Decommissioning Futures

Nuclear

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NDA Head of Cross-Industry Learning

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Today's Nuclear Session

Cross-Industry Collaboration

Karl Sanderson – Nuclear Decommissioning Authority

Nuclear Decommissioning Future Strategy

Martin Liefeith – Nuclear Decommissioning Authority

Supply Chain Opportunities

John Berry – Sellafield Limited

Technical Challenges and Innovation

Frank Allison – Game Changers

International Opportunities

Jon Halladay – Department for International Trade

Common Decommissioning Challenges

Nuclear - Oil & Gas – Defence – Renewables – Space – Process – Resources

Waste – Transport - Power Generation & Distribution - Construction

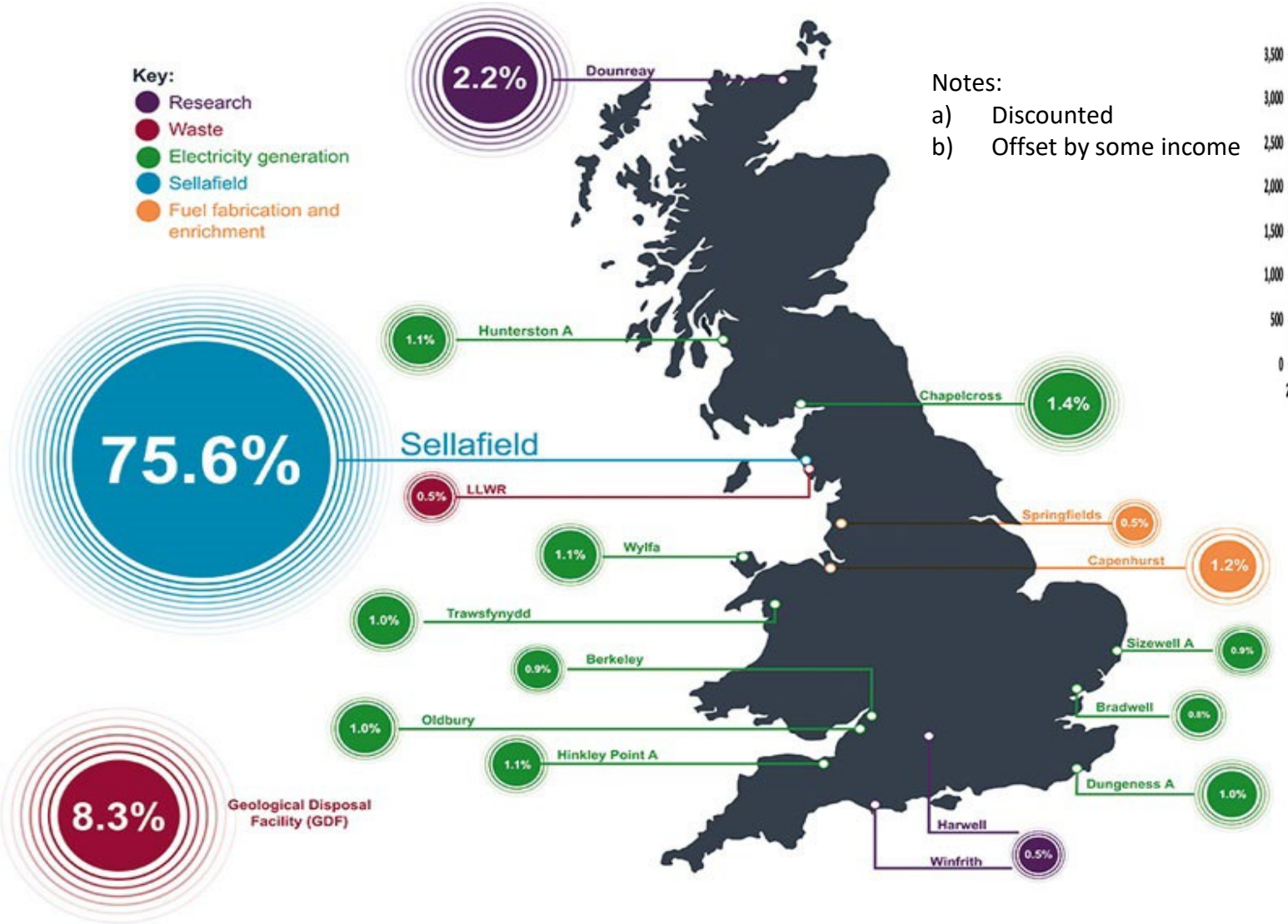
Industry	Cost £ Billion	Schedule (Years)	Major Scope Items
UK Civil Nuclear (NDA)[1]	undiscounted 132 discounted 135 within next 20 years 48	~120 (to 2137)	17 sites, including Sellafield, Dounreay, Magnox NPPs, Capenhurst, Springfields, Low Level Waste Repository
UK Civil Nuclear (EDFE)[2]	provision 20	~100	8 Nuclear Power Stations
UK Defence (Nuclear Powered Submarines)[3]	provision 7.5	>30	20 out-of-service + 10 in-service
UK Oil & Gas[4]	P50 51 P90 66	<50	UK Continental Shelf
UK Renewables[5]	~4-12	~50	Offshore Wind

