

11<sup>th</sup> October 2023

# Circular Economy Innovation Network

## Taking action towards circularity in aluminium

[www.ktn-uk.org](http://www.ktn-uk.org)



# Interaction

- Please use Q&A function to ask questions
- Networking
  - Please add your name, organisation and interest in this area into the chat
  - You can access the attendee list to contact those after the event
- Break out rooms
  - You will be able to select the break out room
  - Break out rooms will not be recorded

Participants



| Circular Design | Circular Recovery | Circular Business Models |
|-----------------|-------------------|--------------------------|
| Ajay Kapadia    | Robert Quarshie   | Chris Pilgrim            |
| Rachel Wiffen   | Graham Hurrell    | Ebad Bagherpour          |

# Agenda

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10:00 Introduction and overview of innovation action plan for aluminium in a circular economy  
Chris Pilgrim – Innovate UK KTN

10:15 Circular Design – How Life Cycle Assessments can facilitate circularity  
**Rachel Wiffen – Innoval**



10:30 Circular Recovery – How data can enhance material value and recovery  
**Graham Hurrell – Hydro Building Systems**



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11:00 Break out rooms – Meet the speakers and discuss themes

11:35 Next steps – Funding, Initiatives, Collaborations  
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11:45 Meeting close

# Contents – Innovation action plan

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## Why?

Circular economy for aluminium

## What?

Does circular economy for aluminium mean

## How?

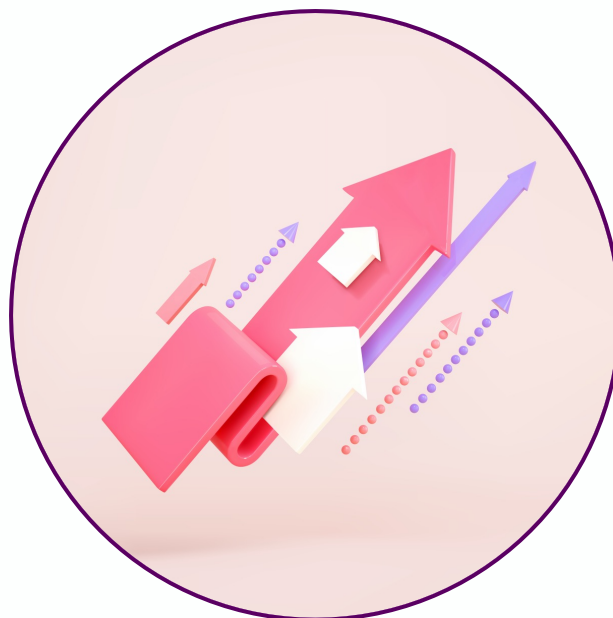
To accelerate circular economy in aluminium

# Drivers for circularity of aluminium in the UK



## Exporting economic opportunity

Export millions of tonnes of aluminium as low grade material, import as high grade for billions of £



## Demand for material

Demand for aluminium is set to increase significantly – securing supply



## Environmental impact

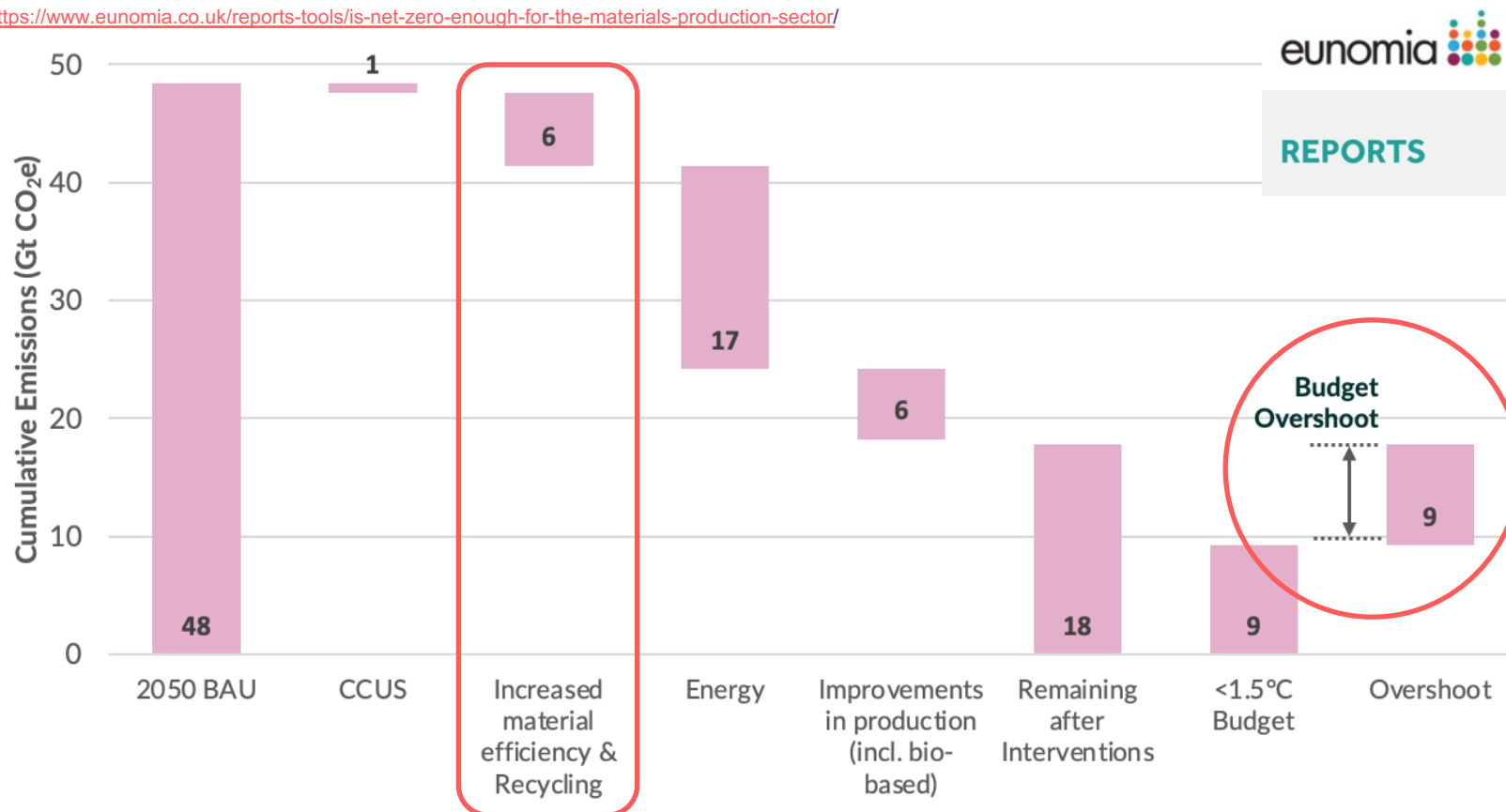
Under increasing scrutiny. Major contribution to Scope 3

# Environmental impact – Net Zero

- Net Zero can't wait to 2050
- Delink growth in aluminium production and GHG emissions
  - Electricity decarbonisation, direct emissions reduction and resource efficiency
  - “To avoid the GHG emissions overshoot, the increase in the demand for virgin aluminium would need to slow and even reverse from current levels.” Eunomia report, 2022, Is Net Zero Enough for the Materials Production Sector?

## Global aluminium sector specific numbers

<https://www.eunomia.co.uk/reports-tools/is-net-zero-enough-for-the-materials-production-sector/>



**Circular Economy  
is essential**

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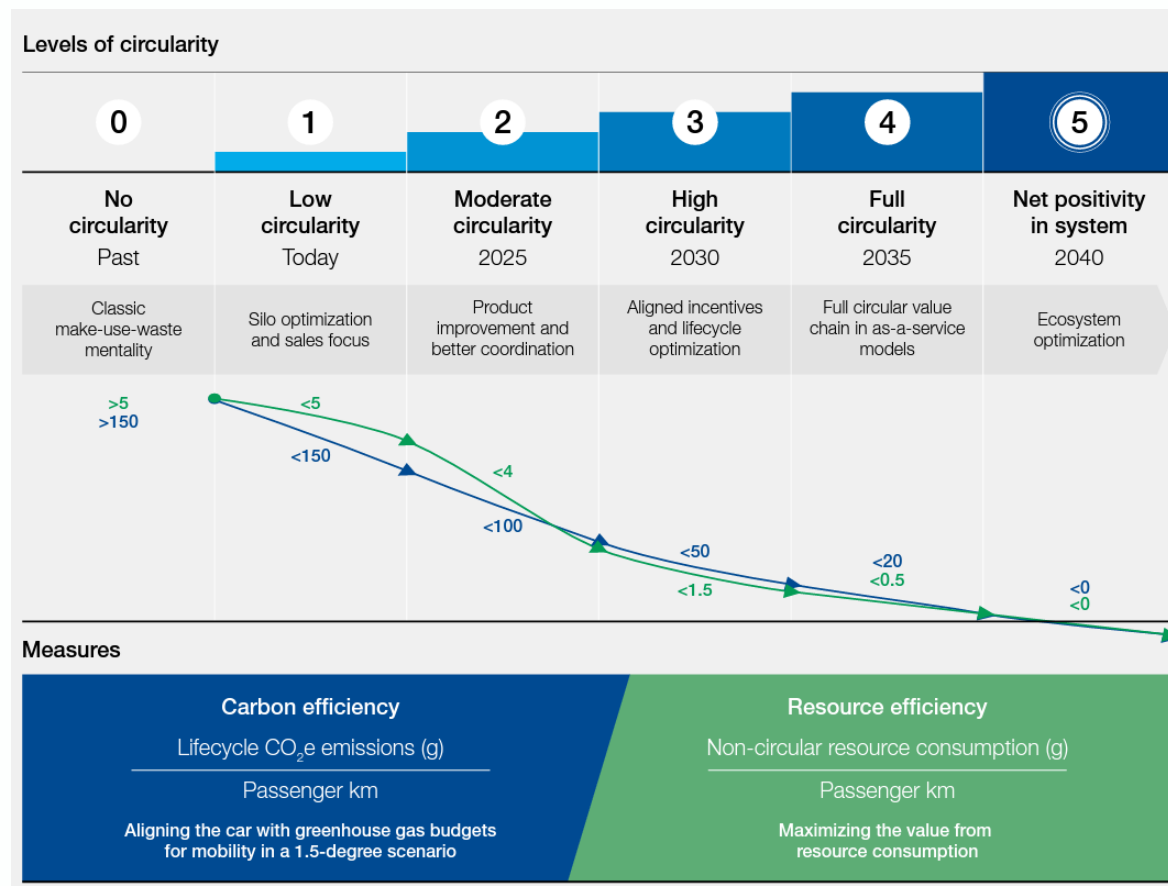
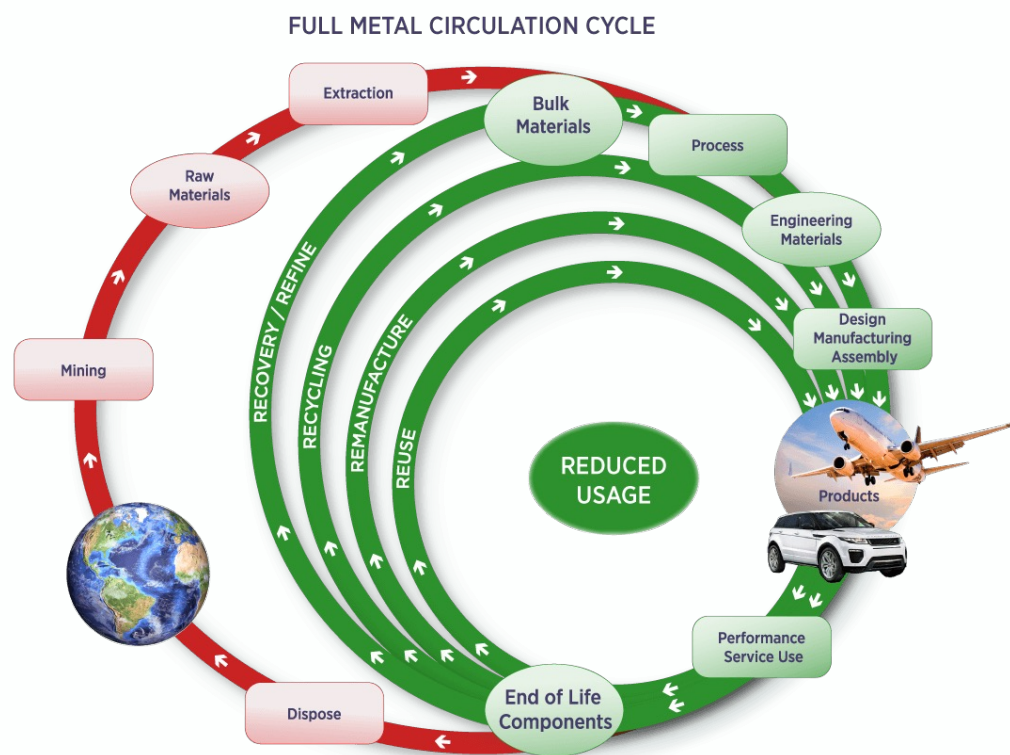
## How?

To accelerate circular economy in aluminium

# Circular Economy Principles

1. Design out waste and pollution
2. Keep products and materials in use – at highest value for longest time
3. Regenerate natural capital – Do more good not just less harm

Driving Ambitions: The Business Case for Circular Economy in the Car Industry  
 INSIGHT REPORT MAY 2022  
[https://www3.weforum.org/docs/WEF\\_Driving\\_Ambitions-2022.pdf](https://www3.weforum.org/docs/WEF_Driving_Ambitions-2022.pdf)





# Circular Economy Innovation Network

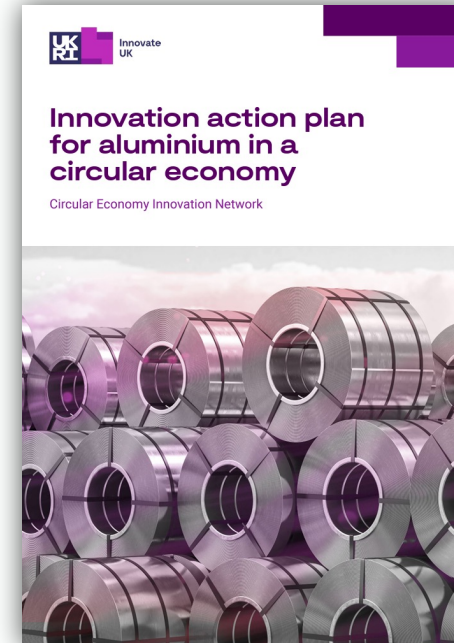
Circular Economy Innovation Network aims to enable stronger, more resilient industries working together, connecting, collaborating, and sharing experiences to achieve Net Zero through circular innovation.



