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Authority

# Technology Insights 2020

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## Summary

*Technology Managers Network presentation*

2<sup>nd</sup> March 2021

# Today's presentation



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- Industry feedback – Operators' Technology Plans 2020
- Technology focus vs asset lifecycle
- Technology development vs deployment spend
- Examples: Exploration, Asset management, Well P&A
- Emerging areas: *Digital* and *Net zero*
- Next steps: OGA's *Technology Insights* released on-line
- Next steps: *Six technology priorities* for the OGA Stewardship

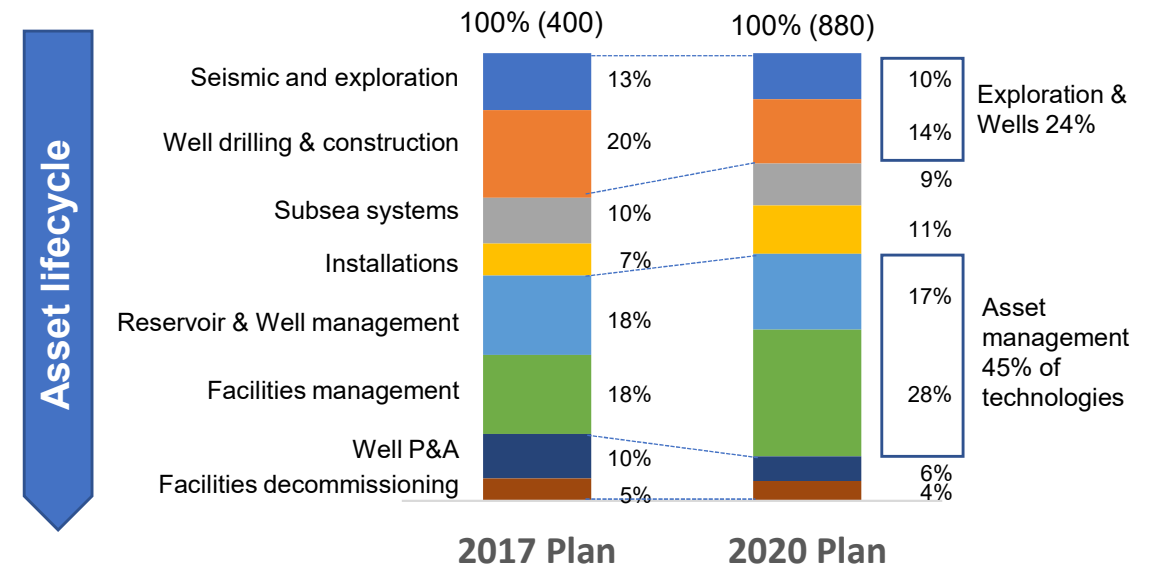
# Technology focus by domain

- Information on 880 individual technologies submitted through the plans of 70 operators in 2020
- Asset management accounted for the largest interest (45%)
  - Technologies for facilities management doubled since 2017
- Exploration and Wells delivery are also areas of strong operator focus (24% of total)
  - Despite 30% decrease in technology associated with well drilling and construction
- Judging by direct Operators' spend on technology Exploration & Wells activity take the lead (33%) with asset management second (30%)
- Decommissioning (both 'wells' and 'facilities') show a muted technology interest and low direct spend (circa 10% of totals)
  - Despite the large decommissioning scope coming later in the 2020's and in the 2030's
  - How will target decom cost savings be delivered without investment in maturing enabling technology?

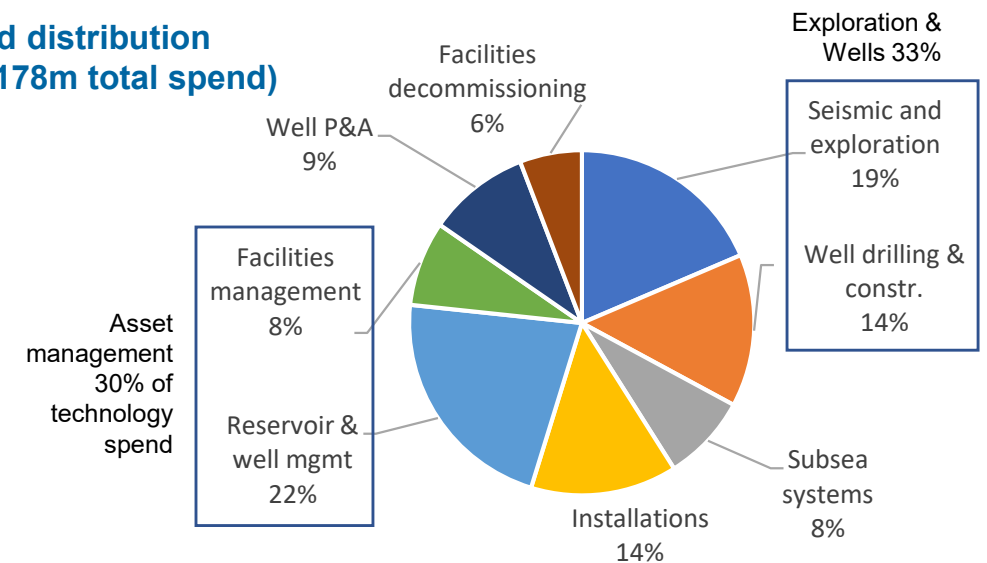


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## N. of technologies in Operators Plans by technical domain



