Oil & Gas Authority

UKCS Production Efficiency in 2017

July 2018

Contents

Cover page image: Triton FPSO – photo courtesy of Dana Petroleum

Executive summary

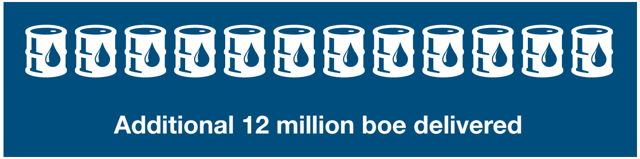
Production efficiency (PE) has risen for a fifth consecutive year. In 2017 it reached 74%, driving increased production in the United Kingdom Continental Shelf (UKCS).

The 1% improvement in efficiency from 2016 helped contribute an additional 12 million barrels of oil equivalent (boe) in 2017; or 32,000 extra boe per day.

Meanwhile, losses to production in 2017 were down to 200 million boe, from 210 million boe the previous year.

Increased PE is being achieved by a range of methods; including deployment of new technology and shifts towards efficiency cultures.

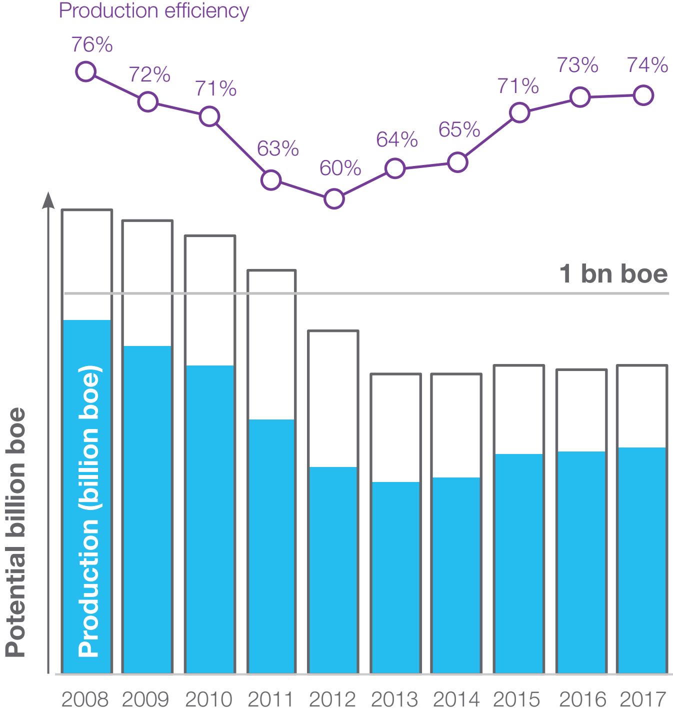
This report uses data collected as part of the 2017 UKCS Stewardship Survey. The OGA's analysis of PE and production losses allows industry to benchmark its performance over time in a clear, consistent, and quantifiable way. Tracking PE allows the OGA to compare relative performance over time, aiding the Asset Stewardship tiered review process and ensuring the Production Optimisation Asset Stewardship Expectation is met.



For the purposes of this report, PE is defined as the total volume of hydrocarbons produced in 2017 as a percentage of economic maximum production potential (Economic Production Efficiency) and is based on guidelines drafted by the Society of Petroleum Engineers (Production Efficiency Reporting – Best Practice Guidelines)

1. 2017 UKCS production efficiency

Production potential and efficiency 2008-2017



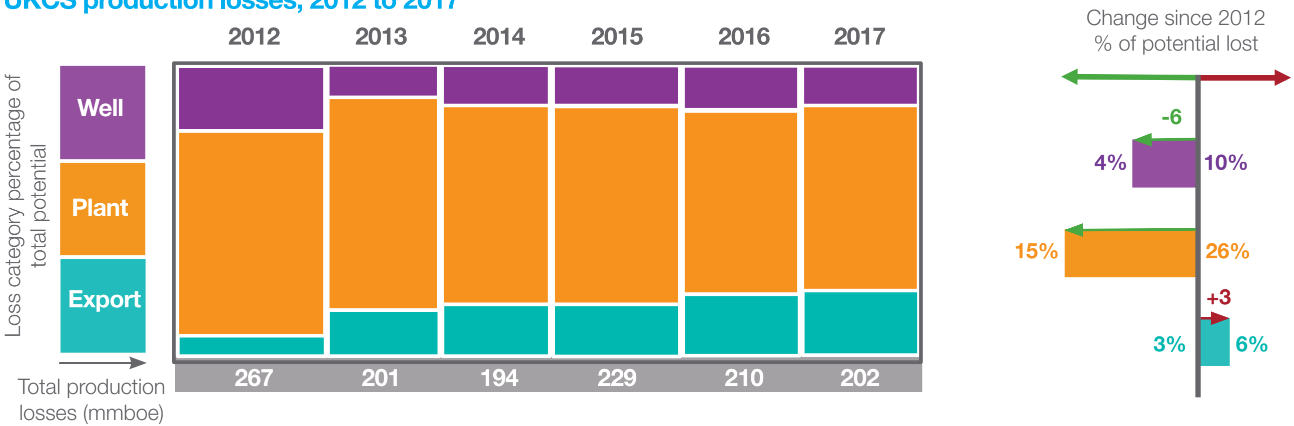
UKCS production efficiency in 2017 was 74%, representing a 1% increase on 2016.

Total UKCS production potential in 2017 (if every field produced to maximum capability 100% of the time) was 800 million boe, a slight increase on 2016. This is due to a number of new fields coming on line, counteracting natural decline in maturing fields.

Improvements to PE improvement in 2017 helped deliver an additional 12 million boe or 32,000 barrels of additional production a day.

Production efficiency in the UKCS has improved for the 5th consecutive year

UKCS production losses, 2012 to 2017

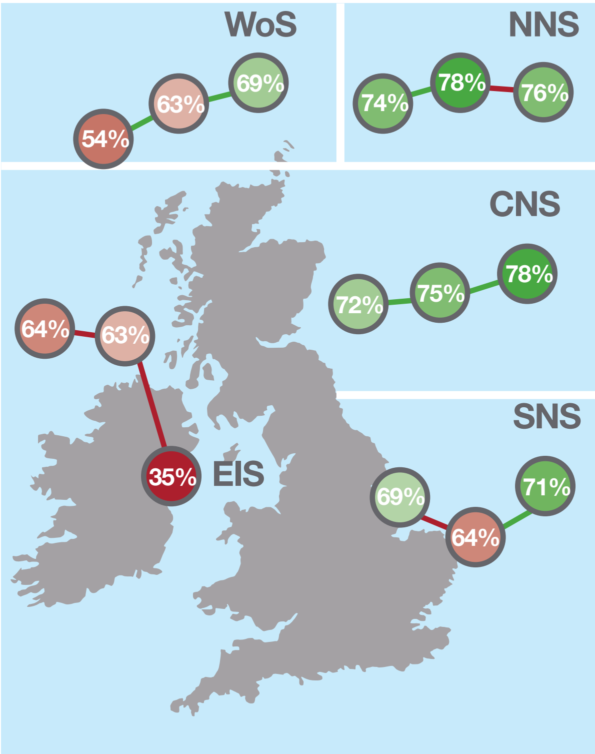


The composition and total volume of production losses has changed and improved significantly since the efficiency low point of 2012. Total production losses have fallen by 65 million boe.

Well losses represented 10% of total potential lost in 2012. This fell to 4% in 2017, however the recent trend in well losses has been relatively flat. The greatest contributor to improvements in production efficiency has been a reduction in plant losses. In 2012, 26% of total potential was lost at the plant choke. In 2017 this fell to 15%.

Export losses is the only loss category showing an increase since 2012. They have now overtaken wells as the second largest loss category. Export losses as a percentage of potential doubled between 2012 to 2017.

