

# The circular supermarket chain

Introducing the Circular Economy in the Building Specification



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4141016  
06-07-2018

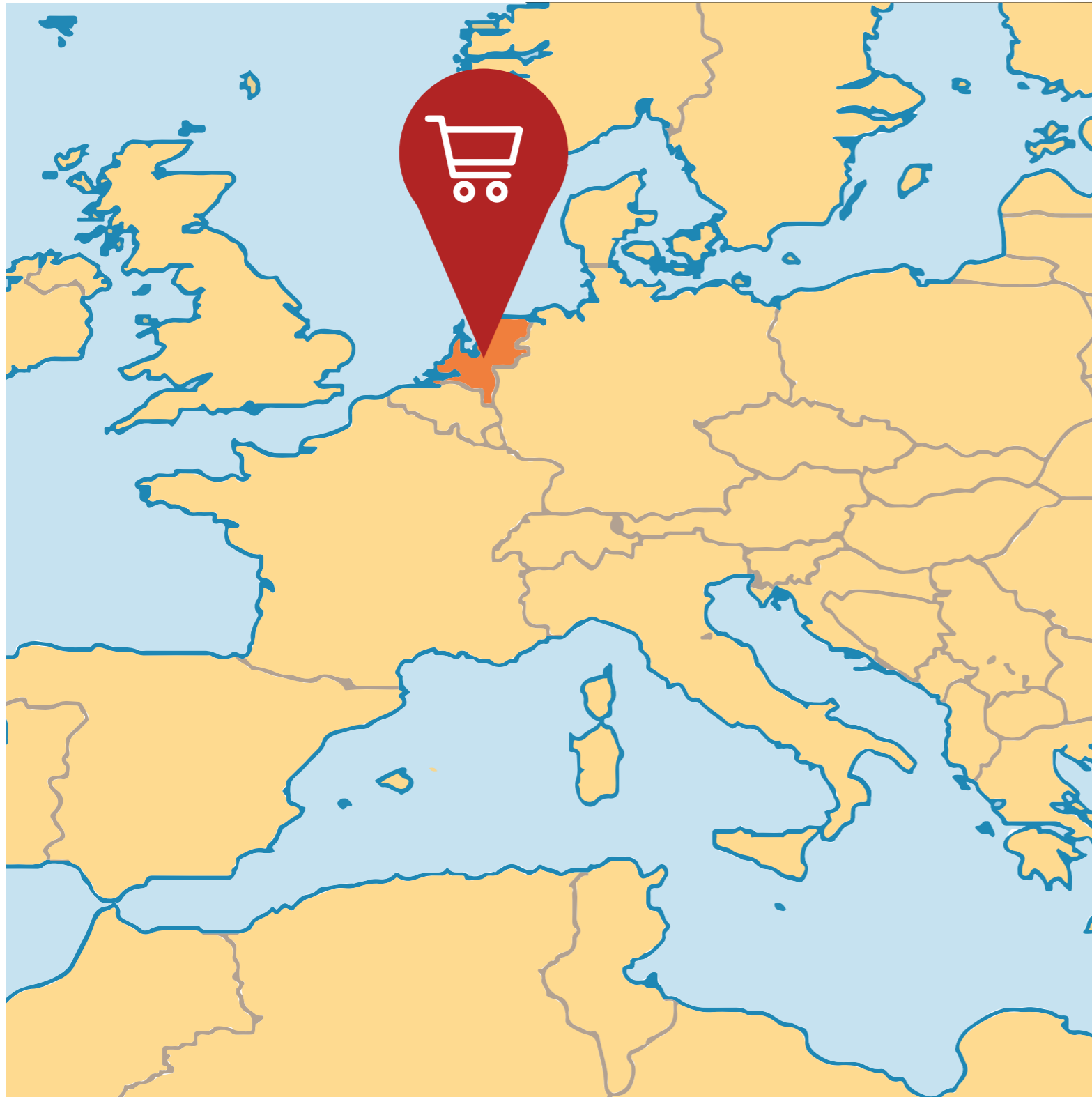


# The Lidl and circularity

Building industry is responsible for 50% all waste.

# The Lidl and circularity

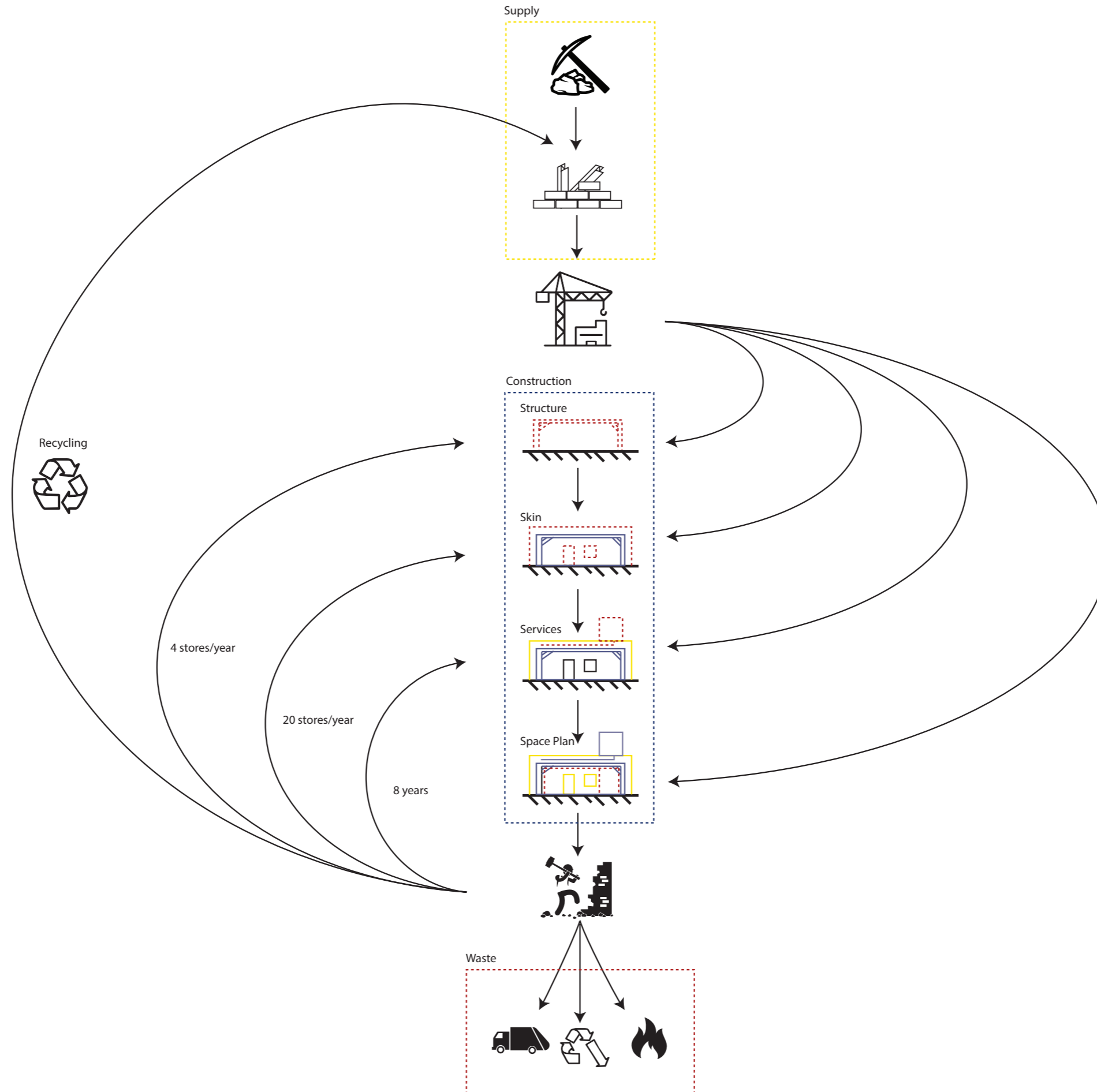
415 Stores



Small  
renovation  
8 years

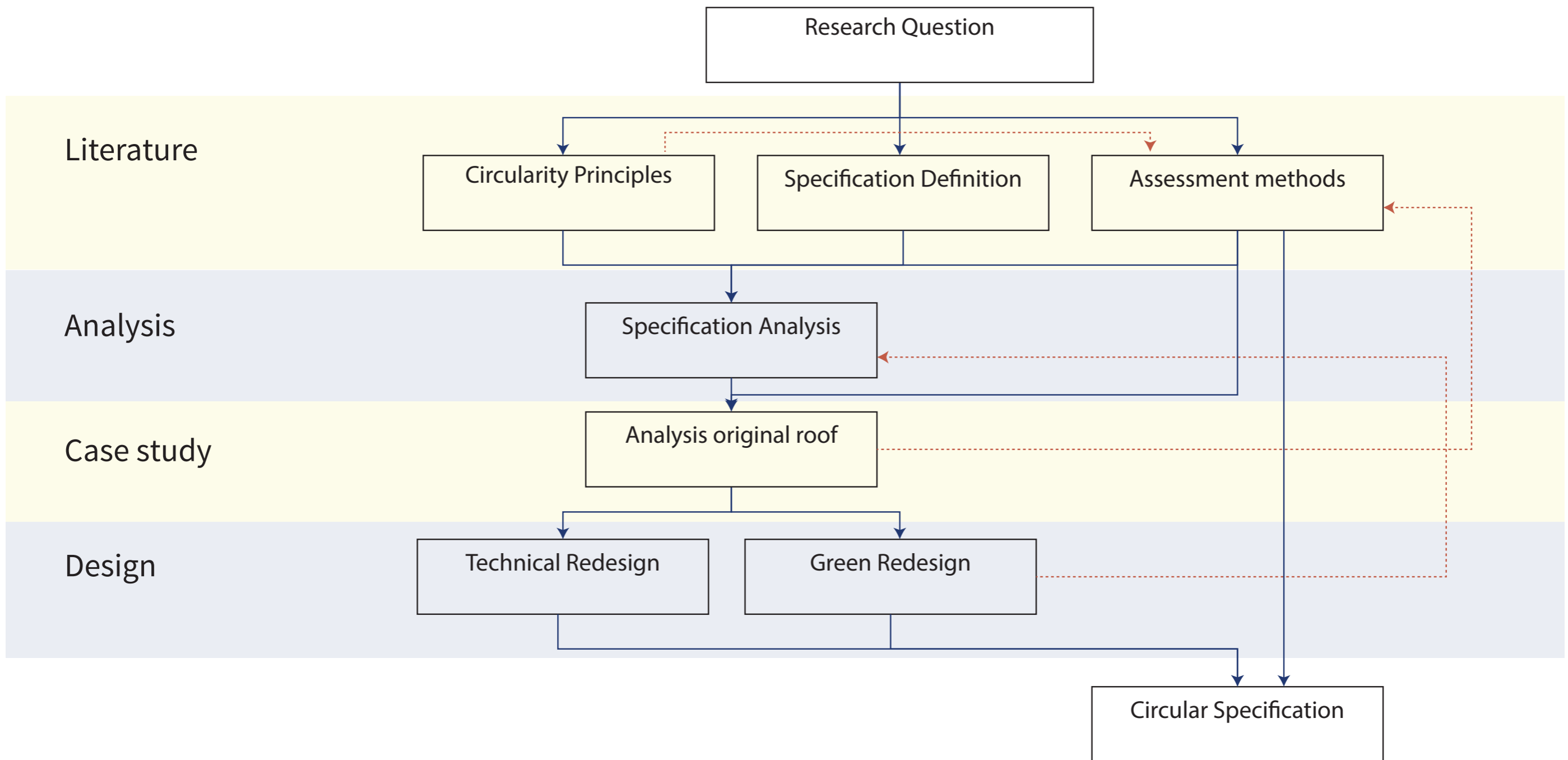
large  
renovation  
20 years

# The Lidl and circularity



# Main question

*Which changes have to be made to make the Lidl's Specification circular, with an emphasis on materials and assembly?*



1. Assessment method
2. Specification analysis
3. Changes to the Lidl's Specification to make it circular



# Principles of the Circular Economy

What are the principles for circularity in the built environment?

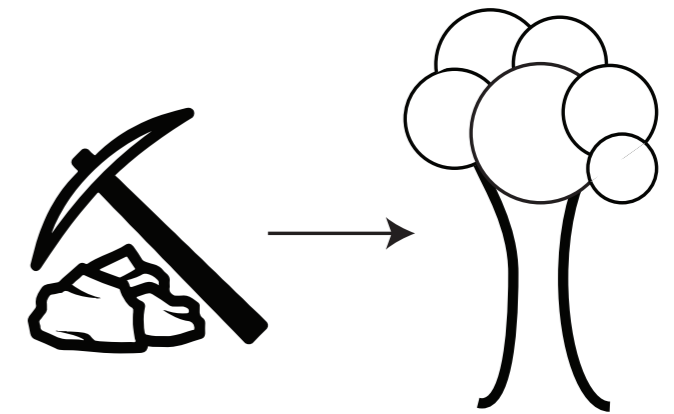
# Principles of the Circular Economy



Eliminate waste

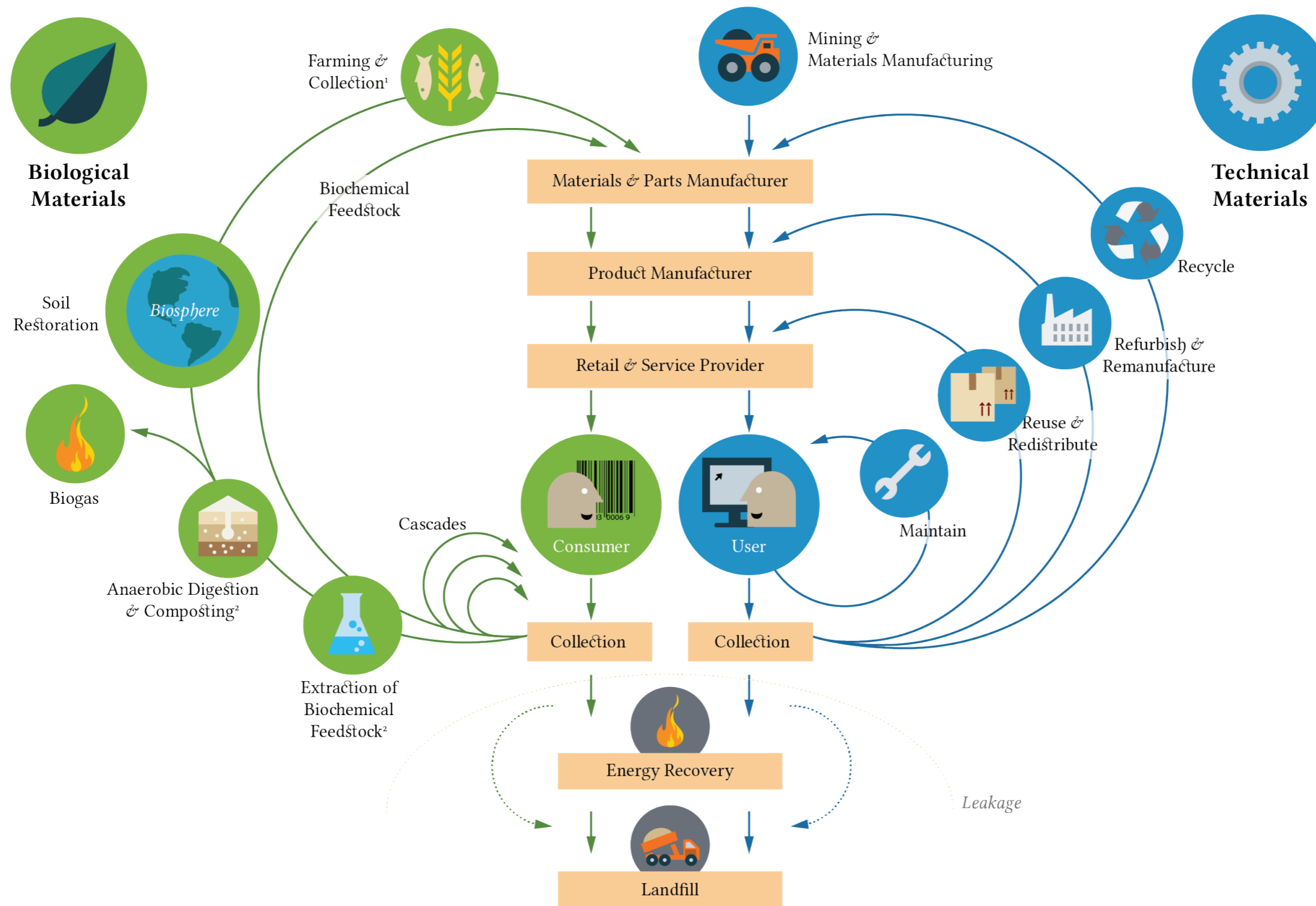


Maintain value



Employ  
renewable  
sources

# Principles of the Circular Economy



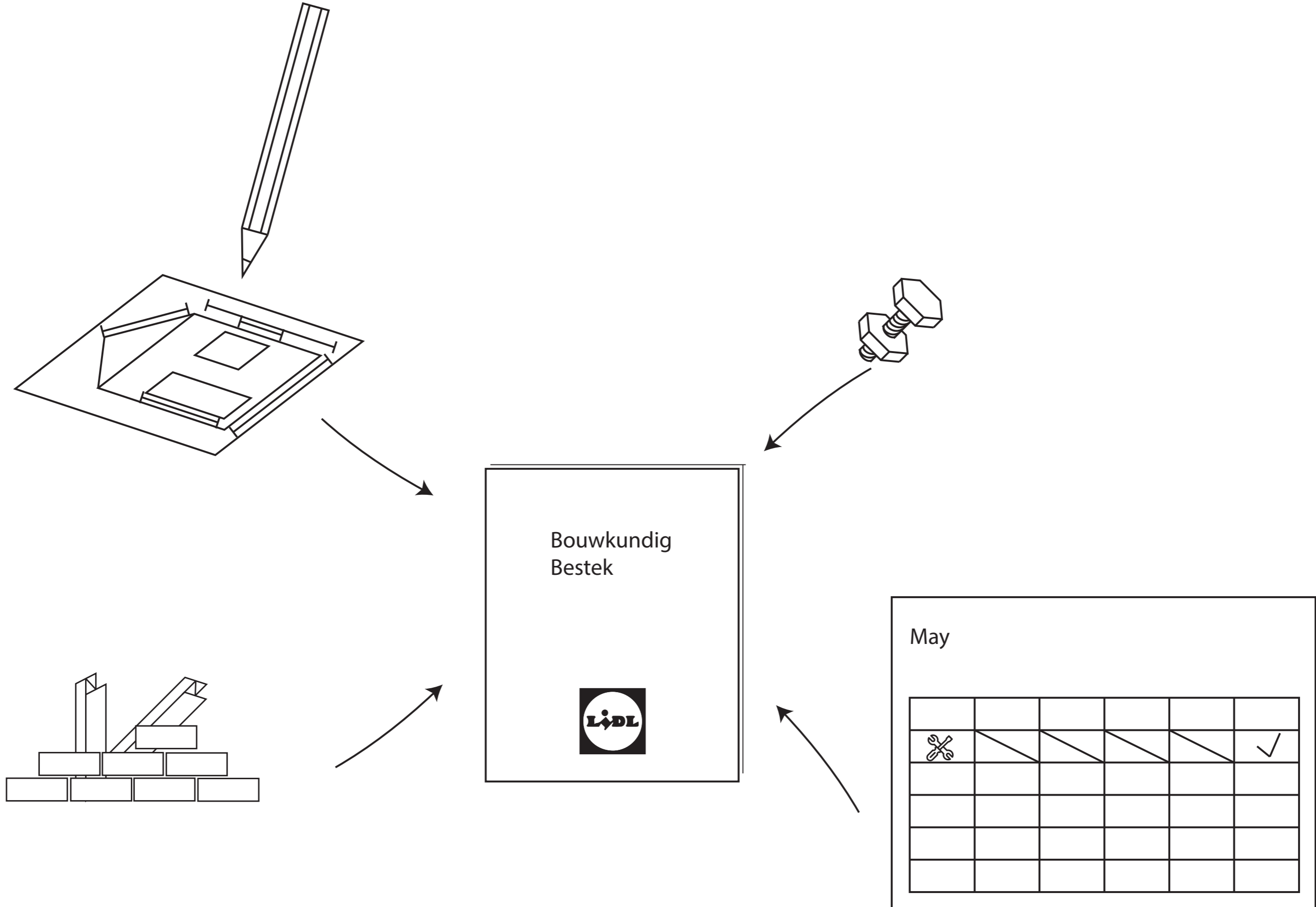
# Dutch Specification

How is the Dutch Specification currently implemented?

