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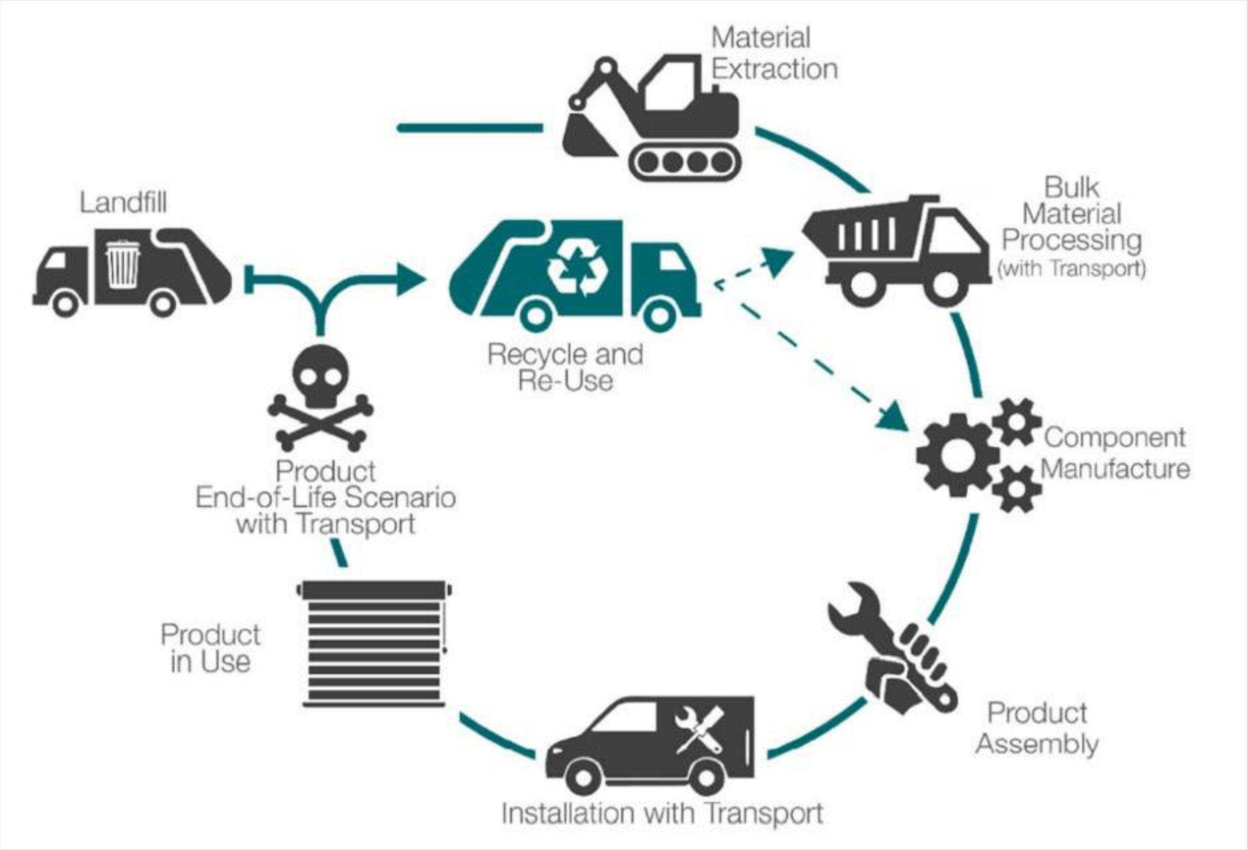
The Circular Economy and future design:
Shifting business perspectives: connecting solar shading with life cycle thinking



Deborah Andrews
Professor of Design for Sustainability & Circularity
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London South Bank University

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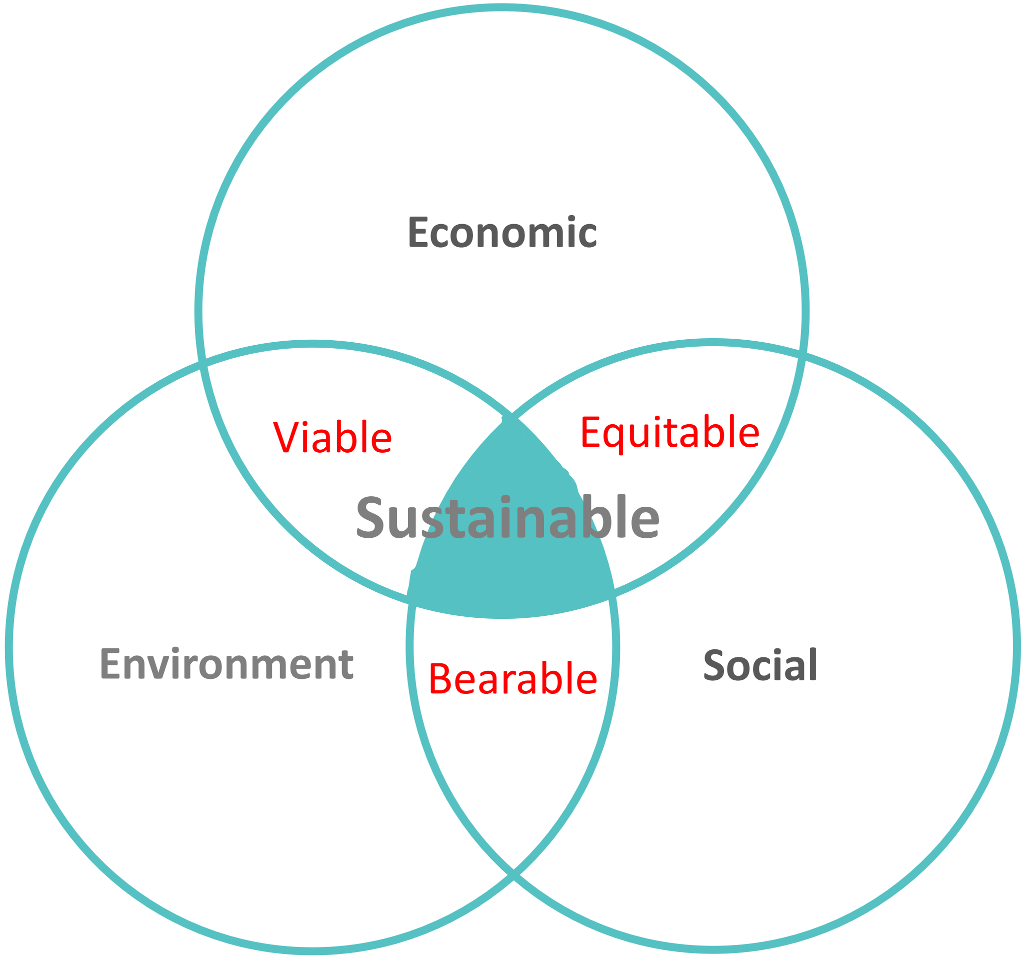
Sustainable development:
meeting the needs of the present generation without compromising the ability of future generations to meet their own needs

Bruntland Report, 1987

Deborah Andrews, 07.11.2024

Sustainable development: meeting the needs of the present generation without compromising the ability of future generations to meet their own needs

Bruntland Report, 1987



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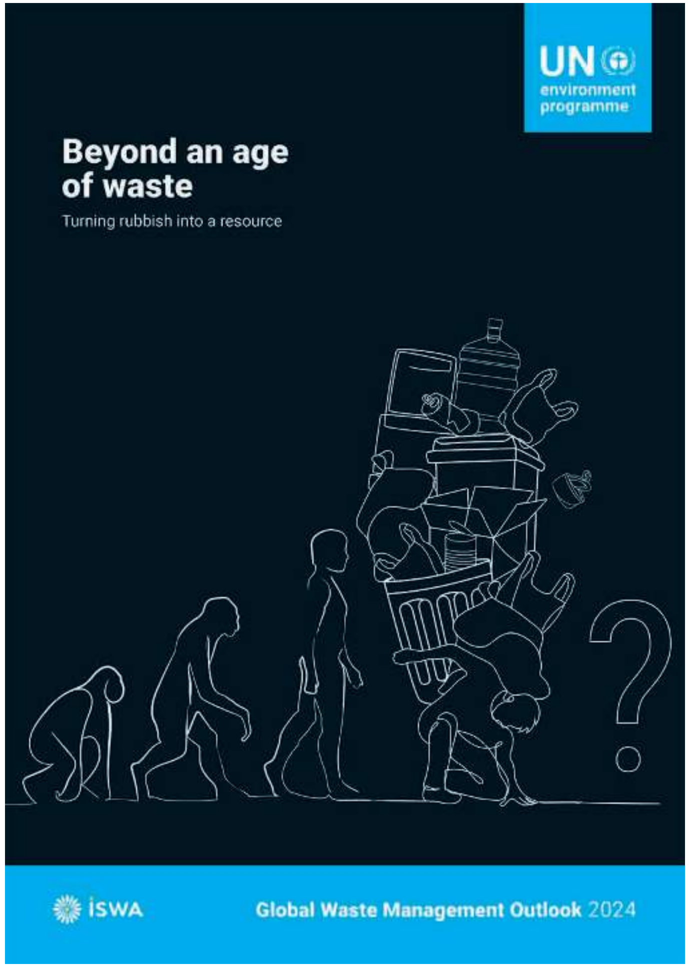
why circularity?