Regional efficiency - 2017



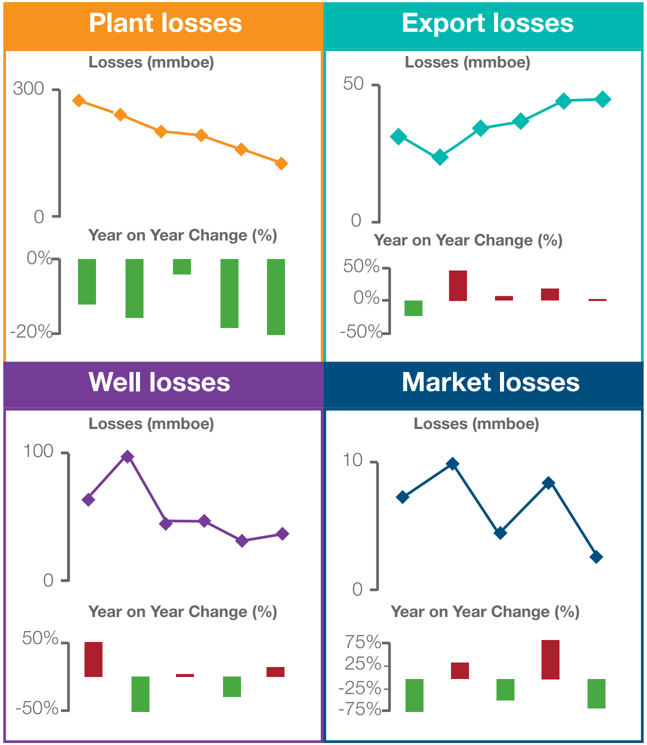
Three out of five regions in the UKCS have seen improvements to production efficiency in 2017, compared to the previous year.

The Southern North Sea (SNS) saw a significant 7 percentage points increase since last year recovering from a drop in 2016. The WoS saw the second largest improvement continuing the trend seen since 2015.

Two regions saw a reduction in efficiency with the Northern North Sea (NNS) falling by 2 percentage points and the East Irish Sea (EIS) falling significantly from an already low base. The CNS region has shown steady improvement over the past 3 years.

The EIS presents a future opportunity to improve the efficiency of the overall UKCS with export losses driving inefficiency. Reducing export losses to levels seen in other regions would have a significant effect on the production efficiency of the UKCS.

Losses by category 2012-2017



Whilst overall UKCS production efficiency has improved for five consecutive years, not all categories of loss have fallen uniformly.

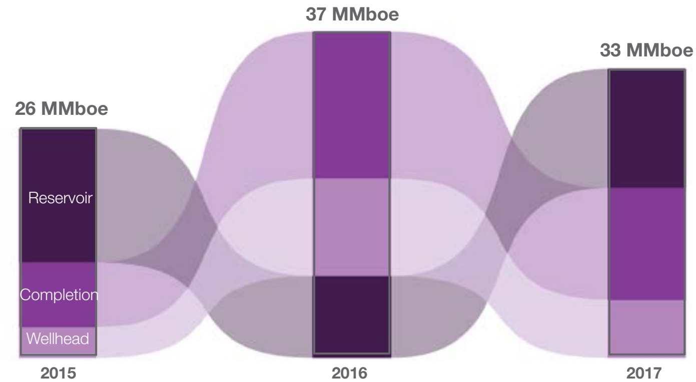
Export losses have been rising for the past five years.

Well losses saw a significant reduction in 2013, but have been fairly flat since then with no clear improving trend.

Plant losses show a clear reduction year on year and have driven the majority of efficiency improvements.

Market losses are not significant in the UKCS due to the nature of hydrocarbon sales arrangements.

Well losses: 2015 to 2017



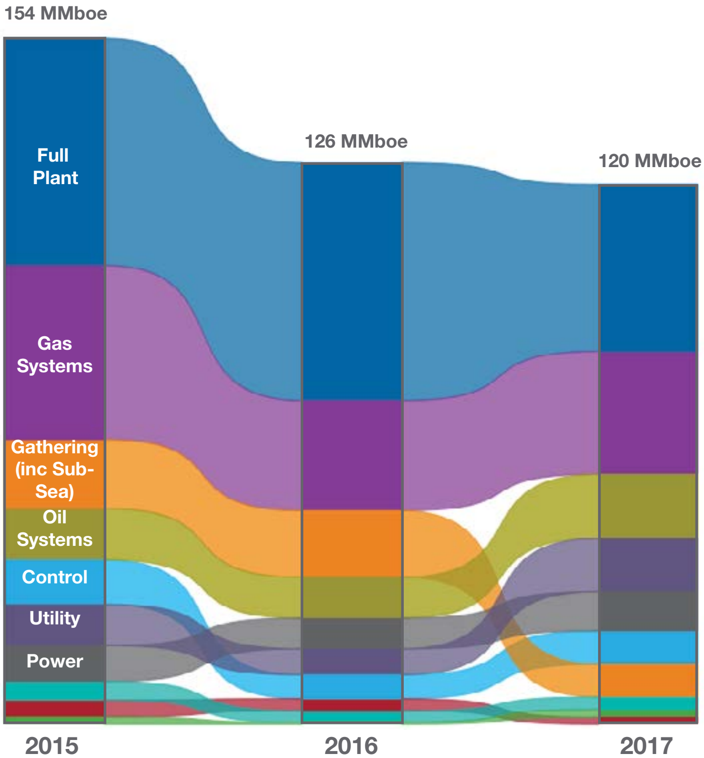
2017 well 'issues' and interventions

Well losses across the UKCS fell by 11% in 2017 after a significant rise in 2016.

Wellhead and completion losses reduced while there was a rise in reservoir related losses. However total losses remain higher than in 2015. There is no clear trend year on year (YoY) in terms of subcategory losses in wells.

In 2017, 11% of the active well-stock was identified as having an issue affecting production. In the same year 12% of wells had interventions.

Plant losses: 2015 to 2017



Plant losses fell by 5% in 2017, helping to drive improved overall efficiency.

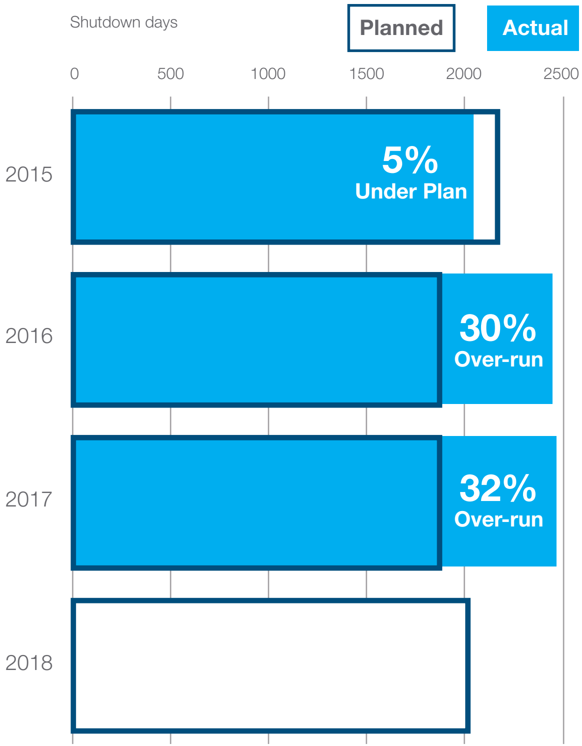
Four out of the top five plant losses saw an increase last year. Despite this, overall plant losses fell.

Full plant losses continue to represent the largest single category of loss. However in 2017, there was a 30% reduction of full plant losses, falling from 6.5% of potential to 4.5%.

A significant reduction was also observed in gathering systems (including subsea) resulting in a move from the UKCS's 3rd largest plant loss in 2016 to the 7th in 2017.

Losses in gas systems increased by 3 million boe in 2017 and are now within 10 million boe of the largest plant category loss in the UKCS.

Shutdown days: UKCS hubs 2015 to 2018



Hubs in the UKCS were shut down for a total of 2,453 days in 2017; 32% longer than planned.

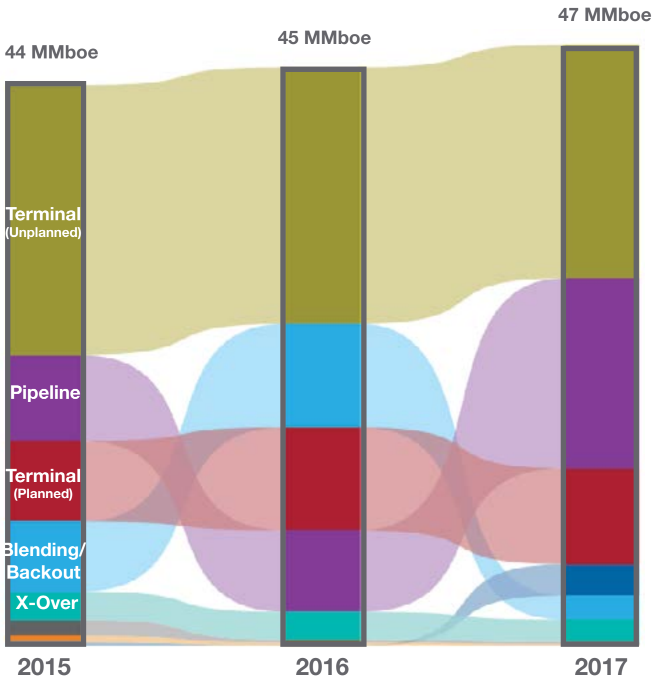
In 2017 there were also 192 days of planned activity deferred into subsequent years. This results in 48% of shutdown days being unplanned or overruns to planned turnarounds (TARs).

