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1 Foreword

Whilst decommissioning will not be the primary activity on the UK continental shelf (UKCS) over the coming decade, it does represent a growing business opportunity as well as a challenge for the supply chain. The survey on which this Decommissioning Insight is based suggests that a total of £4.5 billion is expected to be spent on decommissioning assets on the UKCS from 2012 to 2017.

Oil & Gas UK has responded to feedback and requests from the supply chain and expanded its decommissioning survey for 2012. Alongside the expenditure data traditionally collected, new information on numbers of wells, pipelines, removal tonnages and onshore dismantling volumes has been gathered direct from operators who are carrying out decommissioning in the near term.

Decommissioning will typically be a collaborative effort and makes use of the same supply chain services employed in the installation of infrastructure. The expertise currently available in the UK oil and gas industry should stretch to cope with the demands of the emerging decommissioning market. However, it is expected that the supply chain may take time to adjust and there may be specific challenges such as lift capacity, availability of equipment, vessels, rigs and specialist crews to carry out such work. This may require particular focus from the whole supply chain and operators alike and offers an opportunity for the industry to innovate, drive costs down and improve efficiency.
2 Key Findings

- The projected decommissioning expenditure in the UKCS is £28.7 billion\(^1\) by 2040 for existing facilities and new investments could add £4.3 billion to this total. Over the next decade decommissioning expenditure is expected to be around £10.3 billion.

- Oil & Gas UK surveyed 25 operators directly in July/ August 2012 on their decommissioning expenditure and activities between 2012 and 2017. The survey was expanded in response to feedback and requests from the supply chain as part of a process of continuous improvement. Operators were asked to quantify physical decommissioning activities such as the number of wells to plug and abandon, tonnes of jackets to be removed and onshore dismantling volumes. The forecast expenditure data from operators was collected on a non-attributable basis and aggregated by Oil & Gas UK.

- Over half of the respondents classified expenditure as AACE\(^2\) class 4 or 5 which indicates that their projects are still at an initial scoping stages. Decommissioning projects are similar to brown-field development projects in that expenditure is influenced by many factors and linked activities. Cost estimates and cash-flow forecasts are challenging to generate and are continuously reviewed. The supply chain services used in a development project are mirrored in the decommissioning process including project management, engineering and planning and well plugging and abandonment. Decommissioning projects are not subject to the same time pressures as development projects and there is more flexibility in the execution timing, within integrity and safety constraints.

- The total forecast expenditure on decommissioning in 2012 to 2017 based on this latest survey is £4.5 billion, with over half in the northern North Sea. The total expenditure covers 80 fields, 40 platforms from small normally unmanned platforms in the southern North Sea to large integrated facilities in the central and northern North Sea, and 177 pipelines.

- The largest category of expenditure in 2012 to 2017 is well plugging and abandonment at almost £2 billion, including 286 wells in the central and northern North Sea and 74 wells in the southern North Sea and the east Irish Sea. Of these wells, 76 per cent are platform wells.

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• Significant expenditure (22 per cent of the total) is forecast in the suspension live phase of a decommissioning project, the majority of which is operational costs associated with running facilities whilst decommissioning takes place.

• One fifth of the total expenditure is accounted for by the removal of topsides, jackets and subsea installations. A total of 170,000 tonnes is expected to be removed between 2012 and 2017, costing £800 million. This poses a challenge to the supply chain as currently there are only a limited number of heavy lift companies that service the UKCS and have the capacity to lift and transport such tonnage.

• A total of 162,000 tonnes of material is expected to be transported onshore for dismantling and processing between 2012 and 2017. The demand for related services from UK disposal yards and the supply chain that supports them will increase from 2015 onwards.
3 Introduction

Innovation in technology, capital investment and improved cost efficiencies have all contributed to the successful extension of field life on the UK continental shelf (UKCS). However, the projected decommissioning expenditure in the UKCS is £28.7 billion\(^3\) by 2040 for existing facilities and new investments could add £4.3 billion to this total. Over the next decade decommissioning expenditure is expected to be around £10.3 billion. This report provides detail on 25 operators’ expectations of the goods and services, regions and timescales in which the 2012-2017 expenditure will fall, totaling £4.5 billion.