Industrial waste gases to chemicals



Wool



Aluminium

# Contents – Innovation action plan

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Circular economy for aluminium

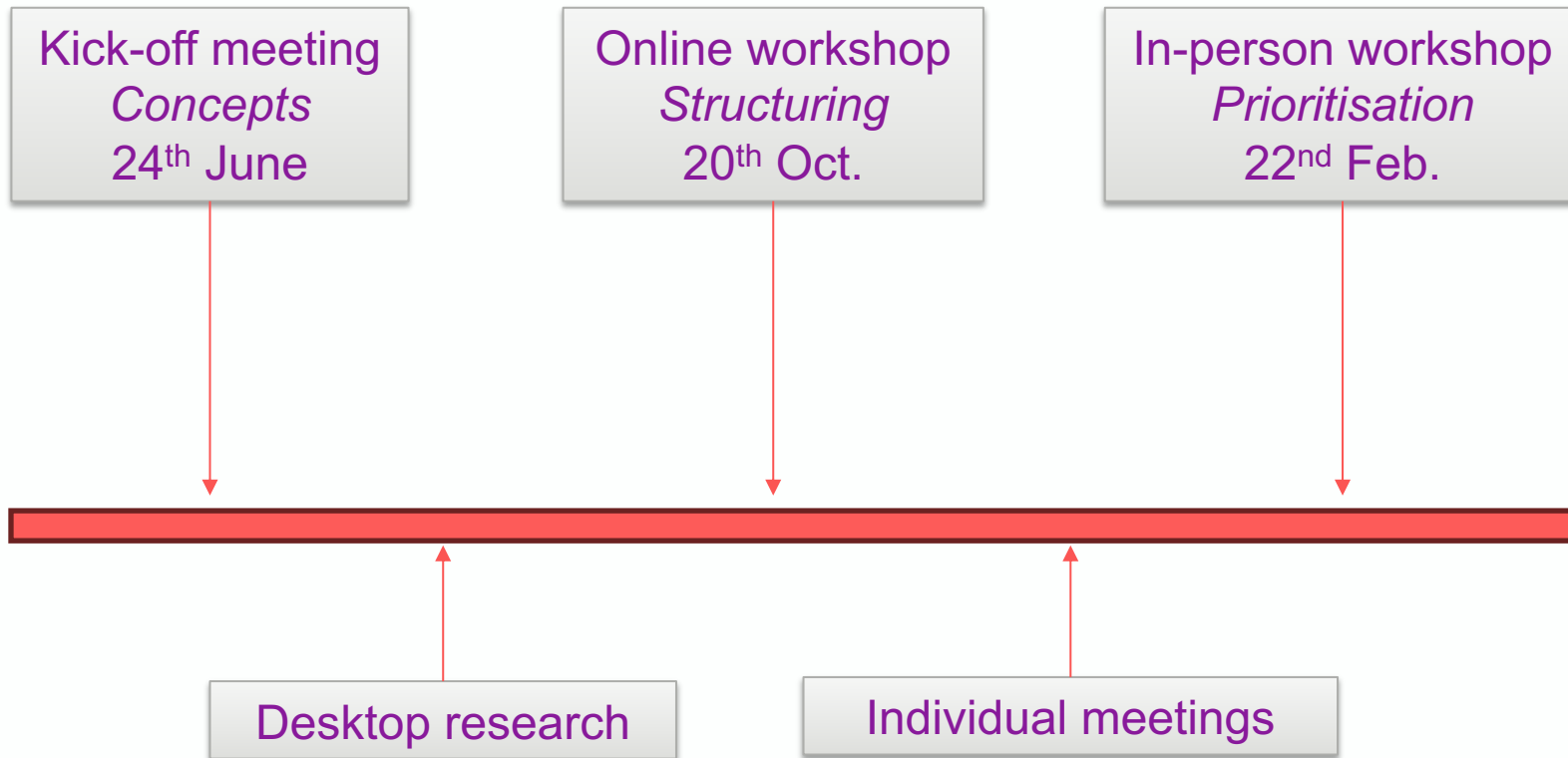
## What?

Does circular economy for aluminium mean

## How?

To accelerate circular economy in aluminium

# How did we create action plan?



## Innovation action plan for aluminium in a circular economy

Circular Economy Innovation Network



Over 1000 members of Circular Economy Innovation Network  
Over 350 members of aluminium workstream

# Innovation action plan



## Circular Economy focus areas



Circular Design

**Greener aluminium**



Circular Recovery

**Maximise re-used**

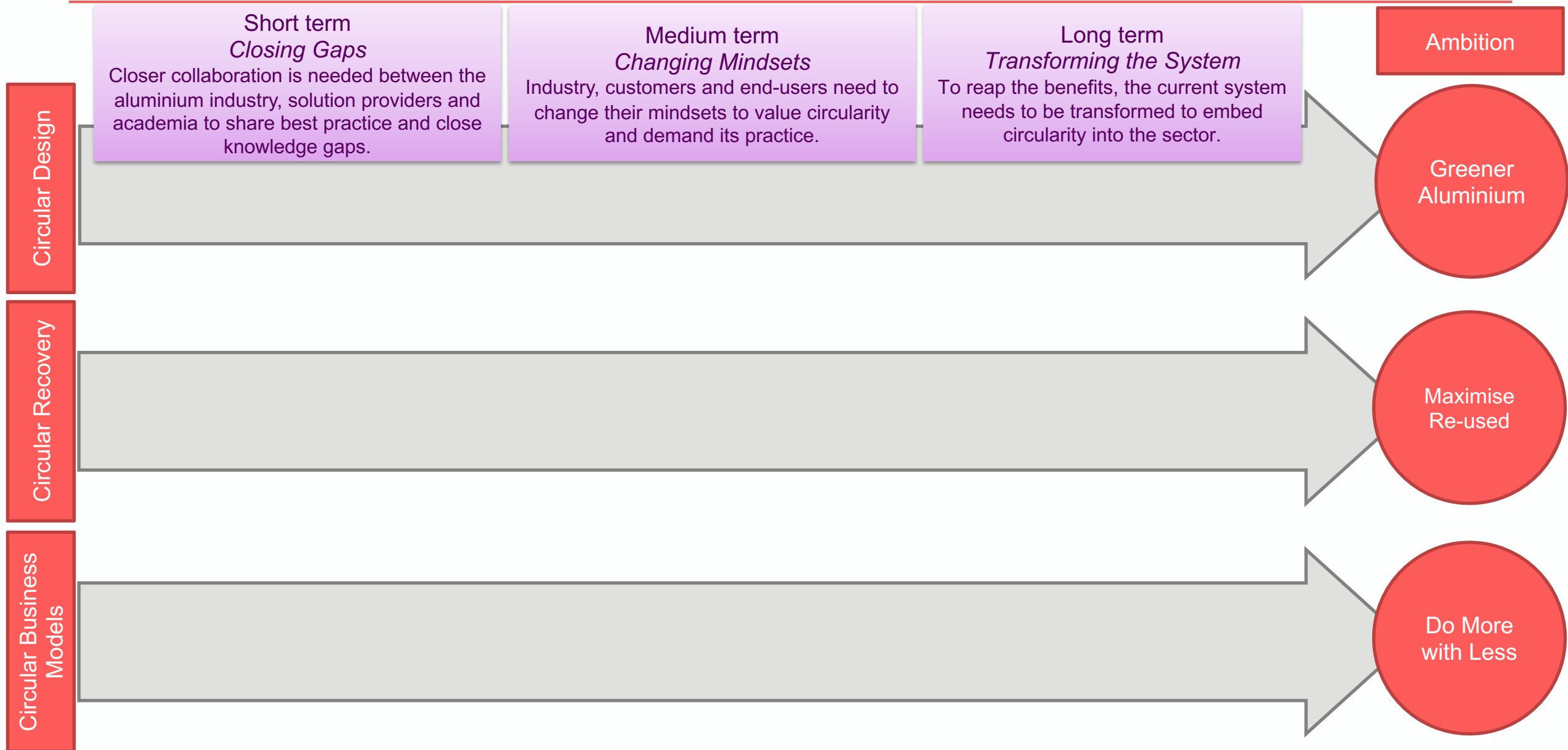


Circular Business Models

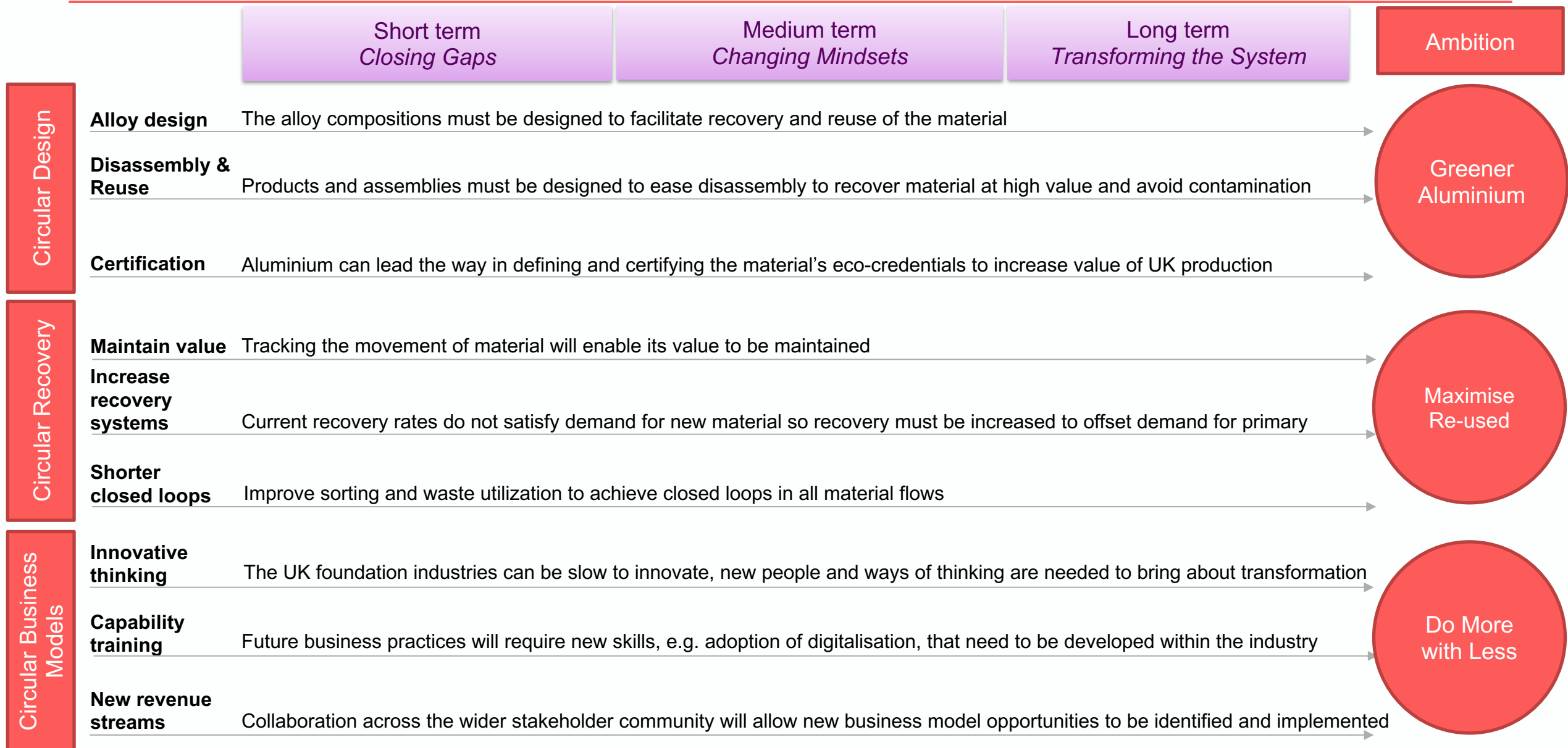
**Do more with less**

**Pathway to accelerating circularity of aluminium**

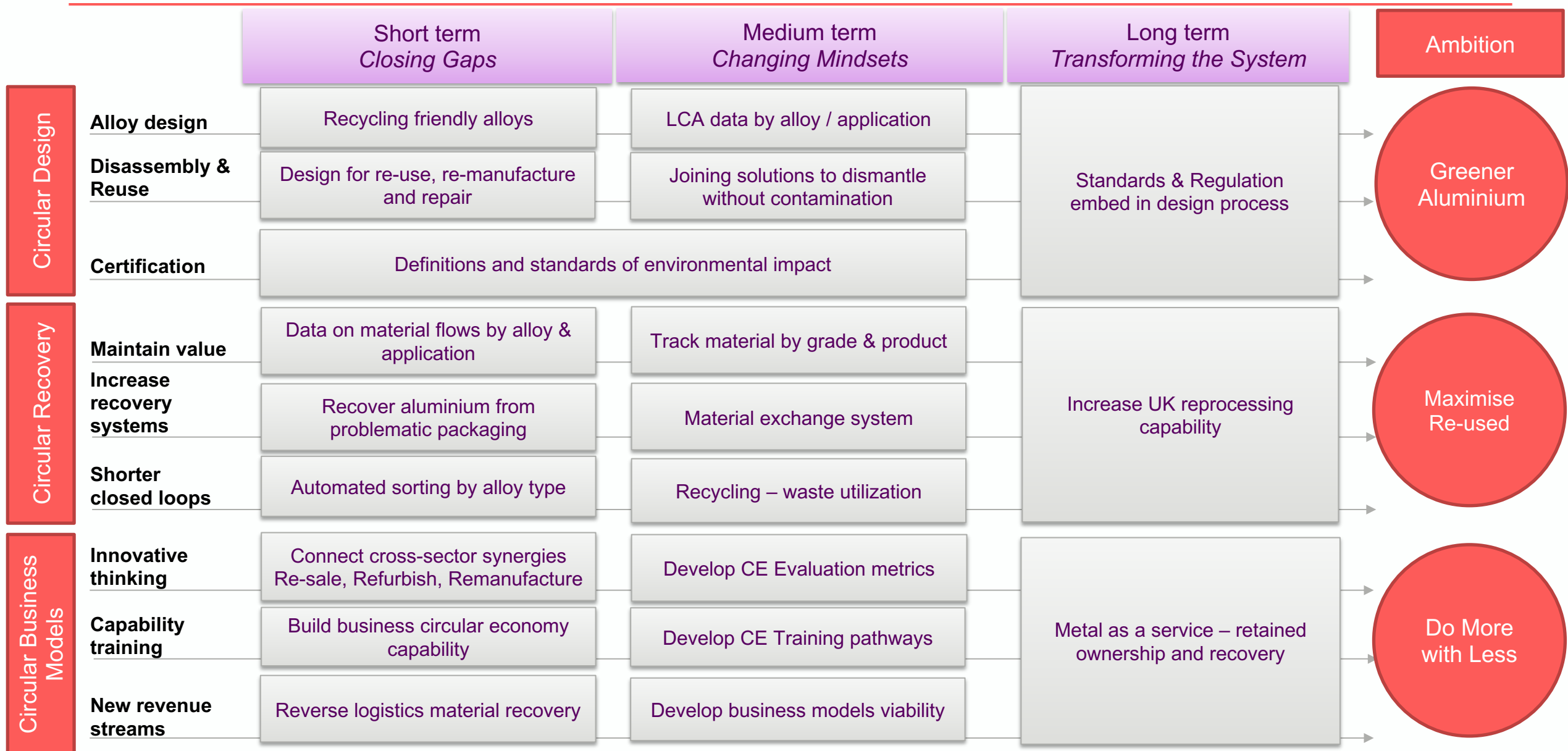
# Overview of action plan – Timeline



# Overview of action plan – Themes



# Overview of action plan – Individual actions



# Circular Design – Greener aluminium

## Alloy Design

- Alloys with increased recycled content becoming available
- Not possible in some applications and industries
- Need to design alloys to facilitate increased use of recovered material

## Product design

- Design products to facilitate reuse, recovery and remanufacture
- Rationalise alloys in assemblies
- Consider the full life of the material – Life Cycle Assessments



### New grades of recycled steel: Project shortlisted for award

August, 2023



A project that seeks to create new high-quality grades of recycled steel as a sustainable alternative raw material for the cement industry – has been shortlisted for the External Partnership Award at this year's [World Sustainability Awards](#).

