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1 Foreword

Oil & Gas UK’s Decommissioning Insight is the leading industry forecast for decommissioning on the UK Continental Shelf (UKCS). Produced annually over the last four years, the publication provides a forecast of regional decommissioning activity and expenditure over the next decade. Working with data from Oil & Gas UK’s membership, the 2013 report builds on the forecasts of 27 operators current at the time of the survey.

Within the UK, the offshore oil and gas industry is the largest investing sector and the largest contributor to national gross value added (GVA) among the industrial sectors of the economy. Oil & Gas UK’s Economic Report 2013 reveals that there is still a significant resource of 15 to 24 billion barrels of oil equivalent (boe) for further recovery from the UKCS, indicating a strong future for domestic oil and gas production. Furthermore, if the current rate of investment is sustained, the UKCS has the potential to satisfy close to 50 per cent of the UK’s oil and gas demand in 2020¹.

Due to improved recovery techniques, divestment of assets and the maintenance of infrastructure for future opportunities, decommissioning programmes are therefore flexible in nature and subject to change in forecast. Furthermore, it is expected that the extensions to the tax allowances in 2012 and the recent introduction of the Decommissioning Relief Deed, a contract between government and industry guaranteeing certainty of future tax relief on decommissioning costs, will help to sustain the record levels of investment forecast this year of £13.5 billion. Pushing back decommissioning will keep oil and gas production at the forefront of the UK energy agenda.

However, the 2013 decommissioning survey indicates that a handful of large decommissioning projects are well underway and will be delivered in the next five to seven years. Experience gained from these flagship projects will provide valuable insight for the industry as it learns how to decommission fields in a cost effective and efficient manner. For example, projects listed on the Department of Energy and Climate Change’s pathfinder website include Brae, Brent, Murchison and Miller². It is important that the lessons learnt from these activities continue to be shared across the industry as this will encourage development of new technologies and lead to streamlined processes.

The world class British oil and gas supply chain, now reported to contribute £27 billion a year to the economy³, supports oil and gas production activities. For this same supply chain, decommissioning offers both a growing business opportunity and a significant challenge.

¹ All references in 2013 money, Oil & Gas UK Economic Report 2013: http://www.oilandgasuk.co.uk/2013-economic-report.cfm
² See the Department of Energy and Climate Change Pathfinder website at https://www.og.decc.gov.uk/pathfinder/decommissioningindex.html
The 2013 Decommissioning Insight forecasts that a total of £10.4 billion is to be spent on decommissioning assets (excluding onshore terminals) on the UKCS from 2013 to 2022. This decommissioning activity, however, represents a small proportion of the overall market; the current inventory will be decommissioned over the next 40 to 50 years, and beyond for any assets still to be developed. As a burgeoning sector, decommissioning therefore provides a platform for innovation, cost reduction and increased efficiency and could reap substantial benefit from collaboration.

We trust you find this document an informative and useful guide to decommissioning activity on the UKCS.

Oonagh Werngren
Operations Director
Oil & Gas UK
2 Key Findings

- From 2013 through to 2040, £31.5 billion is forecast to be spent on decommissioning existing assets. New investment in probable developments would add £3.5 billion to the total, although much of this will be incurred after 2040. This report captures a third of this forecast for existing assets.

- The 2013 decommissioning survey has been expanded to capture decommissioning spend over the next decade to 2022 and to include additional categories of activity. Twenty-seven operators responded to the call for data on decommissioning expenditure and activity between 2013 and 2022. This is an increased sample size on surveys carried out in previous years and provides a better representation for forecasts.

- The 2013 survey has captured a greater mix of complex projects due to the expanded survey timeframe. However, uncertainty may increase for forecasts beyond the five to seven year timeframe (post-2019) due to the changing nature of decommissioning programmes.

- Total forecast expenditure on decommissioning from 2013 to 2022 is £10.4 billion. Forty-four per cent of this expenditure is to be made in the northern North Sea at £4.6 billion.

- Over 2,300 kilometres of pipeline, infrastructure from 74 fields, more than 70 subsea projects and over 130 installations are scheduled for decommissioning over the next decade. This includes floating, production, storage and offloading vessels (FPSOs), small normally unmanned platforms in the southern North Sea, and large integrated facilities in the central and northern North Sea.

- Many of the decommissioning programmes captured in this survey are considered to be in the early scoping stages.

- Wells plugging and abandonment is the largest category of expenditure totalling £4.5 billion. This represents 43 per cent of the total forecast decommissioning expenditure from 2013 to 2022.

- Over 800 wells are scheduled for plugging and abandonment in this time period. Nearly 480 of these wells are in the central and northern North Sea of which nearly 60 per cent are platform wells.

- In the central and northern North Sea, the average forecast for wells plugging and abandonment expenditure is £4.8 million per platform well, £10.1 million per subsea development well and £8 million per subsea exploration and appraisal well.

- In the southern North Sea and Irish Sea, the average forecast for wells plugging and abandonment expenditure is £3.5 million per platform well and £6.6 million per subsea well.

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4 All references in 2013 money, Oil & Gas UK Economic Report 2013: [http://www.oilandgasuk.co.uk/2013-economic-report.cfm](http://www.oilandgasuk.co.uk/2013-economic-report.cfm)

5 This figure excludes £300 million (£10.7 billion total) of data provided for onshore terminal expenditure and any operator data provided as lump sums.
• Removal of topsides, substructure and subsea infrastructure totals 21 per cent of the overall decommissioning expenditure at £2.2 billion. Nearly 470,000 tonnes of material are expected to be removed between 2013 and 2022, with activity peaking at more than 60,000 tonnes in 2017 in the central and northern North Sea. Topside removal accounts for 13 per cent of the total forecast market expenditure at over £1.3 billion.

• In the central and northern North Sea, the average forecast expenditure of removing topsides is £4,100 per tonne and for substructures (jackets) £4,300 per tonne. In the southern North Sea and Irish Sea, the forecasts average £3,600 and £5,700 for topsides and substructures, respectively.

