



CIRCULAR MODELS LEVERAGING INVESTMENTS
IN CULTURAL HERITAGE ADAPTIVE REUSE

Circular Economy Strategies for Adaptive Reuse of Cultural Heritage Buildings to Reduce Environmental Impacts

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- ❖ **Circular Economy (CE)** (in general): aspirational and universal goal & suite of strategies for transitioning to a sustainable, and low-carbon economy based on slowing extraction and renewing resources
- ❖ **Cultural Heritage (CH)** adaptive reuse aligns well with CE: embodied energy of old buildings; durability of old buildings (quality materials); building waste reduction; additional material demand-reduction (for new buildings); retrofit energy & efficiency measures reduce operational energy
- ❖ **Environmental indicators** provide a non-monetary measure of environmental quality and human impact to:
 - ❖ Define the state of environmental quality
 - ❖ Set the baseline
 - ❖ Monitor progress



- Design for energy efficiency including passive methods
- Minimize or eliminate need for new construction materials by reducing space and multi-tasking space
- Substitute non-renewable energy supply with purchased or produced renewable energy
- Use local and culturally significant materials
- Consider environmental impact scenarios in design selection (produced and avoided wastes, embodied energy & emissions)
- Recover water and energy
- Increase or maintain green space
- Plan for long term climate change due to weather-related risks such as flooding
- Plan for long term climate change by choosing flexible heating and cooling
- Enhance lifespan maintainability
- Design achieves Green Building certification (LEED, BREÉAM, DGNB)
- Structure foundation and building corpus to make ready for different uses in the future
- Design for disassembly
- Enhance material durability to extend lifespan
- Historic and/or cultural heritage listing/designations

Design: transformation is planned, designed and financed

- Reduce transport by choosing local sourcing
- Substitute fossil fuel intensive materials with bio-based materials
- Substitute new materials with used materials wherever possible

Building Materials Sourcing: raw materials are extracted and sourced for project

- Limit disturbance of trees, soils and habitat
- Increase or maintain green space
- Revive traditional construction techniques and materials
- Use abandoned or neglected cultural heritage sites
- Implement brownfield development through hazardous waste remediation and/or solid waste removal on site

Build: construction, rehabilitation, adaptation

- Reuse salvaged materials from other demolitions
- Recover materials from project

- Recover water and energy with modern and historical/cultural technology and design
- Implement, incentivise, and encourage users to achieve high rates of product reuse and recycling
- Strive to increase proportion of purchased and produced renewable energy whilst phasing out fossil fuels
- Implement ongoing energy efficiency strategy
- Measure energy efficiency continuously
- Implement use arrangements that meet needs without individual ownership (i.e., shared office, laundry, conference spaces)
- Implement fee for service arrangements that reduce material inputs and incentivise longevity such as paying for light rather than electricity for lighting, copying services rather than copiers, flooring service rather than owning carpeting
- Promote and incorporate local and regional agriculture
- Ensure public access to greenspace and other spaces
- Create habitats for animals and insects
- Improve users quality of life
- Improve land through pollutant remediation and/or increasing nutrients in soil
- Improve users low carbon mobility options
- Measure health impacts e.g., indoor air quality
- Provide facilities for easy collection of recyclable materials and biomass for compost

Use & Operate: the space continuously meets the needs of residents/ users

- Evaluate options for transformation and adaptive reuse
- Implement material passports to facilitate reuse
- Communicate availability of a heritage site for adaptive reuse and/or rehabilitation
- Implement dismantling and disassembly and recovery rather than complete demolition
- Create new value chains from demolition wastes, e.g., gypsum to fertilizer, lumber to wood flooring
- Utilize materials for energy recover when no alternative to landfill

