# Ultra-deep water port feasibility study

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**Private and confidential**

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01 August 2018

Dear Sirs,

**Ultra-deep water port feasibility study**

In accordance with the contract awarded on 8 May 2018, we have prepared a Feasibility Study for the provision of an ultra-deep water port.

**Purpose of our report and restrictions on its use**

This report was prepared on your instructions solely for the purpose of the Scottish Government and should not be relied upon for any other purpose. Because others may seek to use it for different purposes, this report should not be quoted, referred to or shown to any other parties unless so required by court order or a regulatory authority, without our prior consent in writing. In carrying out our work and preparing our report, we have worked solely on the instructions of the Scottish Government and for its purposes.

Our report may not have considered issues relevant to any third parties. Any use such third parties may choose to make of our report is entirely at their own risk and we shall have no responsibility whatsoever in relation to any such use. This report should not be provided to any third parties without our prior approval and without them recognising in writing that we assume no responsibility or liability whatsoever to them in respect of the contents of our deliverables.

**Scope of our work**

Our work in connection with this assignment is of a different nature to that of an audit. Our report to you is based on information available from public sources, information provided by Scottish Government and other public bodies. We have also gathered information from, and made enquiries with, key market stakeholders. We have not sought to verify the accuracy of the data or the information and explanations provided by these parties.

In undertaking our scope we have subcontracted elements to Arch Henderson LLP, specifically the location assessment. Arch Henderson LLP also assisted with points related to the technical requirement for ports and associated infrastructure.

Our work has been limited in scope and time and we stress that a more detailed review may reveal material issues that this review has not.

If you would like to clarify any aspect of this report or discuss other related matters then please do not hesitate to contact me.

Yours faithfully

Ernst & Young LLP

## Executive summary

### Introduction

The Scottish Government's (SG) Programme for Government made a commitment to build the case for an ultra-deep water (UDW) port in Scotland, and made capital funding of £7.5m available to support this development for the decommissioning sector. The purpose of this feasibility study is to assist the SG to identify a potential preferred location and to establish whether there is an economic case for the development of a UK UDW port[1].

### Two locations, in Shetland and at Nigg Energy Park, have been shortlisted from 40 quays across the UK

Working with SG, key stakeholders and Arch Henderson as technical advisors, a long list of 40 potential locations for a UK UDW port was identified. A three stage down-selection process was followed to identify the optimal locations. The stages considered were:

- **Stage 1**: All quays were assessed against a set of hard criteria (minimum requirements) which would need to currently physically exist for a quay to be a potential UDW port. After this stage, 22 quays were removed from consideration.
- **Stage 2**: The remaining 18 quays underwent a practicality assessment to assess the technical feasibility of converting the current quay into an UDW port. This resulted in a further 10 quays being removed due to the cost to develop the approach depths and depth at quayside to the required UDW levels.
- **Stage 3**: The remaining 8 quays were assessed against a set of soft criteria. Two locations, Dales Voe and Nigg Energy Park, emerged as the preferred locations to develop an UDW port.

While a range of criteria were assessed as part of this review, the selection of the preferred locations was governed by technical feasibility of each quay being able to reach the required water depths at the quayside and on approach, as well as proximity to the key North Sea basins.

### Of the £1.2bn estimated expenditure for onshore recycling and disposal activities, an UDW port could target £583m of that expenditure

The Oil & Gas Authority forecast overall expenditure on decommissioning c300 platforms in the UK Continental Shelf (UKCS) at £59.7bn. Of this, an UDW port would participate in onshore recycling and disposal activities and this is estimated to account for £1.2bn or 2%.

There is no standard industry approach to estimating the proportion of the £1.2bn onshore recycling and disposal market that an UDW port could attract.

[1] There is no single definition of what constitutes an UDW port. For the purposes of this study, it is considered to be a port which will allow ultra-heavy lift vessels to transfer modules direct from the vessel deck to the quay. In order to do this, a port needs to have 24m of water depth at the quayside and 14m depth on approach. There is also a requirement to have sufficient load bearing capacity and laydown areas at the port.

Consequently, we developed a bespoke methodology to estimate the potential market size.

There are three primary decommissioning removal methods for transporting topsides and substructures to ports for onshore recycling and disposal. Of these three methods only one, the reverse engineer using ultra heavy lift vessels (UHLV), requires UDW at the quayside. Without this, these decommissioning projects need to use a barge transfer which adds time, cost and risk to decommissioning programmes. As the UK does not have an UDW port, projects using UHLVs have been taken to Norwegian UDW ports.

We estimate 64 platforms in the UKCS, weighing a combined 2m tonnes, are potential candidates for reverse engineer removal using UHLVs, and hence more likely to utilise an UDW port. Based on tonnage data available from OSPAR and a cost estimate of £300 per tonne, the market size for onshore disposal and recycling activities for decommissioning projects which may need an UDW port equates to £583m.

In performing this analysis, it is important to note that we have had to make a number of broad assumptions due to lack of available detail, inherent market related uncertainties and much of the financial information being commercially sensitive and confidential. These assumptions are detailed in Appendix B.

**The ability to estimate direct income for an UDW port owner is restricted by commercial confidentiality, but could be in the region of £68m-£97m**

The UDW port itself could generate income from activities such as charges levied on the vessel operator, the onshore recycling contractor and various other support vessels. The level of charges is held commercially confidential by port authorities. Applying a range of £35-£50 per tonne as a proxy would give a total market in the region of £68m-£97m for port income. This estimate reflects the total income potential. However, factors such as competition from other removal methods or non UK ports would be expected to limit the market share that a UK UDW port could secure.

Section 3 (Decommissioning market), Section 4 (Market assessment) and Section 5 (Sensitivity analysis) provide further detail on the market.

**Currently, there is limited evidence to suggest non-decommissioning markets require an UDW port**

We examined two potential non-decommissioning markets where an UDW port could attract additional revenues. Firstly, supporting future capital and operational expenditure within the oil and gas sector. Secondly, the renewable energy sector, especially floating offshore wind as Scotland looks to expand from its position as a leading destination of fixed bottom wind farms. This is described in more detail in Section 6 (Multi-use opportunities).

An UDW port could support 6th and 7th generation drilling rigs coming straight to shore for maintenance and capex without having to withdraw thrusters. No organisations from the oil and gas sector were able to identify any other specific activities which require an UDW port.

While an UDW port was required for the Hywind floating offshore wind project, floating wind industry reports and stakeholder feedback suggests there is no current need for an UDW port in the UK as its future requirements can be accommodated by existing facilities. We also asked industry contacts whether an UDW port could support other renewable energy activities such as wave or tidal energy; our findings suggested that these industries do not currently require an UDW port.

**Technical alternatives are under consideration, but are at an early stage of development**

Developments in platform removal technology and the contractual arrangements across the supply chain have the potential to impact the market for an UDW port. Alternative approaches to the removal and transfer of platforms to the shore are being considered, such as barge transfer or float and tow method. However, the commercial case remains to be established and the alternatives are at the early stage of development with no fixed date for introduction to the market. Section 7 (Technical alternatives) provides our commentary on technical alternatives.

**Market consultation assessed views from a range of 25 organisations**

In order to gauge market sentiment on the development of an UDW port a series of 25 interviews were conducted. The key messages from the market were:

- There is a lack of clarity on the future market, with no commonly recognised programme and timescale for decommissioning platforms. Currently, the market for ports is considered highly competitive, with a large number of locations and few projects coming to the market. However, it remains unclear what impact an increase in decommissioning activity, especially for large scale projects, would have on market dynamics.
- The ability of a port to offer a comprehensive onshore disposal and recycling capability, and to effectively manage the associated risks, such as fulfilling the safety and regulatory requirements, was considered a key advantage during the selection process. For the physical location, the east coast of the UK was considered preferable primarily due to the shorter transit times from the Northern North Sea and Central North Sea basins.
- No organisations viewed an UDW port as an attractive investment opportunity for them given that this would not align with their existing business model. Neither did they believe that guaranteeing a number of projects to a specific port would be possible.
- The number of direct jobs created by a project was considered to be up to 50, with the market investing in mechanical approaches to reduce labour costs.  The UK market was viewed as a lower cost base for onshore activity compared to Norwegian competitors.
- Regarding specific multi-use opportunities, an UDW port could allow 6$^{th}$ and 7$^{th}$ generation drilling rigs to come straight to shore for maintenance

and capex. However, there was no particular need identified for an UDW port from the offshore renewable industry.

The overall findings from the market consultation are provided in Section 8 (Market consultation). It is important to recognise that views will be based on the experience and commercial priorities of each organisation and accordingly should not be considered a definitive description of the market, but rather as a range of opinions.

**A UK UDW Port could deliver a net economic benefit to the UK if it is able to attract a sufficient number of decommissioning projects**

In all scenarios considered, which vary between a UK UDW port being able to attract 7 and 20 projects over a 20 year period, a UK UDW port is able to deliver a net economic benefit. This does not consider the impact of private financing potentially required for the development. Considering the need for private funding and assuming £10m of public funding to support the project, more than 10 projects would be required to be won by the UDW port to deliver a net economic benefit.

The primary benefits derive from the onshore decommissioning activity which considers work for the onshore contractor and the supporting supply chain.

A UK UDW port also has the potential to support lower overall decommissioning costs through reduced steaming time, lower onshore costs and a simplified waste management process. The level of saving available is largely dependent on a number of broad assumptions. However, analysis indicates that savings from lower onshore costs could be between £8m and £68m which has the potential to equate to a saving of between £3m and £27m for the UK exchequer through reduced future tax liabilities[2]. Potential savings derived from simplified regulatory process and reduced transit times should be further explored as part of the business planning phase.

A range of scenarios were run which considered varying levels of success an UDW port might have in attracting decommissioning projects. Under the scenarios considered, the forecasted economic impacts amount to:

- £184m to £522m of total output impact (i.e. accounting for direct, indirect and induced economic impacts.)
- Between 58 and 165 average FTE positions per year, which considers the wider supply chain impact and beyond direct employment at the UDW port.
- Between £81m and £229m of gross value added.

**A ‘transfer hub’ has the potential to increase the volume of decommissioning projects delivered to the UK**

If the UK UDW port was able to operate as a transfer hub whereby it can receive modules from UHLVs then transport them to other ports for onshore decommissioning work, it would have the potential to increase the volume of projects brought to the UK by freeing up capacity at the UDW port and

[2] Assuming 40% as the appropriate tax rate used for the purposes of this analysis.

opening up opportunities for other ports. However, this may create economic leakage from the UK if the UDW port was used as a transfer hub by non-UK based disposal contractors.

To understand the potential of this opportunity, further analysis is required to determine how such a facility could operate in the most efficient manner, whether such an option would be attractive for operators and if the facility could operate in a cost effective manner to attract decommissioning projects.

**Next steps**

SG should consider the findings of this feasibility study and assess whether it wishes to proceed to the Business Planning phase. If taken forward, the following key areas must be addressed:

- Establish a robust plan on how the UDW port could be funded – in particular, ascertain the quantum of public sector support which may be available for the development.
- Engage with the appropriate port authority in order to outline a clear commercial model for the UDW port. Agree clear roles and responsibilities for all key stakeholders.
- Further develop and refine the following key areas of this feasibility study:
    - Clarify how a transfer hub could technically operate and assess the commercial implications.
    - Perform a technical assessment on future candidate projects to highlight those which should be targeted by an UDW port and complete a more detailed assessment of revenues which can be derived from the associated onshore activities.
    - Complete a more detailed assessment in order to fully understand the expected benefits which could not be quantified through this initial review e.g. additional UHLV activity, transit time savings and simplifying the waste treatment process.

## Abbreviations

| | |
|---|---|
| AH | Arch Henderson LLP |
| BEIS | Department for Business, Energy & Industrial Strategy |
| bn | Billion |
| CBA | Cost benefit analysis |
| CD | Chart Datum |
| CNS | Central North Sea |
| CoP | Cessation of production |
| EPRD | Engineering, Preparation, Removal and Disposal Contracting |
| EY | Ernst & Young LLP |
| HIE | Highlands & Islands Enterprise |
| HLV | Heavy lift vessel |
| JV | Joint Venture |
| m | Metres |
| MW | Mega Watt |
| NNS | Northern North Sea |
| O&G | Oil & Gas |
| OGA | Oil and Gas Authority |
| OPRED | Offshore Petroleum Regulator for Environment and Decommissioning |
| OSPAR | Oslo and Paris Conventions, the mechanism by which 15 Governments & the EU cooperate to protect the marine environment of the North-East Atlantic |
| SE | Scottish Enterprise |
| SNS | Southern North Sea |
| SLV | Single lift vessel |
| STM | Shandong Twin Marine |
| SPMT | Self-propelled modular transporter |
| t | Tonnes |
| TFS | Transfrontier Shipment of Waste |
| TML | Twin Marine Lifter |
| UDW | Ultra-deep water |
| UHLV | Ultra-Heavy Lift Vessel |
| UK | United Kingdom |
| UKCS | United Kingdom continental shelf |

# Contents

# 1. Background

## 1.1 Introduction

Ernst & Young LLP (EY) was appointed by the Energy and Climate Change Directorate of the Scottish Government (SG) in May 2018 to prepare a feasibility study to evaluate the role, demand, cost, benefits and locational drivers of an ultra-deep water (UDW) port. The purpose of the study is to assist SG in identifying a potential preferred location for an UDW port and assess whether there is an economic case to support its development. For the purposes of this study an UDW port is considered to be a port with 24m of water depth directly at the quayside.

## 1.2 Structure of the report

The feasibility study covers the following areas:

- **Section 2 Location Assessment**; identifies a long list of locations for a UK UDW port, determines the criteria by which the sites will be compared and assesses the locations against the criteria establishing a shortlist to be progressed for the cost benefit analysis (CBA).
- **Section 3 Decommissioning Market**; provides an overview to the decommissioning market and the potential role of an UDW port.
- **Section 4 Market Demand**; forecasts the potential market demand for decommissioning projects in the United Kingdom continental shelf (UKCS) which may need an UDW port.
- **Section 5 Sensitivity Analysis**; performs sensitivity analysis on the market demand assessment.
- **Section 6 Multi-use Opportunities**; reviews other possible uses for a UDW port beyond oil & gas decommissioning.
- **Section 7 Technical Alternatives**; analyses potential technical alternatives or new contracting strategies which may have an impact on the demand for an UDW port.
- **Section 8 Market Consultation**; summarises the key findings from interviews with platform operators, vessel operators, port operators, potential multi-use operators and regulators.
- **Section 9 Cost Benefit Analysis**: performs an economic review of the potential costs and benefits deriving from a UK UDW port in the two locations progressed from the location assessment.
- **Section 10 Transfer Hub**: provides a high level review of how a UK UDW port could operate as a transfer hub and the potential commercial models which could be applied.

The appendices to this report provide further detail on specific areas discussed in the main body of our report.

Our scope and the principal assumptions adopted are set out in Appendix A and B respectively.

# 2. Location assessment

**Key Messages**

- Working with the SG and key stakeholders a long list of 40 quays were identified from across the UK as potential locations for an UDW port. The quays were assessed in three stages:
  - Stage 1: assessment of minimum approach depths and current quayside depths. 22 quays were deemed to not meet the minimum criteria and removed from consideration.
  - Stage 2: practicality assessment on a port being able to reach the required approach depths and quayside depth requirements. A further 10 quays were removed following this assessment.
  - Stage 3: review of the 8 remaining quays against a range of soft criteria to determine the locations which are optimal for developing an UDW port.
- Two locations: Dales Voe, Shetland and Quay 3 at Nigg Energy Park on the Cromarty Firth, were identified as the preferred locations. This is primarily driven by both locations' proximity to naturally deep water (meaning lower development and maintenance costs for an UDW port) and key North Sea basins.

## 2.1 Introduction

The location assessment was performed jointly with our sub-contractors, Arch Henderson (AH) who specialise in port development and master planning.

To identify potential locations for a UK UDW port EY discussed, refined and updated a long list of current ports with SG, Highlands & Islands Enterprise (HIE), Scottish Enterprise (SE) and AH.

These discussions identified 25 potential UK port locations. However, as most of the ports selected have multiple quay sides, this list included 40 quays for consideration.

These were reviewed against criteria jointly developed by EY and AH in order to assess their suitability for use as an UDW facility.

This section summarises the work performed and the outcomes of the review. AH's detailed findings are included within Appendix C of this report.

## 2.2 Assessment process

To determine the most appropriate locations for an UDW port we performed the following down selection process:

1. The long list of quays was first assessed against a set of hard criteria based on the current infrastructure in place and whether it could

reasonably be developed into an UDW port. Quays which do not meet the minimum requirements set by the hard criteria were removed from consideration.

2. Remaining quays underwent a practicality assessment to ascertain the feasibility of increasing the dredge depth to -24m chart datum (CD) at the quayside and increasing the approach channel depth to -14m. This assessment was performed using admiralty charts and local knowledge of the marine conditions. Quays which it did not appear reasonably feasible to achieve these requirements were removed from consideration.

3. Quays remaining after stage one and stage two assessments were assessed across a range of soft criteria, with the two best options taken forward for the CBA.

### 2.2.1 Hard criteria

The key physical criteria to determine whether an existing quay could be developed into an UDW port were:

- Current depth at the quay of at least -9m CD. If a quay does not currently have these depths considerable works would be required to increase the depth by 15m (to the desired dredge depth of -24m CD).
- Current approach depth of at least -9m CD. Significant increases to the channel depths would require extensive capital and maintenance dredging.

The quay length required to accommodate ultra-heavy lift vessels (UHLV) was also considered. However, this did not prove to be a limiting factor for any locations considered.

The results of the hard criteria assessment are outlined in the table below.

**Table 1: Locational Assessment: Hard Criteria**

| Port | Quay | Depth below CD at quay (m) | Limiting Approach Channel Depth below CD (m) | Taken forward to Practicality Assessment |
|---|---|---|---|---|
| Dales Voe - Shetland | Dales Voe | 12.5 | 25 | Yes |
| Dales Voe - Shetland | Dales Voe (extension) | 24 | 25 | Yes |
| Greenhead Base - Shetland | Greenhead Base | 9.1 | 9 | Yes |
| Peterhead | Smith Quay | 10 | 12.5 | Yes |
| Peterhead | ASCO South Base | 5.9 | 12.5 | No - due to quay depth |
| Invergordon | SB5 (pre-development) | 13.5 | 14 | Yes |

| Port | Quay | Depth below CD at quay (m) | Limiting Approach Channel Depth below CD (m) | Taken forward to Practicality Assessment |
|---|---|---|---|---|
| Invergordon | Queens Dock | 12 | 14 | Yes |
| Invergordon | SB5 (post-development) | 13.5 | 14 | Yes |
| Aberdeen Harbour | Clipper Quay | 9 | 6.6 | No - due to approach depth |
| Aberdeen Harbour | Torry Quay (3-6) | 7.5 | 6.6 | No - due to quay depth |
| Aberdeen Harbour | Albert Quay | 7.5 | 6.6 | No - due to quay depth |
| Aberdeen Harbour South | East Quay | 10.5 | 10.5 | Yes |
| Aberdeen Harbour South | North Quay | 9 | 10.5 | Yes |
| Montrose - Norsea Support Base | Berths 1 & 2 | 8.2 | 5.5 | No - due to quay depth |
| Dundee | New Quayside | 9 | 6 | No - due to approach depth |
| Nigg | Quay 3 | 12 | 14 | Yes |
| Nigg | Dry Dock | 9.1 | 14 | Yes |
| Energy Park Fife | EPF One | 6.5 | 6 | No - due to quay depth |
| Energy Park Fife | EPF Two | 6.5 | 6 | No - due to quay depth |
| Inverkeithing | | 3 | 1 | No - due to quay depth |
| Ardersier | | 2. 8 | 14 | No - due to quay depth |
| Kishorn | Dry Dock | 8 | 30 | No - due to quay depth |
| Leith | Imperial Dock | 6.7 | 6.7 | No - due to quay depth |
| Wick | Commercial Quay 1 | 4.5 | 4 | No - due to quay depth |
| Hunterston - Platform | Construction Jetty | 3.8 | 7 | No - due to quay depth |
| Hunterston - Platform | Construction Jetty | 10.5 | 10 | Yes |
| Hunterston Dry Dock | Dry Dock | 9.5 | 10 | Yes |
| Hunterston - Ore jetty | Outer Berth | 20 | 30 | Yes |

| Port | Quay | Depth below CD at quay (m) | Limiting Approach Channel Depth below CD (m) | Taken forward to Practicality Assessment |
|---|---|---|---|---|
| Lyness | Lyness Wharf | 8 | 14 | No - due to quay depth |
| Arnish | Materials Quay | 6. 5 | 8 | No - due to quay depth |
| Greater Yarmouth | Outer Harbour | 10 | 11 | Yes |
| Hartlepool (Able Seaton) | Dry Dock | 6.6 | 6 (design of 9.5) | No - due to quay depth |
| Hartlepool (Able Seaton) | Quays 10 & 11 | 15 | 6 (design of 9.5) | Yes |
| Harland & Wolff | Belfast Quay | 6.6 | 9.3 | No - due to quay depth |
| Harland & Wolff | Steel Wharf (DRY) | 8. 5 | 9.3 | No - due to quay depth |
| Harland & Wolff | Belfast Dock (DRY) | 6 | 9.3 | No - due to quay depth |
| Hull Greenport | Main River Quay | 11.5 | 11 | Yes |
| Swan Hunter Yard | | 9.1 | 6 | No - due to approach depth |
| Redcar bulk terminal (Teeside) | Bulk Terminal | 17.3 | 14.1 | Yes |
| Port of Blyth | South Harbour - West Quay | 8. 5 | 6 | No - due to quay depth |

Source: Arch Henderson Analysis

After the hard criteria were considered, 22 quays were removed from consideration. The remaining 18 quays were taken forward for the practicality assessment.

### 2.2.2 Practicality Assessment

A high level practically assessment was undertaken to ascertain the feasibility of increasing the dredge depth to -24m CD at the quayside and increasing the approach channel depth to -14 CD. This was performed using admiralty charts and where applicable, local knowledge of the marine conditions.

| Port | Quay | Taken forward to Soft Criteria Assessment |
|---|---|---|
| Dales Voe - Shetland | Dales Voe | Yes |
| Dales Voe - Shetland | Dales Voe (extension) | Yes |
| Greenhead Base - Shetland | Greenhead Base | No – significantly increasing the approach depth or quay depth is restricted by the width of the channel |

| Port | Quay | Taken forward to Soft Criteria Assessment |
|---|---|---|
| Peterhead - Smith Quay (Norsea) | Smith Quay | No – increasing the quay depth to 24m would require a significant extension to the quay and considerable additional dredging, which would impact much of the existing quayside. |
| Invergordon | SB5 | Yes |
| Invergordon | Queens Dock | Yes |
| Invergordon | SB5 | Yes |
| Aberdeen - (Aberdeen Harbour South) | East Quay | No – deepening the entrance channel would require significant wave modelling work and potentially lead to swell conditions in the harbour. This may need a new breakwater or increasing the size of rock armour. Also issues around closing the harbour to deliver the required works. |
| Aberdeen - (Aberdeen Harbour South) | North Quay | No - deepening the entrance channel would require significant wave modelling work and potentially lead to swell conditions in the harbour. This may need a new breakwater or increasing the size of rock armour. Also issues around closing the harbour to deliver the required works. |
| Nigg | Quay 3 | Yes |
| Nigg | Dry Dock | No – works to dredge the dry dock are too significant to be considered feasible. |
| Hunterston - Platform | Construction Jetty | No – making the quay deeper would require significant dredging in a Site of Specific Scientific Interest (SSSI). |
| Hunterston Dry Dock | Dry Dock | No - works to dredge the dry dock are too significant to be considered feasible, also requirement to dredge in a SSSI. |
| Hunterston - Ore jetty | Outer Berth | Yes |
| Greater Yarmouth | Outer Harbour | No – lengths of quay structures would need extending and significant dredging required which would likely undermine the existing infrastructure and break waters. |
| Hartlepool (Able Seaton) | Quays 10 & 11 | No – Greater water depth could be achieved with construction of a new quay however this would have considerable impact on adjacent infrastructure. No naturally deep water present adjacent to the quay so considerable capital and maintenance dredging would be required. |
| Hull Greenport | Main River Quay | No - No naturally deep water present adjacent to the quay so considerable capital and maintenance dredging would be required. |
| Redcar bulk terminal (Teeside) | Bulk Terminal | Yes |

Source: Arch Henderson Analysis

As a result of the practicality assessment, 10 quays were removed from consideration. The remaining 8 quays were taken forward for assessment across a range of soft criteria.

### 2.2.3 Soft Criteria

The following six key measures were considered:

- Distance to Northern North Sea (NNS) basin (km)
- Distance to Central North Sea (CNS) basin (km)
- Max Load Out Area (m)
- Area of External Laydown ($m^2$)
- General Quay Capacity ($kN/m^2$)
- Heavy Load Out Length (m)
- Heavy Load Out Capacity ($kN/m^2$)

The remaining quaysides were assessed against the above criteria and further practicality considerations to determine the most appropriate locations to develop an UDW port. The results are outlined in the table below.

**Table 2: Quays excluded post soft criteria assessment**

| Port | Quay | Taken forward to Cost Benefit Analysis |
|---|---|---|
| Dales Voe - Shetland | Dales Voe | Yes |
| Dales Voe - Shetland | Dales Voe (extension) | |
| Nigg | Quay 3 | Yes |
| Invergordon | SB5 (pre-development) | No – quays at Invergordon could be upgraded to accommodate an UDW port. However, water depths at these locations are c14m. By comparison, Nigg which is located close to Invergordon quays, is adjacent to naturally deep water. As such, Nigg is considered to be a more optimal option due to lower expected costs for development and maintenance. |
| Invergordon | SB5 (post-development) | |
| Invergordon | Queens Dock | |
| Hunterston - Ore jetty | Outer Berth | No – being located on the west coast of Scotland and c1,000km from Northern North Sea and Central North Sea basins, transit times from platform to port are expected to be over 2 days*. Given most east coast UK and Norwegian locations will be within 1-2 transit day, an UDW port at Hunterston would struggle to compete commercially. |
| Redcar bulk terminal (Teeside) | Bulk Terminal | No – the facility is equipped for bulk handling with a processing plant and infrastructure and on site required for a bulk facility. It is not clear what the quay load capacity is for this site. The existing dredge pocket of -17m is very local to the quayside and a -24m dredge to accommodate an |

| | |
|---|---|
| | UHLV could impact infrastructure on the opposite bank. Offloading operations could also potentially obstruct movement up the river and navigation of oil tankers being serviced at the oil jetties opposite. |

Source: Arch Henderson analysis, *assuming vessel transit speed of 10 knots per hour.

Dales Voe and Nigg were identified as the quays most suitable for development to an UDW port. Considering each location in turn:

- Dales Voe channel provides water depths of -32m CD reducing to -20m CD at the centre of the channel adjacent to the quay. The proposed development of an extended quay and dredging would deliver the -24m water depths required. The quay has high load capacities suitable for self-propelled modular transporters (SMPT) and accommodation of heavy components lifted from UHLVs. In addition, it is in close proximity to NNS and CNS platforms.

- Nigg has a dredge depth of -12m CD adjacent to the quay. However, it could be extended further into the Cromarty Firth in order to deliver the required water depths. Existing quay loadings are sufficient to accommodate SPMTs. In addition, it is in close proximity to NNS and CNS platforms. On approach, there is a sand bar at the entrance of the Cromarty Firth. The depth of this is -15m CD at the lowest astronomical tide, with depths generally greater than this. This is there not considered a limiting factor for this location.  As highlighted in the table above, this location is selected over those at Invergordon due to the required capital and maintenance dredging being lower at Nigg.

## 2.3 Conclusion

The assessment identified two quays as the most suitable locations for developing an UDW port:

- Dales Voe

- Nigg

The governing factors largely relate to the depth of water adjacent to the existing quay. In the case of both of these locations, deep water is naturally present in the approach channels and near to the existing quay. By extending the quay, this deep water could be reached to allow for a vertical quay face with a berthing pocket of -24m CD extending into a channel of the same depth or deeper.

The analysis is based on desktop research, supported by the industry knowledge of AH. A comprehensive location assessment would require detailed consideration of the specific development required at each location, including discussions with the respective Port Authorities on their appetite to provide an UDW capability.

These two ports were taken forward to the CBA. The detailed AH report is included within Appendix C.

# 3. Decommissioning market

**Key Messages**

- The overall expected expenditure on UKCS platform decommissioning is estimated at £59.7bn.
- An UDW port would participate in onshore recycling and disposal activities and this is estimated to account for £1.2bn.
- There are three primary decommissioning removal methods for transporting topsides and substructures to ports for onshore recycling and disposal. Only one of these methods, reverse engineer using UHLVs, requires an UDW port.
- Recent UKCS decommissioning projects using UHLVs have been taken to Norway where current ports already have the required water depth requirements.
- Having UDW enhances a port's ability to attract decommissioning projects for onshore recycling and disposal. The UK currently does not have an UDW port.

