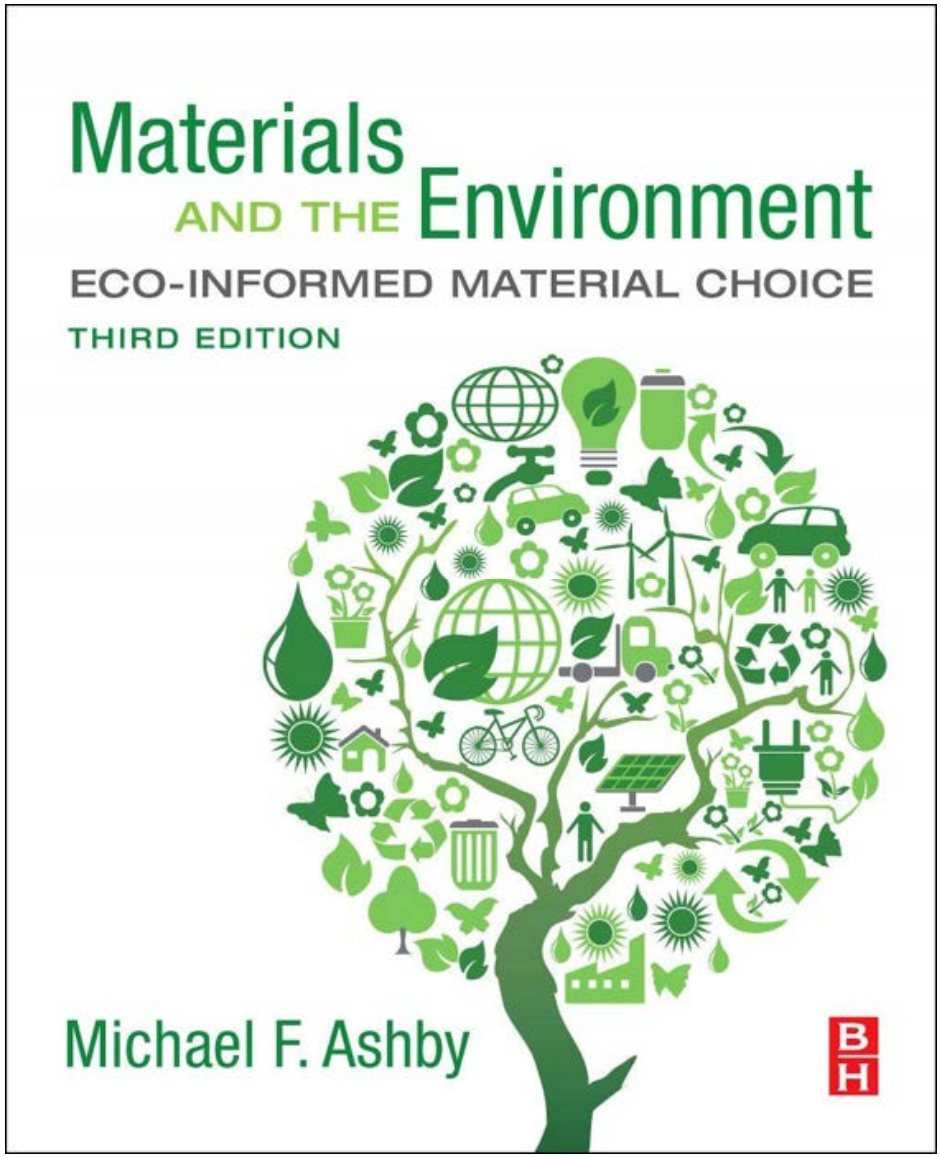
Circular Economy

Kyoung Hee Kim PhD AIA Professor
Ravin School of Architecture
UNC Charlotte


Materials
AND THE Environment
ECO-INFORMED MATERIAL CHOICE
THIRD EDITION
Michael F. Ashby
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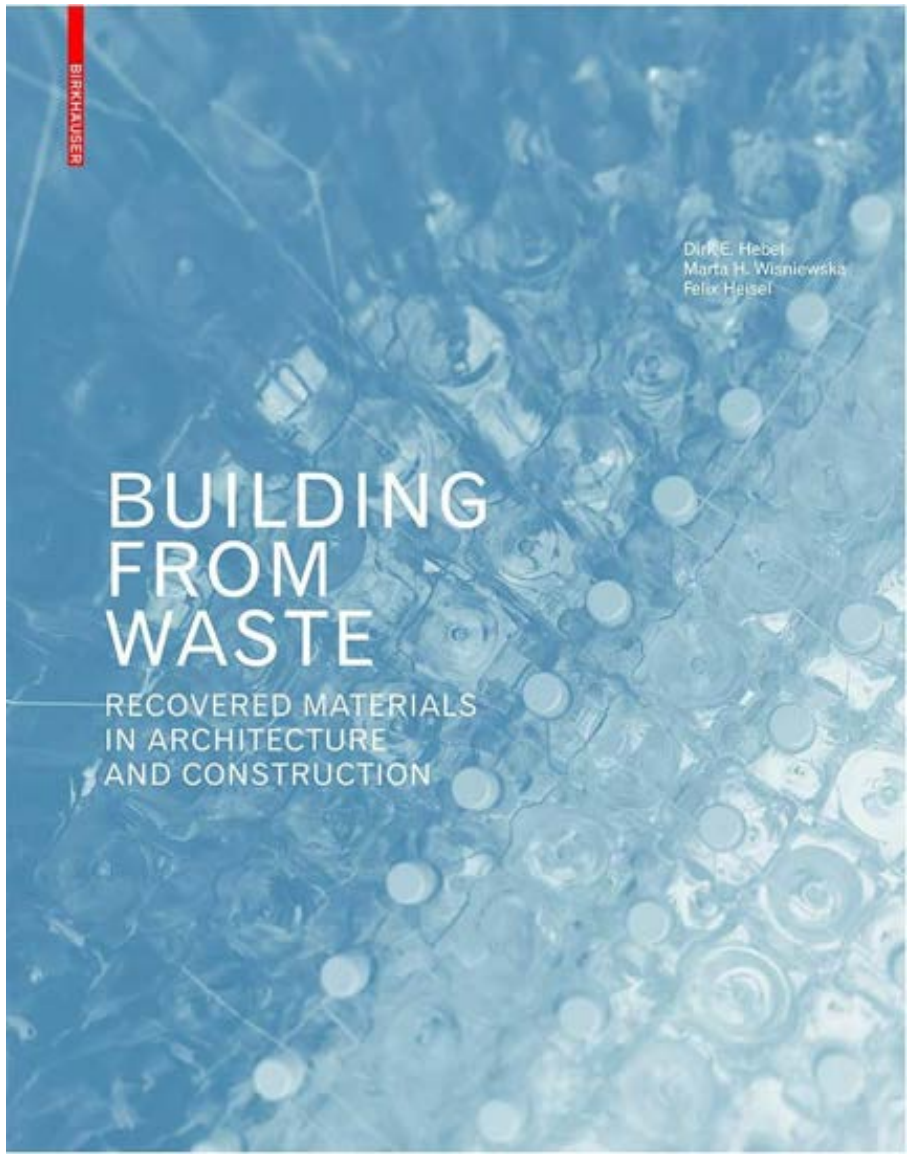
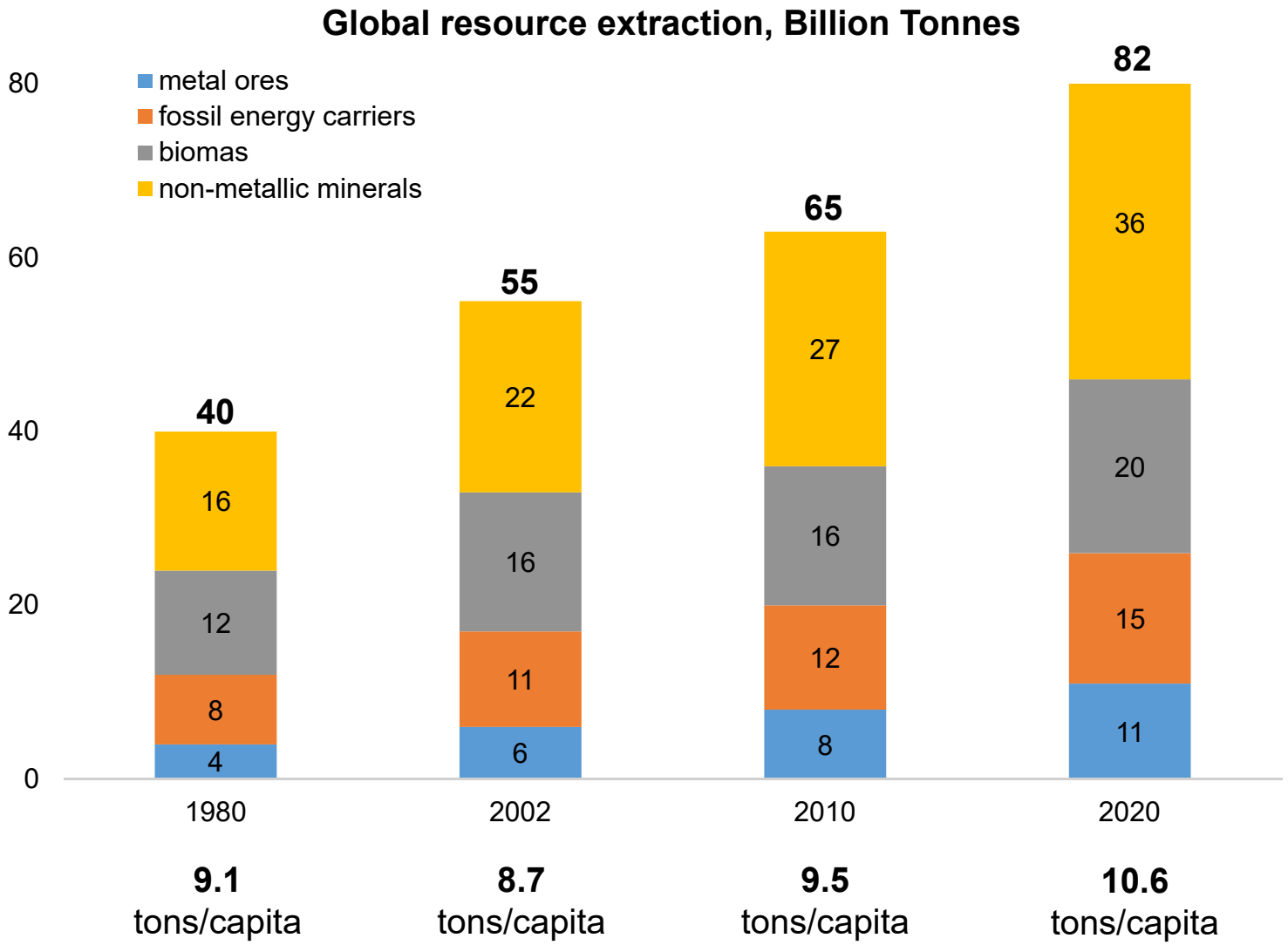
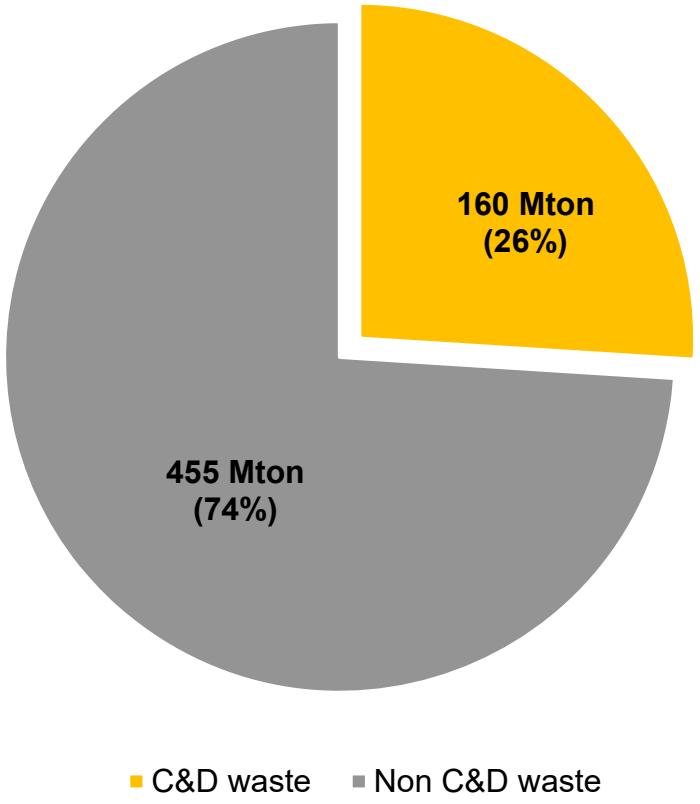

