Oil & Gas Authority

UKCS Decommissioning
Cost Estimate 2020

August 2020

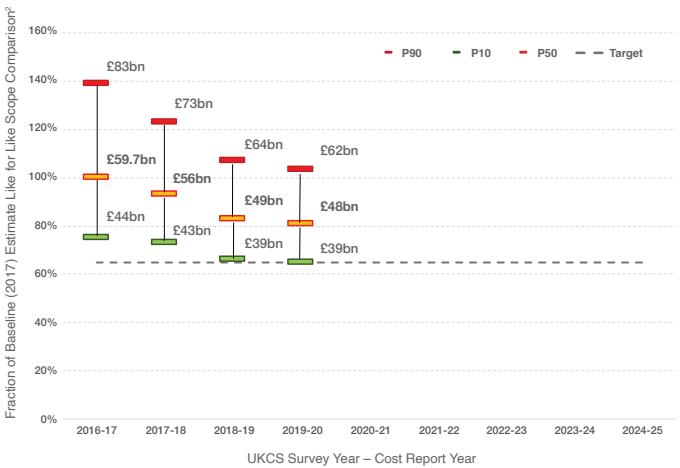
Contents

1. Executive Summary

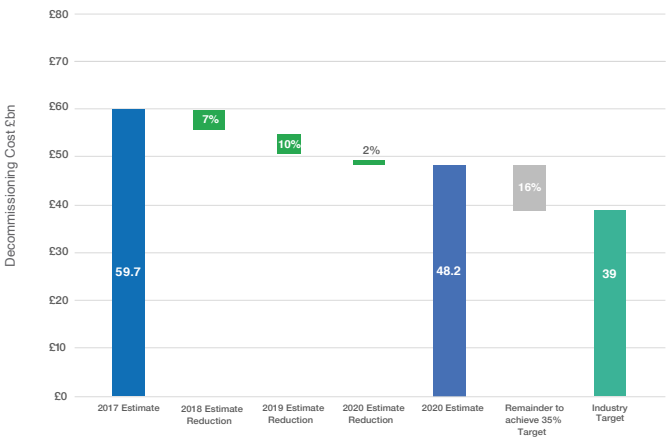
The total cost of decommissioning UK offshore oil and gas production, transportation and processing infrastructure has reduced by 19%, on a like-for-like basis, to £48bn[1] compared with the 2017 base-line estimate of £59.7bn[1].

Figure 1: Decommissioning cost reductions towards 35% reduction target (like-for-like[1])

Cost Estimate Vs Time (Like for Like) (Probabilistic, bn)



Progression Towards 35% Target (Probabilistic, bn)



[1] Costs shown in 2016 prices, for expenditure in 2017 and after

The 2% cost reduction on a like-for-like basis in 2019, building on the 17% achieved in 2017/2018, is driven by minor improvement in planning and execution practices, leading to reductions in the estimated cost of:

- Platform and subsea infrastructure removals in the NNS and CNS
- Reduced cost risk associated with estimating uncertainties

Operator performance is inconsistent. Several operators have made large improvements in subsea well decommissioning costs but these savings have been offset by significant increases from a small number of other, already cost-challenged, operators.

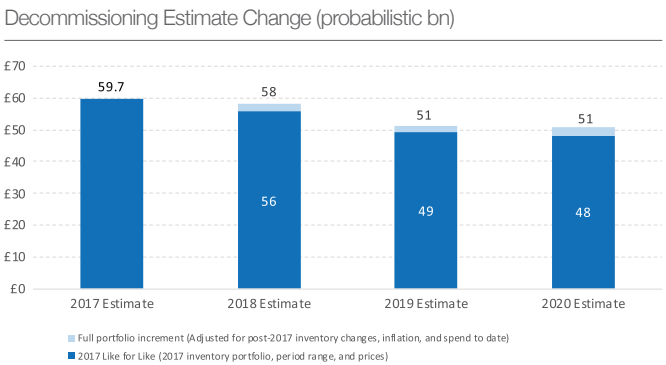
There is considerable opportunity for future cost improvements to meet the targeted UKCS cost reduction target of greater than 35% (to levels below £39bn[2]):

- Extending learning from decommissioning operators and contractors to other offshore assets, and other cost categories
- Extending learning between operators to improve consistency in performance
- Adopting commercial models which reward greater cost efficiency

As identified in the OGA's UKCS Decommissioning Cost Estimate 2019 report, key threats and uncertainties with the potential to increase costs include inconsistent cost performance of different operators and cost threats from oil-sector inflation.

Including inventory changes since 2017, the total cost of decommissioning remaining UK offshore oil and gas production, transportation and processing infrastructure is estimated at £51bn[1].

Figure 2: Decommissioning cost estimate changes with time



Cost reductions are evident in actual decommissioning expenditure, and in 2019 expenditure was £170m lower than estimated the previous year. This is partly due to deferral of activity but 70% represents true total project reductions in cost.

[1] All costs are in 2019 prices, based on forecast expenditure in 2020 and after, unless otherwise stated
[2] Costs shown in 2016 prices, for expenditure in 2017 and after

2. Introduction

The Maximising Economic Recovery (MER) Strategy for the UK sets out a central obligation and supporting obligations, including clarifying the actions and behaviours required for decommissioning. Lower decommissioning costs will help maximise value extraction from the UKCS. For the supply chain, which holds the specialist skills, knowledge and equipment to execute the work, there is a clear and sizeable opportunity to develop an efficient, low cost and exportable industry capability.

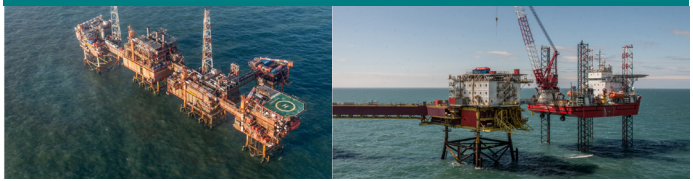
The OGA takes a probabilistic approach[3] to estimating total UKCS decommissioning costs, which takes into account uncertainties inherent in cost estimation. Cost estimates for all fields are provided to the OGA by operators each year via the UKCS Stewardship Survey, with the 2019 survey forming the basis for the 2020 Report.

- Like-for-like estimates[2]: Cost reductions are measured against the £59.7bn[2] baseline calculated in the 2017 report, after inflation-adjusting and like-for-like aligning the portfolio/inventory with that evaluated then
- Full Portfolio estimate[1]: There have been various changes in the remaining, to-be-decommissioned, portfolio since 2017. The remaining decommissioning cost for the updated Full Portfolio (i.e. the latest view of remaining inventory, as from the beginning of each report year) is also calculated

Minimising post-CoP running costs

The SNS area comprises several large manned platform complexes connected to unmanned satellite platforms. Post-CoP running costs for these complexes in warm phase can be high and represent up to 25% of the total hub decommissioning costs. It is therefore good practice to bring these platforms quickly to the cold state after cessation of production.

To do this, one large SNS operator implemented a carefully optimised two vessel decommissioning campaign, with a jack-up work-barge performing isolation and cleaning operations for the pipelines/satellites connected to the hubs, and a jack-up rig also decommissioning satellite wells, and eventually the hub wells. This parallel approach was effective in accelerating the hub platforms to the cold state, substantially reducing post-CoP running costs.



