions

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- 4 Bury (or leave) concrete mattresses? Recovery vs burial...
- 5 Safety, costs, environment, feasibility, society all should be considered (no particular order)
- 6 All options should be considered
- 7 Needs to be considered case by case using best available experience
- 8 Probably not but there is a need for flexibility and holistic approaches
- 9 Site specific "fit for purpose" rather than blanket
- 10 Yes, but oil and gas uses it operational risk assessment
- 11 Yes, Oil and Gas use live plant risk profile in decom. Different industries have different risk profiles
- 12 Oil and Gas need to pull in pool of knowledge earlier
- 13 Additional scope to remove bio-fouling in situ
- 14 Base level is required thereafter novel approaches should be considered
- 15 Safety levels from Oil and Gas perspective are often overly restrictive
- 16 Don't remove re-purpose - use as hubs for other energy solutions (geothermal, wave, etc.)

General consent is that it should be seen as a case by case basis, and no strong opposition to leave in situ / re-use.

Comments on risk assessment to be modified for a decommissioning purpose and not operation, this could promote innovative thinking.

Question 2: Could the Oil & Gas industry simplify its approach to decommissioning by adopting technologies or are there already existing technologies that are not being recognised from other industry sectors?

- 1 Lessons could be learned from renewables industry
- 2 Explore reuse of Oil and Gas infrastructures for other industries
- 3 Clean sheet thinking
- 4 Buoyancy for refloat and tow (surface or submerged)
- 5 Automatic remote oxy asc cutting
- 6 Exothermal cutting, Rail welding reversed
- 7 Recognition of some good examples - but must always be safe and environmentally responsible
- 8 How to stimulate cross sector dialogue?
- 9 Reverse CP to corrode pipelines quickly, need not to remove
- 10 "Make safe" approach by Oil and Gas then pass to salvage companies

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- 11 Simplify via better exchange of ideas between companies + between industries (what directory of good ideas and experience can be used?)
 - 12 Remote vehicles from other industries - nuclear; military; space
 - 13 Yes
 - 14 Bioremediation solutions for cleaning up
 - 15 Offshore renewables already decommissioning
 - 16 Engage with 'wet' salvage industry (sub 50m)
 - 17 P&A costs - thermitite to reduce time / costs
 - 18 Contracting models? Example LoF Lloyds yesterday
 - 19 30 ppm - how clean is clean? Flushing - can timescales be reduced? Flushing technology?
- Regulations...
- 20 Nuclear / salvage industries
 - 21 Topsides removal - topsides decom model - demolition? PoB issues? Fuel / water, etc
 - 22 "mindset approach" to decom jobs

General view was that the Oil and Gas industry could simplify its approach to decommissioning by learning from the salvage, nuclear and renewables industry.

Approach decommissioning with a non-oil and gas mindset.

Question 3: What new innovating technologies or techniques could the Oil & Gas industry use to reduce costs and improve efficiencies?

- 1 Neutral buoyancy to tow "mid sea"
- 2 ROV / UAV technology to self-drive subsea structures for removal
- 3 Capped Aquatic Cell to store dirty sediment
- 4 Use of "sand box" with soft lashings for restraint. E.g. for wellhead recovery
- 5 Bubble curtains
- 6 Textile curtain around explosives
- 7 Oil and Gas to review their organisation structure and the skill sets in the team to encourage innovation and lateral thinking
- 8 Efficiency: change mindset on recovery to surface of items. Why steel sea fastening, why not just land on deck and lash down
- 9 Redefine "fit for purpose" perhaps change to "good enough"
- 10 Technology (in the O&G sector) often associated with engineering. There are other relevant sciences that may provide solutions
- 11 Bioremediation not yet being explored for decommissioning



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- 12 Do not over engineer - lessons from nuclear industry - salvage industry. Keep it simple.
- 13 Look at other sectors - not necessarily new technology but new to oil and gas industry
- 14 Improved cutting techniques
- 15 Have comp-mobile systems on lessen spec vessels - adaptation kits
- 16 Subsea drones / autonomous vehicles
- 17 No body mind a dinteel rusty scrap skip fit for use
- 18 Using buoyancy to "flat" + tow to port
- 19 Adaptable "in-boarding" on anchor handler type vessels
- 20 P&A - Thermite technology - in progress...
- 21 Laser / Plasma cutting?
- 22 Biotech use in P&A
- 23 Rig less well abandonment e.g. via coil tubing operation
- 24 Melting cap rock in well abandonment
- 25 Use of resins in well abandonment

The attendees provided a number of ideas / potential techniques / technologies than can be applied to O&G decommissioning. Again, a requirement for a change in "mindset" was brought up.

