Oil & Gas Authority

Unlocking resources through innovation

SPE Topsides 2018

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Head of Technology

May 2018

MER UK opportunity

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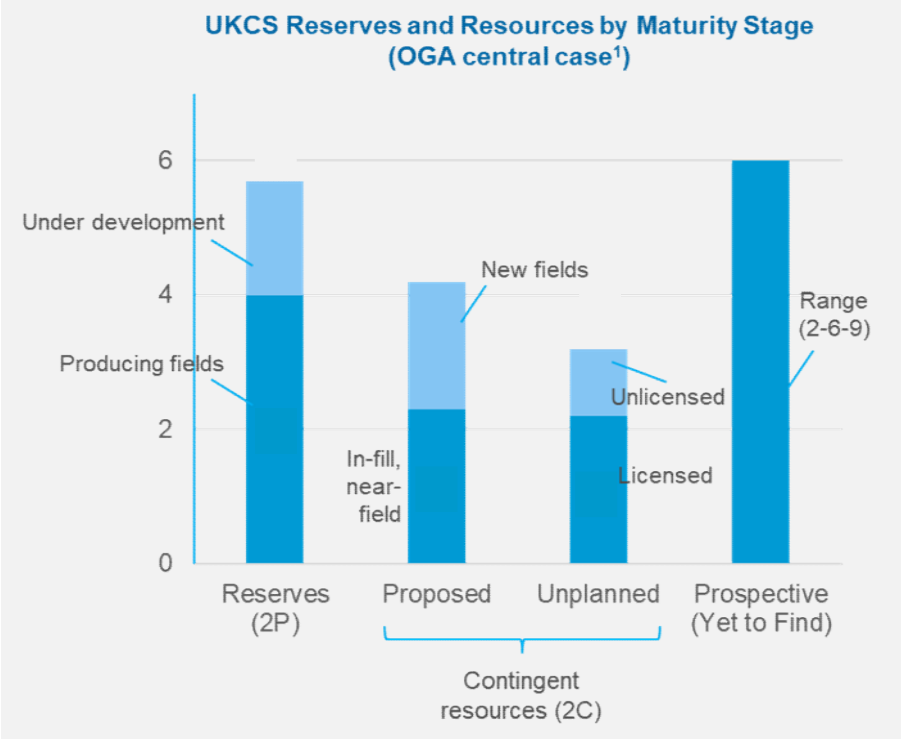

13% reserve replacement in 2016

7.4bn boe contingent resources

- 2.3bn boe within producing fields
- 1.9bn boe in developments under discussion
- 3.2bn boe in marginal fields (small and/or complex)

- New developments will…
  - Protect reserves being produced
  - Stimulate exploration

1) OGA Reserve and Resource report 2016

Need to accelerate resource sanctioning and development

Development activity

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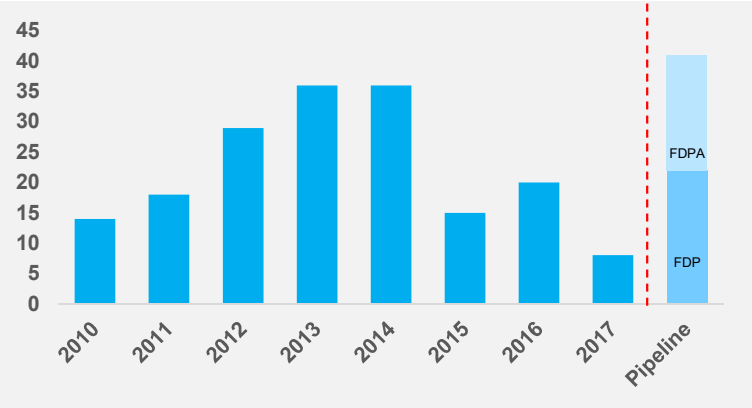
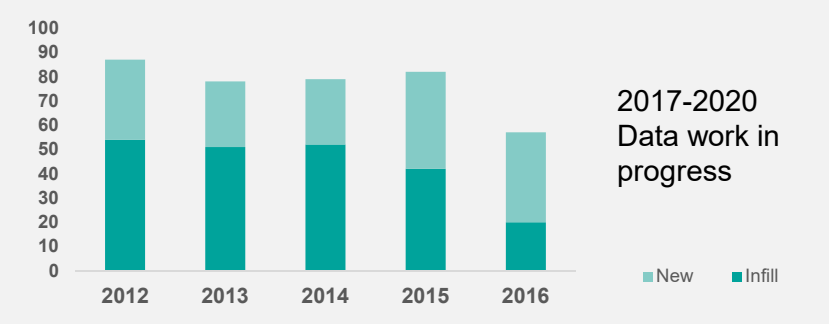
Number of FDP / FDPAs



