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TEAM DEFENCE INFORMATION

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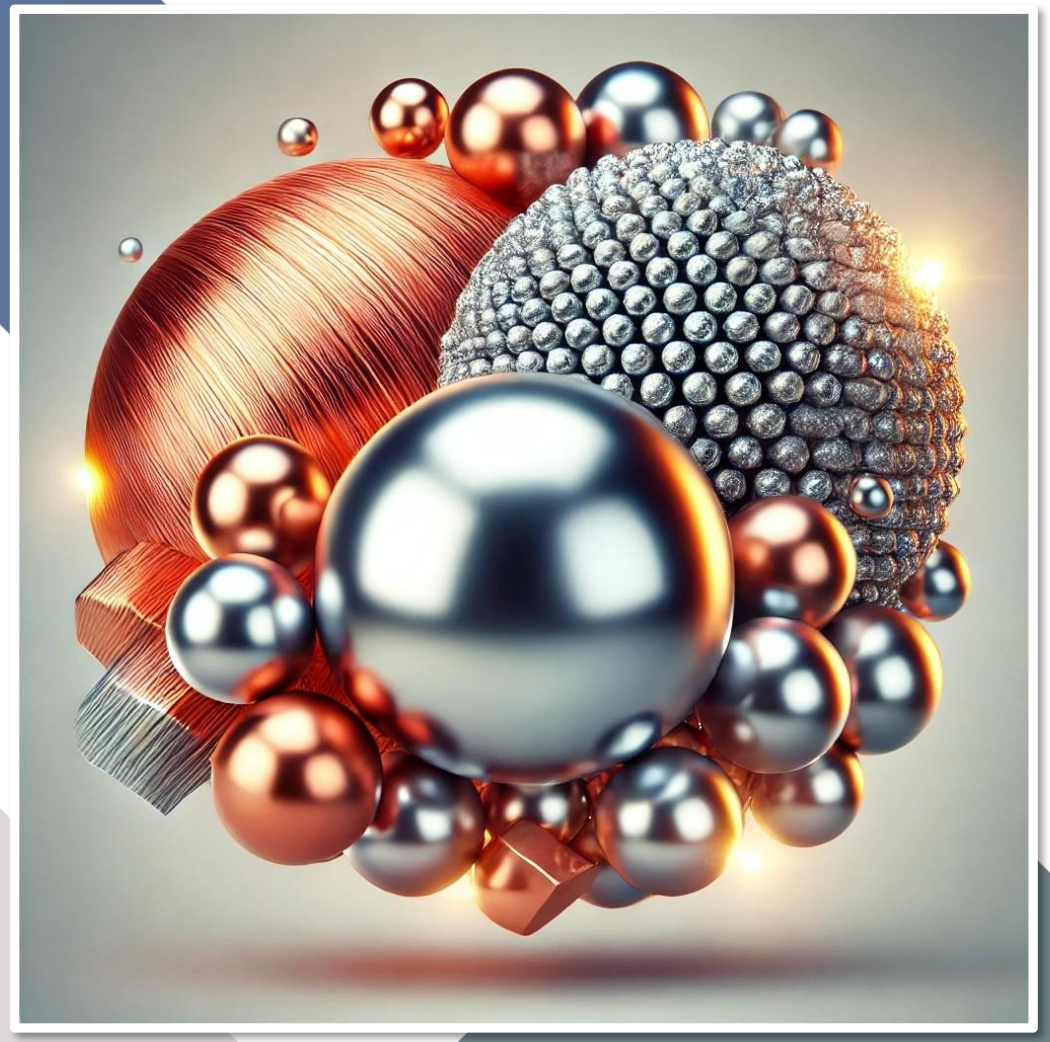

Reclamation Supply Chain Conceptual Design Workshop

10th December 2025

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Purpose of Workshop

To explore the development of a conceptual reclamation supply chain in defence, through facilitated group discussions, covering the following key topics:

- Current UK capabilities, gaps, and priority areas for investment, including what can be filled by global partners versus where the UK must build capacity.
- Future circular models in defence – including supply chain system architecture, traceability and assurance requirements, enabling business models and design-stage circularity
- Priority areas for future research and innovation in circular critical mineral supply chains for defence.

Your insights and contributions will help inform emerging priorities for developing a future defence circular supply chain.