High decommissioning costs shared by a number of industries: UK potential to become global leader, creating a decommissioning capability across sectors, and valuable exportable skills

Sources:

1. NDA Annual Report & Accounts 2019/20 Nuclear Provision
2. Nuclear Liabilities Fund Annual Report & Accounts 2018
3. National Audit Office – Investigation into submarine defueling and dismantling – April 2019 – ISBN 9781 786042552
4. Oil & Gas Authority - UKCS Decommissioning 2020 Cost Estimate Report 2020 inventory 2019 prices
5. The Crown Estate – current versus future estimate for capacity yet to be built

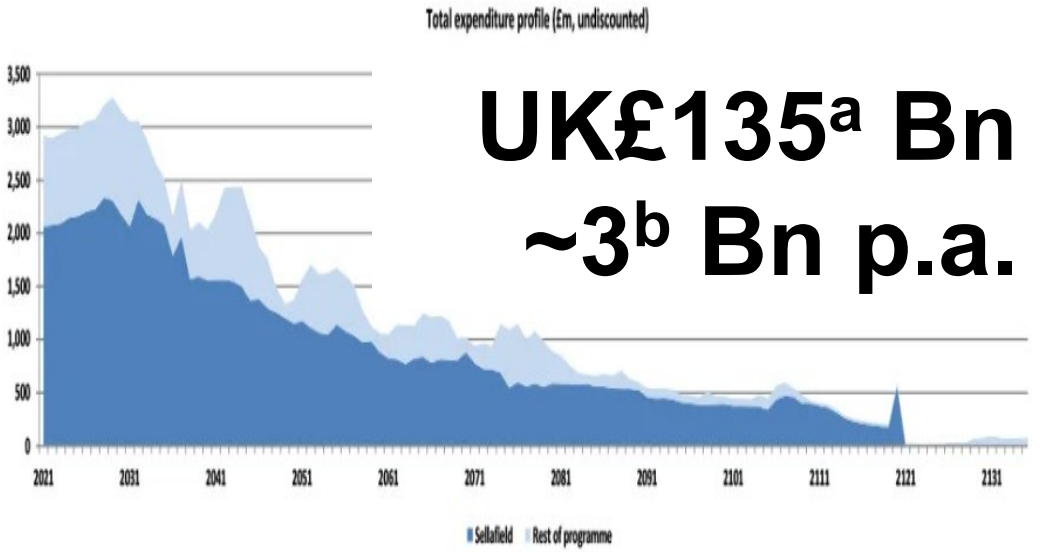
Costs: A UK view over 120+ years



Notes:

a) Discounted

b) Offset by some income



UK£135[a] Bn

~3[b] Bn p.a.