[1] All costs are in 2019 prices, based on forecast expenditure in 2020 and after, unless otherwise stated

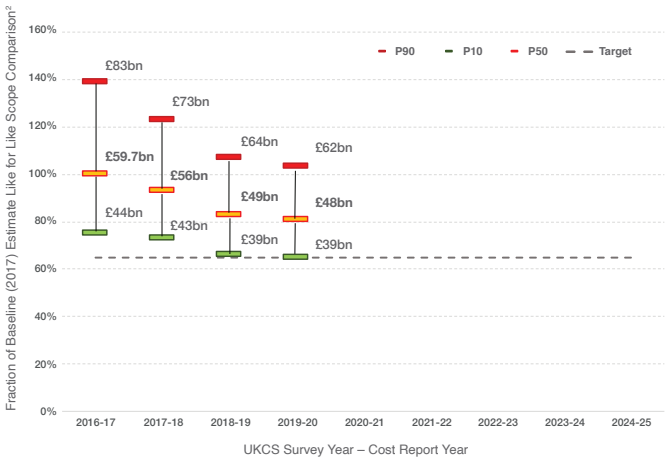
[2] Costs shown in 2016 prices, for expenditure in 2017 and after

[3] 2017 Cost Estimate Report/2018 Cost Estimate Report: https://www.ogauthority.co.uk/decommissioning/cost-estimate/

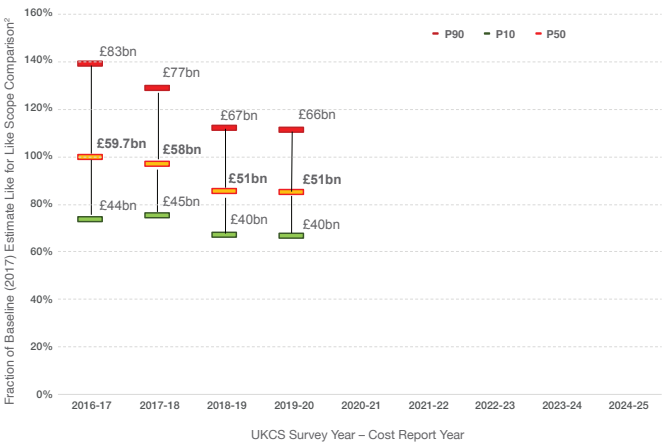
The updated cost distribution ranges for these estimates are (also see Appendix 5):

Figure 3: Like-for-like trend and Full Portfolio cost trends

Cost Estimate Vs Time Like for Like (Probabilistic)[2]



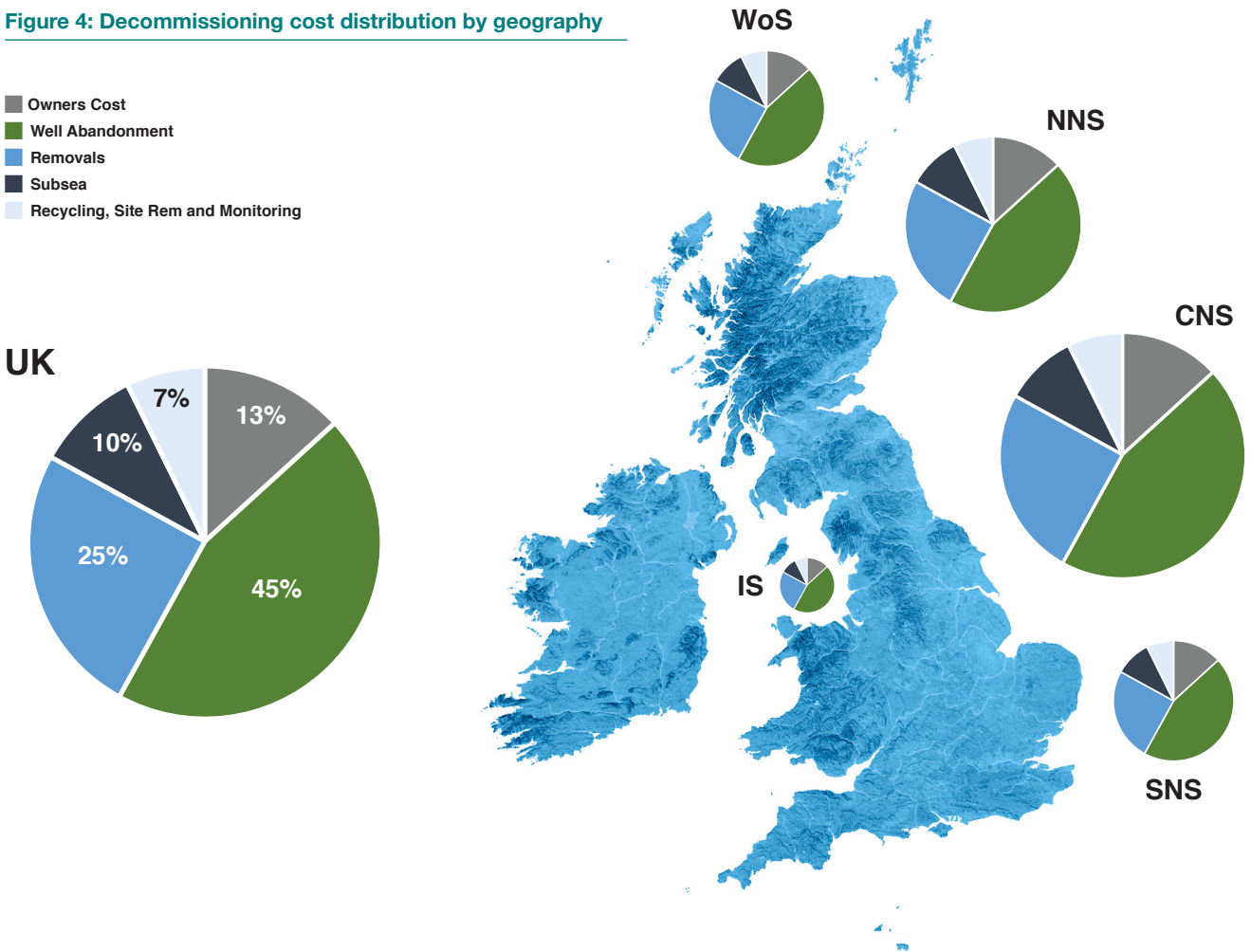
Cost Estimate Vs Time Full Portfolio (Probabilistic)



The 2020 Full Portfolio estimate includes £2bn[1]$_{P50}$ associated with as-yet unsanctioned/not-built projects.