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Workshop Etiquette

Please mute your microphone

Use the *Meeting Chat* feature or *Raise Your Hand* if you wish to ask a question, the facilitator will pick it up and raise it an appropriate point

If your question is not answered during the workshop we will follow up after the event.

The session will be recorded

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Introduction to facilitation team

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About Decision Analysis Services

Decision Analysis Services (DAS) is an independent professional services company. Since 2007 we have provided services globally to more than 200 client organisations within the energy, defence, government, transport, and health sectors.

We specialise in **bridging the gap between strategic planning and operational execution**, developing enduring solutions to the uniquely complex issues faced by our clients.

We are experts in **futures, systems thinking, supply and demand modelling, machine learning, and data analytics.** These unique skills, coupled with our **extensive experience of engineering, regulatory practices and operations delivery** enable us to delve deeper, provide invaluable insight and foresight, and develop sustainable, long-term solutions to client issues.

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Agenda

- High-level overview of the Defence CRM Framework and where reclamation fits
- Defence case study – Submarine Dismantling Project
  - Overview
  - Identification of the key components and material categories
- Highlighting some of the UK's capabilities in the recovery of different material categories
- Break-out room discussions
  - UK strengths and capability gaps
  - Traceability, security and assurance
  - Cross-sector integration
  - Business & Ownership Models
  - Design-Stage Circularity
- BREAK
- Feedback to main group from break-out groups
- Summary and wrap-up

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Policy Landscape

Building Resilience of CRM for UK Defence

"A circular economy approach presents a key opportunity to secure future supply and enhance resilience. This can reduce our reliance on third parties and supply chains which are potentially vulnerable to disruption"

(page 77)

- *"20% of total annual UK industrial demand for critical minerals is met by industry through recycling of products to recover critical minerals by 2035"*
- *"...the UK will support industry-led supply chain resilience in the UK defence sector"*

- Expected early 2026
- Anticipated to be closely aligned to the Industrial Strategy

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Defence CRM Framework

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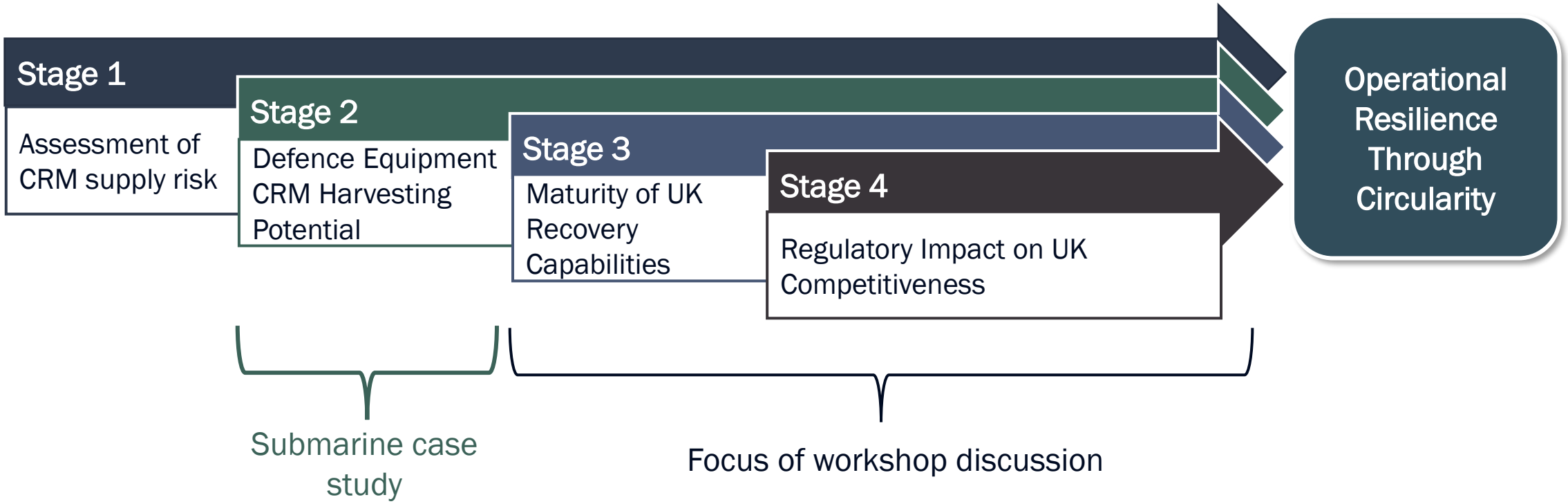
Defence CRM Decision Support Framework