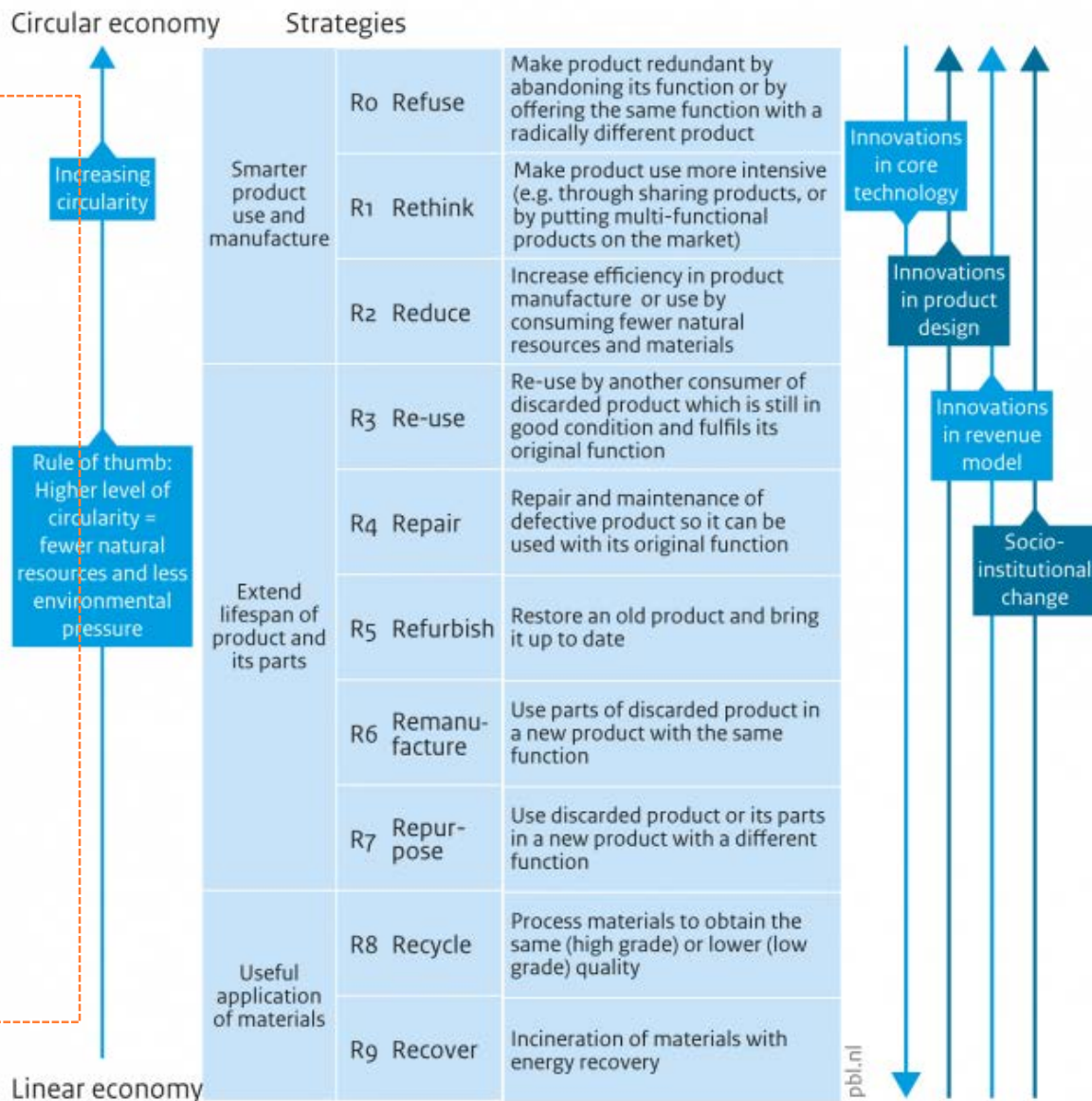
Repurpose & Demolition: end of current use, used materials are extracted and disposed



- ◆ **Product Supply Chain Circularity Strategies framework by Potting et al. (2017)**
- ◆ **Cascading Material Use**
- ◆ **Prioritizes circular concepts and actions**
- ◆ **Higher Circularity = Less Materials & Energy**

Source: Potting, J., Hekkert, M., Worrell, E., Hanemaaijer, A., 2017. Circular economy: measuring innovation in the product chain. PBL.