Municipal waste –

2023 - 2.1 billion tons / year -
on trucks circumnavigates globe x 24
disposal - 99% of ‘stuff’ within 6 months (developed world)
2050 - 3.2 billion tons / year

Construction / Demolition waste –

2025 – 2.2 billion tons / year
40% GHG emissions

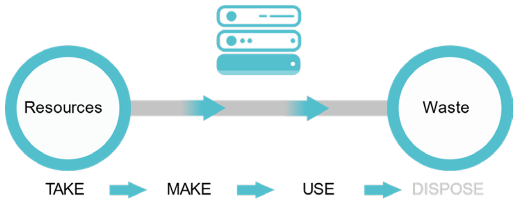
E-waste – 2023 – 62 million tonnes / year
2030 – 80 million tonnes / year

Unsustainable – environment / economics / social

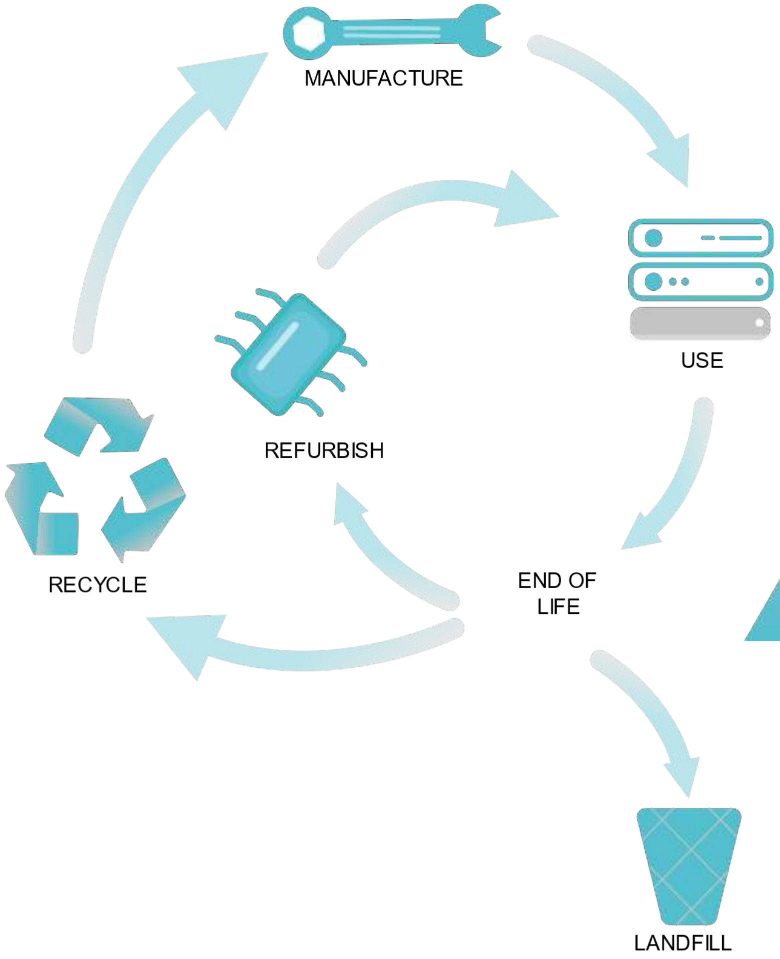
https://www.unep.org/resources/global-waste-management-outlook-2024

Why circularity?

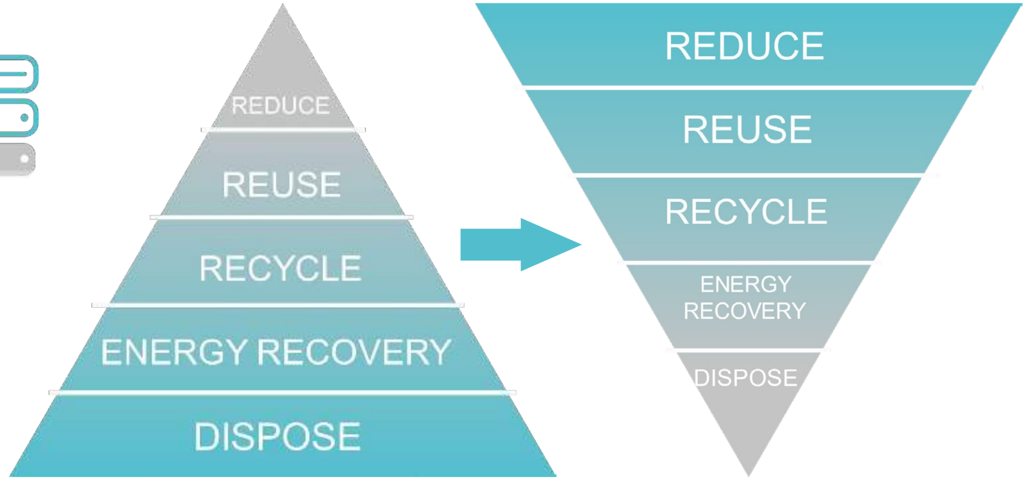
Linear Economy



Circular Economy



Waste Management Hierarchy

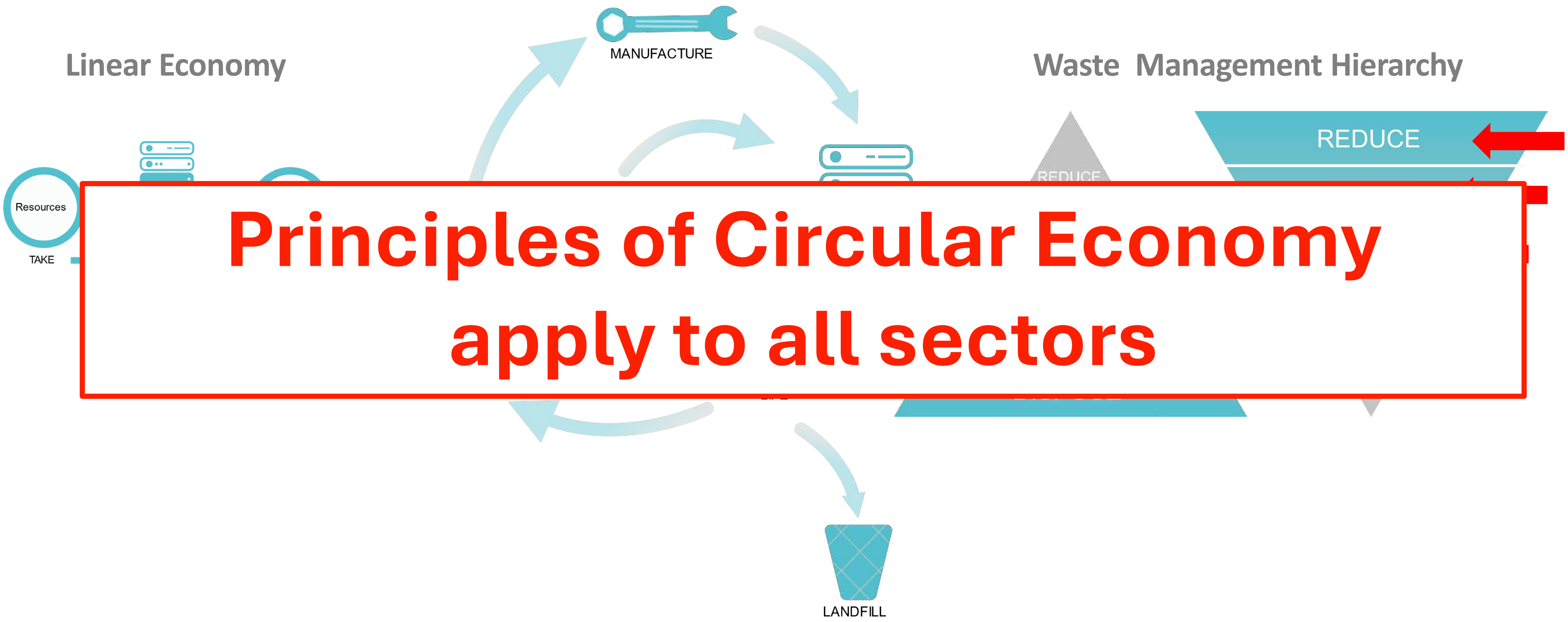


Why circularity?