## 3.1 Introduction

There are more than 300 oil and gas (O&G) platforms in the UK Continental Shelf (UKCS)[3], many of which have reached or are nearing the end of their useful lives. Operators have a legal obligation to decommission the asset unless derogation is granted for it to remain in place. The purpose of this section is to outline the scale of the decommissioning market, the proportion of this that relates to onshore recycling and removal and explain how a specific decommissioning method generates the need for an UDW port.

SG recommended we use the data published by the Oil and Gas Authority (OGA) and OSPAR as our primary sources. Further detail on the decommissioning sector is set out in Appendix D.

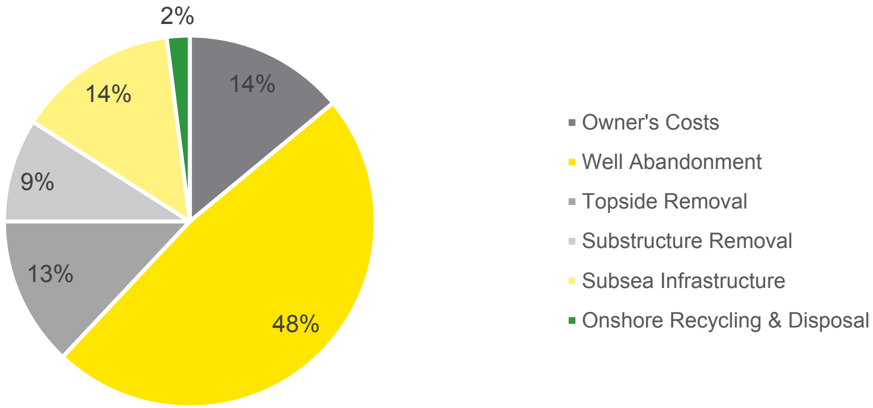
## 3.2 Decommissioning cost forecast

Using operator surveys, the OGA has performed a costing exercise to estimate the total costs of decommissioning across the UKCS[4]. The approach employed captures the high degree of uncertainty in operators' current estimates and outlines an expected total cost of between £44.5bn and £82.7bn, with the OGA using £59.7bn[5] as its base for future cost reduction targets.

[3] OSPAR – Inventory of Offshore Installations
[4] *OGA: UKCS Decommissioning 2017 Cost Estimate Report*
[5] This is the decommissioning cost estimate included in the OGA's 2017 cost estimate report. As the industry progresses there will be updated cost estimated. At the time of concluding this report EY is aware of revised OGA cost estimates which reduce the overall estimated decommissioning costs due to efficiencies in well plugging and abandonment.

Using the information provided by operators, the OGA is able to apportion the expected future costs to different activities in the decommissioning process, as outlined in the figure overleaf.

**Figure 1: Decommissioning costs by activity**




Source: OGA: UKCS Decommissioning 2017 Cost Estimate Report

Well abandonment is the most significant category of cost, accounting for 48% of expected expenditure. Topside and substructure removal combined account for 21% of expected future costs. Therefore, operators are expected to spend between £9.3bn and £17.3bn in removing platforms from offshore locations to onshore ports.

Onshore recycling and disposal accounts for 2% of expected future decommissioning costs. When considering this within the context of the decommissioning cost estimates provided by the OGA, this amounts to an expected expenditure of between £890m and £1.7bn. According to the OGA's base estimate, the cost of onshore recycling and disposal is forecast to be £1.2bn.

## 3.3 Decommissioning removal methods

Three decommissioning removal methods of fixed structures are used in the market[6]. These are described in the table below.

**Table 3: Decommissioning removal methods**

| Method | Description |
|---|---|
| Piece Small | ► The platform is deconstructed offshore and smaller parts are collected then transported onshore using supply vessels for further processing and waste management.<br>► Supply vessels do not have a significant draught requirement and therefore do not require an UDW port.<br>► This method requires a significant amount of time spent offshore deconstructing the platform at site. This has led to escalating levels of expenditure. |
| Single Lift | ► A relatively new method where full topsides are removed and |

[6] Floating structures can be towed to shore for decommissioning

| Method | Description |
|---|---|
| | transported onshore in a single lift. This can only be performed by a specialist single lift vessel (SLV), of which there is only one currently operating in the market: Allseas' Pioneering Spirit.<br>► In performing the lift, the twin hulled Pioneering Spirit will move around the platform so that it is positioned between the vessel's 122m long and 59m wide slot at the bow. It will then use eight sets of lifting beams to lift the topside and then transport it in one piece.<br>► Due to the size of the ship and the substantial weight of the topside the SLV cannot come straight to port. Instead, once the Pioneering Spirit reaches sheltered waters close to the disposal yard, it will transfer the topside onto a purpose built barge, the Iron Lady.<br>► This barge will then be used to transfer the topside to the quay without the need for UDW. |
| Reverse Engineer | ► A crane vessel will remove modules from the platform in the reverse of the installation sequence. Modules can either be placed on the deck of the crane vessel or onto a barge for transport onshore.<br>► The largest reverse engineer decommissioning projects require removal of modules in excess of 5,000 tonnes. There are two ultra-heavy lift crane vessels (UHLV) operating in the North Sea decommissioning market which are capable of this: Heerema Marine Contractors' Thialf and the Saipem 7000 (S7000).<br>► Generally, UHLVs transfer modules to shore on the vessel's deck. Once the vessel reaches the quay, it will use its cranes to place the modules directly on the quay. In order to do this, the UHLVs need UDW by the quayside.<br>► Norway has UDW ports capable of accommodating these UHLVs. The UK currently has no UDW ports.<br>► It is possible to transfer a module onto a barge for transfer to the onshore recycling centre. However, this increases the cost, timing and risks of decommissioning programmes making it unpopular with UHLV operators.<br>► Smaller platforms (typically those located in the Southern North Sea) can use smaller heavy lift vessels which do not need UDW ports to transfer modules to the quay. |

Source: EY Analysis

Of the 28 UKCS platform decommissioning programmes approved by BEIS since 2007[7], reverse engineer has been used in some form in all occasions except two:

- The Janice Floating Production Unit was towed to shore.
- Brent Delta was removed by single lift.

The largest decommissioned structures, located in the NNS and CNS, were all taken to the Norwegian UDW ports (Vats and Stord). The MCP-01 and

[7] *Source: https://www.gov.uk/guidance/oil-and-gas-decommissioning-of-offshore-installations-and-pipelines, https://www.ogauthority.co.uk/data-centre/data-downloads-and-publications/infrastructure/*

Miller platforms were taken to Norway as a direct result of the UK not having an UDW port.

None of the reviewed decommissioning projects (those approved by BEIS since 2007) using the S7000 or Thialf used a barge transfer method.

UDW capability is therefore key to attracting projects using this form of removal, particularly when larger platforms are being removed. It allows UHLVs to directly unload modules to the quayside without the need for barge transfer, lowering the risk, cost and timescales of the decommissioning project.

As such, evidence suggests that without an UDW port, it may be challenging for UK businesses to successfully compete with other locations (which have UDW ports) for future large reverse engineer decommissioning projects.

# 4. Market assessment

**Key Messages**

- There is no standard industry approach to estimating the proportion of the £1.2bn onshore recycling and disposal market that is applicable for an UDW port. As such, we have developed a bespoke methodology to estimate the potential market size.
- Of the 322 platforms in the UKCS, we estimate 64 are potential candidates for removal by reverse engineer using UHLVs, and likely to need an UDW port.
- Based on an onshore recycling and disposal cost per tonne estimate of £300, the overall market value for activities that an UDW port could support equates to £583m.
- The UDW port owner could generate income from activities such as charges levied on the vessel operator, the onshore recycling contractor and various other support vessels.
- The level of charges is held commercially confidential by port authorities. Applying a range of £35-£50 per tonne as a proxy would give a total market in the region of £68m-£97m.
- This estimate reflects the total income potential. Factors such as competition from other removal methods or non UK ports will impact the market share that a UK UDW port could secure.

## 4.1 Introduction

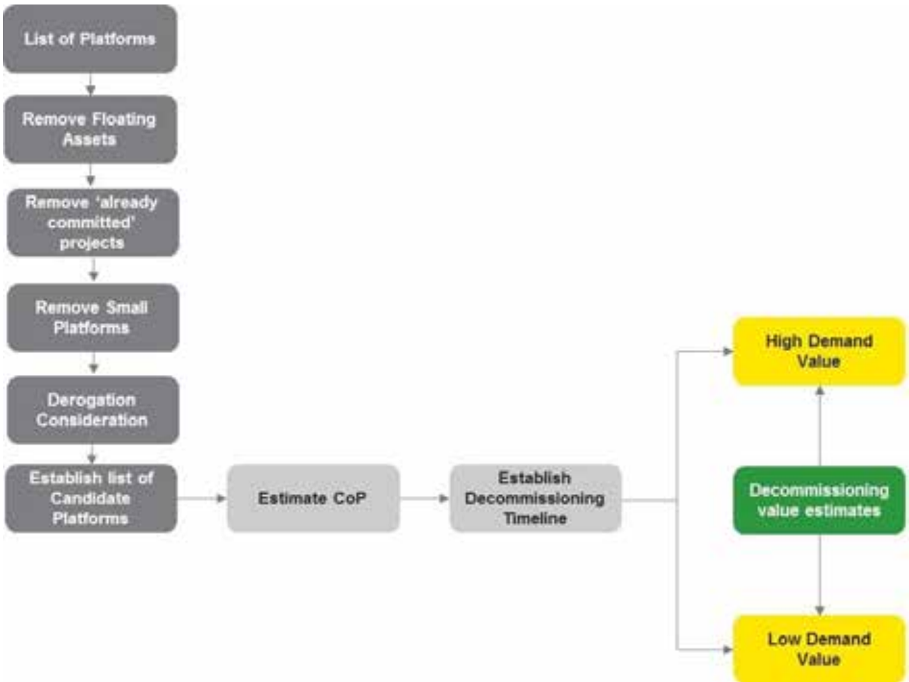
This section forecasts the market size for potential reverse engineer decommissioning projects using UHLVs. It describes our methodology for identifying the number of potential platforms, demonstrates the application of the methodology to calculate potential platform numbers and associated tonnages and finally sets out how this converts to potential income for an UDW port through the application of an estimated income per tonne.

It should be noted that the work performed has not covered a detailed review of each platform and the most appropriate method of removal. Potential reverse engineering projects may also be potential candidates for single-lift or reverse engineering using smaller HLVs which do not require UDW ports.

## 4.2 Our approach

There is no standard industry approach to assessing the size of the market for an UDW port. Consequently, EY developed a bespoke approach for use in this feasibility study. The approach is outlined in the figure overleaf.

**Figure 2: Market Demand Approach**




Source: EY Analysis

The approach followed the following steps:

1. **List of Platforms**: the list of all UKCS offshore installations was obtained from the OSPAR website. This contained information on the asset location, production start dates, substructure tonnage, topside tonnage and asset type (e.g. floating, fixed steel or gravity based concrete).

2. **Remove Floating Assets**: all floating assets were removed from the list on the assumption these assets can be towed directly to the shore for removal and do not require an UDW port.

3. **Remove 'already committed' projects**: projects which have already committed to a particular decommissioning programme (e.g. decommissioning method and disposal yard already agreed) were removed from the sample as a newly developed UK UDW port would not be able to bid for these projects.

4. **Remove Small Platforms**: smaller platforms may opt for the use of smaller vessels in the decommissioning process which do not specifically need an UDW port. As such, these platforms were removed.

5. **Derogation Consideration**: certain structures can be granted derogation from decommissioning regulation, allowing part or all of the structure to remain in situ. Consideration is given to the list of candidate platforms and whether derogation could be granted for these.

6. **List of Candidate Platforms**: the remaining list represents an estimate of those platforms considered candidates for reverse engineer decommissioning using an UHLV.

7. **Estimate Cessation of Production (CoP)**: Estimated CoP dates were obtained from the OGA.

8. **Establish decommissioning timeline**: The annual number of projects and expected tonnage were based on the estimated CoP dates.

9. **Estimate decommissioning value**: define value of platform decommissioning at two levels. Firstly, for all of the onshore recycling and disposal activities. Secondly, for the income an UDW port may receive from those activities. It aims to establish measures which can be used as multiples of tonnage coming onshore to provide an estimate of the value delivered; and

10. **Upper/Lower income range estimate**: established as:

    - Demand (in tonnes) multiplied by the decommissioning upper range income estimate.

    - Demand (in tonnes) multiplied by the decommissioning lower range income estimates.

The results of this process are outlined in the remainder of this section.

## 4.3 List of candidate platforms (Steps 1-6)

The table below outlines how the final list of candidate platforms was established, working through steps 1-6 above.

**Table 4: Calculation of candidate platforms**

| Stage | Number of platforms | Tonnage (Topsides and Substructures) | Note |
|---|---|---|---|
| List of platforms | 322 | 5,558,505 | Per the OSPAR list of UKCS list installations. |
| Floating asset filter | (32) | (1,230,928) | Removed all assets listed as ‘Floating steel’. |
| ‘Already committed’ filter* | (2) | (219,311) | Removal of Brent A and Brent B platforms which have already committed to using single lift decommissioning method. |
| Small platform filter** | (224) | (770,367) | Removed all platforms with topsides under 8,000t. |
| Derogations | - | (1,394,808) | It is assumed that for the five concrete gravity based platforms the substructure is granted derogation to remain in situ. However, the topside will still require removal. |
| **List of candidate platforms** | **64** | **1,943,091** | |

Source: EY Analysis

*The Brent B has a gravity based concrete substructure, but due to its removal method being agreed it has been included in the 'Already committed' category
** Two platforms with a gravity based substructure have been included in this category due to the topsides being under 8000t

This filtering process identifies 64 platforms (5 of which may only perform topside removal) with a total weight of 1.94m tonnes which are potential candidates for reverse engineer decommissioning using an UHLV.

The most subjective element of this filtering process is the assumption applied to the small platform filter. 8,000 tonnes is used on account of Thames AP decommissioning (6,488 tonnes) using the Rambiz vessel. This is the largest such project we have noted using a smaller HLV. This assumption is flexed as part of the base sensitivity testing in Section 5 of this report.

## 4.4 Platform removal timeline (Steps 7 - 8)

The CoP dates for many of the platforms in our sample were provided by the OGA. In reviewing this data, we noted that on average, a platform will reach CoP 35 years after production commences. This was incorporated into the analysis for all platforms where CoP dates are not available.

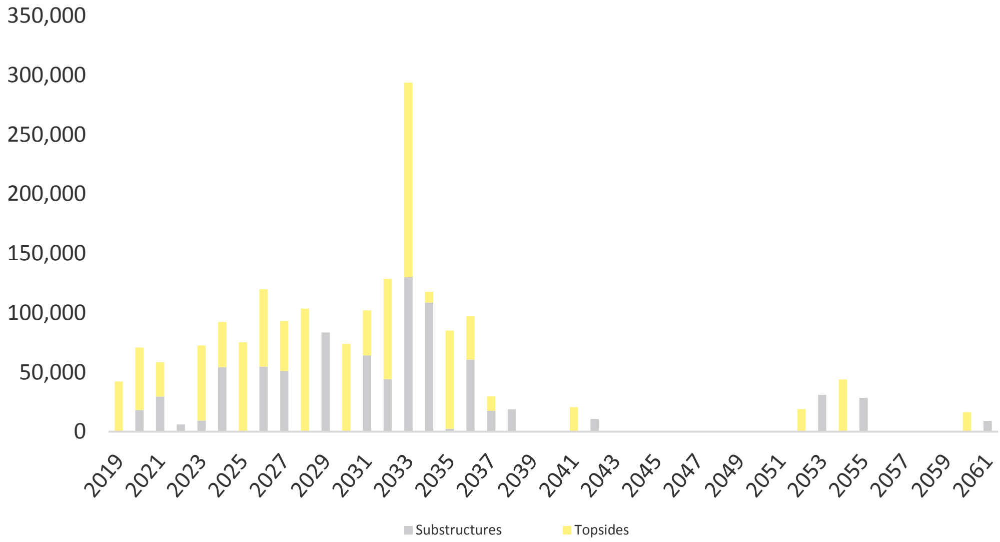
The year in which a topside or substructure is removed post-CoP varies from platform to platform. Therefore for the purposes of this analysis we have assumed that:

- A topside will be removed three years after CoP; and
- A substructure will be removed four years after CoP.

This assumption was discussed with industry stakeholders who agreed it was not an unreasonable assumption to make in the absence of more detailed analysis or information.

Using this data we were able to establish a timeline of expected decommissioning projects which is detailed in the figure below.

**Figure 3: Estimated topside and substructure decommissioning tonnage per year**




Source: EY Analysis

As illustrated:

- For most years under review, there is a consistent stream of tonnage being removed between 75,000t and 100,000t per year; and
- The peak year is 2033 with more than 200,000t forecast to come onshore in this period.

It is important to highlight that these estimates are based on current market conditions which are subject to frequent changes. Two key factors: CoP and time from CoP to platform/substructure removal are different for every platform. A number of factors, which have not been considered in this report, could influence these. A long term increase in oil prices could increase the life of the platform and delay CoP. Conversely, a long term decline in oil prices could accelerate a number of decommissioning programmes.

Operators may also attempt to delay decommissioning projects to benefit from favourable market conditions. For example, if in any given year there are a number of platforms expected to be removed, it could create a strain on the UHLVs and disposal yards. This excess demand could increase prices. As such, operators may wish to change the removal date, to avoid higher decommissioning costs.

## 4.5 Estimate decommissioning value (Step 9)

This step estimates the potential market value for:

- All onshore recycling and disposal activities; and
- Income received by an UDW port as a share of the onshore activity.

These areas are considered in the following sections.

### 4.5.1 Value of onshore recycling and removal

In the previous section we outlined the OGA estimate of onshore recycling and removal activity as £1.2bn, within a range of between £890m and £1.7bn. The table below calculates a cost per tonne for each of these scenarios, based on the total tonnage for all 322 UKCS platforms identified in Step 1.

**Table 5: UKCS estimated onshore recycling and removal cost per tonne**

| Description | Estimated Total Cost<br><br>£m | Tonnage (Topsides and Substructures) | Cost per tonne<br><br>£ |
|---|---|---|---|
| Lower estimate | 890 | 5,558,505 | 160 |
| Mid estimate | 1,200 | 5,558,505 | 215 |
| Upper estimate | 1,700 | 5,558,505 | 305 |

Source: OGA - UKCS Decommissioning 2017 Cost Estimate Report and EY Analysis

It should be noted that in the OGA's decommissioning cost estimate report, the tonnages are not reported. As such, caution should be applied when interpreting the results of this table and the conclusions drawn from combining two data-sets from different sources. However, as a reasonableness check, the table demonstrates that the cost per tonne ranges from £160 in the lower estimate to £305 in the upper estimate, with £215 as the mid estimate.

Through the market consultation a range of quotes were provided for an estimate of the onshore recycling and disposal process on a per tonnage basis. In general, respondents highlighted that the £300 per tonne was a reasonable assumption. Certain responses highlighted this could be less, however the most robust piece of evidence provided to EY outlined it would be more than £300[8]. As such, £300 per tonne is used as the most reasonable estimate for the purposes of this analysis. The actual costs for onshore recycling and disposal activities will vary from platform to platform.

In general, onshore contractors take the risk on the value they will recover from onward sale of recovered material. As such, the £300 per tonne figure used is considered to be net of the value the onshore contractor can recover from recyclable materials, but cover all other aspects of the onshore decommissioning process. The value of the recyclable material is considered as part of the CBA.

To estimate the market size for all onshore disposal and recycling activities that may need an UDW port we have applied the cost per tonne assumption to the list of candidate platforms from step 6.

[8] Information provided in confidence

**Table 6: Estimated onshore recycling and removal market**

| Description | Number of platforms | Tonnage (Topsides and Substructures) | Cost per tonne £ | Estimated Market Value £m |
|---|---|---|---|---|
| List of candidate platforms | 64 | 1,943,091 | 300 | 583 |

Source: EY Analysis

The estimated market value for all onshore activities is therefore £583m. Applying the lowest cost per tonne from the OGA of £160 would reduce this market to £311m, but for the purposes of our analysis the base case is assumed to be £583m.

It should be noted this may not be the market solely for reverse engineer decommissioning projects which require UDW ports. These projects may also be candidates for single-lift decommissioning projects as well as projects which may use smaller HLVs which do not need UDW ports.

### 4.5.2 Estimate of port income

An UDW port would expect to generate income through a series of charges levied on the vessel operator, the onshore recycling contractor and various other support vessels. This information is considered commercially sensitive and accordingly is not publically available.  Industry analysis does not provide published benchmarks of this form of income.  Consequently, the lack of data restricts this aspect of the analysis.

To estimate the port’s share on a per tonnage basis, EY performed an estimate based on an example project of a topside (25,000 tonnes) and substructure (15,000 tonnes) removal over a two year period. The project generated port income of approximately £35 per tonne. Due to lack of available data the £35 was considered a reasonable proxy for the revenue which could be generated by an UDW port for each tonne it receives onshore. However, given that the figure is based on one sample project it is conceivable that other income could be generated on future projects. Therefore the analysis will include a scenario where this income is increased to £50 per tonne, in order to provide a range of estimated income.

## 4.6 Upper/lower income range estimate (Step 10)

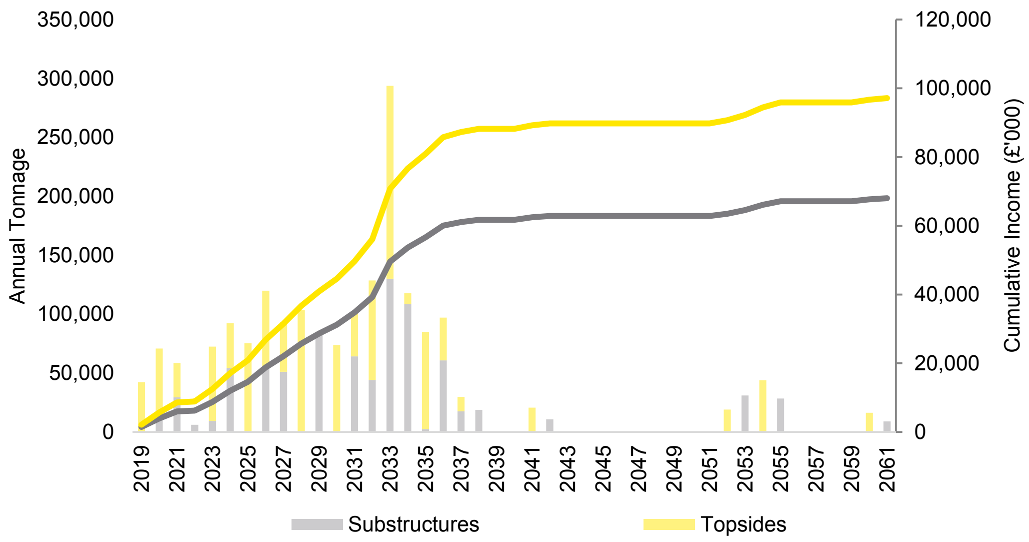
The income range for an UDW port is estimated by applying the rates per tonne to the total tonnage for topsides and substructures. This is set out in the table below, followed by charts illustrating the trend over time.

### Table 7: Estimates income range

| Estimate | Number of platforms | Tonnage (Topsides and Substructures) | Income per tonne £ | Estimated Total Income £m |
|---|---|---|---|---|
| Upper income range | 64 | 1,943,091 | 50 | 97 |
| Lower income range | 64 | 1,943,091 | 35 | 68 |

Source: EY Analysis

**Figure 4: Upper income range (2018 prices)**




Source: EY Analysis

The analysis above indicates:

- The total income for UDW ports is estimated within a range from £68m to £97m, based on 64 platforms with a total tonnage of 1.94m.
- This estimate reflects the total income potential, factors such as competition from other removal methods or non UK ports would be expected to limit the market share that a UK UDW port could secure.

The following section performs sensitivity analysis on this market demand assessment.

# 5. Sensitivity testing

**Key Messages**

- We consider the potential changes to market demand for an UDW port through four areas: new vessels entering service, the number of platforms and tonnage brought to an UDW port, changes in environmental considerations and other markets.
- Following market consultation, we concluded that whilst new vessels and changes to environmental standards may occur there was insufficient certainty to include a specific adjustment to the market assessment. As a result these impacts were considered within a general +/- 20% sensitivity.
- The method of platform removal is determined by a range of factors in addition to tonnage. In order to reflect this uncertainty we performed sensitivity testing by amending the base case limit from 8,000t to 5,000t and 10,000t.
- The results of the sensitivity analysis highlights:
  - For the onshore recycling and disposal, downside sensitivities showed a total market value to £466m compared to £700m in the upside sensitivities.
  - Regarding port income, downside sensitivities showed a total market for UDW ports income to be £54m, compared with £116m in the upside sensitivities.

## 5.1 Introduction

The purpose of this section is to perform sensitivity analysis on the market demand assessment. It sets out factors that could impact the market, such as new vessels entering service, the number of platforms and tonnage brought to an UDW port and the impact of changes in environmental regulations.

## 5.2 Market considerations

As in any industry there are a wide range of complex factors that impact on the market size. The section below considers four aspects specific to the decommissioning sector.

### 5.2.1 New vessels

Currently, there are two UHLVs and one SLV capable of decommissioning the largest platforms in the North Sea. The introduction of new vessels could disrupt the forecast market. Through desktop research and discussions with industry figures we have identified the following vessels as potential new entrants into the market:

- Sleipner (Heerema) - A new UHLV is under development and expected to commence operations in early 2019.

- Zeelandia, Serooskerke and Walcheren (OOS) - Serooskerke and Walcheren are new UHLVs expected to enter service in late 2019. Zeelandia is currently at the design stage.

- Amazing Grace (Allseas) - a proposed new SLV, which is of a similar concept and design, albeit larger, as the Pioneering Spirit. There is currently no certainty when or if this vessel will come to the market.

- Twin Marine Lifter (Shandong Twin Marine) - a different SLV concept to that of Pioneering Spirit or Amazing Grace. There is currently no certainty as to when or if this vessel will come to the market.

Three new UHLVs are in construction and can be expected to enter the market in 2019. The impact of this new capacity could increase the number of projects targeted by UHLVs, increasing the demand for an UDW port.

New SLVs are at the concept stage and the final investment decisions are awaited on both vessels. As such, there is no committed timetable for construction or entry into service.

We are also aware that capacity will be removed from the market as older vessels come to the end of their operational life.

Further detail on each of the new vessels is provided in Appendix E.

Given the uncertainty surrounding the timing and impact of new vessels we do not consider that there is sufficient certainty to include a specific adjustment to the market assessment. Rather, the impact of changes in vessel fleet capacity is considered within a general +/- 20% sensitivity.

### 5.2.2 Number of platforms

The market assessment methodology assumed that only platforms over 8,000t would be candidates for reverse engineer removal using UHLVs. However, the method of removal is determined by a range of factors other than tonnage, such as the form of structural design and whether this supports a particular lifting solution. To reflect this uncertainty we have performed sensitivity testing on revising the assumption to examine the impact of setting the limit at 5,000t and at 10,000t.

### 5.2.3 Environmental requirements

The importance of complying with environmental obligations is a key factor in all aspects of the O&G industry, including decommissioning activity. Any changes in the requirements could impact the market.

**UK & International Regulation**

The decommissioning of offshore O&G installations and pipelines on the UKCS is controlled by the Petroleum Act 1998 (as amended by the Energy Act 2008 and Energy Act 2016). The UK's international obligations are governed principally by the 1992 Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR Convention). The Offshore

Petroleum Regulator for Environment and Decommissioning (OPRED), which is part of the Department for Business, Energy and Industrial Strategy (BEIS), is responsible for ensuring that requirements of the Petroleum Act and international regulations are met.

The most significant obligations for decommissioning offshore O&G operations are set out in OSPAR 98/3, which outlines that ‘the dumping, and the leaving wholly or partly in place, of disused offshore installations within the maritime area is prohibited’[9]. However, OSPAR 98/3 recognises the difficulty in performing a complete removal to land of certain installations and may allow for certain installations to be left wholly or partially in place. The table below provides a summary of options that can be considered for different types of installation.

**Table 8: OSPAR 98/3 Options**

| Installation (excluding topsides) | Weight (tonnes) | Complete removal to land | Partial removal to land | Leave wholly in place | Re-use | Disposal at sea |
|---|---|---|---|---|---|---|
| Fixed Steel | <10,000 | Yes | No | No | Yes | No |
| | >10,000 | Yes | Yes* | No | Yes | No |
| Concrete – gravity | Any | Yes | Yes | Yes | Yes | Yes |
| Floating | Any | Yes | No | No | Yes | No |
| Subsea | Any | Yes | No | No | Yes | No |

Source: BEIS: Decommissioning of Offshore Oil and Gas Installations and Pipelines, *relates only steel installations emplaced before 9 February 1999

Each decommissioning plan is reviewed by OPRED on a case by case basis. In all cases, only the footings or part of the footings can be left in place and partially removed installations which do not project above the sea surface require a minimum water clearance of 55m. All topsides must be returned to land for re-use, recycling or disposal.

