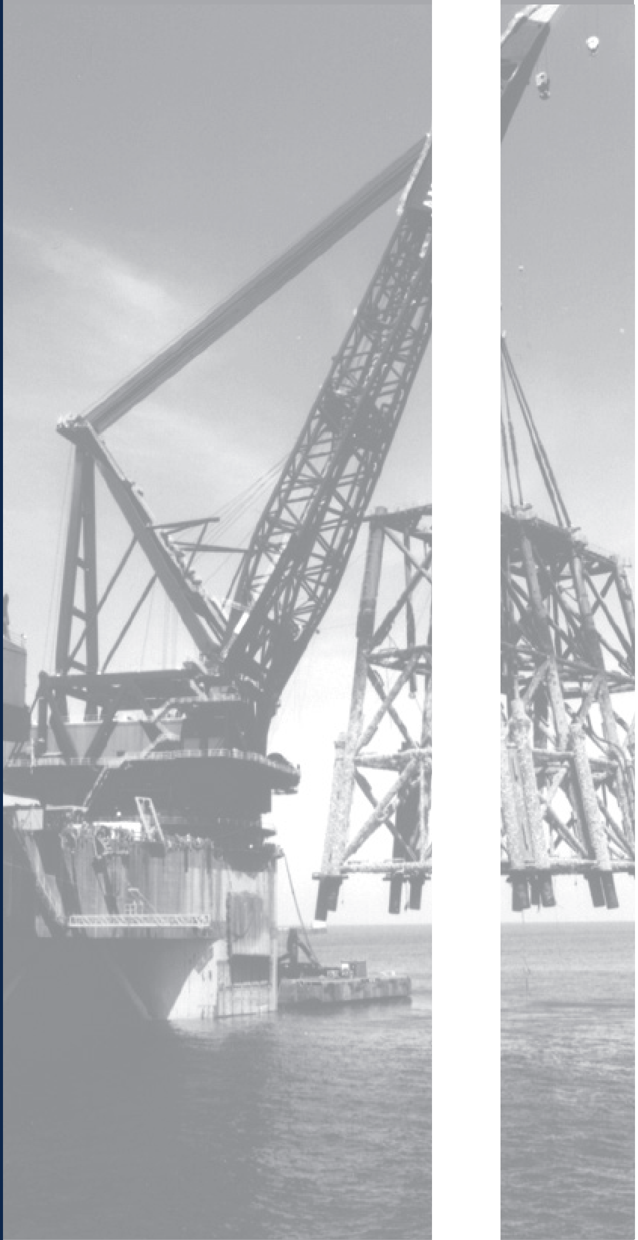
DECOMMISSIONING INSIGHT 2015



Oil & Gas UK
the voice of the offshore industry

DECOMMISSIONING INSIGHT 2015

OIL & GAS UK

Contents

1. Foreword

Oil & Gas UK's *Decommissioning Insight* is the leading forecast for decommissioning activity and expenditure on the UK Continental Shelf (UKCS). Produced annually over the last five years, the publication provides a ten-year forecast by region. The 2015 report focuses on the activities of 28 operators and offers insight to help the industry develop its capabilities in this emerging market.

The industry is forecast to spend a total of £16.9 billion over the next decade on the decommissioning of offshore oil and gas installations, wells, pipelines and other subsea infrastructure on the UKCS. This offers a significant commercial opportunity for the domestic supply chain, particularly those companies offering cost-efficient solutions. Developing new skills and technologies in this area will allow the supply chain to pioneer a comprehensive range of capabilities in the UK that can then be exported worldwide.

There are a small number of major decommissioning projects now under way. Upcoming projects listed on the Department of Energy & Climate Change's (DECC) Pathfinder website[1] include the Brae area, Brent, Miller, Murchison and Thames.

The offshore oil and gas industry delivers significant value to the UK, paying HM Treasury (HMT) £2.2 billion in corporate taxes on production in 2014-15, supporting around 375,000 highly skilled and well-paid jobs, and providing a secure domestic supply of primary energy. The UK-based supply chain is world-class, with a global reach for the export of its goods and services[2]. If the UK is to continue to derive maximum benefit from its oil and gas resource, it will be important that HMT, the Oil and Gas Authority (OGA) and industry work together to avoid premature decommissioning and make efforts to extend the productive life of existing assets to realise the UKCS' full potential.

With the inception of the OGA, it is expected that it will work with operators to agree field cessation of production (CoP) dates that support its underlying objective to maximise economic recovery from the basin. It aims to prevent the 'domino effect', where the decommissioning of one asset increases cost pressures on surrounding assets, potentially leading to their early CoP. Once the decision to decommission has been agreed, the OGA will work to ensure that decommissioning is carried out cost efficiently, that it complies with all environmental regulations and that the learnings are shared across the sector.

In addition to tax reforms announced this year to help attract new investment and government funding of seismic surveys to open up new areas for exploration, HMT is working with the OGA and industry on late-life business models and the barriers to cost-effective decommissioning, including fiscal issues.

While much is being done to extend the UKCS' productive life, decommissioning is an inevitable part of the production life cycle and must be undertaken in an environmentally sound, safe and cost effective manner, with existing efforts to improve the efficiency and reduce the costs of well plugging and abandonment being strengthened by the pan-industry Efficiency Task Force. The experience gained over the next decade will provide the UK supply chain with the opportunity to become word leaders in the field.

Oil & Gas UK would like to thank the operators who provided data to this survey. This document could only have been produced with their continued support.

Oonagh Wernger

Oonagh Werngren
Operations Director, Oil & Gas UK

[1] The DECC pathfinder website can be viewed at https://itportal.decc.gov.uk/pathfinder/decommissioningindex.html
[2] Oil & Gas UK's *Economic Report 2015* is available to download at www.oilandgasuk.co.uk/economicreport

2. Key Findings

- Actual expenditure on decommissioning on the UKCS in 2014 was just over £800 million, with much of the forecast activity completed[3].
- Total forecast decommissioning expenditure from 2015 to 2024 is £16.9 billion. This is an increase of £2.3 billion on the 2014 report's ten-year forecast of £14.6 billion, primarily due to 47 new projects entering this year's survey[4].
- The majority of new projects appear towards the end of the 2015 to 2024 timeframe, with nearly two-thirds of the associated expenditure occurring post-2020. Technological advances and improved production cost efficiency could defer the timing of decommissioning for these projects.
- Expenditure forecasts for existing projects, included in both the 2014 and 2015 surveys, have remained consistent. Future cost reduction can be anticipated as the low oil price, improved decommissioning experience and the work of Oil & Gas UK's Efficiency Task Force take full effect.
- Fifty per cent of the total forecast expenditure from 2015 to 2024 will be concentrated in the central North Sea (£8.4 billion). Thirty-two of the new projects are in this region.
- Since the 2014 report, total forecast expenditure in the central North Sea and the northern North Sea/west of Shetland regions has increased by £3 billion to £14.1 billion, and decreased by nearly £750 million to £2.8 billion in the southern North Sea and Irish Sea.
- Over the next decade, 79 platforms are forecast for removal across the UKCS. This represents almost 17 per cent of the some 470 installations that will require decommissioning over the next 30 to 40 years.
- The largest category of expenditure is well plugging and abandonment (P&A) at 46 per cent of the total forecast expenditure (£7.7 billion). Over 1,200 wells are forecast to be plugged and abandoned over the next decade, representing close to 30 per cent of the total number of wells on the UKCS that will eventually require decommissioning.

[3] This survey covers data from end-of-field-life decommissioning projects and does not include expenditure or activity associated with mid-life decommissioning.

[4] The 2014 survey covers the timeframe 2014 to 2023 and the 2015 survey covers the timeframe 2015 to 2024.

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Forecast Activity 2015 to 2024			
	Central and Northern North Sea/West of Shetland	Southern North Sea and Irish Sea	Total UK Continental Shelf
Number of wells for plugging and abandonment	950	274	1,224
Proportion of wells that are platform wells	55%	73%	-
Topside modules to be removed	255	66	321
Topside weight to be removed	288,000 tonnes	78,890 tonnes	366,890 tonnes
Number of platforms	22	57	79
Substructure weight to be removed	105,140 tonnes	46,200 tonnes	151,340 tonnes
Number of mattresses to be removed	6,145	3,350	9,495
Subsea infrastructure to be removed	80,230 tonnes	2,250 tonnes	82,480 tonnes
Number of pipelines to be decommissioned	598	179	777
Length of pipelines to be decommissioned	2,189 kilometres	3,429 kilometres	5,618 kilometres
Total tonnage coming onshore	492,250 tonnes	127,330 tonnes	619,580 tonnes

Average Forecast of Costs from 2015 to 2024 in the Central and Northern North Sea/West of Shetland		
	2014 Survey	2015 Survey
Platform well P&A	£4.8 million	£4.1 million
Subsea exploration and appraisal well P&A	£17.4 million	£7.8 million
Subsea development well P&A	£11.6 million	£9.9 million
Topside removal cost per tonne	£2,900	£3,300
Substructure removal cost per tonne	£4,300	£4,800

Average Forecast of Costs from 2015 to 2024 in the Southern North Sea and Irish Sea		
	2014 Survey	2015 Survey
Platform well P&A	£2.7 million	£3 million
Subsea exploration and appraisal well P&A	£5 million	£8.8 million
Subsea development well P&A	£7.6 million	£9.6 million
Topside removal cost per tonne	£4,000	£4,600
Substructure removal cost per tonne	£4,500	£4,400

Some of the average cost forecasts are significantly different to those presented in the 2014 survey. These changes will be discussed in section 7.

3. Introduction

3.1 Survey Development and Methodology

The *Decommissioning Insight 2015* is compiled from the responses of 28 companies operating on the UKCS to an Oil & Gas UK survey carried out between June and September 2015. The survey asked operators to provide data on their actual decommissioning spend and activity on the UKCS in 2014 and forecasts for the period 2015 to 2024[5].

Following industry feedback, the 2015 report has been expanded to include:

- The impact of the oil price on decommissioning
- A more in-depth analysis of FPSO (floating, production, storage and offloading vessel) decommissioning projects
- Analysis of the forecast cost per tonne for 'making safe' of facilities for removal

The survey structure is based on the components of the decommissioning Work Breakdown Structure outlined in Oil & Gas UK's *Decommissioning Cost Estimation Guidelines*[6]. Further information on the survey methodology can be found in the Appendix.

The information presented in this report is on a non-attributable and aggregated basis. Oil & Gas UK has not applied any additional conditioning to the figures. Analysis has been carried out on a regional basis and split into two groups: the central and northern North Sea/west of Shetland and the southern North Sea and Irish Sea. Wherever possible, these groups have been split further. Where specific projects are referred to, this information has been gathered from publically available sources.

Following requests from industry, Oil & Gas UK is also surveying decommissioning activity in Norway, which will be reported separately. When combined, this will provide a more comprehensive picture of forecast decommissioning activity across the North Sea.

3.2 Decommissioning Forecasting

Planning for decommissioning can be a long and challenging process that operators start well before cessation of production (CoP). Over time, the scope of each project is refined as comparative assessments are carried out to determine the optimum approach. Forecasting decommissioning expenditure at the outset of a project is therefore challenging. There are also many uncertainties and factors influencing expenditure, such as the duration of well plugging and abandonment (P&A) or the quantities of hazardous waste materials. As the field nears CoP and the project scope becomes more fully defined, expenditure forecasts become firmer.

In the survey, operators were asked to provide a project cost class estimate using the Association for the Advancement of Cost Engineering (AACE) guidelines (see Appendix) for all of their projects.

Ninety-seven per cent of the projects reported in the survey were classified using the AACE Cost Estimation Classification Matrix. Of these, just over half were reported as a class 5 and 38 per cent reported as a class 4. These will have project definition levels from 0 to 15 per cent, revealing that 90 per cent of projects are in the early planning stages of outlining the scope of decommissioning activities and carrying out feasibility studies. There is, therefore, a degree of uncertainty in activity and expenditure forecasts included in the report, particularly for projects towards the end of the survey timeframe.

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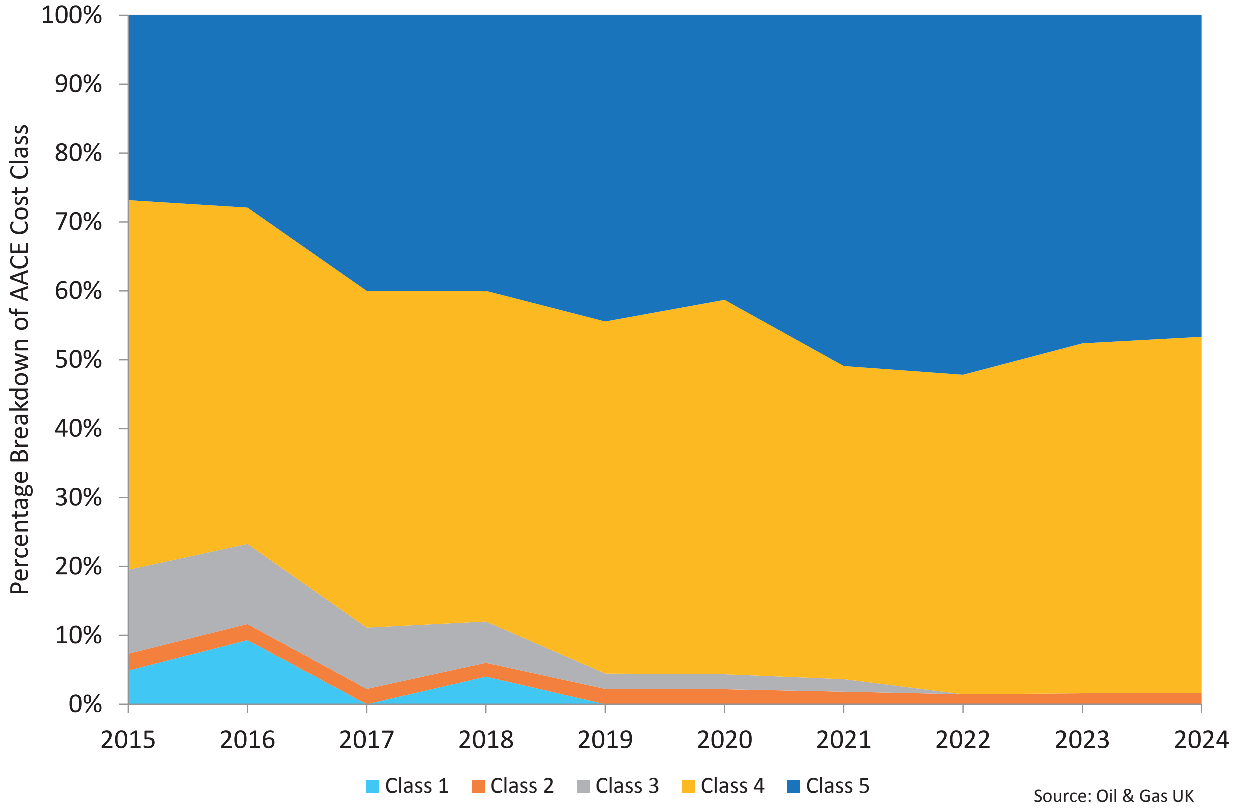
[5] This survey covers data from end-of-field-life decommissioning projects and does not include expenditure or activity associated with mid-life decommissioning.

[6] The *Decommissioning Cost Estimation Guidelines* are available to download at http://bit.ly/1K5Rhzs

Only five per cent of projects were reported as class 1 or 2, where the level of project definition is between 30 and 100 per cent and they are either at the contracting stage or already in execution. Projects that have a class 1 classification have typically already contracted out all of the work and are found in the near-term of the survey timeframe, that is, before 2020.

The following figure shows the percentage of projects that fall into each cost class level by year. Projects that span multiple years are counted in each year that they incur spend.

Figure 1: AACE Cost Class Breakdown by Year



4. 2015 Decommissioning Survey Results

The total forecast decommissioning expenditure on the UKCS between 2015 and 2024 is £16.9 billion[7], compared to the ten-year forecast of £14.6 billion in the *2014 Decommissioning Insight*[8]. This increase is primarily due to new projects entering the survey timeframe rather than increased cost estimates from existing projects.

Although decommissioning is still in its infancy on the UKCS, it is a growing area of the business. Accounting for just over three per cent of total expenditure in 2014, this is expected to rise to around 12 per cent by 2018.

4.1 Annual Forecast Expenditure

Data from previous *Decommissioning Insight* reports (2011 to 2015) have been used to compare annual forecast expenditure. As illustrated in Figure 2 overleaf, deferral of decommissioning activity has caused a fall in annual forecast expenditure from 2015 to 2017, compared to figures published last year. Expenditure has smoothed out and now peaks later. £1.1 billion is now forecast to be spent on decommissioning in 2015 rising to £1.9 billion in 2018.

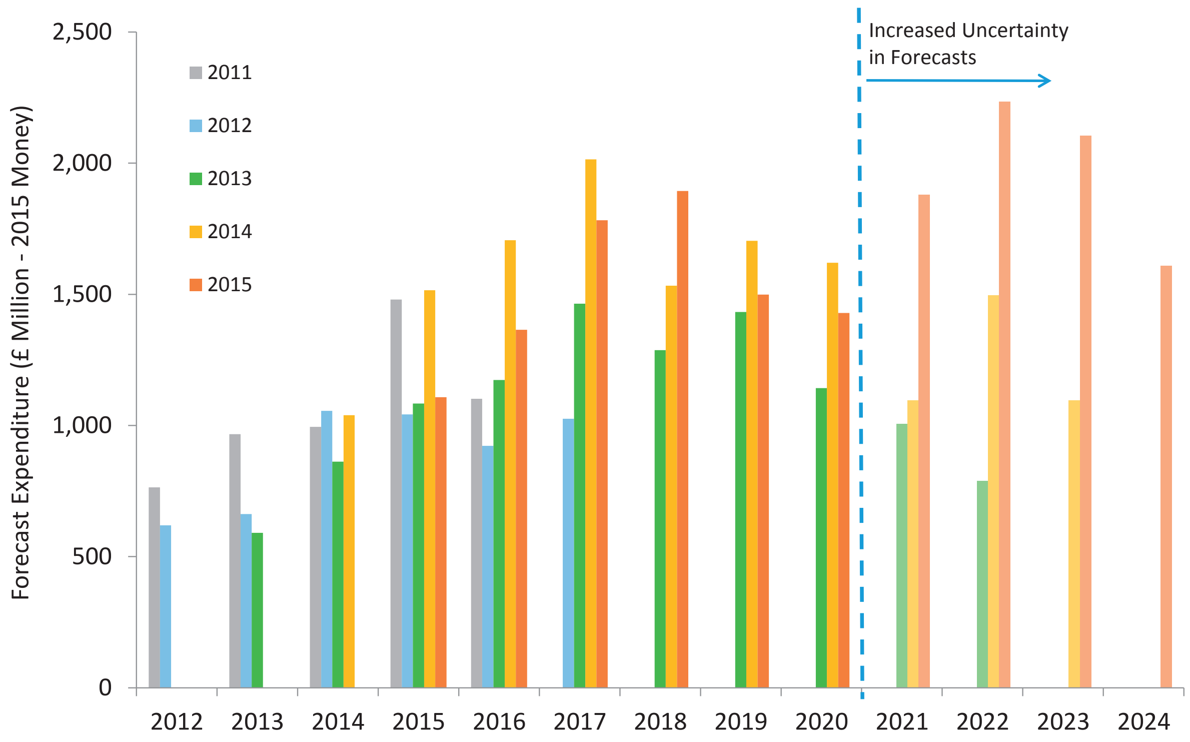
There is, however, a large increase in forecast expenditure post-2020 compared to last year's report. This is due to the influx of new projects and has caused a peak in 2022 of £2.2 billion.