• Eleven per cent (nearly £1.2 billion) of the total decommissioning expenditure is forecast to be spent on facility running and owners’ costs. Assets need to be well maintained for a prolonged period to enable effective decommissioning.

• Over 405,000 tonnes of material are expected to be transported onshore for dismantling and processing between 2013 and 2022, with demand for UK disposal yards peaking in 2018 when over 80,000 tonnes of material are forecast to come onshore from the central and northern North Sea.

• A comparison of forecast data from the 2011, 2012 and 2013 Decommissioning Insights indicates a consistency in the near-term decommissioning forecasts and some smoothing of expenditure.

• Decommissioning expertise is considered to be available within the UK supply chain, but without significant activity in this area the supply chain has not been fully tested. It is expected that some adjustment will be required as activity increases and competition for resources may be experienced in some areas with oil and gas production.
3 Introduction

Fiscal change, technological advances and high oil and gas prices have led to a record level of investment of £13.5 billion being forecast in 2013. New offshore developments and the rejuvenation of existing assets will help to significantly extend the field life of the UK Continental Shelf (UKCS) and may delay decommissioning in favour of redevelopment.

For new investment in existing assets on the UKCS, the Brown Field Allowance (BFA) introduced in 2012 reduces the marginal tax rate by up to 32 per cent for five years on the more costly opportunities. Earlier in 2013, EnQuest’s Thistle oil field development secured a BFA, enabling a new phase of late-life asset extension which is expected to create 1,000 new jobs across the UK supply chain and significantly increase production. Talisman Sinopec’s Montrose Area Redevelopment is another clear example of the impact of the BFA. The programme of £1.6 billion of capital investment is expected to yield an additional 100 million boe of production, extending field life and delaying decommissioning until 2030.

Furthermore, the Decommissioning Relief Deed is expected to delay decommissioning for some projects. This unique contract between government and industry provides certainty of future tax relief on decommissioning costs on the UKCS, enabling companies to move their decommissioning liabilities to a post-tax basis and release additional funds for further investment in oil and gas production, for the benefit of the economy and energy security.

Nonetheless, despite the current growth of the domestic oil and gas industry, decommissioning is a significant and inevitable stage in the life of a field. The Oil & Gas UK Economic Report 2013 details that from 2013 through to 2040, £31.5 billion is forecast to be spent on decommissioning existing assets, with new investment in probable developments adding £3.5 billion to this total\(^6\). This report is based on the results obtained in the annual decommissioning survey and provides details of the operators’ expectations for decommissioning activity and expenditure from 2013 through to 2022, revealing total forecast expenditure of £10.4 billion\(^7\) during this period.

3.1 The Decommissioning Process

Following an update of the Decommissioning Cost Estimating Guidelines\(^8\) by Oil & Gas UK’s Decommissioning Efficient Execution Work Group, the 2013 survey has been modelled around a new Work Breakdown Structure (WBS), which provides a detailed breakdown of the various components of the decommissioning process. This report discusses these components, with the three largest areas of forecast expenditure being wells, topside removal and facility running and owners’ costs.

Figure 1 right illustrates how the 2011 and 2013 structures map in relation to each other. Definitions for the 2013 WBS are listed in the Appendix.

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\(^6\) All references in 2013 money, Oil & Gas UK Economic Report 2013: [http://www.oilandgasuk.co.uk/2013-economic-report.cfm](http://www.oilandgasuk.co.uk/2013-economic-report.cfm)

\(^7\) This figure excludes £300 million (£10.7 billion total) of data provided for onshore terminal expenditure and any operator data provided as lump sums.

\(^8\) See the Decommissioning Cost Estimating Guidelines at: [http://www.oilandgasuk.co.uk/publications/publications.cfm](http://www.oilandgasuk.co.uk/publications/publications.cfm)
Figure 1: Mapping of the 2011 and 2013 Work Breakdown Structures
(The components drawn vertically represent those where expenditure and activity
span the entire decommissioning process)

3.2 Survey Development and Methodology
The 2013 Decommissioning Insight builds on the surveys carried out in 2011 and 2012. Following requests
from the supply chain and support from the Oil & Gas UK Decommissioning Market Insight Work Group, the
survey has been expanded to capture decommissioning activity and expenditure data over the next ten years.

To provide both operators and contractors with aggregated information on near-term projects on the UKCS,
Oil & Gas UK surveyed operators between May and August 2013 on their decommissioning activities and
expenditure forecasts from 2013 to 2022. The information presented in the following sections is solely based
on the data as identified at the time of the survey and collected on a non-attributable and aggregated basis.
Regional analysis has been carried out looking at the data in two groupings: the central and northern North
Sea and the southern North Sea and Irish Sea.
Operators were asked to provide data on expenditure per year for 21 different cost categories, such as substructure removal and pipeline ‘making safe’. The increased number of categories since the 2012 survey enables easier mapping of the data to the new WBS outlined in Figure 1. The type of asset dictates which of these categories operators responded to.

Operators were also asked to quantify physical decommissioning activity, such as tonnes of subsea infrastructure to be removed or numbers of wells to plug and abandon.

The survey has been expanded to include the following activity data:
- Number and length of pipeline to be decommissioned, subdivided into trunk lines (diameter greater than 16 inches and longer than 18 kilometres), other pipelines (any pipeline out with trunk line criteria) and umbilicals
- Length of pipeline to be made safe
- Number of topside modules to be prepared
- The breakdown of subsea infrastructure to be removed into mattresses and ‘other infrastructure’ such as manifolds and subsea isolation valves (SSIV)

Decommissioning Forecast 2013 to 2022
The extended timeframe of the 2013 survey captures data over the next decade. It is considered that forecasts in the short term, five to seven years from now, are consistent with the 2011 and 2012 data in their reflection of activity and expenditure. However, post-2019 there may be an increase in uncertainty in the forecasts. With the flexibility of decommissioning programmes and an increased focus on the life extension of existing assets, the landscape of the market post-2019 is expected to change when forecasts are revisited nearer this time.