Adapted from [Securing-Critical-Raw-Materials-for-Defence_v2-1.pdf]

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Submarine Dismantling Project

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The Submarine Dismantling Project (SDP)

- The majority of the UK's submarines have been out of service longer than they have been in use
- There is a longstanding backlog of decommissioned submarines, with 23 vessels — 7 in Rosyth and 16 in Devonport — awaiting dismantling and recycling
- Keeping decommissioned submarines is costly and takes up limited dock/storage capacity at naval yards
- The SDP aims to deliver a safe, environmentally responsible and cost-effective solution for the dismantling and disposal of the UK's decommissioned nuclear submarines
- Following removal of radioactive material, components will be identified that can be re-used, before around 90% of the remaining materials will either be repurposed or undergo recycling

Decommissioned submarine 'Swiftsure' has its fin cut and removed (June 2025)

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The Submarine Dismantling Project (SDP)

- Swiftsure is the first submarine and considered a pathfinder for future submarine dismantling work at Rosyth and Devenport, due to be completely dismantled by the end of 2026

- Veolia has been appointed as the main contractor to handle, segregate and characterise recycling materials (i.e. collection and sorting role)

- Dismantling and recycling of other submarines will continue far into the 2030s

- Benefits:
  - Reprocessing materials for future defence needs (resilient assured supply)
  - Extracting secondary value from decommissioned assets
  - Lower environmental impact
  - Helps to strengthen UK's midstream processing capability

Decommissioned submarine 'Swiftsure' has its fin cut and removed (June 2025)

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High-Level Submarine Sample Bill of Materials

On-board Electronics

Subsystem	Material
Periscope	Graphite, Steel
Other materials	Lithium, silver, lead, aluminum

Other Materials

Material
Chromium, tungsten, hafnium, niobium, baryte

Sensors

Material
Aluminum, gold, copper, iron, rare earths, silicone

Propulsion

Subsystem	Material
Diesel Engine	Niobium, barium, steel
PEM Fuel Cells	Platinum
Electric Motors	Cobalt, manganese, samarium
Propellor	Chromium, graphite
Batteries	Lithium, silver, lead
Other materials	Aluminium, copper, REEs, titanium, nickel

Hull

Material
Aluminum and alloys, chromium, molybdenum, nickel, iron composite, steel

Sourced from public information

1. https://hcss.nl/report/strategic-raw-materials-for-defence/
2. https://www.iiss.org/globalassets/media-library---content--migration/files/research-papers/2025/03/iiss_critical-raw-materials-and-european-defence_25032025.pdf
3. http://171.67.100.116/courses/2017/ph240/rojas2/docs/ssc2012-5188.pdf#page=69
4. https://publications.jrc.ec.europa.eu/repository/handle/JRC132889

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UK Capability

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UK Capabilities in Material Collection, Sorting and Reprocessing

Collection and Sorting

The systems, infrastructure and organisations involved in gathering end-of-life materials and separating them into defined material streams suitable for further processing.

Example organisations include:

- **Veolia** – General waste collection services with landfill sites located in Rugby and Skelmersdale and industrial services located in Cardiff and Portsmouth
- **Biffa** – National waste collection services across the UK
- **Suez** - Operates over 300 sites nationwide. They have a range of facilities including energy-from-waste and recycling centres
- **Conceptual Defence Specific Recycling Facility** – Proposed collection sites scattered across the UK near military manufacturing facilities

Recovery and Reprocessing

The technologies and facilities that extract usable value from sorted materials to create secondary raw materials ready for downstream manufacturing.

Organisations in the following slides are grouped by material category:

- **Ferrous metals**
  - E.g. ICD Alloys, Liberty Steel
- **Non-ferrous metals**
  - E.g. Metalyasis, Avon Specialists, BASF Metals Recycling
- **Rare earth elements (REEs)**
  - E.g. HyProMag, Silex World
- **Li-ion batteries**
  - E.g. MTC