Circular Economy

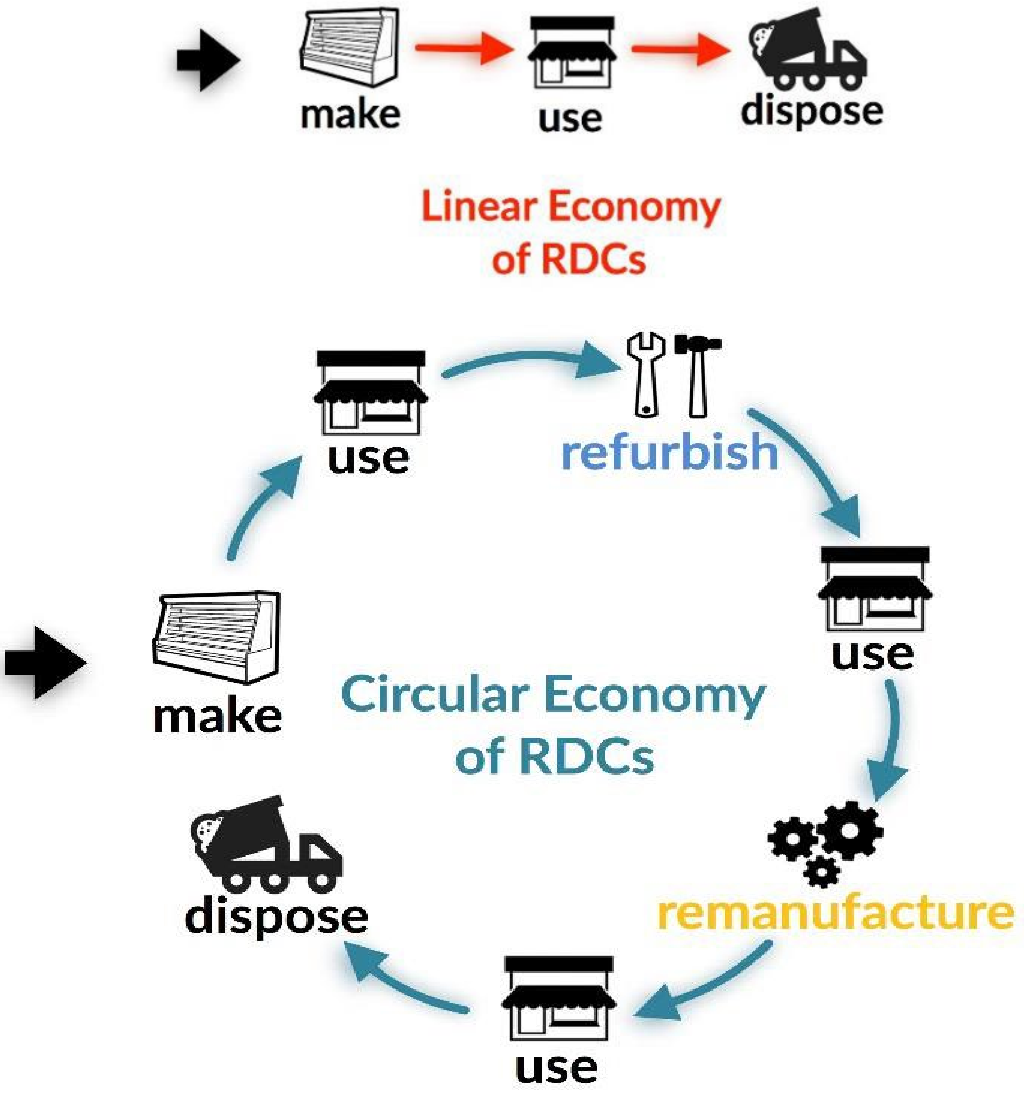
Linear Economy

Waste Management Hierarchy



Principles of Circular Economy apply to all sectors

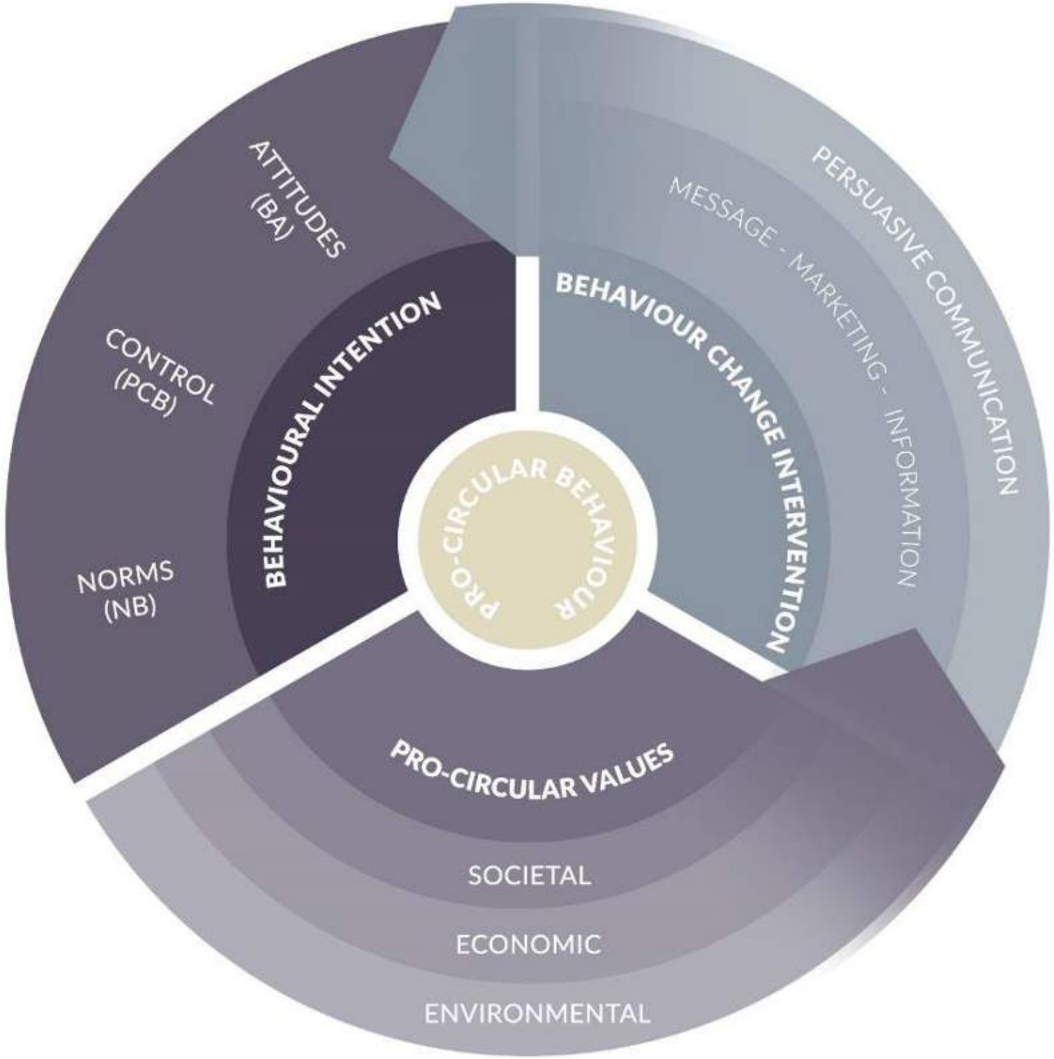
Case study – user behaviour / perception
Commercial refrigeration sector – reuse / second-life market



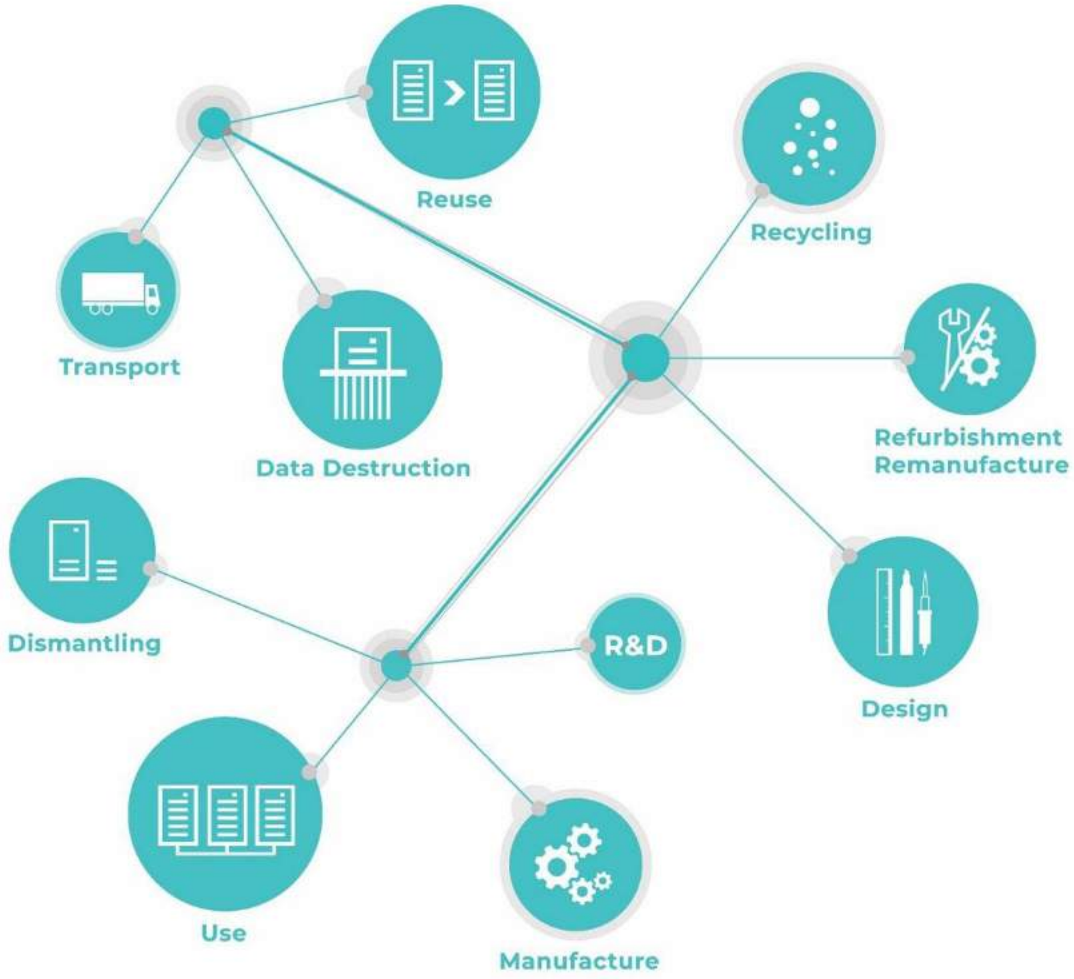
Case study – user behaviour / perception
Significant challenge to second-life market