[1] All costs are in 2019 prices, based on forecast expenditure in 2020 and after, unless otherwise stated
[2] Costs Shown in 2016 prices, for expenditure in 2017 and after

Figure 4: Decommissioning cost distribution by geography

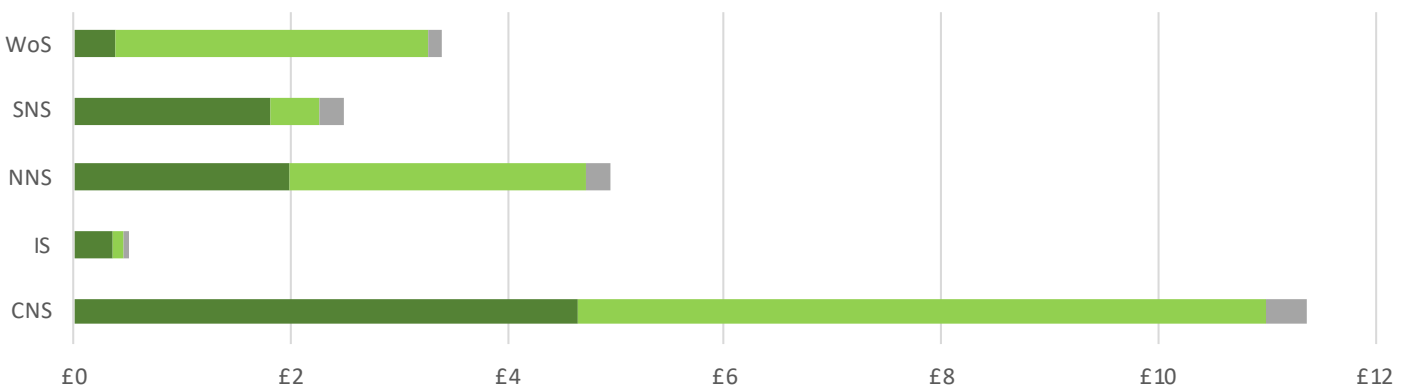


Well decommissioning is 45% of the total, with the CNS comprising a disproportionately large element, due to the many costly-to-decommission subsea wells in the sector, and a substantial number of high well-count production platforms.

Figure 5: Well decommissioning cost distribution by geography

Well decommissioning costs by type and Region

2020 + Full Portfolio (Units: Probabilistic, bn)



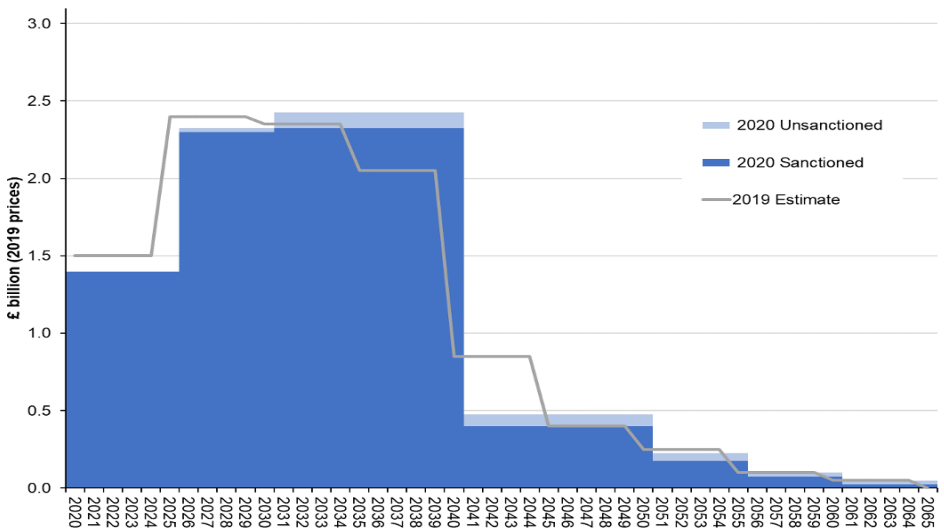
An annualised forecast profile (averaged over five years) was created by scaling operators stewardship submissions, proportionate to the skew of the associated uncertainty distributions. There is considerable uncertainty in this forecast but the profile does show that the majority (approx. 90%) of decommissioning expenditure is projected to be incurred over the coming 20 years.

A lower annual run rate is forecast to be incurred over the next 20 years compared with the 2019 estimate.

The cost projections were provided prior to the rapid fall in oil/gas prices in Q2 2020 and the impact of Covid-19, prompting reduced levels of short-term activity. Based on extensive soundings on industry sentiment, decommissioning activity is considered likely to fall below the levels shown in this projection in 2020/2021.

Figure 6: Annualised decommissioning cost profile

Projected Annual UKCS Decommissioning Costs

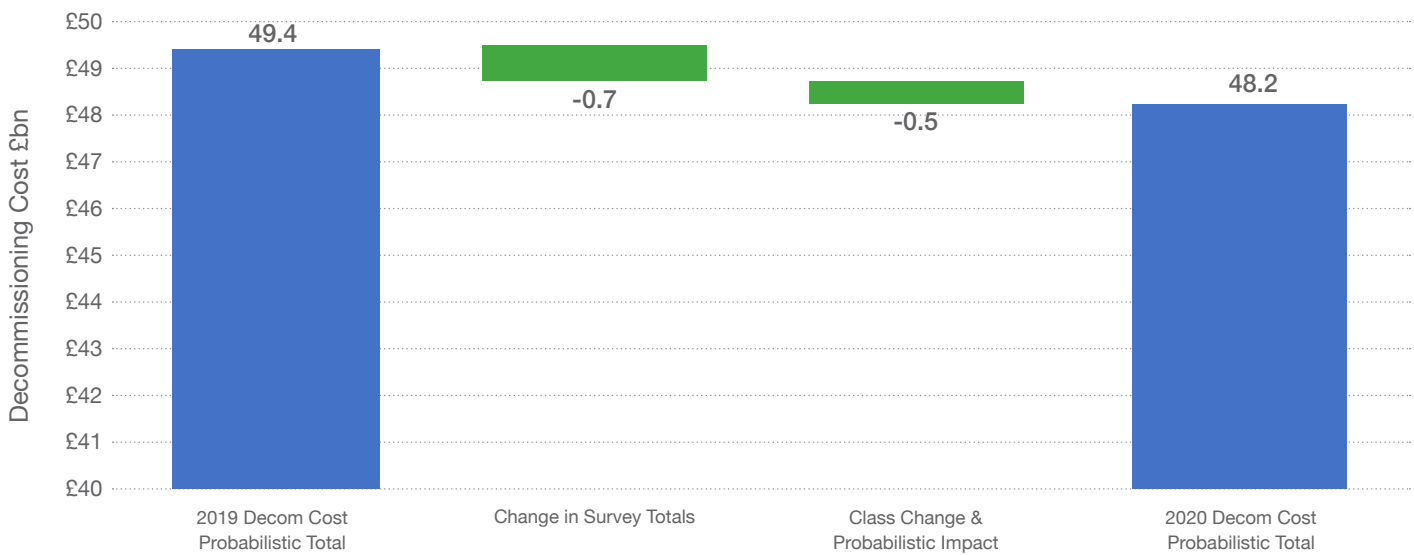


3. Cost Reduction Analysis

Compared with 2019, there has been a £1bn reduction in the like-for-like cost estimate, due to a decrease in forecast and executed activity costs, and reduced risk in the operator cost estimates.

