

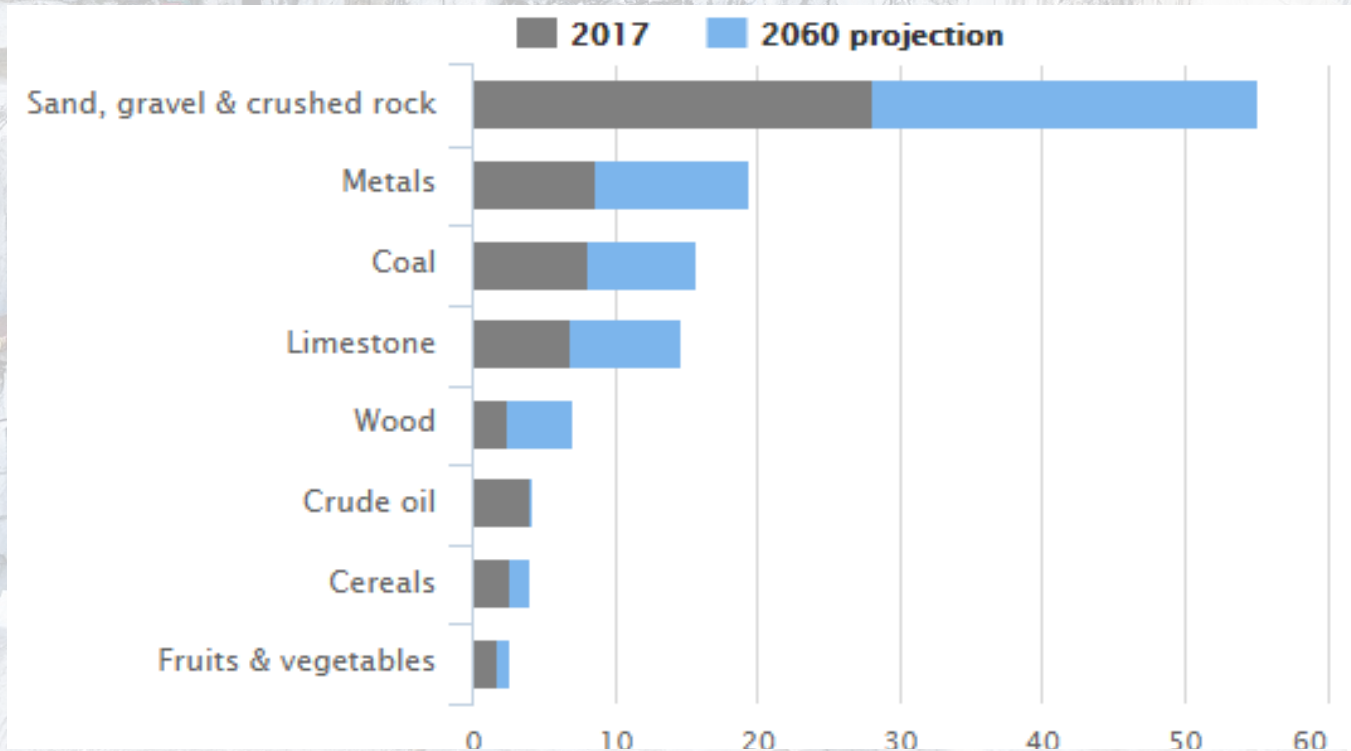
An isometric architectural illustration of a city. In the center is a large, multi-story building with a flat roof and a grid of windows. Surrounding it are various other buildings, including smaller houses and larger commercial structures. The scene is set on a grid of streets, with some areas highlighted in a lighter shade of pink. The overall style is clean and modern, with a focus on geometric forms and perspective.

FACADE REVERSE LOGISTICS

Achieving circularity by application of reverse logistics strategies for curtain walls & window façade constructions

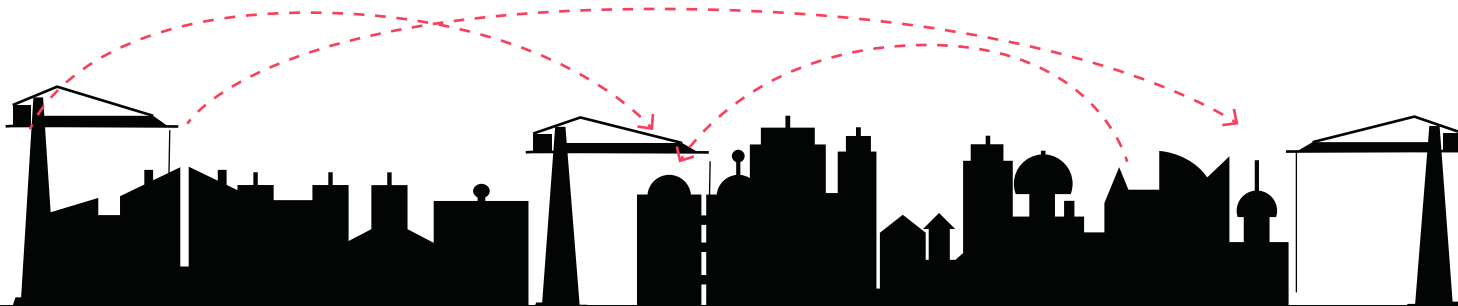
Javier Montemayor

PROBLEM



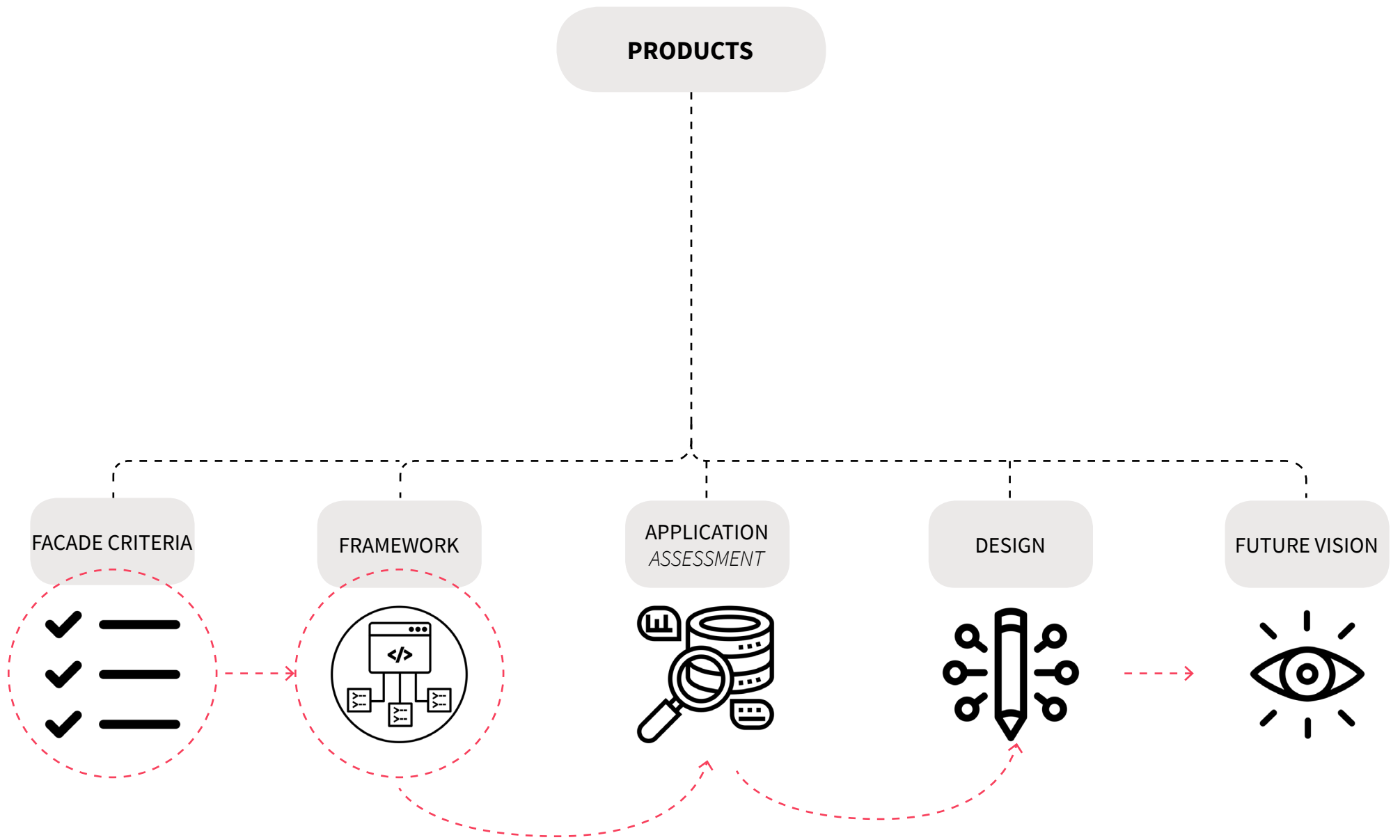
Resource consumption in Gigatonnes by OECD (2018)

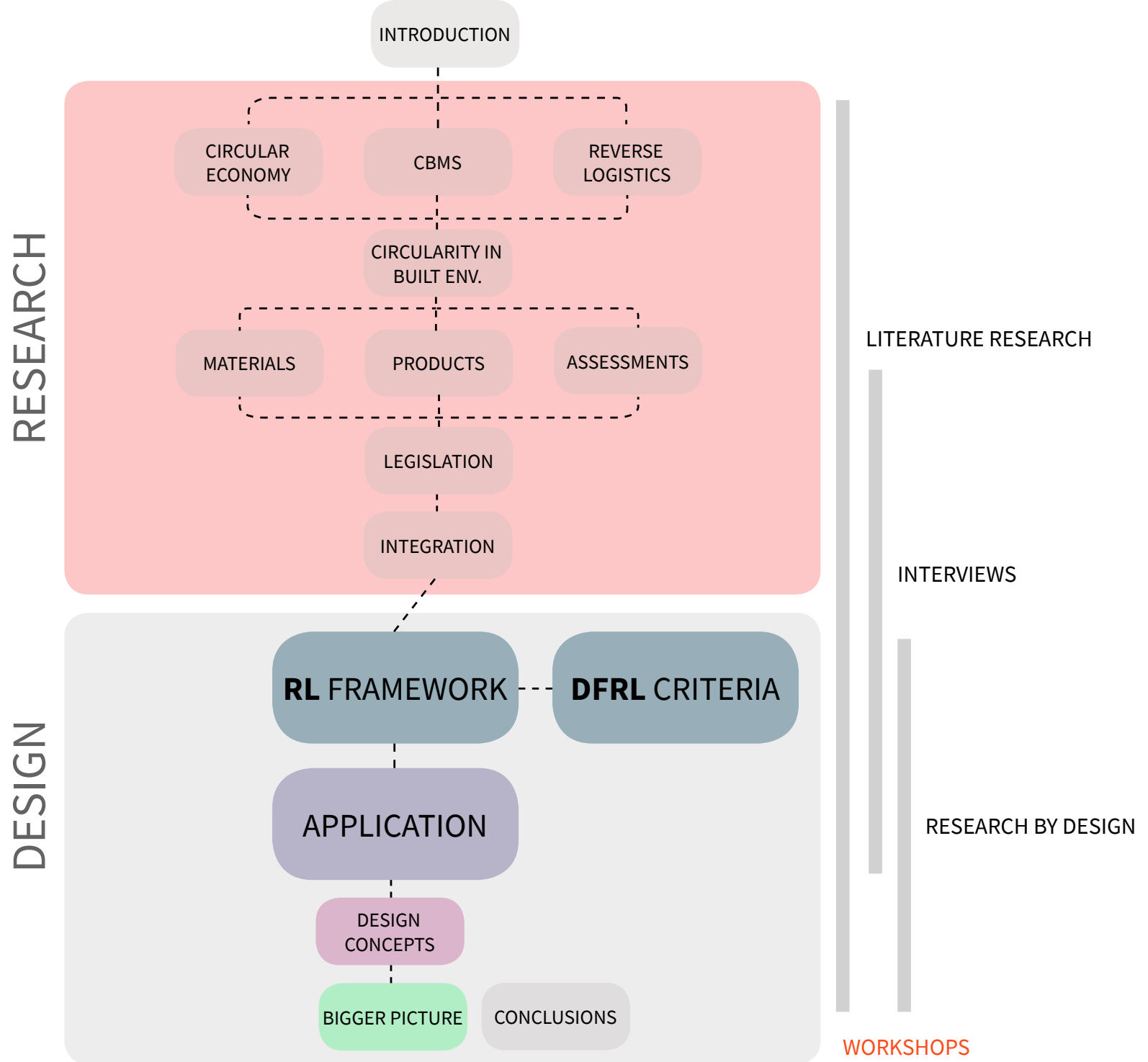
How can the construction industry be ready to implement a **reverse logistics** for façade products and what factors need to align for a smooth transition?

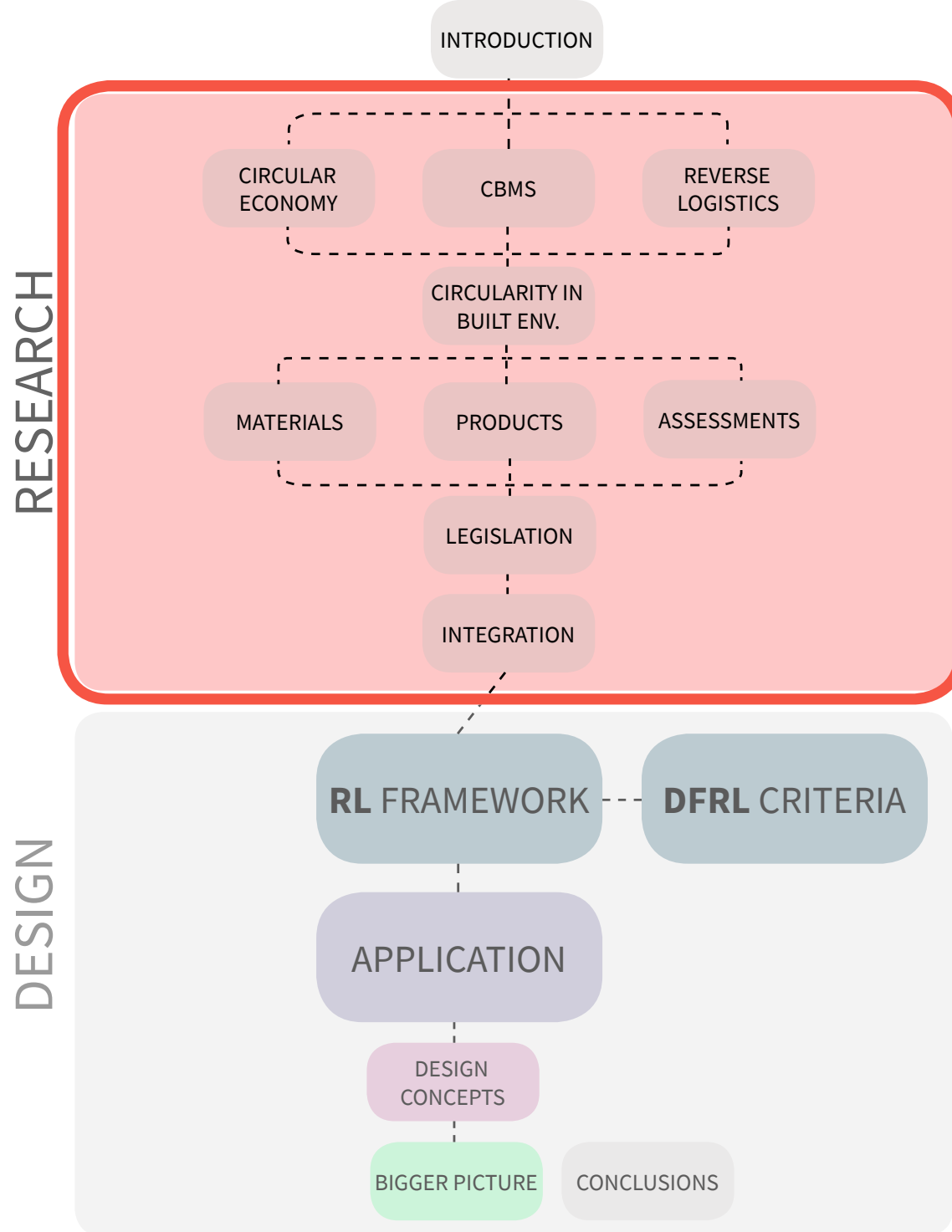


How can the CITG window-wall façade panel proposed be improved to accommodate a **reverse logistics** process?

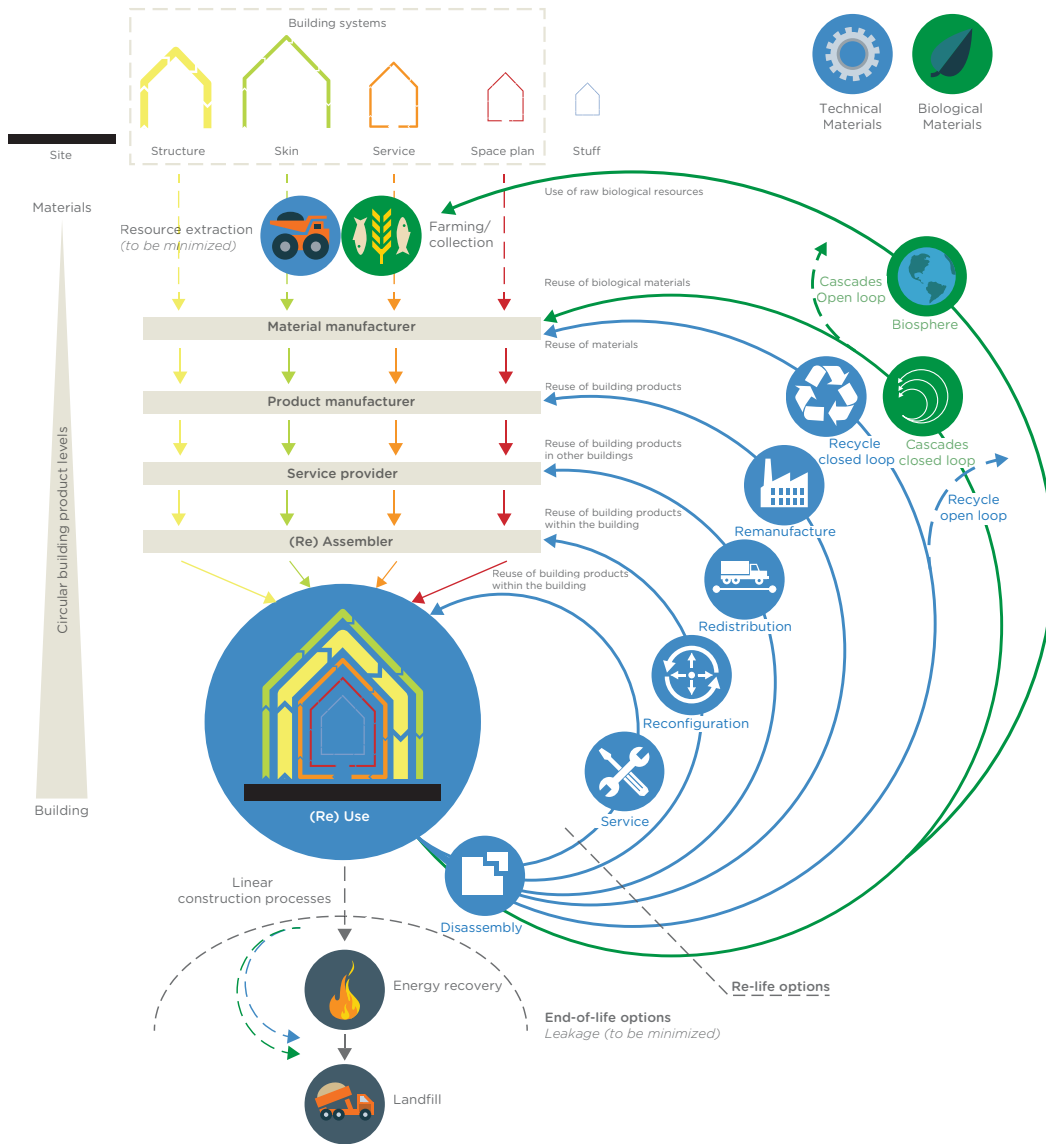






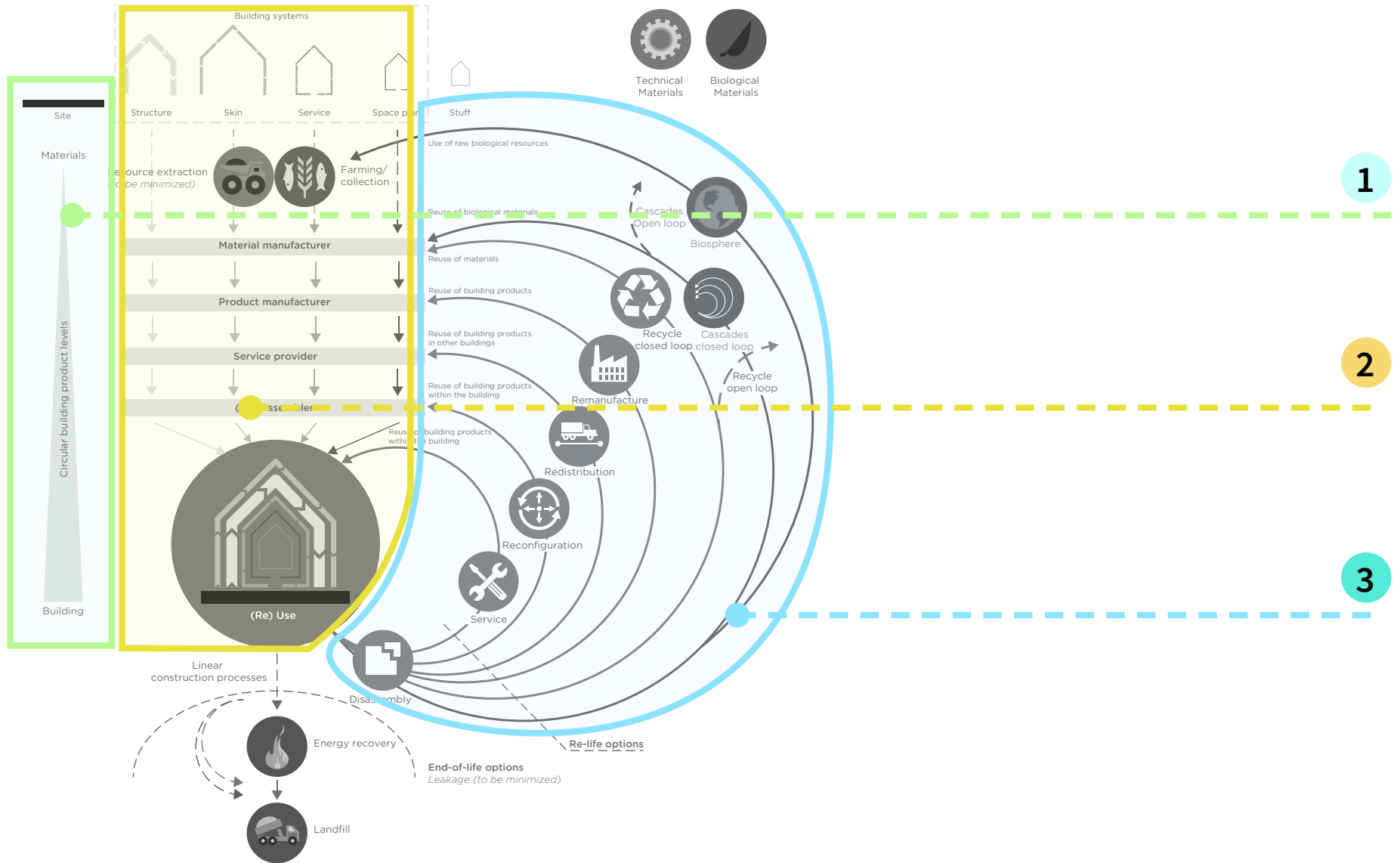


CIRCULARITY



BUILDING CONSTRUCTION MODEL B&B (2015)

CIRCULARITY



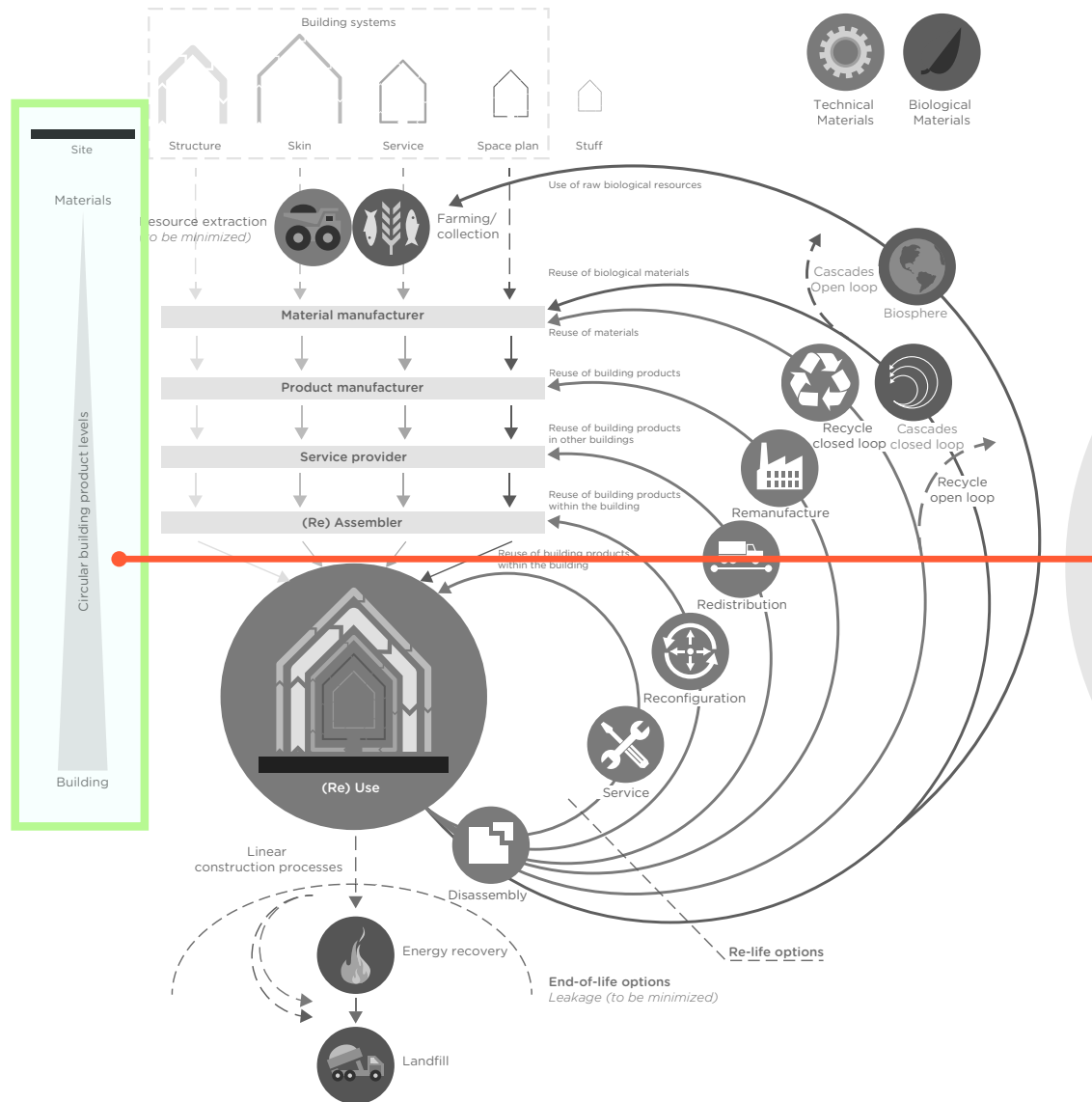
Technical Materials

Biological Materials

The diagram illustrates five concentric circles representing different scales of urban planning, from the most granular to the most regional:

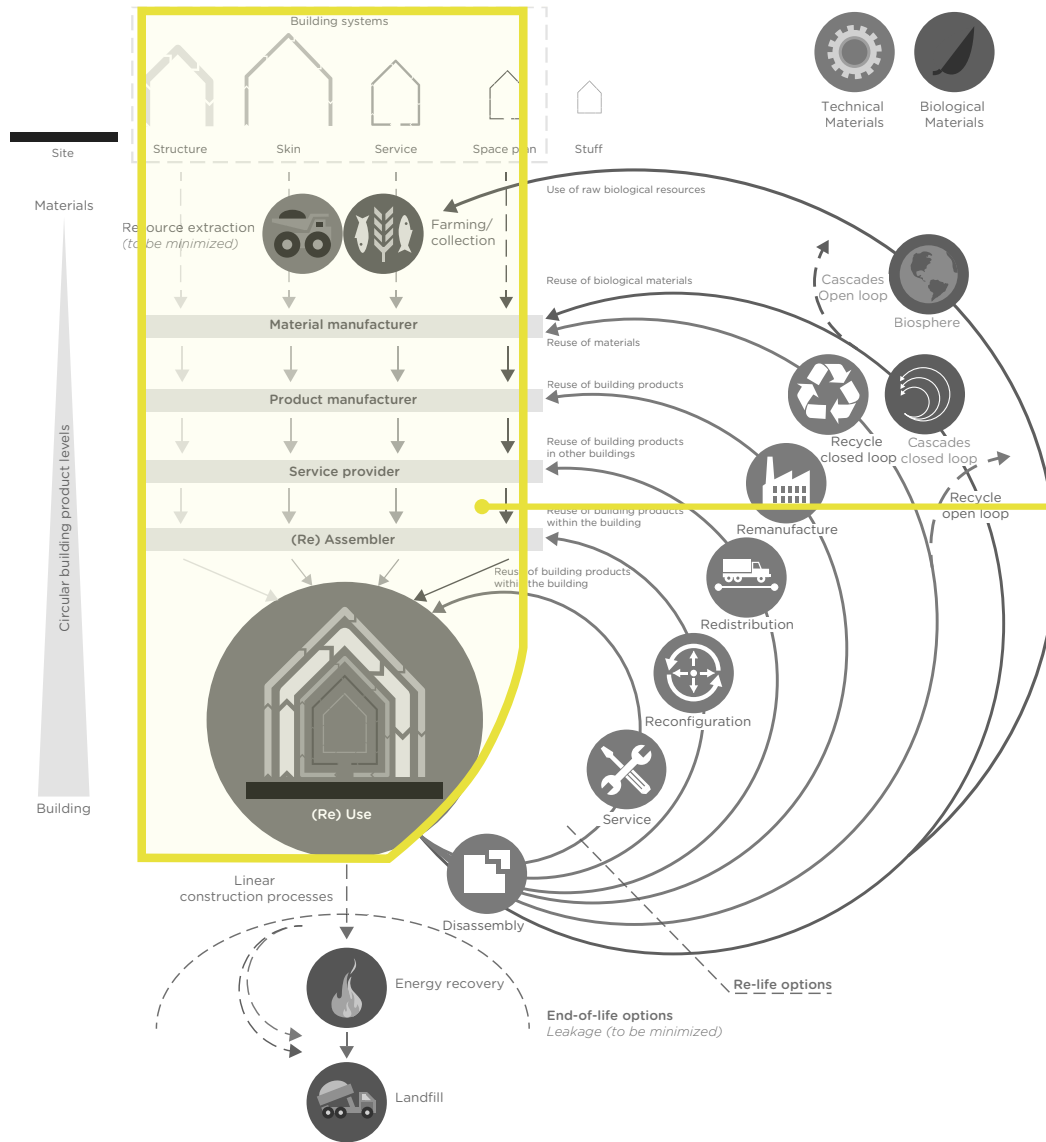
- REGIONS** (outermost circle)
- CITIES**
- BUILDINGS**
- PRODUCTS**
- MATERIALS** (innermost circle)

A dashed arrow points from the center towards the top right. Three orange arrows point from the right towards the circles, labeled **STRATEGY**, **DESIGN**, and **MATERIAL**. A yellow circle is located on the boundary between the **PRODUCTS** and **BUILDINGS** scales.

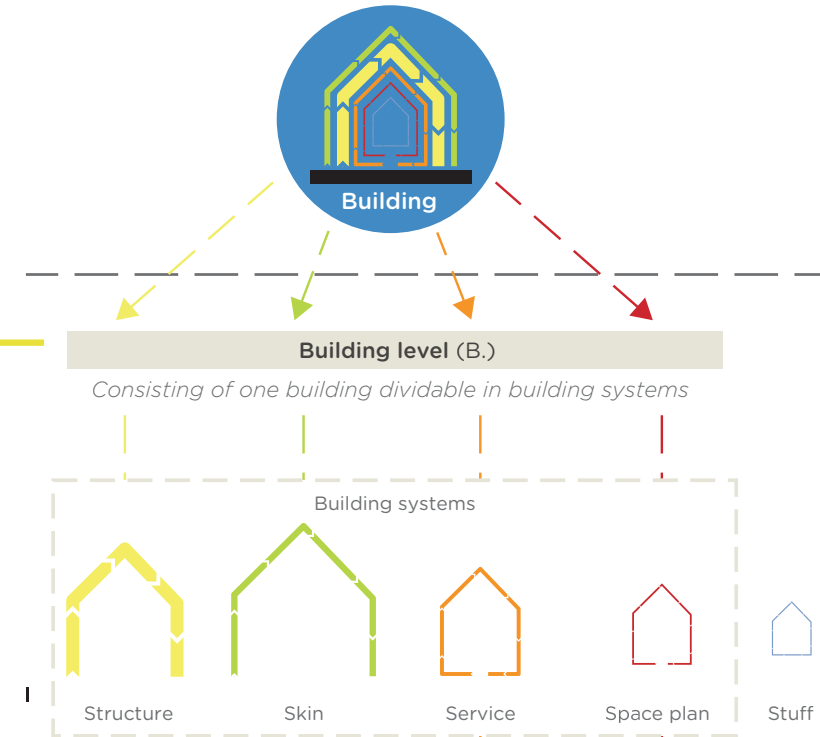


CIRCULARITY LEVELS BY KLEIN (2019)

CIRCULARITY

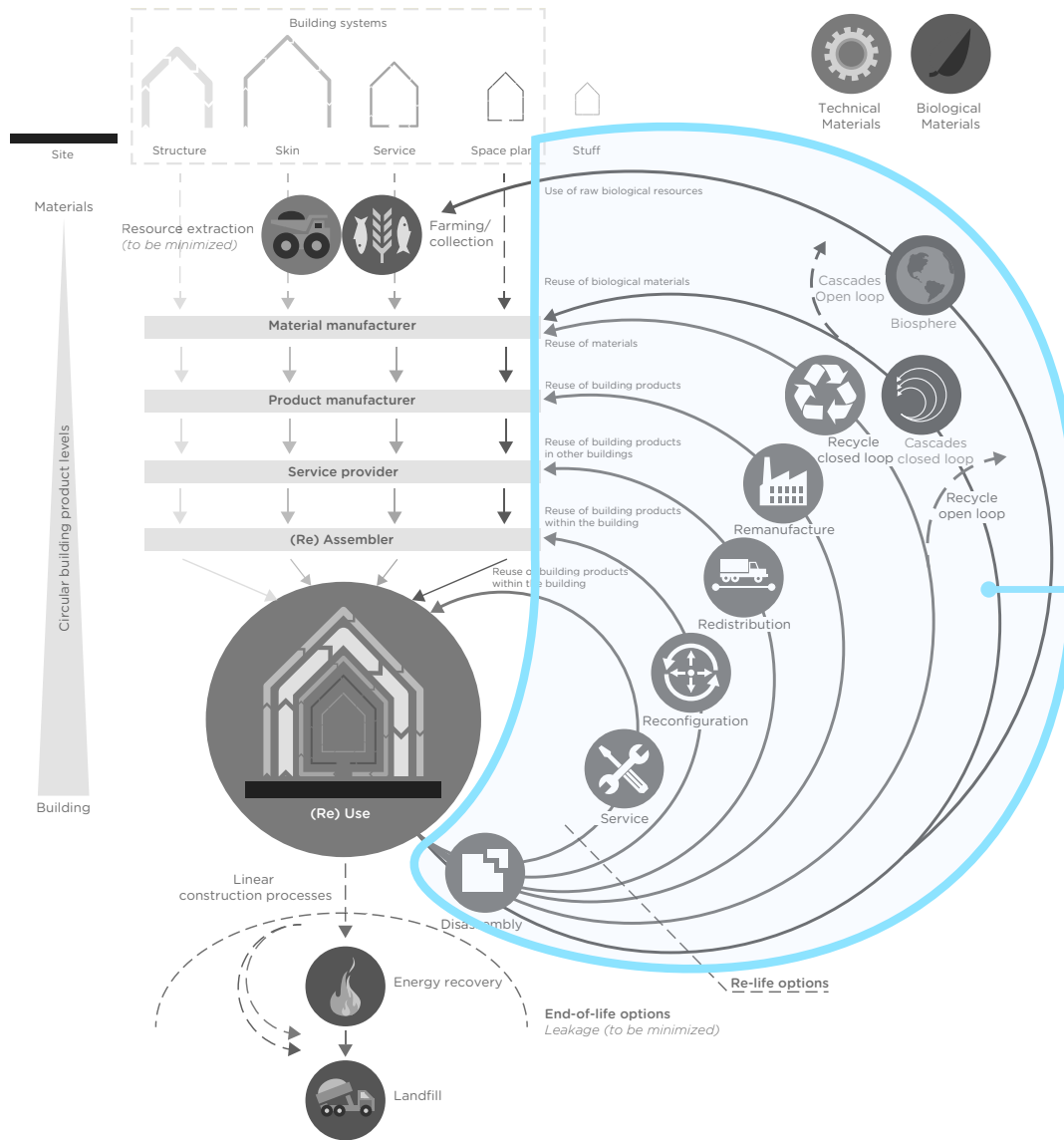


2 BUILDING SYSTEMS & PROCESS

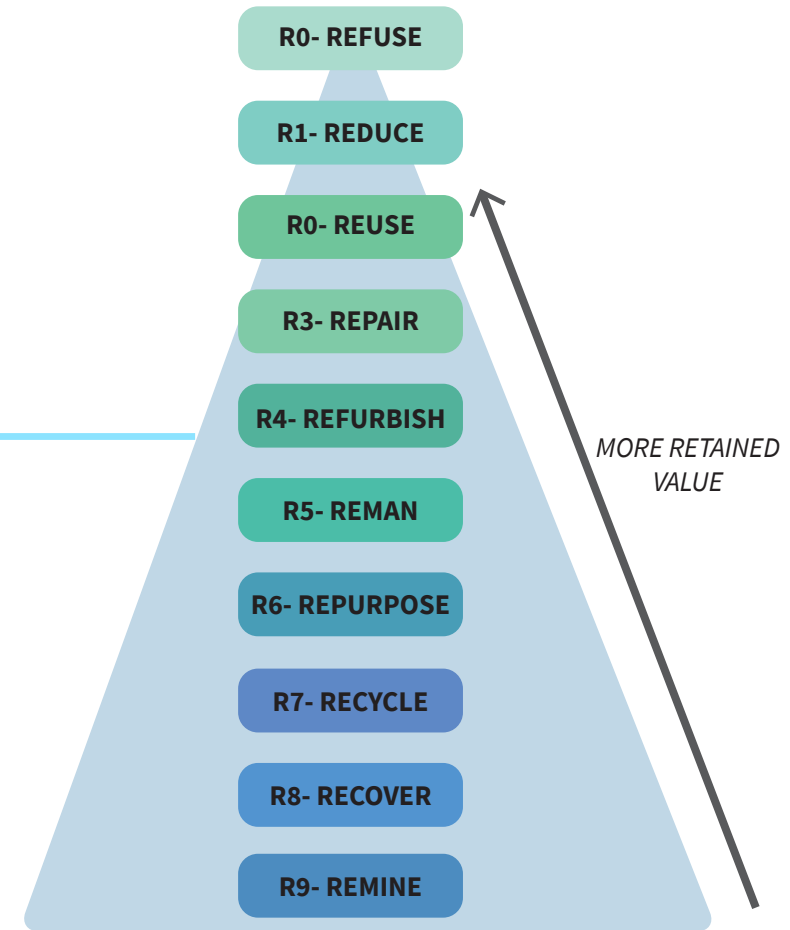


BUILDING LAYERS BY BRAND (1994)

CIRCULARITY

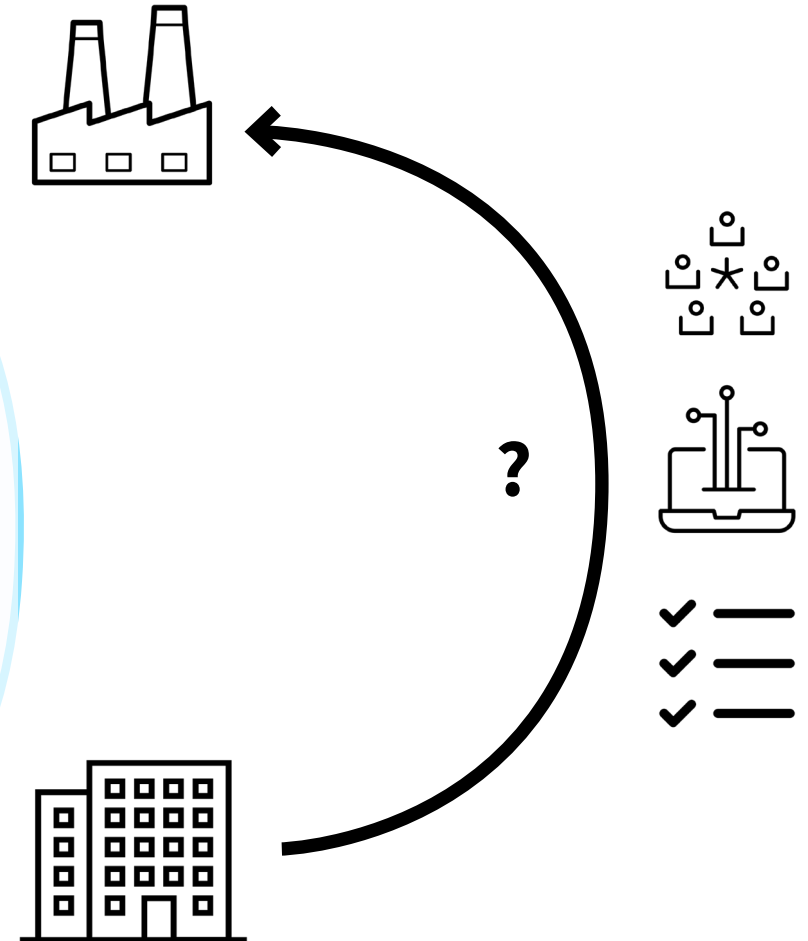
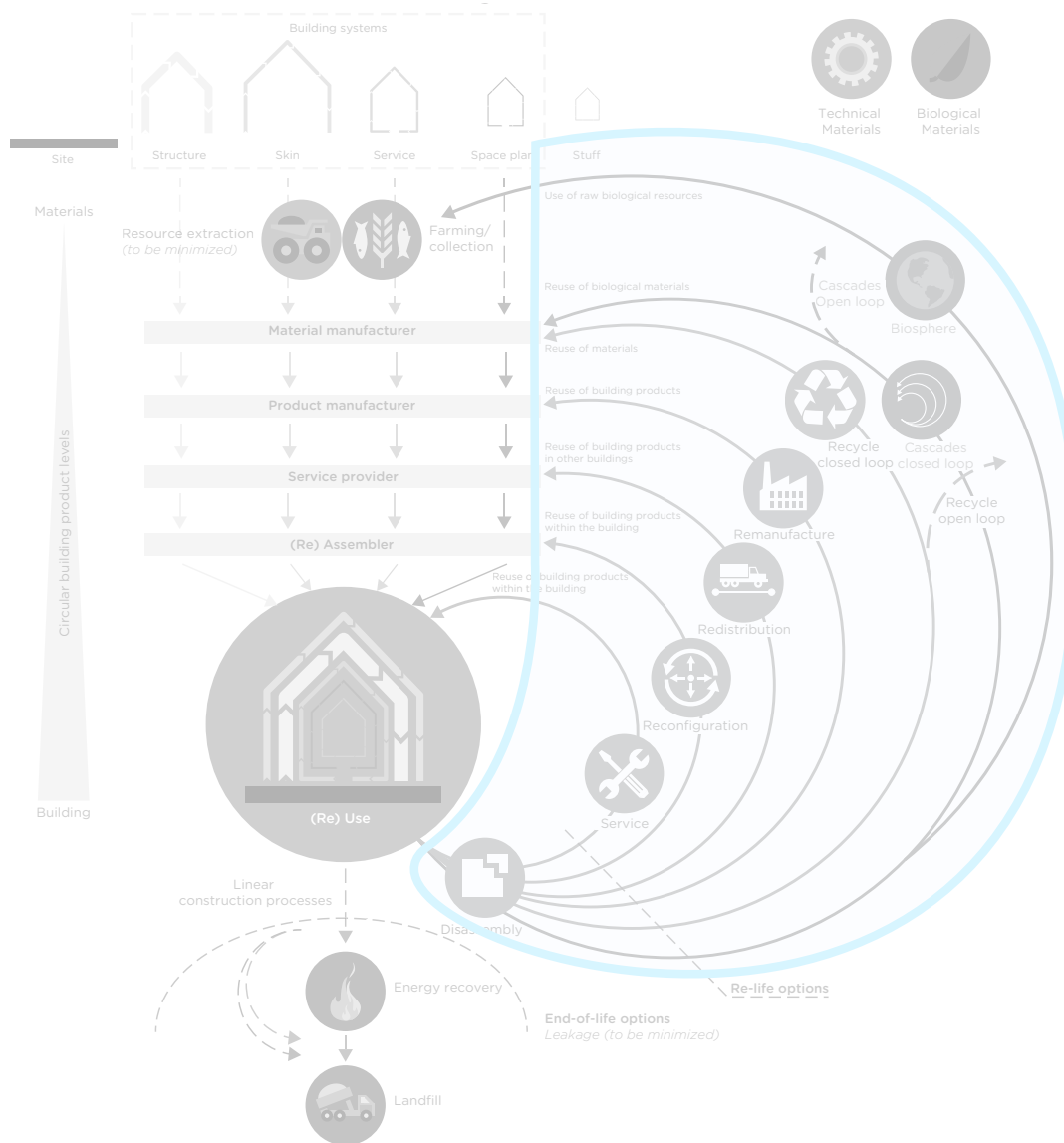


3 RE-LIFE OPTIONS



RE-LIFE OPTIONS ACCORDING TO REIKE, VERMEULEN, & WITJES (2018)

REVERSE LOGISTICS



REVERSE LOGISTICS

WHAT HAPPENS BETWEEN **CONSUMPTION**
POINT BACK TO **MANUFACTURING POINT**
 (C2B)

REVERSE LOGISTICS



Cost saving



Better reputation



Revenue



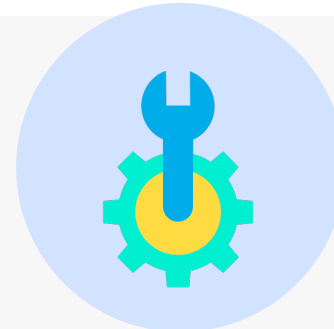
Less pollution



Less impact



Social responsibility



Lack of proper design



Lack of facilities



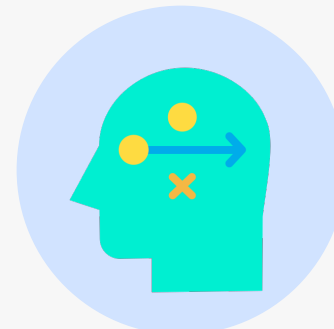
Tight scheduling



Lifecycle of buildings



Lack of standards



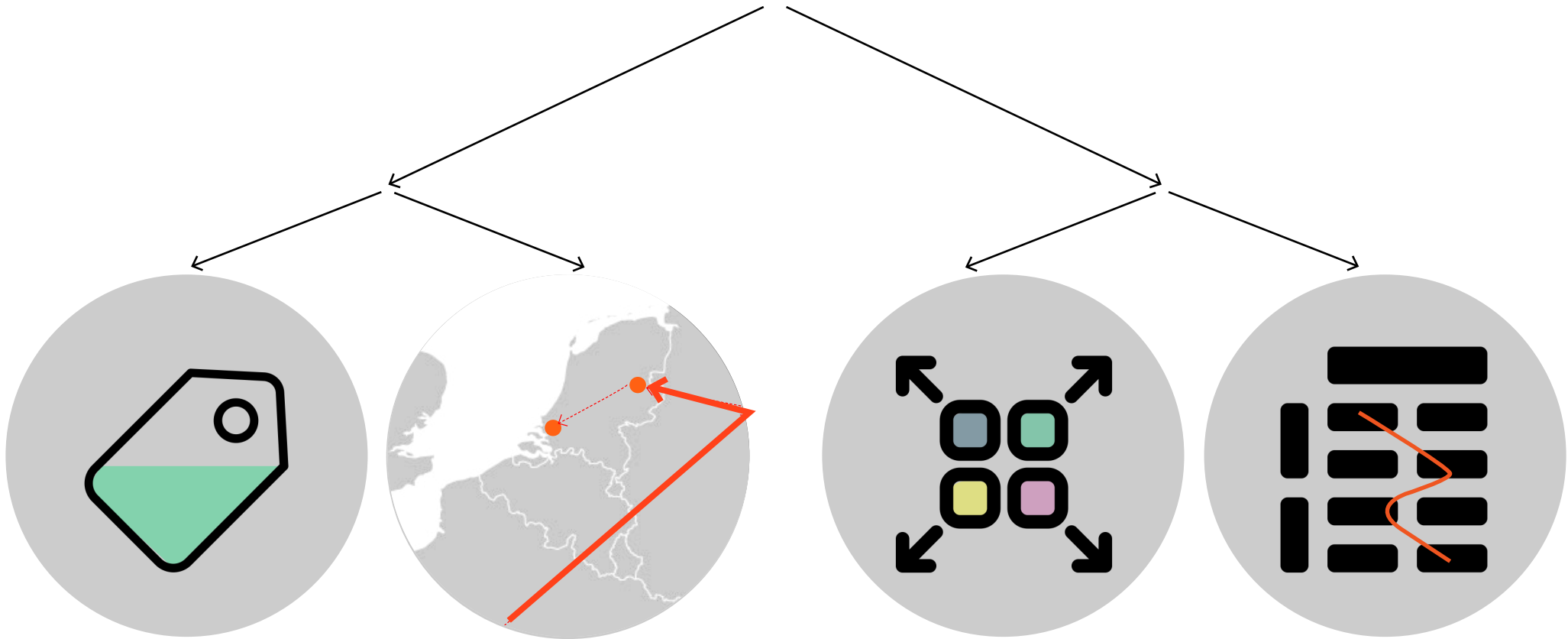
Excessive efforts

OPPORTUNITIES

BARRIERS

ASSESSMENTS

HOW TO ASSESS CIRCULARITY?



