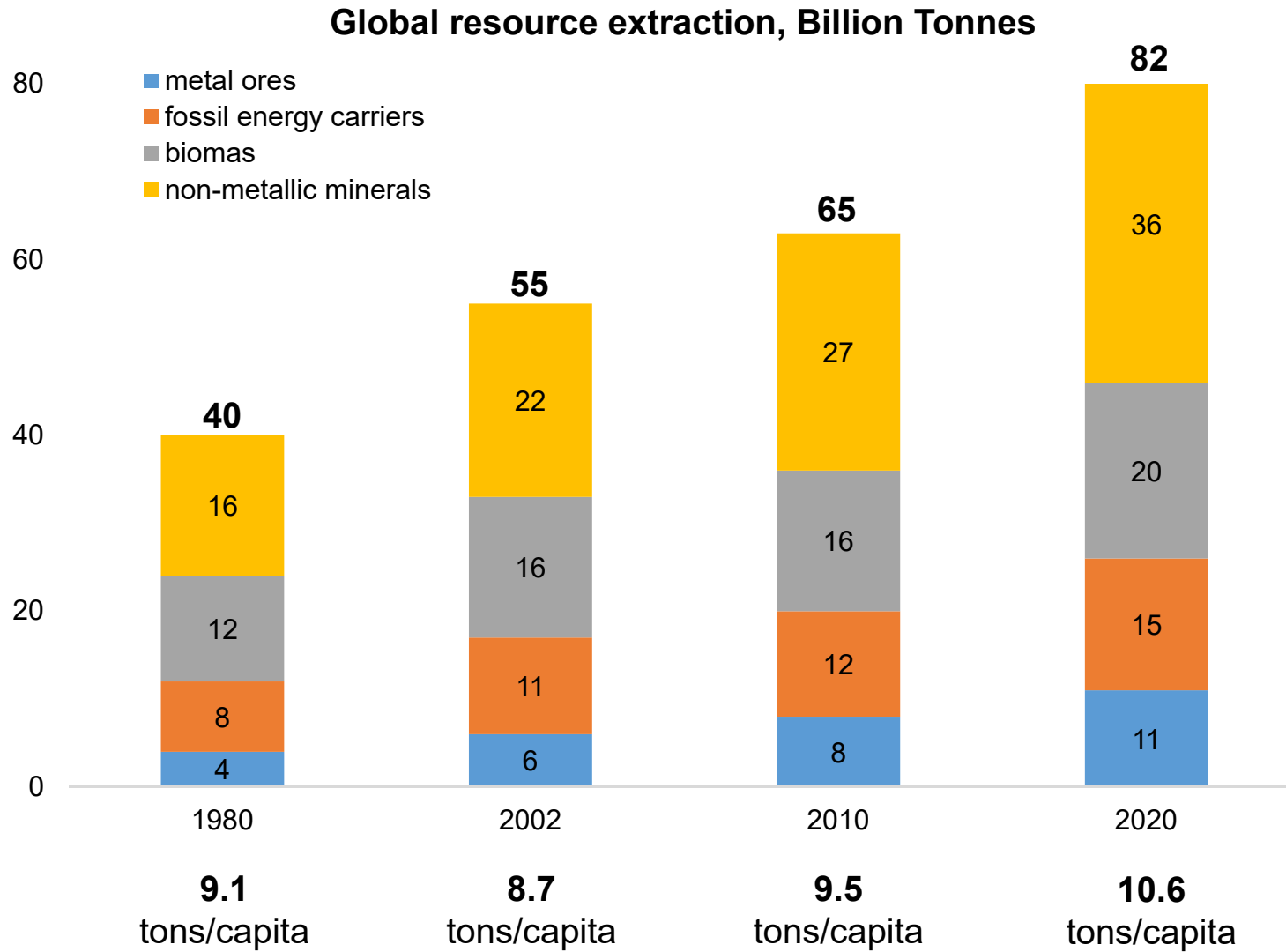




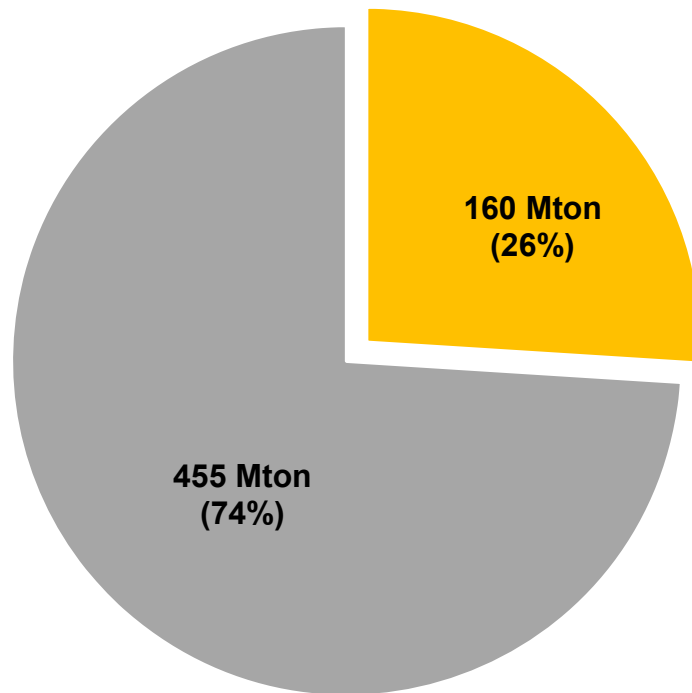
Circular Economy

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

Global resource extraction: 82 Gtons



US Solid Waste: 615 Mtons in 2008



■ C&D waste ■ Non C&D waste

1. Recycled or reused: 20~30% (32-48 Mton)

2. Discarded: 70~80% (112-128 Mton)

Lumber (40%)

Asphalt products (14%)

