



Met4Tech

Met4Tech – UKRI Interdisciplinary Circular Economy Centre for Technology Metals

(PI - Prof Frances Wall, Camborne School of Mines, University of Exeter)

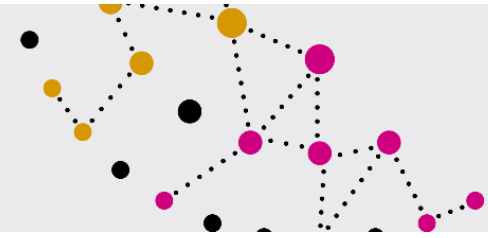
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**UK Research
and Innovation**

UKRI Interdisciplinary Centre for Technology Metals

(21 Co-Is, 9 PDRAs, 8 PhD Students, 3 man./policy staff, 50+ partners (£1.6 million cash/in-kind))



Sara Kurfess



F. Wall



APPA Greenwash



Image: Pixabay

Theme 1 – Virtual Data Observatory – Stocks / Flows & Practices
Li, Co, REE, Te, Se, PGM, In, W, Sn, Ta, Ga, Nb, Sb ...

Theme 2 -
CE Principles for Raw materials
& new Geo-models

Theme 3 -
Design, Manufacturing,
& Recycling Technologies

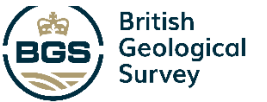
Theme 4 - Roadmap for a new technology metals circular economy system

- POLICY & GOVERNANCE
- ENVIRONMENTAL & LCA

- SOCIAL SCIENCES & VALUE CHAINS
- RESPONSIBLE INNOVATION



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UNIVERSITY OF
EXETER | BUSINESS SCHOOL



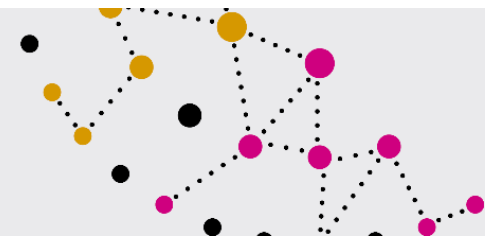
The University of Manchester
Sustainable Consumption Institute

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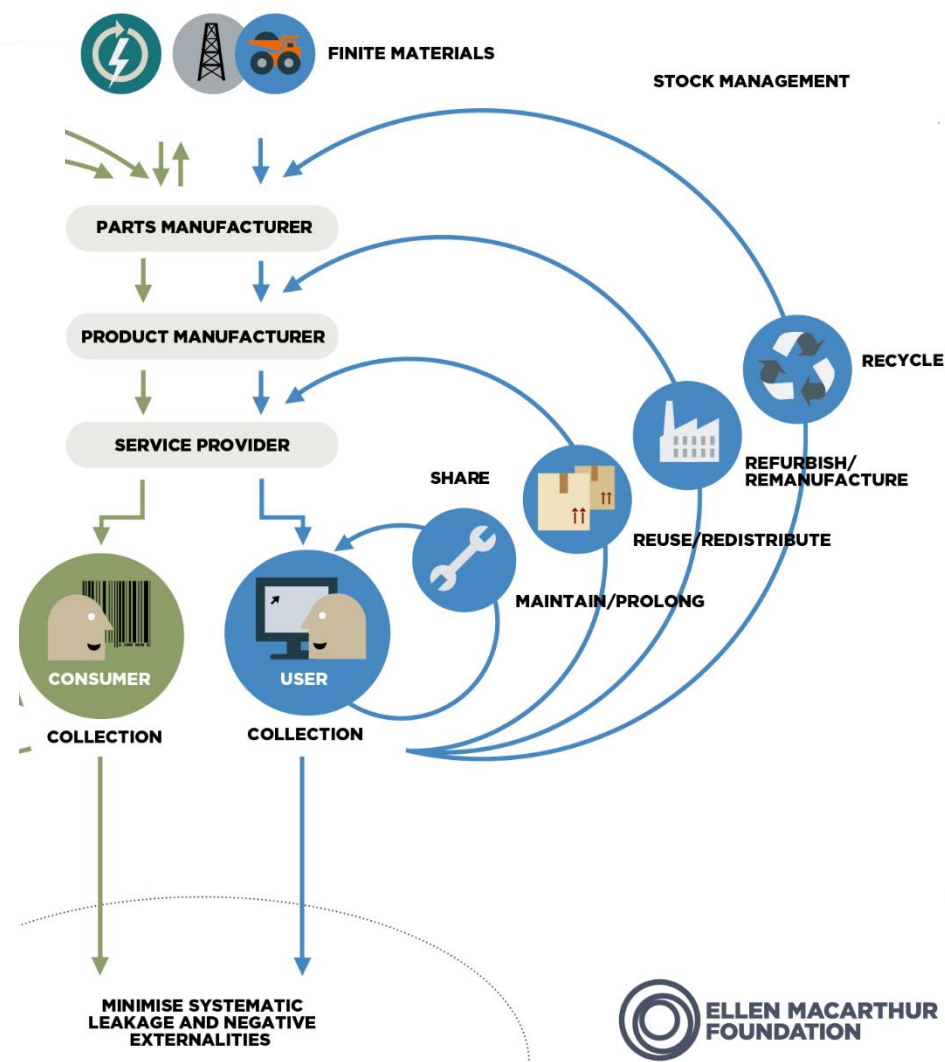
Research Areas for Collaboration?