Figure 7: 2019 to 2020 decommissioning cost reductions

2019 to 2020 Cost Estimate Waterfall (Like for Like, probabilistic, bn)[2]



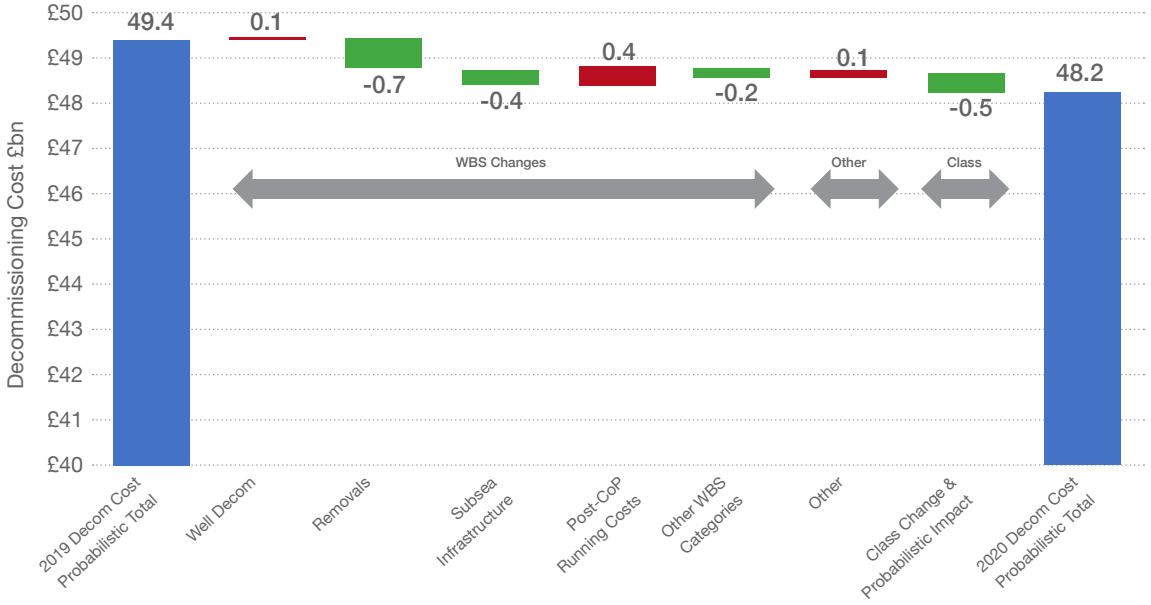
[2] Costs Shown in 2016 prices, for expenditure in 2017 and after

3.1 Activity Costs

The sum of previous and forecast decommissioning activity costs is largely unchanged from that reported in the 2019 report. Detailed analysis of past performance will be provided in a separate report, 'UKCS Decommissioning Cost Benchmarking 2020', in late Q3 2020.

Figure 8: 2019 to 2020 decommissioning cost reduction categories

2019 to 2020 Cost Estimate Waterfall by Category (Like for Like probabilistic, bn)[2]



[2] Costs Shown in 2016 prices, for expenditure in 2017 and after

Well decommissioning costs have continued to benefit from improved scoping of required work, and better execution practices. This is not true for all decommissioning operators and, as observed in the 2019 report, there are very wide differences in cost performance between the most and least cost effective. There are several instances of substantial improvement, but in some cases the projected performance of some already-high-cost operators has deteriorated even further. This is not compatible with MER UK. If operators are unable to put themselves on a cost-effective trajectory, this represents a significant value gap which can reasonably be expected to be targeted by more cost-effective parties, whether in the operator community or in the supply chain.

In the case of subsea wells, 2018/2019 costs benefited from cyclically low rig/vessel rates and greater execution expertise. The near halved unit cost of subsea well decommissioning reported in 2019 has been maintained, and even slightly improved on.

Projected **post-CoP running costs** showed an increase over 2019 due to two factors:

- Weaknesses in late-life/warm-phase asset management on some active projects preventing large running cost savings from being captured, and
- Operators' initial estimates in some cases had too optimistic a starting point. Industry has learned the means to confidently deliver cumulative post-CoP running costs of <£50MM even for large NNS/CNS platforms but this is yet to materialise into the norm

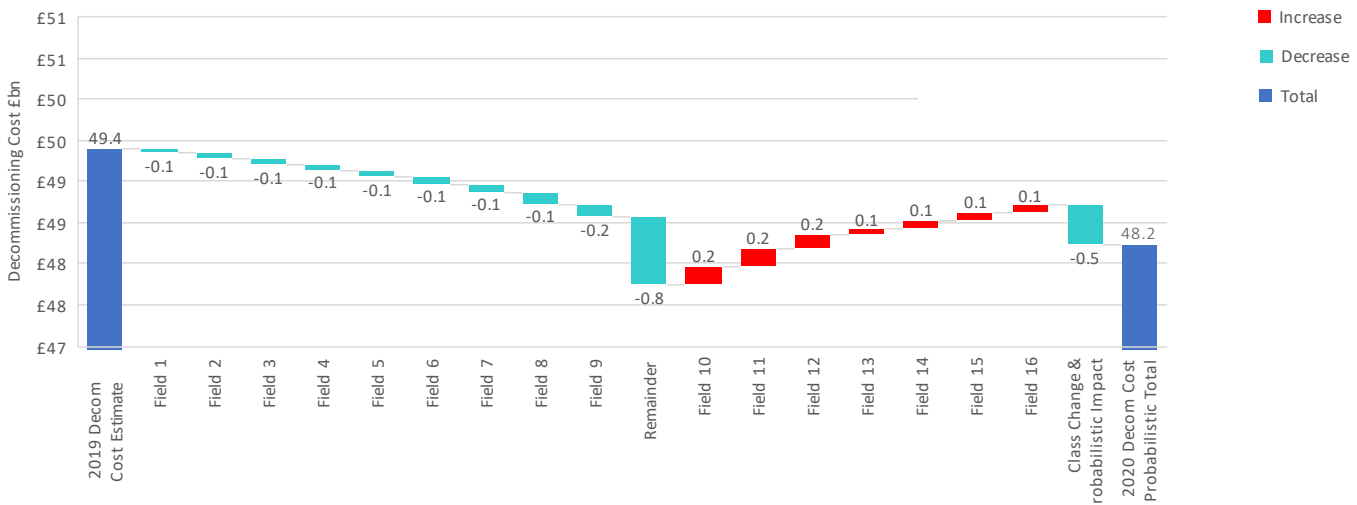
Topsides and substructure removal costs continue to reduce. Lifting contractors have developed impressive removals expertise and execution practices, showing real ingenuity with several recent projects. Operators are in turn customising their project management for decommissioning, providing information and schedule flexibility, to allow the supply chain to craft cost-effective propositions. Regulatory agencies, as part of the decommissioning tripartite, can usefully shape their evolving consenting processes to support these positive operator and supply chain behaviours.

Campaign approaches to **subsea infrastructure** decommissioning, combined with flexible timing, are helping reduce costs. Campaigns are still limited to those which individual operators can assemble within their own portfolio, and opportunities from multi-operator campaigns are yet to be capitalised on.

On a field-by-field basis there continues to be encouraging cost reductions. However, as Figure 9 shows, the encouraging forecast cost reductions in Fields 1–9 and 'Remainder' were largely negated by increases on Fields 10-16, the large majority of which lie in the portfolios of just 5% of operators.