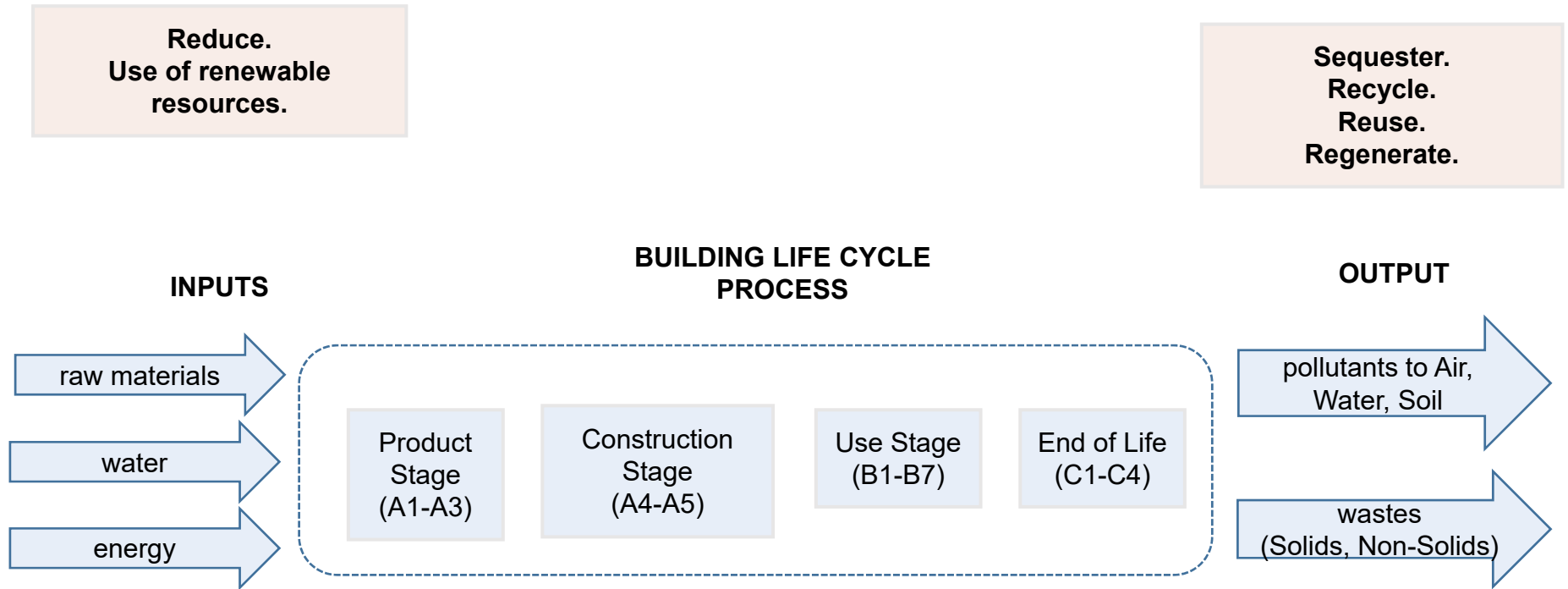
Soil/fines (11%)

Concrete/rock/brick (11%)

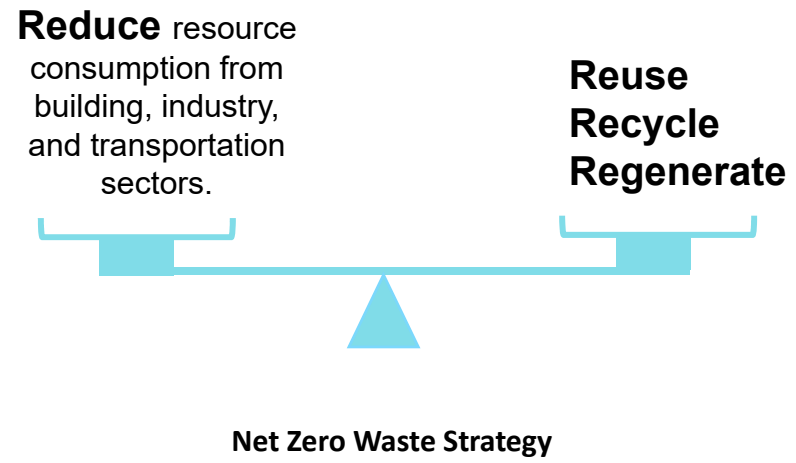
Gypsum board (10%)

Other (14%)

