



Oil & Gas
Authority

Wells Insight Report 2018

4.5 Well Management; 4.6 Well Intervention



Key Insights



The need to keep on drilling



7,800 wells
drilled to date



Story so far
Delivering
44 billion barrels

Significant resource potential remaining

But, drilling activity is in decline:

2017 low well activity

19

E&A
Wells

56

Development
Wells

2128

wells in
operation

Only 18% of
future E&A wells
(2018 to 2020)
have financial
approval

Declining trend
in average
discovery size

Development
drilling has
fallen 50%
from 2015
to 2017



And while well costs are lower...

...this is largely
driven by service
rate reductions,
not performance
improvements...



...with non-
productive time
(NPT) making up
>15% of cost

So in order to see a turnaround and deliver MER UK:

Increase

new well drilling & improve costs

Improve

base management

Improve

well abandonment planning



Huge value

In 2017

Safeguarded 21 million boe production through interventions

Added 22.5 million boe production (by improving underperforming wells and/or reactivating shut in wells)

But...

33 million boe were not achieved as a result of well losses

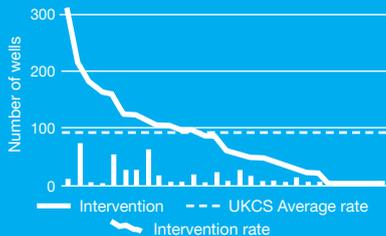


Around 600 wells shut in with significant remaining reserves:
30% of existing active well stock

from existing wells



Well integrity and water production issues account for **62%** of shut-ins



Intervention rates are too low:

8% surveillance rate **14%** intervention rate

OGA will

- Develop a new Wells Strategy to support industry
- Establish a new Asset Stewardship Expectation focused on well management
- Publish a report detailing Wells lessons learned



Well abandonment

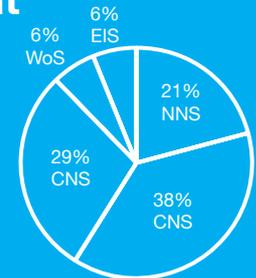
240 open water suspended E&A wells

Average age of 27 years, raising the issue of mechanical integrity

All require to be permanently abandoned

12 operators hold 70% of the wells

Further 28 operators hold the remaining 30%



Suspended E&A wells by area

Well abandonment activity has increased four-fold since 2016

Over 150 wells per year expected to be P&A'd

More wells being plugged and abandoned than drilled

P&A costs account for ca. 45% of the total decommissioning cost: Cost reduction is happening

2016: £402 million was spent on 76 abandonments

2017: £446 million spent on 163 abandonments

OGA work with industry to promote

- | | | | | |
|--|---|---|---|--|
| Information sharing on scope and abandonment plans | Sharing P&A execution experience/ lessons learned | Campaigns to achieve economies of scale, through higher rig and crew utilisations, fast learning curves and continuity of crews | Visibility of future rig and service demand profiles to help supply chain to plan | Novel and efficient contracting models |
|--|---|---|---|--|

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2. Background

2.1 UKCS resource progression and wells

Resource progression is vital to sustain production operations in the UKCS. The OGA estimated that, in addition to the 5.4 bnboe of reserves still to be produced, there are 7.5 bnboe contingent resources which could be developed, plus a substantial yet to find (YTF).

To find and deliver the significant potential resources, a significant increase in drilling activity is required, both in exploration and development. This increase in activity must also be met with an improvement in cost efficiency and value if MER UK is to be achieved.

