

# NORWEGIAN CONTINENTAL SHELF DECOMMISSIONING INSIGHT 2016



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## 1. Foreword

Welcome to the first *Norwegian Continental Shelf Decommissioning Insight*. Working together with Norwegian operators, Oil & Gas UK has produced this report in response to demand from the supply chain for more publicly available information on the potential decommissioning market in Norway.

The Norwegian oil and gas industry is at an earlier stage of maturity than the UK sector. Decommissioning activity on the Norwegian Continental Shelf is, therefore, in its infancy and to date only limited information regarding timing and expenditure has been made publicly available.

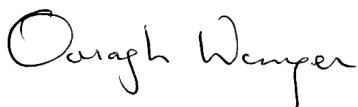
The data presented within this report are based on the decommissioning activity forecasts of the five key operators on the Norwegian Continental Shelf over the next decade. Information on forecast decommissioning activity on the UK Continental Shelf (UKCS) can be found in the *UK Decommissioning Insight*<sup>1</sup> produced by Oil & Gas UK.

The North Sea decommissioning market extends beyond national borders. It is therefore important that both operators and the wider supply chain have access to information about upcoming activity so that they can compare forecasts across different North Sea regions. This Insight expands existing knowledge of the market and outlines to operators and the supply chain where demand for related services is likely to lie so they can plan decommissioning more effectively.

It is expected that the Norwegian decommissioning market has the potential to be the second largest in the North Sea after the UKCS. There are 12 concrete facilities, 19 floating steel facilities, 88 steel facilities and nearly 350 subsea systems in place, most of which will eventually require decommissioning<sup>2</sup>. An estimated 3,000 wells will need to be plugged and abandoned.

The Norwegian Petroleum Directorate estimates that decommissioning could cost around NOK 160 billion (£12.5 billion)<sup>2</sup>. While this is not a definitive figure, it suggests that decommissioning is a significant emerging area of business in the Norwegian sector. This report aims to broaden understanding of this new market to enable the supply chain to develop the skills, technologies, expertise and cost-efficient solutions required by operators.

As with all Oil & Gas UK reports, we aim to take feedback on this document and will work to provide greater insight as time progresses. Please send comments and questions to [operations@oilandgasuk.co.uk](mailto:operations@oilandgasuk.co.uk).



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<sup>1</sup> Oil & Gas UK's *Decommissioning Insight 2015* is available at [www.oilandgasuk.co.uk/decommissioninginsight.cfm](http://www.oilandgasuk.co.uk/decommissioninginsight.cfm)

<sup>2</sup> Estimate does not include the removal of fixed concrete substructures. *Climate and Pollution Agency Decommissioning of Offshore Structures report 2011* available at [www.miljodirektoratet.no/old/klif/publikasjoner/2761/ta2761.pdf](http://www.miljodirektoratet.no/old/klif/publikasjoner/2761/ta2761.pdf)

## 2. Summary of Key Findings

- Twenty-three decommissioning projects are forecast from 2015 to 2024 on the Norwegian Continental Shelf. Projects included range from small subsea tie-backs to full scale, integrated platform removals.
- Almost all of this activity is forecast in the Norwegian North Sea, the most mature region of the Norwegian Continental Shelf.
- 284 wells are estimated to be plugged and abandoned over the next decade, representing close to ten per cent of the total well stock on the Norwegian Continental Shelf that will eventually require decommissioning. Ninety-five per cent of these are platform wells.
- Twenty-six pipelines with a total length of 360 kilometres are forecast to be prepared for decommissioning from 2015 to 2024.
- Fourteen platforms are estimated to be removed, or partially removed, within the survey time frame.
- The total tonnage forecast to come onshore over the next decade is 166,850 tonnes. This equates to nearly 105,300 tonnes of topsides, just over 59,000 tonnes of substructures and just over 2,500 tonnes of subsea infrastructure.
- There is significantly less decommissioning activity forecast on the Norwegian Continental Shelf compared with the UK Continental Shelf over the same period. This reflects the relative maturity of each basin<sup>3</sup>.
- The majority of decommissioning projects are in the early scoping stages. Forecasts are therefore subject to change as the project plans are refined further.

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<sup>3</sup> The UK *Decommissioning Insight 2015* report is available to download at [www.oilandgasuk.co.uk/decommissioninginsight.cfm](http://www.oilandgasuk.co.uk/decommissioninginsight.cfm)

## 3. Introduction

### 3.1 Survey Methodology

The *Norwegian Continental Shelf Decommissioning Insight Report 2016* is compiled from five key operators' responses to an Oil & Gas UK survey carried out between June and December 2015. The companies were asked to provide their decommissioning activity forecasts on the Norwegian Continental Shelf for the period 2015 to 2024.

The survey is based on the components of the decommissioning Work Breakdown Structure outlined in Oil & Gas UK's *Decommissioning Cost Estimation Guidelines*<sup>4</sup> (further information can be found in the Appendix). Operators were asked to quantify physical decommissioning activity for six categories in the Work Breakdown Structure by year and region, such as the tonnes of topsides to be removed and the number of wells to be plugged and abandoned.