In exceptional and unforeseen circumstances, installations can be granted derogation from OSPAR 98/3 for disposal at sea or to be partially or wholly left in place. BEIS guidance outlines that this is only likely to be granted where there is significant environmental, technical or safety reasons why an installation cannot be wholly or partially removed.

As such, the option to not remove parts or all of offshore installations from the UKCS is prohibited under current legislation. If there was a change to the application of these requirements, it could impact on the level of decommissioning

[9] OSPAR 98/3, Paragraph 2

### Transfrontier Shipment of Waste Regulations

Transfrontier Shipment of Waste regulations (TFS) ensure that any UK installations that are to be transported for decommissioning abroad are only taken to places where there is the appropriate due regard for health and safety requirements in the decommissioning process. It also requires that any naturally occurring radioactive waste (NORM) which is part of installations being shipped abroad is repatriated to the UK for treatment and disposal. Operators are required to apply to Scottish Environmental Protection Agency (SEPA) for authorisation to allow NORM waste and NORM contaminated items to leave the UK.

### Mercury Export

Discussions with project stakeholders have highlighted there may be impending changes to mercury waste legislation. It is suggested that the new regulations could prohibit the export of mercury from the UK. This would therefore require that all mercury is removed from platforms before they are transported abroad for decommissioning. It is understood that this would be cost prohibitive and therefore all UKCS based platforms, which contain mercury, would need to be decommissioned in the UK. We have been unable to obtain further detail on these potential regulatory changes, or verify the impact they would have on the onshore decommissioning location decision.

### Potential changes

Certain industry stakeholders have outlined arguments which suggest that leaving a greater number of offshore installations in place could lead to a better overall outcome for the UK and its environment[10] through:

- Lower decommissioning costs and resultant impact on the UK taxpayer; and
- Structures left in situ acting as artificial reefs which can deliver benefits for the marine environment.

These suggestions have been met by opposition from environmental groups such as Greenpeace and World Wide Fund for Nature, which have been aware of and willing to challenge operators' decommissioning plans[11].

There is no evidence to suggest that a relaxation of current regulations is being considered by relevant parties. Conversely, certain industry stakeholders have argued that with advances in technology and the current resources being allocated to decommissioning programmes that there may be an argument for more stringent requirements on operators.

[10] http://www.bbc.co.uk/news/uk-scotland-scotland-business-38720211, http://www.bbc.co.uk/news/uk-scotland-north-east-orkney-shetland-42624580, http://www.abpmer.co.uk/buzz/decommissioning-of-oil-and-gas-structures-call-for-review/
[11] http://www.bbc.co.uk/news/uk-scotland-scotland-business-38720211, http://www.bbc.co.uk/news/uk-scotland-north-east-orkney-shetland-42624580, https://www.bbc.co.uk/news/uk-scotland-scotland-business-39528090

Specifically in relation to transfrontier shipment of waste and mercury legislation, stricter enforcement of existing regulations or changes to the regulation could have an impact on the ability of operators to transfer platforms outside the UKCS for decommissioning. EY have been unable to verify the expected impacts of these regulatory changes during our consultation process.

As such, there is no substantial evidence to support a change in regulation is expected in the future. Therefore, we have not performed a specific sensitivity in this area but have considered it in respect of a general +/- 20% sensitivity.

### 5.2.4 Other markets

The market demand has focused on the value of the UKCS decommissioning market. Given the UK's proximity to the Norwegian Continental Shelf, it is also possible that a UK UDW port could bid for and win projects from there. As such, the potential for this is included within the general 20% upside sensitivity scenario.

## 5.3 Sensitivity testing results

On the basis of the market considerations we have identified the following sensitivities:

Upside sensitivities that could increase the market:

- The number of platforms brought to an UDW port increase as those with a tonnage of between 5,000-8,000t are included; and
- A general upside sensitivity where the total tonnage increases by 20% due to the impact of new vessels, environmental considerations or other markets.

Downside sensitivities that could decrease the market:

- The number of platforms brought to an UDW port decrease as those with a tonnage over 10,000t only are included; and
- A general downside sensitivity where the total tonnage decreases by 20% due to the impact of the types of vessels coming to market, environmental considerations, use of technical alternatives such as barge transfers or other factors.

The following table sets out the impact on the estimated range of total income of each sensitivity.

### Table 9: Results of sensitivity testing

| Scenario | Number of platforms | Tonnage | Onshore Market Cost per tonne (£) | Onshore Market Value (£m) | Port Income range per tonne (£) | Estimated Range of Port Income (£m) |
|---|---|---|---|---|---|---|
| Base Case | 64 | 1,943,091 | 300 | 583 | 35 - 50 | 68 - 97 |
| **Upside sensitivities** | | | | | | |
| Small platforms decreased to 5,000t | 84 | 2,131,105 | 300 | 639 | 35 - 50 | 74 - 106 |
| General Upside Sensitivity (+20%) | 71 | 2,331,709 | 300 | 700 | 35 - 50 | 81 - 116 |
| **Downside sensitivities** | | | | | | |
| Small platform increased to 10,000t | 52 | 1,773,238 | 300 | 532 | 35 - 50 | 62 - 88 |
| General Downside Sensitivity (-20%) | 51 | 1,554,473 | 300 | 466 | 35 - 50 | 54 - 77 |

Source: EY Analysis

The analysis in this table demonstrates that for the onshore recycling and disposal market:

- The upside scenarios increase the market from the base case of £583m to a maximum of £700m under the general sensitivity.
- For the downside sensitivities the market reduced by £51m and £166m for the small platform and general downside sensitivities respectively.

For port income the analysis illustrates:

- Including platforms with a tonnage of between 5,000-8,000t would increase the total number of platforms to 79. In this case, the total income for UDW ports would be within a range of £74m to £106m.
- If total tonnage were to increase by 20% to 2.1mt, the total income for UDW ports would be within a range of £81m to £116m.
- Increasing the small platform criteria from <8,000t to <10,000t would decrease the number of platforms to 52. In this case, the total income for UDW ports would be within a range of £62m to £88m.
- If total tonnage were to be reduced by 20% to 1.5mt, the total income for UDW ports would be within a range of £54m to £77m.

# 6. Multi use opportunities

**Key Messages**

- We examined two potential non-decommissioning markets where an UDW port could attract additional revenues:
  - Firstly, supporting future capital and operational expenditure within the O&G sector.
  - Secondly, the renewable energy sector, specifically floating offshore wind as Scotland looks to expand from its position as a leading destination of fixed bottom wind farms.
- Discussions with O&G sector organisations highlighted that an UDW port could support the maintenance and capex of 6th and 7th generation semi-submersible drilling rigs. No other specific activities or projects that would require an UDW port.
- Floating offshore wind and other renewable energy industries do not necessitate the development of a distinct UDW facility in the UK as their needs are accommodated by existing ports.

## 6.1 Introduction

The purpose of this section is to identify non-decommissioning projects that an UDW port could support. The review is based on desktop research and discussions with relevant organisations though the market consultation exercise. Our focus was on understanding the opportunities available within the O&G and offshore renewable energy sectors.

## 6.2 O&G sector opportunities

Using the Wood Mackenzie upstream data tool we extracted their estimate of the future operational and capital expenditure anticipated (excluding abandonment) until 2054.

**Table 10: Wood Mackenzie forecast of capital and operational expenditure to 2054 (nominal)**

| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 - 2054 | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $'m | $'m | $'m | $'m | $'m | $'m | $'m | $'m | $'m |
| Opera-tional | 10,207 | 9,962 | 9,947 | 9,891 | 9,221 | 8,692 | 8,201 | 50,966 | **117,086** |
| Capital | 6,952 | 6,184 | 5,206 | 6,945 | 7,708 | 5,389 | 2,691 | 4,895 | **45,969** |
| **Total** | **17,158** | **16,146** | **15,153** | **16,835** | **16,928** | **14,082** | **10,892** | **55,861** | **163,055** |

Source: Wood Mackenzie

The Wood Mackenzie data illustrates that 93% and 56% of capital and operational expenditure respectively is forecast in the first 7 years to 2025. Therefore, should a UK UDW port be targeting any specific capital and operational expenditure it would need to be developed in a timely manner to ensure it is able to meet the needs of operators when required. The forecast is examined on a locational basis across five North Sea basins in the table over page.

**Table 11: Wood Mackenzie forecast split by geographical sector (nominal)**

| Sector | Operational | Capital | Total | |
|---|---|---|---|---|
| | $'M | $'M | $'M | % |
| Central North Sea | 48,361 | 12,905 | 61,266 | 38% |
| West of Shetland | 29,405 | 21,149 | 50,554 | 31% |
| Northern North Sea | 30,718 | 9,654 | 40,372 | 25% |
| Southern Gas Basin | 6,529 | 2,055 | 8,584 | 5% |
| Irish Sea | 2,075 | 205 | 2,280 | 1% |
| **Grand Total** | **117,086** | **45,969** | **163,055** | 100% |

Source: Wood Mackenzie

This shows that the highest levels of expenditure are forecast to incur within the CNS ($61.2bn), West of Shetland ($50.5bn) and the NNS ($40.3bn).

This level of expenditure could provide further opportunities for an UDW port, and we tested this prospect in the market consultation exercise.

### 6.2.1 Market feedback

During the market consultation exercise we sought the view of industry operators, particularly those looking to invest in new fields, on whether an UDW port would support any specific activities.

During the discussions with various industry stakeholders one interviewee highlighted that an UDW port would allow $6^{th}$ and $7^{th}$ generation semi-submersible drilling rigs to come to shore without the need to withdraw the thrusters.

No other specific projects or areas of expenditure were noted by the market. The collective view was that the existing ports and their respective capabilities would be able to provide the facilities required for currently anticipated expenditure.

## 6.3 Renewable energy, floating wind opportunities

Floating offshore wind is an emerging low carbon energy technology which has the potential to exploit stronger winds in deep water locations. This has been identified as one of the leading options to support the UK Government's ambition of decarbonising the energy system.

The UK is well positioned to become a world leader in floating wind as it already is one of the leading destinations for fixed bottom wind farm development. Further, the UK also benefits from a skilled supply chain that has the relevant experience and capabilities gained from operating in the shipbuilding and O&G sectors.

Scotland, in particular, is considered well suited for floating offshore wind due to its high wind speeds, abundant near-shore deep water sites and access to a skilled supply chain.

The floating offshore wind turbines in the Hywind Project were assembled in Norway as there was a need to use the S7000 vessel to connect the turbine generators to the floating support structures. As the S7000 vessel was used there was a need for a port with UDW and hence, Stord in Norway was used.

The remainder of this section reviews industry reports and feedback relating to the port requirements of the offshore renewable sector. Further detail on the floating wind market is provided in Appendix F.

### 6.3.1 Port requirements

Compared to fixed structures, floating wind can shift a number of operations port-side instead of performing those offshore. This could lead to a number of benefits such as reduced construction risk and weather related downtime and lower infrastructure costs. However, in order for ports to be able to accommodate floating wind platforms they will have to possess the relevant infrastructure. Based on our research of publicly available information we have identified the following as key requirements for ports to be able to accommodate floating wind platforms:

- **Port Location –** Close proximity to port is very important as long distance from site may lead to complex, lengthy and costly wet tow operations. Research by the Carbon Trust identified that the benefits of port proximity could be maximized for sites which are less than 80-100km from port[12].

- **Port Draft** - Ports will need to ensure they have enough draft to support floating wind platforms. In order to be able to accommodate all three of the most popular wind platform designs a draft of at least 11m will be required[13].

- **Port Entrance** - Floating wind platforms may often be very wide structures with beams of up to 100m. Consequently, the port entrance will have to be able to accommodate such width.

- **Dry Docks** - Dry docks are valuable assets as they allow the structures to be assembled and launched by flooding the dock instead of using expensive heavy lift cranes. However, as mentioned above due to the width of some platforms the docks should preferably be at least 100m.

[12] Carbon Trust (2015), Floating Offshore Wind: Market and Technology Review https://www.carbontrust.com/resources/reports/technology/floating-offshore-wind-market-technology-review/
[13] Carbon Trust (2015), Floating Offshore Wind: Market and Technology Review https://www.carbontrust.com/resources/reports/technology/floating-offshore-wind-market-technology-review/

- **Construction Yard -** Ports would benefit from having large yard facilities available close by, that are able to accommodate serial fabrication. This will reduce the time required to move the structure from factory to site. Research by the Carbon Trust identified that manufacturers forecast an average yard size requirement of 100,000m², but individual manufacturers noted yard sizes of up to 400,000m² or as small as 5,000-10,000m.

- **Cranes** – Onshore cranes will be required for load out and the rotor nacelle assembly. However, the requirement for heavy lift cranes would be limited if a dry dock is available. If a port does not have a dry dock it would have to import a heavy lift crane. These, however, are in very short supply and would therefore require investment.

Within the UK and Scotland in particular there are a number of facilities that could be used for the fabrication and/or installation of floating wind platforms. The National Renewable Infrastructure Plan published by the HIE and SE identified 11 locations in Scotland that offered the potential for attracting and facilitating floating wind projects[14].

A separate report by the Carbon Trust, analysed the ability of Scottish port facilities to accommodate all three dominant platform types[15]. The analysis identified that two facilities, Nigg Energy Park and the Port of Peterhead, were already suitable to accommodate all three technologies. In addition, the report also found that conditional upon some minor to moderate infrastructure upgrades a further twelve facilities had the potential to accommodate all three platform types.

There are a number of requirements that a UK port will have to meet to accommodate floating wind projects, such as sufficient depth of draft and width of port entrance. Currently, Scotland has two ports which can accommodate floating wind projects using any of the three dominant platform types. A further twelve being suitable after undergoing minor or moderate infrastructure upgrades.

As such, there does not appear to be a specific demand for an UDW port to support the floating offshore wind industry.

### 6.3.2 Market feedback

As part of the market consultation we discussed opportunities for floating wind development with companies in the renewable energy sector. This supported the assessment that an UDW port capability was not viewed as a requirement for development of this market. We also enquired if an UDW port could support other renewable energy activities such as wave or tidal energy development.

[14] http://www.hie.co.uk/growth-sectors/energy/n-rip.html
[15] Carbon Trust (2017), Floating Wind Joint Industry Project: Policy & Regulation Appraisal

Operators in this sector highlighted that this industry is in its infancy and it is making significant efforts to prove the commercial feasibility of projects. A primary focus in doing this is to reduce project development costs. Market participants highlighted that they considered UHLVs as expensive and therefore their utilisation would not support cost reduction efforts. As such, operators in these sectors did not view a requirement for an UDW port.

# 7. Technical alternatives

**Key Messages**

- Developments in platform removal technology and the contractual arrangements across the supply chain have the potential to impact the market for an UDW port.
- Alternative approaches to removal and transfer of platforms onshore are being considered, such as barge transfer or float and tow of structures.
- Market feedback indicates:
  - At present the barge transfer concept is more risky and costly compared to a direct vessel to port transfer. However, vessel operators are investing to improve the concept to broaden the choice of ports available to them.
  - There is also some interest from non-vessel operators to develop the barge concept and partner with existing UK ports.
  - If the barge concept is improved sufficiently to become a viable alternative to direct port access, it could open up existing UK ports for reverse engineer decommissioning projects and reduce the reliance on UDW ports.
  - The float and tow of structures is an early stage concept and due to its high risk is unlikely to be used in the foreseeable future.
- The standard industry approach is for platform operators to have a contractual relationship with a single contractor, commonly a vessel operator, transferring substantially all of the risk on a fixed price basis (EPRD contract). Only one alternative structure, alliancing, was identified and market feedback indicated this was unlikely to be adopted for future projects.

## 7.1 Introduction

This section examines potential technological alternatives that could be used to attract onshore decommissioning to the UK without the need for an UDW port. It also, outlines the current main contracting strategy for onshore decommissioning and reviews an alternative contractual strategy that could impact an UDW port’s contractual position in the market.

## 7.2 Removal alternatives

During the market consultation a number of interviewees mentioned barge transfer as an alternative to direct to quay module transfer via UHLV. We are also aware of one market participant outlining a potential float and tow removal method. The alternative removal options are considered in the following section.

### 7.2.1 Barge transfer

The most frequently mentioned alternative during market consultation was the use of a barge to transport the decommissioned structures to port. In this approach, an UHLV would remove the decommissioned module from the platform and take it to a sheltered offshore location. There the module would be offloaded onto a barge and towed to port. As the water depth requirements for a barge are considerably lower than those for an UHLV it would allow existing UK ports to accept reverse engineer decommissioning projects.

The barge concept is not new, and has been used by HLV operators prior to UDW ports being developed. Further, the same approach is being used for single-lift decommissioning whereby the Pioneering Spirit utilises the purpose built ‘Iron Lady’ barge to transfer decommissioned topsides to a disposal yard. However, this alternative has fallen out of favour with UHLV operators due to the risk and cost of using a barge. The process of offloading the decommissioned structure in open water carries the inherent risk of accidental waste spillages or the entire structure falling into the water. A key risk is that the offloading is postponed due to bad weather conditions, with the UHLV having to remain idle until the weather improves. This is a potential cost to the UHLV owner, who acting as the EPRD contractor, risks delays to the overall decommissioning programme and any other work which it has lined up after the project. As the EPRD contract owner, it takes the risk for delays due to weather.

Due to the bespoke nature of many of the offshore O&G structures standard barges may not be suitable for the removal process. As such modifications would have to be performed, which may end up being very costly. However, during the market consultation interviews some vessel operators did note that they have not abandoned the barge transfer concept and are instead investing into research and development to improve the barges and the offloading process.

The reasoning for the investment is to broaden the choice of ports to which structures can be taken, as only being able to go to UDW ports limits UHLVs to non-UK locations. This is viewed as a concern especially if the volume of decommissioning projects increases. Due to the significant size of the larger topsides a port may only have the capacity to accommodate one removal project a year. Therefore, if there are several decommissioning projects in a given year the UHLV operators will need to be able to access numerous ports to perform all of the removals.

During the market consultation interviews it was also proposed that other stakeholders in addition to vessel operators could own barges. It was proposed that an individual port, a consortium of ports or a separate company could develop and own a barge. In addition, it was also noted that the Scottish and/or UK governments could finance the development of a barge. There has been some interest by parties other than vessel operators to develop the barge concept. For example, it was brought to our attention that a company specialising in heavy-lifting is looking to develop a multi-purpose barge, which it would manage and offer to UHLVs operating in the North Sea.

The company is planning to partner with UK ports, which would open up those ports to accept structures from UHLVs without the need for UDW. Ultimately, this would require the barge owner, onshore contractor or port authority to take the risk on weather delays to the barge transfer. Currently, we understand they have been unwilling to take this risk to date.

If the barge concept is improved sufficiently to become a viable alternative to direct port access, it could open up existing UK ports for reverse engineer decommissioning projects and reduce the reliance on UDW ports.

### 7.2.2 Floating and tow method

Under this approach the topside would be cleaned and then fully welded. It would then go through extensive testing to ensure that there are no open spaces for water to enter. Subject to successful testing the platform would eventually be lowered into the water and then towed to port for deconstruction. To our knowledge, this has not been used for platform decommissioning as yet. Interviewees highlighted, that it was unlikely that this approach would be used any time soon due to its high risk as well as the heavy reliance on precision welding and testing.

### 7.2.3 Floating quay

EY has noted that one port operator in Scotland has considered developing a floating quay which could help it attract new work. EY have not been able to obtain any detail on this development, however we have been advised that it would consist of a series of barges which are connected to the quay. It may be possible to operate on these barges or be able to transfer modules from the barge to shore via SPMT's. We are unaware of the feasibility of such an operation. During market interviews, no stakeholders mentioned this option as a viable alternative they had considered or heard of.

## 7.3 Contractual structure alternatives

This section reviews the main contracting structures which are used in the decommissioning market.

### 7.3.1 Current industry approach – EPRD

The current standard approach for removal and onshore disposal and recycling is to use an Engineering, Preparation, Removal and Disposal (EPRD) contract. This allows the platform operator to have multiple activities such as platform preparatory works, topside removal, substructure removal and onshore disposal included in one contract.  This is viewed by platform operators as providing the maximum amount of risk transfer for a fixed price.

The EPRD contractor is then responsible for contracting with the supply chain for the various activities within the scope of the contract, including the form of removal and selecting the onshore destination for the decommissioned platform.  EPRD contractors historically have been the vessel operators, with awards made to both UHLV operators and SLV operators:

- UHLV - Saipem recently won the Miller EPRD contract. The HAF consortium, which includes Heerema Marine Contractors (owner of Thialf) and AF Offshore Decom (operators of an UDW port in Vats Norway) won the Murchison platform EPRD contract.

- SLV - Allseas completed the Brent Delta project using the Pioneering Spirit and the Able Seaton port in Teeside.

When bidding into an EPRD contract, the onshore disposal contractor is required to outline how it will deliver the entire scope of the onshore decommissioning process and exhibit a clear understanding of the approvals process necessary to carry out the contract works. It is therefore the EPRD contractor (rather than the platform operator) who selects the location of onshore decommissioning activity. The result is that at present, an UDW port would be expected to have a contract with one of the three main vessel operators (Heerema, Saipem or Allseas).

During the market consultation interviews, platform operators and vessel operators confirmed that this was the industry preferred contracting method and is the expected main strategy to be used going forward.

### 7.3.2 Alternative approach – Alliancing contracts

During the market consultation, a platform operator raised the possibility of using an alliancing form of contract. This type of contract was used in the early development of the North Sea fields but has not been commonly applied in either the UK O&G sector or the wider construction industry. We understand that it has been more popular in other regions such as Asia, Australia and New Zealand.

An alliancing contract differs from an ERPD approach in areas such as flexibility, collaboration, risk allocation and dispute resolution. Under this approach, relevant contractors form an alliance and jointly bid for work from the platform operator. Through a closer alignment of interests the intention is that parties act in the best interests of the project as a whole. This approach could present an opportunity for an UDW port to have a more active role in the supply chain, broadening contractual relationships from the vessel operators and giving direct access to the platform operators.

However, whilst this was mentioned during market consultations, the overall view remained that EPRD would continue to be the standard contractual structure for the foreseeable future.

The next section sets out the findings from the overall market consultation across a range of areas.

# 8. Market consultation

**Key Messages**

- In order to gauge market sentiment on the development of an UDW port a series of 25 interviews were conducted.
- The key messages from the market were:
  - There is a lack of clarity on the future market, with no commonly recognised programme and timescale for decommissioning platforms.
  - The ability of a port to offer a comprehensive onshore disposal and recycling capability, and to effectively manage the associated risks, such as fulfilling the safety and regulatory requirements, was considered a key advantage during the selection process.
  - No organisations viewed an UDW port as an attractive investment opportunity for them, neither did they believe that guaranteeing a number of projects to a specific port would be possible.
  - The number of direct jobs created by a project was considered to be up to 50.
  - One multi-use opportunity identified which would be supported by an UDW Port: $6^{th}$ and $7^{th}$ generation drilling rigs would be able to come direct to shore for maintenance and capex.
- Views will be based on the experience and commercial priorities of each organisation and accordingly should not be considered a definitive description of the market but rather as a range of opinions.

## 8.1 Introduction

In order to gather views from across the market on the development of an UDW port we conducted a series of interviews. This section summarises the results of the views expressed, identifying the top five points and providing further detail across broad areas of location, market, multi-use opportunities and technical alternatives, appetite for investment and other points of note.

## 8.2 Participating organisations

At the outset of the study a list of suitable organisations was prepared in conjunction with SG, HIE and SE. This resulted in 25 organisations participating in interviews as presented in the table below:

**Table 12: List of market consultation participants**

| Group | No | Organisations |
|---|---|---|
| Platform operators | 7 | To drive insightful discussion during the consultation process it was agreed that all conversations would remain confidential and the participating parties would not be disclosed. As such, these names have been removed from this document. |
| Vessel operators | 5 | |
| Port operators and onshore recycling and disposal contractors | 6 | |
| Alternative providers | 2 | |
| Renewable energy sector | 2 | |
| Others | 3 | |
| **Total** | **25** | |

Source: EY

Interviews were conducted by telephone and typically lasted an hour. In order to encourage an open dialogue the commitment was made that comments would not be directly attributable to individuals or their organisation. In order to maximise the short period of discussion an interview template with questions was sent to the interviewee beforehand, with the questions agreed in advance with SG. The interview questions are set out in Appendix G.

## 8.3 Key points arising

We identified five key points from the market consultation:

1. There is a lack of clarity on the future market, with no commonly recognised programme and timescale for decommissioning platforms. Currently, the market for ports is considered highly competitive, with a large number of locations and few projects coming to the market. However, it remains unclear what impact an increase in decommissioning activity, especially for large scale projects, would have on market dynamics.

2. The ability of a port to offer a comprehensive onshore disposal and recycling capability, and to effectively manage the associated risks, such as fulfilling the safety and regulatory requirements, was considered a key advantage during the selection process. For the physical location the east coast of the UK was considered preferable due primarily to the shorter transit times to the NNS and CNS basins.

3. No organisations viewed an UDW port as an attractive investment opportunity for them given that this would not align with their existing business model. Neither did they believe that guaranteeing a number of projects to a specific port would be possible.

4. The number of direct jobs created by a project was considered to be up to 50, with the market investing in mechanical approaches to reduce labour costs. The UK market was viewed as a lower cost base for onshore activity compared to its North Sea competitors.

5. Regarding specific multi-use opportunities, an UDW port could allow 6th and 7th generation drilling rigs to come straight to shore for maintenance and capex. However, there was no particular need identified for an UDW port from offshore renewable industry.

In terms of general feedback for the development of a UK UDW port:

- Platform operators were generally cautious about open support for a specific UK development. However, several operators did recognise that if there was another port in the market which was cheaper than alternative options and it could perform all the required recycling and disposal processes, this would be beneficial for them.
- One UHLV operator was supportive of the development and another unsupportive. SLV operators, who do not need an UDW port, were unsupportive of the development.
- Onshore contractors provided a range of views which were generally supportive of the development. The exception to this were interviewees with current ports focusing on the decommissioning sector, who opposed such a development as it would have a negative impact on their business.

## 8.4 Areas of discussion

The interviews focussed on five broad areas of discussion, with the level of detail on specific areas varying between organisations dependent on the circumstances of that organisation. In Appendix G we provided detail on the questions used during the consultation. The following table sets out further detail on the views raised across the five areas:

**Table 13: Market consultation areas of discussion**

| Area | Views expressed |
|---|---|
| Location | ► Platform operators had no specific view on location, they left this decision to the EPRD contractor.<br>► From organisations involved in selecting a port, a consistent message was that access to a full onshore recycling and disposal service was more important than location alone. A technical capability from the supply chain to dispose of material (including hazardous), obtain the necessary permits, provide a suitable workforce, have necessary capacity and laydown areas etc. would all be considered.<br>► A number of candidates expressed the view that:<br>  ► A location on the west cost of the UK would not be attractive due to the distance from the North Sea, the additional risk of transiting the north of Scotland and the small size of platforms in the Irish Sea.<br>  ► On the east coast locations from Teeside north would all be potentially attractive from a locational perspective |
| Market | ► Consistent view that the programme for decommissioning platforms was unclear. Operators were engaged in discussions with OGA and regulators but the details were kept confidential. Consequently there was no firm market view on pipeline of projects over short / medium / long term.<br>► General feedback was that broadly SNS platforms would reach CoP |

| Area | Views expressed |
|---|---|
| | earlier, with CNS and NNS to follow. Actual dates would be driven by economic viability.<br>► Vessel operators were viewed as the most likely EPRD tier one contractors. If a port can provide the necessary facilities (outlined above) then price was the key consideration.<br>► The form of removal (HLV, SLV etc.) would be determined by the characteristics of each platform, with no single approach considered to be the default choice. Alternative providers viewed the existing UHLVs and SLV as uneconomical for a significant number of projects.<br>► The level of competition between port locations was considered to be high, with a large number of ports and few projects being brought to market at this time.<br>► However, it remains unclear what impact an increase in decommissioning activity, especially for large scale projects, would have on market dynamics.<br>► Whilst specific prices were considered commercially sensitive, the UK onshore costs were viewed as lower than those of Norwegian locations, an estimate of c40% was provided by one interviewee.<br>► A typical project was estimated to create up to a maximum of 50 direct onshore jobs, with the number dependent on the size of the project and the duration.<br>► Recognised that ports, particularly in Norway, were investing in mechanical processes that would reduce the number of jobs and hence the labour cost, looking to become more competitive with UK onshore costs.<br>► New UHLVs expected to enter the market in the short term (e.g. OOS with 2 vessels and Heerema with 1 vessel in 2019) but that new SLV capability remained at the concept phase. |
| Multi-use opportunities & technical alternatives | ► Multi-use opportunities were considered to be in the floating wind market of the renewable energy sector. None of the organisations operating in this sector outlined a current need for an UDW capability, but acknowledged that with future developments in technology and with greater structures being developed a need could arise.<br>► Other renewable sectors such as tidal and wave energy were also considered. Organisations operating in the sector noted that at present these sectors did not require UDW. Further, due to the industries still being in their infancy it was very hard to predict future requirements.<br>► For technical alternative barge transfer was discussed. This would take the form of a barge that could in effect be hired by ports for specific projects, moving between ports as projects are won / lost within the market. |
| Appetite for investment and guarantee of throughput | ► All of the private sector organisations were asked if investment in an UDW port would be of interest, with none expressing any interest. However, a number of organisations noted that they would not even consider such a proposition as it was not part of their business practice.<br>► No platform or vessel operator would offer a guaranteed number of projects to a specific port. |
| Other points | ► No organisations identified any expected changes to regulations which would impact on their onshore disposal location decision. In considering current regulatory requirements, operators highlighted that they did not consider there to be a material issue with onshore decommissioning being performed by a capable contractor in a non-UK location.<br>► Three organisations raised the prospect of more strategic approach from |

| Area | Views expressed |
|---|---|
| | UK Governments to induce the transfer of decommissioned structure to UK ports.<br>► The impact of Brexit was raised on two occasions, but did not appear to be a significant concern. |

Source: EY

The views in the table represent the main discussion points emerging from the interviews. It is important to recognise that the views will be based on the experience and commercial priorities of each organisation. Accordingly, the views should not be considered as a definitive description of the market but rather as a range of opinions.