BIRKHAUSER
Dirk E. Hebel
Marta H. Wisniewska
Felix Heisel
BUILDING
FROM
WASTE
RECOVERED MATERIALS
IN ARCHITECTURE
AND CONSTRUCTION

Global resource extraction: 82 Gtons



The Ellen MacArthur Foundation's report on the Economics of a Circular Economy

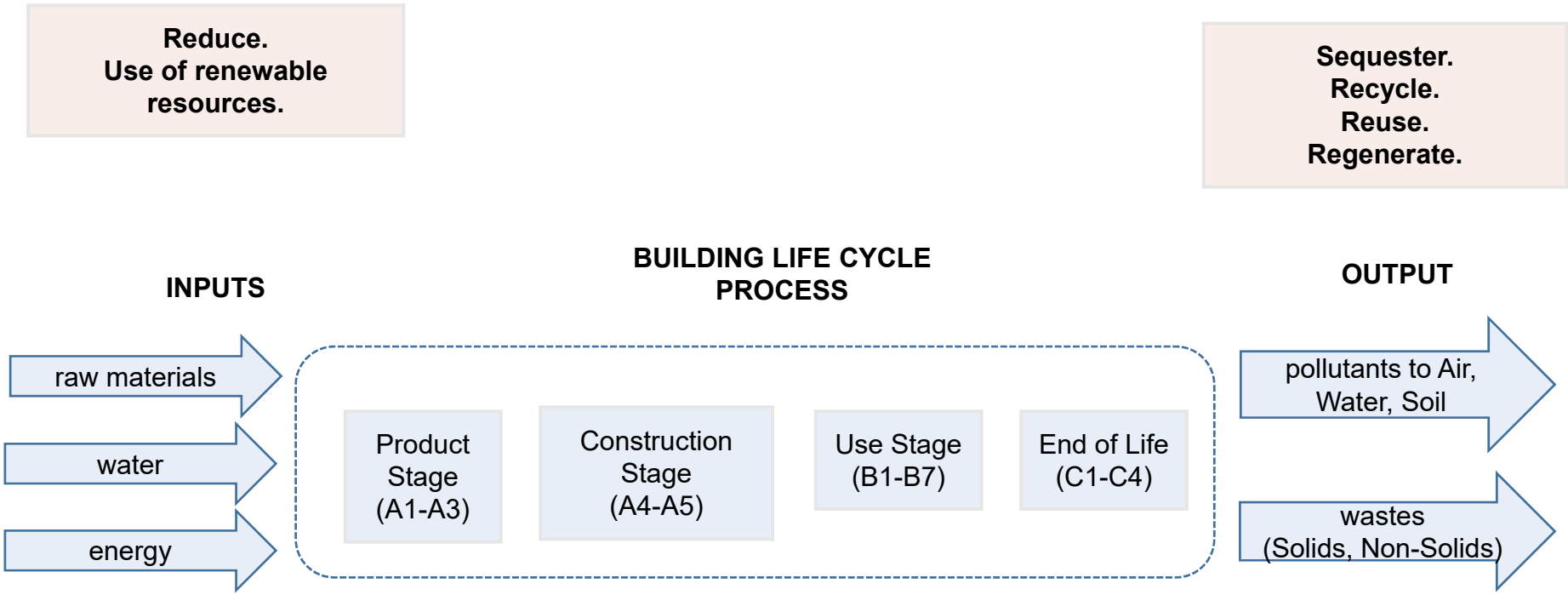
US Solid Waste: 615 Mtons in 2008



1. Recycled or reused: 20~30% (32-48 Mton)
2. Discarded: 70~80% (112-128 Mton)
    - Lumber (40%)
    - Asphalt products (14%)
    - Soil/fines (11%)
    - Concrete/rock/brick (11%)
    - Gypsum board (10%)
    - Other (14%)

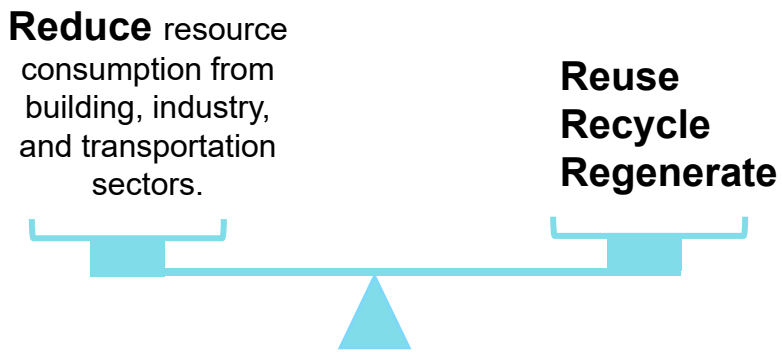
The Ellen MacArthur Foundation's report on the Economics of a Circular Economy