MCI

MATERIAL CIRCULARITY INDEX



MFA

MATERIAL FLOW ANALYSIS



DfD

DISSASSEMBLY POTENTIAL



MDEM

MORPHOLOGICAL MATRIX



MS with mature legislation

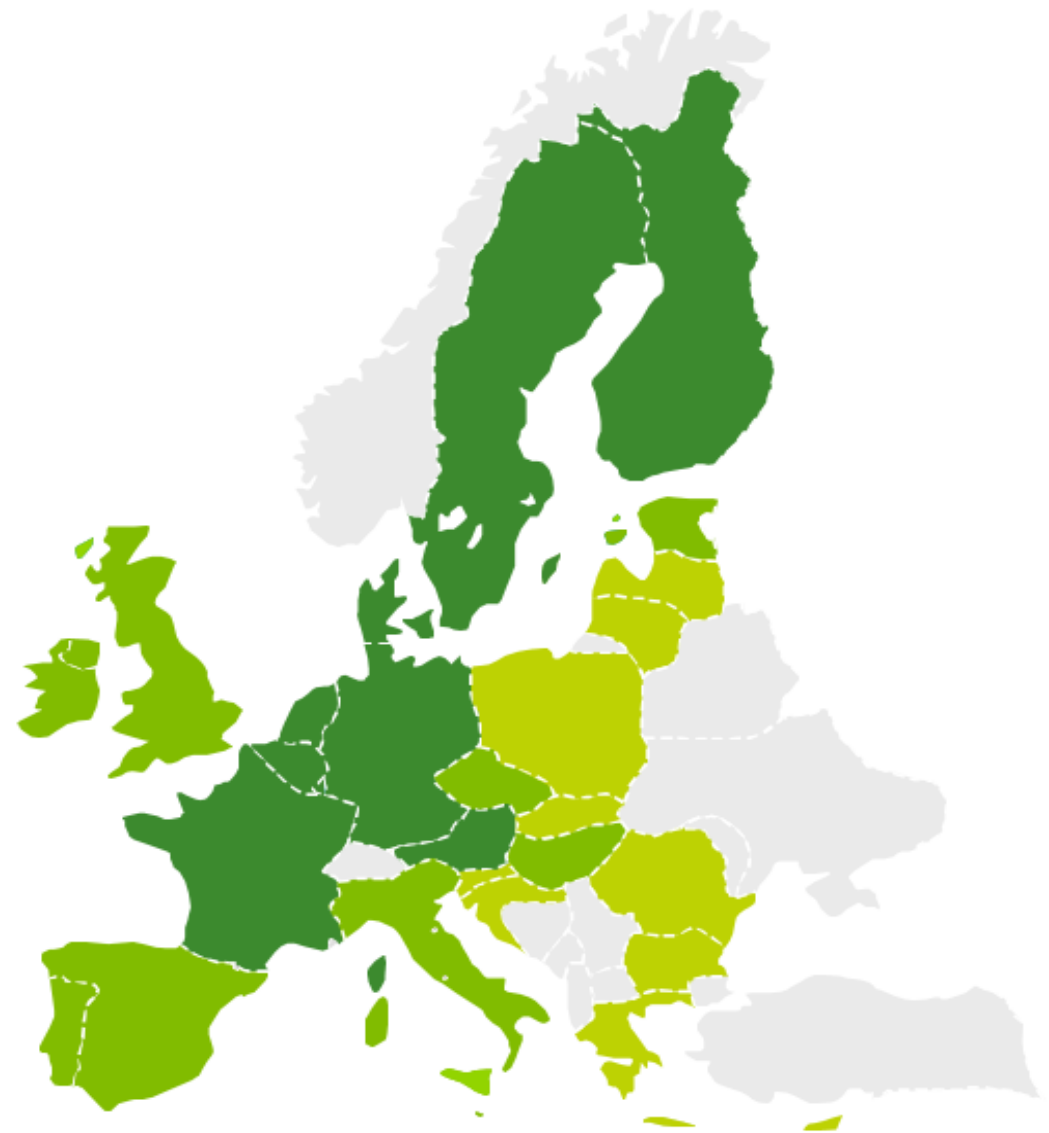
Austria
Belgium
Denmark
Finland
France
Germany
Luxembourg
Netherlands
Sweden

MS with advanced legislation

Czech Republic
Estonia
Hungary
Ireland
Italy
Malta
Portugal
Spain
United Kingdom

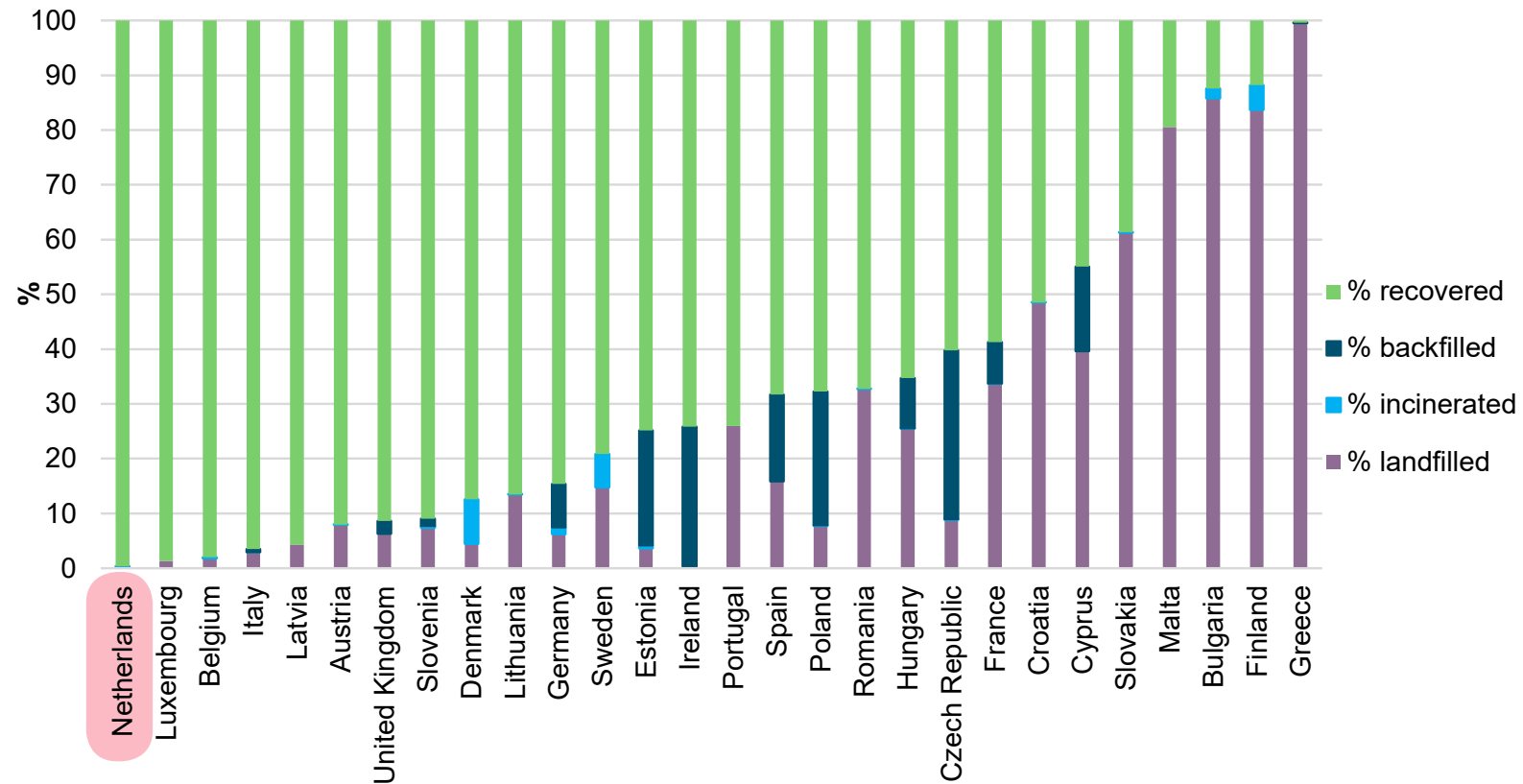
MS with developing legislation

Bulgaria
Croatia
Cyprus
Greece
Latvia
Lithuania
Poland
Romania
Slovakia
Slovenia



MATURITY IN CDW LEGISLATION (DELOITTE 2017)

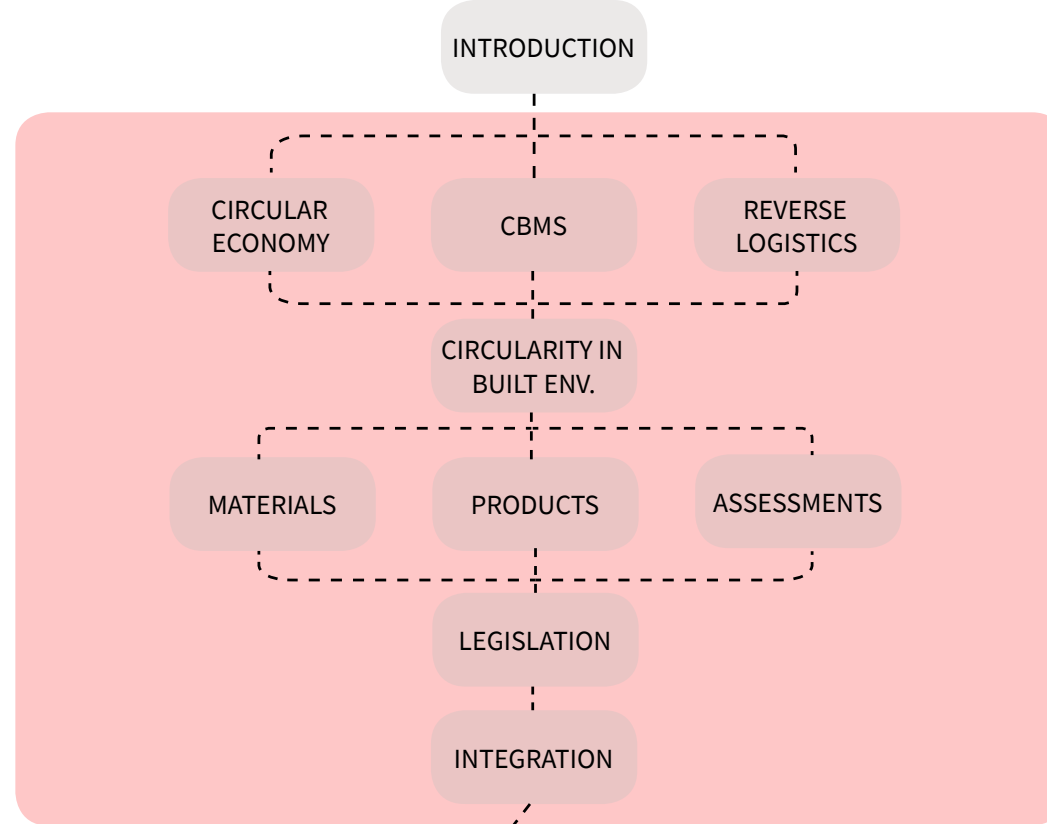
***LEGISLATION



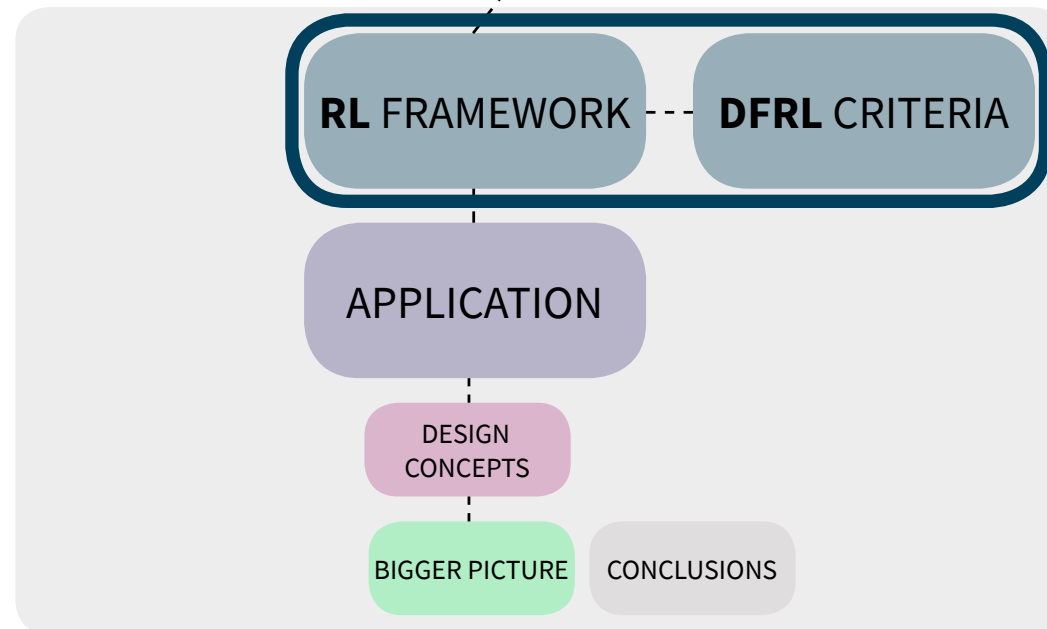
CDW treatment	Recycling	Energy recovery	Other recovery (includes backfilling)	Incineration	Landfill	Disposal and unkown	Other removal	Total
Hazardous waste (Kt)	1,187	16.70	0.72	4.72	262	7.61	0.001	1,479
Non-hazardous waste (Kt)	23,062	927	2.54	11.70	215	8.26	0	24,226
Grand Total (Kt)	24,249	944	3.27	16.42	477	15.87	0.001	25,705

WASTE MANAGEMENT (DELOITTE 2017)

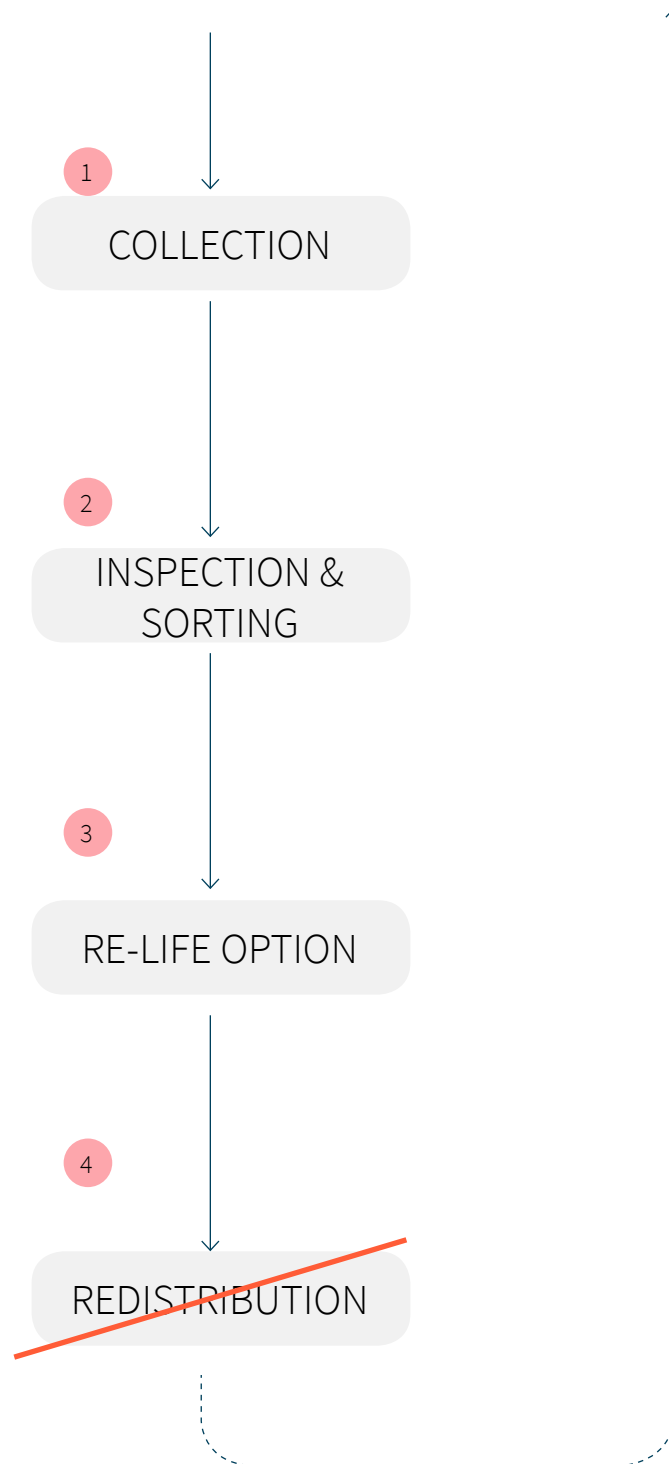
RESEARCH



DESIGN

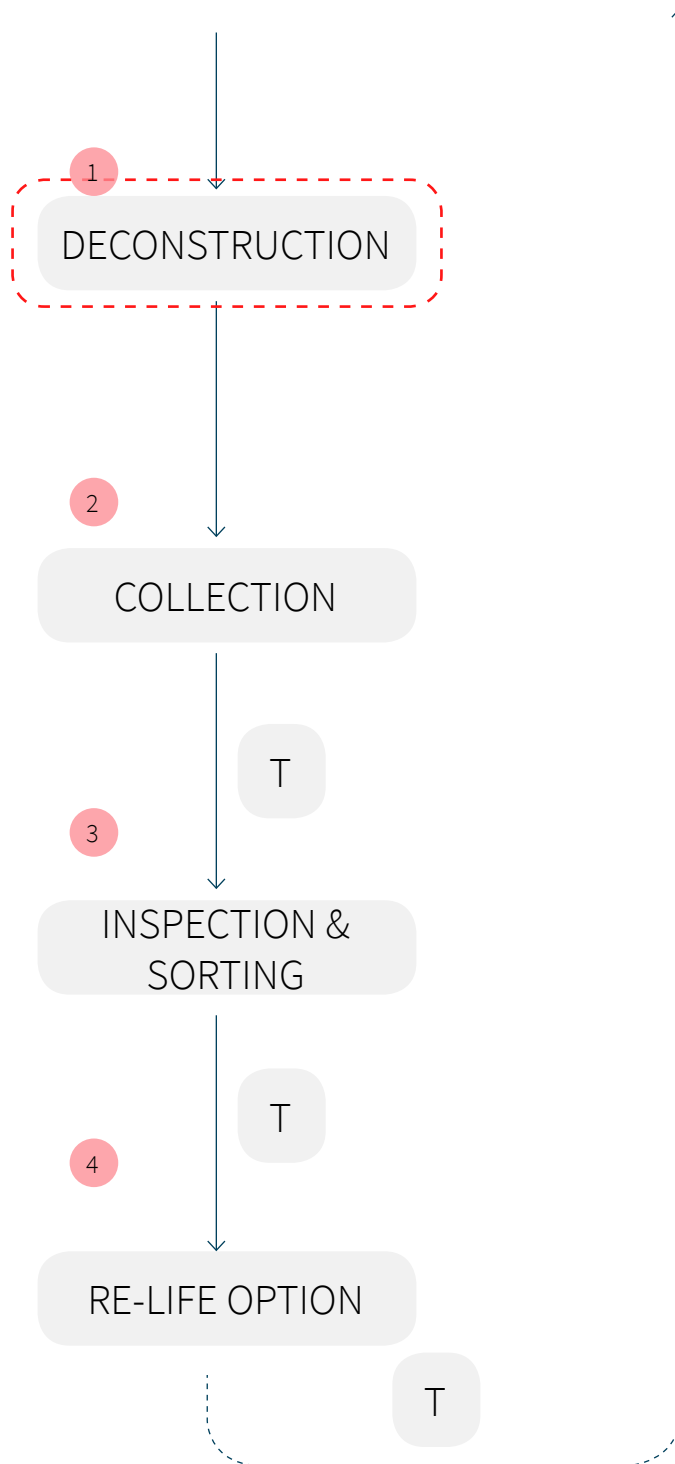


RL FRAMEWORK



(Schultmann 2005)

RL FRAMEWORK



(Montemayor 2020)