Figure 9: Major decommissioning total cost changes relative to 2019 estimate

2019 to 2020 Waterfall By Field (Like for Like) (Probabilistic, bn)[2]

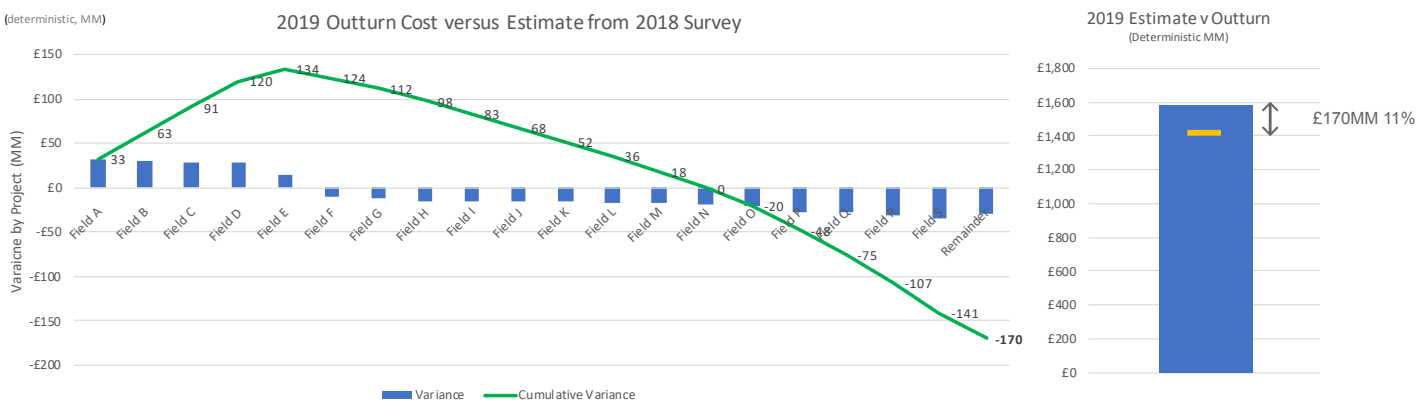


[2] Costs Shown in 2016 prices, for expenditure in 2017 and after

These cost reductions are, in many cases, being realised immediately. Actual decommissioning expenditure in 2019 was £170m lower than estimated the previous year (see Figure 10). Of the projects showing cost reductions, 70% of the variance represents true total project reductions in cost, with the remainder being deferral of activity/expenditure to later years.

Figure 10: 2019 estimate versus 2019 actual cost

2019 Outturn Cost versus Estimate from 2018 Survey



3.2 Cost Uncertainty Classification

The decommissioning estimates provided by operators have higher certainty than those submitted in earlier surveys, which has resulted in a risk-weighted cost adjustment of £0.5bn to the like-for-like estimate. Nonetheless the fraction of decommissioning cost estimates with high uncertainty (AACE Class 4 & 5 quality) remains high.

The OGA expectation is that, for 90% of expenditure within the coming three years, cost estimation quality should be of AACE Class 3 or better. 69% of three-year forecast expenditure meets this expectation (see Appendix 1 for AACE definitions), an improvement from the previous survey, where the equivalent value was 65%.

Figure 11: Decommissioning cost distribution by estimate quality

Class Estimate Improvement

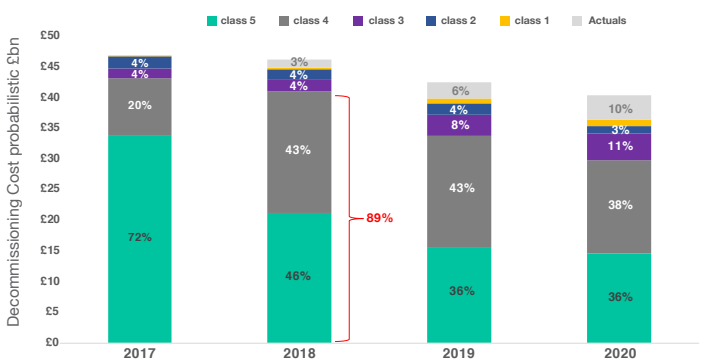
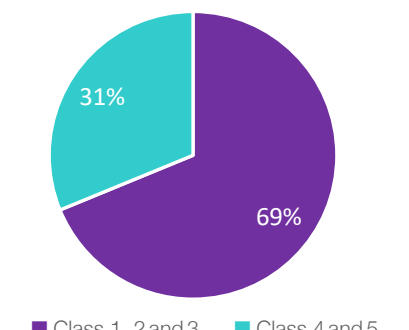


Figure 12: Estimate quality for spend in 2020–2022 and comparison to OGA Key Performance Indicator

Estimate Maturity for Spend 2020–2022



Target: 90% Class 3 or better by 2022

3.3 Cost Management

The continued progress on decommissioning costs is largely built on operators' 2017–2018 experience of achieving significant cost reduction in platform running costs, well decommissioning and removals in the NNS and CNS, with these now being extended to the SNS. Some well decommissioning gains (e.g. for platform well costs in the NNS) have not been sustained in recent performance, as explained in more detail in the end-Q3 2020 report "UKCS Decommissioning Cost Benchmarking 2020", focusing on the cost performance of recent activities.

Use of a modular rig to overcome a unique well decommissioning challenge

Due to the development need for high outstep wells on the shallow Sherwood reservoir, wells on the South Morecambe field are 'slant wells', drilled at a 60° angle from surface*. Traditional (vertical) derricks/masts cannot be used when decommissioning such wells.

A solution proposed by the supply chain, and now adopted on platforms DP3 and DP4, was the modification of an onshore rig design, with a hydraulic mast capable of moving from vertical to slant, able to skid across the platform main deck, and rotate to align with each well. The small footprint (12m x 12m x 30m) and light modular design (200 metric tons total with each part weighing less than 30 metric tons) allows installation using a platform crane. The system can also be used with conventional, vertical wellheads.

*Modern directional drilling technology largely negates the need for this approach

Key opportunities to more cost effective decommissioning (those in green are starting to have significant impact now):

- Consistent application of the 2017–2019 post-CoP running cost, well decommissioning and removal learnings to all assets, in all sectors of the UKCS
- Close working between the OGA and industry facilitates shared learning and knowledge, and increased collaboration
- Further improved asset stewardship to optimise value and costs through late-life and decommissioning
- Service providers to the market initiating different, lower-cost approaches, contracting solutions, and pricing bases specifically for decommissioning projects
    - Less positively, actual adoption of these new commercial models by operators, and capturing economy-of-scale benefits, remains low
- Volume-based efficiencies from campaign or area-based approaches e.g. multi-operator well decommissioning and subsea infrastructure decommissioning campaigns, area-based operator collaborations to optimise schedules and contracts, etc
- Synergies with offshore renewables activity
- Innovative cost reducing technologies or techniques are implemented for well decommissioning activities

Innovation in platform decommissioning

Much of SNS production infrastructure consists of small, Normally Unattended Installations (NUIs), connected by pipelines to larger hub processing facilities. Due to their basic configuration, decommissioning of these NUIs typically needs support from accommodation barges, drilling rigs, and heavy lift vessels.