Circular Economy: Building Life Cycle Perspective



Building LCA Framework from European Standard EN 15978:2011

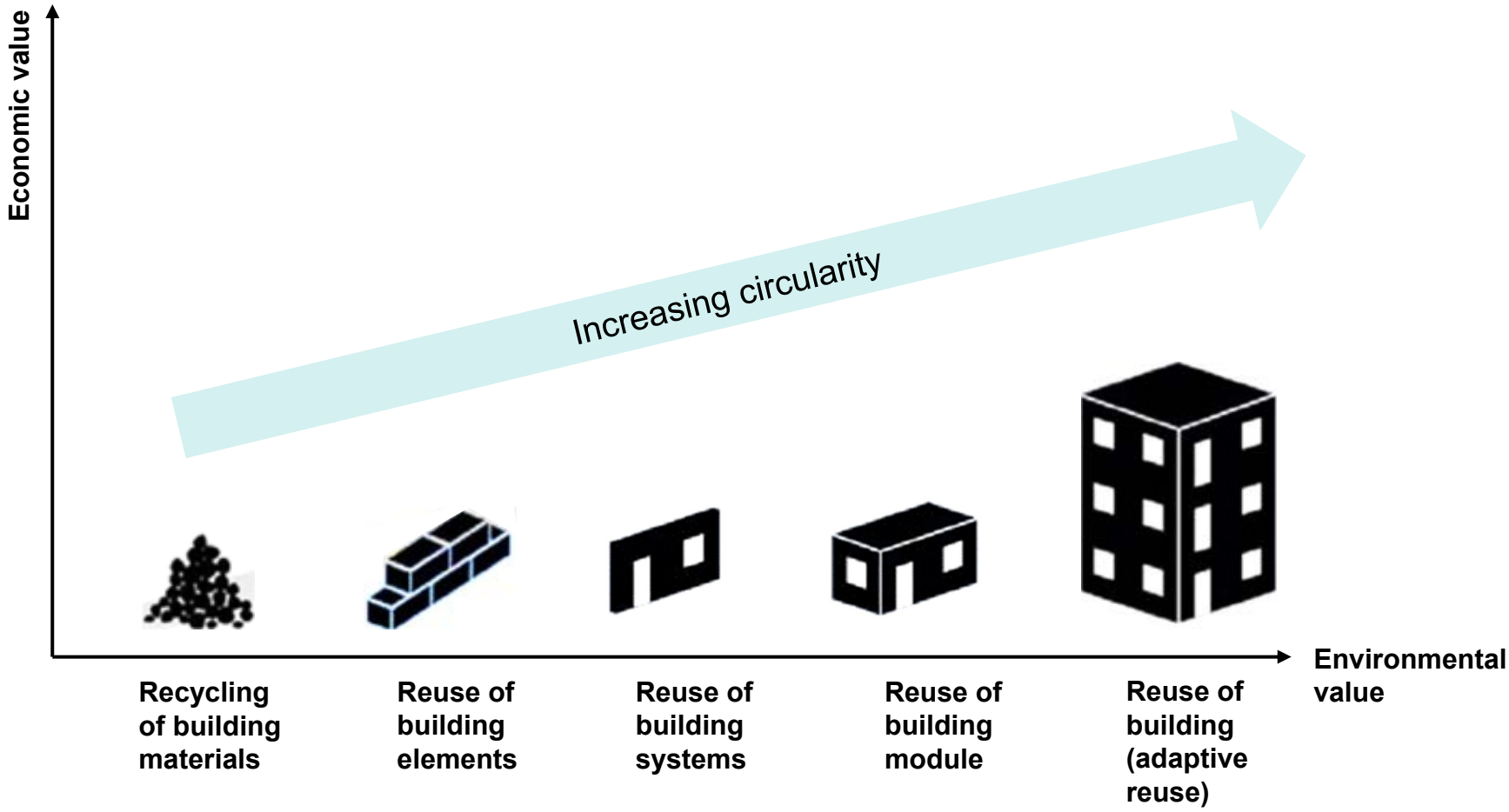
Circular Economy Framework



Net Zero Waste Strategy

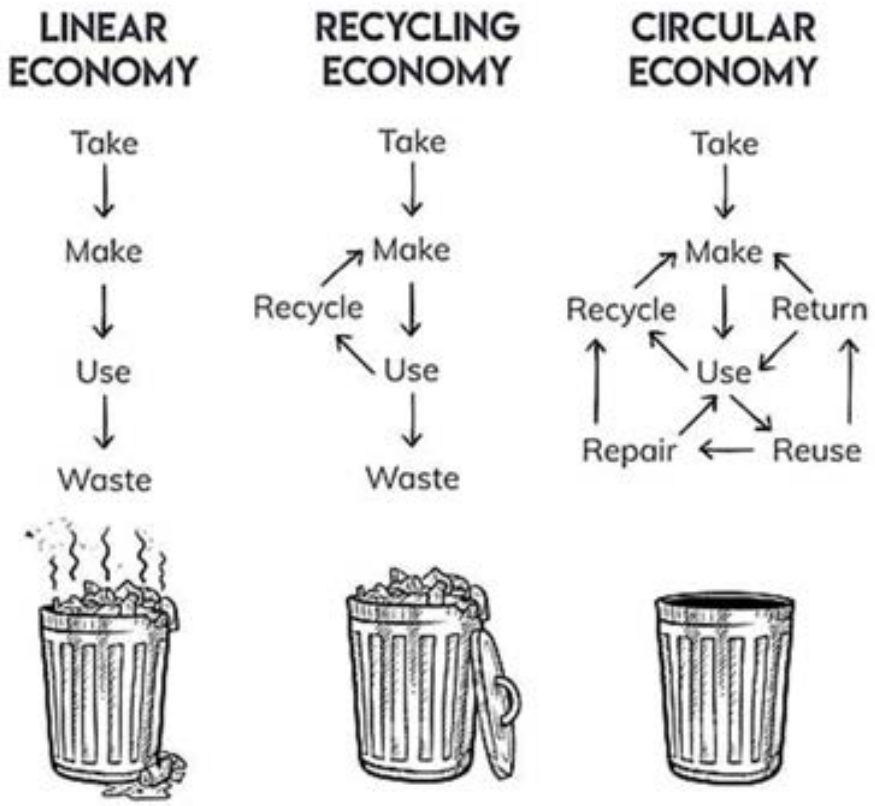
Circularity

Circular Economy



https://iopscience.iop.org/article/10.1088/1757-899X/471/9/092051/pdf

Circular Economy

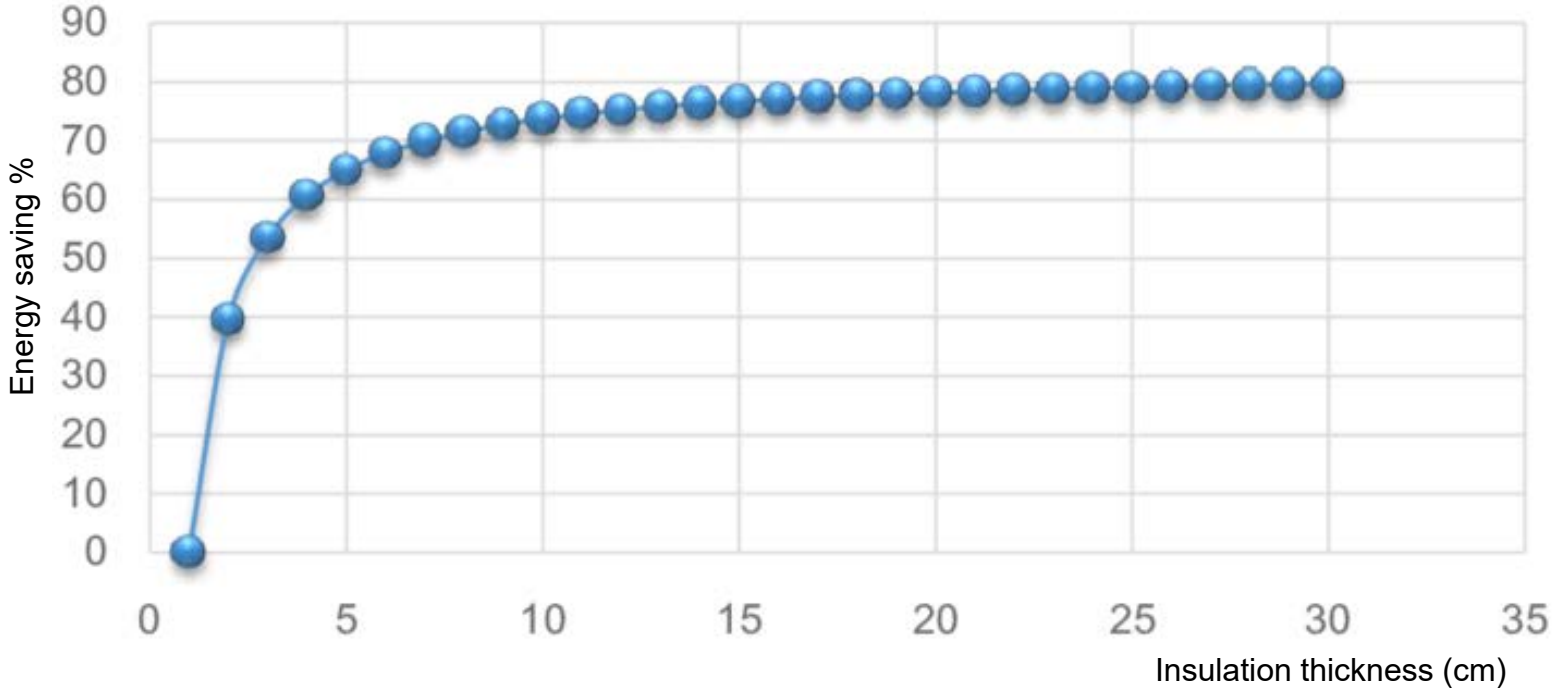


Circular Economy

1. Reduce
2. Recycle
3. Reuse
4. Regenerate

Reduce

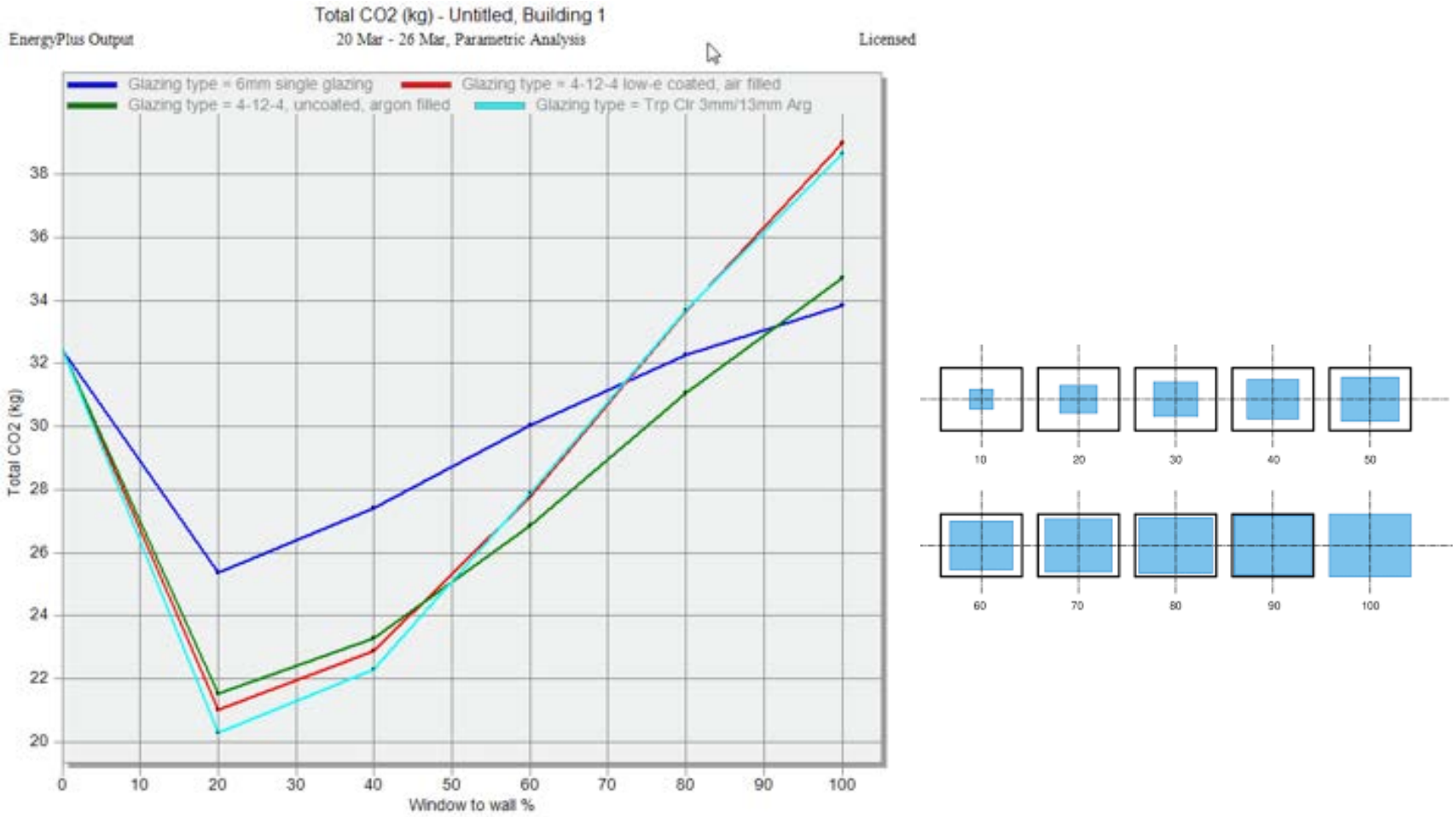
Circular Economy: Reduce Materials



Diminishing energy efficiency for wall insulation