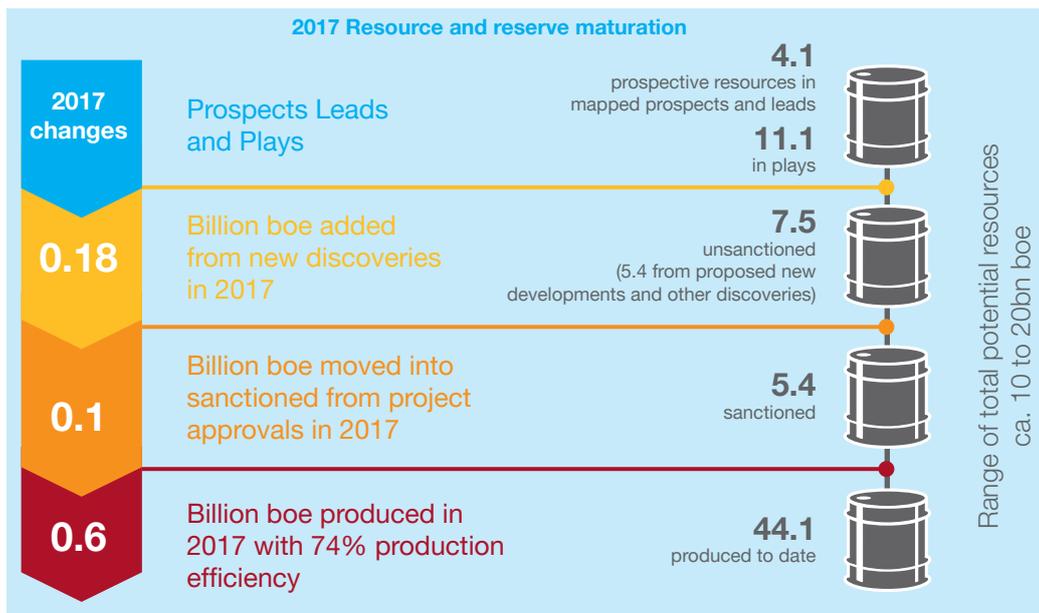


Figure 1



Figure 2

Production levels

Production decline has been arrested since 2014 with sustained consistent production levels over the past 5 five years.

Drilling activity and well interventions have played a significant role in this arrest and it remains crucial to maintain the focus on management of the active well stock.

Production losses due to wells

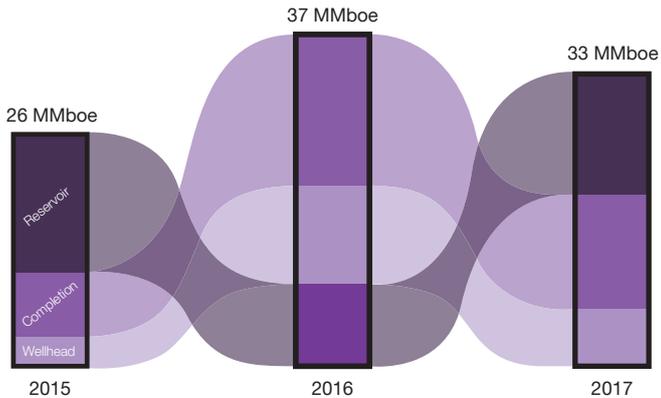


Figure 3

Despite the progress made on improving the overall production efficiency in recent years, well production losses remain high at 33 million mmboe per year and the large number of shut-in wells (circa 30% of total active wells) present opportunities for economic reactivation.

Production levels UKCS

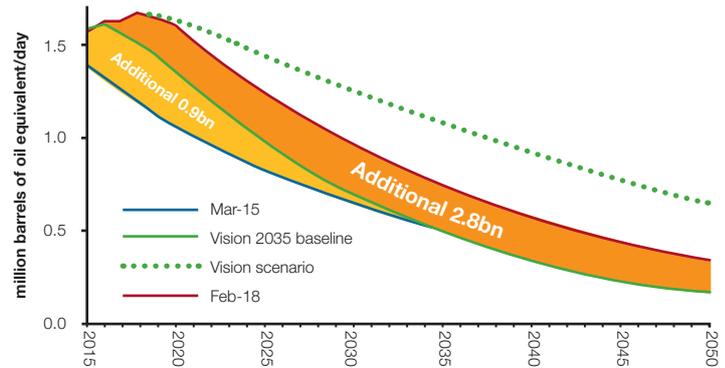


Figure 4

2.2 UKCS well stock (end of 2017)

Over 50 years of exploration and development activity on the UKCS have seen the delivery of a total of over 7,800 wells to the end of 2017 (requiring drilling of over 11,900 wellbores, including sidetracks).

It is evident that approximately half of all wells drilled are still active. AB1 and AB2 wells are plugged prior to abandonment and a significant portion of those wells are in open water. These wells will require to be permanently abandoned at some point in the future.

UKCS well stock and their status. (1964-2017)

Well Status	Well Type					Totals
	Exploration	Appraisal	Dev Platform	Dev Subsea	Combined Development	
Completed (Operating)			1506	622	2128	2128
(Completed Shut In)			386	310	696	696*
Plugged			224	43	267	267
AB1 & AB2	239				409	648
AB3 (Permanently Abandoned)	2345	1145			645	4135
Totals	2486	1373			4015	7874

Figure 5

*Approximately 100 of the 696 completed (shut in) wells are on fields that are due for cessation of production (COP) and are therefore not counted as part of the active well stock.