### Brunel joins Constellium-led consortium working on £10m CirConAl project

By Press Office  
19 Dec 2022

Share this



A collaborative partnership between Brunel University London and Constellium to develop low-carbon aluminium extruded alloys for structural electric vehicle applications has been awarded funding from the UK government.



InnovateUK  
KTN



# Circular Recovery – Maximise re-used

## Data

- Maintain value and facilitate recovery
- Digital ledger technology and QR codes
- Digital design

## Waste utilisation

- Recycling produces hazardous waste
- Technology available to recover materials from waste



### Digital Construction Awards 2023: Skanska triumphs in Delivering Net Zero with Digital Innovation



Cristina Lago  
Deputy editor, Construction Management  
05.07.23



### Nine Blockchain Projects to be Fully Funded by Welsh Government

TECHNOLOGY NEWS WALES, 27TH MAY 2022

SHARE

A Welsh Government fully funded research and development scheme entitled "Demonstrating the Potential of Blockchain", run by Blockchain Connected, attracted such a significant level of interest and high-quality applications that a total of nine projects have successfully received funding.

# Circular Business Models – Do more with less

- Linear model - That's not my problem
- Collaborate along supply chains
- Demand for low carbon materials is increasing
- Unlock purchasing power for investment



## Porsche and Hydro unite to further decarbonize the supply chain of sports cars

Porsche AG and Norsk Hydro ASA will work together to further reduce the carbon footprint of Porsche's car models by using low-carbon aluminum and extrusions from Hydro. In addition, the two companies will collaborate on an innovative value chain concept for battery materials and battery recycling. The German luxury sports car maker and the Norwegian industrial company have signed an agreement in Oslo today, to strengthen the sustainability strategies of both companies.



07.04.2021

## Striving for zero: the 2030 climate-neutral car plan

It's said that a journey of a thousand miles begins with a single step. We've already broken up with the conventions of the car industry, determined to accelerate the change to a more sustainable future. Now we're embarking on our greatest journey so far: challenging ourselves to create a climate-neutral car by 2030, by reducing emissions throughout supply chain and production.

How can you do more with less?

**Flue2CHEM**  
SCIENCE BASED INDUSTRIES JOIN FORCES FOR FIRST TIME TO ADDRESS UK NET ZERO TARGET

**PURPOSE**  
The Flue2Chem project will *convert industrial waste gases* to create more *sustainable consumer products*.

**METHOD**  
Development of a new business model and capability to utilise industrial waste gases to produce affordable feedstocks and chemicals for use in the production of consumer products in the UK.

**FUNDING**  
£2.68 million from Innovate UK

**GOAL**  
Cut around 15-20 MILLION TONNES of carbon dioxide emissions a year and *help* the UK reach its net zero target.

**LENGTH** TWO-YEAR PROGRAMME

**PARTNERS**

- Unilever
- JM
- SCI. where science meets business
- P&G
- cpi
- BASF
- LIPM/BIOFORE BEYOND FOSSELS
- TATA STEEL
- carbon clean
- CRODA
- University of Sheffield
- reckitt
- UNIVERSITY OF SURREY
- cpi
- HOLMEN

Industry giants from £73 billion UK sector embark on first ever cross sector collaboration to tackle decarbonisation.

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INNOVAL

# Can LCA facilitate circular design and encourage a circular economy?

OCTOBER 2023 / ICJ23-021-02  
AUTHORS: R. WIFFEN



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# Can LCA facilitate circular design and encourage a circular economy?

## **Rachel Wiffen.** **Senior Process Engineer.**

- Mechanical Engineering Degree from the University of Nottingham.
- Manufacturing background at an aluminium producer, in various areas of aluminium processing; casting, rolling, finishing.
- Working at Innoval as a Senior Process Engineer, and Quality Systems Manager.
- Working within the process group at client sites, using systems and process modelling tools, delivering training courses.
- Co-leading Innoval's LCA strategic service.



# Life Cycle Analysis.

It is a structured, comprehensive and internationally standardised method (ISO 14040 and 14044) used to assess a product or service.

It relates to the environmental and resource depletion issues. The method quantifies the product or service based on the associated inputs, outputs and processes.

Circular economy would consider a cradle-to-cradle approach.



Image source: [www.bioprocessonline.com/doc/environmental-life-cycle-assessment-of-single-use-technologies-0001](http://www.bioprocessonline.com/doc/environmental-life-cycle-assessment-of-single-use-technologies-0001)

## 1. Goal & Scope Definition.

**Goal:** Can be considered with the commissioner of the study.

**Scope:** Describes the detail and depth of the study.

## 2. Life Cycle Inventory (LCI).

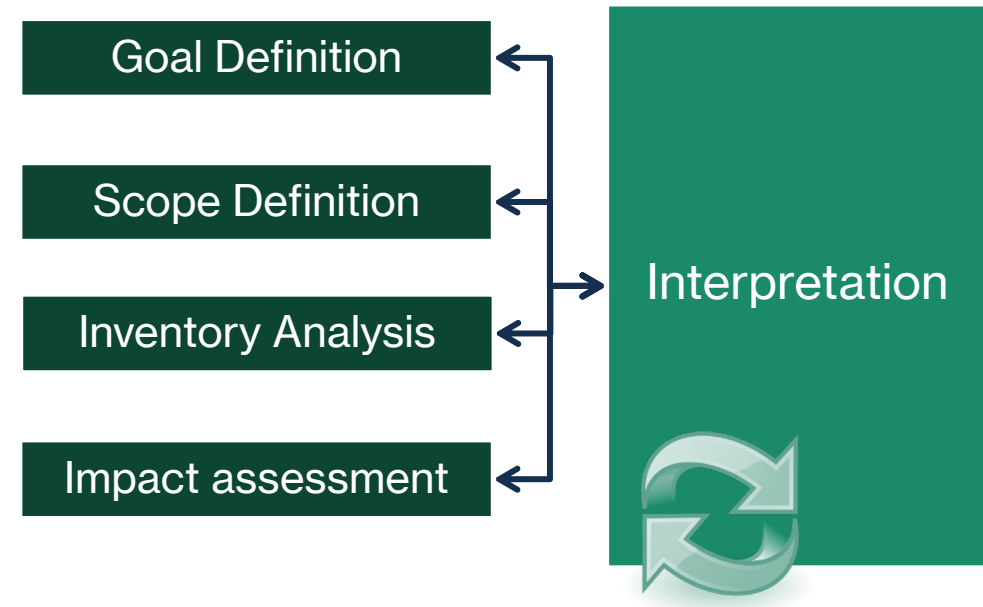
Starts with a model of the flows in and out of a product system. Data is collected for all the modelled activities that are within the system boundary.

## 3. The Life Cycle Impact Assessment (LCIA).

Evaluates the potential impacts resulting from the data collected in the LCI stage. There are several LCIA methodologies to choose from.

## 4. Interpretation.

Assessment of the data collected will be reported as per the intentions of the study which are outlined in the goal and scope definition.





# Environmental Product Declarations (EPDs).

An EPD is an independently verified environmental assessment highlighting the potential impact of a product/service over its life cycle according to ISO 14025.

An EPD shows the results of an LCA, which is conducted within strict requirements as determined by the Product Category Rules (PCR).

Strictly defined PCRs for conformance, transparency and comparability to other products/services.

## Define EPD strategy.

- Select programme operator and highlight relevant PCR.

## Conduct LCA according to Product Category Rules.

- Define life cycle stages to cover.
- Collect data.
- Conduct life cycle impact assessment.
- Prepare LCA background report for EPD and verification.

## Prepare EPD.

- The EPD style will depend on the programme operator and/or PCR.

## LCA/EPD 3<sup>rd</sup> party verification.

- Every EPD (LCA) requires independent verification. The verifier will check for accuracy, reliability and conformance to the PCR.

## EPD Publication.

- In order for the EPD to be put into the public domain, it will need to be submitted to the programme operator who will register, certify and publish the EPD.
- The EPD can then be used for marketing and other commercial activities.
- EPDs are typically valid for 5 years unless significant changes are made to the product/service.

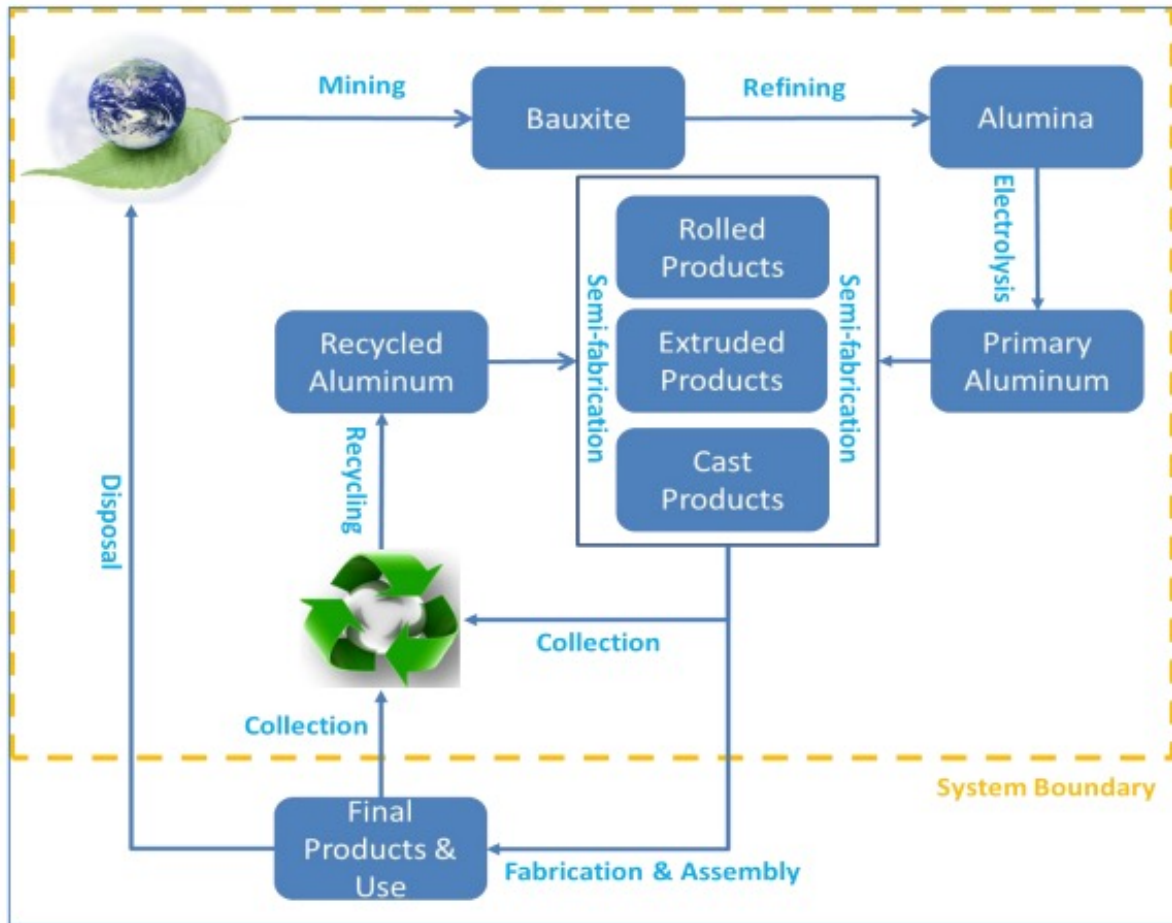
Summary of opportunities based on consultation with UK industry, government and academia

|                          | Short term<br>Closing Gaps | Medium term<br>Changing Mindsets                                | Long term<br>Transforming the System                    | Ambition          |
|--------------------------|----------------------------|---|---|-------------------|
| Circular Design          | Alloy design               | Recycling friendly alloys                                       | LCA data by alloy / application                         | Greener Aluminium |
|                          | Disassembly & reuse        | Design for re-use, re-manufacture and repair                    | Joining solutions to dismantle without contamination    |                   |
|                          | Certification              | Standards and definitions of environmental impact               | Circular Economy certification by product specification |                   |
| Circular Recovery        | Maintain Value             | Data on material flows by alloy & application                   | Track material by grade & product                       | Maximise Re-used  |
|                          | Increase recovery systems  | Recover aluminium from problematic packaging                    | Material Exchange System                                |                   |
|                          | Shorter Closed Loops       | Automated sorting by alloy type                                 | Recycling waste as a feedstock                          |                   |
| Circular Business Models | Innovative thinking        | Connect cross-sector synergies Resale, refurbish, remanufacture | Develop CE Evaluation metrics                           | Do More with Less |
|                          | Capability Training        | Build business circular economy capability                      | Develop CE Training Pathways                            |                   |
|                          | New revenue streams        | Reverse logistics and backhaul optimisation                     | Develop business models viability                       |                   |