User behaviour
Supporting Resource Efficiency
Based on proven practice in healthcare
Pro-Circular Behaviour Change Tool

Impact
Increased sale of remanufactured RDCs in major international supermarket chain -
Economic benefit to customers
Significant environmental impact saving



Case study – Whole Systems Thinking / Approach
CEDaCI – A Circular Economy for the Data Centre Industry



Primary source data collection – reverse engineering – materials composition

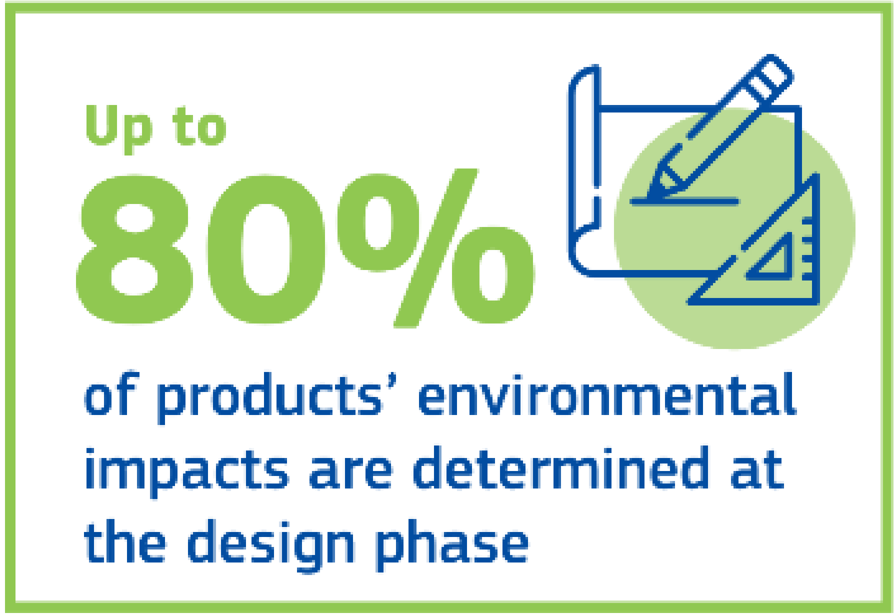
approx 30 servers, switches, load bank, routers

Whole systems / Life Cycle Thinking approach

Product life extension – reuse / remanufacture **REACTIVE**

End-of-life – recycling **REACTIVE**

Beginning of life - Design for circularity **PROACTIVE**



Empirical evidence?

Decisions made during ..... [the design] stage profoundly influence the entire life cycle of the product and determine 80 to 90 percent of its total life-cycle costs.

Graedel, T. E., Comrie, P. R. and Sekutowski, J. C. (1995) 'Green Product Design', *AT&T Technical Journal*, 74(6), pp. 17–25. doi: 10.1002/j.1538-7305.1995.tb00262.x.

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Circular Economy for the Data Centre Industry

Case study - Design for circularity

CEDaCI circular server – prototype

Modular platform format
Consistent component configuration
Easy / rapid disassembly
Reduced overall mass by 33%
Reduced number of components by 50%+
Reduced mass of plastics by 90%

OPEN COMPUTE COMMUNITY®

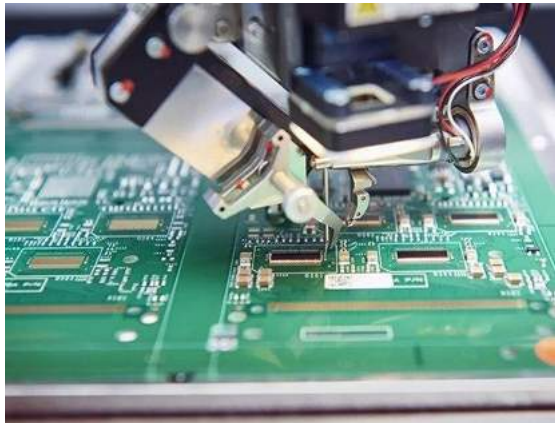
Open access publication on OCP Platform

https://www.opencompute.org/about

Case study – electrical / electronics – incomplete system

E-waste – fastest growing global waste stream

< 20% formally collected / recycling & reclamation rates unknown



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Critical Raw Materials – materials of high technical and economic importance

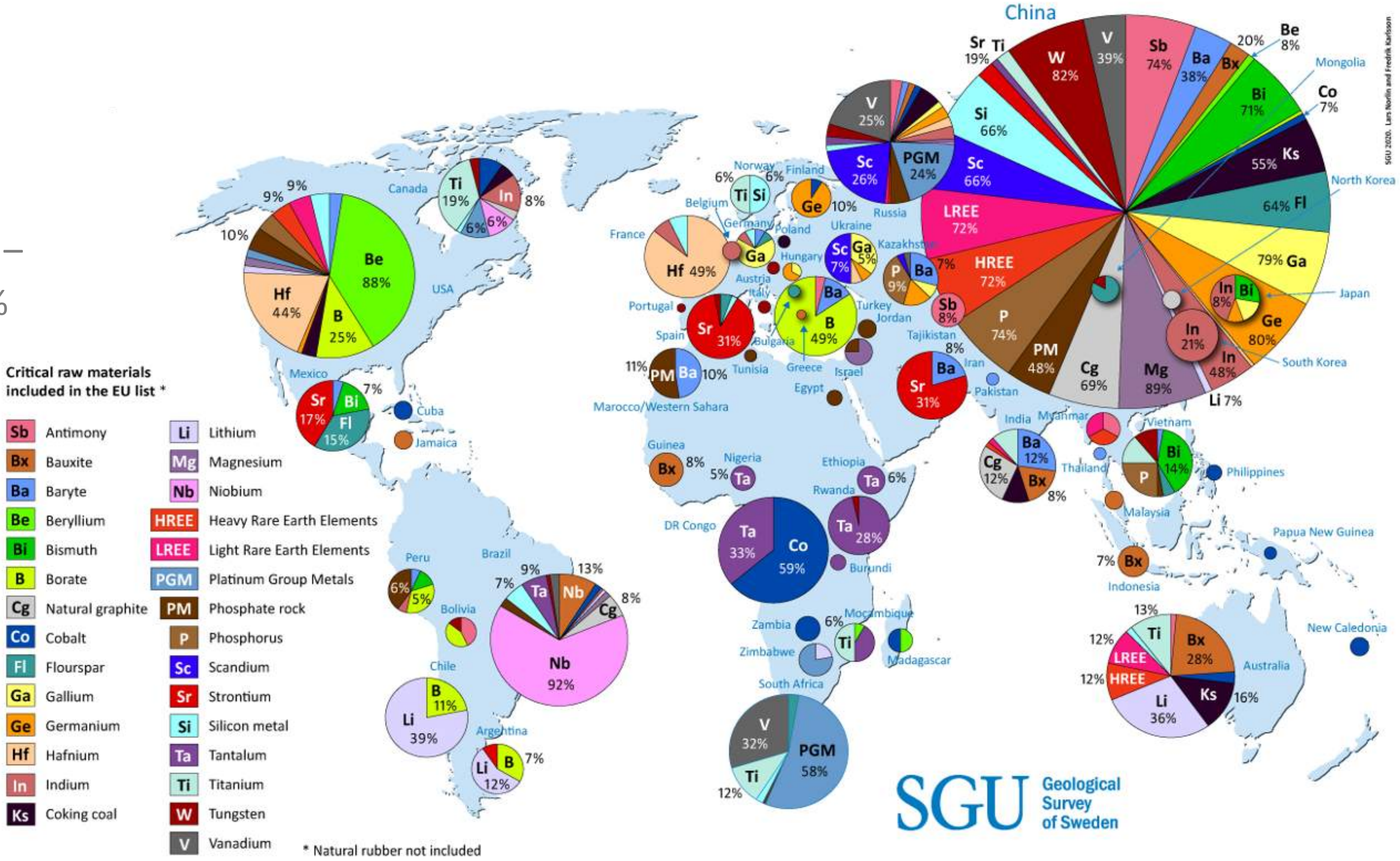
CRM because

Geopolitical location

Unmined reserves

Current recycling rates – very poor – average 1%

Substitution?



