Value from Waste – Developing Innovative Materials

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Value from Waste – Developing Innovative Materials

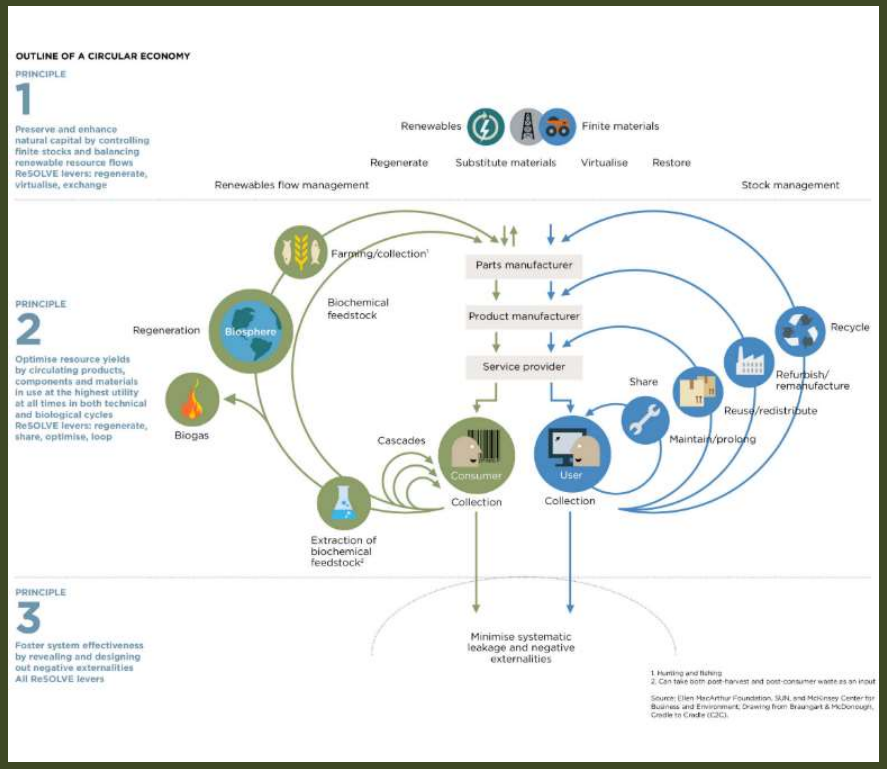
- What is waste?
- The drivers for innovation
- Alternative Raw Materials with Low Impact
- Work in Progress

What is waste?

- The legal definition of waste in the UK is derived from the EU Waste Framework Directive.
- Basically a waste is anything which you decide to, or are required to, throw away.
- Even if the substance or article is given to someone else to be reused or recycled, it is still legally considered to be waste if it is no longer required by the person who produced it.

Drivers for innovation

- To avoid materials falling out of the chain of utility
- To support the circular economy
- To minimise use of natural resources



Source: Ellen Macarthur Foundation

Drivers for innovation

- UK Infrastructure programme
  - Highways England
  - Network Rail
  - HS2
  - Airports
  - Hinkley Point C
  - Offshore Wind farms

Drivers for innovation

Table 2.A: Infrastructure Pipeline, by sector, 2016-17 onwards[1]

Sectors	Projects (number)	Programmes (number)	Pipeline Value (£ billion)
Communications	2	4	6.0
Energy	109	58	255.7
Flood	6	23	4.1
Science and Research	25	7	5.5
Transport	166	163	134.5
Waste	10	0	0.5
Water	1	28	19.3
Total	***319***	***283***	***425.6***

Source: Infrastructure & Projects Authority, Major Infrastructure Tracking Unit

[1] The Pipeline includes individual projects over £50 million and rolls-up investments of less than £50 million into programmes

Drivers for innovation

The Telegraph

Growth slows in UK manufacturing as raw materials drive up costs

The Guardian UK edition

Manufacturers urge action over raw metal prices amid supply worries

INDEPENDENT

Building firms waiting more than a year for bricks as raw material costs rocket, study shows

Peak metal: Scarcity of supply or scare story?

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What is ARLI?

Through a collaborative R&D approach the ARLI team of experienced academics and engineers can support businesses to develop products and processes that provide efficiency gains in the use of raw or waste materials and deliver improved environmental impact with cost effective solutions.

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ARLI seeks to achieve the following goals:

1. A step change in innovation

2. A research and evidence-led approach to supporting business growth

3. A coherent and committed approach to growing our low carbon economy and helping to reduce CO2 emissions whilst at the same time supporting SME's to become more resilient against the threats posed by raw material deficiencies.