3.1 The Decommissioning Survey 2012

Oil & Gas UK surveyed operators directly in July and August 2012 on their decommissioning activities and expenditure between 2012 and 2017 to provide both operators and contractors with aggregated information on the near term projects in the UKCS; the information presented in the following sections is based solely on that data. This data was collected on a non-attributable basis and the responses to the survey by individual operators have been aggregated by Oil & Gas UK.

The 2012 decommissioning survey built on the survey carried out in 2011 and has undergone a process of continuous improvement in response to feedback and requests made by the supply chain. This has resulted in an increased number of responses returned and expansion of the data collected during 2012 which has provided further insight into the decommissioning market over the next five years. This does mean, however, that comparison with data collected in 2011 is limited.

Overall 25 operators responded to the survey request, more than double the number of responses received in 2011. We believe those who responded represent 80% of the operators with decommissioning expenditure from 2012 to 2017, so estimates contained in this report are conservative. Operators were asked to provide data on expenditure per year for 18 different cost categories such as topside removal or pipeline cleaning and to quantify physical decommissioning activity such as tonnes of jackets to be decommissioning, numbers of wells to plug and abandon and onshore dismantling volumes.

Responses were made to the Oil & Gas UK decommissioning survey for 40 platforms ranging from small normally unmanned platforms in the southern North Sea to large integrated facilities in the central and northern North Sea, 368 wells and over 170 pipelines. Data was collected for 80 fields on the UKCS. Some projects covered full field decommissioning but the majority referred to the partial decommissioning of a field, such as removal of single platform, individual well or pipeline.

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3.2 Classification of Expenditure

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

Decommissioning projects are similar to complex brown-field developments and cover many linked activities, which makes definitive cost forecasting at the outset of a project challenging.

Over half of the responses to the survey were assigned AACE\textsuperscript{4} class 4 or 5 by operators. This classification scheme indicates the level of project definition and designation as class 4 or 5 reflects the complexity and early stage of these projects. One third of the responses were designated as class 3; these were small projects such as a single well to plug and abandon within a given field. The only responses to be classified as class 1 or 2 were for projects that are already nearing completion.

3.3 The oil and gas supply chain

With only 39 platforms having been decommissioned since UK oil and gas activity began, the UK supply chain has not yet been tested to a great extent in terms of its capability to meet decommissioning requirements in the North Sea.

The data in this report highlight the increasing need for the current UK supply chain to adapt to the challenges that will be presented as the industry gears up for a steady increase in offshore infrastructure removal post 2014.

Decommissioning projects are similar to infrastructure installation projects in terms of the need to tap into a wide range of supply chain services and often use the same supply chain services as development projects. The timing of decommissioning projects differs from development projects and is often more flexible in decommissioning projects.

Prior to removal, an extensive amount of preparation occurs to ensure the process that is to be carried out is both environmentally and economically sound. Involvement from every aspect of the supply chain is required with the services utilised in the initial installation being mirrored in the decommissioning process. This includes input from the following areas: project management, engineering and planning, well plugging and abandonment (P&A), demobilisation of derrick barges, platform removal.

\textsuperscript{4} Information on the Advancement of Cost Estimating (AACE) classification scheme is available at http://www.costengineering.eu/Downloads/articles/AACE_CLASSIFICATION_SYSTEM.pdf
4 The Decommissioning Process

Planning and executing offshore infrastructure decommissioning in an environmentally sensitive, safe and economical way is a challenge, with a competent supply chain being essential to ensure that decommissioning projects can fulfil all of these requirements. The data collected for this report has been analysed by region and per phase of decommissioning. The phases of decommissioning are defined in the work break down structure in the Oil & Gas UK Cost Estimating Guidelines 2011\(^5\) and outlined in Figure 1.