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Materials composition - typical server

									Either / or	
Elements	**CRM**	**Chassis & Screws**	**Fan**	**CPU**	**RAM**	**MB**	**PCB**	**PSU**	**HDD**	**SSD**
Ag					X	X	X	X	X	X
Al		X	X	X	X	X	X	X	X	X
Au				X	X	X	X	X		X
Ba				X	X	X	X	X	X	X
Ca				X	X	X	X	X	X	X
Co	X			X	X	X	X	X	X	X
Cr				X	X	X	X	X	X	X
Cu				X	X	X	X	X	X	X
Dy	X			X	X	X	X	X	X	X
Fe		X	X	X	X	X	X	X	X	X
In	X								X	
Mg	X			X	X	X	X	X	X	X
Mn				X	X	X	X	X	X	
Mo				X					X	
Nd	X				X			X	X	
Ni				X	X	X	X	X	X	X
Pb					X	X		X	X	X
Pr	X								X	
Sb	X					X		X		X
Si	X			X	X	X	X	X	X	X
Sn				X	X	X	X	X	X	X
Sr	X			X	X	X	X	X	X	X
Ta	X							X		
Ti	X			X	X	X	X	X	X	X
W	X						X	X	X	X
Zn				X	X	X	X	X	X	X
Zr				X	X	X	X	X	X	X

Currently recycled
Critical Raw Materials
Others

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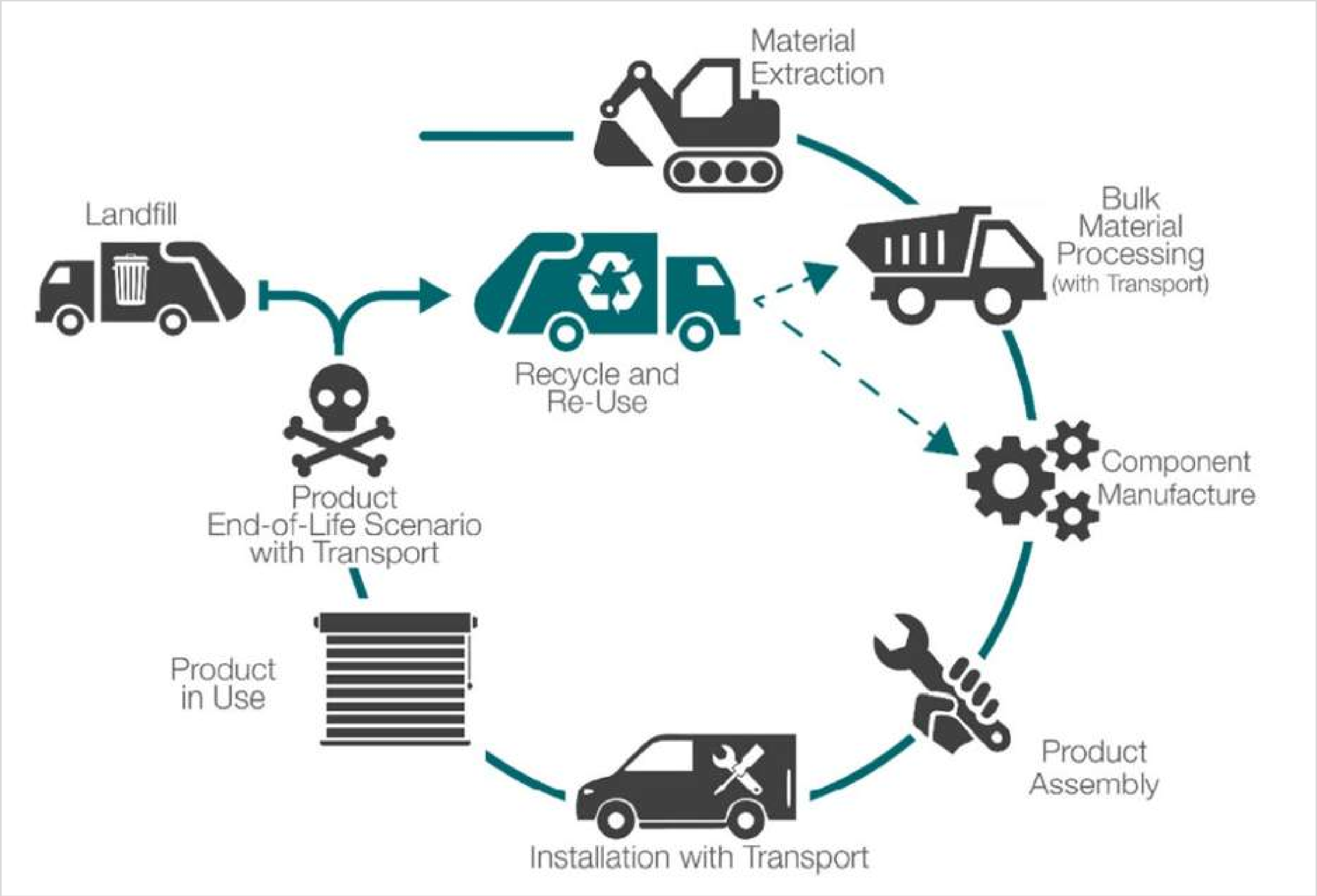
Life Cycle Thinking and Solar Shading



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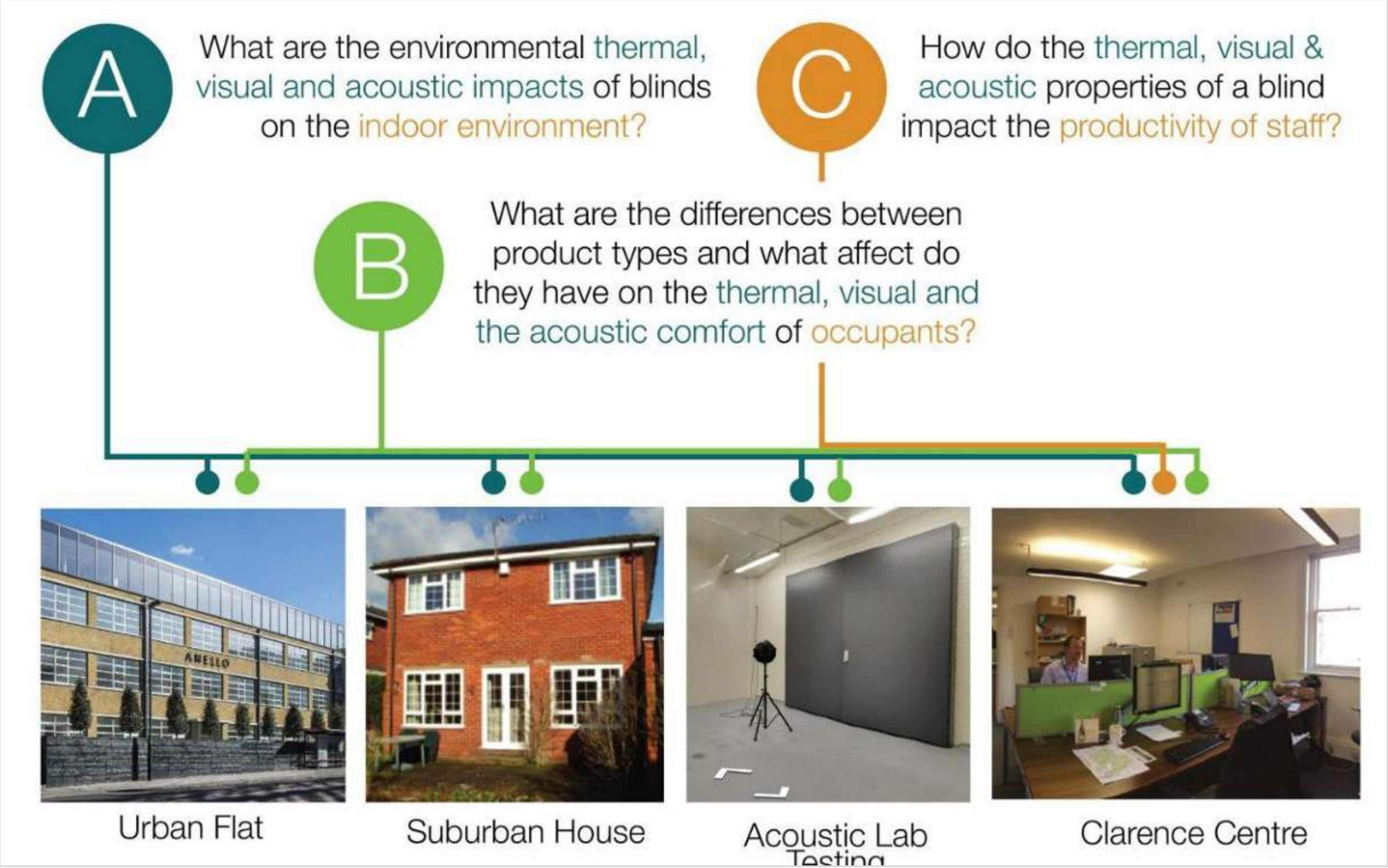
BBSA-LSBU funded PhD

Scientific evidence - environmental, social & economic benefits of shading products