The categories align with those used to compile the UK Decommissioning Insight reports, enabling comparison of the data across the UK and Norwegian Continental Shelves.

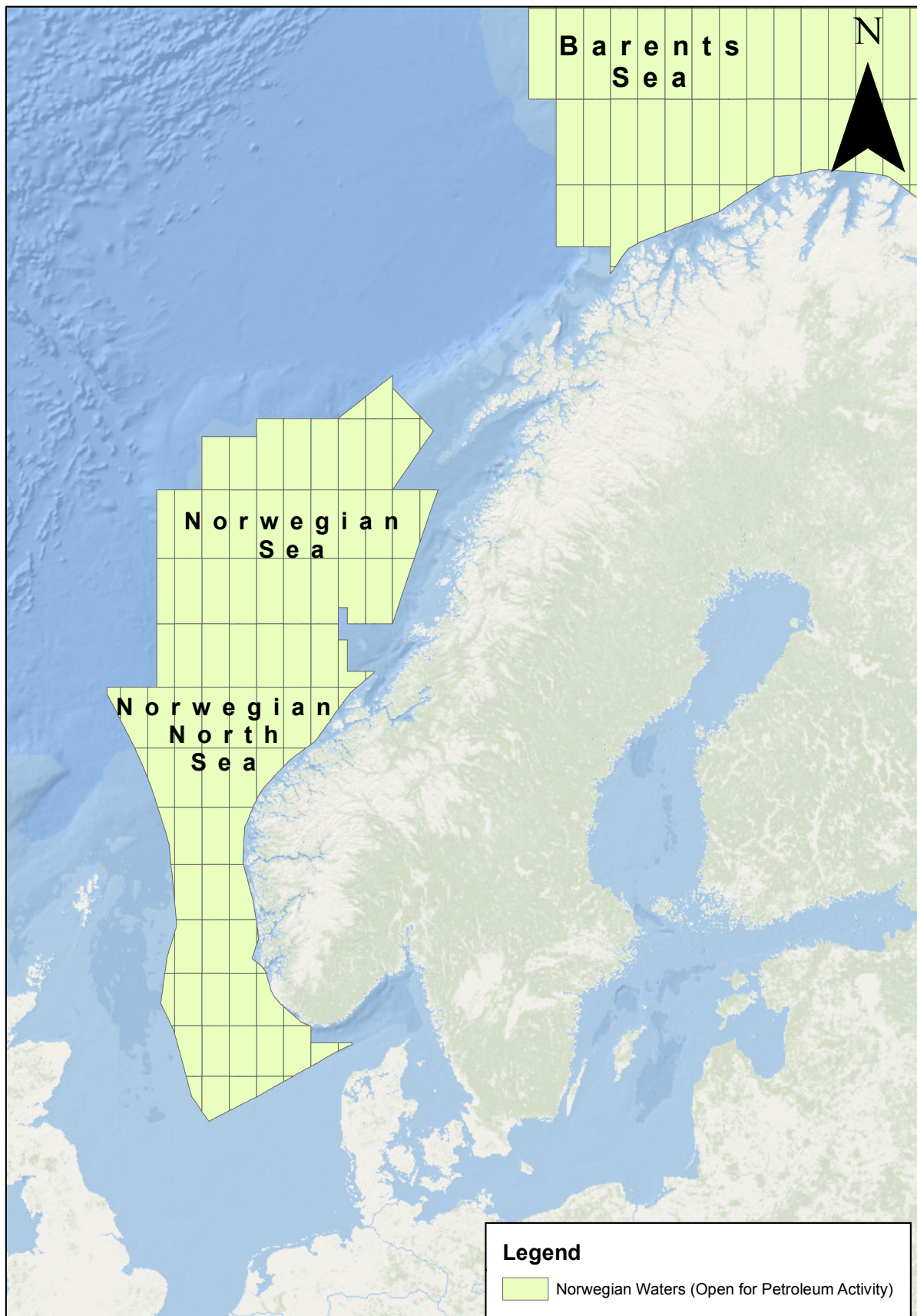
The information presented in the following sections is on a non-attributable and aggregated basis. Oil & Gas UK has not applied any additional treatment to the figures. Due to low activity forecasts in some regions of the Norwegian Continental Shelf, analysis of the data for the Norwegian North Sea and Norwegian Sea has been grouped. No activity is forecast in the Barents Sea within the survey time frame.

The collection and analysis of the data by Oil & Gas UK on behalf of the industry has the support of the Norwegian Petroleum Directorate and Norsk Olje & Gass.