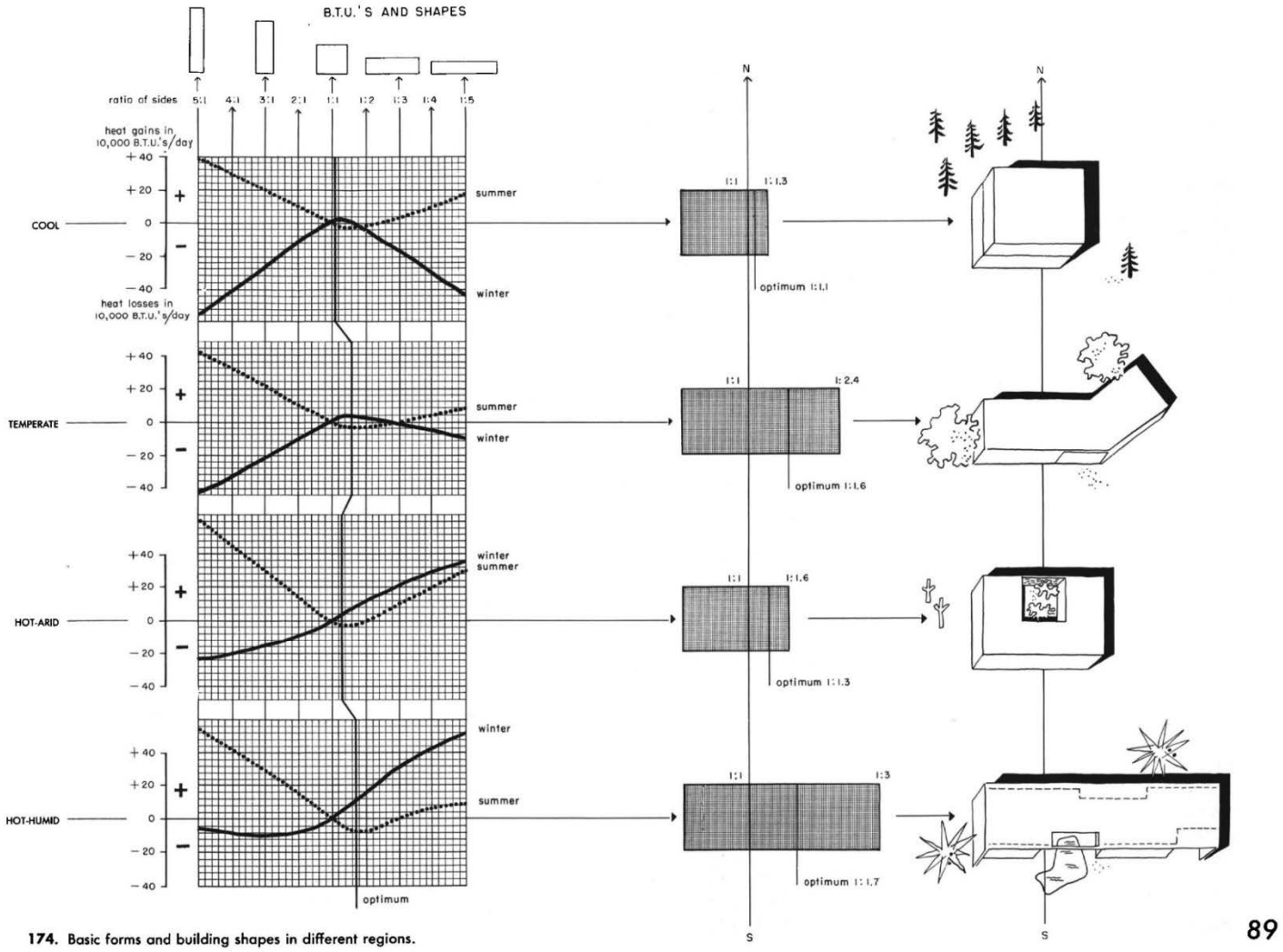

Circular Economy: Reduce Materials
How Far Can Metal Deck Span? - CSM Me

Circular Economy: Reduce Materials



Energy efficiency vs glazing attributes vs %WWR

Circular Economy: Reduce Materials



174. Basic forms and building shapes in different regions.

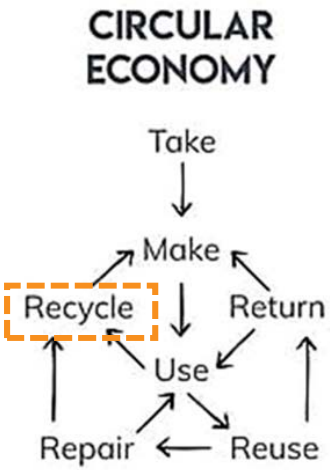
89

Bioclimatic design yields optimum material uses

Design with Climate. Olgyay & Olgyay, 1963

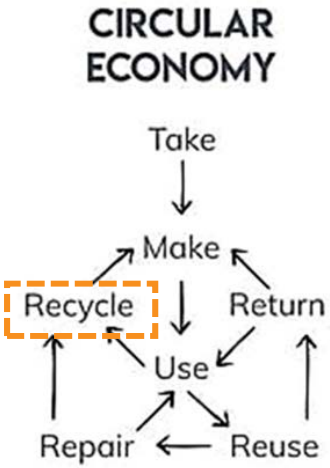
Recycle

Circular Economy: Recycle



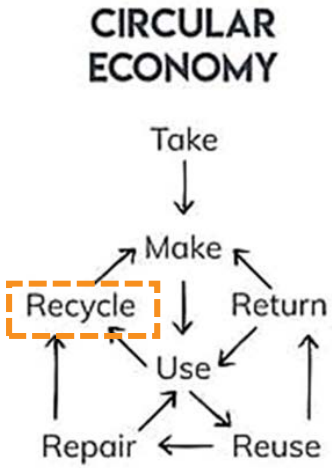
Resource: discarded plastics
