



Graduation thesis P5 Presentation
Meike Mantje
31-10-2023

REUSE OF SCRAP WOOD

as a building product

SCRAP WOOD

WOOD WASTE FROM
CONSTRUCTION & DEMOLITION INDUSTRY



SCRAP WOOD

WOOD WASTE FROM
CONSTRUCTION & DEMOLITION INDUSTRY

435 KTON SCRAP WOOD
↳ 50.000 CLT HOUSES



INDEX

CONTEXT

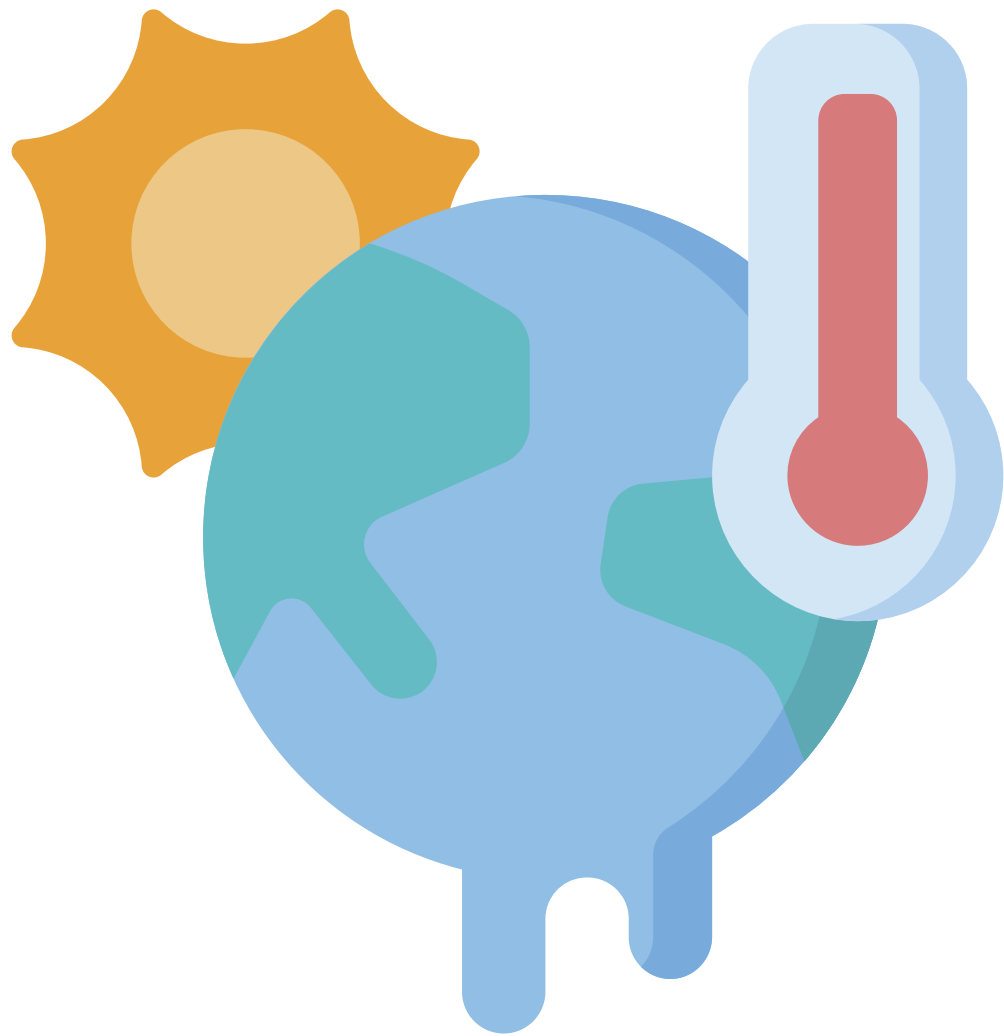
SCRAP WOOD

CLT

CLT FROM SCRAP WOOD

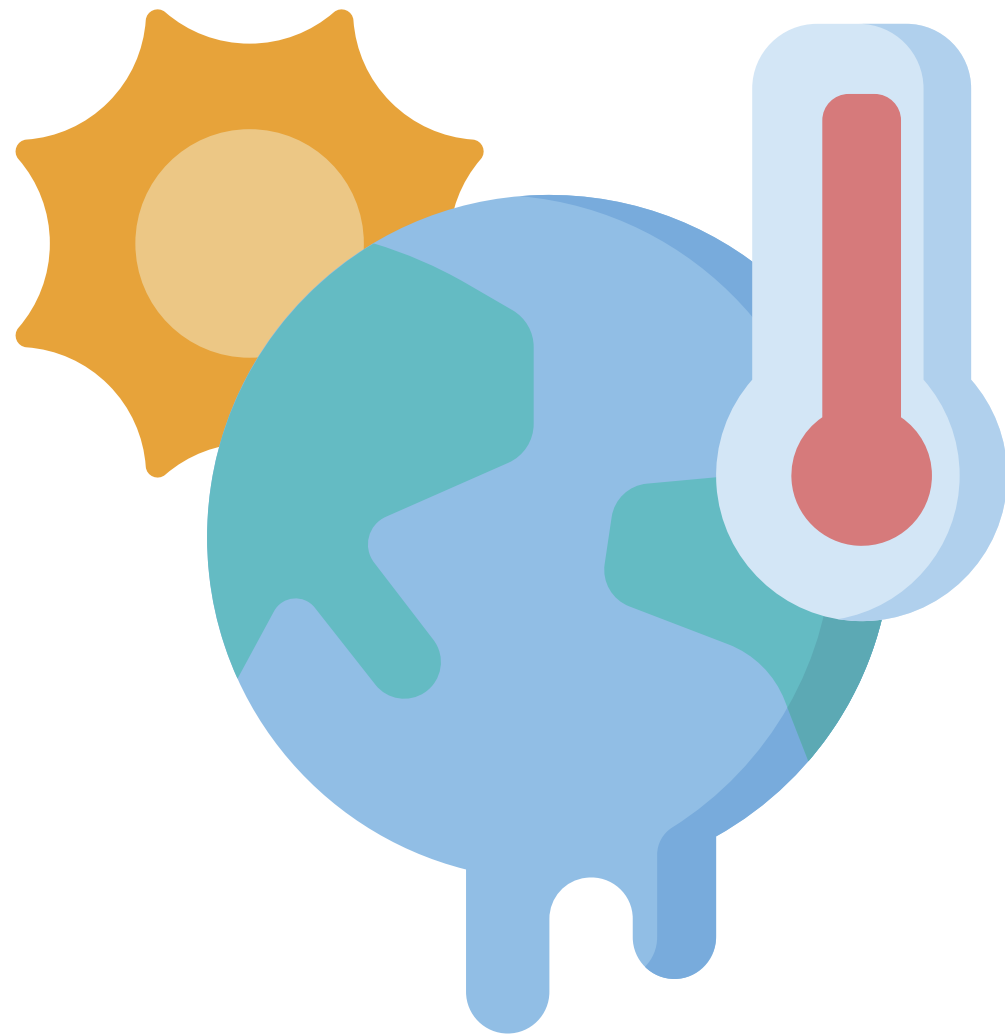


CONTEXT: CLIMATE CHANGE



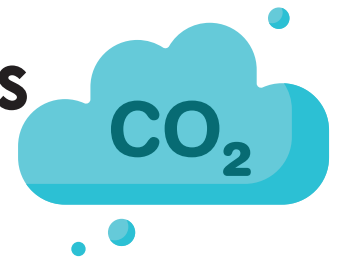
Climate change

CONTEXT: CLIMATE CHANGE



Climate change

Emission greenhouse gases
CO₂ & Nitrogen

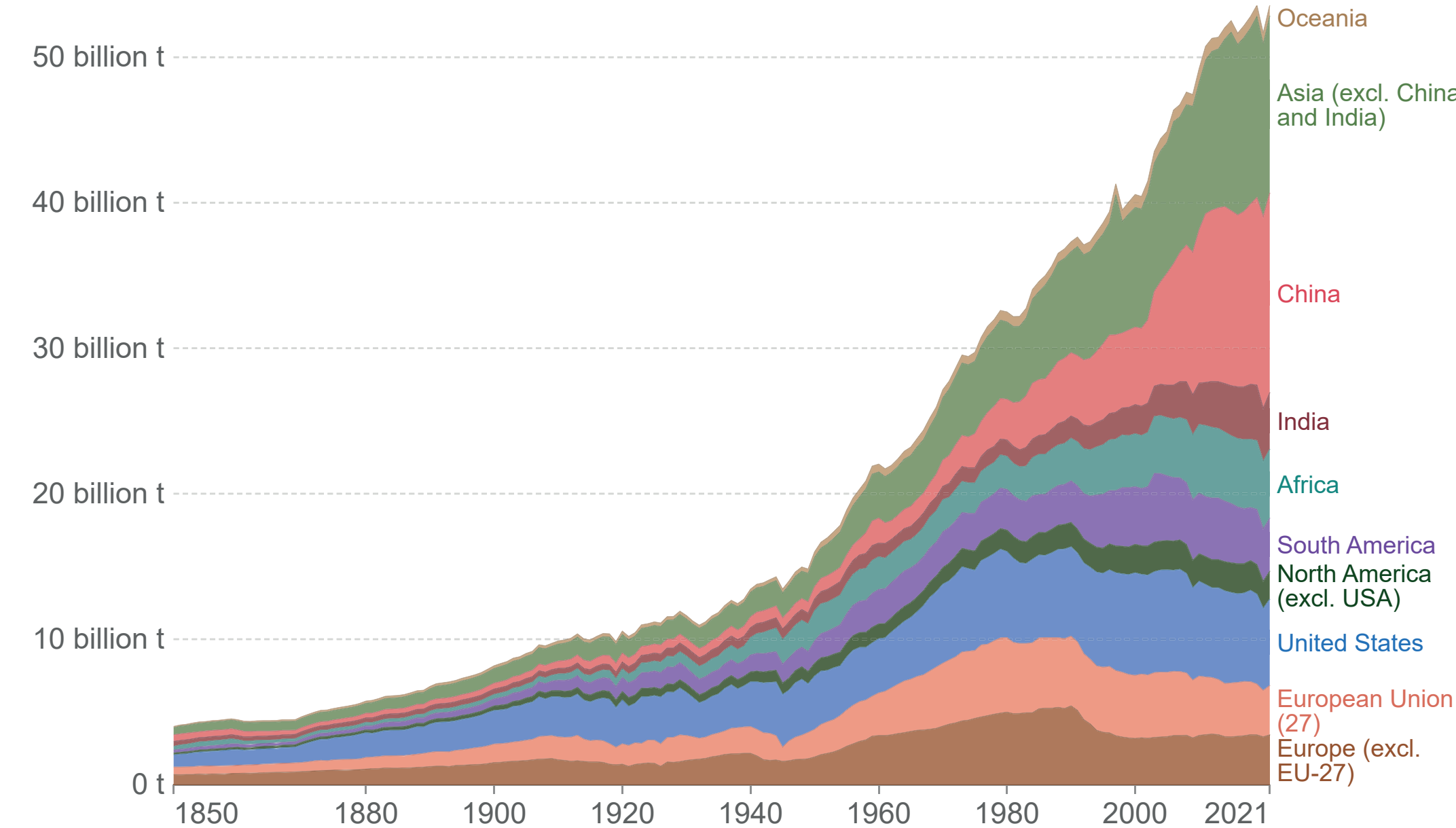


CONTEXT: CLIMATE CHANGE

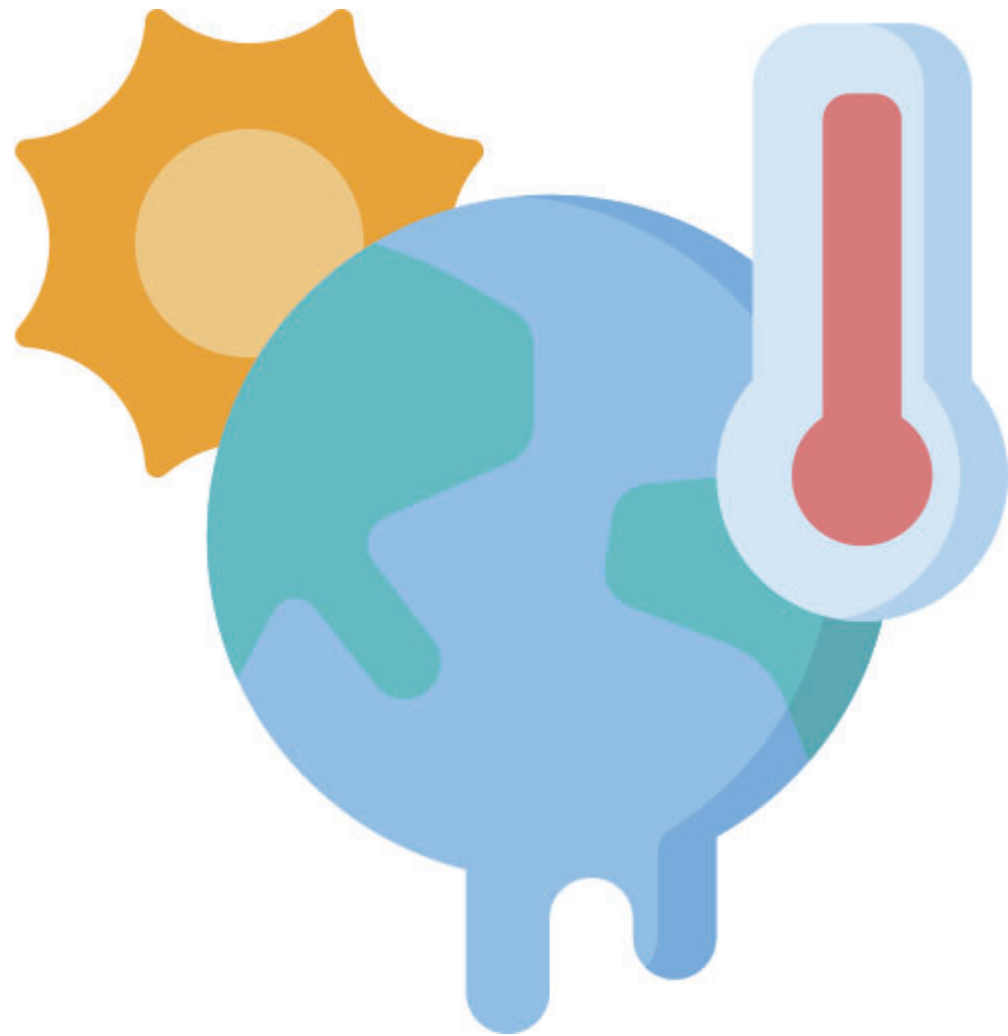
Annual greenhouse gas emissions by world region, 1850 to 2021

Our World
in Data

Greenhouse gas emissions include carbon dioxide, methane and nitrous oxide from all sources, including agriculture and land use change. They are measured in carbon dioxide-equivalents over a 100-year timescale.

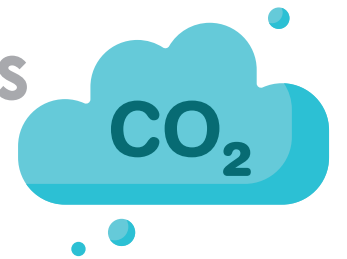


CONTEXT: CLIMATE CHANGE



Climate change

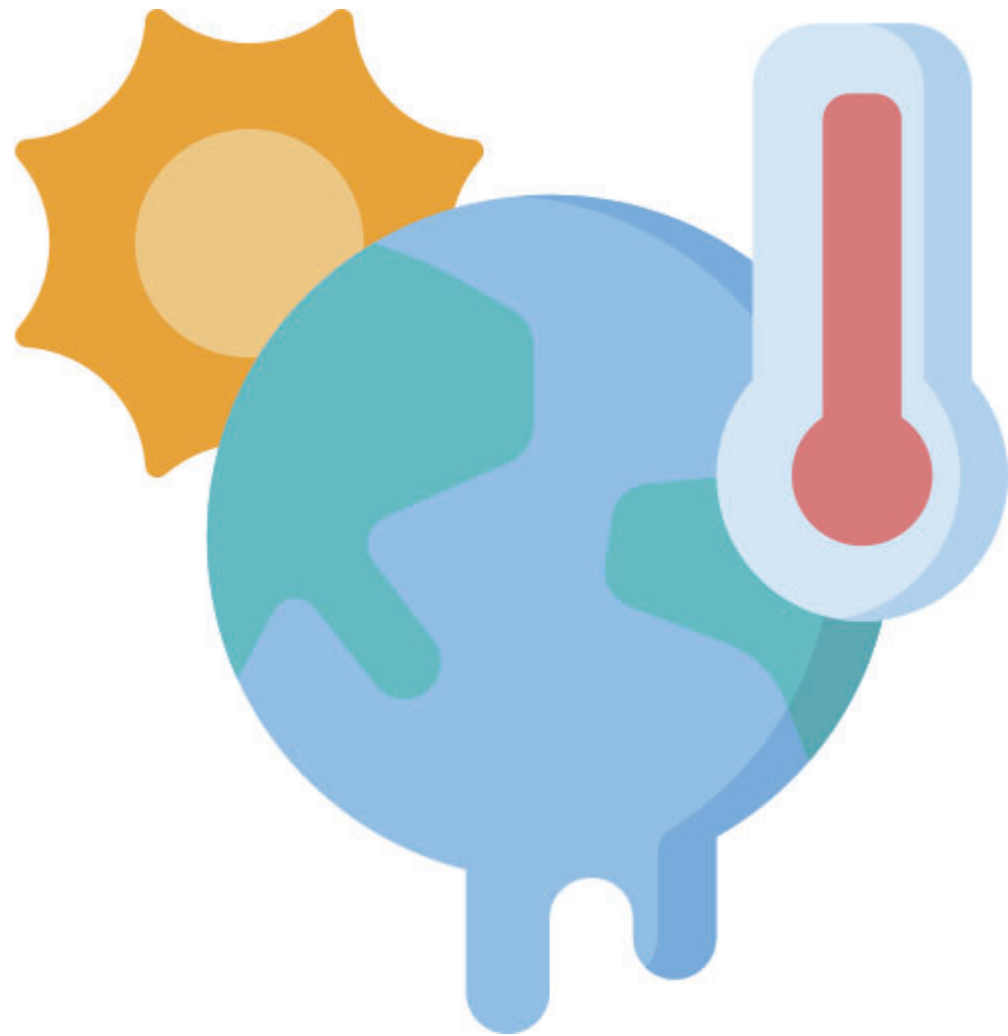
Emission greenhouse gases
CO₂ & Nitrogen