The OGTC would like to invite the participants with the ideas / technologies suggested to come to talk to us.

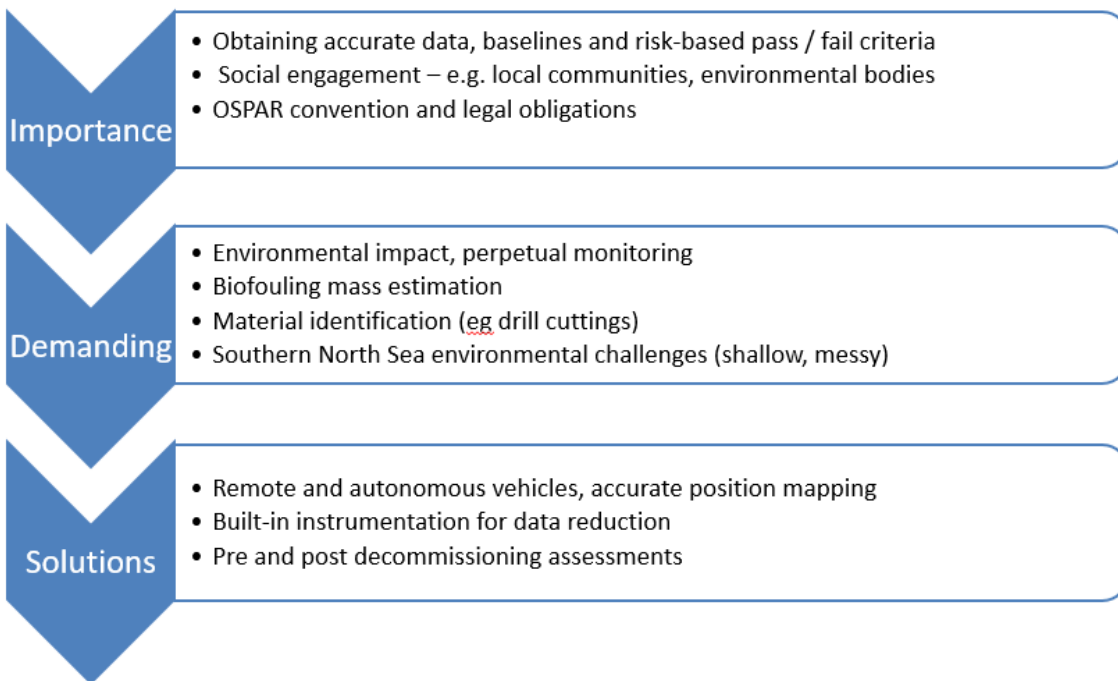
Overall, there was a great interest and engagement from the majority of the participants and a lot of good discussions was observed during the workshop.

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Annex 3: Output from Session 3, Breakout 2 - Monitoring and Inspection: Remote Monitoring and AUVs

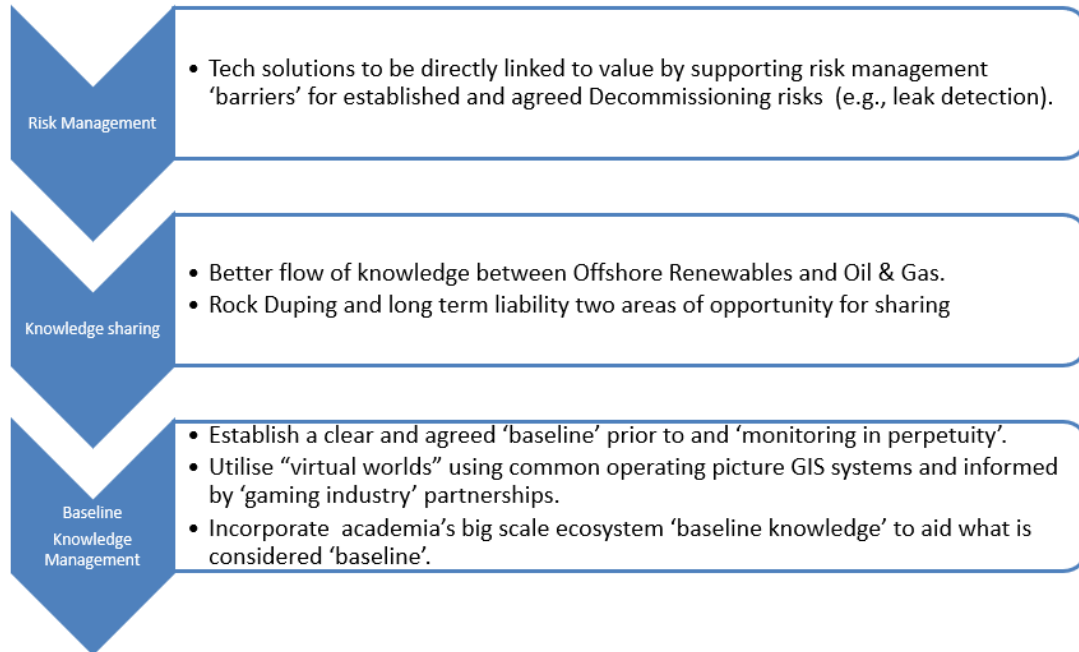
Three questions posed:

1. What are the most demanding and important monitoring and inspection challenges facing the Offshore industry, and their solutions?

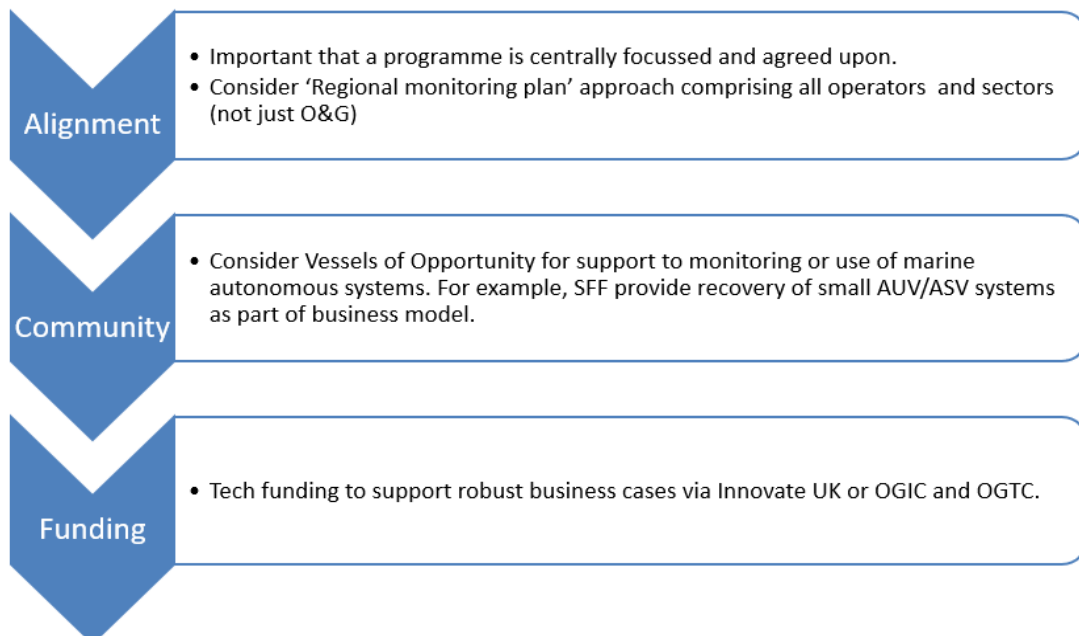


2. What solutions can be adapted from other industries to help us meet these demands, and what gaps are there? /-

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3. What routes to commercial adoption and exploitation exist and are needed to ensure that we meet the industry & stakeholder needs?



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Annex 3: Output from Session 4, Changing Landscapes, Changing Subsea-scapes

Collated comments on pros and cons (and suggested solutions) to either leaving pipelines in place or taking the pipelines out of the system.

General comments on Environment:

- Current processes seem fit for purpose, keep on case-by-case basis.
- Inconclusive, no common consensus
- Public perception is driver, complexity and trade-offs need communicating.
- Public might know about big structures but not the pipes, cables etc

General comments on Economy:

- It is questionable that we understand the actual net impact of the options
- We need a transparent analysis of ‘cost to UK economy’ of various options (as many operators are multinationals)

SOCIETY		
	Pros	Cons & Solutions
IN	<p>Fishing</p> <ul style="list-style-type: none"> • Prevents overfishing and expansion of bottom contact fisheries impacts • Enhance fish production • Fish aggregation could improve catch rates • Restricts fishing activity/overfishing issues • Protected areas from fishing (requires ecological services costing to show long term benefit to fisheries) • No changes for fisheries • Fishery trawl hotspots if left in and protected or buried <p>Employment</p> <ul style="list-style-type: none"> • Use engineers on renewables not as scrap merchants • Creates jobs in diving inspection 	<ul style="list-style-type: none"> • Disruption to fishing patterns • Have to go around stuff (lower catch rates) • Snagging hazards (damage to gear, loss of fishing time & earnings, spoilt catch, safety risk to personnel) • Obstacle to fishing industry • Repurpose exclusion zones & subsea equipment for aquaculture [?] • Interaction with fishing activities (socio-economic and safety issues) • Can FishSafe version 3 be significantly enhanced and funded to provide a really accurate navigation picture, incorporating knowledge on pipelines from operators and HSE <ul style="list-style-type: none"> • Less work for industry