# Dutch Specification

| Sub Phases |             |  |                         |             |                       |  |                   |  |                       |  |                 |  |           |  |                      |  |                     |  |                 |  |                      |  |                 |  |                |
|------------|-------------|--|-------------------------|-------------|-----------------------|--|-------------------|--|-----------------------|--|-----------------|--|-----------|--|----------------------|--|---------------------|--|-----------------|--|----------------------|--|-----------------|--|----------------|
|            | 1. Intiatif |  | 2. Attainability sttudy |             | 3. Project definition |  | 4. Concept design |  | 5. Preliminary design |  | 6. Final design |  | 7. Bestek |  | 8. Price negotiation |  | 9. Work preperation |  | 10. Realisation |  | 11. Finished product |  | 12. Maintenance |  | 13. Demolition |
| Cycles     | Initiation  |  |                         | Preparation |                       |  | Realisation       |  |                       |  |                 |  | Use       |  |                      |  |                     |  |                 |  |                      |  |                 |  |                |

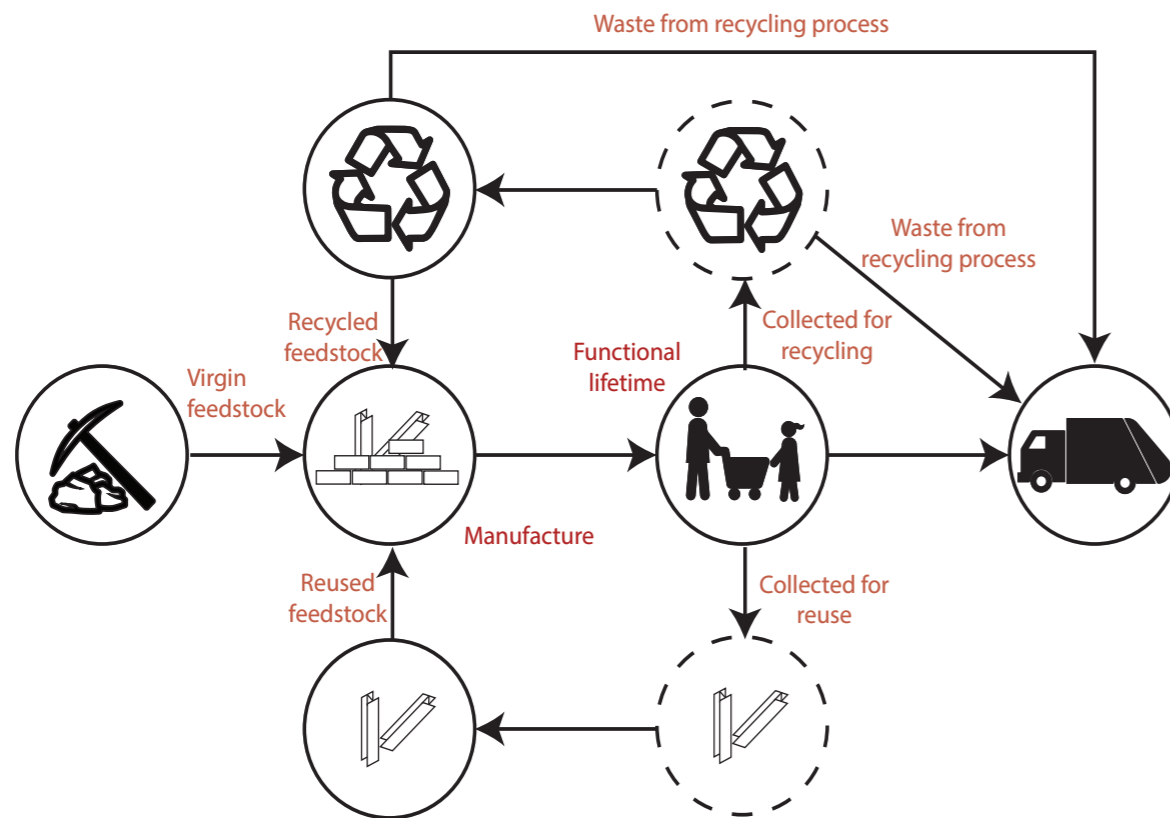
# Dutch Specification



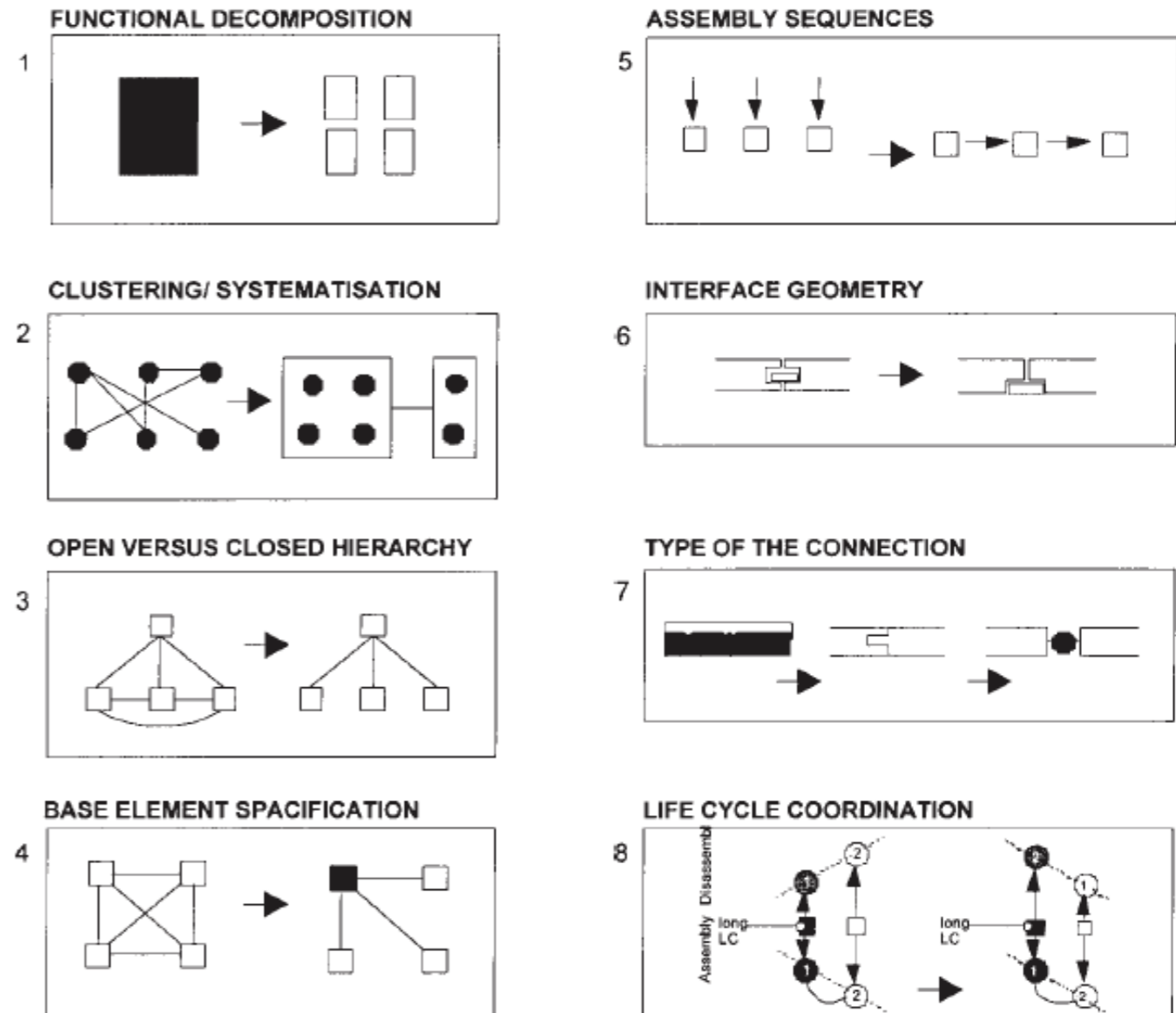
# Assessment Methods

What are the current methods to assess the level of circularity in building designs?

Material Circularity Indicator



Disassembly Potential





# Specification Analysis

What are the circular bottlenecks in the current Lidl's Specification?

# Specification Analysis



## SITE

- 10 - Stut- en sloopwerken
- 12 - Grondwerk
- 13 - Bemaling
- 14 - Buitenriolering en drainage

## STRUCTURE

- 20 - Funderingspalen en damwanden
- 21 - Betonwerken
- 22 - Metselwerken
- 24 - Ruwbouwtimmerwerk
- 25 - Metalen draagconstructies

## SKIN

- 30 - Kozijnen ramen en deuren
- 31 - Systeembekleding
- 33 - Dakbedekking
- 34 - Beglazing
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- 37 - Isolatie
- 38 - Gevelschermen
- 40 - Stukadoorwerken
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## SERVICES

- 51 - Binnenriolering
- 52 - Waterinstallaties
- 53 - Sanitair
- 54 - Brandbestrijdingsinstallaties

## SPACEPLAN

- 41 - Tegelwerken
- 42 - Dekvloeren en vloersystemen
- 43 - Metaal- en kunststofwerken
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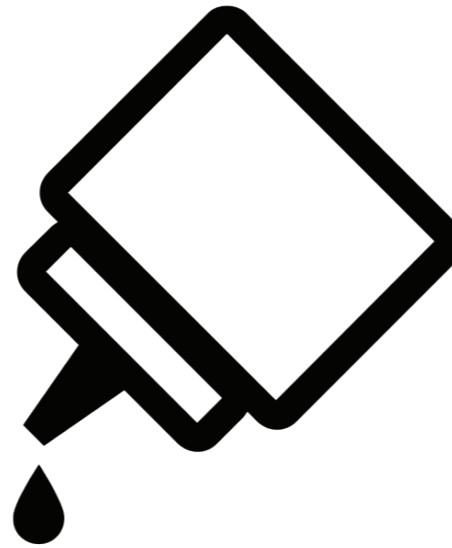
# Sand-lime brick



# Sand-lime brick



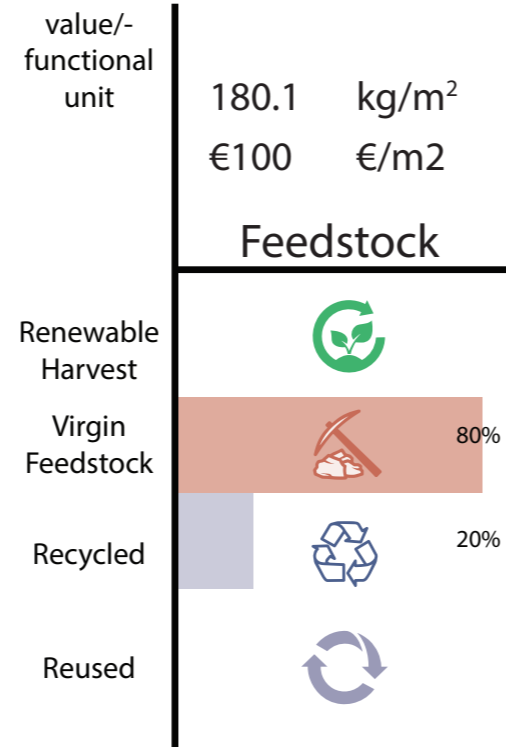
Glued



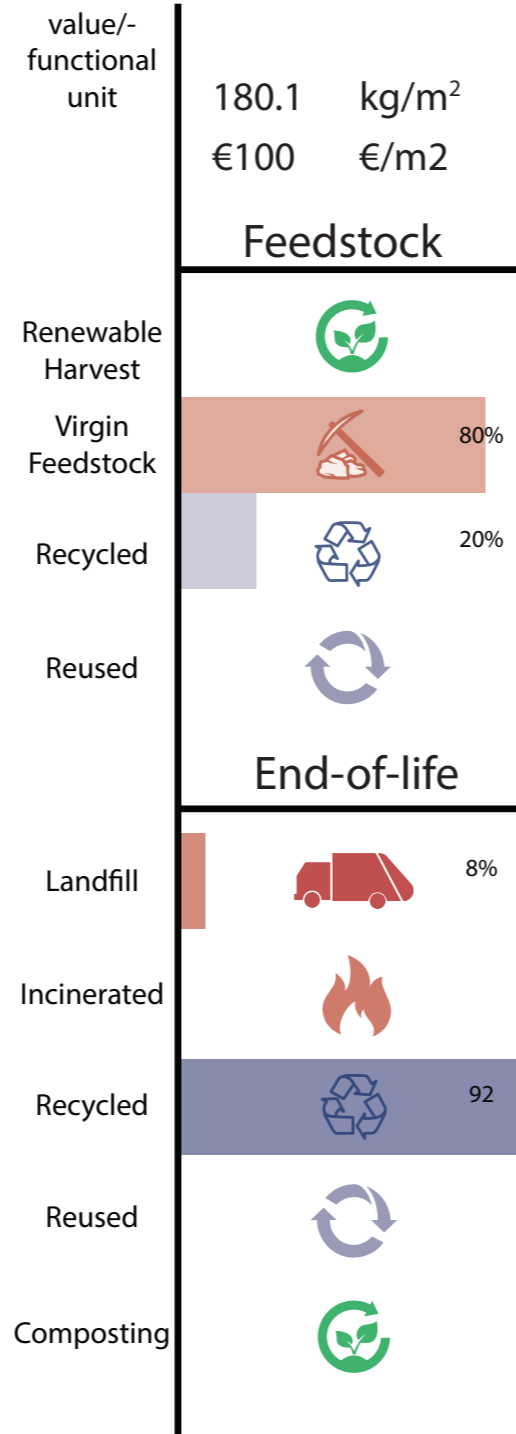
Demolition



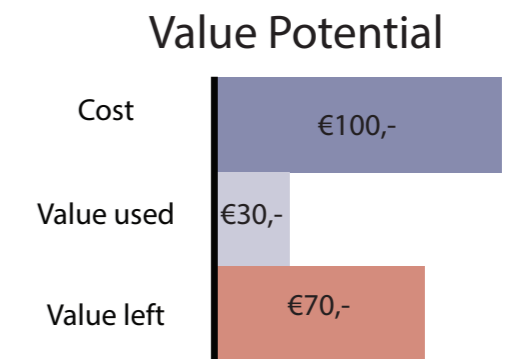
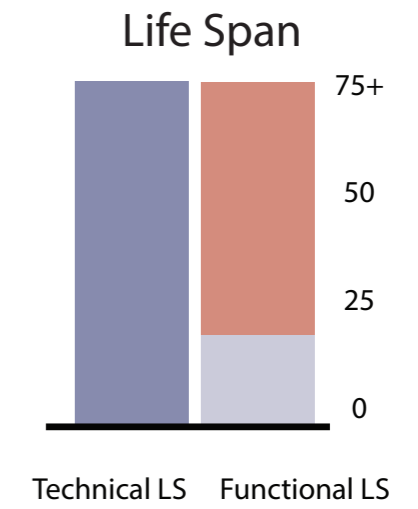
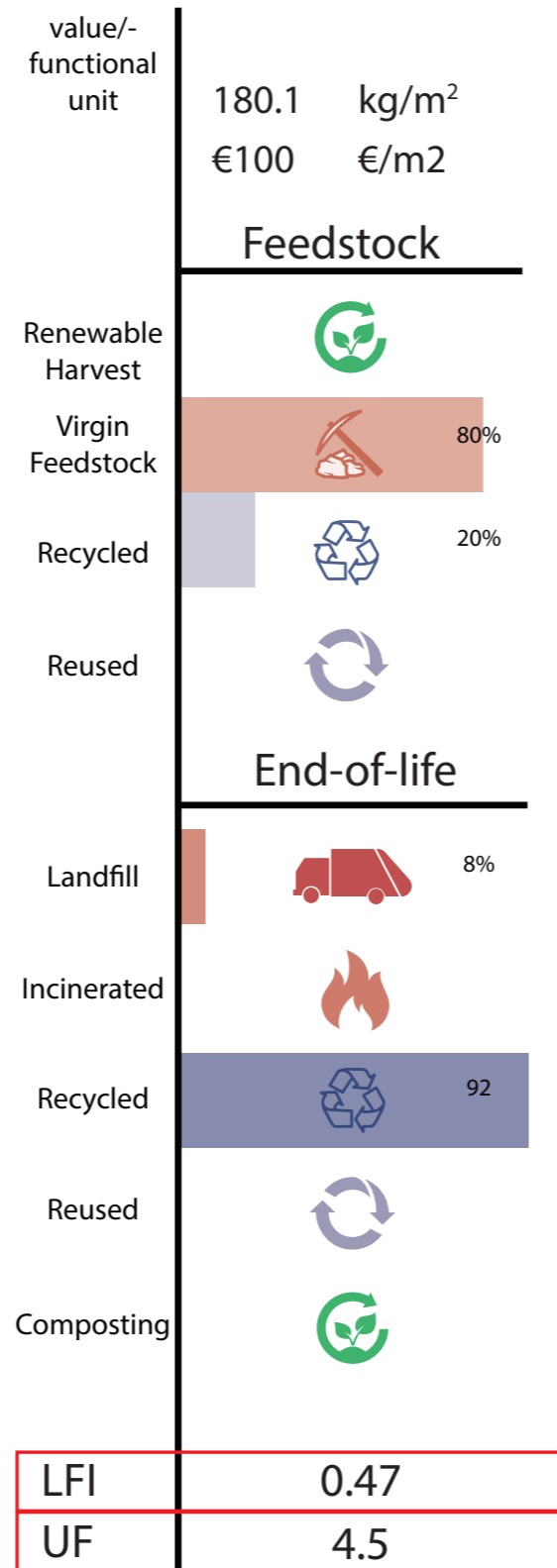
# Sand-lime brick