Massive material consumption
= 11 Gt CO₂ eq by production

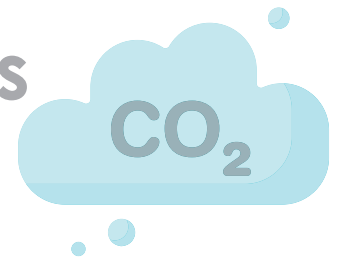


CONTEXT: CLIMATE CHANGE



Climate change

Emission greenhouse gases
CO₂ & Nitrogen

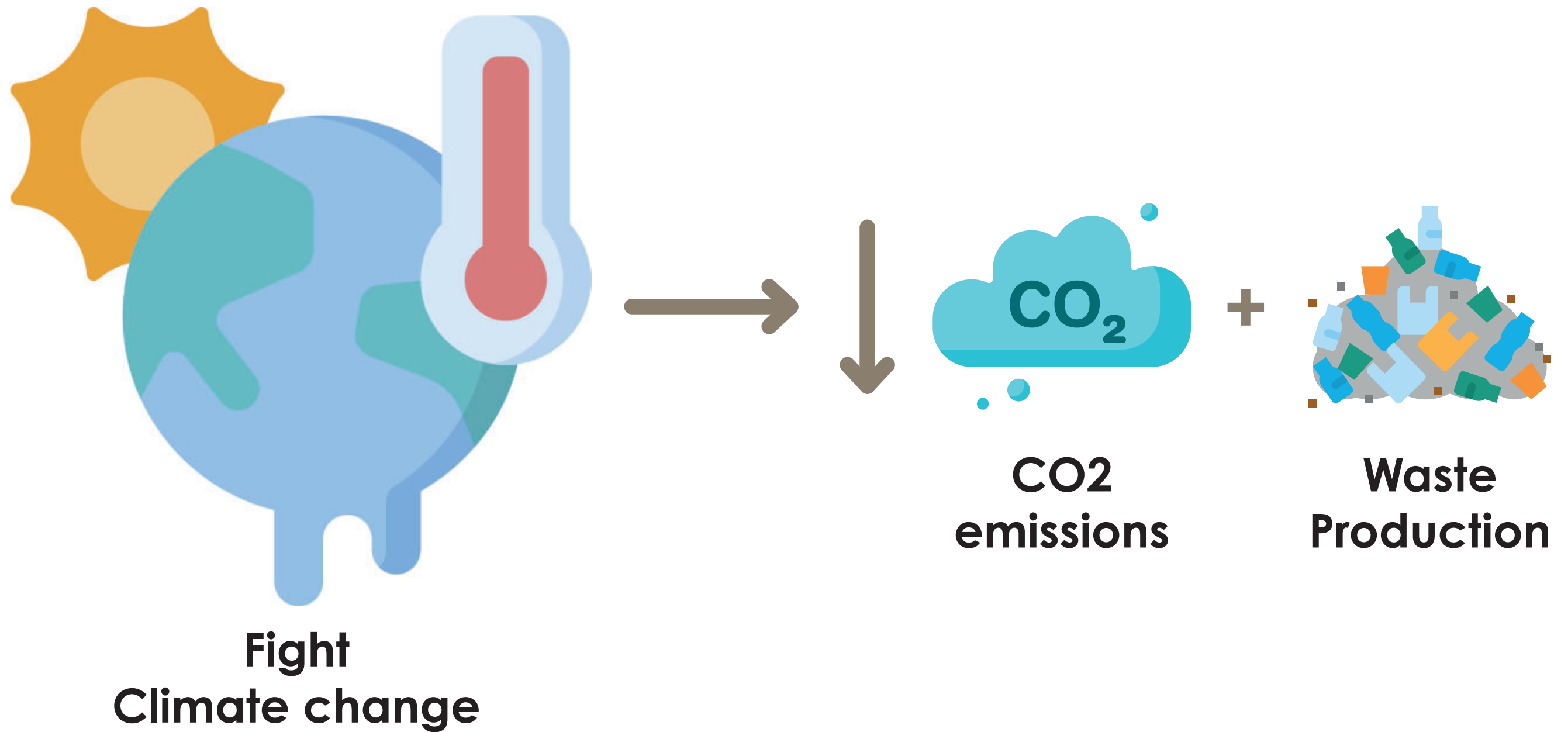


Massive material consumption
= 11 Gt CO₂ eq by production

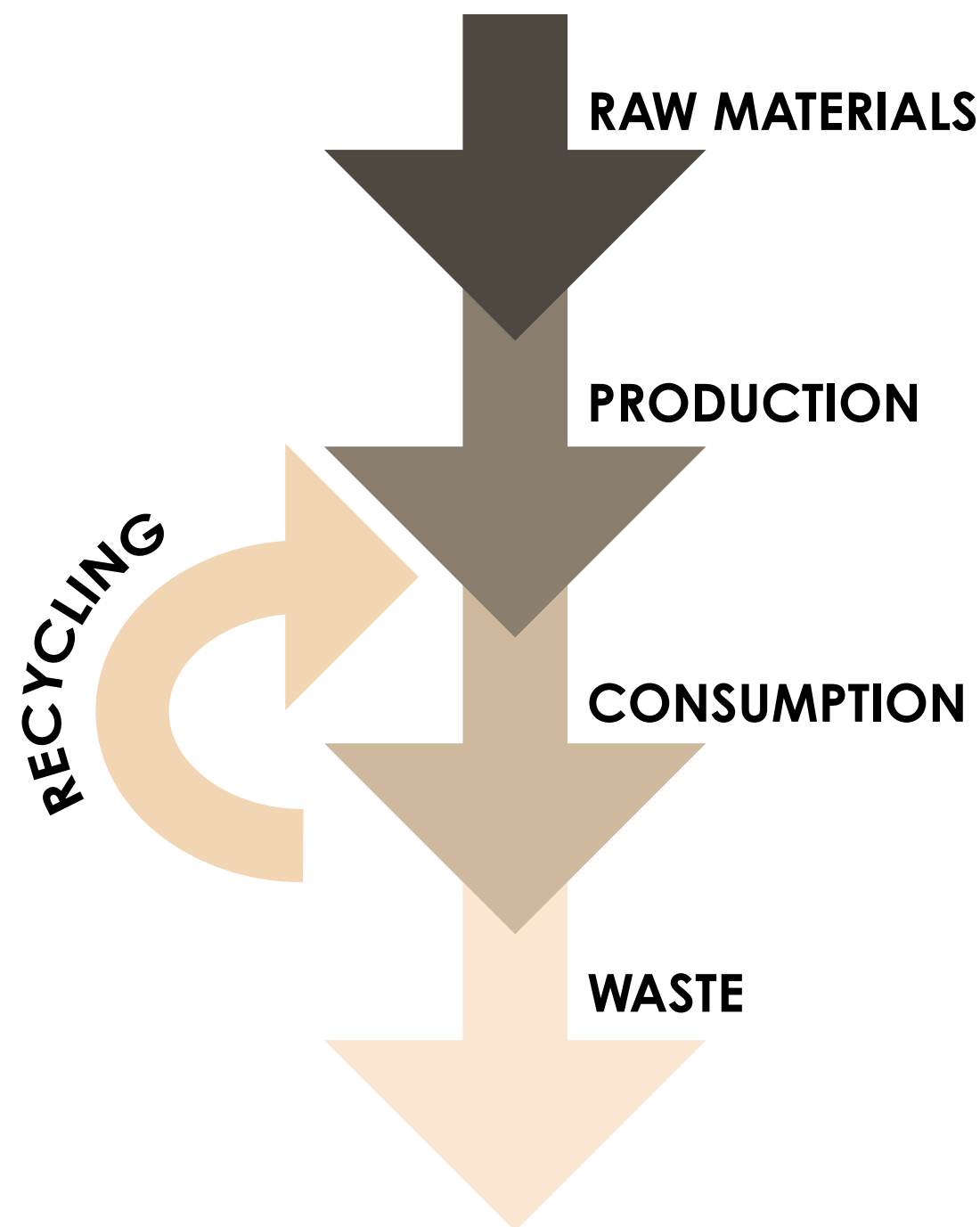


+ Enormous waste production
2 Billion ton

CONTEXT: CLIMATE CHANGE

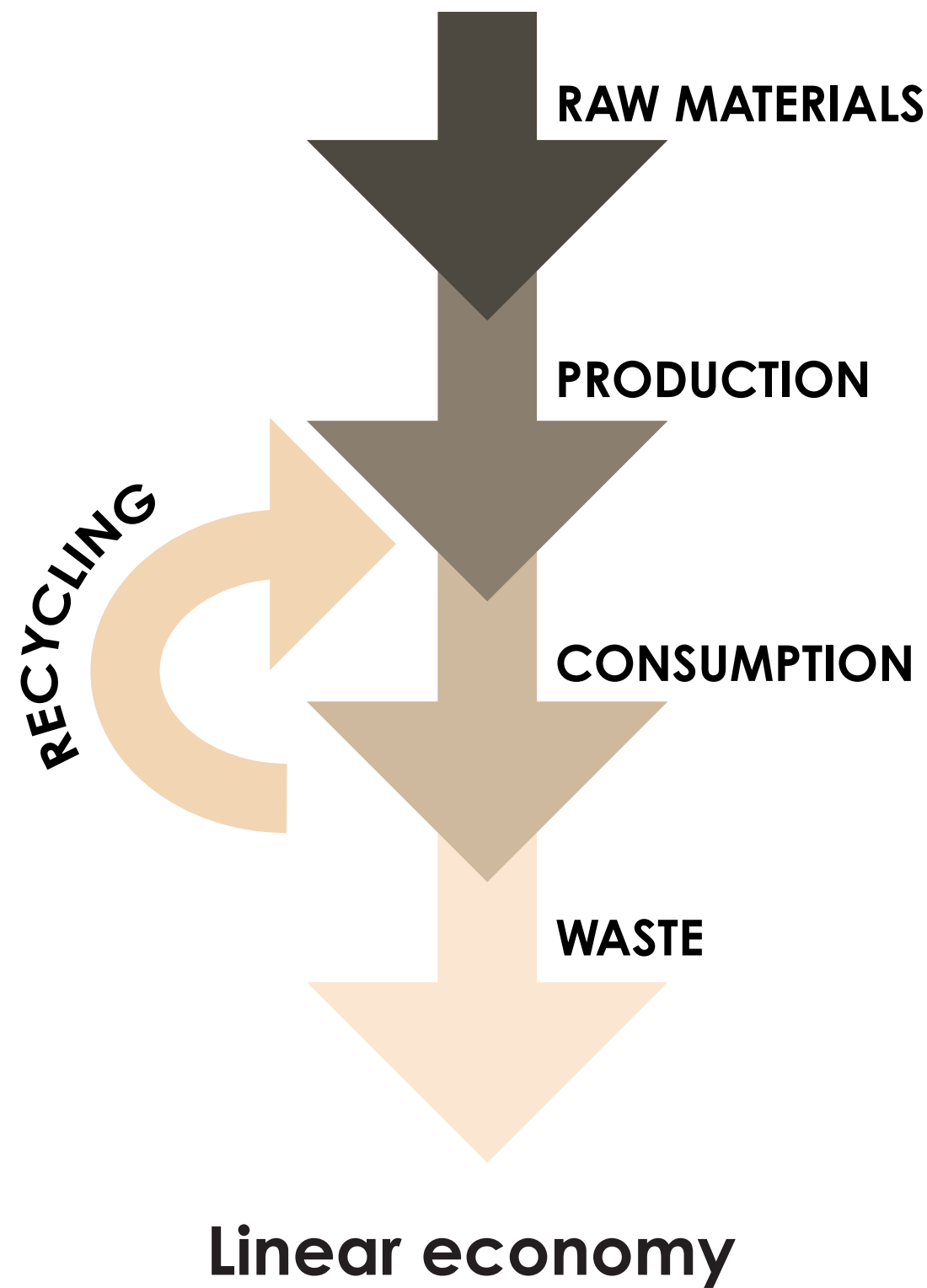


CONTEXT: LINEAR ECONOMY



Linear economy

CONTEXT: LINEAR ECONOMY



Thrift store

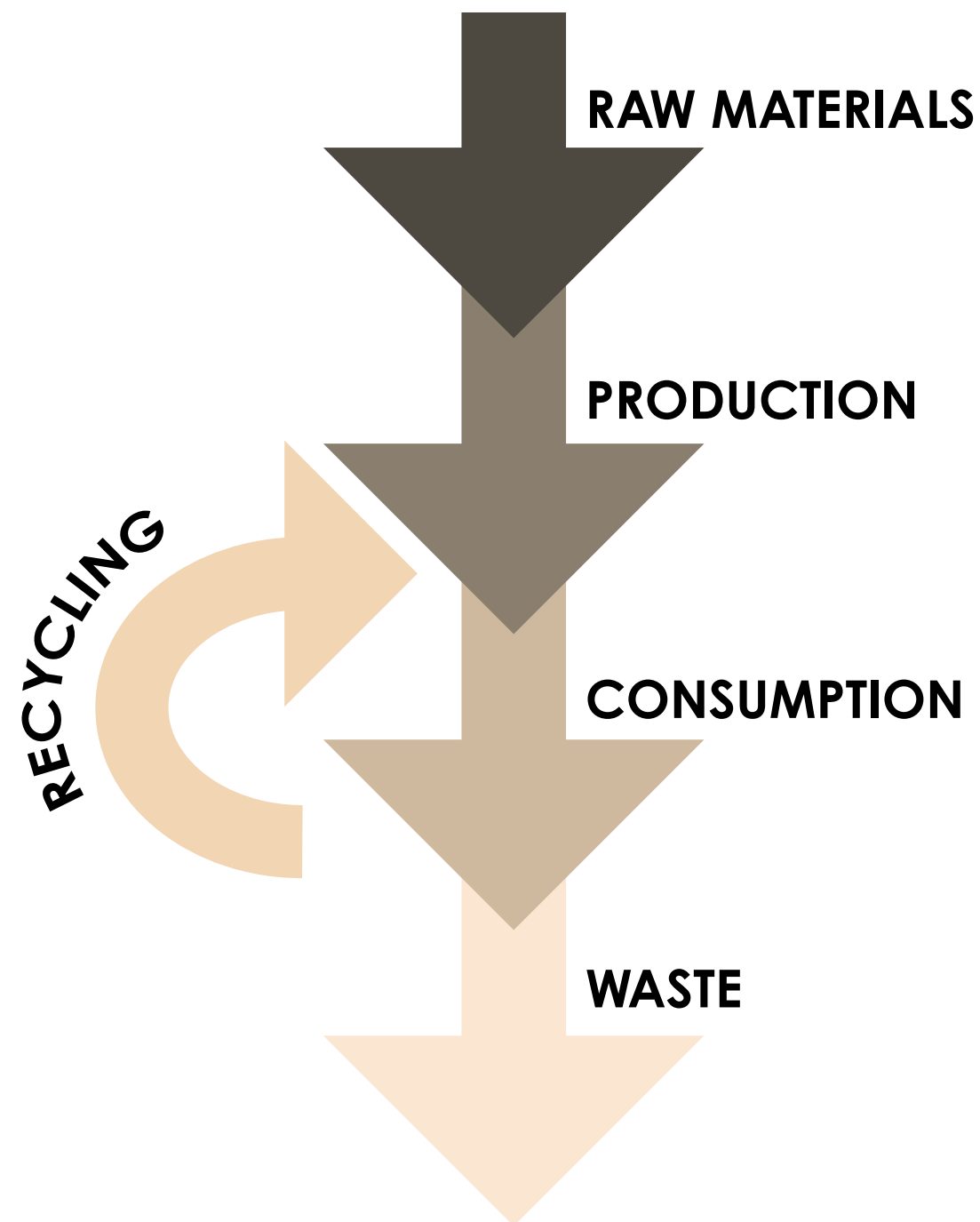
Source: (Stichting voor het Goede Doel, n.d.)



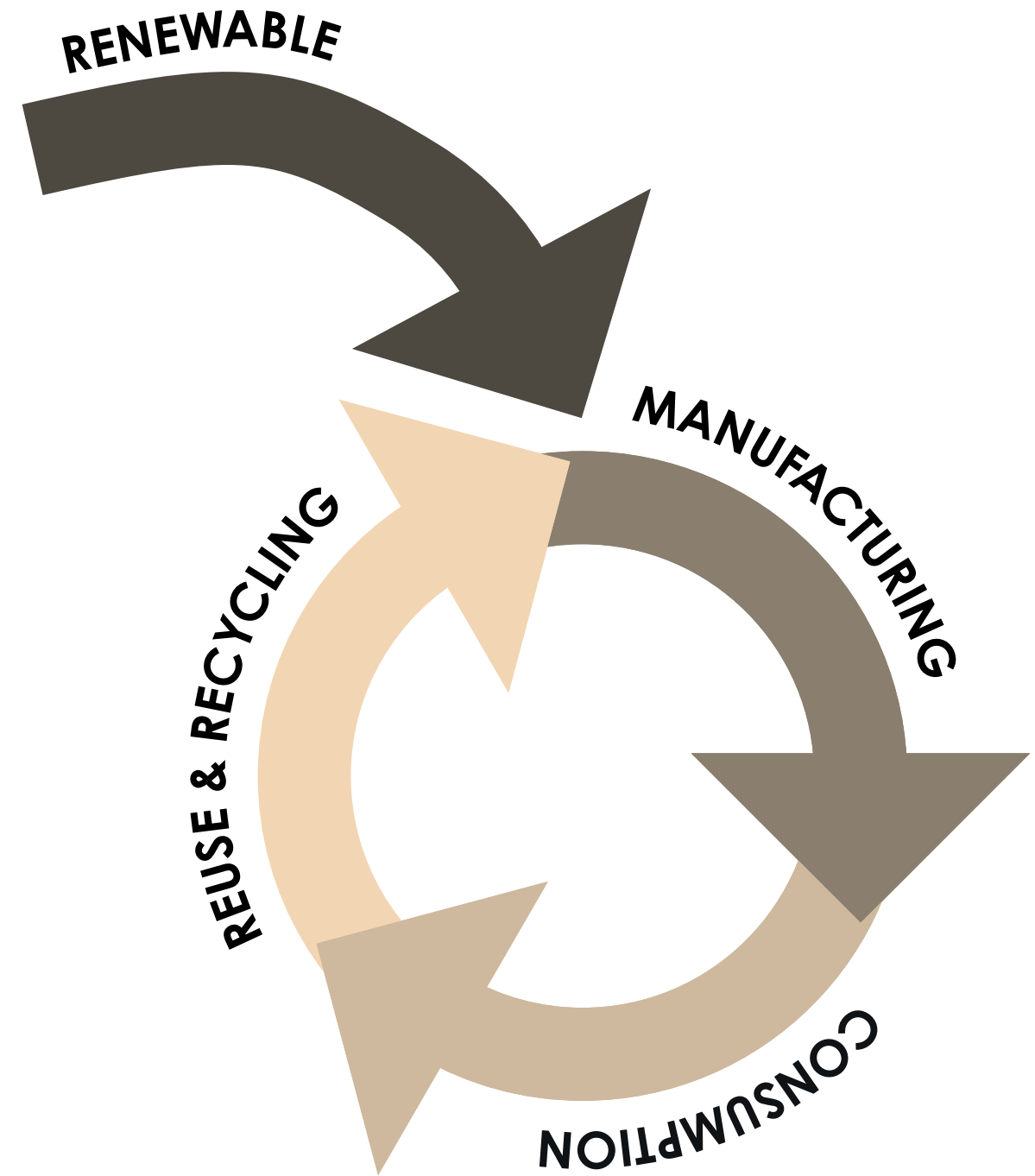
Waste separation

Source: (Weststrate, n.d.)

CONTEXT: LINEAR TO CIRCULAR ECONOMY



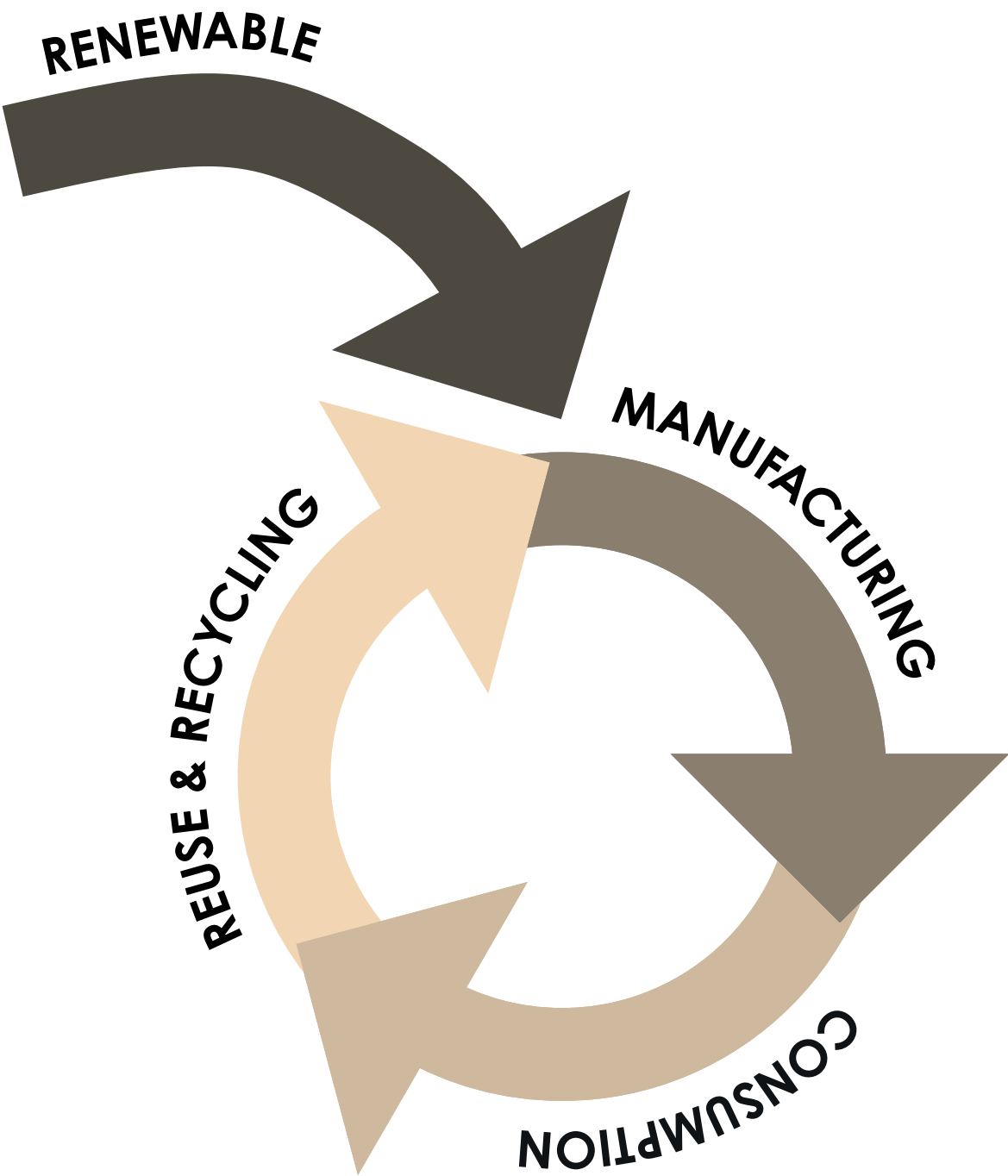
Linear economy



Circular economy

CONTEXT: CIRCULAR ECONOMY

Circular economy by 2050



Circular economy

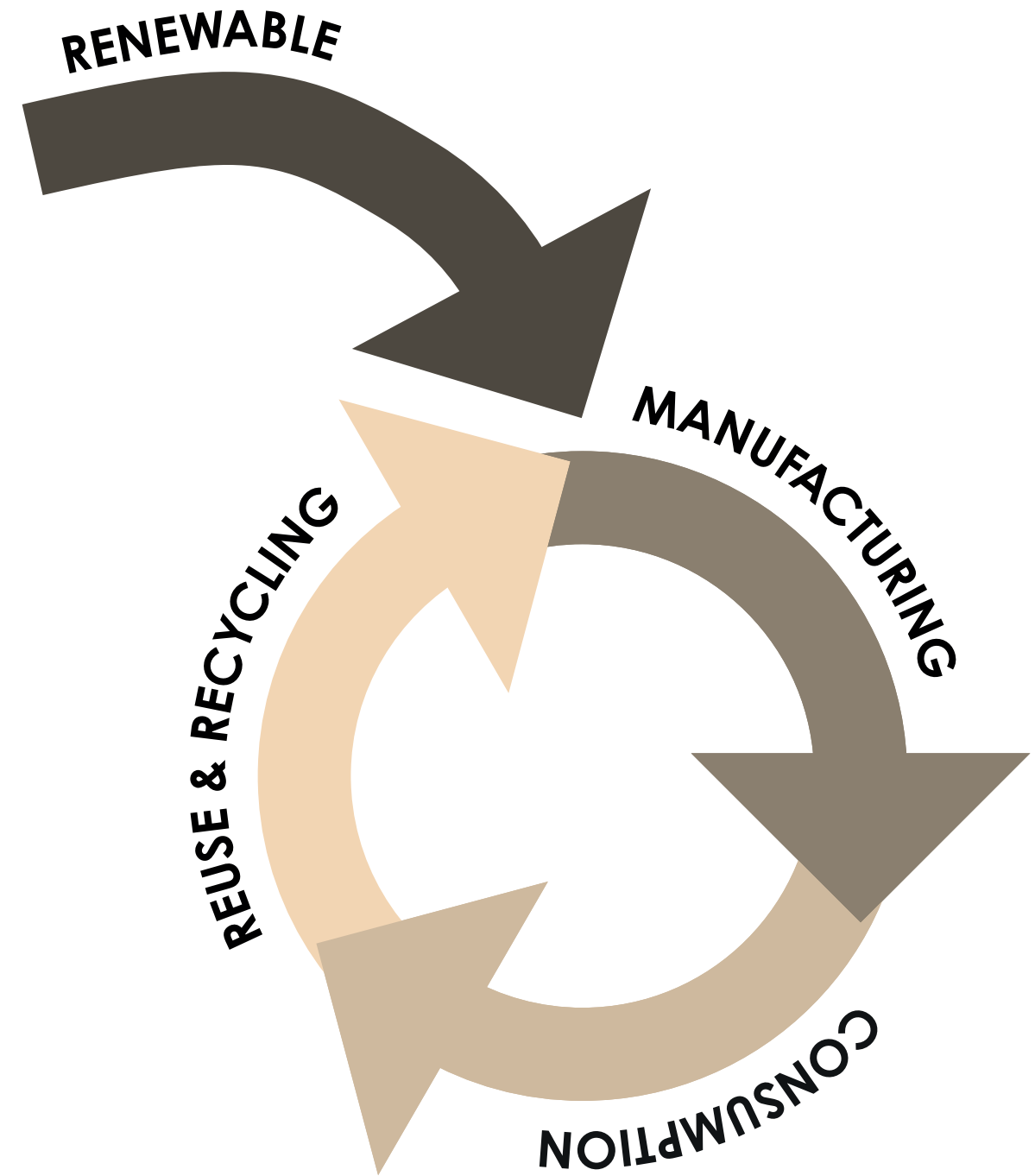
CONTEXT: CIRCULAR ECONOMY

Circular economy by 2050

Goals by 2030:

60% less carbon emissions

50% less use of primary raw materials



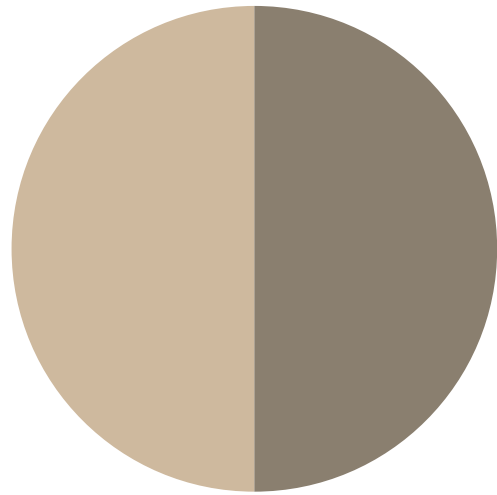
Circular economy

CONTEXT: BUILT ENVIRONMENT

Build environment:

CONTEXT: BUILT ENVIRONMENT

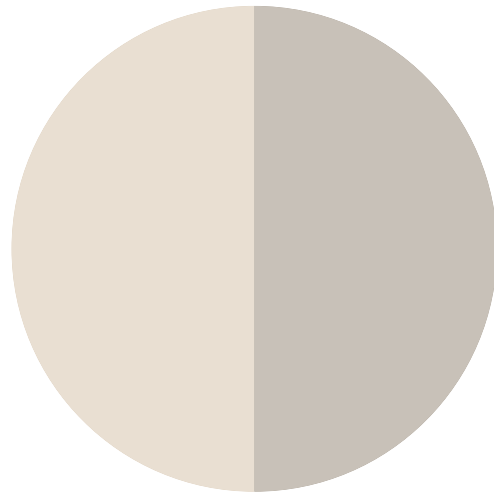
Build environment:



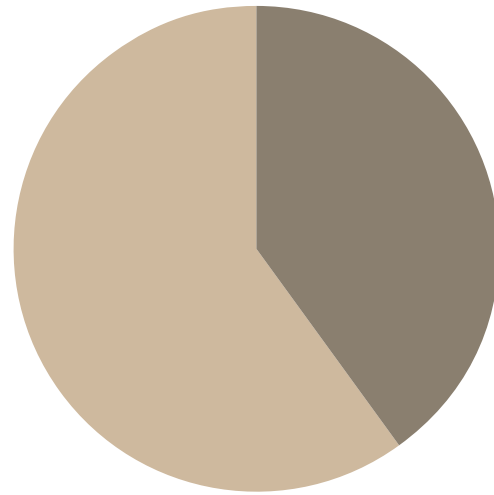
**50% total
raw material
use**

CONTEXT: BUILT ENVIRONMENT

Build environment:



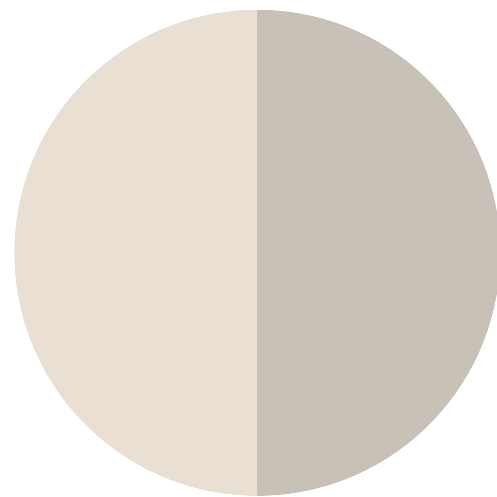
**50% total
raw material
use**



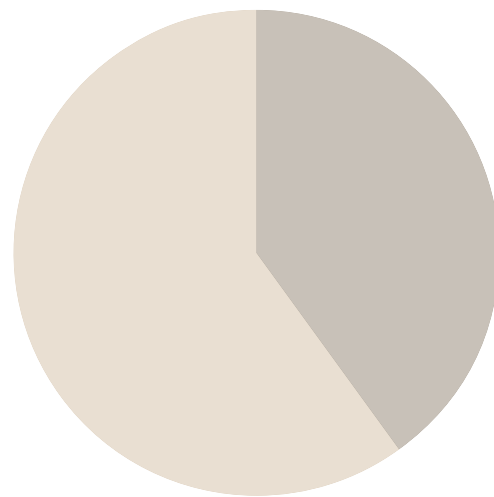
**40% total
waste
production**

CONTEXT: BUILT ENVIRONMENT

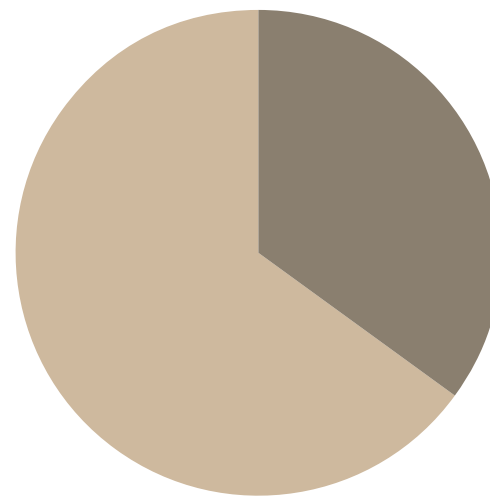
Build environment:



**50% total
raw material
use**



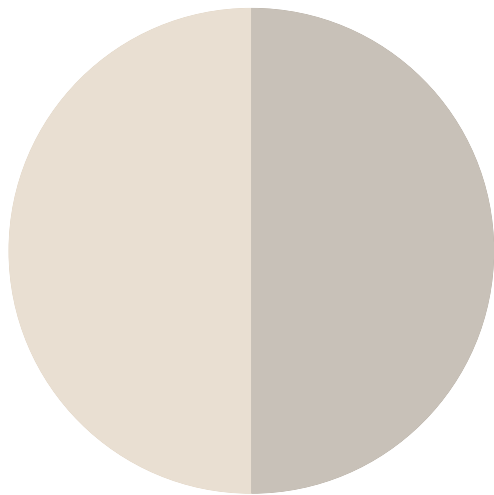
**40% total
waste
production**



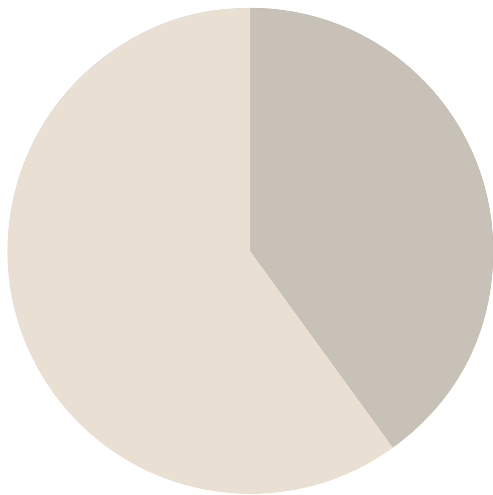
**35% total
CO2
emissions**

CONTEXT: BUILT ENVIRONMENT

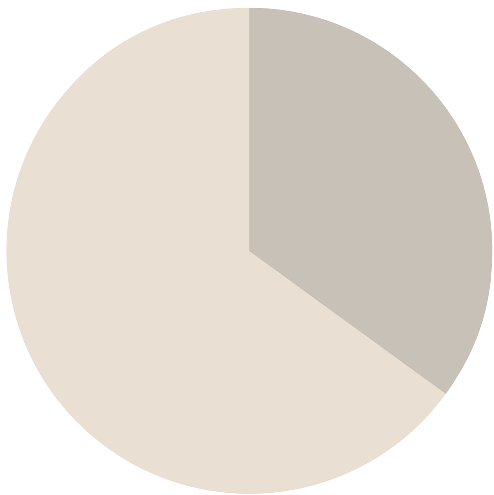
Build environment:



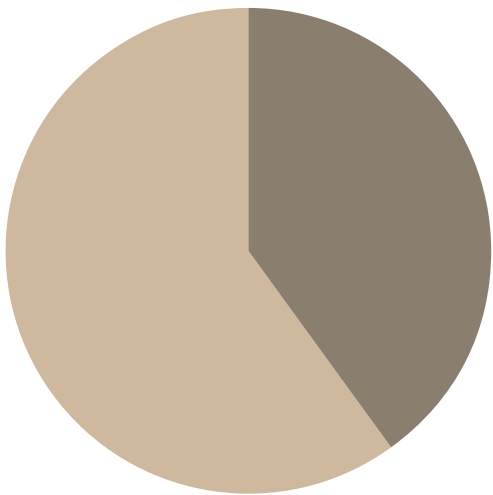
**50% total
raw material
use**



**40% total
waste
production**



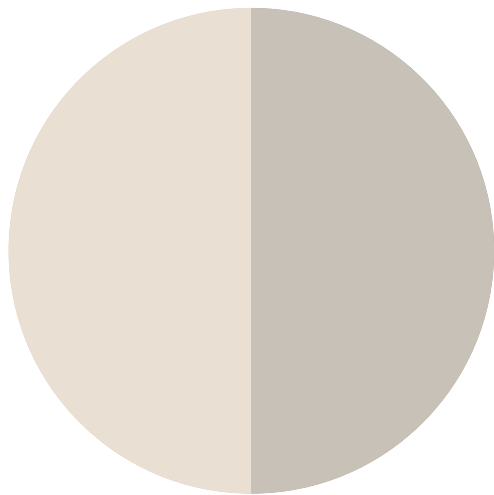
**35% total
CO2
emissions**



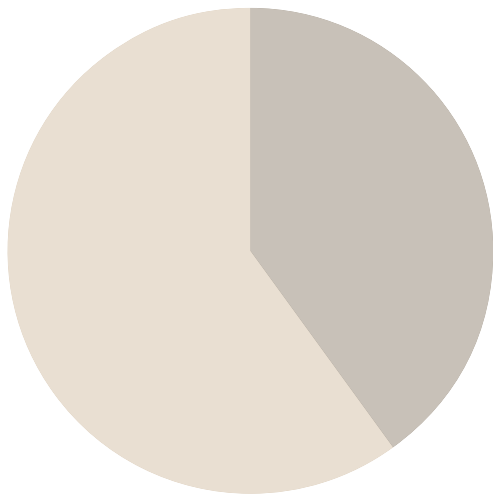
**40% total
energy
use**

CONTEXT: BUILT ENVIRONMENT

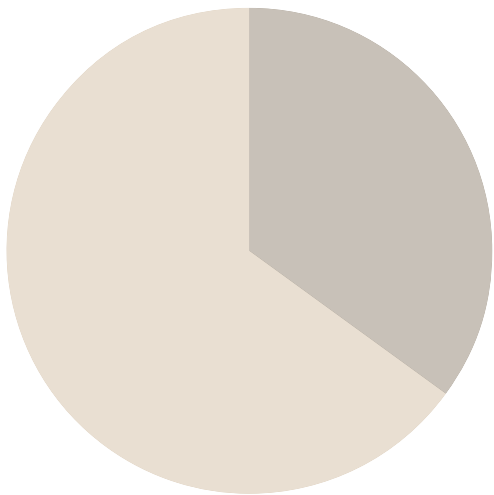
Build environment:



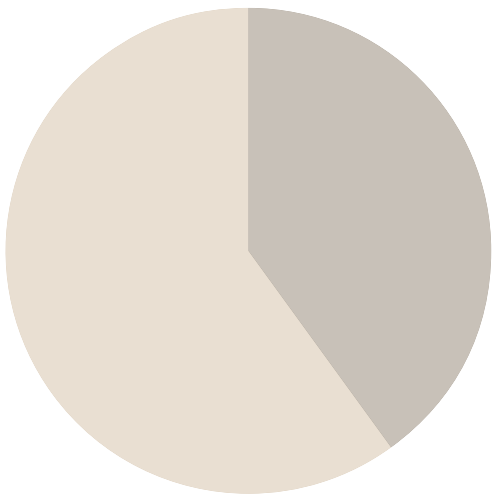
50% total
raw material
use



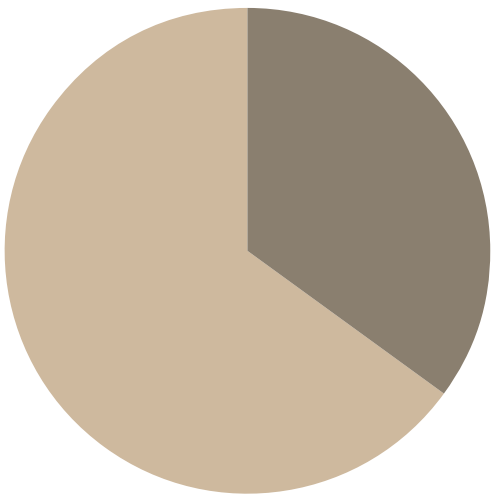
40% total
waste
production



35% total
CO2
emissions



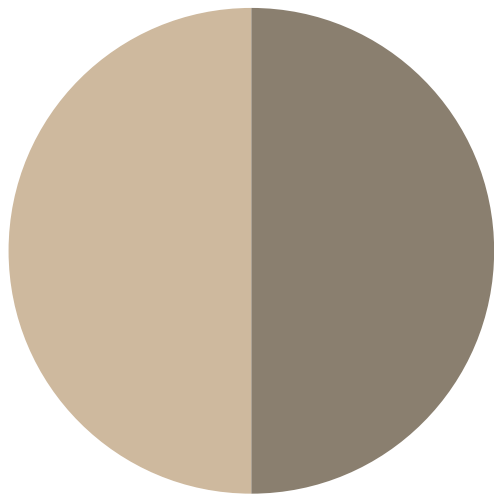
40% total
energy
use



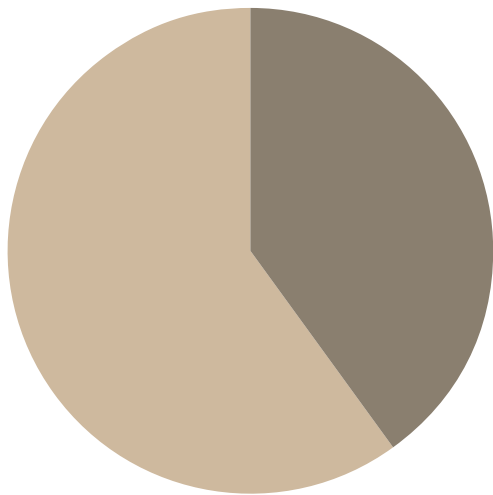
35% total
water
use

CONTEXT: BUILT ENVIRONMENT

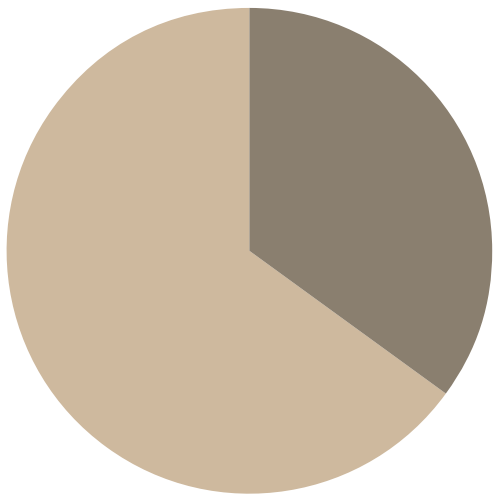
Build environment:



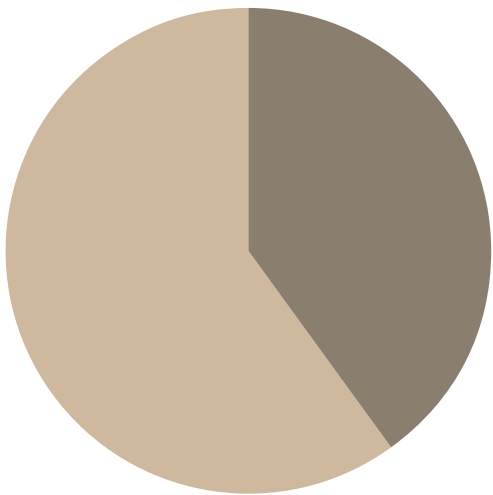
50% total
raw material
use



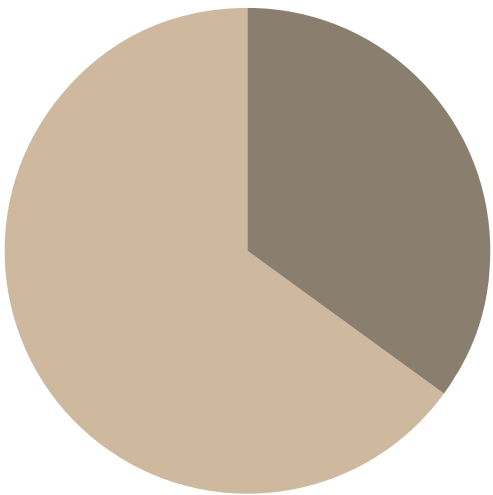
40% total
waste
production



35% total
CO2
emissions

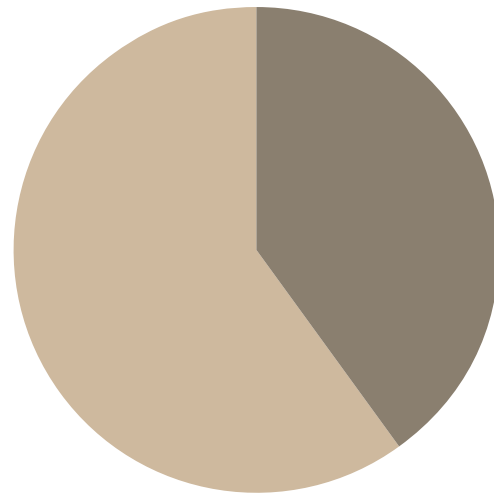


40% total
energy
use



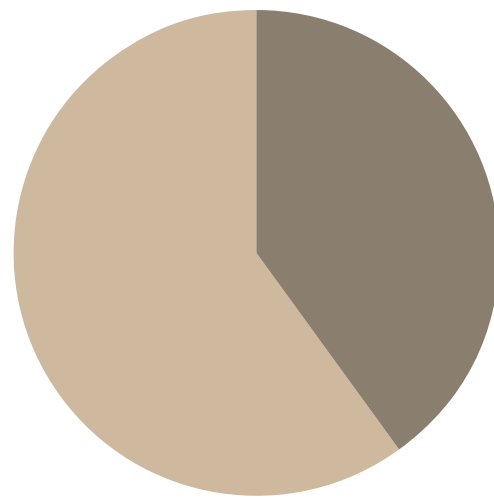
35% total
water
use

CONTEXT: WASTE



**40% total
waste
production**

CONTEXT: WASTE

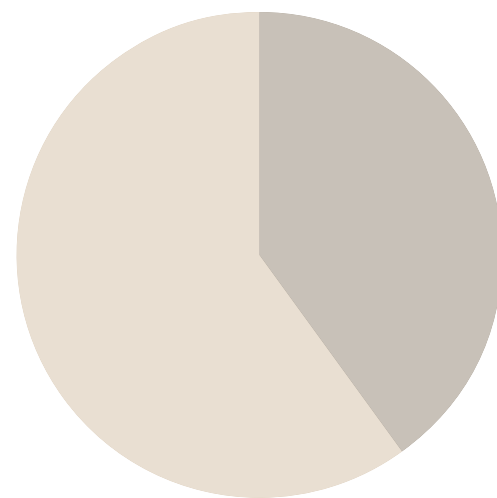


**40% total
waste
production**



**Highest
recycling
rate
97%**

CONTEXT: WASTE



40% total
waste
production

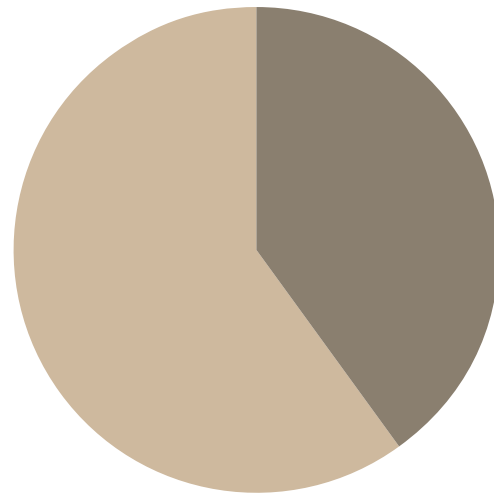


Highest
recycling
rate
97%



**Mostly
downcycled**

CONTEXT: WASTE

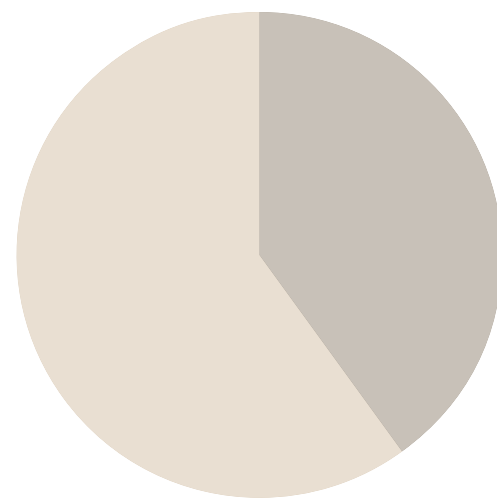


**40% total
waste
production**



**435 kton
scrap wood**

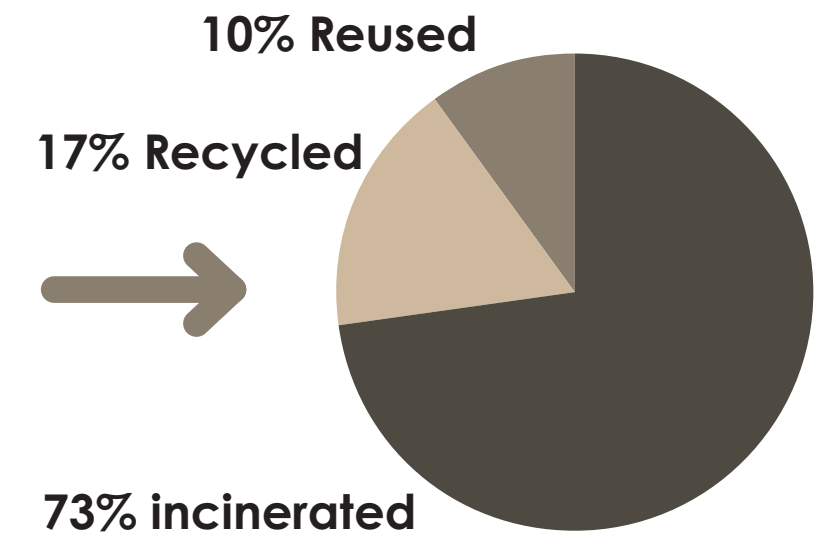
CONTEXT: WASTE



**40% total
waste
production**



**435 kton
scrap wood**

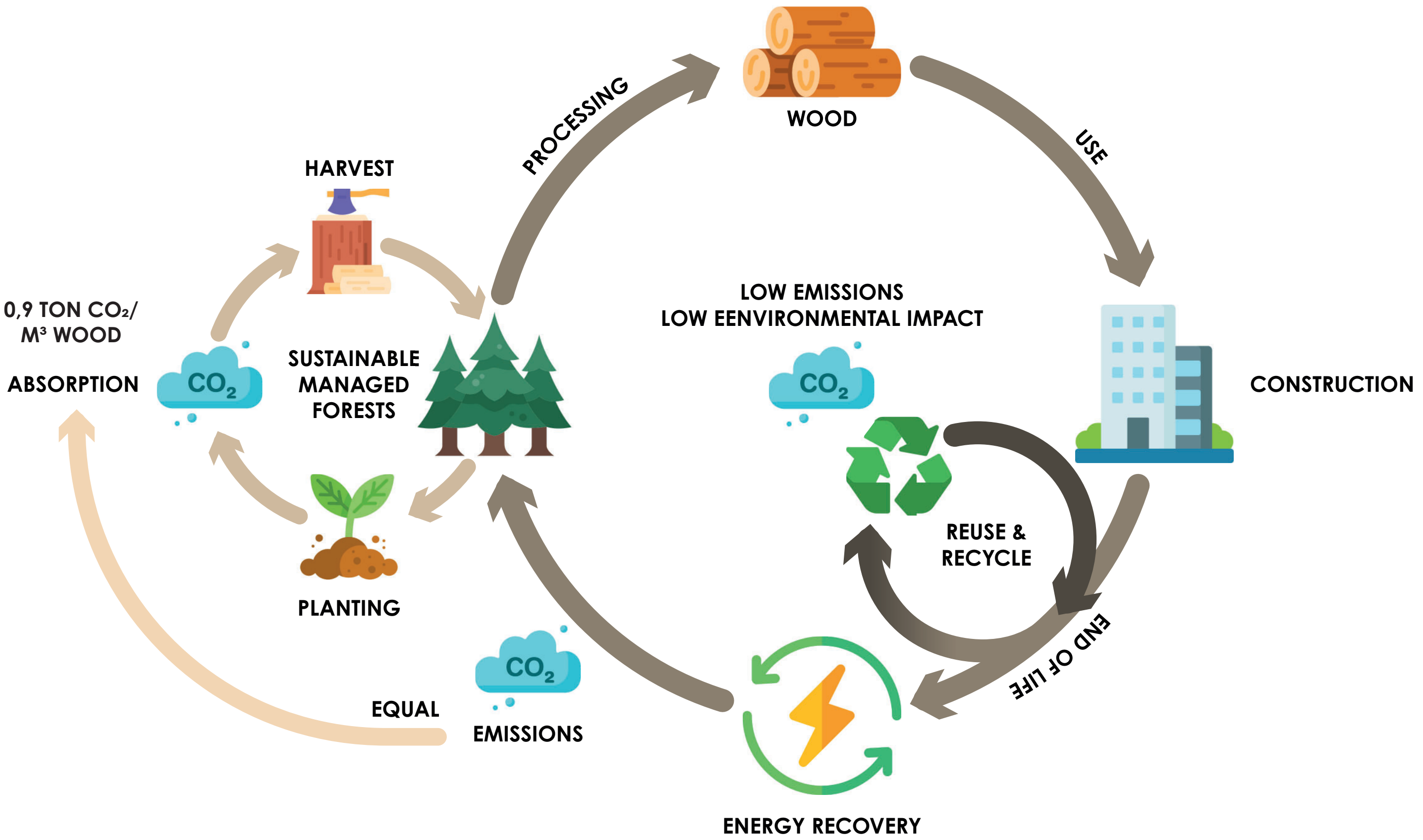


**1.8 Mton
waste wood**

CONTEXT: WASTE

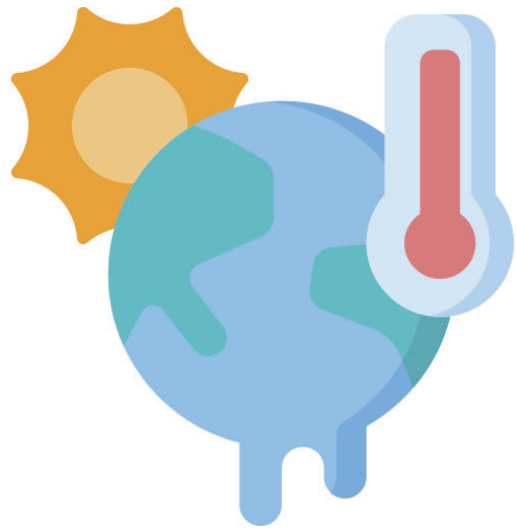


CONTEXT: WOOD

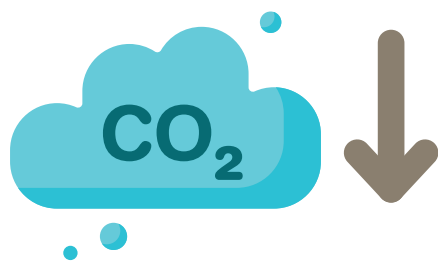


CONTEXT SUMMARY

Climate Change

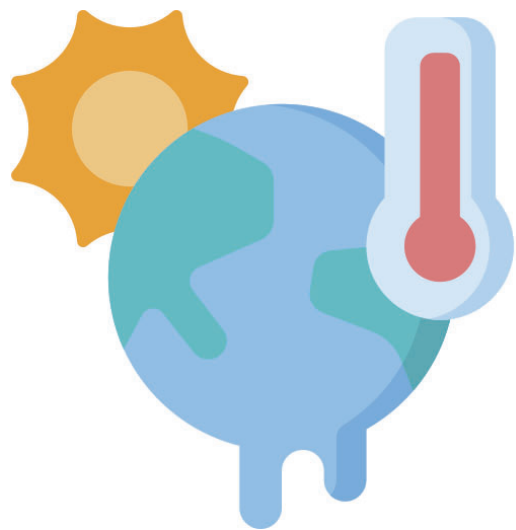


Decrease
emissions

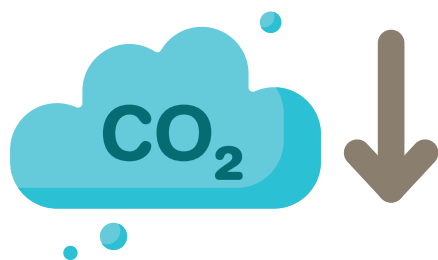


CONTEXT SUMMARY

Climate Change



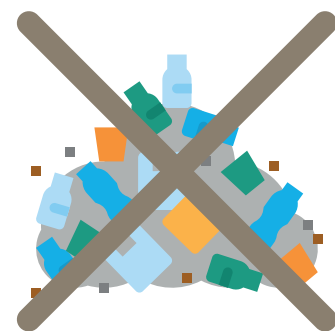
Decrease emissions



Circular Economy



Eliminate waste

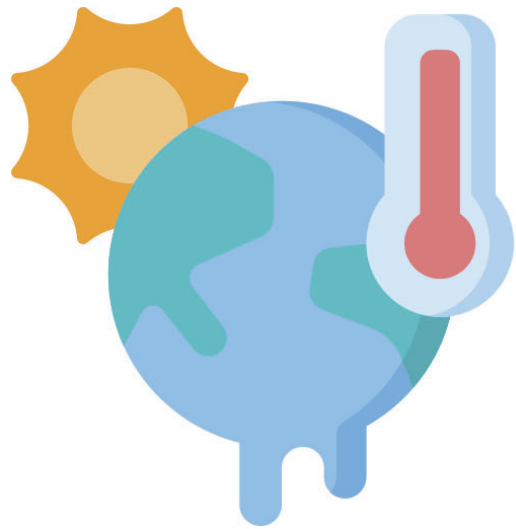


Renewable materials

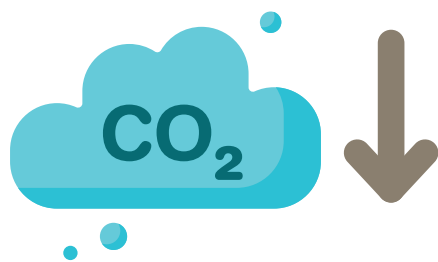


CONTEXT SUMMARY

Climate Change



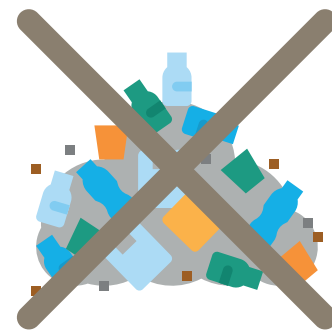
Decrease emissions



Circular Economy



Eliminate waste



Renewable materials



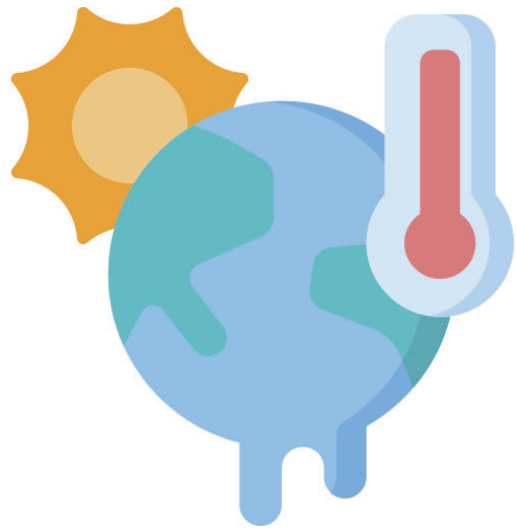
Scrap Wood



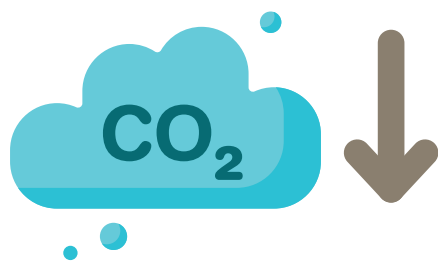
435 kton scrap wood

CONTEXT SUMMARY

Climate Change



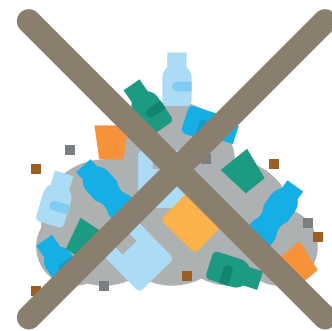
Decrease emissions



Circular Economy



Eliminate waste



Renewable materials



Scrap Wood



435 kton scrap wood

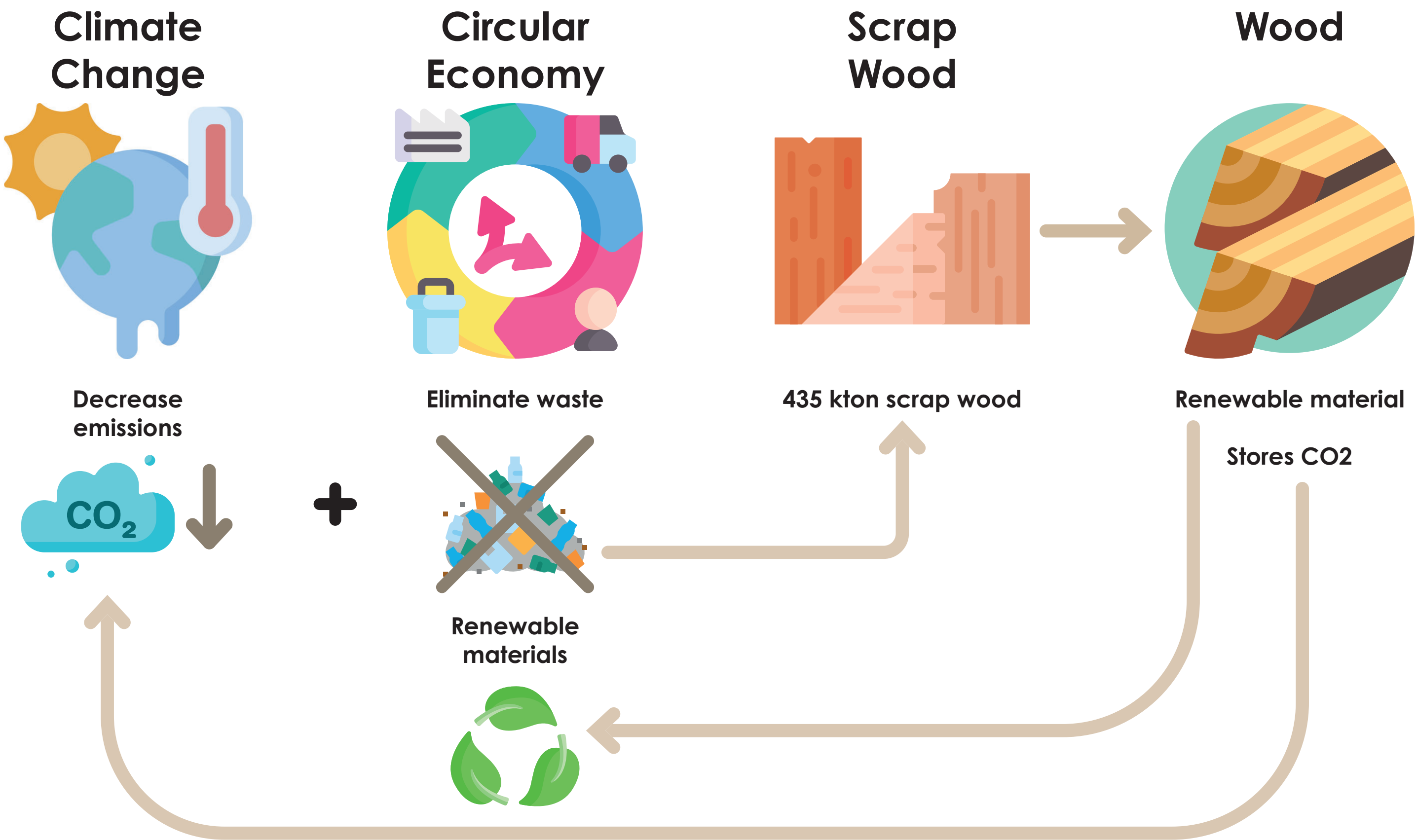
Wood



Renewable material

Stores CO₂

CONTEXT SUMMARY



PROBLEM STATEMENT

*“To fight **climate change** the CO₂ emissions need to decrease and handle material use better. The Netherlands want to have a **circular economy** by 2050. The **built environment** is one of the **largest contributors** to waste production and CO₂ emissions. Yearly **435 kton scrap wood** is produced, while **wood** is a **renewable** material that **stores CO₂**”*

RESEARCH QUESTION

"How can scrap wood be reused in the built environment and what is a suitable building product?"