Manufacturer: Gert de Mulder, The Netherlands
Designer: Shigeru Ben Architects, France
Product directory finishing, self-supporting

Circular Economy: Recycle



Resource: discarded cardboard
Manufacturer: paper recycling facilities, Germany
Designer: Drztz & Dratz Architects, Germany
Product directory: load-bearing, insulating, waterproofing

Circular Economy: Recycle



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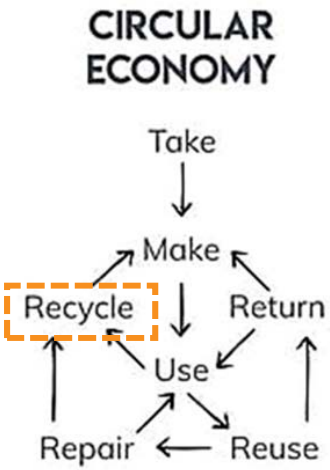
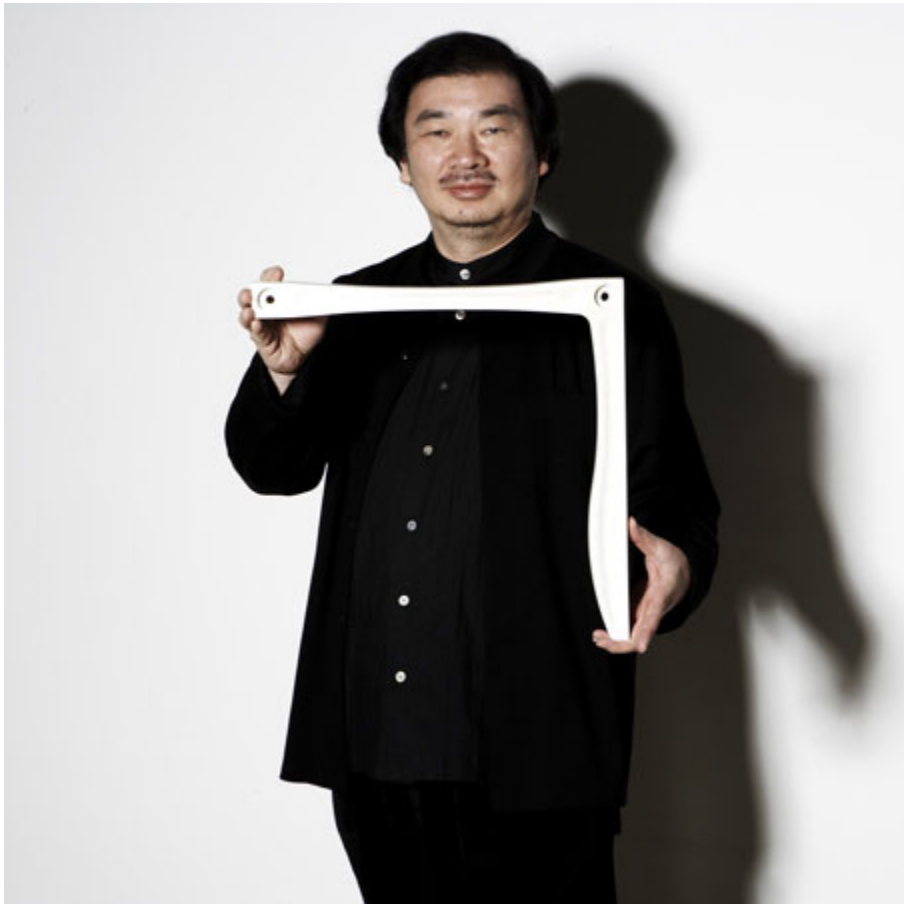
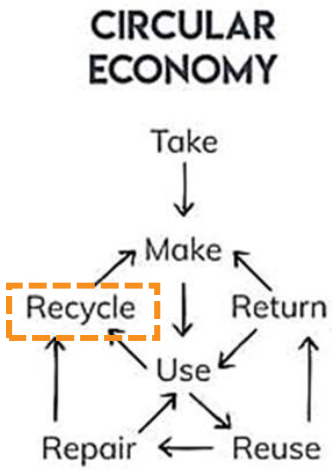
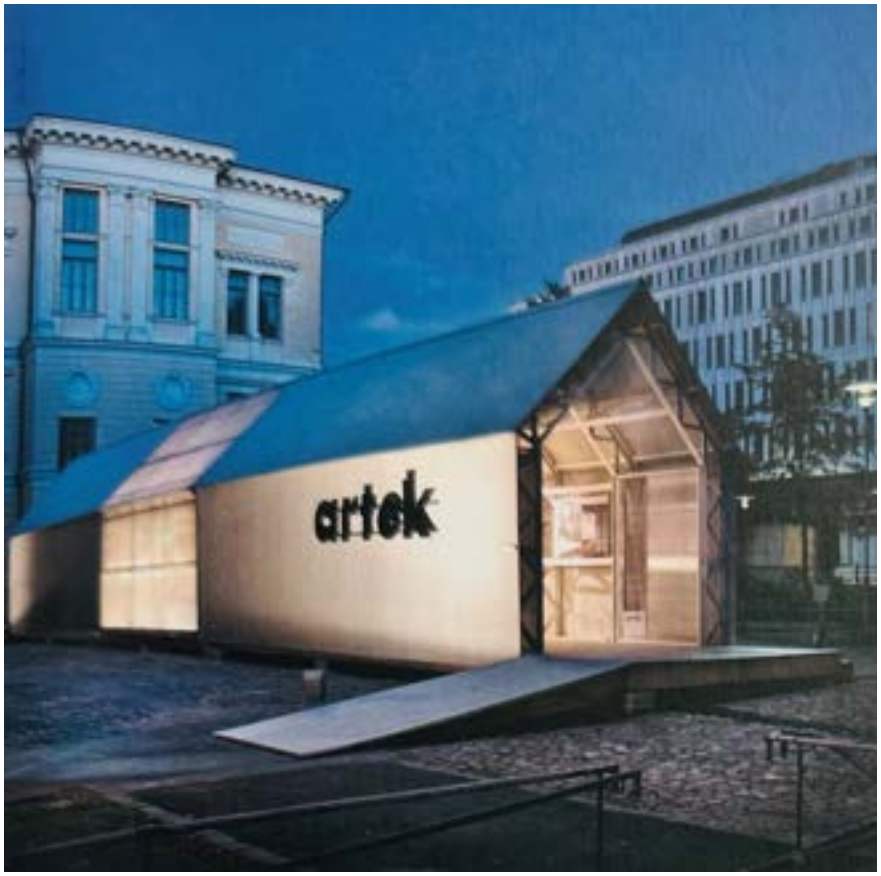