Overall, the average yearly forecast expenditure is now around £1.7 billion, an increase on the £1.5 billion reported in 2014. This is due to new projects causing higher activity forecasts over the decade.

It is important to note that the forecast expenditure is subject to change as the scope of decommissioning projects becomes more defined over time, particularly post-2020. Oil & Gas UK expects forecasts to smooth out as they are revisited in subsequent surveys (see section 3.2 for more details).

[7] This does not include expenditure associated with decommissioning onshore terminals.
[8] The 2015 survey covers the timeframe 2015 to 2024, whereas the 2014 survey covered the timeframe 2014 to 2023.

Figure 2: Comparison of the Annual Forecast Decommissioning Expenditure

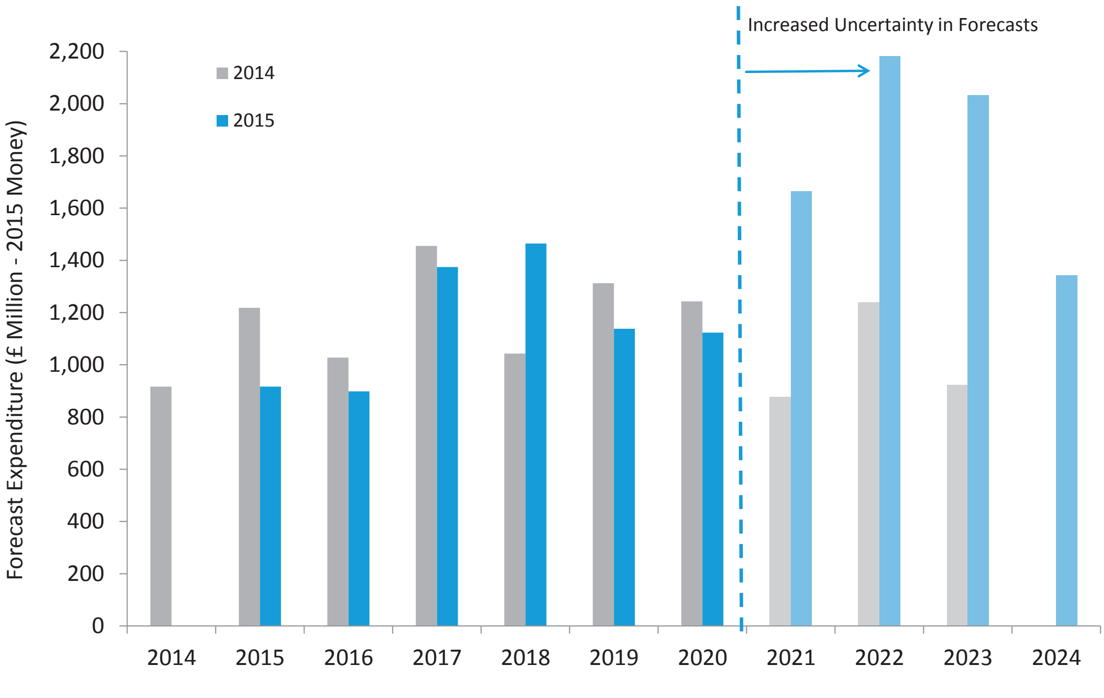


Source: Oil & Gas UK

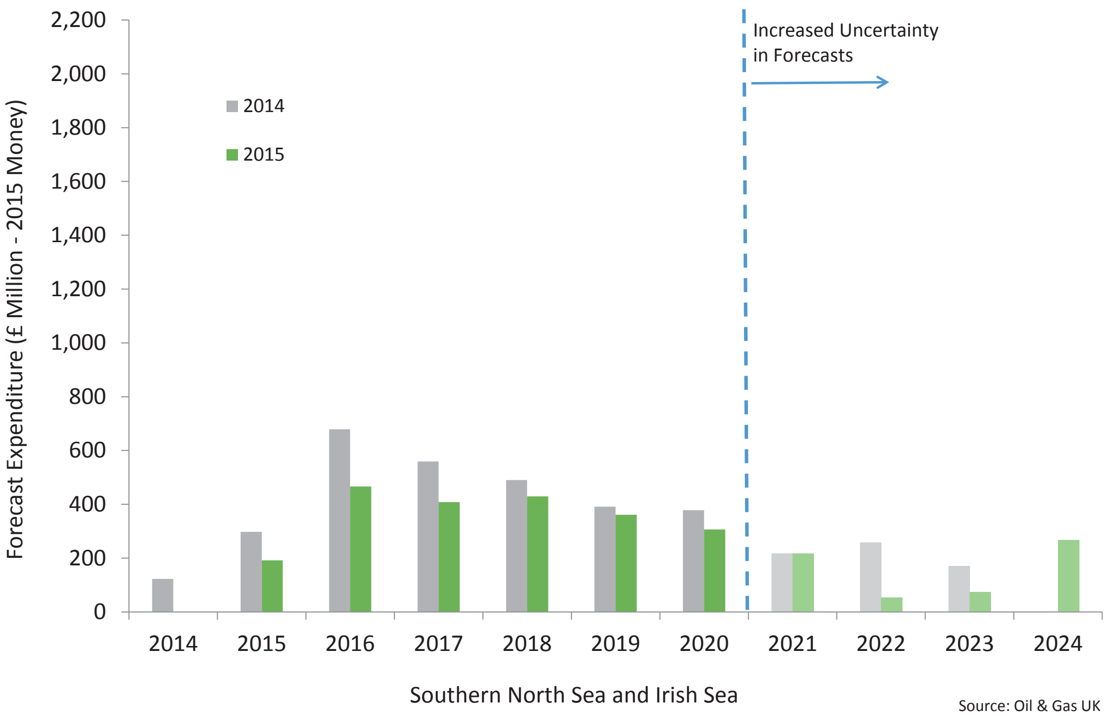
4.2 Regional Breakdown

Looking at the regional breakdown of decommissioning expenditure from 2015 to 2024, 50 per cent (£8.4 billion) is forecast to be spent in the central North Sea (CNS) and 34 per cent (£5.7 billion) in the northern North Sea (NNS) and west of Shetland (WofS). The higher proportion of expenditure in these regions reflects the number, size and degree of complexity of the projects. Sixteen per cent (£2.8 billion) is, meanwhile, forecast to be spent in the southern North Sea (SNS) and Irish Sea.

Figure 3: Comparison of Forecast Decommissioning Expenditure



Source: Oil & Gas UK



Source: Oil & Gas UK

Forecast Expenditure	Central and Northern North Sea/West of Shetland	Southern North Sea and Irish Sea
2014 Report	£11.1 billion	£3.5 billion
2015 Report	£14.1 billion	£2.8 billion

Central and Northern North Sea/West of Shetland

Total forecast decommissioning expenditure in these regions has increased by £3 billion to £14.1 billion. The rise in expenditure of £3.9 billion that is largely driven by 41 new projects of varying sizes has been partially offset by a decline of £850 million due to 14 projects being deferred outside, or partially outside, the survey timeframe (2015 to 2024). The shift in these 14 projects reflects efforts to extend field life or defer decommissioning expenditure to improve cash flow in the current climate, and is contributing to the decline in forecast expenditure seen between 2015 and 2017, in Figure 3 on the previous page.

The majority of new projects entering the survey, meanwhile, appear towards the end of the timeframe and in the CNS area. The largest increase in forecast expenditure is in that region at £2.1 billion. The deferral of projects that previously appeared in the near-term has also contributed to the increased expenditure post-2020.

There is also a significant rise (see section 7) in the volume of material to be decommissioned in the CNS, NNS and WofS regions within the survey timeframe compared to figures published in the 2014 report, particularly in the number of mattresses and length of pipeline. Most of this increase is again forecast in the second half of the survey timeframe and attributed to the new projects. Some operators have, this year, provided a more detailed schedule of decommissioning activity than in previous years, further contributing to the rise in volume to be decommissioned.

Southern North Sea and Irish Sea

Forecast expenditure over the next decade in these regions has decreased by £745 million to £2.8 billion. While six new projects have entered the survey, contributing nearly £120 million of expenditure, this is offset by a reduction of £860 million as seven projects move partially or completely out of the timeframe. Operators report that they are focused on maximising economic recovery and are investing significant effort and capital into extending field life, which has caused these projects to be deferred.

Furthermore, when ownership of an asset changes, it takes the new owner some time to work through the decommissioning plans. This not only causes projects included in the survey to shift, but can also result in decommissioning being deferred. This has been reflected in the SNS/Irish Sea data.

4.3 Oil Price Impact

Operators begin planning for decommissioning far ahead of CoP. The complex decision on the timing of CoP is made by the operator in conversation with industry regulators and takes many factors into account, including future prospects, oil price and the wider business environment.

Survey results show that 57 per cent of projects in the CNS and NNS/WofS regions and 44 per cent of projects in the SNS and Irish Sea have been influenced by the lower oil price. In some cases, this has brought new projects into the survey timeframe (2015 to 2024). For example, the oil price and wider business environment on the UKCS has led operators to consider decommissioning plans more robustly, incurring forecast expenditure in this area towards the end of the survey timeframe. In other instances, the decrease in oil price has actually brought forward the expected CoP date and decommissioning. Fairfield Energy recently announced its decision to decommission the Dunlin cluster, citing the depressed oil price and “challenging operational conditions” among the reasons.

However, even though the impact of the lower oil price can be clearly seen, not all new projects are a direct consequence of the fall in oil price. Operators report that some activity was just outside the 2014 survey timeframe and its inclusion in this year's report is unrelated to changes in the market.

Although, it is possible that the full impact of the oil price cycle is not yet fully reflected in the data. Forecasts for decommissioning are updated at different times during the year, using assumptions on future oil price, operating costs and recovery levels to determine a field's economic limit. A prolonged period of low oil prices could result in more companies electing to cease production and decommission their fields.

The impact of the oil price fall could, however, be partially offset by increased industry focus on efficiency improvements, which is expected to result in an average 22 per cent reduction in the cost of operating existing fields by the end of 2016. These potential gains could maintain the economic viability of some fields[9].

4.4 Forecast Expenditure by Decommissioning Component

Decommissioning expenditure is categorised according to components referenced in the Work Breakdown Structure (see section 3.1 and the Appendix for more on the survey methodology). The components that incur expenditure are determined by the size and type of the project. A large, complex decommissioning project, for example, may incur costs across all categories. Projects such as these will involve significant overheads for project management and operational costs, as well as requiring substantial engineering expertise, equipment and personnel. In contrast, decommissioning a small subsea tie-back may only involve single well P&A.

Figure 4 overleaf breaks down the annual forecast expenditure into three categories:

i. Operator project management/facility running costs (owners' costs)

ii. Well P&A

iii. Removal and other associated activity

Owners' costs are expenses incurred to operate the decommissioning programme post-CoP through to completion. These costs include management of the facility in both the pre-normally unmanned installation (Pre-NUI) and NUI stages, as well as for logistics, a decommissioning team, deck crew, power generation, platform services, integrity management (inspection and maintenance) and specialist services.

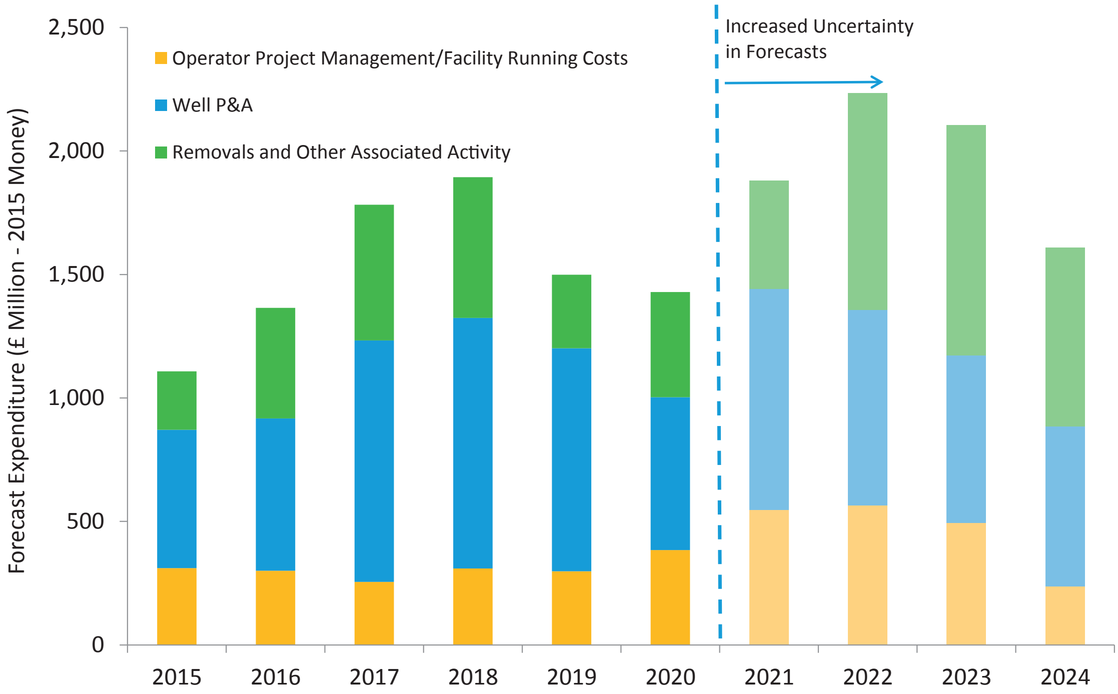
The owners' costs are forecast to remain relatively stable across the timeframe, with an average annual expenditure of just over £370 million. They gradually increase to a peak in 2022 compared to the peak in 2015 forecast last year. This shift reflects the deferral of some existing projects and new projects entering towards the end of the survey timeframe.

Well P&A costs include rig upgrades, studies to support well programmes, well suspension, wells project management, operations support, and specialist services such as wireline or conductor recovery. This spend is forecast to peak in 2018, with an average of just over £770 million per year over the ten-year timeframe. This compares to an annual average of £640 million in last year's report, with the increase primarily due to a large rise in such activity in the CNS and NNS/WofS regions.

[9] Oil & Gas UK's *Economic Report 2015* is available to download at www.oilandgasuk.co.uk/economicreport

Removal and other associated activity includes expenditure on ‘making safe’; topsides preparation; removal of topsides, substructures and subsea infrastructure; pipeline decommissioning; disposal; recycling; site remediation and monitoring. Expenditure from 2015 to 2024 associated with this activity is forecast to be lower in the short term, increasing towards the end of the survey timeframe. The annual average forecast expenditure is £550 million.

Figure 4: Total Forecast Decommissioning Expenditure by Work Breakdown Structure Category



Source: Oil & Gas UK

	Expenditure 2015 to 2024
Operator project management/facility running costs	£3.7 billion
Well P&A	£7.7 billion
Removal and other associated activity	£5.5 billion

Figure 5 overleaf breaks down the total forecast expenditure by Work Breakdown Structure component proportion for all UKCS projects, subsea projects, platform removal projects and FPSO vessel projects. It is important to note that the graphs only include the breakdown of expenditure that falls within 2015 to 2024. Decommissioning projects can span a number of years and therefore some expenditure associated with a project may fall outside the survey timeframe.

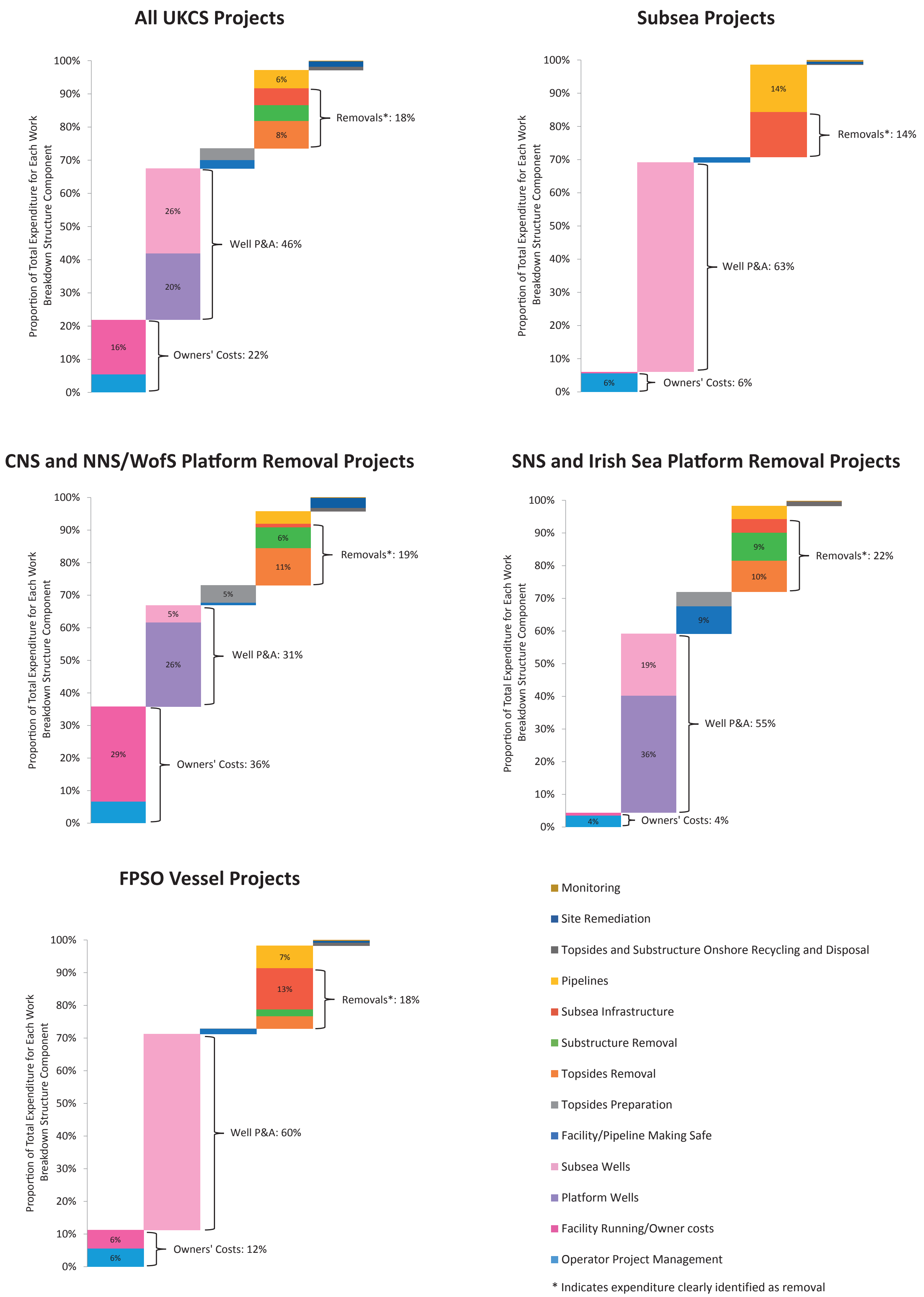
In line with previous reports, well P&A remains the largest category of forecast expenditure, accounting for 46 per cent (£7.7 billion) of the total. For subsea projects, this proportion rises to 63 per cent compared to six per cent for owners' costs.