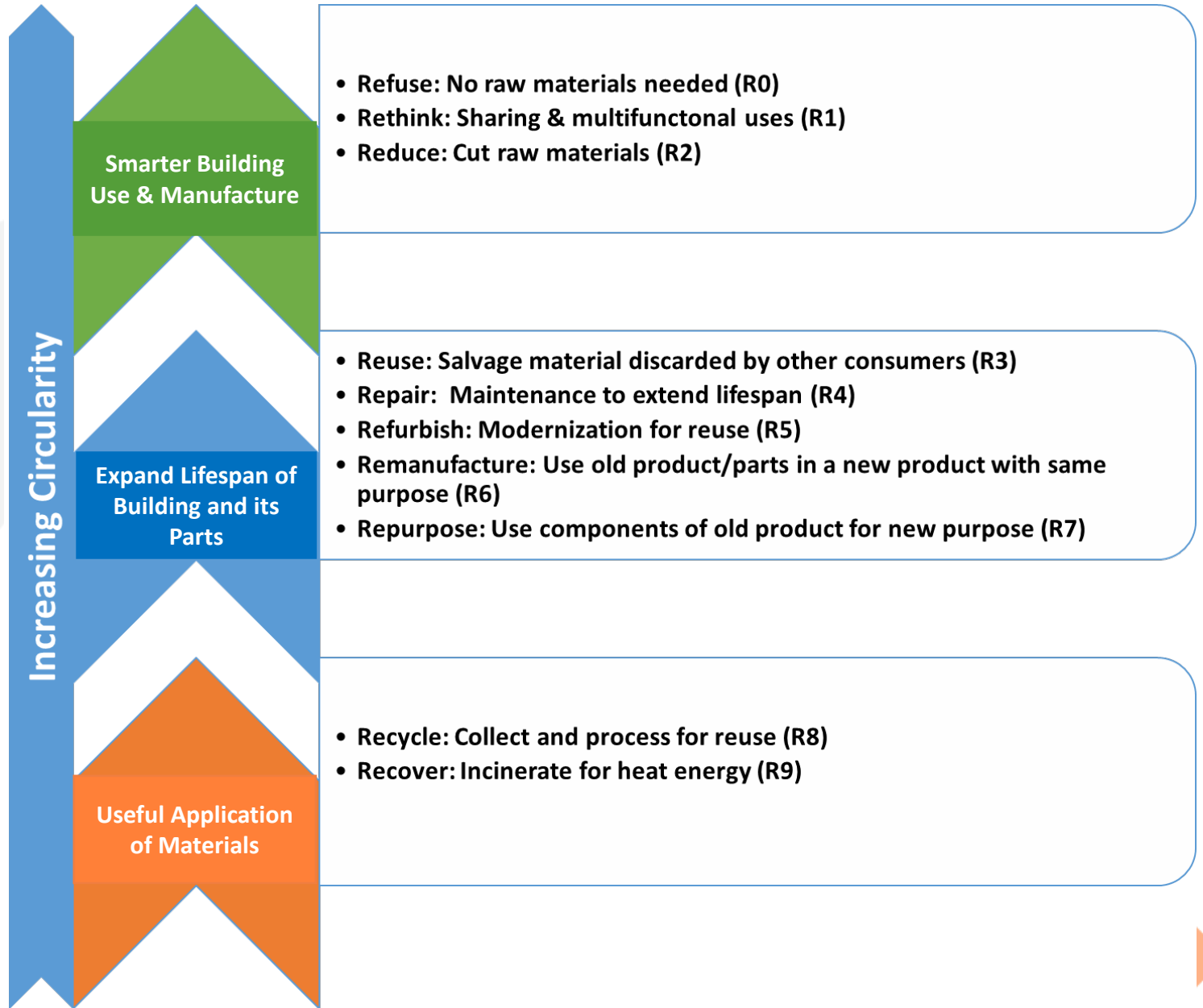
Circularity strategies within the production chain, in order of priority



Source: RLI 2015; edited by PBL

www.pbl.nl

- **Product Supply Chain Circularity Strategies Framework**
- **Applied to Buildings**
- **Transform Linear to Circular**
- **Cascading Material Use**
- **Posits micro to macro transformation**



◆ Building Life Cycle Phases as a Linear Product Supply Chain...