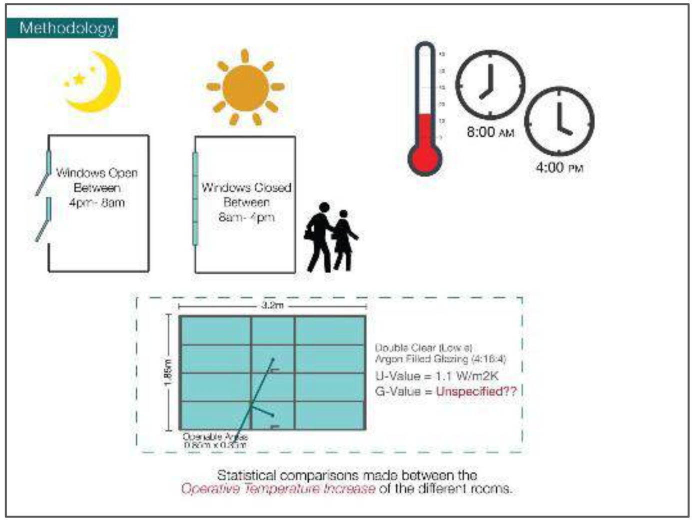


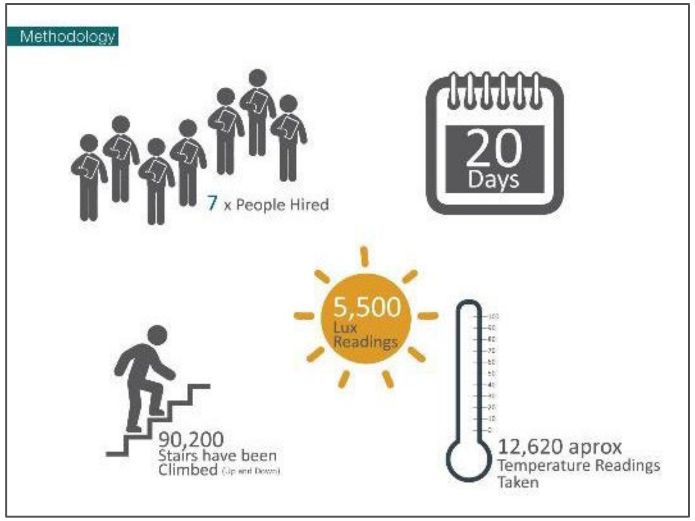
Shading products industry

Reducing thermal gain / over-heating

Original Specified
Aluminium Venetian Blind

Open Blind Room





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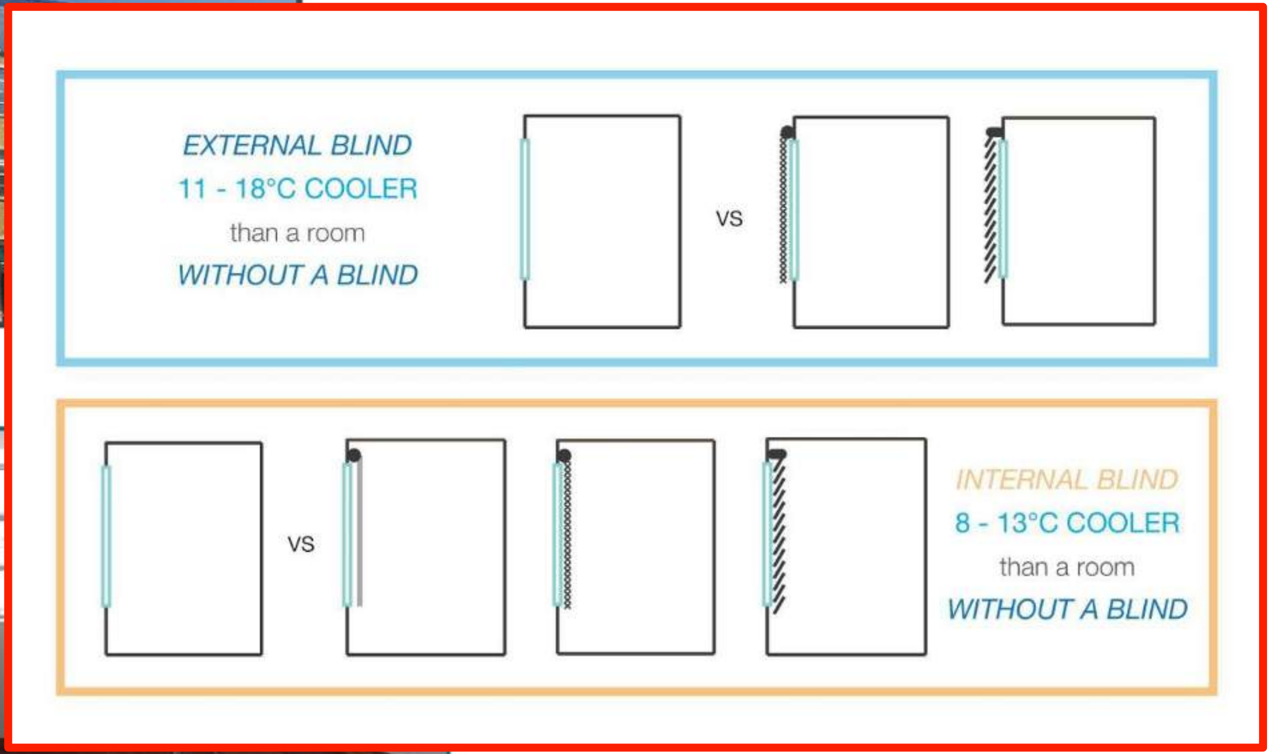

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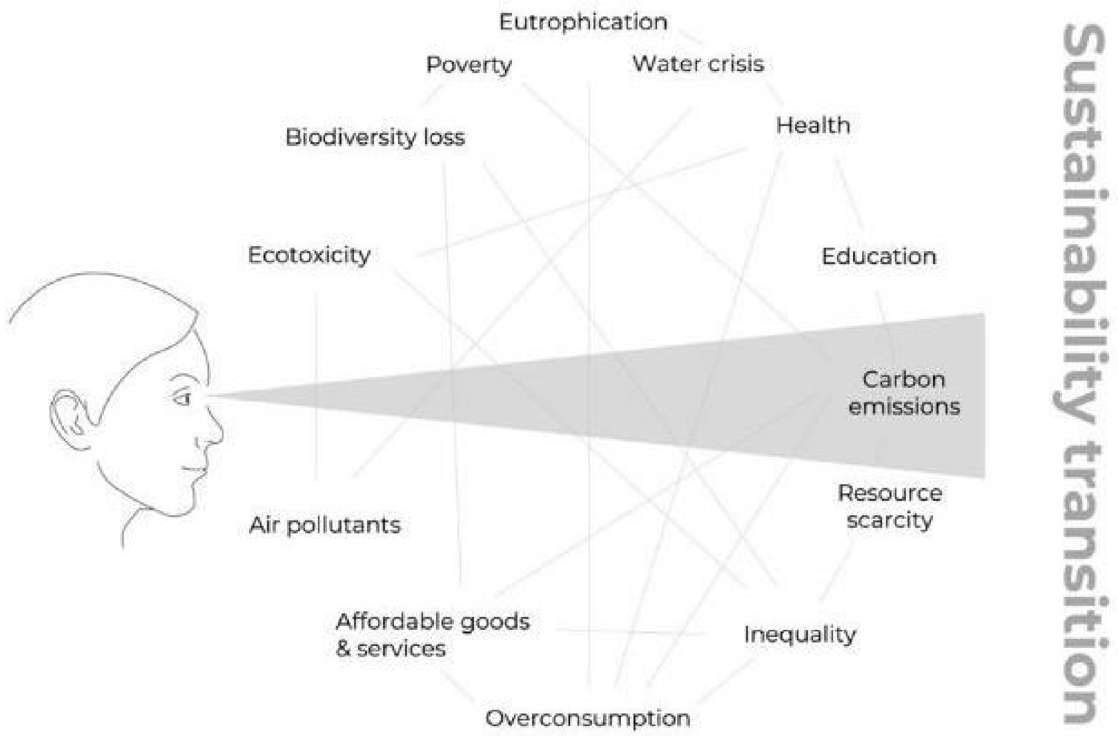
Carbon assessment – inaccurate – at best indicative

Life Cycle Assessment – considerably more accurate – used to assess benefits of solar shading



Graphic by Jan Konietzko

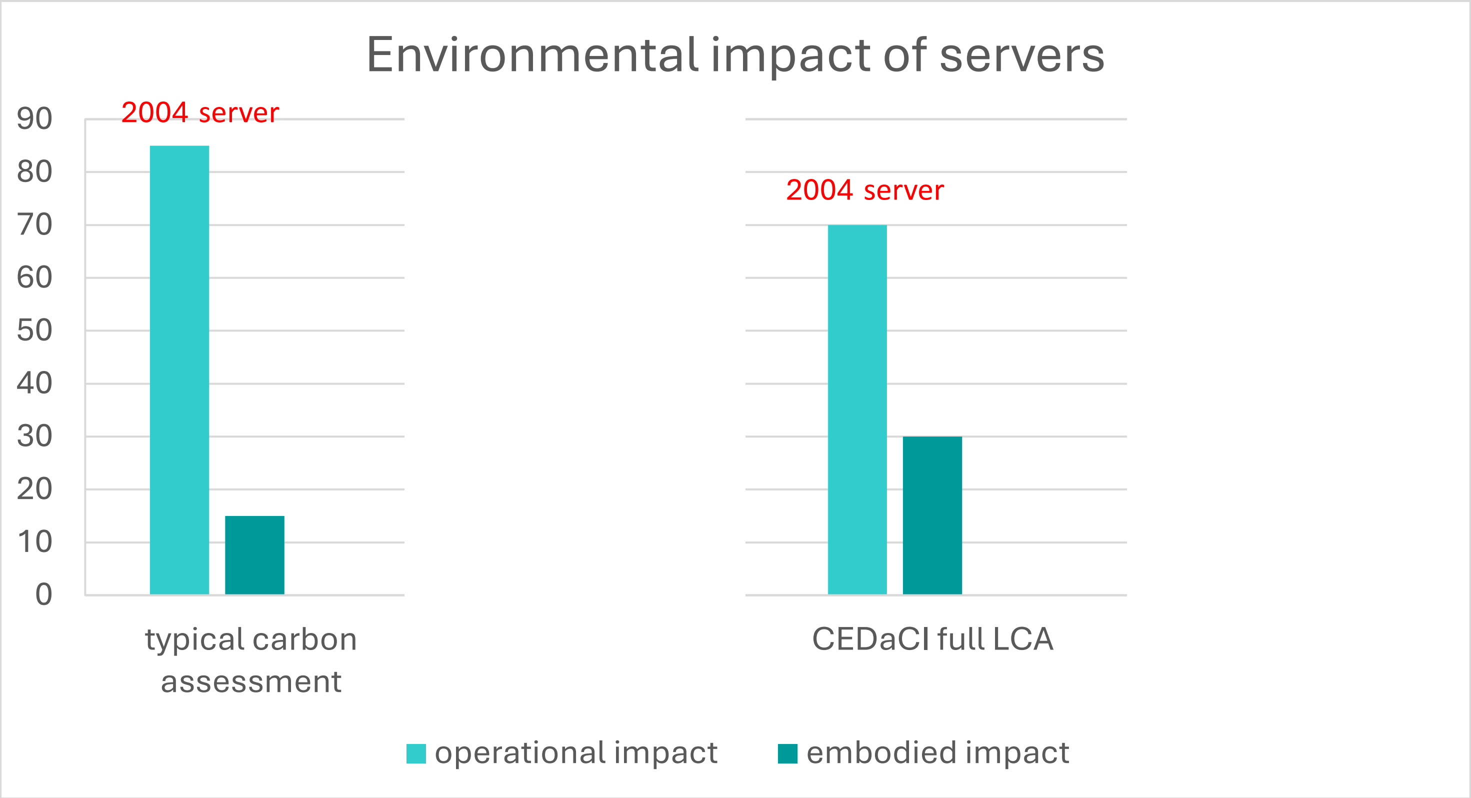
Comprehensive Life Cycle Assessment includes