While it is possible to compare data across 2011, 2012 and 2013, it is important to note that, as outlined in section 3.1, the 2013 survey is modelled on the new WBS.

Results from the 2013 survey are believed to represent 87 per cent of the market from 2013 to 2022, so estimates contained in this report are conservative. The 2013 survey welcomed participation from operators who had not previously submitted data. Expenditure captured in this survey represents only a third of forecast decommissioning activity projected to 2040 and therefore significant activity is expected outside of the survey timeframe.

3.3 Classification of Expenditure
The forecast spend presented in the following sections of this report is a simple aggregation of expenditure provided by operators in the survey responses. Oil & Gas UK has not applied any additional treatment to the figures submitted.

Forecasting decommissioning expenditure at the outset of a project is challenging due to many uncertainties and linked activities influencing expenditure. As decommissioning projects are not subject to the same time pressures as development projects, there is more flexibility in the execution timing, within integrity and safety constraints.
The Association for the Advancement of Cost Engineering (AACE) has developed a set of guidelines\(^3\) to apply estimate classification to projected costs. In this survey, operators were asked to provide an estimate class for their project, which is determined by the level of ‘project definition’ with consideration of a set of secondary characteristics. The five estimate classes in the Cost Estimate Classification Matrix are shown in Figure 2 below.

*Figure 2: Extract from the AACE Cost Estimation Classification Matrix*

<table>
<thead>
<tr>
<th>Estimate Class</th>
<th>Primary Characteristic</th>
<th>Secondary Characteristic</th>
<th>Methodology</th>
<th>Expected Accuracy Range Typical Variations in Low and High Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 5</td>
<td>Level of Project Definition (expressed as % of complete definition)</td>
<td>Concept screening</td>
<td>Capacity factored, parametric models, judgement or analogy</td>
<td>L: -20% to -50% H: +30% to +100%</td>
</tr>
<tr>
<td>Class 4</td>
<td>1% to 15%</td>
<td>Study or feasibility</td>
<td>Equipment factored or parametric models</td>
<td>L: -15% to -30% H: +20% to +50%</td>
</tr>
<tr>
<td>Class 3</td>
<td>10% to 40%</td>
<td>Budget authorisation or control</td>
<td>Semi-detailed unit costs with assembly level line items</td>
<td>L: -10% to -20% H: +10% to +30%</td>
</tr>
<tr>
<td>Class 2</td>
<td>30% to 70%</td>
<td>Control or bid/tender</td>
<td>Detailed unit costs with forced detailed take off</td>
<td>L: -5% to -15% H: +5% to +20%</td>
</tr>
<tr>
<td>Class 1</td>
<td>50% to 100%</td>
<td>Check estimate or bid/tender</td>
<td>Detailed unit cost with detailed take off</td>
<td>L: -3% to -10% H: +3% to +15%</td>
</tr>
</tbody>
</table>

Over 70 per cent of the survey respondents classified their expenditure using the AACE Cost Estimation Classification Matrix. Nearly 60 per cent of them reported class 4 for their projects, with more than 30 per cent reporting class 5. This suggests that the majority of projects are in the early scoping stages.

In comparison to the 2012 Decommissioning Insight, twice as many projects were classified as 4 and 5. This reflects the greater mix of complex projects captured by a larger survey sample size. The few projects stating AACE class 1 or 2 have cessation of production (COP) dates in the past and would be expected to be nearing completion of their decommissioning programmes.

3.4 The Oil and Gas Supply Chain

Decommissioning is a growing market for the UK oil and gas supply chain through the producing life of the UKCS and beyond. Some 475 installations, 5,000 wells\(^{10}\) and over 27,000 kilometres of pipeline (including umbilicals, risers and spools, etc) will eventually need to be decommissioned\(^{11}\). This figure does not include any future developments. As an emerging challenge, decommissioning therefore requires a complex balance of research, planning, engineering expertise and stakeholder consideration.

By using many of the same supply chain services employed during development offshore projects, it is believed that the required expertise for decommissioning is currently available within the UK oil and gas industry. However, while Oil & Gas UK forecasts that capital investment in developments will reach £13.5 billion this year, the annual average forecast expenditure for decommissioning is smaller in comparison at £1 billion per year over the next decade. There may therefore be competition for resources within the supply chain, such as for rigs, vessels and skilled labour. The challenge of finding sufficient skilled personnel is already well documented.

Furthermore, although the capability and expertise to carry out decommissioning is available in the UK, the capacity of the supply chain has yet to be fully tested with increased volumes of decommissioning activity. This is most likely to result in the spreading of activity over time to allow for appropriate adjustment. In light of fiscal incentives, increased investment to extend field life may delay future decommissioning projects and will, in turn, provide additional time for this adjustment and reduce competition within the supply chain.

Overall, the decommissioning sector has strong potential to benefit from collaboration and ensuring that the learnings from current and completed projects are absorbed by the industry, improving knowledge and refining forecasts. As decommissioning grows worldwide there is potential for a global market to develop.

\(^{10}\) See Oil & Gas UK Economic Report 2013 at:  
http://www.oilandgasuk.co.uk/2013-economic-report.cfm

\(^{11}\) See the Oil & Gas UK Decommissioning of Pipelines Report at:  
http://www.oilandgasuk.co.uk/publications/publications.cfm
4 Results of the 2013 Decommissioning Survey

The following results reflect operators’ forecasts of expenditure on decommissioning of UKCS assets for each year from 2013 to 2022, totalling £10.4 billion. This analysis does not include the additional £300 million of operator spend attributed to onshore terminals and data provided as lump sum values.

The analysis has been split into two regional groupings: the central and the northern North Sea and the southern North Sea and the Irish Sea. The operator data have been aggregated and analysed based on the components of the WBS detailed in Figure 1, focusing on the largest areas of expenditure. Some historical comparison of data has been performed and average costs examined.