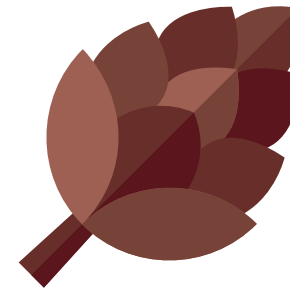
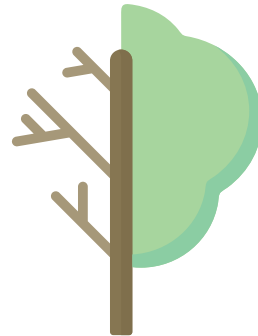
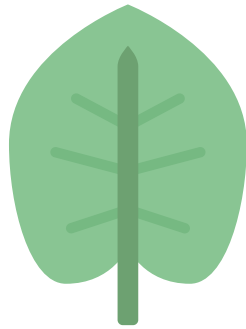
WOOD

WOOD

60.000
species

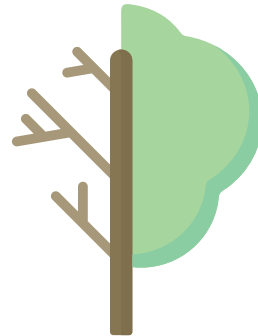
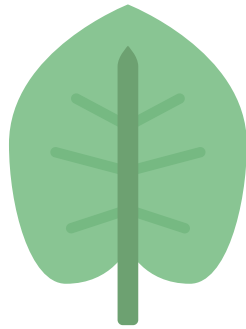
Hard
Wood

Soft
Wood



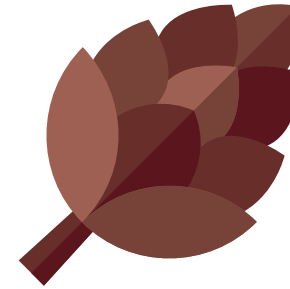
WOOD

60.000
species



Hard
Wood

Soft
Wood



Stronger
Grows slower
Higher Resistance

Exterior use

Cell
structure

Weaker
Grows faster
Easier to handle

Construction

WOOD

60.000
species

Hard
Wood

Soft
Wood

Cell
structure

Stronger
Grows slower
Higher Resistance

Weaker
Grows faster
Easier to handle

Exterior use

Construction



Oak



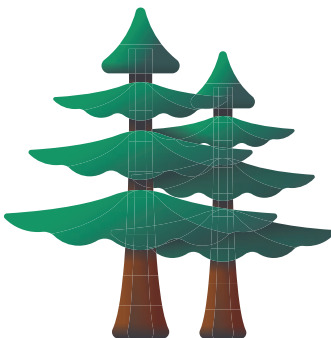
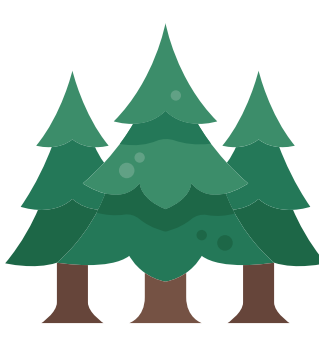
Maple



Birch



Pine, Spruce, Fir



Cedar

WOOD: PROPERTIES

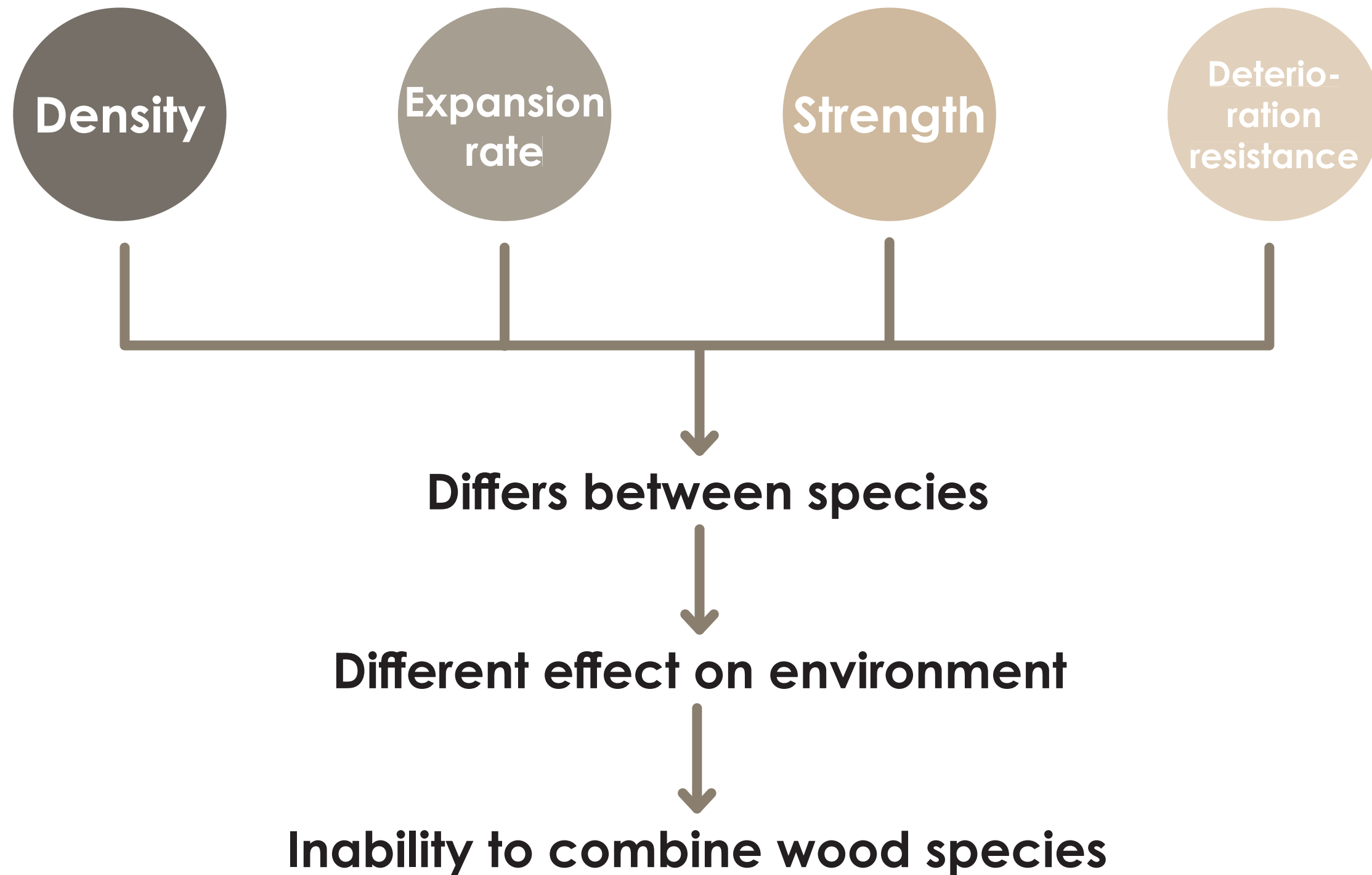
Density

Expansion
rate

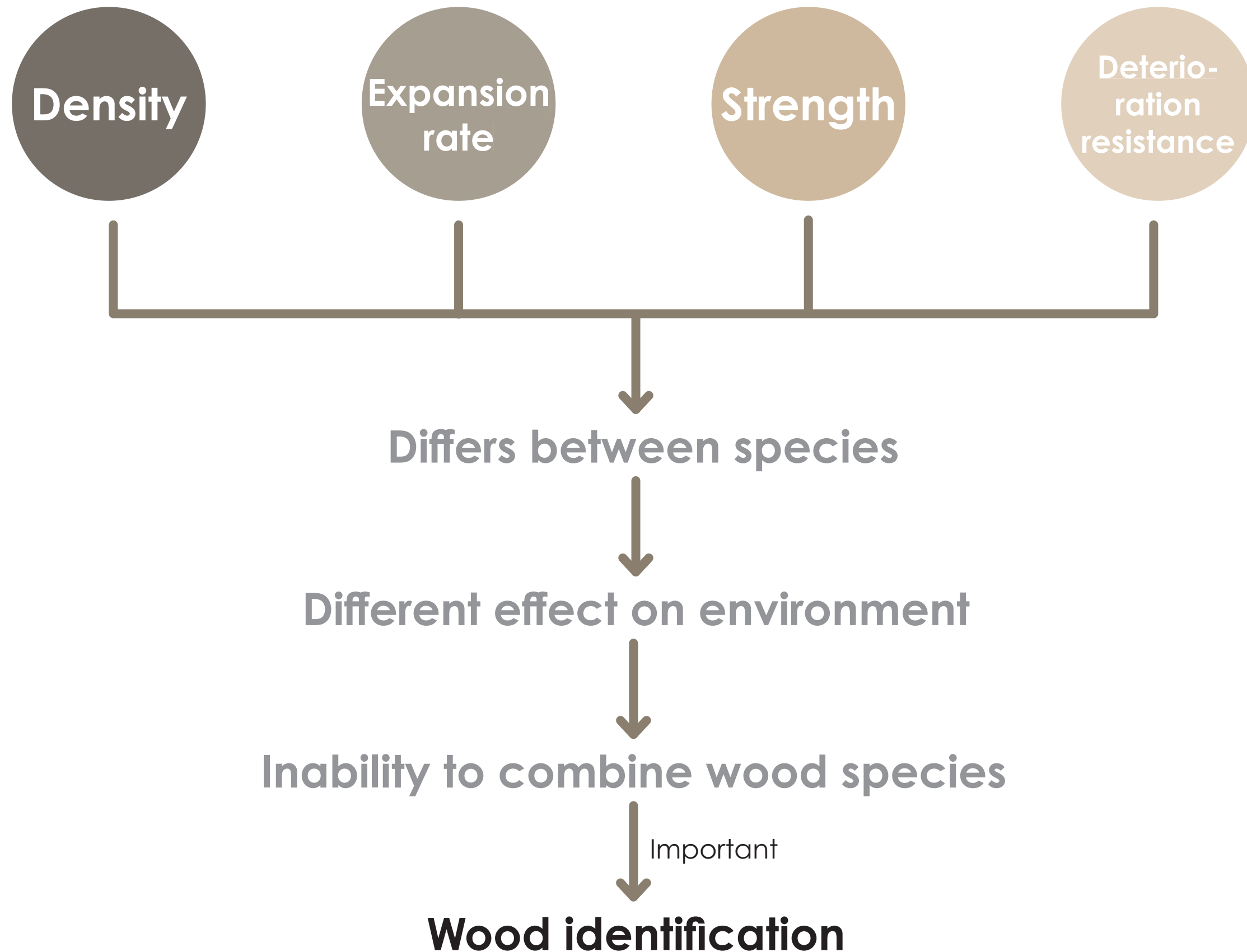
Strength

Deterio-
ration
resistance

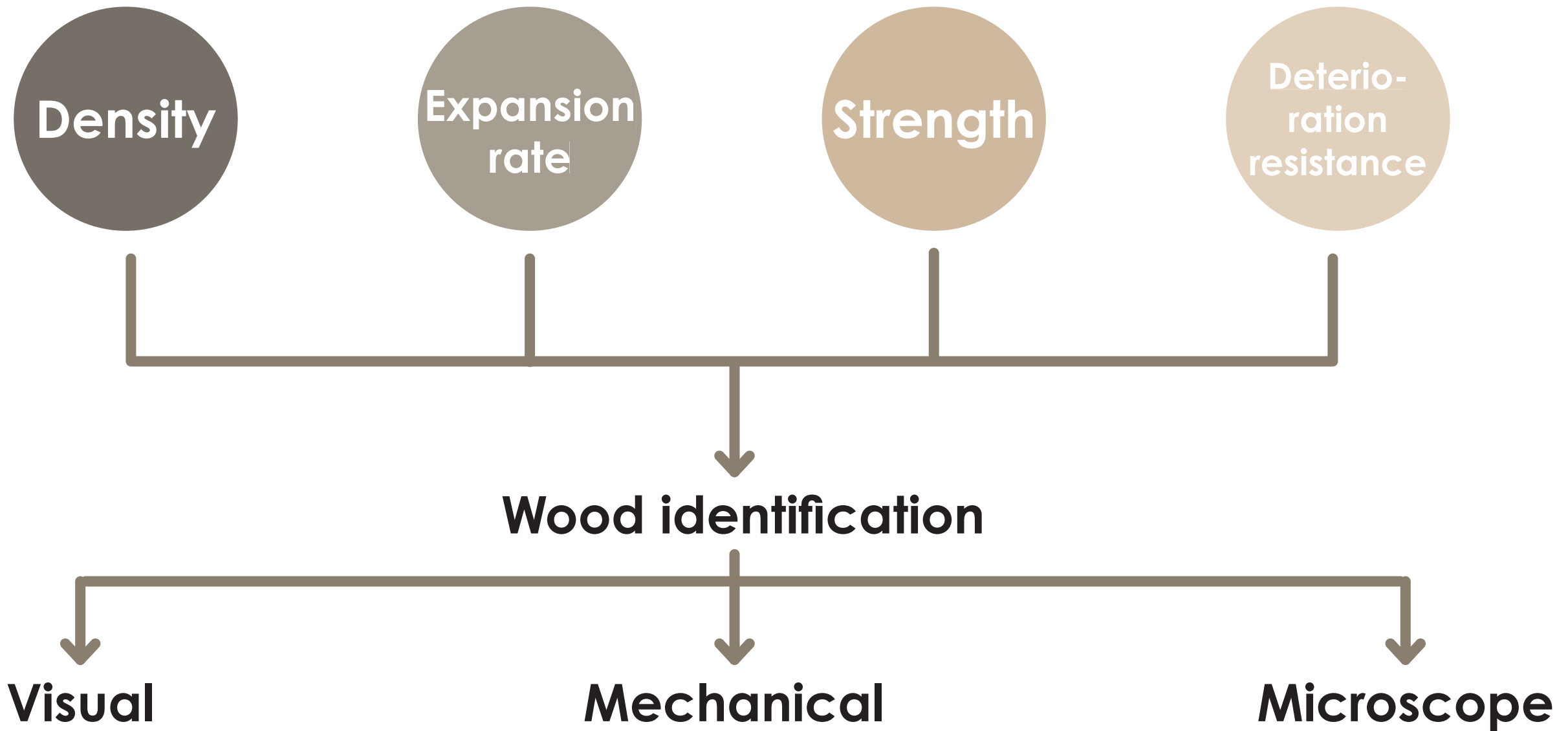
WOOD: PROPERTIES



WOOD: PROPERTIES



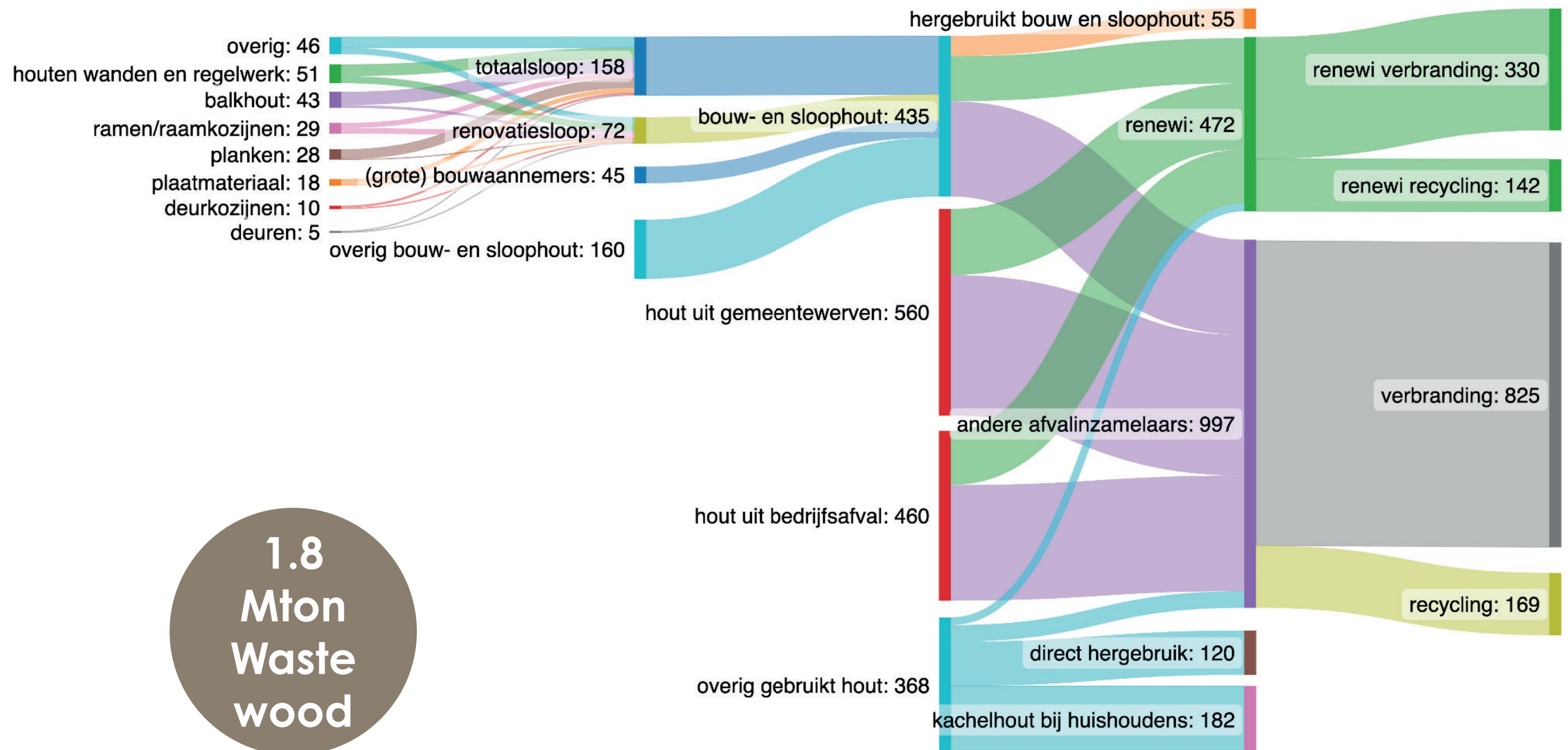
WOOD: PROPERTIES



SCRAP WOOD



SCRAP WOOD

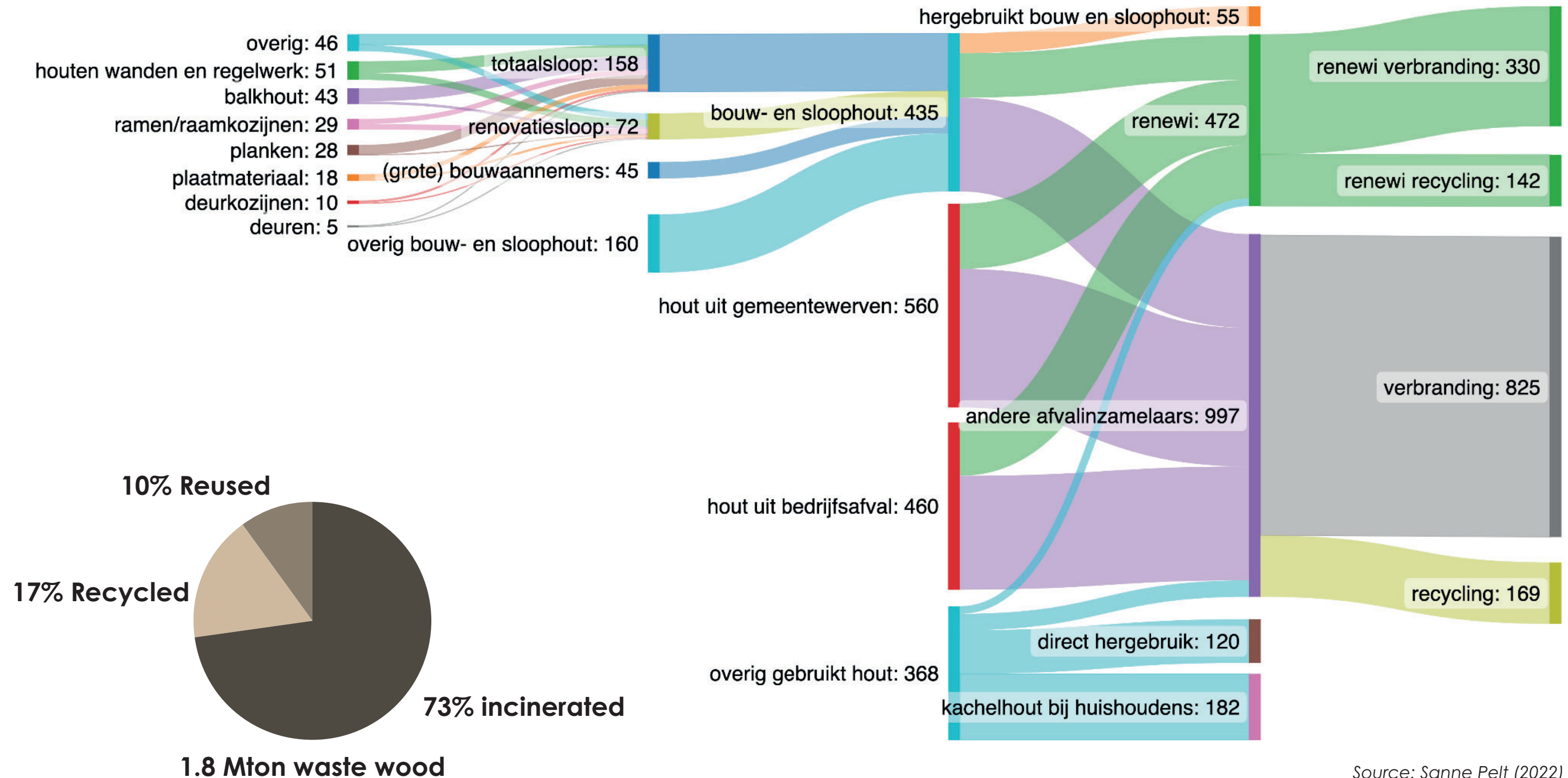


**1.8
Mton
Waste
wood**

Annually

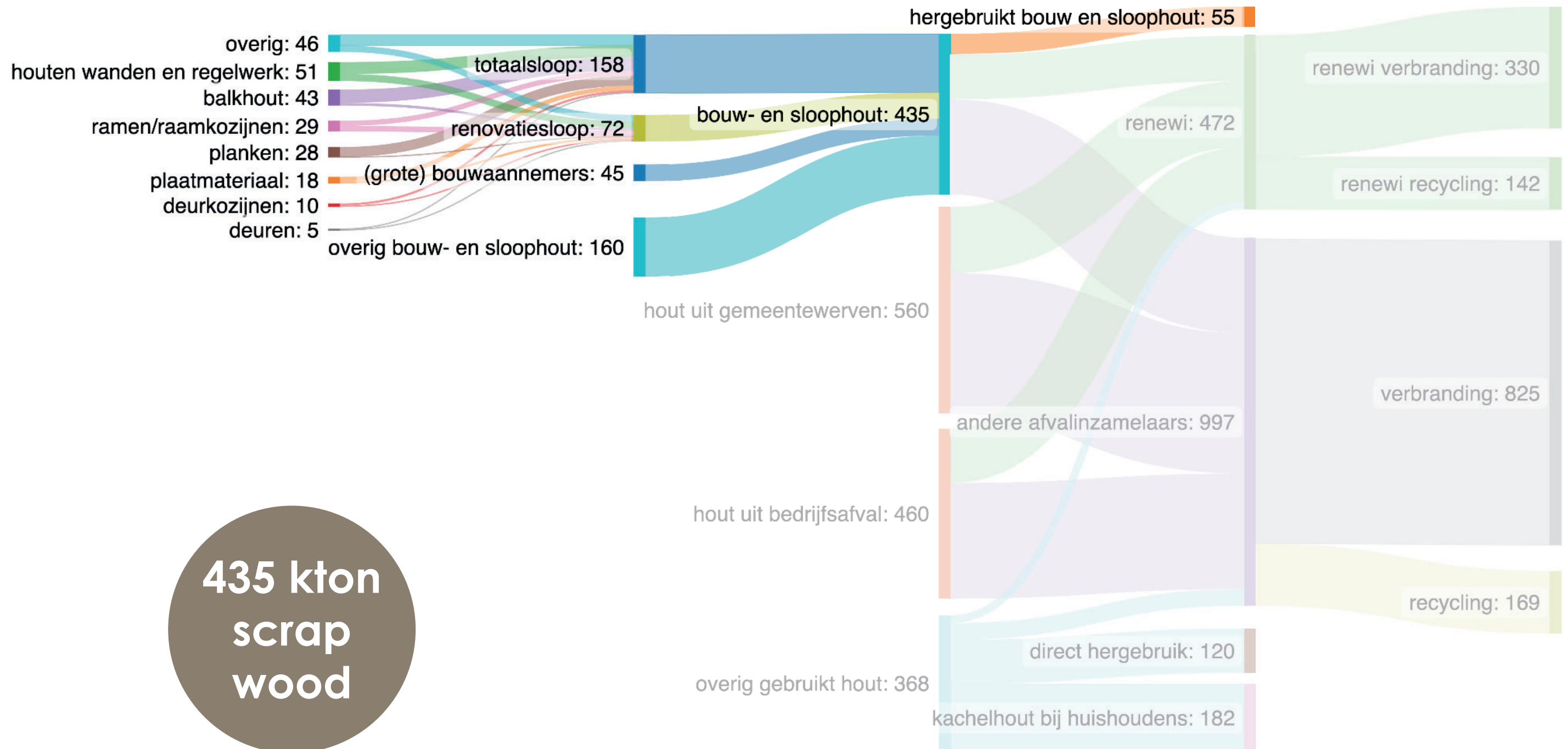
Source: Sanne Pelt (2022)

SCRAP WOOD



Source: Sanne Pelt (2022)

SCRAP WOOD

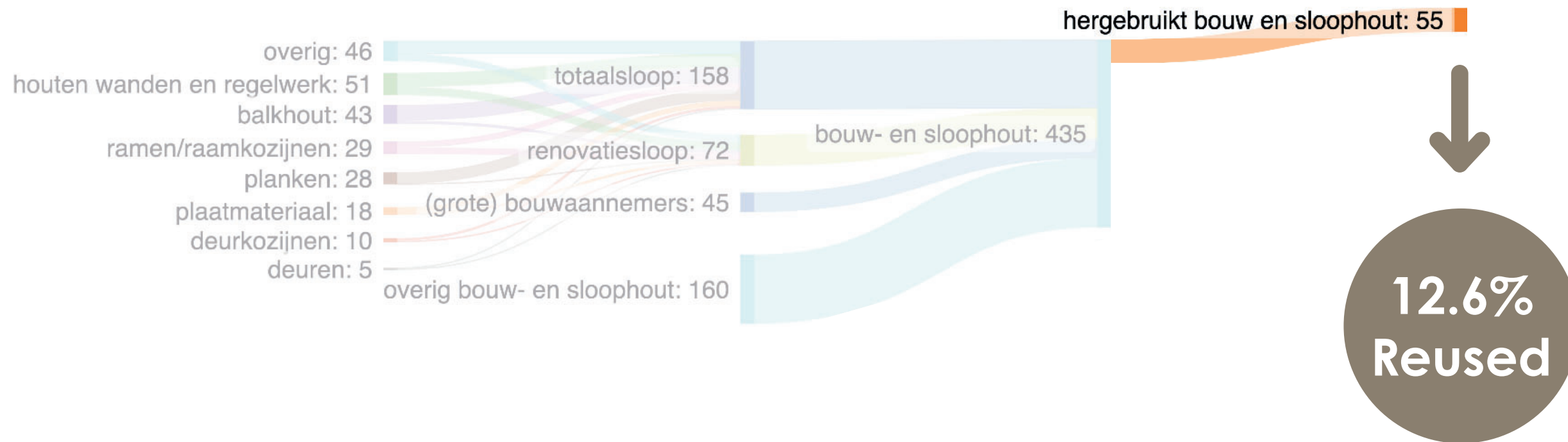


**435 kton
scrap
wood**

**24% Of total
wood waste**

Source: Sanne Pelt (2022)