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	<ul style="list-style-type: none"> • Drive/push for technology development continues <p>Other</p> <ul style="list-style-type: none"> • Increase in public interaction with marine environment • Some sites may be good for recreational diving • Biodiverse habitats • De-pollution of North Sea • Re-use pipelines for CO2 storage 	<ul style="list-style-type: none"> • Negative public perception (inform and educate) • Poor stewardship from oil and gas results in reputational damage • Public concerns about big oil off the hook (Solution: educate the public with respect to energy balance and removal) • Not always possible to trench & bury due to presence of clay • Could be made into exclusion zones for public info [?] • Perception of contaminated seabed being left – polluter pays principle • Media backlash – not doing enough for environment (Solution: saves taxpayer; could be better for environment) • Cannot establish precedent for avoiding cost of removal • Future governments pay for decommissioning
<p>O U T</p>	<p>Employment</p> <ul style="list-style-type: none"> • Industry jobs in decommissioning • Jobs in recovery and waste management • Employment • Removal of contaminants / sport diving / recreation / interaction of public • Creation of employment • Job creation in areas dependent on oil and gas industry • Local jobs • Jobs community serving • Maintain employment across supply chain <p>Ethics</p> <ul style="list-style-type: none"> • Responding to societal requirements • Restoration of cultural community activity • General sense of wellbeing: doing the right thing • Perception of clean seabed being left by polluters 	<ul style="list-style-type: none"> • Loss of jobs [?] • But is it worth it when you consider CO2 expenditure to recover, clean and refurb • High cost to remove for tax payer

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<ul style="list-style-type: none"> • Public consensus that removal is the right thing to do • Sea not used as refuse dump <p>Other</p> <ul style="list-style-type: none"> • Removing everything could be beneficial to fishermen • Re-use of equipment • Potential loss of life due to ship collision eliminated • Opens up seabed to other users 	<ul style="list-style-type: none"> • Removal of structures with protected species contradicts with efforts to protect these elsewhere • Energy expenditure and CO2 emissions required for removal (Solution: let nature take its course) • Safety concerns spawling/cutting with removal • Waste management • Value of surface laid lines demonstrated by active targeted fishing 	
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ENVIRONMENT			
	Pros	Cons & Solutions	
IN	<p>Habitat</p> <ul style="list-style-type: none"> • Retain reef habitat, biota and biomass on structure • Fish habitat • Rare species habitat (<i>Lophelia</i>) • Leaving doesn't disturb environment further • De-facto MPAs • Reduced trawling impacts • Good environment for ecological monitoring (science wins from long-term monitoring) • Longitudinal habitat facilitates migration/habitat connectivity <p>Reduce cost to removal</p> <ul style="list-style-type: none"> • Less CO2 produced doing removing, recycling • Less landfill • Less noise pollution <p>CCS</p> <ul style="list-style-type: none"> • Infrastructure or routes could be used for future CCS 	<p>Habitat</p> <ul style="list-style-type: none"> • Need more info on actual ecological value of structures • Re-suspend sediments and pollutants • Leave artificial habitat/ecosystem • Disrupts hydrodynamics / scouring / sediment transport • Route for invasive species <p>Pollution</p> <ul style="list-style-type: none"> • Degrading equipment leach chemicals • Chemicals released over long time • Degrading equipment break up <p>Cost</p> <ul style="list-style-type: none"> • Long term environmental monitoring needed (Solution: renewable energy used in monitoring) <p>Other</p> <ul style="list-style-type: none"> • Future navigation compromised • Liability from indefinite monitoring • Who pays for clean-up in distant future? 	
OUT	<p>Habitat</p> <ul style="list-style-type: none"> • Return habitat to previous/pristine state • Reduce invasion of non-native species <p>Wider issues</p> <ul style="list-style-type: none"> • Remove dangerous structures 	<p>Habitat</p> <ul style="list-style-type: none"> • Destroying established habitat • Disperse contaminants • Disturb seabed • Re-suspend pollutants 	