Development Drilling activity



Source: OGA

- After recent declines, development plans picking up again
- 41 FDP and FDPAs under discussion with the OGA

- Drilling activity dropped to critical levels
- Early indications of potential rebound with new FDP/A approvals and infill programmes

- Strong industry interest in the 30th Licensing Round, including blocks containing undeveloped discoveries

- Supportive fiscal regime

Difficult past years but signs of an upturn

Protecting the base

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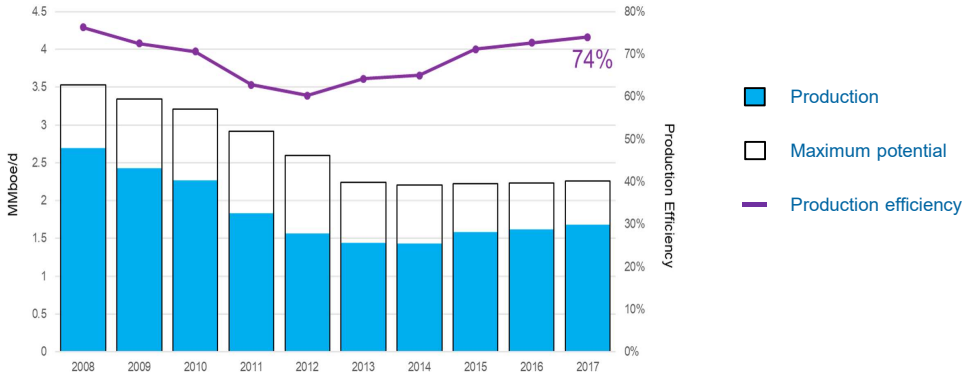
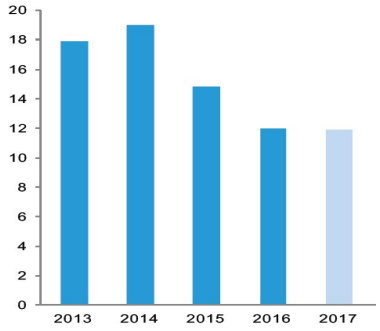
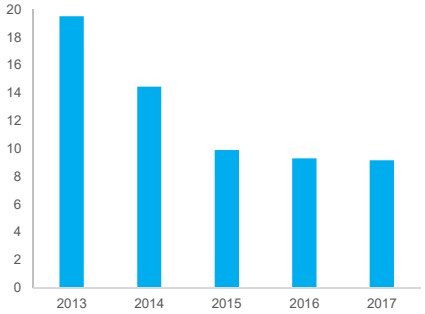
Production efficiency[1]



Unit Operating Cost[2] (£/boe)



Unit Development Cost[3] (£/boe)



5 years of improvement in UKCS
- production volumes (+17%)
- production efficiency (+10 percentage points)

UOC declined 34% versus 2014

2017 UDC 45% lower vs 2013
2018 outlook:
- £12/boe – Average FDPs
- £8/boe – Average FDPAs

Essential to sustain these efficiencies in operations & projects

Sources: 1. OGA (2017) 2. Operating Cost Report (2017) 3.O &G UK Business Outlook 2017 & 2018