**Key Messages**

- Our CBA analysis was developed in line with HM Treasury Green Book and Scottish Government Guidance.
- Three scenarios - low, mid and high - were used to provide a range of quantifiable benefits.
- Under the scenarios considered, the range of economic benefits equates to:
    - £184m to £522m of total output impact (i.e. direct, indirect and induced impact)
    - On average between 58 and 165 average FTE positions per year
    - Total GVA impact of between £81m and £229m.
- All scenarios across Dales Voe and Nigg show a CBR of greater than 1. This assumes no private financing costs are considered in the analysis.
- The NPV across both locations and scenarios ranges from £4m to £112m.
- Including private financing costs and £10m of public sector support, Dales Voe would need to attract more than 10 projects over the 20 year period in order for the CBR to be greater than 1, with Nigg needing to attract slightly more.
- The overriding differentiator is the capex required to develop each port into an UDW facility. We currently estimate Nigg is 20% more expensive than Dales Voe.
- A number of key risks have been identified. These will need to be addressed and mitigated during the subsequent Business Planning phase.

# 9. Cost Benefit Analysis

## 9.1 Introduction

This section assesses the potential costs and benefits of developing an UDW port at the two locations brought forward from the location assessment. It outlines the relevant costs and benefits to the UK economy while highlighting the key risks and sensitivities to the project.

## 9.2 Methodology

The methodology adopted is consistent with HM Treasury Green Book and SG Guidance and covers a 20 year operational period. Our methodology is outlined below:

1. **Identify Costs and Benefits**: in conjunction with SG and its key stakeholders, a range of costs and benefits of an UDW port were identified. This includes an assessment on whether the particular costs or benefits can be quantified or not, and their treatment in the CBA. Costs and benefits which cannot be quantified are included as supplementary commentary to the CBA.

2. **Forecast timeline of projects**: the decommissioning timeline outlined in the Market Demand Section (figure 3) is used as the underlying database which estimates when projects will come to market[16]. We use three scenarios which vary the success of the UDW port being able to attract decommissioning projects.

3. **Estimate direct quantifiable benefits**: following discussion with SG and its key stakeholders, we identified the following quantifiable direct benefits:

   a. Onshore decommissioning activity: output value of decommissioning projects for an onshore contractor. This is determined by valuing each project in the forecast timeline of projects at the estimated price per tonne for the onshore contractor and the value of recycling material brought onshore.

   b. Transit time savings: vessel day rate savings should a UK UDW port offer reduced transit times. This is calculated based on estimates of vessel day rates, the number of transits to a UK UDW port compared to benchmark ports.

4. **Estimate indirect and induced impacts from onshore activity**: The economic value of benefits deriving from the onshore decommissioning activity is calculated by using the direct benefit output impacts then:

   a. Estimating the indirect and induced output impacts from the onshore decommissioning activity by using the economic output multiplier from the SG economic input-output tables.

[16] Sourced from information provided by OGA

   b. Estimating the Gross Value Added (GVA) and employment impacts using employment and GVA effects from the SG economic input-output tables. This provides an estimate of the gross economic benefit from onshore decommissioning activity as a result of developing an UDW port.

   c. Estimating the net economic benefit by considering a displacement factor for work in this industry which may be won by UK yards without the need for developing an UDW port.

   d. Calculating the net economic benefits as net GVA impact in present values.

5. **Estimate Costs**: Costs are estimated based on available information and discussions with market participants, including consideration for optimism bias. Future costs are discounted to present values.

6. **Calculate Cost Benefit Ratio (CBR)**: The CBR is calculated as the present value of total quantifiable costs compared to the present value of total quantifiable benefits over the 20 year assessed period. This also provides commentary on the qualitative benefits and costs of developing an UDW port.

7. **Sensitivity Analysis and Risks Assessment**: The CBR is subject to a number of key assumptions and therefore it is supplemented by sensitivity analysis which assesses and flexes the key inputs. Finally, we highlight key risks impacting the project, together with potential mitigating actions.

## 9.3 Identify Costs and Benefits

The list of costs and benefits of a UK UDW port were identified through discussions with SG and its key stakeholders, as well as feedback from the market consultation.

### 9.3.1 Benefits

The benefits of developing an UDW port are outlined in the table over page. This also highlights whether the benefits can be quantified as part of this feasibility study.

### Table 14: Identified Benefits

| Benefits | Detail | To be quantified |
|---|---|---|
| Onshore decommissioning activity | Onshore recycling and disposal work which could be performed in the UK, including the value of recyclable materials to the onshore contractor. | Yes |
| Transit time savings | Reduced transit time between the platform and port, which reduces the number of days an UHLV is required to be hired for. | Yes – but not included in CBR because savings are deemed too uncertain |
| Cheaper onshore disposal costs | Lower onshore disposal costs in the UK compared to competitors' locations. | Yes – but not included in CBR because savings are deemed too uncertain |
| Construction work | Economic activity generated from the construction work to develop the UDW port. | Yes – but not included in CBR in line with HMT guidance |
| Increased market competition | An additional UDW port in the market may increase the market competitiveness and drive lower decommissioning costs. | No |
| Simplified waste treatment | Simplified process for operators in managing hazardous waste from platforms. | No |
| HLV Activity | Vessels require bunkering, provisions, crew changes, berthing etc. which have benefits for the supply chain and port. | No |
| Multi-use opportunities | Ability to use the UDW port for other economic activity going forward. | No |

Source: EY Analysis

### 9.3.2 Costs

The costs of developing an UDW port are outlined in the table below. This also highlights whether the costs could be quantified as part of this feasibility study.

**Table 15: Identified costs**

| Costs | Detail | To be quantified |
|---|---|---|
| Construction | Costs for developing the UDW port e.g. dredging, quay construction costs. | Yes |
| Financing | Financing costs to deliver the UDW port. | Yes – but not included in the CBR |
| Maintenance | Costs to maintain the up-keep of the UDW port. | Yes |
| Environmental factors | Negative impact of decommissioning activity on the UK environment. | No |
| Disruption to ongoing operations | Negative impact on current operations at the site. | No |

Source: EY Analysis

Construction and maintenance costs are reviewed and quantified for the purposes of estimating the CBR. Financing costs are considered as part of the CBR sensitivity analysis. Environmental factors and disruption to on-going operations are qualitatively discussed.

## 9.4 Forecast timeline of potential projects

### 9.4.1 Additional Drivers

There are a number of factors in addition to having UDW which operators consider when deciding on an onshore disposal location. The following considerations were raised during our market consultation:

- Capability of the onshore contractor to perform all required onshore disposal and recycling activities. In particular the handling of hazardous waste streams.
- Experience of the onshore contractor and confidence in the onshore contractor to perform the required work in a safe manner.
- The port location having all the required waste management licences.

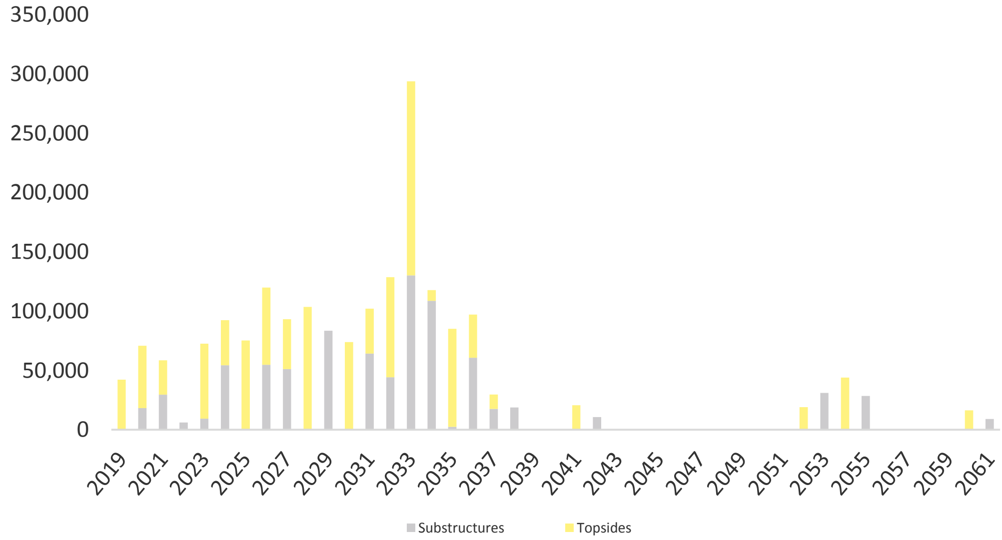
After all these factors have been considered and evidenced, the selection of an onshore disposal location is driven by price offered by the onshore contractor. This message was consistently reiterated during the market consultation exercise.

Given the additional factors, it is not possible to accurately estimate what projects a UK UDW port could attract. However, through consultation and discussion with SG and its key stakeholders, we have sought to provide a reasonable estimate for the purposes of quantifying the benefit. This section assesses a range of success scenarios where an UDW port is able to attract decommissioning work.

### 9.4.2 Scenarios considered

The scenarios considered in this section derive from the forecast of decommissioning projects outlined in the Market Demand section (figure 3). This is replicated below.

**Figure 5: Estimated topside and substructure decommissioning tonnage per year**




Source: EY Analysis

This forecast outlines expected topside and substructure removal timings based on currently forecasted CoP dates. CoP dates can vary due to a number of factors, including changes in oil prices. In addition, the timing of platform removal following CoP will vary from platform to platform. Therefore, this forecast outlines a current best estimate and does not represent a definitive timing of decommissioning projects.

We estimate a three year development period which includes one year to secure the relevant consents followed by two years of construction. We assume the consents process can commence in 2019, meaning a UK UDW port will be completed and able to attract decommissioning projects from 2022 onwards.

As the CBA is assessed over a 20 year period, only projects which are forecasted to come to market between 2022 and 2041, inclusive, are considered as potential projects to be included in the analysis. A 20 year period has been selected as this is a standard length of time over which project appraisals are performed and it covers the period over which the majority of decommissioning activity expected to come to market. This reduces the 64 platforms included in the candidate platform list (per Market Demand section) to 52 as 8 projects are forecast to come to market before 2022 and a further 4 projects are forecast to come to market after 2041.

The scenarios considered for the CBR are outlined in the table below.

**Table 16: Cost benefit scenarios**

| Scenario Name | Description | Number of projects | Average Platform* Weight (Tonnes) | Percentage of market share^ |
|---|---|---|---|---|
| Low | The UK UDW port wins a project on average every three years | 7 | 38,179 | 13% |
| Mid | The UK UDW port wins a project on average every two years | 10 | 37,978 | 19% |
| High | The UK UDW port wins a project on average every year | 20 | 37,870 | 37% |

Source: EY Analysis, *includes topside and substructure, ^proportion of the 52 projects expected to come to market over the 20 year operational period

The differentiating factor between the scenarios is the number of projects which are won over the course of the 20 year operational period. In determining the projects to include within each scenario, consideration is given to the size of projects which are expected to come to market in each year. Medium sized projects (i.e. excluding the largest and smallest projects each year where applicable) were used. The projects included in each scenario have approximately the same average tonnage so fair comparisons can be made.

A range of factors are considered when deciding an appropriate onshore location for the platform decommissioning. As there is no single factor which would support this decision, no differentiation is made between the potential projects which would be taken to either Dales Voe or Nigg for the purposes of this analysis.

## 9.5 Direct Quantifiable Benefits

This section reviews the benefits deriving from the UDW port through each of the assessed scenarios. Where applicable, the benefits are quantified. Benefits which are not quantified are discussed at the end of the section.

### 9.5.1 Onshore Decommissioning Activity

The value for onshore decommissioning activity includes value derived from the onshore contractor costs and value recoverable from recycling materials.

#### Onshore Contractor Costs

Based on a review of current decommissioning forecasts and market feedback, £300 per tonne is used as our estimate of the decommissioning work. This estimate is net of value derived from the onward sale of material from decommissioning projects.

The table below outlines total tonnages and onshore contractor costs under each scenario.

### Table 17: Direct value of onshore decommissioning work

| Scenario Name | Tonnes | Value (£'000) |
|---|---|---|
| Low | 267,253 | 80,176 |
| Mid | 379,778 | 113,933 |
| High | 757,406 | 227,222 |

Source: EY Analysis

As highlighted above, the direct value of work for an onshore contractor, net of the value recoverable from recyclable materials, is estimated between £80m and £227m depending on the scenarios considered.

### Recycling value streams

To estimate the quantum of recyclable materials in future projects we reviewed the lists of platform inventory from five decommissioning programmes. Each programme outlined inventory at different levels of detail. As such, they have been allocated to broad categories to allow for a comparison of expected materials. The results are highlighted in the table below.

### Table 18: Inventory Assumptions

| Inv. | Project 1 (tonnes) | Project 2 (tonnes) | Project 3 (tonnes) | Project 4 (tonnes) | Project 5 (tonnes) | Total (tonnes) | % |
|---|---|---|---|---|---|---|---|
| Carbon Steel | 41,017 | 21,686 | 92,619 | 23,417 | 36,792 | **215,531** | **77.0%** |
| Non-ferrous metals | 3,481 | 2,857 | 4,215 | 1,000 | 3,276 | **14,829** | **5.3%** |
| Stainless Steel | 1,236 | 579 | 8,429 | 1,700 | 1,899 | **13,843** | **4.9%** |
| Marine Growth | 2,394 | 2,117 | 6,100 | 997 | 1,657 | **13,265** | **4.7%** |
| Other* | 1,517 | 573 | 3,660 | 3,400 | 2,930 | **12,080** | **4.3%** |
| Concrete | 1,295 | 1,669 | 1,996 | 461 | 588 | **6,009** | **2.1%** |
| Plastic | 1,228 | 649 | 998 | 351 | 153 | **3,379** | **1.2%** |
| NORM / Hazardous Waste | 246 | 455 | 333 | 62 | 21 | **1,117** | **0.4%** |

Source: EY Analysis, *includes a range of inventory including, but not limited to rubber, wood, residual oils, paint, insulation.

The top three categories are for metals which will be sold by the onshore contractor. To estimate a value of these metals we reviewed quotes[17] over the previous three years. The prices for metals are dependent on a number of global demand and macroeconomic factors. As such there is no set price which can be applied to the analysis. To provide a conservative estimate, we used prices at the lower end of price ranges[18]. The prices used for the purposes of our study are:

- Carbon Steel - £100 per tonne. We noted prices varying between £50 and £200 per tonne over the last three years.
- Non-ferrous metals - £500 per tonne. This refers to a basket of different metals including aluminium, copper and zinc. These metals are more valuable than steel. Prices for metals contained within this basket have varied between £250 and £4000 per tonne over the last three years. In general, copper was often the most significant metal in this group. It has traded towards the upper end of our non-ferrous price range over the last three years. As such, the use of £500 per tonne may be considered a conservative estimate for non-ferrous metals from platforms.
- Stainless steel - £500 per tonne. We have noted prices between £450 and £940 per tonne over the last three years.

By applying the inventory assumptions and the assumed prices to the tonnages in each scenario we can estimate the direct value of the onshore recyclable material. This is outlined in the table below.

**Table 19: Recycling value streams**

| Scenario Name | Tonnes | Value (£'000) |
|---|---|---|
| Low | 267,253 | 34,249 |
| Mid | 379,778 | 48,670 |
| High | 757,406 | 97,064 |

Source: EY Analysis

The combination of onshore contractor costs (outlined in Table 17) and recycling value revenues (outlined in Table 19) equates to the direct output impact of onshore decommissioning economic activity. This is used to determine the economic value of onshore decommissioning work in terms of indirect and induced economic impacts, GVA and jobs in Section 9.6.

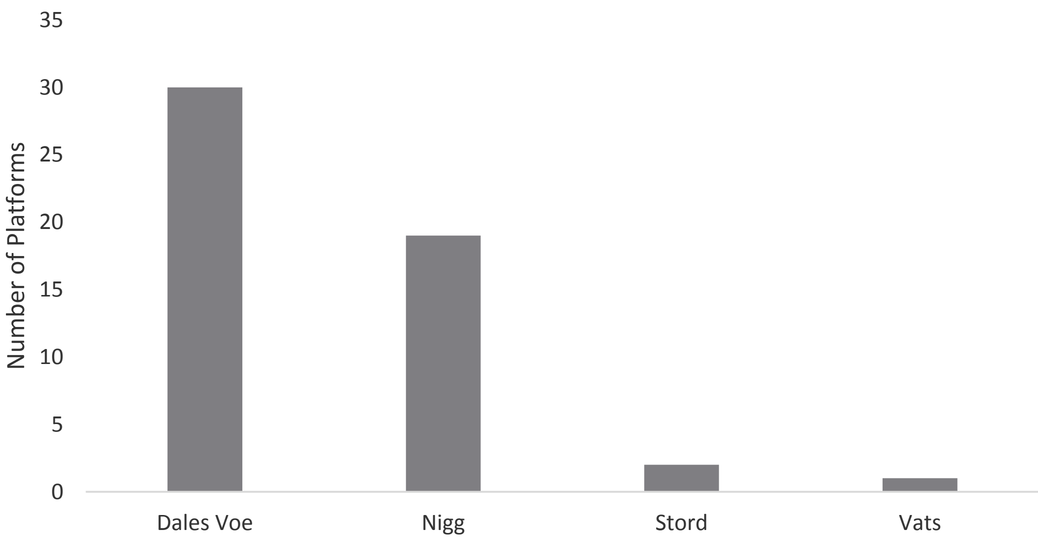
### 9.5.2 Transit time savings

When removing platforms, UHLVs are often required to make several trips to and from the onshore location to transfer modules. As UHLVs charge per day for the use of their vessel, shorter distances to a UK UDW port could reduce the transit times between platform and port, resulting in lower overall decommissioning costs.

17 Prices from: https://www.letsrecycle.com/
18 The prices used are EY assumptions based on the range prices viewed. For the avoidance of doubt, they do not represent an average of prices over the reviewed period.

We have reviewed the distances between the 52 candidate platforms expected to come to market between 2022 and 2041 and Nigg, Dales Voe, Stord and Vats[19]. All platforms with the exception of three are closer to UK ports than Norwegian alternatives. More than half are closest to Dales Voe.

**Table 20: Closest Port to Platform**




Source: EY Analysis

In deciding the appropriate alternative ports to include we considered the capabilities of key Norwegian ports. Stord and Vats both have experience in performing reverse engineer decommissioning projects using UHLVs. Consideration was given to a Lutelandet port which is currently targeting decommissioning projects. Ultimately, this was not included in the analysis as we understand this site is not able to accommodate reverse engineer projects due to not having the required water depths or load bearing capacities at its quays.

In order to estimate the value of achieved journey time savings, we have been required to make a number of assumptions on vessel day rates and the number of trips made between platform and port during the decommissioning process. These are:

- The number of trips between platform and port is generally dictated by the size of modules the UHLV can place on its deck. As we do not have the detailed information on the dimensions of platforms and their modules we use weight as a proxy. Our working assumption is that 8,000 tonnes will be transported each time from platform to port[20].

[19] EY has performed a high level review which maps the distances between platform locations per their coordinates detailed on the OSPAR website to ports. This has not used a sophisticated vessel mapping system and therefore actual distances between locations may vary from those used in our analysis.
[20] The total deck load capacity of the Thialf is 12,000 tonnes. 8,000 tonnes per trip is used as a high level assumption that UHLVs will attempt to load their decks to maximum capacity, but be restricted by deck space.

- The day rates for UHLVs can significantly fluctuate depending on the demand for their services. Understandably, no operator is willing to provide commercial detail on what they charge or what they have been charged. Therefore, our working assumption from speaking with industry stakeholders is that a rate of £500k per day is not unreasonable.

- How transit times are modelled into decommissioning costs by UHLV operators is commercially sensitive. We do not have sight of this, as such, we have considered there to be a transit time saving under two scenarios:

  - **Daily basis**: transit time savings are achieved when it would take less than one day to reach either Dales Voe or Nigg, compared to taking more than one day to reach the closest Norwegian alternative. The saving per trip equates to the full vessel day rate.

  - **Hourly basis**: transit time savings are achieved when its takes at least one hour less to reach either Dales Voe or Nigg, than it would to the closest Norwegian alternative. The saving per trip equates to the number of hours saved and the estimated vessel hourly rate (i.e. vessel day rate divided by 24 hours).

Factoring these assumptions into the analysis, the number of trips equates to the platform weight (topside and substructure) divided by 8,000 tonnes. This is multiplied by two to estimate the number of trips to and from the platform.

Whether there is true transit time savings available for UK ports compared to alternative locations depends on the particular vessel used and its transit speed. The Thialf vessel has a transit speed of 6 knots whereas the Sleipner vessel (expected in the market in 2019) has an expected transit speed of 10 knots[21].

**6 Knots Transit Speed**

At 6 knots, when transit time savings are calculated on a daily basis:

- 20 platforms are within a one day transit to Dales Voe, whereas it would take more than one day to reach the closest alternative Norwegian Port. For these 20 platforms, we estimate that 206 transit days could be saved which equates to an expected £103m of transit time savings.

- 4 platforms are within one day transit time to Nigg, whereas it would take more than one day to reach the closest alternative Nowegian Port. For these 4 platforms, we estimate that 32 transit days could be saved which equates to £16m of transit time savings.

At 6 knots, when transit time savings are calculated on an hourly basis:

[21] The Saipem website details the Saipem 7000 vessel has a transit speed of 9.5 knots. New OOS International vessels expected in the market in 2019 advertise transit speeds of 11 knots. We have been unable to verify if these vessels can achieve these transit speeds when loaded with modules.

- 42 platforms are closer to Dales Voe than the closest alternative Norwegian port. For these platforms, we estimate that 2,940 transit hours could be saved, equating to £61.25m of transit time savings.
- 29 platforms are closer to Nigg than the closest alternative Norwegian port. For these platforms, we estimate that 984 transit hours could be saved, equating to £20.5m of transit time savings.

**10 Knots Transit Speed**

At 10 knots, when transit time savings are calculated on a daily basis:

- All platforms included in our list of projects have the same number of day's transit between the UK ports and the closest Norwegian port. As such, there is no estimated transit time savings for vessels which travel at this speed.

At 10 knots, when transit time savings are calculated on an hourly basis:

- 42 platforms are closer to Dales Voe than the closest alternative Norwegian port. For these platforms, we estimate 1,730 transit hours could be saved, equating to £36m of transit time savings.
- 29 platforms are closer to Nigg than the closest alternative Norwegian port. For these platforms, we estimate 984 transit hours could be saved, equating to £11.5m of transit time savings.

**Summary**

Transit time savings may be achievable with a UK UDW port depending on the particular platform considered, vessel used and how the transit costs are modelled. Due to the lack of certainty over whether the transit speeds could lead to actual cost savings, this benefit is not quantified for the CBR, and is considered as a potential qualitative benefit at Section 9.6.2.

### 9.5.3 Summary of Direct Quantifiable Benefits

This section has reviewed the direct quantifiable benefits from having a UDW port in the UK which is able to attract greater levels of decommissioning activity. The table below summarises the value of the quantified direct output benefits applicable for both Dales Voe and Nigg.

**Table 21: Summary of Direct Benefits**

| Scenario Name | Onshore Contractor (£'000) | Recycling Value (£'000) | Onshore Contractor Decommissioning Activity (Output) (£'000) |
|---|---|---|---|
| Low | 80,176 | 34,249 | **114,425** |
| Mid | 113,933 | 48,670 | **162,603** |
| High | 227,222 | 97,064 | **324,286** |

Source: EY Analysis

These direct benefits are used in the next section to quantify the economic benefit from having this extra activity in the UK. Unquantified benefits are also discussed in the next section.

## 9.6 Economic Value of Benefits

In this section we estimate the economic value and supply chain effects of the direct benefits identified in the previous section. There are three main sources of economic benefit to the UK economy:

- **Economic Activity and Location Impacts (EALIs)**: The impacts of the proposed intervention expressed in terms of their net effects on the local and national economy. Specifically, these are associated with the onshore decommissioning activity; through onshore decommissioning work and recycling value streams.
- **Decommissioning Economic Efficiencies (DEEs)**: The potential decommissioning cost reduction impacts of the proposed intervention; i.e. transit time savings, lower onshore contractor costs.
- **Wider Economic Benefits (WEBs)**: This relates to the notion that a potential UK UDW port facility can deliver transport impacts or agglomeration effects (a concentration of activity) and other impacts. We do not assess these benefits quantitatively, but rather identify some of the additional benefits which have been highlighted in consultations.

EALIs are associated with onshore decommissioning economic activity. The economic value of benefits from the onshore decommissioning activity at an UDW port are calculated using the methodology outlined in Section 9.2. The working assumption is that these impacts are additional relative to a counterfactual where there is no UK UDW port facility. This reflects recent evidence that all reverse engineer decommissioning projects using UHLVs have been taken to Norway. It does not necessarily mean that no future large decommissioning projects will be won in the UK. Per table 16, the high scenario assumes the UK UDW port is able to capture 37% of projects over the 20 year operational period. Thus, a substantial number of UKCS projects are still available for other UK operators to target, specifically those capable of accommodating single-lift. Consideration has been given to the potential for a UK UDW port to displace future activity which could be generated through barge transfer of modules. However, while we note a number of operators are investing to improve the efficiency of barge transfers, we have not been made aware of a commercially competitive alternative to direct to quay module transfer. As such, for the purposes of performing the CBR, no displacement is assumed. However, a displacement assumption is included in the sensitivity analysis to illustrate the impact this would have on the results.

DEEs drive cost reductions arising through a number of areas of potential saving and efficiency. These costs savings would be expected to benefit platform operators through reduced overall decommissioning costs and therefore do not have a direct impact on the UK economy in terms of activity. It depends on how any savings are deployed by operators. For example, savings could be allocated to further investment in the offshore sector, and given the nature of the global industry may be deployed elsewhere. It is also feasible that savings would be redeployed as profit or dividends to shareholders, with a number of operators not being UK headquartered and shareholders being global in nature. As such, we do not assume that decommissioning efficiencies will feed directly to increased onshore economic activity.

However, there may be expected direct benefits to the wider UK public sector from reduced overall decommissioning costs through reduced allowances provided by the UK tax system for assets being decommissioned in UK basins. This could be a direct benefit to the UK Exchequer, but at this feasibility stage we do not have sufficient sight of expected operator costs at present. Given a lack of detail on current operator cost estimates and whether these savings will materialise we do not consider these estimates sufficiently robust to include in the CBR. Instead we do discuss these benefits in the DEEs subsection below.

Finally, we qualitatively discuss the WEBs.

### 9.6.1 Economic Activity and Location impacts (EALIs)

In estimating the economic activity and location impacts we assume the direct output impact of the onshore decommission activity is sufficiently captured by the sum of the onshore decommissioning work and recycling value stream, which have already been estimated in 2018 current prices. Furthermore, we assume that the final demand is to the waste, remediation & management Industrial organisation category (IOC) in the SG Input-Output (IO) Framework.

To calculate the direct impacts upon an industry we employ the following Scottish Government methodology and latest available SG IO multipliers for Standard Industrial Categorisation (SIC) 38, 39.

- **The total effect on output (using Output Multipliers)**: The indirect and induced effect on this industry's suppliers, we multiply the direct output impact by the Type II output multiplier for this industry (1.6) giving a total of direct plus indirect and induced impacts (direct, indirect and induced effects).
- **The total effect on employment/jobs (using Employment Effects)**: Multiplying the direct output change (in millions) by the Type II employment effect for the Waste, remediation & management industry (10.2) to give an estimate of the direct plus indirect and induced employment changes resulting from this additional output.
- **The total GVA impact (using GVA Effects)**: The GVA effects estimate the effect of the direct change in output upon GVA in Scotland. Multiplying the direct output change by the Type II GVA effect for Waste, remediation & management (0.7) gives an estimate of the direct plus indirect and induced GVA impact resulting from this additional output.