Circular Economy: Building Life Cycle Perspective

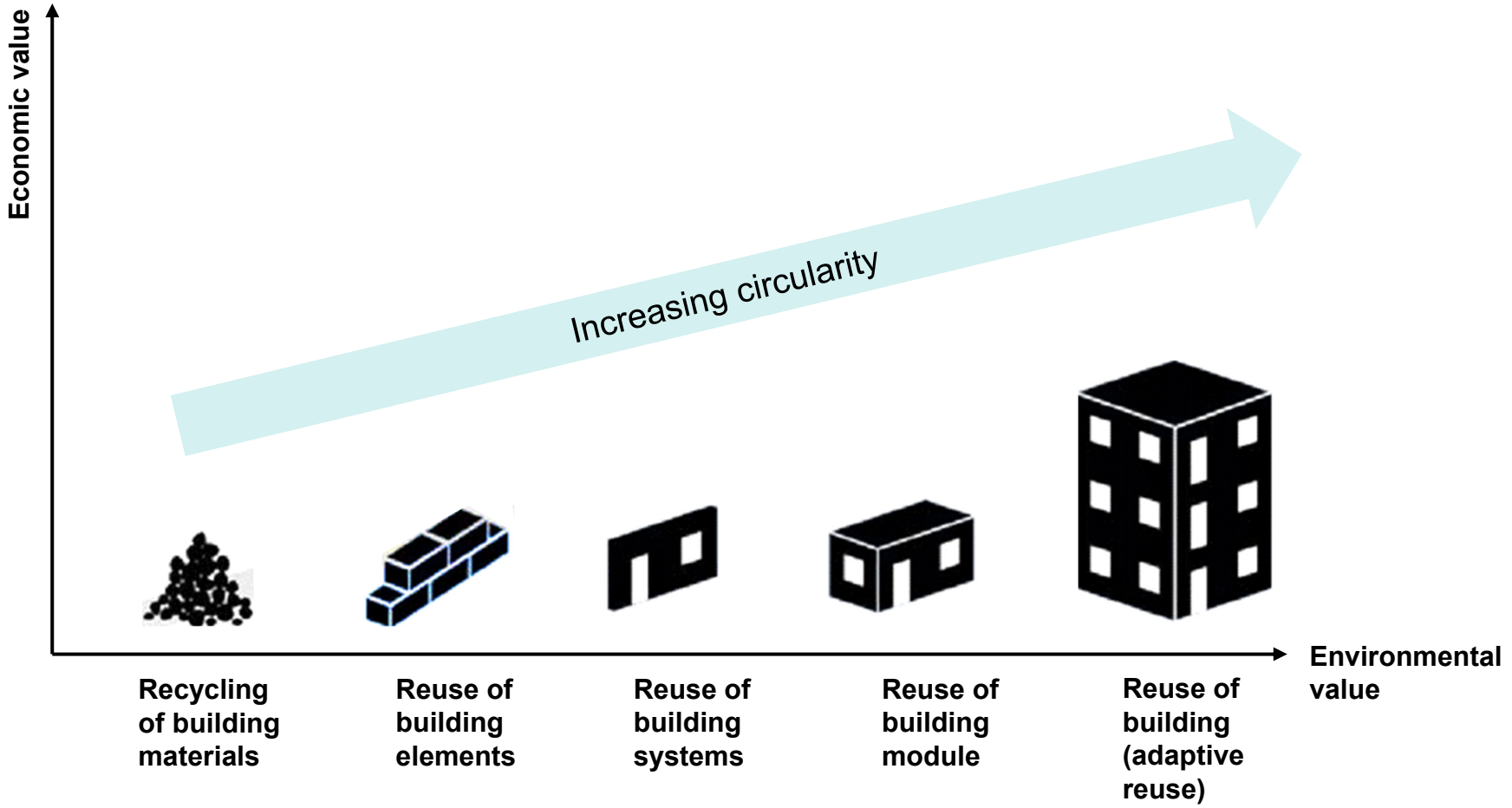


Circular Economy Framework



Circularity

Circular Economy



Circular Economy

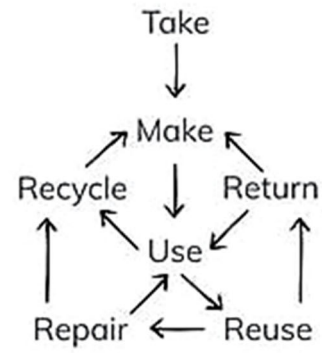
LINEAR ECONOMY



RECYCLING ECONOMY



CIRCULAR ECONOMY

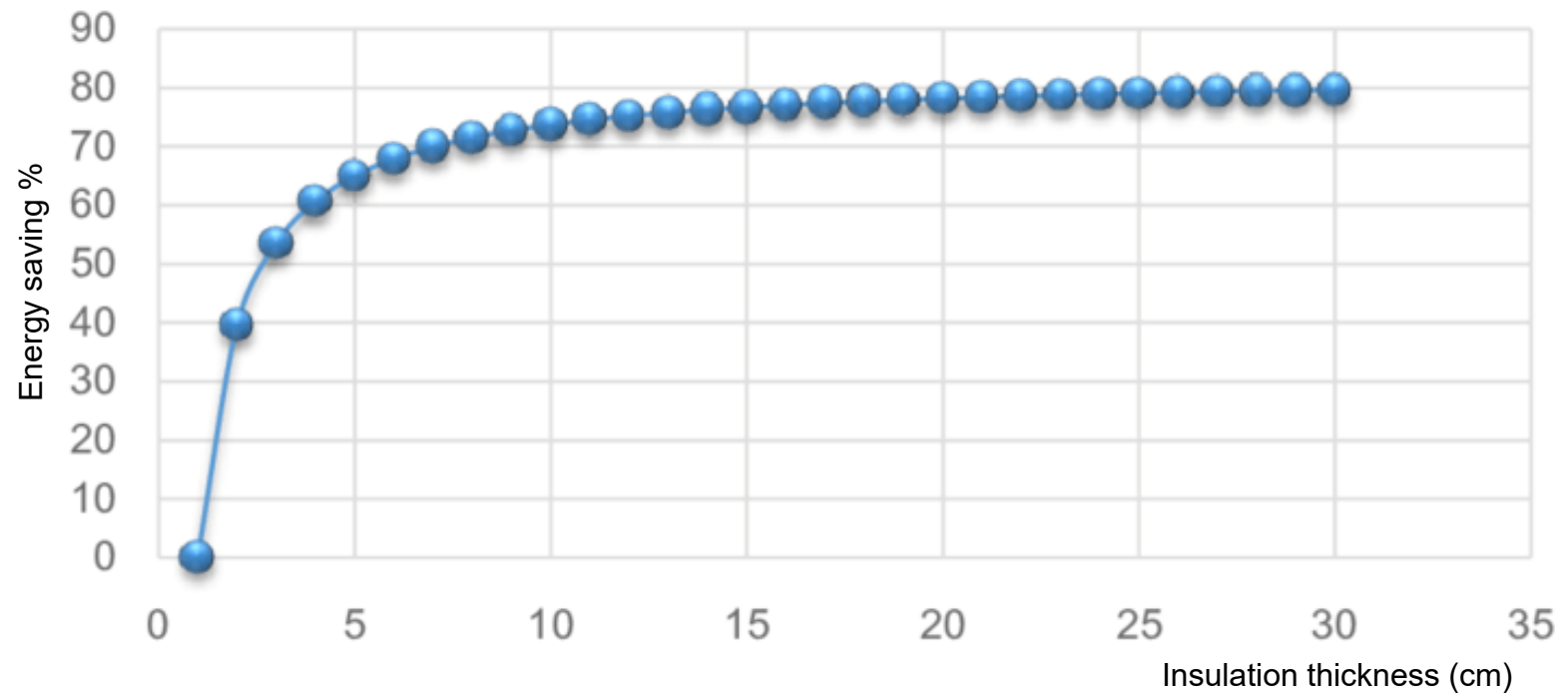


Circular Economy

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

Reduce

Circular Economy: Reduce Materials

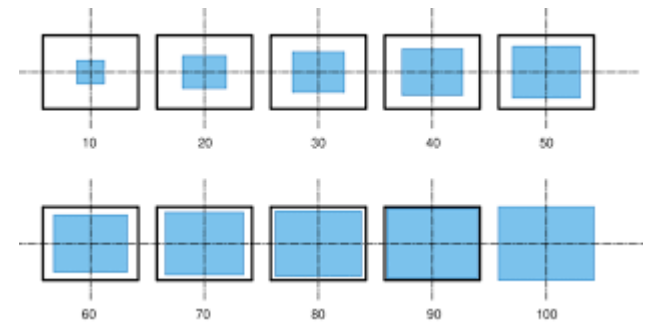
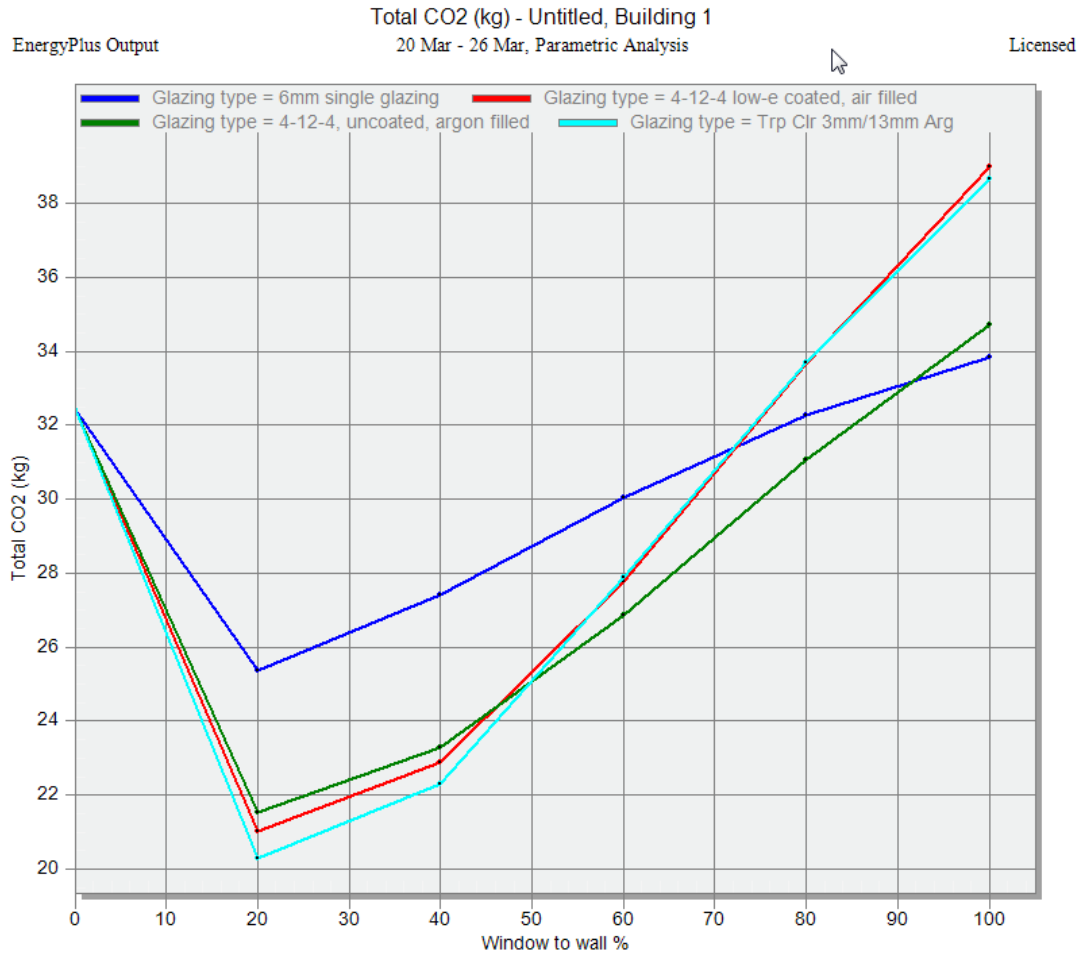