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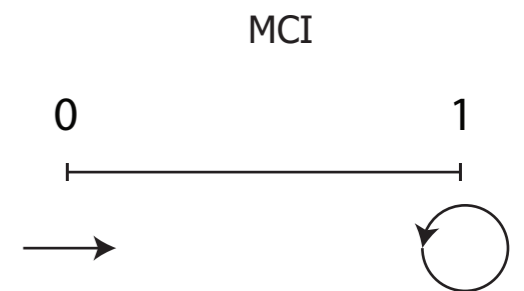
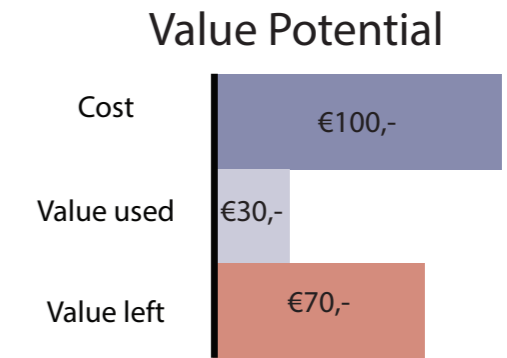
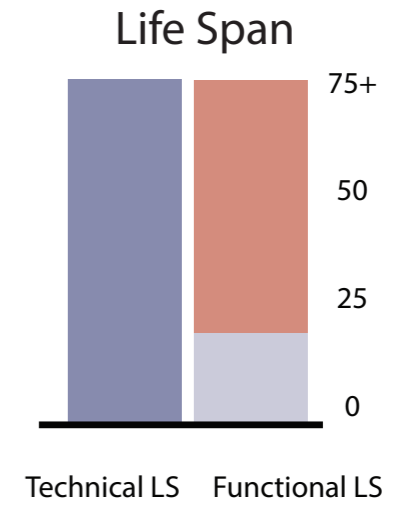
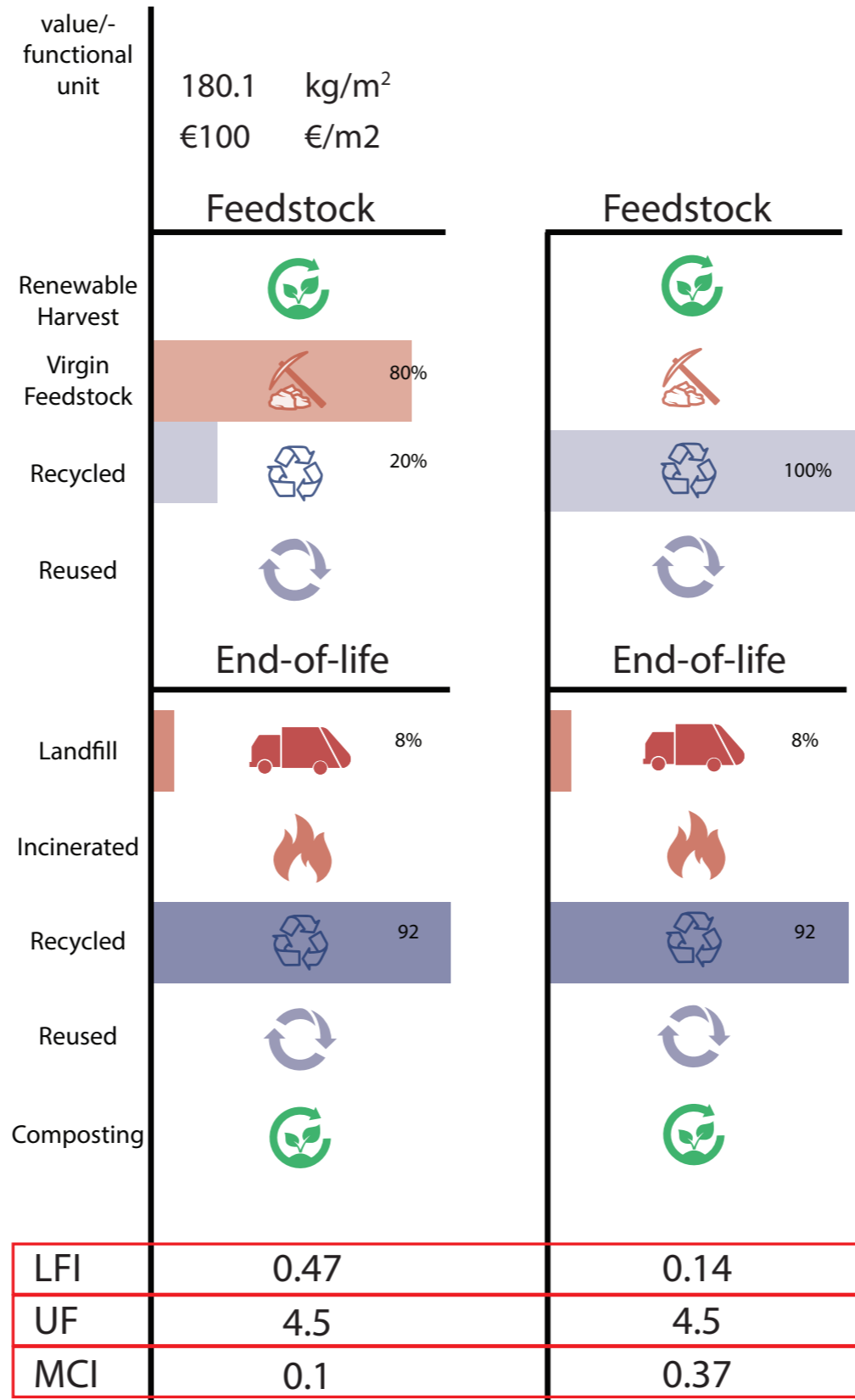


# Sand-lime brick



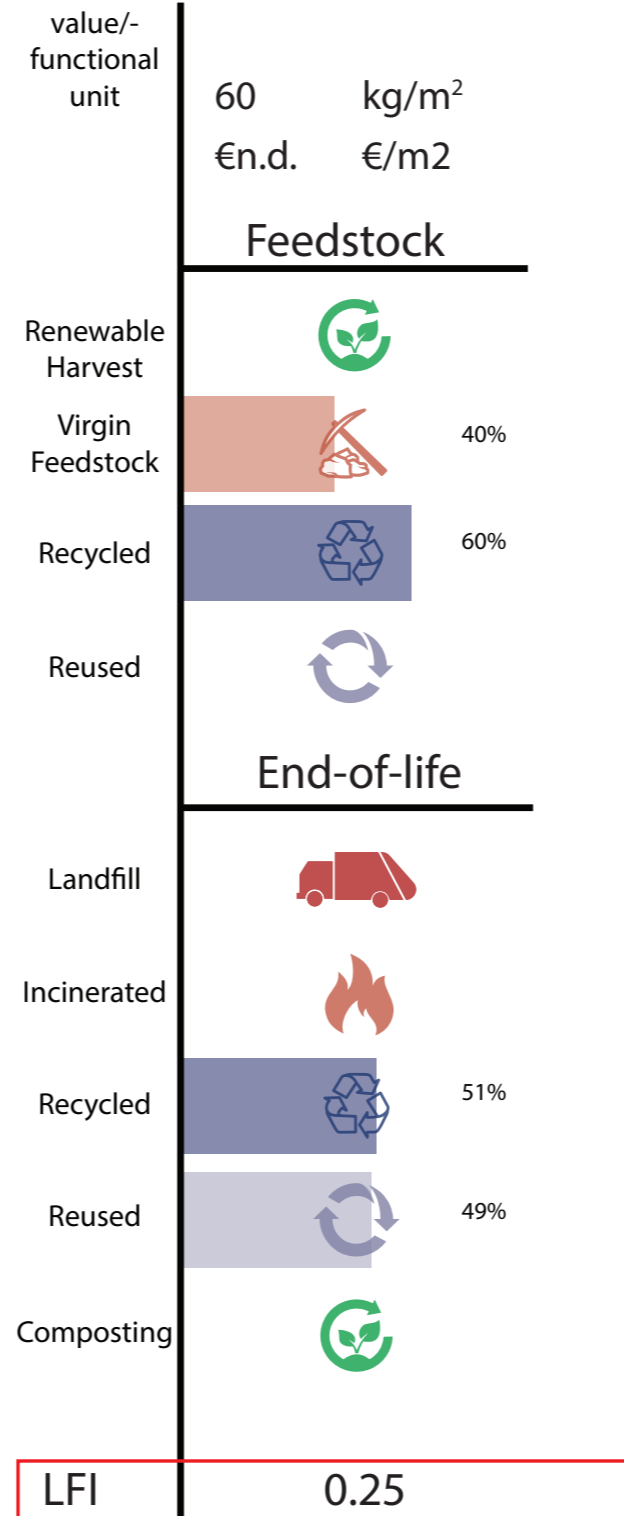


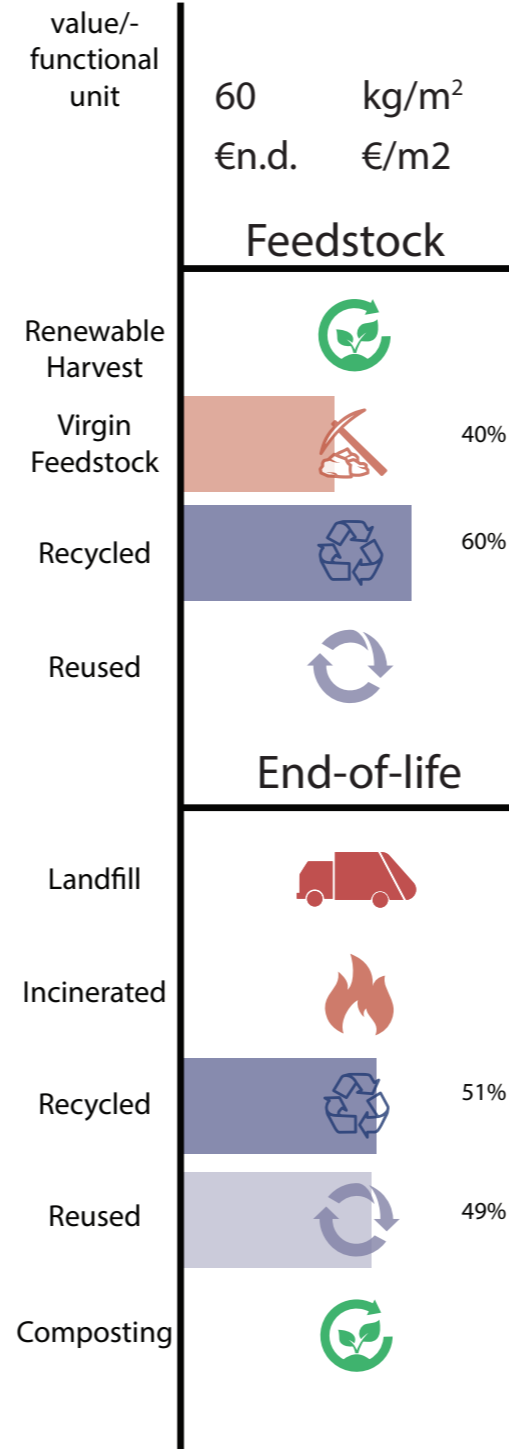
# Sand-lime brick



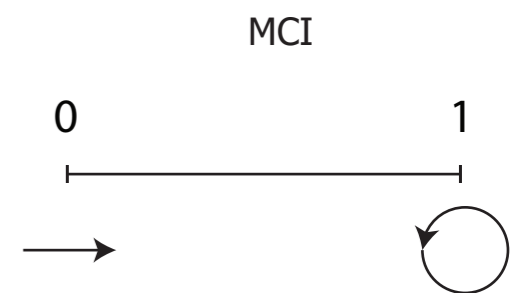
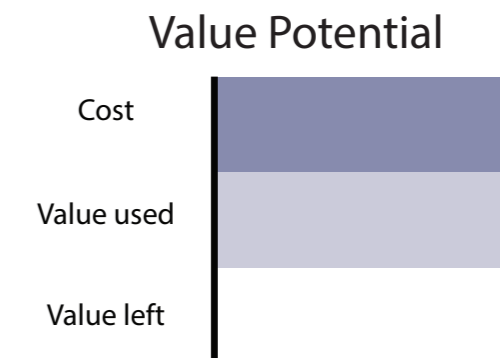
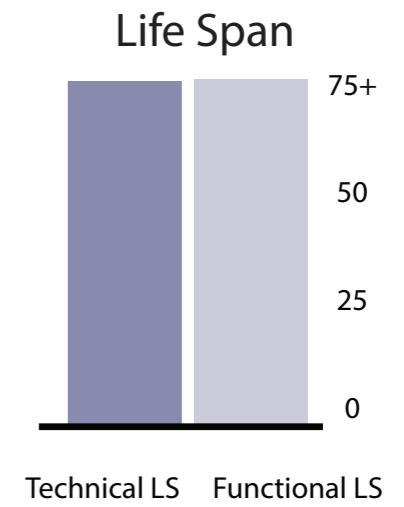
# Steel beams



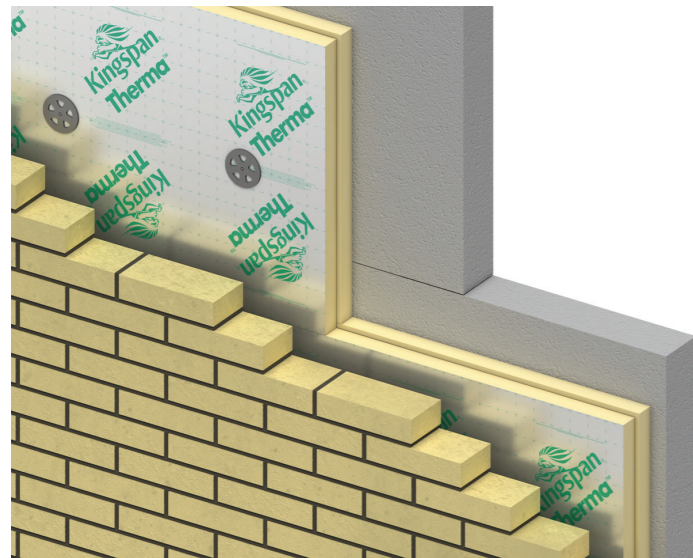




|     |      |
|-----|------|
| LFI | 0.25 |
| UF  | 0.9  |
| MCI | 0.78 |

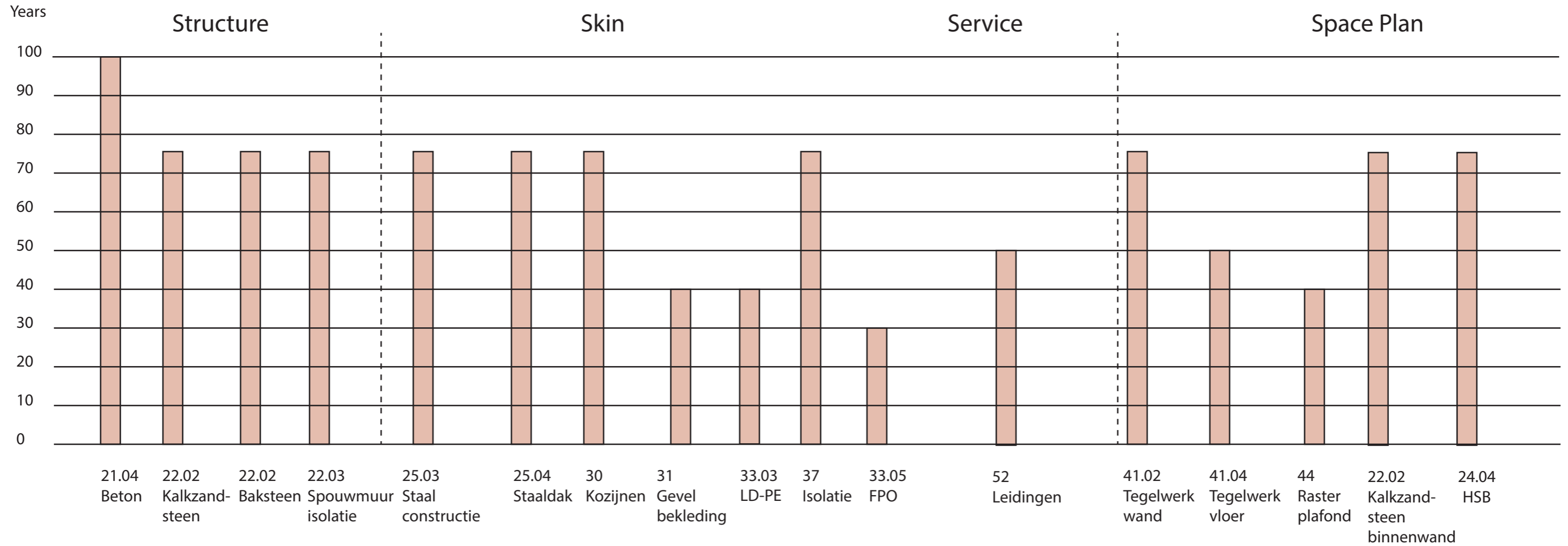


# Analysed materials

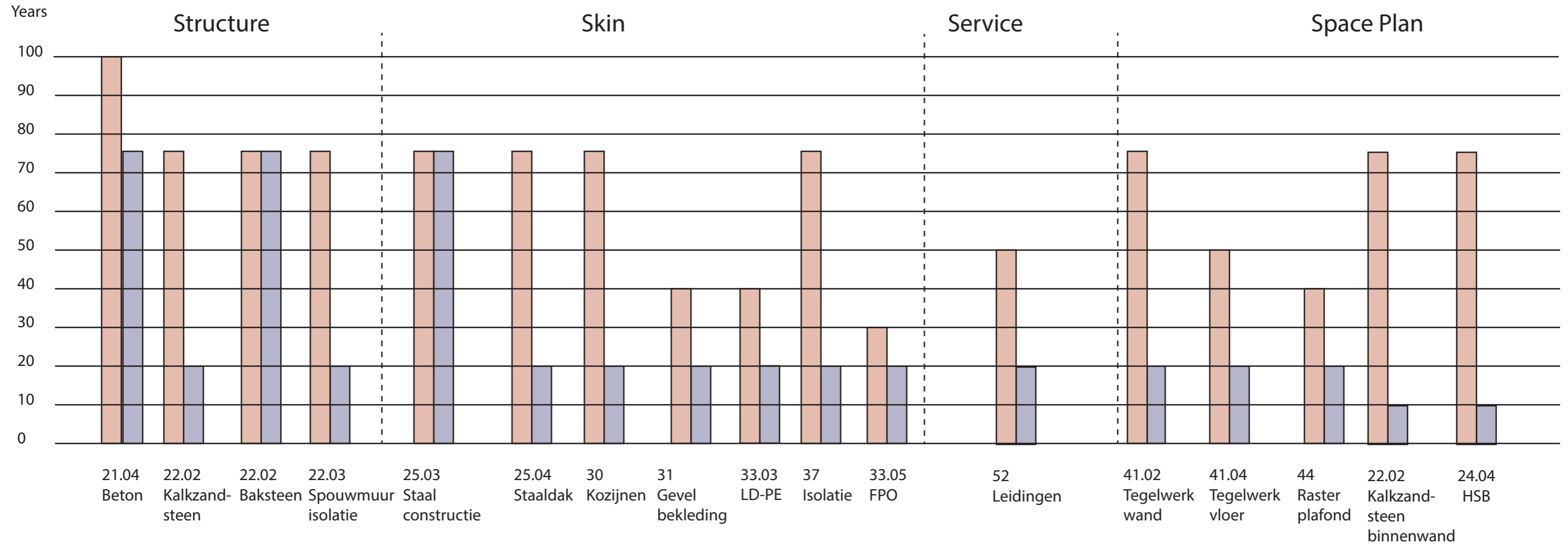




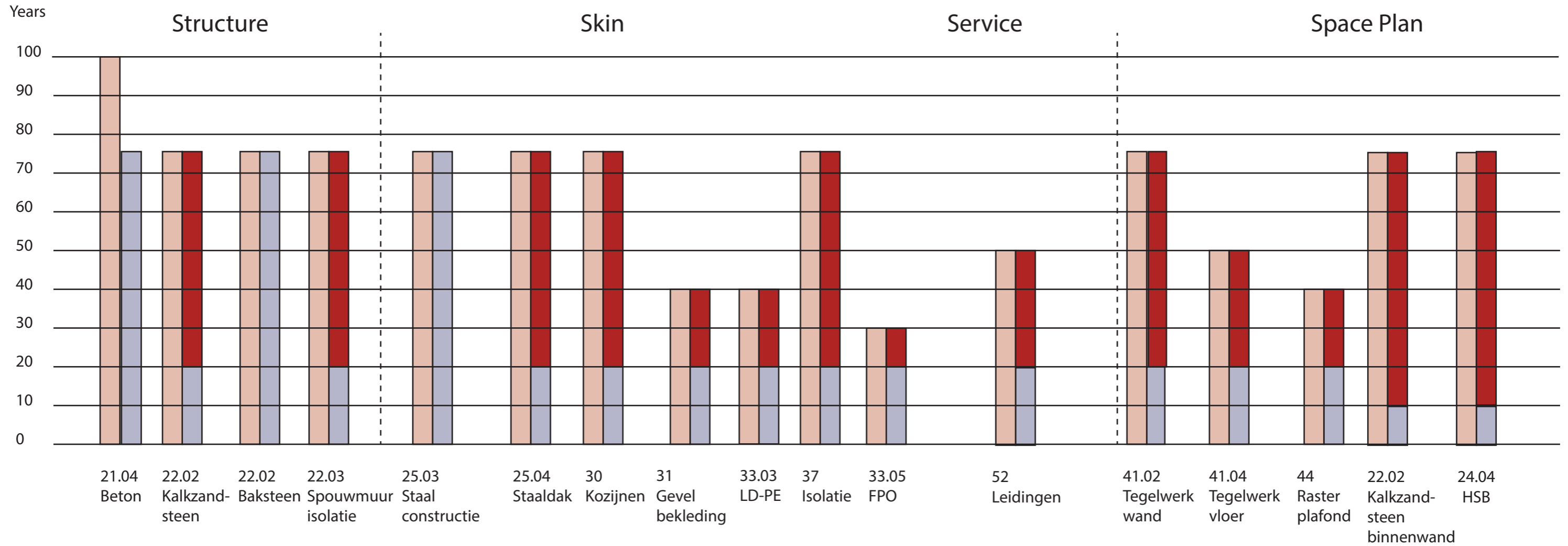
# Technical life span



# Functional life span







# Specification Analysis

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- Sufficient
- Partially sufficient
- Insufficient

