Future Offshore Technology & Innovation Strategy in the North Sea
In context

1999 Peak Production
5 mmboe/day

2016 Production:
1.65 mmboe/day

44bn barrels since 1970
£330 billion in corporation tax

10-20 billion barrels potential remaining

300,000 jobs in UK from oil & gas
(~ population of 4th, 5th & 6th Scottish cities combined)

Every 1bn barrels produced generates £50bn of value for the economy
Enabling MER UK

Fix today
- Drones
- Thermit plug
- Virtual reality
- Additive manufacturing
- Subsea snake
- Advanced Inspection

Maximise recovery
- Small pools
- Remote operations
- Big data
- Artificial intelligence
- Robotic systems
- Composites

- Asset Integrity
  Eliminating the impact of asset integrity on uptime
- Well Construction
  Reducing drilling costs by 50%
- Small Pools
  Developing up to 3.4 billion barrels of oil and gas discoveries
- Decommissioning
  Driving down the cost of decommissioning
- Digital Transformation
  Transforming performance and unlocking hidden data

Inspiring, accelerating and funding technology innovation
# 21st Century Oil and Gas

Technology will transform the oil and gas industry for the future.

<table>
<thead>
<tr>
<th>Fix today</th>
<th>Enable MER UK</th>
<th>Transform tomorrow</th>
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<tbody>
<tr>
<td>Drones</td>
<td>Small pools</td>
<td>Product driven</td>
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<tr>
<td>Thermite plug</td>
<td>Remote operations</td>
<td>Service oriented</td>
</tr>
<tr>
<td>Virtual reality</td>
<td>Big data</td>
<td>Recycled infrastructure</td>
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<tr>
<td>Additive Manufacturing</td>
<td>Composites</td>
<td>Unmanned facilities</td>
</tr>
<tr>
<td>Subsea snake</td>
<td>Robotic systems</td>
<td>Hydrogen driven</td>
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<tr>
<td>Advanced inspection</td>
<td>Artificial intelligence</td>
<td>Carbon focused</td>
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The Oil & Gas Technology Centre
Your Innovation Partner
Low carbon future

Meeting our needs for energy, materials and climate change

COP21

Driving change

- COP21: Came into force in November 2016
- 60% of global power generation by 2040
- $23 trillion energy efficiency investment
- Oil demand increases by 11% by 2040
- Gas fastest growing fuel up 33% by 2040
- 150 million vehicles by 2040
- Composites market worth $105 billion by 2021

Low carbon oil and gas

- Hydrogen produced; carbon left behind
- Gas replacing coal for power generation
- Essential role for carbon capture and storage
- Gas to wire delivering power direct to grid
- Gas replacing petrol for transportation

IEA World Energy Statistics 2016
Creating value

Unlock the potential of the UK North Sea

Anchor the supply chain in the North East of Scotland

Create a culture of innovation that attracts academia and industry

£180m City Region Deal public funding
Our Centre

Solution Centres
- Well construction
- Asset integrity
- Small pools
- Decommissioning
- Digital

Centres of Excellence
- World class R&D
- Partner universities
- Leverage capabilities
- Develop new skills
- Test, simulate, develop

Technology Accelerator
- Enable innovation
- Support SMEs
- Connect investors
- Co-fund and mentor
- Provide expertise

Innovation Hub
- Inspiring environment
- Learn and experience
- Ideas from other sectors
- Tech Talk programme
- Facilitated workshops

Become the ‘Go To’ Technology Centre in the UK and internationally
Small Pools

Key aspirations:

- **Rapid Tiebacks**
- **50% Cost Reduction by 2025**
- **50% Under Development by 2030**
- **No Stranded Assets**

Key Work Themes:

- TieBack of the Future: ½ the COST in ½ the TIME
- Facility of the Future: Compact / Unmanned / Automated
- Decarbonising the UKCS
- Call for Ideas: Plug n Play / Heavy Oil / Reservoir Delineation
- Cluster Developments

Incremental Technology:

- Subsea Retrofit Flow Meters
- Renewable Power Generation
- Mechanical Hot taps

Unlocking the Small Pool Reserves
Small Pools Solution Centre

Aspirations
- Rapid Throttle
- 50% Cost Reduction by 2025
- No Stranded Assets

Key Objectives
- Energy Transfer
- Resource Gains from All Hydrocarbons
- New Development Options
- Installing Subsea
- Improved Recovery

Objective Enablers
- Reservoir Technology
- Improved Maintenance
- Clusters
- Flow Management
- Fluid Transfer
- Gas Handling
- Improved Options
- New Design Methods

Work Themes
- Made-in-Materials
- SP Economics
- Cluster Developments
- Furinng Industry Interface
- The Back of the Future
- Wellbore Monitoring