4.1 Regional Analysis

Of the total £10.4 billion, Figure 3 below shows that 44 per cent (£4.6 billion) of the decommissioning expenditure will be concentrated in the northern North Sea over the next ten years. A further 32 per cent (£3.3 billion) will be spent in the central North Sea, and the remaining 24 per cent (£2.5 billion) in the southern North Sea and Irish Sea.

The greater proportion of expenditure in the central and northern North Sea reflects the complexity and size of projects in these regions, although decommissioning is expected to be executed earlier in the southern North Sea.

Annual expenditure rises over the ten-year period from just under £600 million in 2013 and peaks at over £1.4 billion in 2017. Following another peak in 2019, this trend reverses and expenditure declines, resting at approximately £800 million in 2022. This may be attributed to uncertainty towards the end of the decade.

From 2013 to 2017, the regional split in decommissioning and the rise in expenditure is consistent with the 2012 Oil & Gas UK Decommissioning Insight.

Figure 3: Total Forecast Decommissioning Expenditure on the UKCS by Year and Region from 2013 to 2022
4.2 **Historical Comparison of Data**

Using data from three *Decommissioning Insights* (2011, 2012 and 2013), it has been possible to compare forecast expenditure figures (see Figure 4 below). The 2013 forecast of £10.4 billion of expenditure over the next decade represent 88 per cent of the decommissioning market. The forecasts made in 2011 and 2012 represent a smaller sample size and have therefore been scaled to allow comparison. All expenditure is in 2013 money.

The forecasts gathered for the year of the survey are an indicator of sanctioned expenditure. Forecasts for this year submitted this year, for example, will capture some expenditure from earlier in 2013 and sanctioned expenditure expected to be completed by the end of the calendar year. Comparison of near-term forecasts illustrates small differences in predictions suggesting overall consistency in operator forecasting. However, change in decommissioning activity can occur, and in future surveys it may be possible to compare forecasts with a review of actual executed expenditure and activity.

*Figure 4: Comparison of Annual Forecast Decommissioning Expenditure on the UKCS (2011, 2012 and 2013)*

In the figure above, the peak in expenditure forecast for 2015 in the 2011 survey can now be mapped to 2017 in the 2013 survey results. The total expenditure and activity allocated between the years of 2014 to 2016 for each survey remains fairly consistent, highlighting that a number of large decommissioning projects remain active on the UKCS. Examining projects across surveys, it can be seen that these projects are underway and have not moved significantly. The 2013 survey data overall highlight a smoothing of decommissioning expenditure over time. This will help alleviate pressures in the supply chain as activity increases in future years.

The Department of Energy and Climate Change provides an indication of the scheduled decommissioning projects as well as those awaiting approval\(^\text{12}\).

4.3  Forecast Expenditure by Decommissioning Component
The nature of the decommissioning project will dictate which of the components of the WBS will incur expenditure. Decommissioning activity for large complex projects can include topsides, substructures, wells, pipelines and sometimes floating, production, storage and offloading vessels (FPSOs). These will require significant overheads for project management and operational costs in addition to substantial engineering expertise, equipment and personnel. Large integrated projects, commonly seen in the central and northern North Sea, will require activity throughout the supply chain. In comparison, a small southern North Sea tie-back may only involve single abandonment of a well.

The proportion of total estimated decommissioning expenditure from 2013 to 2022 for each component of the WBS is shown in Figure 5 below. In line with the past two decommissioning surveys, wells plugging and abandonment represents the largest category for expenditure at 43 per cent (£4.5 billion) of the total expenditure. Topside removal accounts for 13 per cent (over £1.3 billion) of the forecast expenditure and a further 11 per cent (nearly £1.2 billion) is attributed to facility running and owners’ costs, the majority of which are operational costs associated with running a manned facility while decommissioning takes place.

Further insight into the forecast expenditure and associated activity for each component of the decommissioning process is provided in the following sections.

*This relates to expenditure clearly identified as removal
Source: Oil & Gas UK
4.3.1 Operator Project Management

As illustrated in Figure 1, operator project management spans the whole decommissioning process, encompassing expenditure relating to project management, preparation of decommissioning programmes, studies and reports (engineering, reservoir and environmental), any associated consultation, and stakeholder engagement. A substantial number of studies and reports are required to support projects; recent public consultation of decommissioning programmes, such as for Murchison and Miller, have included 50 to over 100 supporting documents.

Operator project management costs are estimated at almost £900 million in total over the next ten years, of which over £200 million is allocated to preparing the decommissioning programmes.

Operator Project Management Regional Analysis

More than 70 per cent of the operator project management expenditure is attributed to projects in the central and northern North Sea, peaking in 2017 and 2019 during periods of increased activity. Costs remain low throughout the majority of the ten-year timeframe for the southern North Sea and Irish Sea given the less complex nature of projects in these regions. However, expenditure in the southern North Sea is forecast to increase towards the end of the decade and is associated with the preparation of decommissioning programmes, which suggests further activity outside of the survey timeframe.

Figure 6: Forecast of Operator Project Management Expenditure on the UKCS, from 2013 to 2022

Increased Uncertainty in Forecasts
4.3.2 Facility Running/Owners’ Costs

Expenditure allocated to facility running and owners’ costs encompasses the operational expenses incurred post cessation of production (COP) through to completion of decommissioning. This involves managing the facility both as a pre-normally unmanned installation (pre-NUI) and normally unmanned installation (NUI), with expenditure on logistics (aviation and marine), an operations team, the deck crew, power generation, platform services, integrity management (inspection and maintenance) and specialist services.

For a pre-NUI, approximately 95 per cent of the production staff are still required as the operator works towards making the facility hydrocarbon free. Once the facility is unmanned (NUI) and positively isolated from hydrocarbons, there are lower levels of activity aside from integrity and maintenance visits.

Figure 7 below illustrates the forecast annual expenditure for facility running and owners’ costs which rises significantly from 2014 to 2017, suggesting that a large number of assets are entering decommissioning at this time.