For the past two years, there has been a significant underestimation in the duration of full plant shutdowns from the start of the year to the actual duration at the end.

In 2015 there was a underestimation of plant shutdown activity, however it is unclear how much of this could be attributed to deferral of activity to subsequent years.

The number of planned shutdown days in 2018 is expected to be higher than in 2017. However, if these shutdowns are completed without any over run, there is potential for the actual number of shutdown days to fall in 2018.

Export losses / 2015-2017

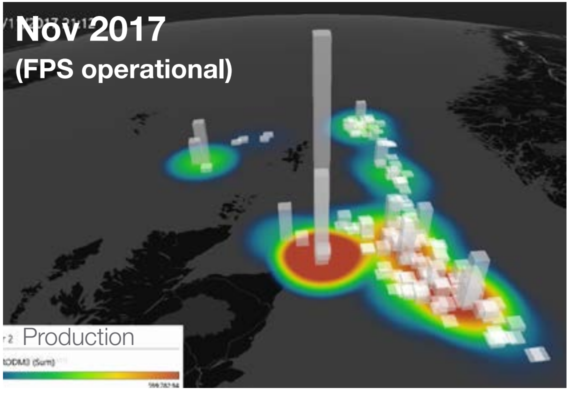


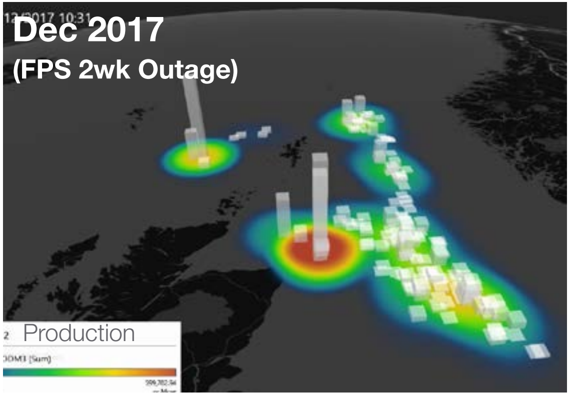
Export losses grew in 2017, however the overall composition of losses changed, with planned and unplanned terminal losses down.

Pipeline losses were the single largest contributor to the 2017 increase in export losses. However the majority of theses losses are attributed to a one-off event.

Blending and backout losses have significantly reduced over the 2015 to 2017 period.

Overall terminal losses (planned and unplanned) fell in 2017, down from 3.4% of total potential to 3.1%. If this trend continues and one-off export events are avoided in 2018, the outlook for export losses looks positive.



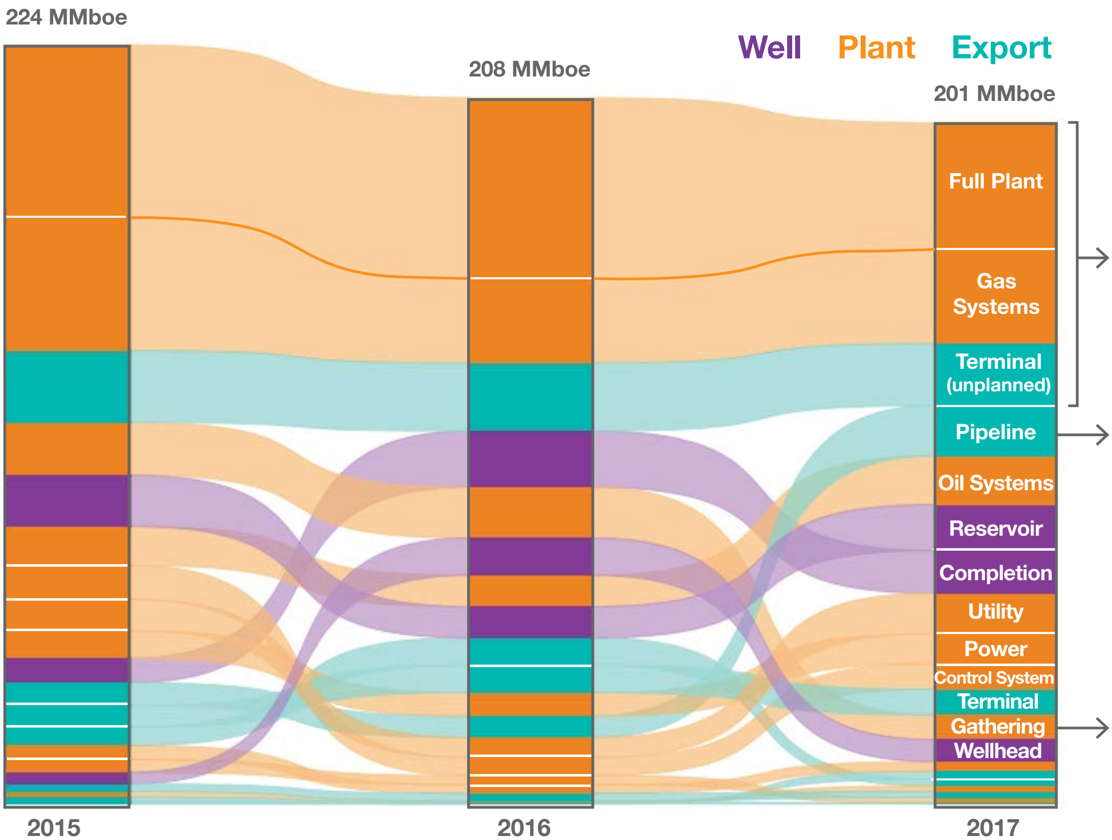


The Forties Pipeline System (FPS) is the UK's largest oil pipeline export route serving the majority of fields in the CNS.

In December 2017 it was shut down for two weeks to repair a hairline crack to the onshore section of the pipeline. The reduction to oil production in the CNS can be clearly seen on the two images opposite.

In total there was 12mmboe of lost production due to closure of the export pipeline. This represents 6% of production losses in the UKCS during 2017 and 26% of export losses.

Summary of production losses: 2015 to 2017



The top three production loss categories remain unchanged. All three have reduced since 2015, showing the progress made in tackling the largest loss causes.

Pipeline export losses jumped to become the 4th largest loss. However as this was a result of a one-off event, this presents future upside potential to overall PE.

Losses from gathering systems (including subsea) have fallen substantially in recent years.

2. The Bigger Picture

UKCS Unit operating cost and PE

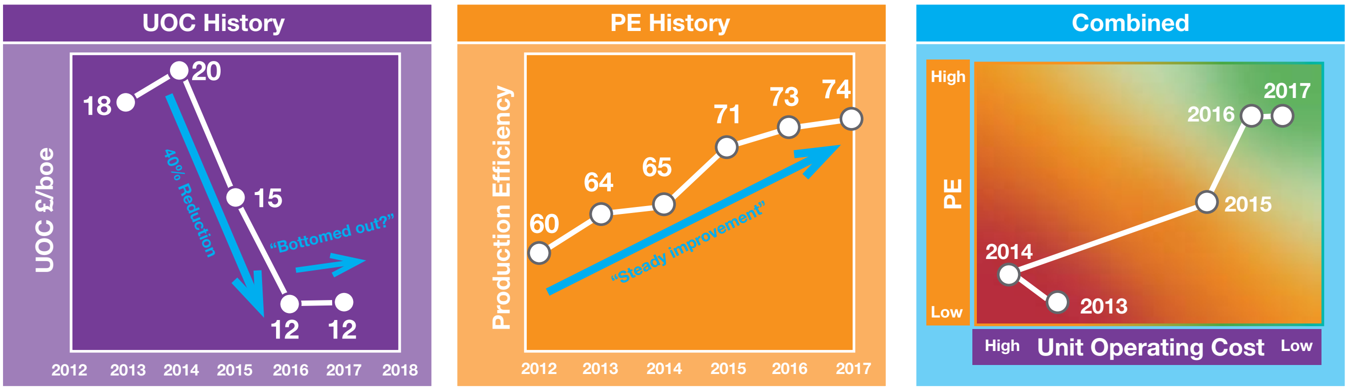
While PE is a measure of efficiency, the ultimate goal is to maximise value. This is why cost must also be considered alongside efficiency.