We need to transform the current linear system for supply/use (take-make-waste) into a new **Technology Metals Circular Economy system and network**.

Some Areas for collaboration opportunities include:

- New approaches for the extraction/production of tech metals that reduce waste, energy use, and pollution.
- Ways to retain technology metals for use in strategic applications and in products with longer service life;
- Innovative technology for more efficient recovery and recycling of technology metals from wastes/products at end-of-life; and,
- New industry/business models with more circular approaches to promoting the technology metal values chains in the UK.



SOURCE
Ellen MacArthur Foundation
Circular economy systems diagram (February 2019)
www.ellenmacarthurfoundation.org
Drawing based on Braungart & McDonough,
Cradle to Cradle (C2C)



Which Technology Metals & Products?

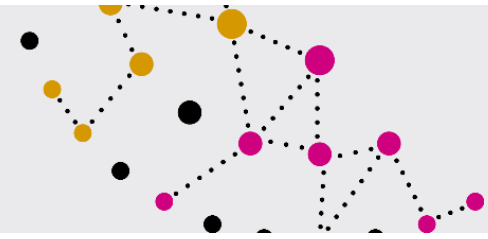


Antimony	Sb	Alloys, Batteries, semi-conductors
Cobalt	Co	Batteries, superalloys, catalysts, magnets
Gallium	Ga	Electronics (circuit boards and optoelectronics)
Germanium *	Ge	Electronics (IF detectors and thermal imaging)
Indium	In	Photovoltaics, Batteries, LCDs, phone screens
Lithium - UK	Li	Batteries
Niobium	Nb	Super conductor, electronics
Platinum Group Metals	PGM	Auto catalysts, fuel cells, electronics
Rare Earth Elements	REE	Magnets (wind turbines, EVs), catalysts, phosphors (low energy lighting), alloys, smartphones
Selenium *	Se	Electronics, alloys
Tantalum (3TG)	Ta	Electronics, superalloys
Tellurium	Te	Alloys, solar cells
Tin – UK (3TG)	Sn	Solder in all electronics
Tungsten – UK (3TG)	W	Wear-resistant materials, superalloys, electrical and electronics, catalysts

- All metals shown above are on UKs List of Critical Minerals 2022 (* except for Ge and Se)
- Several of these metals (Li, Sn, W) have mineralisation / mining projects in the UK
- Metals shown as 3TG are on the list of Conflict Minerals

Thematic Area 1 (TA1)