Importance of sustaining efficiencies

OGA Stewardship

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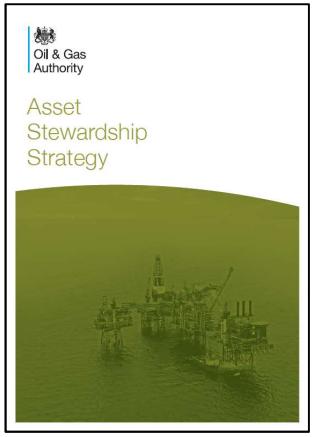
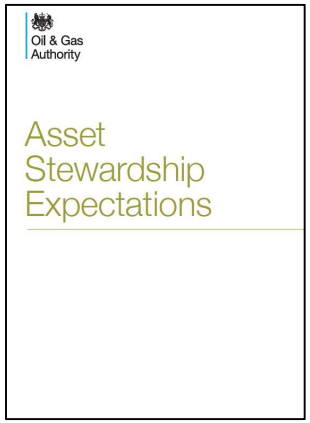
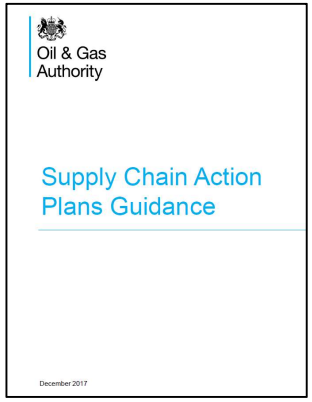
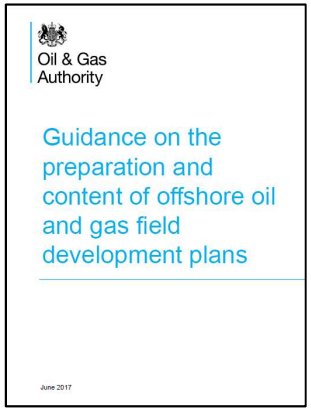




1. Joint Venture Hub Strategy
2. Exploration and Appraisal Subsurface Work Programmes
3. Optimum Use of Subsurface Data
4. License Activities Decision Points and Milestones
5. Robust Project Delivery
6. Production Optimisation
7. Information Management
8. Technology Plans
9. Collaboration
10. Planning for Decommissioning





Technology

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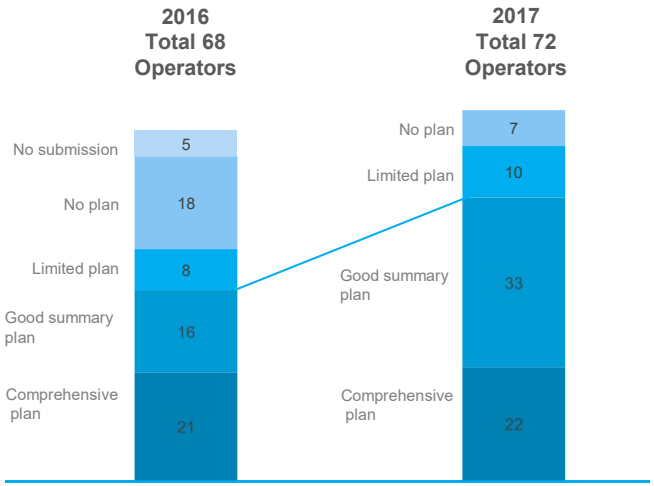
Annual UKCS Survey
Operators' Technology Plans