The unit operating cost (UOC) of the UKCS highlights the potential for value by combining production and cost. The other aspect when considering profit is the oil price.

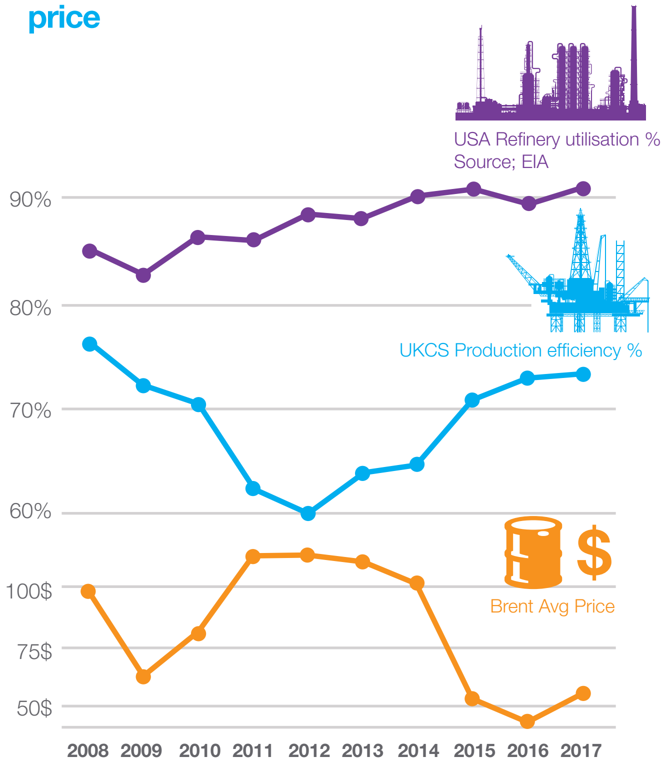
The UOC of the UKCS fell rapidly in response to the recent oil price downturn, while at the same time PE was improving. In 2017, UOC levelled out after a period of significant reduction.

When looking at both measures together it can be seen that momentum has slowed in 2017 with UOC little changed and the pace of improvement in PE lower.

Summary of production losses: 2015 to 2017



UKCS production efficiency against oil price



Refinery utilisation rates are the total volume of refined products produced vs the theoretical maximum potential in each year. It can be seen that refinery utilisation rates have been relatively stable and does not trend with oil price.

Production efficiency has shown improvement over the same time period, with a seeming inverse correlation between oil price and PE.

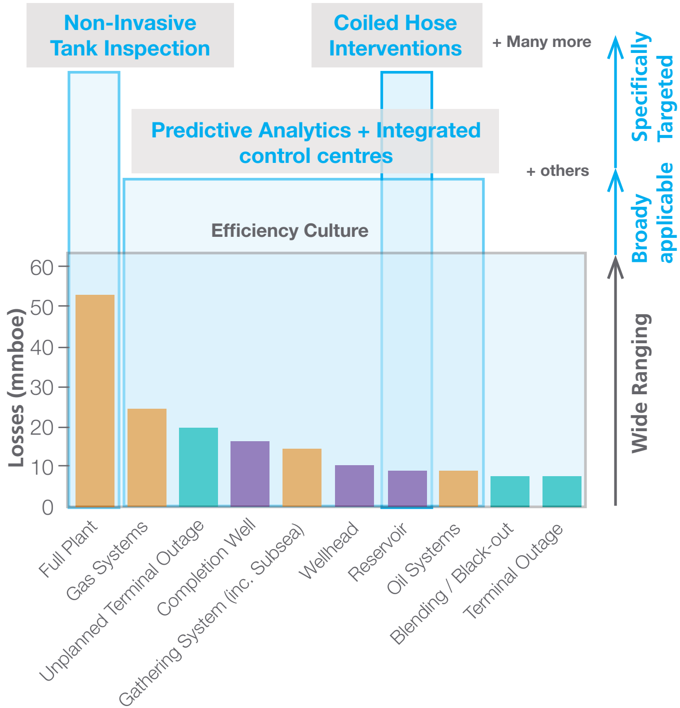
In the past, sustained higher oil prices have coincided with periods of low efficiency. The challenge now is for industry to continue improvements to PE seen in recent years amidst a more bullish outlook to oil price.

3. Improving production efficiency

The following section highlights some strategies and best practice deployed in recent years in the UKCS.

New techniques, increased use of existing data and creating a culture of efficiency are some of the methods used to improve efficiency, and are all widely applicable across the UKCS.

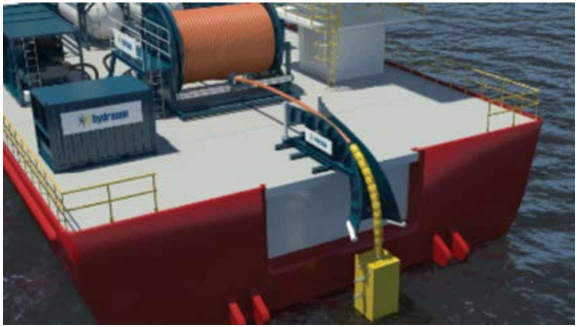
The losses targeted by each strategy/technique are shown against the overall UKCS losses.



New techniques

Non-invasive tank inspection

Coiled hose interventions



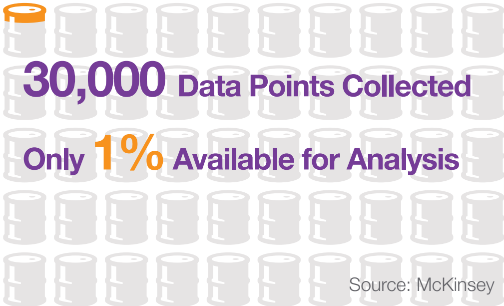
There are a number of new technologies in use today that have the potential to help to increase production efficiency by fundamentally changing the way production facilities and wells are maintained and operated.

One area where new techniques are being actively pioneered in the UKCS is in light well intervention using vessels on subsea wells. In 2016 the worlds first subsea intervention using coiled tubing was carried out and another world first was achieved a year later with the use of coiled-hose on a subsea well. Techniques such as this provide operators with low cost alternatives for reducing well losses.

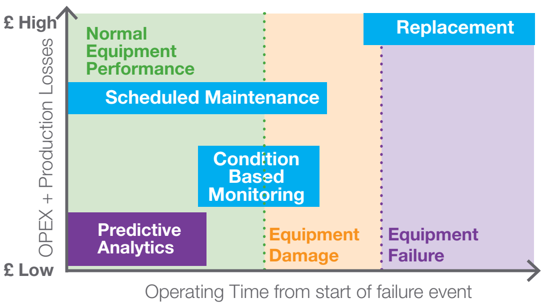
Another technology that is being used by some operators to enhance PE is non-invasive tank inspection. The Oil and Gas Technology Centre (OGTC) identified that 80% of tanks could be inspected using this method with possible savings of £242 million a year across the UKCS.

Increase data analysis

Data collected vs used: average production facility



Predictive analytics: identify early, reduce cost



The average production platform constantly captures around 30,000 separate data points, however only 1% of these are being analysed.

Techniques that use the existing stream of data being generated from platforms are already playing a part in improving efficiency.

One such technique is using data science to run predictive analytics on production systems. The advantage of using this alongside traditional methods is that future equipment performance degradation and failure can be mitigated early.

Analytics can spot relationships across a wide data set, creating an early warning system allowing action before losses occur, improving efficiency and reducing cost.

New techniques such as predictive analytics are already improving PE for some operators, increased uptake could help drive UKCS efficiency higher in the future.

Safety first, efficiency second

Question efficiency and safety cultures in the same way

Ask these questions about your efficiency culture:

Management Commitment:

Where is efficiency perceived to be in management priorities?

how do they show this?

Do they talk often about efficiency and is this visible to the workforce

Communication

Is there effective two-way communication about efficiency?

How often are efficiency issues discussed?, with managers and colleagues?

Employee Involvement

Are individual employees asked for their input on efficiency?

Is there continuous improvement / total quality approach?