Evi Petavratzi, Markus Zils

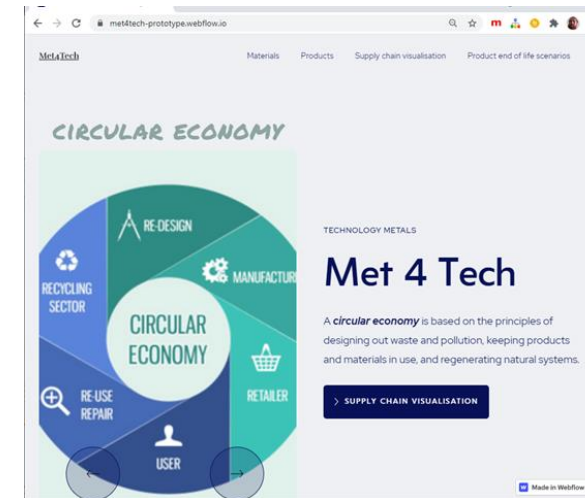
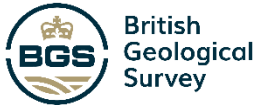
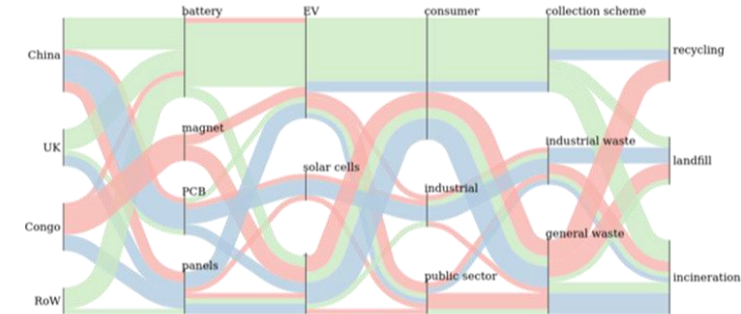


Overall objective:

- To develop a knowledge base for assessing flows and stocks of technology metals across their value chains.
- To form the **UK tech metals CE National Virtual Data Observatory (NVO)**

Key questions addressed in TA1:

- Where (sectors/ applications/ products) are tech metals located in the UK economy?
- What is the tech metals resource potential in UK stocks?
- What is the fate of the UK tech metal stocks reaching the end-of-life stage and the amount of leakage across existing systems?



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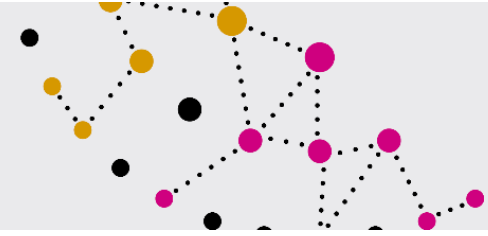
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Thematic Area 2 (TA2)

Karen Hudson-Edwards, Aleks Cavoski



➤ CE Principles for Raw Materials & new Geo-Models

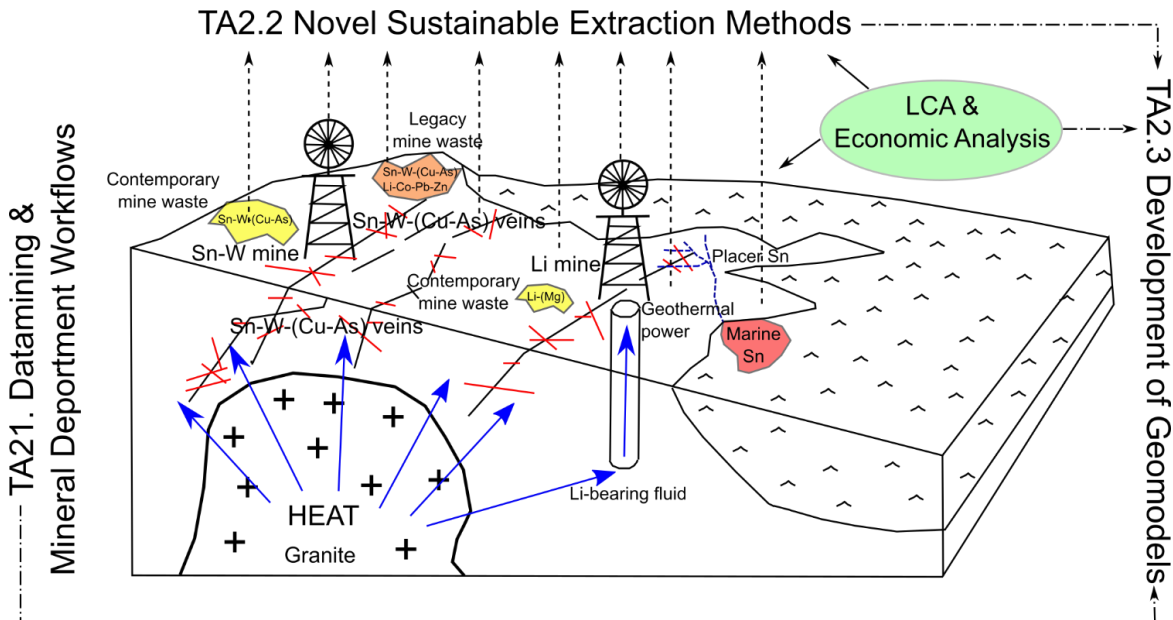


Figure 2. Preliminary conceptual circular economy geomodel for Cornish granite-related Li, Sn and W mineralisation and related mine waste