Resource: label printer waste
Manufacturer: UPM biocompoents, Finnand
Designer: Shigeru Ben Architects, France
Product directory: load-bearing, waterproofing

Circular Economy: Recycle





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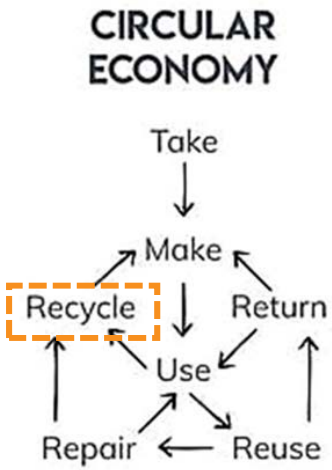

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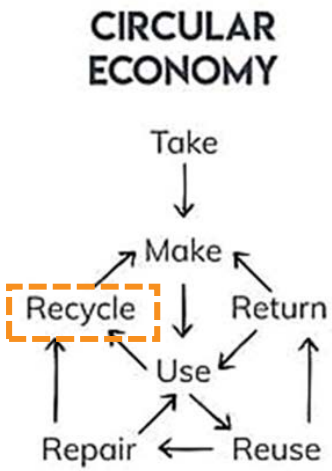
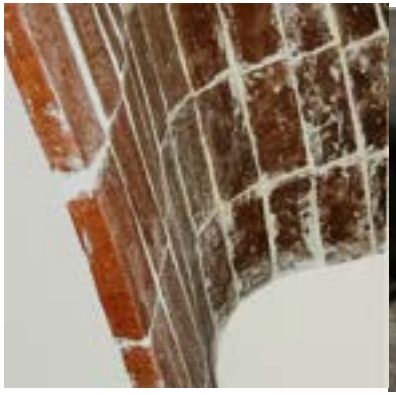


Arthur Huang has created a hospital ward made from trash | CNN

https://www.cnn.com/videos/world/2021/06/03/cte-arthur-huang-miniwiz-video-spc-intl-hnk.cnn

Recycle: Load-bearing Products



Green Leaf Bricks
Construction Beams.
Sewage waste
Masonry Research Group,
MA USA.

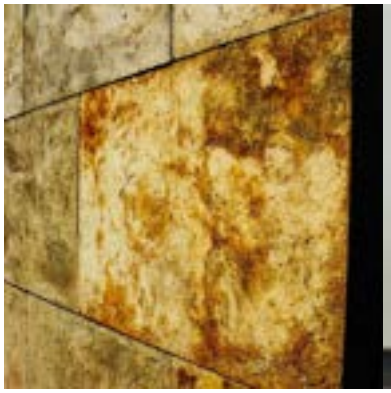
Blood Bricks
Construction Bricks.
Discarded animal blood and sand.
Munro, UK.

Mushroom Bricks
Construction Bricks.
Mycelium, straw waste.
The Living, NY, USA.

Mycoform
Construction Bricks.
Mycelium, paper waste,
discarded aluminum.
Foachim, NY, USA.

Songwood Boards
Construction Panels.
Furniture wastes
Engineered Timber
Resources. CO, USA

Recycle: Self-supporting Products



GreenStone
Construction Bricks.
Discarded glass bottles.
Realm of Design, NV, USA.

Recy Blocks
Construction Bricks.
Discarded plastics.
Gert de Mulder, Netherlands.

ECOR
Construction Panels.
Waste materials with high fibres.
Noble Environ. Tech, CA, USA.

Vbc3000 Bricks and Lightened Granulates
Construction Aggregates.
Sewage treatment sludge
Vbc3000 Entreprise
Innovante, France.

Recycle: Insulating Products

FoamGlas T4+
Insulating Blocks.
Discarded glass.
Pittsburgh Corning Europe NV, Belgium.

NeptuTherm Balls
Insulation Infill.
Sea balls.
NeptuTherm e. K., Germany.

Unltratouch Denim Insulation Batts
Insulating Infill.
Discarded jeans, denim fabrics.
Bonded Logic Inc., AZ, USA.

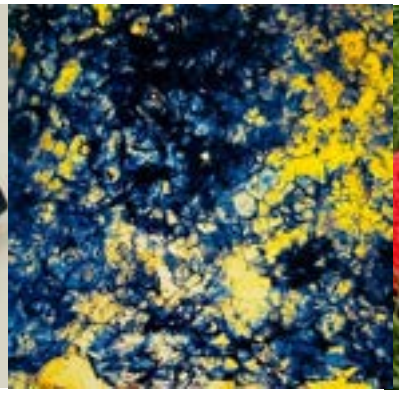
Enviro Board
Insulating Panels.
Straw waste.
Enviro Board Corp, NJ, USA.

Seaweed Insulation
Insulation Infill.
Eradicated seaweed, ib Ungermand, Denmark.

Recycle: Waterproofing Products

StoneCycling
Waterproofing Tiles.
Demolition waste.
Tom van Scest, The Netherlands.

Tuff Roof
Waterproofing Panels.
Discarded Tetra Pak cartons.
Deman Ganga Paper Mill, India.



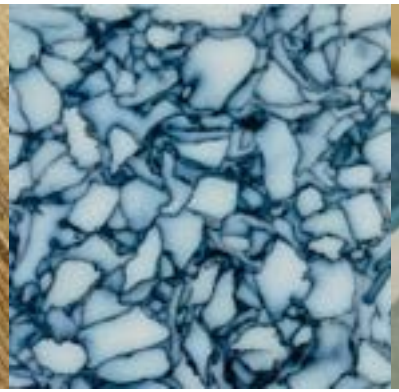
Cristalejo (recycled Crystal Glass)
Waterproofing Panels.
Discarded crystal glass cullet.
Marques, Portugal.

ReMaterials Roof Panels
Waterproofing Panels.
Packaging and agricultural waste.
Hasit Ganatra and Swad Komanduri, India.

Recycle: Finishing Products

Origins Sheets
Finishing Panels.
Discarded milk jugs, soap bottles
Yemm & Hart Green Materials, MO, USA.

Rocco Sheets
Finishing Panels.
Discarded newspapers.
La Casa Deco, Philippines.

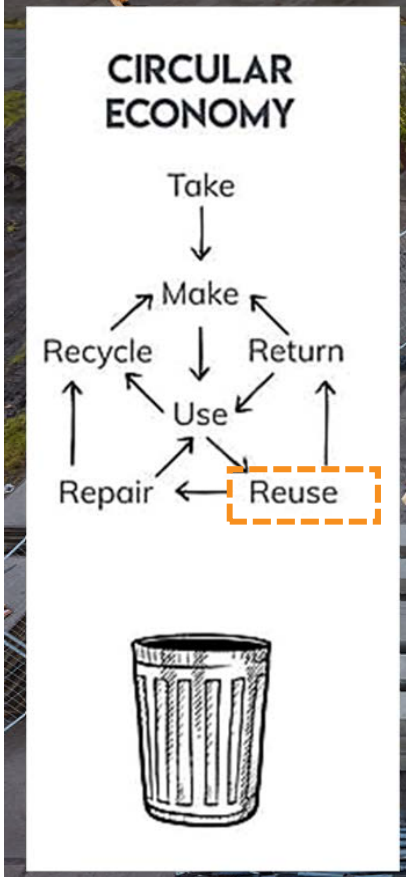


Dapple Sheets
Finishing Panels.
Discarded HDPE.
Smile Plastics, UK.

Flexisurf Sheets
Finishing Panels.
Polyvinyl chloride waste.
Yemm & Hart Green Materials, MO, USA.