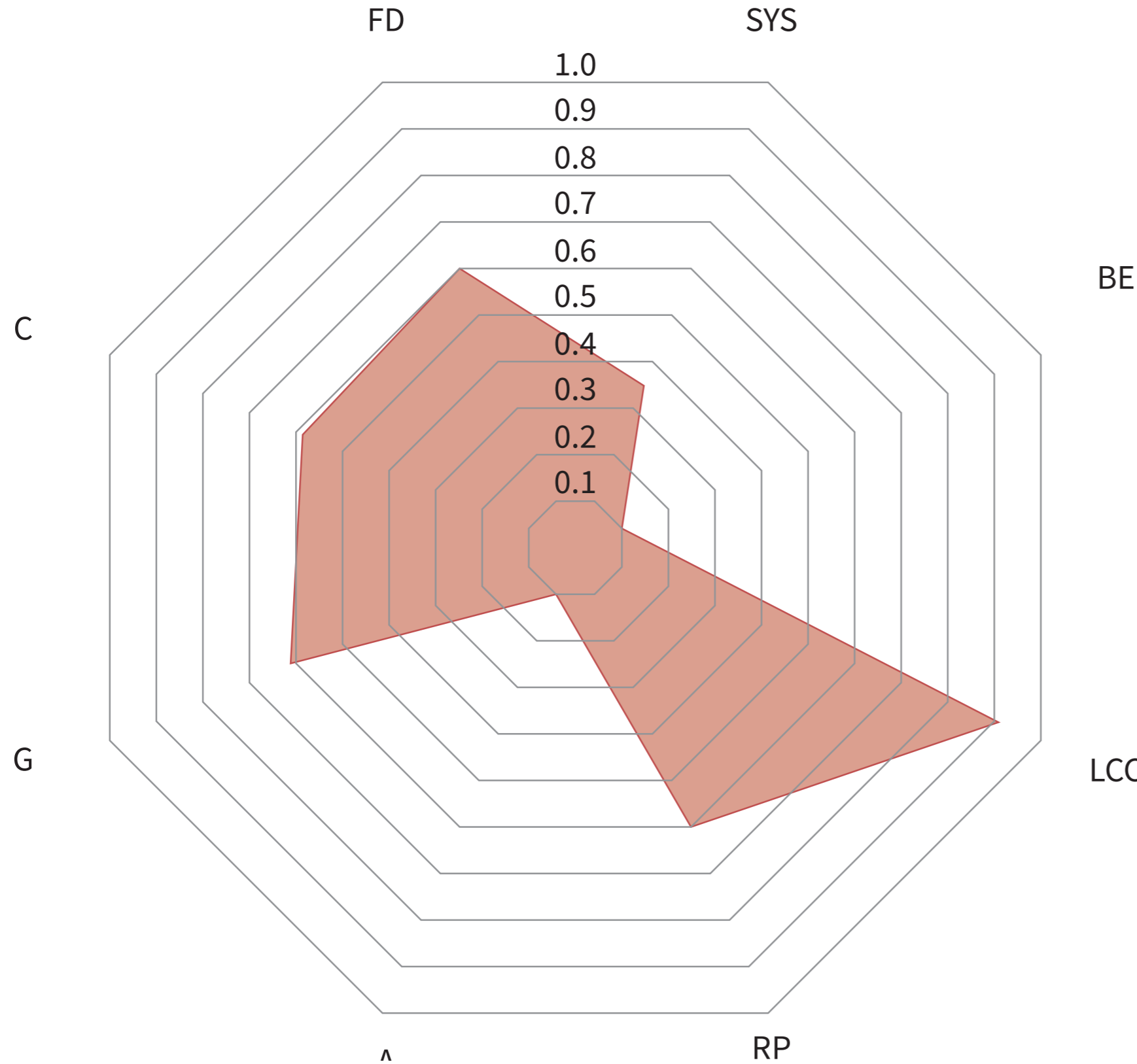
How can a building system, as described in the Specification, be redesigned into a circular one?

# Roof original



# Roof original

## Disassembly Potential

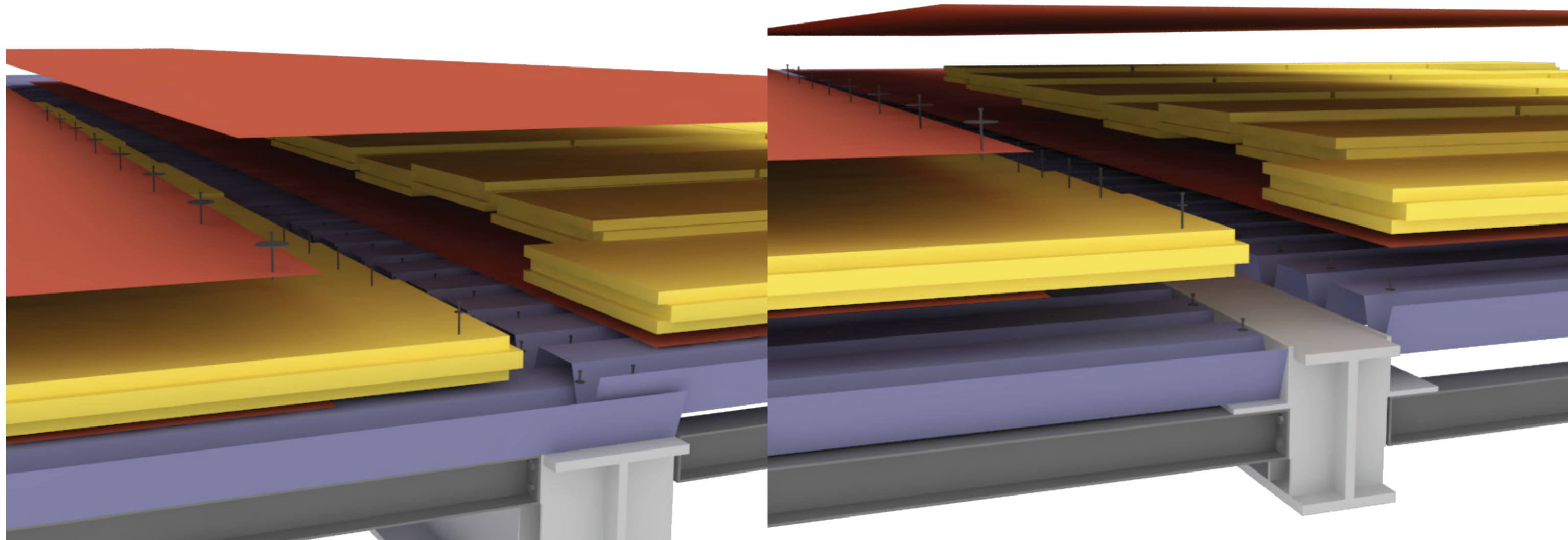


TC = 0.44

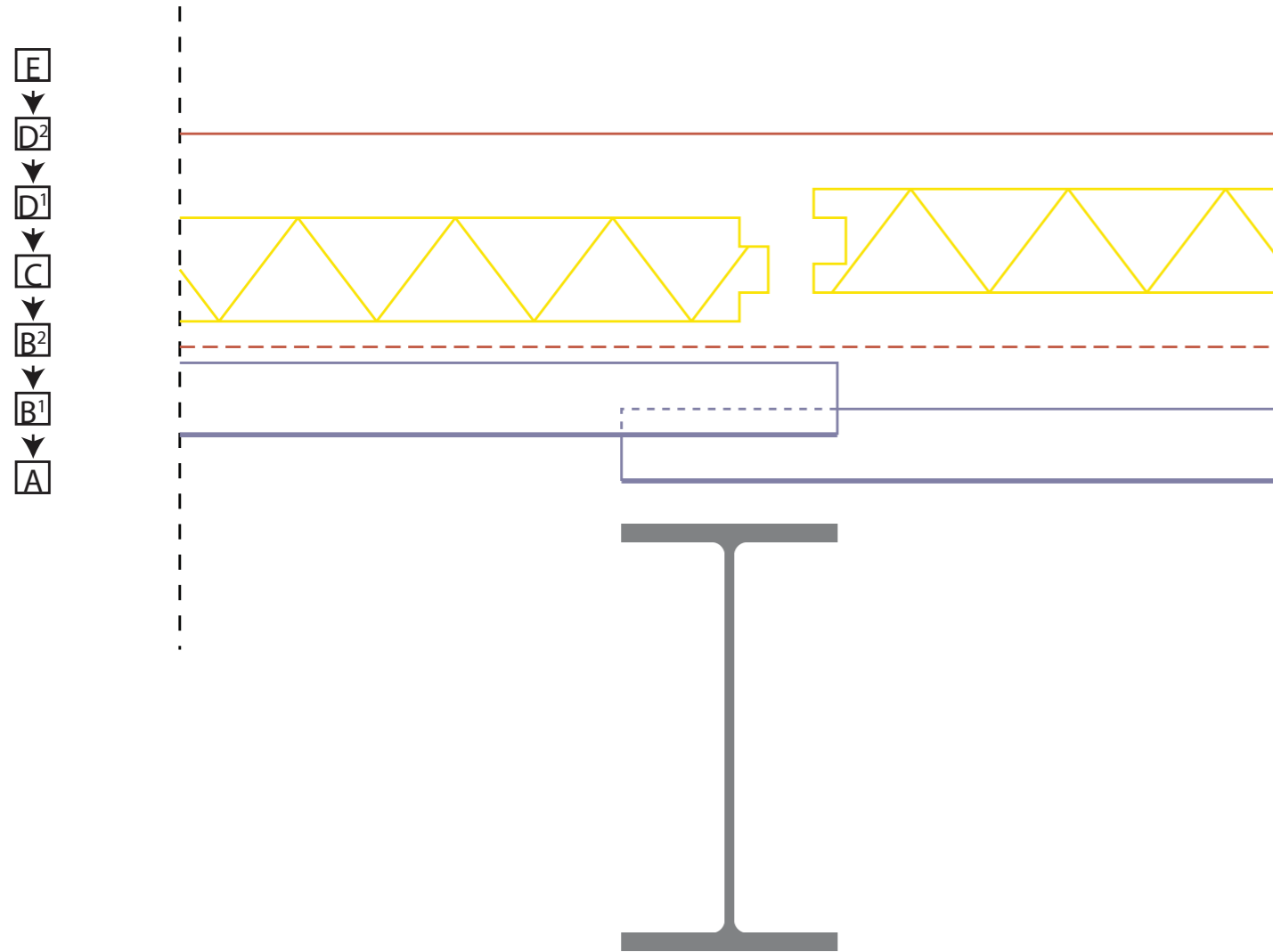
30% - 70%  
demolition



# Assembly (A)

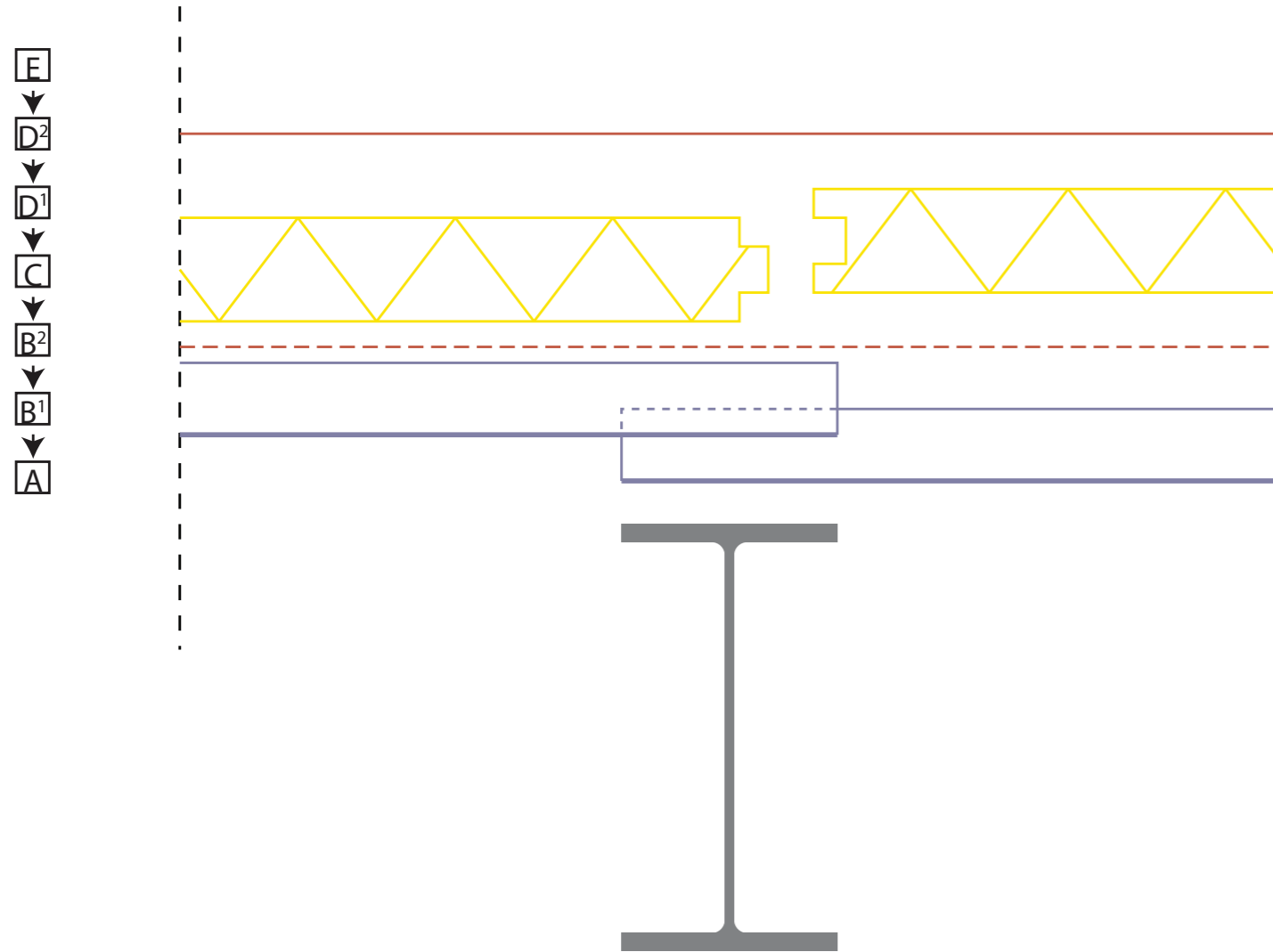


# Assembly (A)



Corruated steel

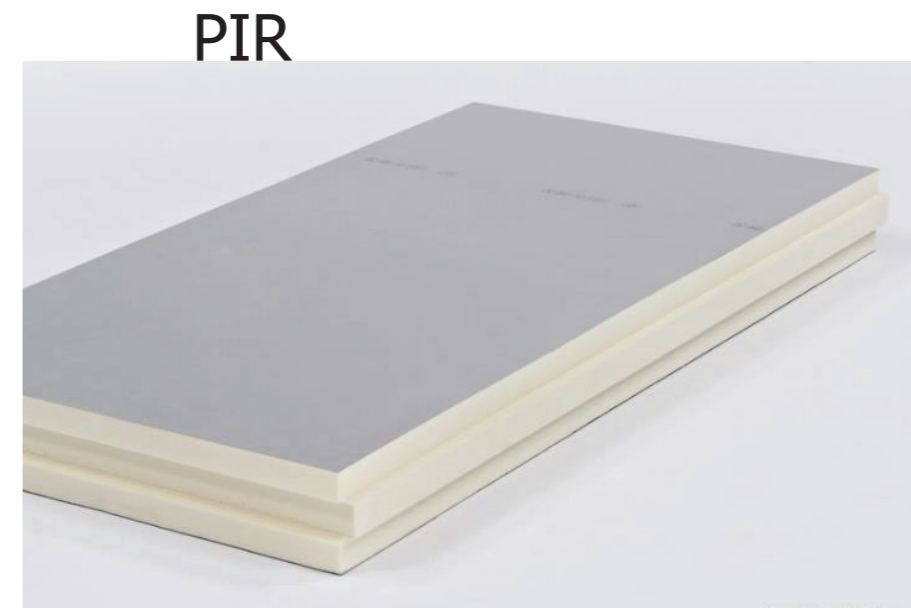
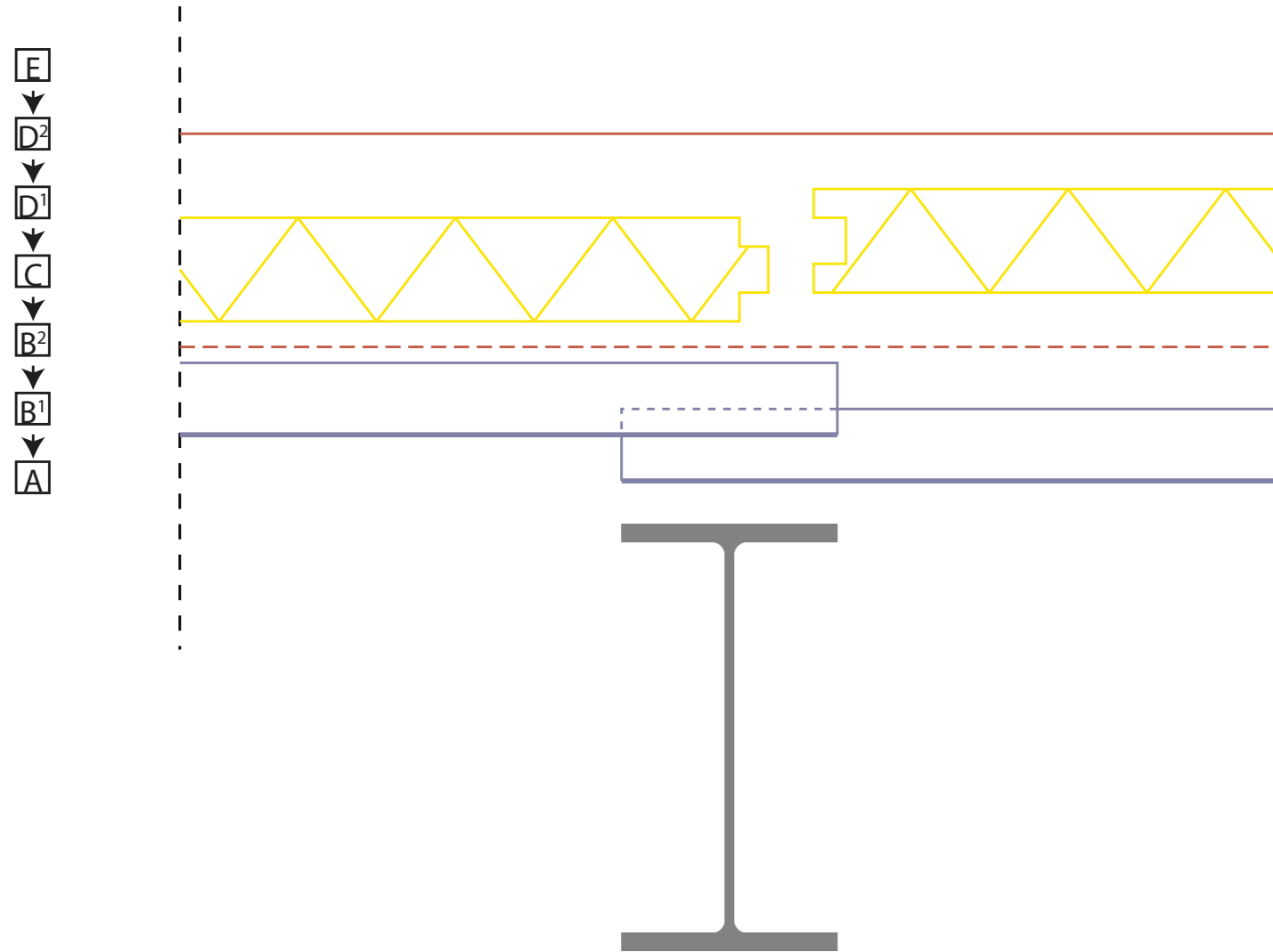