One decommissioning contractor is now implementing a radically different ‘1-visit’ approach for NUIs, with well abandonments, pipeline isolation/cleaning and removals all being executed from a single jack-up barge, reducing operations time and costs. The final topsides removal is achieved by sliding the topsides on skid beams onto the deck of the work barge.

Conversely, key risks to future decommissioning costs are (those in red are having impact now):

- Operators may commence planning for decommissioning too late, thereby precluding access to cost saving options
  - 'Too late' can be a consequence of unexpected events, such as a fall in oil/gas price, or the emergence of an asset integrity issue. The cost consequences of not being positioned for such eventualities are very high
- Traditional development project and contracting approaches are adopted for planning, managing and executing decommissioning projects, unnecessarily over-engineering the solutions and increasing the cost
  - Some operators continue to approach decommissioning as they would any other medium-large project, and resource/fund/contract accordingly. Parties with the greatest capital projects expertise are not necessarily best positioned to deliver cost-effective decommissioning, due to organisational/cultural incompatibilities and the very different value drivers of capital and decommissioning projects
- Funding constraints may result in sub-optimal decommissioning timing due to competing exploration and development funding needs
- Some operators may be optimistic/pessimistic when developing provisioning estimates and this could result in unrepresentative estimate values, knowingly or otherwise
- The depressed supply chain market and strong competitive forces have contributed to the cost reductions, supplementing and contributing to execution improvements. Decommissioning will continue for decades, over multiple economic cycles, with corresponding risks of less attractive price offerings
- Subsea wells are disproportionately costly to decommission relative to platform wells, so there is a strong incentive to reduce those costs. Recent cost trends are very positive. However, since this activity typically uses equipment also used for other upstream activity (e.g. semi-submersible rigs), there is substantial risk from increased day-rates as offshore development activity increases
  - Should it prove problematic to reduce subsea well decommissioning costs, it will be difficult to compensate by reducing other decommissioning cost types
- Low investment in new technologies, and ineffective transfer of existing technologies from other sectors, may prevent access to cost reduction opportunities
- Increased demand from offshore renewables activity driving higher vessel-utilisation/prices
- The challenging operating environment in 2020 could see supply chain companies fail. A reduced and constrained supply chain could impact on costs

3.4 OGA Actions and Next Steps

The OGA will take specific actions to support/facilitate increased competence and cost effectiveness of operators and their contractors to deliver the targeted >35% savings relative to the 2017 baseline:

Current OGA practice

Stewardship Engagements	The OGA-Operator Stewardship Engagement Process (Appendix 2) has proved an effective contributor to understanding and managing decommissioning performance • Operator stewardship reviews comprising more than 90% of 10-year forecast expenditure were implemented in 2019
Benchmarking	Systematic use of benchmarks derived from actual cost results has been very effective when assessing estimates during stewardship reviews with individual operators, as well as during Decommissioning Programme (DP) discussions. • These form an objective, quantitative basis for substantive discussions on cost performance to be targeted, and the savings to be captured. The number and quality of benchmarks is being constantly improved • They prompt the right behaviours, with decommissioners striving to be in the top quartiles
Learning	• The OGA is closely supported by industry groups such as Oil & Gas UK (OGUK) in organising post-project reviews and subject-specific 'good practice' workshops • Learnings are published on the OGA and OneDecom learning sites
Data	Annual improvements to the UKCS Stewardship Survey have improved quality/consistency, and increased the value of data collected
Contracting	The OGA has publicised collaborative win-win contacting models
Market Transparency	The OGA promotes market transparency, including hosting the online Oil & Gas Pathfinder market intelligence website
Technology	The OGA works with industry, the Oil & Gas Technology Centre (OGTC) and the National Decommissioning Centre (NDC) to promote the development of cost-effective technologies

Next OGA actions, in addition to current practice

Stewardship Engagements	Stewardship Engagements will now be used to proactively prompt: • the building of campaigns and contractual linkages, extending operator/contractor insights by drawing on OGA analyses of the large Stewardship Survey datasets available to them • more extensive repurposing of offshore infrastructure in support of UK Net Zero ambitions
Benchmarking	• The OGA is supporting industry body Oil & Gas UK in developing a framework for decommissioning operational benchmarks, giving Operators/contractors better ability to manage the factors (e.g. durations) underlying costs • From late Q3 2020, a dedicated report, "UKCS Decommissioning Cost Benchmarking" will focus on decommissioning cost benchmarking
Learning	The OGA will strengthen its collaboration, and that with other decommissioning-focused industry groups such as Decom North Sea and OneDecom, to evolve an increasingly effective learning ecosystem
Data	This process of continuous improvement will be extended
Contracting	The OGA will actively promote the development of collaborative contracting solutions, where suppliers are incentivised and empowered to deliver improved costs
Market Transparency	The OGA will increase the online accessibility of scope and schedule information to allow the supply chain to craft attractive offerings, and operators/contractors to recognise campaigning/aggregation opportunities
Technology	The OGA and its collaborating parties will investigate greater adoption of technologies from other sectors such as renewables and nuclear

Appendix 1: Methodology

The 2019 UKCS Stewardship Survey was used as the data source, with decommissioning cost inputs provided by all operators for all current and proposed offshore facilities, pipelines, development wells, suspended open water exploration and appraisal wells and onshore terminals. Data was collected using the Oil & Gas UK Work Breakdown Structure (WBS).

The OGA's approach, unchanged from previous years, has been to develop a probabilistic cost estimate which takes into account the wide range of uncertainties in estimates submitted by operators. Estimate classes in the survey were requested with reference to the Association for the Advancement of Cost Engineering (AACE Recommended Practice No. 18R-97, see Figure 19) and AACE guidance followed for selecting the values from these ranges.

The estimate is comprised of various elements, not all having the same estimate classification. The estimate classification was requested from the operators responding to the UKCS Stewardship Survey and no adjustments were made to these operator self-assessments.

Figure 13: AACE classification of estimates

	Primary characteristic	Secondary characteristic
Estimate Class	**Maturity level of project definition deliverables** Expressed as % of complete definition	**Expected accuracy range** Typical variation in low and high ranges at an 80% confidence interval
Class 5	0% to 2%	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	L: -3% to -10% H: +3% to +15%

The values within the 'Expected Accuracy Range' and used in the probabilistic distributions were selected at the higher end of the low (L) and higher end of the high (H) accuracy ranges shown above. For example, Class 5 estimates were given an expected accuracy range of -20% / +100%. This was to address the possibility of estimating optimism from operators for decommissioning scope. This potential was assessed as being high for the following reasons:

- Estimates may be influenced by issues such as estimating bias
- Immaturity of decommissioning expertise within many UKCS operators
- The lack of industry experience generally with decommissioning

The project scope includes the decommissioning of all UKCS infrastructure including:

- Facilities and development wells still in place and yet to be decommissioned
- All infrastructure and development wells currently undergoing decommissioning, excluding work performed prior to 2017
- All sanctioned facilities and wells not yet in place
- Proposed project developments, not yet sanctioned or built, weighted by probability of occurrence/execution
- All intra-field pipelines and export lines
- Suspended open water exploration and appraisal wells
- Onshore terminals

The estimated raw data has been collected using the Oil & Gas UK decommissioning Work Breakdown Structure (WBS) which has the following categories:

- Project management
- Post-CoP running costs
- Well decommissioning
- Facilities/pipelines permanent isolation and cleaning
- Topsides preparation
- Topsides removal
- Substructure removal
- Topsides and substructure onshore disposal
- Subsea infrastructure (incl. subsea structures, pipelines, mattresses, etc.
- Site remediation
- Post-decommissioning monitoring

Where required, deflation factors have been taken from the 'GDP deflators at market prices, and money GDP Statement', published by HM Treasury from data provided by the Office for National Statistics (ONS) and Office for Budget Responsibility (OBR). Values are taken from the Spring statement each subsequent year.