RL FRAMEWORK

RELIFE OPTION

1

DECONSTRUCTION

2

COLLECTION

3

INSPECTION &
SORTING

4

RE-LIFE OPTION

BARRIERS

INFO BOXES

STAKEHOLDER

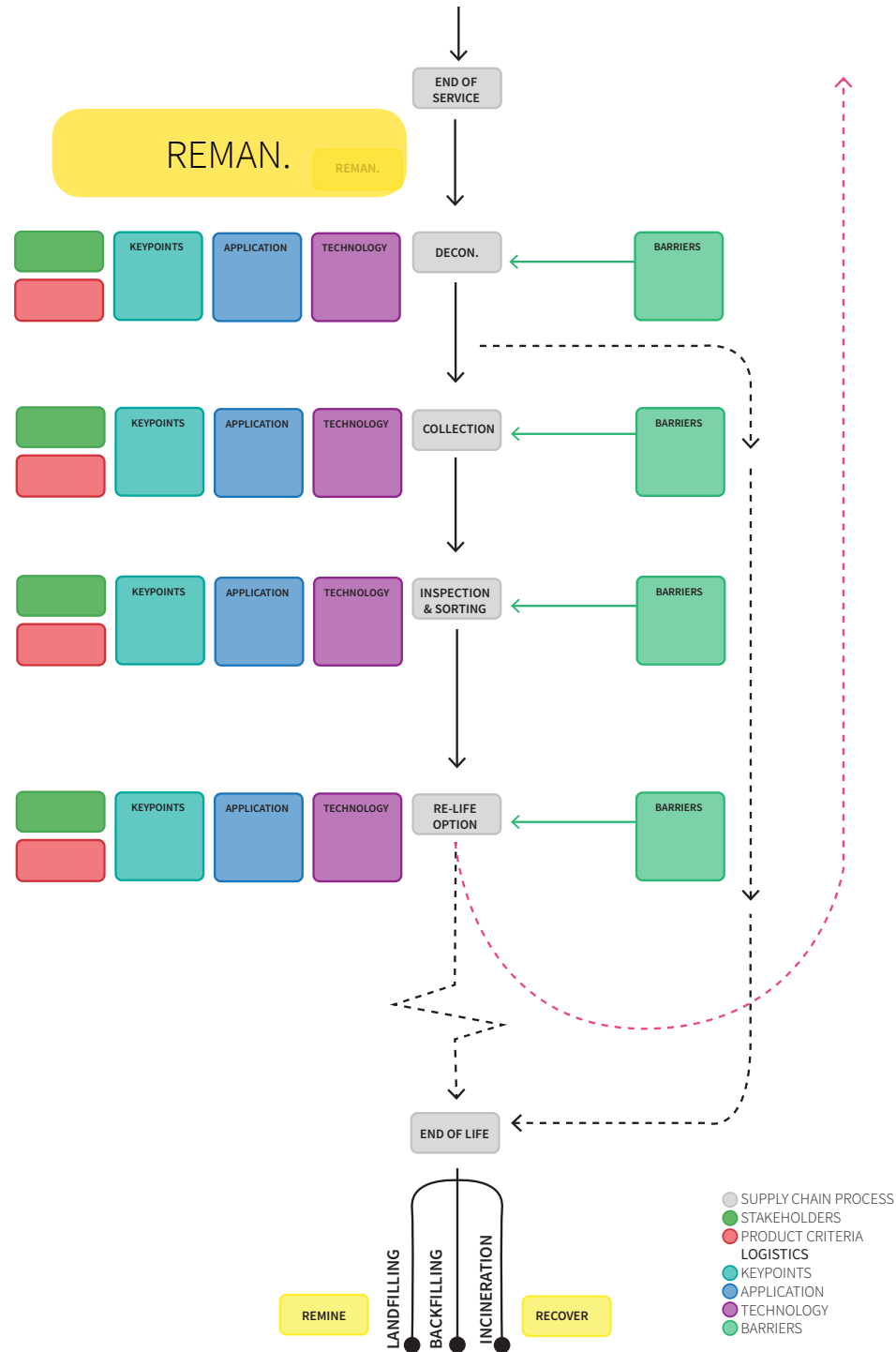
PRODUCT CRITERIA

KEYPOINTS

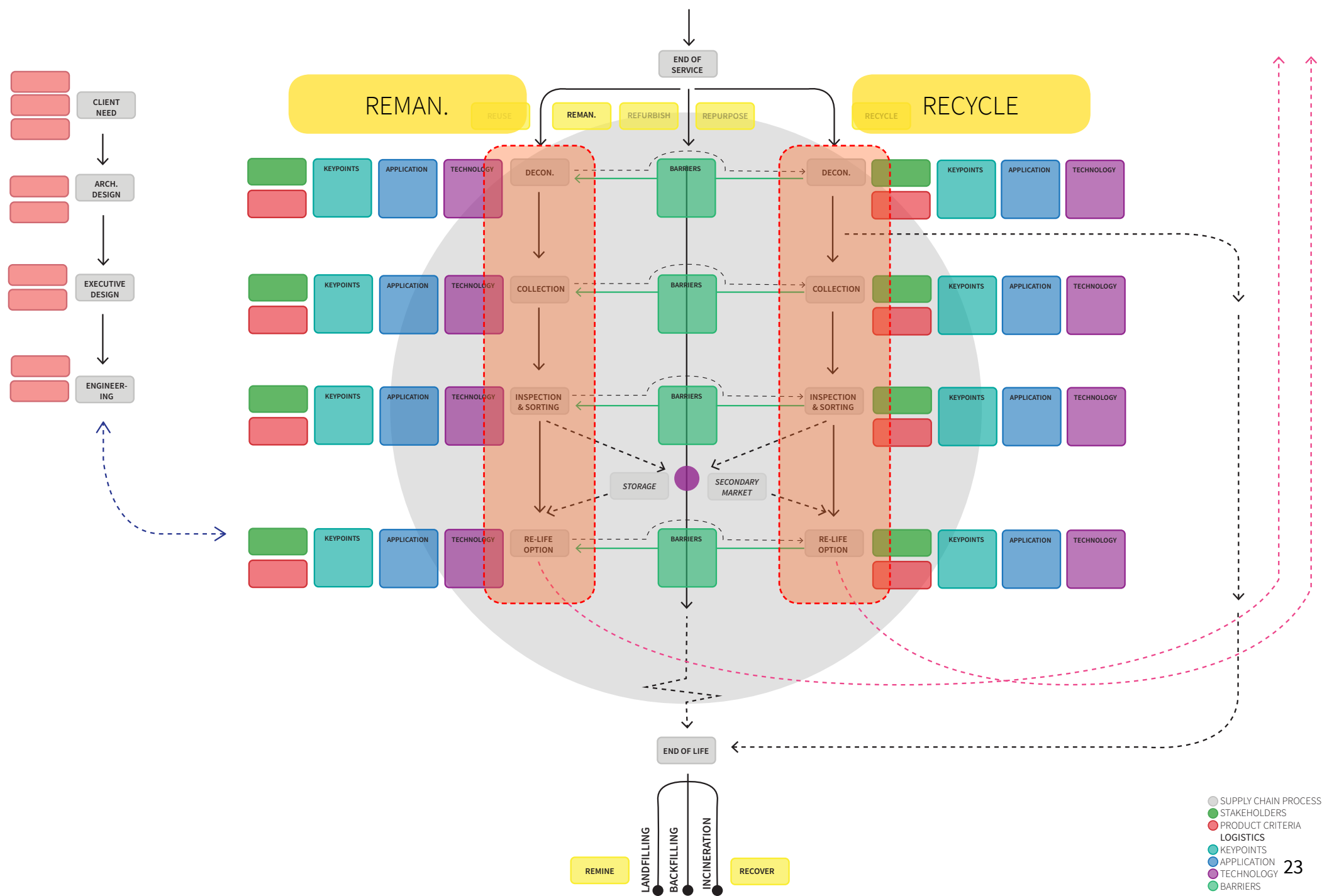
APPLICATION

TECHNOLOGY

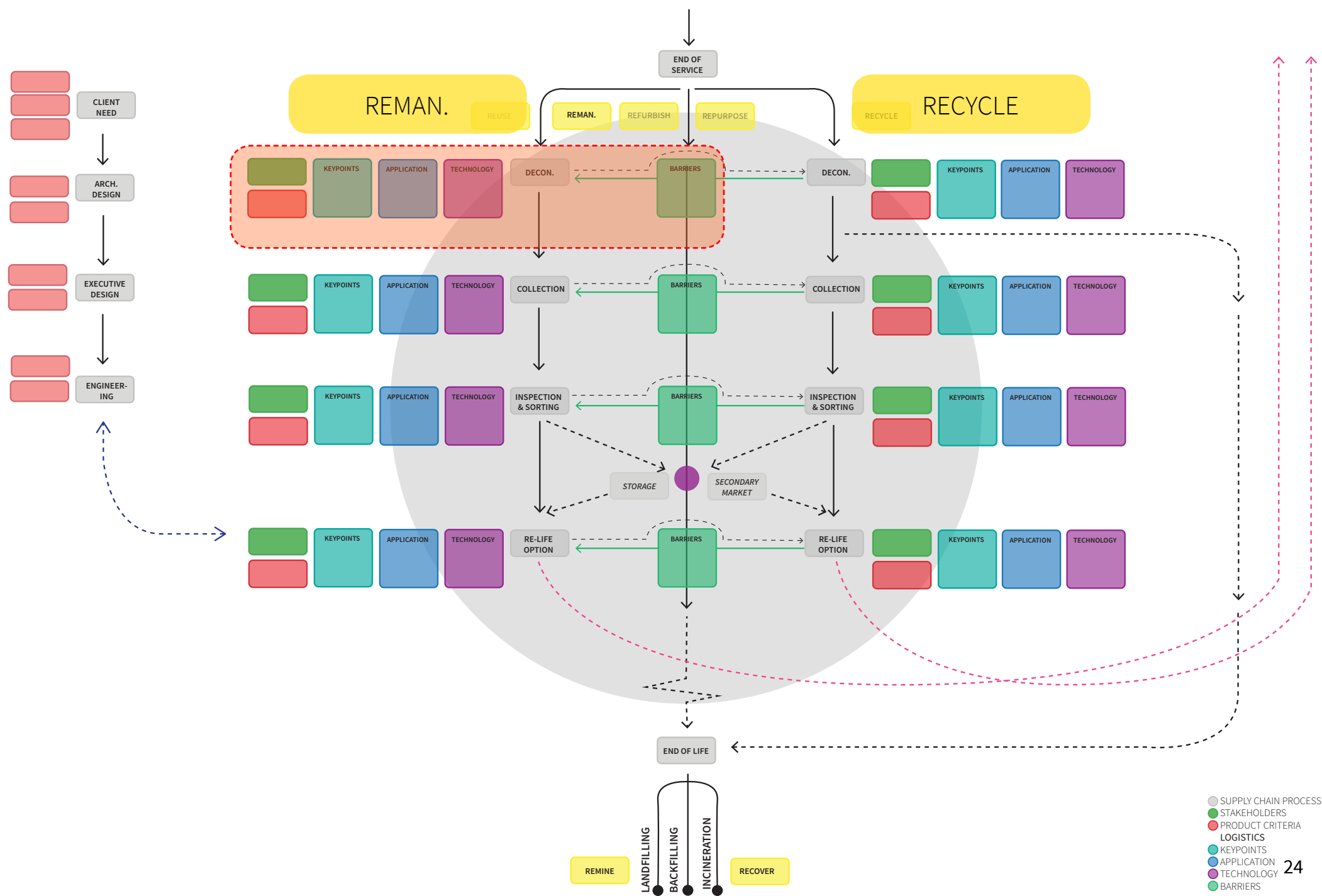
RL FRAMEWORK



RL FRAMEWORK



RL FRAMEWORK

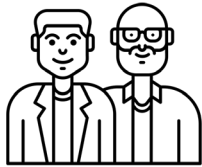


RL FRAMEWORK

EXAMPLE: DECONSTRUCTION

1

DECONSTRUCTION



AUDITING CONSULTANT
GENERAL CONTRACTOR
DECON. COMPANY



KEYPOINTS

DECON. **PLAN**
+
CONDUCT **AUDITING**
+
TRAIN LABOUR FORCE



APPLICATION

W
DECONSTRUCTION PROCESS
T
SPECIALIZED LABOUR
\$
DECON. INCENTIVES

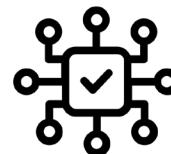


BARRIERS

LACK OF GOVERNMENT
INCENTIVES
-
DECON. IS 25% HIGHER THAN
CONVENTIONAL DEMOLITION

TECHNOLOGY

BATIRIM & CIRLINQ PROVIDE INFO
FOR RECOVERY & TRACKING



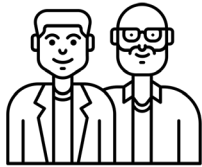
W: WORK/EFFORT
T: TIME
\$: MONEY/COST

RL FRAMEWORK

EXAMPLE: DECONSTRUCTION

1

DECONSTRUCTION



AUDITING CONSULTANT
GENERAL CONTRACTOR
DECON. COMPANY



KEYPOINTS

DECON. **PLAN**
+
CONDUCT **AUDITING**
+
TRAIN LABOUR FORCE



APPLICATION

W
DECONSTRUCTION PROCESS
T
SPECIALIZED LABOUR
\$
DECON. INCENTIVES



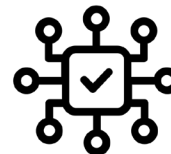
BARRIERS

LACK OF GOVERNMENT
INCENTIVES
-
DECON. IS 25% HIGHER THAN
CONVENTIONAL DEMOLITION

5 DfRL CRITERIA

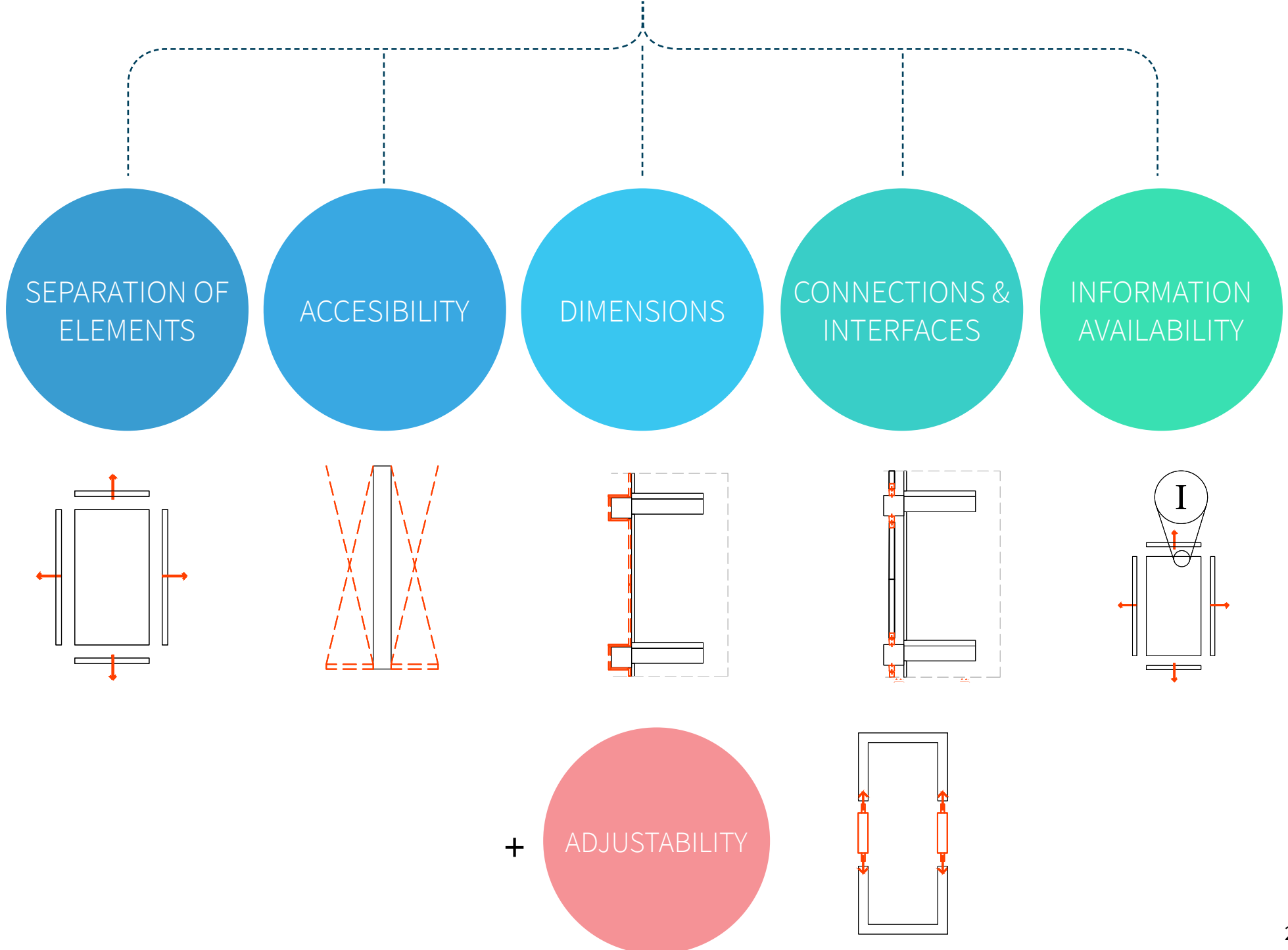
TECHNOLOGY

BATIRIM & CIRLINQ PROVIDE INFO
FOR RECOVERY & TRACKING

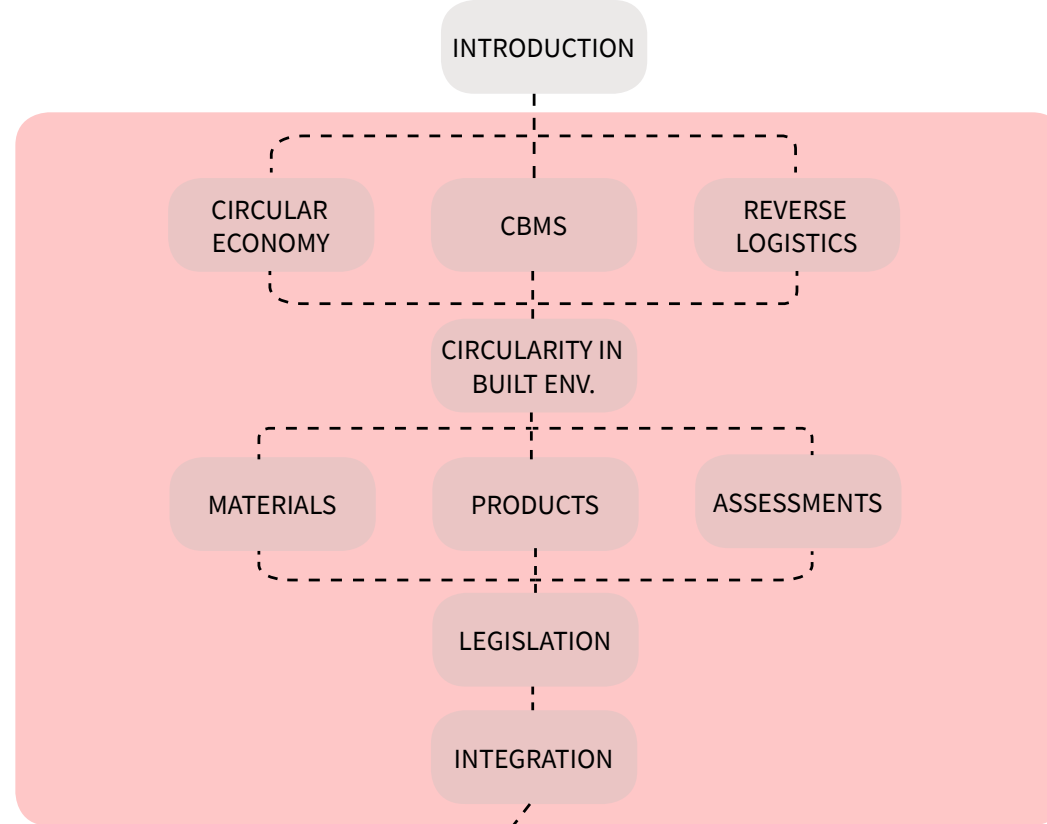


W: WORK/EFFORT
T: TIME
\$: MONEY/COST

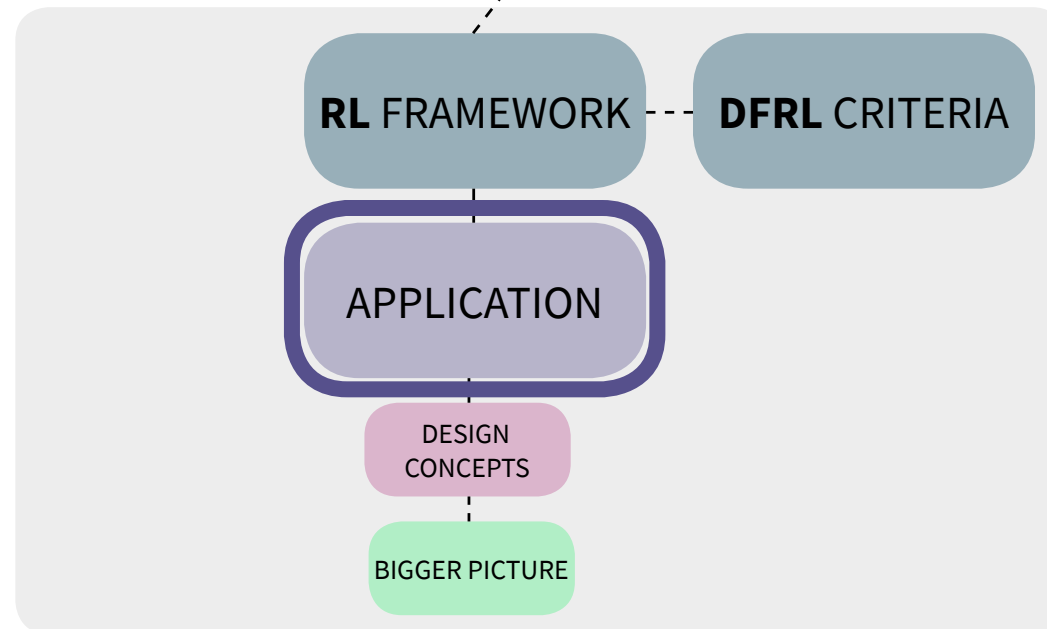
DfRL (*Design for Reverse Logistics*)