technology leadership board

The Oil & Gas Technology Centre
Your Innovation Partner

Source: OGA 2016 & 2017 UKCS Stewardship Survey

UKCS Technology Portfolio

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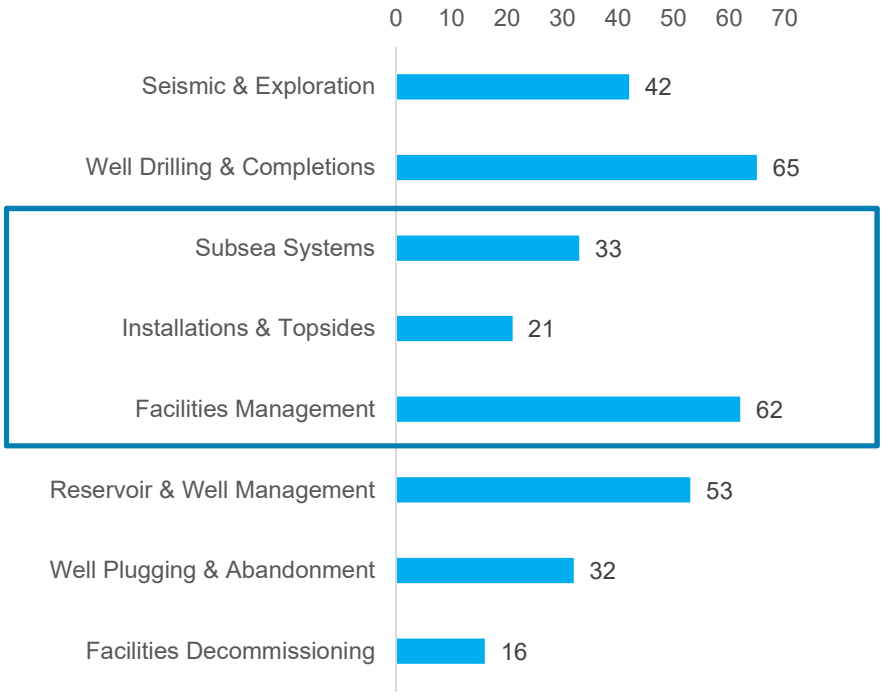
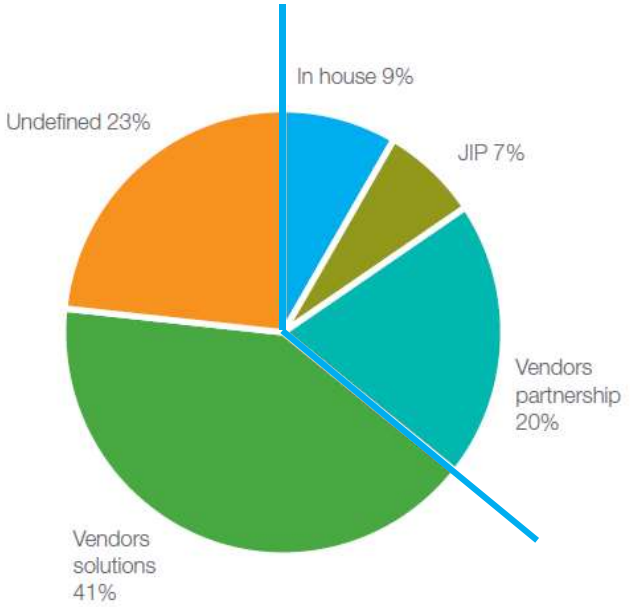
Number of Technologies in Operators' Plans (Total = 324)



Technologies by Source



Source: OGA 2016 UKCS Stewardship Survey, OGA Technology Insights (2018)

Facilities management

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Deploying existing technologies

Operators' focus

- Increase production efficiency
- Reduce OPEX - maintenance and operations
- Improve safety - improved inspections techniques, reduce the need for exposure to hazards

- Inspection of hard to reach areas (Drones, digital surveying)
- Wearable, wireless technologies supporting inspection, planning and maintenance operations
- Digital operations, connecting offshore to shore and automation
- Predictive maintenance systems

Source: Sky-Futures

Source: Repsol Sinopec

Use of Composites structural repair

A structural carbon fibre repair was used on > 80m of beams and tubulars to repair stair tower on Auk platform which had been out of use due to heavy corrosion.

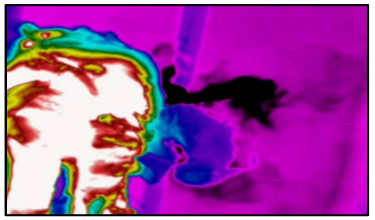
Source: Repsol Sinopec

Benefits: - reinstate structural capacity
- life extension
- cost effective and timely

Forward Looking Infra-red (FLIR)

As part of Claymore platform return to service FLIR was used to identify and manage 19 fugitive releases.

Benefits: - cost effectiveness
- safety
- timely response



Source: Repsol Sinopec

Facilities management

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Piloting new technologies

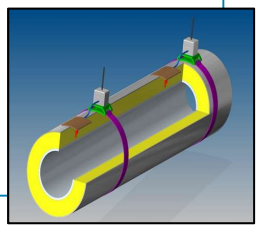
Operators' focus

- Radically change approach to integrity management
- Efficient and accurate inspections techniques
- Avoid vessel entries, removal of insulation, plant outages
- Leverage technologies from other industries

- NDT and NII advanced inspection technologies
- Corrosion under insulation (CUI) – advanced technologies for, prevention, detection and monitoring
- Advanced robotic and autonomous inspections
  - modular systems
  - robotic arms
  - beyond visual range drones and live streaming
- Cleaning and preparation techniques
- Protective coatings

Source: Repsol Sinopec

Source: OGTC



Source: 3-Sci

Non-intrusive inspection technology trials (Total & OGTC)

Asset experience: Two online process pressure vessels on the Elgin Franklin platform were inspected using NII technologies (ultrasonic and time of flight). Results correlated with traditional intrusive inspection process.