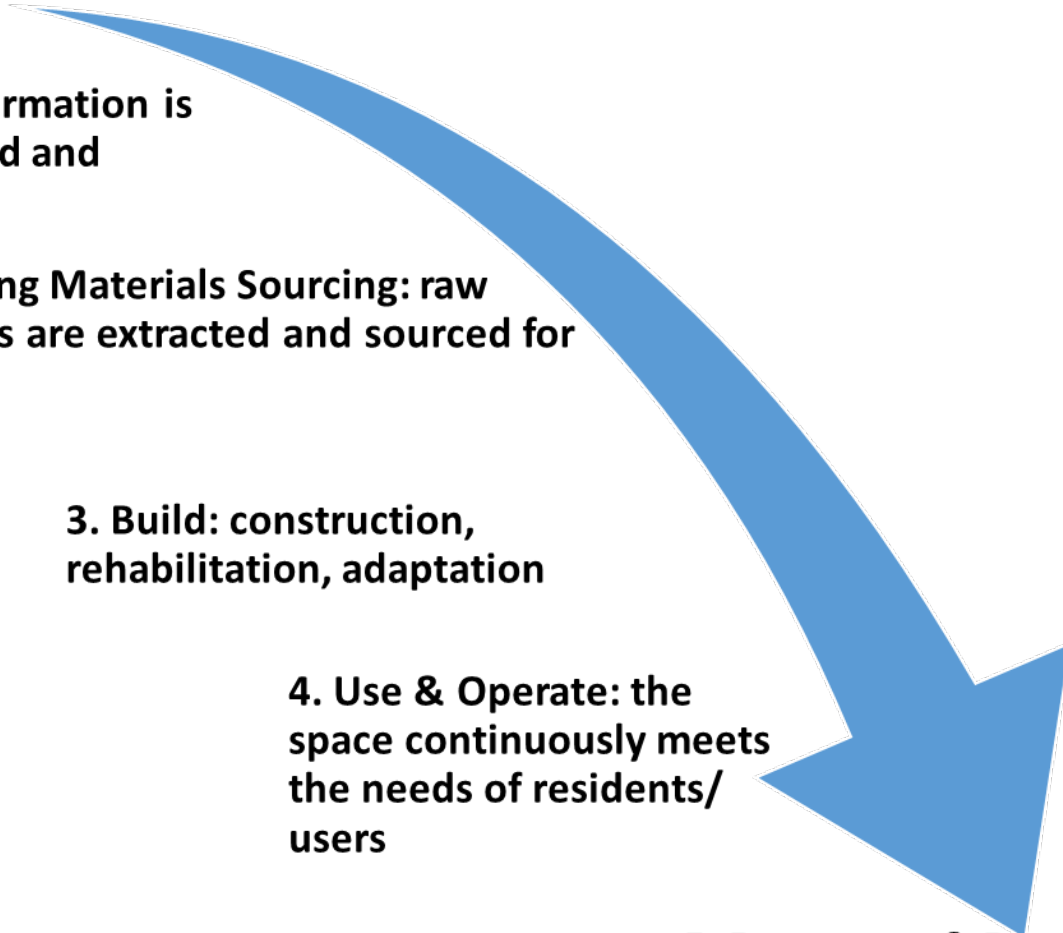
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5. Repurpose & Demolition: end of current use, used materials are extracted and disposed