## Technology spend distribution (2019 act., % of £178m total spend)

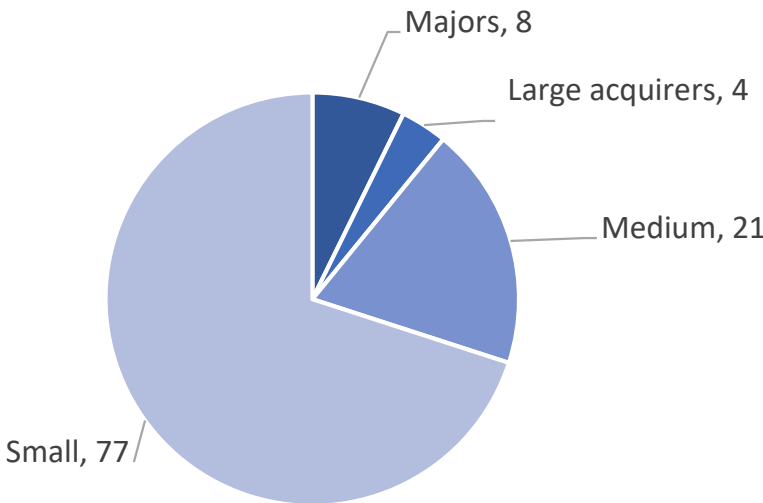


# UKCS survey of Technology Plans



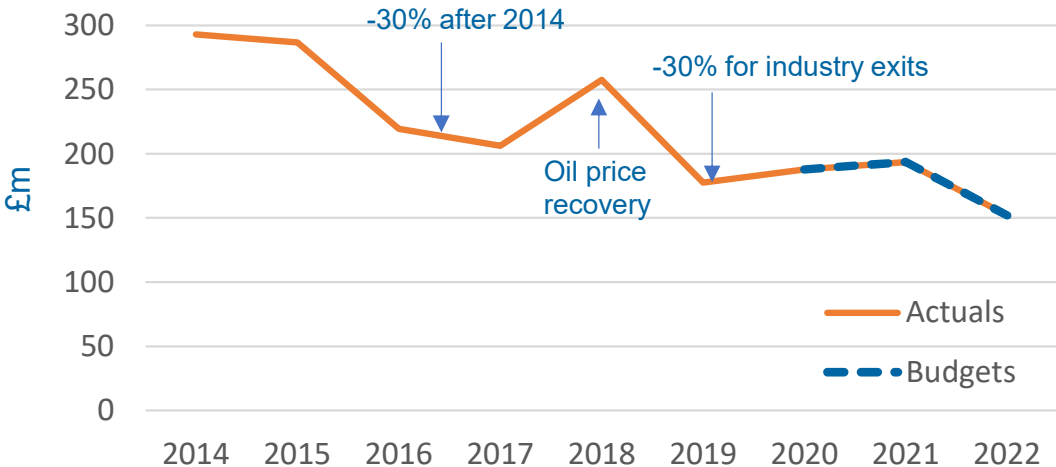
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## Survey of UKCS licence operators

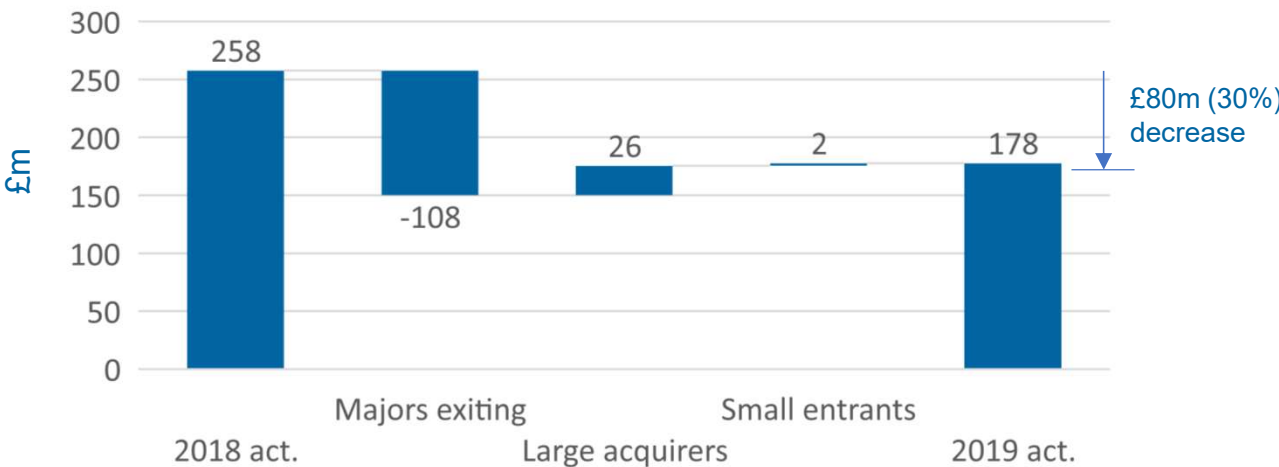


- Technology spend has declined steadily in the past 6 years
- Nearly 30% drop after the 2014 oil price crisis
- Exit of major operators in 2018/19 – spend decrease not completely offset by other companies
- Going forward, spend outlook is flat at 2019 levels
- Surveyed 112 UKCS operators, 5 years (2017-2020)