2016–2017 deflation factor: 1.97%

2017–2018 deflation factor: 1.85%

2018–2019 deflation factor: 1.86%

Appendix 2: Stewardship review process

The OGA interacts with decommissioning operators based on the 'long glidepath' strategy by which early, structured engagements support operators to embed good practices in sufficient time to deliver cost effective decommissioning. The framework and requirements are set out in the OGA Stewardship Expectation SE-10 Cost Effective Decommissioning.

Figure 14: 'Long glidepath' cost reduction strategy

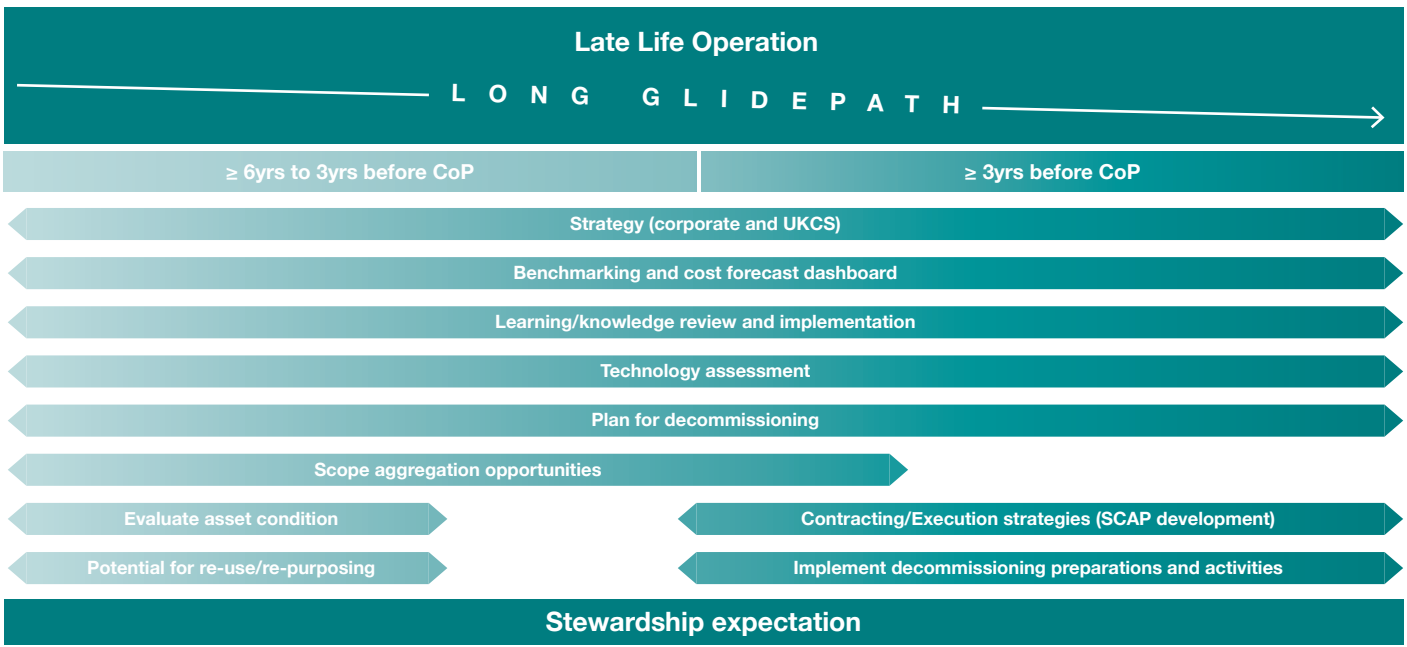


Figure 15: Standard OGA operator stewardship agenda

Annual 'Tier 2' strategic engagements are scheduled with operators, prioritised based on the timing, materiality and competitiveness of their decommissioning costs, as well as their learning/sharing behaviours. The engagements are structured on a standard agenda, to ensure a comprehensive discussion and efficient follow-up of plans to mature cost reduction opportunities.

1. Decommissioning portfolio	
• High-level decommissioning strategy	Operator
• Assets (including open-water E&A wells)	Operator
• Schedule/schedule-changes	Operator
• Anticipated project outcome/end-state	Operator
• Estimated cost/cost-changes by cost-category	Operator
• Learning and impact	Operator/OGA
2. Cost reduction opportunities	
• Expected magnitude of savings *(by cost-category/activity e.g. P&A, technology)*	OGA/Operator
3. Plan/schedule to mature cost reduction opportunities ('Glidepath')	
• Risks, Uncertainties, Decisions	Operator
• Supply Chain opportunities (including Supply Chain Action Plans)/Area Plans	Operator
4. Future engagement schedule	All

Changes from standard agenda to be agreed in advance. Meeting materials ideally to be provided three working days ahead.

A ‘Decommissioning Dashboard’, using the operators’ own data as submitted through the UKCS Stewardship Survey, is used as the basis for performance/cost analysis and discussion. The Oil and Gas UK Decommissioning Work Breakdown Structure (WBS) is used as the basis for cost classification.

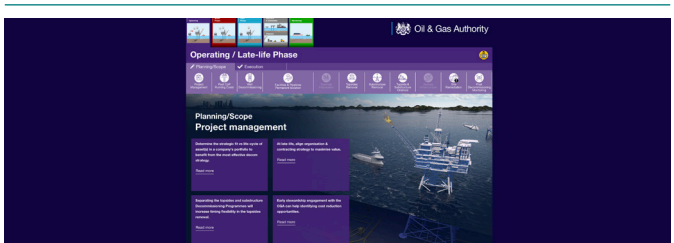
Figure 16: Example decommissioning benchmarking dashboard

Decommissioning Dashboard

In certain cases, the OGA requests operators to facilitate separate OGA reviews of certain decommissioning activities with key contractors involved. The purpose of this is to allow, with the benefit of hindsight, identification of unrealised savings or performance improvements which might not be apparent to the client/operator). Non-proprietary, non-confidential elements of this may then be shared with industry through:

- Encouraging the parties to increase awareness through presentations at relevant conferences, or through industry knowledge-sharing portals (e.g. L2P2 and OneDecom – Lessons Learned)
- The OGA making other operators aware directly through the stewardship engagement process, and perhaps including follow-up in the agreed cost-reduction plan
- The OGA informing industry directly through decommissioning knowledge-sharing website – https://www.ogauthority.co.uk/lessons-learned/

Figure 17: Illustration OGA decommissioning learning website



Appendix 3: Key Performance Indicators

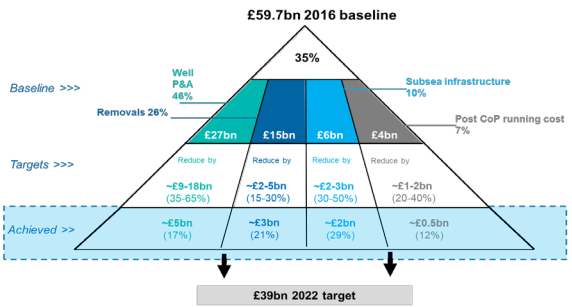
Key Performance Indicators (KPIs) were introduced in 2019 in support of the two objectives of 35% cost reduction relative to the 2017 baseline, and more than 90% of expenditure within three years being at least an AACE Class 3 estimate quality.