SCRAP WOOD



CONSISTENCY OF SCRAP WOOD

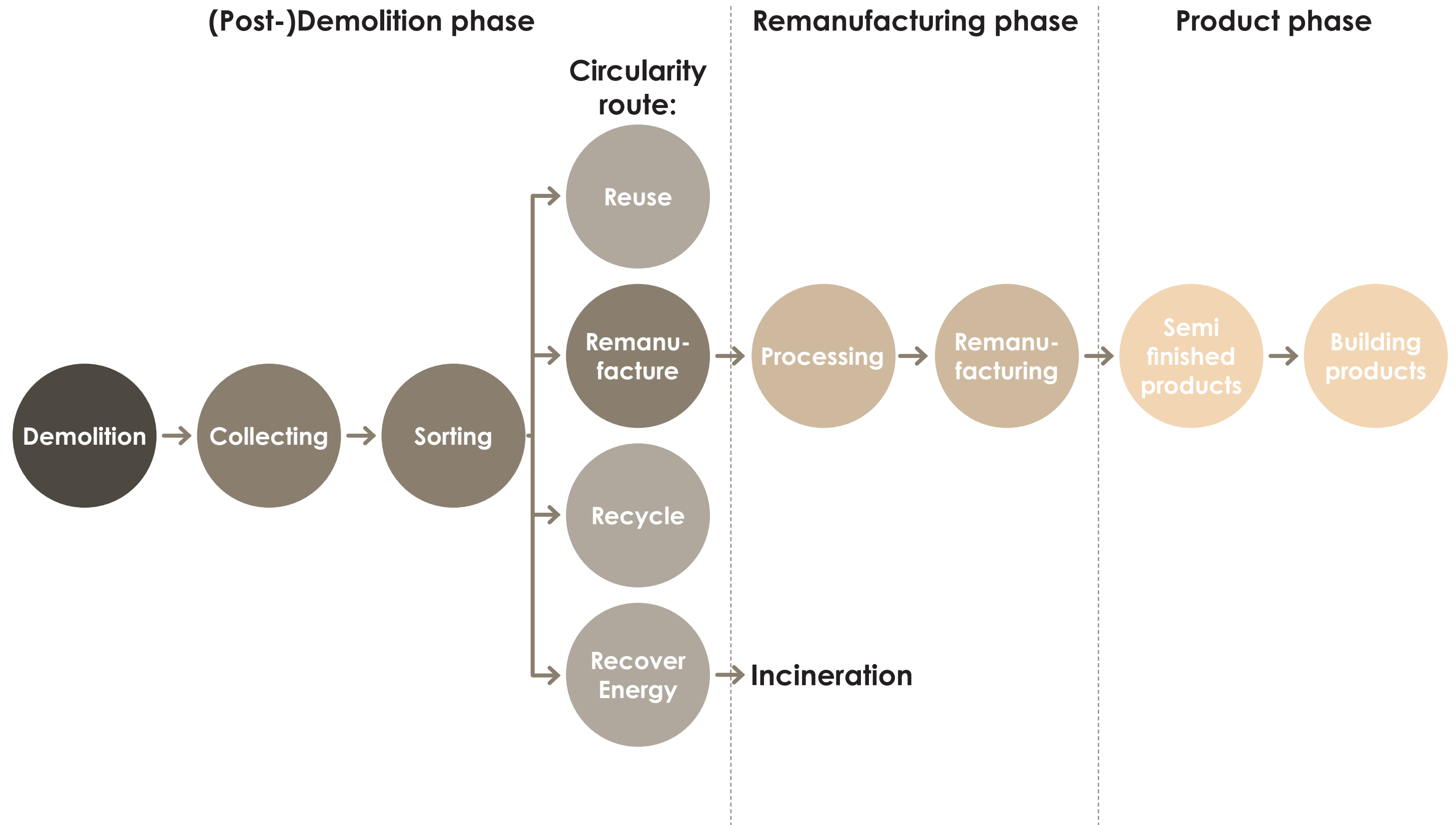


CONSISTENCY OF SCRAP WOOD

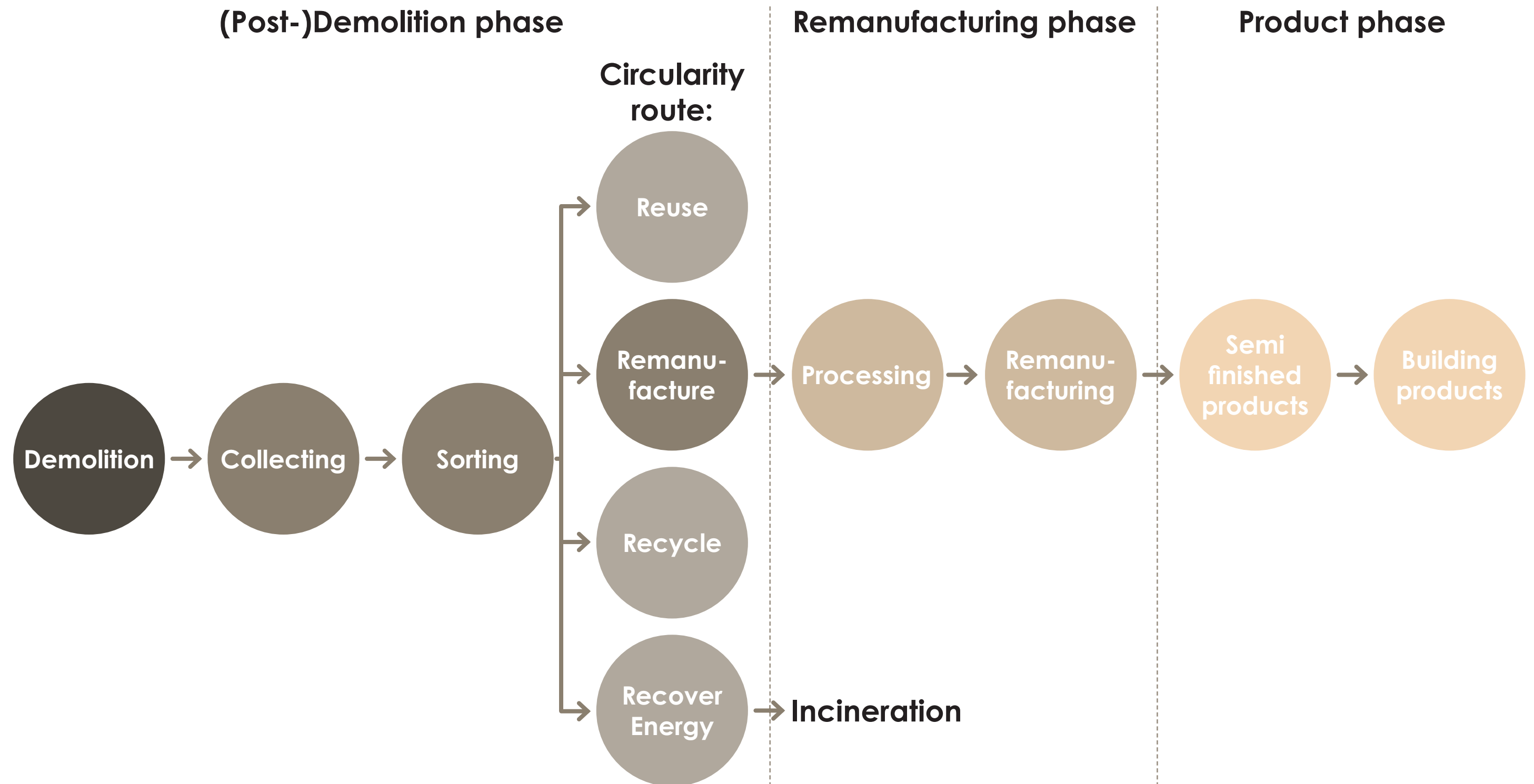


= varying consistency

SCRAP WOOD CHAIN



SCRAP WOOD CHAIN



SCRAP WOOD CHAIN



Scrap wood pieces

**Processing &
Remanufacturing**



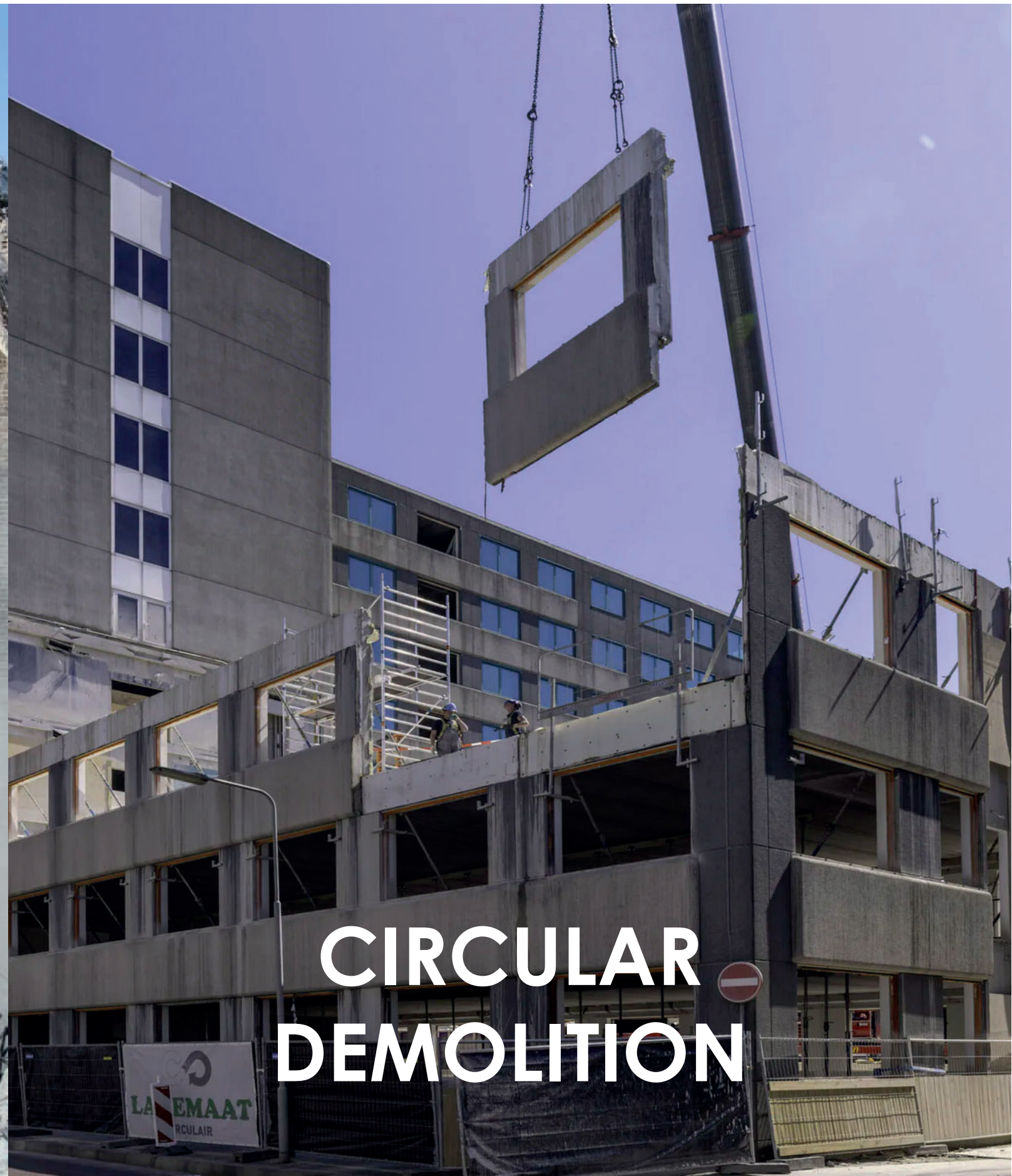
Building products

SCRAP WOOD CHAIN

(Post-)Demolition phase



**TRADITIONAL
DEMOLITION**

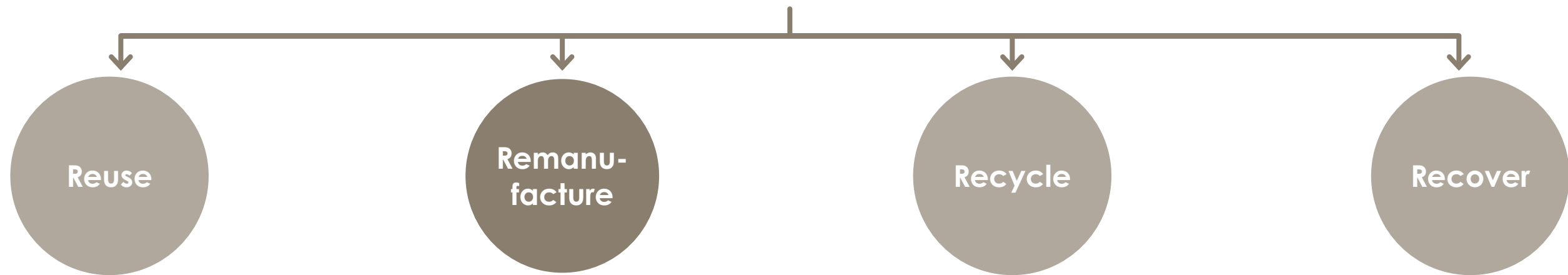


**CIRCULAR
DEMOLITION**

SCRAP WOOD CHAIN

(Post-)Demolition phase

Sorting



SCRAP WOOD CHAIN

(Post-)Demolition phase

Sorting



Reuse

Remanu-
facture

Recycle

Recover



Products

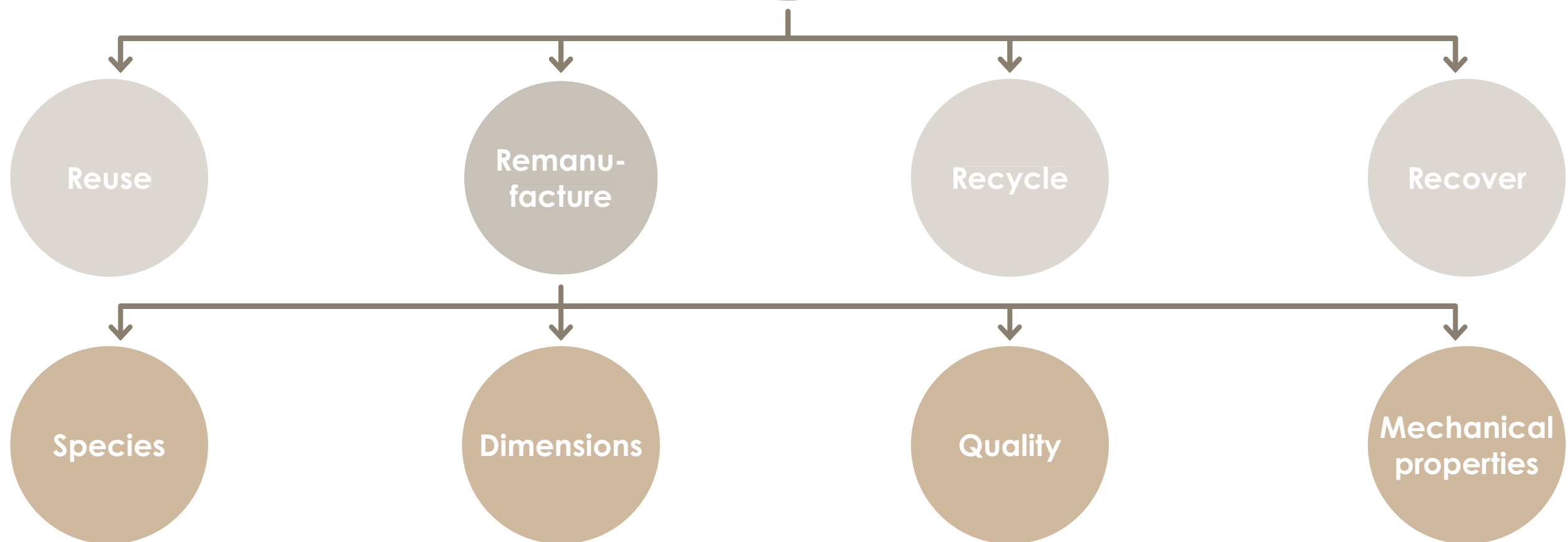


Pieces

SCRAP WOOD CHAIN

(Post-)Demolition phase

Sorting



SCRAP WOOD CHAIN

Remanufacturing phase



SCRAP WOOD CHAIN

Remanufacturing phase

Processing



Clean wood



**Added
Layer**



**Contains
Metal**



**Broken
Pieces**

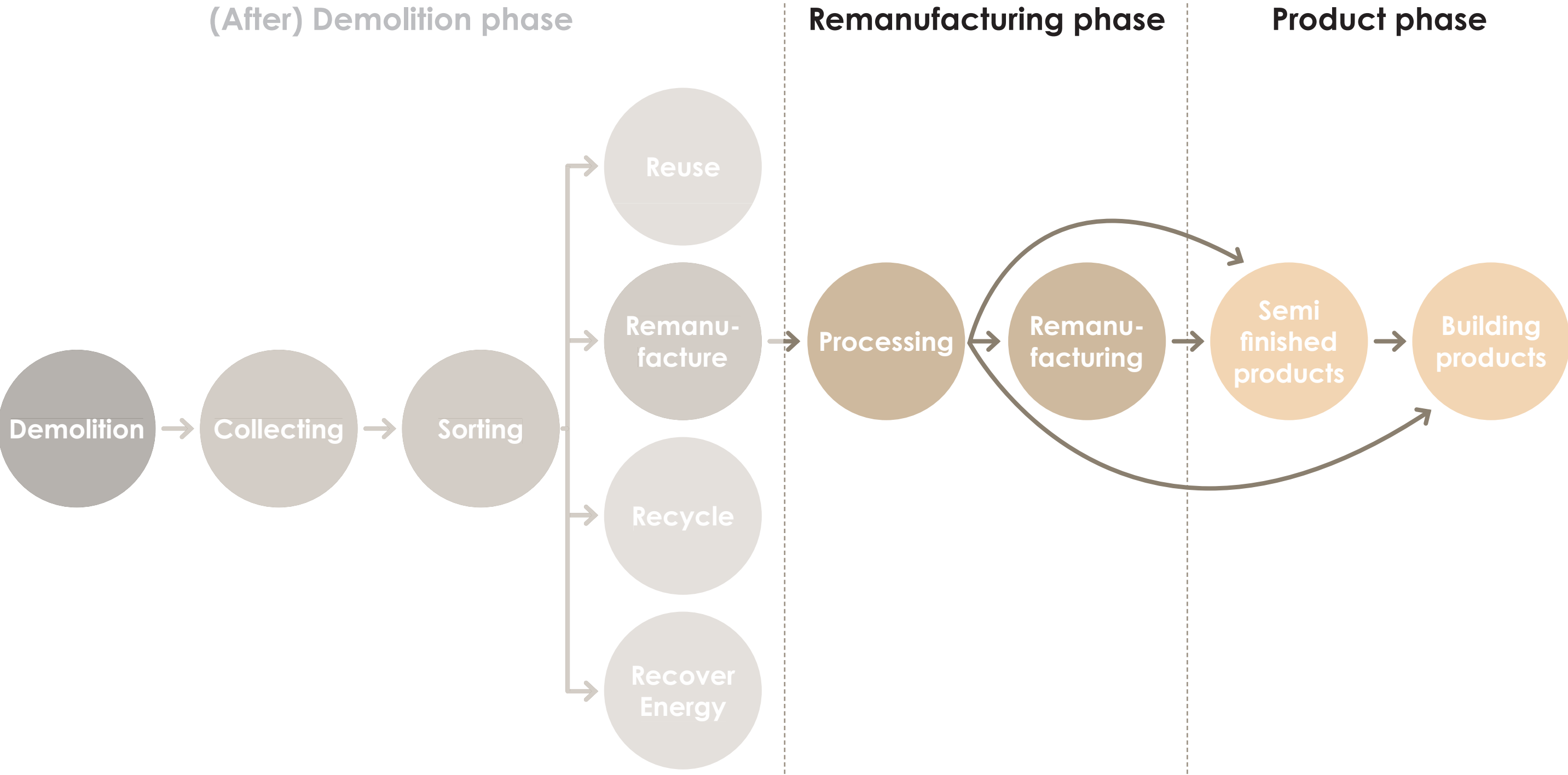
SCRAP WOOD CHAIN

Remanufacturing phase

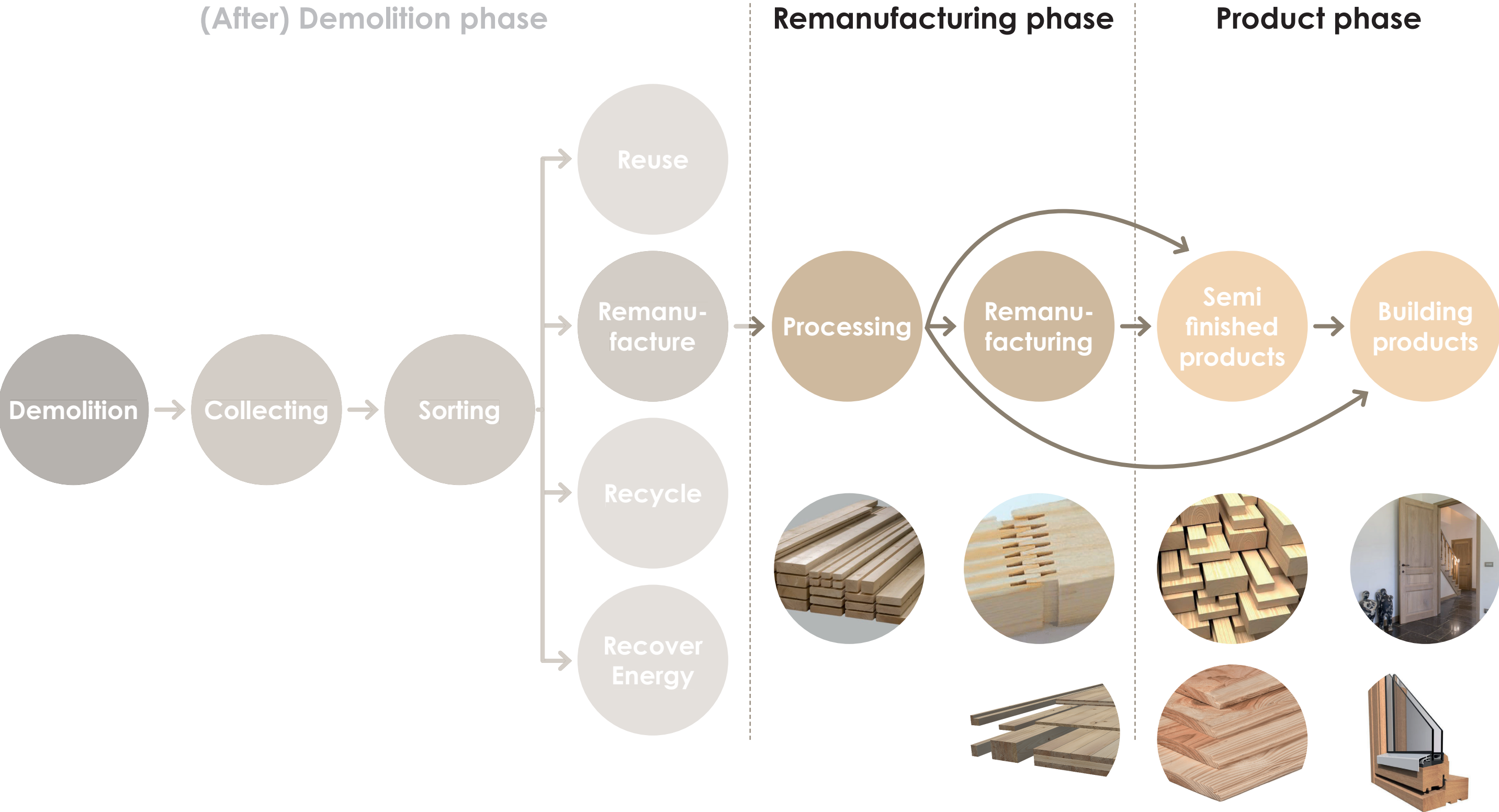


Wooden slats

BARRIERS

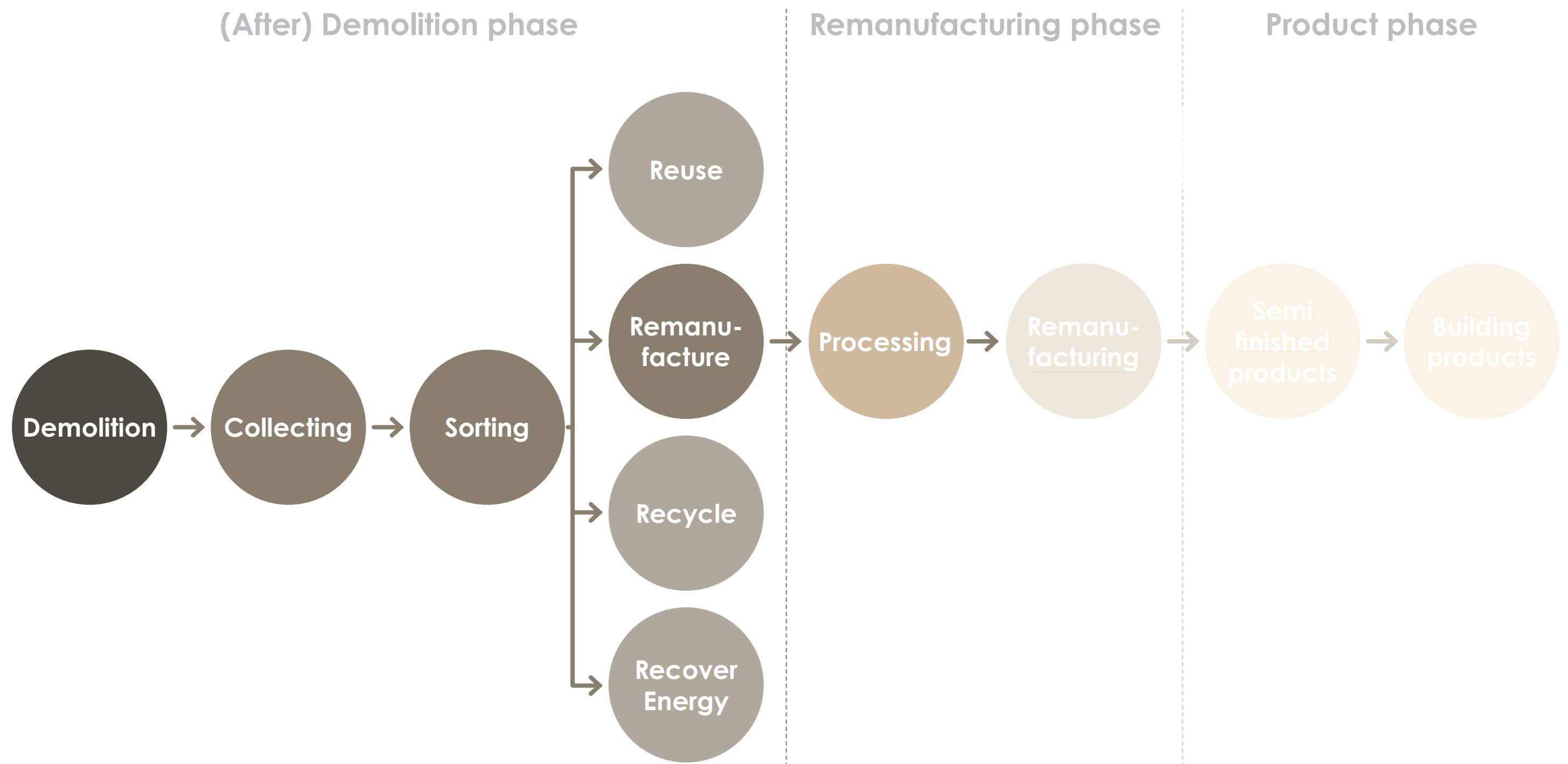


BARRIERS



BARRIERS

Biggest barriers for reuse



BARRIERS

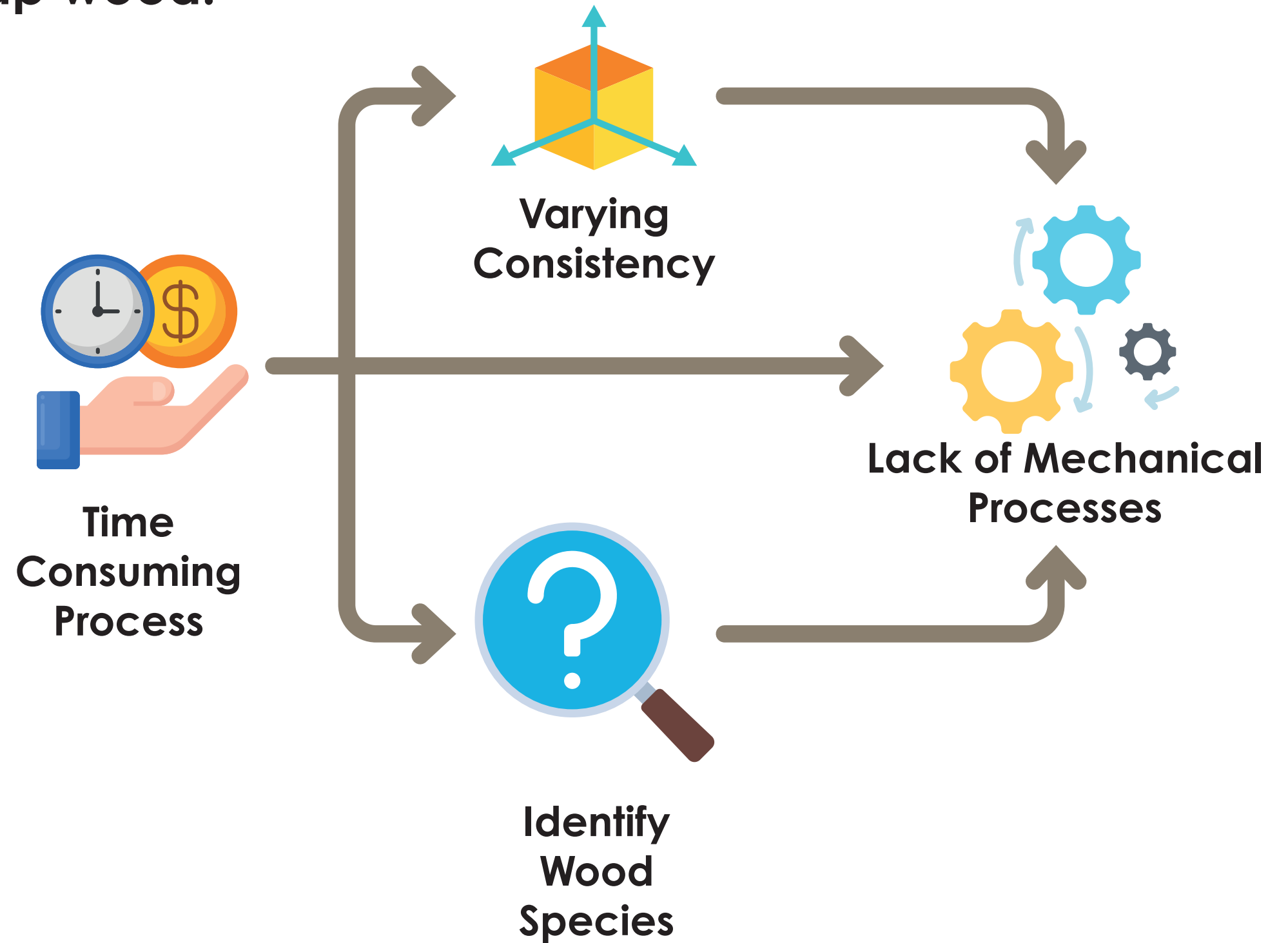
Barriers for reusing scrap wood:



**Time
Consuming
Process**

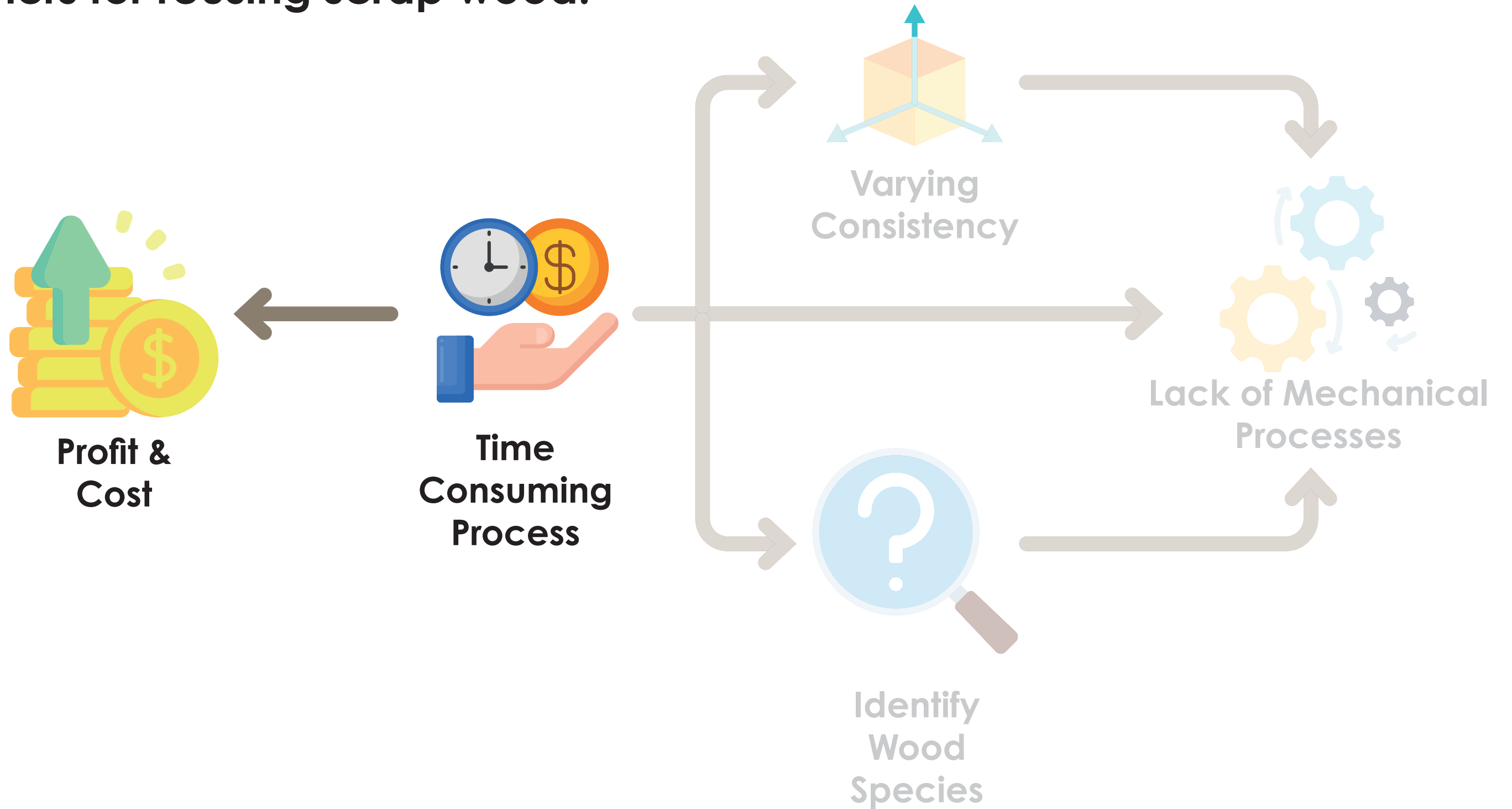
BARRIERS

Barriers for reusing scrap wood:



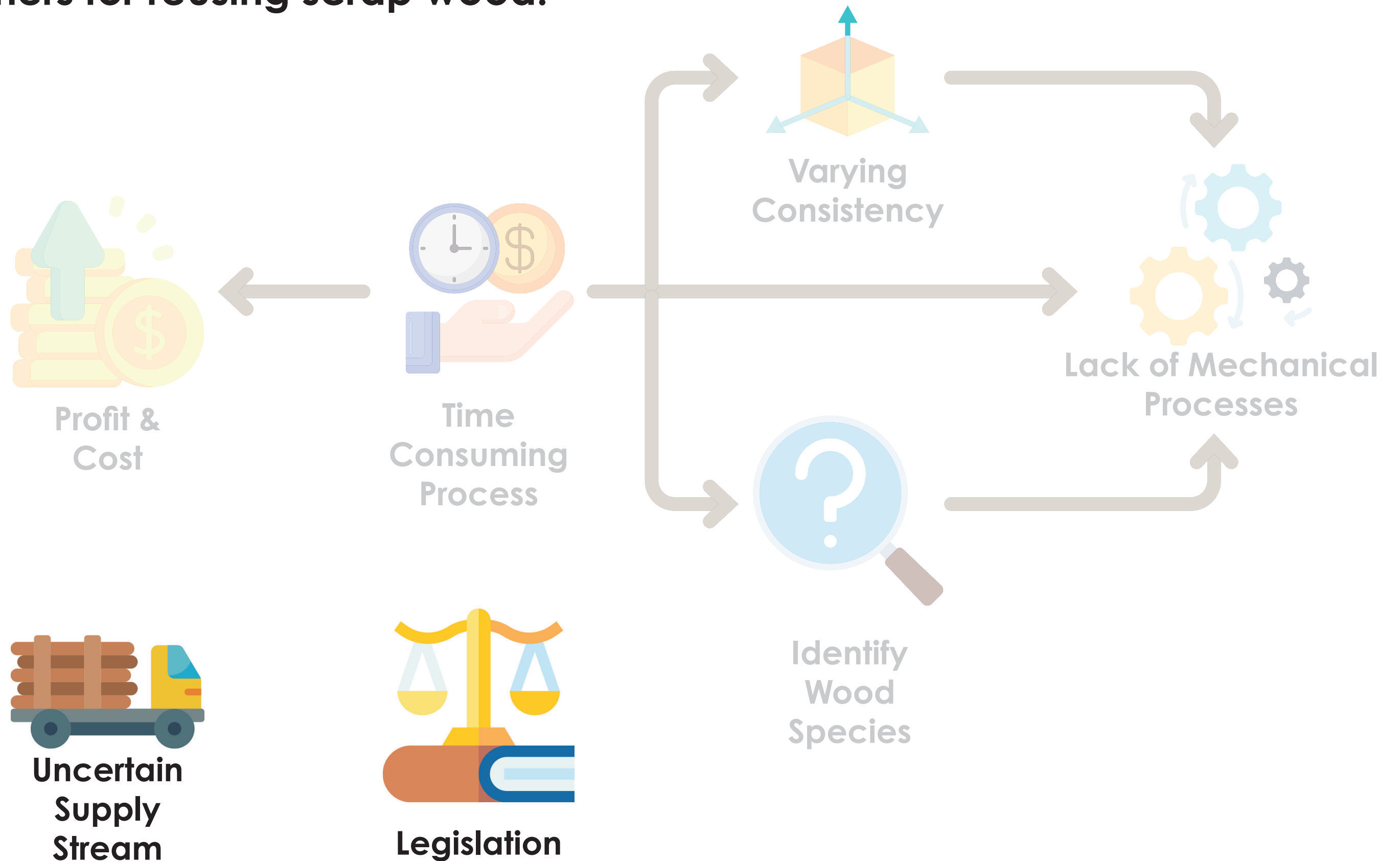
BARRIERS

Barriers for reusing scrap wood:

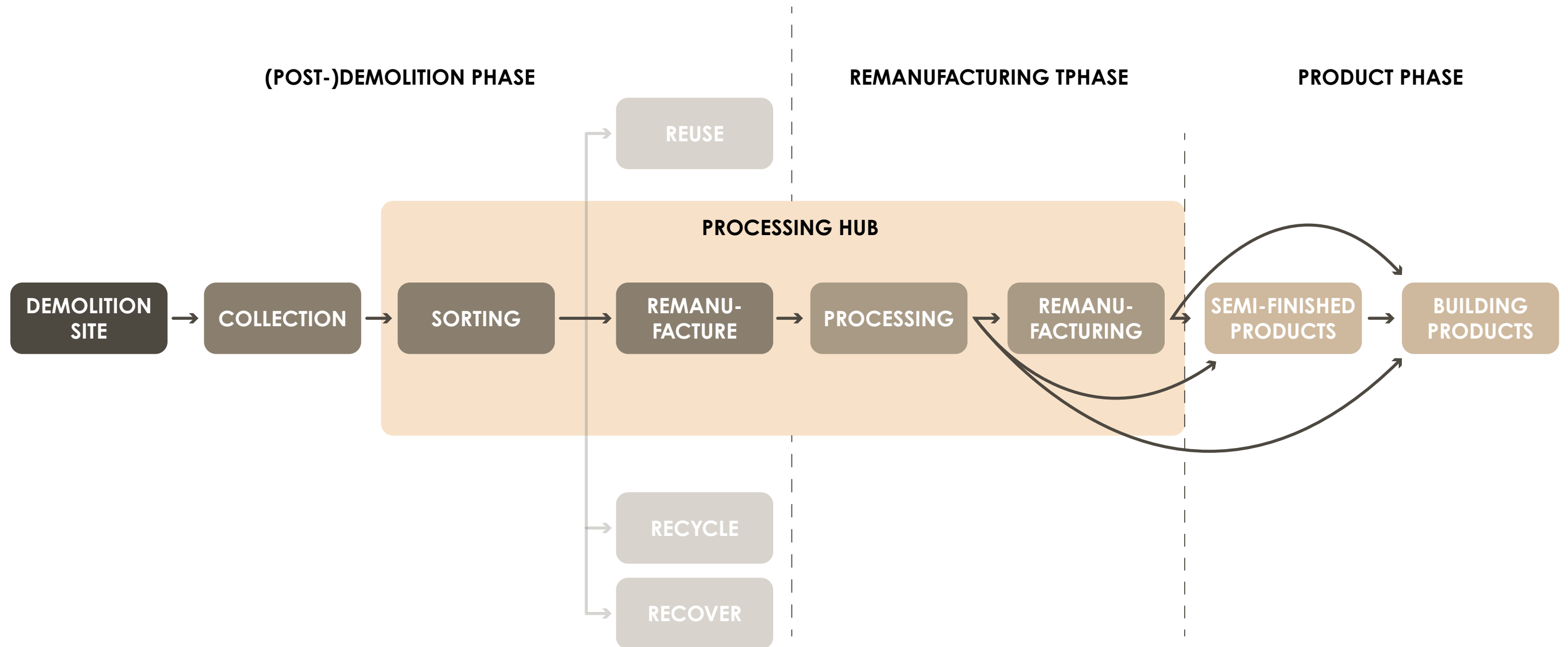


BARRIERS

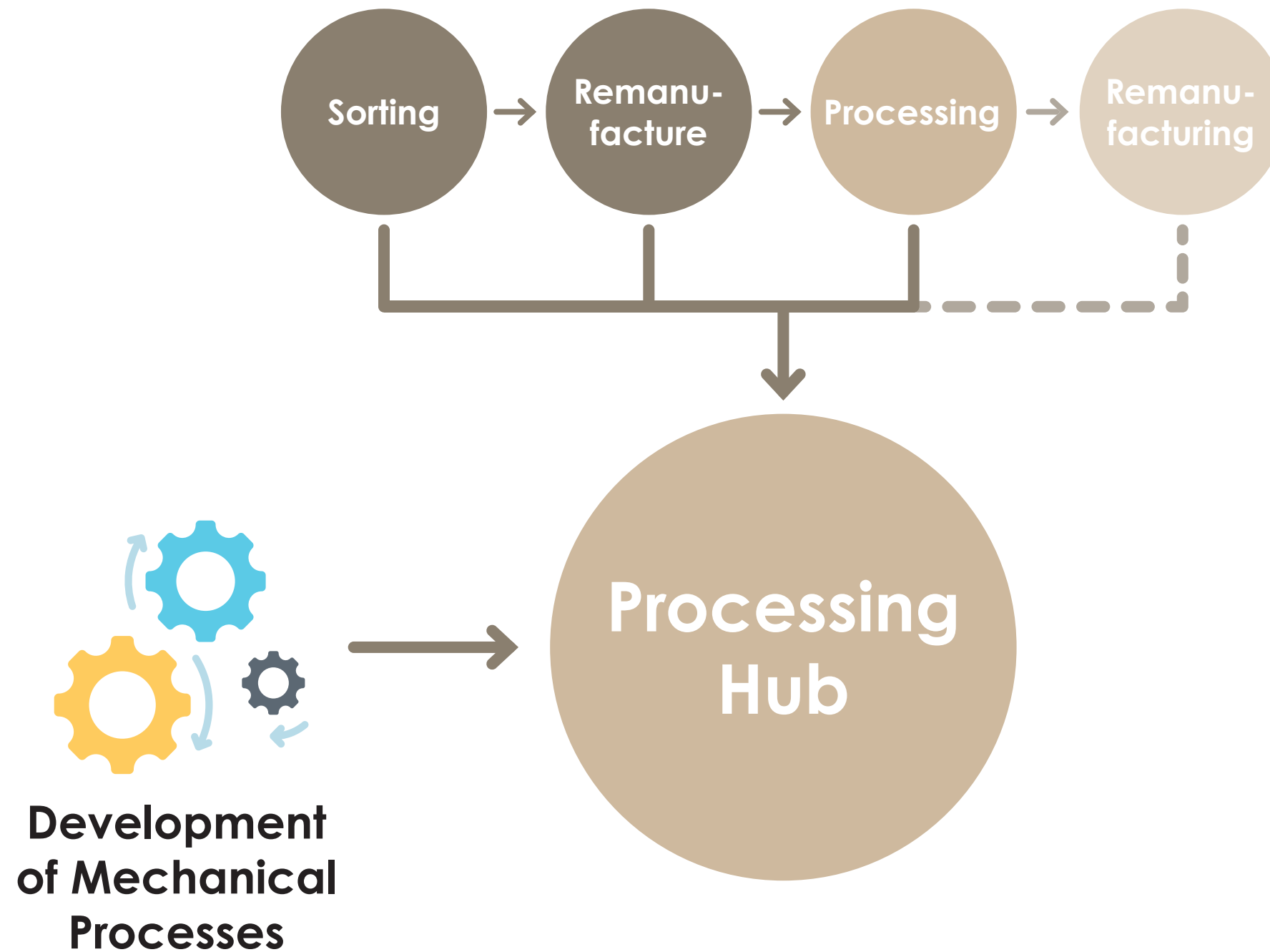
Barriers for reusing scrap wood:



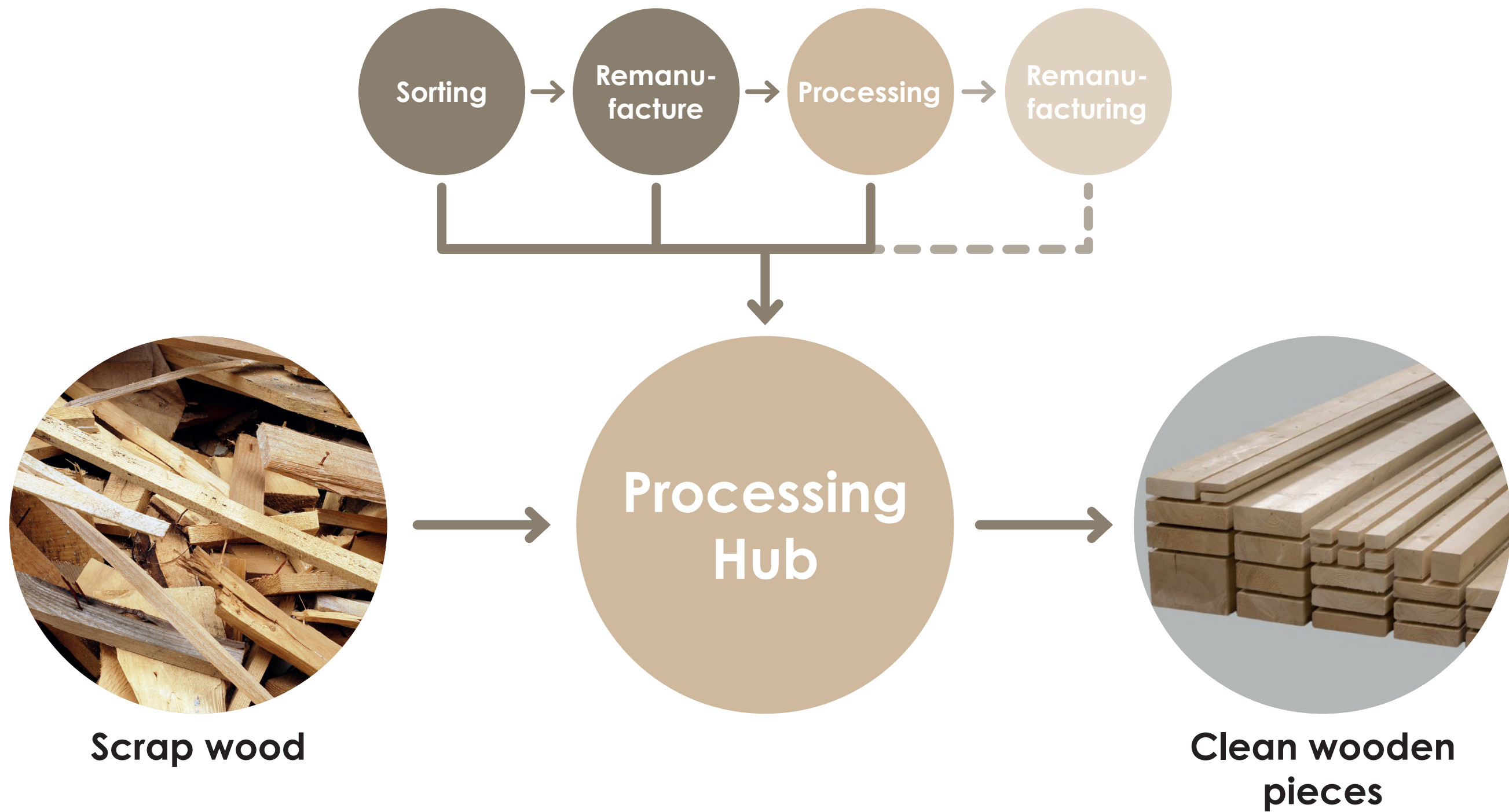
SOLUTION: PROCESSING HUB



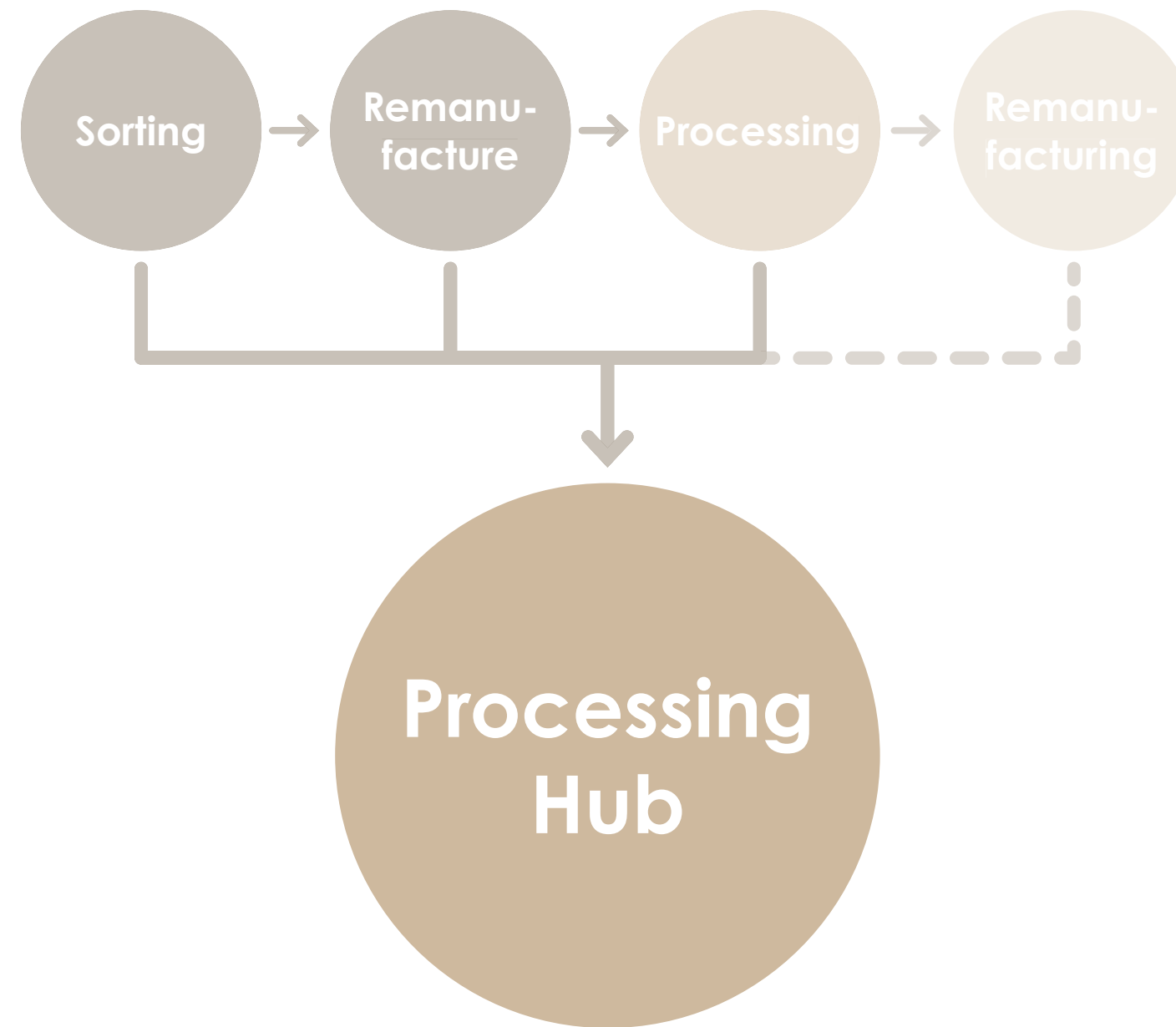
SOLUTION: PROCESSING HUB



SOLUTION: PROCESSING HUB



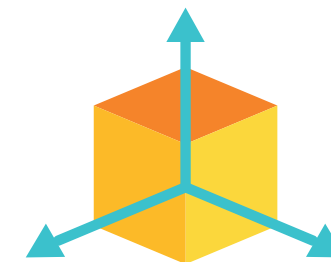
SOLUTION: PROCESSING HUB



**Time
Consuming
Process**



**Profit &
Costs**



**Varying
Consistency**



**Identify
Wood species**

CLT



M'DAM



CLT

Uneven layers



CLT

Uneven layers

Perpendicular glued



CLT

Uneven layers

Perpendicular glued

Varying dimensions

Length: up to 30 meters

Width: up to 4.8 meters

Thickness: 60 - 540 mm



CLT

Uneven layers

Perpendicular glued

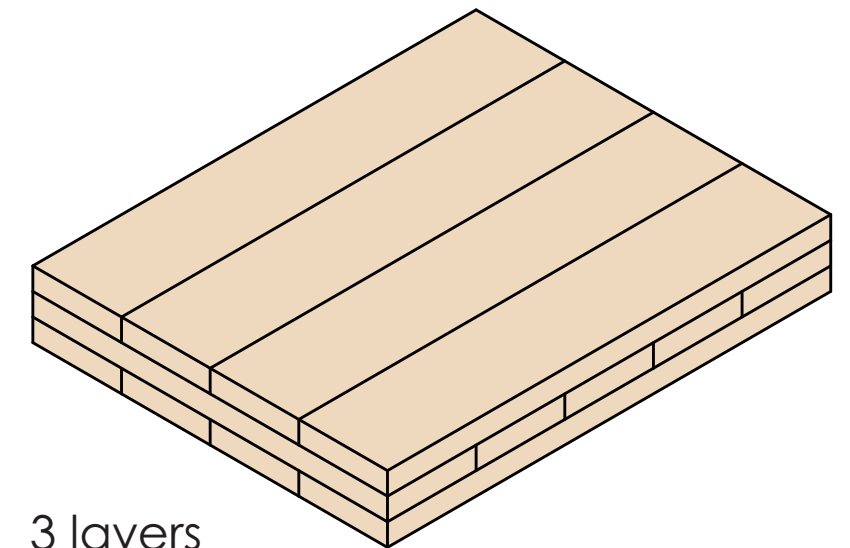
Varying dimensions

Length: up to 30 meters

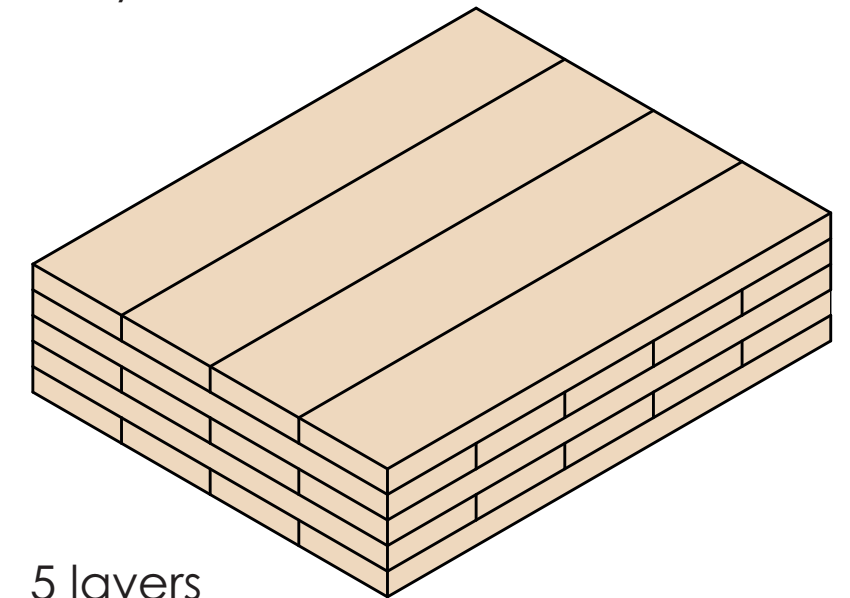
Width: up to 4.8 meters

Thickness: 60 - 540 mm

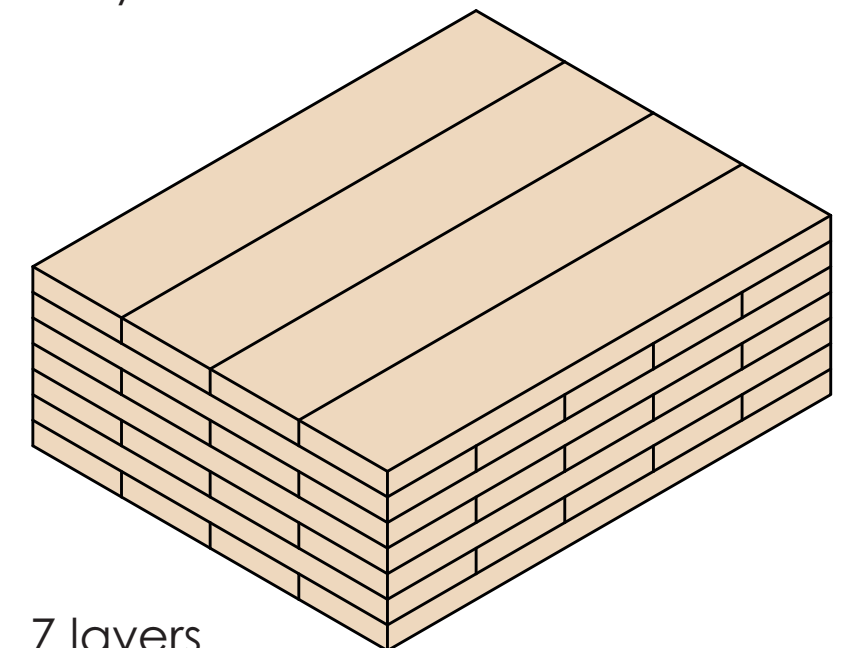
Layers: 3, 5 or 7 to 25



3 layers



5 layers



7 layers

CLT

Wood

Renewable material

Stores CO₂

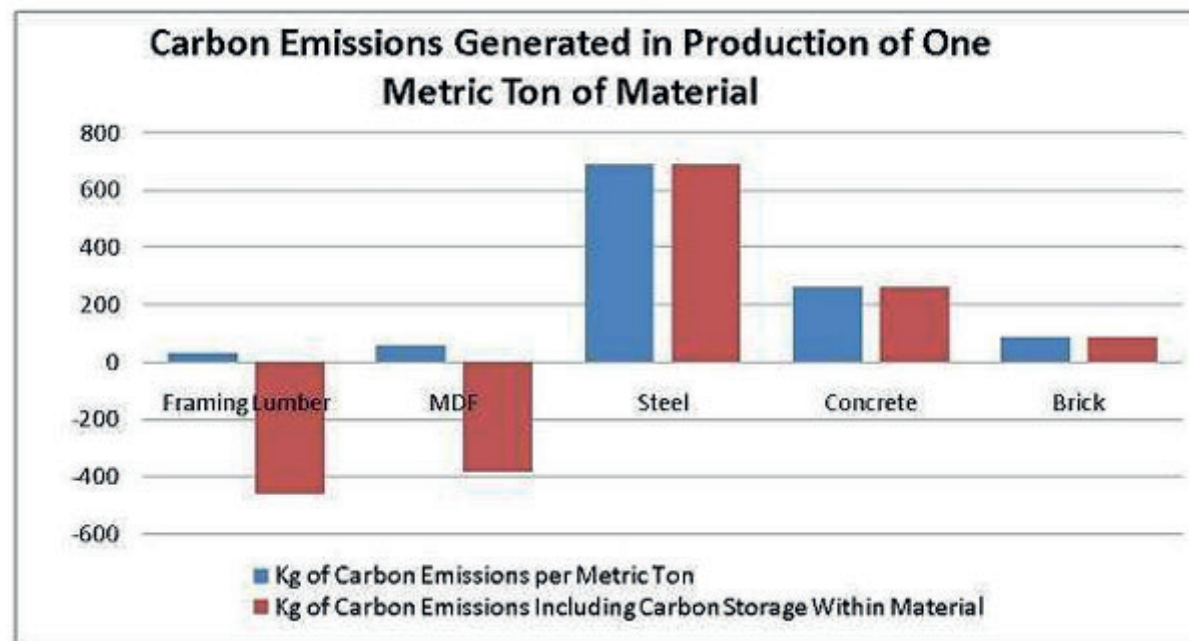


CLT

Wood

Renewable material

Stores CO2



Soure (Centrum Hout, 2016)