Diminishing energy efficiency for wall insulation

Circular Economy: Reduce Materials

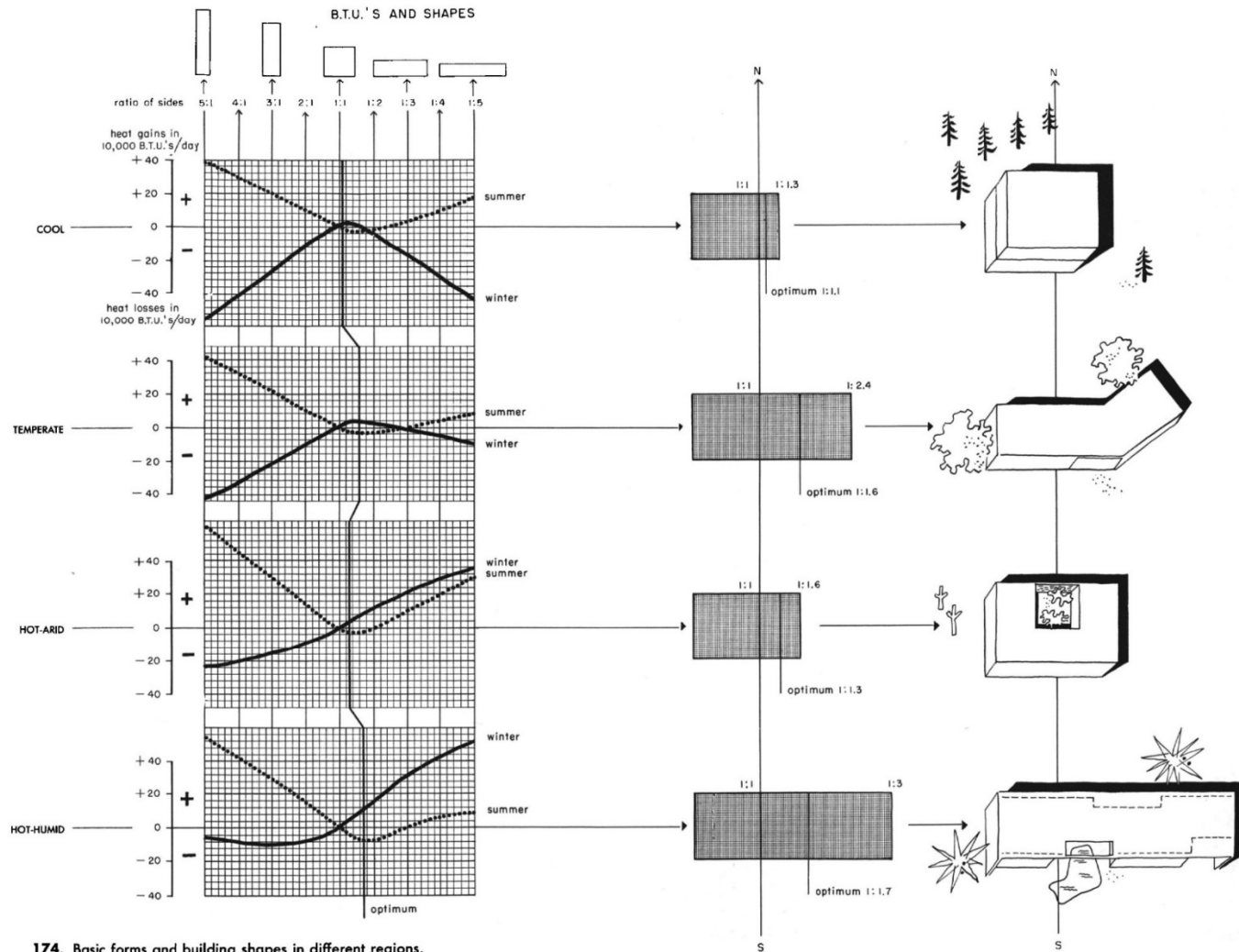


Circular Economy: Reduce Materials



Energy efficiency vs glazing attributes vs %WWR

Circular Economy: Reduce Materials

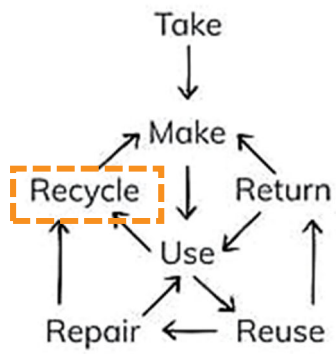


Bioclimatic design yields optimum material uses

Recycle

Circular Economy: Recycle

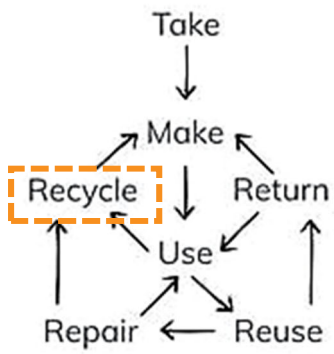
CIRCULAR ECONOMY



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

Circular Economy: Recycle

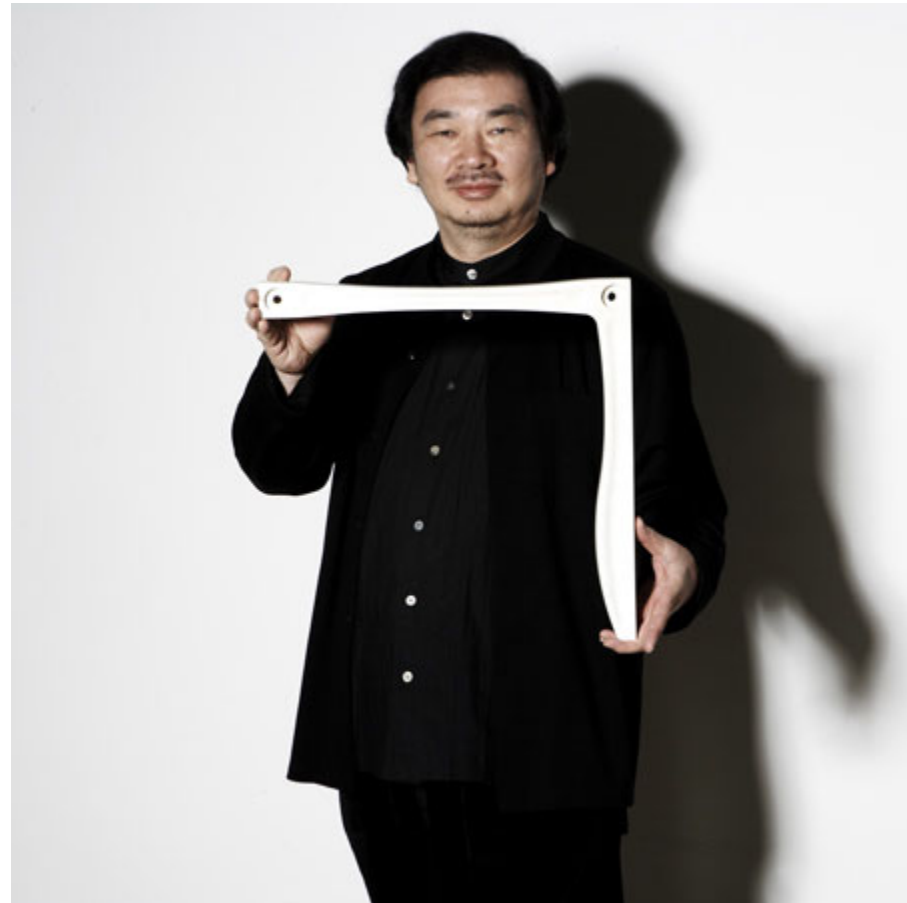
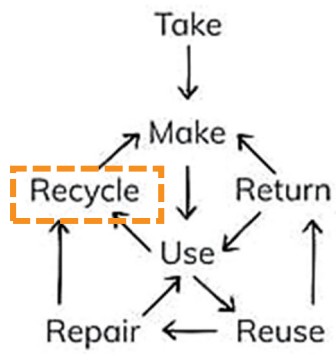
CIRCULAR ECONOMY