RESEARCH



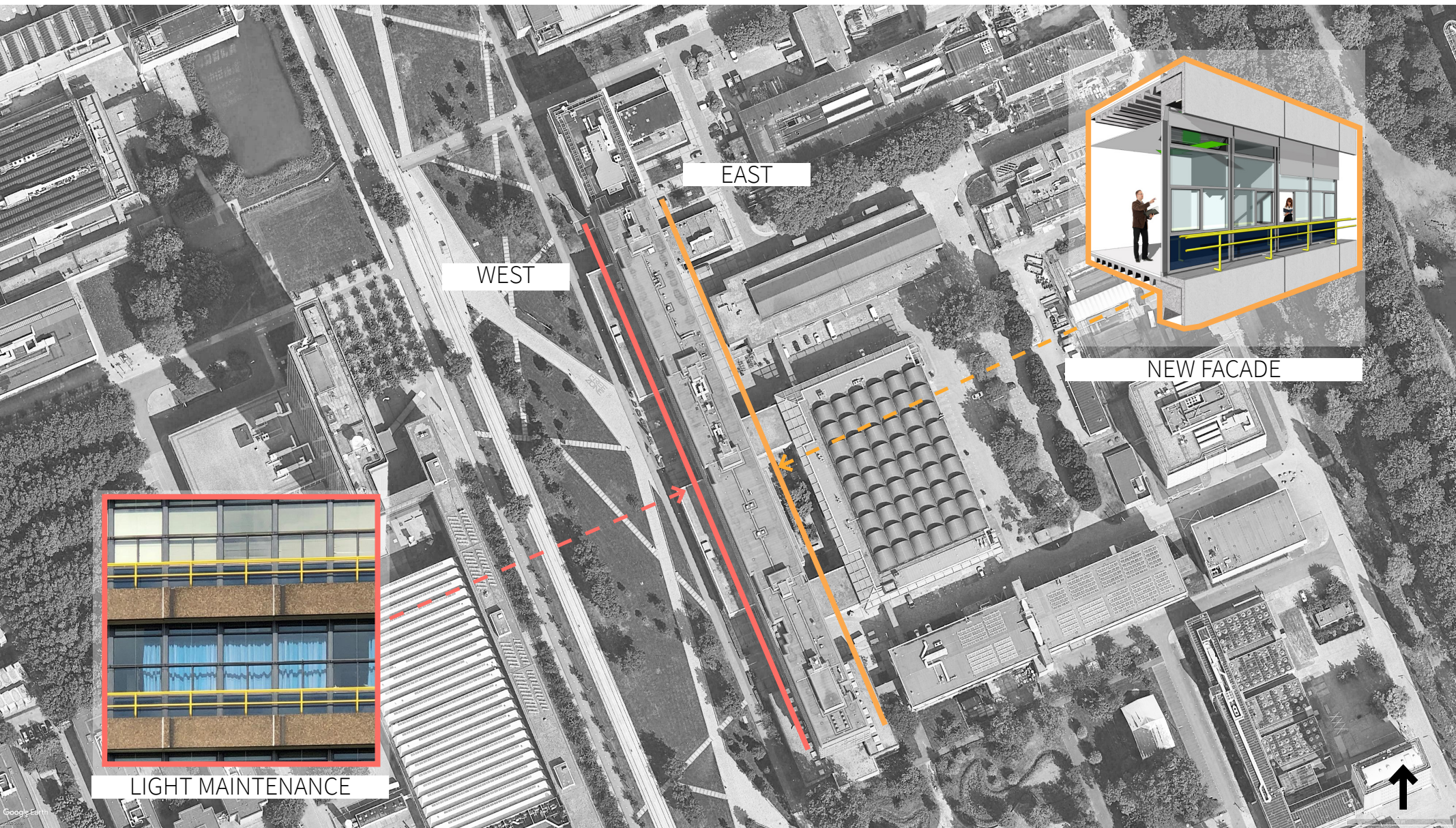
DESIGN

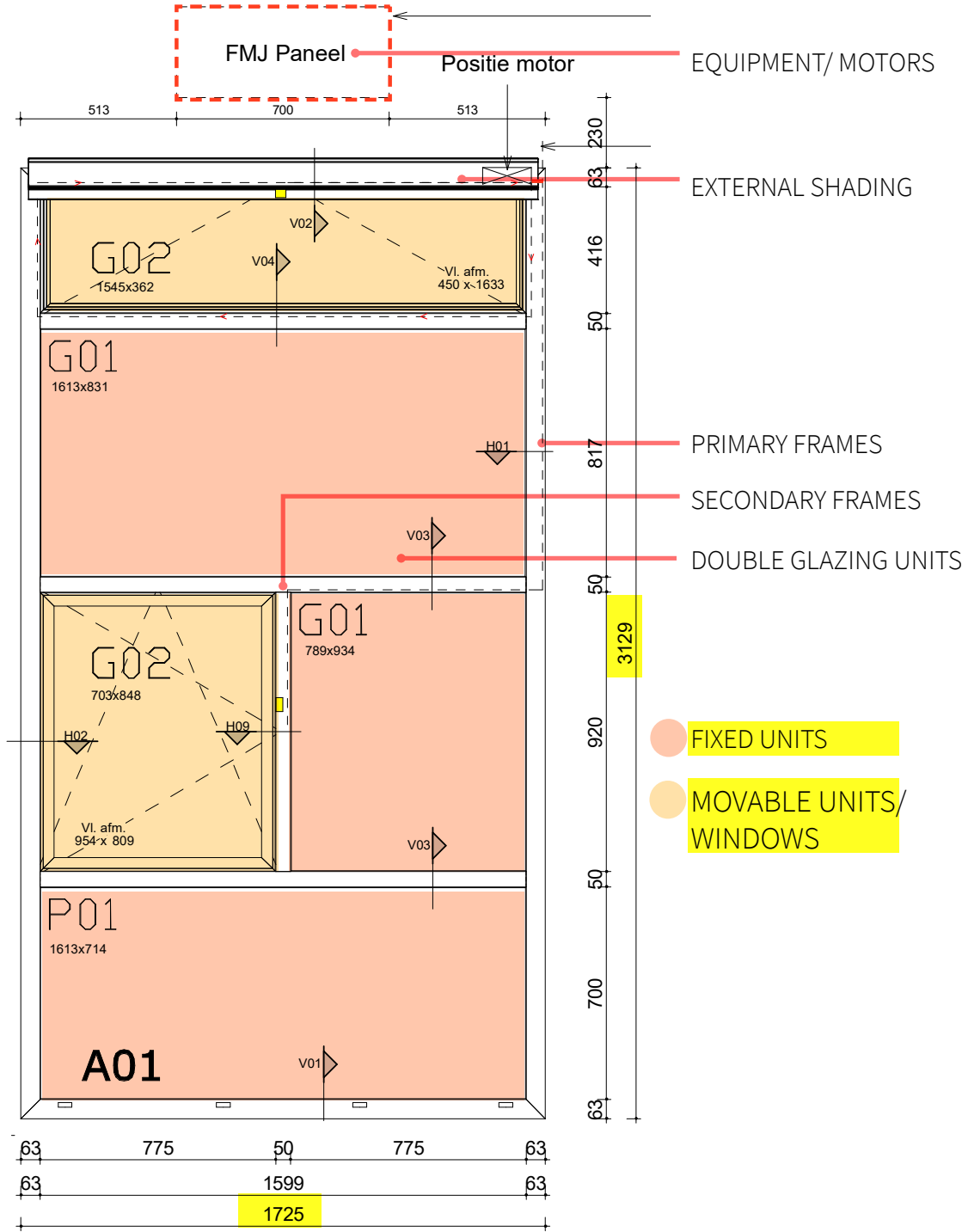


CITG Building



APPLICATION



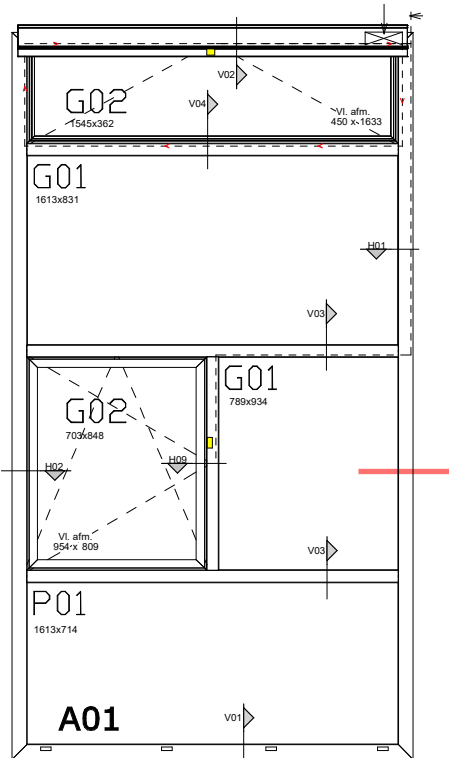


Generic panel & components

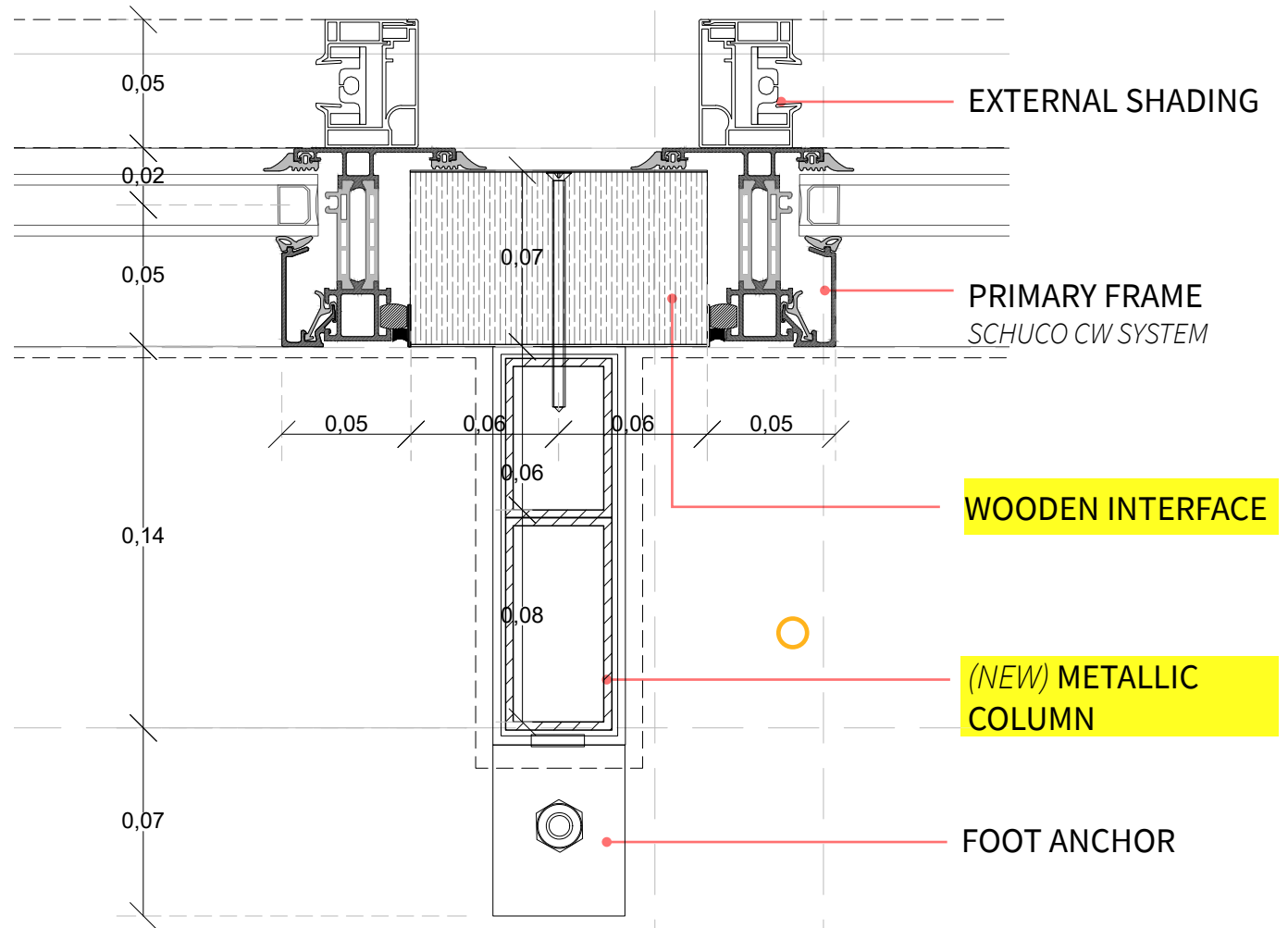


Products used

NEW FAÇADE: DETAILS

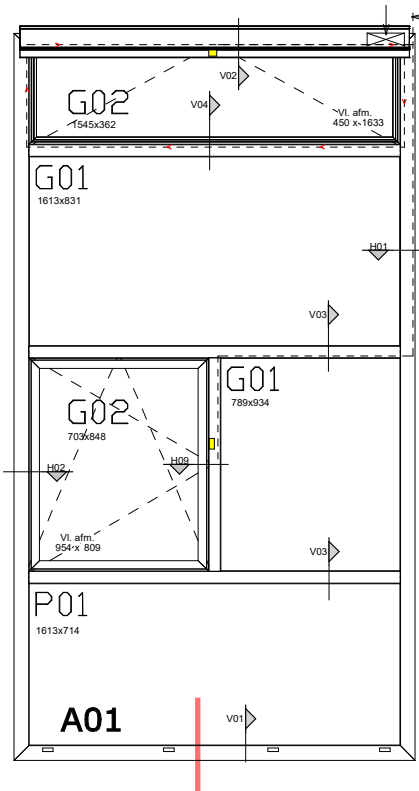


ELEVATION

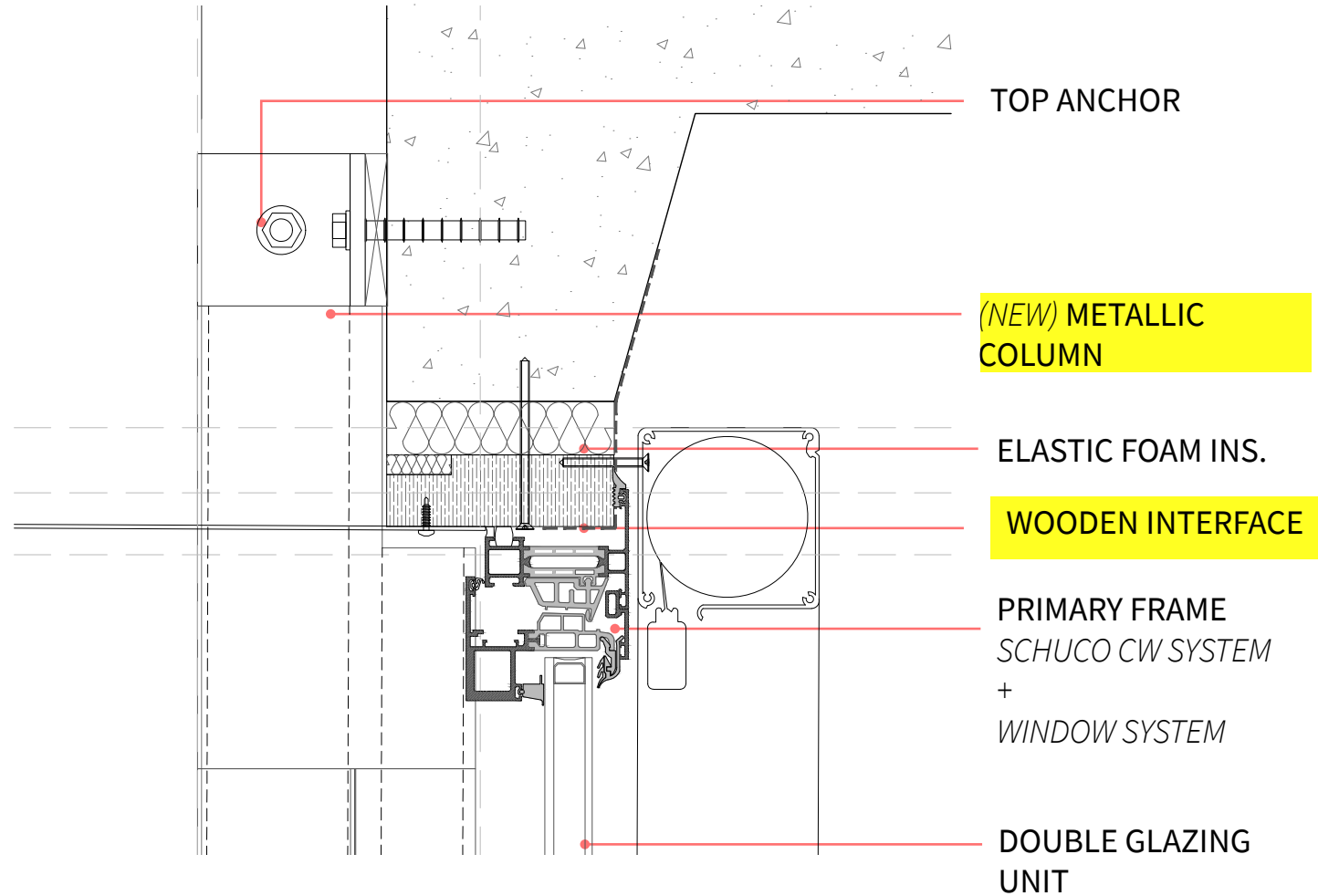


HORIZONTAL DETAIL OF CONNECTION

NEW FAÇADE: DETAILS

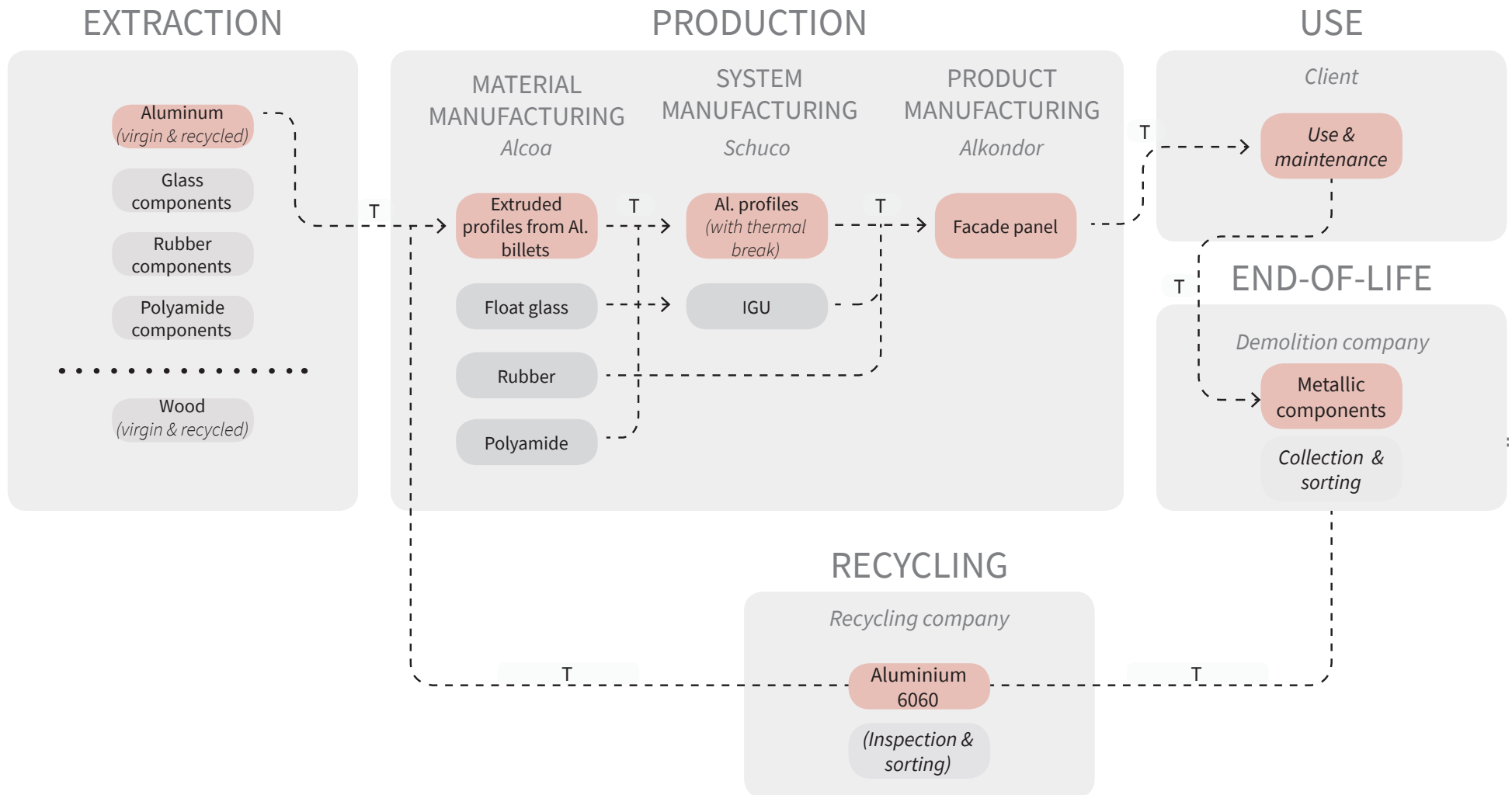


ELEVATION

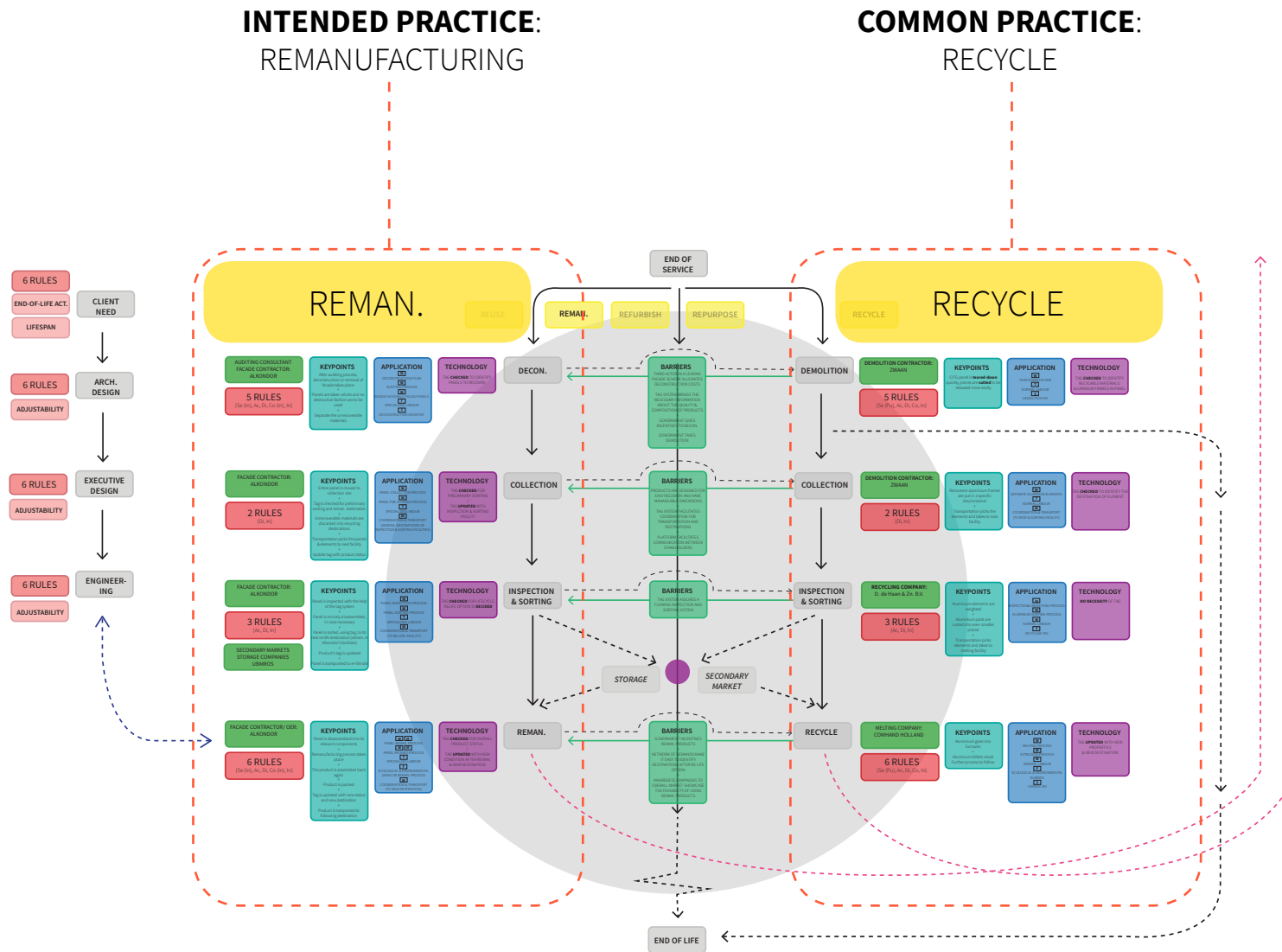


VERTICAL DETAIL OF CONNECTION
TOP CONNECTION

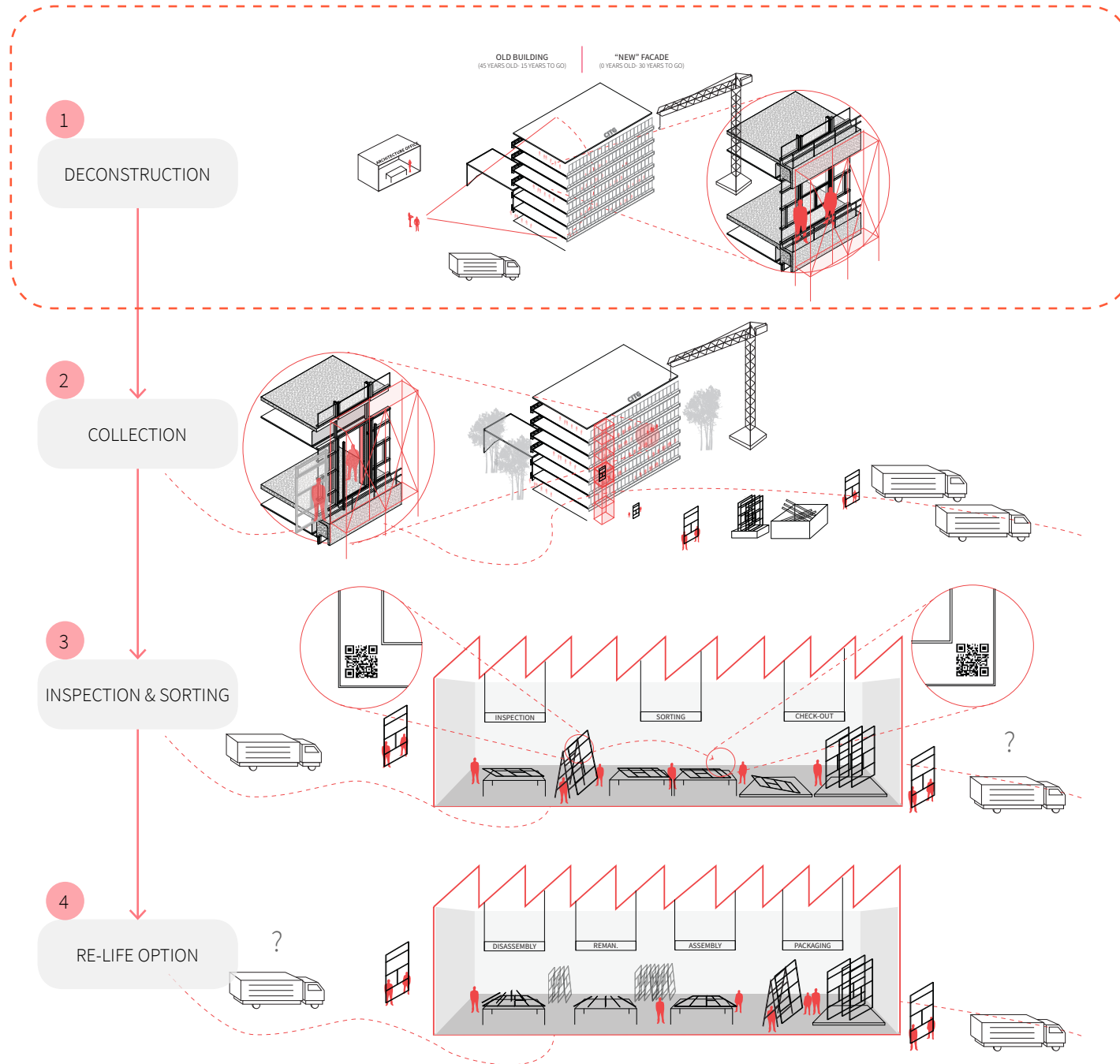
MATERIAL FLOW OF PRODUCT (COMMON PRACTICE)



FRAMEWORK APPLICATION



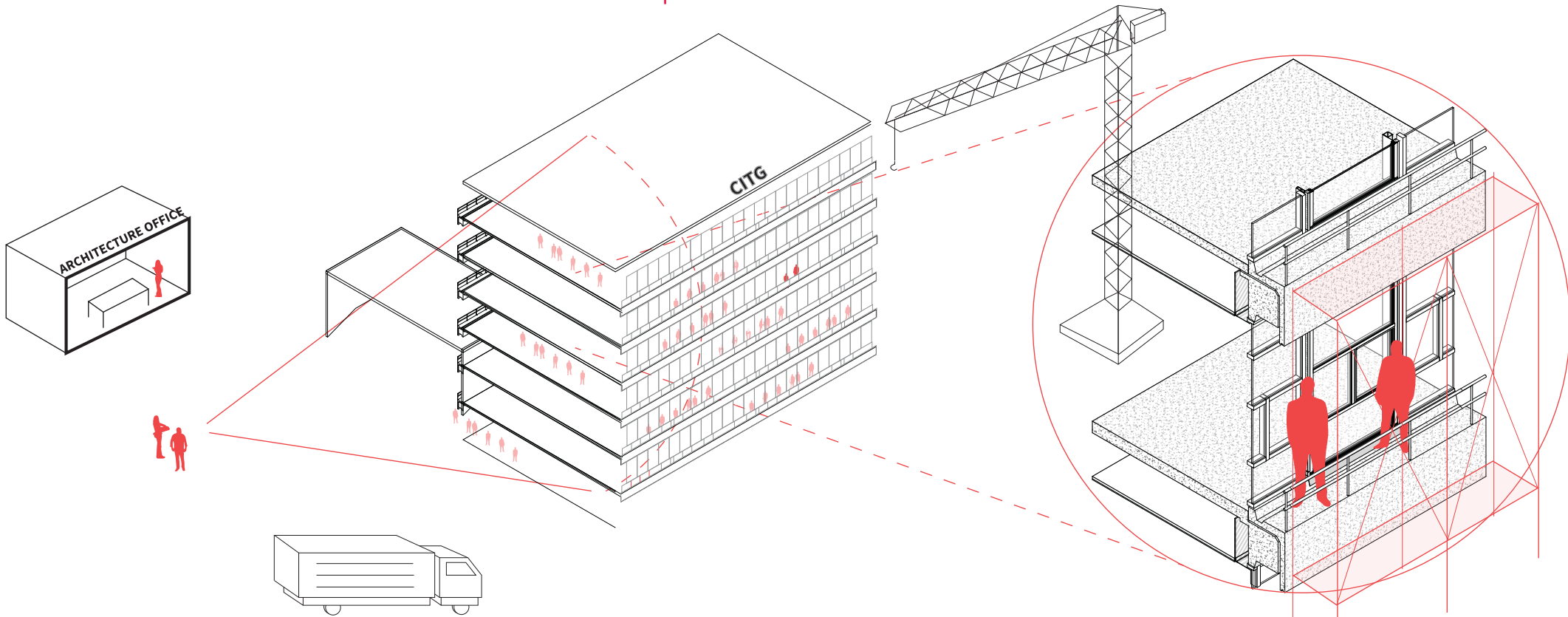
GRAPHICAL FRAMEWORK APPLICATION



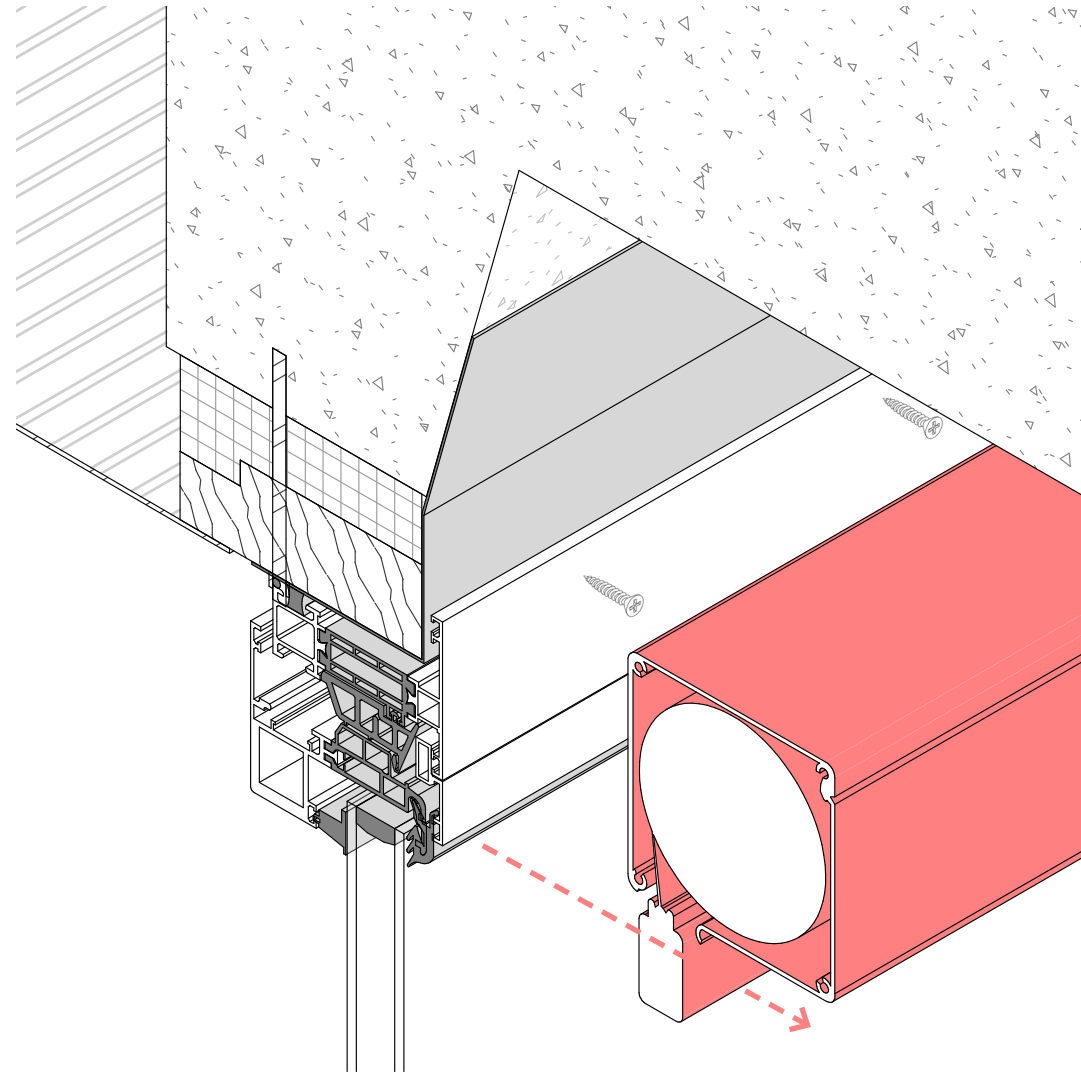
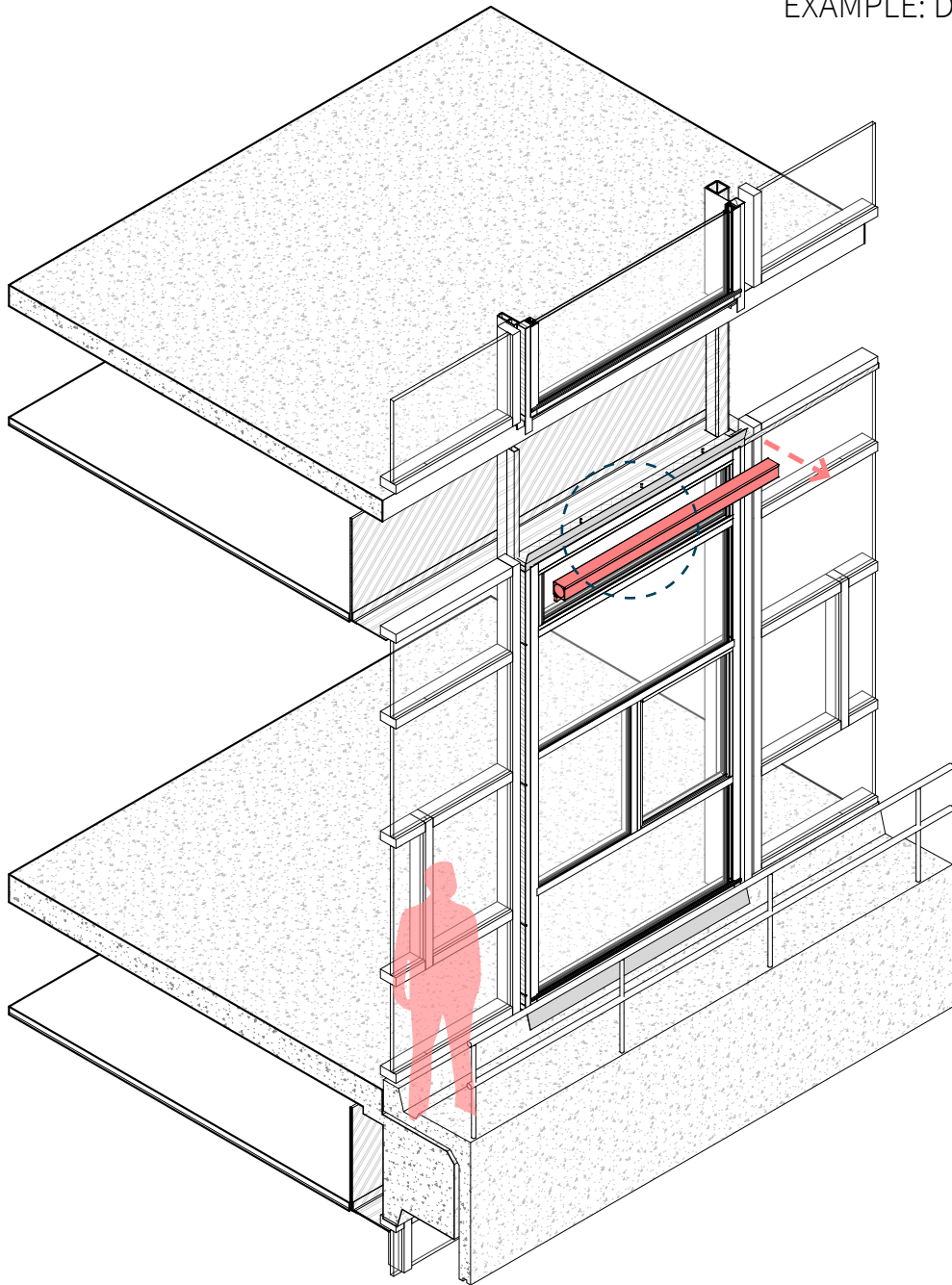
GRAPHICAL FRAMEWORK APPLICATION EXAMPLE: DECONSTRUCTION

OLD BUILDING
(45 YEARS OLD- 15 YEARS TO GO)

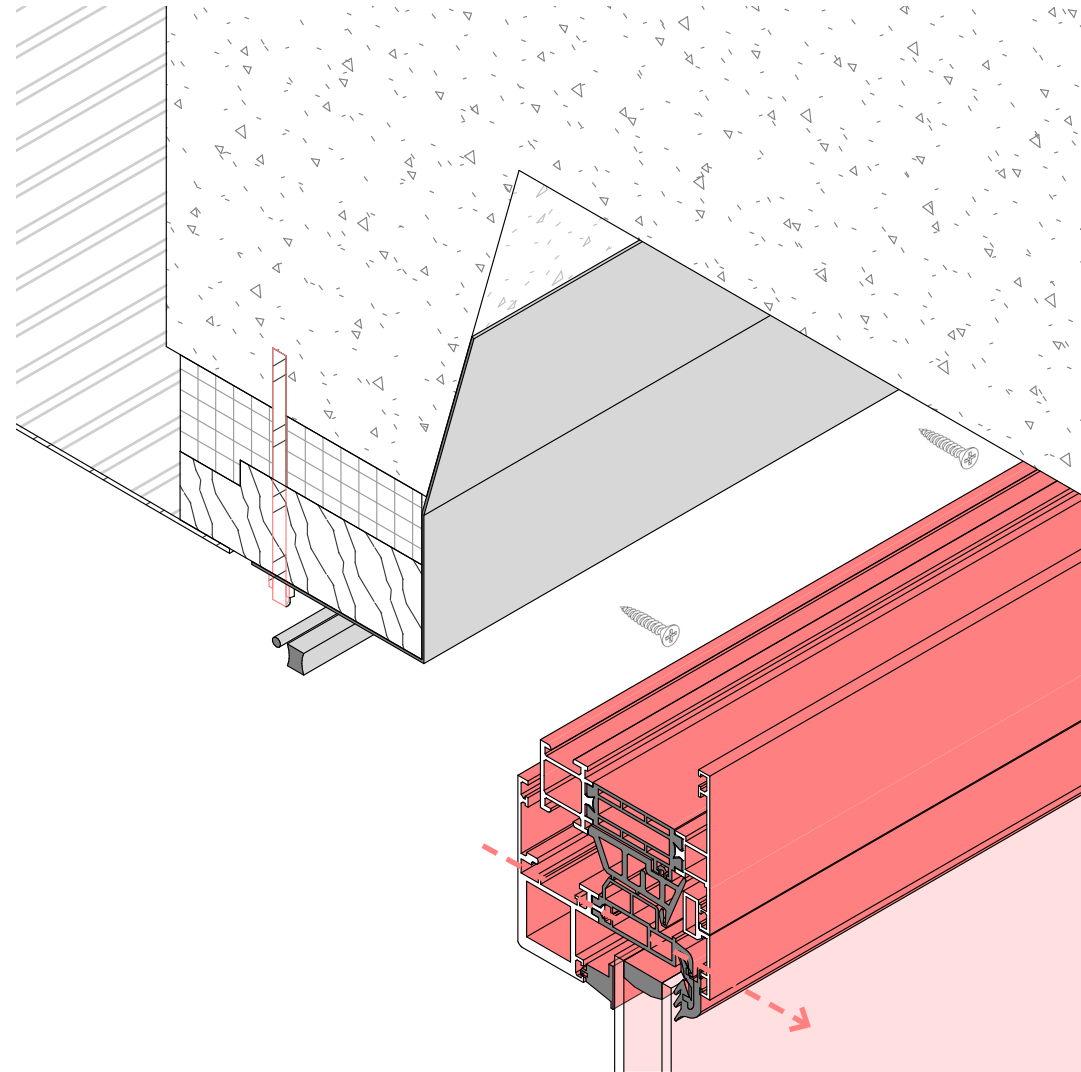
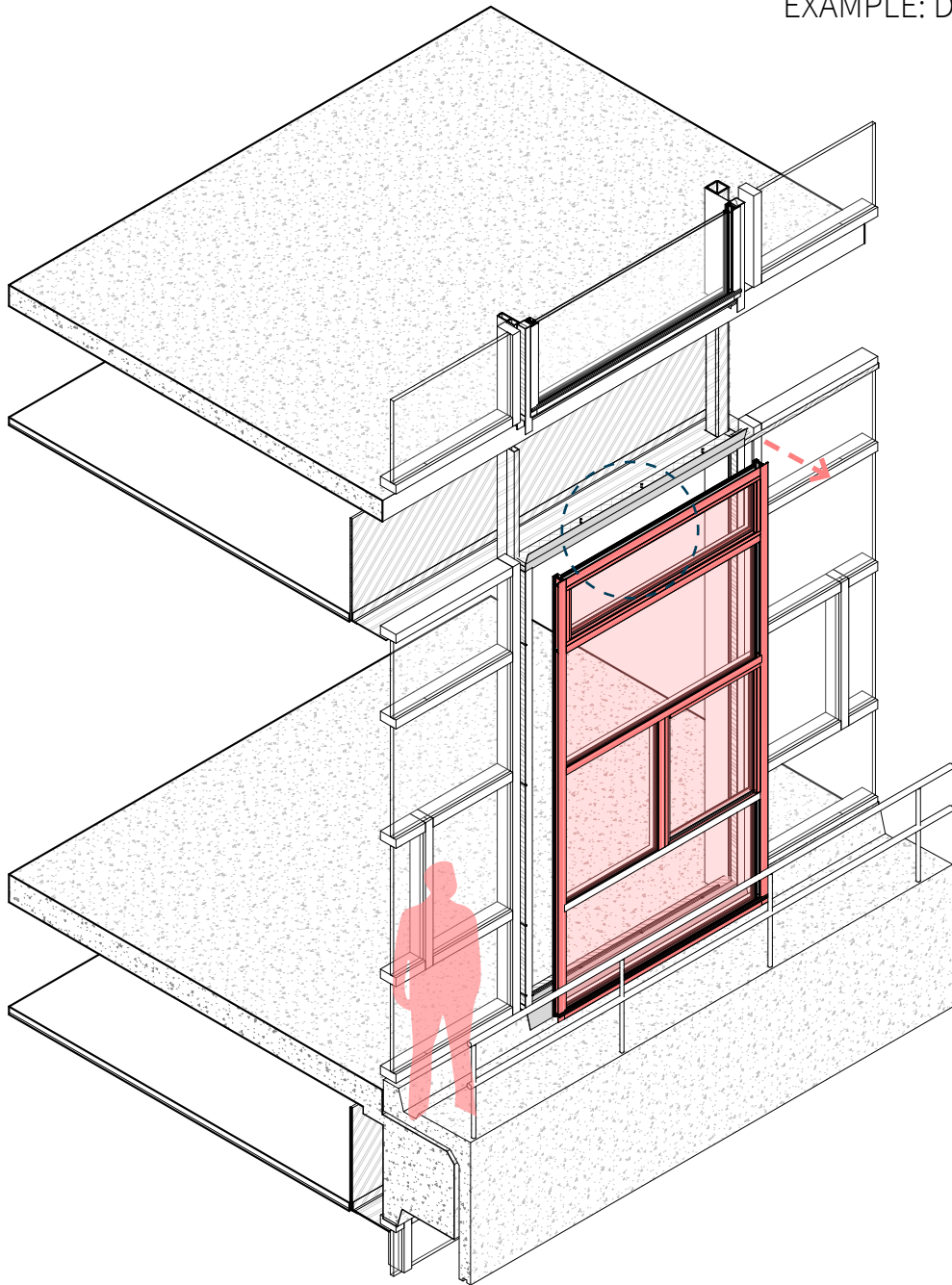
“NEW” FACADE
(0 YEARS OLD- 30 YEARS TO GO)