CLT

Wood

Renewable material

Stores CO₂

Long lifespan + Reusable



CLT

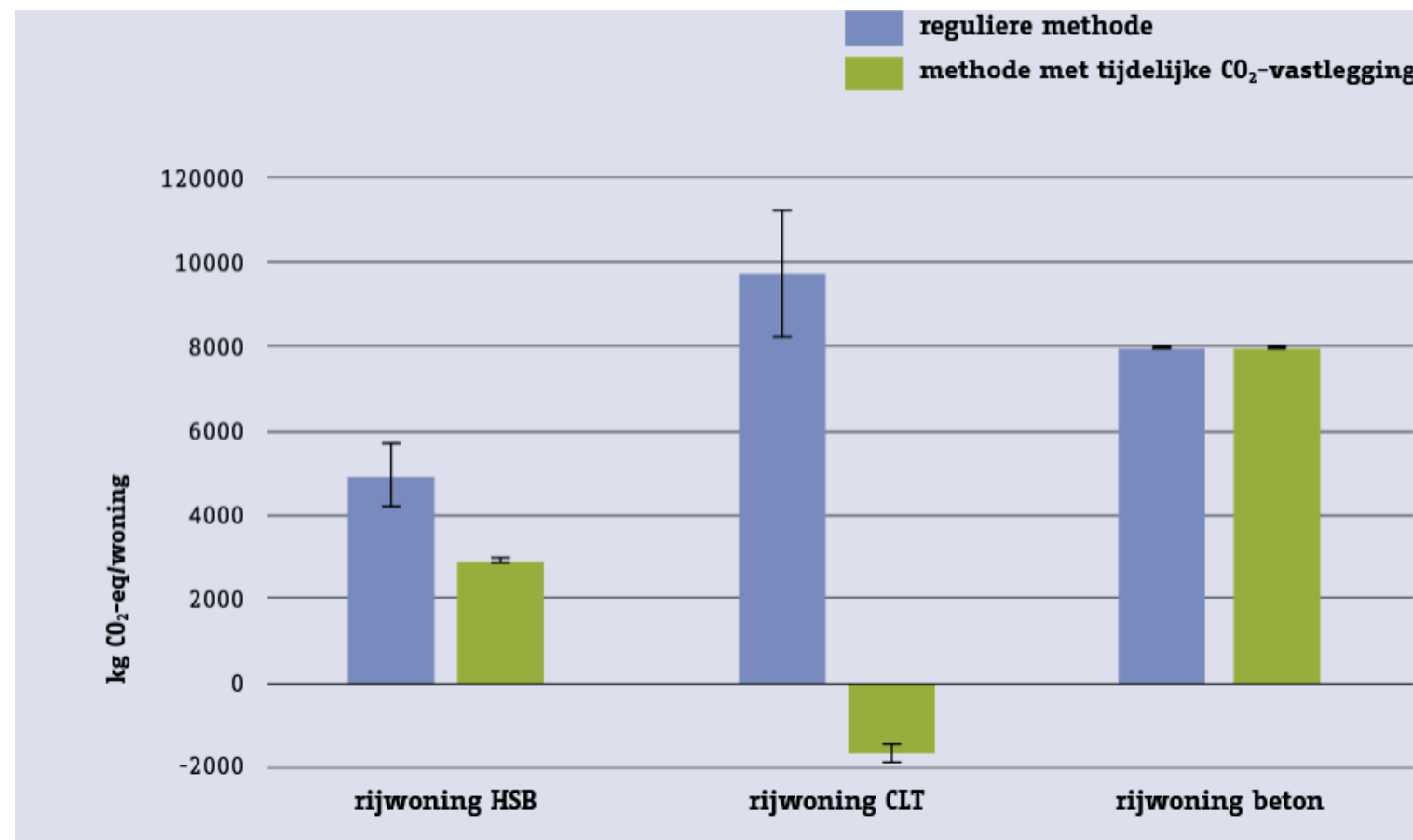
Wood

Renewable material

Stores CO₂

Long lifespan + Reusable

= long CO₂ storage



Source (Van der Lugt, 2021)



CLT

Wood

Renewable material

Stores CO₂

Long lifespan + Reusable

= long CO₂ storage

Sustainable product

Rise in demand wood



CLT

Wood

Renewable material

Stores CO₂

Long lifespan + Reusable

= long CO₂ storage

Sustainable product

Rise in demand wood

Scrap wood



CLT

Wood

Renewable material

Stores CO₂

Long lifespan + Reusable

= long CO₂ storage

Sustainable product

Rise in demand wood

Scrap wood

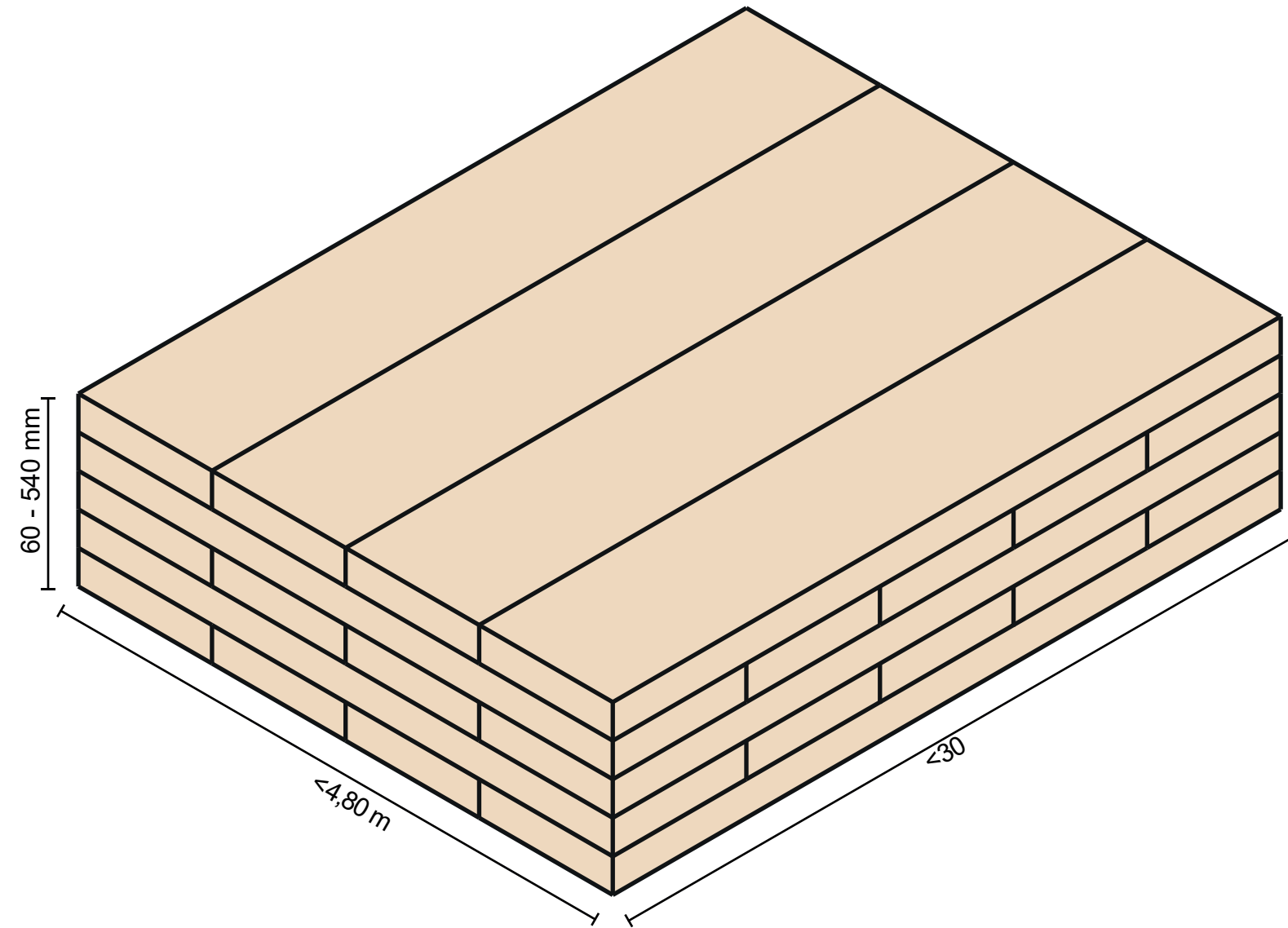
Provide wood for demand

Keeps more CO₂ stored



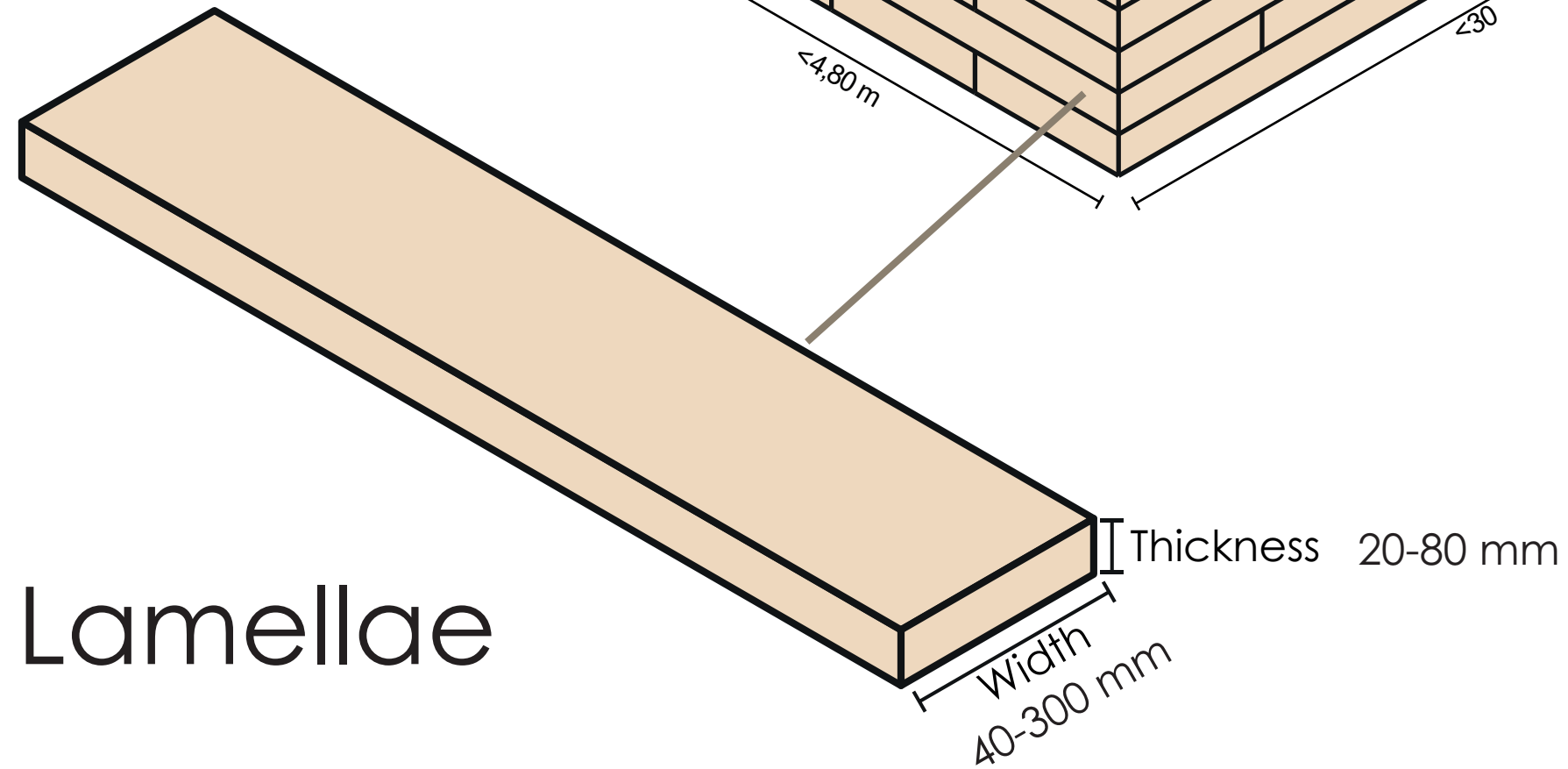
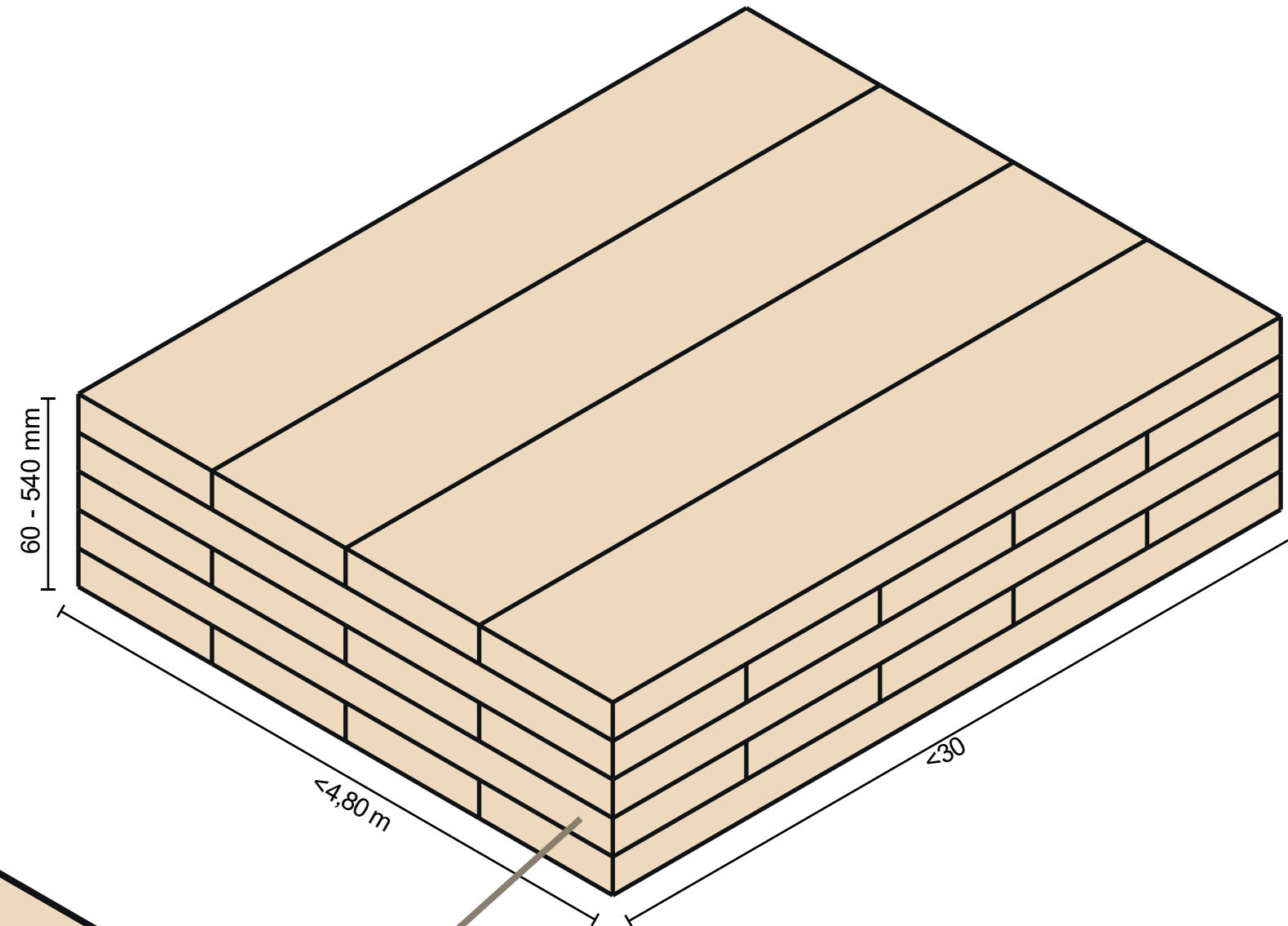
CLT: PANEL

5 layer panel



CLT: PANEL

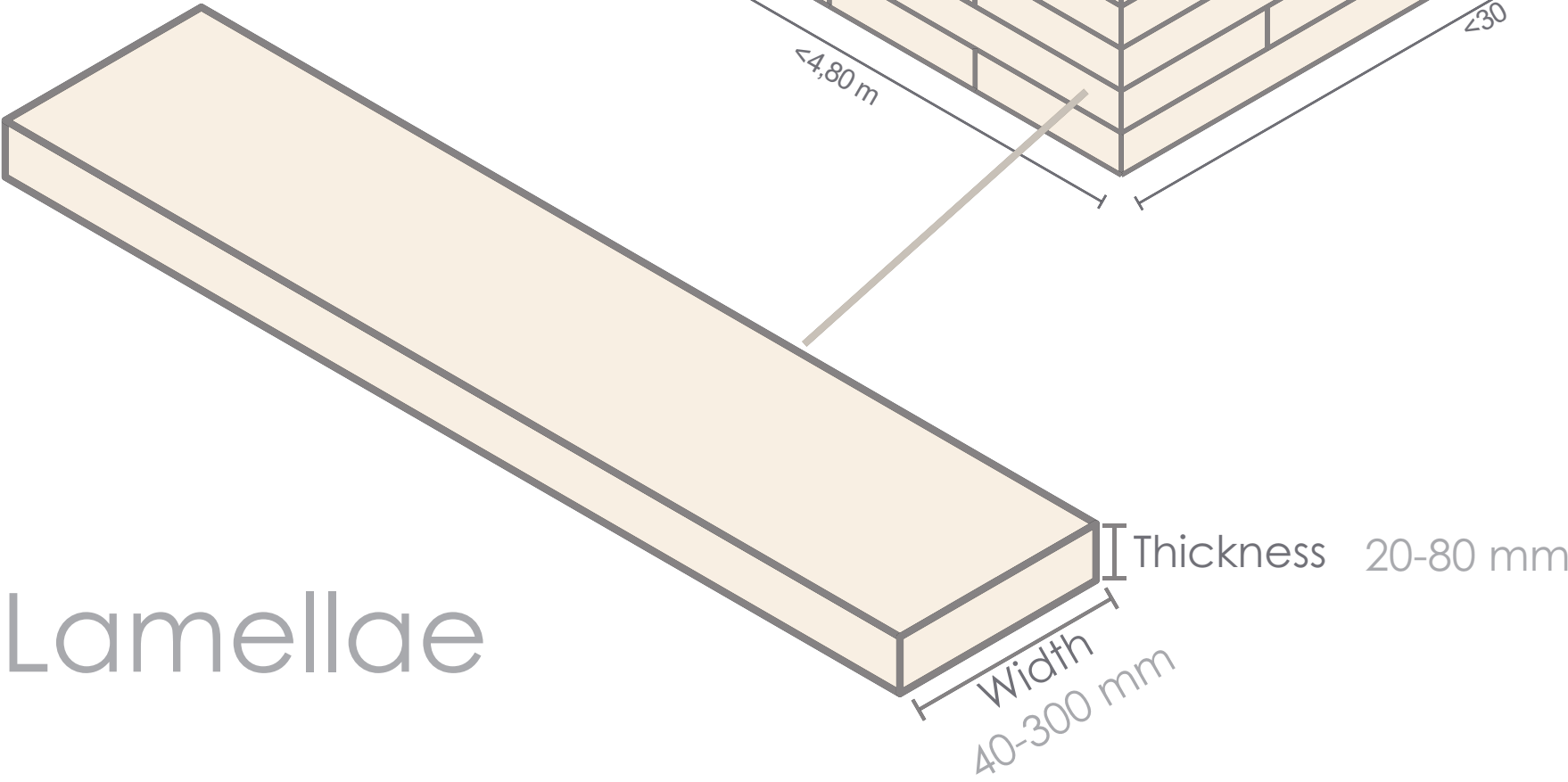
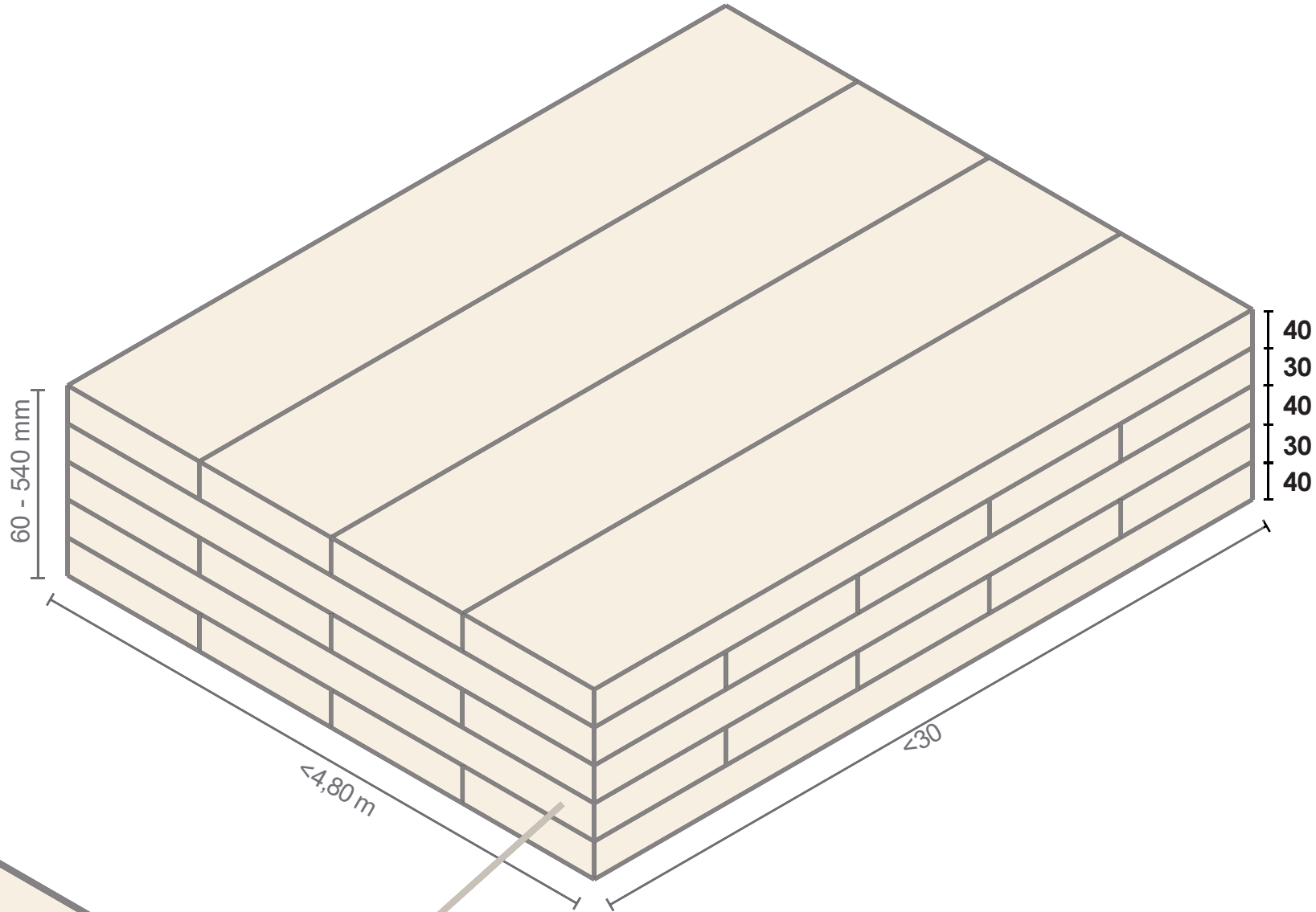
5 layer panel