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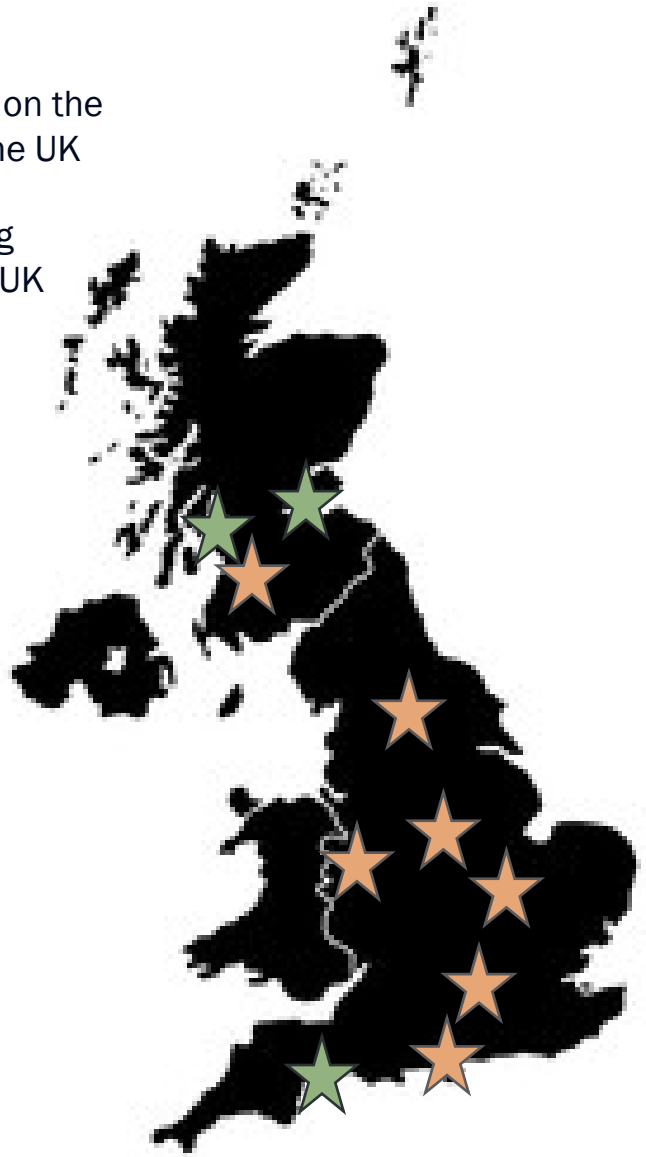
Potential Defence-Specific Collection and Sorting Facility Locations

3x Naval Dockyards located on the north and south coasts of the UK

Other military manufacturing facilities located across the UK



Naval dockyards are located on the Scottish coastlines and the south coast of England.
A future naval-specific end-of-life material collecting and sorting centre could be located:

- **Scotland** (Rosyth Dockyard is the location of the current Swiftsure dismantling project. Rosyth has strong aspirations to become a centre of excellence for these projects)*
- **South England**

Since other military manufacturing sites are scattered around the country, there may be a need for further defence-general collecting and sorting facilities that are close to these sites.

* https://www.babcockinternational.com/news/babcock-awards-milestone-recycling-contract-in-uks-submarine-dismantling-project/

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Planned and Operational Recovery and Processing Capacity - Ferrous Metals

Organisation	Location
British Steel	Scunthorpe
Liberty Steel	Rotherham
Cronimet GB Ltd	Cannock/Rotherham
Marcegaglia Stainless Sheffield	Sheffield
Sheffield Forgemasters	Sheffield
ICD Alloys	Sheffield
Tata Steel	Port Talbot
Celsa Steel	Cardiff

Source: UK Critical Minerals Recycling and Midstream Processing Capability Assessment

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Planned and Operational Recovery and Processing Capacity – Non-ferrous metals

Organisation	Factory Location	Material Specialists in:
Alvance British Aluminium	Lochaber, Scotland	Aluminium
R.S Bruce Ltd	Sheffield	Platinum Group Metals (PGMs), Gold, Silver
Metalysis	Rotherham	Tantalum, Aluminum, Titanium
Mastermelt Refining Services	Buxton UK	PGMs, Gold, Silver
S.A.R Metals Ltd	Immingham	PGMs
G.C. Metals Ltd	Lutterworth	PGMs, Gold, Silver
Vale Europe	Swansea	Nickel
Platinum Recoveries	Swindon	PGMs
BASF Metals Recycling Ltd	Cinderford	PGMs
Avon Speciality Metals	Tockington (Bristol)	Nickel, Cobalt
StoneX Metals Ltd	West Bromwich	PGMs
Britannia Refined Metals	Kent	Copper, Nickel
Hensel Recycling	Horsham	PGMs
Kaug Refinery Services	Located around the UK	PGMs
Johnson Matthey	Located around the UK	PGMs