Ninety-seven per cent (£3.6 billion) of the total owners' costs are concentrated in the CNS and NNS/WofS regions. In these areas, more platforms are typically manned resulting in much higher facility running costs and projects are also larger and more complex, with, in turn, higher operator project management costs. The owners' costs account for 36 per cent (£2.9 billion) of expenditure on platform removal projects in these regions compared to four per cent (£115 million) in the SNS and Irish Sea regions.

Removals expenditure (topsides, substructure and subsea infrastructure) accounts for 19 per cent (£1.6 billion) of the total expenditure in the CNS and NNS/WofS regions and 22 per cent (£590 million) in the SNS and Irish Sea. This is due to the lower proportion of expenditure on owners' costs in the SNS and Irish Sea areas.

Decommissioning a field serviced by an FPSO primarily involves subsea activity, although some expenditure is also associated with disconnecting the FPSO. These activities are reflected in the breakdown of expenditure seen in Figure 5. The total forecast decommissioning expenditure for fields serviced by an FPSO is £2 billion, almost all of which will be spent in the CNS and NNS/WofS regions. Sixty per cent of these costs are attributed to well P&A and 13 per cent due to subsea infrastructure removal. Removal of substructure refers to structures such as anchor points that are used to fix the vessel to the seabed and subsea templates.

Figure 5: Forecast of Total Decommissioning Expenditure by Work Breakdown Structure Component and Project Type from 2015 to 2024



5. Actual Decommissioning Expenditure and Activity in 2014

Analysis was carried out to assess actual decommissioning activity in 2014 versus forecasts.

Figure 6: Forecast versus Actual Decommissioning Activity

Decommissioning Activity	2014 Forecast Activity	2014 Actual Activity
Platform well P&A	37	30
Subsea well P&A	19	20
Mattresses	11	11
Subsea infrastructure	253 tonnes	253 tonnes
Pipelines	27 kilometres	0.2 kilometres
Number of modules for 'making safe'	33	34
Number of modules for topside preparation	5	0
Tonne of topsides to be removed	10,000 tonnes	0
Tonnes of substructure to be removed	3,000 tonnes	0

Much of the planned decommissioning activity was undertaken last year. The forecast expenditure on decommissioning for 2014 was £1 billion compared to the actual expenditure of just over £800 million.

Activities that were not carried out have been postponed to this year or until later in the decade. In some cases, this could reflect the current market and the need to defer decommissioning expenditure to improve cash flow.

6. Supply Chain Capability

With over £800 million spent on decommissioning on the UKCS in 2014 (see section 5) and £16.9 billion forecast to be spent in total over the next ten years, decommissioning offers a significant opportunity for the UK supply chain to develop skills, technologies and expertise that can also be exported worldwide.

A small number of large decommissioning projects are already under way, while 95 per cent of projects included in this survey are in the early planning stages and will move towards the contracting stage within the next few years.

Companies and local authorities are preparing for this growth in the market by investing in new decommissioning facilities and extending harbours and ports. Aberdeen harbour, for example, is being expanded to include additional facilities at Nigg Bay, with heavy-lift capabilities and the ability to accommodate larger vessels[10]. The Lerwick Port Authority is also investing around £30 million into extending its quays and developing deep-water berths. It believes this expansion will make Lerwick well placed to take on further decommissioning work[11]. Montrose Port Authority will be investing £15 million to build on previous upgrades to the harbour to include more deep-water berths and heavy-lift pads[12]. Also, Peterson and Veolia are developing a £1 million decommissioning facility in Great Yarmouth to make this area the centre for decommissioning in the SNS region[13].

These investments will help establish the UK as a hub for decommissioning expertise and capability. A key element in developing the supply chain's future capability will be co-operative working practices to create innovative solutions to undertake decommissioning in an environmentally sound, safe and cost-effective manner.

[10] www.aberdeen-harbour.co.uk/future/nigg-bay-development/project-progress
[11] www.lerwick-harbour.co.uk/quay-contract-dalesv
[12] www.montroseport.co.uk/news
[13] www.onepeterson.com/en/news and www.veolia.co.uk/media/media

7. Decommissioning Activity Forecast 2015 to 2024

The following sections focus on specific areas of decommissioning activity.

7.1 Well Plugging and Abandonment

The purpose of well P&A is to isolate the reservoir fluids within the wellbore and from the surface or seabed. This activity is carried out on the UKCS in accordance with industry guidelines[14] and legislation[15] and can be challenging. It may involve intervention; the removal of downhole equipment, such as production tubing and packers; and well-scale decontamination treatment. The process also requires the wellhead and conductor to be removed to three metres below the seabed.

Well P&A is the largest component (46 per cent) of decommissioning expenditure in the UKCS over the next decade and is forecast to cost £7.7 billion in total over this period with 1,224 wells scheduled for P&A. This represents close to 30 per cent of the some 4,300 wells that will eventually require decommissioning in the basin.

This survey covers three types of wells: platform wells; subsea development wells; and suspended subsea exploration and appraisal (E&A) wells.

7.1.1 The Central and Northern North Sea/West of Shetland

Between 2015 and 2024, 950 wells are forecast to be plugged and abandoned in these regions. This is an increase of over 400 wells compared to the 2014 report, primarily due to the 41 new projects entering the survey in these regions, the majority of which are concentrated in the CNS.

The rise in total forecast expenditure on well P&A in these regions by £1.5 billion to £6.2 billion is small in comparison to this growth in activity. This points to the relatively low expenditure forecasts for a number of the new projects as some of the wells will be simple P&As and are cheaper to perform. Deflated rig rates in the current climate may also be reflected in these expenditure forecasts.

The majority of the increase in activity is concentrated towards the end of the survey timeframe, although there are additional wells in the nearer term. In 2021, 153 new wells are forecast to be plugged and abandoned. This peak is due to 27 fields scheduling well P&A at the same time. It is expected that this activity will smooth out as forecasts are revisited to balance the demand for vessels and personnel that carry out the work.

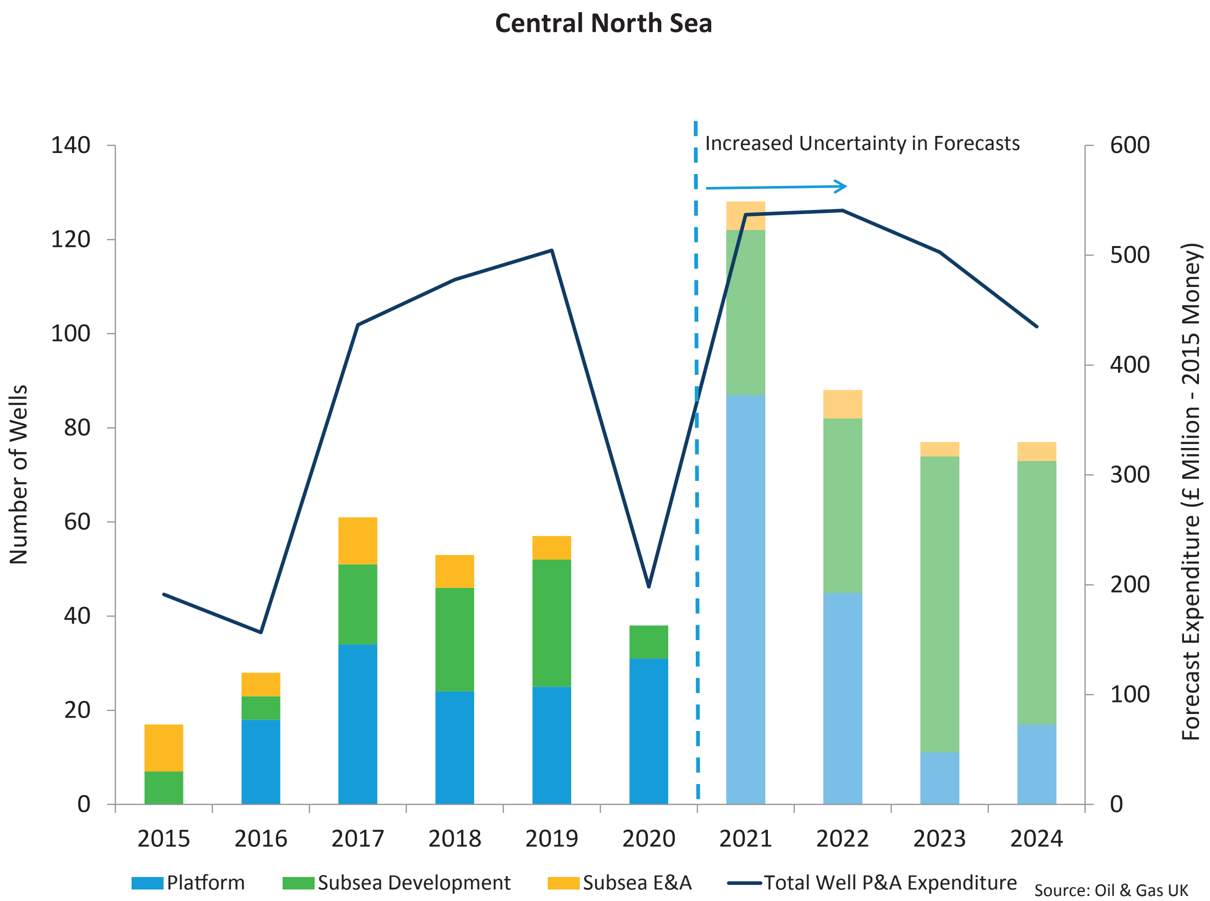
[14] *Guidelines on the Abandonment of Wells and Qualification of Materials for Abandonment* are available to download at http://oilandgasuk.co.uk/product/op105 and http://oilandgasuk.co.uk/product/op109

[15] See www.legislation.gov.uk/uksi/1996/913/made

As seen in Figure 7, activity in the CNS is forecast to peak in 2021 and remain high thereafter. By contrast, activity in the NNS/WofS regions is forecast to be higher in the near-term, dropping off towards the end of the timeframe. The proportion of platform wells in the CNS is much lower than all the other regions of the UKCS.

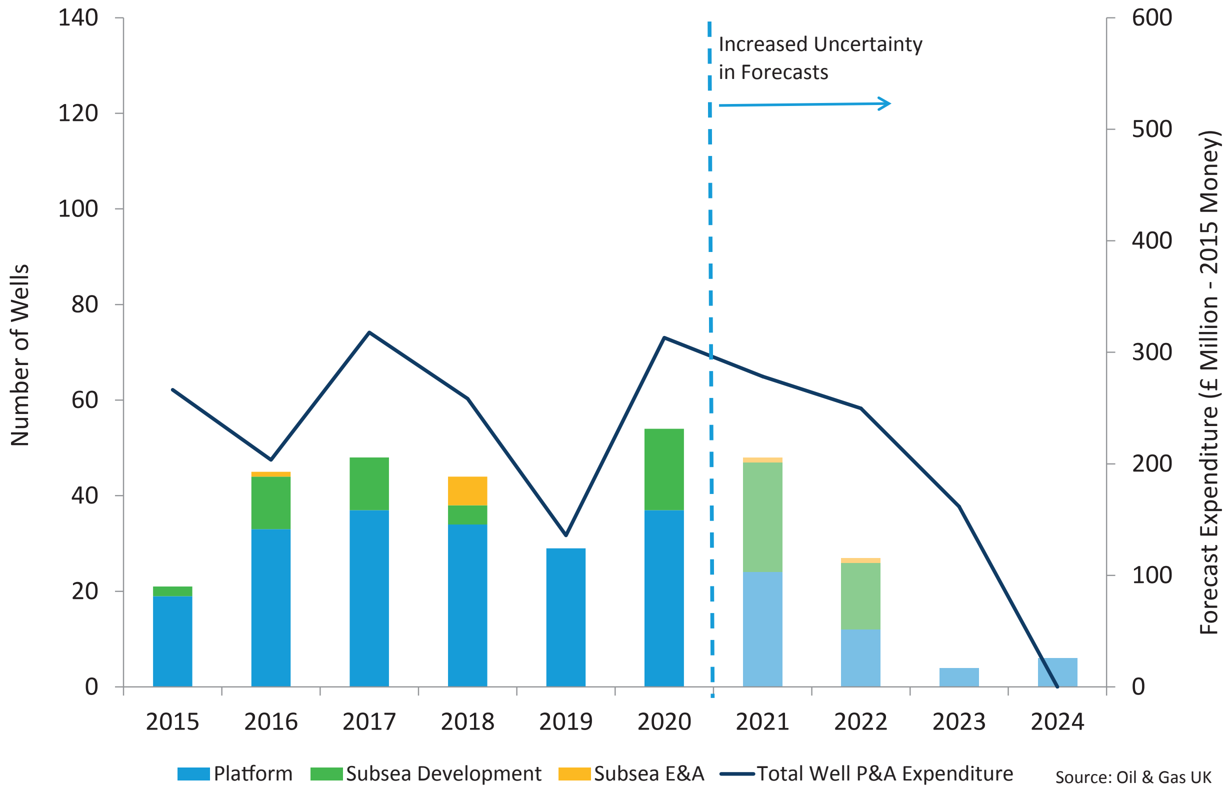
Forecast expenditure, however, does not closely correlate with these levels of activity, but is influenced by the type of wells. Years with a greater proportion of subsea wells typically have higher expenditure as these wells are relatively more expensive to plug and abandon. Furthermore, the complexity of the wells to be plugged and abandoned in a year can also influence expenditure.

Figure 7: Number of Wells Forecast to be Plugged and Abandoned by Type and Annual Expenditure



Source: Oil & Gas UK

Northern North Sea and West of Shetland



	Number of Wells 2015 to 2024	Total Expenditure 2015 to 2024	Proportion of Platform Wells
Total	950	£6.2 billion	55%
CNS	624	£4 billion	47%
NNS/WofS	326	£2.2 billion	72%

Historical Variation in Cost Forecasts

The cost of well P&A is dependent on a number of factors, including water depth, weather, complexity, the well's age and potentially measures that may be required to prevent well collapse caused by depressurisation.

As seen in Figure 8 opposite, the average and range of expenditure forecasts for platform well P&A are lower than for both types of subsea wells. Platform wells are typically not subject to the same weather constraints or rig requirements and are therefore cheaper to perform. Platform well P&A can also be carried out more easily in batches or campaigns, allowing the operator to share mobilisation costs and other efficiency gains across a number of wells.

A wide range in expenditure forecasts for subsea wells has been reported consistently over the last three survey years. This reflects variations in the types of wells. Operators have advised that wells at the low end of the cost range are typically simple, rig-less P&As, using wireline, pumping or crane jacks where the reservoir may already have been isolated. Wells at the top of the cost range are typically complex, rig-based P&As, with challenging access and cementing. They may require retrieval of tubing and casing, milling and cement repairs.

The average expenditure forecast for all well types has decreased since the 2014 report by varying degrees. The significant drop in average forecast expenditure for suspended subsea E&A wells is due to a number of new wells with relatively lower expenditure forecasts, and brings it back in line with the forecasts seen in 2013.

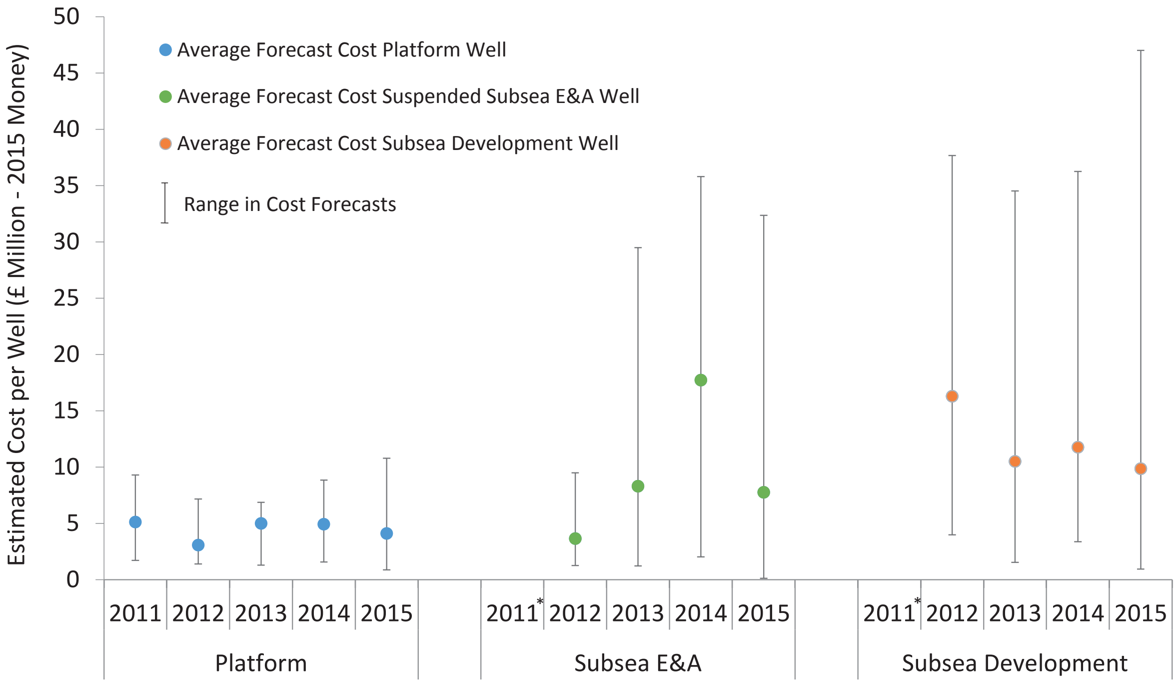
For subsea development wells, the average has slightly decreased while the range has widened. For some of the wells at the top of the cost range, forecasts have been revised up and operators who have carried out well P&A report that there can be unexpected problems with the condition of the well, also highlighting the potential savings that can be gained from effective logistics planning. Several of the lower cost wells are new, also widening the cost range and bringing the average forecast expenditure down.

The lower average well costs forecast in this year's survey may also reflect the fall in rig rates. From January 2014 to July 2015, the day-rates for semi-submersible rigs fell by around 40 per cent, while day-rates for jack-up rigs declined by a lesser extent[16]. However, cost estimation methods vary across operators, with some using historic averages to forecast future costs. Operators also update their cost estimates at various times during the year, so it is possible that the lower rig rates have not yet been fully reflected in the forecasts.

Oil & Gas UK is working co-operatively with industry, through its Efficiency Task Force, to explore measures that will improve efficiencies and reduce well P&A costs. As the largest category of decommissioning expenditure, there are substantial gains to be made by reducing costs while maintaining high health, safety and environmental standards.