Of these well status categories the Completed (Operating) and Completed (Shut In) wells together on fields where there are still reserves represent the UKCS active well stock. Plugged, AB1 and AB2 wells are not included in the active well stock but are theoretically still accessible for future use as they are not permanently abandoned. The permanently abandoned wells are considered no longer accessible.

2.3 Industry landscape

The bulk of the historical drilling activity has been undertaken by oil and gas majors. By contrast, today a much more varied group of operators are undertaking exploration and development drilling activity.

This change in activity mix combined with recent asset transactions has resulted in a diverse distribution of well operatorship. The UKCS today has 12 companies operating 77% of the development well stock (each holding between 100 and 350 wells) and 60 further companies holding the remaining 750 wells.

Some 3000 development wells drilled to date are still active, either operating or still accessible through intervention work. This is a significant capital asset for the UKCS which operators must manage optimally. This is discussed further in section 4.5, Well Management.

UKCS development well stock ownership (operating, shut in, plugged, Ab1 and Ab2)

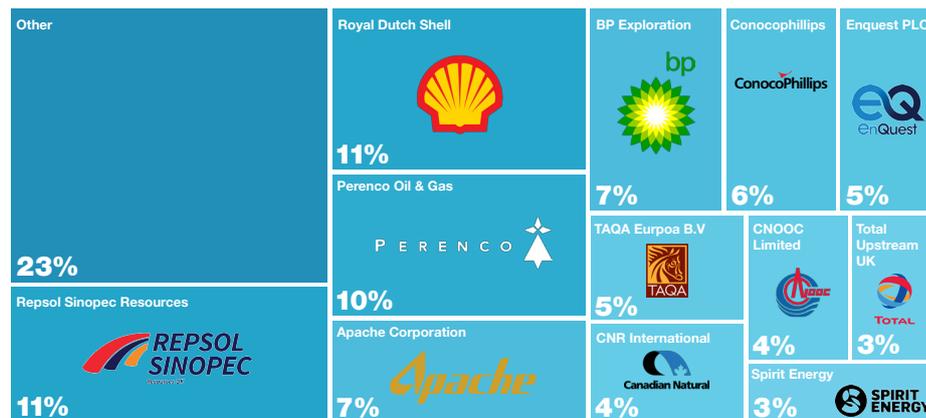


Figure 6

2.4 Role of OGA

Current well activity must increase to deliver MER UK. The OGA supports to improve well performance through benchmarking of performance data, sharing of lessons learned and targeted stewardship to drive increased well activity.



OGA supporting performance improvements



The image shows the cover of the 'UKCS Wells Insights Report' from the Oil & Gas Authority. The cover features the title, a subtitle 'Advice, tools and capabilities across the well lifecycle', and a collage of images related to oil and gas operations.

The OGA supports performance improvements by gathering and sharing comprehensive industry data across the well life-cycle. The annual Wells Insights report and other ad hoc reports such as the Wells Lessoned Learned report will be published to further the industry's knowledge.



OGA focusing on regulatory excellence

OGA Wells Strategy (1Q 2019)

OGA Wells Stewardship Expectations (1Q 2019)

The OGA's stewardship focus in this area will be defined by a wells strategy and a new wells stewardship expectation. The strategy will set out regulatory compliance, performance improvement and investment decision process requirements. The wells stewardship expectations will identify expected performance and benchmarks and form the basis for operator reviews.



Driving increased well activity

Project contents

Well Interventions E&A drilling

Senior industry leadership and action

The OGA is also driving increased well activity through project consents, well interventions, E&A drilling and engagement with senior industry leaders.

4.5 Well management

In total, around 7,500 development wellbores have been drilled on the UKCS from just over 4,000 surface locations. Of these, approximately 2,700 wells represent the UKCS active well stock with over 2,000 wells currently reported on-line and around 600 wells shut in. The remaining development wells have one of the following status: plugged, AB1, AB2 or AB3 and are no longer considered to be an active well.

In 2017, around 600 million boe was produced through the 2,128 operating wells, however, 33 million boe of production losses were attributed to wells (16% of the total UKCS production losses for 2017).

This existing well stock represents a significant capital asset for the UKCS which the industry must manage. The OGA expects this to be carried out through effective surveillance, intervention and workover operations to maximise value to UKCS.

In 2017:

- 21 million boe of production was safeguarded through intervention operations (mainly pumping)
- An additional 22.5 million boe of production was added (by improving underperforming wells and/or reactivating shut in wells)
- 33 million boe were not achieved, as a result of well losses

Approximately 41% of the well stock is in the CNS with 26% and 24% in the SNS and 24% in the NNS, with the remaining 9% split between WoS and EIS areas.