Figure 1: The phases of the decommissioning process

**Preparation for CoP (Cessation of Production)**
This is the initial stage of decommissioning which involves DECC approval, preparation of decommissioning programme and CoP programme and internal and JV / co-venturer sanction

**Suspension (Live)**
This stage occurs immediately after CoP, it is the period of time where facilities are still live and hydrocarbons are present but decommissioning has not yet commenced

**Well Abandonment (this may occur before CoP)**
All activities comprising plugging and abandoning the wells

**Decommissioning & cleaning**
This involves all activities including shut-down, depressurisation, removing and residual hydrocarbons, disposal of hazardous wastes and flooding of pipelines

**Disconnection**
All activities including disconnection of pipework and cabling across the modules boundaries, preparation for any NUI (Normally Unmanned Installation) or MMI (Minimally Manned Installation)

**Suspension (Cold)**
This stage occurs once the installation is hydrocarbon free. Typical activities are maintenance of navigational aids, structural integrity and ongoing monitoring

**Removal**
Final preparation and removal of facilities including jackets, topsides and subsea infrastructure onshore

**Disposal**
Transportation of materials onshore including removal of hazardous materials, marine growth, deconstruction and disposal/reuse/recycle

**Continued liabilities**
The obligation exists to monitor the site(s) and any facilities that remain. An appropriate monitoring programme should be established with a provision for ongoing liabilities.
5 Results

The following presentation of results refers to 25 operators’ forecast expenditure on decommissioning UKCS assets between 2012 and 2017 of £4.5 billion.

5.1 Regional Analysis

Figure 2: Total expenditure forecast by year 2012 - 2017

Over half of the forecast expenditure is in the northern North Sea, one third in the central North Sea and 14 per cent in the southern North Sea. The total forecast expenditure in the southern North Sea is £610 million. Expected annual expenditure on the UKCS increases over the five year time period from £500 million in each of 2012 and 2013 to around £800 million a year from 2014 to 2017.
5.2 Expenditure by Phase

The proportion of the total estimated decommissioning expenditure from 2012-2017 falling within each phase of the decommissioning process is shown in Figure 3. The phase with the largest expenditure (44 per cent) is well plugging and abandonment and 20 per cent of the expenditure lies within the removal phase. The suspension live phase contains accounts for 22 per cent of the forecast expenditure, the majority of which is the operational costs associated with running the facilities whilst decommissioning takes place.

Further insight into the forecast expenditure and quantification of physical decommissioning activities within each phase of the decommissioning process is provided in the following sections.

Source: Oil & Gas UK

Figure 3: Proportion of total forecast decommissioning expenditure in the UKCS accounted for by each phase of the decommissioning process 2012 - 2017
5.2.1 Preparation for Cessation of Production and Suspension Live Phases

The beginning of the decommissioning process is represented by a preparatory phase, preparation for the cessation of production (CoP). The work is characterised by engineering, reservoir and environmental studies, preparation of CoP and decommissioning programme documents and associated consultation.

This is followed by the suspension live phase where hydrocarbons are still present on the facility but production has ceased, during which 95 per cent of the staff required for production are still typically needed. The suspension live phase comprises expenditure on project management and support as shown in Figure 4.

![Bar chart showing forecast expenditure for preparation for CoP and suspension live phases in the UKCS 2012 - 2017](source: Oil & Gas UK)

The total forecast expenditure in the next five years for the UKCS for both the preparation for CoP and suspension live phases is over £1 billion.

Almost £30 million is forecast to be spent on preparation for CoP activities in 2012 alone. The expenditure in this activity decreases through the time period as decommissioning projects move into the later phases of the decommissioning process.
During the suspension live phase, operators’ project management expenditure totals £240 million over the timeframe. The annual cost increases as more detailed plans get underway and the decommissioning projects submitted in the survey responses move into the later phases of decommissioning process.

Expenditure on operations support totals £730 million from 2012 to 2017 and increases sharply from 2014 onwards. Operational support costs that, until decommissioning are included in the asset’s operating expenditure are from this stage usually recorded under the decommissioning project costs. Operational support costs remain significant during the suspension live phase as work is carried out to maintain the integrity of the asset into decommissioning. There is an opportunity to improve cost efficiencies of decommissioning projects by minimising the length of time an asset is in the suspension live phase.

5.2.2 Well Abandonment Phase

Well plugging and abandonment (P&A) is carried out on the UKCS following approval from the regulators and in accordance with regulatory and industry guidelines. Well P&A may involve some intervention, removal of some downhole equipment, such as production tubing and packers, and well scale decontamination treatment. Well P&A includes the removal of the wellhead or conductor to three metres below seabed. The well abandonment phase represents the largest category of decommissioning expenditure in the UKCS over the next five years; it is forecast to cost almost £2 billion.