Source: UK Critical Minerals Recycling and Midstream Processing Capability Assessment

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Planned and Operational Recovery and Processing Capacity – Li-ion Batteries

Organisation	Factory Location
Tees Valley Lithium	Northeast England
Green Lithium	Northeast England
R.S Bruce Ltd	Sheffield
S.A.R Metals Ltd	Immingham
Manufacturing Technology Centre (MTC)	Coventry
Britannia Refined Metals	Kent
Altilium Metals	Plymouth
Veolia	Multiple Locations

Source: UK Critical Minerals Recycling and Midstream Processing Capability Assessment

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Planned and Operational Recovery and Processing Capacity – REEs

Organisation	Factory Location
Ionic Technologies	Northern Ireland
Less Common Metals	Cheshire
Peak Rare Earths	Northeast England
Silex World	Leeds
HyProMag	Birmingham
Avon Speciality Metals	Gloucester

Source: UK Critical Minerals Recycling and Midstream Processing Capability Assessment

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High-Level Submarine Sample Bill of Materials

Materials with UK recovery and processing capacity in red

On-board Electronics

Subsystem	Material
Periscope	Graphite, steel
Other materials	Lithium, silver, lead, aluminium

Other Materials

Material
Chromium, tungsten, hafnium, niobium, baryte

Sensors

Material
Aluminium, gold, copper, iron, REEs, silicon

Propulsion

Subsystem	Material
Diesel Engine	Niobium, barium, steel
PEM Fuel Cells	Platinum
Electric Motors	Cobalt, manganese, samarium
Propellor	Chromium, graphite
Batteries	Lithium, silver, lead
Other materials	Aluminium, copper, REEs, titanium, nickel

Hull

Material
Aluminium and alloys, chromium, molybdenum, nickel, iron composite, steel

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3. http://171.67.100.116/courses/2017/ph240/rojas2/docs/ssl2012-5188.pdf#page=69
4. https://publications.jrc.ec.europa.eu/repository/handle/JRC132889

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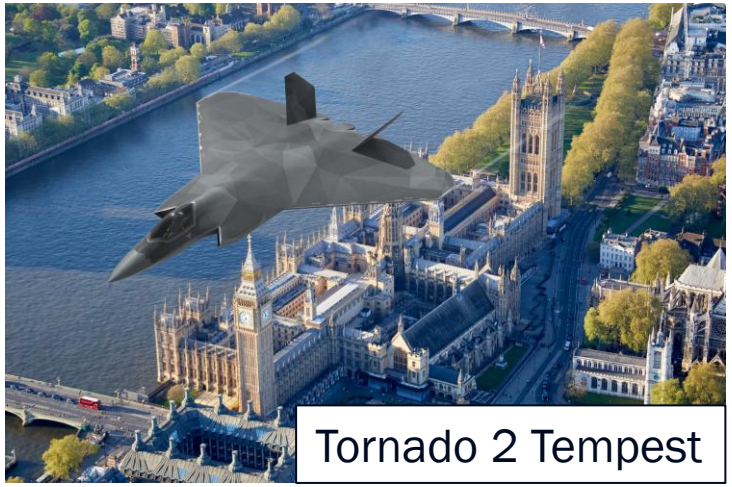
Opportunities across the Defence Sector

Material recovery 'pathfinder' examples

Submarine Dismantling Project



Tornado 2 Tempest

Example retired/retiring assets

Air

- Tornado GR4 fleet
- Puma HC2 helicopter
- Typhoon Tranche 1

Land

- Viking (2029)
- Bulldog (2030)
- Warrior IFV (2027)

Sea

- Type 23 frigate
- Swiftsure-class submarine
- Trafalgar-class submarine

Source: British Army reveals armoured vehicle retirement dates

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Breakout Room Discussion

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Discussion Points

Note that you may find that the answers to these questions vary on a material group basis.

1. **UK capability** - What parts of the circular supply chain are strongest in the UK today, and where are the biggest capability or infrastructure gaps? Which of these could be filled by global partners and allies, and which require UK investment to retain strategic advantage?

2. **Circularity barriers** - What are the main barriers in implementing circularity in defence and what practical measures or approaches can overcome them? Consider aspects such as material tracing, security, assurance.

3. **Cross-sector integration** - How can recovered materials, infrastructure, or processes deliver benefits across multiple sectors, other than just defence? Is this possible with defence-specific security and assurance needs? Where do the greatest synergies and opportunities lie?