The asset type of the UKCS well stock is 68% platform based, whether manned or un-manned, and the remaining 32% are subsea wells.

The well stock can also be split into fluid type showing 50% of UKCS development wells are liquids (oil or condensate) producers, and 35% are gas producers, with the remaining 15% being injectors

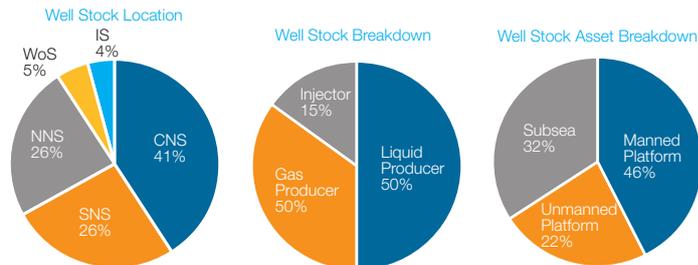


Figure 51

Production losses

Production losses attributable to the well stock in 2017 was 33 million boe, down from the 37 million boe reported in 2016. However, the 2017 figure is still 27% higher than the 2015 figure of 26 million boe so there is no discernible downward trend. Although industry has significantly improved overall production efficiency, there is still a challenge in reducing losses attributed to wells.

2015 to 2017 Reported Well Losses

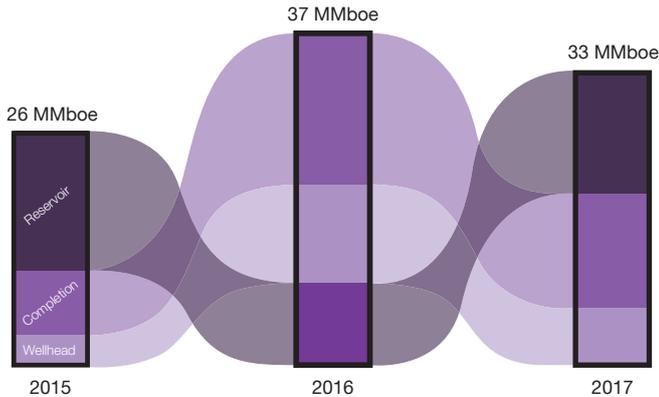


Figure 51

The main issues reported in the 2017 survey effecting well production losses were:

- Integrity
- Scaling
- water production
- Artificial lift
- Sand production

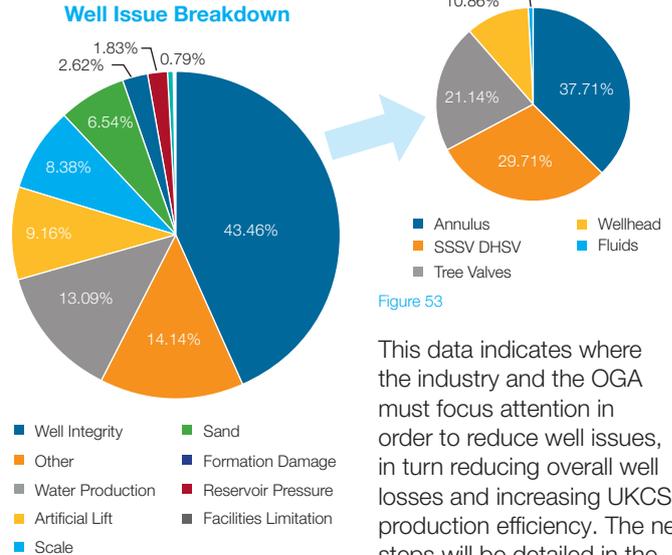


Figure 52

Figure 53

This data indicates where the industry and the OGA must focus attention in order to reduce well issues, in turn reducing overall well losses and increasing UKCS production efficiency. The next steps will be detailed in the Wells Strategy.

4.5 Well management (Continued)

Shut-in wells

There are currently around 600 of the active wells stock shut-in. While it is unknown how much production potential relate to these wells, it remains evident that there is a large stock of active wells shut-in in fields that have large remaining resources to be produced.

There may be opportunity to realise additional upside through rejuvenation of these wells and improve the recovery factor on the field where the shut in wells reside.