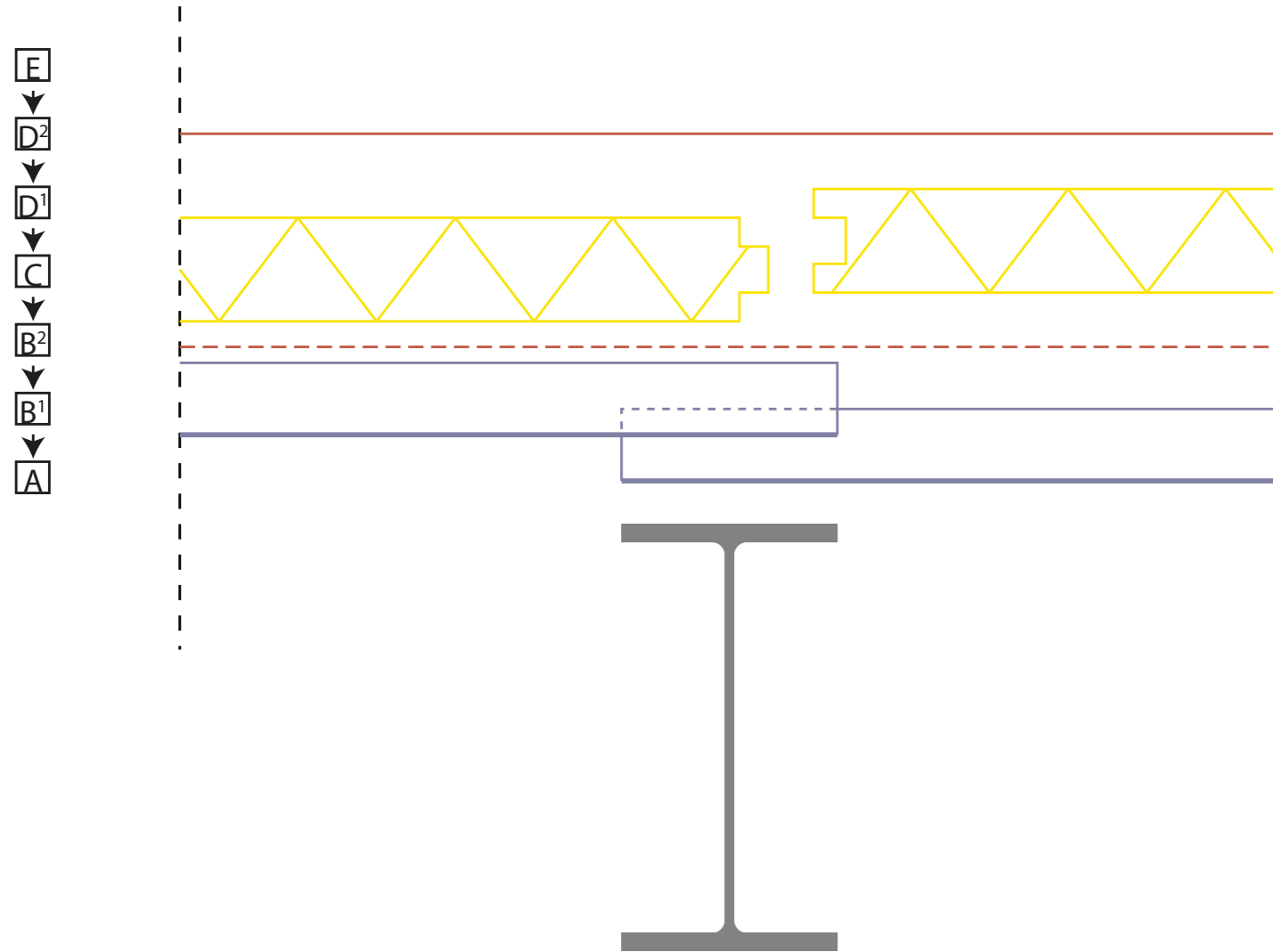


LD-PE Vapour









FPOBarrier



# Material Circularity

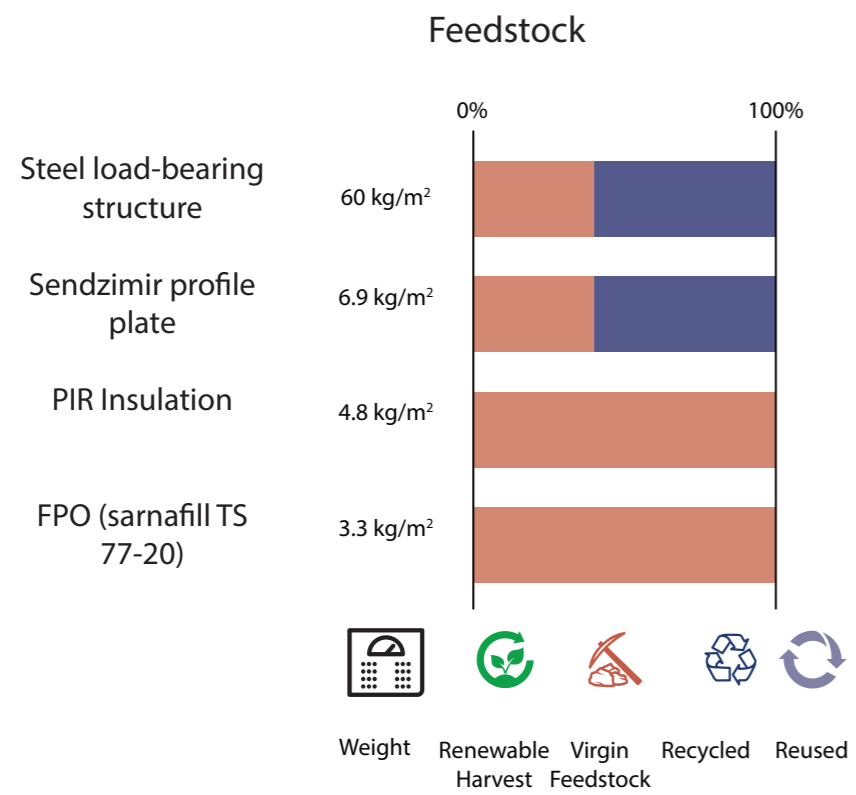
Steel load-bearing  
structure

Sendzimir profile  
plate

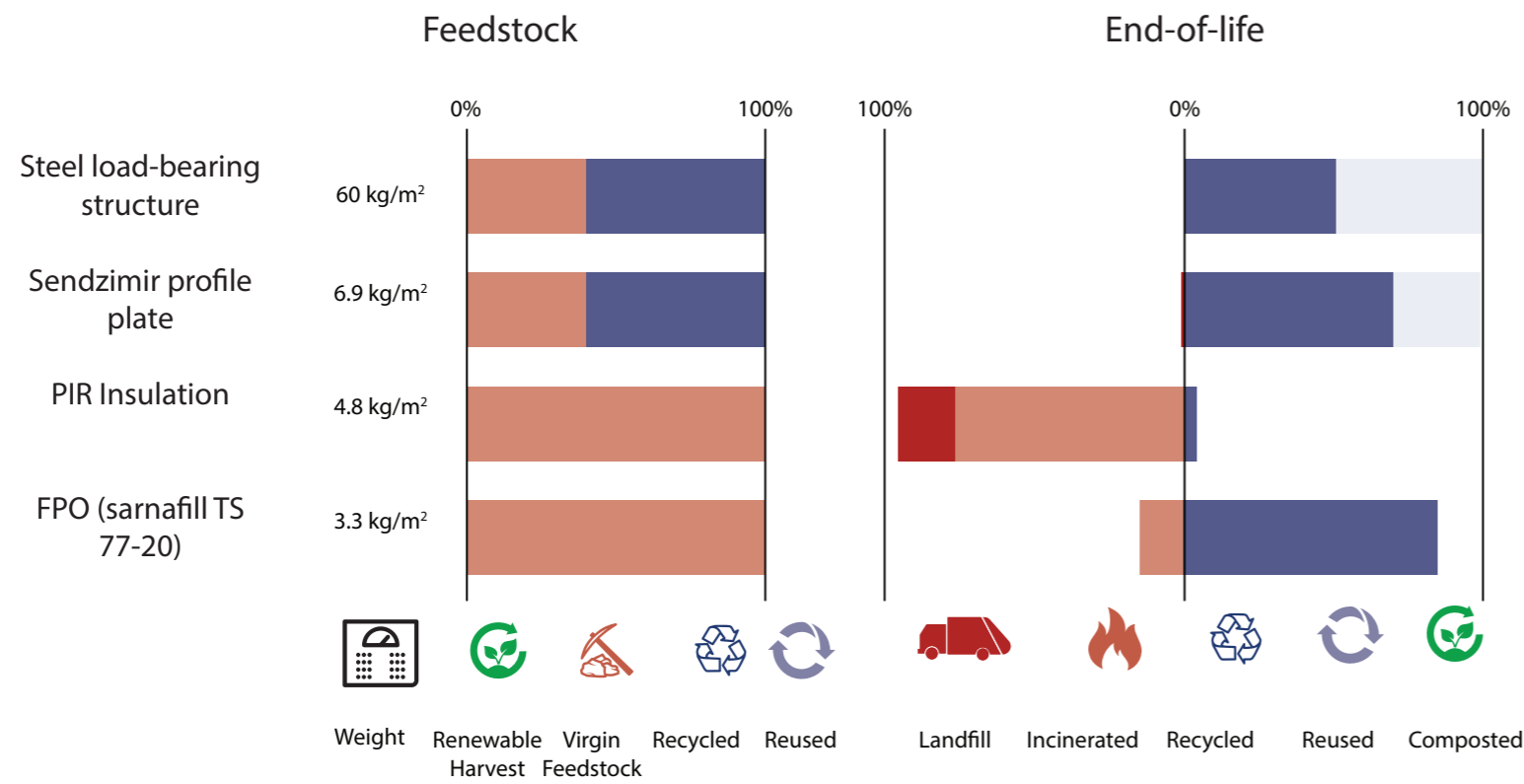
PIR Insulation

FPO (sarnafill TS  
77-20)

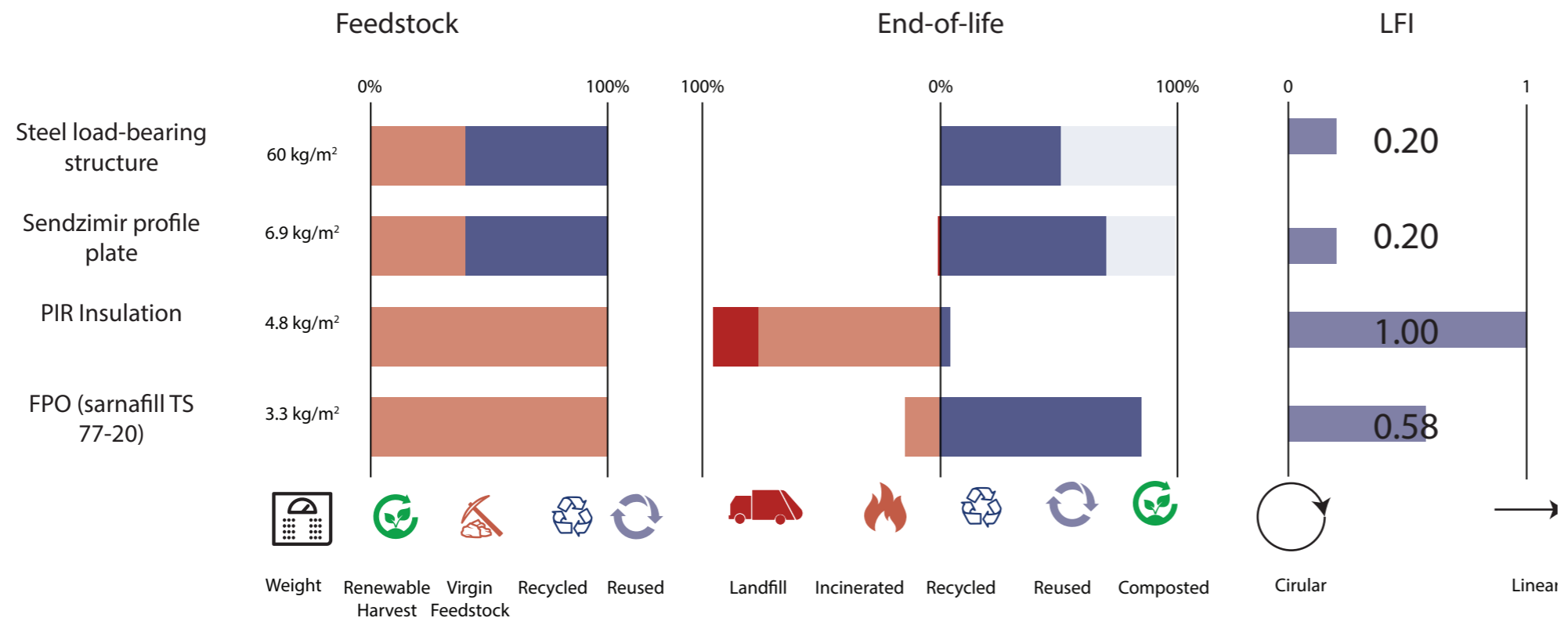
# Material Circularity



# Material Circularity



# Material Circularity



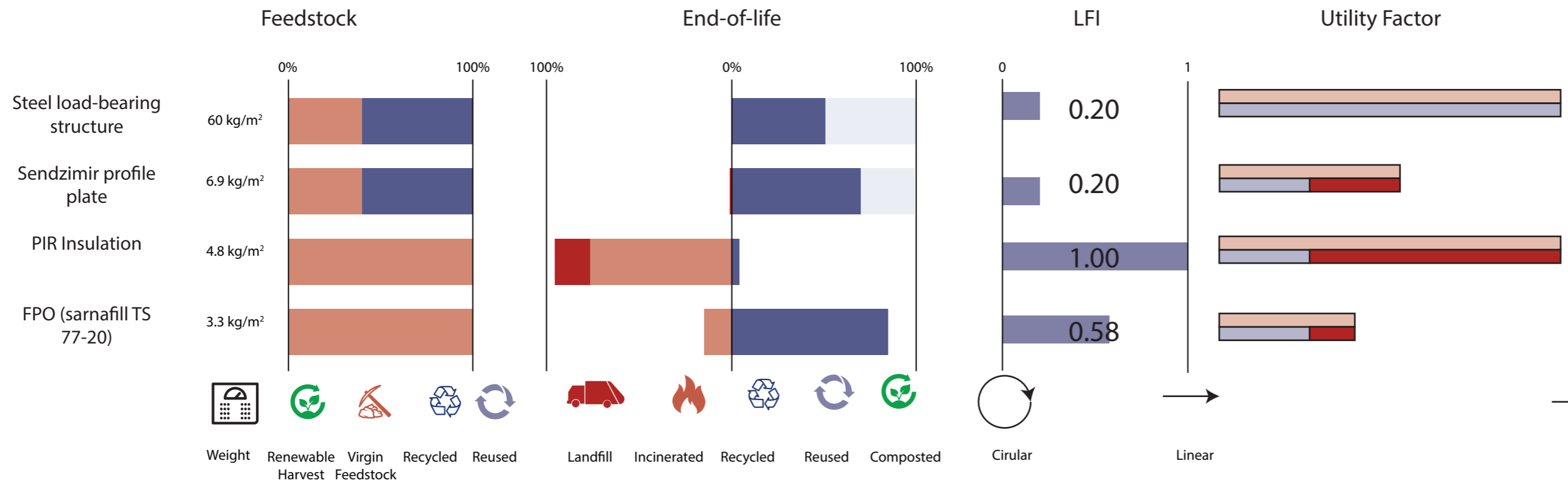
Structure and roof MCI

Total LFI = 0.25

Roof only MCI

Total LFI = 0.54

# Material Circularity



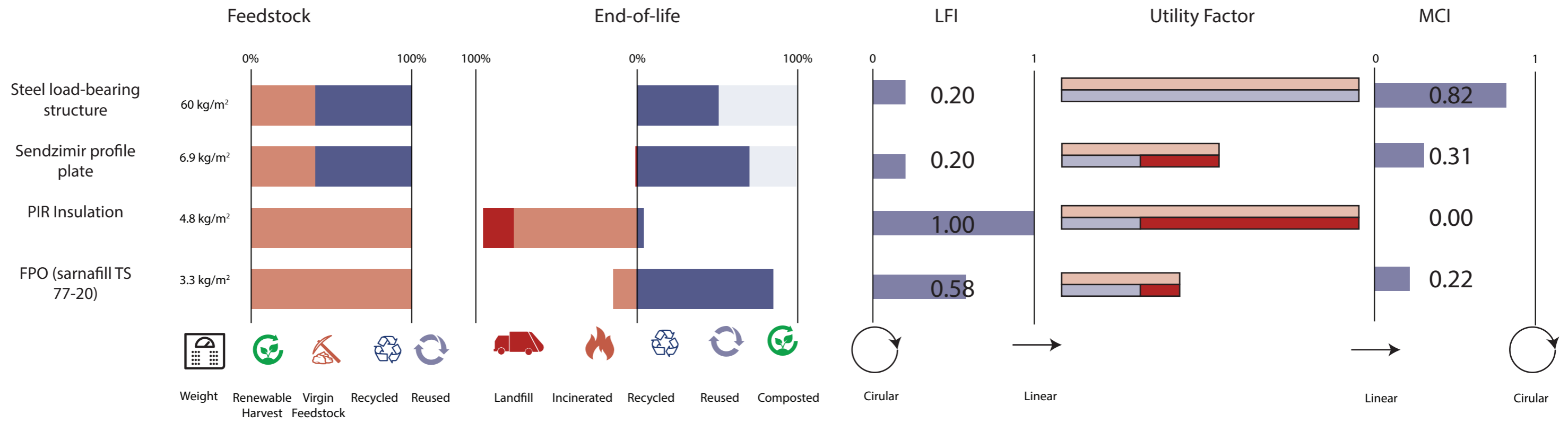
Structure and roof MCI

Total LFI = 0.25

Roof only MCI

Total LFI = 0.54

# Material Circularity



## Structure and roof MCI

Total LFI = 0.25

Total MCI = 0.69

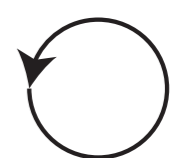
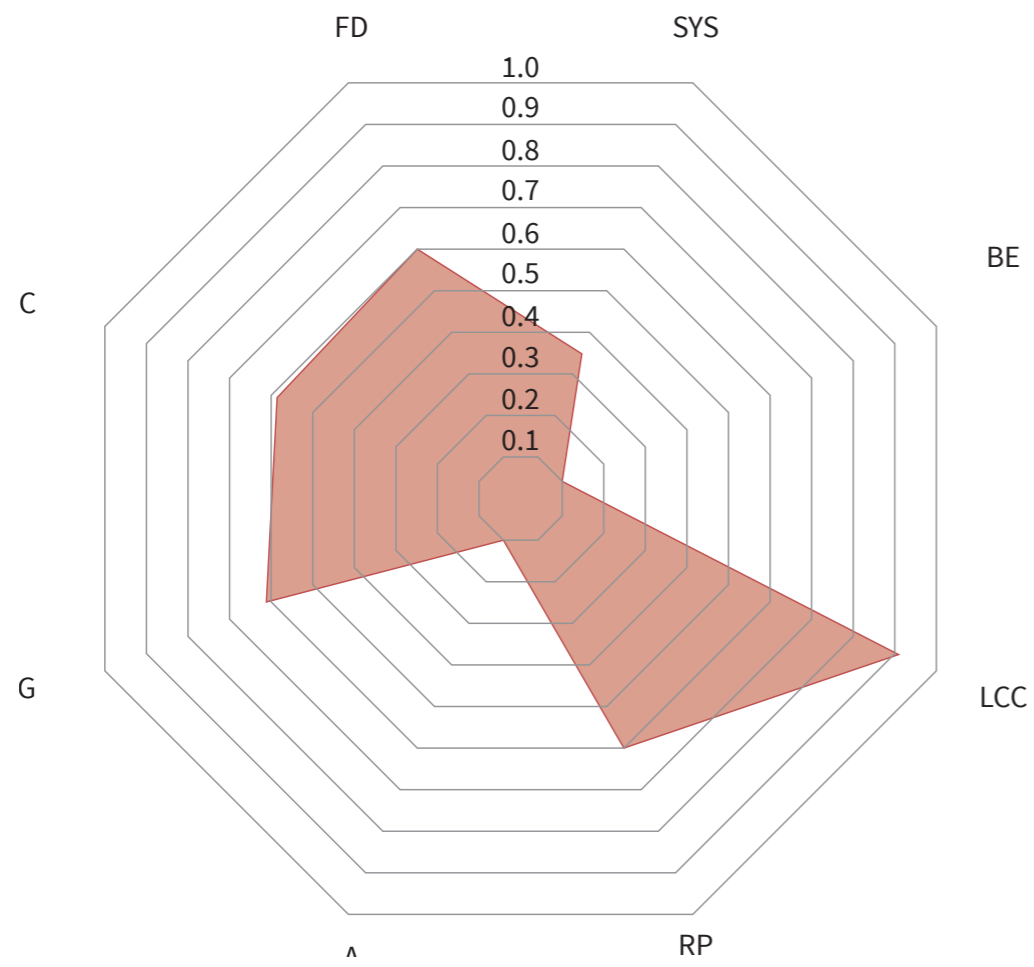
## Roof only MCI