4. Supporting the development of the skills base in high growth areas

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Support available

The support on offer to business is a minimum of 2 days funded activity which can be anything from:

- Material testing
- Product development
- Process engineering
- Laboratory work and analysis
- Modelling and simulation
- Consultancy and innovation support

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Work in Progress

Plastics

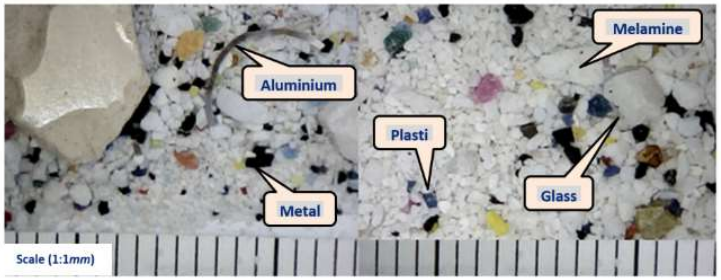
Recycled Melamine plastic

- Contaminated with metal particles
- <250µm fraction to be removed

Developed process for

- Removing metal, wood, fabric
- Removing <250µm fraction

Currently investigating potential uses for <250µm fraction



Contaminated melamine sample


Magnetic separation machine

Particle sizes

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Work in Progress

Plastics

Packaging and single use

Developed process for

- Grinding down to sand size fraction
- Use as filler for lightweight concrete, pavements, sand replacement in geotechnical solutions, etc

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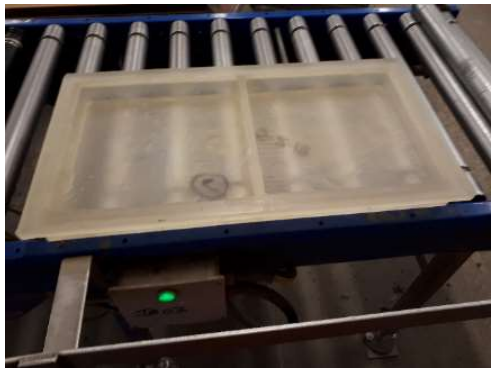
Work in Progress

Polyurethane moulds

Mechanical recycling

- Grinding
- Adhesive pressing
- Injection moulding



Reject

Used

Testing programme

- Fragment moulds to achieve controlled particle size
- Physical material tests to prove strength and durability

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Work in Progress

Potential applications

No.	Application	
1	In Concrete	To replace sand and aggragete and for use in special mixes, e.g. lightweight concrete, flexible concrete.
2	Drainage Backfill	In areas where lifing of stone chippings on the carraigeway may be an issue, coarse (25 to 38mm) gravel size rubber may be used.
3	Road Furniture	Used for traffic humps, flexible traffic cones, kerbs.
4	Ground Improvement	Used to improve the mechanical properties of the soil (such as in single size sand).
5	House Furniture	Mats (car & house), sheeting, etc

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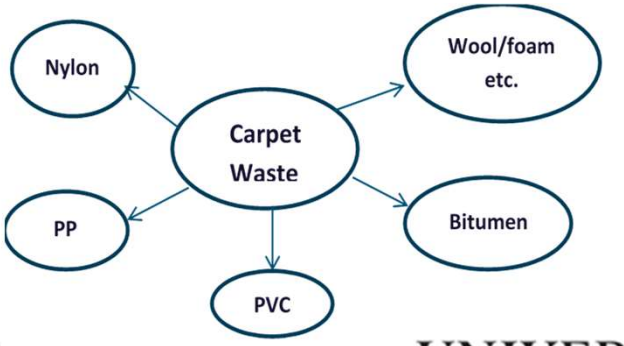
Work in Progress

Carpets

Only 35% of carpet waste is recycled in the UK compared to 85% in Europe

Objectives

- Identify the valuable materials in carpets waste/post-customer carpet.
- Propose procedures for recycling carpet waste.
- Find suitable applications for carpets waste and their components



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Work in Progress

Applications for the Construction Industry

Synthetic polypropylene fibre

- Strengthen weak soils
- Reinforce concrete
- Improve durability, reduce permeability and plastic cracking of concrete


Unreinforced soil


Reinforced soil

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Work in Progress

Off-site and Modular Construction

A number of projects

- Process improvements of systems
- Investigating
  - wastes for insulation
  - improving traditional material performance
  - testing innovative materials for panels

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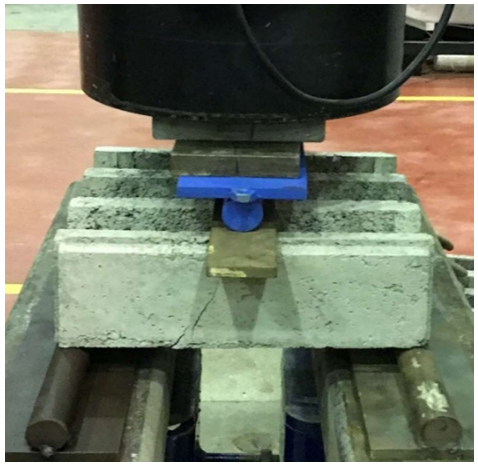
Work in Progress

