Wells Insight Report

4.5 Well Management; 4.6 Well Intervention
Key Insights

The need to keep on drilling

Story so far

- 7,800 wells drilled to date
- Delivering 44 billion barrels
- Only 18% of future E&A wells (2018 to 2020) have financial approval
- Declining trend in average discovery size

But, drilling activity is in decline:

- 2017 low well activity
  - 19 E&A Wells
  - 56 Development Wells
  - 2128 wells in operation

- Development drilling has fallen 50% from 2015 to 2017

- Only 18% of future E&A wells (2018 to 2020) have financial approval
- Declining trend in average discovery size

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

And while well costs are lower...

...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

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)
- 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
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%

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

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

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 utilisation, 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
<table>
<thead>
<tr>
<th>Contents</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background</td>
<td>5</td>
</tr>
<tr>
<td>Well management</td>
<td>10</td>
</tr>
<tr>
<td>Well Intervention</td>
<td>13</td>
</tr>
<tr>
<td>Glossary</td>
<td>20</td>
</tr>
<tr>
<td>Further contact</td>
<td>21</td>
</tr>
</tbody>
</table>
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

2017 well activity and inventory

<table>
<thead>
<tr>
<th>19 E&amp;A wells completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>56 development wells completed</td>
</tr>
<tr>
<td>2,148 wells in operations</td>
</tr>
<tr>
<td>It has taken 7800+ wells to find &amp; produce 44 bnboe</td>
</tr>
</tbody>
</table>

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.

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 losses due to wells**

![Diagram showing production levels](image)

2015: 26 MMboe
2016: 37 MMboe
2017: 33 MMboe

Figure 3

**Production levels UKCS**

![Graph showing production levels](image)

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)

<table>
<thead>
<tr>
<th>Well Type</th>
<th>Exploration</th>
<th>Appraisal</th>
<th>Dev Platform</th>
<th>Dev Subsea</th>
<th>Combined Development</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed (Operating)</td>
<td></td>
<td></td>
<td>1506</td>
<td>622</td>
<td>2128</td>
<td>2128</td>
</tr>
<tr>
<td>(Completed Shut In)</td>
<td></td>
<td>386</td>
<td>310</td>
<td>696</td>
<td>696*</td>
<td></td>
</tr>
<tr>
<td>Plugged</td>
<td></td>
<td>224</td>
<td>43</td>
<td>267</td>
<td>267</td>
<td></td>
</tr>
<tr>
<td>AB1 &amp; AB2</td>
<td>239</td>
<td></td>
<td></td>
<td></td>
<td>409</td>
<td>648</td>
</tr>
<tr>
<td>AB3 (Permanently Abandoned)</td>
<td>2345</td>
<td>1145</td>
<td></td>
<td>645</td>
<td>4135</td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>2486</td>
<td>1373</td>
<td></td>
<td>4015</td>
<td>7874</td>
<td></td>
</tr>
</tbody>
</table>

*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.
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.

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.

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.

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.

<table>
<thead>
<tr>
<th>Well Stock Location</th>
<th>CNS</th>
<th>SNS</th>
<th>NNS</th>
<th>WoS</th>
<th>IS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>41%</td>
<td>26%</td>
<td>24%</td>
<td>5%</td>
<td>4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well Stock Breakdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNS</td>
</tr>
<tr>
<td>Liquid Producer 50%</td>
</tr>
<tr>
<td>Gas Producer 50%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well Stock Asset Breakdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsea 32%</td>
</tr>
<tr>
<td>Unmanned Platform 22%</td>
</tr>
<tr>
<td>Manned Platform 46%</td>
</tr>
</tbody>
</table>

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.

The main issues reported in the 2017 survey effecting well production losses were:
- Integrity
- Scaling
- Water production
- Artificial lift
- Sand production

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.

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)

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.
4.6 Well intervention

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

- Well surveillance – Activities to measure the condition of a well
- Safeguarding – Activities to maintain production
- Optimisation – Activities that generate additional production
- Restoration – Activities to return a well to production
- Well plug and Abandon – Activities associated with the final P&A of a well

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.

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.

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**4. Development Wells**
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.

**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.

![Intervention vs Activity on Well Stock](image1)

![Issues vs Activity on Well Stock](image2)
**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

It should be noted that the barrels reported for an intervention were for a total of one year’s 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:

- Scale Squeezes
- Regular washes
- Solvent treatments
- Tubing clean outs

### Safeguarding Breakdown

<table>
<thead>
<tr>
<th>Restoration Type</th>
<th>Barrels (MM)</th>
<th>Cost per Barrel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale squeezes</td>
<td>12.19</td>
<td>£0.78</td>
</tr>
<tr>
<td>Other</td>
<td>3.74</td>
<td>£10.45</td>
</tr>
<tr>
<td>Reg water washes and other reg solvent treatments</td>
<td>3.5</td>
<td>£0.08</td>
</tr>
<tr>
<td>Clean outs</td>
<td>1.48</td>
<td>£9.26</td>
</tr>
<tr>
<td>Grand Total</td>
<td>20.91</td>
<td>£2.99</td>
</tr>
</tbody>
</table>

Fig 63

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Well Insight Report 2018
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 SCSSSV/DHSV repairs.

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

### Restoration Breakdown

<table>
<thead>
<tr>
<th>Restoration Type</th>
<th>Barrels (MM)</th>
<th>Cost per Barrel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree or wellhead repairs</td>
<td>7.31</td>
<td>£2.27</td>
</tr>
<tr>
<td>Other</td>
<td>4.34</td>
<td>£4.08</td>
</tr>
<tr>
<td>SC, SSV or DHSV repairs or inst.</td>
<td>2.31</td>
<td>£4.03</td>
</tr>
<tr>
<td>Downhole pump replacement or rod repairs</td>
<td>0.51</td>
<td>£12.10</td>
</tr>
<tr>
<td>Fishing jobs</td>
<td>0.61</td>
<td>£34.36</td>
</tr>
<tr>
<td>Gaslift valve repairs</td>
<td>0.48</td>
<td>£3.45</td>
</tr>
<tr>
<td>Tubing changeout or recompletion or casing repairs</td>
<td>0.37</td>
<td>£124.25</td>
</tr>
<tr>
<td>Unloading</td>
<td>0.14</td>
<td>£0.03</td>
</tr>
</tbody>
</table>

Grand Total: 16.07

Average Cost per Barrel: £8.29/boe
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

<table>
<thead>
<tr>
<th>Restoration Type</th>
<th>Barrels (MM)</th>
<th>Cost per Barrel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Re add perforations</td>
<td>3.587925</td>
<td>£4.87</td>
</tr>
<tr>
<td>Other</td>
<td>0.93</td>
<td>£16.88</td>
</tr>
<tr>
<td>Acid stimulations</td>
<td>0.9</td>
<td>£6.65</td>
</tr>
<tr>
<td>Water and Gas Shut Offs</td>
<td>0.65</td>
<td>£29.39</td>
</tr>
<tr>
<td>Gaslift optimisation or retrofit</td>
<td>0.43</td>
<td>£28.06</td>
</tr>
<tr>
<td>Foam lift installation</td>
<td>0.1</td>
<td>£0.24</td>
</tr>
<tr>
<td>Downhole pump optimisation or retrofitting</td>
<td>0</td>
<td>£0.00</td>
</tr>
<tr>
<td>Grand Total</td>
<td>6.597925</td>
<td>£10.69</td>
</tr>
</tbody>
</table>

Fig 67

Fig 68
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.
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).