1. Climate change
2. Resource depletion (fresh water)
3. Human toxicity
4. Abiotic resource depletion
5. Fossil fuel resource depletion
6. Eutrophication
7. Acidification – earth and oceans
8. Ozone layer depletion
9. Ionizing radiation
10. Particulate matter
11. Land and land use change

Carbon assessment – inaccurate – at best indicative

Life Cycle Assessment – considerably more accurate – used to assess benefits of solar shading

Comparing carbon assessments with preliminary LCA results – indicate much higher embodied impact



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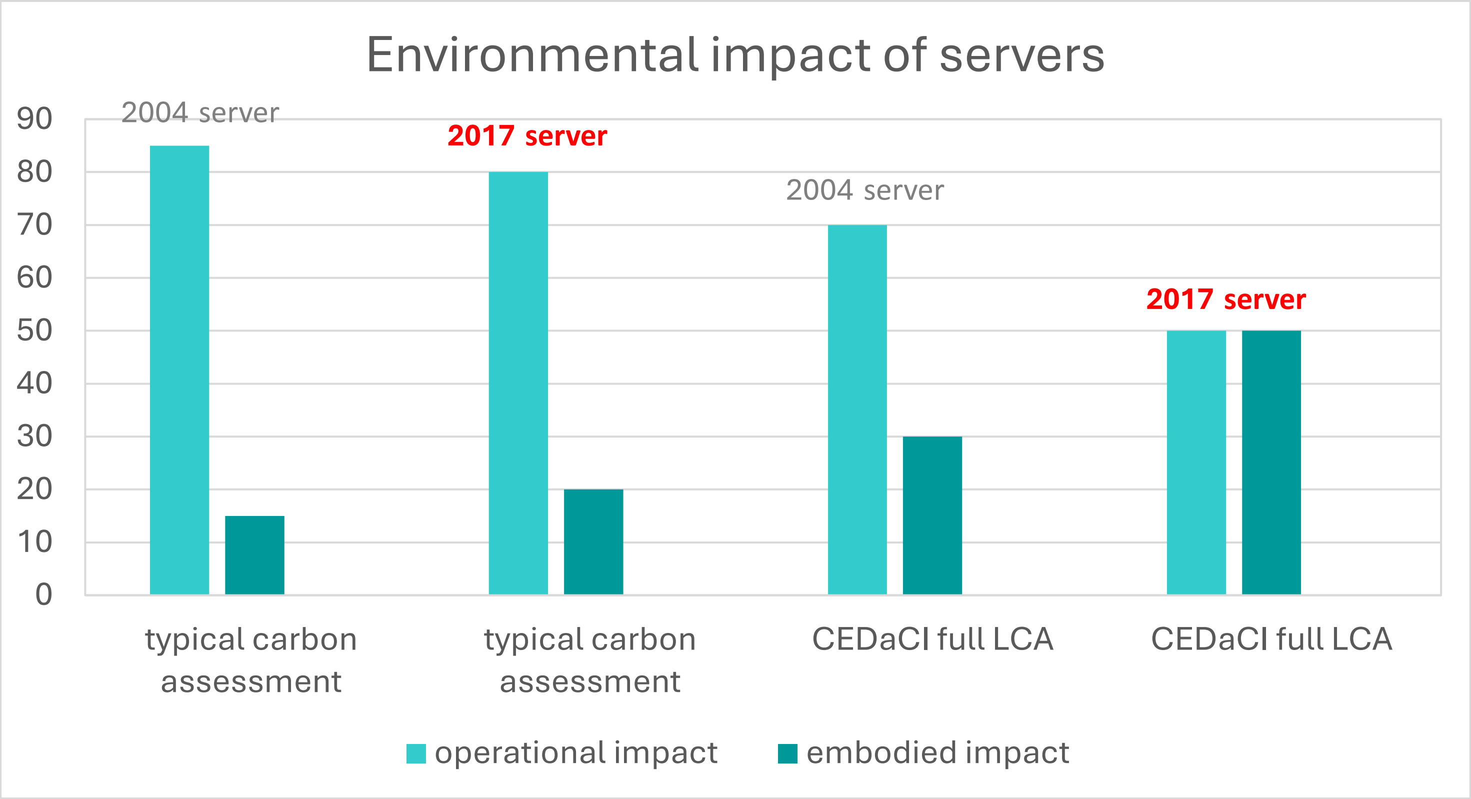

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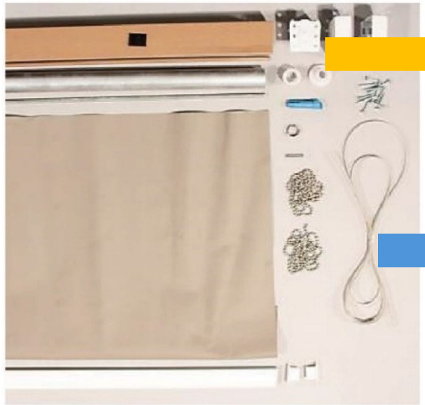
Assessing overall – operational + embodied - impacts of shading products

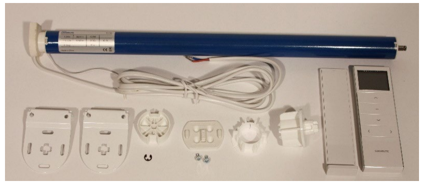
Manual roller – internal

Manual venetian – internal & external

Motorised - internal

Automated- external





Operational Annual Heating Energy Savings*	Control System	End-of-life Scenario	Operational and Embodied Environment Savings – Product Lifetime (Years): 3	5	10	15	20
5%	Manual	Recycle	2.51%	3.13%	3.88%	4.13%	4.25%
		Landfill	-1.48%	-0.71%	1.24%	1.89%	2.21%
	Internal Motorised	Recycle	1.70%	2.53%	3.52%	3.85%	4.02%
		Landfill	-2.88%	-1.78%	0.59%	1.37%	1.77%
	External	Recycle	-3.91%	-0.46%	2.21%	3.10%	3.55%
		Landfill	-12.95%	-6.00%	-0.62%	1.18%	2.08%
10%	Internal Manual	Recycle	7.51%	8.13%	8.88%	9.13%	9.25%
		Landfill	3.52%	4.29%	6.24%	6.89%	7.21%
	Internal Motorised	Recycle	6.70%	7.53%	8.52%	8.85%	9.02%
		Landfill	2.12%	3.22%	5.59%	6.37%	6.77%
	External Automated	Recycle	1.09%	4.54%	7.21%	8.10%	8.55%
		Landfill	-7.95%	-1.00%	4.38%	6.18%	7.08%
15%	Internal Manual	Recycle	12.51%	13.13%	13.88%	14.13%	14.25%
		Landfill	8.52%	9.29%	11.24%	11.89%	12.21%
	Internal Motorised	Recycle	11.70%	12.53%	13.52%	13.85%	14.02%
		Landfill	7.12%	8.22%	10.59%	11.37%	11.77%
	External Automated	Recycle	6.09%	9.54%	12.21%	13.10%	13.55%
		Landfill	-2.95%	4.00%	9.38%	11.18%	12.08%
20%	Internal Manual	Recycle	17.51%	18.13%	18.88%	19.13%	19.25%
		Landfill	13.52%	14.29%	16.24%	16.89%	17.21%
	Internal Motorised	Recycle	16.70%	17.53%	18.52%	18.85%	19.02%
		Landfill	12.12%	13.22%	15.59%	16.37%	16.77%
	External Automated	Recycle	11.09%	14.54%	17.21%	18.10%	18.55%
		Landfill	2.05%	9.00%	14.38%	16.18%	17.08%

Black (positive) figures - blind use: embodied and operational benefit is GREATER than that of not having blinds.

Red (negative) figures - blind use: embodied and operational benefit is LESS than that of not having blinds.

* Total Heating Energy = 6,690 kWh/yr ≡ 205 mPt/yr.