Three quarters of this expenditure is in the central and northern North Sea covering 286 wells, of which 61 per cent are platform wells. In these areas of the North Sea, activity peaks in 2014 when over 90 wells are scheduled for P&A; 80 per cent of these are platform wells which may be plugged and abandoned using existing equipment on the platform. It is expected that some smoothing of the well P&A activity will be seen over the timeframe due the availability of equipment, rigs, vessels and skilled crews to carry out such abandonment work.

Data from CDA’s DEAL database reflect that by August 2012, 23 wells had been plugged and abandoned in the central and northern North Sea.

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6 Oil and Gas UK’s Well Suspension and Abandonment Guidelines
http://www.oilandgasuk.co.uk/publications/viewpub.cfm?frmPubID=447

7 CDA’s DEAL database can be accessed at https://www.ukdeal.co.uk/dp/jsp/PleaseLoginDeal.jsp.
The average cost of plugging and abandoning a well in the central and northern North Sea is £2.9 million for a platform well, £3.5 million for a subsea exploration and appraisal (E&A) well and over £15 million for a subsea production well.

Whereas the routine abandonment of an E&A well (from which only the wellhead needs to be removed) can be completed from a vessel, abandonment of a subsea production well requires removal of subsea production equipment involves the costly hire of a rig. However, it is expected that complex E&A wells that require rig intervention may incur higher costs in future.

The cost of each well is dependent on a wide range of factors such as water depth, weather, well type, complexity and age.
In the southern North Sea and east Irish Sea forecast, expenditure for well P&A is £380 million from 2012 to 2017. This includes 74 wells, over 80 per cent of which are platform wells. Well P&A in the southern North Sea may be carried out from the platform or from a rig alongside, due to the simpler nature of these platforms. Decommissioning of platform wells is concentrated in 2015 which corresponds with a peak in forecast expenditure. It is expected that some smoothing of the well P&A activity will be seen over the timeframe due the availability of rigs, vessels and skilled crews to carry out such abandonment work.

The average cost of well P&A in the southern North Sea and east Irish Sea is £2.8 million for a platform well, around £2.5 million for a subsea production well and £2.2 million for a subsea E&A well. There is less variation in the cost of P&A between subsea production wells and platform or subsea E&A wells in the southern North Sea and east Irish Sea than in the central and northern North Sea because all wells in the southern North Sea may be abandoned utilising a rig. The actual cost of each well is dependent on a wide range of factors such as water depth, weather, well type, complexity and age.
5.2.3 Decommissioning and Cleaning, Disconnection and Suspension Cold Phases

The next stage in the decommissioning process involves preparing for removal activities such as cleaning, removal of loose items and disconnection of process equipment and modules. Over the next five years, decommissioning and cleaning (captured in the survey as cleaning costs) expenditure totals almost £190 million and the cost of disconnection phase activities is over £330 million.

![Forecast expenditure on cleaning and disconnection on the UKCS 2012 - 2017](source)

Figure 7: Forecast expenditure on cleaning and disconnection on the UKCS 2012 - 2017

The majority of cleaning costs captured in the survey represent topside cleaning and expenditure is centred on the central and northern North Sea because the majority of southern North Sea assets are small satellite or normally unmanned facilities which may require less cleaning activity.

Both disconnection and cleaning costs increase throughout the timeframe and increase sharply from 2014 onwards as more projects move into this phase of the decommissioning process. The suspension cold phase of the decommissioning process is characterised by low levels of activity; at this point, the preparation for removal activities will be complete and the facility will be awaiting removal. The decommissioning survey did not ask operators for specific expenditure in this phase.
5.2.4 Removal Phase

The removal phase of the decommissioning process includes the removal of topsides, jackets and subsea installations. The removal of topsides may include some cutting and re-engineering of the topside modules. Topsides are removed using techniques such as piece-small, reverse-installation or single lift. These techniques use platform cranes, modified jack-ups, semi-submersible crane vessels or heavy lift vessels and the topside modules are usually transported to shore on barges.

Once the topsides have been removed the platform jacket may be lifted and brought ashore. This can involve some subsea cutting and the installation of lift points. Smaller jackets such as those commonly used in the southern North Sea may be lifted in a single lift and transported to shore either on a barge or the lift vessel. Larger jackets commonly require multiple lifts and have to be cut into manageable pieces.