[16] Oil & Gas UK's *Economic Report 2015* is available to download at www.oilandgasuk.co.uk/economicreport

Figure 8: Historical Variation in Well Plugging and Abandonment Cost Forecasts in the Central and Northern North Sea/West of Shetland



* Data cannot be split out for subsea E&A and development wells for 2011

Source: Oil & Gas UK

Well P&A	2014 Average	2015 Average
Platform wells	£4.8 million	£4.1 million
Subsea E&A wells	£17.4 million	£7.8 million
Subsea development wells	£11.6 million	£9.9 million

7.1.2 The Southern North Sea and Irish Sea

Between 2015 and 2024, 274 wells are forecast to be plugged and abandoned in these regions. This is a decrease of 143 wells on the 2014 report, as seven projects are deferred and therefore move partially or completely outside of the survey timeframe while operators work to maximise economic recovery and extend field life or postpone decommissioning expenditure to improve current cash flow.

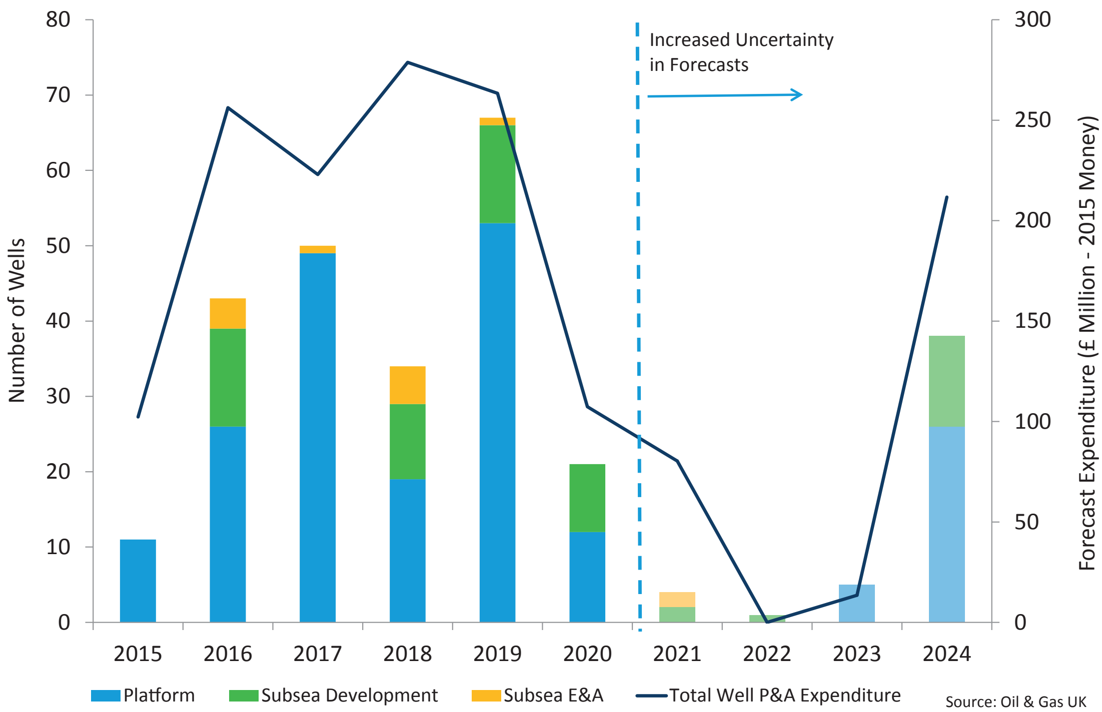
The associated expenditure for well P&A in these regions has therefore also fallen by £200 million to £1.5 billion. The decline in the forecast is relatively small compared with the anticipated fall in activity as the average costs for well P&A in these regions have been revised up, as seen in Figure 10 opposite.

Figure 9 shows that the majority of activity in the SNS and Irish Sea is concentrated in the first half of the survey timeframe, where there has been a slight increase in well P&A activity. This reflects how some operators are consolidating well P&A activity for their projects into fewer years than previously forecast.

By contrast, the forecast towards the end of the timeframe has reduced as projects are deferred, highlighting the level of uncertainty in forecasts towards the end of the decade. Oil & Gas UK expects that activity will smooth out more evenly across the ten-year timeframe as forecasts are revisited.

As in the CNS and NNS/WofS regions, the years with higher subsea well P&A activity tend to have relatively higher expenditure forecasts as these wells are more expensive to plug and abandon.

Figure 9: Number of Wells Forecast to be Plugged and Abandoned by Type and Total Annual Expenditure in the Southern North Sea and Irish Sea



Source: Oil & Gas UK

Number of Wells 2015 to 2024	Total Expenditure 2015 to 2024	Proportion of Platform Wells
274	£1.5 billion	73%

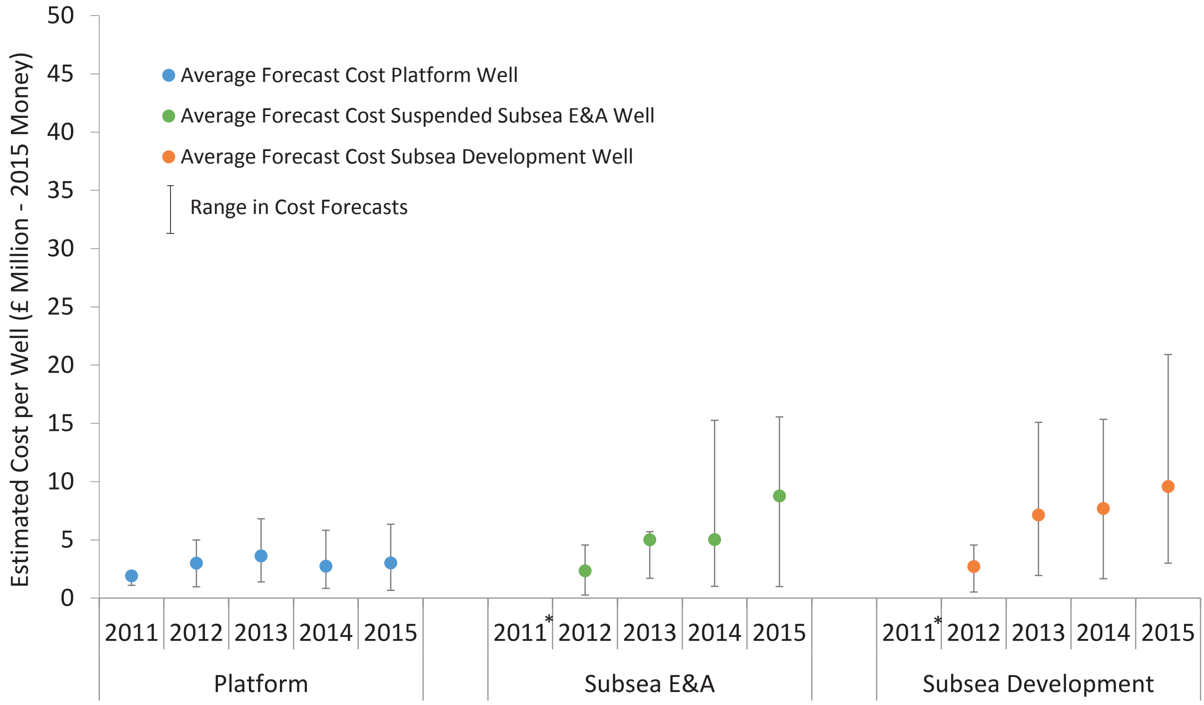
Historical Variation in Cost Forecasts

The average and range of cost forecasts for platform well P&A in the SNS and Irish Sea have remained relatively stable over the last five surveys.

For suspended subsea E&A and subsea development wells, average forecast costs have increased consistently over the last four years, as some operators revise their forecasts upwards based on experience gained in well P&A. A number of wells with lower costs that were previously included in the survey are deferred and move out of the timeframe, increasing the average for both types of subsea well. In the SNS and Irish Sea, recent reductions in rig rates driven by the current low oil price have not yet been detected in these expenditure forecasts.

As in the CNS and NNS/WofS regions, the average and range of expenditure forecasts for platform well P&A are lower than for the subsea wells.

Figure 10: Historical Variation in Well Plugging and Abandonment Cost Forecasts in the Southern North Sea and Irish Sea



*Data cannot be split out for subsea E&A and development wells for 2011

Source: Oil & Gas UK

Well P&A	2014 Average	2015 Average
Platform wells	£2.7 million	£3 million
Subsea E&A wells	£5 million	£8.8 million
Subsea development wells	£7.6 million	£9.6 million

7.1.3 Rig Type

There are a number of methods that can be used for platform well P&A and the rig type will depend on whether the original drilling derrick is in place and the water depth where the platform is located.

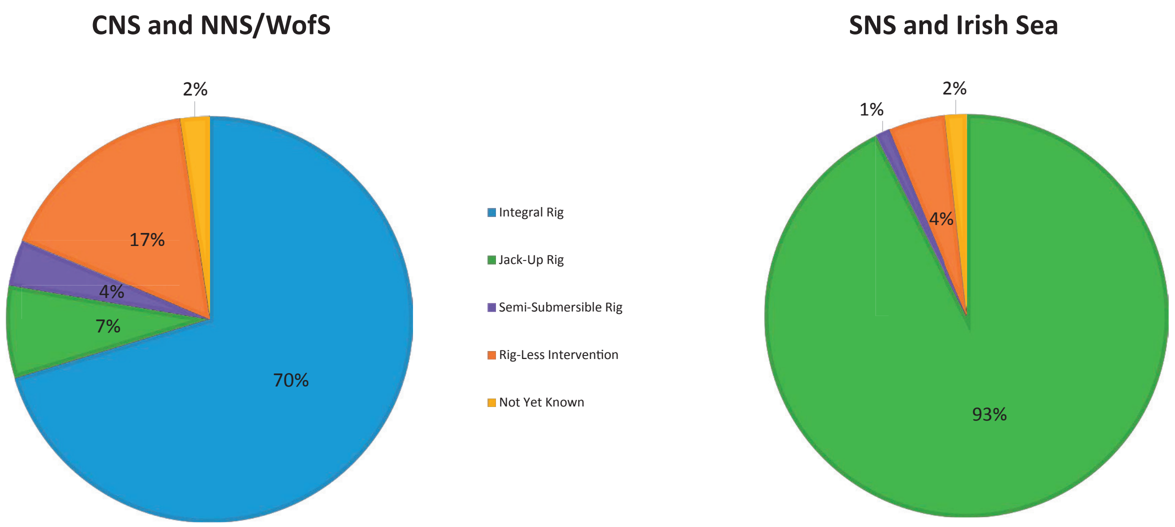
Platform wells are typically plugged and abandoned in phases. The first phase can be rig-less and uses lower cost methods such as wireline, coil tubing or a hydraulic workover unit. This is followed by the second and third phases that are more likely to require a rig.

In the CNS and NNS/WofS areas, the majority of platform wells (70 per cent) will be plugged and abandoned using an integral platform rig. By contrast, jack-up rigs are most commonly used (93 per cent) in the SNS and Irish Sea as many of the platforms do not have integral rigs.

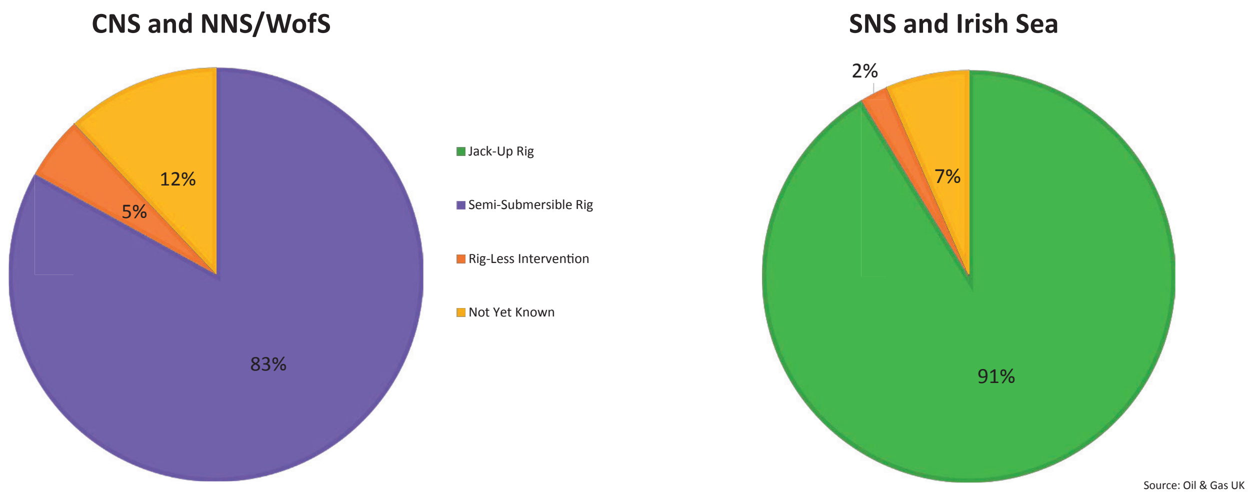
For subsea wells, the deeper water depths in the CNS and NNS/WofS mean that semi-submersible rigs are typically used, while jack-up rigs will be used in the shallower waters of the SNS and Irish Sea.

Figure 11: Forecast Rig Type for Well Plugging and Abandonment from 2015 to 2024

Platform Well P&A



Subsea Well P&A



Source: Oil & Gas UK

7.2 Facilities and Pipeline Making Safe and Topside Preparation

'Making safe' activities must be carried out in line with environmental and safety considerations in preparation for removing a facility or decommissioning a pipeline. 'Making safe' of facilities includes cleaning, freeing equipment of hydrocarbons, disconnection and physical isolation, and waste management. The 'making safe' of pipelines involves depressurising the pipeline and removing any hydrocarbons. The pipeline will then be cleaned and purged, with the cleaning programme based on the specific needs of the system. This may involve pigs, which are maintenance tools used to clean or inspect the inside of pipelines.

Pipelines 'making safe' is sometimes carried out alongside facilities 'making safe', particularly in the case of small topside and pipeline tiebacks. In these cases, the same team and some of the same equipment can be used for both activities. 'Making safe' can be carried out several years prior to removing a platform or decommissioning a pipeline, leaving them hydrocarbon free until the next phase of decommissioning.

For facilities, the next phase involves separating the topsides and process and utilities modules, and carrying out appropriate engineering, such as installation of lift points to prepare for removal. The topside preparation required will depend on the removal method used. For pipelines, this next phase of decommissioning is discussed in section 7.4.

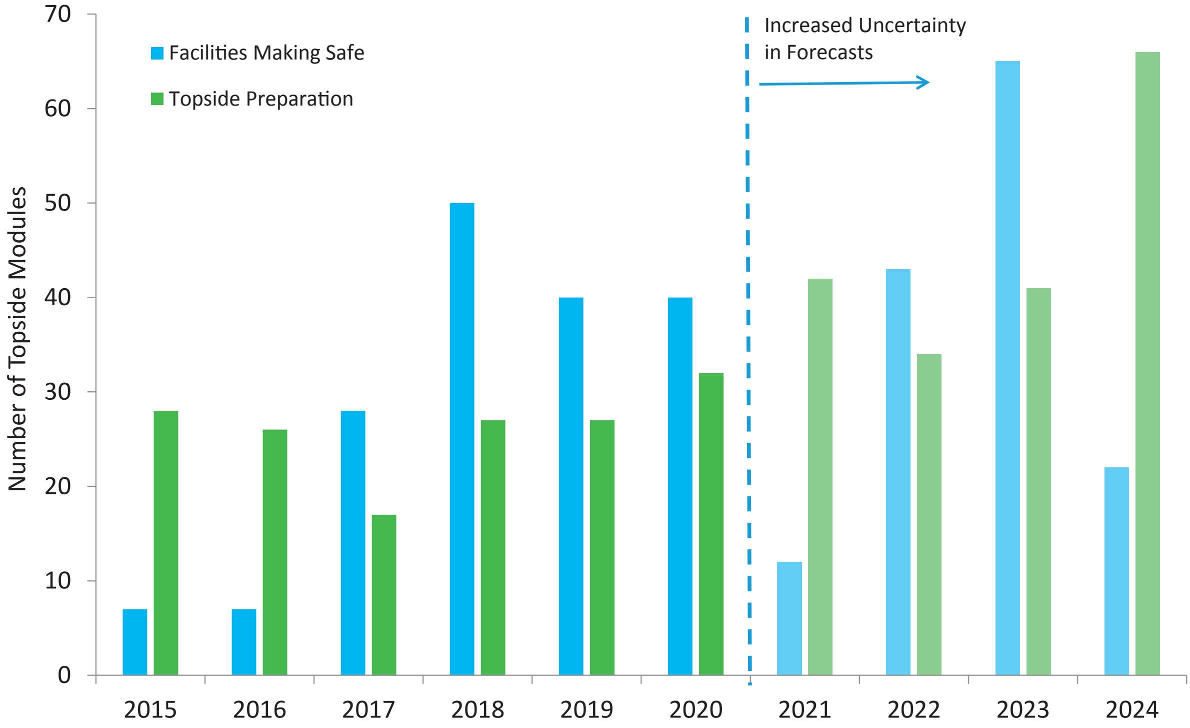
7.2.1 Central and Northern North Sea/West of Shetland

From 2015 to 2024, there are forecast to be 314 topside modules for 'making safe' and 340 modules for topside preparation in these regions. This is an increase of 113 modules for 'making safe' and 126 modules for preparation since the 2014 report, reflecting the new projects added to this year's survey. Additional activity is included between 2017 and 2019, with a large increase from 2020 onwards. Near-term activity has smoothed out since the 2014 forecast and is spread more evenly across the decade.

The total expenditure on facilities 'making safe' and topside preparation over the next decade in these regions is forecast to be £566 million, a rise of £146 million on last year's estimate.

In the CNS and NNS/WofS areas, topside preparation is typically carried out in the year prior to removal and 'making safe' two years before removal. As seen in Figure 12 overleaf, there is a higher number of modules for topside preparation than 'making safe' in the years 2015 and 2016, as the associated 'making safe' activities would have already been carried out.