Details of the economic impacts are provided in the table below. This captures the forecasted economic activity over the 20 year operational period in each scenario considered.

**Table 22: Decommissioning activity – Economic Impacts**

| Scenario Name | Direct Output Impact (£'000) | Total Output Impact (£'000) | Total Job Impact (Average FTE per year) | Total GVA Impact (£'000) | Total Discounted GVA Impact (£'000) |
|---|---|---|---|---|---|
| Low | 114,425 | 184,208 | 58 | 80,734 | 51,315 |
| Mid | 162,603 | 261,768 | 83 | 114,726 | 74,147 |
| High | 324,286 | 522,053 | 165 | 228,803 | 150,908 |

Source: EY Analysis, Scottish Government Input-Output Type II Multipliers

In summary:

- In the mid scenario, it is estimated that a UK UDW port facility could contribute £115m net to Scotland's economy and support on average approximately 80 net jobs per year.
- In the low scenario this falls to just over £80m in net contributions to the economy and 58 net jobs per year.
- For the high scenario, this increased to a £229m economic contribution and over 160 net jobs per year.

The net GVA impact is discounted using the Social Time Preference Rate of 3.5%, as per HMT Green Book guidance. This accounts for the notion that people tend to prefer goods and services now, rather than in the future. The GVA impact across the 20 year period, discounted at the Social Time Preference Rate, is the quantified benefit which is included in the CBR.

### 9.6.2 Decommission Economic Efficiencies (DEEs)

This section considers each of the identified DEEs in turn. Where estimates of DEEs are made, the benefit to the UK is considered as the reduced tax liability for the UK Exchequer. Platform operators are able to offset decommissioning costs against taxable revenues. The relevant tax rate is different per operator with a range of 40% to 75% being generally applicable. For the purposes of outlining potential tax savings, we use 40%, as the lower end of this range to outline a more conservative estimate. This is used as a broad range for all operators in the market. Due to the complexity of the fiscal regime and Decommissioning Relief Deeds a more detailed estimate is not possible for the purpose of this study.

**Transit time savings**

When removing platforms, UHLVs are often required to make several trips to and from the onshore location to transfer modules. As UHLVs charge a day rate for the use of their vessel it is possible that shorter distances to a UK UDW port could reduce the transit times between platform and port, resulting in lower overall decommissioning costs.

### Lower onshore decommissioning costs

Through our market consultation, it was highlighted by interviewees that in their experience UK port disposal costs were lower than the Norwegian options. This is primarily due to the lower costs of labour in the UK. It was however noted that Norwegian ports are actively investing in mechanical solutions to reduce their reliance on labour to offer more competitive prices.

To provide an illustration of the potential quantum of these savings we have considered a number of situations where UK decommissioning costs are 10%, 20% and 30% lower than Norwegian options. This is based on feedback from market consultations with one interviewee suggesting Norwegian Ports were up to 40% more expensive than UK options. The table below outlines the value of these cost savings and the potential tax savings for the UK Exchequer.

**Table 23: Lower onshore decommissioning cost savings**

| | Potential Operator Cost Savings (£m) | | | Potential Tax Savings (£m) | | |
|---|---|---|---|---|---|---|
| **Level of Saving** | **10%** | **20%** | **30%** | **10%** | **20%** | **30%** |
| Low | 8,018 | 16,035 | 24,053 | 3,207 | 6,414 | 9,621 |
| Mid | 11,393 | 22,787 | 34,180 | 4,557 | 9,115 | 13,672 |
| High | 22,722 | 45,444 | 68,167 | 9,089 | 18,178 | 27,267 |

Source: EY Analysis

Depending on the scenario considered and the level of saving assumed, operators could benefit from a saving of between £8m and £68m from bringing the modelled projects back to the UK as opposed to alternative more expensive ports. This level of saving would result in a benefit to the UK Exchequer of between £3m and £27m, assuming an applicable tax rate of 40%. Assuming an applicable tax rate of 75%, this would result in a benefit to the UK exchequer of between £6m and £51m.This analysis considers that Norwegian yards are more expensive than the UK's £300 per tonne estimate. If the UK is able to offer decommissioning projects below £300 per tonne and Norwegian port costs remain the same, this would increase the overall level of savings, but reduce the level of direct benefit from onshore activity.

### Increased competition in the market

The addition of a new UDW port into the decommissioning market will provide added competition which can drive efficiencies leading to lower prices charged for decommissioning. There is a circularity to this point whereby lower costs would lead to a lower level of benefit per our calculations for the onshore decommissioning activity.

**Simplifying waste treatment**

Market consultations highlighted that a UK UDW port may have benefits from a waste handling perspective. These are:

- Operators need to apply to SEPA for permission for naturally occurring radioactive material (NORM) waste of NORM contaminated items to leave the UK. If the platform was brought to the UK, then operators would not be required to undergo this process.
- Any radioactive wastes removed from platforms abroad needs to be returned to the UK. This requires an extra transfer of waste from the country of platform destination to the UK. If the platform was decommissioned in the UK, then there is no need for this, saving costs.
- A potential requirement to remove mercury before any platform leaves the UK or repatriate it if it does leave the UK would add costs to the decommissioning project. If the platform was decommissioned in the UK, it would avoid these additional costs.
- One market participant highlighted that Norwegian regulators have a policy of requiring the treatment of refractory ceramic fibres the same as asbestos. As a result of this treatment, costs for the onshore disposal element increase. This is not the requirement in the UK suggesting that this element of the cost could be lower if performed in the UK.

### 9.6.3 Wider Economic Benefits (WEBs)

The WEBs from a UK UDW port are highlighted below:

**Multi-use opportunities**

Our market consultation highlighted that an UDW port could also support 6$^{th}$ and 7$^{th}$ generation drilling rigs coming direct to shore for maintenance and capex. No other specific activities from the oil and gas sector were identified which require UDW.

There were no specific need from the offshore renewable energy sector for an UDW port. However, as this industry develops and structures become bigger, there may be a need for an UDW port at some point in the future.

Given the proximity of a UK UDW port to the North Sea, the location may be able to support existing capital expenditure programmes.

**UHLV Activity**

An increased level of UHLV activity at a specific port location can provide additional benefits to the wider supply chain such as bunkering, provisions, crew changes, berthing, etc.

## 9.7 Costs

This section reviews the costs deriving from the UDW port through each of the assessed scenarios. Where applicable, the costs are quantified. Costs which are not quantified are discussed at the end of the section.

### 9.7.1 Construction Costs

This section gives consideration to the estimated construction costs of an UDW port and any residual value which may derive from it from the end of the operational period.

**Development costs**

Dales Voe has performed an assessment which outlines the cost to develop an UDW port at that site is c£40m.

To our knowledge, Nigg has not performed a detailed cost assessment for developing their quay into an UDW port. Arch Henderson have performed a high level assessment on the expected costs for developing NIGG into an UDW port. It is estimated to cost £48m which is 20% greater than the costs at Dales Voe. In reaching this conclusions Arch Henderson considered:

- Both quays would require significant dredging, with Dales Voe requiring more than Nigg due to there being a greater distance to an existing channel depth of -24m CD. This is because a proposed UDW quay at Nigg could be built at the end of the existing finger jetty which reduces the distance of the proposed quay to natural deep water in the channel. At Dales Voe the quay would be built out from the existing shoreline.

- Both quays would also require extremely high modulus quay walls which would be tied back to anchor walls via a tie system. Due to the fact that the extension at Nigg would extend from the end of the existing finger jetty, rather than the shoreline, a greater length of quay wall would be required here than at Dales Voe, due to the requirement of the berthing face return walls. Dales Voe could utilise rock armour faced revetments extending out from the shoreline.

- Broadly speaking, the cumulative cost of new quay construction and dredging could be considered to be similar between Dales Voe and Nigg.

- However, the existing finger jetty at Nigg is not considered to be wide enough to support transportation of components from a newly developed UDW quay, nor does it have the required load capacity. It would therefore be necessary to widen the existing finger jetty and strengthen the existing section of finger jetty by installing a pile supported slab. The cost associated with widening and strengthening the finger jerry at Nigg can approximately be considered the difference in cost between developing an UDW quay at the two facilities, estimated at around 20%.

**Residual value**

As quays tend to have a useful life which is significantly greater than the 20 year operational period assumed as part of this analysis, consideration has been given to the residual value of an UDW port. In order to provide an estimate of this, we would need to have a reasonable understanding of the expected activities which would be performed at the quay beyond the operational period and the value derived from it. As we do not have sight of this, we have included a residual value of £1 in our model.

**Total construction costs**

The total construction costs are highlighted in the table below. As the construction is expected to commence in 2020 and be spread evenly over two years, the present value of these costs are also outlined.

**Table 24: Construction Costs**

| | Total Construction Costs (£'000) | Discounted Total Construction Costs (£'000) |
|---|---|---|
| Dales Voe | 40,000 | 36,709 |
| NIGG | 48,000 | 44,051 |

Source: EY Analysis

In accordance with HMT Green Book guidance we do not consider the construction impacts as benefits. Although it is not uncommon in local economic impact assessments to consider the construction benefits.

For illustrative purposes, our analysis of this shows that the £40 million (for Dales Voe) or £48 million (for Nigg) spending on construction for the development of a UK UDW port facility over the two years 2020-2021 is estimated to support, in gross terms, on average 300 jobs (for Dales Voe) or and over 350 jobs (for Nigg) and contribute approximately £33 million (Dales Voe) or £40 million (Nigg) to Scotland's GVA in each year.

### 9.7.2 Maintenance Costs

Over time, it is assumed that regular maintenance work will be required for up-keep of the UDW port. The working assumption used for this equates to 0.5% of construction costs per annum[22], for example, Dales Voe at an estimated cost of £40m, would equate to £200k per annum in maintenance costs. This is incurred each year over the 20 year operational period.

The total maintenance costs for each of the locations are outlined in the table below.

[22] An assumption we are aware was applied in a previous commercial assessment of developing a UK based UDW port.

**Table 25: Maintenance Costs**

| | Total Maintenance Cost (£'000) | Discounted Total Maintenance Cost (£'000) |
|---|---|---|
| Dales Voe | 4,000 | 2,563 |
| NIGG | 4,800 | 3,077 |

Source: EY Analysis

### 9.7.3 Financing Costs

HM Treasury Green Book guidance outlines that financing costs either through borrowing or raising taxes should not be considered when performing an economic appraisal on a proposed development. Instead, financing costs should be considered as part of the financial appraisal. This guidance is generally focused on public sector developments (e.g. schools, hospitals). Based on our understanding of the project, it will likely need to be financed by a mixture of public and private finance, the details of which would need to be developed at the business planning phase.

As there is no currently defined plan for funding the project, we have not considered the impacts of financing costs for the CBR. However, within the sensitivity analysis, we outline what the impacts may be on the CBR through different levels of private and public sector support.

### 9.7.4 Other costs

Other costs noted are:

- **Environmental costs**: As noted in Table 18, marine growth accounts for c5% of the expected platform tonnage. When this is brought onshore it decomposes and creates a foul odour. During discussions with the market it was highlighted that residents in the local proximity to Norwegian UDW ports have recently complained about the negative impact this work is having on them.
- **Disruption of ongoing activities:** It can be expected that the development of an UDW port at Dales Voe or Nigg may disrupt current activities. This is not quantified for the purposes of this study as EY does not have details on the future business plans, projects and expected work at each location.

## 9.8 Cost Benefit Ratio

This section compares the quantified costs and benefits to highlight a CBR for each location under each scenario. The table below summarises the analysis.

**Table 26: Cost Benefit Ratio**

| | Dales Voe | | | Nigg | | |
|---|---|---|---|---|---|---|
| | Low (£'000) | Mid (£'000) | High (£'000) | Low (£'000) | Mid (£'000) | High (£'000) |
| Construction | 36,709 | 36,709 | 36,709 | 44,051 | 44,051 | 44,051 |
| Maintenance | 2,563 | 2,563 | 2,563 | 3,077 | 3,077 | 3,077 |
| **Total Cost** | **39,272** | **39,272** | **39,272** | **47,128** | **47,128** | **47,128** |
| | | | | | | |
| Onshore contractor & recycling | 51,315 | 74,147 | 150,908 | 51,315 | 74,147 | 150,908 |
| **Total Benefits** | **51,315** | **74,147** | **150,908** | **51,315** | **74,147** | **150,908** |
| **Cost Benefit Ratio** | **1.31** | **1.89** | **3.84** | **1.09** | **1.57** | **3.20** |

Source: EY Analysis

As we assume each location could win the same projects, the quantified benefits are the same. Therefore, costs are the differentiating factor between the locations. As Nigg has a higher estimated construction cost, it also has assumed maintenance costs, making the CBR higher for Dales Voe across all scenarios.

All scenarios show a CBR of greater than 1. The key determinant on the ultimate success of a UK UDW port depends on its ability to attract a sufficient proportion of the market share. Beyond having UDW, the economic and commercial success of a new UDW port will also depend on the capabilities of onshore contractors who will use the port and the price they can offer the market.

It should be highlighted that the above analysis does not consider the impact of private financing costs. As it is likely that the development will require private finance, this is considered in the following section.

## 9.9 Sensitivity Analysis

### 9.9.1 General Sensitivities

A number of assumptions have been made to determine the CBR. These are sensitised to highlight the impacts on the CBR. Sensitivities considered are:

- **Construction Costs**: Construction costs are increased and decreased by 20% to highlight the impact of potential efficiencies or overruns and more significant optimism bias assumption.
- **Onshore Contractor Value**: The anticipated £300 per tonne estimate is increased and decreased by £100 to highlight the impact that increased demand or greater competition may have on the value of onshore work.
- **Steel Price**: The onshore contractor is able to hold its stock of steel until a point when market prices are favourable for sale. In this case, £250 is received per tonne of steel.
- **Displacement**: For illustrative purposes, 20% of the activity won by the UDW port is a displacement of activity which would have been won by other UK ports.

The results of this sensitivity analysis is highlighted in the table below.

**Table 27: Cost Benefit Ratio Sensitivities**

| | Dales Voe | | | Nigg | | |
|---|---|---|---|---|---|---|
| | Low (CBR) | Mid (CBR) | High (CBR) | Low (CBR) | Mid (CBR) | High (CBR) |
| Base Case | 1.31 | 1.89 | 3.84 | 1.09 | 1.57 | 3.20 |
| Construction Costs +20% | 1.09 | 1.57 | 3.20 | 0.91 | 1.31 | 2.67 |
| Construction Costs -20% | 1.63 | 2.36 | 4.80 | 1.36 | 1.97 | 4.00 |
| Onshore Contractor Value £200 | 1.00 | 1.45 | 2.95 | 0.83 | 1.21 | 2.45 |
| Onshore Contractor Value £400 | 1.61 | 2.33 | 4.74 | 1.34 | 1.94 | 3.95 |
| Steel Price £250 | 1.66 | 2.40 | 4.88 | 1.38 | 2.00 | 4.07 |
| 20% Displacement | 1.05 | 1.51 | 3.07 | 0.87 | 1.26 | 2.56 |

Source: EY Analysis

The analysis highlights:

- How sensitive the CBR is to construction costs. As increased construction costs also impact on the maintenance costs, project overruns will materially impact the CBR.
- The total benefit varies significantly with the value derived from the onshore decommissioning activity. The actual amount an onshore contractor will charge will vary from project to project. Therefore lower contract values have the potential to significantly reduce the benefits derived.
- If an onshore contractor was able to store recovered materials until a point where the market prices are favourable it could substantially increase the benefits derived from this activity. A key assumption to this is that improved returns on the recovery of materials is re-invested into the UK economy.
- Displacement of current activity will reduce the net benefits derived from an UDW port.

### 9.9.2 Financing Cost Sensitivities

Financing costs have not been considered within the CBR. However, as the UDW port development is expected to be funded by a mixture of private and public finance it is appropriate to perform sensitivity analysis which considers the impact of financing costs on the CBR, under different levels of public support.

The financing costs outlined in this section reflect a high level estimate and calculation of what financing profile and costs such a development may attract. The rates and types of funding have been outlined at high level and in generic terms. We have not performed a detailed review of the funding market.

The key financing cost assumptions are outlined in the table below.

**Table 28: Financing Cost Assumptions**

| | Assumption | Justification |
|---|---|---|
| Gearing | 60% Senior Debt, 40% Sub-debt/Equity | Due to nature of the transaction and uncertainty of future cash flows significant levels of sub-debt/equity required |
| Tenor | 22 Years - 2 years development period plus 20 year repayment period. | Assumed loan tenor to match the operational period. |
| Repayment Profile | Interest capitalised during development period followed by 20 years of annuity repayments. | Typical development loan repayment profile. |
| Senior Debt Interest Rate | 6% | General rate applied given type of funding. |
| Equity/Sub-debt Rate | 15% | General rate applied given type of funding. |

Source: EY Analysis

At these gearing levels, and assuming no public sector funding for the project Dales Voe is funded with £24m senior debt and £16m sub-debt/equity. Likewise, Nigg's construction costs would be financed by £28.8m senior debt and £19.2m sub-debt/equity.

However, in order to support the development, there is likely to be a need for public sector support. At present, it is not decided what level of public sector support would be available therefore we have assumed three different levels are offered: £5m, £10m and £20m. For the avoidance of doubt, these values do not represent any commitments from any government or public sector organisation.

The table below reviews the CBR with the inclusion of private financing costs. Private financing costs are included based on the proportion of project costs which are not met by public sector financing. For example, where Dales Voe development is £40m and £5m of public funding is available, £35m of private sector funding is required to be sourced. Any public sector funding is assumed to reduce the requirement for sub-debt/equity financing first, followed by reducing the level of senior debt where applicable[23].

[23] This is a general assumption made at this stage as in reality, sub-debt/equity may still be required to attract debt lenders.

**Table 29: Sensitivity Analysis – Financing Costs**

| | Dales Voe | | | Nigg | | |
|---|---|---|---|---|---|---|
| | Low (CBR) | Mid (CBR) | High (CBR) | Low (CBR) | Mid (CBR) | High (CBR) |
| Base Case | 1.31 | 1.89 | 3.84 | 1.09 | 1.57 | 3.20 |
| £5m public funding | 0.66 | 0.96 | 1.95 | 0.54 | 0.78 | 1.59 |
| £10m public funding | 0.76 | 1.10 | 2.24 | 0.61 | 0.87 | 1.78 |
| £20m public funding | 0.98 | 1.42 | 2.89 | 0.79 | 1.14 | 2.31 |

Source: EY Analysis

The inclusion of private financing costs has a significant impact on the CBR. With £5m of public funding available, £35m for Dales Voe and £43m for Nigg, would need to be funded through private sources. Under this case, a significant element of the construction costs would need to be funded through relatively expensive sub-debt/equity. For both Dales Voe and Nigg, this reduces the CBR to below 1 under the mid scenarios.

As public sector support increases, the CBR's across each scenario increase. With £20m of public sector support, under the assumed gearing levels, neither facility would need sub-debt/equity. As such, with only senior loan financing costs, the CBR ratios significantly increase.

The CBR difference between Dales Voe and Nigg is accentuated by including financing costs. This is due to the higher construction cost of Nigg requiring greater levels of private sector funding when the same level of public sector support is available.

## 9.10 Risks

The key risks for the project, alongside potential mitigating actions, are outlined in the table below.

**Table 30: Key Project Risks**

| Risk Type | Description | Mitigating Actions / Next Steps |
|---|---|---|
| Timeline Risk | A key assumption to the analysis is the timing of decommissioning programmes and platform removal dates. This depends on currently estimated CoP dates and timing from CoP to platform removal. Both of these aspects are unique for each platform and subject to changes for a range of factors including changing oil prices. As such, there is no certainty that the estimated decommissioning programme will transpire as outlined in this analysis. | It is important that operators of an UDW port are consistently up to date with new market developments and when certain platforms are expected to come to market. There should be a clear plan of targeted platforms which is regularly maintained and managed. Constant engagement with the market will be required to ensure the most up to date analysis is being used. |
| Demand Risk | After development, there is low demand for the UK UDW port for decommissioning activity. | Early engagement with the key market operators to ensure that the facility design is cognisant of their specific needs. |
| Value Risk | The economic value from working on decommissioning projects may be lower than the value outlined in CBA. | Detailed review of future projects coming to market and the likely value of work from them. |
| Price Risk | The price offered to market for use of an UDW port is too high to attract businesses. Potential for this where there are significant levels of borrowing required to deliver an UDW port. | Detailed commercial modelling of future projects to assess the impact of borrowing costs on the level of prices offered to the market. |
| Technology Risk | New solutions come to market which negate the need for an UDW port and are attractive for market operators. | Detailed technical assessment of emerging options and their ability to replace the need for an UDW port from an efficiency and commercial perspective. |
| Funding Risk | Funding not available for the project from commercial sources. | Early engagement with potential funders to gauge appetite to provide funding for the facility.<br>Scottish and UK Governments to set out a clear and robust strategic business plan for the project. |

Source: EY Analysis

All risks need to be reviewed, assessed and addressed however, value risk and technology risk should be addressed as a priority as part of a more detailed study. The justification of public sector support relies on certainty around the quantum of benefits that may derive from an UDW port and that there is not a reasonable alternative that will attract decommissioning projects using UHLVs to the UK without one. A more detailed review of these factors will be able to provide more certainty on these points.

Funding risk and price risk aspects are inter-related and should be reviewed alongside one another. It is important that the level of public sector support for the project delivers value for money, but also allows the UDW port to offer competitive rates in the market to attract projects.

Timeline risk will always be prevalent given that the timing of decommissioning programmes is based on a number of factors which are not in the control of an onshore contractor. Demand risk can be addressed through a detailed technical assessment and engagement with the market.

In order to progress the project, the above risks should be taken into consideration along with any other key risks which have not been highlighted. These should be considered in the subsequent Business Planning phase.

# 10. Transfer Hub

The level of economic benefit generated from an UDW port depends on its ability to attract projects. One approach which may support a higher number of projects to the UK is through the UDW port operating as a 'transfer hub'. If the UDW port could receive and quickly distribute modules to other sites this could free up capacity at the UDW port and create further activity at other locations. How this could operate, the potential commercial arrangements and the peak times of market demand are reviewed in this section.

### 10.1.1 Operational Assessment

At a high level, the following steps outline how a transfer hub could operate:

1. An UHLV will remove modules from the platform and transfer them to the UDW port. Once it has reached the port, modules will be transferred from the UHLV to the port laydown area.

2. Modules will either be broken down into smaller pieces or left as they are depending on the size requirements for onward transportation.

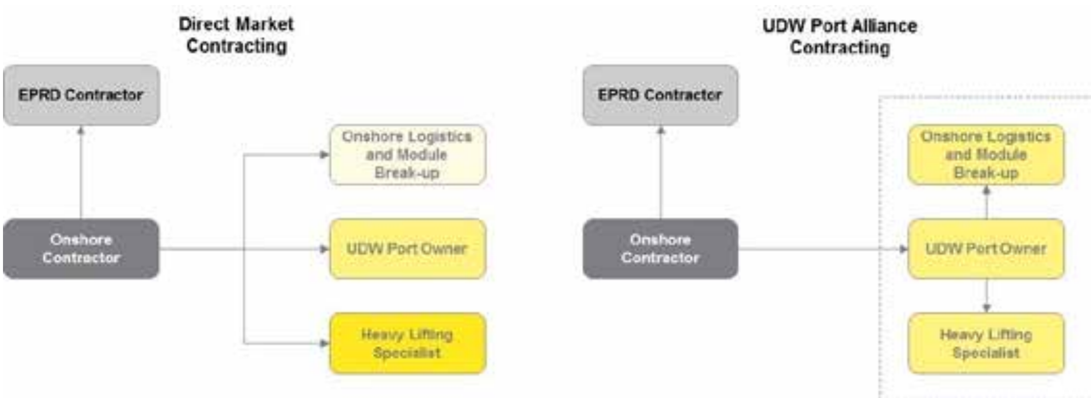
3. Broken down modules or whole modules are transferred to another yard for disposal and recycling activity.

The technical specifics within each of these steps should be considered in more detail as part of a subsequent technical review. This should include an assessment on the capital equipment needs at the UDW port, how the transfer of modules could operate in the most efficient and safe manner and what impact this may have on project costs.

### 10.1.2 Commercial Arrangements

The appropriate commercial model employed at a transfer hub would need to be tested with key market operators to ensure it is attractive for them. Two potential options - Direct Market Contracting and UDW Port Alliance Contracting - are outlined in the figure below.

**Figure 6: Transfer Hub Commercial Models**




Source: EY Analysis

Key roles in the process are:

- **EPRD Contractor**: Expected to be the UHLV operators as per the current industry norm.
- **Onshore Contractor**: The onshore contractor from the disposal yard which will perform the onshore decommissioning work.
- **Onshore Logistics and Module Break-up**: A contractor will be required to operate at the UDW port to support the receipt of modules and break them down into smaller pieces for transfer to the final port destination.
- **UDW Port Owner**: Provider of the UDW port used as the transfer hub.
- **Heavy Lifting Specialist**: Businesses specialising in heavy lifting who can transport modules from the UDW port to the onshore disposal yard.

In outlining potential commercial arrangements for a transfer hub, we have considered the need for the facility to be open for all onshore contractors to bid through. Our working assumption is that the onshore contractor is not tied to any port and would bid directly to the EPRD contractor.

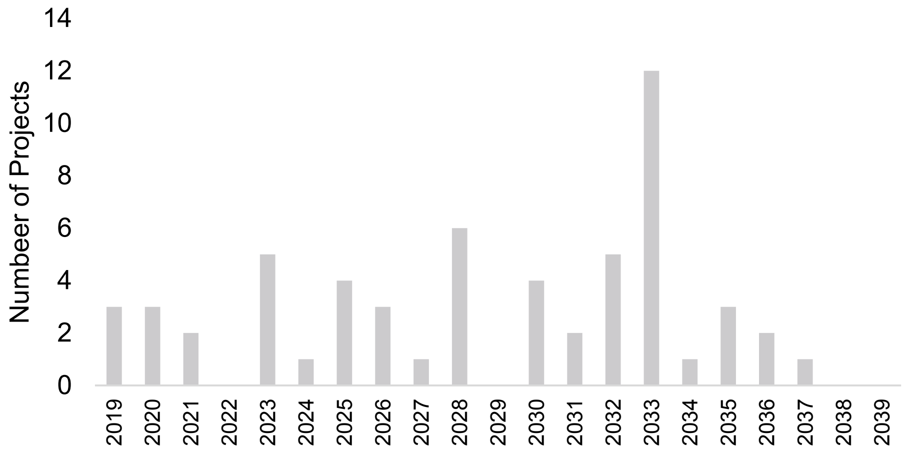
Under the Direct Market Contracting, the onshore contractor will engage with these market participants separately and agree costs, apportionment of risks and scope of works with each contractor individually.

In the UDW Port Alliance Contracting, it is assumed that the UDW port has an alliance or series of alliances in place for the required services. This means that the onshore contractor would only be required to have one contract with the UDW port owner. This will places more risk and responsibility with the UDW port owner. However, if a standardised process is established, this may be attractive for the onshore contractor, who would not need to contract with multiple different businesses and be able to show the EPRD they are using a tried and tested process.

### 10.1.3 Market Assessment

The benefits of operating as a transfer hub will likely be realised when there is a significant demand for an UDW port. The figure below highlights the forecast timeline of decommissioning projects.

**Figure 7: Forecast of Decommissioning Projects**




Source: EY Analysis

There is a clear peak projects coming to market in 2030 to 2033. During this period, there could be a capacity constraint at existing facilities which would mean that having an UDW port that can operate as a transfer hub could help attract as many of these projects as possible.

Between 2023 and 2028, the forecasts highlight 20 projects coming to market. Again, operating as a transfer hub may help the UK attract as many of these projects as possible.

### 10.1.4 Risks

Key risks associated with developing the transfer hub are highlighted in the table below. This is supported by proposed mitigating actions. Further development of the project should consider these risks in more detail and have an agreed plan of how they can be managed and mitigated.

**Table 31: Transfer Hub Key Risks**

| Risk Type | Description | Mitigating Action |
|---|---|---|
| Price Risk | With a transfer hub, there is a requirement for multiple modules to be moved from one onshore location to another. This has the potential to increase the overall costs of the decommissioning process. | A detailed technical assessment is required to outline how this process could operate to ensure that the price charged for decommissioning via a transfer hub is competitive with direct to shore options. |
| Funding Risk | The funding for an UDW port is still to be determined. Potential funders may include an onshore disposal contractor who we expected would require exclusive use of the facility for future projects. | Further work is required to test the market and assess how the UDW port would be funded. |
| Demand Risk | It is unclear on the demand for a transfer hub and how this option would be viewed by operators who may prefer that platform inventory is handled and managed as little as possible. | Further work required to test the market and assess whether they would have a demand for this type of facility. |
| Economic Leakage | As a transfer hub, there may be potential for onshore disposal work to be performed in locations outside the UK resulting in leakage of economic activity from the UK. | To be reviewed and discussed with project stakeholders at a business case development stage. |

Source: EY Analysis

### 10.1.5 Summary

As a concept, the transfer hub has potential to be an attractive option if it is able to increase the capacity of the onshore decommissioning work which may be attracted to the UK and provide further benefit and income to other UK locations.