Reuse

Circular Economy: Reuse

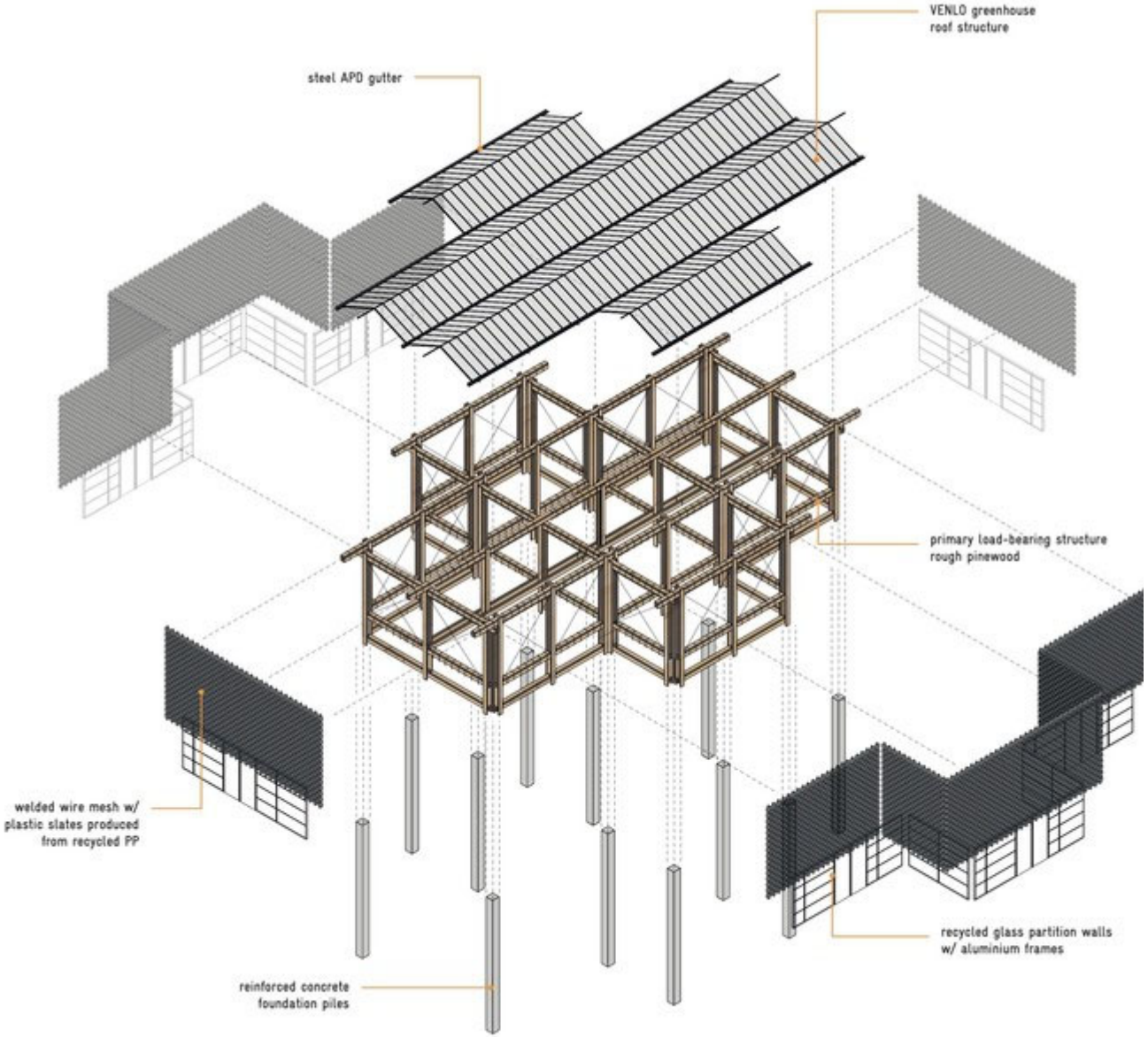


People's Pavilion / bureau SLA + Overtreders W, The Netherlands

Circular Economy: Reuse

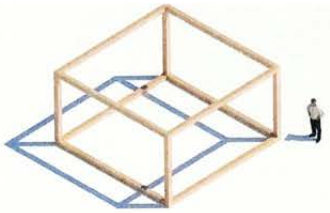
People's Pavilion / bureau SLA + Overtreders W, The Netherlands

Circular Economy: Reuse

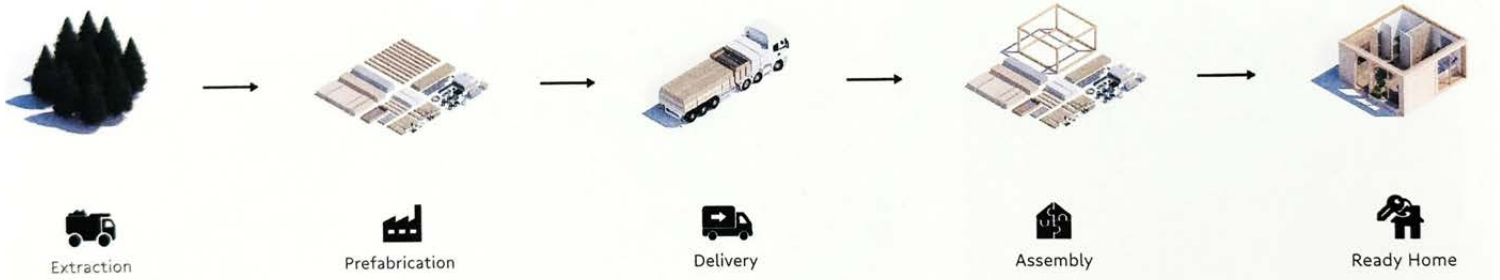


People's Pavilion / bureau SLA + Overtreders W, The Netherlands

Circular Economy: Reuse



Building with sustainably sourced timber enables CO2 reductions, faster construction, minimized waste and a healthier indoor climate

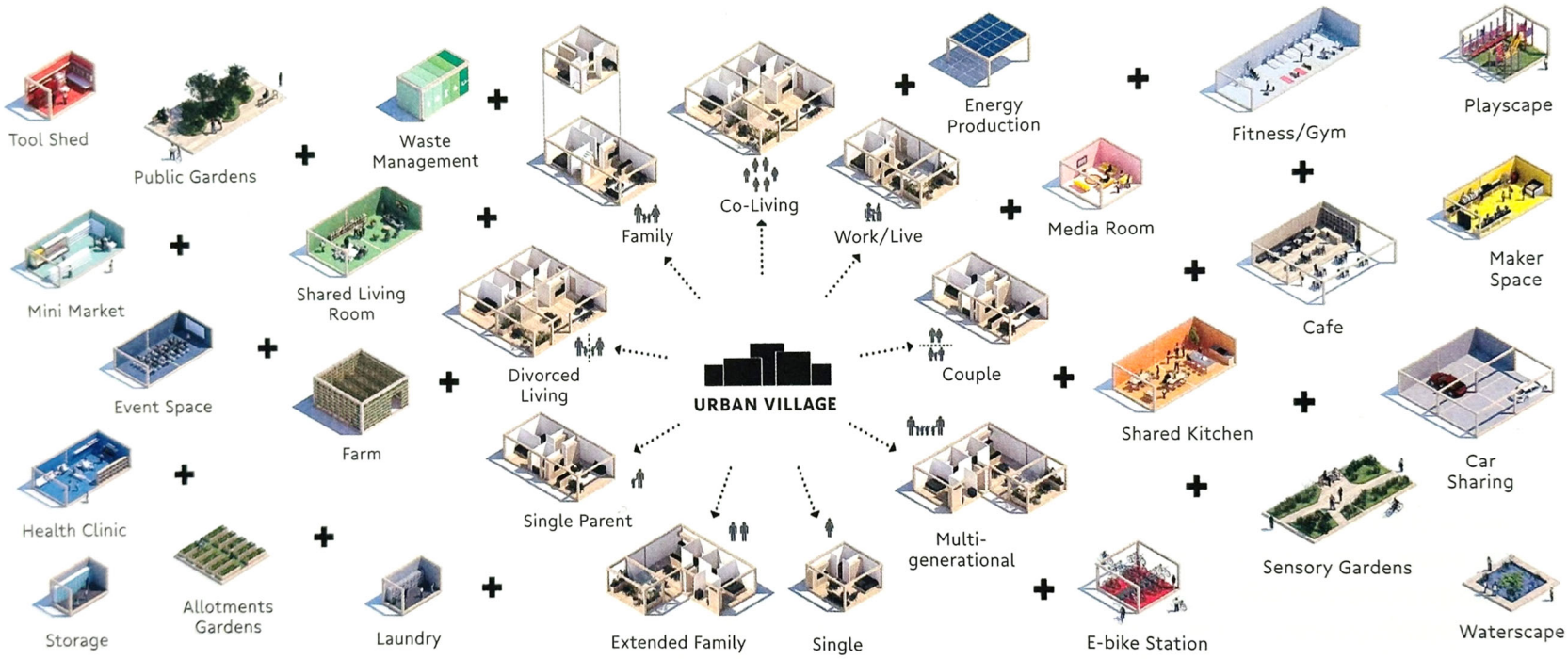


A modular building system that can be prefabricated, flat packed and disassembled ensures a circular approach to the management and life cycle of our buildings

Building Better - Less - Different: Circular Construction and Circular Economy, Heisel, Hebel, et al.