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<sup>4</sup> The *Decommissioning Cost Estimation Guidelines* are available to download at <http://bit.ly/1K5Rhzs>

**Figure 1: Regions of the Norwegian Continental Shelf**



Service Layer Credits: Esri, GEBCO, NOAA, CHS, CSUMB, National Geographic, DeLorme and NAVTEQ  
Shapefiles accessed from the Norwegian Petroleum Directorate, edited and displayed by Oil & Gas UK



## 3.2 Planning for Decommissioning and Activity Forecasting

Decommissioning is the final stage in the full life cycle of a field. Historically, estimates of the lifetime of fields have varied with oil prices, but the overall trend shows that the productive lives of fields on the Norwegian Continental Shelf are being extended through technological advances and enhanced oil recovery techniques. There will, however, come a time when the costs of further recovery can no longer be sustained by income from the field and the surrounding region is considered to have insufficient prospectivity to support future operations, and so the decision is taken to cease production and decommission the assets. The actual timing of cessation of production (CoP) is uncertain and will depend on a number of factors including the oil price, production trends, operating and maintenance costs, and the installation's technical condition.

In addition to the uncertainty around CoP dates, there are many factors that impact the timing and duration of the decommissioning project itself. Planning for decommissioning is a long and often complex process that begins far ahead of CoP and there is considerable variation in the size and complexity of fields on the Norwegian Continental Shelf. Furthermore, development operations within a field can take place in several phases, resulting in some installations being decommissioned while others are still on-stream. The phases of decommissioning are also linked, such that the platform removal start date can be affected by the timing of well plugging and abandonment (P&A) and pipeline disconnection. Campaign-based well P&A and removal operations across several assets simultaneously may also influence operators' plans.

The Norwegian Petroleum Act regulates the shutdown and disposal of facilities on the Norwegian Continental Shelf. Between two and five years prior to an installation ceasing production, operators are required to submit a decommissioning plan, including an Environmental Impact Assessment and plans for public consultation. The Norwegian Ministry of Petroleum and Energy makes the final decision on decommissioning in consultation with the Norwegian Petroleum Directorate.

The information presented in this report gives operators' current best estimates of decommissioning activity on the Norwegian Continental Shelf and is not a list of sanctioned programmes. These forecasts are likely to change as the scope of each project is refined and the schedule becomes more defined. This is particularly the case for projects towards the end of the survey time frame.

## 4. Forecast Decommissioning Activity from 2015 to 2024

This section presents operators' activity forecasts for decommissioning on the Norwegian Continental Shelf from 2015 to 2024. In total, there are 23 decommissioning projects within the survey time frame, ranging from small subsea tie-backs involving single well P&A to large, complex programmes requiring activity in all categories of the Work Breakdown Structure. These large projects span several years and some of their associated activity may fall outside the survey time frame.

### 4.1 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 on the Norwegian Continental Shelf requires regulatory approval and is carried out in accordance with NORSOK D-010 regulation<sup>5</sup>. Well P&A can be challenging and may involve intervention; the removal of downhole equipment, such as production tubing and packers; and well-scale decontamination treatment. The process in Norway requires the wellhead and conductor to be removed to five metres below the seabed.

Approximately 800 of the 3,800 production, injection and monitoring wells that will eventually require decommissioning have already been plugged and abandoned on the Norwegian Continental Shelf<sup>6</sup>. Of the remaining 3,000 wells, close to ten per cent (284 wells) are forecast to be decommissioned between 2015 and 2024. Almost all of this activity is in the Norwegian North Sea region of the basin.

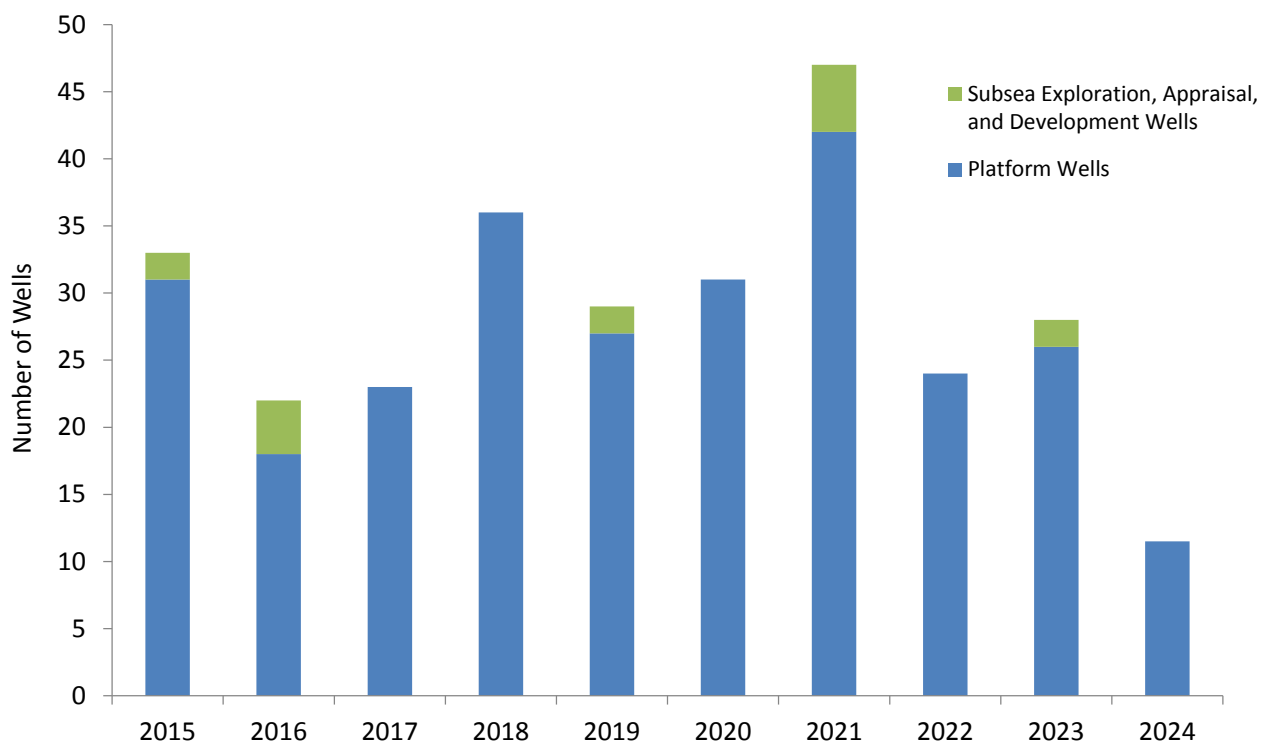
Figure 2 opposite shows that 33 wells are forecast to be plugged and abandoned in 2015 with an annual range of 22 to 36 wells over the near term (2015 to 2019). Activity is estimated to peak at 47 wells in 2021 before decreasing towards the end of the survey time frame. Oil & Gas UK expects that activity will smooth out more evenly across the decade as forecasts are revisited as existing project scopes are refined and new projects come into the survey time frame.