Figure 12: Forecast Number of Topside Modules for 'Making Safe' and Topside Preparation in the Central and Northern North Sea/West of Shetland

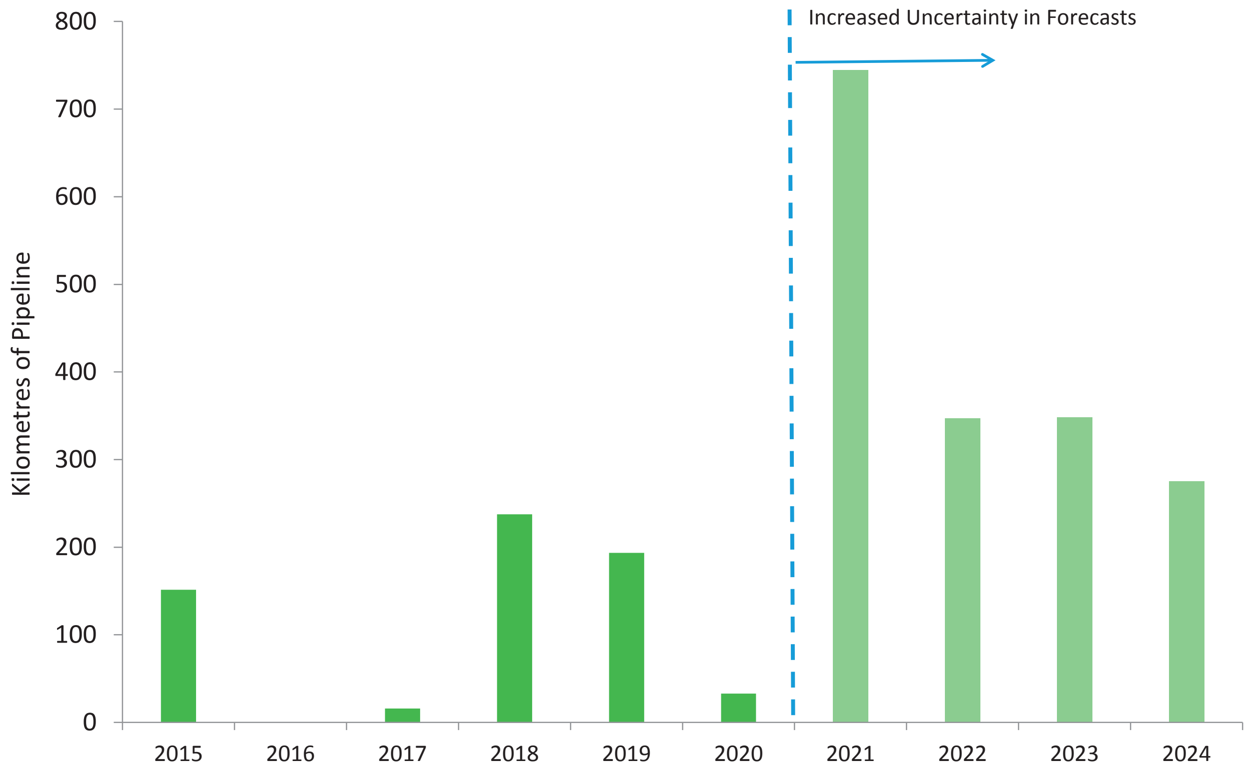


Source: Oil & Gas UK

	Number 2015 to 2024	Total Expenditure 2015 to 2024
Facilities 'making safe' and topside preparation	22 platforms	£566 million
Number of topside modules –facilities 'making safe'	314	
Number of topside modules –topside preparation	340	

Between 2015 and 2024, nearly 2,400 kilometres of pipeline are forecast to be 'made safe' in the CNS and NNS/WofS areas. As seen in Figure 13, activity is not spread evenly across the decade, but is forecast to peak at close to 750 kilometres of pipeline in 2021, with 11 projects scheduling activity. The majority of activity is concentrated post-2020 and the forecast largely mirrors that for pipeline decommissioning (see section 7.4).

Figure 13: Forecast Kilometres of Pipeline for 'Making Safe' in the Central and Northern North Sea/West of Shetland



Source: Oil & Gas UK

	Length (km) 2015 to 2024	Total Expenditure 2015 to 2024
Pipeline 'making safe'	2,350	£117 million

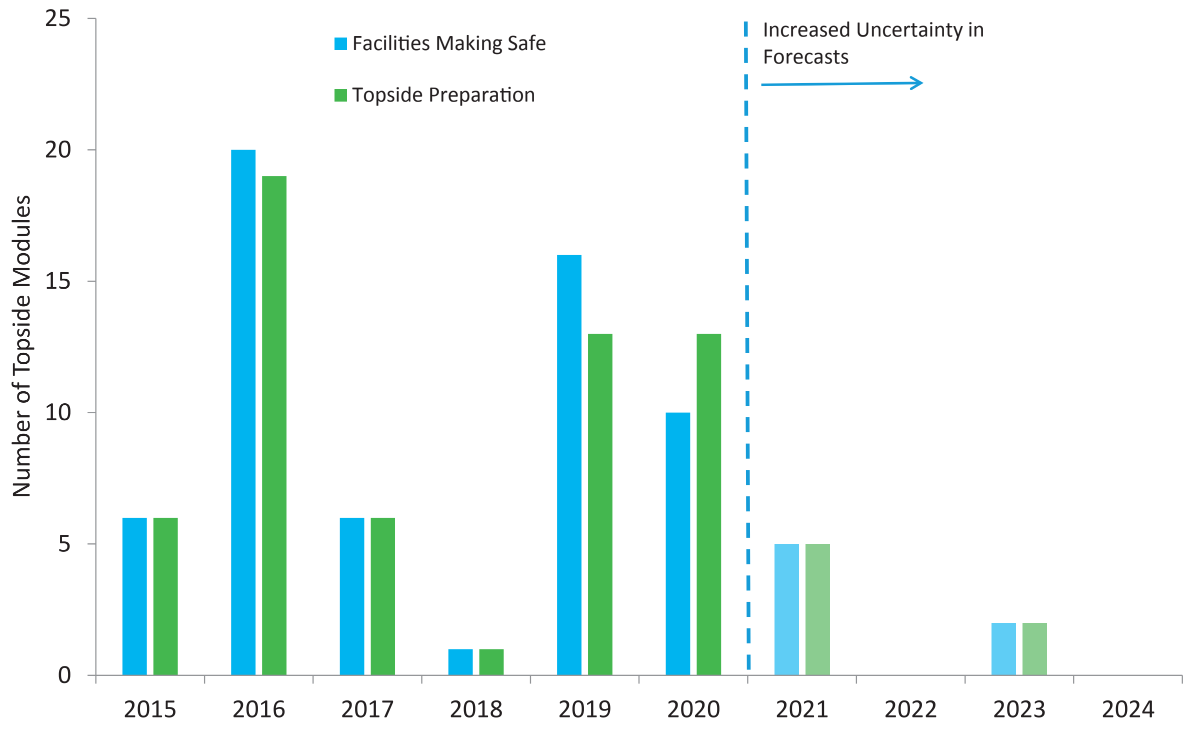
7.2.2 Southern North Sea and Irish Sea

From 2015 to 2024, there are forecast to be 66 topside modules for ‘making safe’ and 65 modules for topside preparation in these regions. This is significantly lower than in the CNS and NNS/WofS areas, as a large proportion of the platforms in the SNS and Irish Sea are small satellite installations and NUIs with fewer topside modules. The total expenditure on facilities ‘making safe’ and topside preparation in these regions is therefore forecast to be much lower at £137 million over the next decade.

The smaller size of the installations in the SNS and Irish Sea also means that it is possible for both ‘making safe’ and topside preparation activity to be carried out in a single year, reflected in their closely aligned schedules seen in Figure 14. Some operators do, however, plan to carry out ‘making safe’ in the year prior to topside preparation.

Activity is not spread evenly across the decade, with years of high activity and years of next to no activity. Oil & Gas UK expects that this will smooth out as forecasts are revisited.

Figure 14: Forecast Number of Topside Modules for ‘Making Safe’ and Topside Preparation in the Southern North Sea and Irish Sea

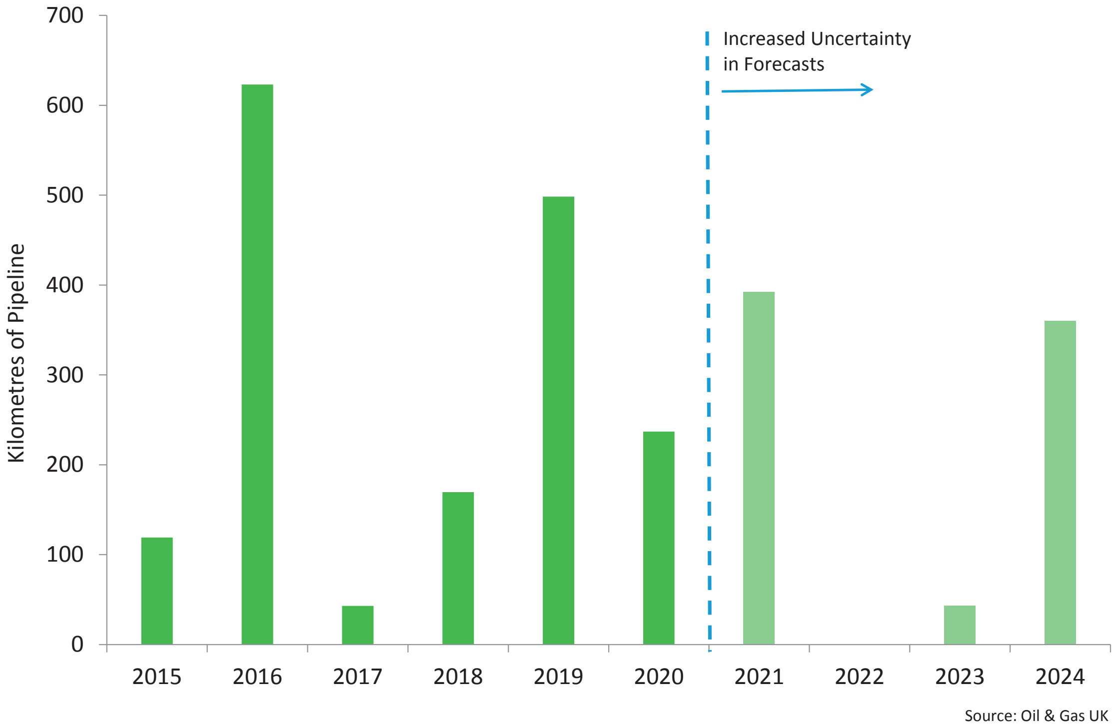


Source: Oil & Gas UK

	Number 2015 to 2024	Total Expenditure 2015 to 2024
Facilities 'making safe' and topside preparation	57 platforms	£137 million
Number of topside modules –facilities 'making safe'	66	
Number of topside modules –topside preparation	65	

Over the next decade, nearly 2,500 kilometres of pipeline are forecast to be 'made safe' in the SNS and Irish Sea. Activity is forecast to peak at just over 600 kilometres of pipeline in 2016, and varies significantly over the next ten years. The spikes in pipeline 'making safe' activity generally precede the spikes in pipeline decommissioning activity shown in section 7.4. It is expected that activity will smooth out as forecasts are revisited.

Figure 15: Forecast Kilometres of Pipeline for 'Making Safe' in the Southern North Sea and Irish Sea

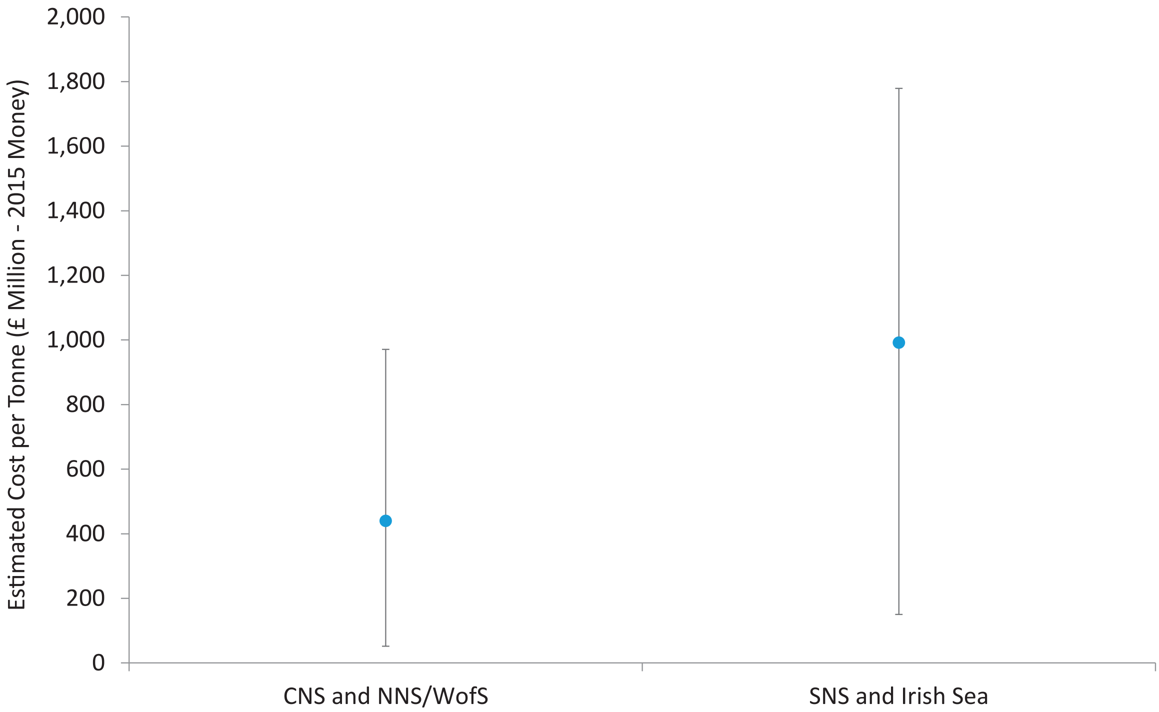


	Length (km) 2015 to 2024	Total Expenditure 2015 to 2024
Pipeline 'making safe'	2,490	£207 million

7.2.3 Average Cost per Tonne Forecasts for Making Safe

The average cost per tonne forecast for 'making safe' of facilities is £440 in the CNS and NNS/WofS regions and £990 in the SNS and Irish Sea. The range of cost per tonne forecasts is broad in all regions, but especially in the SNS and Irish Sea. The scope of work associated with 'making safe' will be similar across different platform types. Activity will take longer on larger structures, but the fixed costs will be similar, increasing the cost per tonne forecasts for the smaller, lighter structures commonly found in the SNS and Irish Sea. The NUIs will also require transport by helicopter or an accommodation vessel for a team to carry out 'making safe' activities, adding further cost. Many of the installations in the SNS are smaller NUIs, contributing to the higher average cost forecasts and larger range. Expenditure at the lower end of the range is in line with those seen in the CNS and NNS/WofS areas and is likely to be associated with larger, manned platforms.

Figure 16: Variation in the 'Making Safe' Cost per Tonne Forecasts for Topsides Split by Region



Source: Oil & Gas UK

	Central and Northern North Sea/West of Shetland	Southern North Sea and Irish Sea
Average cost per tonne	£440	£990

7.3 Removal

Removal is classified as the removal of topsides, substructures (jackets) and subsea infrastructure and accounts for 18 per cent (£3 billion) of the total forecast decommissioning expenditure on the UKCS from 2015 to 2024. FPSO weights have not been included in this category as they are usually relocated or sold for reuse or recycling.

As well as the costs associated with physical removal, this phase also includes expenditure for transportation and onshore load-in, where the structure is transferred to the dock.

The most common methods for topside removal are piece-small, reverse installation or single lift. The piece-small method involves dismantling the topside using onshore demolition techniques to produce small, manageable pieces that can be transported onshore. For reverse installation, the topside modules are lifted separately onto a transportation barge or the deck of the crane vessel before being taken onshore. The single-lift method involves removing the topside in one piece, and may involve extra engineering work to reinforce the topside in preparation for removal. As technology moves on to keep up with the decommissioning market, vessels are being designed to lift heavier loads.

Earlier this year, Royal Dutch Shell began a public consultation on its plan to remove the first of the Brent platforms in what will be the biggest North Sea decommissioning project to date. Following a 30-day consultation, the decommissioning programme was approved by the UK Government. The 24,200 tonne topside of the Brent Delta platform will be removed by Allseas Group in a single-lift by the Pioneering Spirit heavy-lift vessel.

The lift will be carried out on completion of thorough preparations, including the strengthening of the topside using 200 tonnes of steel, and will be one of the heaviest the North Sea has ever seen. According to Shell, this single-lift technique will substantially reduce the risk, cost and environmental impact of removing the Brent platforms[17].

7.3.1 Topside Removal

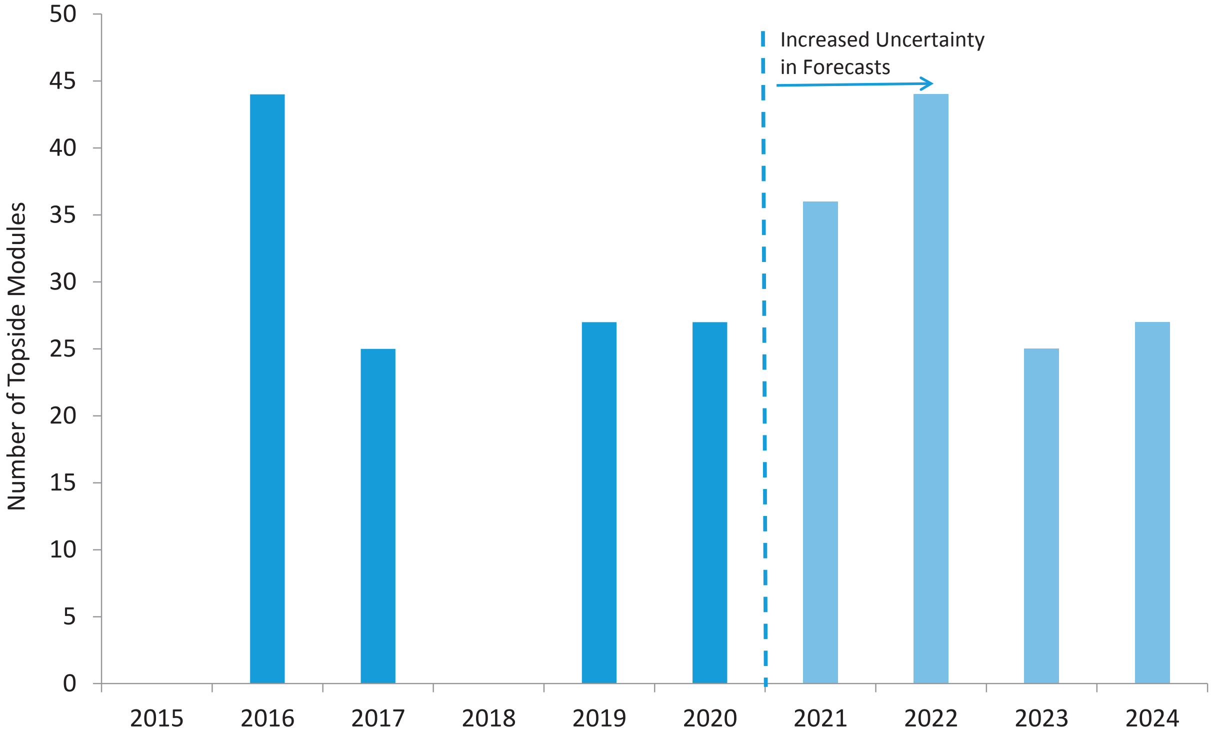
Central and Northern North Sea/West of Shetland

A total of £1.1 billion is forecast to be spent removing 255 topside modules over the next decade in these regions (see Figure 17 overleaf), with an average topside weight of 13,000 tonnes. Over half (134 modules) of this activity is located in the CNS compared to 80 per cent in the NNS in the 2014 report. This shift is due to the large number of new projects now earmarked for decommissioning in the CNS region, rather than a decrease in forecast activity in the NNS.

The near-term forecast for topside removal is similar to the 2014 report, with high levels of activity in 2016. Some of these projects are well under way and the timelines for removal are relatively fixed, although some flexibility is typically built into these contracts. By contrast, activity in the second half of the decade has increased significantly since last year, with nine new platforms entering the survey. Relative to the 2014 report, activity is spread more evenly across the decade. Last year, a peak was forecast in 2020, but this is now spread across multiple years as projects undergo small timeline shifts in response to the market.