Who's responsibility is efficiency regarded to be

Training/information

How accurate are employees perceptions of production losses?

Is efficiency information easily available?

Motivation

Do managers give feedback/praise on efficiency / loss prevention?

Do managers always confront avoidable losses?

Compliance with procedures

What are written procedures used for?

are they read / widely used?

Are they written by users?

Learning Organisation

Does the company really learn from past losses?

Do employees feel confident reporting potentials sources of losses?

Adapted from HSE, Common topic 4: Safety culture

Top performing operators often use culture to improve PE, ensuring that an efficiency culture permeates through their business.

The impact of corporate culture on operations has been shown in the past, as safety-focused cultures spread thorough operators, helping improve safety performance. Driving an efficiency culture has also been shown to have a similar effect.

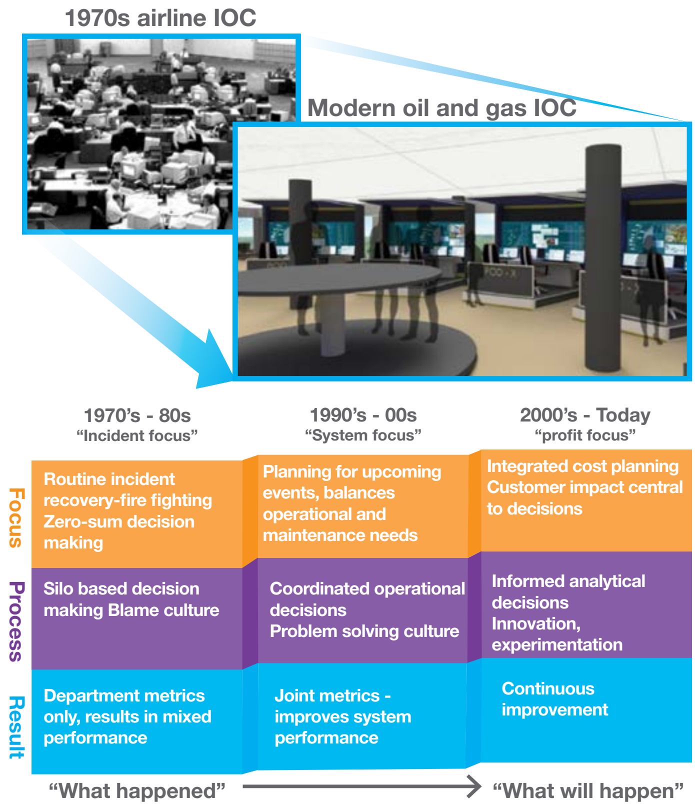
Some practical examples of this seen in the UKCS include: informing employees of the total value of production losses each day; and senior management team talks emphasising the importance of TAR efficiency on the businesses success before each shift changeout during a TAR.

Learning from other industries

The airline industry has long benefitted from integrated operation centres (IOCs). The use of this concept in oil and gas is now increasing.

The airline industry pioneered the use of integrated operation centres in the 1970s. The value of having a wide array of disciplines and subject matters in the same environment has driven efficiency and reduced siloed decision making.

Use of the same concept in oil and gas is not new however its use is increasing. With the rise of digital connectivity to offshore installations, the value of this approach is ever increasing. Integrated control centres help to bridge the divide between disciplines, contractors and locations and allow for a coordinated approach with a focus on maximising overall value.



The OGA's Role in Production Efficiency

Asset stewardship is crucial to maximising economic recovery from the UKCS and to deliver greater value overall. Effective stewardship means :

- Asset owners consistently do the right things to identify and then exploit opportunities
- Assets are in the hands of those with the collective will, behaviours and capabilities to achieve this

Production efficiency benchmarking allows the industry to further analyse their performance relative to their peers.

The OGA also works with operators through the tiered review process to better understand the individual challenges facing specific assets and ensures that assets are stewarded in a way that benefits MERUK

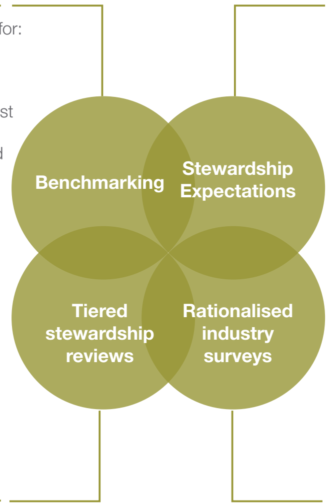
Benchmarking

Benchmarking assets for:
- production efficiency
- recovery factor
- operating cost
- decommissioning cost

Results communicated confidentially in a non-attributable way to help continuous improvement

Stewardship expectations

Expectations for industry, across the lifecycle, and underpins the MER UK Strategy and supporting obligations



Stewardship reviews

Proactive, structured and prioritised tiered reviews with operators to evaluate stewardship

Priority given to the greatest MER UK Impact

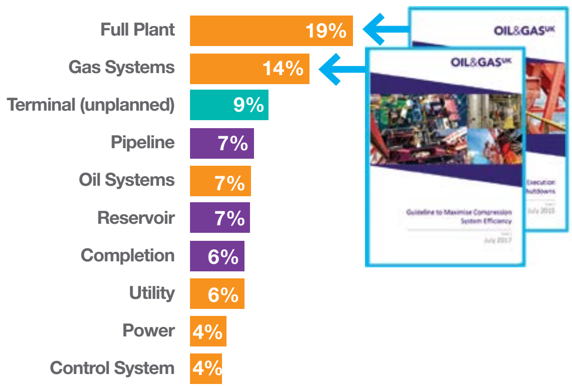
Rationalised industry survey

Annual UKOS Stewardship Survey which replaced nine previous surveys. Reduces complexity, time, effort and burden on operators and the OGA

Further Information on production efficiency

Industry guidance

Percentage of Total Losses



Guidelines that tackle the two largest sources of production losses have been published by Oil and Gas UK. These guidelines were developed by industry through the Production Efficiency Taskforce.

Wider tools, information and case studies are available on the subject of efficiency through the Oil & Gas UK Efficiency hub; https://oilandgasuk.co.uk/efficiencyhub/

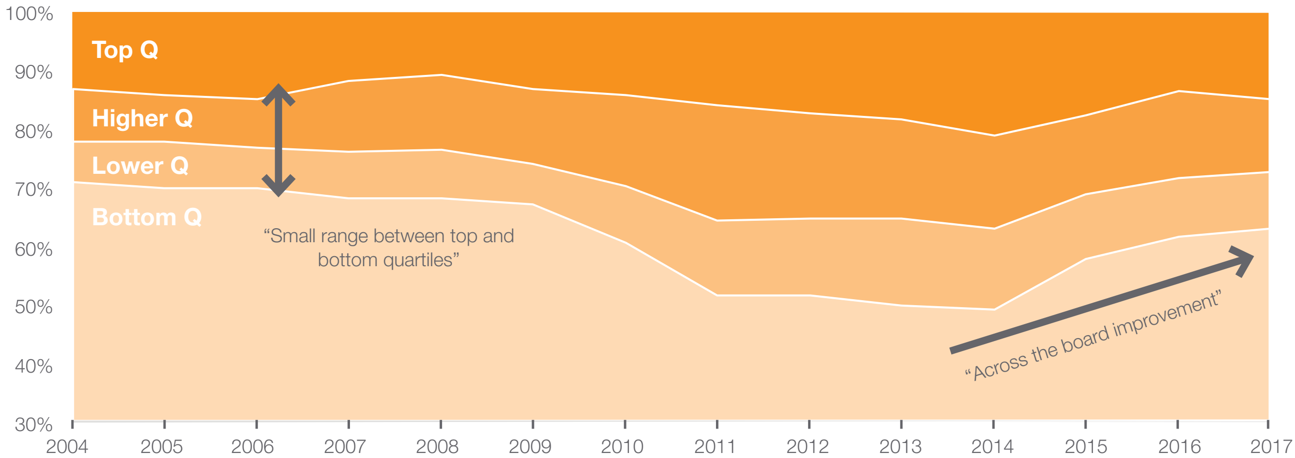
Operator benchmarking packs

Any operator can request a bespoke operator benchmarking pack from the OGA by emailing, PPR.Team@Ogauthority.co.uk

Packs contain more detailed information about hub and operator level performance relative to others in the UKCS.