Between 2012 and 2017, the expenditure forecast during the removal phase is over £800 million in the UKCS. 84 per cent of this is to be spent in the central and northern North Sea and of this, £340 million is on topside removal, £150 million is on jacket removal (peaking in 2016) and £166 million is on subsea removal.
Figure 8 a) Topside, jacket and subsea tonnage and number of topside modules (indicated by green line on right hand axis) to be removed in the central and northern North Sea 2012 - 2017

8 b) Forecast expenditure for removal activities in the central and northern North Sea 2012 - 2017

The increase in expected expenditure in the removal phase through the time frame corresponds to an increase in topside and jacket removal activity towards the end of the time period. In total there are 150,000 tonnes to be removed in the central and northern North Sea, covering 105 topside modules, 35,000 tonnes of jackets and 3000 tonnes of subsea facilities. In this region many of the projects extend beyond the five year time frame and in some cases, physical removal will continue after 2017. Decommissioning projects are not subject to the same time pressures as development projects and therefore there is more flexibility in the execution timing.

The average topside module in the decommissioning survey in the central and northern North Sea weighs 1,710 tonnes and costs £4,200 per tonne to remove whereas jackets cost £3,100 per tonne to remove on average. Actual removal costs per tonne are dependent on a wide variety of factors such as location, weather, previous experience and age of installation.
The forecast of removal expenditure in the southern North Sea and east Irish Sea is almost £130 million and includes 9,000 tonnes of topsides and a similar weight of jackets. The activity is focused in 2015 and 2016, with very little planned for 2013 and 2017. It is expected that some smoothing of the removal activity within the southern North Sea and east Irish Sea sector will occur over the time frame due the availability of vessels, equipment and crew to carry out such work. Subsea removal activity is spread over the time period totalling 1,200 tonnes and with a forecast expenditure of almost £40 million. The average topside module weight in decommissioning survey in the southern North Sea and east Irish Sea is 648 tonnes.

During 2015, approximately 43,000 tonnes of topside structures are forecast to be removed; this equates to over 40 heavy lifts taking place (depending upon the available lift capacity and installation specifications). Currently there are only a limited number of heavy lift vessel companies that service the UKCS with the capacity to lift and transport such tonnage.

Figure 9 shows that between 2015 and 2017, 43,000 tonnes of jackets are also scheduled to be removed. Specialist vessels that are capable of lifting and transporting such large structural objects are required to undertake this activity. Currently there is not an established service base of these vessels in the North Sea but there is evidence of specialist companies engineering new solutions such as the Allseas Pieter Schelte heavy lift vessel.
Not only will the heavy lift market have to cope with the demands of decommissioning, there are also a number of significant offshore facilities scheduled to be installed in 2015. This will put enormous pressure upon the heavy lift market and companies carrying out decommissioning may have to look further afield than the UK to fulfil their requirements.

5.2.5 Disposal Phase

The disposal phase of the decommissioning process encompasses activities such as the dismantling, reuse of items and recycling of material brought onshore during a decommissioning project after offshore removal has taken place. The dismantling of facilities is handled at specialist sites. Items that may be dismantled and processed for reuse or recycling include whole jackets and topside modules, large individual items such as cranes, booms, compressors and smaller pieces of equipment such as a single well head or pipe work.

The options that are typically considered in the disposal phase of the decommissioning process are described in Figure 10.

![Disposal decision tree](image)

**Figure 10: Disposal decision tree**

Reuse, which in the broadest sense means any activity that lengthens the life of an item, is often confused with recycling which is the reprocessing of an item into a new raw material. Reuse can help address the challenge of waste disposal and can often be a cost efficient option.

Incidence of reuse of complete topside modules in the UKCS is currently limited to southern North Sea gas platforms; for example, in 2011, Perenco reused the topsides from their southern North Sea Welland platform on a new development in West Africa. While each facility should be considered on its own merits, a number of common factors can drive the disposal decision including the amount of maintenance required, the ease of access, the prevalence of obsolete technology and long-term liability for the structure.
The expenditure within the disposal phase was captured in the decommissioning survey as onshore dismantling costs and volumes. The total expected onshore dismantling expenditure from 2012 to 2017 is £56 million which corresponds to a volume of 160,000 tonnes, 87 per cent of which will occur in the central and northern North Sea. Activity and spend is due to increase throughout the time period, peaking at 55,000 tonnes in 2016, which corresponds to an increase in removal of jackets, topsides and subsea installations at that time.