With nearly £1.2 billion forecast over the next ten years, this category makes up 11 per cent of the total decommissioning expenditure in this timeframe and the costs can be almost wholly attributed to the operational expenses incurred whilst running a pre-NUI facility.

Operators can reduce these costs by carrying out some decommissioning activity during the downturn of production and therefore accelerating the pathway to the facility becoming an NUI. Overall, assets need to be well maintained for a prolonged period to enable them to be decommissioned effectively.
4.3.3 Wells Abandonment

The plugging and abandonment (P&A) of wells on the UKCS is carried out in accordance with industry guidelines\textsuperscript{13}. The process of well P&A can be challenging and may involve intervention, the removal of down-hole equipment (such as production tubing and packers), and well scale decontamination treatment. It also requires removal of the wellhead and conductor to three metres below the seabed.

Over 800 wells are scheduled for decommissioning over the next decade, representing 16 per cent of the some 5,000 wells that will need P&A in total on the UKCS from the current inventory. At a cost of £4.5 billion, wells P&A is the largest component (43 per cent) of decommissioning expenditure on the UKCS over the next ten years.

Wells Plugging and Abandonment in the Central and Northern North Sea

Nearly 70 per cent of the forecast wells P&A expenditure is in the central and northern North Sea, equating to £3.1 billion. Almost 480 wells are scheduled for decommissioning in these regions, of which nearly 60 per cent are platform wells. The activity is concentrated from 2013 to 2019, with significant peaks in 2015, 2017 and 2019, when over 80 wells per year are scheduled for P&A.

\textit{Figure 8: Forecast of the Number of Wells to be Plugged and Abandoned by Type and Total Annual Expenditure in the Central and Northern North Sea, from 2013 to 2022} (expenditure indicated in purple and scale on the right hand axis)

\textsuperscript{13} See the \textit{Guidelines for the Suspension and Abandonment of Wells} at: \url{http://www.oilandgasuk.co.uk/publications/viewpub.cfm?frmPubID=447}
As wells P&A activity continues to rise and industry shares its experiences and learnings, it is expected that the forecasting and efficiency of execution will improve. Overall, the average forecast well abandonment costs have changed since 2012 and it is considered that the averages reported in the 2013 survey are more representative due to learning from recent well P&A experience, the larger sample size and the expanded timeframe covered by this year’s survey. The actual cost of each well is dependent on a wide range of factors, such as water depth, weather, well type, complexity and age.

The average forecast cost for P&A of a well in the central and northern North Sea is £4.8 million for a platform well, £10.1 million for a subsea development well and £8 million for a subsea exploration and appraisal (E&A) well.

Although the average cost per subsea development well has decreased by almost £5 million per well, compared to the 2012 forecast, the P&A of these wells remains the most expensive, predominantly due to costly rig intervention and the inflation of day rates.

E&A wells, meanwhile, can be plugged and abandoned routinely by vessel but in some cases require rig intervention. The £4.5 million rise in average forecast abandonment costs for E&A wells compared to 2012 may be due to increased intervention costs for the more complex wells captured in this expanded survey.

Wells Plugging and Abandonment in the Southern North Sea and Irish Sea
In the Southern North Sea and Irish Sea, the forecast expenditure for wells P&A totals £1.4 billion from 2013 to 2022 (see Figure 9 overleaf), encompassing approximately 330 wells, over 80 per cent of which are platform wells. The majority of this activity and expenditure is associated with projects in the southern North Sea.

The level of activity from 2013 to 2017 is consistent with the 2012 Decommissioning Insight but the extended timeframe of this year’s survey now reveals a forecast of increased activity from 2020 to 2022. In comparison to the 2012 forecast, a small amount of smoothing of activity can be seen between 2013 and 2018.

The average cost of wells P&A in the southern North Sea and Irish Sea is £3.5 million per platform well and approximately £6.6 million per subsea well. Due to the small number of E&A wells captured in this study, the average cost of E&A subsea well abandonment has not been calculated separately. The nature of gas wells in the southern North Sea and Irish Sea often means wells P&A is easier to perform, although rig hire is often required.

The actual cost of each well is dependent on a wide range of factors such as water depth, weather, well type, complexity and age.
Figure 9: Forecast of the Number of Wells to be Plugged and Abandoned by Type and Total Annual Expenditure in the Southern North Sea and Irish Sea, from 2013 to 2022 (expenditure indicated in purple and scale on the right hand axis)

Wells Plugging and Abandonment Supply Chain
Oil & Gas UK’s Economic Report 2013 forecasts a rise in E&A drilling over the next three years with activity peaking in 2014. Roughly 85 per cent of exploration wells and 100 per cent of appraisal wells to be drilled this year have secured firm rig slots. If the current forecasts for wells P&A and E&A activities remain, significant competition for rigs may therefore be expected, although the 2013 decommissioning survey did not query whether rig space had been allocated for wells P&A activity. Furthermore, although P&A of many platform wells can be achieved using existing equipment on the platform, upgrade of these facilities may be required. Some smoothing of wells P&A activity over the next decade is therefore expected due to the availability and competition for equipment, rigs, vessels and skilled crews.

Data from CDA’s DEAL database shows that over 6,000 wellbores have been plugged and abandoned on the UKCS to date and 34 wellbores have been plugged and abandoned from January to September 2013.

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15 CDA’s DEAL database can be accessed at: [https://www.ukdeal.co.uk/dp/jsp/PleaseLoginDeal.jsp](https://www.ukdeal.co.uk/dp/jsp/PleaseLoginDeal.jsp)
4.3.4 Making Safe and Topside Preparation

Prior to the physical removal of a facility it must first be prepared for removal in line with environmental and safety considerations. The ‘making safe’ of both facilities and pipelines includes cleaning, draining, engineering and waste management. Thereafter, the topsides, process and utilities modules are separated and appropriate engineering, such as the installation of lift points, can take place to enable removal.