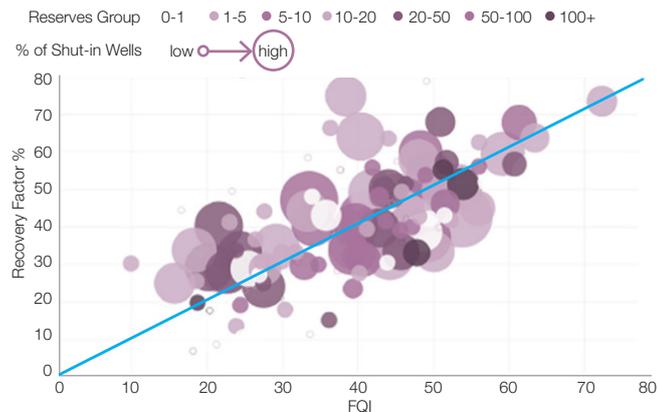


Fig 54

Figure 54 shows the percentage of shut-in wells on fields on a plot showing the Field Quality Index (used by the OGA for benchmarking) and recovery factor. The large bubbles and dark colour indicate remaining resources in fields with a high number of shut-in wells. The OGA use data such as these to help inform stewardship conversations.

Analysis of the shut-in wells stock indicate a high incidence of:

- Subsea wells that are shut-in (representing 40% of 32% of the total well stock)
- Injector wells that are shut-in (representing 20% of 15% of the total well stock)

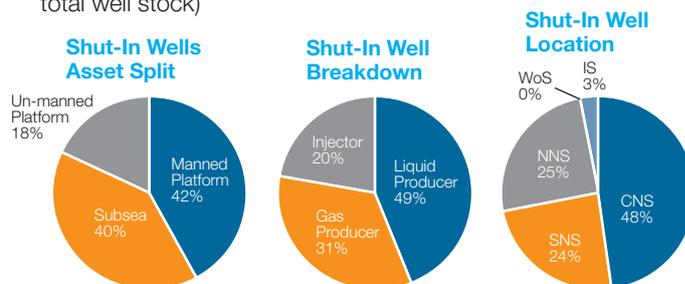


Fig 55

Of the reported shut-in wells the two dominant issues, which account for 62% of the issues associated with shut-in wells, are well integrity and water production.

Shut-In Wells - Issue Breakdown

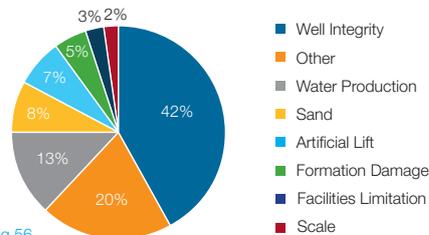


Fig 56

4.6 Well intervention

In 2017, UKCS operators spent £685 million on well intervention. The intervention activities are reported in five categories, listed below:



Safeguarding was the most common type of intervention activity, followed by plug and abandon activities.

Surveillance rates are very low (around 8%) and this is a concern as to whether this is sufficient to understand and optimise production.

Activity breakdown

The vast majority of the reported intervention and surveillance activities occurred on manned platforms. Subsea and unmanned platforms saw far fewer intervention and surveillance activities as a proportion of their share of UKCS well stock. The well intervention cost in subsea remains a potential issue with 14% of all subsea wells having an intervention accounting for 54% of the cost.

Intervention by Objective

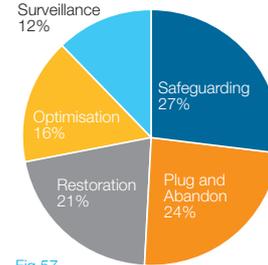


Fig 57

Intervention by Asset Type

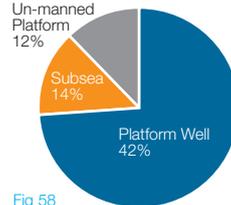
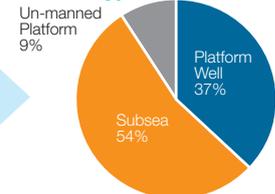


Fig 58

The vast majority of the reported intervention and surveillance activities occurred in the CNS on manned platforms, which also accounted for 69% of the total well intervention spend.

Well Intervention Cost by Asset Type



Intervention by Area

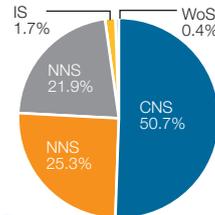
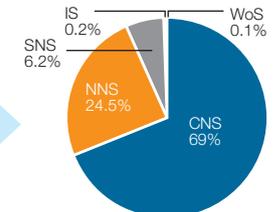


Fig 59

Well Intervention Cost by Area



4.6 Well intervention (Continued)

Well Intervention rate

The average intervention rate on the UKCS well stock in 2017 was 14%. However, there were also large differences in the approach. Figure 60 indicates the well interventions carried out as a function of the active well stock held by each operator.