Call for Ideas/Plug-in Play
- Offshore Power for O&G Facilities
- Gas To Wire Technology
- Call for Ideas: Heavy Oil
- Call for Ideas: Subsurface
- SRC/MEchanical Holdings
## Project Overview
### EC-OG – Subsea Power Hub

<table>
<thead>
<tr>
<th>Technology company</th>
<th>What is it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC-OG</td>
<td>A small scale turbine extracting energy from seabed currents to power remote subsea equipment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Why it’s needed?</th>
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<tbody>
<tr>
<td>• Eliminates the need to provide topside power to temporary marginal pool assets</td>
</tr>
<tr>
<td>• Eliminates the need for a power umbilical to a platform</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How does it work?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Converts, stores and delivers autonomous electric power</td>
</tr>
<tr>
<td>• Harnesses the power of ocean currents</td>
</tr>
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<table>
<thead>
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<th>Benefits</th>
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<td>• NE Region based company - Scotland focus</td>
</tr>
<tr>
<td>• Reduces costs and removes capital expenditure associated with electric cables</td>
</tr>
<tr>
<td>• Re-deployable between fields and is road transportable</td>
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<table>
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<th>Design</th>
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<table>
<thead>
<tr>
<th>Key milestones</th>
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</thead>
<tbody>
<tr>
<td>• June - Oct 2017 – Phase 1A Project Engineering</td>
</tr>
<tr>
<td>• Sept – Dec 2017 – Phase 1B Project Engineering</td>
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</table>

Perfect alignment with umbilical-less system
Asset integrity

Corrosion costs the global economy £4 trillion pa and £28 billion pa in the UK

14 projects
Focused on solutions to vessel inspection and corrosion under insulation

8 field trials
With major operators ongoing during 2017 shutdown period

Call for Ideas
Use of robotics in vessel inspection attracted 29 submissions

Eliminate the impact of asset integrity on uptime
Asset Integrity Focus Areas

Current Activities:
- 6 field trials approved
  - 3 x NII Vessel Inspection
  - 1 x CUI Monitoring
  - 1 x CUI Detection
  - 1 x Coating System
- 2 projects underway
  - inspection of composite repair wraps
  - next generation of UAVs
- 1 field trial underway
  - 6 month trial of EMAT technology for corrosion monitoring

3 Calls for Action:
1. The use of Robotics for Vessel & Tank Integrity
2. Coating and Insulation Systems for the elimination of CUI
3. Conditioning Monitoring of Subsea Infrastructure

Investigate:
- The use of Robotics in an Offshore Environment
- Digital Worker – Change the way we work
- Additive Manufacturing – as an alternative repair solution

No Vessel Entry by 2026
Project Overview
Fail Force Actuator Safety Gauntlet

What is it?
Flexible containment device based on Kevlar protection and strapping to encapsulate the actuator and make it safe.

Why it’s needed?
• Failure of a spring return pipeline emergency shut down valve
• Estimated cost of replacing all actuators in the UKCS £1.4bn
• Eliminates the risk to personnel and infrastructure of a failure

How does it work?
Prevents the internal spring being catastrophically released via the end or side of the spring housing, resulting in uncontained and uncontrolled releases of energy, presenting a high risk to personnel and equipment.

Benefits
• Estimated UKCS cost saving of £329 million
• Certified by Lloyd’s Register
• Maersk Oil UK Ltd technical consultant
• Easily stored, meaning no lead time
• Installation by platform personnel

Design

Key milestones
• November 2017 – Detailed Design Complete
• December 2017 – Prototype Build Complete
• April 2018 – Project Complete

Estimated UKCS cost saving of £329 million
Well Construction Solution Centre

Key themes in first three years:

35% Abandonment Cost Reduction
- Rigless P&A
- Alternative barriers

50% Well Construction Cost Reduction
- Drilling optimisation
- Standardisation of equipment
- Transform well design

100% Well Reliability for Design Life
- Enhancing lifecycle integrity

Flawless Delivery
- Rig automation
- Augmented decision making

Transforming well activity to unlock the potential of the North Sea
# Project Overview
## Thermite Plug

<table>
<thead>
<tr>
<th>Technology company</th>
<th>Benefits</th>
</tr>
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<tbody>
<tr>
<td>interwell</td>
<td>• Collaborative approach</td>
</tr>
<tr>
<td></td>
<td>• Large number of operators</td>
</tr>
<tr>
<td></td>
<td>• High potential contributor to reducing P&amp;A costs by 35%</td>
</tr>
<tr>
<td></td>
<td>• Technique could unlock significant value</td>
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</table>