Over the next ten years, ‘making safe’ is forecast to cost £300 million in total with topside preparation equating to over £420 million. This includes nearly 840 kilometres of pipelines and nearly 280 topside modules. A peak of activity can be seen between 2015 to 2018 which corresponds with a period of high removal activity and increased removal expenditure. Removal activity is discussed in section 4.3.5.

Making Safe and Topside Preparation Regional Analysis

The topsides preparation and facility ‘making safe’ costs detailed in this report are largely concentrated on the central and northern North Sea, as the southern North Sea has a large number of small satellite facilities or NUIs which require less of such activity. Pipeline ‘making safe’ expenditure, meanwhile, is markedly higher in the southern North Sea and Irish Sea.

Figure 10: Forecast of ‘Making Safe’ and Topside Preparation Expenditure on the UKCS, from 2013 to 2022

Source: Oil & Gas UK

Increased Uncertainty in Forecasts

<table>
<thead>
<tr>
<th>Year</th>
<th>Facilities Making Safe Costs, Southern North Sea and Irish Sea</th>
<th>Pipeline Making Safe Costs, Southern North Sea and Irish Sea</th>
<th>Topside Preparation Costs, Southern North Sea and Irish Sea</th>
<th>Facilities Making Safe Costs, Central and Northern North Sea</th>
<th>Pipeline Making Safe Costs, Central and Northern North Sea</th>
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</table>

Source: Oil & Gas UK
4.3.5 Removal
Removal encompasses the removal of topsides, substructures and subsea infrastructure. Prior to removal, detailed studies and engineering take place to support the structural separation and chosen removal method. Beyond the costs associated with physical removal, this component also includes expenditure attributed to transportation and onshore load-in.

Topside removal can involve re-engineering and cutting of topside modules. Most commonly topside removal is achieved by the piece-small, reverse-installation or single-lift methods. Smaller substructures, such as those common to the southern North Sea, can be removed in a single lift and transported onshore via barge or lift vessel. Larger substructures may require sectioning into manageable pieces and multiple removal lifts.

The removal of substructures, topsides and subsea infrastructure accounts for 21 per cent (£2.2 billion) of the total decommissioning expenditure on the UKCS from 2013 to 2022. Pipeline and mattress decommissioning costs have been addressed separately in section 4.3.6.

Removal in the Central and Northern North Sea
More than 70 per cent (£1.6 billion) of this total expenditure on removal will be concentrated in the central and northern North Sea where £1.1 billion is forecast to be spent on topside removal, £270 million on substructure removal and almost £240 million on the removal of subsea infrastructure. It should be noted that some operators have provided expenditure and tonnage values for FPSO decommissioning within the substructure category.

Figure 11: Forecast of Topside, Substructure and other Subsea Infrastructure Removal Tonnage and Expenditure in the Central and Northern North Sea, from 2013 to 2022 (expenditure indicated in purple and scale on the right hand axis)
The pattern of high activity and increasing expenditure from 2015 to 2017 reported last year has also been reflected in this year’s forecasts. Although tonnage has increased marginally, similar expenditure forecasts are reported.

Removal expenditure over the next ten years in the central and northern North Sea peaks between 2015 and 2018, at the same time as the ‘making safe’ and topside preparation activity. Over 200,000 tonnes of material is scheduled for removal in this period on account of a limited number of large integrated platform projects. Some slight discrepancy in mapping activity to expenditure can be seen due to the ability to spread the cost data but not activity over the timeframe. Topside removal costs are quite variable and will be greatly influenced by the type, size and complexity of the modules being removed.

Overall, from 2013 to 2022, nearly 340,000 tonnes are to be removed in the central and northern North Sea. This includes over 230 topside modules (270,000 tonnes), approximately 53,000 tonnes of substructure, more than 9,000 tonnes of other subsea infrastructure, such as manifolds and subsea isolation valves (SSIV), and over 7,000 tonnes of mattresses. The significant volumes of topside material to be removed will require a variety of removal methods to be employed and, depending on the integrity of the asset, significant engineering may be required. As substructure removal peaks between 2016 and 2018, a large demand for heavy lift vessels is expected.

Based upon the survey results, the average topside module weighs approximately 1,100 tonnes and costs £4,100 per tonne to remove. These figures closely align with the 2012 average removal forecasts. Jacket removal (not including FPSO substructure removal costs or tonnage) is forecast to cost £4,300 per tonne to remove, a higher figure than previous predictions. The larger sample size has provided more representative forecasts for removal averages per tonne. Actual removal costs are dependent on a wide variety of factors, such as location, weather, previous experience and age of installation.
Removal in the Southern North Sea and Irish Sea
In the southern North Sea and Irish Sea, the forecast for removal expenditure is almost £600 million (see Figure 12 below) and accounts for 75,000 tonnes of topsides, 46,000 tonnes of substructure and nearly 3,000 tonnes of subsea infrastructure. A further 6,000 tonnes of mattresses will also be removed but are not accounted for in the removal expenditure.

The average topside module in the southern North Sea and Irish Sea weighs approximately 1,000 tonnes and costs just over £3,600 per tonne to remove. Jacket removal forecasts (not including FPSO substructure removal costs or tonnage) total £5,700 per tonne. Actual removal costs are dependent on a wide variety of factors such as location, weather, previous experience and age of installation.

In the southern North Sea, platforms are commonly removed in one piece and in the 2013 survey operators were asked to include topside and substructure costs in the substructure cost category if a removal is expected to be by single lift. Removal activity in this region runs from 2013 through to 2022. In this timeframe, almost 40,000 tonnes of topsides and substructures are expected to be removed in 2020 alone. This peak relates to less than 10 individual projects. Comparison with the 2012 survey illustrates a spreading of activity in the near term.