Circular Economy: Reuse

The Urban Village Project seeks to make life more affordable by enabling people to share more pool resources and unlock better deals on daily needs



Building Better - Less - Different: Circular Construction and Circular Economy, Heisel, Hebel, et al.

Circular Economy: Reuse

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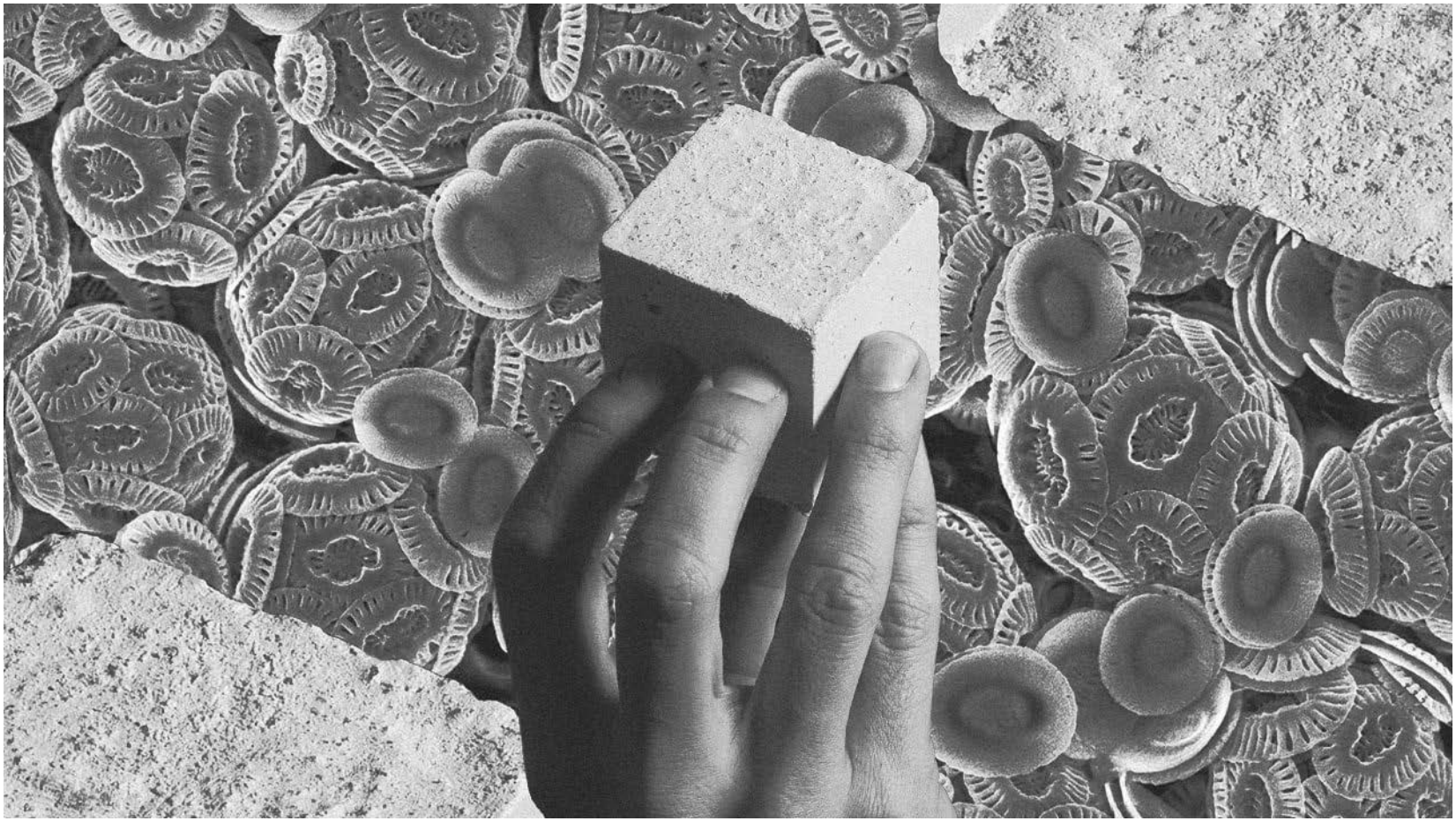
Building Better - Less - Different: Circular Construction and Circular Economy, Heisel, Hebel, et al.

Re/Generate

Circular Economy: Re/Generate

Circular Economy: Re/Generate

Circular Economy: Re/Generate

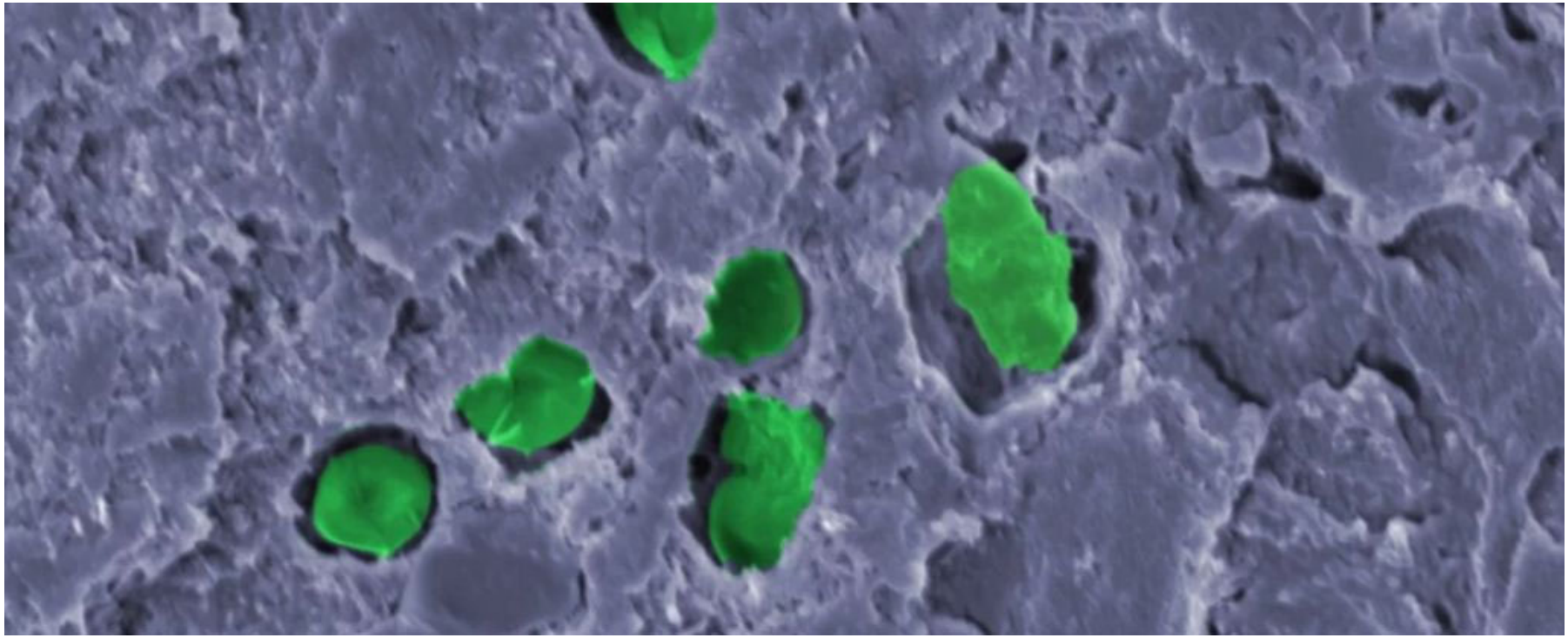


Microalgae as bio-cement

University of Surrey, England

Circular Economy: Re/Generate

Scientists Just Came Up With a Wild Idea For Making Oxygen on Mars



Microalgae as bio-coating

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