## Reported technology spend (Total = R&D + field transfer)

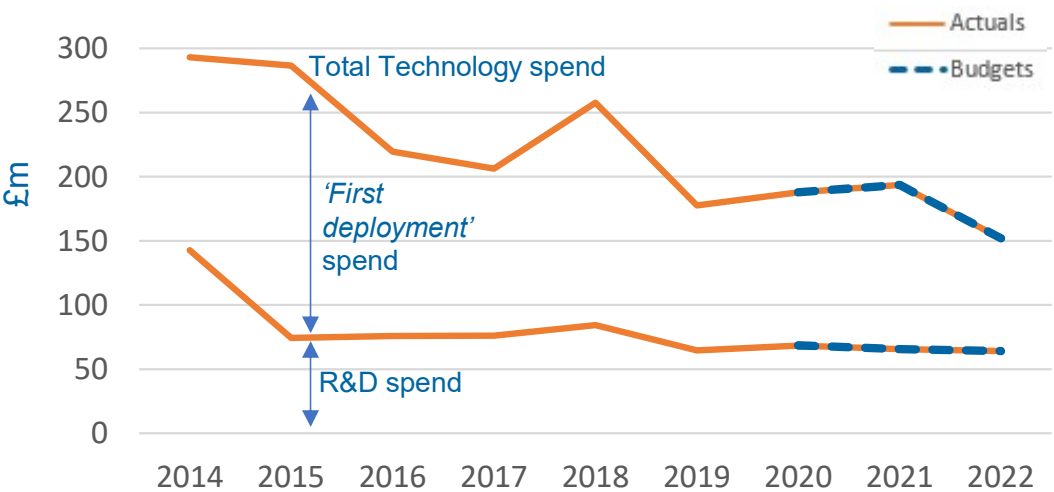


## 2018-2019 impact of industry turnover on Total technology spend



# Operators' technology spend

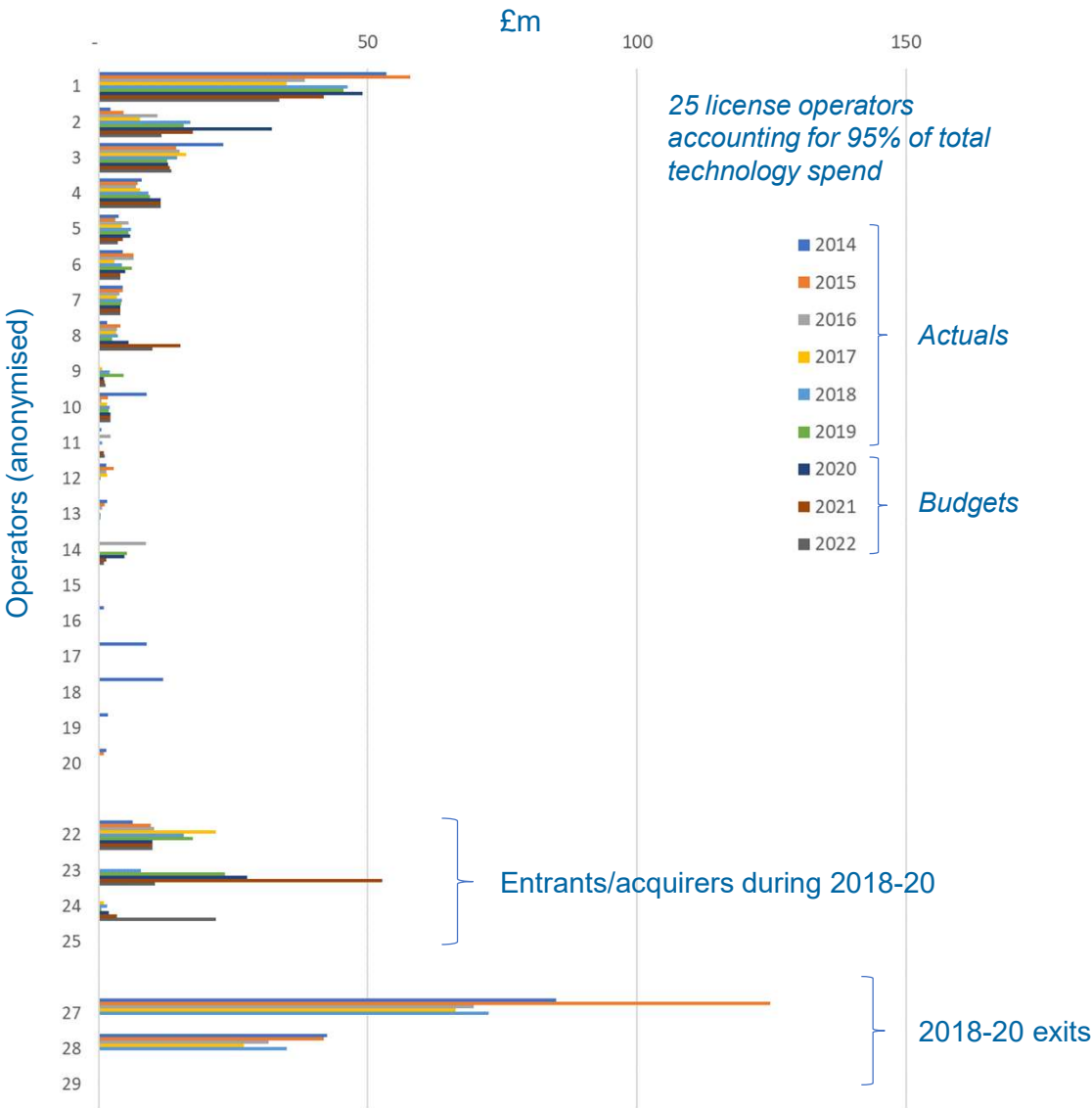
Reported technology spend



Total Technology spend = R&D spend + Field transfer

- About one third of the overall spend is for new technology development (R&D)
- The remainder is allocated to 'field transfer'
- Spend is concentrated with few operators (10 operators account for 90% of total technology spend)
- The negative impact on the spend of majors exiting the basin is significant

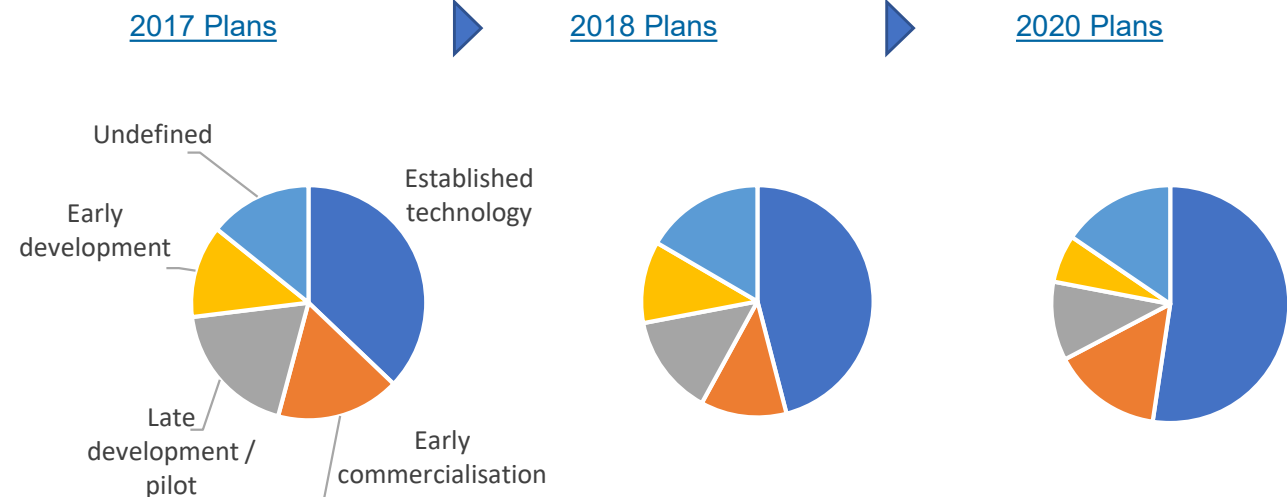
Total annual technology spend by operator (2014-2022)