Benefits: - large potential savings
- no costly shutdown required
- improved safety

Source: OGTC

Protective coating (Total & other operators)

Asset experience: Trials on offshore platform with a chemically bonded protective coating that 'eats' rust on surfaces, self-healing when damaged.

Benefits: - asset life extension
- cost and time savings
- safe, non-hazardous

Source: OGTC

Installations and topsides

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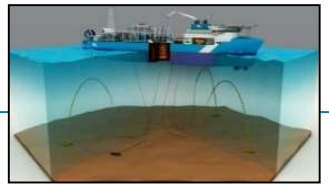
Operators' focus

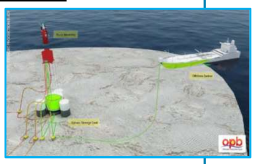
- Use of unmanned facilities
- Use of innovative platforms and floating facilities
- Remote facilities monitoring and greater use of automation
- Multiphase metering systems with improved accuracy
- Metering systems for heavy oil systems
- Interest in emerging technologies to improve development economics

Solutions



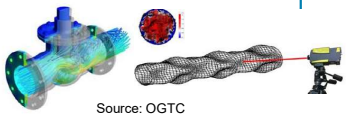
Source: Amplus

- Efficient unmanned platforms
- Versatile production units



Source: OPB

- Unmanned production buoys
- Non intrusive subsea flowmeters
- MP 3 in 1 heavy oil flowmeter
- Dashboard limpet flowmeter



Source: OGTC

ORANJE-NASSAU – EFFICIENT NUI

Efficient NUI concept in action that could help reduce cost of UKCS shallow water oil and gas fields.

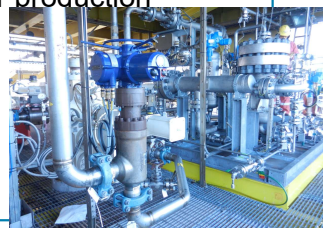
- Standardised design (modular jacket)
- 3 well slots, tie in for subsea well and 2nd NUI
- Helideck and 5t crane
- Emergency shelter for 8 persons
- Local power supply (solar and wind turbines)

Source: Oranje-Nassau BV

ALPHA PETROLEUM – WATER TREATMENT

Small scale produced water treatment package retrofitted onto the Kilmar unmanned platform following higher than expected water production

- Low cost modular configuration
- Light weight and small footprint
- In line system components
- Assembled on platform



Source: Alpha Petroleum

Contingent resources – Unplanned

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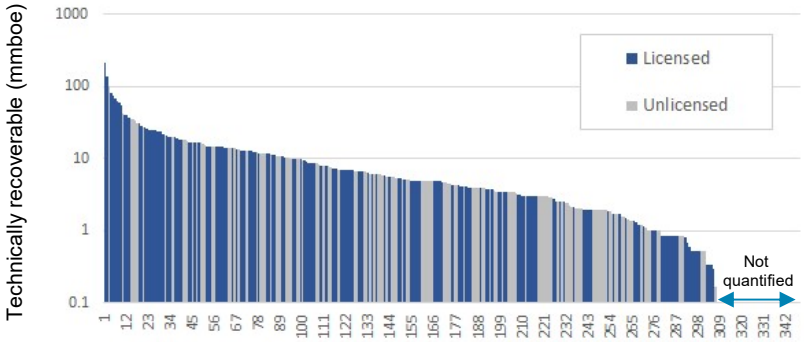
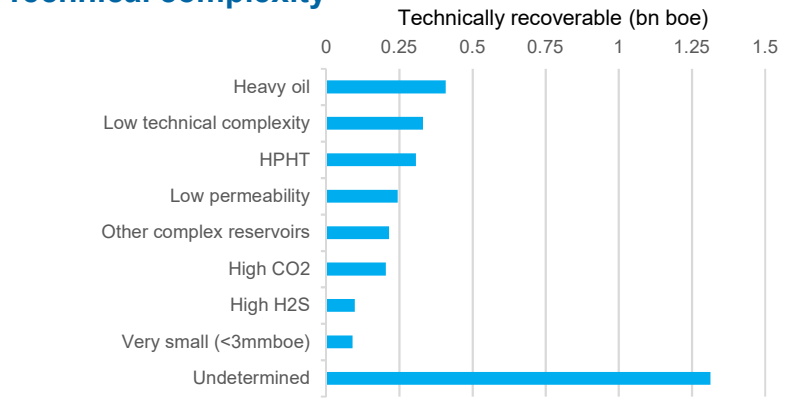
Undeveloped discoveries