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Materials composition –

typical motorised / automated shading products

Currently recycled

Critical Raw Materials

Others

Elements	CRM	Brackets & Screws	Motor	PCB	D Cell Batteries	Li batteries
Ag				X		
Al		X	X	X		
Au				X		
Ba				X		
C					X	X
Ca				X		
Co	X			X		X
Cr				X		
Cu			X	X		
Dy	X			X		
Fe		X	X	X	X	
K					X	
Li	X					X
Mg	X			X	X	X
Mn				X		
Ni				X		
Si	X			X		
Sn				X		
Sr	X			X		
Ti	X			X		
W	X			X		
Zn				X	X	
Zr				X		

Mechanism design – contemporary Roman blind

Component assemblies – mixed materials

PA – nylon + steel

POM

Assembly / disassembly

PC fastener / coated steel chain

ABS

Acrylic painted steel brackets

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Solar shading – materials composition

Annual textile production in EU –
175m tonnes primary raw material, millions litres water and chemicals

Shading products - woods, metals and plastics and

Textiles – some 100% natural / most mixed natural & synthetic fibres, coatings and laminated layers

End-of life -
1% of textiles - new products, some are downcycled, 87% sent to landfill/incinerated along with other components

Urgent need to increase resource efficiency by extending product life through repair, reuse, remanufacture

Increase recycling at end of life

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UK Government Circular Economy Package
EU / UK Guidelines changing to legislation

Priority … product groups in the

2012 – 2018
5% increase in CE linked jobs

Design for Circularity / Eco-design is not an option

Regulation (EU) 2024/1781 of the European Parliament and of the Council of 13 June 2024 establishing a framework for the setting of **ecodesign requirements for sustainable products**, amending Directive (EU) 2020/1828 and Regulation (EU) 2023/1542 and repealing Directive 2009/125/EC

Designs must ….

- use less energy
- last longer
- can be easily repaired
- parts can be easily disassembled and put to further use
- contain fewer substances of concern
- can be easily recycled
- contain more recycled content
- have a lower carbon and environmental footprint over its lifecycle

Also consider

- WEEE regulations
- producer responsibility regulations
- Scope 1, 2 and 3 carbon emissions
- EPDs
- On going research BBSA – glazing data, + shading / U-tot values

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Simple start - Circular Economy for SMEs - participatory research – focus on reuse of textiles

Shadescape

Ella Doran

YODOMO

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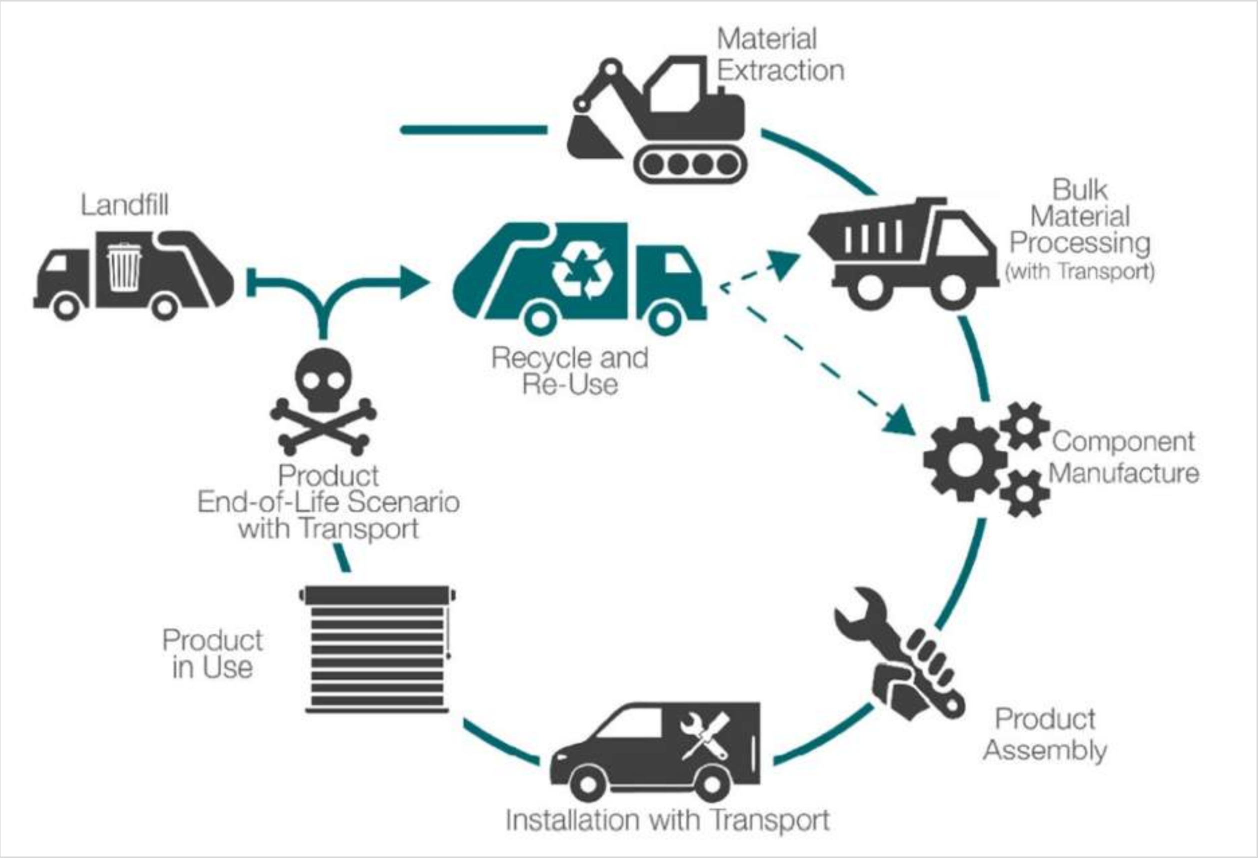
Conclusion and recommendations

- Potential for circularity exists
- Urgent need to consider **design**
- Assess and compare impacts and benefits of different materials – operational benefits + embodied impacts
    - textiles – natural vs synthetic
    - mono-materials vs composites & laminates
- Can changes increase recycling?
- Design for disassembly as well as assembly
- Increase component reuse and remanufacture
- Increase recycling of textiles, slats etc, manual mechanisms

- Assess user behaviour – drivers for change
- Strategies to increase take-back – manufacturer responsibility – legislation?



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Thank you for listening

Any questions?

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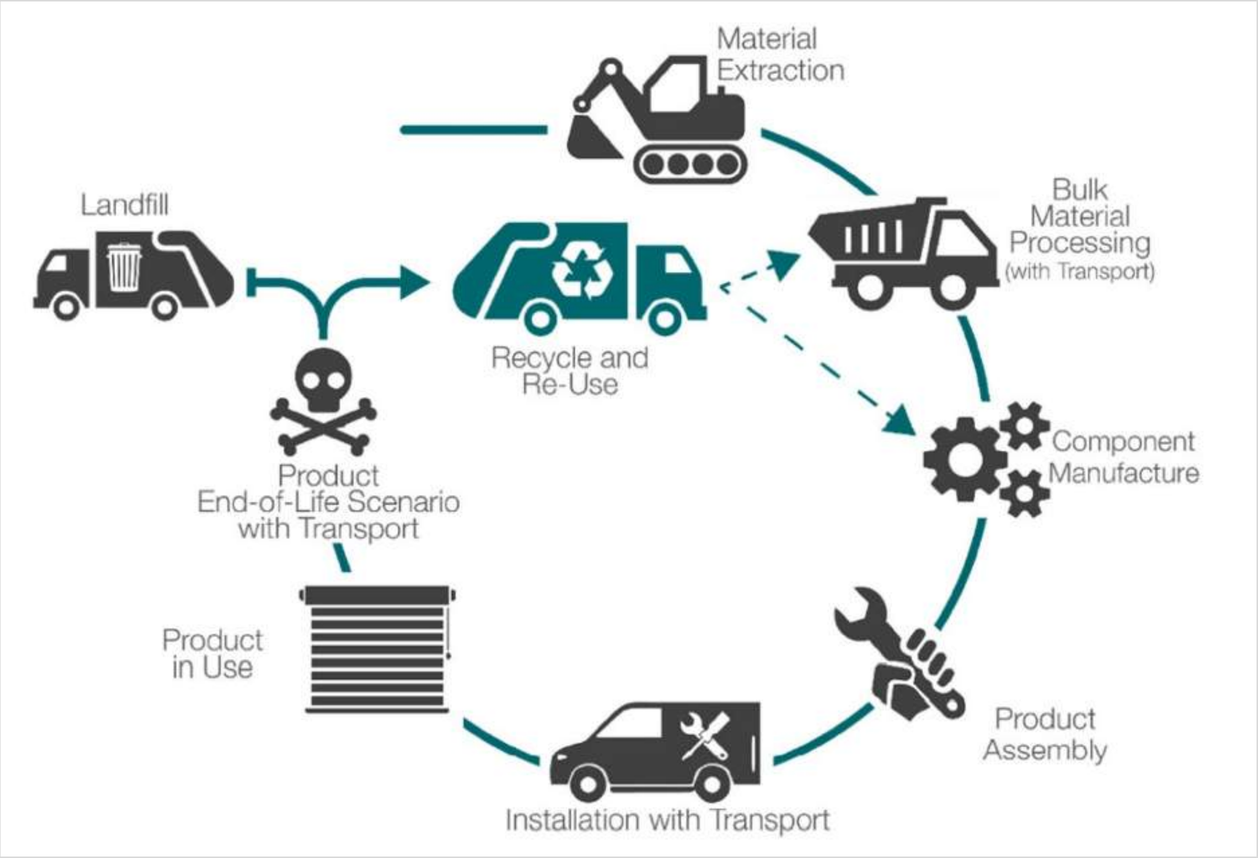

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