- CAPEX rather than ABEX
- CAPEX mixture of Green & Brownfield
- Mostly in the Supply Chain

Themes of Common Interest – Sharing Lessons Learned

✓ Completed
✸ Imminent
★ Planned

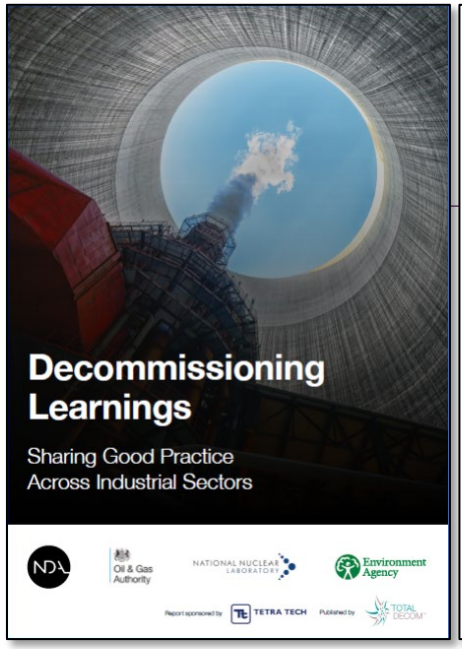
- Net Zero & Environmental Sustainability ✓
- Attracting Talent & Building Capability ✓
- Sustainable Regional Economies ✸
- Designing for Decommissioning ✸
- Winning International Business ★
- Late Life Asset Management ✓
- Governance & Assurance ✸
- Project Management ✓
- Technical Innovation ✓
- Commercial Models ✓
- Policy & Regulation ✓
- Cost & Schedule ✓
- Supply Chain ✓
- Standards ✓
- Safety ★

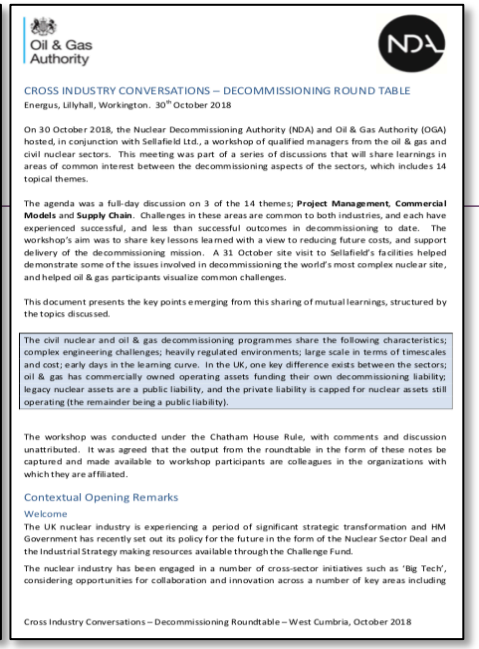
2021: emerging themes of common interest:

1. Scope Aggregation / Campaigning / Parallel Workfronts
2. Digital / AI / BIM / Machine Learning / Virtual Working
3. Regulatory Change