Appendix: Additional analysis, statistics & data

UKCS efficiency quartiles, 2004 to 2017



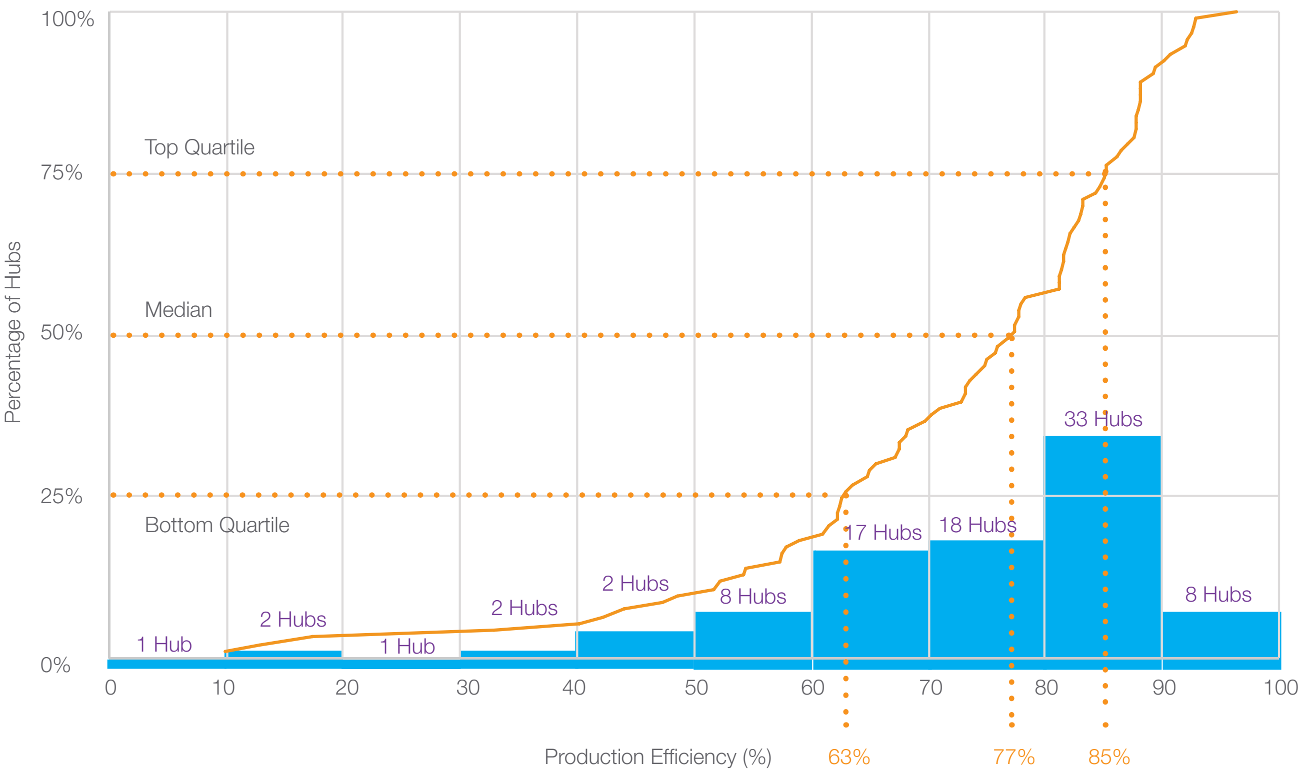
The chart shows production efficiency quartiles for UKCS hubs back to the beginning of PE records.

From 2004 to 2009 the range between top quartile and bottom quartile performers was less than 20% until 2010. After this, the gap swelled to a maximum of 32% in 2014.

From 2014 there has been a narrowing of the performance range with the gap now standing at 22%.

Since 2014 there has been a generally steady improvement across the quartiles leading to the recent improvements to PE. However 2017 did see a drop of top quartile performance.

2017 hub efficiency - distribution



This section can be used to plot the overall production efficiency of a hub relative to all other hubs in the UKCS.

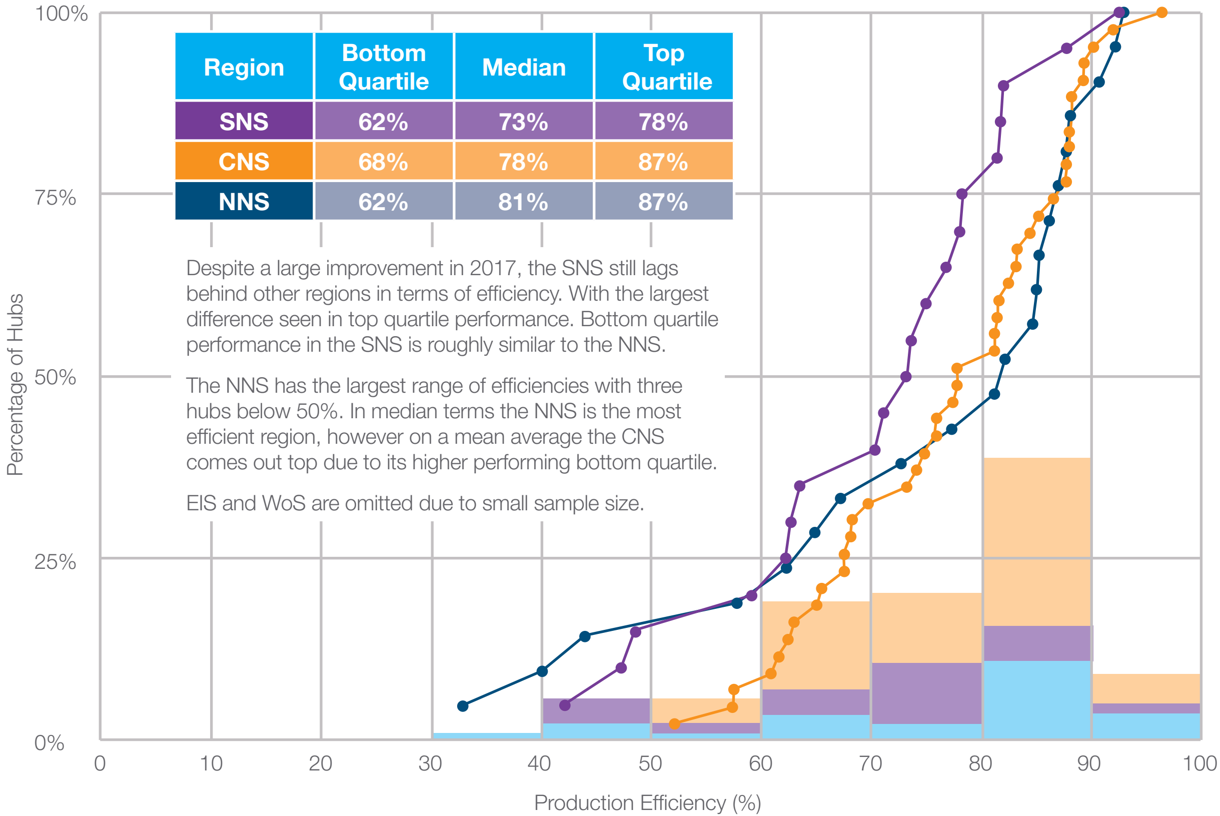
Production efficiency distribution by region

Region	Bottom Quartile	Median	Top Quartile
SNS	62%	73%	78%
CNS	68%	78%	87%
NNS	62%	81%	87%