Figure 12: Topside, Substructure and Other Subsea Infrastructure Removal from the Southern North Sea and Irish Sea, from 2013 to 2022
(expenditure indicated in purple and scale on the right hand axis)
Removal Supply Chain

Each removal method has its own individual merits and project compatibility. If decommissioning activity is to rise as forecasted, this offers opportunities and challenges for the supply chain to expand lift capacity. For example, new single-lift vessels with considerable lift capacity are due to enter the market.

At present, the largest single lift achieved on the UKCS during decommissioning using a heavy lift vessel was for the removal of the Frigg TCP2 module support frame at 8,500 tonnes. Some heavy lift vessels are equipped with tandem cranes allowing a total crane capacity in excess of 14,000 tonnes, however, removal is dictated by the geometry of the lift and the integrity of the installation, which means multiple lifts are often required\(^{16}\). At present there are a limited number of heavy lift vessel companies with capacity to lift and transport such tonnage.

Data on the limited number of platforms successfully decommissioned up until 2011 reveals that the majority of topside weight lifted has been restricted to below 5,000 tonnes. Almost a third of topside weight removed was less than 500 tonnes and two thirds of substructure removal has occurred in the southern North Sea for substructures below 1,000 tonnes. Forecasts would therefore suggest that the supply chain will need to become accustomed to the removal of larger weights and volumes as decommissioning activity increases.

Furthermore, a study of fabrication activity of UK oil and gas structures has shown that many steel structures ranging from 4,000 to over 20,000 tonnes have been approved for fabrication between 2008 and 2013\(^{17}\). Many of these structures are forecast to be ready for production between now and 2017, which is expected to create significant competition for heavy lift vessels during peak periods of installation and removal activity, particularly as there is not an established service base of heavy lift vessels specifically for decommissioning. The flexibility of timing in decommissioning programmes will, nevertheless, allow the supply chain to adapt to this demand. It is beneficial to minimise the decommissioning programme schedule, because the longer an installation remains in pre-NUI, the higher the facility running costs and overall outlays.

\(^{16}\) See Oil & Gas UK’s publication on The Decommissioning of Steel Piled Jackets in the North Sea Region (October 2012) at: [http://www.oilandgasuk.co.uk/cmsfiles/modules/publications/pdfs/OP074.pdf](http://www.oilandgasuk.co.uk/cmsfiles/modules/publications/pdfs/OP074.pdf)

\(^{17}\) See Oil & Gas UK’s Economic Report 2013 at: [http://www.oilandgasuk.co.uk/2013-economic-report.cfm](http://www.oilandgasuk.co.uk/2013-economic-report.cfm)
4.3.6 Pipeline and Mattress Decommissioning

Pipelines are integral to field life extension and future development opportunities and it is of benefit to the UKCS basin that major pipelines are decommissioned later. The decommissioning of pipelines and mattresses can occur at several stages, including wells P&A, ‘making safe’ and removal.

This year, pipeline data have been gathered for the kilometres and number of trunk lines, ‘other pipelines’ and umbilicals, alongside the number of mattresses. For this survey, ‘other pipelines’ are classified as those which fall out with the trunk link criteria of more than 16 inches in diameter and in excess of 18 kilometres in length.

It should be noted that as this is the first year that this information has been gathered a limited number of operators have provided only the number and not the length of pipelines. Improvements to the survey format will be considered in future years.

From 2013 to 2022, forecasts suggest over 2,300 kilometres (nearly nine per cent of the total pipeline length on the UKCS) is scheduled for decommissioning in the next decade.

Pipeline and Mattress Decommissioning in the Central and Northern North Sea

In the central and northern North Sea, decommissioning of pipelines and mattresses is estimated to cost over £400 million from 2013 to 2022. Over the ten-year period, nearly 40 trunk lines (130 kilometres), 115 ‘other pipelines’ (420 kilometres), 87 umbilicals (250 kilometres) and almost 900 mattresses have been identified for decommissioning in these regions, with significant expenditure from 2019 to 2022. These forecasts would suggest that pipeline decommissioning will occur towards the latter end of decommissioning programmes. The peak in 2019 can be attributed to at least ten pipeline decommissioning projects.

Despite having a similar number of pipelines as the southern North Sea, the decommissioning of ‘other pipelines’ in the central and northern North Sea is considerably more expensive. This would suggest that more complex work is required to decommission pipelines in this area.

*Figure 13: Forecast of Pipeline and Mattress Decommissioning Expenditure in the Central and Northern North Sea, from 2013 to 2022*
Pipeline and Mattress Decommissioning in the Southern North Sea and Irish Sea

Decommissioning of pipelines and mattresses in the southern North Sea and Irish Sea totals over £100 million from 2013 to 2022. In this region, four trunk lines (64 kilometres), 116 other pipelines (1,300 kilometres), 21 umbilicals (150 kilometres) and over 2,100 mattresses have been scheduled for decommissioning. There is a fairly consistent forecast annual expenditure from 2014 to 2022, averaging around £12 million per year.

A considerably larger length of ‘other pipelines’ are to be decommissioned in the southern North Sea and Irish Sea, and mattress decommissioning expenditure and activity is also considerably higher in the southern North Sea. Due to the mobile nature of the seabed in this region, additional mattresses are required for pipeline stabilisation.

A large number of satellite developments and NUI platforms characterise the southern North Sea. These developments will have various pipelines associated with them and the number of ‘other pipelines’ to be decommissioned is roughly similar to the number of platforms. This suggests that in the southern North Sea the removal of pipelines occurs at the same time as facility decommissioning.

Figure 14: Forecast of Pipeline and Mattress Decommissioning Expenditure in the Southern North Sea and Irish Sea, from 2013 to 2022
4.3.7 Topsides and Substructure Recycling

Topside and substructure recycling as part of the decommissioning process captures activity and expenditure related to the onshore cleaning and handling of hazardous waste, deconstruction, reuse, recycle, disposal and waste management accounting.

Following the waste hierarchy, reuse, recycling and onshore disposal are preferred options to deal with disused offshore structures. Once the structures are brought onshore the dismantling and processing is handled by specialist licensed sites.