Ninety-five per cent (269 wells) of the wells forecast for P&A on the Norwegian Continental Shelf are platform wells, which are often simpler and cheaper to plug and abandon than subsea wells. The type of rig used for platform well P&A will depend on whether the original drilling derrick is still in place or if a jack-up or modularised drilling unit is required. For 61 per cent (164) of the platform wells to be decommissioned within the survey time frame, the original derrick is no longer operational and operators assume that jack-up or modular rigs will be required. The remaining 39 per cent (105 wells) will be plugged and abandoned using an integral platform rig. Of the 15 subsea wells forecast for P&A over the next decade, operators assume that jack-up rigs will be used where possible, with the exception of one simple well P&A that will be carried out using another rig-less method.

<sup>5</sup> See NORSOK Standard D-010 *Well Integrity in Drilling and Well Operations*, (Rev.4, June 2013) at <http://bit.ly/20BWqdD>

<sup>6</sup> See *Abandonment of Obsolete Wells and Installations on the Norwegian Continental Shelf; a Study into the Magnitude of the Technical and Economic Challenges*, June 2014, University of Stavanger, at <http://bit.ly/1m8jpNW>

**Figure 2: Number of Wells Forecast to be Plugged and Abandoned**



Source: Oil & Gas UK

|                            | Number of Wells<br>2015 to 2024 | Proportion of Platform Wells |
|----------------------------|---------------------------------|------------------------------|
| <b>Total</b>               | 284                             | 95%                          |
| <b>Norwegian North Sea</b> | 281                             | 96%                          |
| <b>Norwegian Sea</b>       | 3                               | 0%                           |
| <b>Barents Sea</b>         | No activity                     | No activity                  |