4. **Business and ownership models** – Is there a need for new commercial models (e.g. leasing, product-as-a-service) that could incentivise recovery and reuse?

5. **Design-stage circularity:** What steps does defence need to take to adopt design principles to enable easier recovery and reuse of materials in the future? Where should the priority be?

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Summary

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Summary

We have started to explore the development of a conceptual reclamation supply chain in defence, through facilitated group discussions, covering topics such as:

- UK capability strengths and gaps
- Circularity barriers, such as traceability, security & assurance requirements
- Cross-sector integration
- Business models
- Design stage circularity.

We will now synthesise your insights and contributions into a short summary report for circulation.

Thank you very much for your time and contributions.

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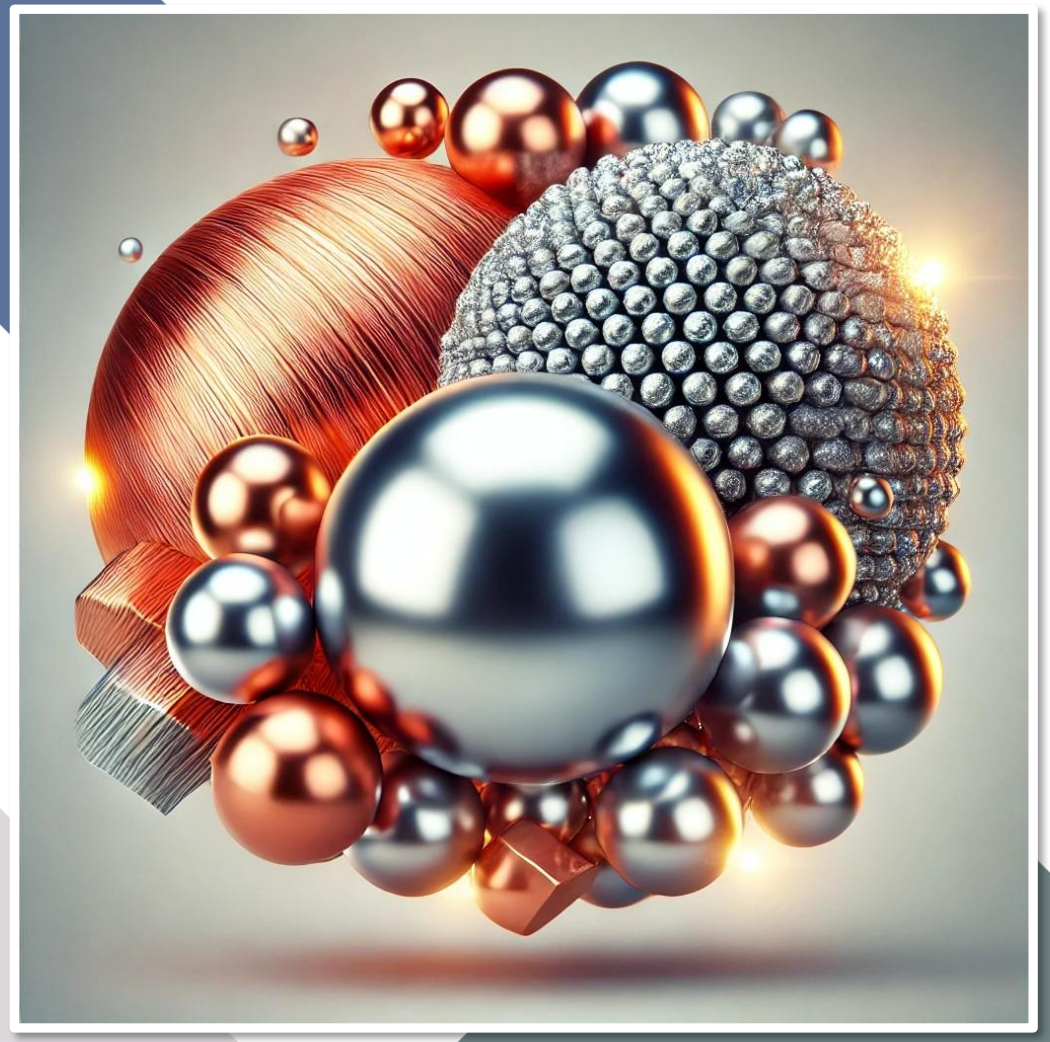

Thank You

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