Total LFI = 0.54

Total MCI = 0.19



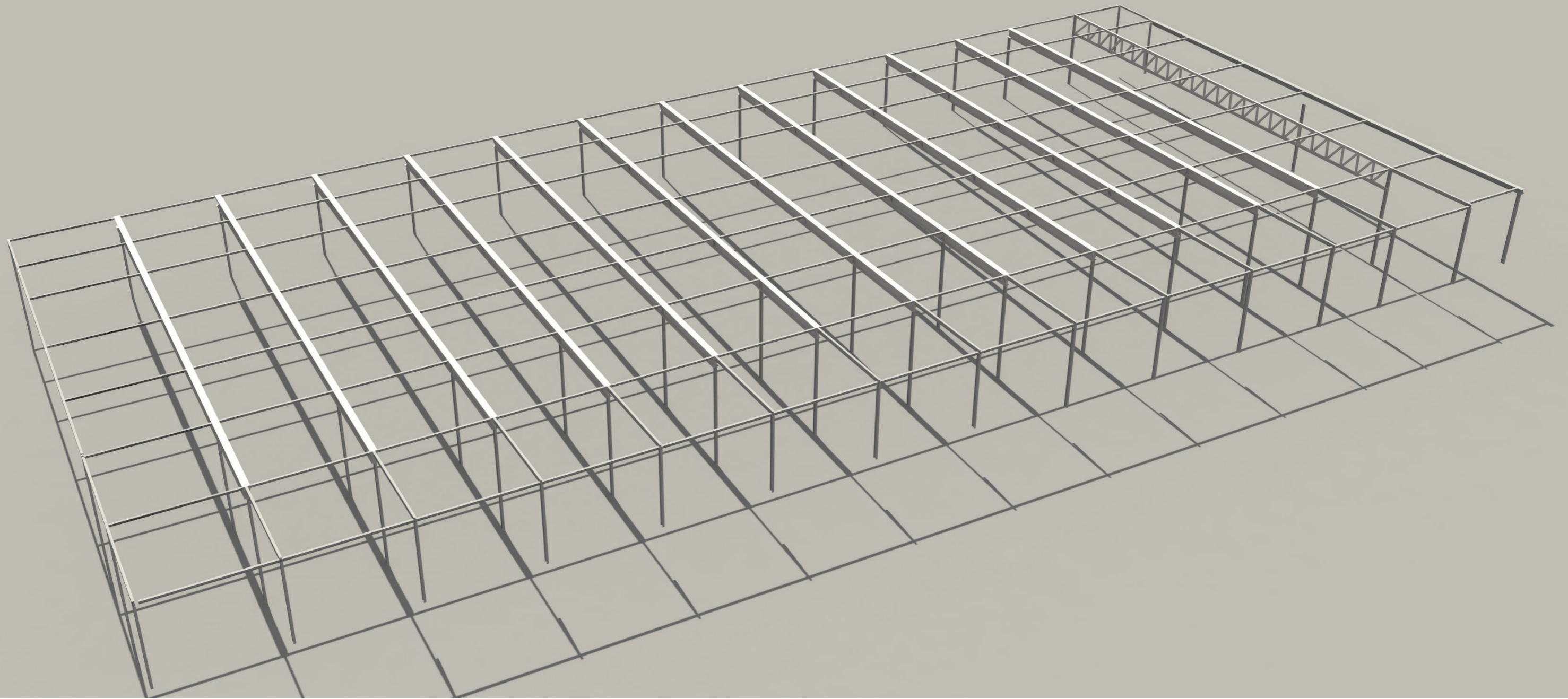
# What did we learn?