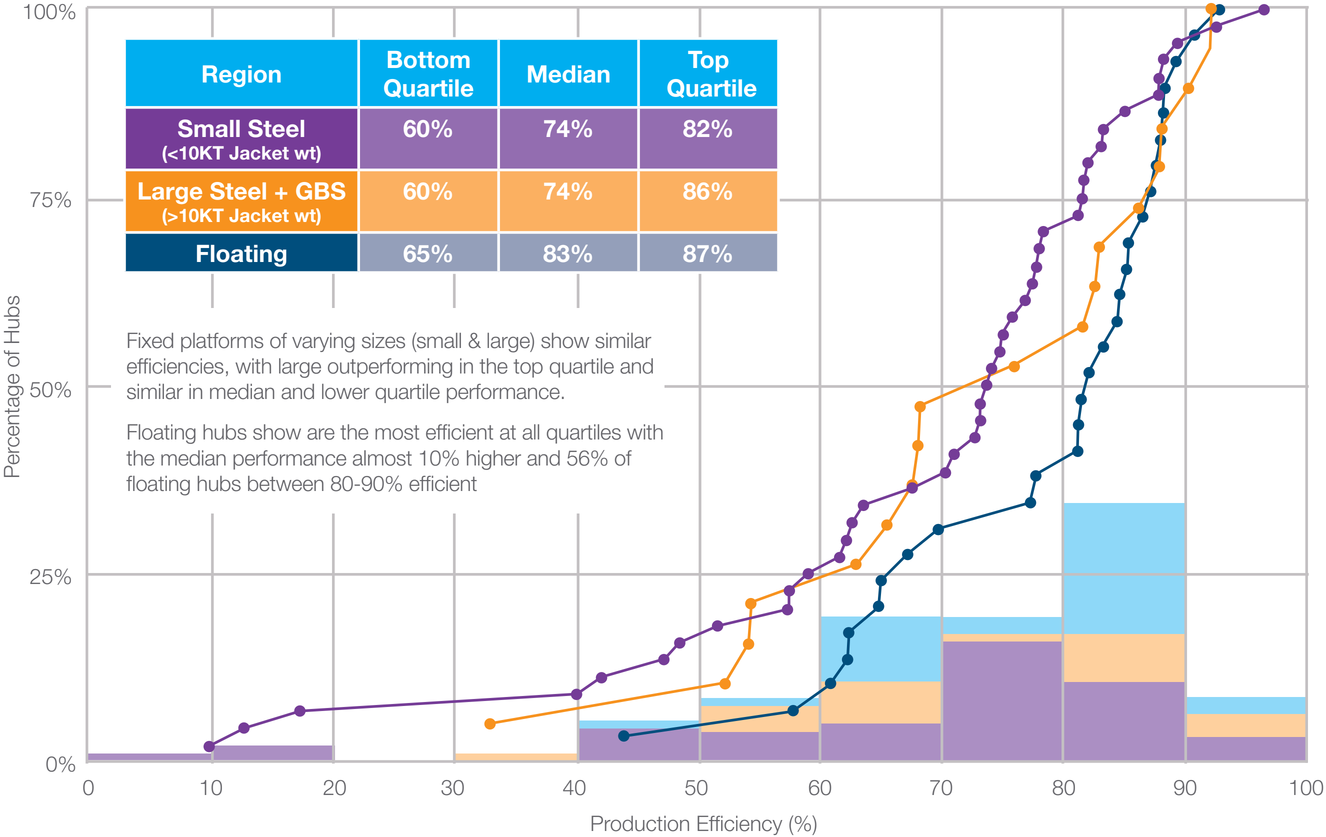
Despite a large improvement in 2017, the SNS still lags behind other regions in terms of efficiency. With the largest difference seen in top quartile performance. Bottom quartile performance in the SNS is roughly similar to the NNS.

The NNS has the largest range of efficiencies with three hubs below 50%. In median terms the NNS is the most efficient region, however on a mean average the CNS comes out top due to its higher performing bottom quartile.

EIS and WoS are omitted due to small sample size.



Production efficiency distribution by development type

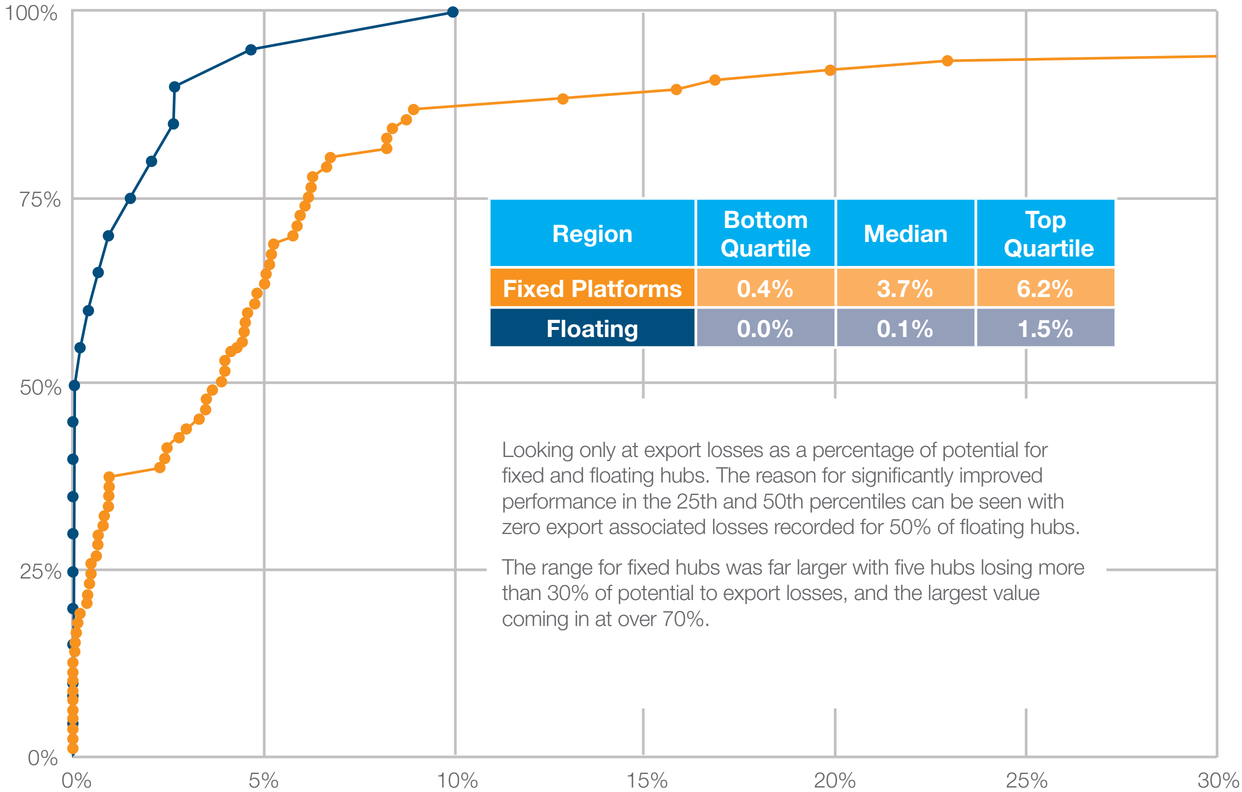


Region	Bottom Quartile	Median	Top Quartile
Small Steel (<10KT Jacket wt)	60%	74%	82%
Large Steel + GBS (>10KT Jacket wt)	60%	74%	86%
Floating	65%	83%	87%

Fixed platforms of varying sizes (small & large) show similar efficiencies, with large outperforming in the top quartile and similar in median and lower quartile performance.

Floating hubs show are the most efficient at all quartiles with the median performance almost 10% higher and 56% of floating hubs between 80-90% efficient

Export losses % of potential, fixed vs floating

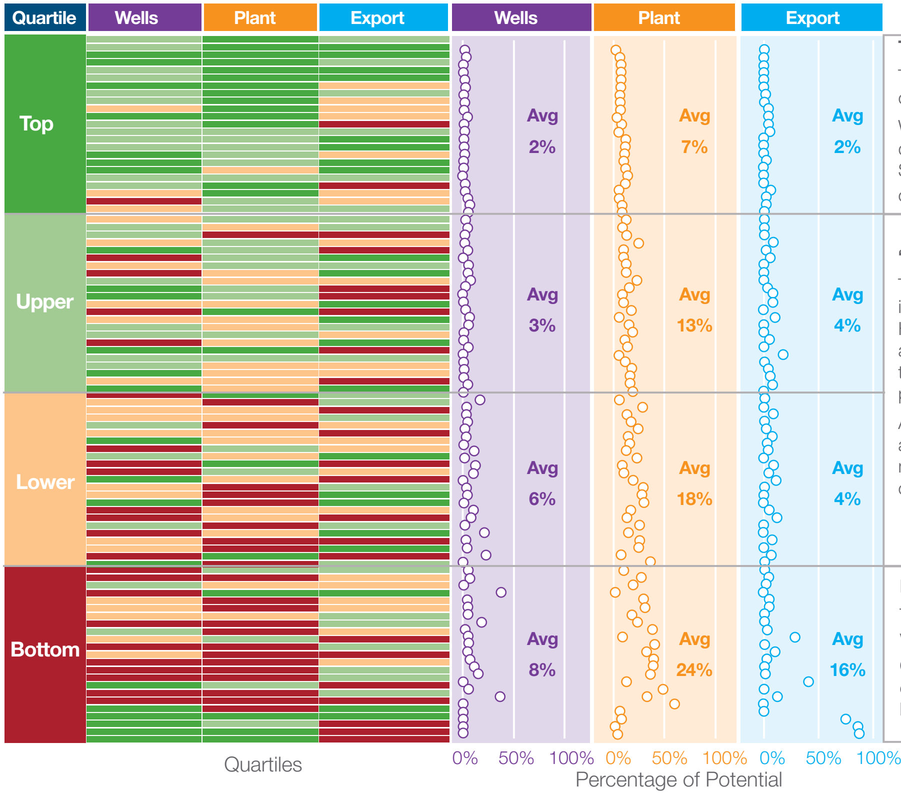


Region	Bottom Quartile	Median	Top Quartile
Fixed Platforms	0.4%	3.7%	6.2%
Floating	0.0%	0.1%	1.5%

Looking only at export losses as a percentage of potential for fixed and floating hubs. The reason for significantly improved performance in the 25th and 50th percentiles can be seen with zero export associated losses recorded for 50% of floating hubs.