# Circular Design and LCA.

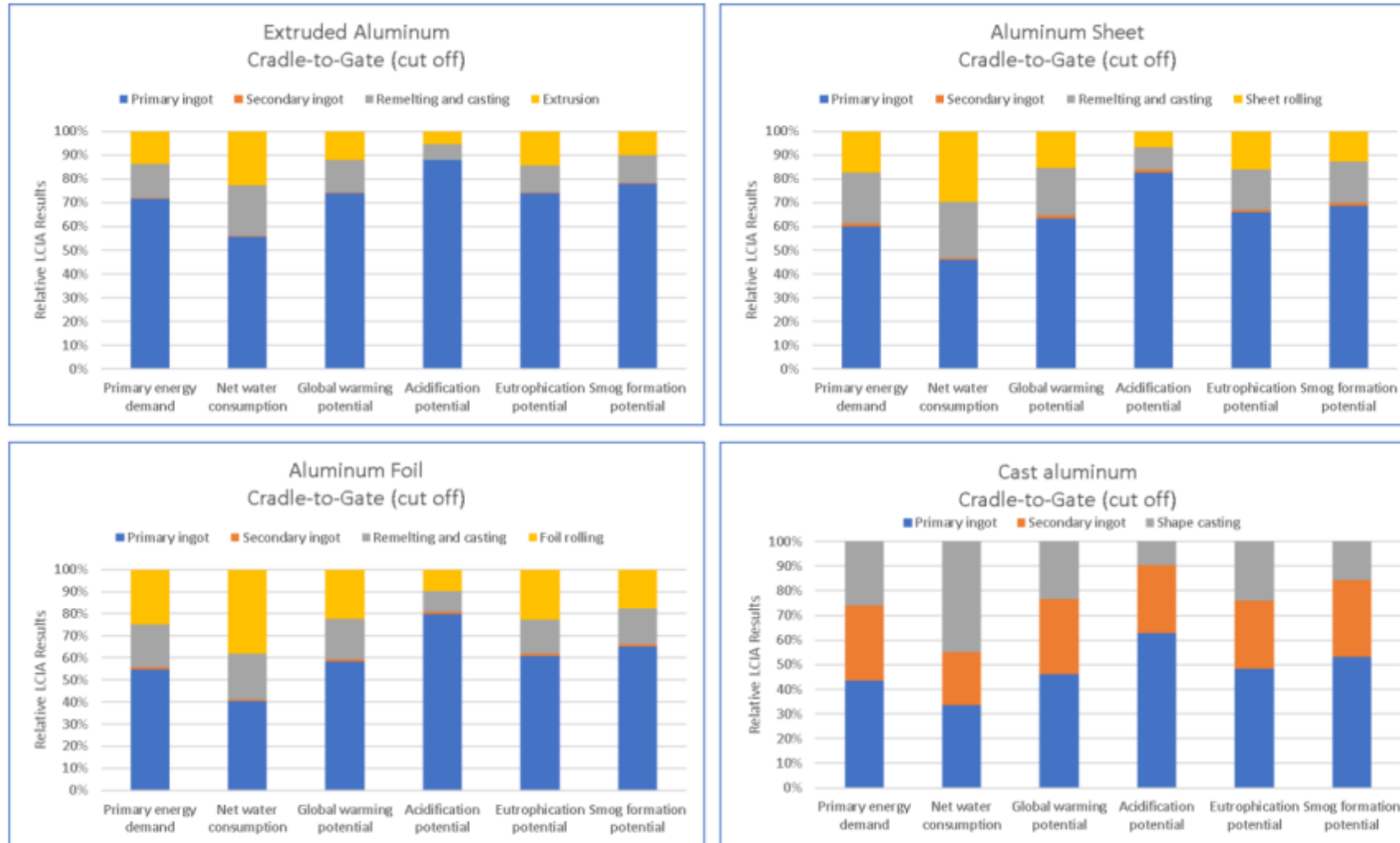
## LCA data by alloy / application

Develop a modular and consistent life cycle assessment (LCA) for aluminium products. Existing LCAs are inconsistently applied so difficult to compare. The LCA needs to consider the full life of the product and as such can articulate the benefits of circularity.



As an example:

This study looks at rolled, extruded, and cast, aluminium products.

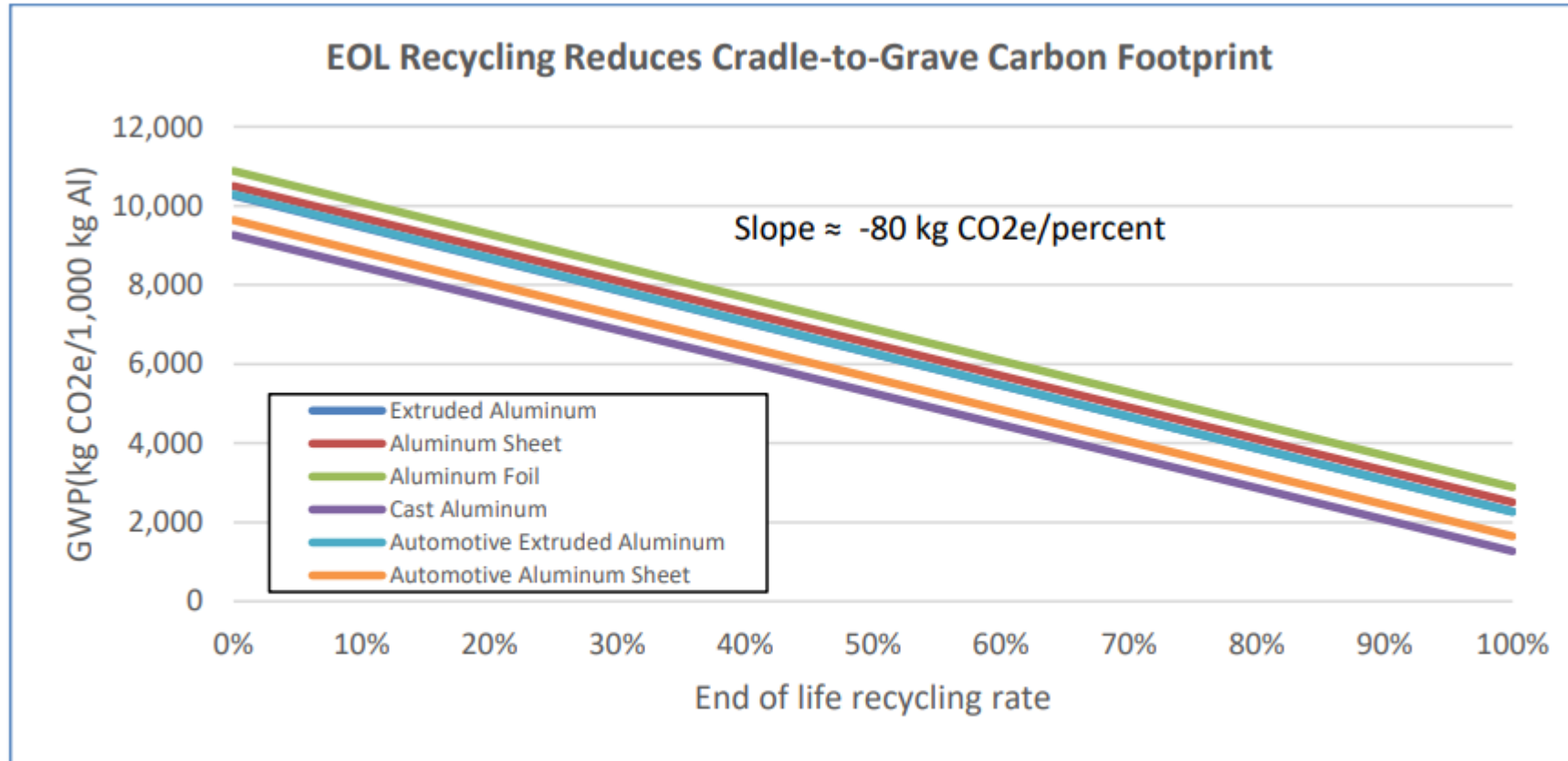


**Figure 9-1: Breakdown of Cradle-to-Gate LCIA Results for extrusion, sheet, foil and cast aluminum**

Source: The environmental footprint of semi-fabricated aluminium products in North America. A life cycle assessment report. The aluminium association, Jan 2022., Marshall Jinlong Wang.



**Figure 9-7: Breakdown of Cradle-to-Grave (excluding fabrication and use phases) LCIA results**



**Figure 9-10: The impact of recycling on the overall global warming potential of semi-fabricated aluminum products**

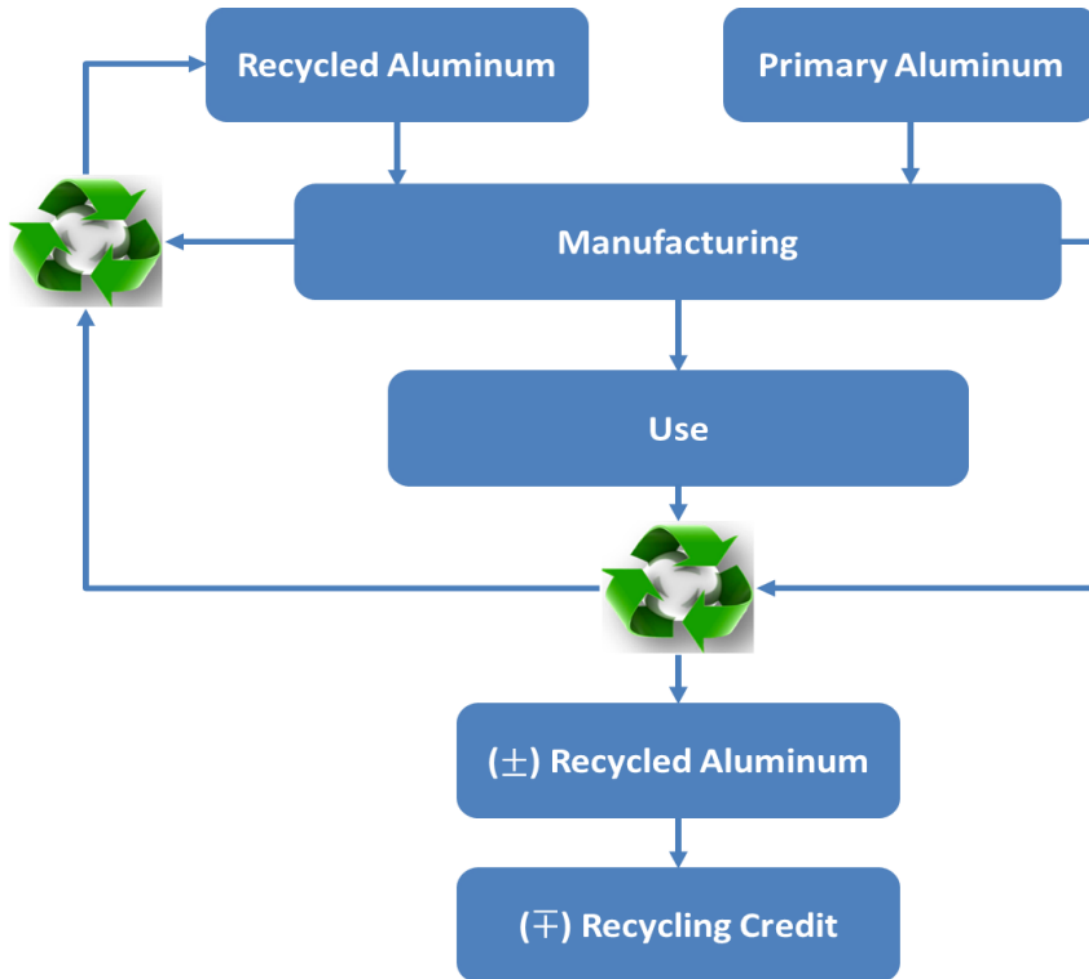


Figure 5-1: Process flow chart for the Net Scrap Substitution Approach

The net scrap method is a variant of the substitution method and is said to promote a circular economy.

# Allocation methodologies.

Examples of allocation methodology:

- Cut –off
- Substitution
- Hybrid Approaches
- PEF CFF (Product Environmental Footprint, Circular Footprint Formula).

The method chosen will affect the results of the study, it is paramount that allocation method is justified and where possible more than one methodology is demonstrated.

European Commission recommend the use of PEF method using CFF:

[https://environment.ec.europa.eu/news/environmental-footprint-methods-2021-12-16\\_en](https://environment.ec.europa.eu/news/environmental-footprint-methods-2021-12-16_en)



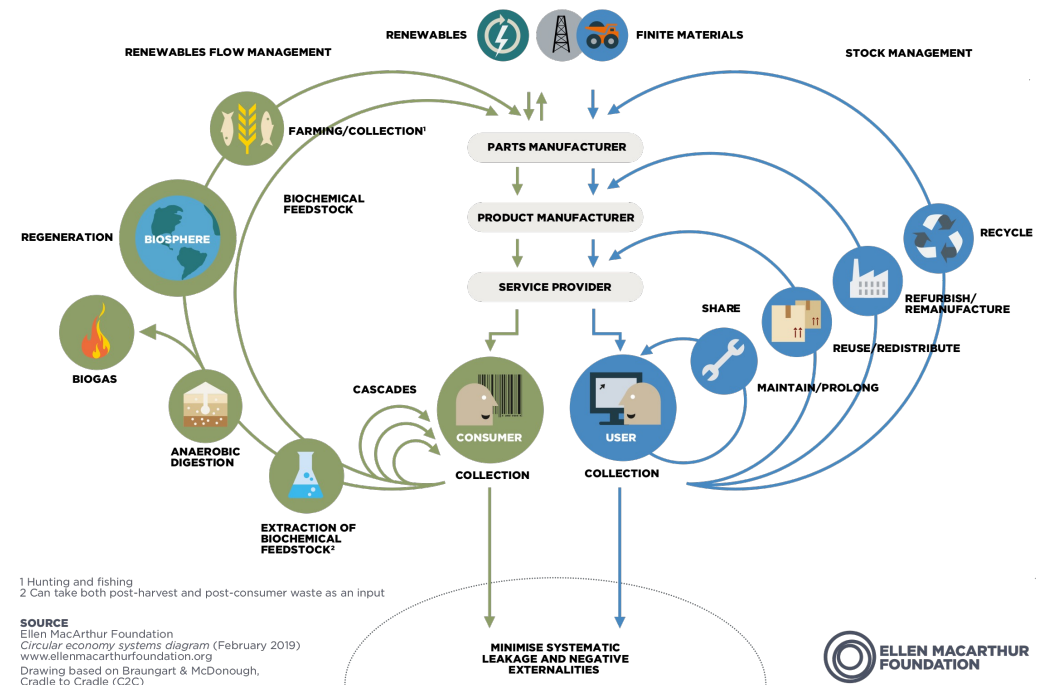
# LCA can facilitate circular design and encourage a circular economy.

There are numerous impacts to consider not just carbon footprint.

LCA helps us to highlight and understand the environmental impacts of our products and services. Improvements can be made at design stage.

Transparency is key to unlocking the barriers and consistency issues.

Supply chain collaboration is integral to a circular economy for aluminium.



# Thank you.

We are a collective of expert consultants who work with partners to develop products and production methods that put sustainability first.

[enquiries@innovaltec.com](mailto:enquiries@innovaltec.com)

# About Innoval.

We believe that all products should be good for people and for the planet.

We are a collective of expert consultants who work with partners to develop products and production methods that put sustainability, usability and efficiency first. We build long-term relationships to help organisations design, develop and manufacture better products for end-users and the environment.

Our remit is not limited to aluminium. However, we work predominantly with aluminium because of its many benefits.

We are constantly evolving and innovating our approaches based on the best materials and methods that are available, and that may become available in the future.