Theme	Commonality between Decommissioning of Nuclear - Oil & Gas - Offshore Wind Industries	Defence	Space	Process	Resources	Utilities	Transport	Construction	Waste
Project Management	Management of large complex projects that exhibit similar characteristics e.g. brownfield. Efficiency of scope aggregation (fleet) approaches to multiple sites; pooling of project / engineering team / vessel resources across projects. Uncertainties associated with ageing infrastructure; uncertainties related to chacterization of inventory; approaches to demolition / dismantling. Transition from operations to decommissioning; cultural leadership & transitions / change management / EDI; building project delivery capability fit for decommissioning. Performance reporting approaches. Brand / Reputation Resilience; re-assuring the public / building public confidence; reputation threat mitigations / opportunities. What happens when things go wrong (e.g. 2014 Geologic Disposal Facility)?	■	■	■	■	■	■	■	
Commercial Models	Decommissioning requiring a different mindset to risk transfer; difficulty in developing novel / fit-for-purpose commercial models for decommissioning in industries that have well-established commercial behaviours. Lessons learned from Nuclear include for example; Parent Body Organisation (PBO) model versus wholly-owned subsidiary models; Programme & Project Partner (PPP) model. LL from O&G include for example; bundling scope into campaigns across fields and across operators. Opportunity to turn net cost into profit by bundling decommissioning operations (e.g. offshore wind subsea cables).	■	■		■	■	■	■	
Supply Chain	Supply chain opportunities; barriers to entry; how are they advertised and procured. Measures to ensure support for UK based jobs; Social Value; Supply Chain Action Plans. Government versus provate sector procurement rules. Support for SMEs. Taking advantage of R&D Innovation grant funding, nationally, regionally & across sectors to develop expertise. Platforms for sharing innovation and collaboration.	■	■	■	■	■	■	■	■
Technical Innovation	Developing new technologies, techniques, systems & processes to solve difficult and complex decommissioning challenges. Innovation centres / organizational models / campaigns; grand challenges. Specific technologies; robotics; land / sub-sea / aerial ROVs / AUVs / drones; characterization of as-built condition; digital twins / AI / Augmented Reality / BIM techniques / post-Covid; impermeable barriers; under-water laser cutting; explosives; vibrating hammer foundation removal; automated detection & removal (e.g. sub-sea cables). Joint calls for academic research.	■	■	■	■	■	■	■	■
Cost and Schedule	Ability to compare (transparency in) cost and schedule estimates & outcomes, in a timely manner, across the process of decommissioning; sector premiums. Accelerating the reduction of risk (schedule), and reducing the decommissioning provision (cost). Drivers of cost and schedule over-runs may be different in nature from enablers of cost and schedule reductions and may need exploring separately. Challenges in accurate estimation. Good practice in approaches to; benchmarking; reference class forecasting; probabilistic forecasting; optimism bias removal. Workfront productivity / 'tool-time'; performance management. Challenges in annual budgetary cycle versus business planning cycle.	■	■	■	■	■	■	■	
Late Life Asset Management	Managing the final phases of an asset's life to optimise its productivity whilst maintaining its integrity and preparing it for decommissioning. Efficient overlapping of late operations and onset of decommissioning; minimizing duration of warm stacking; managing trade-offs between OPEX and ABEX; cultural change and leadership during transition.	■		■	■	■	■	■	
Policy & Regulation	Multiplicity of agencies covering regulation onshore and offshore, together with changing legislation. Level-playing fields between industries. Common approaches to future regulation / challenging of existing treaties; governance structures. Implications of Brexit for changes to policy. 'Social Licence to Operate' and supportive communities. Commercial viability / desirability of decommissioned end-states / approaches. Efficient regulation within environmental, economic and social contract boundaries. Full costs of leaving *in situ* versus removal. High levels of regulatory oversight.		■		■	■	■	■	■
Attracting Talent & Building Capability	Competition with new build / development and operations for attracting and retaining diverse talent. Capability development; transferability of skills; ageing workforce.	■		■	■	■			■
Winning International Business	UK depth of experience throughout the supply chain & exportable UK expertise. Role of Authorities and operators in facilitating supply chain exports. Encapsulating and exporting the Intellectual Property of Authorities.	■	■	■	■	■		■	■
Sustainable Regional Economies	Changing primary, regionally based economic activity into something more diversified, resilient and sustainable. Long term job creation in areas facing decline or change. HMG drive to use SMEs for driving innovation and creating new jobs.	■		■	■				
Net Zero & Environmental Sustainabilty	Government and market trends impact, such as energy transition and Net Zero targets. Scope 1, 2 and 3. Opportunity to repurpose on-shore and off-shore assets for other uses, including industrial and ecological, e.g. H_2 production, CO_2 capture and storage. Design for re-use. Low-carbon manufacturing. Recycling; polymer turbine blades; uncontaminated steel structures; contaminated metals; management of waste streams.	■	■	■	■	■	■	■	■
Standards	Aligning standards; removing duplication and improving consistency, across industries & internationally. Streamlining standards for decommissioning versus new-build. Road-map and funding for industry groups. Standardised methodology for review and issue of standards.	■		■		■	■		■
Governance & Assurance	Methodologies, tools and techniques in support of high decision quality. The assurance (peer review and assist) of projects during maturation. 1st, 2nd and 3rd line. Measuring assurance effectiveness and value. The withholding of bad news. Optimism bias removal.	■		■		■	■	■	
Safety	Commonalities in decommissioning; unstable onshore facilities (power stations, chimneys, grounded offshore platforms), and high hazard facilities in congested spaces (e.g. within nuclear site fences, offshore platforms). Safety cases and integrated attitude to risk (safety, security and environment).	■		■	■	■	■	■	■
Designing for Decommissioning	The idea of including, in the design phase of new-build and brownfield work, consideration for more efficient ultimate decommissioning.	■	■	■	■	■	■	■	