# Green



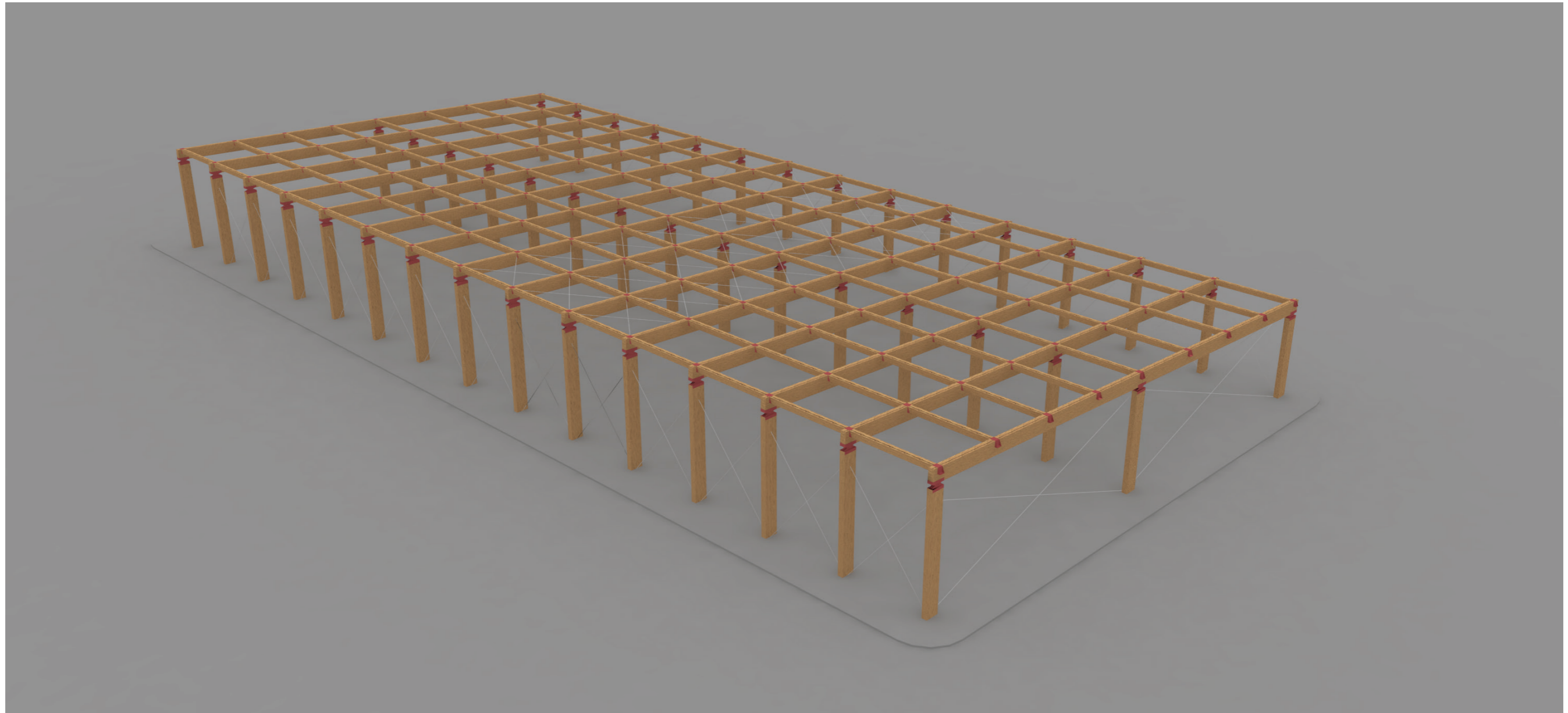
# Technical



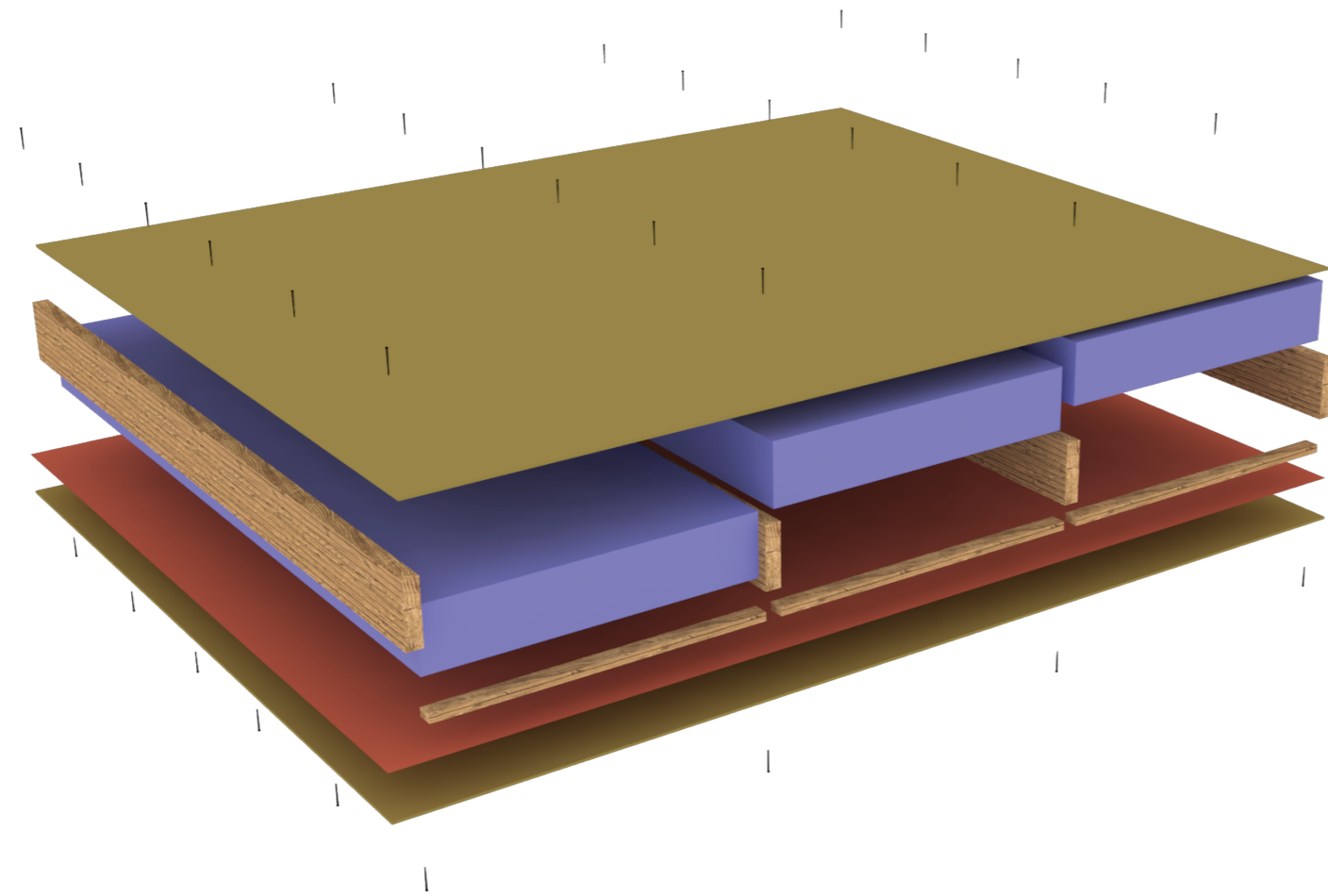
# Green Redesign



# Load-bearing Structure



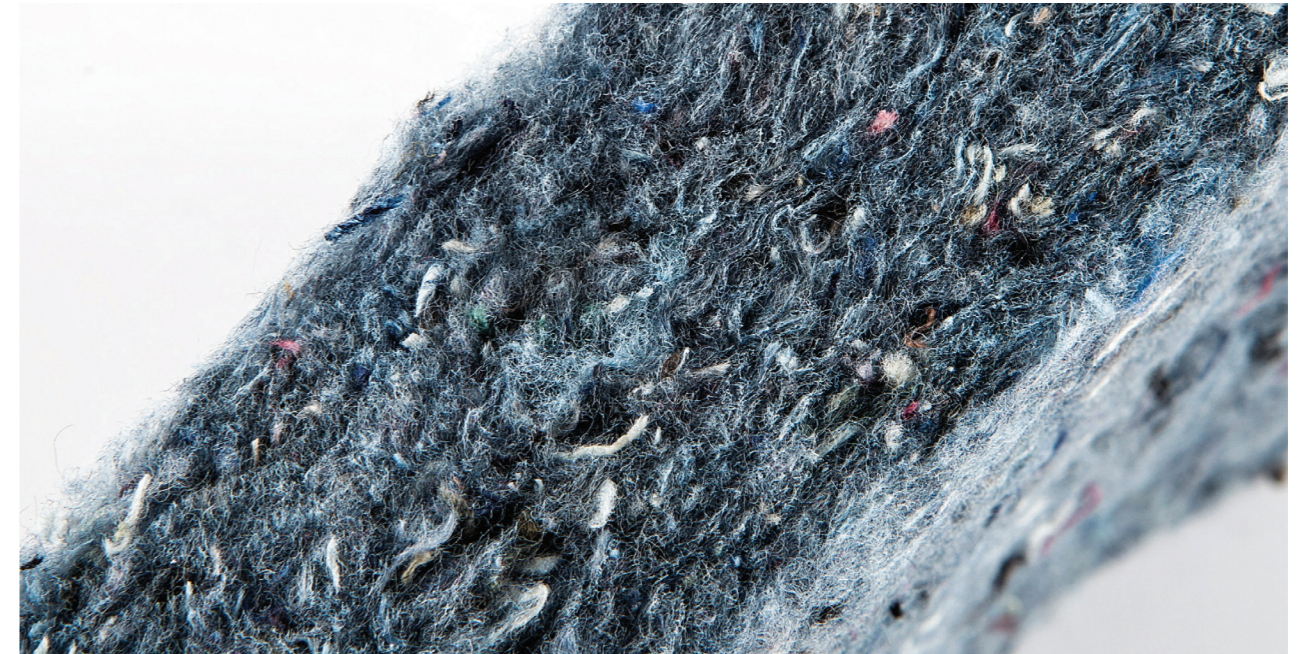
# Sandwich panel System



Accoya Gluelam



Metisse



ECOBoard

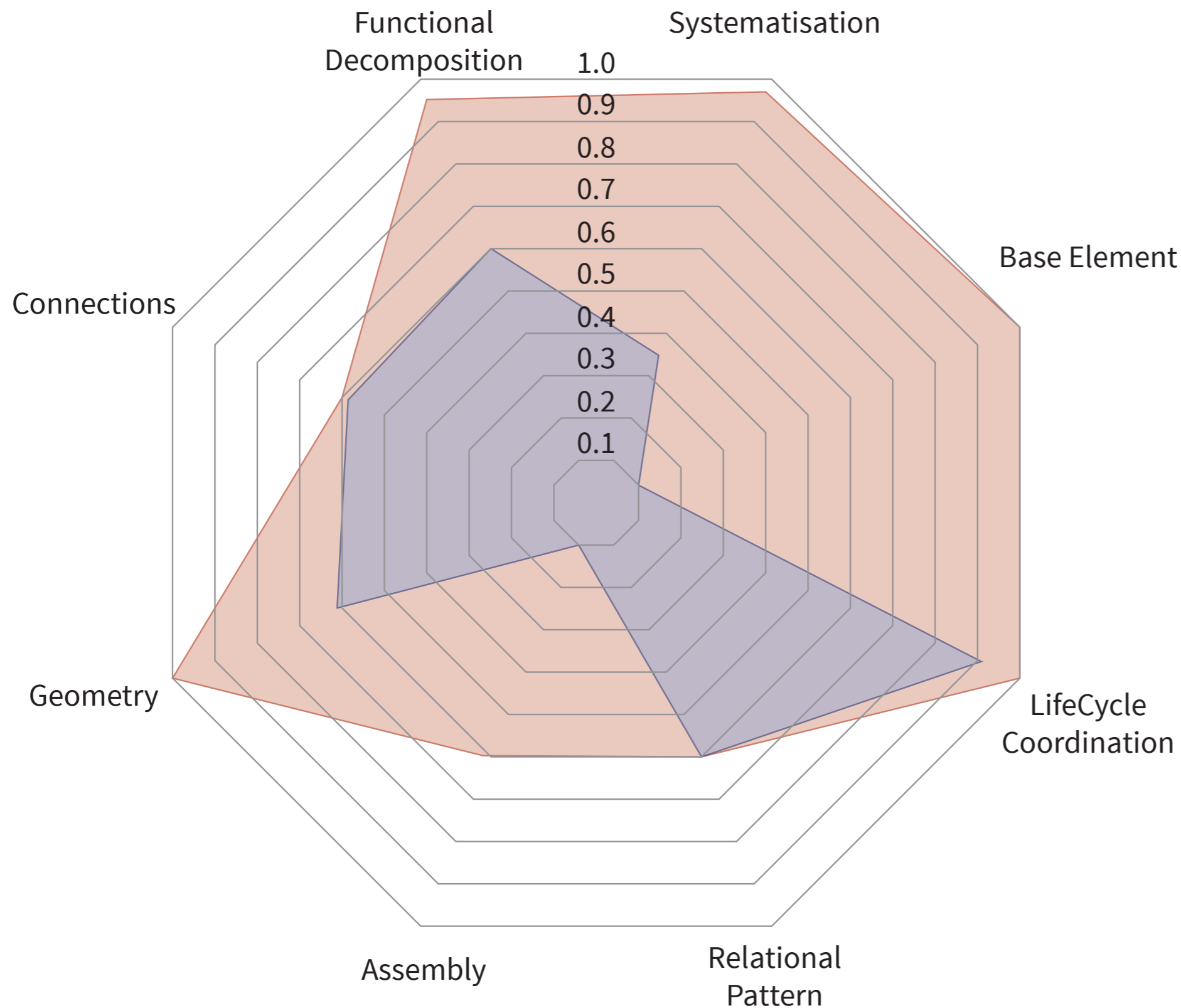


Derbipure



# Green Redesign

## Disassembly Potential

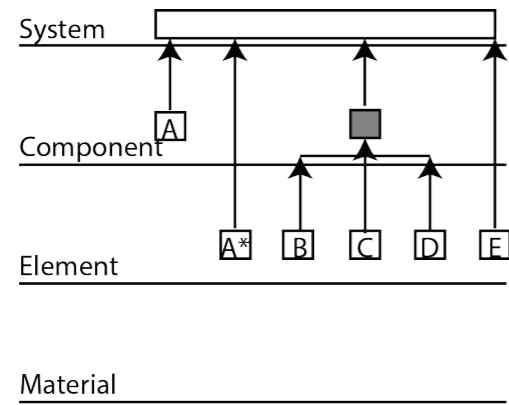


TC = 0.81

0% - 30%  
demolition

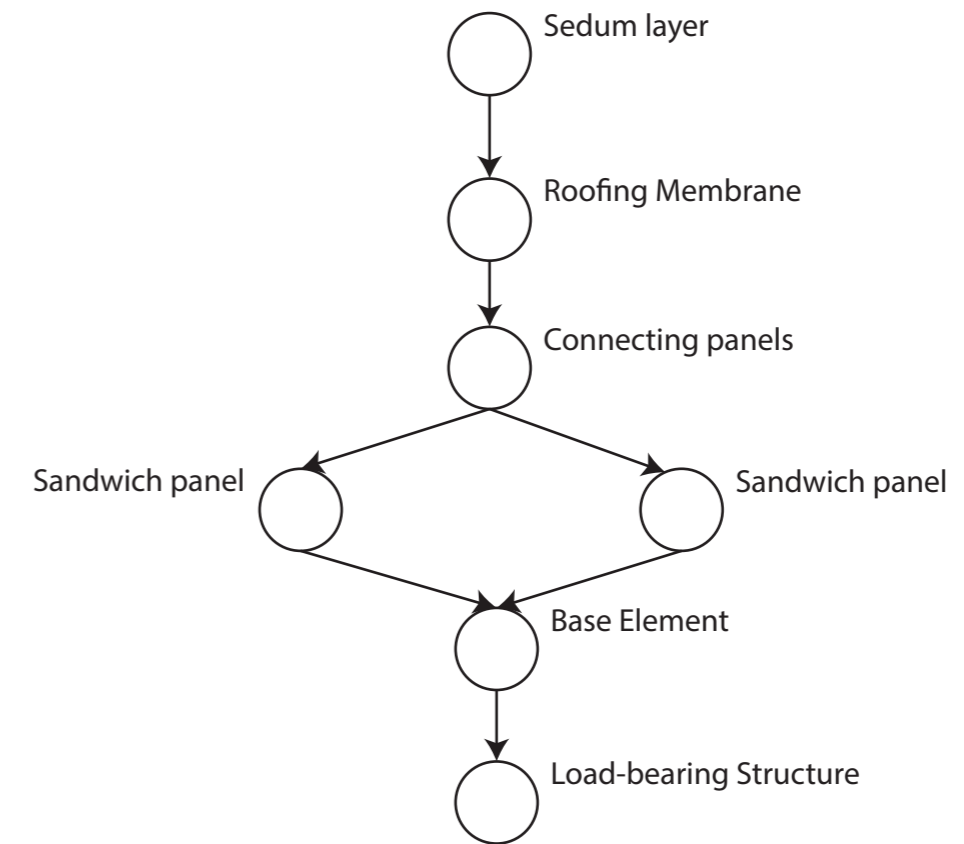




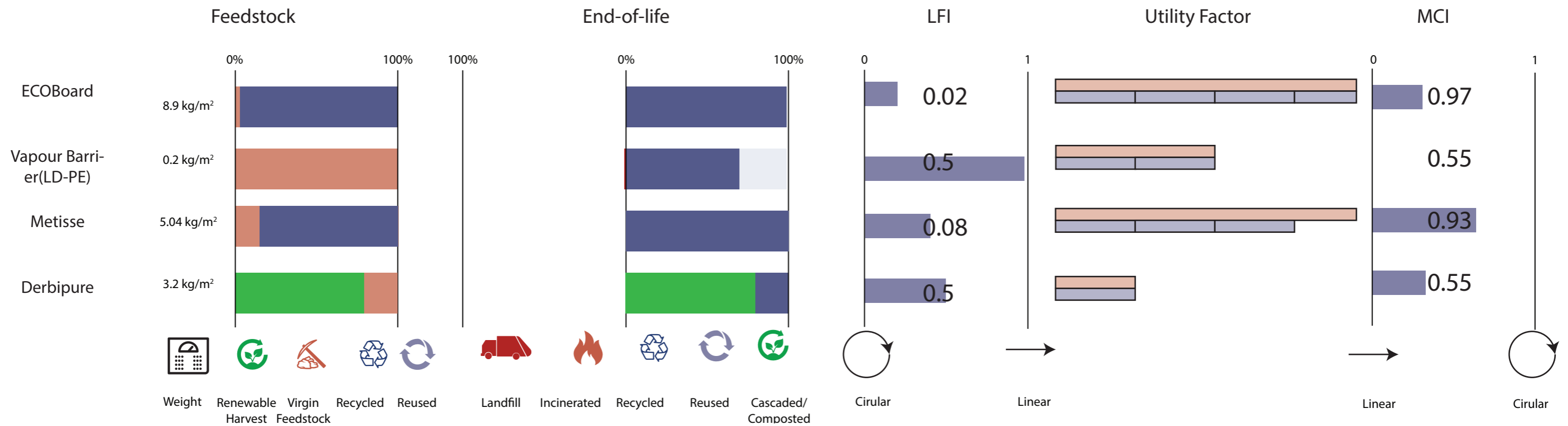


$ml = 0.8$

Clustering to functionality  
 $c = 1$



# Material Circularity



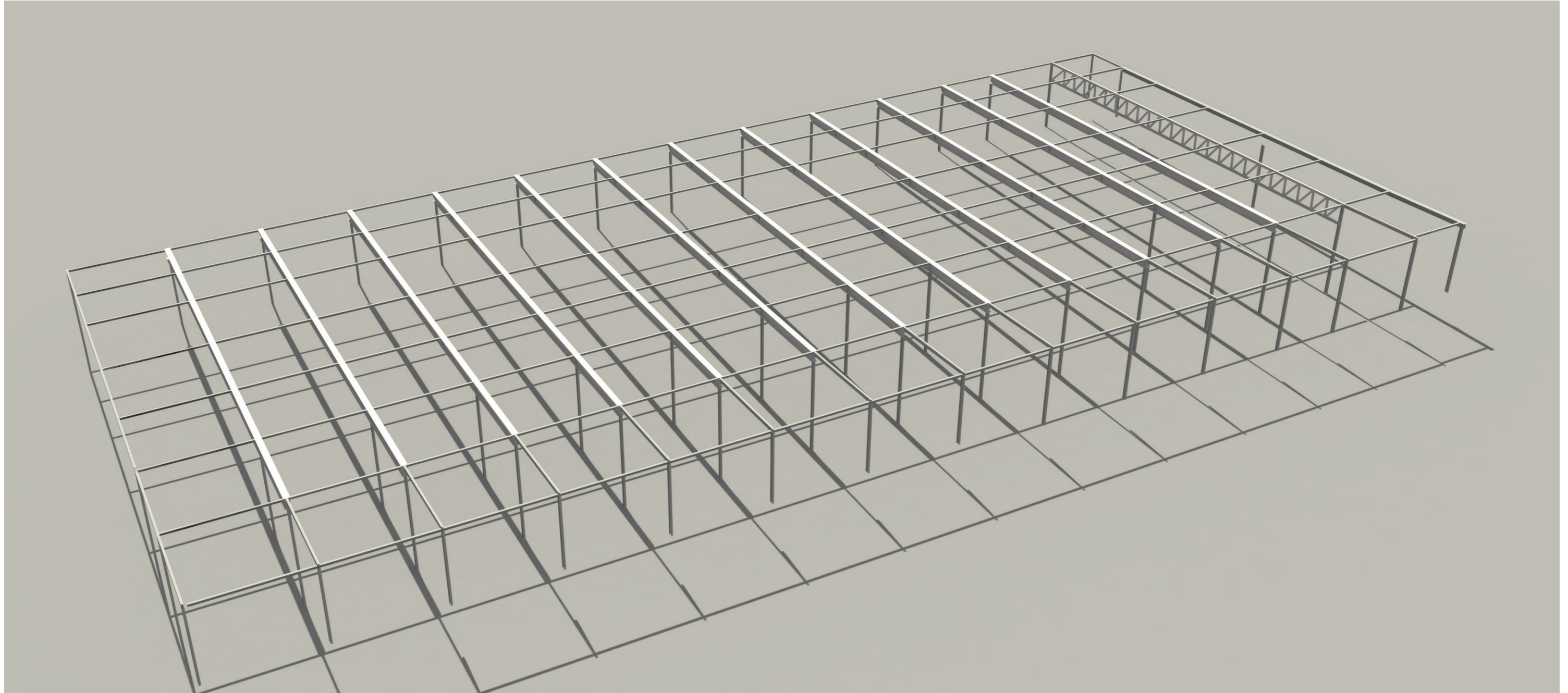
## Green redesign MCI

Total LFI = 0.37

Total MCI = 0.52

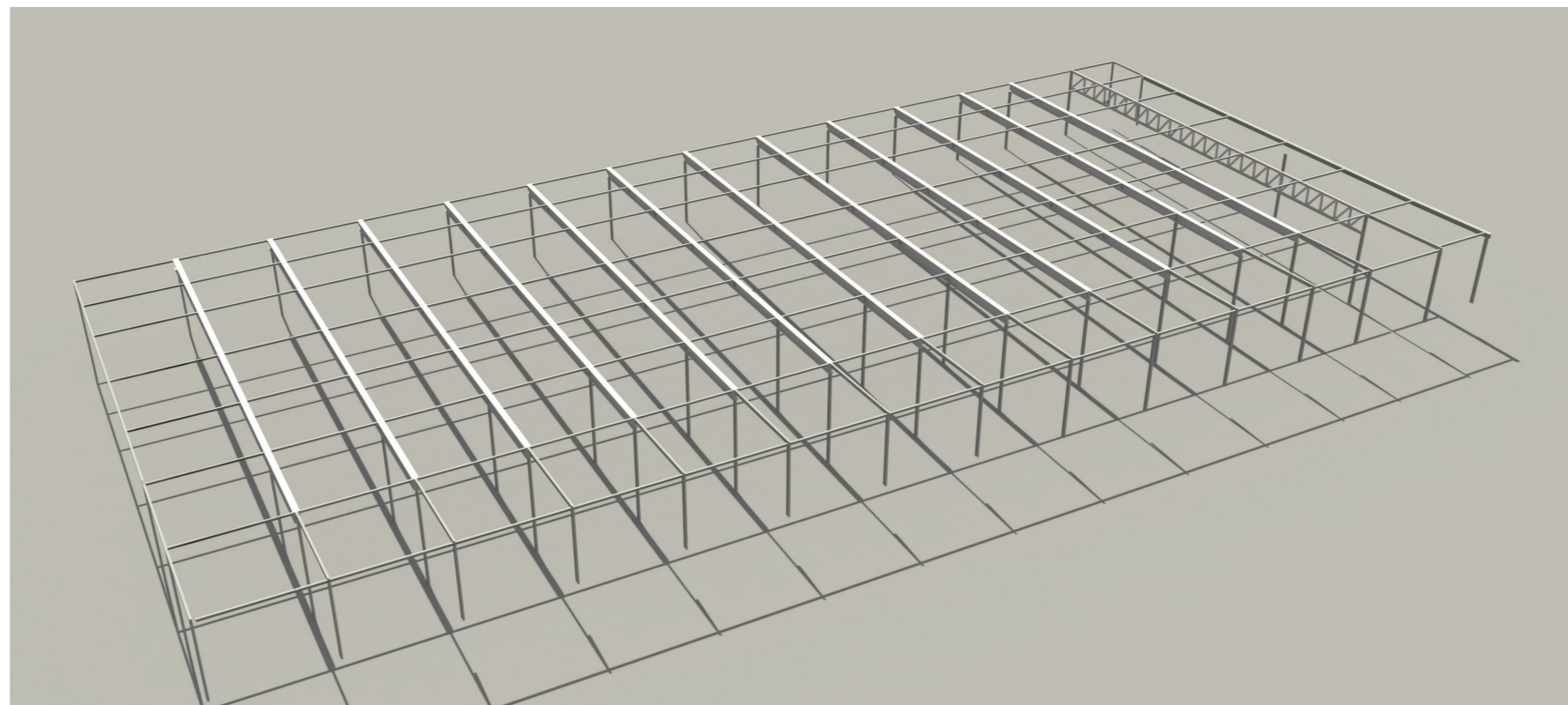
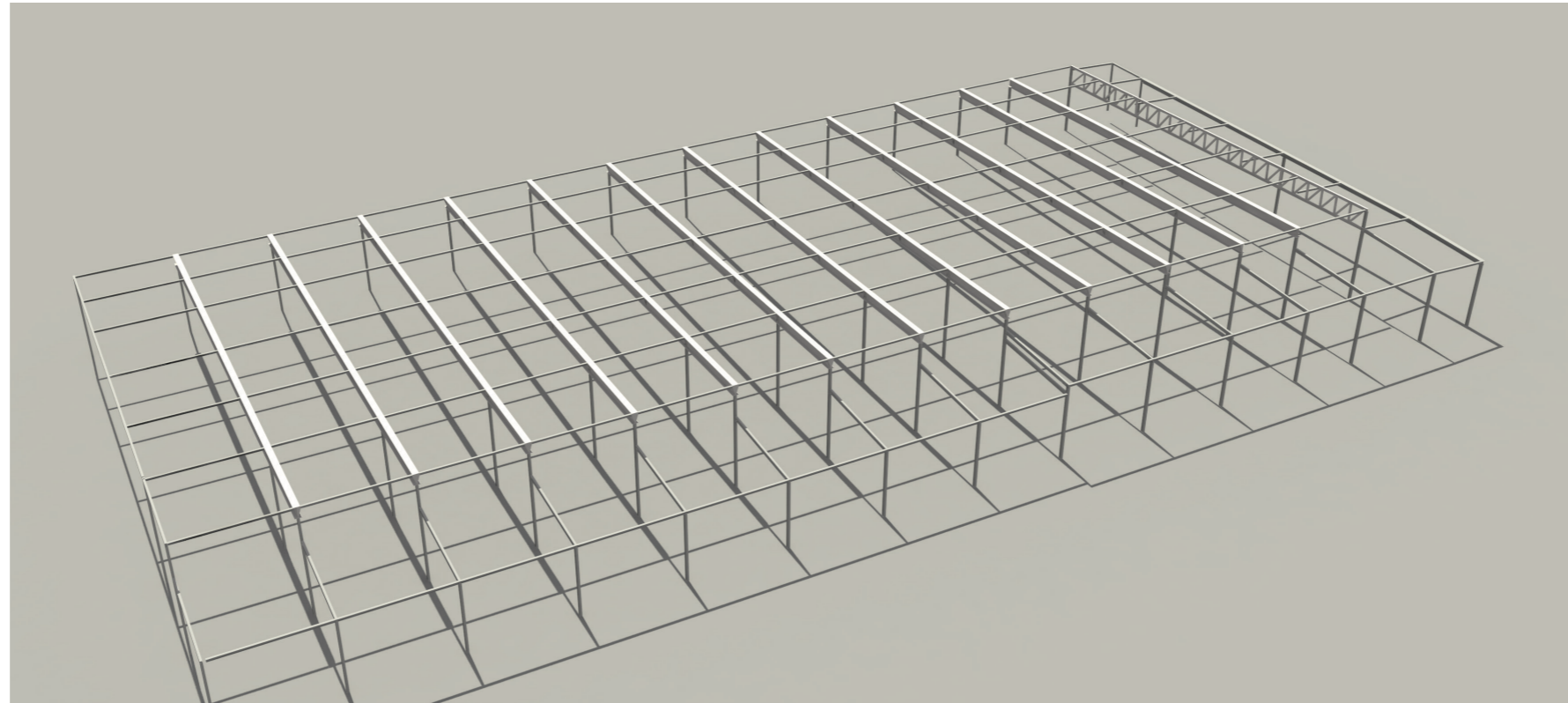
# Technical Redesign