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

Circular Economy: Recycle

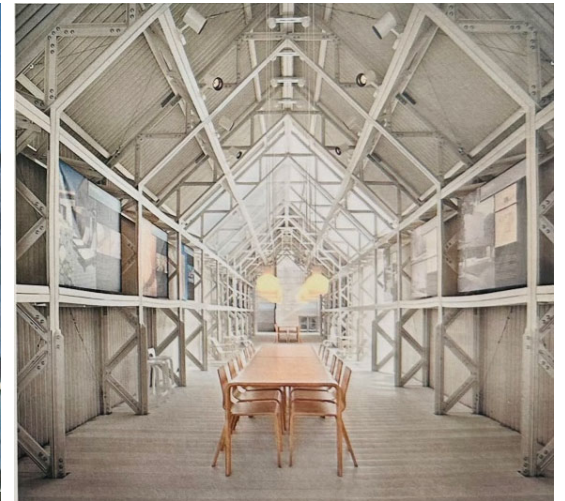
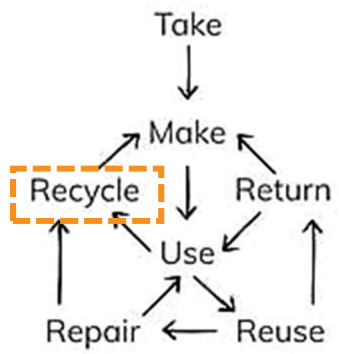
CIRCULAR ECONOMY



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

Circular Economy: Recycle

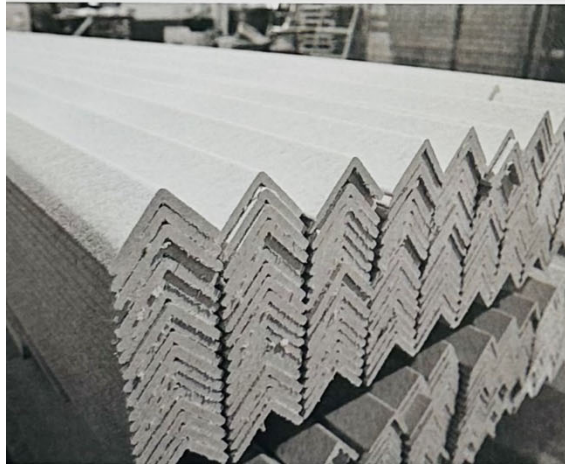
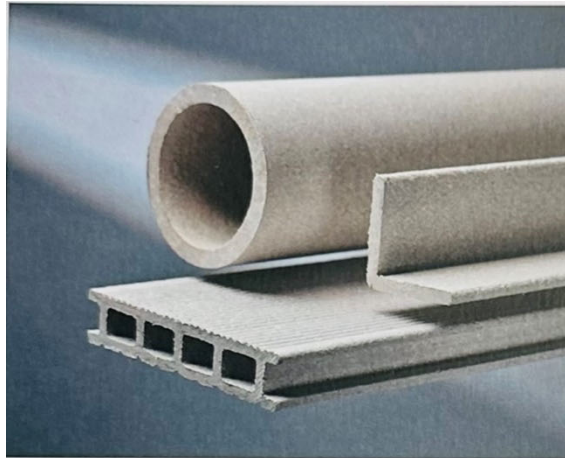
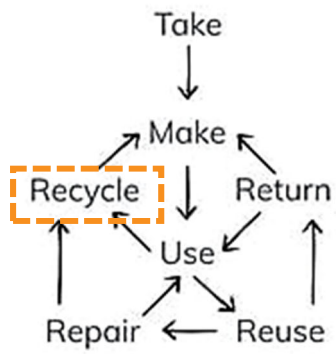
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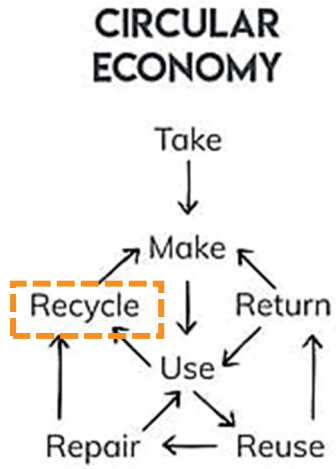
Circular Economy: Recycle

CIRCULAR ECONOMY



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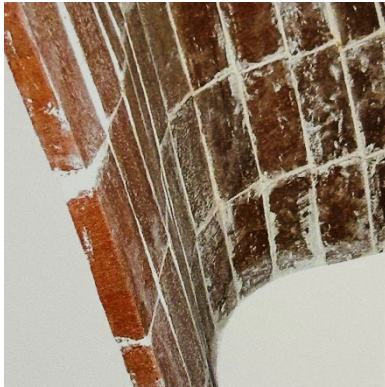
Circular Economy: Recycle



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.

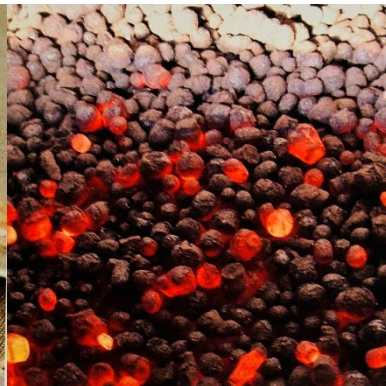
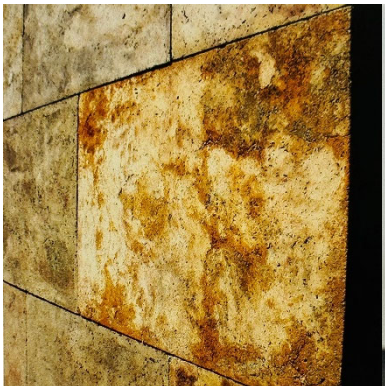
Mycoform

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.