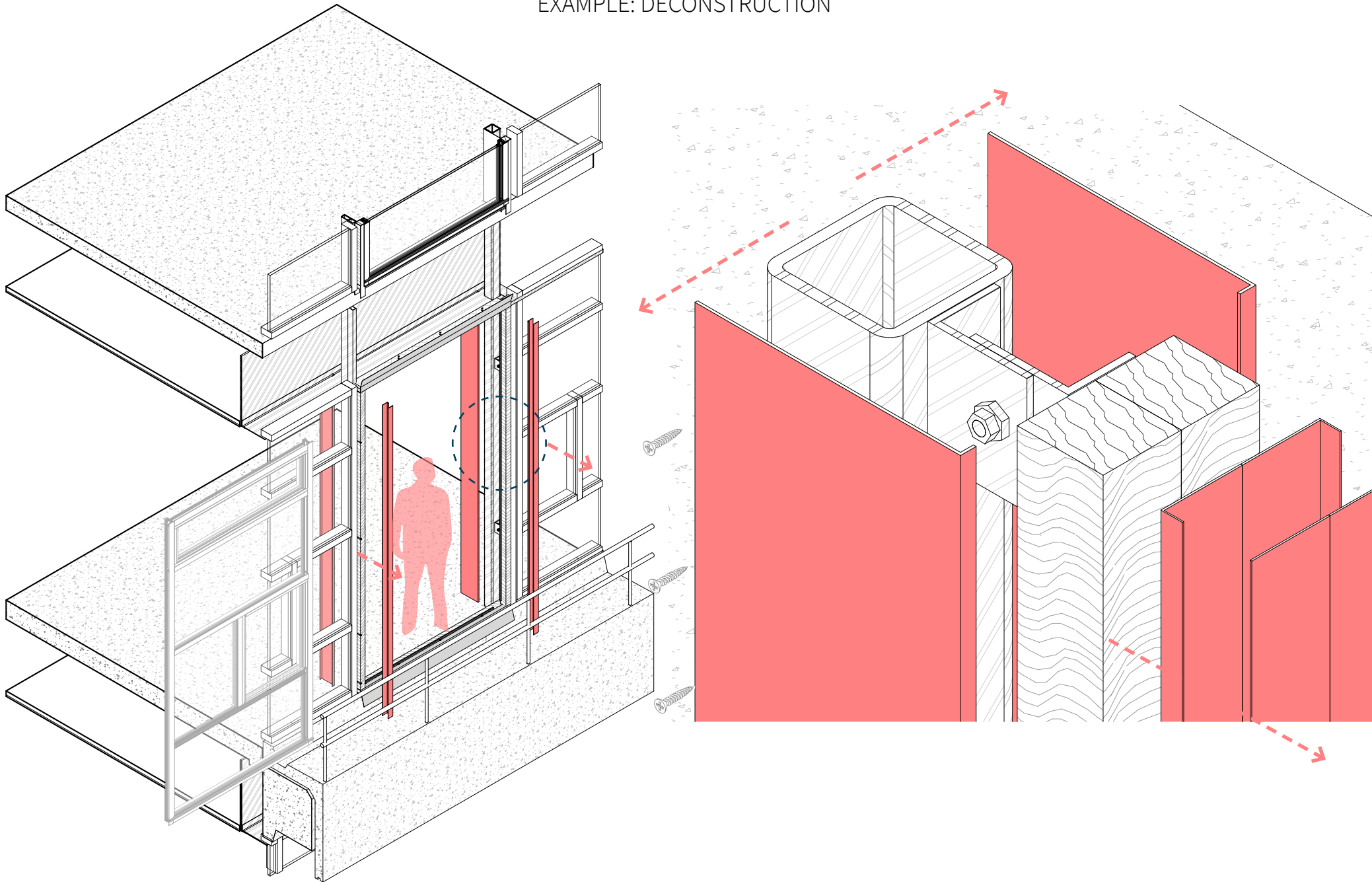
GRAPHICAL FRAMEWORK APPLICATION
EXAMPLE: DECONSTRUCTION



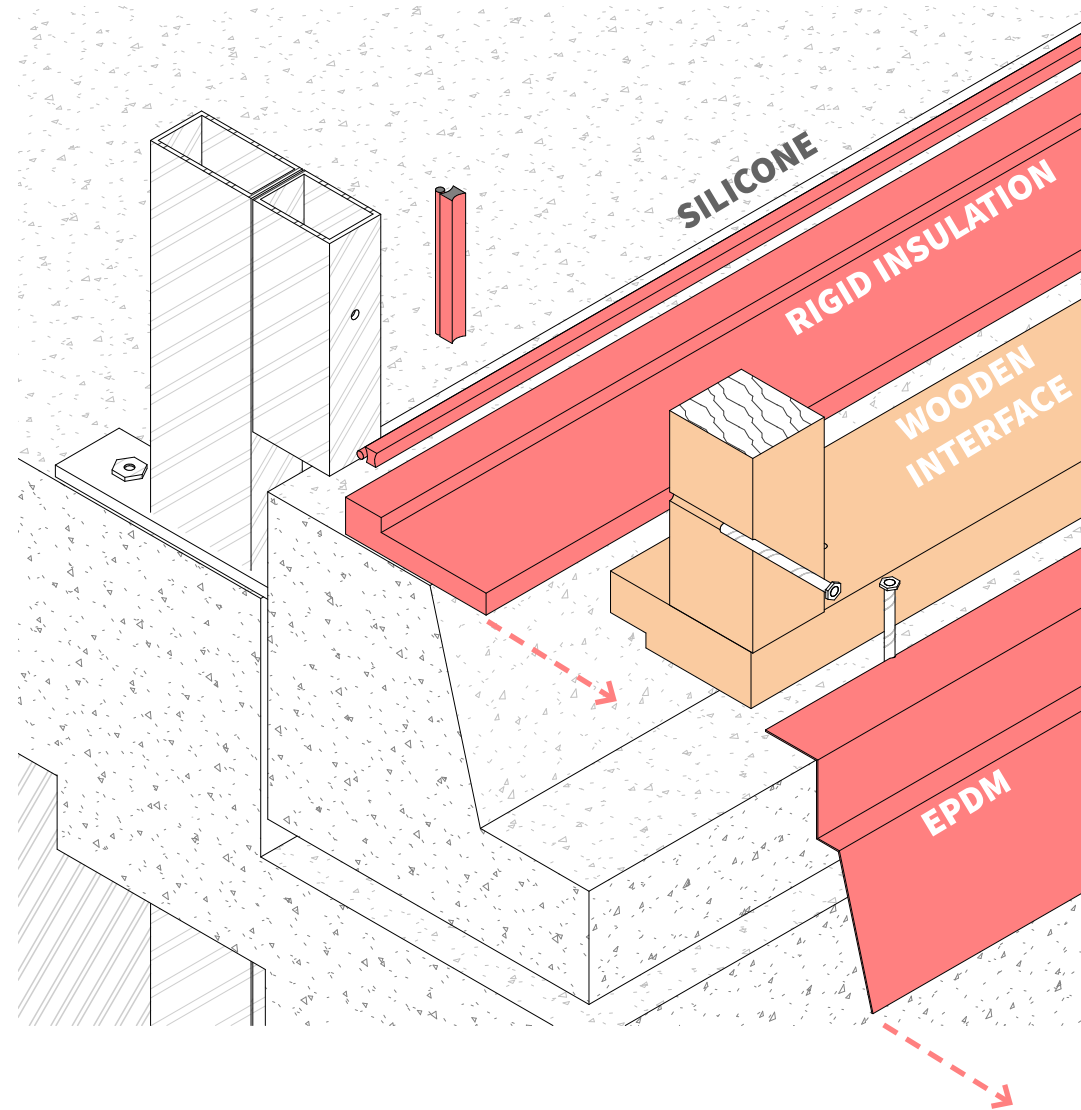
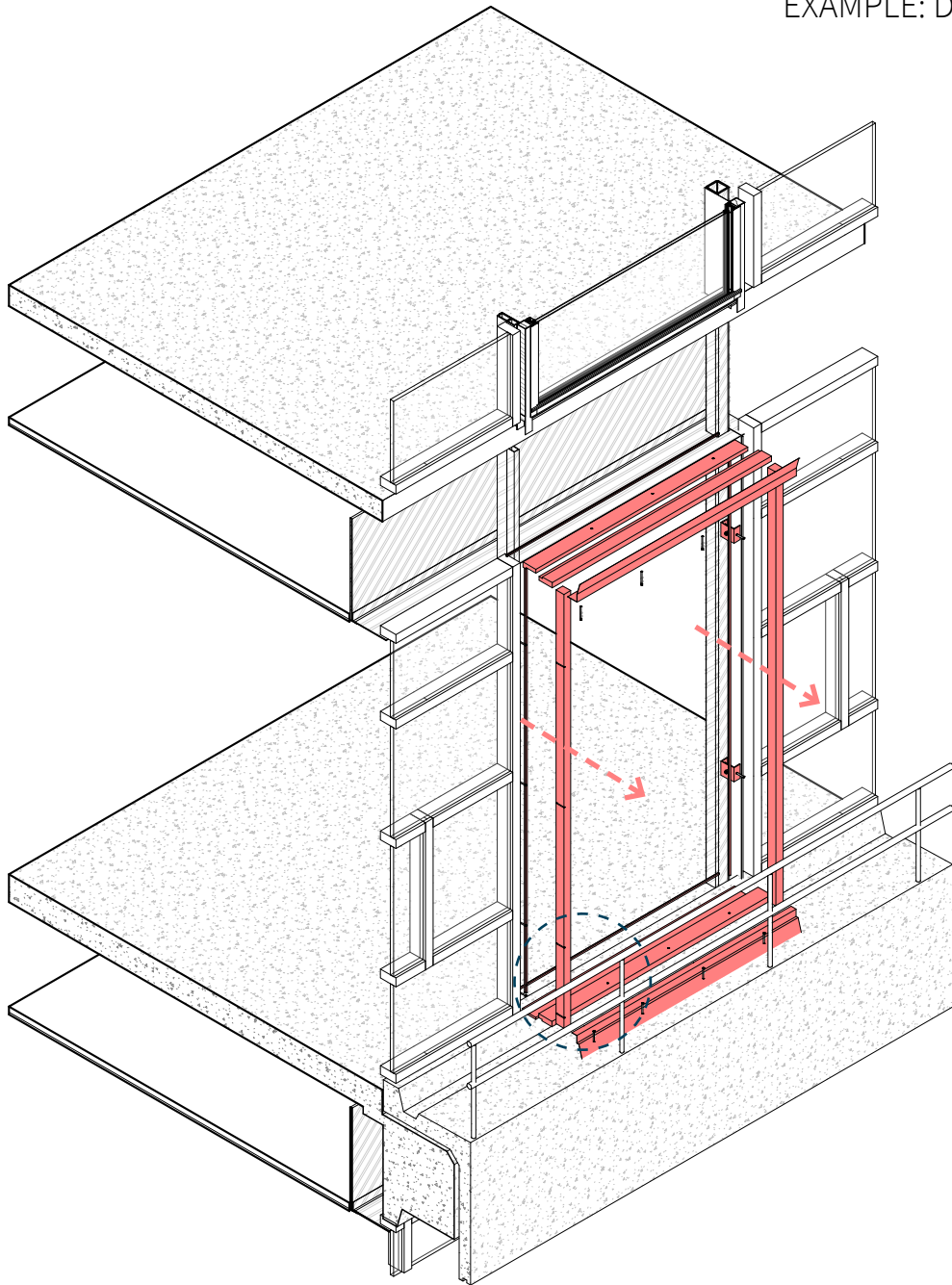
GRAPHICAL FRAMEWORK APPLICATION
EXAMPLE: DECONSTRUCTION



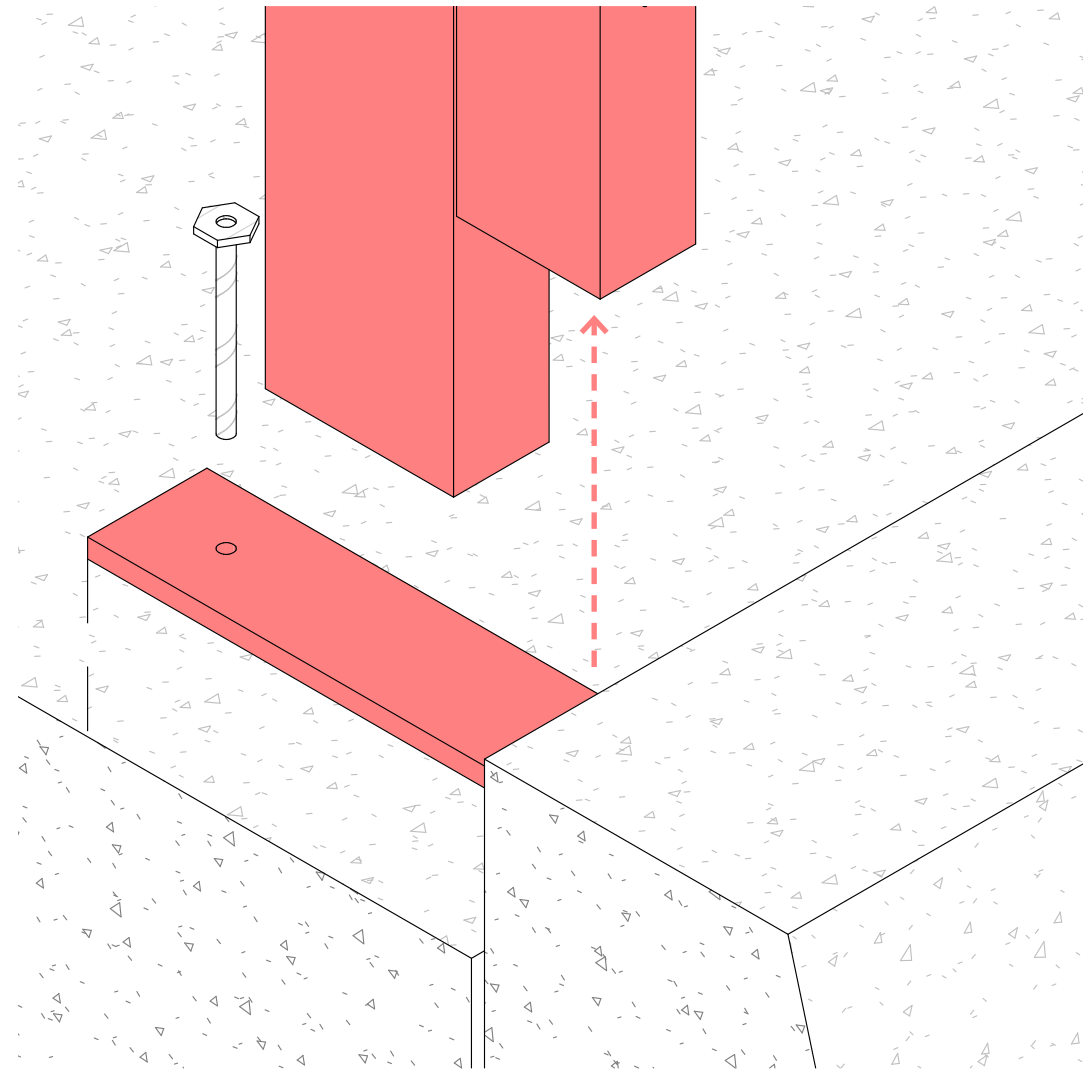
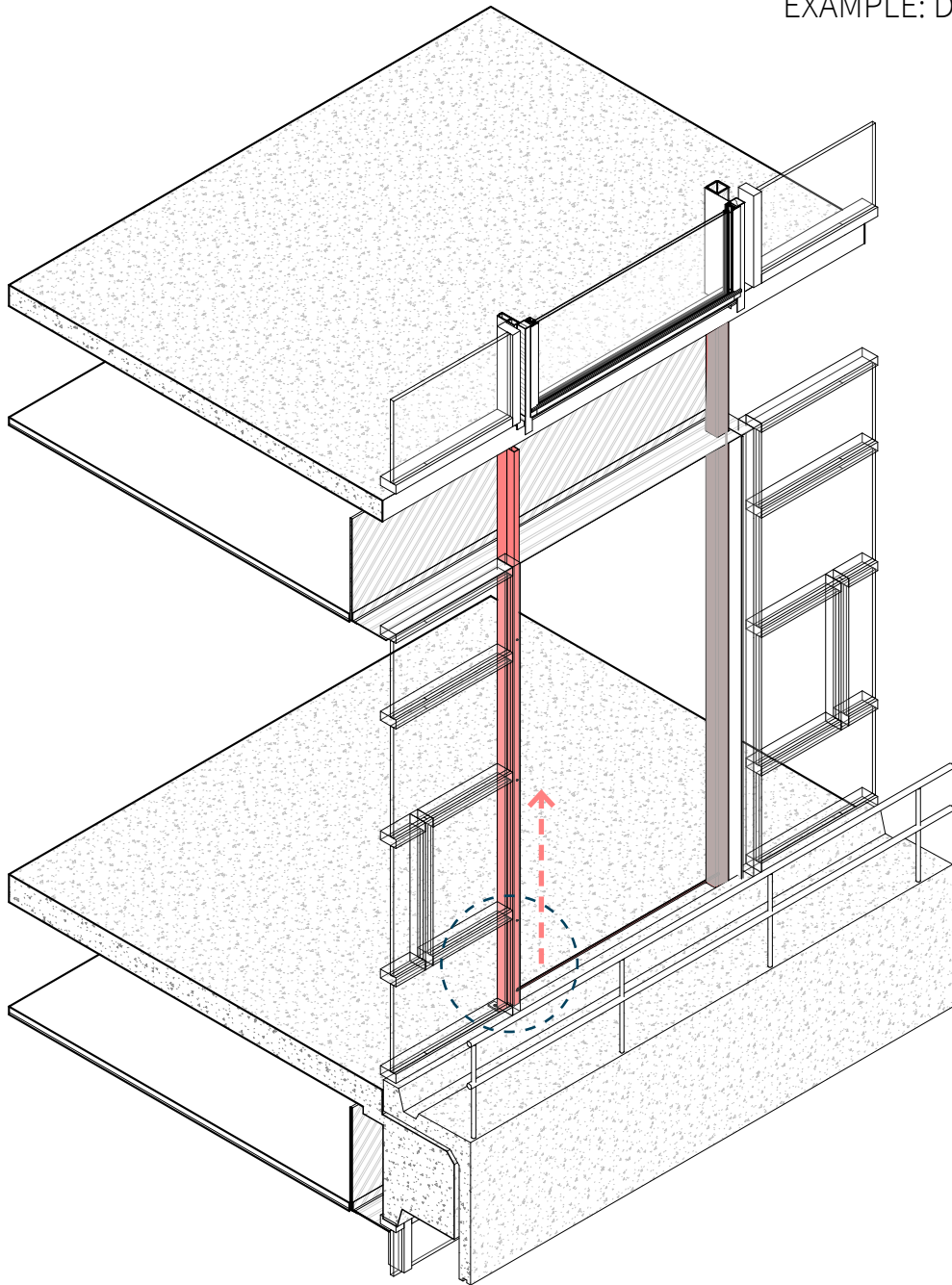
GRAPHICAL FRAMEWORK APPLICATION
EXAMPLE: DECONSTRUCTION



GRAPHICAL FRAMEWORK APPLICATION
EXAMPLE: DECONSTRUCTION



GRAPHICAL FRAMEWORK APPLICATION
EXAMPLE: DECONSTRUCTION



GRAPHICAL FRAMEWORK APPLICATION

EXAMPLE: DECONSTRUCTION

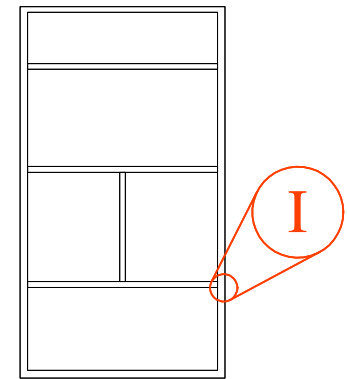
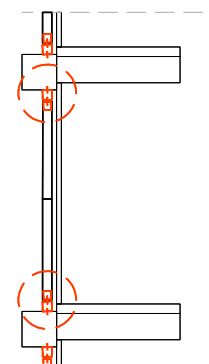
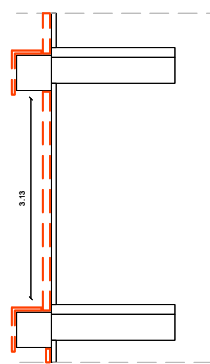
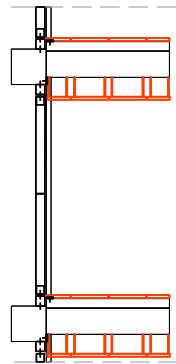
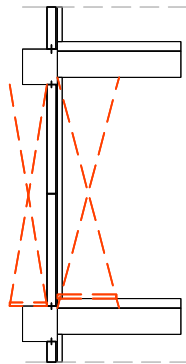
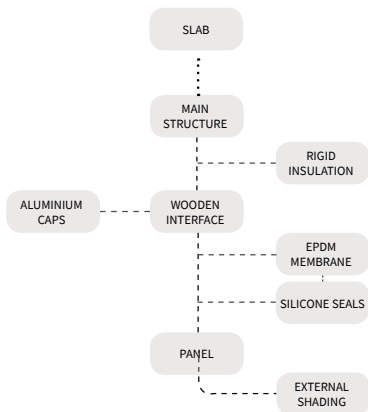
SEPARATION OF ELEMENTS