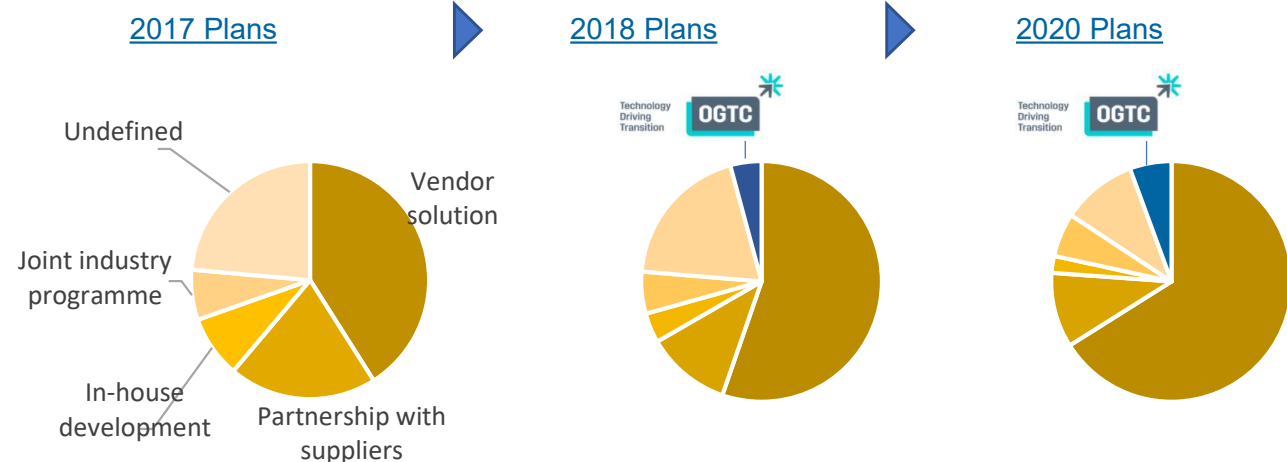
# Technology selection and provision

- As direct spend on technology development has declined...
- ...increasing reliance on ready-to-use existing technology
  - trend mirrored within all individual technology categories
  - Exploration and Well Drilling rely on existing technology for 60 – 65% of operator needs
  - Subsea Systems and Well P&A are the only categories where <50% of solutions are existing technology
- ... in parallel, growing reliance on Vendors solutions
  - Vendor investment in technology is not directly reflected in the spend profile
- Growing number of OGTC programmes is evident
- Significant collaboration through participation in JIPs and partnership with suppliers
- However, seldom reference to technology sharing from other industries
  - Could be useful in *asset integrity* and *digital*

## Maturity of technologies reported the Operators Plans



## Technology delivery plans

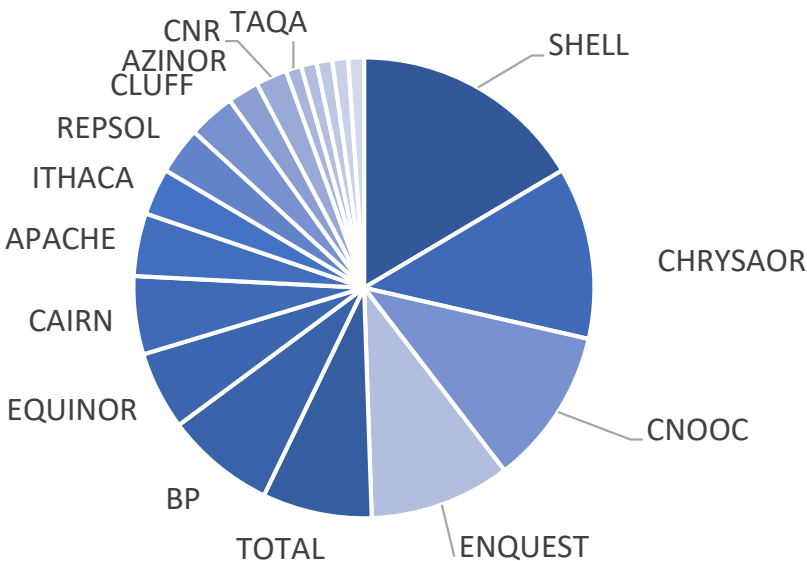


# Exploration & subsurface

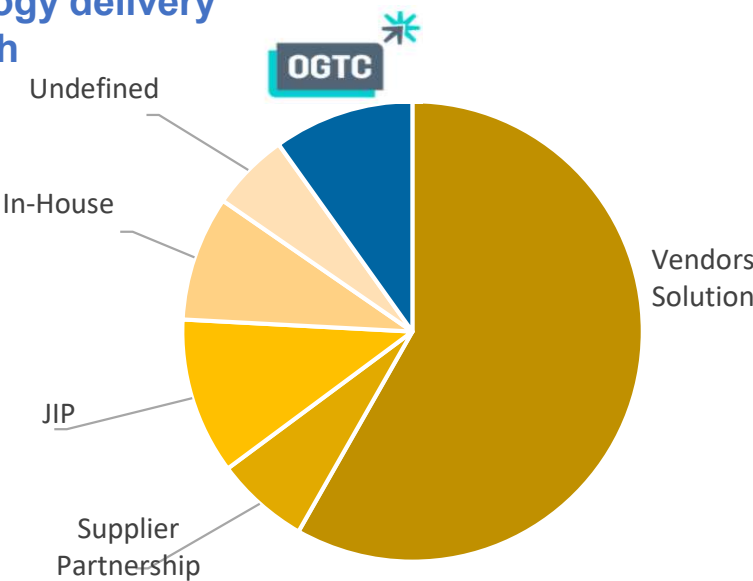


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## Number of technologies in the plans




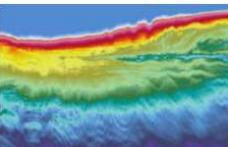
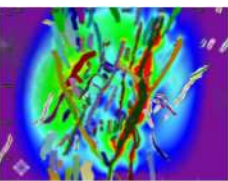
## Technology delivery approach



## Key insights

- Broad cross-industry interest in exploration and subsurface technologies – seen as strategic across the asset lifecycle
- Many technologies provided by Suppliers, but still significant Operators R&D participation through OGTC and Academia
- Three main priorities
  - *Acquisition* – improving quality to illuminate difficult targets
  - *Processing* – extract full value from the data
  - *Subsurface modelling* – enabling decisions & cycle time efficiency

## Key technologies

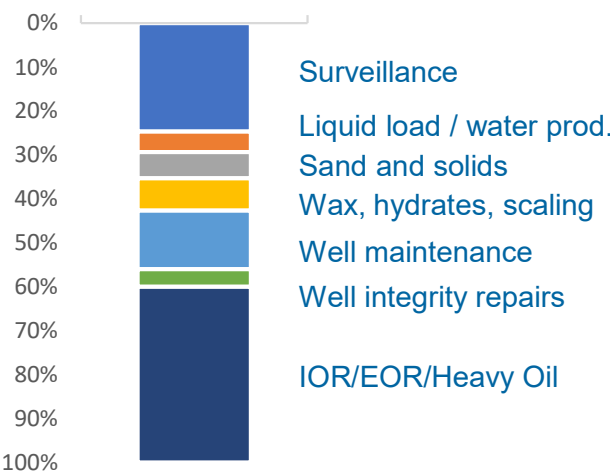
<b>Acquisition</b>	<ul style="list-style-type: none"> <li>• Steerable streamers</li> <li>• Multi-source and multi-azimuth surveys</li> <li>• Use of OBNs on difficult targets and for 4D repeatability</li> <li>• VSP and 4D seismic acquisition using DAS</li> <li>• Forward-looking acoustic and deep-resistivity surveys</li> </ul>	
<b>Processing</b>	<ul style="list-style-type: none"> <li>• Broadband seismic processing</li> <li>• Reprocessing of 3D seismic</li> <li>• Advanced processing techniques e.g. FWI, AVO</li> <li>• 4D seismic processing</li> <li>• Digital solutions for workflow efficiency (inc <i>cloud</i>)</li> </ul>	
<b>Modelling</b>	<ul style="list-style-type: none"> <li>• Integrated inversion/subsurface modelling</li> <li>• Applications or AI / Machine learning, inc to:                             <ul style="list-style-type: none"> <li>• Fault mapping</li> <li>• Missed-pay identification</li> <li>• 4D seismic to locate remaining oil</li> </ul> </li> </ul>	