[17] See www.shell.co.uk/sustainability/decommissioning/brent-field-decommissioning.html

Figure 17: Forecast Number of Topside Modules to be Removed in the Central and Northern North Sea/West of Shetland



Source: Oil & Gas UK

	Weight (Tonnes) 2015 to 2024	Number 2015 to 2024	Total Expenditure 2015 to 2024
Topside removal	288,000	255 modules on 22 platforms	£1.1 billion

Southern North Sea and Irish Sea

Over the next decade, £250 million is forecast to be spent on removing 66 topside modules in these areas (see Figure 18 opposite). This is a decrease on the forecast in the 2014 report as some activity shifts out of the survey timeframe.

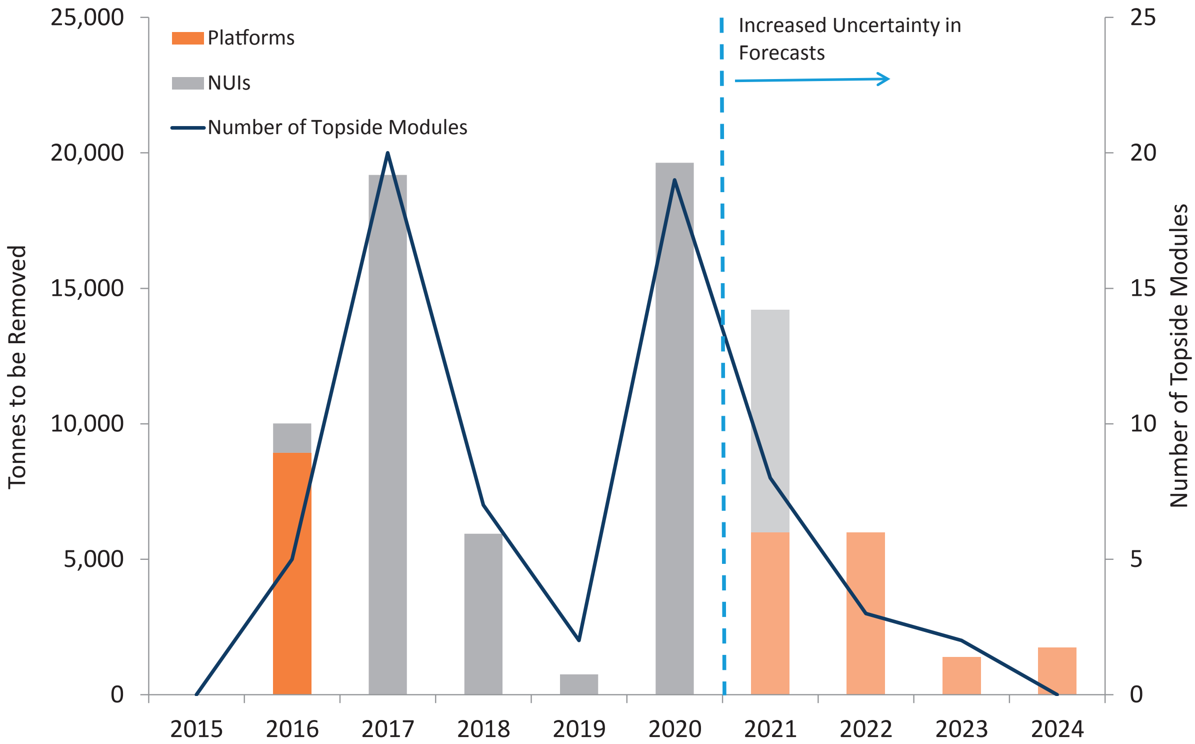
The average weight of the 57 platforms to be removed in the next decade is almost 1,400 tonnes. While large heavy-lift vessels can be used for removal, smaller barges are also capable of lifting this weight. The single-lift method is likely to be the most commonly used in these regions due to the smaller structure size. In some cases, the topside and substructure can be removed together in one lift, however, for the majority of platforms, the topside and substructure will be removed separately.

In contrast to the CNS and NNS/WofS regions, the near-term forecast has changed significantly in the SNS and Irish Sea since the 2014 report. In 2016 and 2017, there is an increase as a result of new topside removals, whereas, in 2018 and 2019, there has been a decline as some projects are deferred. These shifts in the near-term could reflect the shorter lead times for removal in these regions, allowing schedules to be changed at shorter notice. This is due to the generally smaller projects and less challenging conditions.

The spread of activity across the timeframe is less consistent than in 2014, with peak years of removal activity forecast in 2017 and 2020 (16 and 14 NUIs, respectively). Oil & Gas UK expects activity to smooth out as forecasts are revisited. As seen last year, removal activity is forecast to decline towards the end of the survey timeframe. Years with high numbers of removals often coincide with greater pipeline decommissioning activity seen in section 7.4.

Some of the platforms included in the survey may represent key processing hubs for the region. To meet government and industry objectives of maximising economic recovery from the UKCS, it is important that key infrastructure is not decommissioned prematurely. As such, a Southern North Sea PILOT Rejuvenation Work Group was established to carry out a joint industry project to understand the remaining reserves and resource base in this region and to identify how best to protect reserves and enable maturation into development opportunities. The work aims to create a blueprint of what the area will look like in ten years' time and assess whether incentives are required to extend the region's life. The next phase of work will be led by the Oil and Gas Authority's area manager for the SNS.

Figure 18: Forecast Number of Topside Modules and Topside Weight to be Removed in the Southern North Sea and Irish Sea by Facility Type



Source: Oil & Gas UK

	Weight (Tonnes) 2015 to 2024	Number 2015 to 2024	Total Expenditure 2015 to 2024
Topside removal	78,900	66 modules on 57 platforms	£250 million

7.3.2 Substructure Removal

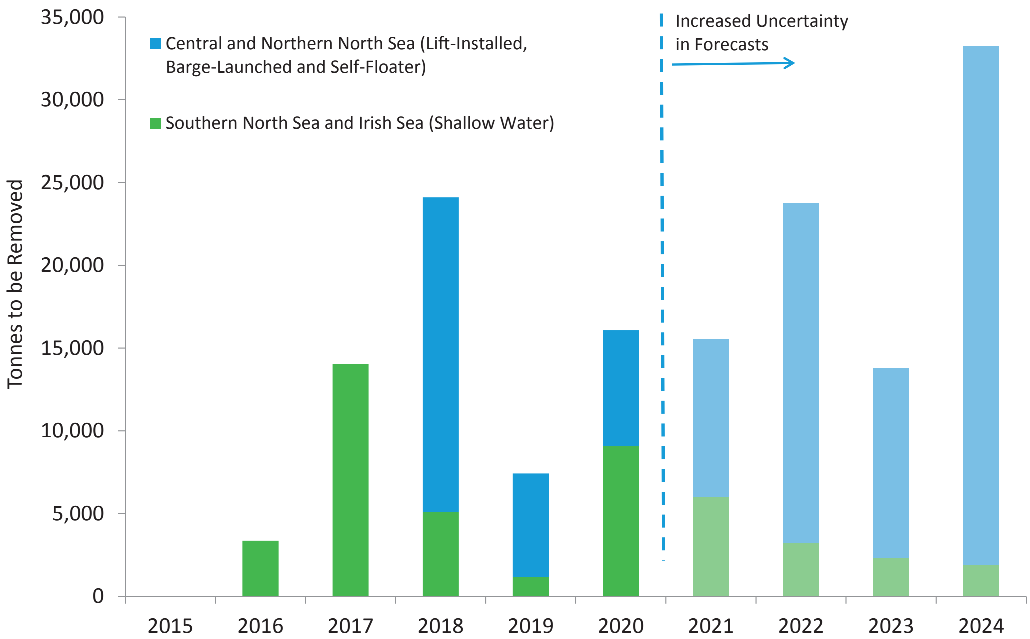
The removal method will depend on the type and weight of the substructure to be cut and lifted. The substructures to be removed in the SNS and Irish Sea regions are shallow water jackets that typically weigh less than 2,000 tonnes and are usually deployed in water depths of 55 metres or less so they may use a single-lift removal method.

For larger structures (barge-launched and some self-floaters), the jacket may be cut into smaller sections *in situ* and removed in segments. The ability to cut large and often complex steel sections in an offshore environment is one of the key challenges during this stage of the decommissioning process. These more complex projects are typically located in the CNS and NNS/WofS areas. In 2009, the removal of BP's North West Hutton jacket in the NNS region involved 248 cuts using three different methods. The decommissioning sector continues to innovate in developing existing and new cutting technology.

Within the survey timeframe, substructure removal activity in the CNS and NNS/WofS regions is forecast to begin in 2018, peaking in 2024 (see Figure 19). Compared to the 2014 report, activity has shifted slightly later and there has also been a large increase towards the end of the survey timeframe, with substructure removal forecast for six projects in 2024. Between 2018 and 2024, an average of 15,000 tonnes is anticipated to be removed each year.

Substructure removal activity in the SNS and Irish Sea largely mirrors that seen for topside removal in these regions, with 2017 and 2020 the years of greatest activity. Compared to the 2014 report, shifts in project schedules have brought the peak year of activity forward from 2020 to 2017. Between 2016 and 2024, an average of just over 5,100 tonnes is forecast to be removed each year.

Figure 19: Forecast for Substructure (Jacket) Weight Removal



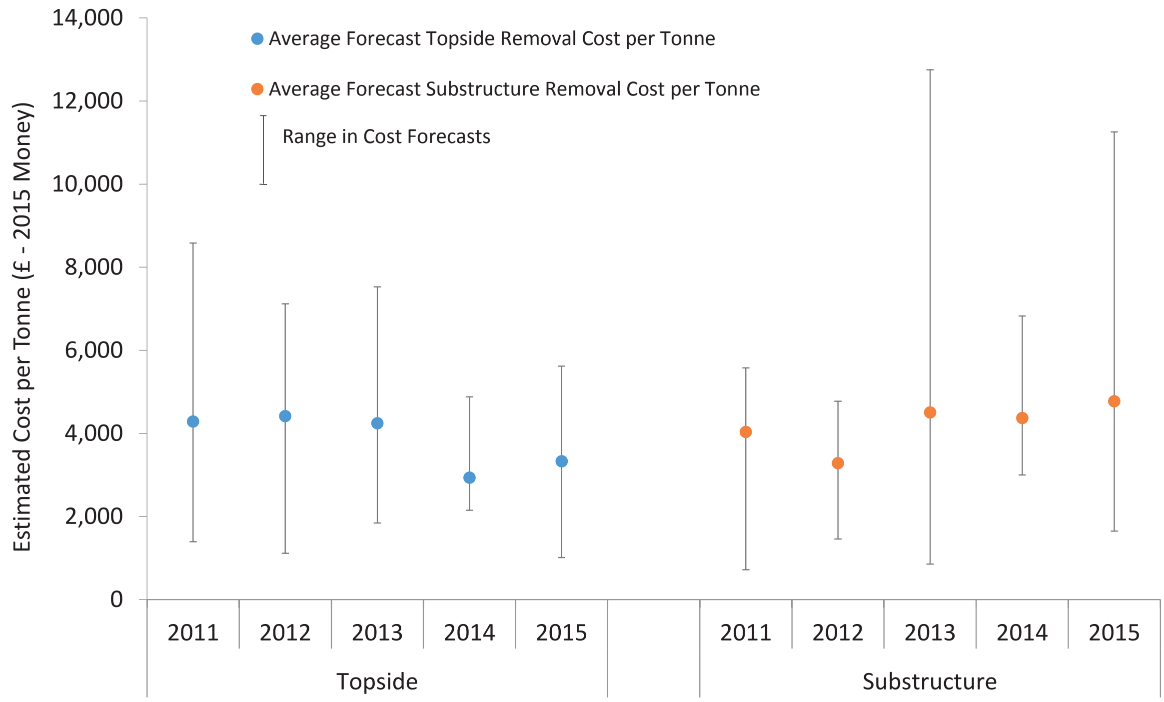
Source: Oil & Gas UK

Substructure Removal	Weight (Tonnes) 2015 to 2024	Total Expenditure 2015 to 2024
Central and Northern North Sea	105,100	£588 million
Southern North Sea and Irish Sea	46,200	£226 million

Historical Variation in the Removal Cost per Tonne Forecasts

The forecasts for average removal costs per tonne in the CNS and NNS/WofS regions have increased slightly on those reported in 2014, as shown in Figure 20. The range of costs per tonne has also widened, particularly for substructure removals due to the variation in substructure types and weights and planned removal methods, with data also coming from the many new projects entering the survey this year. While the cost per tonne forecasts for many projects lie within a smaller range, a handful contribute to the much larger range, primarily due to their size. For projects in the early scoping phases, the removal method may not yet be determined as operators carry out comparative assessments to determine the best approach. As removal methods become more defined, this can explain changes in the cost per tonne forecasts from one year to the next.

Figure 20: Historical Variation in the Removal Cost per Tonne Forecasts for Topsides and Substructures in the Central and Northern North Sea/West of Shetland



Source: Oil & Gas UK

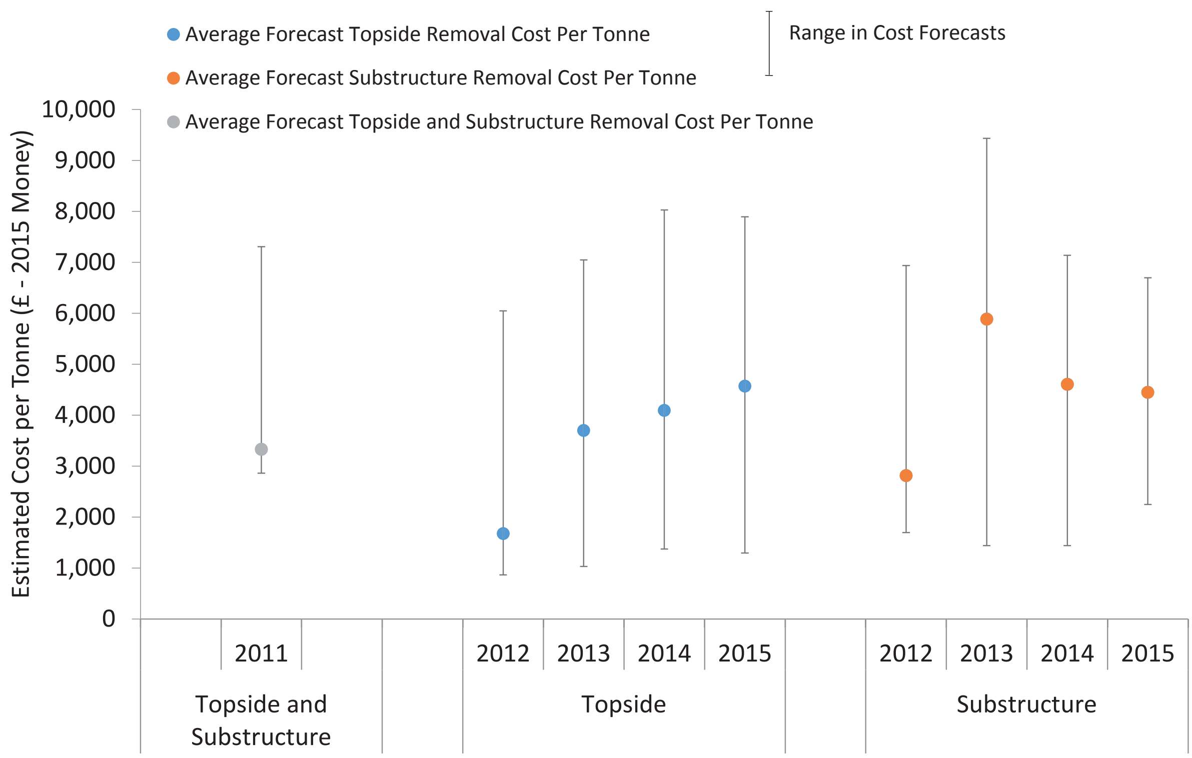
Removal Cost per Tonne	2014 Average	2015 Average
Topsides	£2,900	£3,300
Substructures	£4,300	£4,800

As illustrated in Figure 21 overleaf, the average forecast cost per tonne for topside removal in the SNS and Irish Sea is slightly higher than in previous years. For substructure removal, the average cost per tonne and range of costs in the SNS and Irish Sea have reduced compared to the last three years. The changes could reflect the shift in projects, as a number of projects have been deferred outside the survey timeframe while new activity has also entered the timeframe.

The weight of a platform will have little effect on some of the expenditure associated with removal, including removal preparation, vessel mobilisation, sea-fastening, transportation and load-in onshore. This can result in a larger average cost per tonne forecast for topside removal for the smallest and lightest structures commonly found in the SNS and Irish Sea regions, compared to larger structures in the CNS and NNS/WofS regions. However, the cost per platform is significantly lower in the SNS and Irish Sea.

The large range in costs per tonne for both topside and substructure removal seen in the SNS and Irish Sea is primarily due to the varying approaches to platform removals. Where possible, decommissioning is carried out in batches or campaigns to maximise efficiency gains and reduce costs. In the SNS and Irish Sea, several operators plan to remove multiple platforms in one campaign, allowing mobilisation and other fixed costs to be spread across the structures being removed. Projects at the bottom of the range are typically those included in a batched approach, while those at the top of the range are typically planned as individual removals.

Figure 21: Historical Variation in the Removal Cost per Tonne Forecasts for Topsides and Substructures in the Southern North Sea and Irish Sea



Source: Oil & Gas UK

Removal Cost per Tonne	2014 Average	2015 Average
Topsides	£4,000	£4,600
Substructures	£4,500	£4,400

7.3.3 Subsea Infrastructure Decommissioning

Mattresses are concrete structures usually used to protect or support subsea pipelines. Mattress decommissioning typically involves recovery from the seabed. This is a diver and vessel-intensive operation, with duration of the work dependant on the mattress age and condition. In some cases where the mattresses are badly degraded, approval may be sought from the Department of Energy & Climate Change to decommission the mattresses *in situ*.

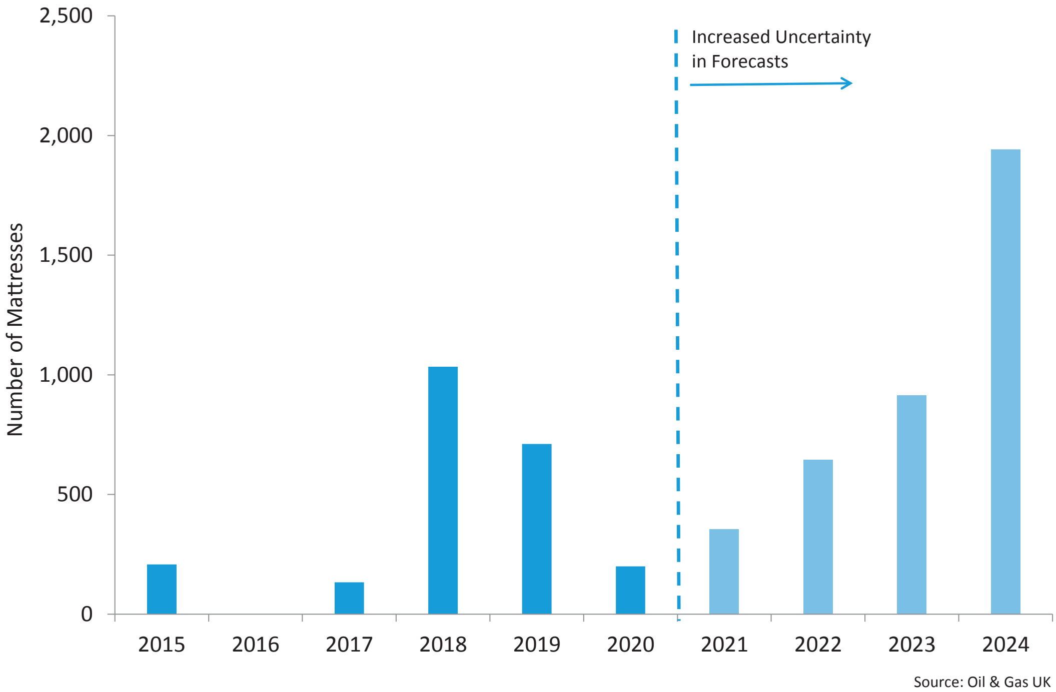
Other subsea infrastructure includes manifolds, Christmas trees, risers, spools, jumpers, anchors and subsea isolation valves, which are removed as part of the decommissioning programme.