There is a wide range of activity levels, with some companies working on over 30% of their wells, and other operators not carrying out any surveillance or intervention activity.

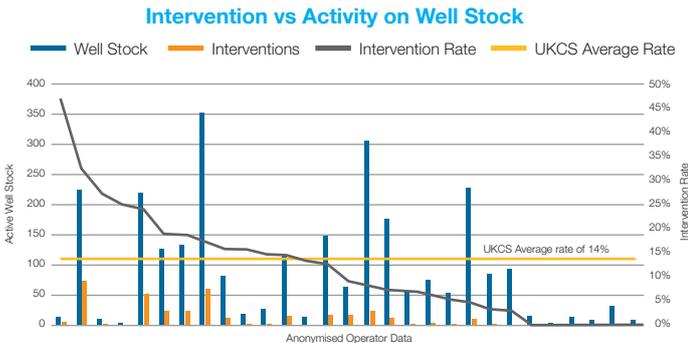


Fig 60

Well Issues addressed

Related to well intervention rate is the effectiveness of industry to respond to well issues that have been raised. It can be seen from figure 61 that the number of wells issues that resulted in work being carried out on the well/issue varies considerably.

On average operators only carried out intervention or surveillance on 53% of wells where issues occurred in 2017. This gives room for a significant improvement which could reduce well losses and is an area of attention for the OGA.

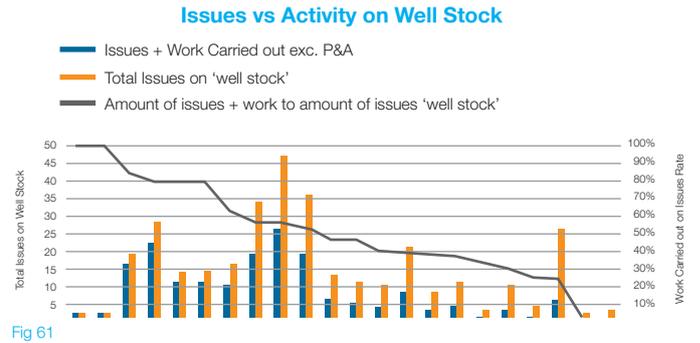


Fig 61

Results of well interventions

Intervention efforts that were undertaken in 2017 were very positive, with approximately 43.5 million boe safeguarded, restored or added to the UKCS production figures.

Of the total of £685 million that was spent on intervention and surveillance activities, £400 million was spent on P&A associated intervention activities meaning the 43.5 million boe maintained and added to the UKCS production figures was achieved for £285 million. This equates to an average unit cost of £6.48/boe in 2017.

The 43.5 million barrels attributed to intervention activities was made up of:

- 6.5 million boe from optimisation
- 16 million boe from restoring or improving underperforming wells
- 21 million boe from safeguarding



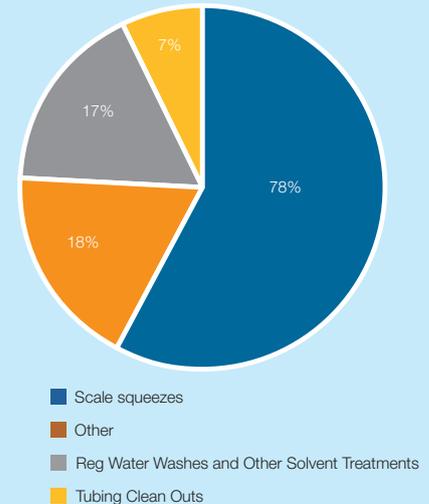
Fig 62

It should be noted that the barrels reported for an intervention were for a total of one years production. This may have a significant impact on the cost per barrel figures of certain intervention activities where the activity itself will have a positive effect on the well for years to come. An example of this will be the re-completion of a well that could extend the well life for many years.

4.6 Well intervention (Continued)

Safeguarding

Activities regarding the safeguarding of wells were split into four operational categories:



Safeguarding Breakdown



Fig 64

Fig 63

Restoration Type

Restoration

Restoration activities accounted for approximately 16 million boe of production restored in 2017. The majority of the reported barrels were attributed to Tree/Wellhead repairs SCSSV/DHSV repairs.