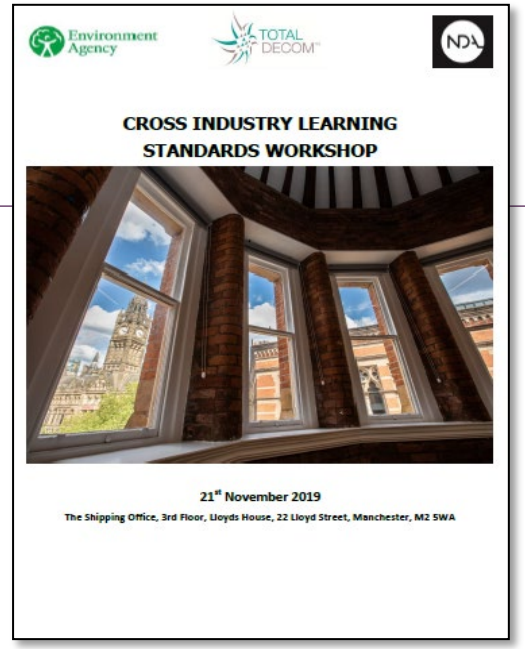
Public Domain Materials

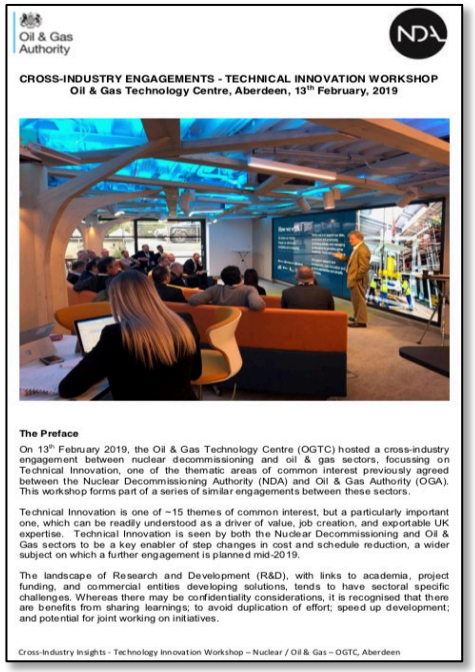


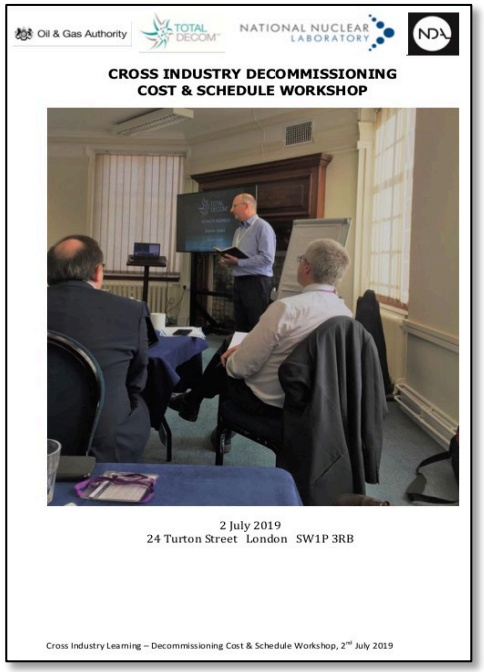


www.totaldecom.com/cross-industry-collaboration/

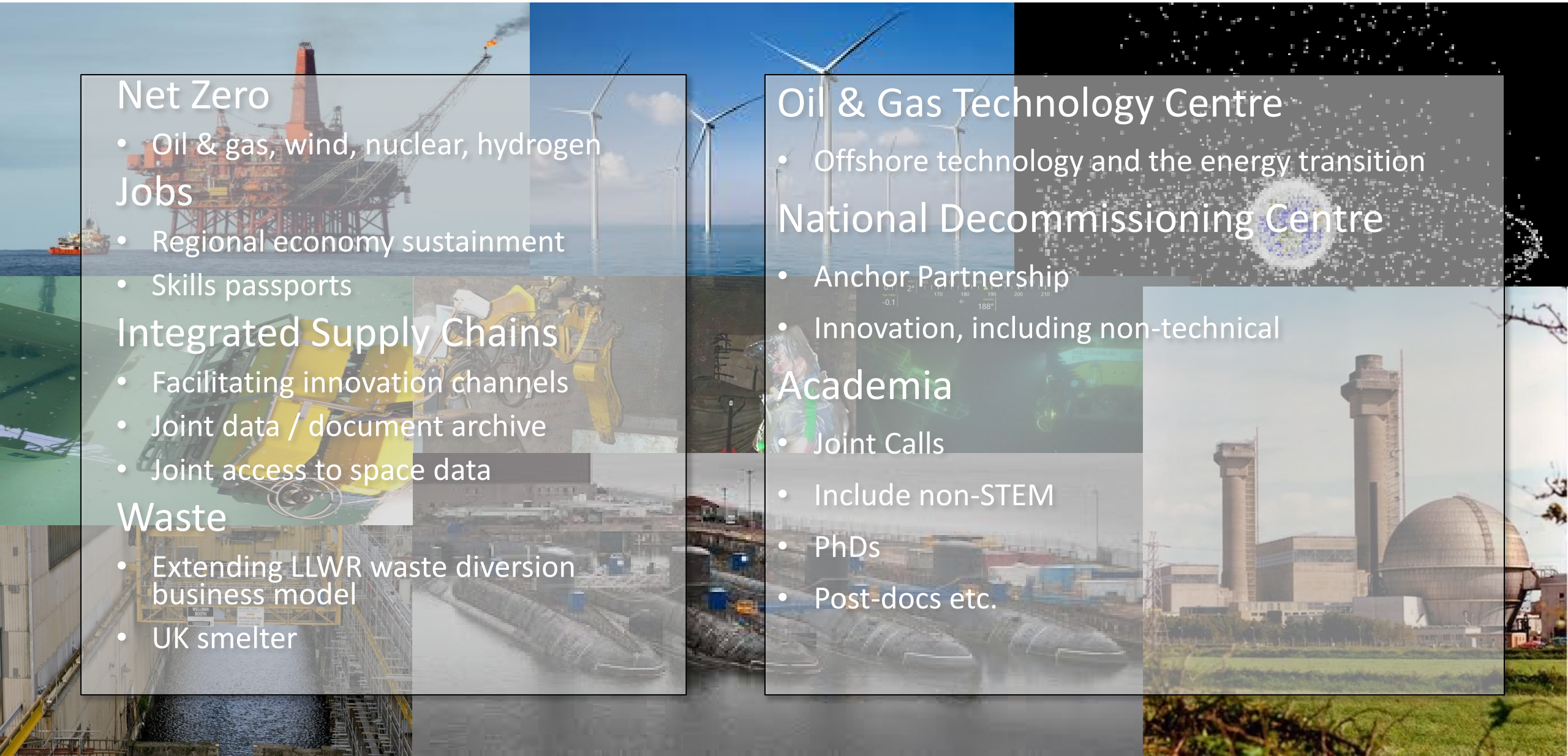
- Workshop write-ups
- Webinars
- Progress Report







Cross-Industry Collaborative Projects – Examples & Potential



Net Zero

- Oil & gas, wind, nuclear, hydrogen

Jobs

- Regional economy sustainment
- Skills passports

Integrated Supply Chains

- Facilitating innovation channels
- Joint data / document archive
- Joint access to space data

Waste

- Extending LLWR waste diversion business model
- UK smelter

Oil & Gas Technology Centre

- Offshore technology and the energy transition

National Decommissioning Centre

- Anchor Partnership
- Innovation, including non-technical

Academia

- Joint Calls
- Include non-STEM
- PhDs
- Post-docs etc.

Making a difference