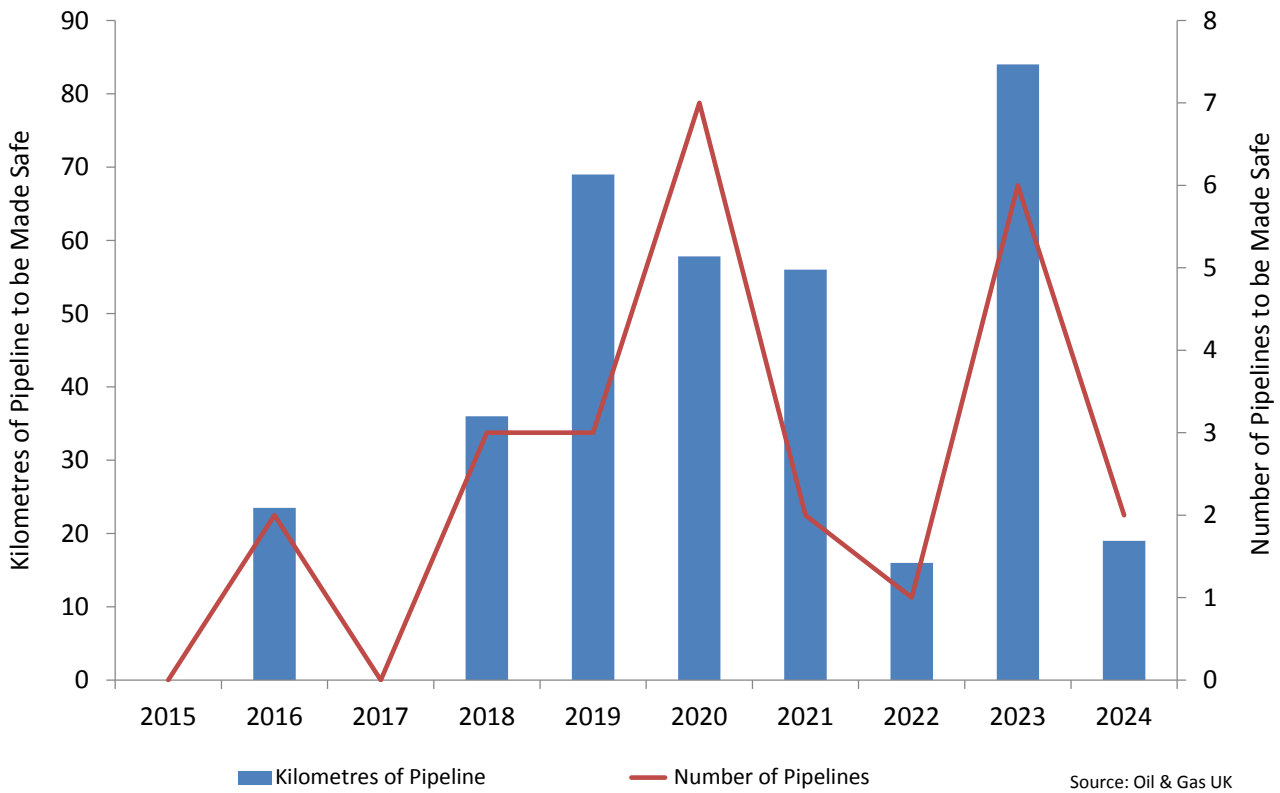
## 4.2 Pipeline Decommissioning

To decommission a pipeline, it is first depressurised and any remaining hydrocarbons removed. It is then purged of its contents and cleaned in accordance with industry standards. This may involve the use of pigs, which are pipeline maintenance tools for cleaning or inspecting the inside of a pipeline. This activity is referred to in the Work Breakdown Structure as pipeline 'making safe' and is carried out in line with environmental and safety considerations. Other activities within the 'making safe' category include physical isolation and waste management.

For the second stage of pipeline decommissioning, the pipeline is brought to its end state, either through removal and being brought to shore, or by being decommissioned *in situ* where regulatory approval has been given to do so. 'Making safe' can be carried out several years prior to this stage of pipeline decommissioning, leaving the pipeline hydrocarbon free for future reuse or the next phase of decommissioning. This report captures activity for pipeline 'making safe' only.

Operators forecast that 26 pipelines with a total length of 360 kilometres will be made safe in preparation for decommissioning over the decade. The length of the pipelines to be made safe ranges from four to 43 kilometres. As illustrated in Figure 3 opposite, activity is not spread evenly across the decade, with years of higher activity and other years of little or no activity.

**Figure 3: Forecast for Pipeline ‘Making Safe’ Activity**



| Pipeline ‘Making Safe’     | Length 2015 to 2024 | Number of Pipelines |
|----------------------------|---------------------|---------------------|
| <b>Total</b>               | 360 kilometres      | 26                  |
| <b>Norwegian North Sea</b> | 284 kilometres      | 22                  |
| <b>Norwegian Sea</b>       | 76 kilometres       | 4                   |
| <b>Barents Sea</b>         | No activity         | No activity         |