Technical complexity



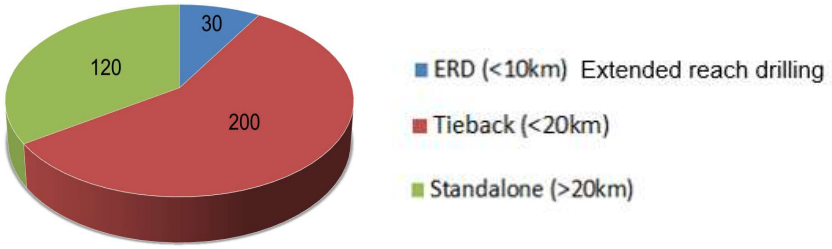
Source: OGA PARS 2016, OGA Technology Insights 2018

- 350 discoveries – currently no plan
- 3.2 bnboe technically recoverable

- Fragmented ownership, >40% unlicensed
- Successful 30th Round, to be announced

- Marginal fields, complex and/or small (72% of discoveries less than 10mmboe)
- Tie-backs vs standalone developments

Development concept (distance)



350 discoveries – 3.2 bnboe opportunity

Development attractiveness

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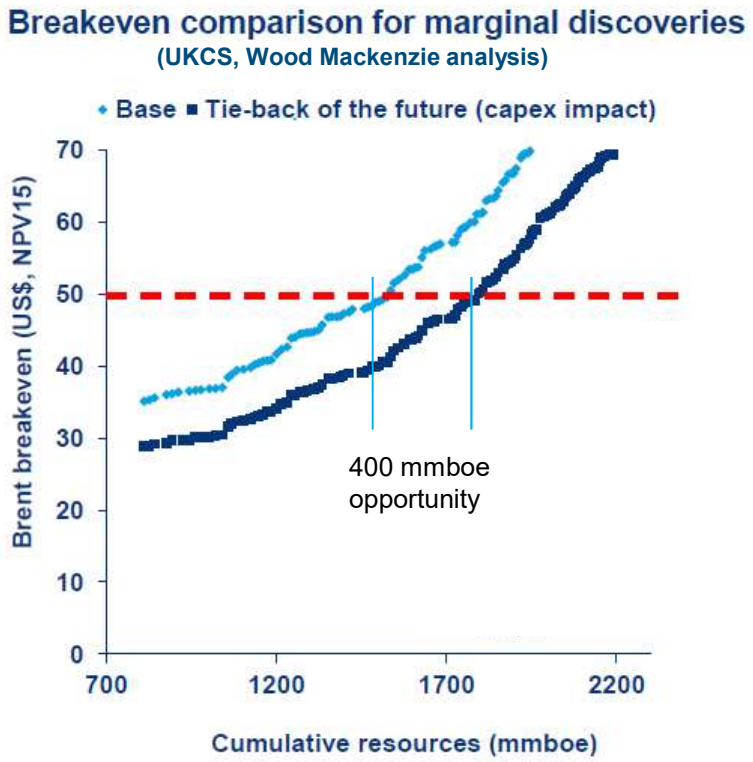


- Woodmac analysis, 223 fields within tie-back distance, 2.2bnboe

Capex efficiencies - Technology:

- 50% subsea Capex and Abex reduction would unlock 400mmboe

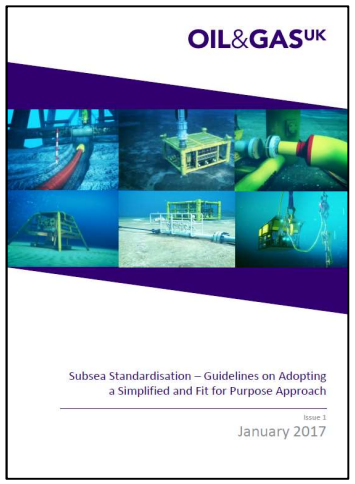
Other levers:

- Development clusters
- Licensing alignment
- Commercial access
- Vendors engagement