The average cost per barrel for restoration activities was £8.29/boe

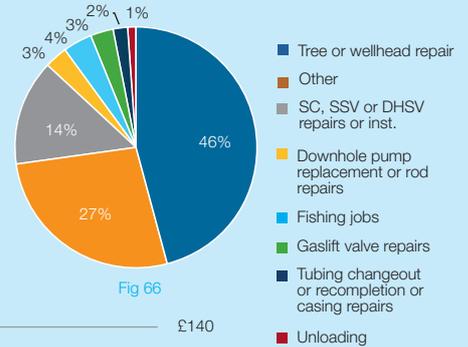


Fig 66

Restoration Breakdown

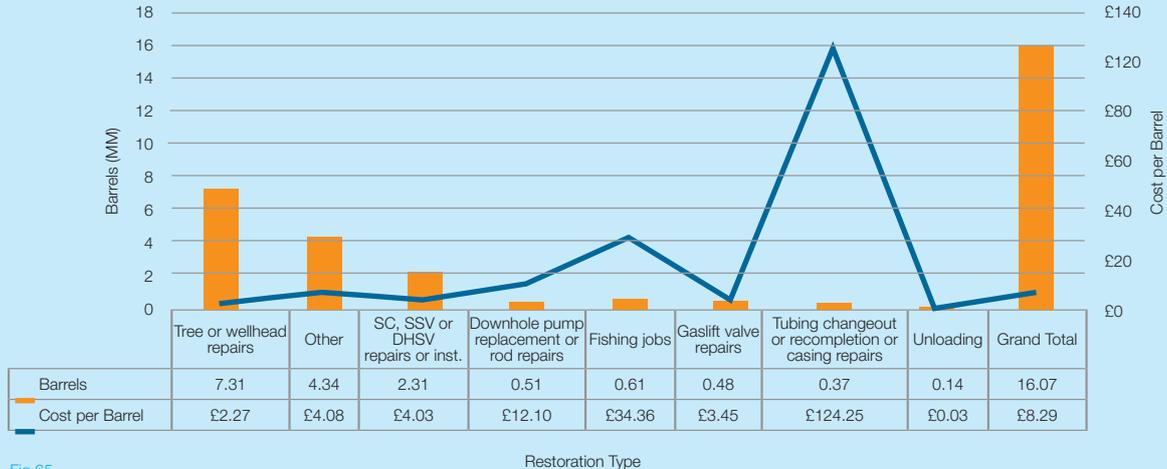


Fig 65

4.6 Well intervention (Continued)

Optimisation

Around 6.5 million boe of production was added in 2017 by optimisation activities. The majority of the reported barrels were attributed to re-perforating and adding perforations. The average cost per barrel for optimisation activities was £10.69/boe.