### 4.3 Facilities 'Making Safe' and Topside Preparation

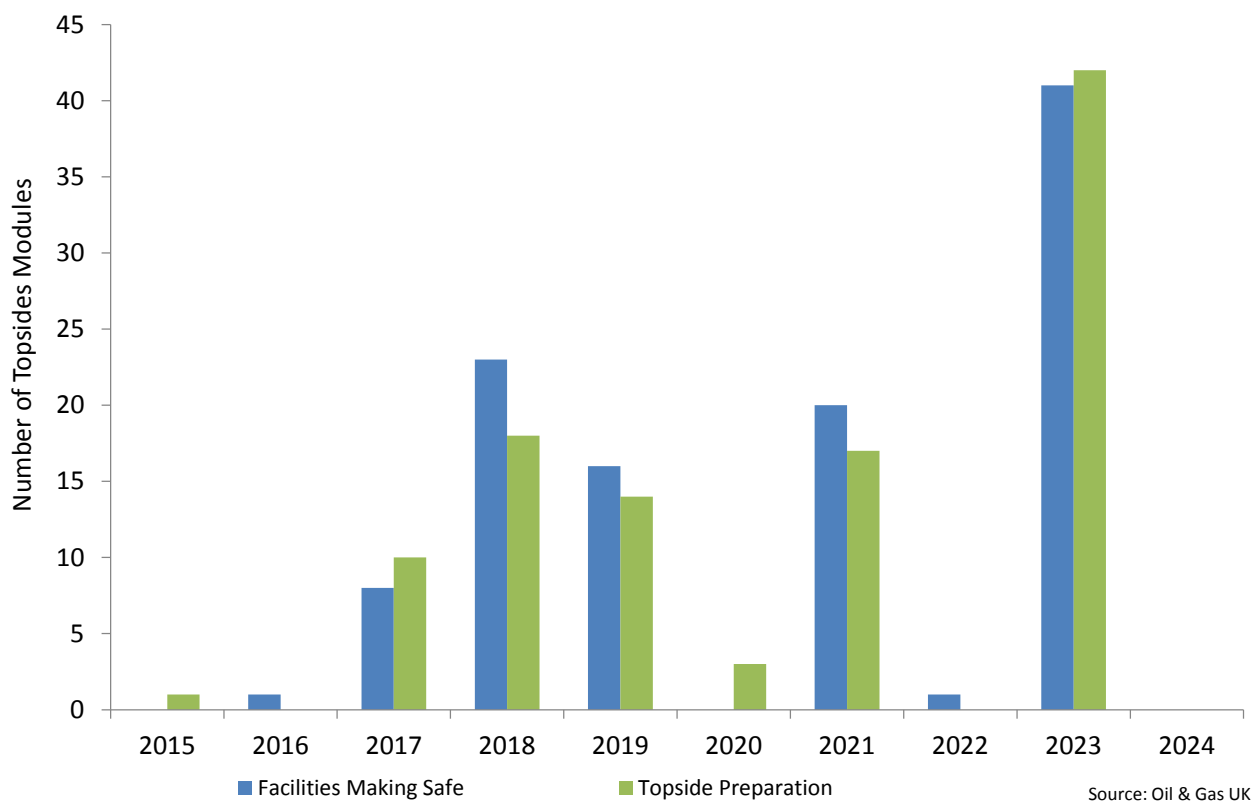
Following CoP and before a platform is prepared for removal, the topsides must be cleaned and flushed to free them of hydrocarbons in line with environmental and safety considerations. This activity is referred to in the Work Breakdown Structure as facilities 'making safe'. Other tasks included in this category include disconnection and physical isolation, as well as waste management.

'Making safe' can be carried out several years prior to removing a platform, leaving it hydrocarbon free until the next phase of decommissioning. Facilities 'making safe' is sometimes carried out alongside pipelines 'making safe', particularly in the case of small topsides and pipeline tie-backs. In these instances, the same team and some of the same equipment can be used for both.

The next phase of platform decommissioning is referred to in the Work Breakdown Structure as 'topside preparation'. This involves separating the topsides and process and utilities modules, as well as carrying out the appropriate engineering work for removal such as installing temporary power, air and water utilities. The topside preparation required will depend on the removal method used. Additional associated activities include carrying out dropped object surveys and subsequent remedial action to address their findings.

Facilities 'making safe' and topside preparation are forecast to be carried out on 12 and 14 platforms, respectively, from 2015 to 2024. Figure 4 opposite shows the number of topside modules associated with these activities. The work is concentrated between 2017 and 2023 and peaks at over 40 topsides modules in 2023. The two activities are closely aligned, although 'making safe' work has already been carried out on some platforms. It is likely that activity will smooth out as forecasts are revisited as it is possible that the work will be carried out over several years, particularly for larger structures.

**Figure 4: Forecasts for Facilities ‘Making Safe’ and Topside Preparation**



|                            | Facilities ‘Making Safe’<br>from 2015 to 2024 | Topside Preparation<br>from 2015 to 2024 |
|----------------------------|---|--|
| <b>Norwegian North Sea</b> | 110 modules on 12 platforms                   | 105 modules on 14 platforms              |
| <b>Norwegian Sea</b>       | No activity                                   | No activity                              |
| <b>Barents Sea</b>         | No activity                                   | No activity                              |

## 4.4 Topside and Substructure Removal

Installations on the Norwegian Continental Shelf must be removed to shore and delivered to an approved disposal site as per regulations, unless they are reused (such as single buoys and wind turbines) or decommissioned *in situ* (such as concrete substructures that are eligible for OSPAR derogation approval<sup>7</sup>). The removal method deployed will depend on the type and weight of the topside and substructure and will be determined through comparative assessment of the available options.

The ability to cut large and often complex steel sections in an offshore environment is one of the key challenges during this stage of decommissioning. The availability of heavy lift vessels, the development and use of new technology for removing installations, and the capacity of disposal sites will all affect how decommissioning on different projects is implemented.

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

To remove the substructure, the type, weight and configuration will determine the removal method applied. Substructures can be removed in a single lift or cut in sections and removed piece-small using a crane vessel. For large steel substructures weighing greater than 10,000 tonnes, the bottom section may be left in place, subject to OSPAR derogation approval.

Floating installations on the Norwegian Continental Shelf may be dismantled into smaller sections while anchored in a fjord off the decommissioning yard, before being taken ashore.

Operators forecast the removal or partial removal of 14 platforms on the Norwegian Continental Shelf within the survey time frame. As shown in Figure 5 opposite, activity varies year-on-year with a peak in 2024 when 44,320 tonnes are forecast to be removed in a single year. It should be noted that the survey sent to operators asked them to select a specific year for removal, whereas the removal window identified in contracts typically spans several years, so actual activity will be more spread out than forecast.