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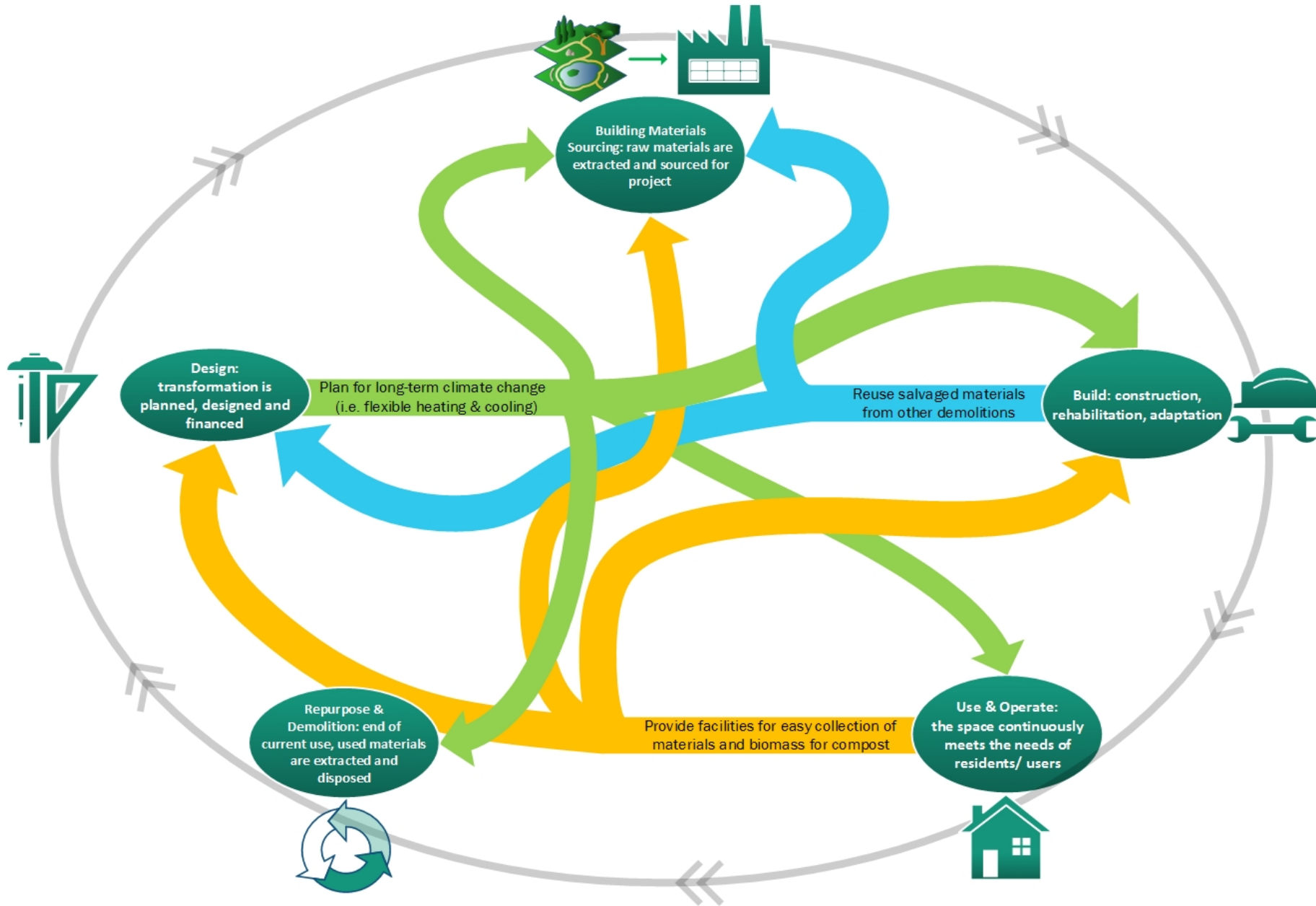
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◆ 46 cradle-to-cradle strategies

◆ Beyond linear supply chain cradle-to-gate perspective

- ✓ Design considered as a critical separate phase (left out of many LCAs)
- ✓ Building Materials Sourcing considered as separate stage
- ✓ Embodied energy, impacts of occupancy stage and end-of-life of building included
- ✓ Project teams made up of all stakeholders at every stage of a building's life cycle
- ✓ Straightforward and easily understood

- ◆ **Environmental Indicators and Strategies may be used for education and policy development**
 - **For example, public procurement including the level of environmental circularity that a building project achieves.**
- ◆ **Strategies can be practically applied for:**
 1. **Planning and evaluation at the start of project development**
 2. **An exploratory scoping exercise in combination with other participatory methods**
 3. **Post project review of environmental circularity**
- ◆ **Next step is testing with adaptive reuse of cultural heritage project teams**



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THANKS FOR YOUR ATTENTION!!!

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