<table>
<thead>
<tr>
<th>Companies involved</th>
<th>Design</th>
</tr>
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<tbody>
<tr>
<td>centrica</td>
<td>Thermite Plug</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total funding</th>
<th>How does it work?</th>
</tr>
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<tbody>
<tr>
<td>£1 million</td>
<td>creates a high temperature chemical reaction in the wellbore, leading to a molten metallic plug that melts the adjacent casing strings and on solidification fuses to the rock creating a barrier.</td>
</tr>
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<th>Key milestones</th>
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<tr>
<td>• August 2017 – Build collaborative industry group</td>
</tr>
<tr>
<td>• December 2018 – Cross industry verification</td>
</tr>
<tr>
<td>• October 2017 – Field Trial with Centrica</td>
</tr>
<tr>
<td>• March 2018 - Field Trial with ENI</td>
</tr>
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High potential contributor to reducing P&A costs by 35%
Project Overview
Acoustic Data Transmission

What is it?
A system providing high speed wireless acoustic data transmission through a pipe.

Why it's needed
- Increases drilling efficiency
- Provides high quality data to enable better decision making

How does it work?
Increases target data rates to 300bit/sec, which exceeds performance improvement of 10x, using a downhole tool (non drilling)

Key milestones
- November 2017 – Update algorithms & tool and test
- April 2018 – Analyse results
- April 2018 – Build downhole tool system
- July 2018 – Design drilling system
- October 2018 – Analyse performance

Benefits
- Increased data bandwidth could enable other technologies
- Low risk field trial
- Strong industry interest
- Local organisation – retention of local focus for technology development

Design

Acoustic data transmission through pipe

Technology company
RAPTOR OIL

Companies involved
Statoil

Total funding
£1.2 million

Exceeds 10x performance improvement rate
Decommissioning

- Decom, Asset and Liability Cost reduction
- Decom Scope & Asset Decisions
- Knowledge
- Extending Life

Technology Projects linked to industry demands
## Decommissioning Initial Focus Area

### Knowledge Exchange
- Best practice
- Standardisation
- Learning from each other
- Culture Change
- Competency

### Environmental
- Re-use of equipment and materials
- Reduce impacts
- Marine science

### Alternative Power
- Facilities running costs
- Wave
- Solar
- Lower cost options

### Innovative Lifting Solutions
- Dropped object protection
- Integrity / HSE of lifted items
- Alternative solutions for structures removal and transportation

## Long Term Liability
- Monitoring
- Inspection
- Data acquisition
- Sensors
- UAV / ROV

## Pre-Removal Activities
- Topsides preparation
- NORM / LSA management
- Optimising PoB / Post CoP OPEX

## Subsea Infrastructure
- Burial techniques
- Mattress removal
- Residual liability
- Underwater cutting
Digital Transformation

Using digital technology to drive operating performance
Digital Current Focus Areas

**Current Activities:**

**Landscaping**
- TLB evaluating Industry needs
- 2 key projects identified
- Progressing scoping

**Accessing Capability**
- Understanding University & Industry offering
- Understanding NS Gaps
- Understanding other industry parallels

**Current Work:**
1. Marine Logistics project
2. Exploration – machine learning project
3. 10 proposals underway

**Near Future and Investigate:**
- Digital Worker – Optimise and automate the way we work
- Smart Facilities - Leverage IIoT to enhance operations and management
  - Remote operations, Digital Twins, 6D Models, Condition based monitoring
- Data driven and augmented decision making
- Production optimisation

Applying Data to Transform the Way We Work
Accelerating innovation

<table>
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<tr>
<th>Funding</th>
<th>Mentoring</th>
<th>Facilities</th>
<th>Relationships</th>
<th>Programmes</th>
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</thead>
<tbody>
<tr>
<td>Funding with no equity or pay back required</td>
<td>Advice from experienced mentors</td>
<td>Access to facilities and tailored training</td>
<td>Support to develop industry relationships</td>
<td>Start-ups, Market entries, Ventures</td>
</tr>
</tbody>
</table>

Support 100 start-ups and SMEs in 10 years
Our programmes

Start-ups
TechX Pioneers
Mentoring and support for entrepreneurs to develop business, validate products, acquire customers and attract funding
2 programmes each year
10 companies per programme

Market entry
TechX Associates
SME with a unique and near market ready product, preferably from a different industry, needing operational testing, benefit validation and scaling
Applications anytime
Ongoing programme

New ventures
TechX Ventures
Filling technology and supply chain gaps with new companies and products formed through creativity, innovation and determination.
Deep Science Ventures collaboration
6-9 months programme

Accelerating the future today
Strong delivery

The story so far...

£12M+ of investment approved with 70% funding leverage

40 members from major operators to SME technology providers

21 live projects to accelerate the adoption of innovative solutions

8 field trials ongoing to be completed in October 2017

300+ technologies and projects reviewed for offshore trial or investment

100+ ideas generated through our ‘Call for Ideas’ process

Positive engagement with the industry