Optimisation Breakdown

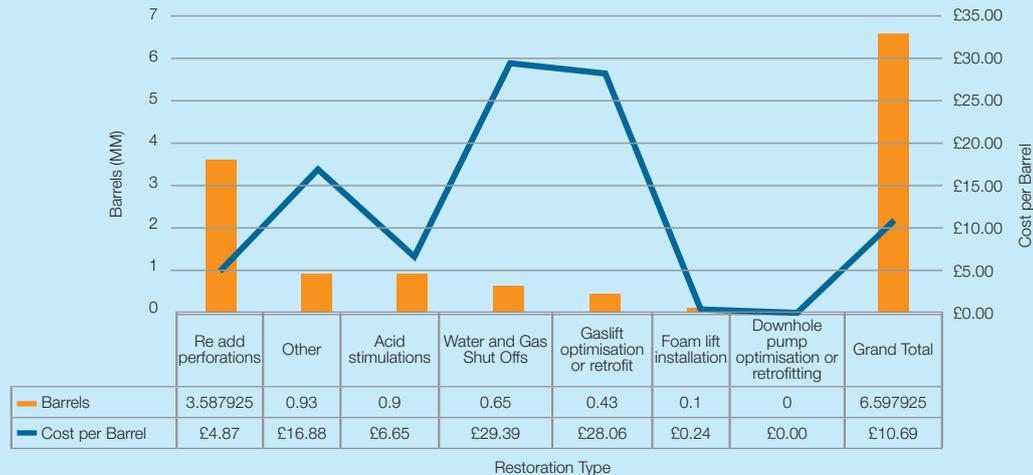


Fig 67

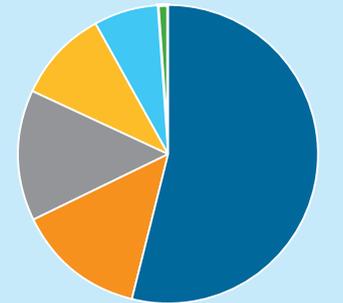


Fig 68

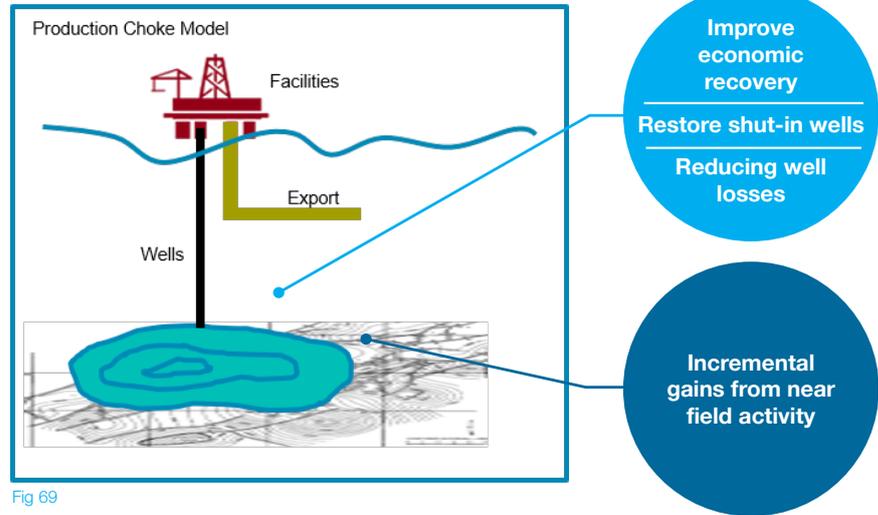
- Re Add Perforations
- Other
- Acid simulations
- Water and gas shut offs
- Gas lift optimisation or retrofit
- Foam lift installation

Opportunity from well management

The economic opportunity from effective management of the UKCS well stock is significant. In 2017 the industry effectively added 22.5 million boe to 2017 production figures and safeguarded 21 million boe. However, as discussed previously well losses still accounted for 33 million boe (16%) of the total 2017 production losses.

The data gleaned from the UKCS Stewardship Survey highlights the economic opportunity to continue and increase investment in the maintenance, restoration and improvement of the UKCS well stock. With the cost per barrel of well activities (note only one year of production is reported) clearly showing operators should examine existing well stock for cost efficiencies. Effective well management should be viewed alongside incremental brownfield gains.

Another potential economic opportunity is the 600 wells that are reported to be shut in. The OGA is working with industry through the stewardship process to evaluate and determine the economic value of these wells.



6. Glossary

We use the number of wells in order to report the size of the UKCS well stock and its status, since wells are largely managed (with the exception of multilaterals) and decommissioned per surface location.

Annual drilling activity data is based on wellbore spuds.

All other annualised well delivery related data is based on the completion date, defined in this case as the date at which planned drilling operations on the wellbore were completed to leave it completed for production, abandoned or suspended (as per WONS).

Completed (Operating)

A wellbore that is currently active.

Completed (Shut in)

A wellbore that is shut in either at the tree valves or subsurface safety valve (usually only applied if the wellbore is intended to be shut in for 90 days or more).

Plugged

A wellbore that has been plugged with a plug rather than an abandonment barrier.

AB1

The reservoir has been permanently isolated.

AB2

All intermediate zones with potential to flow have been permanently isolated.

AB3 (Permanently Abandoned)

The well origin at the surface has been removed and will never be used again.

Active well stock

Consists of completed operating and complete shut in with fields with a DevUK code of 600, 700 and 799 (fields that have reserves). Codes 800, 899 and 900 have no reserves and production is suspended or ceased so these wells are not included.

New & Infill Wells

The New/Infill classification is derived as 'New' if the development is not yet in production, or began production after 1-Jan-2012; otherwise, it is 'Infill'.

Sub Area Operator

Current designated field operator and the responsible party for holding data.

Open water Suspended E&A well

An exploration or appraisal well that has not been tied back to infrastructure.

Exploration and Appraisal wells

Wells which are primarily drilled to gather subsurface information.

Development wells

Wells that are drilled to produce hydrocarbons.

MER UK

Relevant persons must take the steps necessary to secure the maximum value of economically recoverable petroleum is recovered from the strata beneath UK waters.

NPT

Non Productive Time, in this case defined as any operational, mechanical or geological based cost event (Excluding waiting on weather).

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