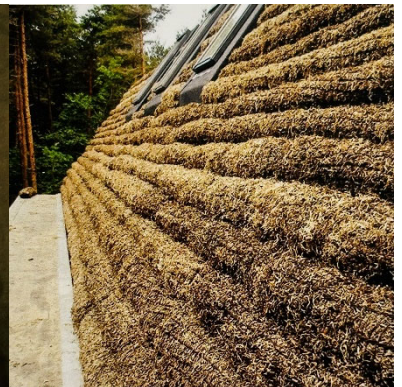
ECOR

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.

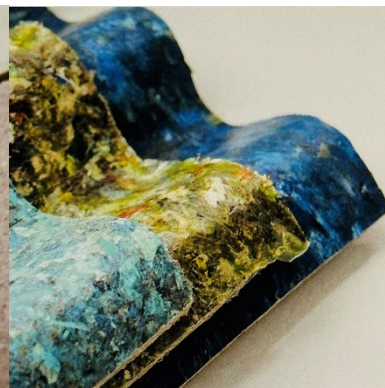
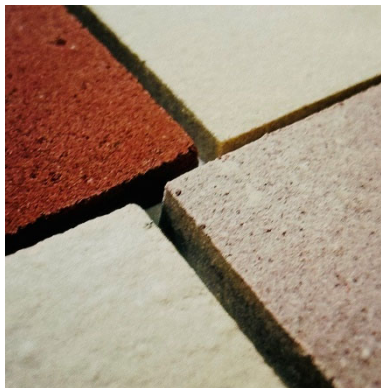
NeptuTherm Balls
Insulation Infill.
Sea balls.
NeptuTherm e. K.,
Germany.

**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



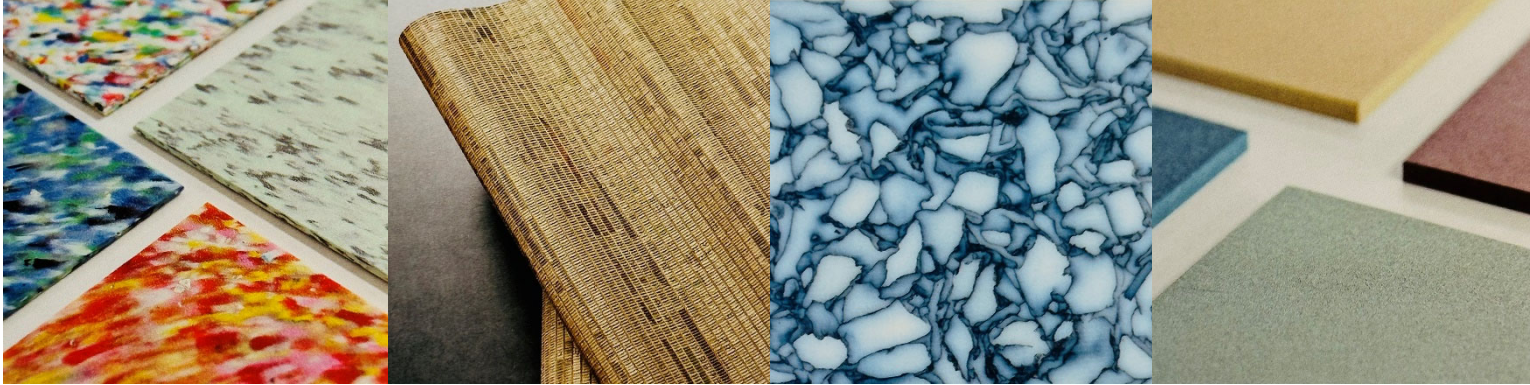
ReMaterials Roof Panels
Waterproofing Panels.
Packaging and agricultural
waste.
Hasit Ganatra and Swad
Komanduri, India.

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.

Recycle: Finishing Products



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

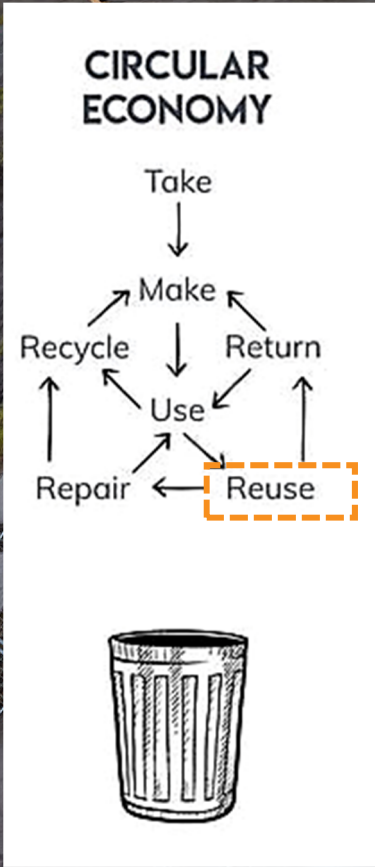
Rocco Sheets
Finishing Panels.
Discarded newspapers.
La Casa Deco, Philippines.