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# INNOVAL

PART OF THE **DANIELI** GROUP

# Agenda

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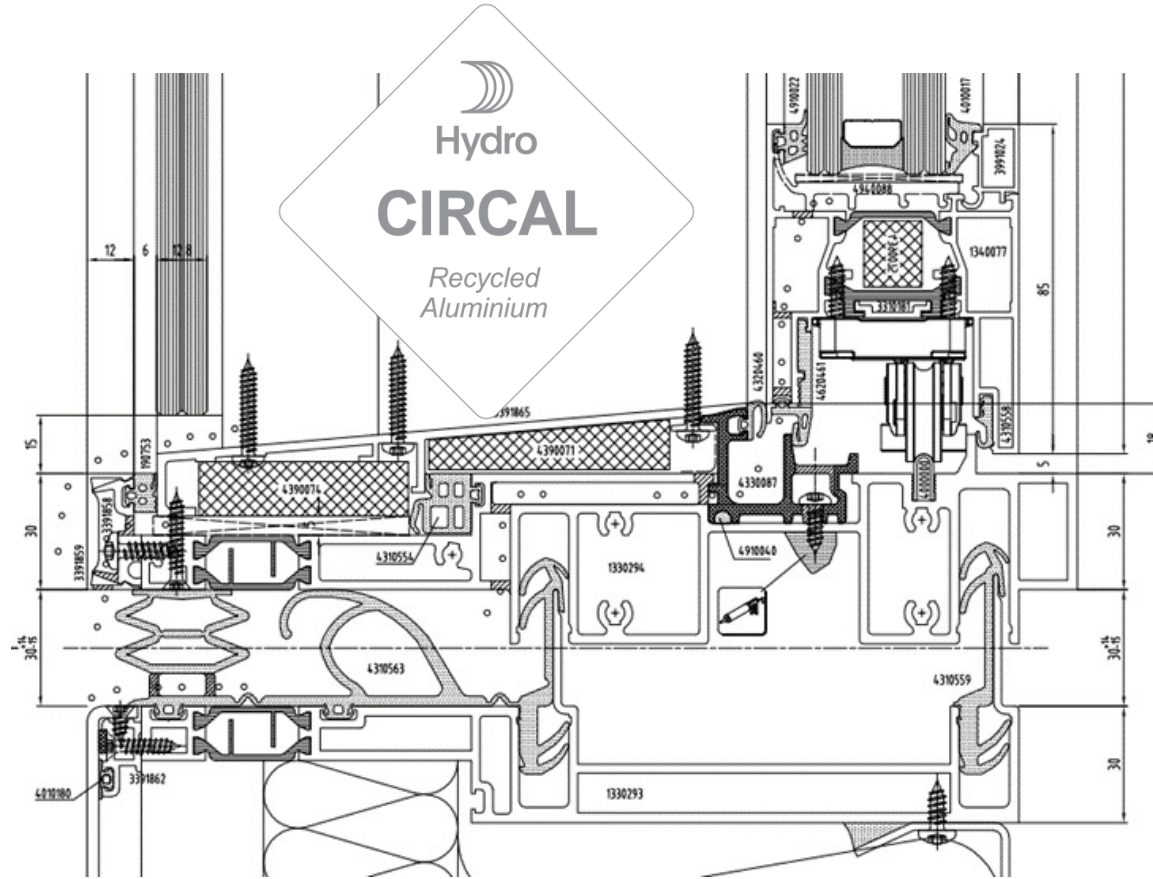
Hydro

# Aluminium building facades: Improving circularity with data

Graham Hurrell

11<sup>th</sup> October 2023

# Hydro and Hydro Building Systems



**WICONA®**  
By  Hydro

  
**TECHNAL®**

By  Hydro

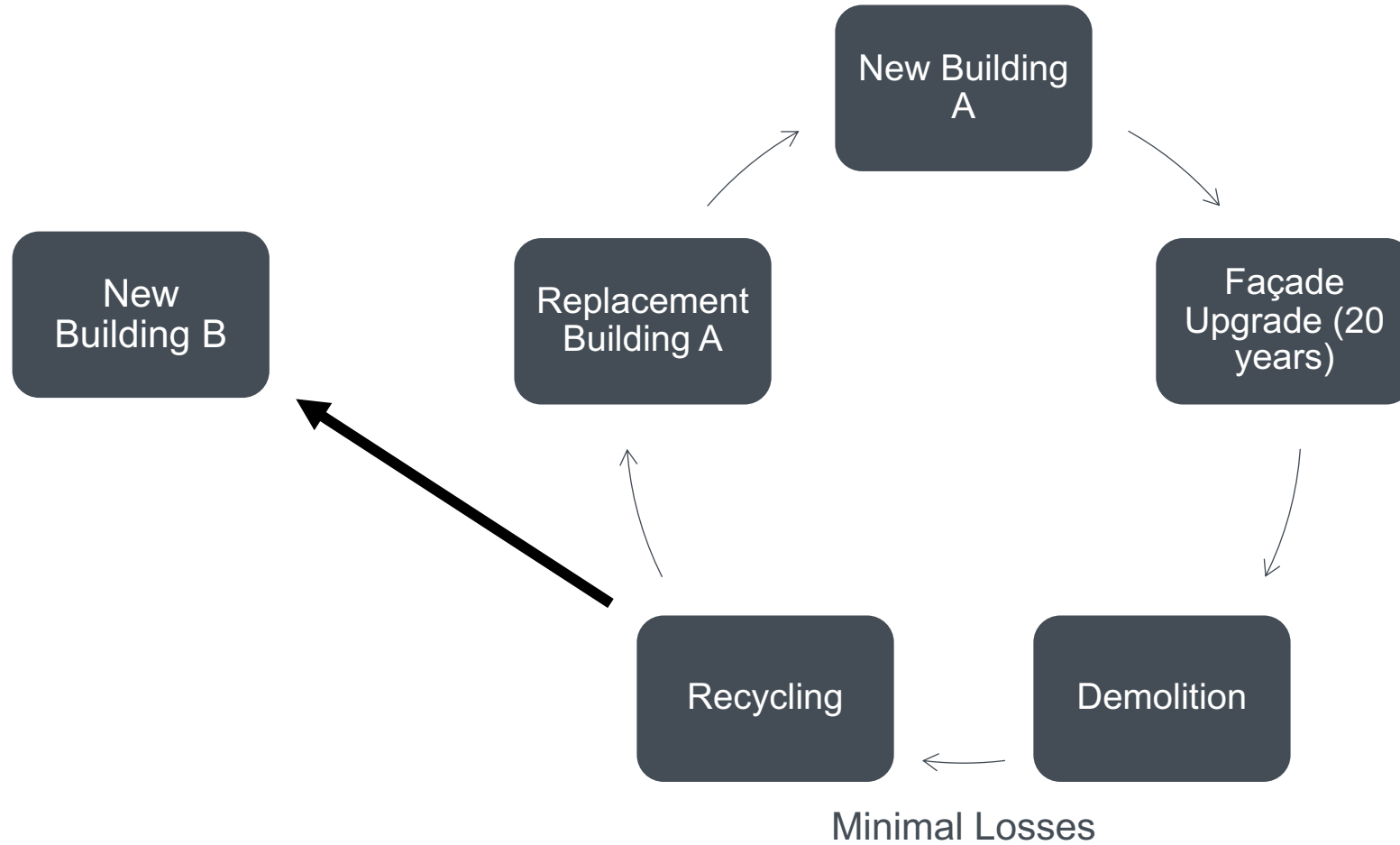
# The Challenge & Barriers To Circularity

1. Facades wear out and fall behind the performance curve.
2. Building owners' needs change over life of the building.

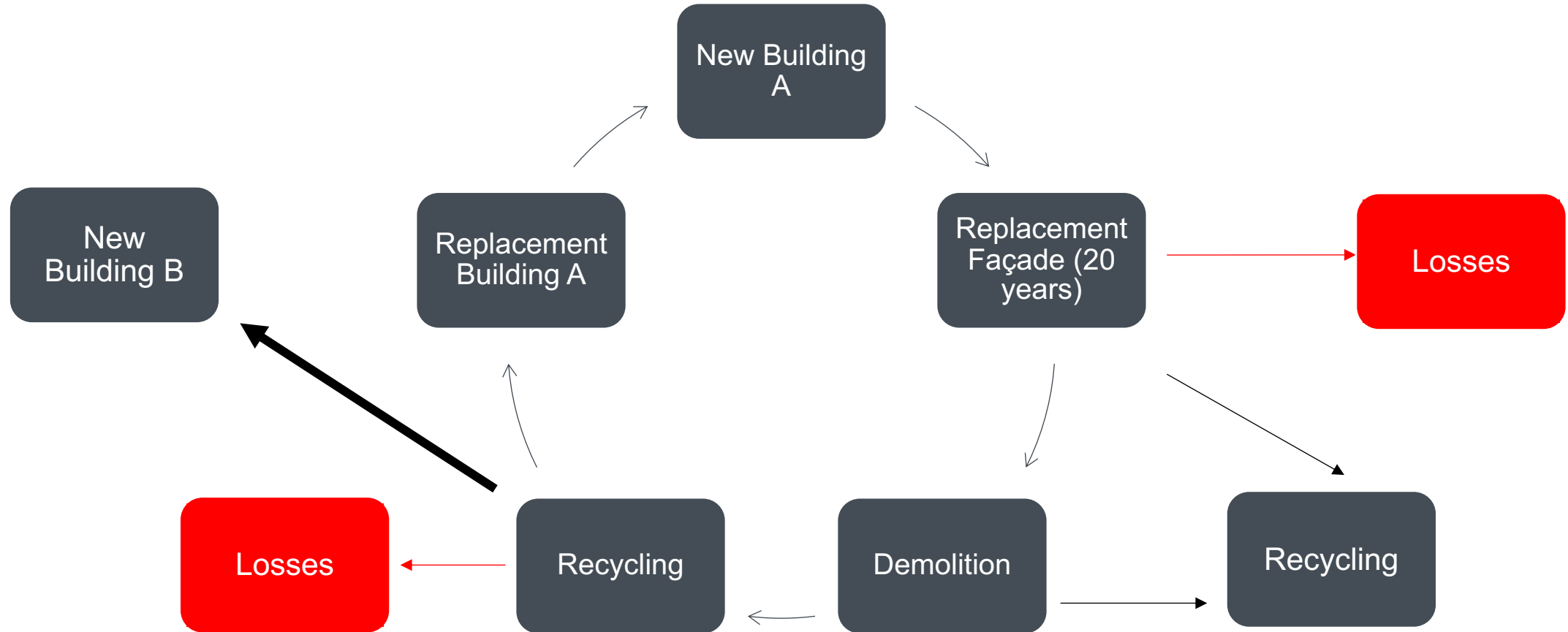
1. Façades replaced prematurely (building demolition/rebuild or renovation) due to perceived lack of adaptability.
2. Façade materials removed from the building may not be curated into the best recycling chain (glass to landfill or secondary use is a big issue)



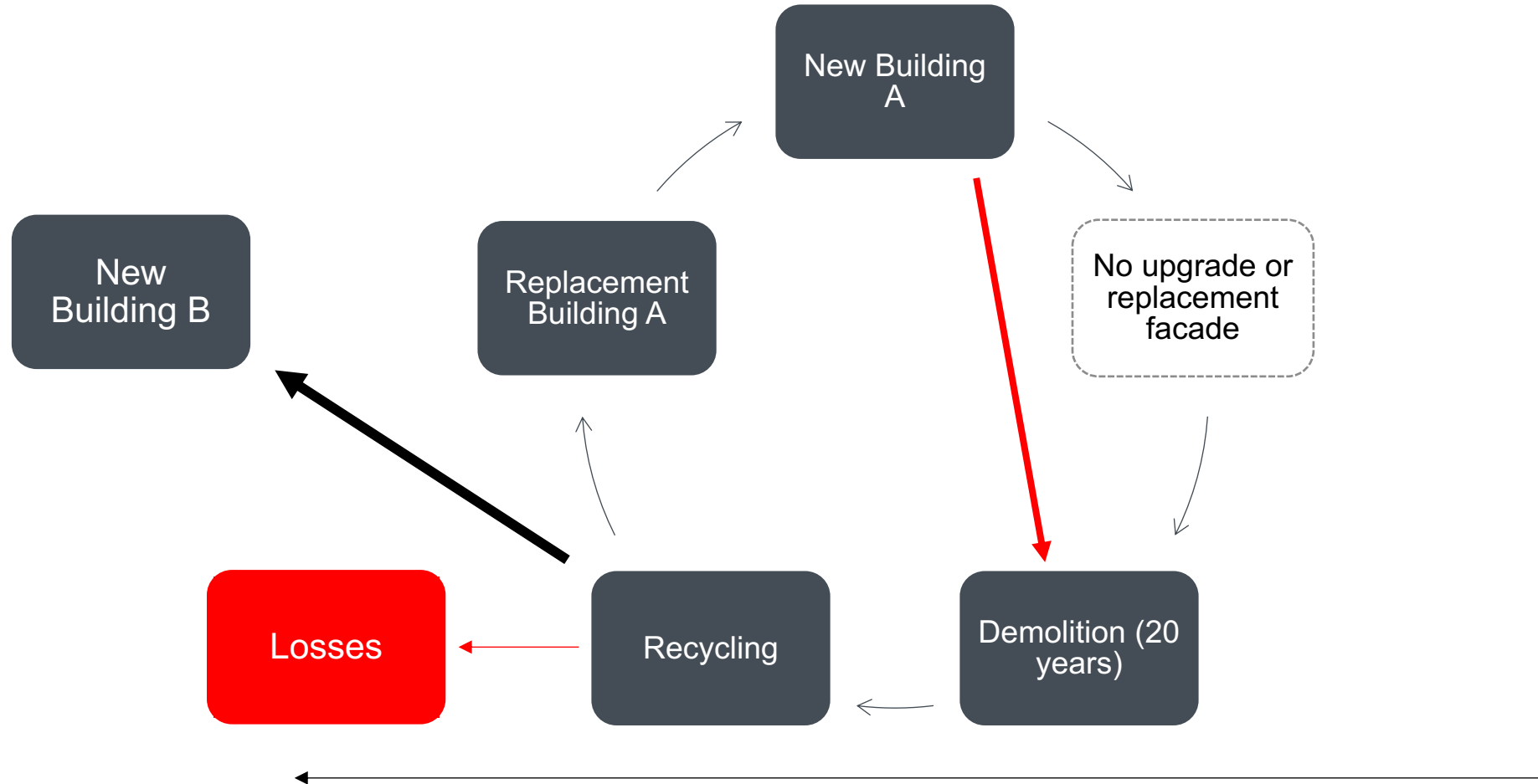
# Façade Ideal Cycle (40 years?)



# What Often Happens.....



# What Often Happens (20 Year Cycle)



# How Can The Facade Be Upgraded?

- Change double glazing to triple glazing
  - Energy efficiency, acoustic insulation
- Add or remove opening lights
  - Ventilation, safety
- Modify hardware
  - Accessibility
- Improve weather seals
  - Weather tightness and energy efficiency
- Add solar shading
  - Energy, comfort



# Typical Reasons For Not Upgrading A Façade

- Client not aware it's possible.
- Records of the relevant data to specify the upgrade may not be on file.
  - Building Safety File?
  - Use of BIM data is sporadic.
  - Building owner changes and records are not transferred.
  - Golden Thread prioritises safety info not circularity.
  - Material passports?
- Façade products may not be designed to be modified.
- Circularity is a “relatively new” idea.

# Getting The Data

- **What data do we need?**

- Material specifications
- Component references
- Quantities
- O&M manual
- Manufacturing manuals
- Installation manuals

- Nice to have...

- **EPD**
- **Etc.....**

- **Where can it be kept?**

- Building owner files?
- Land Registry?
- Third party cloud storage (eg Madaster)?
- Fixed to the window?