However, there are a number of key risks of such an operation with a key factor being potential leakage of work from the UK. A technical assessment of how such a facility could operate along with a review of impact on prices and key risks should be addressed as part of the Business Planning phase.

## Appendix A EY Scope of services

Our scope of services encompasses the following:

**Stage 1**

- Perform a locational assessment for an UDW port
  - Identify a long list of locations which could accommodate a UDW port and successfully compete with established international facilities.
  - Undertake a desktop analysis of the Norwegian UDW facilities to establish the criteria to which UK sites will be compared.
  - Assess the long list of locations against the criteria to determine the two best suited locations.
  - In this area EY worked with Arch Henderson LLP as technical specialist consultants.
- Undertake a market assessment for an UDW port
  - Request information from the OGA on the O&G sector in the UKCS and review it to determine the ‘base case’ demand for reverse engineer decommissioning in the UKCS.
  - Perform a desktop review to identify potential changes in market conditions, focusing on new vessel commissioning and changes in regulation, in order to run sensitivity analysis on the base case.
- Examine multi-use opportunities
  - Review publicly available information and hold discussions with SG and its partners to identify non-decommissioning projects that an UDW port could support.
- Complete a market consultation
  - Perform telephone interviews with platform operators, UHLV operators and multi-use operators to get a better understanding of the market views and demand for a UK UDW port.

**Stage 2**

- Undertake a CBA on the two shortlisted options to identify the preferred location.
- Determine an initial list of possible operational structures for the preferred location and identify opportunities for operational efficiencies.
- Set out our recommendations for next steps.

The feasibility study does not include analysis of the tax, state aid or accounting implications of the project, as these were specifically excluded from the detailed scope set out by the SG in the Invitation to Tender (Tend Ref: 536870). These matter should be considered by the SG prior to a final decision being made.

## Appendix B Main assumptions and sources of information

In undertaking our work it has been necessary to make a number of assumptions, reflecting that all the required data was not publically available or considered commercially sensitive.

Our main assumptions are set out in the table below

### Table 32: Main assumptions

| Assumption | Explanation |
|---|---|
| **Locational assessment** | |
| An UDW port is considered to be a port with a capability of 24m draught directly at the quayside. | To reflect the definition set out in the Invitation to Tender for the Feasibility Study. |
| **Market Demand** | |
| UKCS Platforms and Floating Assets analysis<br>All data used has been collated from the OSPAR list of offshore installations (Based on information contained within OSPAR list of offshore inventory, filtered to remove platforms which have already been removed to shore), which was refined by EY to account for certain installations which have already been removed to shore for decommissioning. | To establish the list of platforms and floating assets for inclusion in the market assessment, adjusting for areas where data is not complete. |
| Floating assets are excluded from the market assessment. | All floating assets were removed from the list on the assumption these assets can be towed directly to the shore for disposal and recycling. |
| Small platforms (defined as <8,000tonnes) are excluded from the market assessment | Small platforms are considered less appropriate for reverse engineering heavy left removal and therefore may not require an UDW port capability.<br>8,000 tonnes is used on account of evidence showing the Thames AP (6,488 tonnes) using the Rambiz vessel.<br>This assumption is flexed as part of the base sensitivity testing. |
| Gravity-based concrete structures will be granted derogation by the decommissioning regulation and be allowed to remain in place. This is consistent with the treatment for the Frigg MCP-01 and Brent Alpha platforms | EY makes no representation on whether a particular platform should or will be granted derogation to allow it to remain in place. This adjustment is included in the analysis to allow the prudent assessment of tonnages which may come onshore from decommissioning projects. |
| Platform removal timelines:<br>Where a CoP is not available it is assumed platform will reach CoP 35 years after production commences.<br>Topsides will be removed three years after CoP and a substructure four years after | To forecast a timetable for decommissioning projects. |

| Assumption | Explanation |
|---|---|
| CoP. This assumption was discussed with industry stakeholders who agreed it was a reasonable assumption to make without more detailed analysis or information being available. | |
| The cost per tonne of UKCS onshore recycling and removal is set as £300 per tonne. | This information is considered to be commercially sensitive and accordingly is not publically available. Analysis of OGA figures has allowed to estimate a range of £160 to £305 per tonne. During the market consultation interviewees it was confirmed that £300 per tonne was a sensible estimate, which is also consistent with the OGAs upper range.<br><br>Based on this information we have adopted £300 as a reasonable cost per tonne assumption, recognising that it is at the upper end of the OGA range but is consistent with current market views. |
| Income range for a port set as £35-£50 per tonne. | This information is considered by port authorities to be commercially sensitive and accordingly is not publically available. Industry analysis does not provide published benchmarks of this form of income. Consequently, the lack of data restricts this aspect of the analysis.<br>Assumption is based on a single comparator project available to EY. |
| The total tonnage for suitable platforms includes the weight of the 59 platforms that will require both topside and substructure removal as well as the weight of an additional 5 platforms which will require topside removal only. | To reflect that even if platforms are granted derogation the topside will still require removal. |

Source: EY

We have also relied on the following sources of information within the main body of the report:

- Arch Henderson LLP locational assessment
- Wood Mackenzie upstream data
- Oil & Gas Authority – Table of Current UKCS Installations
- OGA: UKCS Decommissioning 2017 Cost Estimate Report
- OSPAR 98/3, Paragraph 2
- Carbon Trust (2017), Floating Wind Joint Industry Project: Policy & Regulation Appraisal

- Carbon Trust (2015), Floating Offshore Wind: Market and Technology Review https://www.carbontrust.com/resources/reports/technology/floating-offshore-wind-market-technology-review/
- http://www.bbc.co.uk/news/uk-scotland-scotland-business-38720211,
- http://www.bbc.co.uk/news/uk-scotland-north-east-orkney-shetland-42624580,
- http://www.abpmer.co.uk/buzz/decommissioning-of-oil-and-gas-structures-call-for-review/
- http://www.hie.co.uk/growth-sectors/energy/n-rip.html

## Appendix C Location assessment by Arch Henderson LLP

# 185014

# Ernst & Young LLP

# Ultra-deep Water Port Feasibility Study
# Port Assessments

***Rev 3***

## Issue Date: May 2018

**Arch Henderson LLP**
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## Document Control

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### Document Approvals

| Role | Name | Signature | Date |
|---|---|---|---|
| Project Partner | A Kilbride | Alan Kilbride | 04/07/18 |
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## Table of Contents

# 1 Introduction

This report accompanies and provides supporting narrative to a spreadsheet which was developed to capture all relevant marine infrastructure criteria necessary to assess the feasibility of an Ultra-deep water port in the UK. The spreadsheet in question is included in Appendix A.

## 1.1 Description of Study

A list of ports to be considered for use as ultra-deep water ports was provided to Arch Henderson by EY and had input from various parties.

As most selected ports have multiple quays, the most appropriate quay(s) within each port for use as an ultra-deep water quay were identified and these are used in the criteria assessment. This approach results in some ports having multiple quays for consideration, which ensures that the optimum location within a port is considered for use, especially with regards to quay length and depth of water available. If a port, supposed to a specific quay, was used in the assessment then the figures would be misleading as not all quay length is continuous or has the same depth of water available.

A list of assessment criteria was developed between EY and AH to allow for a comparison of quays in relation to their suitability for use as an ultra-deep water quay.

Where port development is underway or planning for expansion is known to be in advanced stages then the developed quay in question has been included in the list so as to capture the future parameters of the quay.

# 2 Criteria

## 2.1 Hard Criteria

Depth below CD (m)

The depth of water below chart datum available adjacent to the quay. Chart datum is approximately the lowest tide level therefore this depth can be considered the minimum depth of water that is always available.

Tidal Range MHWS – MLWS (m)

The mean spring range which represents the difference in height between spring high water and spring low water. This is generally considered the largest tidal range within a typical calendar month.

Quay Length (m)

The length of the quay that is being assessed.

Approach Channel

Details of the approach including the limiting approach depth (m below CD). In a number of cases the limited depth of the approach channel does not permit access of heavy lift vessels.

## 2.2 Soft Criteria

LOA (m)

The overall length of a vessel. In this context the value given refers to the maximum vessel size that can berth at the quay. This could be governed by quay length and also port access.

Area of external laydown ($m^2$)

Represents the approximate land available for laydown within the port that is readily accessible from the quay. In some ports all laydown area is reasonably accessible due to the port layout. However in some ports, normally within a city, some port land is not easily accessed from a particular quay. In this instance the area considered accessible is given. The area given does not consider existing land leases that may be in place.

Distance to NNS Basin (km)

The distance from the port to a location in the NNS basin which has been calculated by averaging the coordinates of all platforms located within the NNS basin which have a fixed base and weigh more than 10,000 tonnes.

Distance to CNS Basin (km)

The distance from the port to a location in the CNS basin which has been calculated by averaging the coordinates of all platforms located within the MFD basin and the CNS basin which have a fixed base and weigh more than 10,000 tonnes.

General Quay Capacity (kN/m$^2$)

The load rating of the quay, excluding any heavy lift zones.

Heavy Load Length (m)

The length of any heavy lift zones on the quay.

Heavy Load Capacity (kN/m$^2$)

The load rating of any heavy lift zones on the quay.

Load ratings have been given in kN/m$^2$. It is the case for a lot of quays that they have been designed to accommodate certain outrigger / crane track loadings which will facilitate specific heavy lifts. Where this information is known, it has been included in the comments column.

# 3 Assessment

## 3.1 Hard Criteria - Stage 1

A common requirement of an ultra-deep water quay is that it should have at least a depth of water adjacent to the quay of -24m CD. This is to accommodate the depth of water required by a heavy lift vessel during a lift. In transit, a fully laden heavy lift vessel may only require 11 to 14m of water depth, however when lifting, the ballast tanks are flooded and the depth of water required can increase to 24m+. Clearly very few of the existing facilities meet this criteria at present therefore the first stage of the assessment was to eliminate quays where it is felt that the extent of works required to upgrade the facility are simply not feasible or would require an exceptional engineering solution.

It should be noted that some heavy lift vessels require water depths of up to 34m to facilitate a lift of 10,000T +, however for the purposes of this report, Arch Henderson have been asked to use a value of 24m as a bench mark for an ultra-deep water port.

As a starting point for this stage of the assessment, any quay with a depth of water less than -9m CD at the quay or with an approach channel depth of less than -9m CD was considered not to be a viable and favoured option for an ultra-deep water quay. To increase a quay depth by 15m would take considerable re-engineering and significant large scale dredging operations to accommodate the deeper berthing pocket. Similarly to significantly deepen the approach channel depths would involve extensive capital and maintenance dredging.

The quays considered non-viable due to the following hard criteria requirements are included in the table below:

- Depth of water at quay of less than -9m CD
- Limiting depth of water in approach channels of less than -9m CD

| | | |
|---|---|---|
| Harland & Wolff | Current | Steel Wharf (DRY) |
| Port of Blyth | Current | South Harbour - West Quay |
| Montrose - Norsea Support Base | Current | Berths 1 & 2 |
| Kishorn | Current | Dry Dock |
| Lyness | Current | Lyness Wharf |
| Aberdeen Harbour | Current | Torry Quay (3-6) |
| Aberdeen Harbour | Current | Albert Quay |
| Aberdeen Harbour | Current | Clipper Quay |
| Leith | Current | Imperial Dock |
| Hartlepool (Able Seaton) | Current | Dry Dock |
| Harland & Wolff | Current | Belfast Quay |

| | | |
|---|---|---|
| Energy Park Fife | Current | EPF One |
| Energy Park Fife | Current | EPF Two |
| Arnish | Current | Materials Quay |
| Harland & Wolff | Current | Belfast Quay |
| Peterhead - ASCO South Base | Current | ASCO South Base |
| Wick | Current | Commercial Quay 1 |
| Hunterston - Platform | Current | Construction Jetty |
| Inverkeithing | Current | Main Quay |
| Ardersier | Current | Main Quay |
| Dundee | Current | New Quayside |
| Swan Hunter Yard | Current | Main Quay |

## 3.2 Practicality Assessment – Stage 2

Of the remaining quays, a high level practicality assessment was undertaken to ascertain the feasibility of increasing the dredge depth to -24m CD at the quay side and of increasing the approach channel depth to -14m CD. This was undertaken using admiralty charts and where applicable, local knowledge of the marine conditions.

The quays that were considered non-viable at this stage are listed below, together with the reasoning:

Greenhead Base – Shetland

The depth of the approach channel to Greenhead base is limited to -9m CD and it would be difficult to significantly increase this due to the width of the channel. Creating a dredge pocket of -24m CD would also be difficult due to the width of the channel.

Peterhead – Smith Quay

Much of Peterhead Port (Peterhead Bay) is dredged to -12m CD and the approach channels are deep. It would therefore be feasible to get fully laden heavy lift vessels in to the Port. Smith Quay however only has a dredge depth of -10m CD adjacent to the quay. To increase this to -24m CD would take a significant extension to the quay and also considerable additional dredging within the port to maintain the lower dredge pocket. This would impact on much of the existing quayside.

Hunterston – Dry Dock

The dry dock at Hunterston is currently at design stage. To increase the depth of the dry dock to -24m CD would require exceptionally increased engineering costs and would also require extensive dredging within a SSSI area.

Hunterston – Platform

The new platform quay at Hunterston is currently at design stage. The make the quay any deeper would require extensive dredging in a SSSI area.

Nigg - Dry Dock

The level of the dry dock is -9.1m CD and to deepen this would require significant construction work. The dry dock is restricted by the fact that it cannot be extended out in to the deep channel.

Aberdeen Harbour South

There has been a large investment into wave modelling at the Aberdeen Harbour South development. Deepening the entrance channel would require significant re-modelling and potentially lead to high swell conditions in the harbour. The result may be a new breakwater for vessels to manoeuvre around or increasing the size of all the rock armour. There is also the logistics of closing the harbour to dredge rock out the inner basin while rebuilding or strengthening the surrounding structures.

Hull Greenport

Hull Greenport is located on the river Humber approximately 40 kilometres from the estuary mouth. The Humber channel is presently dredged to a depth of -8.8m CD and any increase to this would require extensive dredging and maintenance dredging operations.

Hartlepool (Able Seaton)

Quays 10 & 11 are currently dredged to -11m CD however they have been designed for a -15m CD dredge. A greater water depth could be achieved with the construction of a new quay however this would have considerable impact on adjacent infrastructure and ultimately there is no naturally deep water present adjacent to the quay so considerable capital and maintenance dredging would be required.

The Tees approach channel is dredged to approximately -14mCD, however the Seaton-on-Tees Channel which is the direct approach to Able Seaton is only currently dredged to -6mCD (although it has been design for a -9.5m dredge). In order to provide a deeper approach, considerable capital and maintenance dredging would be required.

Great Yarmouth

Extensive development would be required to increase the depth of water at Great Yarmouth. Considerable lengths of the quay structures would need extending and significant dredging would be required within the port which would likely undermine much of the existing infrastructure and the breakwaters.. The Holm Channel is currently the deepest approach to Great Yarmouth with limiting water depths of approximately -11m CD.

The heavy lift vessels have large turning circles and it is very unlikely these can be accommodated at the required depth within Great Yarmouth Port.

### 3.3 Soft Criteria – Stage 3

Following the assessments in stages 1 and 2, the ports listed in the table below are remaining and are therefore considered the most appropriate for an ultra-deep water quay development. It was therefore necessary to assess the soft criteria to identify the Port / Ports which are considered the most viable.

| | | |
|---|---|---|
| Dales Voe - Shetland | After Expected Development | Dales Voe (extension) |
| Dales Voe - Shetland | Current | Dales Voe |
| Invergordon | Current | SB5 |
| Invergordon | After Expected Development | SB5 |
| Invergordon | Current | Queens Dock |
| Hunterston - Ore jetty | Current | Outer Berth |
| Nigg | Current | Quay 3 |
| Redcar Bulk Terminal | Current | Main Quay |

Invergordon

Of the quays at Invergordon, the most suitable will be SB5 following the extension works which are currently underway. The existing dredge depths are not suitable for an ultra-deep water port, however further development could be undertaken to increase the depth of water available. The works would be considerable however it is feasible. The general quay capacity will be $70kN/m^2$ which is considered too small for operation of fully loaded SPMT's, however there are strengthened sections of quayside to facilitate heavy crane lifts and additional strengthening could potentially be carried out.

The Cromarty firth is generally deep and the channel adjacent to Invergordon Port has a water depth of approximately -14m CD.

Post development, there will be approximately $130{,}000m^2$ of laydown available at Invergordon.

The Cromarty Firth is well located to the North Sea basins, with Invergordon located 445 kilometres to the NNS basin and 310 kilometres to the CNS basin.

It should be noted that the depth of the Cromarty Firth is greater adjacent to Nigg Energy Park and for this reason it would be a better engineering solution to develop an UDW quay Nigg rather than Invergordon. As the depth of the channel adjacent to Invergordon is only -14m CD, significant capital and maintenance dredging would be required to develop and maintain the quay. At Nigg natural deep water is present in the channel.

Redcar Bulk Terminal

Redcar bulk terminal has a 300m long quay with a dredge pocket of -17.1m CD. The Tees approach channel is dredged to -14.1m CD. The facility is equipped for bulk handling and there is appropriate processing plant and infrastructure on-site suited to a bulk facility. Whether this facility is compatible with an UDWP would need to be determined. The quay has two ship to shore cranes which it is assumed operate along two strengthen rail positions. It is unknown what the UDL quay load capacity is.

Hunterston – Ore Jetty

The jetty head originally facilitated the operation of a STS crane which ran along two rails beams. The jetty head does therefore not provide a large quay area for offloading, transporting or storage. Much of the jetty is rated at $25kN/m^2$ only, however the two longitudinal beams which served the STS Crane can accommodate a greater load and there is a central strongpoint in the jetty head which could likely accommodate greater loadings.

The jetty head is connected to land via an approach jetty which is not rated to accommodate SPMT loads. This facility would therefore only be suitable for lifting platform sections on to smaller barges located on the inner berth of the jetty head. Alternatively the approach jetty could be strengthened to accommodate SPMT's.

Hunterston is located off the West coast of Scotland with a distance to the NNS and CNS basins in the order of 1,000km. The steaming time to reach the Port from the North Sea is therefore considerably greater than the Ports located on the East and quite possibly economically unviable.

Dales Voe – Shetland

The Dales Voe channel provides water depths of -32m CD which reduces down to approximately - 20m CD in the centre of the channel adjacent to the quay. Therefore if the proposed development works and associated dredging have been carried out, a -24m CD depth of water will be provided at the quay and along the approach channels.

High quay loading capacities ensure that Dales Voe can facilitate heavy lifts, operation of SPMT's and accommodate laydown of heavy components lifted from heavy lift vessels.
The quay is close to both the NNS basin and the CNS basin.

Laydown area is not extensive but at 90,100m$^2$, following the proposed development, there is still sufficient space for landside operations. It is considered that 100,000m$^2$ of additional laydown area could be generated by excavating in to the hill behind the port if required.

Nigg Energy Park

Quay 3 at Nigg Energy Park has a dredge depth of -12m CD adjacent to the quay. The quay could be extended out further in to the Cromarty firth in order to increase the depth of water available. This would be a costly development however it would be feasible without disturbance of adjacent infrastructure.

The Cromarty Firth is deep adjacent to Nigg Energy Park with water depths in the order of -30m CD in the centre of the channel. There is however a straight of shallower water (-14m CD) just before the Cromarty Firth meets the Moray Firth. This should still however be able to accommodate heavy lift vessels in transit.

Existing quay loadings are sufficient to accommodate SPMT loads at 100kN/m$^2$. The Cromarty Firth is well located to the North Sea basins, with Nigg located 440 kilometres to the NNS basin and 305 kilometres to the CNS basin.

The depth of the Cromarty Channel adjacent to the quay at Nigg is greater than the depth at Invergordon. This reduces the required dredging operation associated with upgrading to an ultra-deep water quay. Ultimately the close proximity of natural deep water to the existing quay means there is a sensible engineering solution for creation of an UDW quay at Nigg.

# 4 Conclusion

Based on the port assessments carried out, it is apparent that there are, at present, no facilities which can serve as a conventional Ultra-deep water port.

The assessment has however, identified the two ports which are conceivably best equipped for upgrading to an Ultra-deep water port; Nigg Energy Park and Dales Voe. The governing factors are largely due to the depth of water adjacent to the existing quay. In the case of both of these quays, deep water is naturally present in the approach channels and near to the existing quay edge. By extending the quay, this deep water can be reached to allow for a vertical quay face with a berthing pocket of -24m CD that extents in to a channel of the same depth or deeper.

<u>Dales Voe:</u>

Existing quay capacity of 600 kN/$m^2$ can facilitate very heavy lifts.

Approach channels are very deep.

Plan for development of Ultra-deep water quay in place.

Close proximity to both the NNS and the CNS.

<u>Nigg Energy Park:</u>

Existing quay capacity of 100 kN/$m^2$. Suitable for operation of SPMT's but not necessarily suitable for all requirements of an Ultra-deep water quay. May have to be strengthened.

Approach channel is deep, however there is a straight of shallower water (-14m CD) just before the Cromarty Firth meets the Moray Firth.

No known current plan for development of Ultra-deep water quay.

Close proximity to both the NNS and the CNS basins.

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# Ultra-deep water port feasibility study

Date: 04/07/2018

| Ports | Port Status | Specific Quay | Hard Criteria: Tidal Range MHWS - MLWS (m) | Depth below CD at Quay (m) | Quay Length (m)* | Limiting Approach Channel Depths - below CD (m) | Passes Hard Criteria Requirements (✔/✘) | Soft Criteria: Distance to NNS Basin (km) | Distance to CNS (km) | Max LOA (m) | Area of External Laydown (m²) | General Quay Capacity (kN/m²) | Heavy Load Out Length (m) | Heavy Load Out Capacity (kN/m²) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dales Voe - Shetland | Current | Dales Voe | 2.2 | 12.5 | 127 | 25 | ✔ | 145 | 302 | 330 | 59,600 | 600 | 75 | 600 | 8,000kN/m line load capacity |
| Dales Voe - Shetland | After development (Currently development a proposal only) | Dales Voe (extension) | 2.2 | 24 | 100 | 25 | ✔ | 145 | 302 | 250 | 90,100 | 100 | 100 | 500 | Opportunity to develop a further 100,000m2 of laydown. |
| Greenhead base - Shetland | Current | Greenhead Base | 2.2 | 9.1 | 468 | 9 | ✔ | 145 | 302 | 200 | 160,000 | 50 | 200 | 500 | |
| Peterhead - Smith Quay (Norsea) | Current | Smith Quay | 3.3 | 10 | 120 | 12.5 | ✔ | 370 | 170 | 130 | 60,000 | 30 | 30 | 50 | Deck designed for local point loads of 80T |
| Peterhead - ASCO South Base | Current | ASCO South Base | 3.3 | 5.9 | 486 | 12.5 | ✘ | 370 | 170 | 280 | 8,000 | 27 | | 27 | Small local heavy lift zone. Too small for most cranes. Recent very specific lift. |
| Invergordon | Current | SB5 | 3.7 | 13.5 | 154 | 14 | ✔ | 446 | 310 | 185 | 80,000 | 70 | | 120 | |
| Invergordon | Current | Queens Dock | 3.7 | 12 | 150 | 14 | ✔ | 445 | 310 | 150 | 80,000 | 70 | | 70 | |
| Invergordon | After development (Currently at construction tender) | SB5 | 3.7 | 13.5 | 369 | 14 | ✔ | 445 | 310 | 300 | 130,000 | 70 | | 120 | |
| Aberdeen Harbour | Current | Clipper Quay | 3.7 | 9 | 174 | 6.6 | ✘ | 410 | 195 | | 7,000 | 40 | | 40 | |
| Aberdeen Harbour | Current | Torry Quay (3-6) | 3.7 | 7.5 | 400 | 6.6 | ✘ | 410 | 195 | | 40,000 | 50 | 60 | 100 | 115T outrigger load (1.5m by 1.5m spreader pad) |
| Aberdeen Harbour | Current | Albert Quay | 3.7 | 7.5 | 490 | 6.6 | ✘ | 410 | 195 | | | 40 | | 40 | |
| Aberdeen - (Aberdeen Harbour South) | After development (Currently at construction stage) | East Quay | 3.7 | 10.5 | 400 | 10.5 | ✔ | 410 | 195 | | 125,000 | 150 | | 150 | |
| Aberdeen - (Aberdeen Harbour South) | After development (Currently at construction stage) | North Quay | 3.7 | 9 | 540 | 10.5 | ✔ | 410 | 195 | | 125,000 | 150 | | 150 | |
| Montrose - Norsea Support Base | Current | Berths 1 & 2 | 5.2 | 8.2 | 225 | 5.5 | ✘ | 470 | 235 | 164 | 8,000 | 75 | | 150 | |
| Dundee | Current | New Quayside | 4.8 | 9 | 200 | 6 | ✘ | 530 | 285 | 200 | 145,000 | 200 | | 800 | 80T/m2 ultra heavy lift pad |
| Nigg | Current | Quay 3 | 3.7 | 12 | 370 | 14 | ✔ | 440 | 305 | 241 | 700,000 | 100 | | 100 | 230,000m2 storage adjacent to quay. 700,000 across site |
| Nigg | Current | Dry Dock | 3.7 | 9.1 | 240 | 14 | ✔ | 440 | 305 | 260 | 700,000 | 200 | | | 230,000m2 storage adjacent to quay. 700,000 across site. 122m opening |
| Energy Park Fife | Current | EPF One | 4.8 | 6.5 | 184 | 6 | ✘ | 560 | 310 | 190 | 380,000 | 200 | | | Up to 60T/m2 patch loads) |
| Energy Park Fife | Current | EPF Two | 4.8 | 6.5 | 176 | 6 | ✘ | 560 | 310 | 180 | 380,000 | 200 | | 200 | |
| Inverkeithing | Current | | 5 | 3 | | 1 | ✘ | 580 | 335 | | | | | | |
| Ardersier | Current | | 3.7 | 2.8 | | 14 | ✘ | 445 | | | | | | | Closed in 2001 |
| Kishorn | Current | Dry Dock | 4.6 | 8 | 166 | 30 | ✘ | 625 | 570 | 200 | 100,000 | | 166 | | Dry dock. Lifting positions possibly restricted to dock gate |
| Leith | Current | Imperial Dock | 4.8 | 6.7 | 1396 | 6.7 | ✘ | 570 | 325 | 210 | 90,000 | 50 | | 50 | Port is locked, depth governed by cill height |
| Wick | Current | Commercial Quay 1 | 3.1 | 4.5 | 140 | 4 | ✘ | 335 | 255 | 110 | 6,600 | 75 | | 115 | Proposals to develop Shaltigoe deep water berthing basin |
| Hunterston - Platform | Current | Construction Jetty | 3.5 | 3.8 | 66 | 7 | ✘ | 1025 | 965 | 80 | 404,686 | TBC | | TBC | |
| Hunterston - Platform | After Development (Currently at design stage) | Construction Jetty | 3.5 | 10.5 | 101 | 10 | ✔ | 1025 | 965 | 120 | 404,000 | 150 | 101 | 150 | |
| Hunterston Dry Dock | After Development (Currently at design stage) | Dry Dock | 3.5 | 9.5 | | 10 | ✔ | 1025 | 965 | | 404,000 | | | | Dry Dock |
| Hunterston - Ore jetty | Current | Outer Berth | 3.5 | 20 | 443 | 30 | ✔ | 1025 | 965 | 300+ | 404,000 | 25 | | TBC | Heavy lifts possible from central strongpoint (approx 40m by 20m) |
| Lyness | Current | Lyness Wharf | 3 | 8 | 122 | 14 | ✘ | 335 | 280 | 180 | 310,000 | | | 50 | |
| Arnish | Current | Materials Quay | 4.1 | 6.5 | 100 | 8 | ✘ | 540 | 485 | 100 | 48,000 | 40 | 50 | 100 | 50m general quay can also takie 100T outrigger loads on quay edge |
| Greater Yarmouth (Veolia & Peterson) | Current | Outer Harbour | 2.5 | 10 | 875 | 11 | ✔ | 870 | 570 | 200 | 360,000 | | | | 360,000m2 of land potential? |
| Hartlepool (Able Seaton) | Current | Dry Dock | 4.6 | 6.6 | 350 | 6 (design of 9.5) | ✘ | 655 | 370 | 350 | 300,000 | 100 | 50 | 600 | Dry Dock |
| Hartlepool (Able Seaton) | Current | Quays 10 & 11 | 4.6 | 15 | 306 | 6 (design of 9.5) | ✔ | 655 | 370 | 300 | 300,000 | 200 | 20 | 600 | Seaton Channel currently-6m CD. Design depth -9.5m CD<br>Quays currently at -11m however have been designed for -15m dredge. |
| Harland & Wolff | Current | Belfast Quay | 301 | 6.6 | 432 | 9.3 | ✘ | 976 | 920 | 300 | 60,000 | | | | 40T crane @ 30m radius |
| Harland & Wolff | Current | Steel Wharf (DRY) | 3.1 | 8.5 | 170 | 9.3 | ✘ | 976 | 920 | 160 | 60,000 | | | | Kroll Tower Crane 20T @ 19m radius. |
| Harland & Wolff | Current | Belfast Dock (DRY) | 3.1 | 6 | 270 | 9.3 | ✘ | 976 | 920 | 250 | 60,000 | | | | Gantry Cranes - 2 * 840T. Tower Cranes 2 * 60T. Dock Floor 23,600m2 |
| Hull Greenport | Current | Main River Quay | 6.9 | 11.5 | 420 | 11 | ✔ | 790 | 500 | 350 | 580,000 | 80 | | 100 | |
| Swan Hunter Yard | Current | | 4.3 | 9.1 | | 6 | ✘ | 630 | 345 | | | | | | |
| Redcar bulk terminal (Teeside) | Current | Bulk Terminal | 4.6 | 17.3 | 300 | 14.1 | ✔ | 655 | 370 | 300 | 1,000,000 | | | | Currently used for bulk offload to serve Redcar Steelworks. Served by STS cranes. |
| Port of Blyth | Current | South Harbour - West Quay | 3.3 | 8.5 | 175 | 6 | ✘ | 610 | 330 | 150 | 40,000 | | | | Max 120 T capacity craneage |
| **BENCHMARK** | | | | | | | | | | | | | | | |
| Vats - AF Decom | | Main Quay | | 23 | 182 | | | 325 | 355 | | 68,000 | 100 | | 100 | |
| Stord Kvaener | | Main Quay | | 15 | 149 | | | 258 | 343 | | 63,000 | 150 | | 150 | |

* Details are provided for what is considerd the most appropriare quay / quays in the Port for use as an UDWQ
* Laydown area shown is approximately the total area accessable within the port boundary
* Hard Criteria requirement is considered to be a Quay depth of -9m CD and an approach depth of -9m CD.

