

a regenerative approach to façade design with a focus on endof-life challenges

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waste and circular

economy

"CE - a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops...achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling."

The Circular Economy – A new sustainability paradigm?; Martin Geissdoerfer; 2017



where does the façade sit within the framework?

under CE lens

Glass Facade



- Integral to the success of the crisp...
- Integral to the energy performance of the building



façade significance and <u>implicat</u>ions

- Whole-life energy shift
- Increasing complexity and decreasing recovery



Embodied energy of different building components



the system to perform its design function or new requirements"

'endof-life' "the inability for

component "end-of-life"



Building "Shearing Layers"

Adapted from building shearing layers from Stuart Brand: 'How Buildings Learn' Façade component service life figures taken from specification sheet from Meinhardt Façade Technology

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Original figure from F. Pomponi & A. Moncaster; Circular economy for the built environment: A research framework; 2017

research problem

existing "end-of-life" route



Social/Cultural

Environmental



new façade system ~£500/m²

- Weight ~ 60 kg/m^2 ٠
- Glass : Aluminium -> 60:40

existing disposal scenario...



resale value ~£7.20/m²

Social/Cultural

luminium recycled sold at

£200/tonne or £0.2/kg

Environmental

Technical

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- "lost value" ~1.4% of initial
 - cost
- Resale values taken from conversations with demolition contractors Economic



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Existing barriers Potential motivation, with further research Existing motivation

industry perspective:

existing barriers and motivations for EOL recovery methods

> focus of future research



Economic

Social/Cultural

Environmental



four constructed end-of-life scenarios...



Comparison of total embodied energy per functional unit



Comparison of total GWP per functional unit





scenario comparison

Scenario	Net Avoided Impact, PENRE (MJ)	Net Avoided Impact, GWP (CO2kg)
1 - Demolition	None	None
2 - Recycle	30.3%	34.4%
3 - Component Reuse	76.1%	83.5%
4 - System Reuse	100%	100%

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Economic

Social/Cultural

Environmental



Economic

Social/Cultural

Environmental



Economic

Environmental

Technical



- Compressive shear test to initiate interfacial failure
- Variables
 - Temperature
 - Strain rate
 - Relative Humidity

exploring methods for separating flat glass sheets for reuse

separating laminated glass



Attempt at removal of adhesive from existing glass panels

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Social/Cultural

Environmental



further work

'future' of glass?

 "Larger, more transparency, design and minimalism*, complex all-glass facades. The next 30 years of constructive glass will deal with the functionalisation of glass**" – Glasstec 2018

Glasstec - Biggest global trade fair and exhibition for glass

*Minimalist by impact, not just aesthetic? **Functional, with **whole-life** in mind?

Image: UN Secretariat Building, New York, renovation complete 2015

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