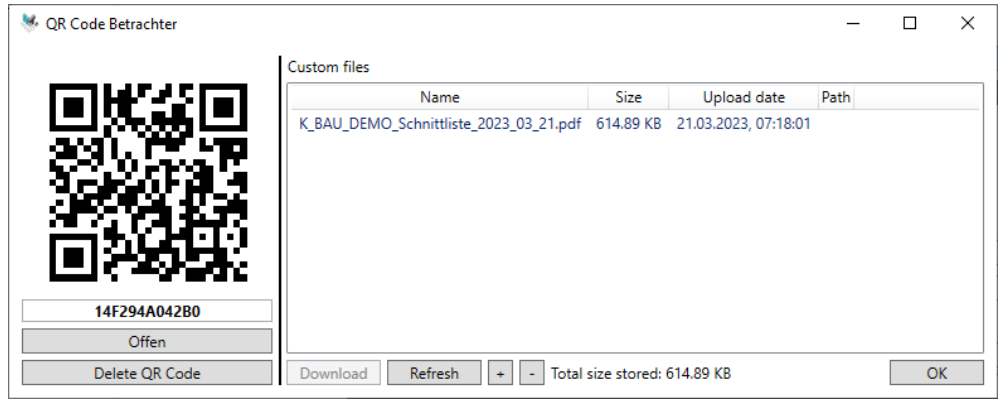
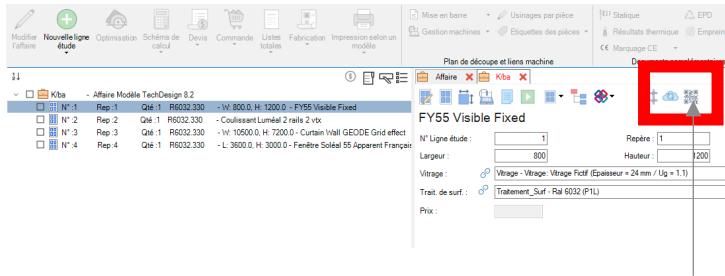
- **Where can we get it from?**

# WICTOP – Manufacturing Software

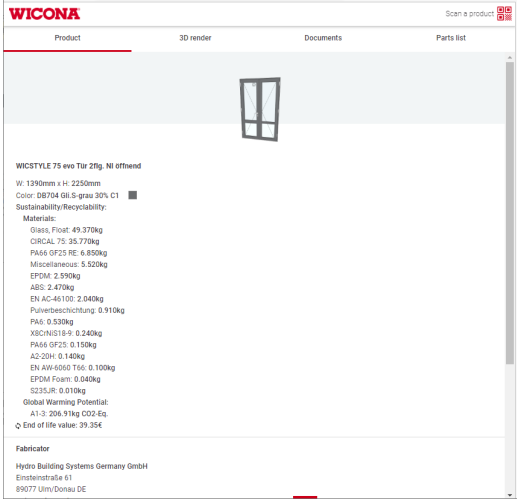


Digital ID

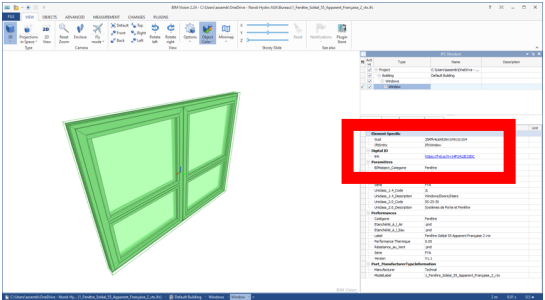
Direct access to the webpage to visualise the content.



QR code visualisation



Also integrated in BIM export



# QR Code Attached Long Term

TechDesign

/TRY ME !







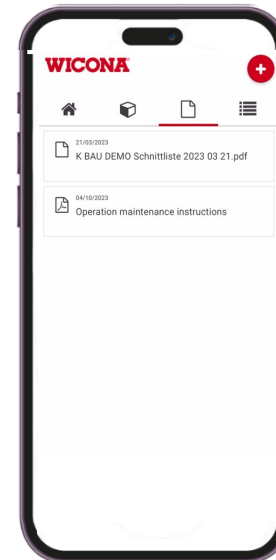
Materials  
by weight



WICONA

WICSTYLE 75 evo Tür 2flg. NI öffnend  
W: 1390mm x H: 2250mm  
Color: DB704 Gl. S-grau 30% C1  
Sustainability/Recyclability:  
Materials:  
Glass, Float: 49.370kg  
CIRCAL 75: 35.770kg  
PA66 GF25 RE: 6.850kg  
Miscellaneous: 5.520kg  
EPDM: 2.590kg  
ABS: 2.470kg  
EN AC-46100: 2.040kg  
Pulverbeschichtung: 0.910kg  
PA6: 0.530kg  
XBCrNiS19-9: 0.240kg  
PA66 GF25: 0.150kg

Download  
manual



WICONA

21/03/2023  
K BAU DEMO Schnittliste 2023 03 21.pdf  
04/10/2023  
Operation maintenance instructions

3D Visualisation

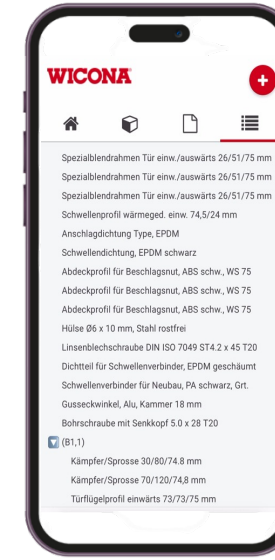


WICONA



Open in AR app  
Get our AR app

All components  
with references,  
colour



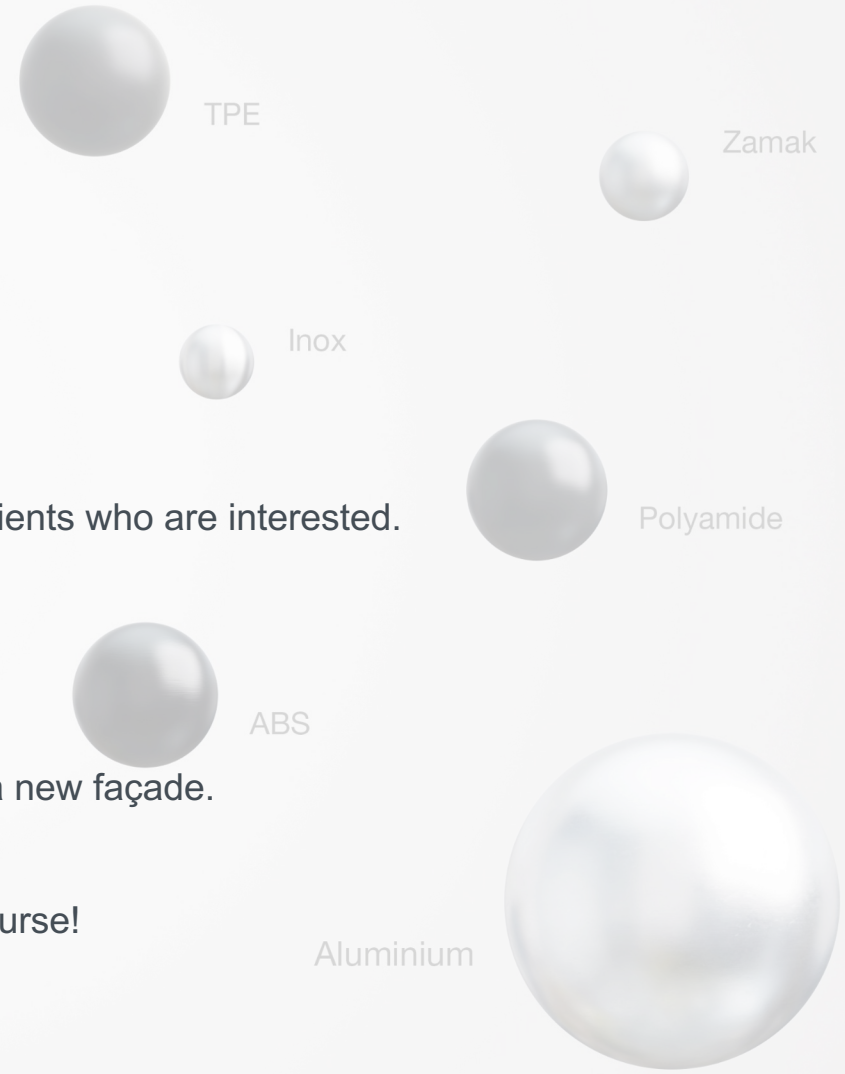
WICONA

Spezialblendrahmen Tür einw./auswärts 26/51/75 mm  
Spezialblendrahmen Tür einw./auswärts 26/51/75 mm  
Spezialblendrahmen Tür einw./auswärts 26/51/75 mm  
Schwellenprofil wärmegeed. einw. 74,5/24 mm  
Anschlagdichtung Type, EPDM  
Schwellendichtung, EPDM schwarz  
Abdeckprofil für Beschlagsnut, ABS schw., WS 75  
Abdeckprofil für Beschlagsnut, ABS schw., WS 75  
Abdeckprofil für Beschlagsnut, ABS schw., WS 75  
Hülse Ø6 x 10 mm, Stahl rostfrei  
Linsenblechschraube DIN ISO 7049 ST 4.2 x 45 T20  
Dichtteil für Schwellenverbinder, EPDM geschäumt  
Schwellenverbinder für Neubau, PA schwarz, Grt.  
Gusseckwinkel, Alu, Kammer 18 mm  
Bohrschraube mit Senkkopf 5.0 x 28 T20  
☑ (B1.1)  
Kämpfer/Sprosse 30/80/74.8 mm  
Kämpfer/Sprosse 70/120/74.8 mm  
Türflügelprofil einwärts 73/73/75 mm

# The Business Model For Hydro

- <https://www.wicona.com/en/int/sustainability/beyond-materials/75-95/>
- Systems which are easily adapted and recycled can justify a premium price for clients who are interested.
- Hydro takes a long term approach.
- If we can sell materials for upgrades this is preferable to our competitor winning a new façade.
- There will still be enough demand for new product - from recycled materials of course!

All of our new products  
contain at least  
**75% recycled and**  
**95% recyclable** content



The proportion of materials used differ depending on the system solution



Hydro

Thank You

# Agenda

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11:45 Meeting close

Circular Economy Innovation Network – Taking action towards circularity in aluminium

# Metal Health Service (MHS)

- Prof. Zhongyun Fan**
- Dr Ebad Bagherpour**
- Dr Alessio Franconi**

Brunel Centre for Advanced Solidification Technology

11<sup>th</sup> October 2023



**Brunel**  
University  
London



UKRI Interdisciplinary  
Centre for Circular  
Metals

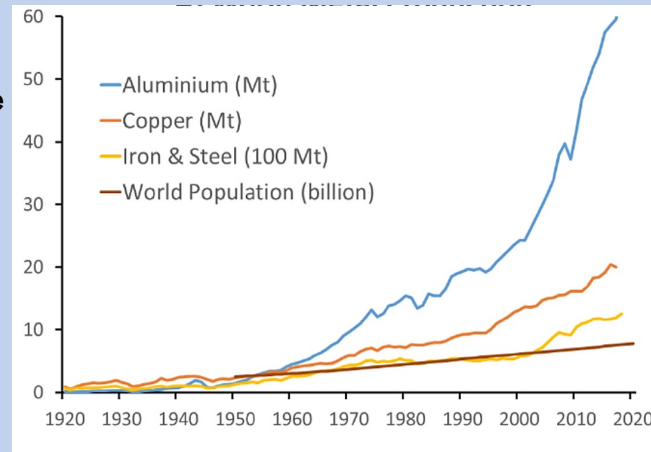


# Mining in the 21st century: historical & future demand



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Centre for Circular  
Metals

The demand for metals increased throughout the twentieth century, driven by a growing population, urbanisation, industrialisation, and increased per capita income.