# Reservoir & well management

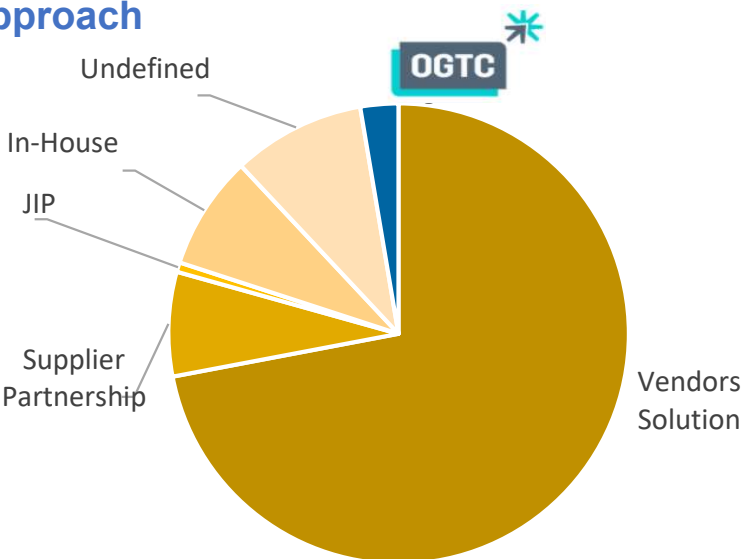


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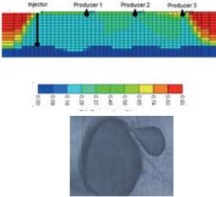

## Technology sub-domains (technology count)



## Technology delivery approach



## Key technologies

<b>Well Surveillance</b>	<ul style="list-style-type: none"> <li>Single use fibre optic</li> <li>Fibre DAS for VSP and 4D</li> <li>Permanent monitoring</li> <li>Laser interferometry non-intrusive flow measurement</li> <li>Expansion of chemical tracer applications</li> <li>Digital wells and dashboards for well monitoring</li> </ul> 
<b>Production Optiisation</b>	<ul style="list-style-type: none"> <li>Produced gas reinjection huff n' puff</li> <li>Low pressure water injection/dump flood</li> <li>Artificial lift                             <ul style="list-style-type: none"> <li>Liquid assisted gas lift to deepen operating point</li> <li>ESP reliability, control and monitoring software</li> <li>Retrofit gas lift</li> </ul> </li> <li>Liquid loading                             <ul style="list-style-type: none"> <li>Velocity strings</li> <li>Nanoparticle stabilisation of surfactants</li> </ul> </li> </ul> 
<b>Intervention</b>	<ul style="list-style-type: none"> <li>Conductive slickline</li> <li>Subsea well SISQ (diverless hydraulic interfaces)</li> <li>Retrofit wireless DHSV</li> <li>Wireline stimulation tools</li> </ul> 
<b>EOR</b>	<ul style="list-style-type: none"> <li>Polymer EOR evolution                             <ul style="list-style-type: none"> <li>Polymer formulation improvement</li> <li>ESP performance on polymer breakthrough</li> <li>process performance issues on flowback</li> </ul> </li> <li>Microbial / Enzyme EOR</li> </ul> 
<b>Heavy Oil</b>	<ul style="list-style-type: none"> <li>Downhole diluent completion</li> <li>Artificial lift solutions</li> <li>EOR Polymer formulation</li> <li>Crude blend management</li> </ul> 

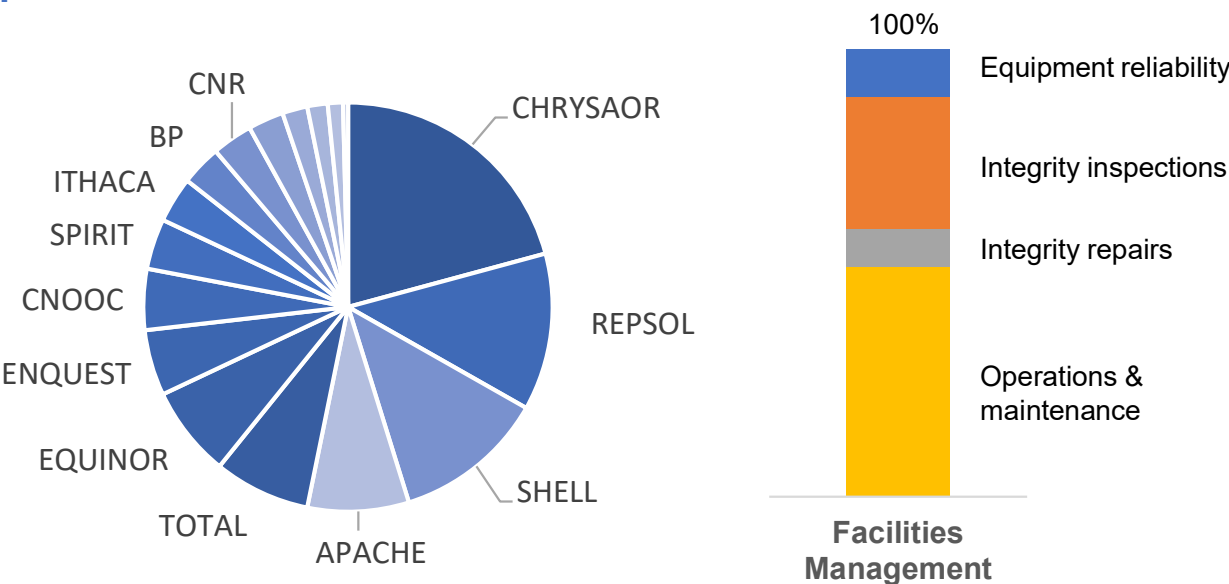


# Facilities management



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## Number of technologies in the plans