Reuse is defined as any activity that lengthens the life of an item while still being used for its original purpose and can often be confused with recycling, which is the reprocessing of an item into a new raw material. Although more challenging, reuse often proves to be particularly cost efficient and can help to address the challenge of waste disposal. The decision to reuse, recycle or dispose to landfill can often be driven by a number of common factors including the amount of maintenance required, or prevalence of obsolete technology and the amount of hazardous material on an asset.

Topsides are made from a variety of materials and may contain hazardous substances. The safe dismantling and waste management of topside structures can pose a greater challenge than the management of substructures which are predominantly made of steel and can be processed and recycled. Recent decommissioning projects demonstrate high levels of reuse and recycling at 95 per cent of all recovered material\(^{18}\). Examples of reuse and recycling of material from the UKCS include Perenco’s reuse of topsides from their southern North Sea Welland platform for a new development in West Africa and the use of North West Hutton’s accommodation module as an office facility at a disposal yard.

In the 2013 decommissioning survey, topside and substructure recycling activity has been captured as total onshore tonnage volumes, including subsea infrastructure. £120 million is forecast to be spent on the transport, process and management of these materials in the next decade and over 405,000 tonnes are expected to come onshore. Seventy-five per cent of this activity will occur from projects in the central and northern North Sea. For all regions the pattern of tonnage coming onshore corresponds to, or follows, periods of removal activity.

The chosen offshore removal method has implications for onshore disposal, as the size of vessel, as well as the weight and dimensions of the material removed, will dictate where disposal can take place. An informal study of disposal yards illustrated that there are a number of strategically located UK onshore disposal yards. Many of these have the facilities, space, equipment and expertise to deal with large volumes and weights of decommissioned material, with some also having the capability to expand should the market dictate this. However, it is clear that the yards currently experience sporadic decommissioning activity and therefore this market has yet to be fully tested. Some yards may also undertake both fabrication and decommissioning activities, which may create competition for space.

\(^{18}\) See Oil & Gas UK’s publication on *The Decommissioning of Steel Piled Jackets in the North Sea Region* (October 2012) at: [http://www.oilandgasuk.co.uk/cmsfiles/modules/publications/pdfs/OP074.pdf](http://www.oilandgasuk.co.uk/cmsfiles/modules/publications/pdfs/OP074.pdf)
4.3.8 Site Remediation and Monitoring

Site remediation activities include pile management, decommissioned oil field debris clearance (with a 500-metre zone and 200-metre pipeline corridor) and over-trawl surveys.

Expenditure for site remediation is forecast at a total of over £300 million in the next decade, with activity peaking from 2018 to 2020 as removal activity is completed.

Monitoring is the final stage in the decommissioning process; operators are required to carry out post-decommissioning surveys and monitor the site beyond physical decommissioning. The specific details of the programme are agreed with the regulator on a project by project basis.

In the 2012 Decommissioning Insight, only £1.4 million was reported for carrying out monitoring as the majority of activity was outside the timeframe of that survey. In this year’s survey, a total forecast of £30 million has been captured given the extended timeframe as monitoring activity begins at the end stage of decommissioning projects.

Nearly all of the site remediation and monitoring expenditure can be attributed to the central and northern North Sea. Looking at project activity in the southern North Sea and Irish Sea, this activity is outside the timeframe of this survey.
### Appendix: Work Breakdown Structure Definitions, extract from the Oil & Gas UK Cost Estimating Guidelines 2013

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator Project Management</strong></td>
<td>Activities included are: project management, stakeholder engagement, studies to support the decommissioning programme and scope definition/method development, preparation and reporting/close-out (Admiralty charts, fish safe, etc.).</td>
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<tr>
<td><strong>Facility Running/Owners’ Costs</strong></td>
<td>Activities included are: logistics (aviation and marine), running of the operations team, deck crew, power generation, platform services, integrity management (inspection and maintenance), and operations specialist services e.g. waste management.</td>
</tr>
<tr>
<td><strong>Wells Abandonment</strong></td>
<td>Activities included are: rig upgrades, studies to support well programmes, well suspension (spread rate/duration), wells project management, operations support and specialist services, such as wireline, conductor recovery, cleaning and recycling.</td>
</tr>
<tr>
<td><strong>Facilities/Pipelines Making Safe</strong></td>
<td>Activities included are: operations (drain, flush, purge and vent), physical isolation (de-energise, vent and drain), cleaning, pipeline pigging and waste management.</td>
</tr>
<tr>
<td><strong>Topsides Preparation</strong></td>
<td>Activities included are: engineering-up of temporary utilities (power, air and water), module process/utilities separation, dropped object surveys and subsequent remedial actions.</td>
</tr>
<tr>
<td><strong>Topsides Removal</strong></td>
<td>Activities included are: removal preparation (reinforcements and structural separation for removal), vessel operations, sea-fastening, transportation and load-in.</td>
</tr>
<tr>
<td><strong>Substructure Removal</strong></td>
<td>Activities included are: removal preparation, removal, vessel, sea-fastening, transportation and load-in.</td>
</tr>
<tr>
<td><strong>Topsides and Substructure Onshore Recycling</strong></td>
<td>Activities included are: cleaning and handling of hazardous waste, deconstruction, reuse, recycle, disposal and waste management accounting (traceability of all streams).</td>
</tr>
</tbody>
</table>
### Subsea Infrastructure (pipelines, umbilicals)

Activities included are: vessel preparation for subsea end-state (remove, trench, rock-dump), sea-fastening and transportation, load-in, subsea project management, waste management accounting (traceability of all streams).

### Site Remediation

Activities included are: pile management, oil field debris clearance (500-metre zone and 200-metre pipeline corridor) and over-trawl surveys.

### Monitoring

Activities included are: navigation aids, maintenance and monitoring programme for any facilities that remain.

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Note: Although logistics (aviation and marine) are only itemised here for facility running/operator costs they should be assigned to each stage, as appropriate.
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ISBN 1 903 004 12 8
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