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<ul style="list-style-type: none"> • Improve navigation safety • Removes future contamination risk <p>Mixed approach</p> <ul style="list-style-type: none"> • Default unless proven habitat benefit <p>Science</p> <ul style="list-style-type: none"> • Opportunity to learn if benefits to removal 	<ul style="list-style-type: none"> • Potential for spills • Opens up yet more habitat for fishing <p>Wider issues</p> <ul style="list-style-type: none"> • Environmental cost to recover, reuse, recycle, dump • Onshore disposal may be in countries with less stringent environmental regulation • Convert offshore to onshore problem • Money could be spent on something else
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ECONOMY		
	Pros	Cons & Solutions
IN	<ul style="list-style-type: none"> • Skills and experience can be transferred (sold) to other basin/industries • Pipelines – reuse for CO2 transfer to storage – first priority for relevant pipelines; Use by other offshore industries in the future therefore reduces/shares additional costs; Other users can use the pipeline for energy storage (wind, wave); Infrastructure already present to use in the future for new technology and to boost marine life • More monitoring will be required which could be expensive, Long term monitoring costs, Continued monitoring jobs + Inspection and monitoring jobs • Quicker, easier and cheaper today when market tight (6 responses) and saves money, to allow Government spending elsewhere about and reduction in government contribution to decom cost (good for society); Taxpayer saves money (£60 bn) could be used elsewhere, health, education, renewables; Redirect non-spent sum on compensatory environmental measures • The renewable energy industry needs to be more proactive now to achieve future saving in decom costs • Possible positive impact on fisheries through retaining nursery habitat; Fisheries impacts 	<ul style="list-style-type: none"> • Tax bill for future tax payers – remedied by saving money from current taxes from oil/gas • Legacy remains at some point – decom may become a requirement in the future • Someone has to pay for long term monitoring; Toxicity assessment expensive and safety; Monitoring long term can be costly • Making the costs distribution fair is difficult; Legacy monitoring may not be possible in perpetuity and revert to government when companies fail – solution additional contribution to FLTC fund on insurance basis; Company goes into liquidation, no money left, taxpayers foots all costs • No new decom industry • Consider obligations on operators to invest part of avoided cost in other economic stimuli • Damage to vessels • Lifting and cutting requires new technologies – it is currently very expensive • Prioritise what needs to be left in place • Balance the costs/savings overall and use savings to funnel into strategic monitoring and research projects • Cost of making safe • Restricts fishing activity; Fisheries impacts • Future maintenance or problems

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	<ul style="list-style-type: none"> • Case-by-case assessment of jacket for consideration of retention in safe navigation configuration to retain habitat – maintain exclusion zone 	
O U T	<ul style="list-style-type: none"> • Work for hard pressed North Sea service companies; Keeps oil and gas economy buoyant; Regional economic development from ship building/ports etc. • Innovation of new technology that may be used in other industries; Creating technology and knowledge for export; Developing UK as centre of excellence for global decommissioning industry • Supports industry, creates new tech and services = competitive/ comparative advantage for future exports • Benefits to oil and gas supply chain in challenging market conditions • Service provision for monitoring, boosts jobs; Jobs; Creation of jobs, Opens opportunities for other stakeholders; Jobs, new industry; Decom industry jobs; Employment; Job creation • Most of costs have been realized • Allows seabed to be used for other activities; Removes liability and removes risk to other sea users 	<ul style="list-style-type: none"> • Drill cutting material might be useful for other purposes – munitions, ballast/glass • Recycling in the UK leading to creating jobs • Building a decom industry • keeping costs down by recycling topsides etc. • jobs going to other countries • removal takes away future potential use, e.g. carbon capture • high cost for industry; costly to remove facilities • solutions - industry to get smarter with recovery technology, investment in technology, export expertise

OTHER ASPECTS	
IN	Pipeline re-use for CO2 transport: requires clear “picture” (geographic and schedule) of where pipelines may be re-used for CO2 transport and when.
	Pipeline re-use for CO2 transport: need national body to take on ownership of pipeline(s) when operators are scheduling decommissioning if no CO2 storage operators ready yet.
	Pipeline re-use for CO2 transport: need to require deferral of decommissioning for relevant pipelines; need to require preservation of pipelines by cleaning and refitting before recommission for CO2 transfer.
	Re-purpose.
OUT	Get smarter when developing new fields and engineer for decommissioning.



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	Meeting the original commitment: structures were placed there with the clause that they would be removed*
	Adherence to OSPAR Decision 98/3 requirement**
OPPORTUNITY	Pioneering technology would set the standard globally and result in international interest for advice, services and products which would boost economic and societal benefits.

** comment relates to structures rather than pipelines*

*** comment relates to installations not pipelines which are not covered by OSPAR rules*