![Expected onshore dismantling tonnage 2012 - 2017](image)

**Figure 11: Expected onshore dismantling tonnage 2012 - 2017 (Forecast expenditure indicated by purple and green lines and scale on right hand axis)**

Specialist facilities that are capable of safely and controllably dismantling large offshore structures and efficiently disposing of the resultant waste are in short supply in the UK. Yards must be of a certain specification to be suitable to deal with disposal of offshore facilities. The yard must have sea access and sufficient quayside depth, either for heavy lift vessels unloading of 10-15 metres or barge unloading of 4-6 metres. The quayside must also cater for heavy load-ins and the movement of large objects, have good logistical access for distributing recycled items and waste materials and contain a bunded area where spillages can be controlled.

Onshore disposal sites will typically offer services including the assessment of decommissioned materials, the decontamination and control of hazardous materials, storage and recycling. Most UK disposal yards also have the capability to refurbish and fabricate when reuse is the chosen disposal method.
Figure 11 shows that over the next 5 years an increasing amount of onshore dismantling will take place with a total of 160,000 tonnes due to be transported onshore. It is evident that UK disposal yards, and the supply chain that supports them, may be subject to considerable strain from 2015 onwards as demand for their services increases in line with the increased amount of decommissioned materials.

### 5.2.6 Continued Liability Phase

The final phase in the decommissioning process is the continued liability stage. After a decommissioning project has been executed there is a requirement for the operator to carry out monitoring of the site. The specific monitoring programme will be agreed with the regulator on a project by project basis. The total forecast expenditure for continued liability phase is £1.4 million from 2012 to 2017. The majority of the large decommissioning projects submitted as part of the survey will continue beyond 2017 so will not reach the continued liability phase within the time frame under study here.
5.3 Pipeline and Mattress Decommissioning

Pipeline and mattress removal may occur at several stages of the decommissioning process including the well abandonment, decommissioning and cleaning, disconnection and removal stages or at the end of a decommissioning programme. The timing of pipeline and mattress decommissioning depends on individual connections and availability of equipment. Forecast expenditure and numbers of pipelines and mattresses to be decommissioned were captured within the survey and analysed separately.

The total forecast expenditure on decommissioning and cleaning of pipelines from 2012 to 2017 is £141 million for 177 pipelines. Over two thirds of this expenditure is in the central and northern North Sea and within this region 66 per cent is focused on trench and burial activities.

Figure 12 shows a high level of activity in 2013 and low forecast expenditure. This discrepancy in the results may be because some respondents to the survey have included all possible connectors and conductors as pipelines. In some years there may be a high volume of small, short lines such as well head jumpers which are relatively quick, easy and cheap to decommission. The type of pipeline to be decommissioned varies...
decommissioned was not collected as part of the survey but could be explored further in future surveys.

In the southern North Sea and east Irish Sea, it is planned that 49 pipelines will be decommissioned between 2012 and 2017. The expected activity and spend is greatest in 2015 and 2016. Pipeline removal costs account for 63 per cent of the forecast expenditure in this region.

**Figure 13**: Forecast expenditure on pipeline decommissioning in the southern North Sea and east Irish Sea 2012 - 2017 (numbers of pipelines are indicated by green line and scale on right hand axis)

A total of 2,700 mattresses are expected to be decommissioned on the UKCS between 2012 and 2017 and half of these are located in the southern North Sea. Activity is greatest in 2016 when 810 mattresses are planned to be decommissioned.
Contact for further information:

Oil & Gas UK Aberdeen
3rd Floor
The Exchange 2
62 Market Street
Aberdeen AB11 5PJ
Tel: +44 (0)1224 577250
Fax: +44 (0)1224 577251

Oil & Gas UK London
6th Floor East
Portland House
Bressenden Place
London SW1E 5BH
Tel: +44 (0)20 7802 2400
Fax: +44 (0)20 7802 2401

Email: info@oilandgasuk.co.uk
Website: www.oilandgasuk.co.uk

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