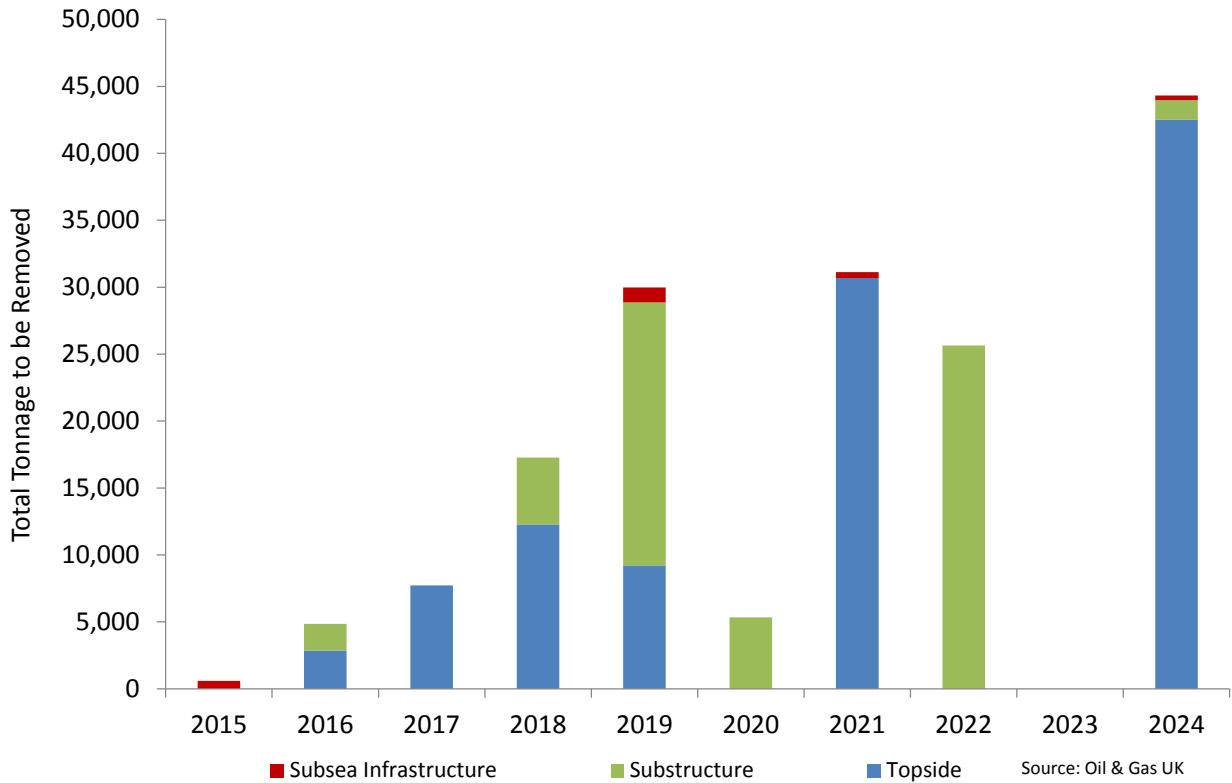
There is a wide range in the weights and types of installations forecast to be removed, from smaller normally unmanned installations (NUIs) weighing around 3,000 tonnes to large, integrated platforms of more than ten times this weight. For the majority of platforms, the topside and substructure will be removed separately.

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<sup>7</sup> OSPAR is the Oslo and Paris Convention for the protection of the marine environment of the North East Atlantic.



**Figure 5: Forecasts for Topsides, Substructure and Subsea Infrastructure Removal**



|                            | Topside        | Substructure  | Subsea Infrastructure |
|----------------------------|----------------|---------------|-----------------------|
| <b>Total</b>               | 105,275 tonnes | 59,055 tonnes | 2,520 tonnes          |
| <b>Norwegian North Sea</b> | 105,275 tonnes | 59,055 tonnes | 2,170 tonnes          |
| <b>Norwegian Sea</b>       | No activity    | No activity   | 350 tonnes            |
| <b>Barents Sea</b>         | No activity    | No activity   | No activity           |

## 4.5 Onshore Recycling and Disposal

Topside and substructure onshore recycling includes activity and expenditure related to onshore cleaning and handling of hazardous waste, deconstruction, reuse, recycle, disposal and waste management accounting.