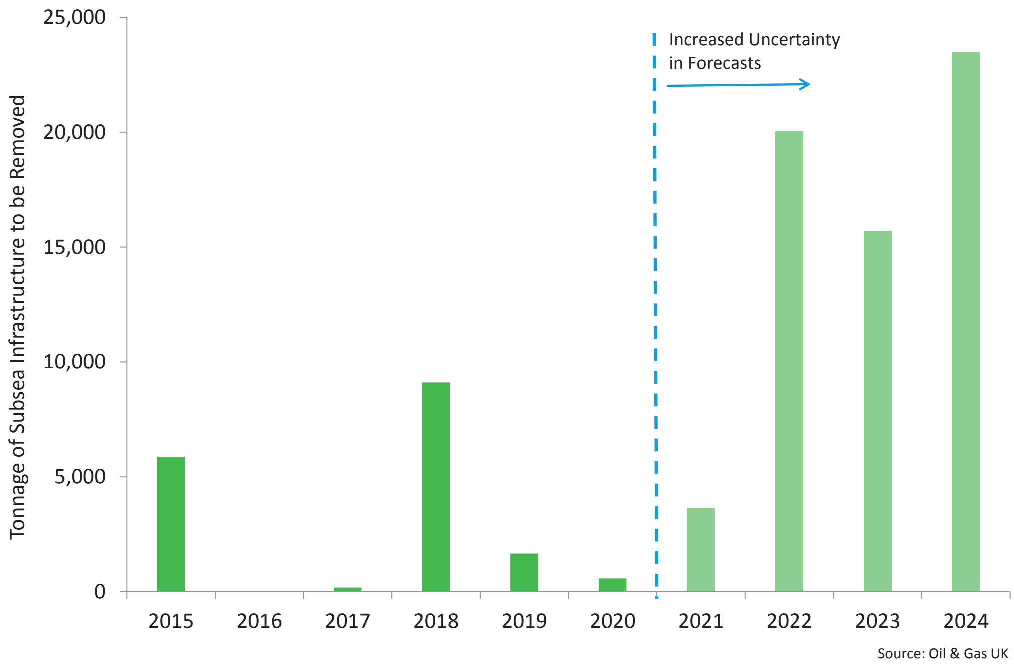
Central and Northern North Sea/West of Shetland
Over the next decade, over 6,000 mattresses are forecast to be decommissioned in these regions (see Figure 22 overleaf), double the forecast in the 2014 report. Around half of this increase is due to new projects, while the remainder comes from more detailed activity forecasts for existing projects. The number of mattresses to be decommissioned was introduced into the survey template in recent years, explaining the improved granularity of forecasts between surveys.

The forecast tonnage of other subsea infrastructure to be removed has increased by over 26,000 tonnes since the 2014 report to 80,200 tonnes. The majority of this increase is from new projects.

The decommissioning of mattresses and other subsea infrastructure is typically carried out simultaneously so these activities are closely aligned. In the near term, forecasts are in line with those seen last year, with 2015 a year of high activity followed by limited or no activity in the subsequent years. Activity is forecast to be high in 2018, although the majority of activity comes post 2020, peaking in 2024.

Figure 22: Forecast for Mattress and other Subsea Infrastructure Decommissioning in the Central and Northern North Sea/West of Shetland





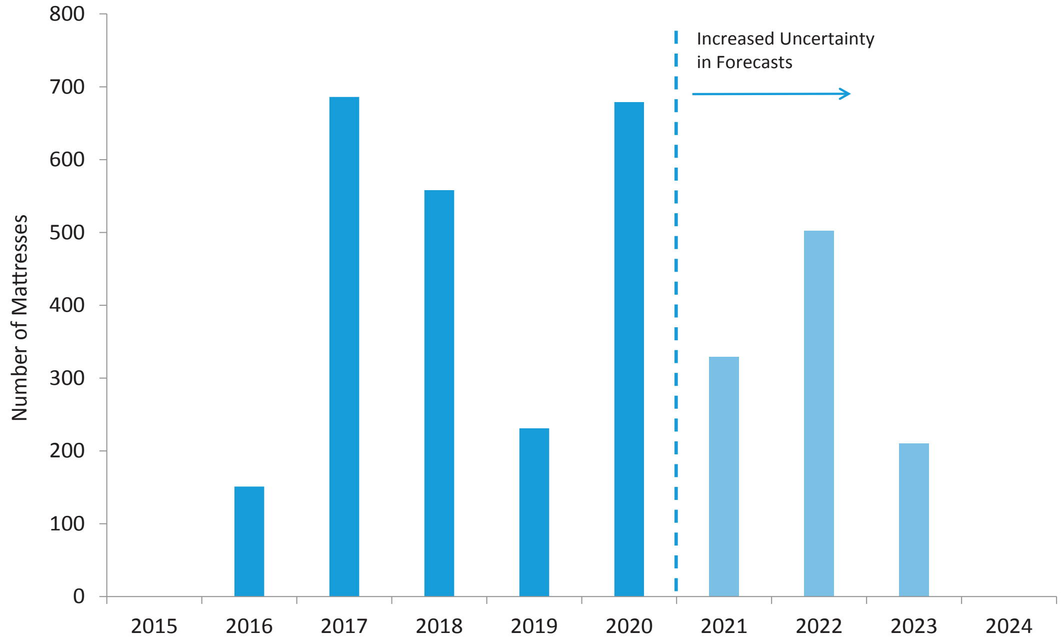
	Number/Weight 2015 to 2024	Total Expenditure 2015 to 2024
Mattresses and subsea infrastructure	-	£720 million
Mattresses	6,100	-
Subsea infrastructure	80,200 tonnes	-

Southern North Sea and Irish Sea

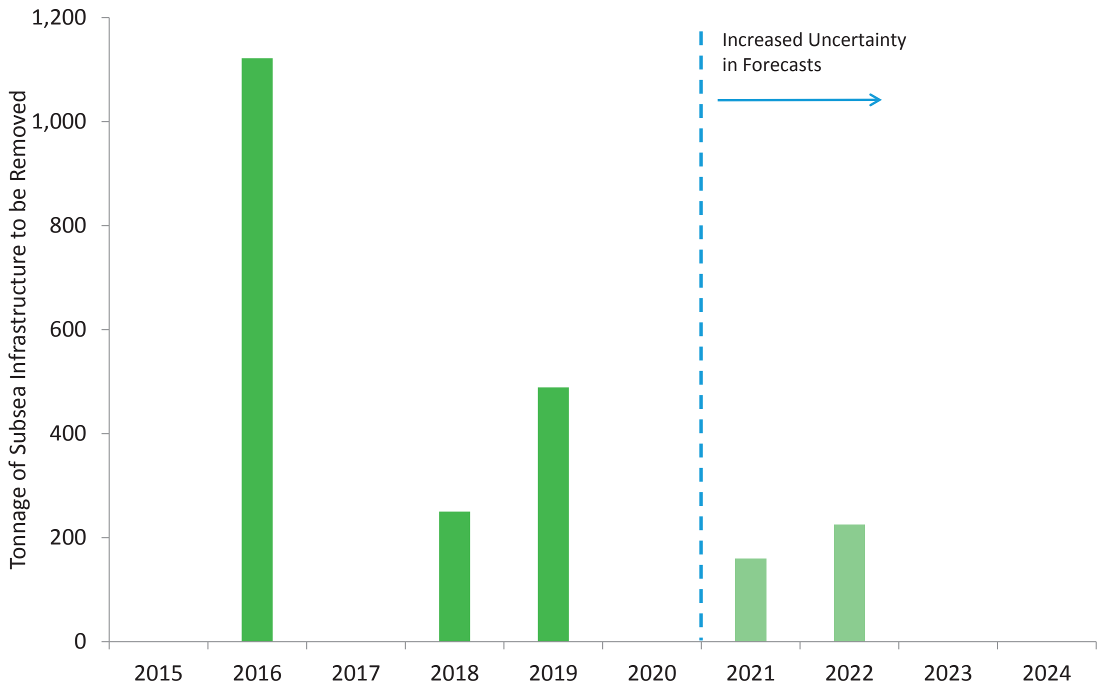
Mattress decommissioning in these areas is anticipated to be concentrated between 2016 and 2023, with the greatest activity in 2017 and 2020 (see Figure 23 overleaf). The number of mattresses to be decommissioned in the SNS and Irish Sea has increased slightly since the 2014 report to 3,300 because of the improved granularity in activity forecasts. The projects deferred outside of the timeframe in these regions have little forecast activity in this area and so limited impact on the total to be removed.

Removal of other subsea infrastructure is forecast to peak in 2016. The total amount of subsea infrastructure to be removed in the SNS and Irish Sea has increased by 700 tonnes to 2,200, although it remains substantially lower than in the CNS and NNS/WofS regions. The increase is due to new projects and more detailed activity forecasts for existing projects.

Figure 23: Forecast for Mattress and other Subsea Infrastructure Decommissioning in the Southern North Sea and Irish Sea



Source: Oil & Gas UK



Source: Oil & Gas UK

	Number/Weight 2015 to 2024	Total Expenditure 2015 to 2024
Mattresses and subsea infrastructure	-	£120 million
Mattresses	3,300	-
Subsea infrastructure	2,200 tonnes	-

7.4 Pipeline Decommissioning

The pipeline network in the North Sea is in excess of 45,000 kilometres and is used to deliver hydrocarbons to receiving facilities and end-users across Europe. This transportation network is of vital importance when the economics of field-life extension projects and future development opportunities are being assessed and it is therefore essential that major pipelines are not decommissioned prematurely. The deferral of pipeline decommissioning to the end of field life, or for possible reuse, is sometimes carried out under the Interim Pipeline Regime, whereby the regulator may request that the pipeline owner carries out 'making safe' activities and maintains the pipeline for possible future reuse.

Pipelines on the UKCS include rigid pipelines and flexible flowlines. Their diameters can vary between two and 44 inches. Options for decommissioning include full removal, decommissioning *in situ*, trenching and burial. The approach adopted will be based on comparative assessments of the different options and a number of factors, including safety, environmental, technical feasibility, other sea users and cost. All decisions are made on a case-by-case basis in consultation with key stakeholders and with regulatory approval.

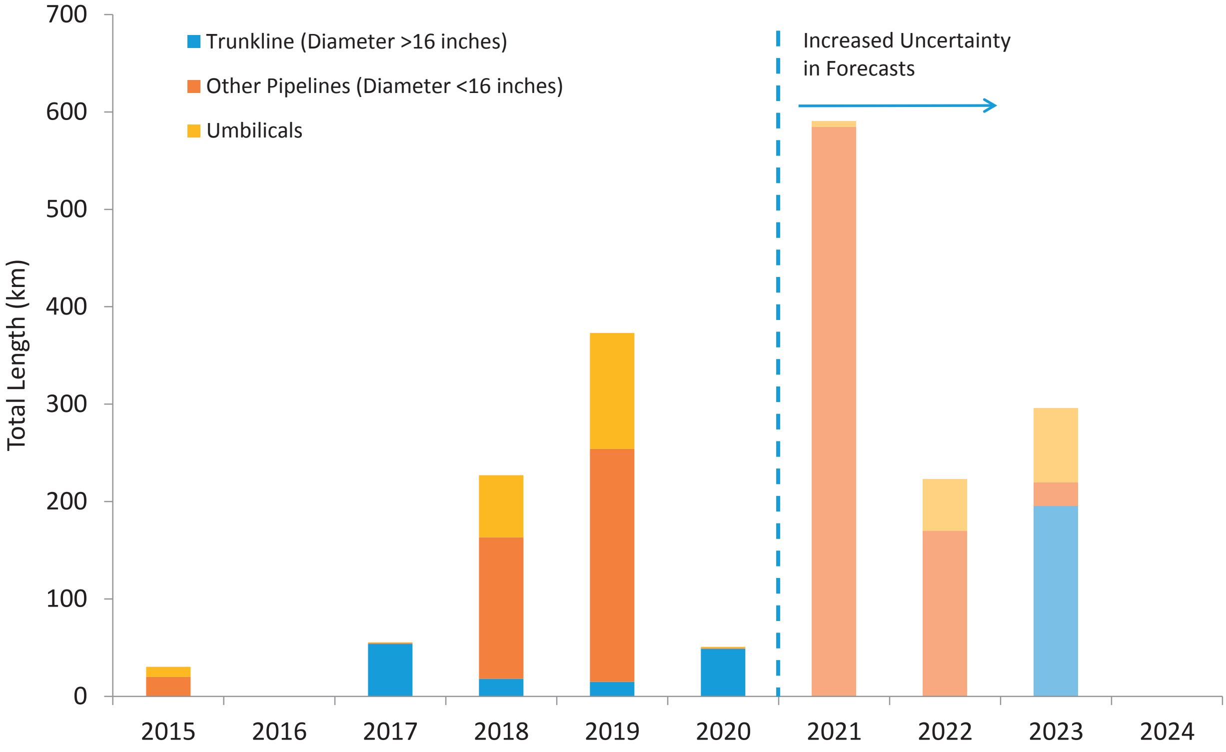
7.4.1 Central and Northern North Sea/West of Shetland

The number and length of pipelines to be decommissioned in these regions over the next decade has increased since the 2014 report by over 1,300 to 2,190 kilometres. Eighty per cent of the rise is because of new projects and the remainder is due to more detailed activity forecasts for existing projects. The largest increase is in the 'other pipelines' category, which is defined as pipelines with a diameter less than 16 inches and includes tie-backs, short flowlines and bundles.

The average length of pipeline to be decommissioned over the next decade is less than four kilometres and it is deemed that no major transport lines are forecast to be decommissioned in these regions.

Pipeline decommissioning is closely aligned to pipeline 'making safe' (see section 7.2), as these activities are typically carried out sequentially (see Figure 24 overleaf). Activity is forecast to increase year-on-year from 2017 to 2019 and will peak in 2021. Oil & Gas UK expects that activity will smooth out as forecasts are revisited.

Figure 24: Forecast of Pipeline Decommissioning Activity in the Central and Northern North Sea/West of Shetland



Source: Oil & Gas UK

	Number 2015 to 2024	Length (km) 2015 to 2024	Total Expenditure 2015 to 2024
Pipeline decommissioning		2,190	£812 million
Umbilicals	178	465	
Trunklines	17	351	
Other pipelines	403	1,374	
Peak year of pipeline decommissioning activity			
2021	214	590	

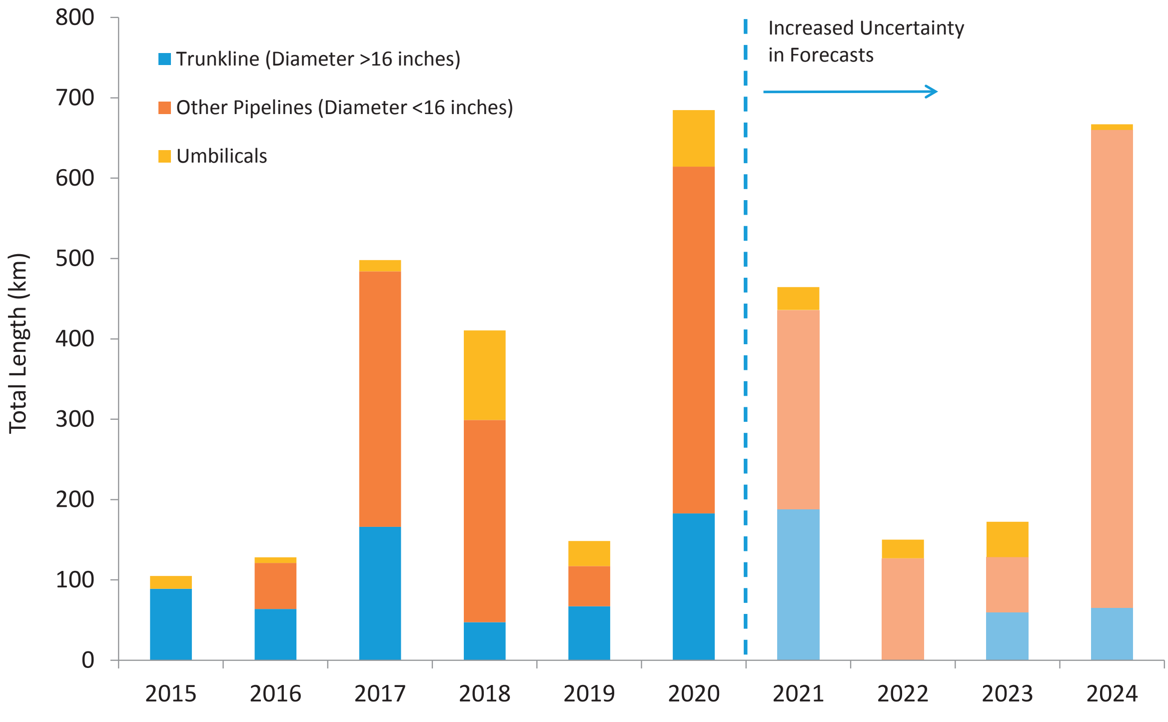
7.4.2 Southern North Sea and Irish Sea

The forecast for pipeline decommissioning in these regions has increased by nearly 1,000 to 3,430 kilometres since the 2014 report, primarily because of more detailed forecasts for existing projects.

The spread of activity is forecast to be relatively high across the decade, as illustrated in Figure 25, although it is not evenly distributed. High activity is forecast in 2020 and 2024 and Oil & Gas UK would expect this to smooth out. This reflects operators' current best estimates and are not sanctioned decommissioning programmes; a complete list of which can be found on DECC's Project Pathfinder website[18].

The SNS PILOT Rejuvenation Work Group is looking to maximise recovery of reserves in the region and there is ongoing industry discussion about the proposed decommissioning of some critical infrastructure.