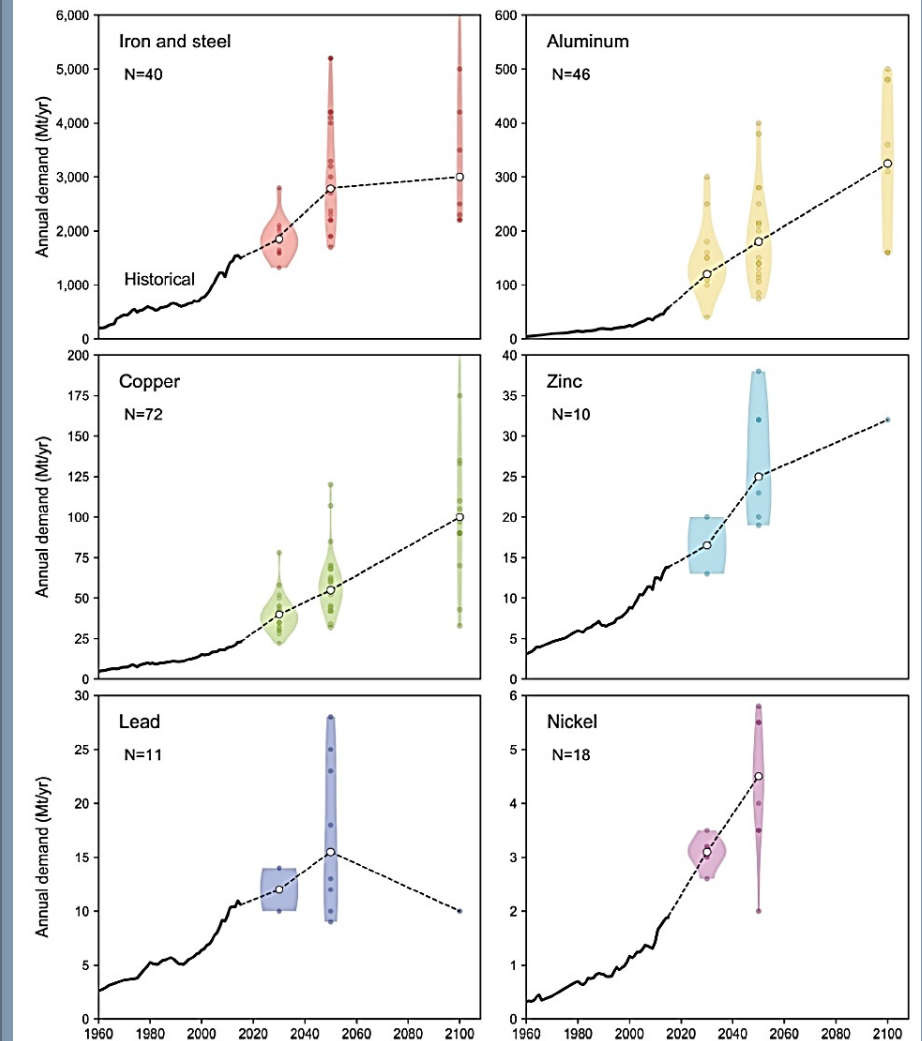
Global metal production

## Demand growth rate by 2050:

Aluminium: 215%  
Copper: 140%

## Demand growth rate by 2100:

Aluminium: 470%  
Copper: 330%

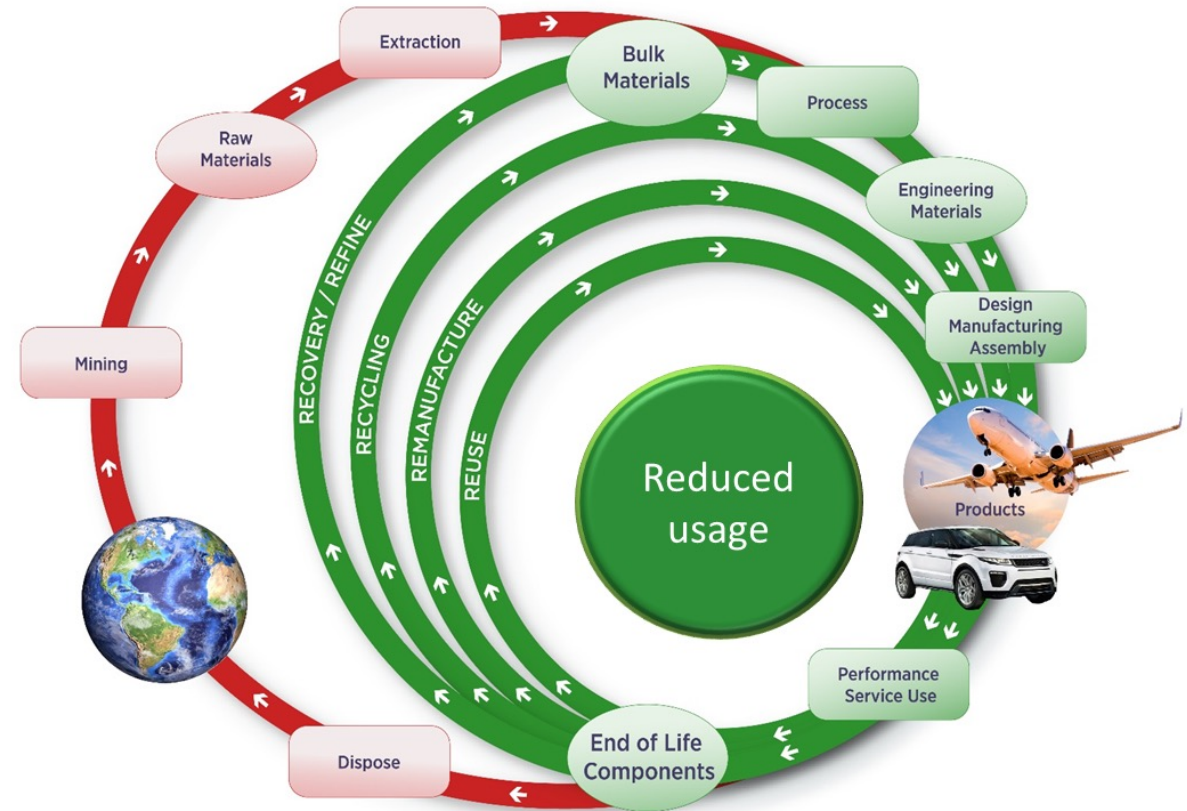


The demand outlook for major metals through 2030, 2050, and 2100

1. Danial smith, Jonathan Wentworth. UK parliament Research briefing: Mining and the sustainability of metals. 20 January 2022
2. Watari, T., Nansai, K., & Nakajima, K. (2021). Resources, Conservation and Recycling, 164, 105107.

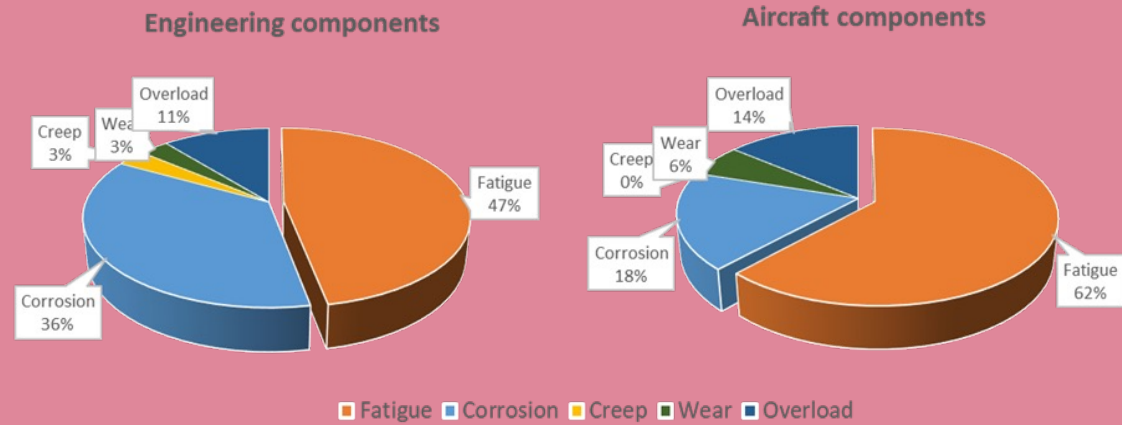
# BCAST long-term vision: Full Metal Circulation

- **Closing the loop – designing out waste and pollution:** eliminating extraction; use of existing metals
- **Slowing down the loop – keeping metals in use:** designing for durability, reuse, remanufacture.
- **Narrowing the loop – using less for more:** use less; serve longer; higher performance; encouraging sufficiency ...



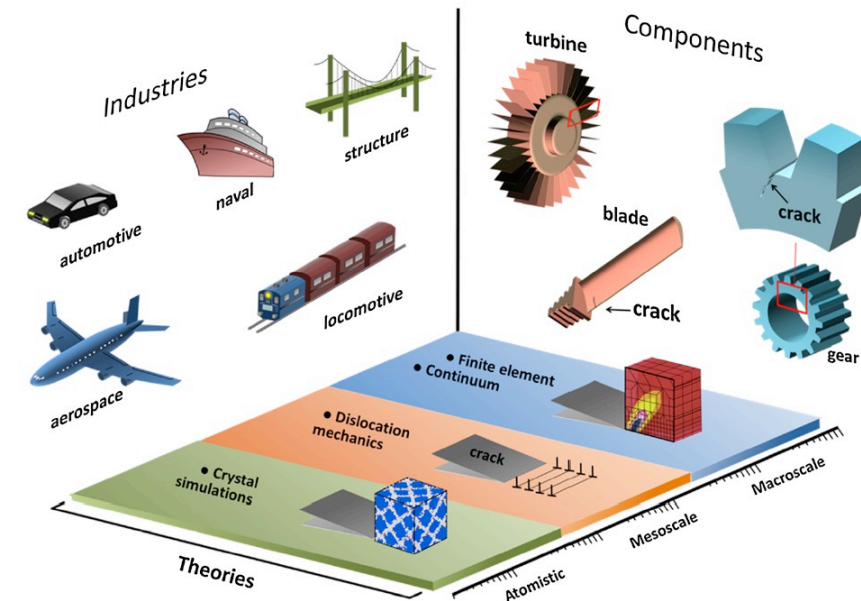
# Failure Modes of Metals

1. Overload
2. Impact
3. Creep
4. Wear
5. Corrosion, stress corrosion cracking
6. **Fatigue**



➤ The total economic costs of fatigue fracture-related events to the economies of advanced countries are **4% of the GDP (2005)**. In the UK this is equivalent to twice the amount spent on defence (defence 2% GDP) and comparable to what is spent on education or health (education 5.2% GDP).

❖ It is estimated that more than 80% of metallic components at the end of their service have perfect physical dimensions but reduced mechanical performance due to the existence of flaws, which all originate from fatigue during the operation.





# Metal health service (MHS): Our vision (inspired by NHS)



UKRI Interdisciplinary Centre for Circular Metals



Regular performance monitoring: NDI



Regular Rejuvenation Treatment: Tired components (**Stage A**)- Analogous to the Eat-Drink- Sleep for Human beings



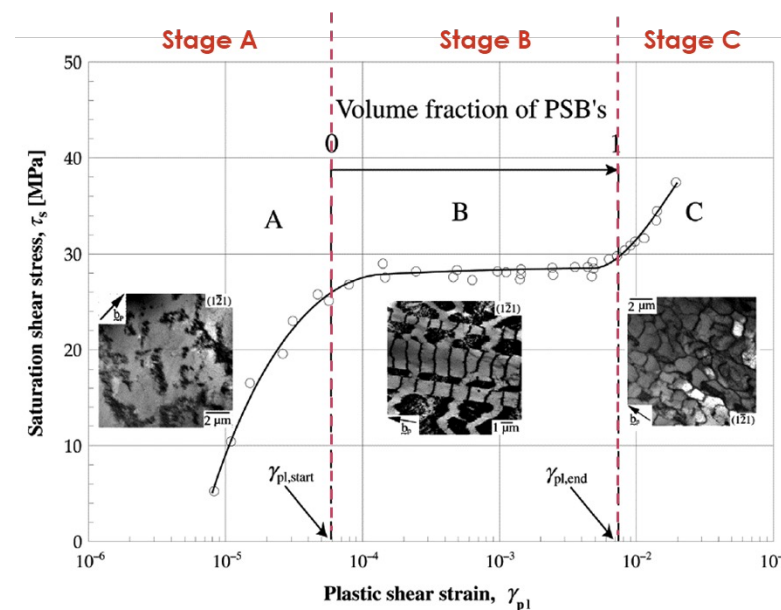
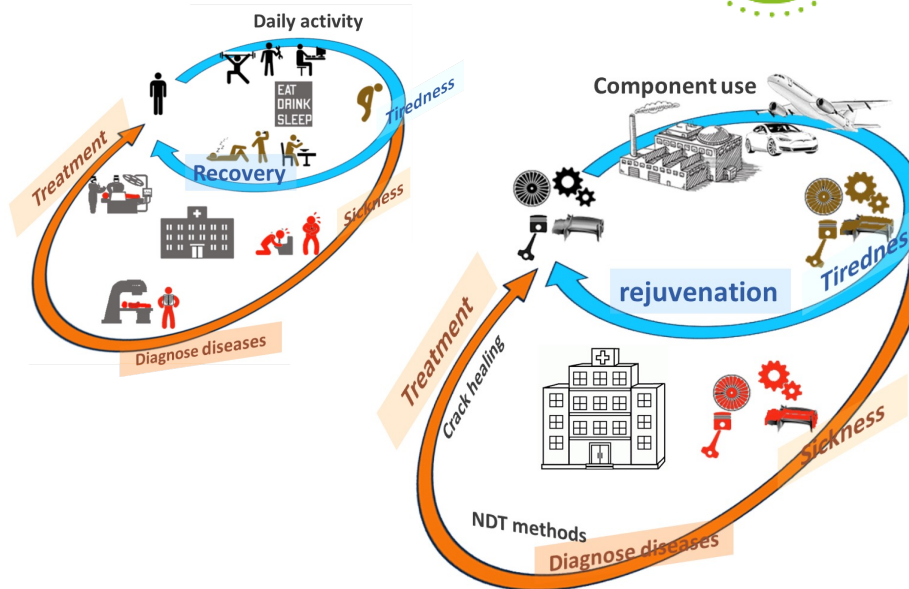
**Metal clinic for minor damages:** Sick components (**Stage B**)- Analogous to a GP surgery where medication and outpatient treatments are available



**Metal hospitals for severe damages:** Damaged components (**Stage C**)- Analogous to a hospital where advanced therapies and inpatient treatments are available



**Digital health record:** All the health records of a metal component will be saved in a digital passport



## WHY DOES THE METAL ECONOMY NEED THIS BUSINESS MODEL?

- This model relates to the inherent change in microstructure and the occurrence of micro-cracks and defects on the metallic components throughout their manufacturing and operational lifespan.
- The presence of these defects negatively impacts the mechanical properties of the materials.
- Preventive rejuvenation, recovery and healing procedures are applied prior to or during the initial stages of fatigue, aiming to mitigate the formation of micro-cracks.
- The implementation of a proactive approach successfully extends the durability of the material, thereby reducing the necessity for intrusive interventions or replacement, resulting in cost savings.

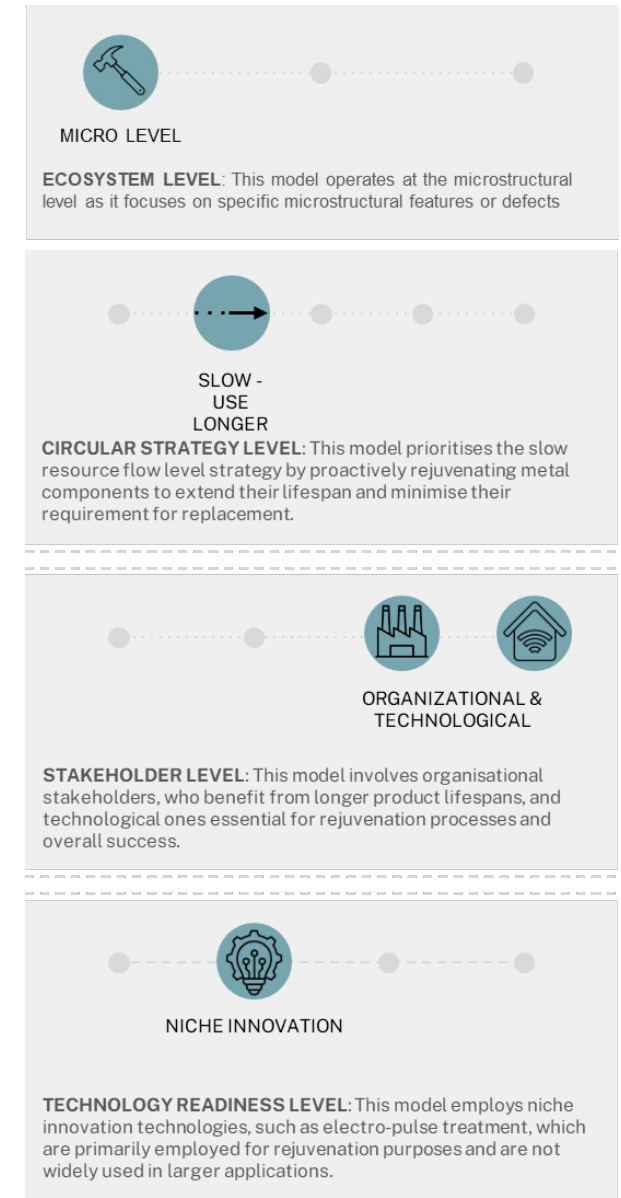
## Value is captured through various means:

- Revenue generated from one-time rejuvenation services
- Revenue generated from ongoing or recurring rejuvenation services, such as an annual fee.
- Another potential situation involves the collection of revenue through a rejuvenation service that is integrated into a broader offering, such as a service incorporated within an access or performance/results business model.

## POTENTIALLY RELEVANT TO

**Solution providers:** Solution providers are the entities that offer rejuvenation treatments. These could be companies or research institutions that have developed technologies for the rejuvenation of metallic materials.

**Customers/users:** The customers are industries that manufacture and use metallic components. These could include sectors such as aerospace, automotive, construction, and any other industry that relies heavily on the use of metallic materials and components.