Case Studies & Projects:

- ❑ Granite-related (Li, Sn, W) mineralisation and related mine waste in Cornwall – **in progress**
- ❑ Cobalt deposits mined by large scale mining (LSM) and artisanal and small-scale mining (ASM)
- ❑ Carbonatite-related REE mineralisation and mine wastes
- ❑ Maximising value of (Te, Bi, W) by-products from gold mining



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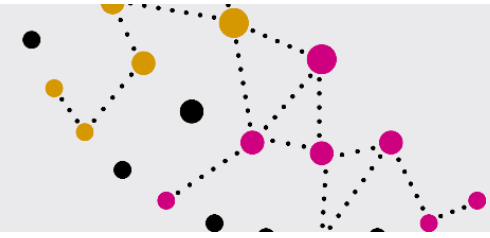
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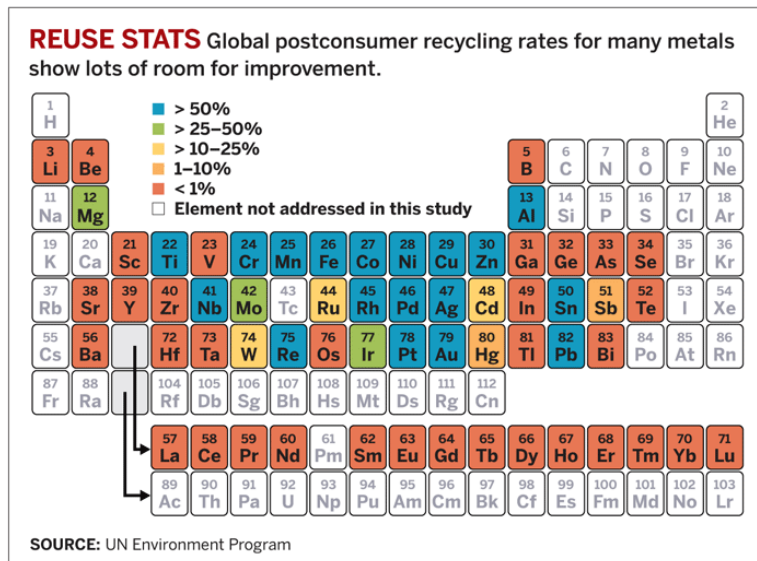
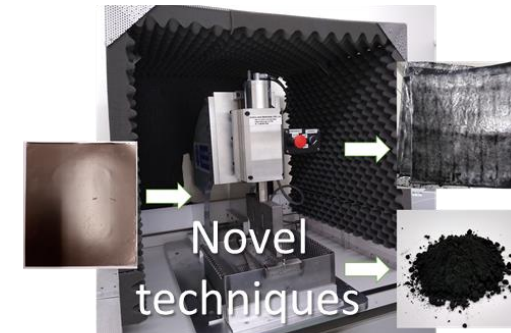
Thematic Area 3 (TA3)

Andy Abbott, Allan Walton



Design, Manufacturing & Recycling:

Develop novel separation and recycling techniques for technology metals, linking together chemistry, materials science, AI and robotics.



Fast and selective separation methods:

- Fast delamination techniques
- Changes in physical properties
- Developing selective etchants
- Developing de-bondable adhesives
- Design for recycle and reactor design