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

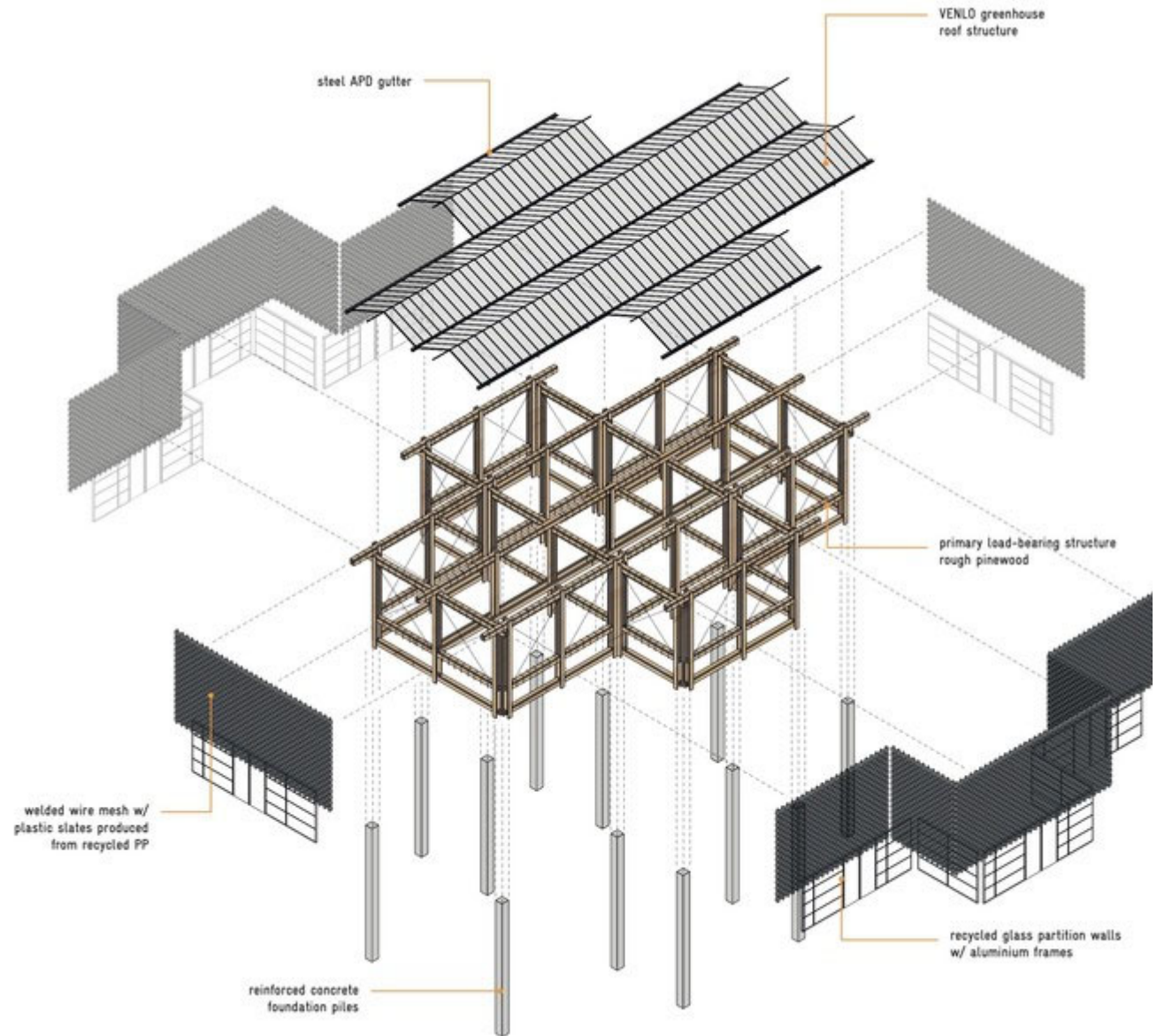
Circular Economy: Reuse



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

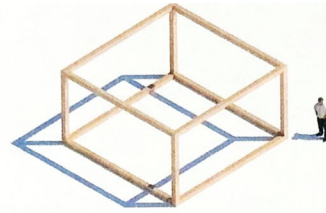
Circular Economy: Reuse

CIRCULAR ECONOMY

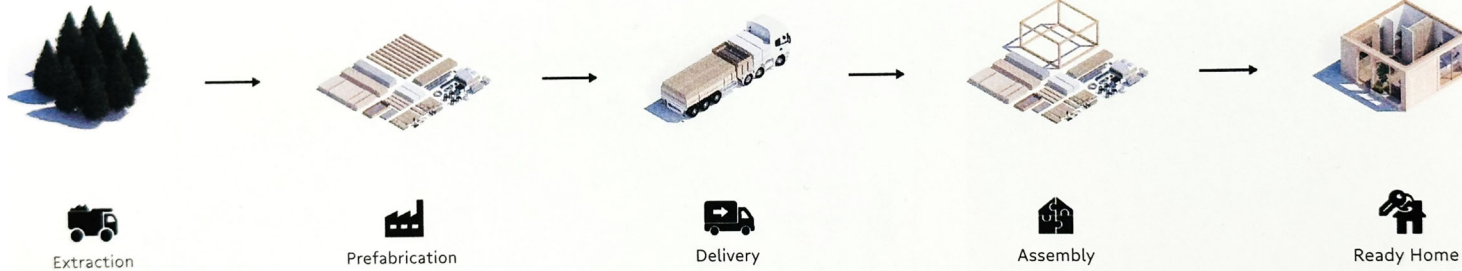


People's Pavilion / bureau SLA + Overtreders W, The Netherlands

Circular Economy: Reuse



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

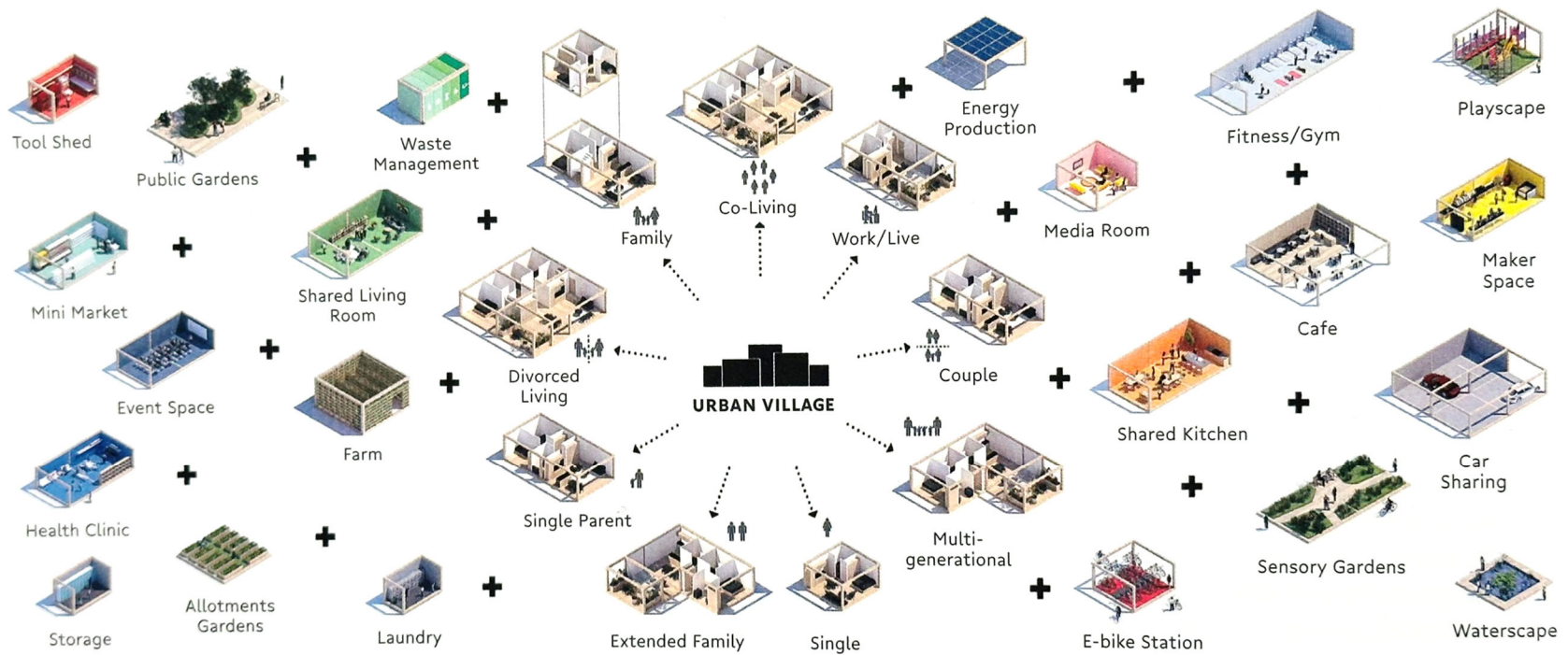


A modular building system that can be prefabricated, flat packed and disassembled ensures a circular approach to the management and life cycle of our buildings