## Appendix D Analysis of decommissioning sector

Appendix D provides an overview of the offshore oil and gas UKCS decommissioning market, it covers:

- A breakdown of the current UKCS platforms and floating assets;
- An explanation of the decommissioning process and expenditure forecast; and
- Reviews previous decommissioning projects and future projects that have been submitted to BEIS for approval.

Each area is examined in turn.

### UKCS Platforms and Floating Assets

All data used in this section has been collated from the OSPAR list of offshore installations[24], which was refined by EY to account for certain installations which have already been removed to shore for decommissioning.

### Location of offshore installations

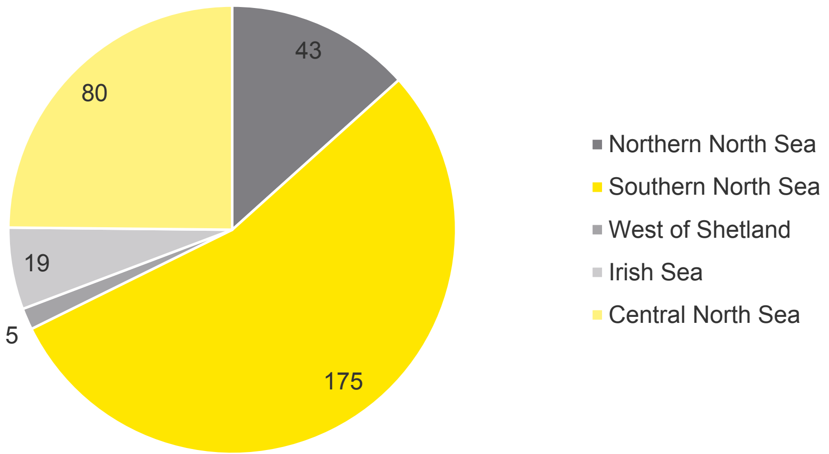
There are 322 offshore installations, being platforms and floating assets, in the UKCS as at 2018:

- 290 of these installations are platforms with 282 being fixed steel structure, while 8 are gravity-based concrete; and
- The remaining 32 are floating assets.

The installations are grouped across five areas, with the number in each area illustrated by the following figure.

[24] Based on information contained within OSPAR list of offshore inventory, filtered to remove platforms which have already been removed to shore.

### Figure 8: Location of UKCS Platforms and Floating Assets



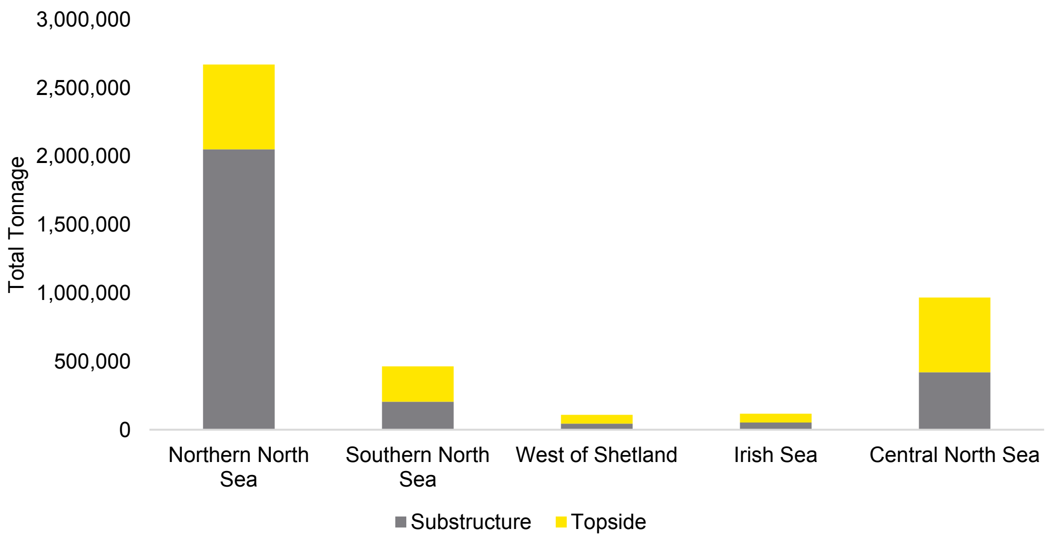

Source OSPAR

With 175 the majority of these installations are therefore located in the Southern North Sea (SNS), followed by CNS with 80 and NNS with 43.

### Platform Tonnage

While the majority of platforms are located in the SNS, these platforms tend to be smaller than those which are located in the CNS and NNS. The average topside weight for a platform located in the SNS is c 1,500 tonnes compared to c18,900 tonnes in the NNS. The total tonnage of platforms sub-structures and topsides located in the UKCS is outlined in the figure below.

**Figure 9: UKCS Platform Weights – including concrete gravity based sub-structures**

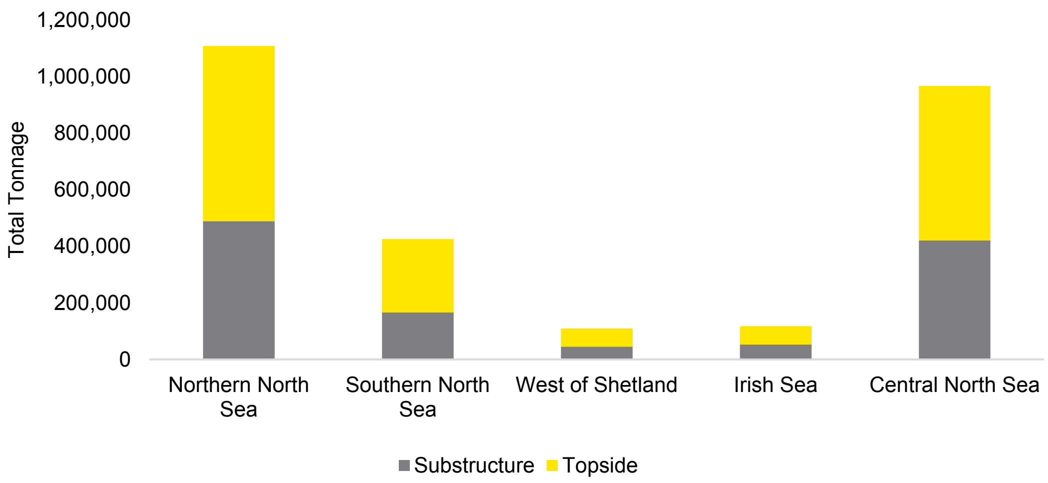



Source OSPAR

In total, platforms in the NNS have significantly greater weight than those in other locations. However, it should be noted that the weights for the NNS include seven sub-structures which are gravity-based concrete. These structures account for 75% of the total sub-structure weight for the NNS. Operators of concrete gravity based sub-structures may be able to apply for derogation from the regulations requiring these parts of the structure to be removed onshore. As such, the total weights presented in the table above, may not directly correlate with the total expected tonnage that will come onshore.

The figure below restates the analysis to remove gravity based sub structures.

**Figure 10: UKCS Platform Weights – excluding concrete gravity based sub-structures**




Source OSPAR

If the concrete gravity based structures are excluded from the analysis, the total weight of all UKCS assets is 1.2m tonnes for sub-structures and 1.6m for topsides. The majority of platform tonnage is located in the NNS and CNS. These two locations account for 78% of UKCS platform sub-structure tonnage and 76% UKCS platform topside tonnage.

## Decommissioning Process

### The need for decommissioning

In the oil & gas field life cycle, operators will eventually reach a point where the continued production at the site becomes uneconomical. There are a number of factors which impact this, but a key issue is the prevailing oil price. In periods of long term low oil prices, operators may find that future returns from the field are outweighed by future costs. Once an operator has made its decision to cease production, it needs to apply to the OGA for approval for a permanent CoP.

Following the decision to permanently cease production at a field, an operator must decide what it will do with the assets located at the field - platforms, substructures, pipelines etc. If possible, assets will be re-used elsewhere or, with the exception of some structures, they must be returned to shore for recycling and disposal.

The requirement for offshore operators to perform asset decommissioning is established in UK and international legislation. The most significant obligations for operators are outlined in OSPAR decision 98/3 (OSPAR 98/3) which prohibits the dumping or leaving wholly or partially in place offshore installations. Derogations to allow certain structures to remain in situ can and have been granted in the past. Where no derogation for the requirements is granted, all offshore assets must be removed and re-used or recycled.

### The decommissioning process

The activities in a decommissioning process are generally allocated to the phases of work outlined in the table below.

**Table 33: Decommissioning work breakdown structure**

| Phase | Description |
|---|---|
| Owner costs | ► Project management core team, stakeholder engagement, studies to support decommissioning programme and scope definition/method development, decommissioning programme preparation and decommissioning programme reporting/close-out (admiralty charts, fish safe etc).<br>► Logistics (aviation and marine), operations team, deck crew, power generation, platform services, integrity management (inspection and maintenance) and operations specialist services e.g. waste management. |
| Well Abandonement | ► Rig upgrades, studies to support well programmes, well suspension (spread rate/duration), wells project management, operations support, specialist services e.g. wireline, conductor recovery, cleaning and recycling, vessel. |
| Topside removal | ► Operations (drain, fluch, purge and vent), physical isolation (de-energise, vent, drain), cleaning, pipeline pigging and waste management.<br>► Engineering-up of temporary utilities (power, air and water), module process/utilities separation, dropped object survey and subsequesnt remedial actions.<br>► Removal preparation (reinforcements and structural separation for removal), removal, vessel operations, sea-fastening, transportation and load-in. |
| Substructure removal | ► Removal preparation, removal, vessel, sea-fastening, transportation and load-in. |
| Subsea Infrastructure | ► Vessel preparation for subsea end-state (remove, trench, rock-dump), sea fastening and transportation, load-in, subsea project management and waste management accounting (tracability of all streams)<br>► Cuttings pile management, oil field debris clearance (500m zone and 200m pipeline corrifor) and over-trawl surveys.<br>► Activities include navigation aids, maintenance and monitoring programme for any facilities that remain. |
| Onshore recycling and disposal | ► Cleaning and handling hazardous waste, deconstruction, re-use, recycling, disposal and waste management accounting (tracability of all streams). |

Source: Oil & Gas UK: Decommissioning Insights 2017, OGA: UKCS Decommissioning 2017 Cost Estimate Report

The feasibility study focuses on the onshore recycling and disposal element of the decommissioning process.

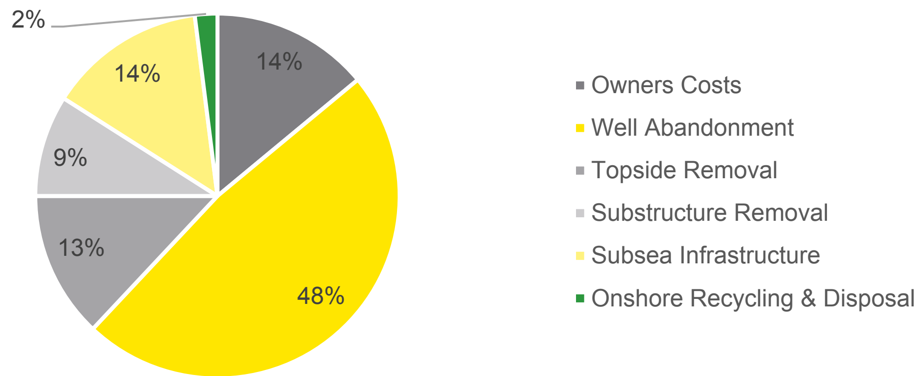
Onshore disposal largely constitutes the work performed by the onshore contractor to dismantle, recycle and where applicable dispose of materials from installations transported onshore.

### Total Decommissioning Costs

Using operator feedback, the OGA has performed a costing exercise to estimate the total costs of decommissioning across the UKCS[25]. The approach used was to determine a probalistic cost estimate which captures the high degree of uncertainty in current decommissioning cost estimates. This provided a cost distribution of £44.5bn to £82.7bn with the OGA using £59.7bn as its base for future cost reduction targets.

The OGA used the information collected from operators to apportion costs to the decommissioning phases, this is illustrated in the following figure:

**Figure 11: Decommissioning costs per WBS**




Source: OGA

This demonstrates:

- Well abandonment is the most significant category of cost accounting for 48% of expected expenditure;
- Topside and substructure removal combined account for 21% of expected future costs; and
- Onshore recycling & disposal is the smallest expected cost category at 2%. When considering this within the context of the decommissioning cost estimates from the OGA, this would amount to expected expenditure between £890m and £1.7bn. According to the OGA's base estimate the cost of onshore recycling and disposal is £1.2bn.

[25] *OGA: UKCS Decommissioning 2017 Cost Estimate Report*

## Decommissioning projects

### Approved decommissioning projects

A number of decommissioning projects have already been completed in the UKCS to date which provide an evidence base of decommissioning methodologies, vessels and disposal yards used in the process. A list of BEIS approved platform decommissioning projects since 2007 onwards is outlined in the table overleaf.

**Table 34: Approved decommissioning projects**

| Platform | Operator at approval | Basin | Topside Weight (Tonnes) | Jacket Weight (Tonnes) | Methodology | Vessel | Disposal Yard |
|---|---|---|---|---|---|---|---|
| Audrey A (WD) | Spirit Energy North Sea Limited | SNS | 1,276 | 1,063 | Not available | | |
| Audrey B (XW) | | SNS | 1,298 | 865 | Not available | | |
| Markham ST-1 | Centrica Production Nederland B.V. | SNS | 1,299 | 1,219 | Reverse Engineer | Stanislav Yudin | Not available |
| Vulcan UR | ConocoPhillips (U.K.) Limited | SNS | 916 | 1,138 | Reverse Engineer | Not available | |
| Viscount VO | | SNS | 330 | 731 | | | |
| Vampire OD | | SNS | 345 | 587 | | | |
| Leman | Shell U.K. Limited | SNS | 1,039 | 566 | Reverse Engineer | Not available | Greater Yarmouth |
| Janice (FPU) | Maersk Oil UK Limited | CNS | 30,600 | n/a | Towed to shore | N/a | Vats, Norway |
| Viking - CD | ConocoPhillips (U.K.) Limited | SNS | 172 | 1,185 | Not available | | |
| Viking - DD | | SNS | 171 | 756 | | | |
| Viking - ED | | SNS | 409 | 752 | | | |
| Viking - GD | | SNS | 164 | 586 | | | |
| Viking - HD | | SNS | 164 | 743 | | | |
| Horne & Wren | Tullow Oil SK Limited | SNS | 90 | 455 | Reverse Engineer | Rambiz | Holland |
| Thames Complex AP | Perenco UK Limited | SNS | 6,488 | 1,100 | Reverse Engineer | Rambiz | Holland |
| Thames Complex AW | | SNS | 2,035 | 950 | | | |
| Thames Complex AR | | SNS | 406 | 600 | | | |
| Brent Delta | Shell U.K. | NNS | 24,200 | n/a | Single lift | Pioneering Able | |

| Platform | Operator at approval | Basin | Topside Weight (Tonnes) | Jacket Weight (Tonnes) | Methodology | Vessel | Disposal Yard |
|---|---|---|---|---|---|---|---|
| | Limited | | | | | Spirit | Seaton, UK |
| Murchison | CNR | NNS | 24,584 | 24,640 | Reverse Engineer and piece small | Thialf | Vats, Norway |
| Miller | BP Exploration (Alpha) Limited | NNS | 28,732 | 18,584 | Reverse Engineer | Saipem 7000 | Kvaerner Stord, Norway |
| Camelot CA | Energy Resource Technology (UK) Limited | SNS | 1,220 | 600 | Reverse Engineer | Rambiz | Holland |
| MCP-01 | Total E&P UK Limited | NNS | 13,500 | 0 | Piece Small and Reverse Engineer | Saipem 7000 | Greenhead Base, Lerwick and Kvaerner Stord, Norway |
| Juliet-D | Shell U.K. Limited | SNS | 2,345 | 910 | Piece small and reverse Engineer | Stanislav Yudin | Swan Hunter, Newcastle |
| Juliet-P | | SNS | 655 | 363 | | | |
| Kilo | | SNS | 2,818 | 816 | | | |
| Lima | | SNS | 1,448 | 836 | Reverse Engineer | | |
| Mike | | SNS | 522 | 637 | | | |
| November | | SNS | 495 | 703 | | | |

Source: https://www.gov.uk/guidance/oil-and-gas-decommissioning-of-offshore-installations-and-pipelines, https://www.ogauthority.co.uk/data-centre/data-downloads-and-publications/infrastructure/

Of the 28 platforms, reverse engineering was used in some form on all occasions except two, highlighting that has been the most frequently used method in the decommissioning industry. For MCP-01, Juliet-D, Juliet-P and Kilo, where piece small decommissioning was used, close out reports for these projects highlighted that the use of piece small led to an increased expenditure.

The majority of decommissioning projects have been on smaller platforms which are based in the SNS. These projects have used smaller crane vessels such as the Stanislav Yudin or the Rambiz. Larger structures, such as the Miller, Murchison and Brent Delta have used UHLVs or SLVs for their decommissioning projects.

The Janice Floating Production Unit was towed to shore using the same methodology employed for the Buchan Alpha floating production vessel. Highlighting that the decommissioning of floating structures does not necessarily require UHLVs or SLVs.

The Brent Delta platform, which was decommissioned via single lift was the second platform to be removed in this manner. It set a world lifting record and effectively demonstrated the methodology as viable for large scale decommissioning projects going forward.

No projects on the list using an UHLV have been taken to the UK for decommissioning. As noted in the MCP-01 close out report:

> ‘Initially the intention was that 100% of the topsides would be sent to Shetland. However, the decision to remove the large modules using the Saipem 7000 and transporting them on deck to shore meant that Shetland could not be used for that purpose as the water depth at quayside is insufficient. In the final accounting some 5400 tons went to Shetland and the remainder – 9600 tons – went to Stord.’

This issue is further highlighted in an article discussing the Miller decommissioning project

> ‘This does require access to an ultra-deepwater quayside and port so that the S7000 can remain ballasted down at transit depth until off-load is complete. Given the current lack of such facilities in the UK, Saipem has opted to take the Miller sections to the Kværner Stord AS yard in Norway for final disposal and recycling’[26].

Thus highlighting vessel operators’ unwillingness to bring decommissioning projects using UHLVs to the UK due to a lack of an UDW port.

As such, from a review of past decommissioning programmes it appears that UHLV will be required to decommission larger structures which tend to be focused in the NNS. For smaller structures, typically found in the SNS, smaller vessels are used, while floating units can be towed to shore.

[26] http://decomnorthsea.com/news/the-miller-decommissioning-project

### Planned decommissioning projects

The table below outlines planned projects which have decommissioning programmes submitted with BEIS for approval.

**Table 35: Planned UKCS decommissioning projects**

| Platform | Location | CoP | Expected topside removal timing | Expected jacket removal timing | Topside weight | Jacket Weight | Decommissioning methods being considered |
|---|---|---|---|---|---|---|---|
| Windemere | SNS | 2016 | 2021 | 2021 | 452 | 382 | Reverse engineer with small HLV |
| Jacky wellhead platform | MF | 2017 | 2022 | 2022 | 663 | 596 | Reverse engineer with small HLV |
| East Brae | NNS | 2020 | 2021 | 2023 | 20,000 | 10,054 | All considered |
| Brae Alpha | NNS | 2021 | 2023-2025 | 2026 | 30,200 | 20,000 | All considered |
| Brae Bravo | NNS | 2018 | 2026-2028 | 2029 | 36,200 | 22,000 | All considered |
| Ninian Northern Platform | NNS | 2017 | 2019-2020 | 2032 | 12,453 | 15,561 | All considered |
| Brent Alpha | NNS | 2014 | 2021 | 2022 | 16,000 | 10,113 | Single lift |
| Brent Bravo | NNS | 2014 | 2020 | N/a | 24,100 | Leave in Place | Single lift |
| Brent Charlie | NNS | tbc | Not before 2025 | N/a | 31,000 | Leave in Place | Considering HLV, SLV or piece small |

Source: https://www.gov.uk/guidance/oil-and-gas-decommissioning-of-offshore-installations-and-pipelines

Of the planned decommissioning projects, those with smaller tonnages have outlined plans to use smaller HLVs, which is in line with past projects.

The Brent Alpha and Brent Bravo platforms will use the single lift removal method which is in line with the method used on the Brent Delta field. All other decommissioning programmes outline they will select the appropriate method following a tendering process with removal operators. As such, there does not appear to be a clear correlation between the characteristics of a platform and the preferred decommissioning method.

For the large platforms, topside removal is expected to be between one and ten years following CoP with substructures generally being removed the following year. Even within these expected timeframes, operators often highlight in decommissioning programmes that topside removal could take place over a three to four year window of opportunity. As such there is no clear definition of when a topside could be removed and may ultimately take place when market and other conditions prove favourable for the operator.

### Decommissioning Market Summary

The key findings from the decommissioning market overview are as follows:

- There are over 300 platforms in the UKCS. While the majority are located in the SNS, the largest structures are based in the CNS and NNS.
- The overall expected expenditure on UKCS platform decommissioning is estimated at £59.7bn, with onshore recycling and disposal activities estimated to account for £1.2 billion, 2%, of it.
- Reverse engineer decommissioning has been frequently applied, either for the full removal or as part of the process of completed decommissioning projects. Large platforms using this method require the use of an UHLV. Due to a lack of UDW at UK ports, all projects using an UHLV have been taken to Norway, where there are ports with UDW.
- The successful completion of the Brent Delta platform decommissioning using SLV effectively demonstrated the methodology as viable for large scale decommissioning projects going forward.
- Going forward, there is expected to be competition for each platform from existing UHLVs and SLVs, with the potential for new solutions to enter the market due to the long timespan of the remaining platforms.
- Selection of the removal method is likely to be driven by a number of factors such as cost, complexity of the platform, operator confidence in the vessel operator, health and safety considerations and other requirements.

## Appendix E Analysis of new lifting vessels

Appendix E provides a review of publicly available information on new vessels entering the market. The vessels considered as part of this report are:

- Amazing Grace (Allseas);
- Twin Marine Lifter (Shandong Twin Marine);
- Sleipner (Heerema); and
- Serooskerke, Walcheren and Zeelandia (O.O.S International).

### Amazing Grace (Allseas)

Allseas' is planning to build a sister vessel for the existing Pioneering Spirit: the Amazing Grace. Reuter's reported new vessel is expected to be significantly larger than its sister vessel with a reported length/width of 400m/160m compared to 382m/124m on the Pioneering Spirit. The Amazing Grace is expected to have a lift capacity of 72,000 tonnes allowing it to manage the largest structures in the North Sea[27].

The Amazing Grace is still at concept phase with no clear timetable for introduction to market. The Reuter's report from February 2018 highlighted that the Allseas' chief executive officer had stated that an investment decision could come in three years.

Construction on the Pioneering Spirit took place over 2011 to 2014 in DSME shipyard in South Korea. It then transferred to Rotterdam for installation, commissioning and testing of the topsides lift system. It departed the shipyard in early August 2016 to perform testing before performing the first single-lift decommissioning project - the Yme platform in Norway - later that month. Given the expected size of the Amazing Grace and its likely high day rate, it is expected to target the largest decommissioning projects in the North Sea and possibly elsewhere around the world.

Assuming an investment decision is made in three years (early 2021) and a similar construction, installation, commissioning and testing timeframe to the Pioneering Spirit (five years), the Amazing Grace could be operating in the decommissioning market by 2026. However, given the uncertainty on timescales it is possible that the Amazing Grace could enter the market before this point, after it or potentially not at all.

### Twin Marine Lifter (Shandong Twin Marine)

In performing topside removals, the Twin Marine Lifter (TML) concept involves two DP3 semi-submersible vessels which set-up on either side the installation

[27] https://www.reuters.com/article/us-oil-gas-decommissioning/switzerlands-allseas-plans-worlds-largest-construction-vessel-idUSKBN1FR26O

and use multiple heavy duty cranes to remove the platform in one lift. The TML would have a maximum lifting capacity of 34,000 tonnes[28].

Shandong Twin Marine (STM), a joint venture (JV) between Twin Marine Heavylift AS and Shandong Shipping Corporation, is the owner of the TML concept. When the JV was formed, it outlined plans to offer operators a fixed price for decommissioning work which would be underwritten by insurers. STM expected this would be an attractive offer for operators concerned about the cost uncertainty of the decommissioning process[29].

STM originally announced that the TML construction would commence in 2014 for a 2017 delivery. However, this has been delayed. In November 2016, Shandong Twin Marine placed an order with shipbuilder CIMC Raffles for the design and construction of three semi-submersible vessels. Two will be used for platform decommissioning as described above, and the other for transporting other parts from the decommissioning process. It is expected that the TML would be a potential candidate for performing decommissioning projects on topsides below 34,000 tonnes.

No press announcements have provided an update on this project and an expected delivery date. Given the uncertainty in the market it is not possible to forecast when the vessel will enter the market or whether it will be constructed at all. .

**Sleipner (Heerema)**

Heerema Marine Contractors are currently developing Sleipner: a semi-submersible crane vessel. It will be equipped with two cranes of 10,000 metric tonnes lifting capacity each. Its reinforced deck area 220m long by 102m wide will make it the largest crane vessel in the world[30].

Sleipner is intended to install and remove substructures and top sides as well as for the installation of foundations, moorings and other structures in deep water. An interview with the Sleipner Project Director recently outlined its capabilities

> "The size of the vessel's deck allows the crane, operating in revolving mode, to pick up single or multiple modules from the platform location; put these on the deck; then take the jacket in the cranes and sail to the disposal yard in a single trip"[31].

The vessel development is progressing in line with schedule and is expected for delivery in early 2019. In 2017, Sleipner won three contracts[32]:

[28] https://www.offshoreenergytoday.com/shandong-places-order-for-three-decommissioning-vessels/
[29] https://worldmaritimenews.com/archives/133800/twin-marine-heavylift-teams-up-with-shandong-shipping/
[30] https://hmc.heerema.com/fleet/sleipnir/
[31] https://www.offshore-mag.com/articles/print/volume-77/issue-4/engineering-construction-installation/sleipnir-raising-the-bar-for-offshore-platform-lifts.html
[32] https://hmc.heerema.com/news-media/news/heerema-awarded-first-contracts-for-its-new-crane-vessel-sleipnir/

- Transportation and installation services associated with the Leviathan Production Platform in the Mediterranean Sea, from Noble Energy Mediterranean Ltd;

- Transportation and installation services for the new production and living quarters as part of the Tyra Future project, from Mearsk Oil; and

- Offshore lifting services in the Tyra East and West complexes related to the replacement of the wellhead and riser platforms.

The introduction of the Sleipner vessel will increased the supply of HLVs from 2 to 3. This could increase competition in the market, potentially lowering day rates and increasing the reverse engineering competitiveness with single lift options.

**Serooskerke, Walcheren and Zeelandia (O.O.S International).**

O.O.S International currently have two semi-submersible heavy lift crane vessels under construction, the OOS Serooskerke and the OOS Walcheren. The identical vessels are multi-purpose, heavy lifting vessels which can perform decommissioning work, windmill installations, offshore accommodation as well as modular plug and abandonment. The vessels feature a hotel capacity which can accommodate 750 people, two heavy lift Huisman cranes with a total tandem lift capacity of 4,400t with subsea lifting and active compensation capability.