- Largest theme by number of technologies in operators plans
- Widespread interest (over 20 operators) with activity proportional to asset portfolio sizes
- Focus areas with significant *digital* components:
  - *Asset integrity* – non-intrusive inspections, integrity repairs methods
  - *Operations & maintenance* – growing roll out of digital technologies and remote vehicles across surface operations
  - Equipment reliability -

NII of Current Blind Spots

Lead sponsors

Technology Driving Transition

Working group

- Utilise CATS Terminal as a trial site to build confidence in existing techniques
- Trialling of a number of new NII technologies – initial focus on corrosion under insulation
- Potential for trials both in 2021 and 2022 with verification opportunities
- Communicating and sharing learnings

**OISL / Speir Hunter –**  
Stress Concentration Tomography

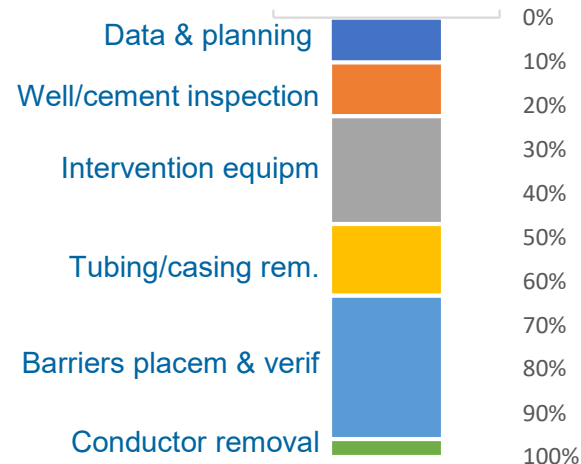
Speir Hunter Limited

**D&D Isoltechnics –**  
Monitoring Fluids & Corrosion Under Insulation

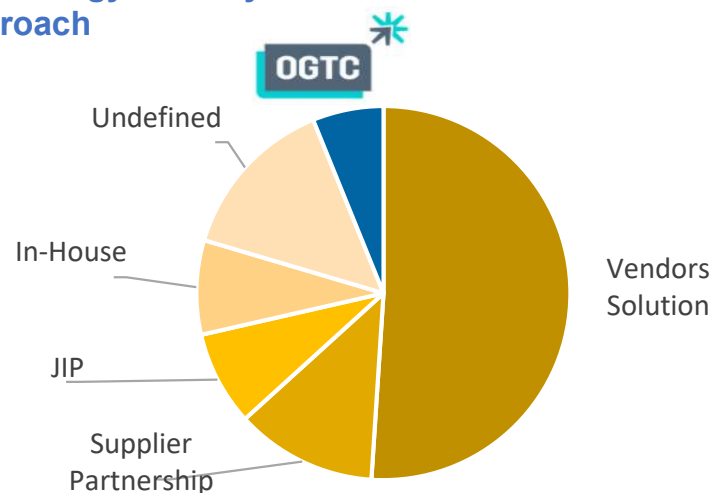
**ESR / HOIS –**  
Evaluation of CUI Inspection Technologies

# Well Plug & Abandonment

## Technology sub-domains (technology count)



## Technology delivery approach



- Focus predominantly on Barriers and intervention equipment
- High proportion of technology in development through collaboration and in-house indicative of low level of technology maturity
- Operator spend has declined and ranks among the lowest focus areas in terms of spend and number of technologies



**Alternative Plug & Abandonment Barriers**  
Working collaboratively to drive cost reduction & efficiency.

### Lead sponsors




Technology Driving Transition

### Steering group




### Scope and objectives

- 'Alternative barriers' can contribute to significant cost reductions in P&A
- Industry needs to understand the complete technology portfolio to benefit from the potential
- New technologies need testing and qualification to be available for coming growth in activity
- A collaborative approach will accelerate development of these technologies and establish consistent methodologies for evaluation

OGA targeting 35% decommissioning cost reduction

Technology Development

Barrier Verification

Material & Barrier Qualification

OGUK focus on novel barrier material qualification in Barrier Qualification Guidelines

Industry needs to establish verification method for alternate barriers to satisfy regulations



### Status

- Start of testing of first technology in onshore well in Canada due end Q1
  - Interwell Thermite
  - Builds on previous JIP run in Alberta (Spirit, BP, Equinor, NRC)
- Selection ongoing for next technology
- Side-scope on specific guidelines for material qualification
- Address funding gap to sustain the programme

### Next step

- Select further technologies (initial plan to test 6 technologies)
- Maintain phased schedule of testing
- Secure funding from operators to continue the programme of testing
- OGA communication with operator MD's to raise awareness and support

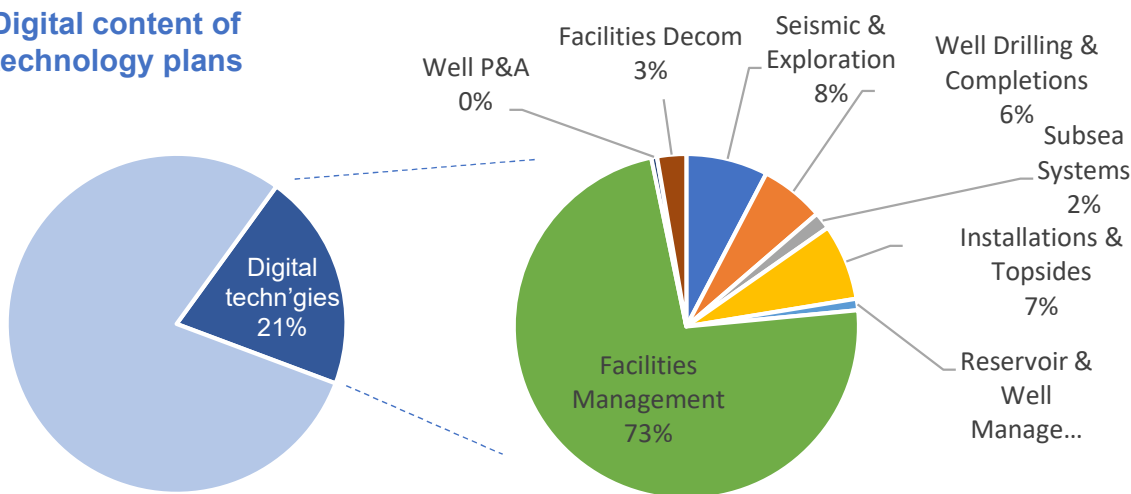
# Emerging: Digital and 'Net zero'