ACCESIBILITY

DIMENSIONS

CONNECTIONS & INTERFACES

INFORMATION AVAILABILITY



✓ Dismounting

● Destructive ways

Accesible outside

✓ Accesible connections

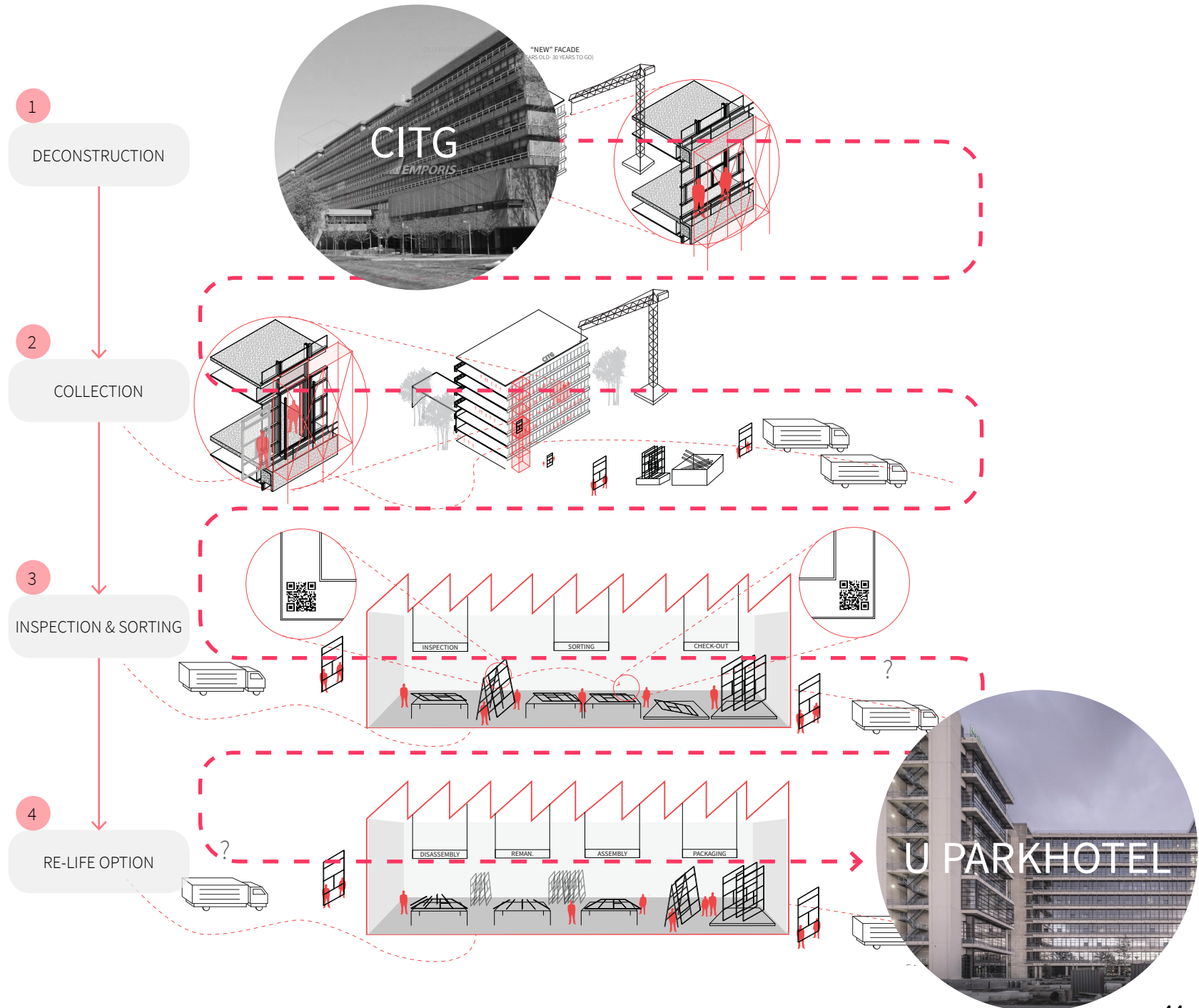
● Panel too big

✓ Interface

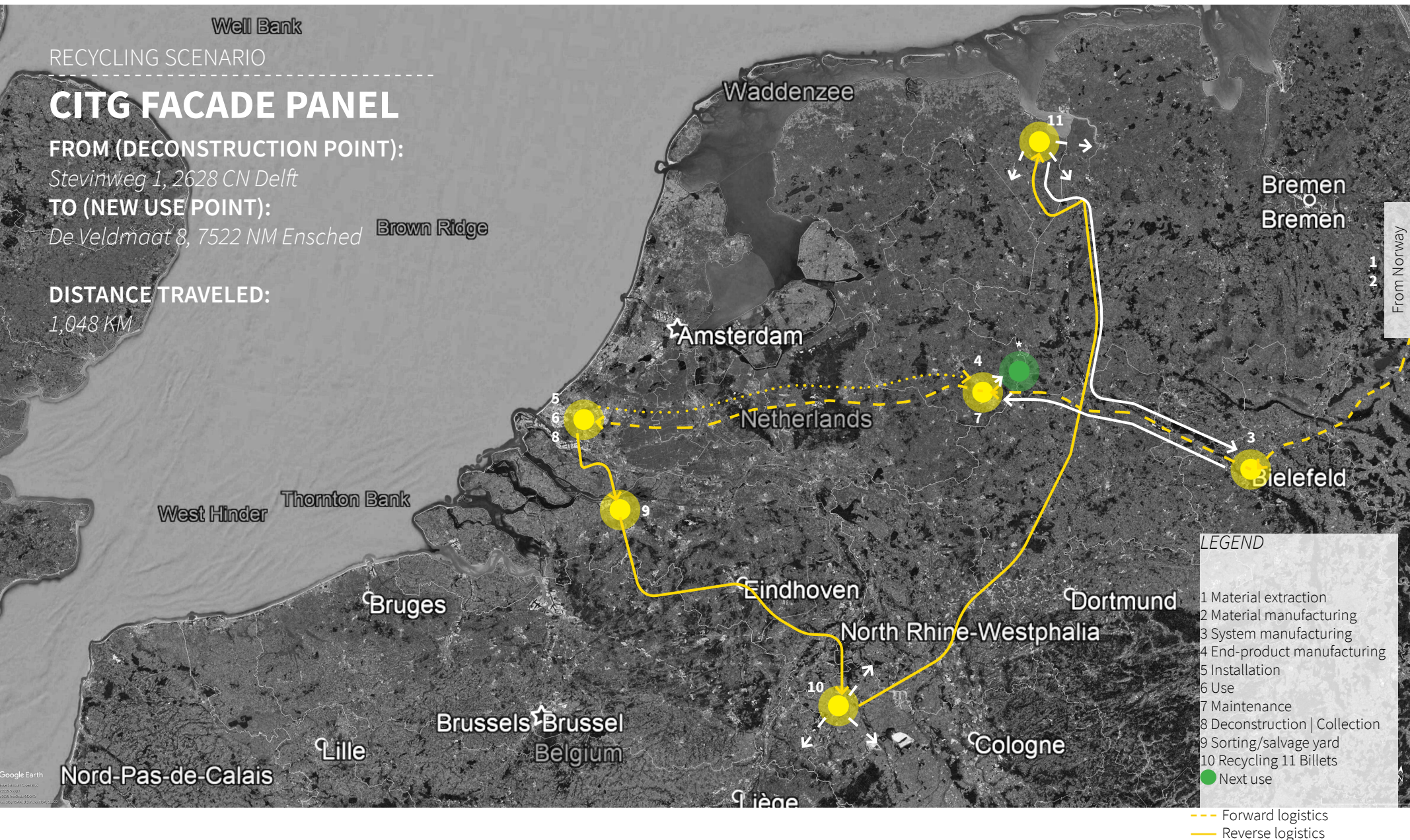
● Nails connection

✓ Tag available

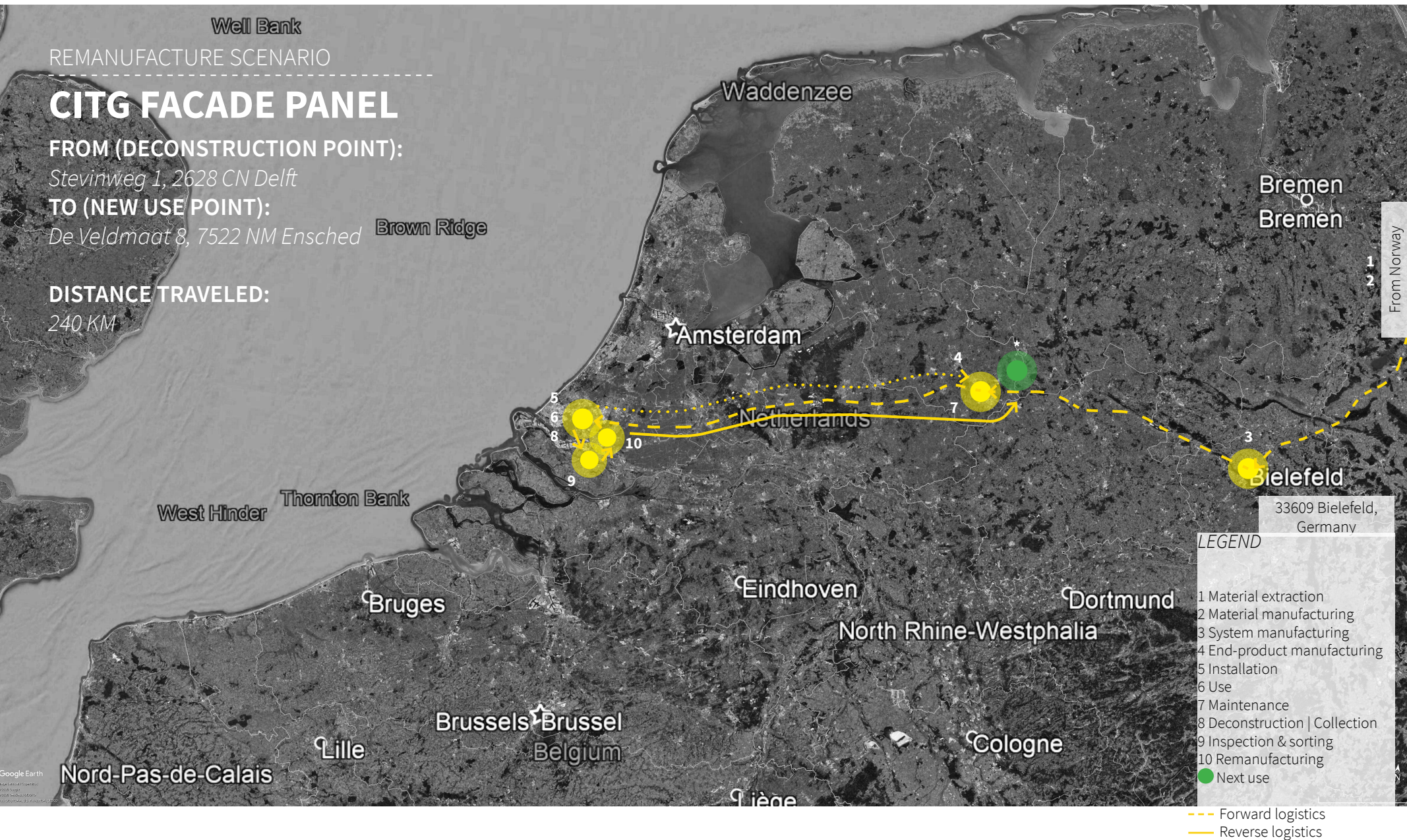
GRAPHICAL FRAMEWORK APPLICATION



GRAPHICAL FRAMEWORK APPLICATION
MFA



GRAPHICAL FRAMEWORK APPLICATION
MFA



FORMAT: Factsheet

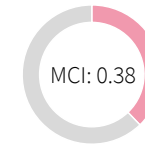
DESTINED TO:
Facade and system providers, designers, engineers.

FACTSHEET

PRODUCT DESCRIPTION

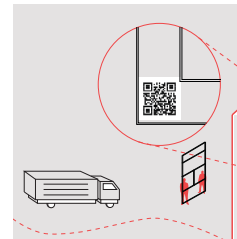
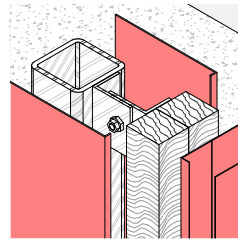
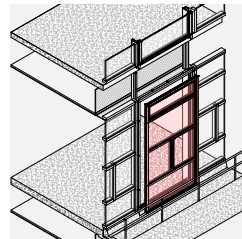
Facade panel for the CITG building
Window wall construction
Facade provider: Alkondor Hengelo
System provider: Shuco
Location: Stevinweg 1, 2628 CN Delft

MCI & CIRCULARITY INDEXES



GRAPHICAL ASSESSMENT: HIGHLIGHTS

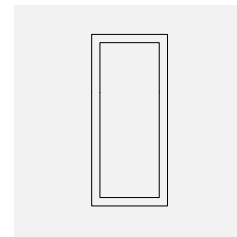
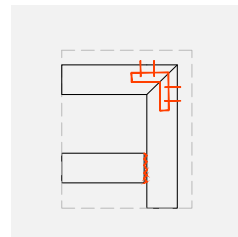
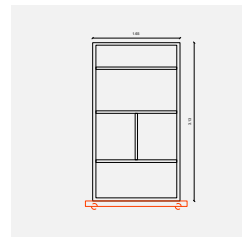
**Consult the Descriptive Assessment*



COMMENTS

- Panel dimension too big for logistics
- Al. covers screwed to interfaces
- * Transportation/coordination as main barrier

DFRL CRITERIA: HIGHLIGHTS



COMMENTS

- Panel dimension too specific
- Wet connection in frame unions
- Non-adjustable mullions & transoms



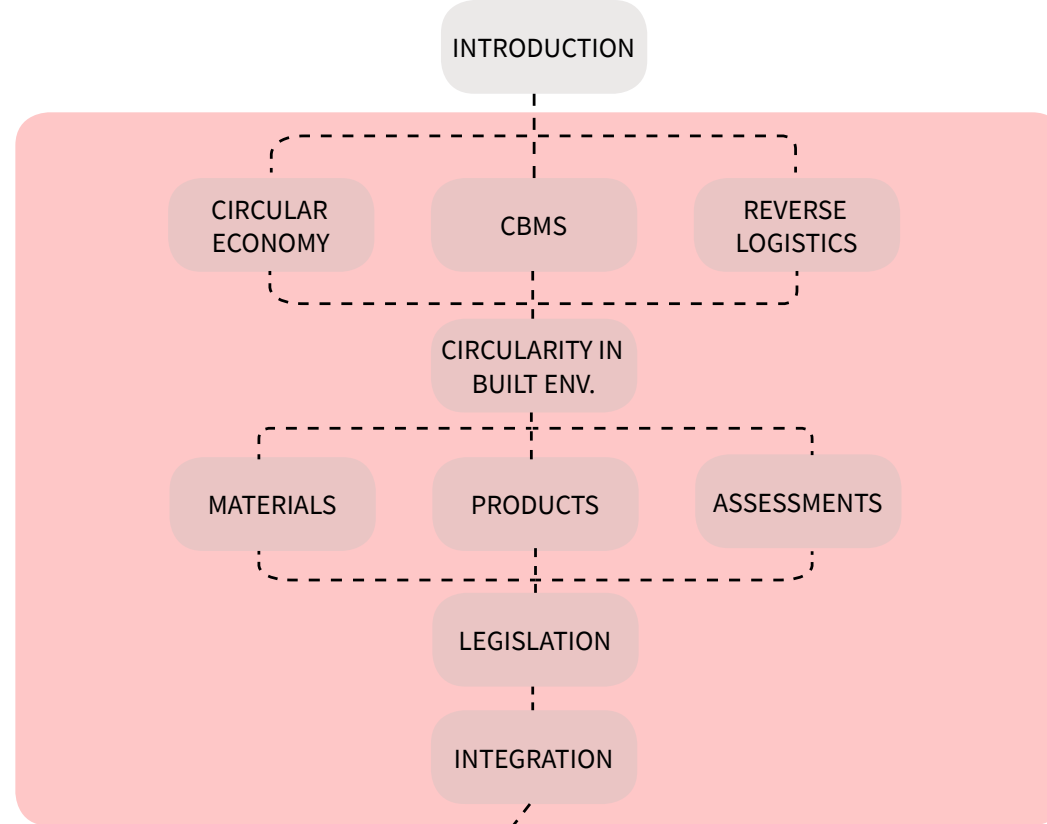
GEOGRAPHICAL ASSESSMENT

LEGEND

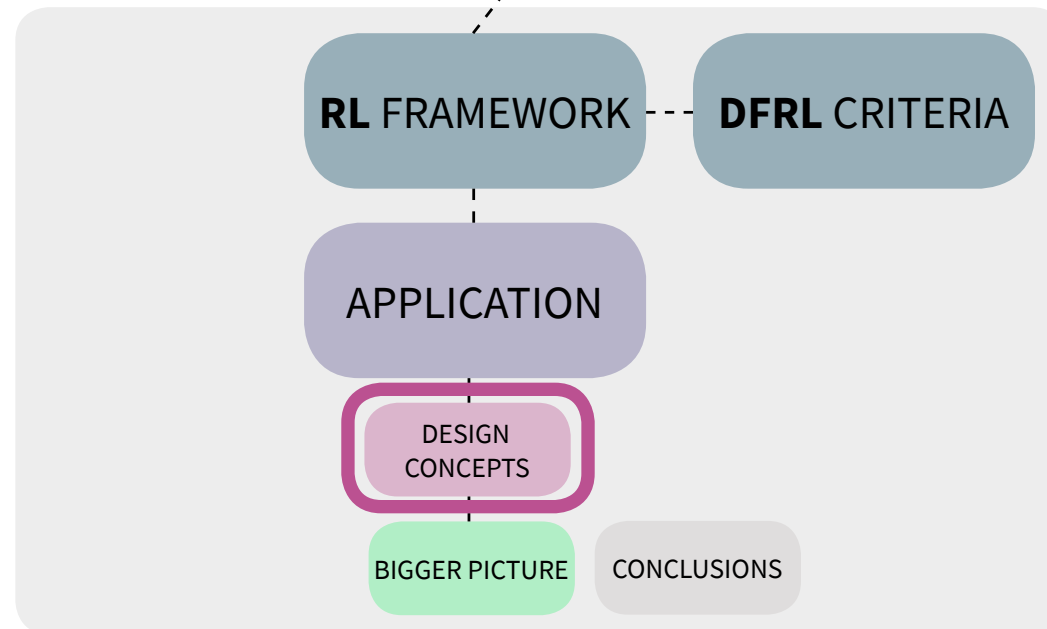
- 1 Material extraction
 - 2 Material manufacturing
 - 3 System manufacturing
 - 4 End-product manufacturing
 - 5 Installation
 - 6 Use
 - 7 Maintenance
 - 8 Deconstruction | Collection
 - 9 Inspection & sorting
 - 10 Remanufacturing
 - Next use
- Forward logistics
--- Reverse logistics

Format 1 Factsheet, summary of the assessments

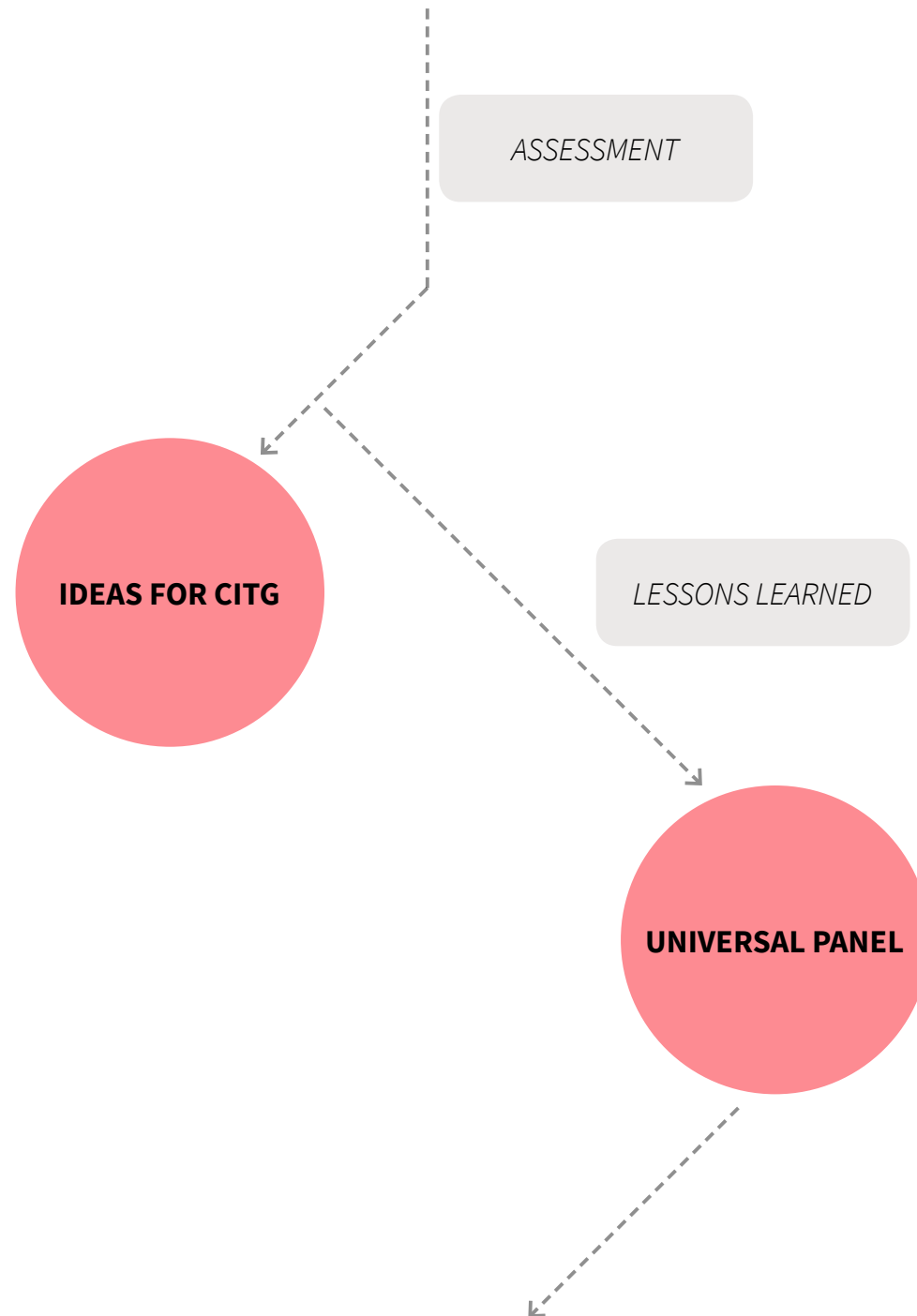
RESEARCH



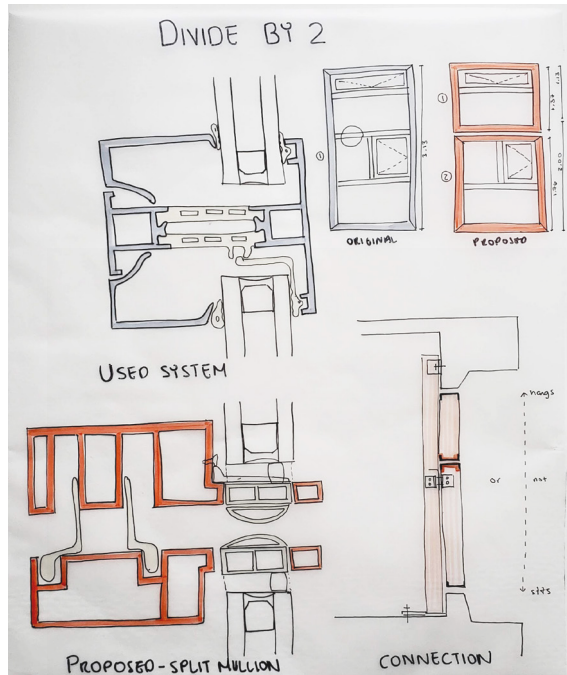
DESIGN



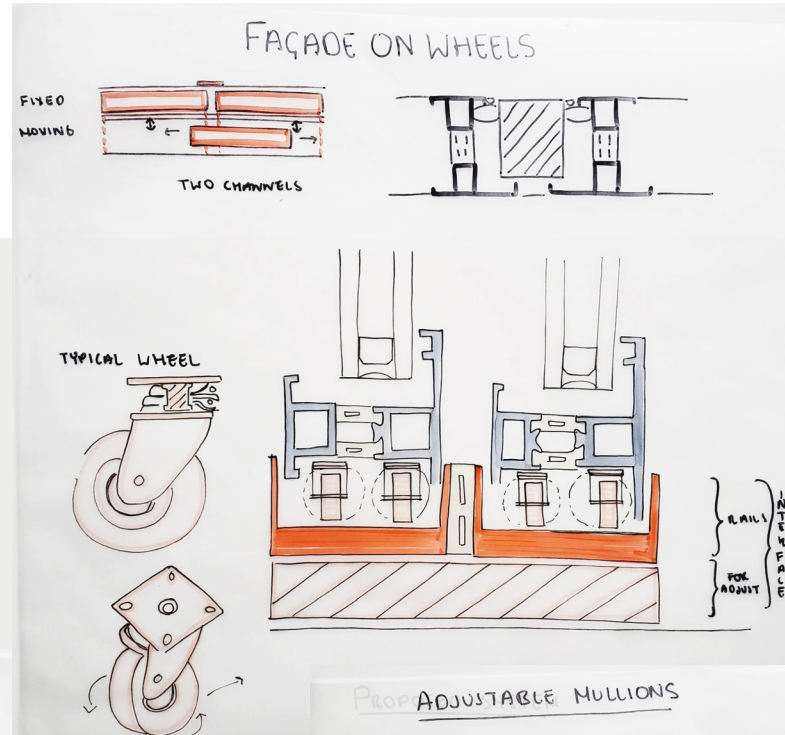
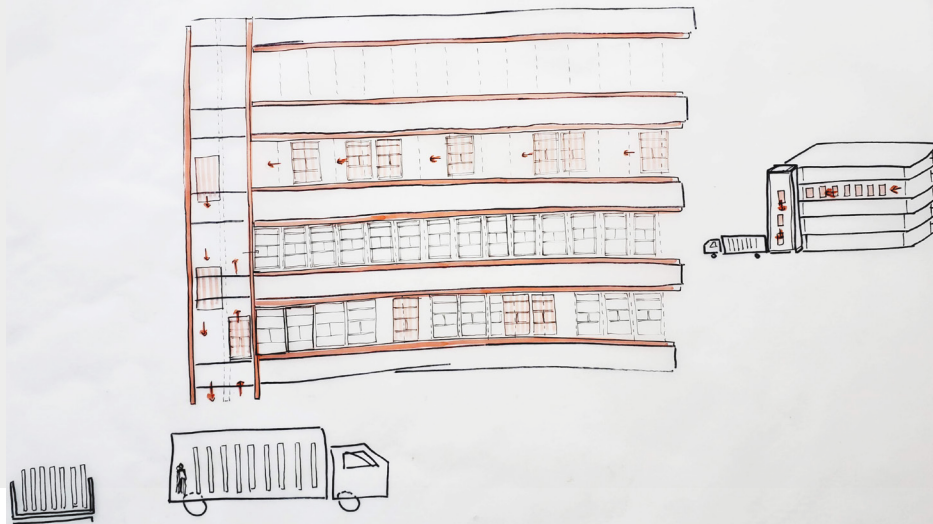
DESIGN CONCEPTS