Both vessels are currently under construction in China and are due for delivery in mid-2019 (Serooskerke) and early 2020 (Walcheren).

OOS International has also signed a MOU for the design and construction of another UHLV, the OOS Zeelandia, which it outlines will be the biggest in the world if constructed. Initial plans outline that the vessel will have two cranes, each with a 12,000 tonne lifting capacity and a transit speed of 15.4 knots. [33]

[33] https://www.maritime-executive.com/article/design-of-worlds-largest-crane-vessel-underway#gs.mmbG57E

## Appendix F Analysis of floating wind market

Appendix F provides a high level review of the potential multi-use opportunities available to an UDW port within the floating offshore wind sector.

When performing this review, we undertook a desktop exercise of publicly available research material, with particular focus on the reports shared by the Scottish Government and its partners.

### The technology

To date the fixed bottom foundation technology is the preferred technology for offshore wind farms, with 3.15 GW of new capacity being installed and total installed capacity reaching 15.78 GW in Europe alone by the end of 2017[34]. Of that new capacity over 50% has been installed in the UK, solidifying the North Sea's position as a leading destination for offshore wind development.

However, as the number of developments increase fewer shallow water near shore sites will remain, necessitating the development of ever larger foundations and therefore increasing costs. This creates an opportunity for floating offshore wind, which could exploit the stronger winds in near and far shore deep water locations and deliver high volumes of low carbon electricity at a competitive cost of energy. The technology, however, is still in the early stages as no large scale commercial projects have been deployed to date.

Approximately 40 different floating wind concepts have been identified by the Carbon Trust as being in various stages of development[35]. These concepts can be grouped into three dominant platform types, but no one technology been identified as preferred to be deployed at scale. The three dominant technologies consist of the following:

- **Semi-submersible platform** - Is a buoyancy stabilised free surface structure, which is anchored to the seabed with catenary mooring lines. Its low draft allows for flexibility to different site conditions, but is often heavy requiring a high steel mass to maintain stability;
- **Spar platform** - The structure is stabilised by a cylindrical ballast, which gains its stability from having the heavier parts beneath the water, while the upper parts are lighter. The design provides stability and is relatively easy to fabricate. However, it requires a large draft which may create challenges during assembly, transportation and installation; and
- **Tension-leg platform** - It is a tension stabilised structure that is anchored to the seabed with tensioned mooring lines. Its design allows for a lighter structure and a shallower draft, but may present higher operational risk and limit locations due to specific requirements for soil conditions at site.

[34] https://www.theguardian.com/environment/2018/feb/06/uk-built-half-of-europes-offshore-wind-power-in-2017
[35] Carbon Trust (2018), Floating Wind Joint Industry Project – Phase 1 Summary Report

### The opportunity

Floating offshore wind is an emerging low carbon energy technology, which has been identified as one of the leading technology options to support the UK government's ambition of decarbonising the energy system. Current industry aspirations are for global wind farm deployment to reach 8GW by 2025 and 30GW by 2030[36]. However, the Carbon Trust has noted that 12GW of installed capacity by 2030 would be more realistic, with a number of industry participants supporting this view[37]. The UK is well positioned to become a world leader in floating wind as it already is one of the leading destinations for fixed bottom wind farm development. Further, the UK also benefits from a skilled supply chain that has the relevant experience and capabilities gained from operating in the shipbuilding and O&G sectors.

Scotland, in particular, is considered well suited for floating offshore wind due to its high wind speeds, abundant near-shore deep water sites and access to a skilled supply chain. In 2014 Marine Scotland published the "Regional Locational Guidance" document, which identified seven areas in Scotland that are well suited as test sites for deployment and potential commercial expansion of floating wind farm project[38]. These include the following locations:

- North of Minch
- West of Colonsay
- West of Barra
- South East of Aberdeen (Dogs Hole, Kincardine)
- North East of Aberdeen (Buchan Deep, Peterhead)
- East of Shetland
- East West of Orkney

Buchan Deep is already home to Hywind Scotland, a 30 MW wind farm which is the first pre commercial array deployment[39]. Further, Dogs Hole has been chosen as the location for the Kincardine Offshore Windfarm Project, a 7 turbine floating windfarm with maximum capacity of 50 MW[40]. Even though, activity in Scotland is growing there is concern that it may be constrained by policy uncertainty resulting from the closure of Renewable Obligations Certificates in October 2018. This will reduce the funding support available and result in floating offshore wind projects having to compete with more established technologies, such as fixed bottom wind, for Contract for Difference feed in tariffs.

### Hywind Scotland

The Hywind project has been developed by Equinor, formerly Statoil, in partnership with Masdar and is one of the most mature floating wind farm projects. Initially a 2.3 MW prototype was deployed off the coast of Norway in

[36] Carbon Trust (2018), Floating Wind Joint Industry Project – Phase 1 Summary Report
[37] Carbon Trust (2018), Floating Wind Joint Industry Project – Phase 1 Summary Report
[38] Marine Scotland (2014), Deep Water Floating Wind Technologies – Draft Regional Locational Guidance http://www.gov.scot/Topics/marine/marineenergy/Planning/DRLG
[39] https://www.equinor.com/en/what-we-do/hywind-where-the-wind-takes-us.html
[40] https://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK2H

2009. The prototype had a traditional spar-buoy structure and a draft of 100m[41]. Following extensive research and the success of the prototype, Equinor elected to scale up the device to 6 MW and install a pre-commercial array of 5 turbines off the coast of Scotland. The wind farm became operational in October 2017 off the coast of north east Aberdeen.

In comparison to the prototype the new devices were not only more powerful, but also had a smaller draft of 78m. Further, Equinor claim to have reduced the cost of the device by 60-70%[42]. The project was delivered through a pan European approach, with the initial spar and tower fabrication taking place in Spain. Works relating to the electrical systems interface were performed by UK based Balfour Bettie and the suction anchors were prepared at the Nigg Energy Park by Global Energy Group. The final upending and turbine assembly was executed at an UDW Port in Norway. This was required so the S7000 vessel could transport the wind turbine generators from the quay onto the floating support structures. After which, the fully assembled structures were towed to site, 30km off Peterhead, Scotland[43].

The total amount invested was approximately NOK 2 billion or £200m, with the project estimated to generate enough energy to power over 20,000 homes[44]. Over the first three months of operation the windfarm achieved average capacity factors of 65% which, as noted by the Carbon Trust, proves the commercial viability of the project[45].

**Port availability**

In section 6.3.1 we identified the key port requirements for floating wind farm development. Within the UK and Scotland in particular there are a number of facilities that could be used for the fabrication and/or installation of floating wind platforms. The National Renewable Infrastructure Plan[46] published by the HIE and SE identified 11 locations in Scotland that offered the greatest potential for attracting and facilitating floating wind projects.

A separate report by the Carbon Trust[47], analysed the ability of Scottish port facilities to accommodate all three dominant platform types. The analysis identified that two facilities, Nigg Energy Park and the Port of Peterhead, were already suitable to accommodate all three technologies. In addition, the report also found that conditional upon some minor to moderate infrastructure upgrades a further twelve facilities had the potential to accommodate all three platform types.

[41] Carbon Trust (2015), Floating Offshore Wind: Market and Technology Review https://www.carbontrust.com/resources/reports/technology/floating-offshore-wind-market-technology-review/
[42] https://www.equinor.com/en/what-we-do/hywind-where-the-wind-takes-us.html
[43] https://www.equinor.com/en/what-we-do/hywind-where-the-wind-takes-us.html
[44] https://www.equinor.com/en/news/hywindscotland.html
[45] Carbon Trust (2018), Floating Wind Joint Industry Project – Phase 1 Summary Report
[46] http://www.hie.co.uk/growth-sectors/energy/n-rip.html
[47] Carbon Trust (2017), Floating Wind Joint Industry Project: Policy & Regulation Appraisal

### Summary

Floating offshore wind is an emerging low carbon technology that has the potential of becoming one of the leading technologies for decarbonising the energy system. Nonetheless, the technology is still in the early stages, with considerable research and work still required prior to the commissioning of the first large scale commercial projects. However, the opportunity is there for the UK to become the preferred location for floating offshore wind projects. Attracting floating wind projects will not only require favourable geographical features, but also an experienced supply chain and suitable port infrastructure.

There are a number of requirements that UK port will have to meet to accommodate floating wind projects, such as sufficient depth of draft and width of port entrance. In spite of those requirements solely in Scotland there are two ports that at present can accommodate floating wind projects using any of the three dominant platform types. A further twelve being suitable after undergoing minor or moderate infrastructure upgrades.

As such, there does not appear to be a specific need for an UDW port to support the floating offshore wind industry.

## Appendix G Market consultation questions

Appendix G sets out the questions submitted to the organisations participating in the market consultation covering:

- Platform operators
- Vessel operators
- Onshore contractors
- Floating wind
- Tidal power.

The questions in each area are set out in the tables below.

**Table 36: Interview questions - platform operators**

| No | Question |
|---|---|
| 1 | What contracting options would you consider going forward for decommissioning programmes? E.g. EPRD (Engineer, Procure, Remove and Disposal). Is there any other contracting strategy you would consider? |
| 2 | Would you consider including multiple platform decommissioning projects in the one contract or do you expect to perform this on a platform by platform basis? |
| 3 | What are the key criteria you consider when selecting a removal and disposal contract? |
| 4 | How attractive would a UK UDW Port be for decommissioning and other projects, and how could it benefit your business? Would a UK UDW Port have any influence on contracting? |
| 5 | Would there be any particular offshore capex or opex activities which an ultra-deep water port would support? What types of activities do you expect these to be and where do you see these happening in the future. |
| 6 | Do you have an opinion on what would be your preferred location for a UK UDW port? Please give reasons |
| 7 | How many platform removals would you look to perform in any one year? |
| 8 | How attractive is the use of the single-lift method for your future decommissioning projects? Are any decommissioning methods optimal over others for your specific platforms? |
| 9 | What impact do you expect new vessels will have on the demand for particular decommissioning methods? |
| 10 | What do you view as the key factors which will impact on the market demand for specific decommissioning methods in the future? |
| 11 | Would you consider any investment towards developing a UK UDW port? |
| 12 | Would you be willing to guarantee any throughput for a UK UDW Port in order to make it happen? |

Source: EY

### Table 37: Interview questions - vessel operators

| No | Question |
|---|---|
| 1 | What are the key criteria you consider in looking for a port to contract with? |
| 2 | What are the key criteria you look for when considering an onshore disposal contractor? |
| 3 | How attractive would a UK UDW Port be for decommissioning projects and why? What factors would make it most attractive? |
| 4 | Do you have any preference on the location of a UK UDW port? |
| 5 | Do you expect all future removal and disposal decommissioning activity being undertaken through EPRD contracts? Is there any other contracting strategy you expect to play an important role in the future? |
| 6 | Please talk us through the onshore disposal value streams which derive from an EPRD contract? (i.e. how are ports/onshore disposal contractors paid) |
| 7 | What activities beyond decommissioning do you expect a UK UDW port could support? What specific port requirements would these activities need? |
| 8 | Are there specific decommissioning projects which you would be targeting? Are there any projects you have recently won? What are their timescales for topside/jacket removal? Would you consider any projects too small or too large for your vessel to bid for? |
| 9 | Have you been approached with any technical innovations which would support the reverse engineer decommissioning without the need to transfer modules direct to the quayside? What impact do you see these as having on the need for an UDW Port? |
| 10 | What impact do you expect single-lift vessels would have on the demand on reverse engineer decommissioning in the future? What impact due you expect to see of Amazing Grace and Shandong Twin Marine entering the market? |
| 11 | How long do you expect your current fleet to continue to operate for? |
| 12 | Would you consider any investment towards developing a UK UDW port? |
| 13 | How many large decommissioning projects do you expect your vessel could complete in one year? What would be the factors that could impact on this? |
| 14 | What are the key lessons learned from projects completed to date? What would improve the experience? |
| 15 | Do you have any case studies available for a recently completed projects which highlight issues faced at the port and how you could be better accommodated? Do you have any cost information outlining the impact of issues faced? |

Source: EY

### Table 38: Interview questions - onshore contractors

| No | Question |
|---|---|
| 1 | Going forward, do you see all large decommissioning projects being procured through an EPRD contract? Are there other contracting strategies which you see being explored and would consider bidding through? |
| 2 | Can you talk us through the revenue and expenditure areas from onshore decommissioning? (e.g. yard income, disposal income, etc). Are these paid on a day rate, per tonne, or other basis? |
| 3 | How attractive do you expect a UK UDW Port be for decommissioning projects and how could it benefit your business? |
| 4 | What are the important characteristics for a port to attract onshore disposal activities? |
| 5 | What non-decommissioning projects do you believe an UDW port could support? (Floating offshore wind, O&G Capex/Opex) |
| 6 | What are the important characteristics for a multi-use port? |
| 7 | Are you aware of any technical innovations which would support the reverse engineer decommissioning without the need to transfer modules direct to the quayside with a HLV? |
| 8 | What would be your timeframe for deconstructing a large topside and jacket? (assume 20,000 tonnes for topside and 10,000 tonnes for jacket) |
| 9 | What do you view as the key factors which will impact on the market demand for specific decommissioning methods in the future? |
| 10 | What impact do you expect single-lift vessels will have on the demand on reverse engineer decommissioning in the future? |
| 11 | Would you consider any investment towards a UK UDW port? |
| 12 | Do you have any case studies for recent decommissioning projects which have been completed without an UDW port? How could these have been improved through the use of an UDW port? |

Source: EY

### Table 39: Interview questions - renewables (floating wind)

| No | Question |
|---|---|
| 1 | At what stage is the floating offshore wind market at the moment? |
| 2 | What do you see as the future demand/potential for floating offshore wind farms? |
| 3 | When do you see the first large scale commercial projects being commissioned? |
| 4 | What are the key developments happening in the market and how does this impact on the structures being developed? Which of the most common platform types do you think will be the preferred for commercialisation? |
| 5 | What are the key locational characteristics required for the development of an offshore wind farm? Does Scotland meet those characteristics? |
| 6 | What are the key criteria you consider in looking for a port to contract with? |
| 7 | Would an UDW port support the future development of offshore floating wind farms? |
| 8 | Could you tell us more about the Hywind project? Was a heavy lift vessel used to assemble the turbines? |
| 9 | Do you think an UDW port could support other renewable energy activities such as tidal or wave energy? |

Source: EY

### Table 40: Interview questions - renewables (tidal)

| No | Question |
|---|---|
| 1 | What are the key criteria you consider in looking for a port to contract with? |
| 2 | Would an UDW port support the future development of tidal energy projects? |
| 3 | Could you tell us more about your recent project? Has the project necessitated the use of heavy lift vessels? |
| 4 | Do you think an UDW port could support other renewable energy activities such as fixed and floating wind or wave energy? |
| 5 | At what stage is the tidal energy market at the moment? |
| 6 | What do you see as the future demand/potential for tidal energy projects? |
| 7 | When do you see the first large scale commercial projects being commissioned? |
| 8 | What are the key locational characteristics required for the development of tidal projects? Is the UK an attractive location for tidal development? |
| 9 | Are there any key developments or factors that could deter the development of tidal energy projects in the UK? |

Source: EY

## Appendix H List of candidate platforms

| ID | Country | Name | Location (blocks) | Latitude | Longitude | Water depth (m) | Operator | Production start | Current Status | Primary production | Category | Function | Weight sub-structure (tonnes) | Weight topside (tonnes) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UK677 | United Kingdom | Alba northern | 16/26 | 58.058692 | 1.081275 | 140 | Chevron | 1994 | Operational | Oil | Fixed steel | Above water production | 17000 | 25534 | |
| UK678 | United Kingdom | Alwyn north NAA | 3/9 | 60.809278 | 1.683611 | 125 | Total E&P | 1987 | Operational | Oil | Fixed steel | Above water production | 18500 | 21400 | |
| UK679 | United Kingdom | Alwyn north NAB | 3/9 | 60.810117 | 1.743450 | 125 | Total E&P | 1987 | Operational | Oil | Fixed steel | Above water production | 14500 | 15000 | |
| UK680 | United Kingdom | Andrew | 16/28 | 58.047531 | 1.404322 | 116 | BP | 1996 | Operational | Oil | Fixed steel | Above water production | 6500 | 10200 | |
| UK682 | United Kingdom | Armada Platform | 22/5 | 57.957433 | 1.845906 | 88 | BG | 1997 | Operational | Gas | Fixed steel | Above water production | 6120 | 10548 | |
| UK683 | United Kingdom | Auk A | 30/16 | 56.403833 | 2.182500 | 84 | Repsol-Sinopec | 1975 | Operational | Oil | Fixed steel | Above water production | 3414 | 8093 | |
| UK531 | United Kingdom | Beatrice AD | 11/30 | 58.115303 | -3.085969 | 45 | Repsol-Sinopec | 1981 | Operational | Oil | Fixed steel | Above water production | 3225 | 8167 | |
| UK752 | United Kingdom | Beryl A | 9/13 | 59.545686 | 1.537903 | 119 | Apache Beryl | 1976 | Operational | Oil | Gravity-based concrete | Above water production | 200000 | 32500 | |
| UK685 | United Kingdom | Beryl B | 9/13 | 59.610342 | 1.512742 | 119 | Apache Beryl | 1976 | Operational | Oil | Fixed steel | Above water production | 13250 | 21800 | |
| UK687 | United Kingdom | Brae A | 16/7 | 58.692778 | 1.281944 | 112 | Marathon | 1983 | Operational | Oil | Fixed steel | Above water production | 18600 | 38000 | |
| UK689 | United Kingdom | Brae B | 16/7a | 58.792364 | 1.347415 | 102 | Marathon | 1988 | Operational | Condensate | Fixed steel | Above water production | 18900 | 42000 | |
| UK690 | United Kingdom | Brae east | 16/03a | 58.794318 | 1.350303 | 113 | Marathon | 1993 | Operational | Condensate | Fixed steel | Above water production | 9308 | 18500 | |
| UK754 | United Kingdom | Brent Charlie | 211/29 | 61.206256 | 1.750936 | 142 | Shell | 1976 | Operational | Oil | Gravity-based concrete | Above water production | 287542 | 29846 | |
| UK693 | United Kingdom | Brittania Platform | 16/26 | 58.048631 | 1.138747 | 148 | ConocoPhillips | 1998 | Operational | Condensate | Fixed steel | Above water production | 20000 | 18500 | |
| UK695 | United Kingdom | Bruce PUQ | 9/8a | 59.742778 | 1.673333 | 118 | BP | 1993 | Operational | Condensate | Fixed steel | Above water production | 9600 | 20339 | |
| UK975 | United Kingdom | Buzzard Production Platform | 20/06 | 57.814200 | 0.974331 | 97 | Nexen | 2006 | Operational | Oil | Fixed steel | Above water production | 5569 | 10950 | |
| UK976 | United Kingdom | Buzzard Utilities Platform | 20/06 | 57.813522 | 0.975981 | 97 | Nexen | 2006 | Operational | Oil | Fixed steel | Above water production | 5130 | 9651 | |
| UK933 | United Kingdom | Clair Phase 1 Platform | 206/8 | 60.698333 | 2.548333 | 130 | BP | 2004 | Operational | Oil | Fixed steel | Above water production | 9010 | 16360 | |
| UK1155 | United Kingdom | Clair Ridge DP Platform | 206/8a | 60.763167 | 2.592472 | 141 | BP | 2016 | Operational | Oil | Fixed steel | Above water production | 19742 | 27776 | |
| UK1156 | United Kingdom | Clair Ridge QU | 206/8a | | | 139 | BP | 2016 | Operational | Oil | Fixed steel | Above water production | 8705 | 16122 | |
| UK697 | United Kingdom | Claymore A | 14/19 | 58.449318 | -0.253607 | 111 | Repsol-Sinopec | 1977 | Operational | Oil | Fixed steel | Above water production | 17000 | 18000 | |
| UK699 | United Kingdom | Clyde | 30/17b | 56.452778 | 2.288333 | 81 | Repsol-Sinopec | 1987 | Operational | Oil | Fixed steel | Above water production | 10400 | 17900 | |
| UK700 | United Kingdom | Cormorant north | 211/21a | 61.240556 | 1.149444 | 160 | TAQA | 1982 | Operational | Oil | Fixed steel | Above water production | 20052 | 15290 | |
| UK756 | United Kingdom | Cormorant south A | 211/26a | 61.125000 | 1.127778 | 155 | TAQA | 1979 | Operational | Oil | Gravity-based concrete | Above water production | 294655 | 25600 | |
| UK548 | United Kingdom | Douglas DP | 110/13b | 53.571972 | 3.684139 | 33 | ENI | 1996 | Operational | Oil | Fixed steel | Above water production | 2500 | 9100 | |
| UK702 | United Kingdom | Dunbar | 3/14a | 60.810117 | 1.735242 | 127 | Total E&P | 1994 | Operational | Oil | Fixed steel | Above water production | 9500 | 9500 | |
| UK757 | United Kingdom | Dunlin A | 211/23a | 61.274289 | 1.595847 | 151 | Fairfield | 1978 | Closed down | Oil | Gravity-based concrete | Above water production | 228611 | 19350 | |
| UK703 | United Kingdom | Eider | 211/16a | 61.423056 | 1.262222 | 159 | Taqa Bratani | 1988 | Operational | Oil | Fixed steel | Above water production | 17100 | 11200 | |
| UK904 | United Kingdom | Elgin PUQ platform | 22/30c | 57.011753 | 1.838911 | 100 | Total | 2001 | Operational | Condensate | Fixed steel | Above water production | 9000 | 26500 | |
| UK705 | United Kingdom | Everest north | 22/9 | 57.246667 | 1.771111 | 88 | BG | 1993 | Operational | Condensate | Fixed steel | Above water production | 4500 | 12000 | |
| UK707 | United Kingdom | Forties FA | 21/10 | 57.731947 | 0.972719 | 106 | Apache | 1975 | Operational | Oil | Fixed steel | Above water production | 12310 | 10551 | |
| UK708 | United Kingdom | Forties FB | 21/10 | 57.749303 | 0.915058 | 106 | Apache | 1975 | Operational | Oil | Fixed steel | Above water production | 14152 | 10551 | |
| UK709 | United Kingdom | Forties FC | 21/10 | 57.726953 | 0.847428 | 106 | Apache | 1975 | Operational | Oil | Fixed steel | Above water production | 14152 | 10551 | |
| UK710 | United Kingdom | Forties FD | 21/10 | 57.722403 | 0.903117 | 106 | Apache | 1975 | Operational | Oil | Fixed steel | Above water production | 14152 | 10551 | |
| UK711 | United Kingdom | Forties FE | 22/6 | 57.716114 | 1.032222 | 106 | Apache | 1975 | Operational | Oil | Fixed steel | Above water production | 8000 | 13700 | |
| UK714 | United Kingdom | Fulmar A | 30/16 | 56.493639 | 2.154631 | 83 | Repsol-Sinopec | 1982 | Operational | Oil | Fixed steel | Above water production | 12400 | 24000 | |
| UK716 | United Kingdom | Gannet A | 21/25 | 57.184376 | 0.998425 | 94 | Shell | 1993 | Operational | Oil | Fixed steel | Above water production | 7750 | 12350 | |
| UK1157 | United Kingdom | Golden Eagle PUQ Platform | 20/1 | 58.070525 | 1.060331 | 105 | Nexen | 2014 | Operational | Oil | Fixed steel | Above water production | 6200 | 11500 | |
| UK717 | United Kingdom | Harding Platform | 9/23 | 59.279444 | 1.516111 | 111 | Taqa Bratani | 1996 | Operational | Oil | Fixed steel | Above water production | 88000 | 23000 | |
| UK718 | United Kingdom | Heather A platform | 2/5 | 60.953611 | 0.940000 | 144 | Enquest Heather | 1978 | Operational | Oil | Fixed steel | Above water production | 18700 | 12200 | |
| UK720 | United Kingdom | Judy Riser Platform | 30/7 | 56.824056 | 2.385278 | 71 | ConocoPhillips | 1995 | Operational | Condensate | Fixed steel | Above water production | 7500 | 9800 | |
| UK721 | United Kingdom | Kittiwake A | 21/18a | 57.468333 | 0.512142 | 87 | Enquest | 1990 | Operational | Oil | Fixed steel | Above water production | 5370 | 9000 | |
| UK722 | United Kingdom | Lomond | 23/21 | 57.287542 | 2.170697 | 86 | BG | 1993 | Operational | Condensate | Fixed steel | Above water production | 5200 | 8200 | |
| UK723 | United Kingdom | Magnus | 211/12 | 61.620114 | 1.307200 | 190 | BP | 1983 | Operational | Oil | Fixed steel | Above water production | 35057 | 34600 | |
| UK1176 | United Kingdom | Mariner PDQ Platform | 9/11a | 59.589103 | 1.057042 | 110 | Statoil | 2018 | Operational | Oil | Fixed steel | Above water production | 31000 | 19000 | UC |
| UK724 | United Kingdom | Marnock ETAP PDR Platform | 22/24a | 57.295103 | 1.663031 | 93 | BP | 1998 | Operational | Condensate | Fixed steel | Above water production | 7000 | 14000 | |
| UK728 | United Kingdom | Montrose A | 22/17 | 57.450681 | 1.388250 | 91 | Repsol-Sinopec | 1976 | Operational | Oil | Fixed steel | Above water production | 6500 | 10812 | |
| UK1264 | United Kingdom | Montrose BLP | 22/17n | 57.480897 | 1.432083 | 90 | Repsol-Sinopec | 1976 | Operational | Oil | Fixed steel | Above water production | 7548 | 8163 | |
| UK731 | United Kingdom | Morecambe CPP1 | 110/3 | 53.846708 | -3.580739 | 32 | HRL | 1985 | Operational | Gas | Fixed steel | Above water production | 11754 | 12933 | |
| UK736 | United Kingdom | Nelson | 22/11 | 57.662876 | 1.145564 | 85 | Enterprise | 1994 | Operational | Oil | Fixed steel | Above water production | 8500 | 9900 | |
| UK760 | United Kingdom | Ninian Central | 3/03 | 60.856784 | 1.469093 | 135 | CNR | 1978 | Operational | Oil | Gravity-based concrete | Above water production | 384000 | 39000 | |
| UK737 | United Kingdom | Ninian north | 3/3 | 60.960639 | 1.462389 | 135 | CNR | 1978 | Operational | Oil | Fixed steel | Above water production | 14100 | 17400 | |
| UK738 | United Kingdom | Ninian south | 3/08 | 60.805562 | 1.450377 | 135 | CNR | 1978 | Operational | Oil | Fixed steel | Above water production | 43700 | 25500 | |
| UK739 | United Kingdom | Piper B | 15/17 | 58.461361 | 0.251056 | 146 | Repsol-Sinopec | 1976 | Operational | Oil | Fixed steel | Above water production | 22555 | 28000 | |
| UK740 | United Kingdom | Rough BD | 47/3d | 53.833636 | 0.441917 | 37 | Centrica | 1985 | Operational | Gas | Fixed steel | Above water production | 2651 | 9090 | |
| UK632 | United Kingdom | Rough BP | 47/3d | 53.834556 | 0.443000 | 37 | Centrica | 1985 | Operational | Gas | Fixed steel | Above water production | 2397 | 8254 | |
| UK741 | United Kingdom | Saltire A | 15/17 | 58.416806 | 0.334194 | 143 | Repsol-Sinopec | 1993 | Operational | Oil | Fixed steel | Above water production | 15000 | 14744 | |
| UK742 | United Kingdom | Scott JD | 15/22 | 58.292222 | 0.200833 | 142 | Nexen | 1993 | Operational | Oil | Fixed steel | Above water production | 16130 | 20839 | |
| UK743 | United Kingdom | Scott JU | 15/22 | 58.288333 | 0.198889 | 142 | Nexen | 1993 | Operational | Oil | Fixed steel | Above water production | 8800 | 15477 | |
| UK852 | United Kingdom | Shearwater C PUQ Platform | 22/30b | 57.153911 | 1.984250 | 92 | Shell | 2000 | Operational | Condensate | Fixed steel | Above water production | 5040 | 12466 | |
| UK744 | United Kingdom | Tartan A | 15/16 | 58.369847 | 0.073606 | 142 | Repsol-Sinopec | 1981 | Operational | Oil | Fixed steel | Above water production | 14090 | 14400 | |
| UK745 | United Kingdom | Tern | 210/25 | 61.360111 | 0.944972 | 167 | TAQA | 1989 | Operational | Oil | Fixed steel | Above water production | 20500 | 19300 | |
| UK746 | United Kingdom | Thistle A | 211/18a | 61.363036 | 1.579761 | 160 | Enquest Heather | 1978 | Operational | Oil | Fixed steel | Above water production | 31500 | 25200 | |
| UK747 | United Kingdom | Tiffany | 16/17 | 58.505329 | 1.265230 | 125 | CNR | 1993 | Operational | Oil | Fixed steel | Above water production | 17500 | 20000 | |

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