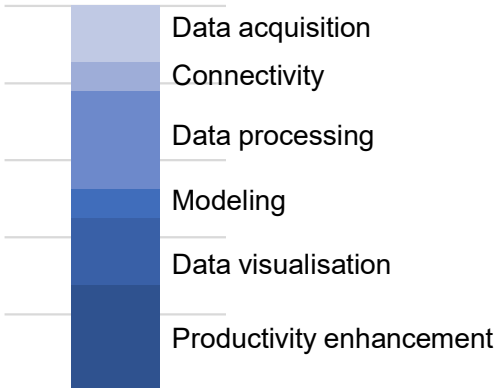
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## Digital technologies

### Digital content of technology plans



### Applications type

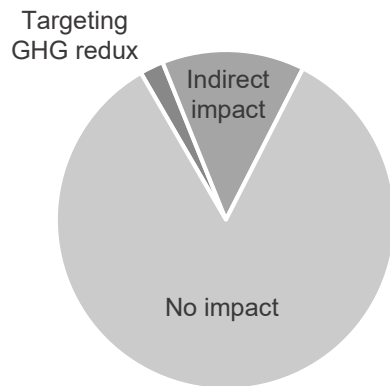


### Digital trends

- Growth of digital applications reported in plans (from ~5% in 2016 to 21% of technologies in 2019)
- Focus on improving Asset management, followed by Seismic, Wells and Installations
- Data processing and visualisation with productivity enhancement tools are the most common applications

## Technologies for 'net zero'

### Reported technologies w/ 'net zero' impact



Growing attention on 'net zero' themes in the 2020 technology plans, with efforts driven directly by Operators, with the support of the OGTC, and in partnership with Suppliers.

Reported technologies included:

#### Operational emission abatement

- Power efficiency (ring mains, umbilicals, avoiding spinning reserve, compressor retooling, NOX/SOX abatement)
- Local renewable power (subsea and NUIs)
- Flaring abatement (stand-by compressors, flare recover systems)

#### 'Scope 3' emission reduction

- CO<sub>2</sub> capture (also offshore) and reinjection
- Hydrogen offshore generation
- Hydrogen uses (turbines and cells)

### Case study: OPT's PB3 Powerbuoy



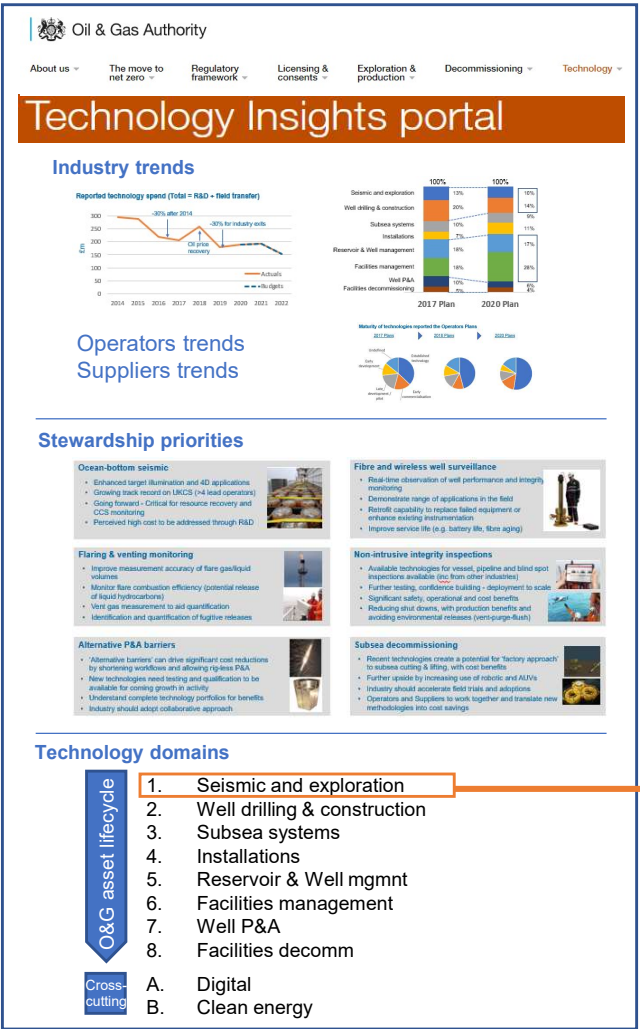
- Uninterruptable Power Supply (UPS) which constantly recharges itself from waves
- Tested at Premier's Huntington in 2019, further pilots at ENI in the Adriatic Sea, interest by other operators inc Total – Over 2.7 MWh generated
- To power surface and subsea payloads, can be integrated with solar power and storage

# Next steps: OGA Technology Insights on-line

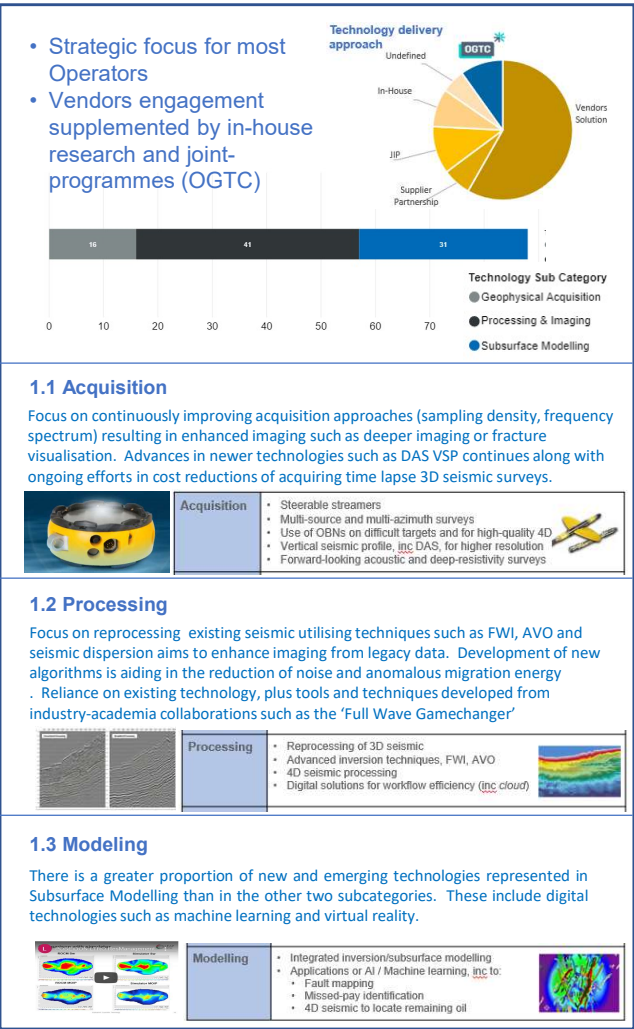


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## Technology Insights – Entry portal