Off-site and Modular Construction

- Physical testing and experiments on building materials and structural components used as lintels
- Numerical analysis
- Recommendations are made for the improvement of the product
  - Fundamental material response (axial, shear and bending) for both concrete and steel rebar
  - Diameter and positioning of the rebars
  - Span of the lintels
  - the effect of concrete material and grouting strength



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Work in Progress

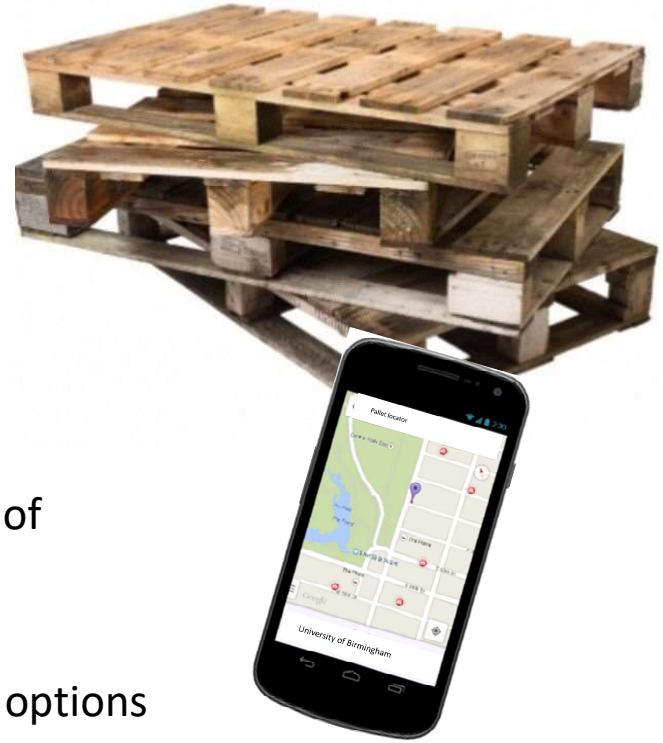
Pallet tracking

Problem

- University has large number of deliveries across Campus
- Often pallets are ‘abandoned’ in corners of Campus
- Time and effort spent cleaning campus up

Solution

- Developing ‘phone app to locate pallets, without use of bar coding
- Mapping allows ease of collection
- Efficient collection leads to better re-use or recycling options



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Work in Progress

Sustainable clothing

Problem

- The majority of resources used by textile and fashion industry such as cotton and polyester, are in limited supply and the increasing demand for them is harming the plant.

Solution

- Fabric from orange, coffee ground, seaweed, and pineapple and hemp fibre can be used in clothing manufacture.
- the innovative fabric properties can make them good enough to be either alternative materials or can be blended with existing fabric to replace man-made plastic.

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Work in Progress

Bicycles tyres & inners

Problem

- There are no available studies for bicycles tyres waste.
- As tyres and inner tubes are durable and not naturally biodegradable, they remain in dumpsites with little degradation over time, presenting a continuing environmental hazard.

Solution

- Landfill: Car Tyres are currently used to create a protective layer of shredded tyre chips over the landfill liner. as the drainage layer above the landfill liner.
- Rubberized asphalt: skid resistance, reduced fatigue cracking, improved resistance to rutting, tensile strength and toughness, longer pavement life and reduced maintenance costs.
- Aggregate: a great alternative to gravel, children's playgrounds, sealing materials, and speed bumps.

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Work in Progress

Reinforcement & stabilization of asphalt concrete

Problem

Asphalt concrete (AC), a mixture of bitumen and aggregates, is a sensitive material compared to other materials used in civil engineering. Moisture beneath pavement softens subgrade soil and weakens base materials to destroy the structural capacity of the pavement as well as the traffic load.

Solution

- To improve the performance of asphalt mixture and pavement;
    1. Synthetic fibres
    2. Rubber
    3. Additives materials (fly ash, lime & slags ect.)

Modified binders are used mainly for high stress, high traffic volume, and/or extreme climate conditions.

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The Future

- We still have 1 year to go
- We are on target to support at least 100 companies
- We are interested in any waste type for any application, not just civil engineering
- While the support is for SME's we are happy to work through large corpora supply chains
- We can apply for additional research funding to bring new products to market

  beyond ARLI

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Further Information

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