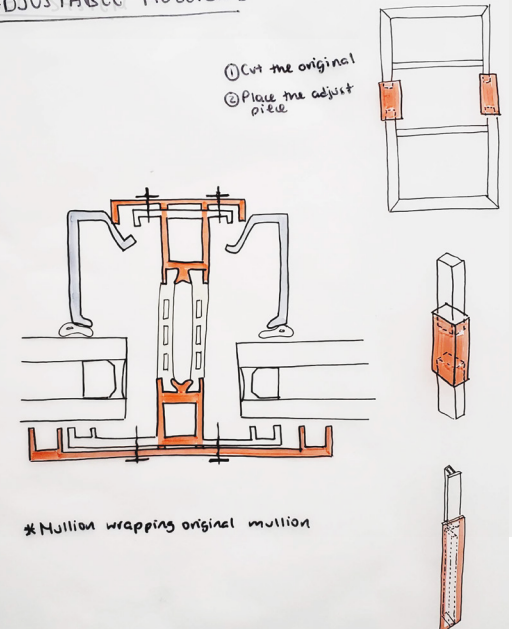
IDEAS FOR CITG BRAINSTORM



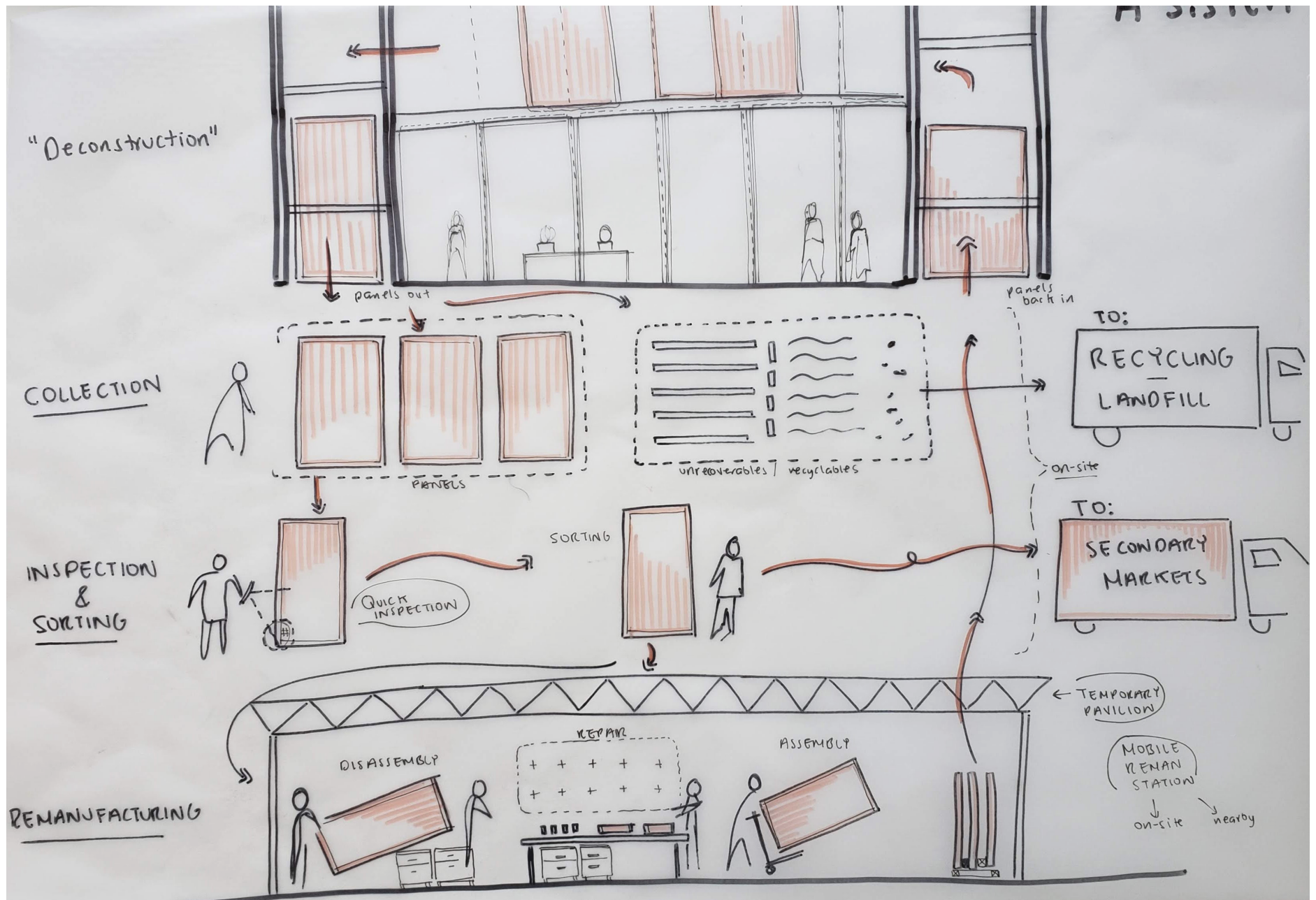
ELEVATOR



PROPOSED ADJUSTABLE MULLIONS



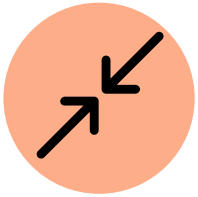
IDEAS FOR CITG BRAINSTORM



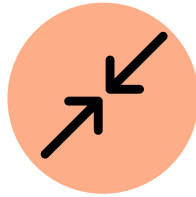
MOBILE STATIONS

LESSONS LEARNED

DESIGN



INTERFACE FOR ON-SITE ADJUSTMENT



RIGHT PANEL DIMENSIONS

LITERATURE



INSPECTION & SORTING ON SITE



ASSURING MARKET DEMAND

INTERVIEWS

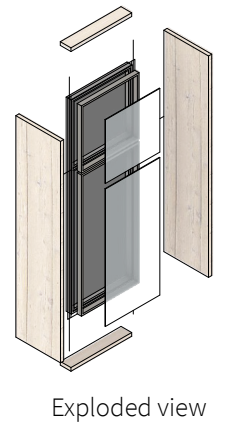
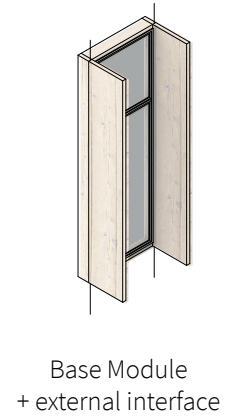
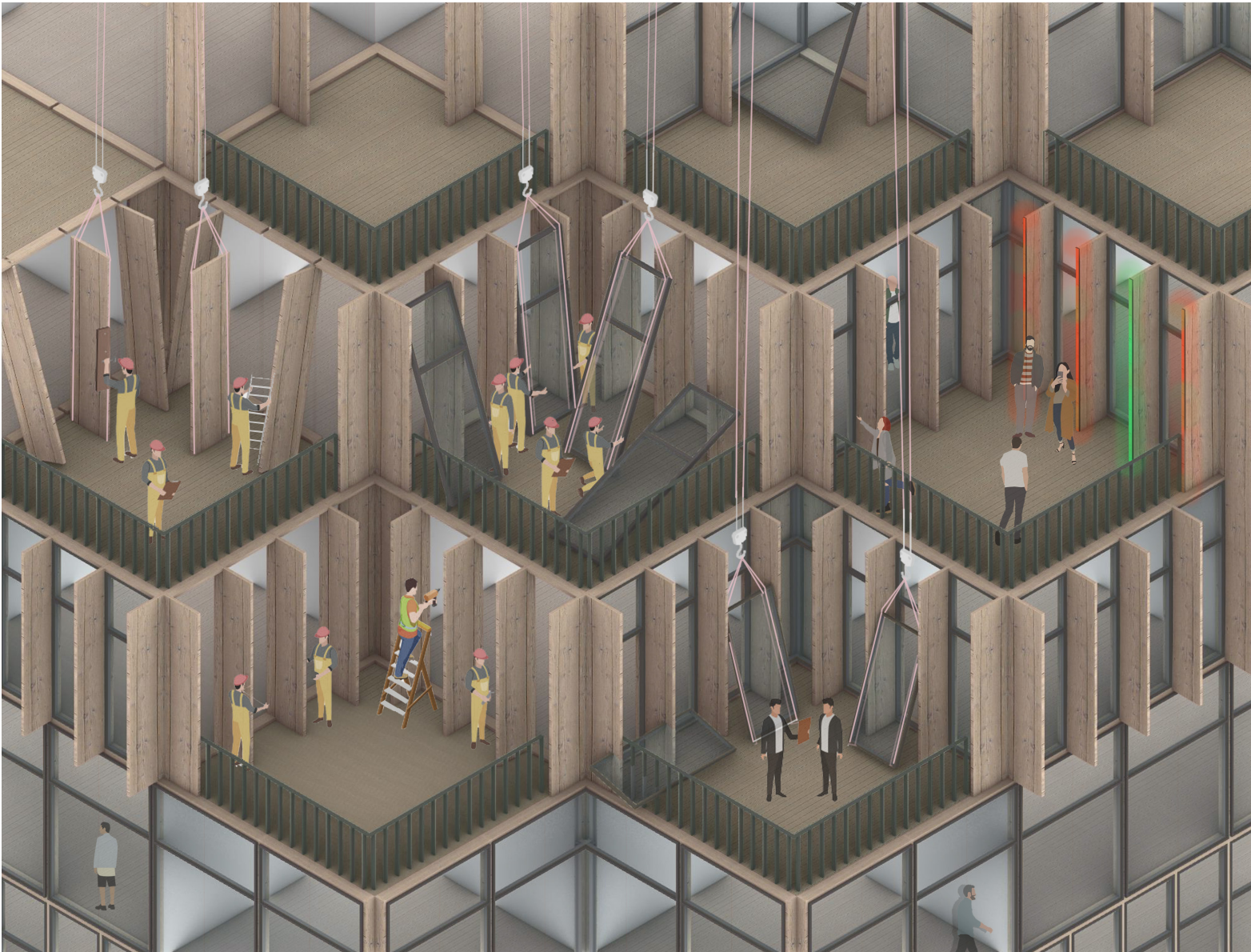


NO SPECIFIC DIMENSIONS



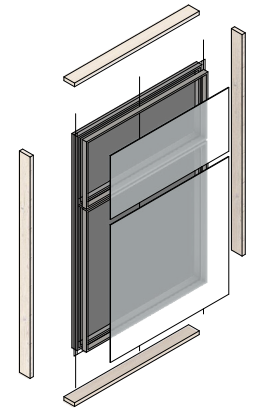
TRANSPORTATION IS A BARRIER

UNIVERSAL PANEL

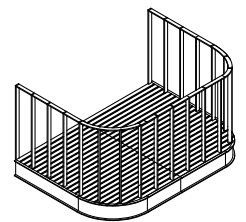


Base Module + external interface + info system

UNIVERSAL PANEL



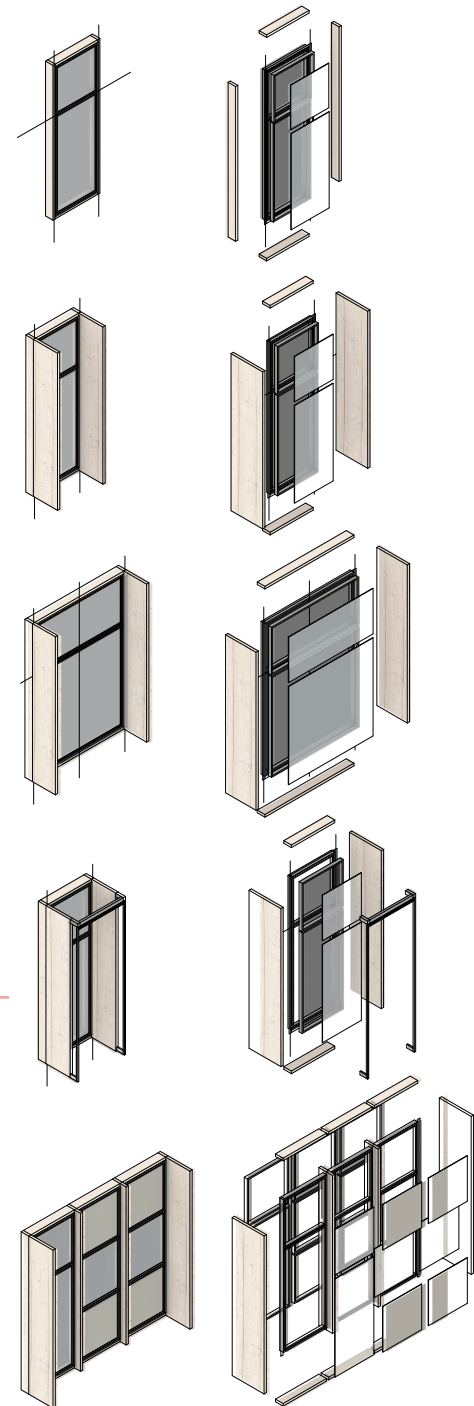
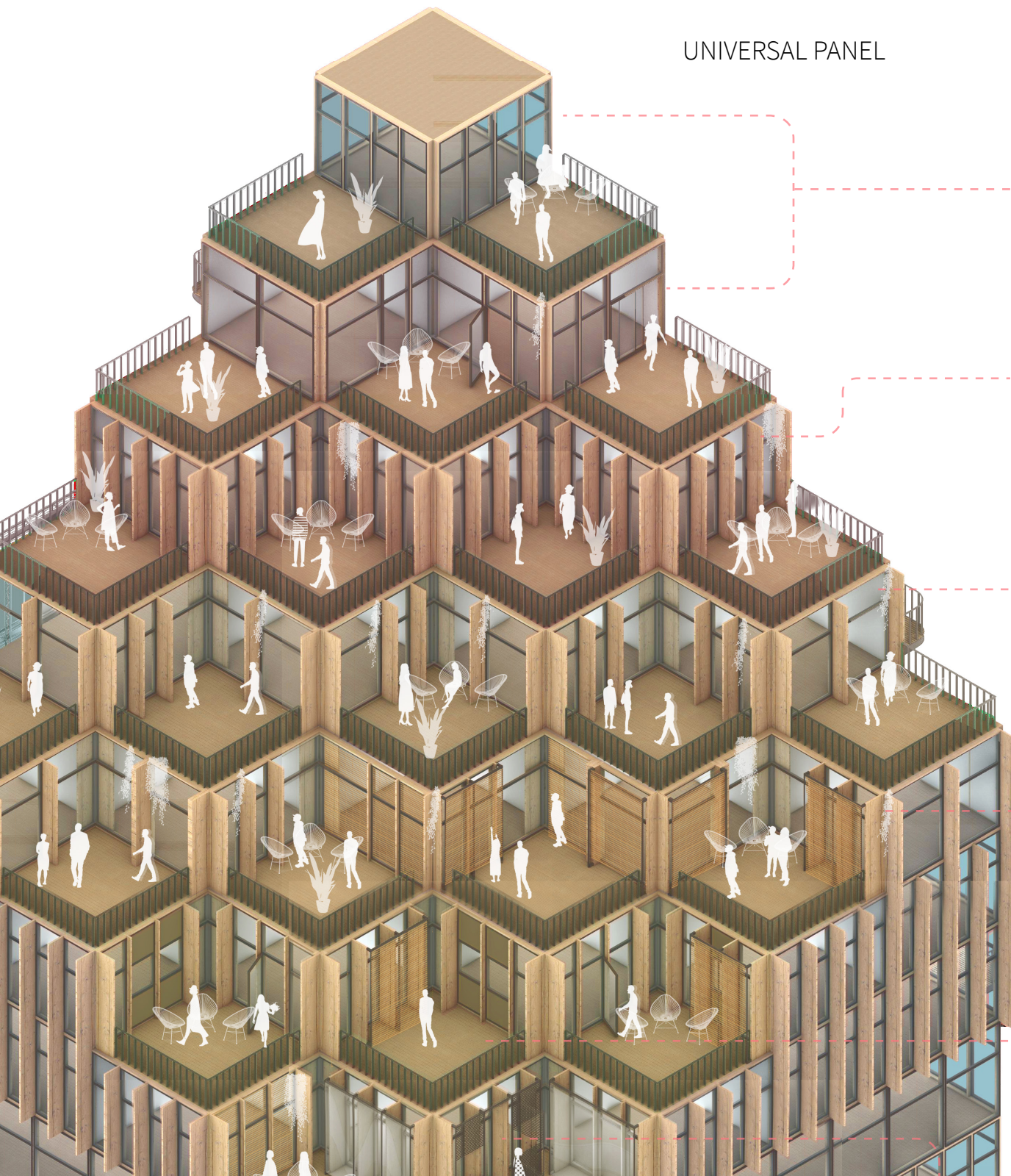
Double Module
2.40 x 3.60 m



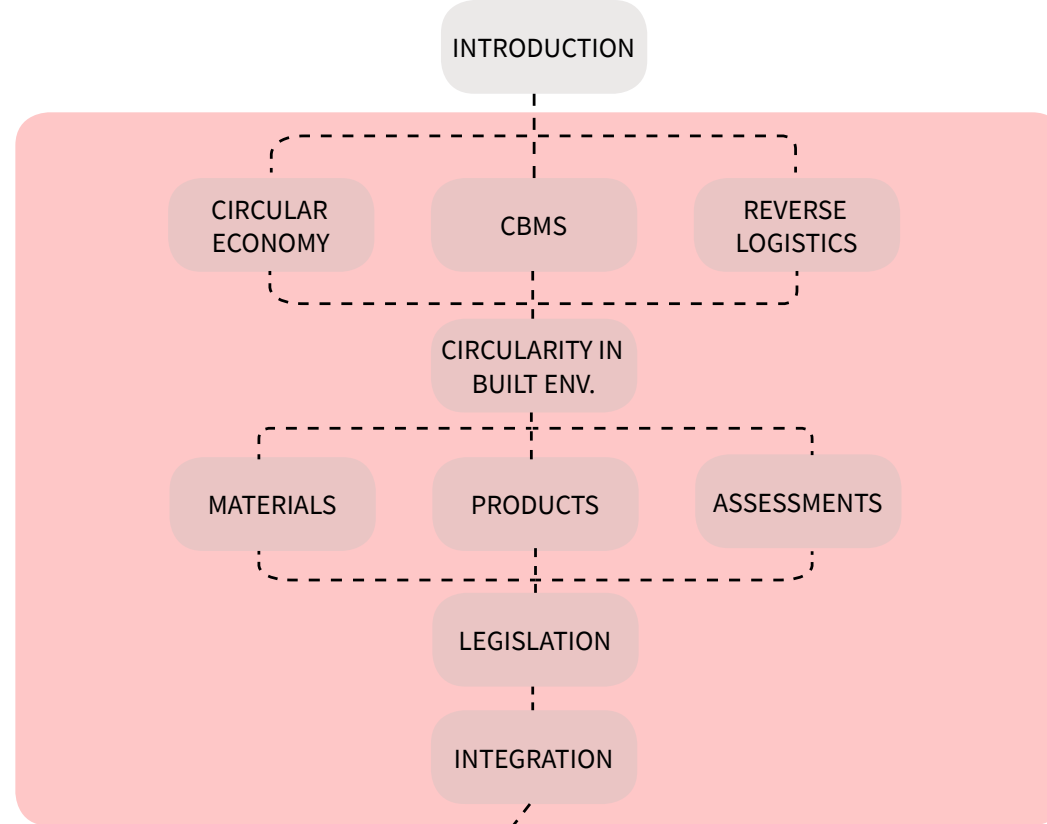
Façade addition
Curved balcony

Base Module + unitized balconies

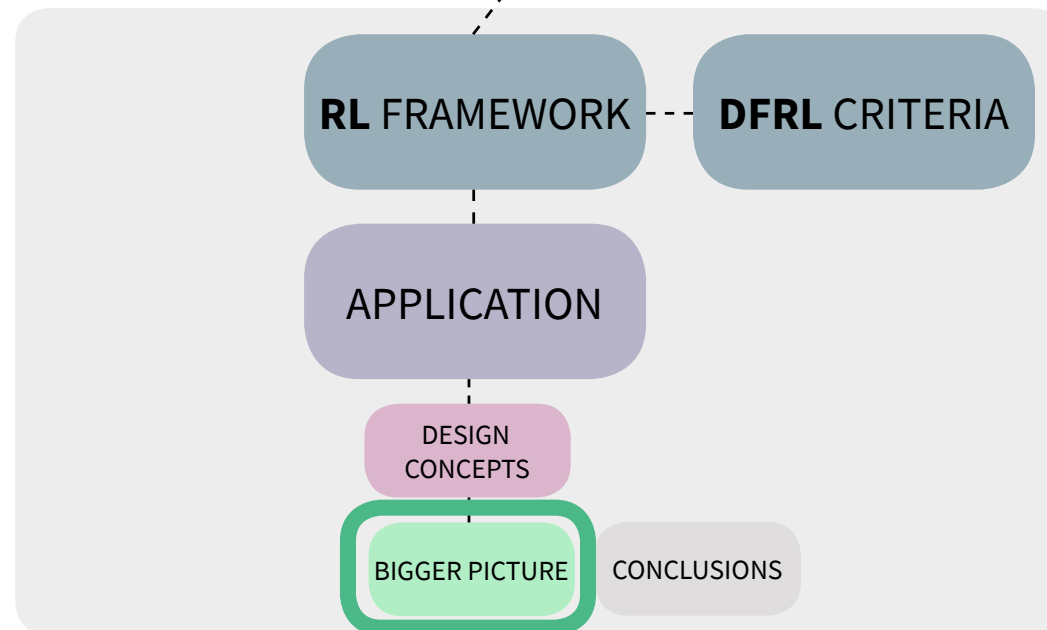
UNIVERSAL PANEL



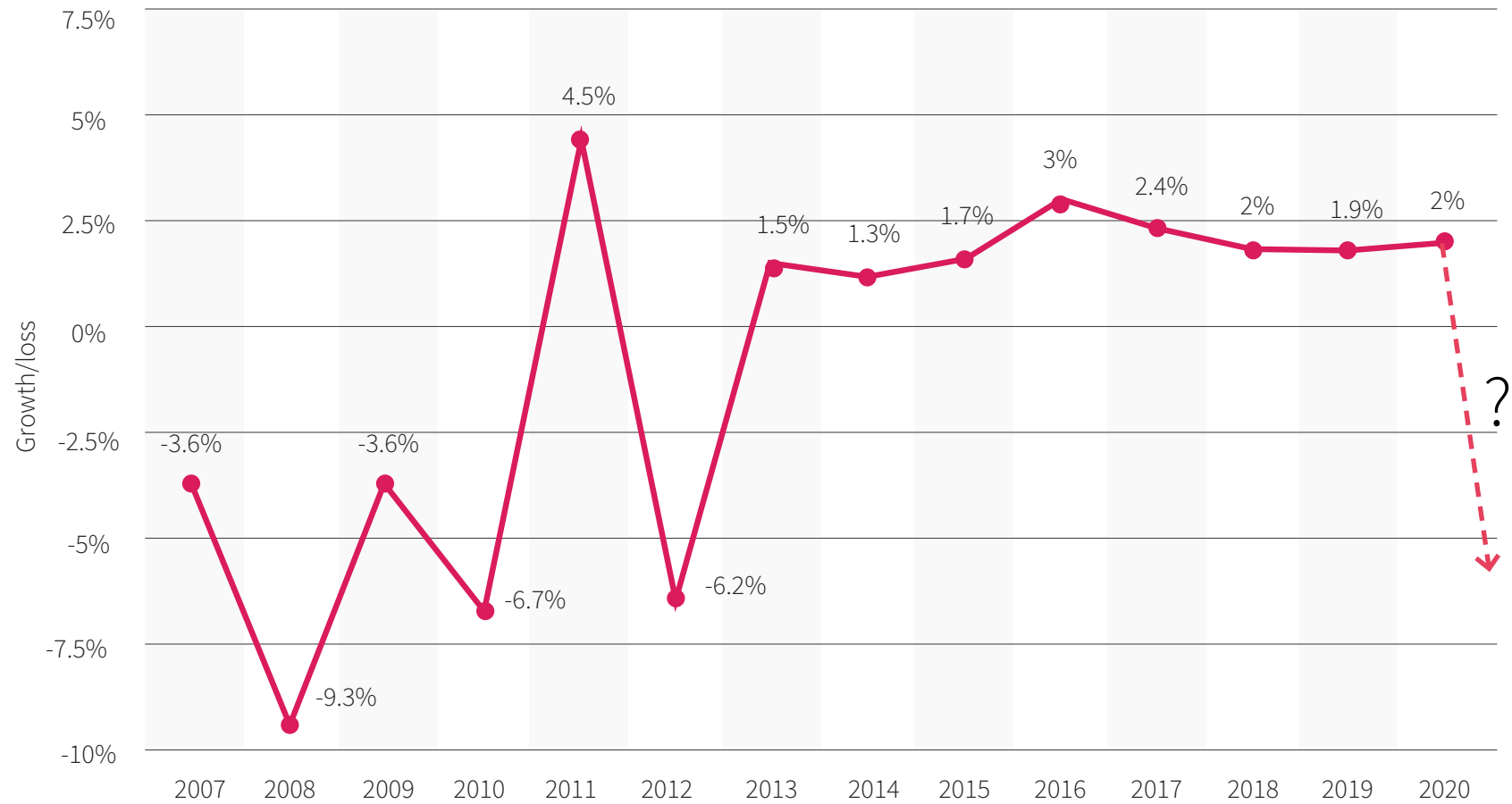
RESEARCH



DESIGN

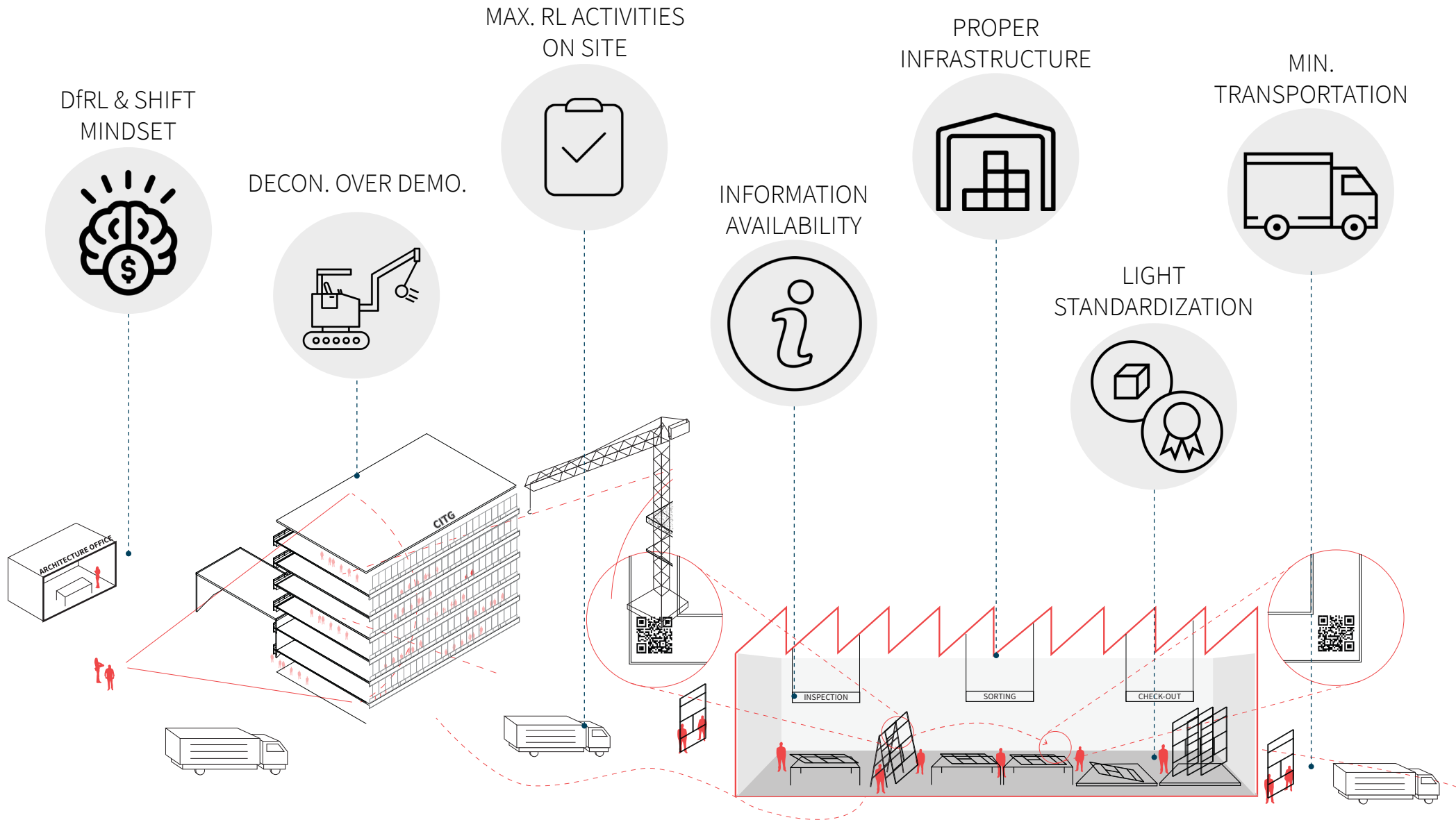


CONSTRUCTION INDUSTRY



ANNUAL PERCENTAGE GROWTH/LOSS IN THE CONSTRUCTION INDUSTRY IN
EUROPE (STADISTA 2020)

CONCLUSIONS ACCELERATORS

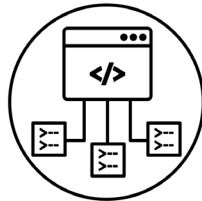


FUTURE RESEARCH

FACADE CRITERIA
VALIDATION



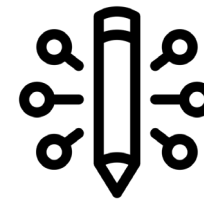
FRAMEWORK
VALIDATION



PROTOTYPING



IMPACT
CALCULATION



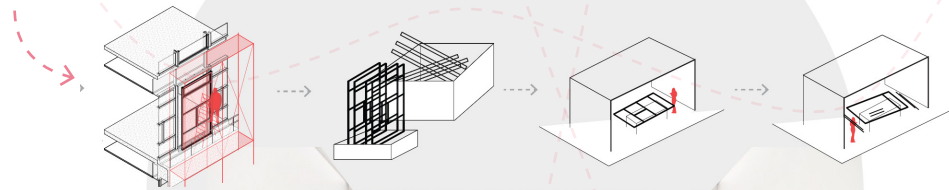
FINANCIAL
ANALYSIS



FUTURE VISION



CIRCULAR
BUILDINGS



RL



LEGISLATION
+ DESIGNERS



SOCIETY

PLAY THE VIDEO

THANKS

ANY QUESTIONS?

QUANTITATIVE ASSESSMENT