## Technical



# Technical Redesign

## Make it generic



# Technical Redesign

## Original



PIR

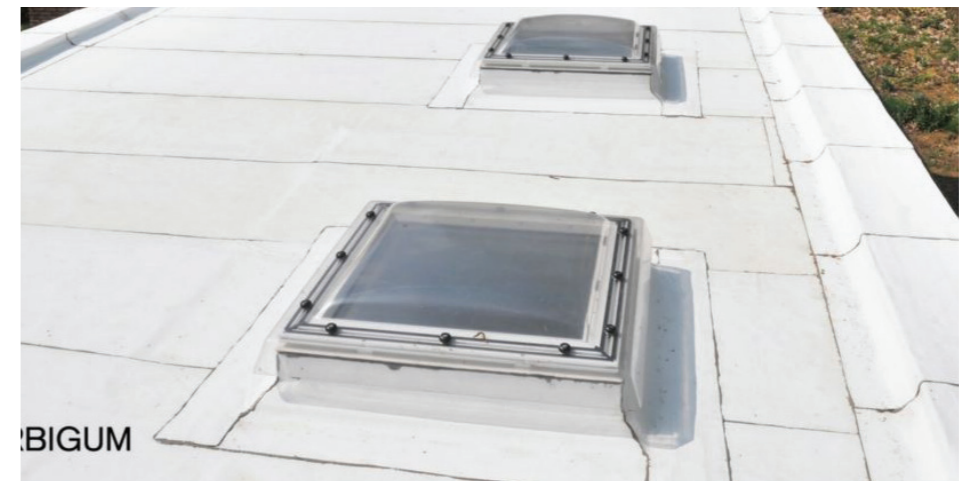
## Recyclable



Rockwool



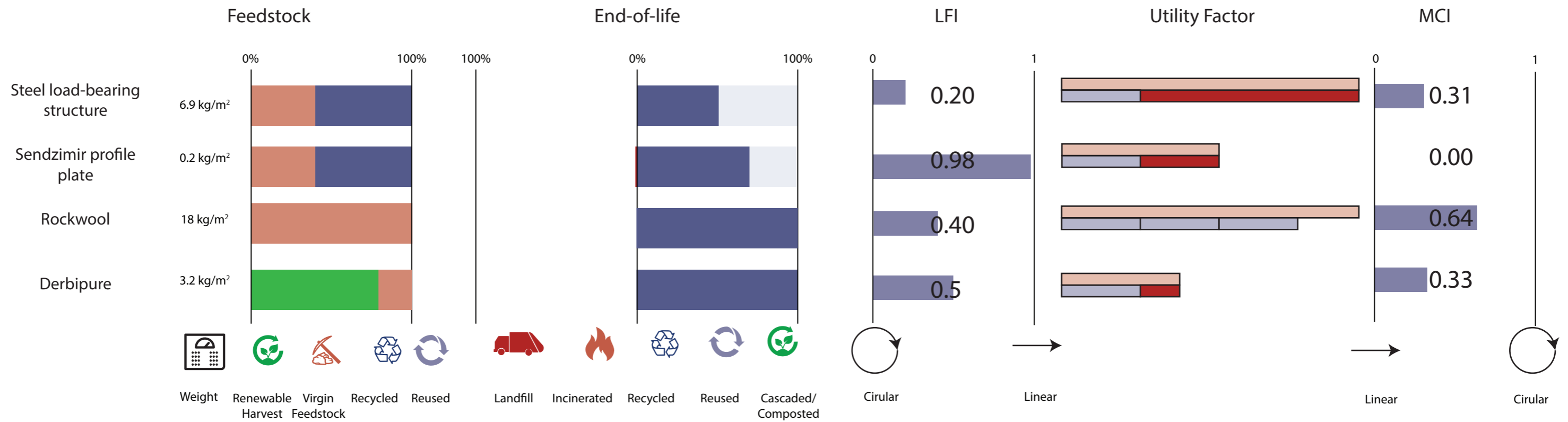
(FPO) Sarnafil 77 - 20



Derbipure



## Material Circularity



### Technical redesign MCI

Total LFI = 0.37

Total MCI = 0.52

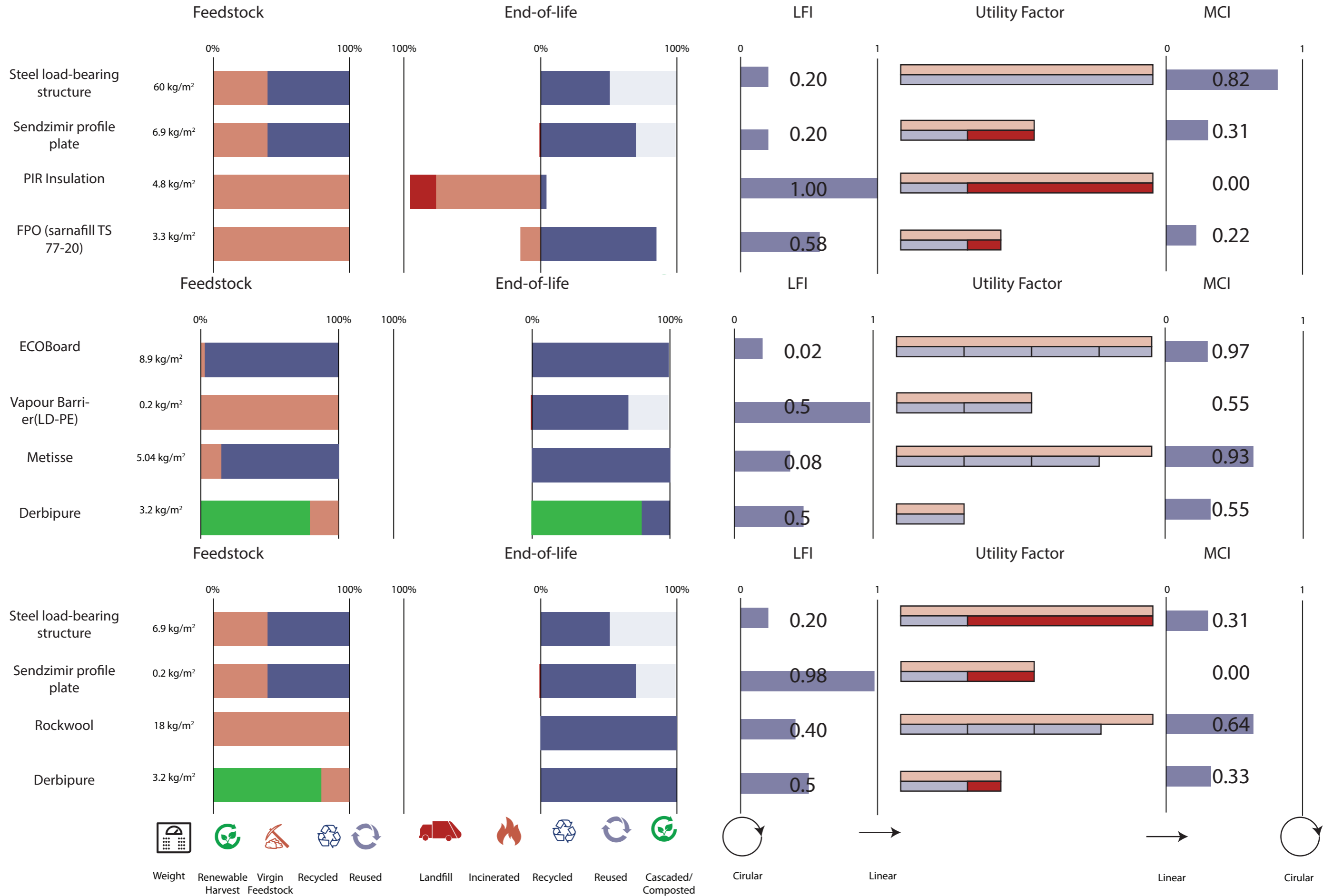
# Introduction Comparison

## Analysis

## Case study

## Redesign

## Reimplementation

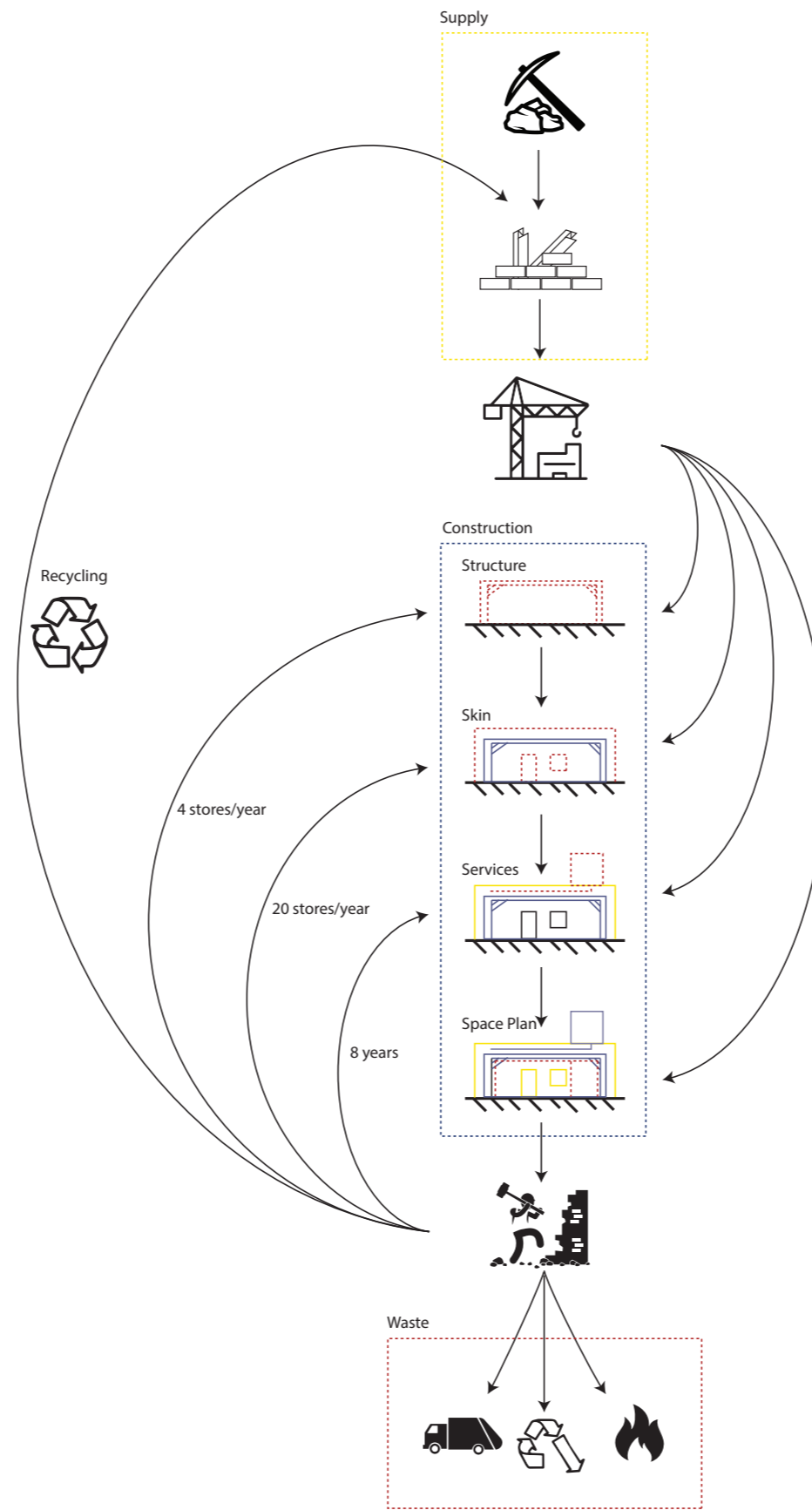


# Reimplementation

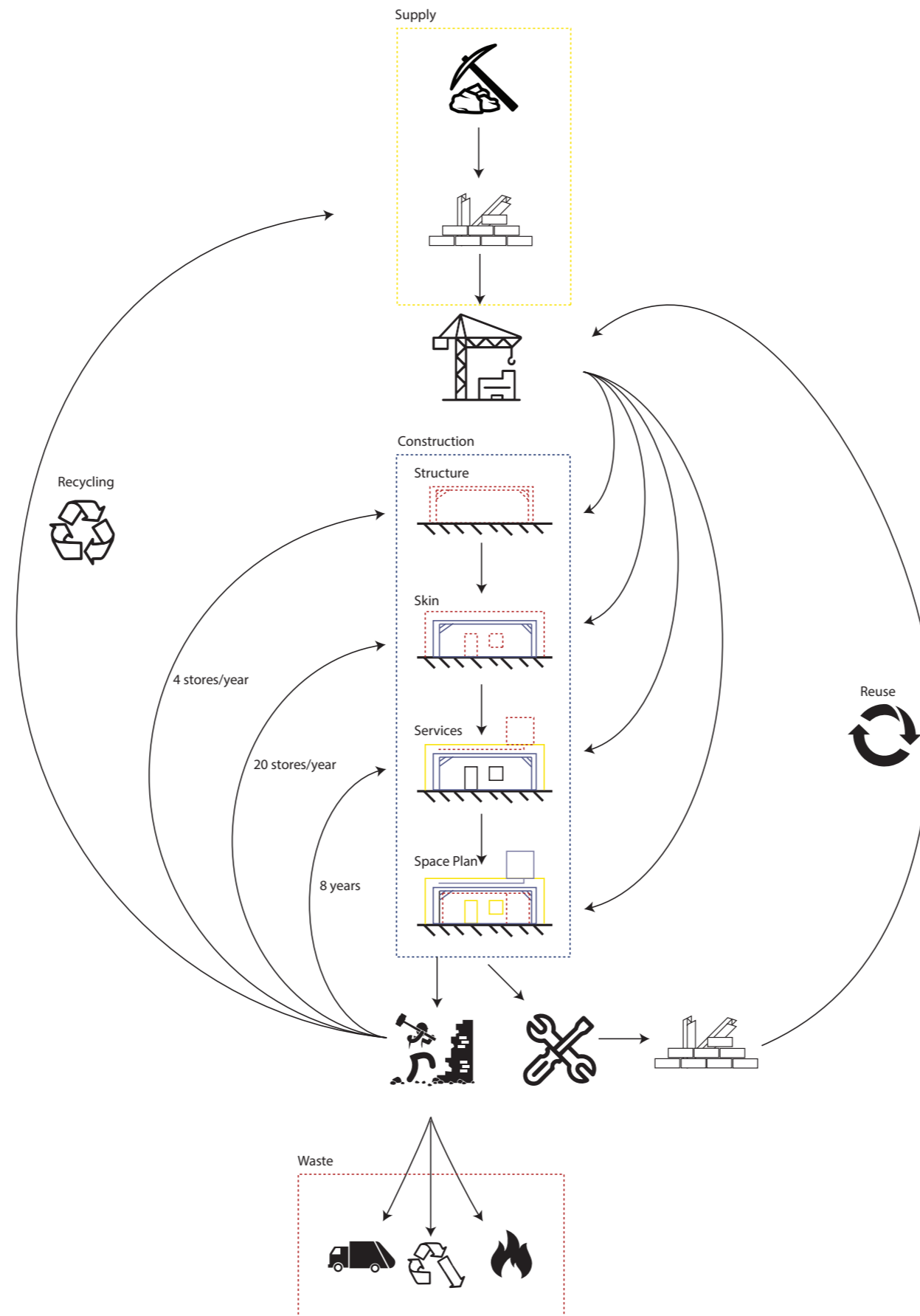
Which changes have to be made to make the Lidl's Specification circular, with an emphasis on materials and assembly?



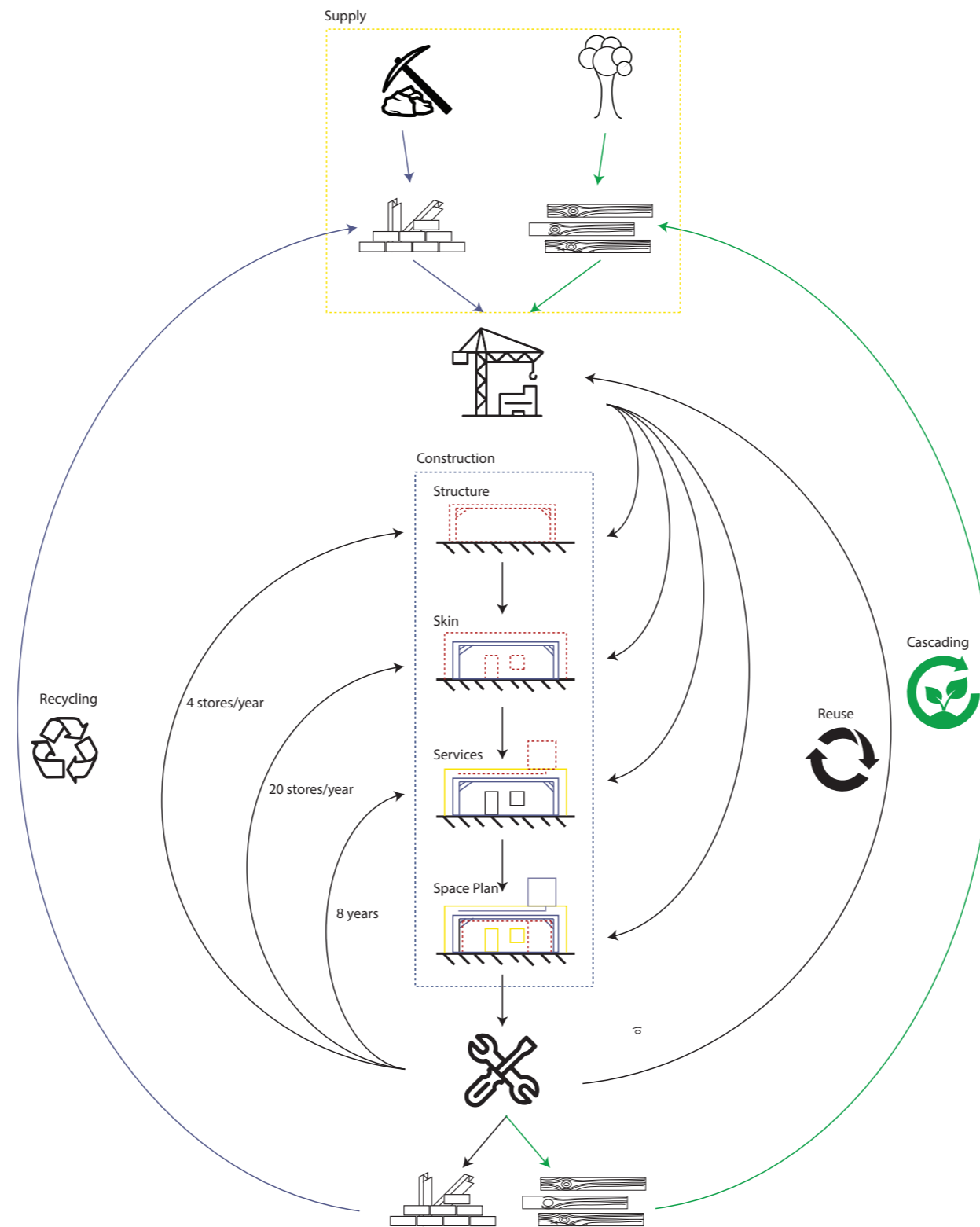
# Development strategy -linear



# Development strategy - reuse

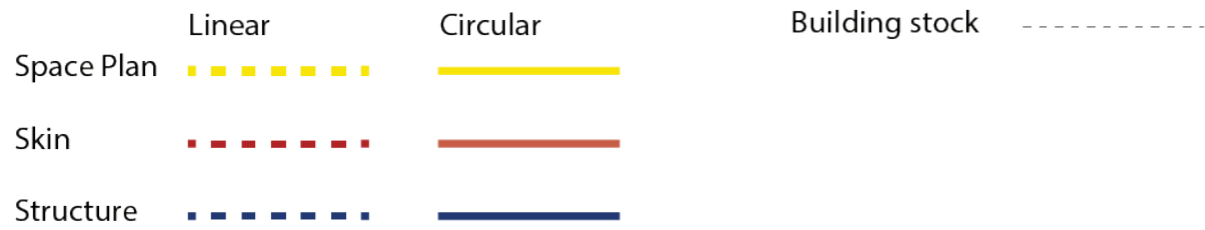
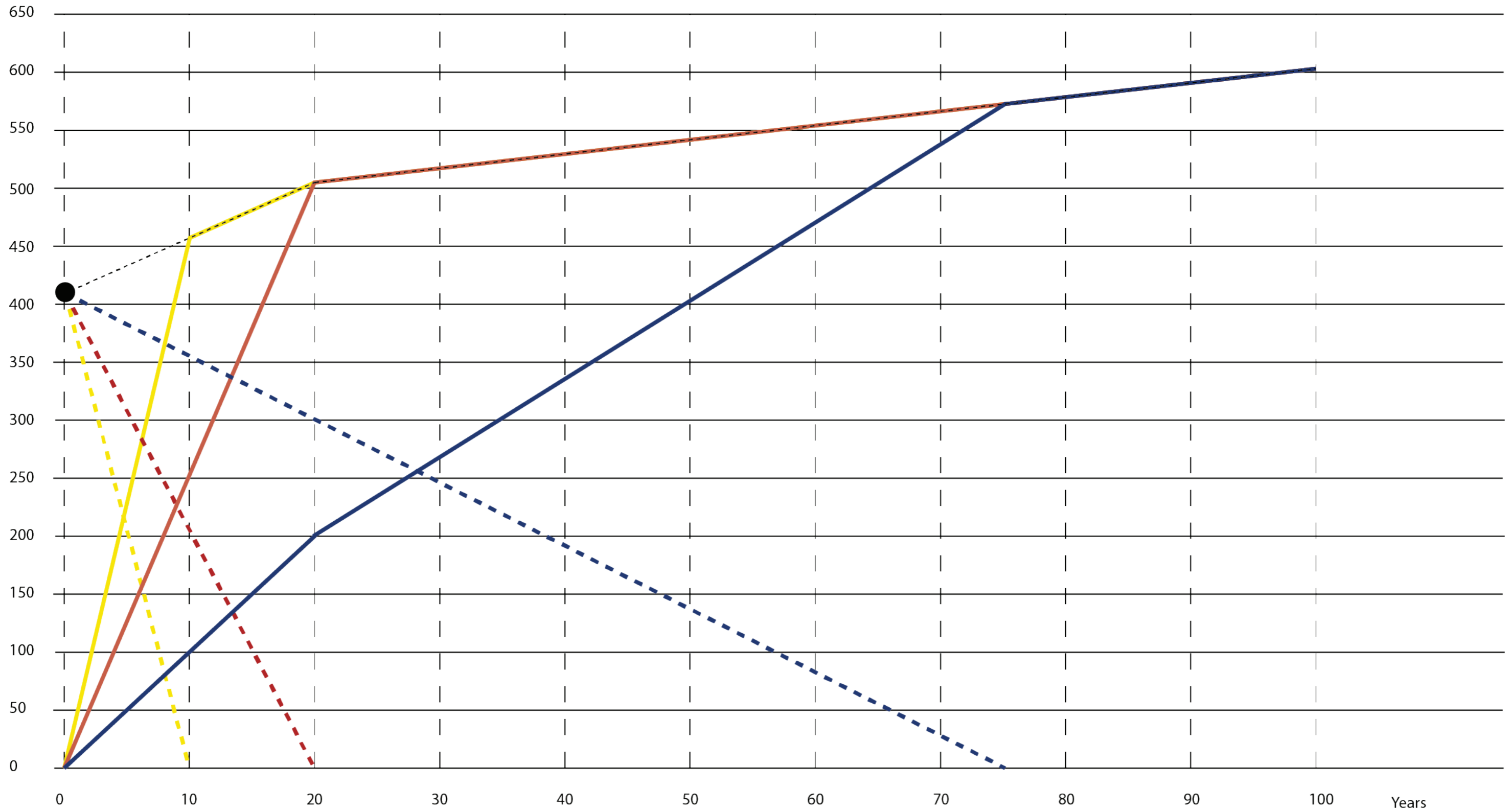


# Development strategy - fully circular



# Future

Amount of Stores



# Changes

- Non-circular materials to circular materials, which can be economically- recycled or are renewable.
- Enable reuse, remove static construction methods make all connections reversible.
- Make dimensions and connections generic
- Implement criteria from the Circularity Indicator to the Specification.
- Change the development strategy, reuse elements and components which are still performing at their technical

# Recommendation further research

## A full circular Assessment method

- Inclusion of emissions and the biological cycle

## Recycling Efficiency

- Economical recycling processes, which are there, how often employed?

## Economic viability

- How much value is actually saved, when will there be a return on investment?

## Lidl from construction waste

- - How long will it take before we can build a Lidl supermarket out of demolition and renovation waste?

## Supermarket in the Biological cycle

- The current design is fully in the technological cycle, I propose a step for the roof and load-bearing structure. How far can we actually get?