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



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



Re/Generate

Circular Economy: Re/Generate

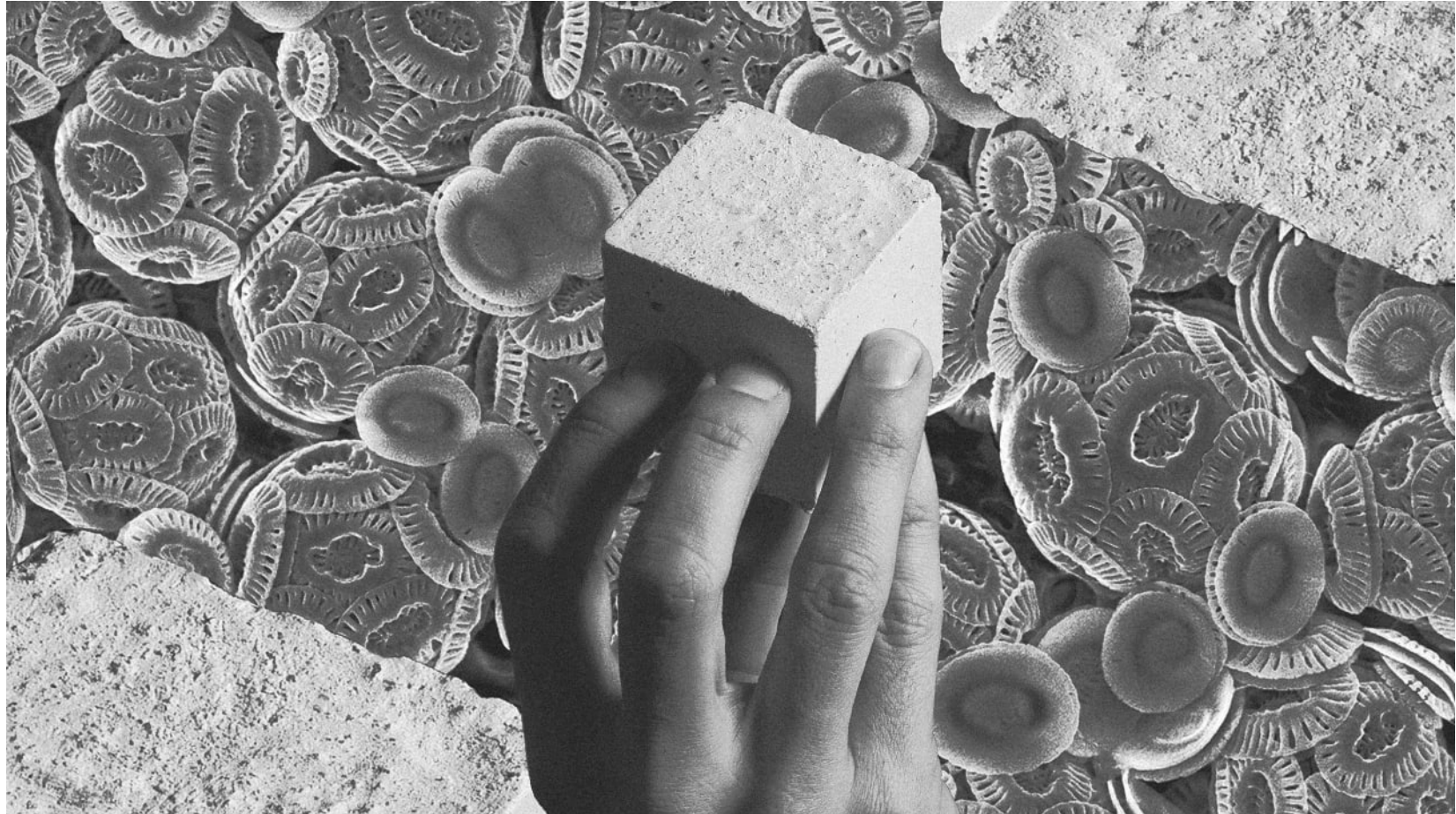


M



**PLASTIC EATING
WORMS**

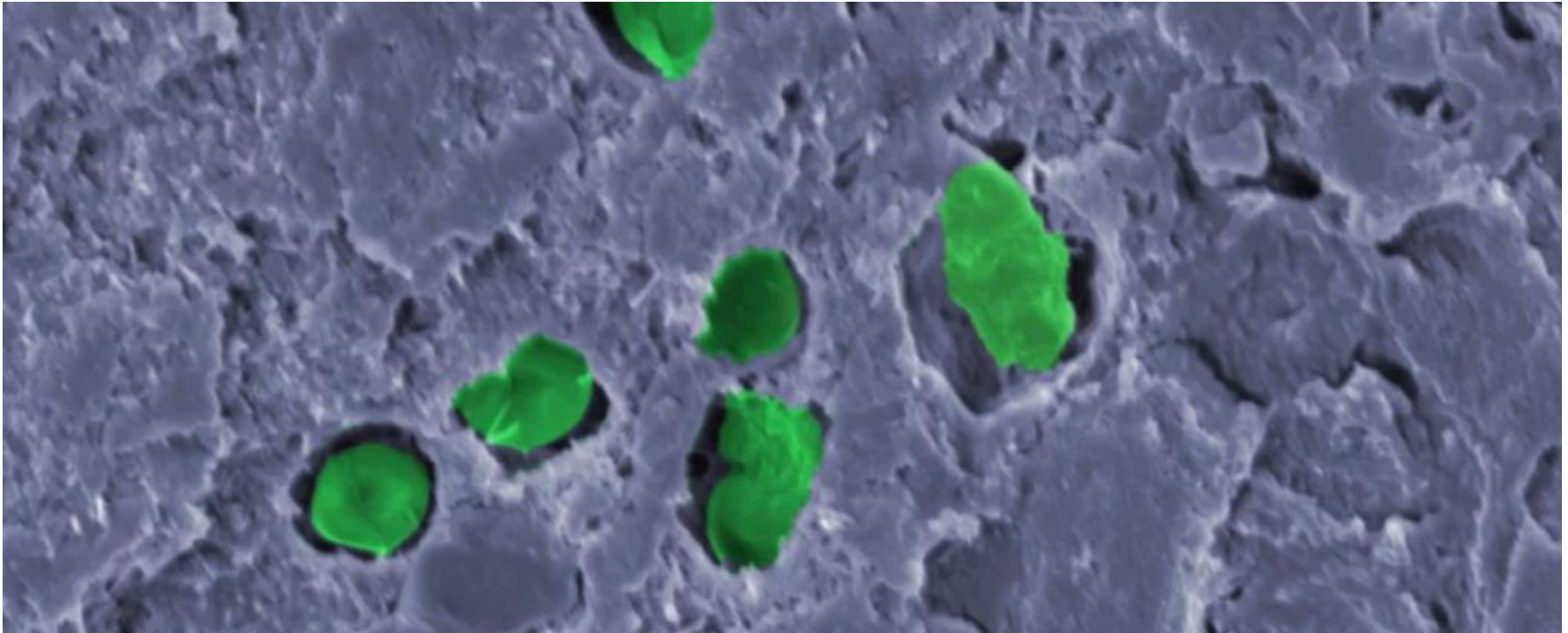
Circular Economy: Re/Generate



Microalgae as bio-cement

Circular Economy: Re/Generate

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



Microalgae as bio-coating

Kyoung Hee Kim, PhD AIA NCARB
Professor of Architecture
Director of Integrated Design Research Lab
UNC Charlotte
kkim33@uncc.edu



**U.S.-ASEAN SMART
CITIES PARTNERSHIP**