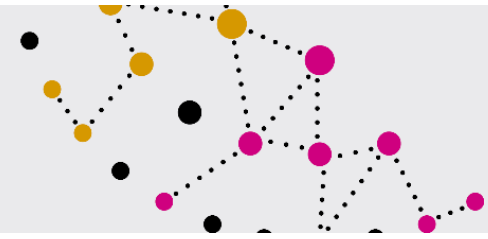
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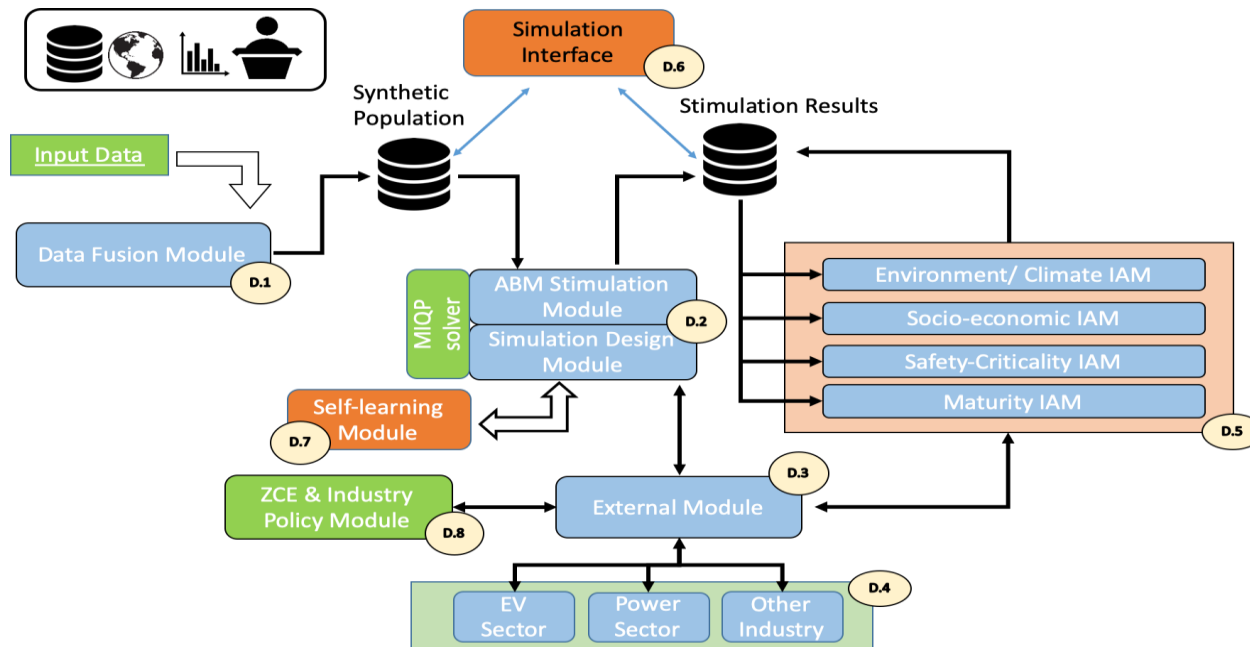


Thematic Area 4 (TA4)

Josh Ignatius, Frank Boons



Developing the technology metals CE Roadmap: Agent-Based Model with Policy Evaluation Architecture



We will examine:
**Scenarios, Interventions,
and Options**

We will conduct:
**Deep Dive / Spark sessions,
Constructor Workshops, and
User Testing of the Roadmap**



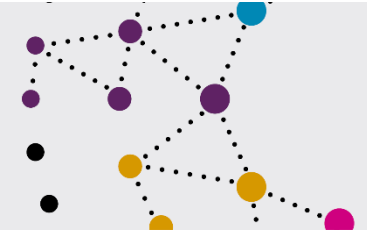
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Some recent Case Study Examples:



Joint Case Study Met4Tech & CE-Hub

Value chains for Rare Earth Elements (REEs) used in Magnets for Electric Vehicles (motors) and Wind Power (turbine blades)



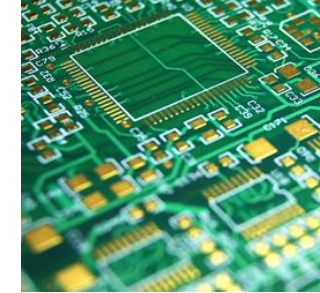
Cornwall Case Study with Company partners

Looking at lithium, tin, tungsten mineralisation and applying new Circular Economy Geo-models (will also be contributed to UN Resource Management System)



Lithium-Ion Batteries Value Chain

Ten challenges for developing a circular economy for Lithium-ion batteries



Solvent Extraction / Delamination Research Innovations

Recovery of tech metals from waste electronic products such as mobile phones, photovoltaic devices, super-magnets, and lithium ion batteries



Responsible Innovation

Development of guidelines based on transparent interactive review of activities and 'learning lessons' for more circular and sustainable approaches



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Many ways to collaborate...



Data collation & value chains



CE systems development



Stakeholder interviews and workshops



CE principles & technology innovations



Developing & testing the CE Roadmap



Providing feedback and ideas

Website: <https://met4tech.org/>

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University of Exeter - Carol Pettit (*senior impact manager*), Victoria Smyth (*project coordinator*)
University of Birmingham - Sam King (*project manager*)