Four key activities (post-CoP running costs, well decommissioning, removals, subsea infrastructure decommissioning) constitute approximately 90% of overall decommissioning cost, and it is essential to reduce the costs of several, if not all, of these if the overall >35% cost reduction target is to be realised. Decommissioning KPIs are therefore focused on these four cost areas, with industry guided to calibrate its ambitions accordingly e.g. reductions of 35–65% for well decommissioning being potentially achieved from a combination of improved downhole barrier technology/practices, rig-less expertise and campaign economies.

To-date reductions of 17%, 21%, 29% and 12% have been achieved for well decommissioning, removals, subsea infrastructure and post-CoP running costs respectively.

Figure 18: Decommissioning Key Performance Indicators

Achieving the 35% Reduction



	Cost reduction drivers					Actions
Planning ↑	Technical Scope	35%	10%	15%	20%	Critical asset status review, define requirements and challenge, use of new technology, lessons learned.
	Supply Chain	20%	10%	20%	5%	Promote change in current practice, develop new business models, campaign and scope aggregation.
Planning ↓	Execution	10%	10%	15%	15%	Effective execution, applying lessons learned.
	OGTC Technology Roadmap	**35%**	**20%**	**20%**	**20%**	**OGTC Decom Roadmap Goals for Technology**

Tech & Innovation ↑ / Tech & Innovation ↓

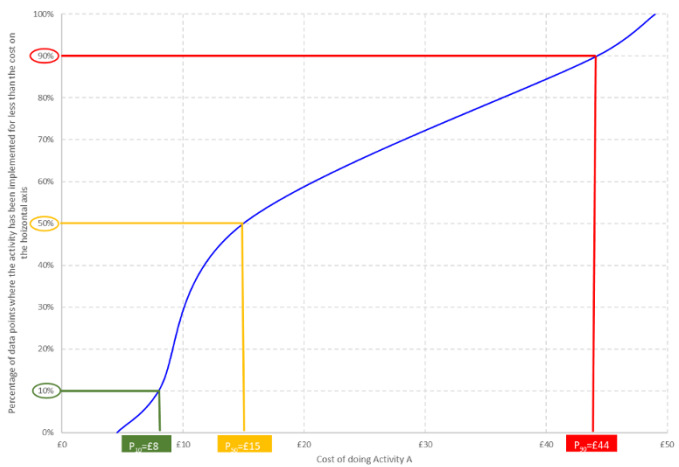
Several combinations of the above savings would result in a >35% overall decommissioning cost reduction. High potential lines of action are being progressed (see Figure 18) including focused technology maturation in collaboration with operators, suppliers and the Oil and Gas Technology Centre (OGTC). Strengthened international standardisation of benchmarks and decommissioning performance measurement is being progressed to facilitate global comparisons and learning.

Appendix 4: Representation of Cost Uncertainty

The terms P_{10}, P_{50} and P_{90} are used extensively throughout this document. These represent the values for which, respectively, 10%, 50% and 90% of possible future outcomes are lower than this figure.

These values are extracted from the type of graph shown (see Figure 26). In this illustrative example, 10% of possible outcomes for Activity A are forecast to be executed for £8 or less, 50% for £15 or less, and 90% for £44 or less. The terms P_{10}, P_{50} and P_{90} refer to these values i.e. the cost values below which 10%, 50% and 90% of possible outcomes will be achieved.

Figure 19: Example of 's-curve' used to characterise uncertainty

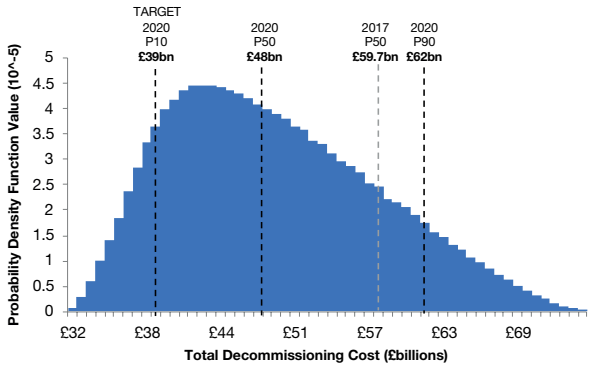


The P_{90} value, therefore represents the value at which 90% of future outcomes, based on remaining uncertainties, will be cheaper than this – figures at or above this are most expensive 10%. Conversely, figures below the P_{10} represent the cheapest 10% of possible future outcomes, and the P_{50} the value at which there are an equal fraction (i.e. 50%) of outcomes above and below.

Appendix 5: Probabilistic Cost Distributions

Figure 20: Decommissioning cost distribution

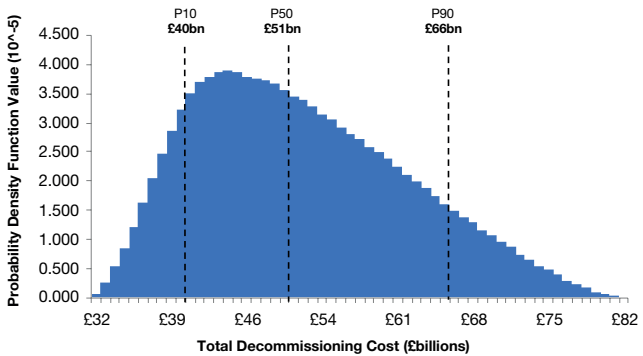
(Like-for-like comparison with 2017 estimate, 2016 prices)



Like-for Like	P_{10}	P_{50}	P_{90}
2020 Estimate[2]	£39bn	£48.2bn	£62bn
2019 Estimate[2]	£39bn	£49.4bn	£64bn
2018 Estimate[2]	£43bn	£55.7bn	£73bn
2017 Estimate[2]	£44bn	£59.7bn	£83bn
Change from 2017 to 2020	-£5bn	-£11.5bn **19%**	-£21bn

Figure 21: Decommissioning cost distribution

(Updated 2020 inventory, 2019 prices)



Full Portfolio	P_{10}	P_{50}	P_{90}
2020 Estimate[1]	£40bn	£51bn	£66bn
2019 Estimate[4]	£40bn	£51bn	£67bn
2018 Estimate[3]	£45bn	£58bn	£77bn
2017 Estimate[2]	£44bn	£59.7bn	£83bn

[1] All costs are in 2019 prices, based on forecast expenditure in 2020 and after, unless otherwise stated
[2] Costs shown in 2016 prices, for expenditure in 2017 and after
[3] Costs shown in 2017 prices, for expenditure in 2018 and after
[4] Costs shown in 2018 prices, for expenditure in 2019 and after

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