The range for fixed hubs was far larger with five hubs losing more than 30% of potential to export losses, and the largest value coming in at over 70%.

What do hubs in each efficiency quartile look like?



Top Quartile;

Top quartile hubs have one thing in common, low levels of plant losses.

What is interesting is that several hubs in the top quartile did so despite bottom quartile levels of export losses. Showing high PE can be achieved even with export constraints

"Middle Pack";

The difference between the upper and lower quartiles is generally lower levels of either well or plant losses. Hubs that are within the upper quartile have generally achieved low levels of plant and well losses showing the importance of managing well stock to outstanding performance

Again export losses in the upper and lower quartiles are variable showing that high export losses can be mitigated by higher performance during uptime (outside of "train wreck" export scenarios)

Bottom Quartile;

The bottom three hubs have all experienced "train wreck" scenarios in terms of Export losses.

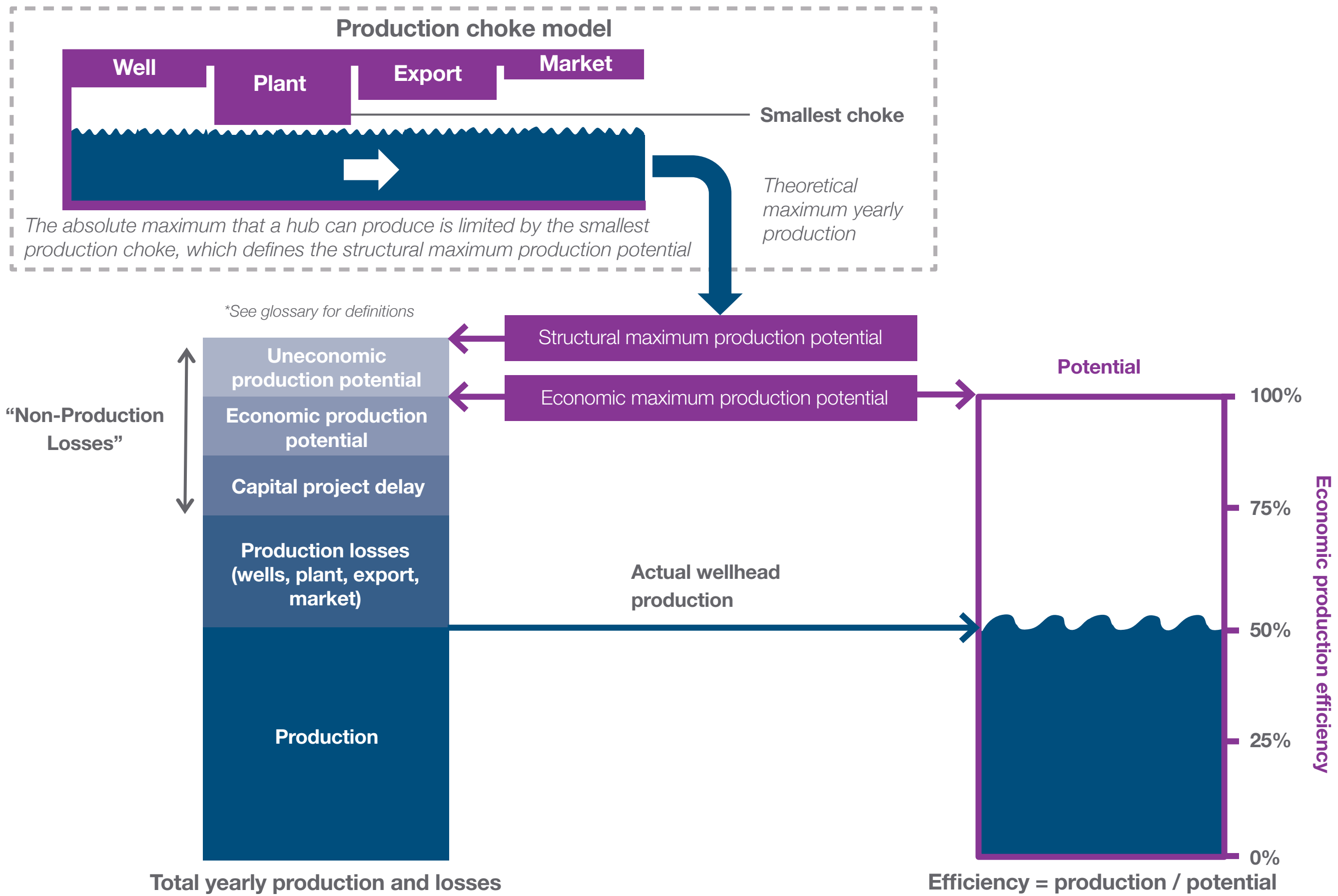
Outside of these hubs the bottom quartile is the exact opposite of the top quartile with high levels of plant losses being the common factor

This chart highlights what the performance of a high / middle / low performing hub looks like. Showing how production losses vary amongst each grouping.

UKCS Loss category data

		boe	boe	boe	% of Potential	% of Potential	% of Potential
Type	Loss	2015	2016	2017	2015	2016	2017
Export	Pipeline	6,699,380	6,369,269	14,835,953	0.81%	0.78%	1.79%
Export	Shuttle Tanker	501,548	196,389	131,923	0.06%	0.02%	0.02%
Export	Blending/Backout	5,460,274	8,082,083	1,890,950	0.66%	0.99%	0.23%
Export	Terminal (Planned)	6,306,973	8,047,084	7,492,481	0.76%	0.98%	0.90%
Export	Terminal (unplanned)	21,079,172	20,028,898	18,240,756	2.53%	2.44%	2.20%
Export	X-Over Platform	2,211,685	2,150,940	1,731,095	0.27%	0.26%	0.21%
Export	Force Majure	244,701	45,154	2,438,148	0.03%	0.01%	0.29%
Export	Utilities Import	1,257,572	231,204	156,303	0.15%	0.03%	0.02%
Plant	Oil Systems	11,497,840	9,212,656	14,396,706	1.38%	1.12%	1.73%
Plant	Gas Systems	39,145,592	24,794,666	27,638,128	4.71%	3.02%	3.33%
Plant	Gathering (inc Subsea)	15,534,760	14,907,025	7,310,448	1.87%	1.82%	0.88%
Plant	Power	8,070,823	6,908,795	8,802,325	0.97%	0.84%	1.06%
Plant	Produced Water	4,144,963	2,534,263	2,822,635	0.50%	0.31%	0.34%
Plant	Utility	9,259,893	5,841,296	11,952,614	1.11%	0.71%	1.44%
Plant	Injection	3,803,283	2,726,276	1,568,281	0.46%	0.33%	0.19%
Plant	Control System	9,992,464	5,344,776	7,539,910	1.20%	0.65%	0.91%
Plant	Full Plant	50,949,492	53,360,393	37,473,202	6.13%	6.51%	4.51%
Plant	Structural	1,662,137	491,878	1,745,487	0.20%	0.06%	0.21%
Wells	Reservoir	15,100,000	9,200,000	13,500,000	1.82%	1.12%	1.63%
Wells	Completion	7,300,000	16,600,000	12,600,000	0.88%	2.02%	1.52%
Wells	Wellhead	3,400,000	11,000,000	6,500,000	0.41%	1.34%	0.78%

Methodology



Oil & Gas Authority

Oil and Gas Authority is a limited company registered in England and Wales with registered number 09666504 and
VAT registered number 249433979. Our registered office is at 21 Bloomsbury Street, London, United Kingdom, WC1B 3HF

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