## Example: Technical domain – 1. Exploration



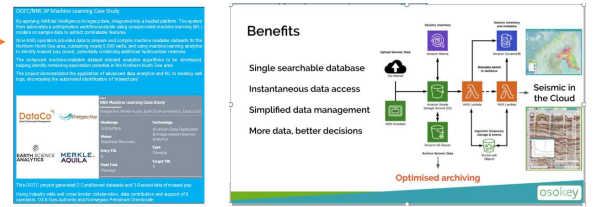
## Technology tables: links to contacts and information

- Pointers to key technologies from the Plans
- By sub-domain, and by maturity (TRL)
- Links to Operators and Suppliers

Sub domain	Maturity	Technologies	Operators	Suppliers
Geophysical Acquisition	Existing (TRL 8-9)	<ul style="list-style-type: none"><li>4D high density source-receiver array for fracture identification (BP, VeS)</li><li>Steerable streamers &amp; repeatability criteria for high-quality 4D (Apache)</li><li>Ocean bottom nodes (Total, Equinor, Chrysaor)</li><li>Multi-source and Multi Azimuth surveys (Chrysaor)</li><li>4D Seismic Acquisition (Total, Bp, BP)</li><li>Gravity &amp; Magnetic Acquisition (Shell)</li><li>Vertical Seismic Profile - Use of VSP equipment to allow higher resolution seismic data gathering - Halliburton FibreVSP (Total)</li></ul>	Shell, Total, Equinor, Apache, BP, Chrysaor	OGTC, Aberdeen Uni
Emerging (TRL 5-7)		<ul style="list-style-type: none"><li>Distributed Acoustic Sensing (DAS) VSP (BP, VeS, TRL 6-7)</li><li>Micro Seismic - real time monitoring of micro seismic events during hydraulic fracturing using downhole sensors (Schlumberger)</li></ul>	Shell, CNOOC, Chrysaor	OGTC, Aberdeen Uni
Processing and imaging	Existing (TRL 8-9)	<ul style="list-style-type: none"><li>3D Seismic Reprocessing (Alpha, Apache, Chrysaor, Cairn, Aztec, KNOG, Shell, Repsol, Geopac)</li><li>4D Seismic processing (BP, Chrysaor, Apache, CNOOC, Heriot-Watt University, Total)</li><li>CRMA Seismic Inversion (Equinor)</li><li>Pre-stack inversion (Equinor)</li><li>Coastal ODS workflow - Invert OGS TerraCube PSTM (Bp) CNS</li><li>Full Waveform Inversion (FWI) (Total, Apache, Cuff Natural Resources)</li><li>Amplitude Variation with Offset (AVO) Seismic Inversion (Equinor, Cairn, Bp, Repsol)</li><li>LWD High Resolution Acoustic Imaging (Chrysaor) CNS</li><li>LWD deep directional resistivity - Baker Hughes (Chrysaor) CNS</li><li>CSEM Controlled source Electromagnetic Magnetotelluric (Chrysaor) CNS</li></ul>	Shell, CNOOC, Chrysaor	OGTC, Aberdeen Uni
Emerging (TRL 5-7)		<ul style="list-style-type: none"><li>Fault Mapping using Artificial Intelligence (Bp, Cuff Natural Resources) CNS TRL 5-7</li><li>Innovative Full Waveform Inversion Processing Techniques (CNOOC/Imperial College London &amp; OGTC/Sapien/Equinor) TRL 4-6</li><li>Advanced Migration Algorithms - reduce noise &amp; anomalous migration energy (Shell) TRL 6-7</li></ul>	Shell, CNOOC, Chrysaor	OGTC, Aberdeen Uni

## Case studies: lessons learned, development & deployment

- Notable experience on key technologies
- Covering both the Development and Deployment phases
- Links to Operators as well as Suppliers teams



- Based on operators technology plans, and supply chain information gathered by the OGA
- To communicate industry technology priorities and progress, supporting resource maturation and net zero
- To provide useful info and contacts for companies to deploy technologies
- To connect more companies into joint OGTC and other technology developments



# Next steps: OGA Stewardship *top-6 technologies*



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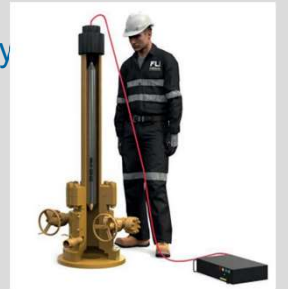
## Ocean-bottom seismic

- Enhanced target illumination and 4D applications
- Growing track record on UKCS (>4 lead operators)
- Going forward - Critical for resource recovery and CCS monitoring
- Perceived high cost to be addressed through R&D



## Fibre and wireless well surveillance

- Real-time observation of well performance and integrity monitoring
- Demonstrate range of applications in the field
- Retrofit capability to replace failed equipment or enhance existing instrumentation
- Improve service life (e.g. battery life, fibre aging)



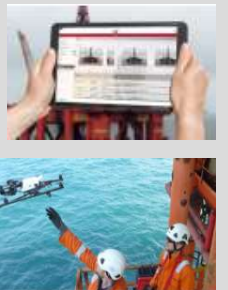
## Flaring & venting monitoring

- Improve measurement accuracy of flare gas/liquid volumes
- Monitor flare combustion efficiency (potential release of liquid hydrocarbons)
- Vent gas measurement to aid quantification
- Identification and quantification of fugitive releases



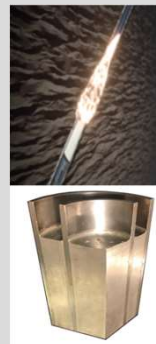
## Non-intrusive integrity inspections

- Available technologies for vessel, pipeline and blind spot inspections available (inc from other industries)
- Further testing, confidence building - deployment to scale
- Significant safety, operational and cost benefits
- Reducing shut downs, with production benefits and avoiding environmental releases (vent-purge-flush)



## Alternative P&A barriers

- 'Alternative barriers' can drive significant cost reductions by shortening workflows and allowing rig-less P&A
- New technologies need testing and qualification to be available for coming growth in activity
- Understand complete technology portfolios for benefits
- Industry should adopt collaborative approach



## Subsea decommissioning

- Recent technologies create a potential for 'factory approach' to subsea cutting & lifting, with cost benefits
- Further upside by increasing use of robotic and AUVs
- Industry should accelerate field trials and adoptions
- Operators and Suppliers to work together and translate new methodologies into cost savings