**WHY DOES THE METAL ECONOMY NEED THIS BUSINESS MODEL?** This model has the potential to reduce metal consumption by prolonging the lifespan of products within a specific and localised context:

- Local economy centred around repair rather than consumption.
- One of the main barriers for this model is the lack of customer demand for environmental behavior. This lack of demand means that there is little incentive for firms to comply with environmental regulations unless they are strictly enforced or required by insurance companies.
- Another barrier is the high cost of environmental compliance, which SMEs often find difficult to bear. These costs are not easily transferable to customers and provide few benefits without a competitive advantage.

**Value is captured** through delivering a low-cost, convenient, and reliable service to clients and working with other companies to repair their customers' products. Original Brand Manufacturers (OBMs) and Original Equipment Manufacturers (OEMs) may partner with local enterprises to offer repair services for their own products. This allows them to comply with environmental regulations and gives them a competitive advantage when consumers demand environmental compliance.

### POTENTIALLY RELEVANT TO

#### Solution providers:

- Internally, an individual may assume the role of a sole repair professional who establishes and operates her own local repair enterprise.
- Externally, various entities such as franchisees, dealerships, and trade organisations play a significant role in advocating for environmental and professional standards.

**Customers/users:** individual product owners in need of repair and maintenance services.



MICRO LEVEL

**ECOSYSTEM LEVEL:** This model operates at the microstructural level as it focuses on specific microstructural features or defects



SLOW -  
USE  
LONGER

**CIRCULAR STRATEGY LEVEL:** This model promotes the Slow Resource Flow strategy by emphasising the extension of product lifetimes, thereby slowing the consumption and processing of metals.



INSTITUTIONAL & ORGANIZATIONAL

**STAKEHOLDER LEVEL:** The primary focus of this model mostly encompasses organisational stakeholders, while the influence of the government can significantly impact its establishment.



NICHE INNOVATION

**TECHNOLOGY READINESS LEVEL:** This mode may employ technologies with varying levels of growth, but the majority can be categorised as mainstream innovation levels such as laser welding, ultrasonic testing, etc.

### BUSINESS MODEL ASPECTS

**WHY DOES THE METAL ECONOMY NEED THIS BUSINESS MODEL?** This approach offers innovative solutions for asset management and utilisation in the metal industries through the integration of advanced self-healing technologies with a service-oriented approach. It encourages the use of self-healing materials in the design and production of products, which reduces the frequency of expensive repairs.:

- By adopting a strategic shift in their business approach, companies can enhance customer loyalty and operational efficiency by transitioning from a product-centric sales model to a service-oriented provision model, facilitated by the implementation of performance-based contracts.
- Strategic alliances play a crucial role in surmounting various challenges, such as securing financial resources for initial research and development (R&D) endeavours, as well as facilitating the integration of digital technologies.

**Value is captured** through the collection of premium prices for high-end products, or by minimising the expenses associated with product maintenance in the case of products provided as part of a product-service solution

### POTENTIALLY RELEVANT TO

#### Solution providers:

- researchers and organisations engaged in the development of such materials, as well as companies involved in the production and sale of these metals or related products.
- Externally, there may be entities that offer servitisation of self-healing metals. These organisations are engaged in the scientific investigation and advancement of self-repairing metallic materials.

**Customers/users:** The customer of this model primarily consists of industrial entities that incorporate metals into their operational processes. These sectors encompass areas such as energy, transportation, healthcare, safety, and infrastructure.



MICRO LEVEL

**ECOSYSTEM LEVEL:** This model operates at the micro level, with a focus on individual businesses, collaborations, and strategic alliances across the metal industry.



SLOW -  
USE  
LONGER

**CIRCULAR STRATEGY LEVEL:** This model aims to slow resource use by prolonging the lifespan of metal products and assets, leveraging advanced self-healing technologies and performance-based contracts to achieve this goal



INSTITUTIONAL, ORGANIZATIONAL & TECHNOLOGICAL

**STAKEHOLDER LEVEL:** This model incorporates various organisational stakeholders. However, technological and institutional stakeholders are also essential for the coordination of R&D funds and activities.



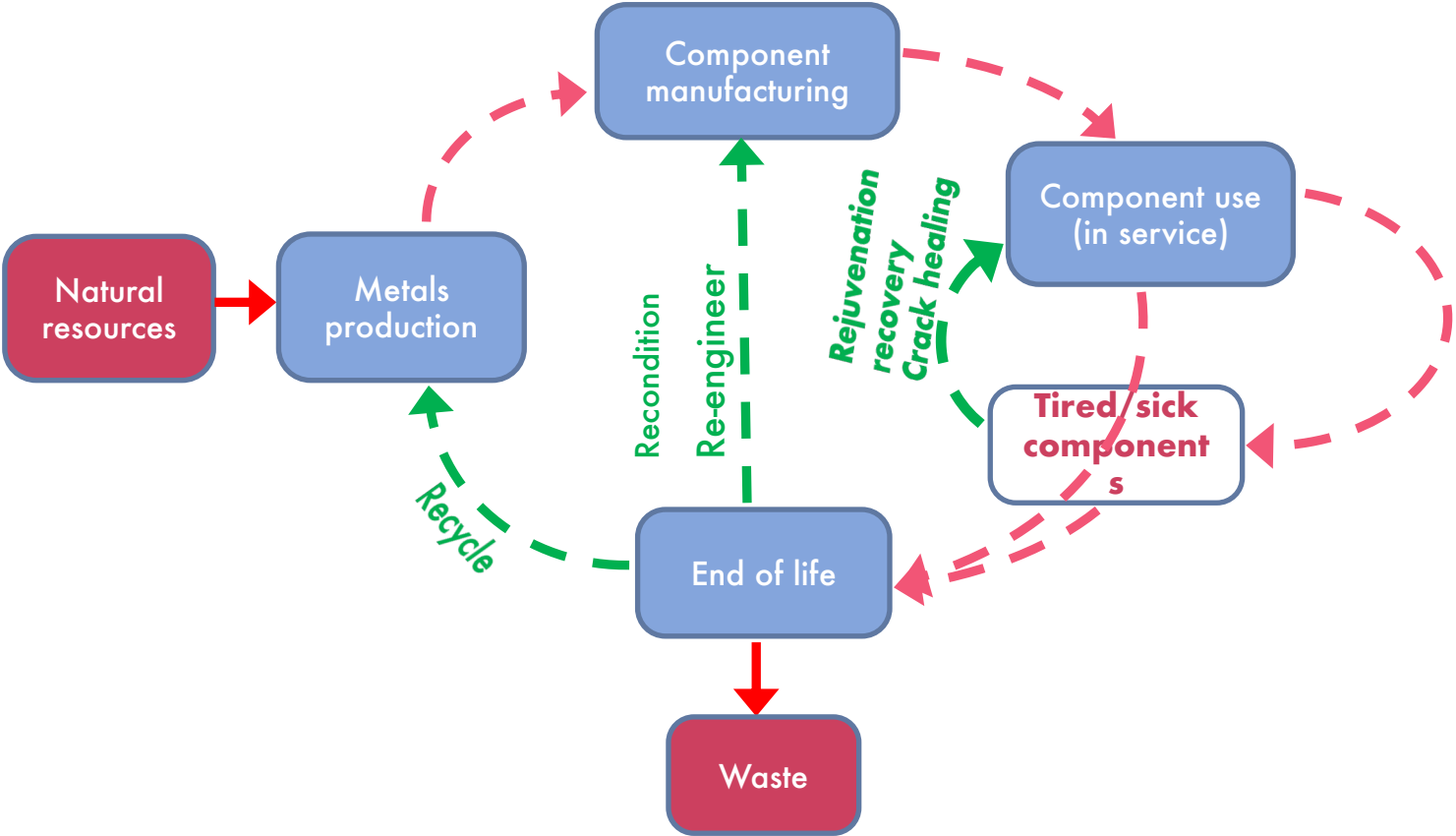
NICHE INNOVATION

**TECHNOLOGY READINESS LEVEL:** This model incorporates advanced technologies, such as self-healing materials, which can be considered as a niche innovation due to the limited use of this technology beyond academic settings.

# Metal health service (MHS)



UKRI Interdisciplinary  
Centre for Circular  
Metals



# Agenda

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Chris Pilgrim – Innovate UK KTN

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# Break out rooms

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- You will be able to select the break out room
- Break out rooms will not be recorded

| <b>Circular Design</b> | <b>Circular Recovery</b> | <b>Circular Business Models</b> |
|------------------------|--------------------------|---------------------------------|
| Ajay Kapadia           | Robert Quarshie          | Chris Pilgrim                   |
| Rachel Wiffen          | Graham Hurrell           | Ebad Bagherpour                 |

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# Innovate UK

- We are the UK's innovation agency
- We support business-led innovation in all sectors, technologies and UK regions
- A key delivery body of the Government's Innovation Strategy
- £6bn of Managed Expenditure 2022-2025

## Our Mission

To help UK businesses grow through the development and commercialisation of new products, processes, and services, supported by an outstanding innovation ecosystem that is agile, inclusive, and easy to navigate.



# Inspire

To **inspire** innovative businesses to create value through innovation

# Involve

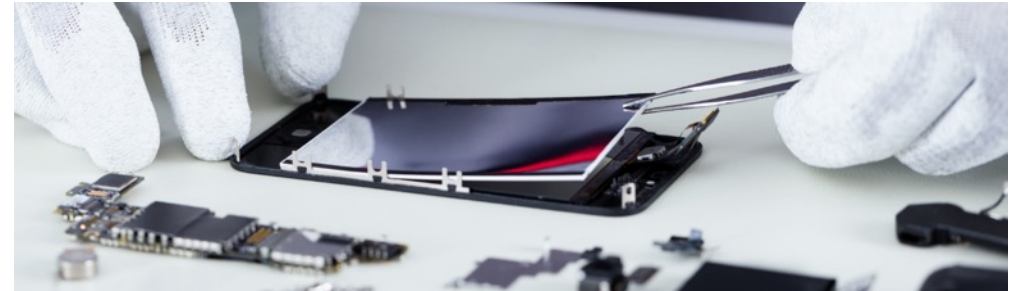
To **involve**, utilising talented organisations and people to create a vibrant and successful ecosystem

# Invest

To **invest** in innovation to make a clearly tangible positive impact on the UK's economy and society

# Resource Efficiency for Materials and Manufacturing (REforMM)

- £15m (Innovate UK)
- Resource efficient, competitive materials and manufacturing across sectors



## Core focus areas of the programme



FOCUS AREA

### Materials for the future economy

New material applications for cutting-edge products that reduce emissions, energy consumption and costs.



FOCUS AREA

### Smart design

Effective design methods, design for resource efficiency, and design for maximum through-life value.



FOCUS AREA

### Resilient supply chains

Sustainable feedstocks, supply chain visibility, and co-location of waste and emission streams.



FOCUS AREA

### World-class production

Flexible production capacity, minimal material waste, high-quality products, high productivity, and full adaptivity.



FOCUS AREA

### Longer in use and reuse

Minimising materials use and waste, practising complete traceability, and using new remanufacturing services.

## Questionnaire



# BridgeAI

Empowering UK organisations to harness the power of AI through support and funding, bridging the AI divide for a more productive UK.



BridgeAI is a **£100m programme** that invests in the UK's future by stimulating both AI demand and supply side engagement, develop end-user driven AI technologies and address systemic barriers limiting adoption of AI by key sectors (shown below).



KEY SECTOR

**Agriculture**



KEY SECTOR

**Creative industries**



KEY SECTOR

**Construction**



KEY SECTOR

**Transport**

# Transforming Foundation Industries Challenge

- £250m programme with £118m of government funding, running until 2025.
- Foundation industries are worth approximately £45bn to the UK economy and employ 500,000 people. However, these sectors are the largest polluters generating 10% of all UK CO<sub>2</sub> emissions.
- Catalysing innovation to develop resource and energy efficient technologies and new ways of working:
  - Scaling Innovation
  - Industry-led Innovation
  - University Technology Transfer
  - Supporting Innovation
  - Providing Late-Stage Finance



Paper



Glass



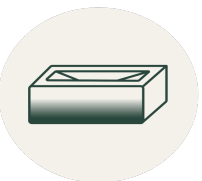
Chemicals



Cement



Metals



Ceramics



**Fully Funded Leadership Programme for those with a Vocational Background working in the Foundation Industries**



# FISC

Foundation  
Industries  
Sustainability  
Consortium

FISC is leading on a £19.5m project called EconoMISER (Economy, Materials, Innovation, Sustainability Efficiency and Resources)

This project will upgrade five facilities across the UK by providing key infrastructure to demonstrate low carbon technologies at scale.

Delivery partners:

Henry Royce Institute, Glass Futures, Materials Processing Institute, Lucideon, Centre for Process Innovation

Five theme areas:

Alternative fuels  
Circular economy  
Digital control and sensors  
Process optimisation  
Sustainable materials

# Horizon Europe Funding calls

- Many relevant open calls
- Travel grants available for brokerage events

[HORIZON-CL4-2024-TWIN-TRANSITION-01-03](#)

Manufacturing as a Service: Technologies for customised, flexible, and decentralised production on demand

[HORIZON-CL4-2024-TWIN-TRANSITION-01-05](#)

Technologies/solutions to support circularity for manufacturing

[HORIZON-CL4-2024-TWIN-TRANSITION-01-32](#)

Optimisation of thermal energy flows in the process industry

[HORIZON-CL4-2024-TWIN-TRANSITION-01-34](#)

Renewable hydrogen used as feedstock in innovative production routes

[HORIZON-CL4-2024-TWIN-TRANSITION-01-35](#)

Turning CO2 emissions from the process industry to feedstock

[HORIZON-CL4-2024-TWIN-TRANSITION-01-38](#)

Hubs for circularity for industrialised urban peripheral areas

[HORIZON-CL4-2024-TWIN-TRANSITION-01-41](#)

Breakthroughs to improve process industry resource efficiency

[HORIZON-CL4-2024-TWIN-TRANSITION-01-01](#)

Bio-intelligent manufacturing industries

[HORIZON-CL4-2024-RESILIENCE-01-04](#)

Technologies for processing and refining of critical raw materials

[HORIZON-CL4-2024-RESILIENCE-01-11](#)

Technologies for extraction and processing of critical raw materials

[HORIZON-CL4-2024-RESILIENCE-01-24](#)

Development of safe and sustainable by design alternatives

# Resources



## Innovate UK KTN Website

<https://ktn-uk.org/>

[Foundation Industries](#)

[Materials](#)



## Innovate UK KTN Newsletters

Relevant examples:

Foundation Industries  
Materials  
Clean Energy & Infrastructure  
Complex Systems  
Circular Economy

Subscribe at the  
bottom of the  
webpages



## Funding opportunities

<https://ktn-uk.org/opportunities/>

Filter by sector,  
eligible organisations,  
funding types etc.



## Contact

Chris Pilgrim  
[christopher.pilgrim@iuk.ktn-uk.org](mailto:christopher.pilgrim@iuk.ktn-uk.org)



11<sup>th</sup> October 2023

# Circular Economy Innovation Network

## Taking action towards circularity in aluminium

[www.ktn-uk.org](http://www.ktn-uk.org)