Figure 25: Forecast of Pipeline Decommissioning Activity in the Southern North Sea and Irish Sea



Source: Oil & Gas UK

	Number 2015 to 2024	Length (km) 2015 to 2024	Total Expenditure 2015 to 2024
Pipeline decommissioning		3,430	£118 million
Umbilicals	44	350	
Trunklines	19	930	
Other pipelines	116	2,150	
Peak year of pipeline decommissioning activity			
2020	46	680	

[18] The DECC Pathfinder website can be viewed at https://itportal.decc.gov.uk/pathfinder/decommissioningindex.html

7.5 Onshore Recycling and Disposal

Topside and substructure recycling and disposal includes activity and expenditure related to onshore cleaning and handling of hazardous waste, deconstruction, reuse, recycling, disposal, and waste management accounting. Operators have a duty of care to manage and monitor all wastes generated offshore and their subsequent handling and disposal through an environmental management system.

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

Reuse is defined as any activity that lengthens an item's life cycle while still being used for its original purpose. This 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 the prevalence of obsolete technology and the amount of hazardous material on an asset.

Topsides are made from a variety of materials and safe dismantling and waste management of these 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 materials. Hess details a reuse and recycling percentage of 96.93 per cent in the close-out report for the Fife, Fergus, Flora and Angus fields decommissioning programme, with a reuse rate of 48.21 per cent[19].

Between 2015 and 2024, nearly 620,000 tonnes of material is forecast to come onshore, 80 per cent of which is coming from the CNS and NNS/WofS areas. This includes tonnage from topsides, substructures and other subsea infrastructure.

Four projects report negative spend for onshore recycling as the money received for materials can, in some cases, outweigh the associated costs.

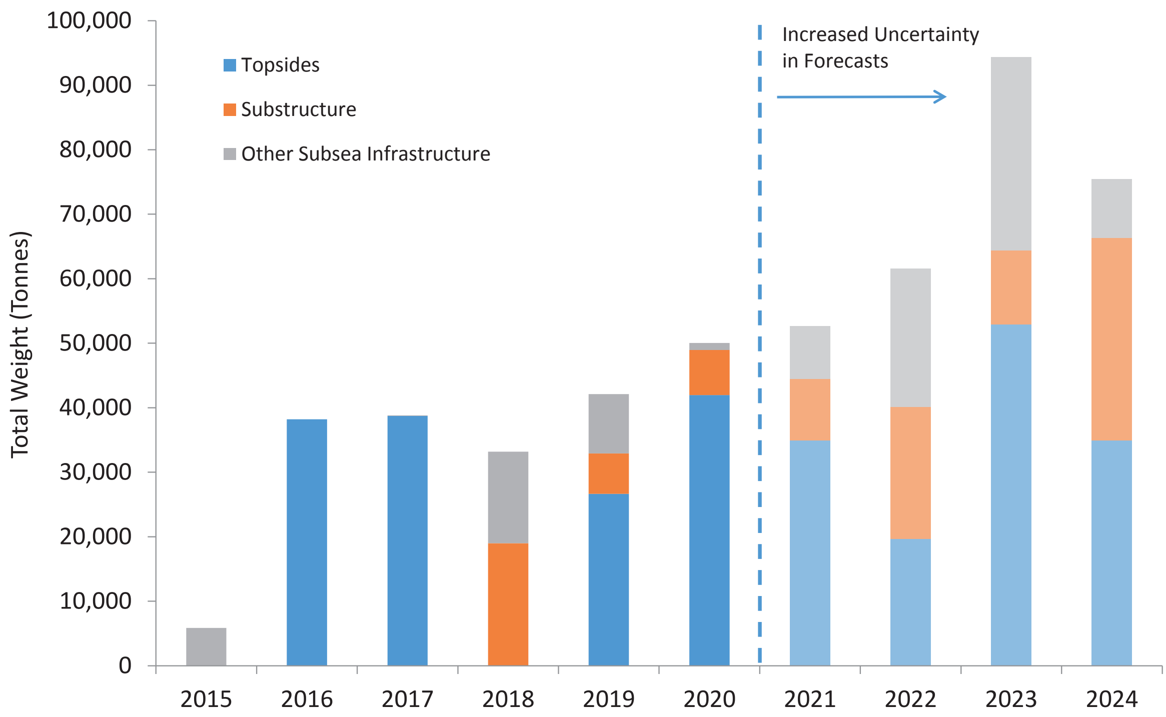
[19] See www.hess.com/docs/default-source/sustainability/fffa-close-out-report.pdf?sfvrsn=2

7.5.1 Central and Northern North Sea/West of Shetland

Between 2015 and 2024, 492,200 tonnes are forecast to come onshore from these regions, an increase of over 130,000 tonnes on the 2014 report. Around two-thirds of this is due to new projects and the remainder comes from more detailed forecasts for existing projects.

In line with topside and substructure removal, onshore recycling and disposal is forecast to take place across the decade (see Figure 26). There are high activity levels later in the timeframe, with a peak in 2023 at nearly 95,000 tonnes. The annual average over the next decade is 50,000 tonnes.

Figure 26: Forecast of Tonnage Coming Onshore for Recycling and Disposal in the Central and Northern North Sea/West of Shetland



Source: Oil & Gas UK

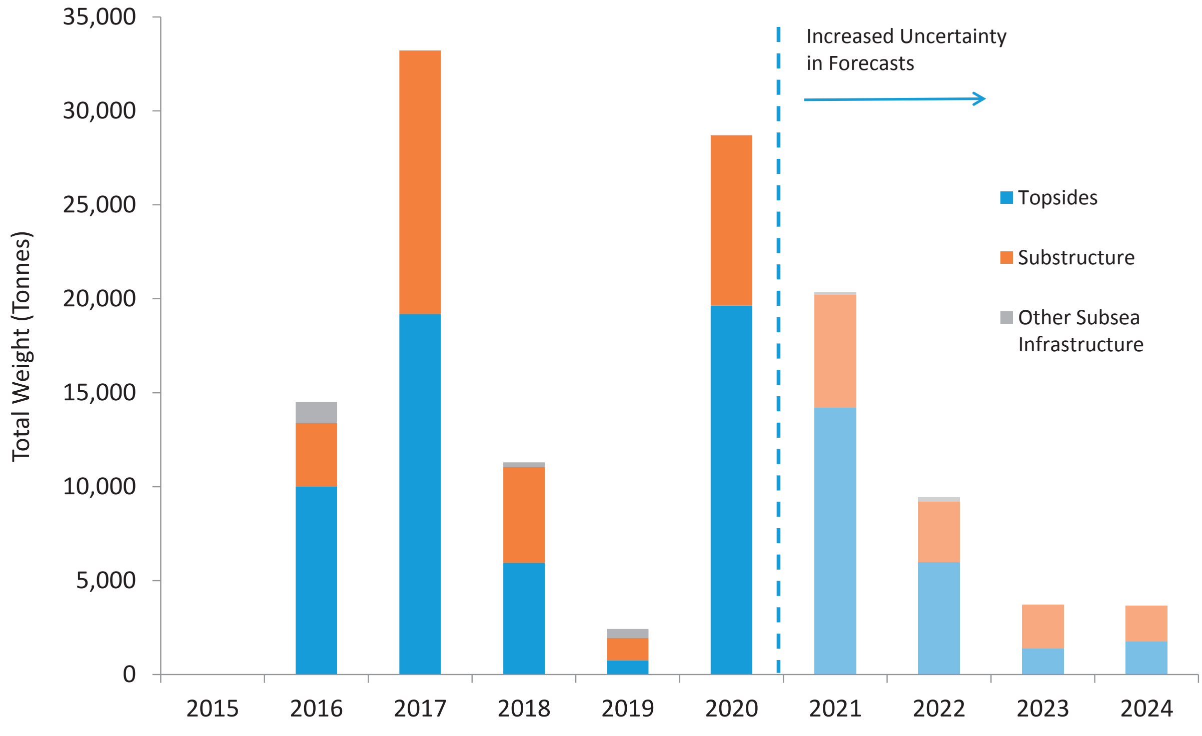
	Weight (Tonnes) 2015 to 2024	Total Expenditure 2015 to 2024
Onshore recycling and disposal	492,200	£137 million
Topsides	288,000	
Substructure	105,100	
Subsea infrastructure	99,100	

7.5.2 Southern North Sea and Irish Sea

Between 2015 and 2024, 127,300 tonnes are forecast to come onshore from these regions, a decrease by over 65,000 tonnes on the 2014 report as projects are deferred and shift outside the survey timeframe.

The peak year for onshore recycling and disposal of material from these areas is 2017 (33,221 tonnes), in line with the peaks in topside and substructure removal. There are also high activity levels forecast later in the decade, again corresponding to removals activity.

Figure 27: Forecast of Tonnage Coming Onshore for Recycling and Disposal in the Southern North Sea and Irish Sea



Source: Oil & Gas UK

	Weight (Tonnes) 2015 to 2024	Total Expenditure 2015 to 2024
Onshore recycling and disposal	127,300	£38 million
Topsides	78,900	
Substructure	46,200	
Subsea infrastructure	2,200	

7.6 Site Remediation and Monitoring

Site remediation activities include cuttings piles management, oil field debris clearance (with a 500-metre zone and 200-metre pipeline corridor) and over-trawl surveys. Over-trawl surveys ensure that the seabed can be deemed clear for resuming normal fishing activities.

Nearly £280 million is forecast to be spent on site remediation over the next decade, with 98 per cent of this concentrated in the CNS and NNS/WofS regions.

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.

Expenditure on monitoring is forecast at £32 million between 2015 and 2024. Eighty-eight per cent of this is forecast to be spent in the CNS and NNS/WofS areas. The expenditure forecast has not increased since the 2014 survey, despite new projects being included. This is because a number of projects are completed outside the survey timeframe. If the spend attributed to these projects is included in the total forecast expenditure, the total spend on site remediation would nearly double and the expenditure on monitoring would triple. However, overall, this is a fraction of the total cost to decommission a field.

8. Appendices

A. Work Breakdown Structure and Survey Methodology

Operators were asked to provide expenditure forecasts for the 20 different components of the Work Breakdown Structure outlined in Oil & Gas UK's *Decommissioning Cost Estimation Guidelines*[20]. They were also asked to quantify physical decommissioning activity by components, such as the tonnes of topside to be removed or the length of pipeline to be made safe.

The *Decommissioning Insight* report has been produced annually since 2011. Although it is possible to compare data across the reports, it is important to note that since 2013 surveys have been modelled on a new Work Breakdown Structure. Historical analysis has therefore only been carried out on comparable categories.

Figure 28: Work Breakdown Structure Categories

STAGES - LEVEL 1	
Operator project management	Activities include 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.).
Facility running/owner costs	Activities include 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 plugging and abandonment	Activities include 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.
Facilities/pipelines making safe	Activities include operations (drain, flush, purge and vent), physical isolation (de-energise, vent and drain), cleaning, pipeline pigging and waste management.
Topsides preparation	Activities include engineering-up of temporary utilities (power, air and water), module process/utilities separation, dropped object surveys and subsequent remedial actions.
Topsides removal	Activities include removal preparation (reinforcements and structural separation for removal), vessel operations, sea-fastening, transportation and load-in.
Substructure removal	Activities include removal preparation, removal, vessel, sea-fastening, transportation and load-in.
Topsides and substructure onshore recycling	Activities include cleaning and handling hazardous waste, deconstruction, re-use, recycling, disposal and waste management accounting (traceability of all streams).
Subsea infrastructure (pipelines, umbilicals)	Activities include vessel preparation for subsea end-state (remove, trench, rock-dump), sea fastening and transportation, load-in, subsea project management and waste management accounting (traceability of all streams).
Site remediation	Activities include cuttings pile management, oil field debris clearance (500 metre zone and 200 metre pipeline corridor) and over-trawl surveys.
Monitoring	Activities include navigation aids maintenance and monitoring programme for any facilities that remain.

[20] The *Decommissioning Cost Estimation Guidelines* are available to download at http://bit.ly/1K5Rhzs

B. Association for the Advancement of Cost Engineering Classifications

The five estimate classes in the AACE Cost Estimation Classification Matrix are determined by level of 'project definition' with consideration to a set of secondary characteristics.

	Primary Characteristic	Secondary Characteristic		
Estimate Class	Level of Project Definition (expressed as % of complete definition)	End Usage Typical Purpose of Estimate	Methodology Typical Estimating Method	Expected Accuracy Range Typical Variation in Low and High Range
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgement or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 5%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorisation or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 70%	Control or bid/tender	Detailed unit costs with forced detailed take off	L: -5% to -15% H: +5% to +20%
Class 1	50% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take off	L: -3% to -10% H: +3% to +15%

9. Glossary

AACE	Association for the Advancement of Cost Engineering
Barge-launched jacket	Barge-launched jackets weigh between 5,000 and 25,000 tonnes. They are yard fabricated and transported horizontally to the field on a transportation barge, then launched from the barge over rocker beams and upended through controlled flooding. Final positioning may require crane assistance.
Casing	Pipe installed in the wellbore to retain the borehole dimension and seal off hydrocarbon and water-bearing formations. Casing is usually cemented in place to ensure the pipe remains in place. The formation behind the pipe remains intact and flow does not occur in the annulus between the casing and the formations.
Christmas tree	The valves and fittings assembled at the top of a completed well to provide the ability to open and close access to the production tubing and the annuli between the tubing and casing strings and the annuli between casing strings.
CNS	Central North Sea
Coiled tubing	A long, continuous length of pipe wound on a spool. The pipe is straightened prior to pushing into a wellbore and rewound to coil the pipe back onto the transport and storage spool.
CoP	Cessation of Production
Conductor	A large diameter pipe extending upwards from or beneath the sea floor to the top of the well on the platform. The purpose of the conductor is to act as a guide for drilling the well and a protective barrier from the elements for the well casings and tubing during the life of the well.
Cuttings piles	Cuttings are formation fragments created by the drill bit in the well and brought to the surface in the drilling fluid. These cuttings are removed from the drilling fluid at the surface and in some cases are discharged overboard. The cuttings sometimes accumulate into cuttings piles around the footings of the installed jackets.
DECC	Department of Energy & Climate Change
Decommissioning *in situ*	Leaving infrastructure in place and carrying out appropriate work to ensure that there is minimal risk to other sea users or the marine environment. This could apply to any installed facilities on the seabed, such as pipelines, manifolds, pipeline crossings and the footings of larger jackets.
E&A Wells	Exploration and Appraisal Wells
Flexible flowlines	Flexible flowlines usually transport hydrocarbons between subsea infrastructure and the host platform or vessel. They are manufactured from composite layers of steel wire and polymer sheathing that provide protection and flexibility to the flowline.
FPSO	Floating, production, storage and offloading vessel – a floating vessel used by the offshore oil and gas industry for the processing of hydrocarbons, storage of oil and the offloading of the oil either to a tanker or into a pipeline.
HMT	HM Treasury
Hydraulic workover unit	Remedial work carried out in a well using a mast powered by hydraulic fluid.

Intervention	Well servicing operations conducted within a completed wellbore to restore or improve production or injection.
Jumper	A short segment of flexible pipe with a connector half at either end. A jumper is commonly used to connect flowlines and/or subsea facilities together.
Lift-installed jackets	These structures weigh less than 10,000 tonnes and are yard fabricated before being transported horizontally or vertically on a barge to the field. Once at the field, the jacket is lifted from the barge into position using a suitable crane vessel.
Manifold	A manifold in the context of oil and gas production is a pipe to which wells are connected in order to collect, co-mingle and direct fluid flow from more than one well. Such an installation can be on a platform or on the seabed for accumulating several subsea wells. Manifolds can be used for the distribution of fluids for injection into a series of wells.
Mattresses	Mattresses are often used to provide protection, for stabilisation, and as crossover support for pipelines. These comprise flexible blocks linked with rope or wire, or concrete forms or grout bags filled with cement.
Milling	A mill or similar downhole tool is used to remove casing in the well where a barrier needs to be installed in the case of pressure or potential movement of hydrocarbons behind the casing. The objective is to prevent fluids flowing into another formation or to surface.
NNS	Northern North Sea
NUI	Normally Unmanned Installation
OGA	Oil and Gas Authority
Production packer	A device installed in a well, used to isolate the annulus and anchor or secure the bottom of the production tubing string.
Rigid pipelines	Rigid pipelines are manufactured from carbon steel or a high performance steel alloy, with additional coatings providing corrosion protection, stabilisation or, in some cases, insulation. Rigid pipelines transport hydrocarbons between subsea infrastructure and platforms and to shore.
Risers	The portion of a pipeline extending from the seafloor to the surface is termed a riser. The function of a riser is to provide conduit(s) for the conveying of produced fluids and/or injection fluids between the seafloor equipment and the production host. Such risers are generally known as production risers in order to distinguish them from other types of risers such as marine drilling risers and completion/workover risers.
Satellite installations	Small, unmanned platforms consisting of minimal facilities (wells, manifolds, and perhaps minimal separation and or testing facilities). These installations are designed to operate in conjunction with a host fixed production platform to provide further processing and onward transportation of fluids.
Sea-fastening	The securing of cargo to a vessel so that movement during transportation does not cause damage.
Self-floaters	These steel jacket structures weigh in excess of 12,000 tonnes and are designed with two large diameter legs for buoyancy during installation. The jacket is fabricated in a construction yard, floated horizontally to the field using the structure's inherent buoyancy, and then upended through controlled flooding. Final positioning may require crane assistance.

Shallow water jackets	These structures usually weigh less than 2,000 tonnes and are typically deployed in water depths of 55 metres or less. They include smaller launched and lift-installed jackets, as well as minimum facilities platforms.
SNS	Southern North Sea
Spool	Short segment of rigid pipe with a connector half at either end. A spool is commonly used to connect flowlines and/or subsea facilities together, e.g. a subsea tree to a subsea manifold. On platforms, spools are used to connect pre-installed piping where final connection is performed offshore.
Subsea isolation valves	In relation to wells these may be referred to as a subsurface safety valve (SSSV). This is a safety device installed in the upper wellbore to provide emergency isolation of the producing fluids in the event of an emergency. Two types of subsea isolation valves are available: surface-controlled and subsurface controlled. In each case, the safety valve system is designed to be fail-safe, so that the wellbore is isolated in the event of any system failure or damage to the surface production-control facilities. In subsea facilities, isolation valves are included in the seabed manifold to isolate wells and piping to protect facilities in the event of an emergency or routine need to prevent fluid flow.
Subsea tie-back	Subsea tie-backs usually connect small reservoir accumulations, developed using subsea trees and manifolds, back to a host platform for onward processing and or transportation.
Tubing	Usually referred to as production (or injection) tubing. This is a pipe inserted in the well to carry and contain the production (or injection) from the reservoir to the surface.
UKCS	UK Continental Shelf
Well scale decontamination	The removal and decontamination of scale build-up that deposits in the tubing of a well during production of reservoir fluids.
Well P&A	Well Plugging and Abandonment
Wellhead	The wellhead is the termination point where the casing strings in the well are supported and provide pressure containment.
Wireline	A form of well intervention that uses an electrical cable to lower tools into the borehole and to transmit data to the surface.
WofS	West of Shetland

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Oil & Gas UK (Aberdeen)
3rd Floor
The Exchange 2
62 Market Street
Aberdeen
AB11 5PJ

Tel: 01224 577 250

Oil & Gas UK (London)
6th Floor East
Portland House
Bressenden Place
London
SW1E 5BH

Tel: 020 7802 2400

info@oilandgasuk.co.uk

www.oilandgasuk.co.uk

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