Marginal economics – importance of reducing costs

Efficient concepts

O&G UK and Efficiency Task Force – Subsea Standardisation Initiative



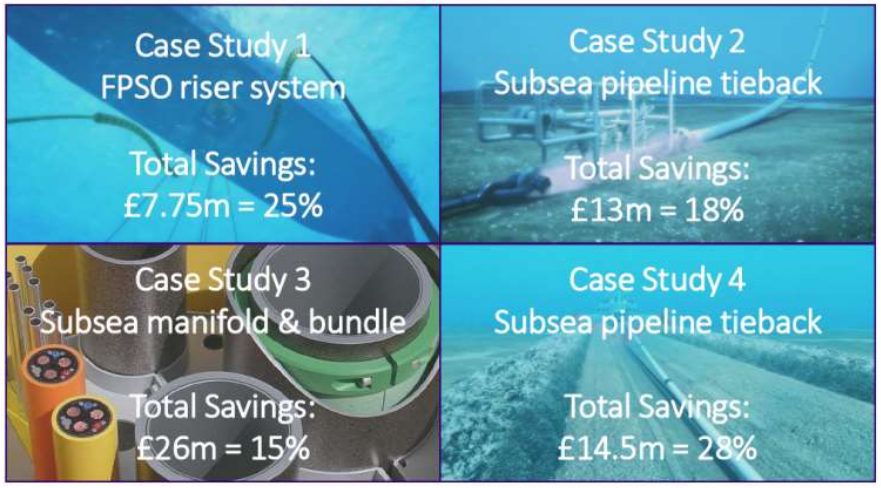


Image Courtesy of Oil & Gas UK

Recent and ongoing field applications

- Apache / Subsea 7 – Callater
- Nexen – Golden Eagle SP2
- Nexen – 2x concept studies
- Shell – 3x projects under evaluation
- Spirit Energy – 1 project under evaluation
- Chevron – 1 project under evaluation

Lean design, industry standards, vendors' engagement

Technology-driven efficiencies

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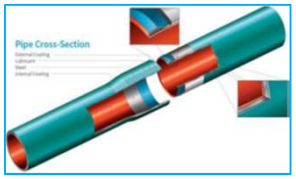
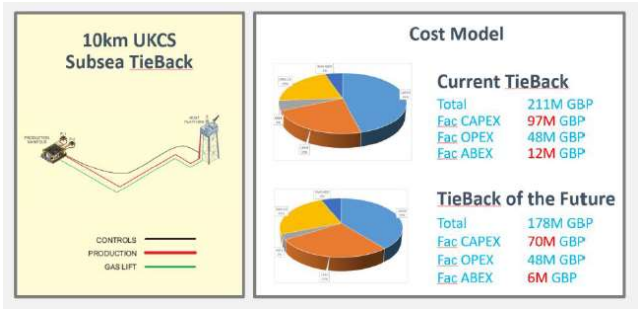
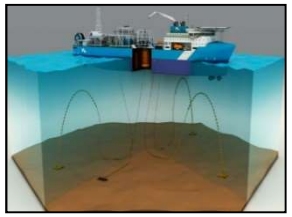
Tie-back of the Future

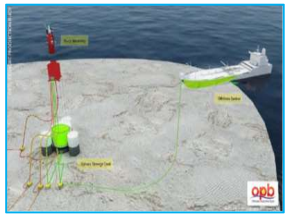




GOAL IS HALF OF THE COST IN HALF OF THE TIME

Standalone Facilities





Small-scale floating solutions and unmanned production buoys as alternative concepts to traditional FPSOs:

- Reduce economic field, through reduced Capex
- Reduce Opex through reducing offshore manning
- Re-use equipment on later projects

These technologies may support:

- Sequential development of many small discoveries
- Cluster/aggregated volume opportunities
- Alternative brownfield redevelopment
- Novel commercial models: joint developments, operator/vendor collaborations, leasing, financing

Novel concepts and technologies to unlock more difficult resources

Key messages

Oil & Gas Authority

1. Urgency – replace reserves to sustain UKCS production avoiding risk of stranded resources

2. Positive trends – activity and costs, supportive fiscal regime

3. Must sustain efficiencies – through applying best practices, new technologies, vendors engagement

4. OGA Stewardship: focus on asset management, new projects, and technology and innovation

Oil & Gas
Authority

Thank you