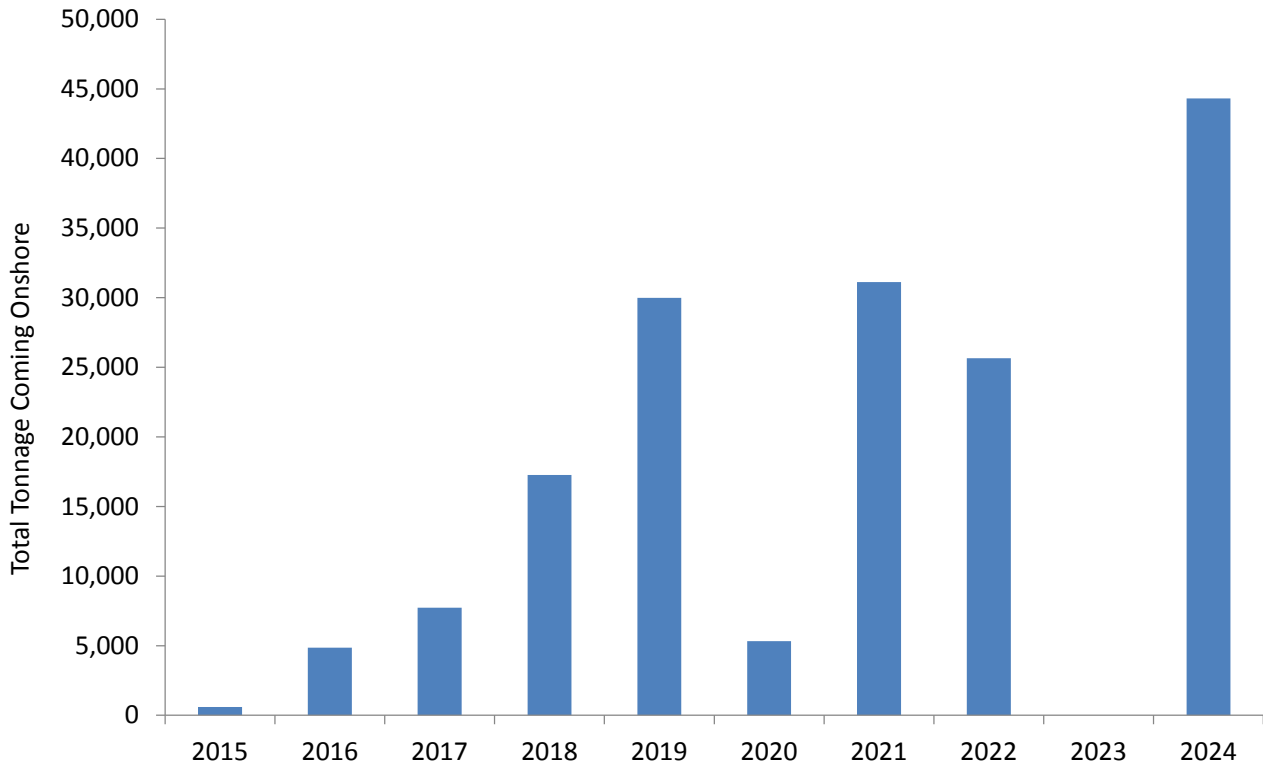
The preferred options to deal with disused offshore structures follow the waste hierarchy of reuse; recycling; and onshore disposal. Once the structures are brought onshore, dismantling and processing is handled by specialists at licensed sites.

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 identification of reuse options, 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 so safe dismantling and waste management of these structures can pose a greater challenge than for substructures, which are predominantly made of steel and can be processed and recycled. There are currently four onshore locations in Norway suited to handle material from decommissioned offshore installations.

Between 2015 and 2024, 166,850 tonnes are forecast to be brought onshore for recycling and disposal. Activity is forecast to peak at 44,320 tonnes in 2024, although it is expected that this could smooth out as forecasts are revisited.

**Figure 6: Forecast of Tonnage Coming Onshore**



Source: Oil & Gas UK

| Tonnage Coming Onshore from 2015 to 2024 |                |
|--|----------------|
| <b>Total Weight</b>                      | 166,850 tonnes |

## 5. Glossary

|                                       |   |
|---------------------------------------|---|
| <b>CoP</b>                            | Cessation of Production   |
| <b>Conductor</b>                      | 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 a well and a protective barrier from the elements for the well casings and tubing during the life of the well.           |
| <b>Decommissioning <i>in situ</i></b> | 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. |
| <b>Intervention</b>                   | Well servicing operations conducted within a completed wellbore to restore or improve production or injection.  |
| <b>NUI</b>                            | Normally Unmanned Installation  |
| <b>Dropped object survey</b>          | A survey of the seabed for items that may have become detached from the installation.   |
| <b>Subsea tie-backs</b>               | 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.  |
| <b>Tubing</b>                         | 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.  |
| <b>Well-scale decontamination</b>     | The removal and decontamination of scale build-up that deposits in the tubing of a well during production of reservoir fluids.  |
| <b>Well P&amp;A</b>                   | Well Plugging and Abandonment   |
| <b>Wellhead</b>                       | The wellhead is the termination point where the casing strings in the well are supported and provide pressure containment.  |

## 6. Appendix – Work Breakdown Structure Categories

Oil & Gas UK’s *Decommissioning Cost Estimation Guidelines*<sup>8</sup> outline the following stages of decommissioning within the Work Breakdown Structure. This survey of decommissioning activity on the Norwegian Continental Shelf explores a subset of these stages, as detailed throughout the report.

| 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.  |

<sup>8</sup> The *Decommissioning Cost Estimation Guidelines* are available to download at <http://bit.ly/1K5Rhzs>







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