Lamellae

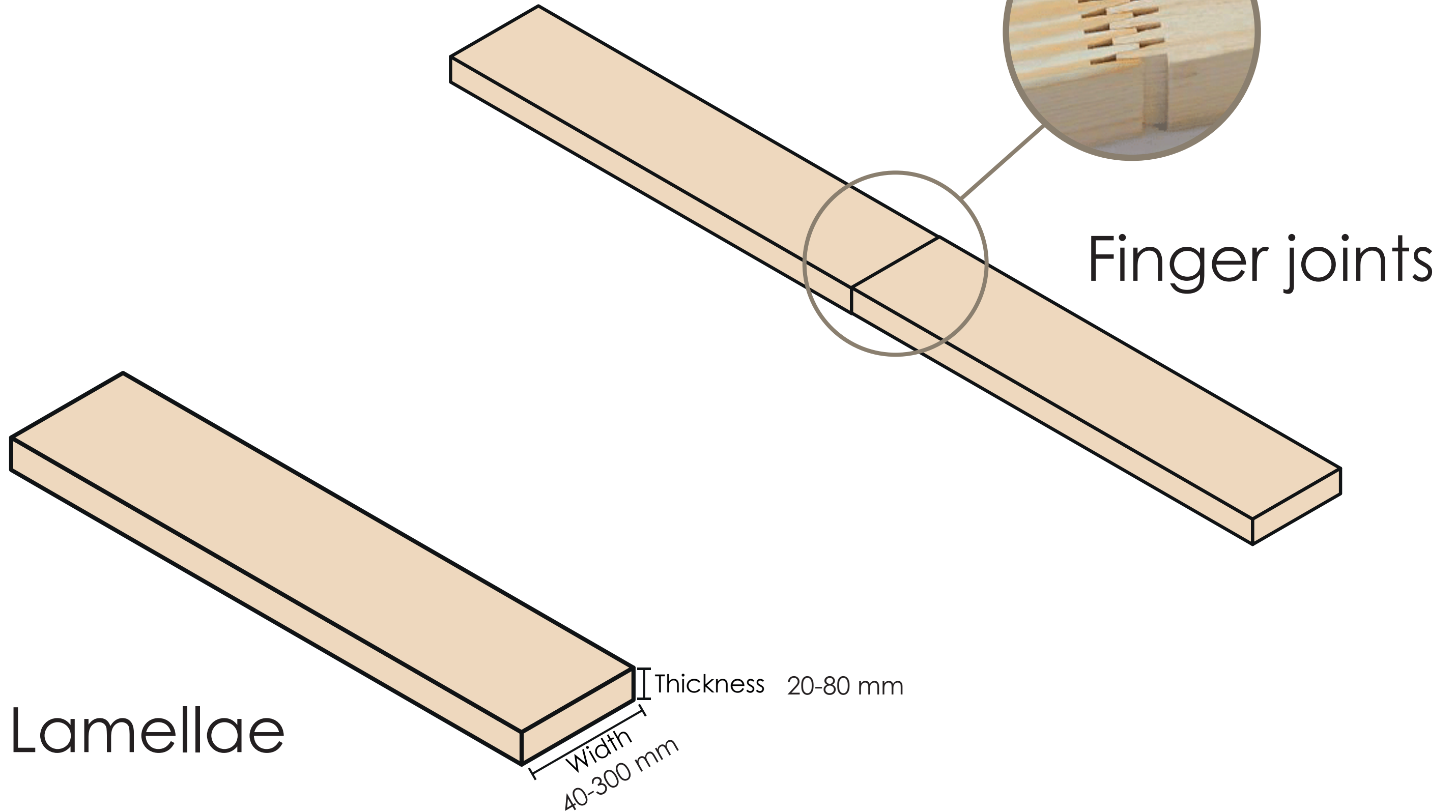
CLT: PANEL

5 layer panel



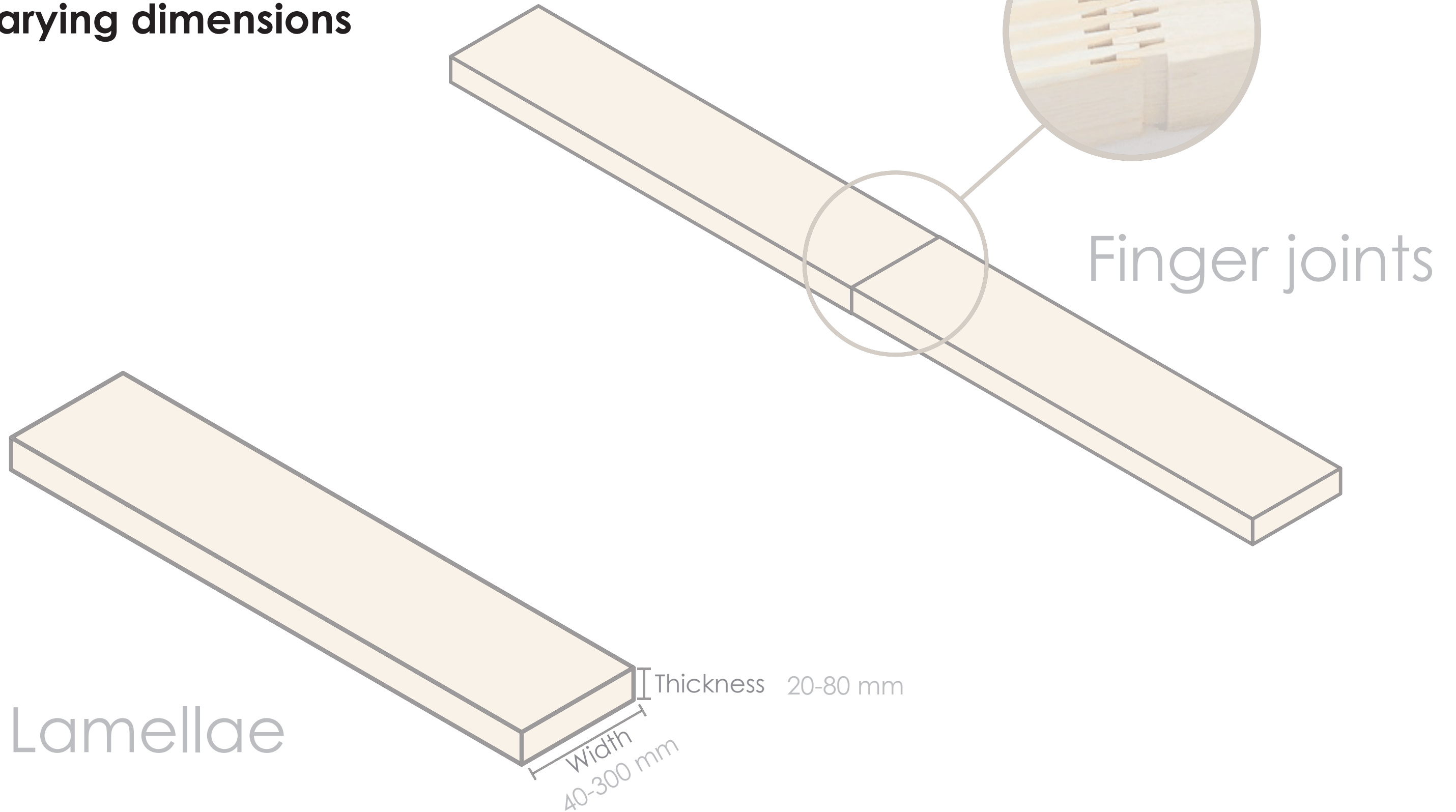
Lamellae

CLT: LAMELLAE



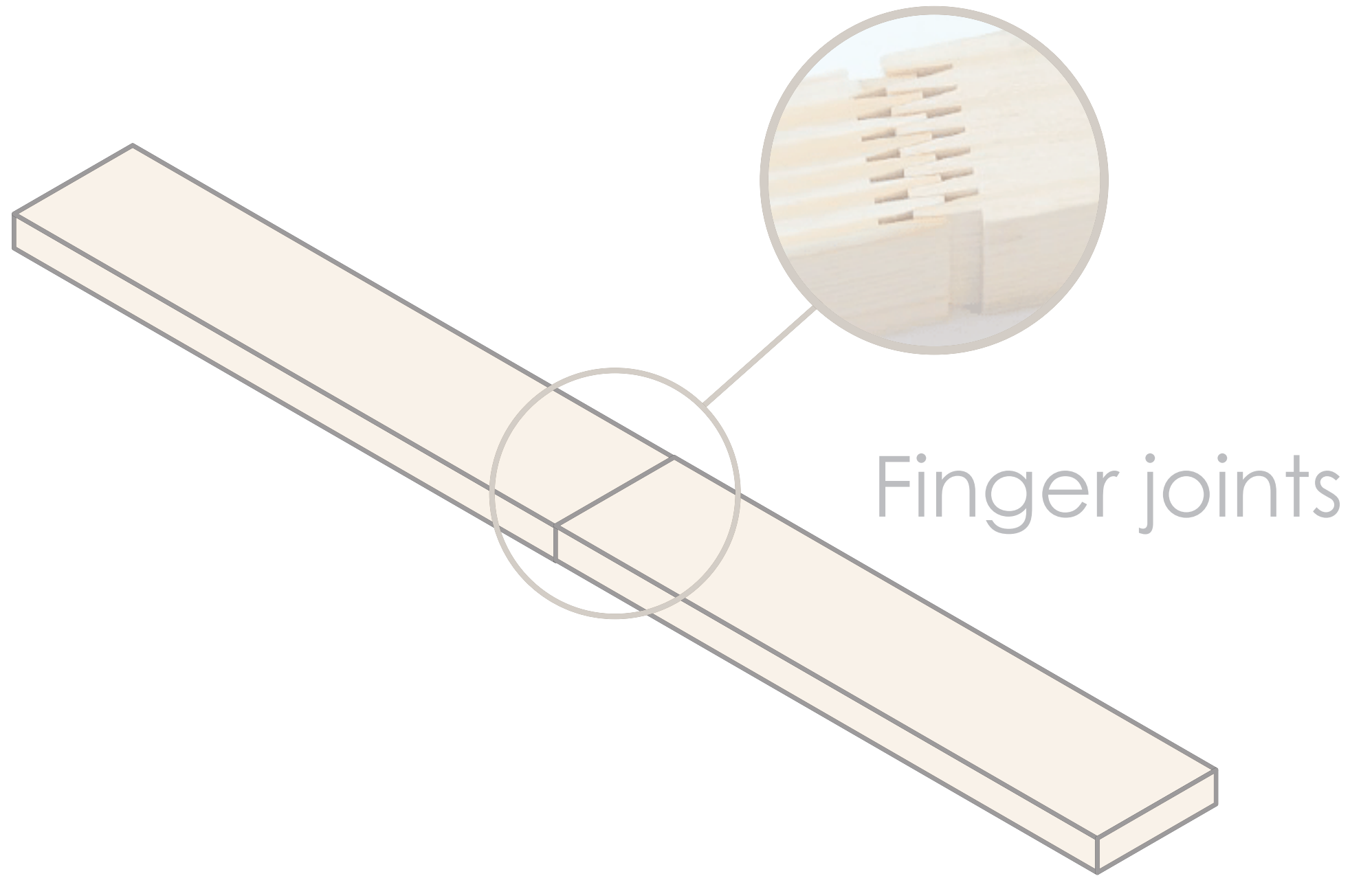
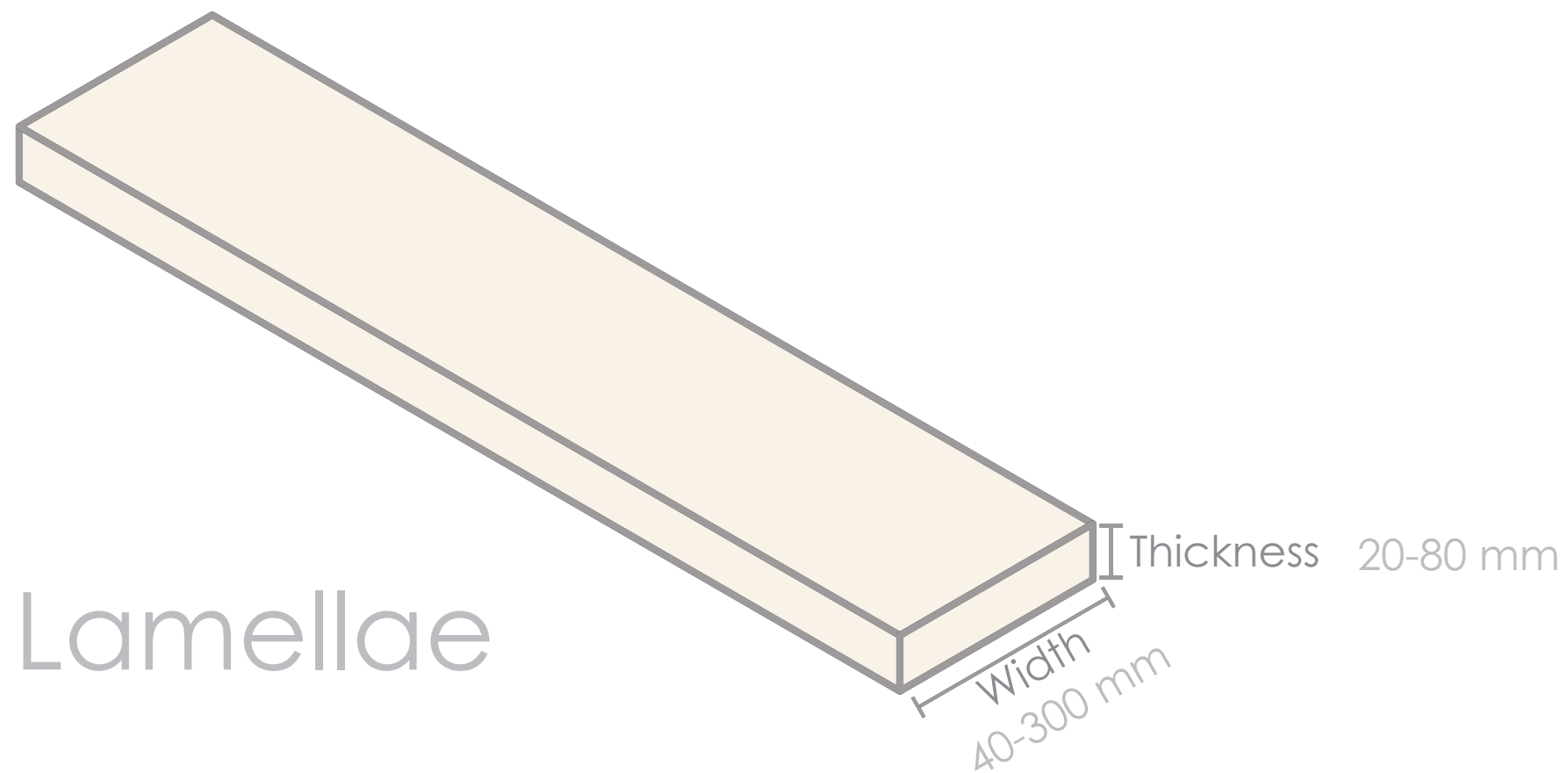
CLT: LAMELLAE

Varying dimensions

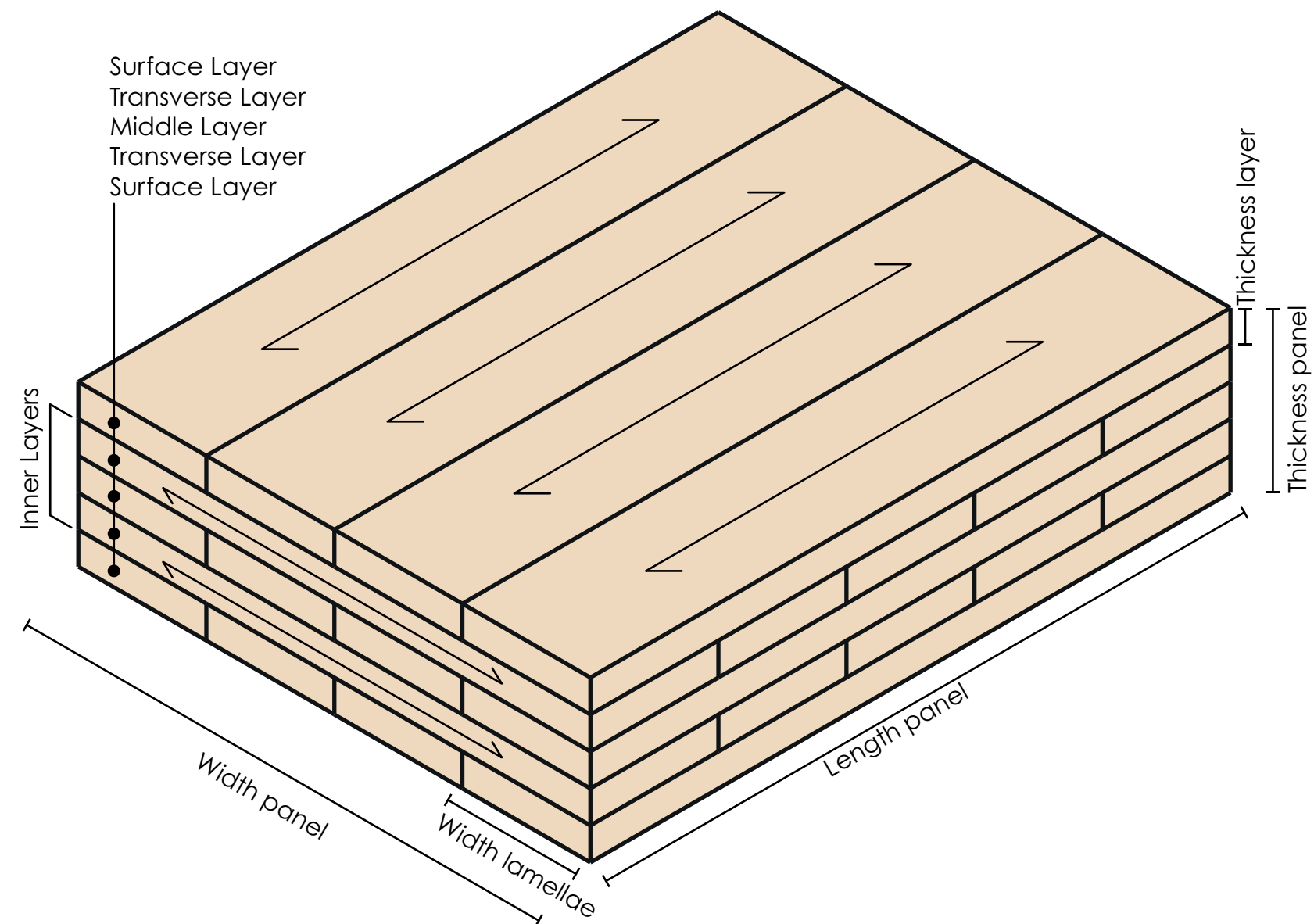


CLT: LAMELLAE

Varying dimensions
Ideal for scrap wood

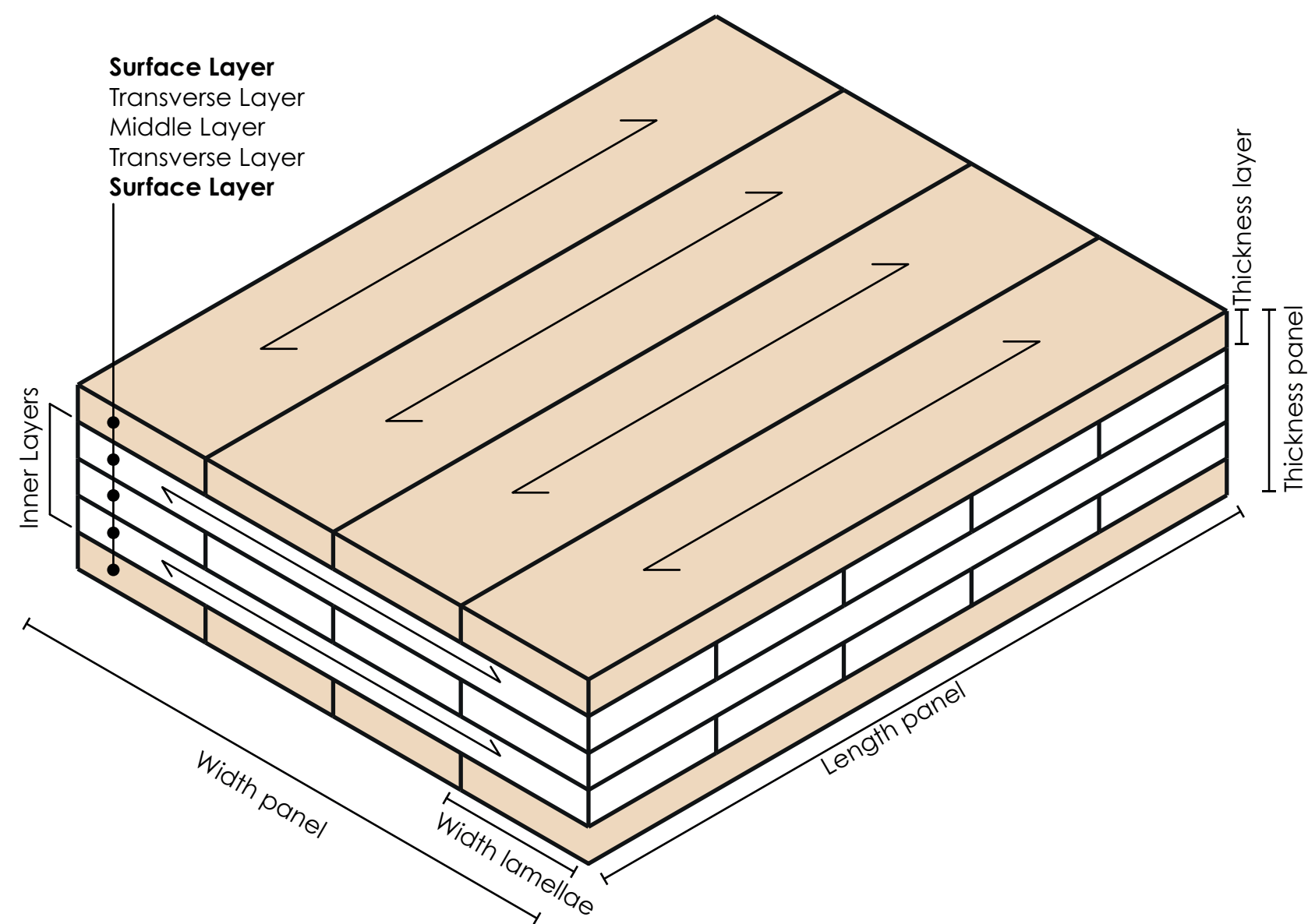


5 layer panel



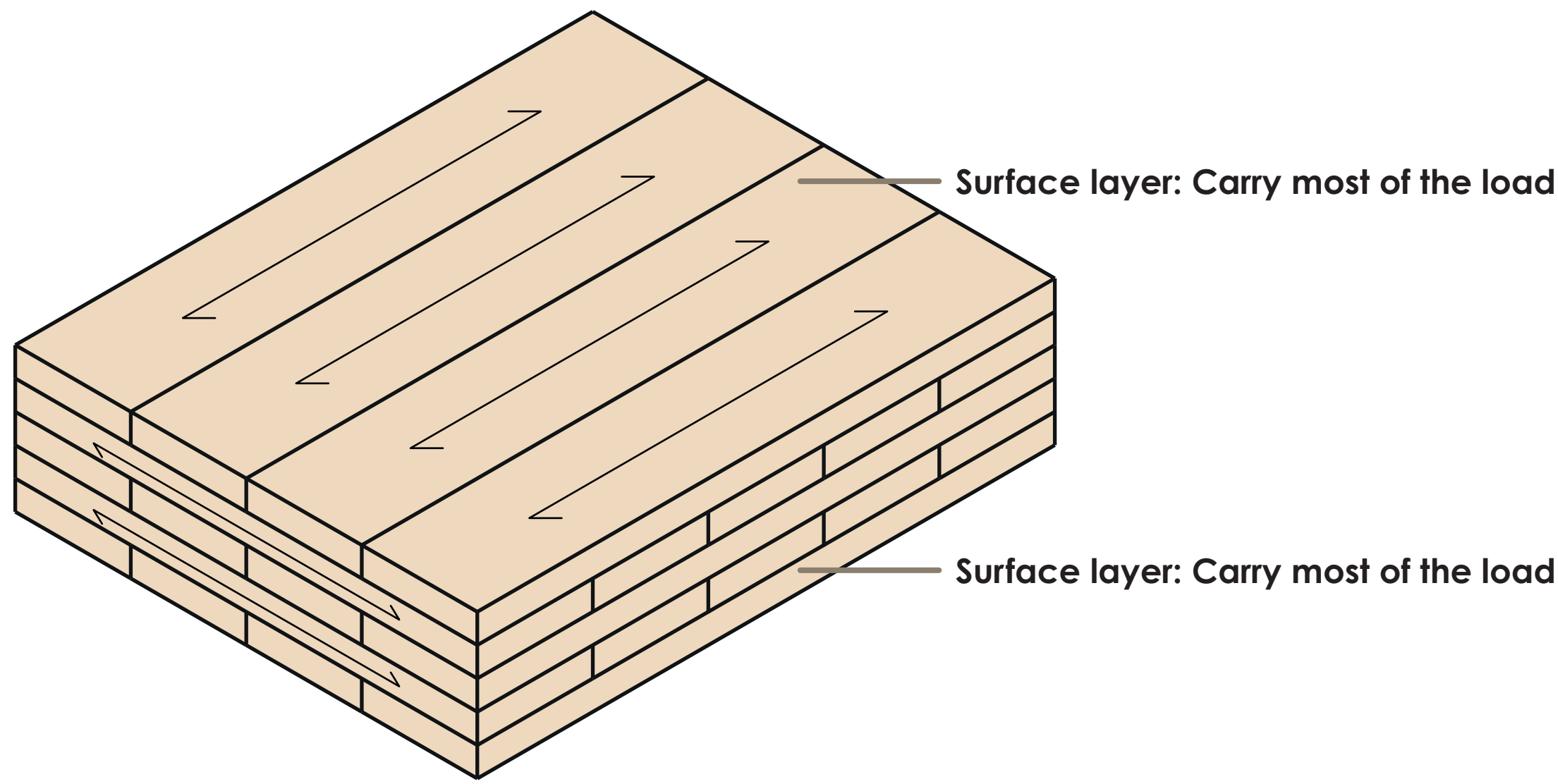
CLT: SURFACE LAYERS

5 layer panel

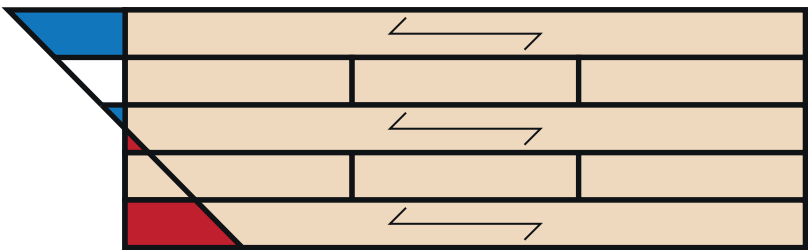


CLT: LOAD BEARING PANELS

5 layer panel

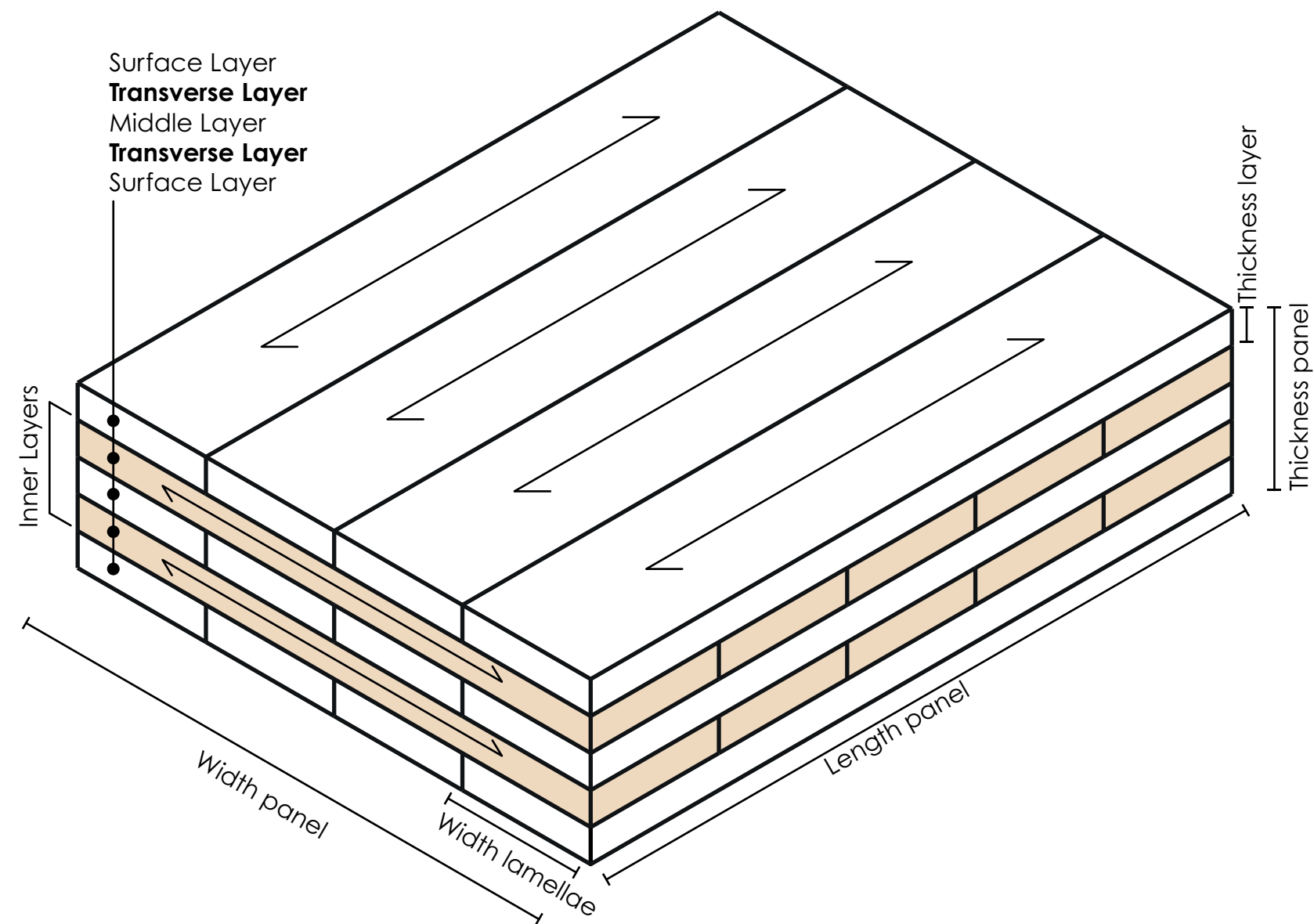


Load distribution



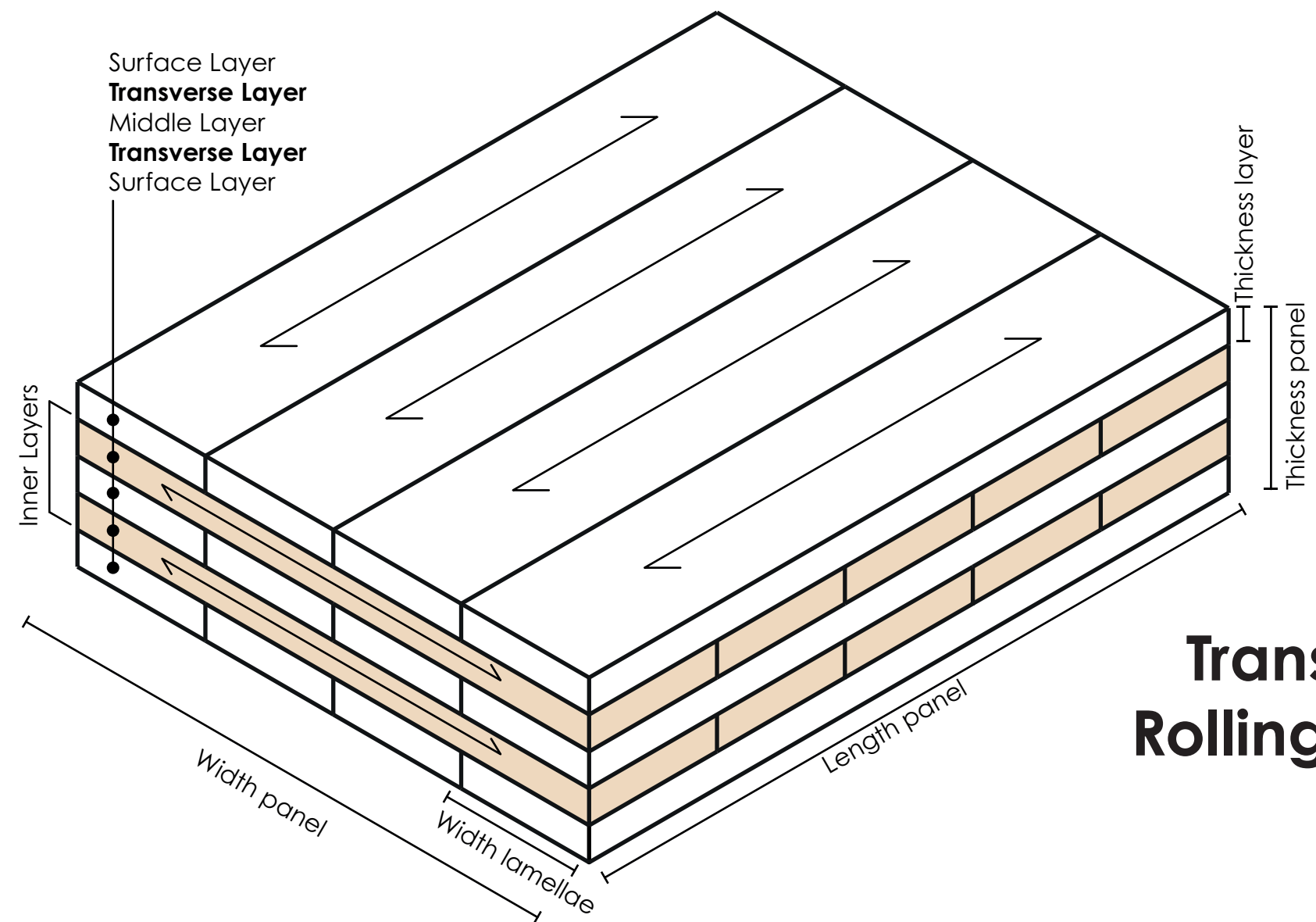
CLT: TRANSVERSE LAYERS

5 layer panel



CLT: TRANSVERSE LAYERS

5 layer panel



Transverse layers:
Rolling shear strength



Shear failure

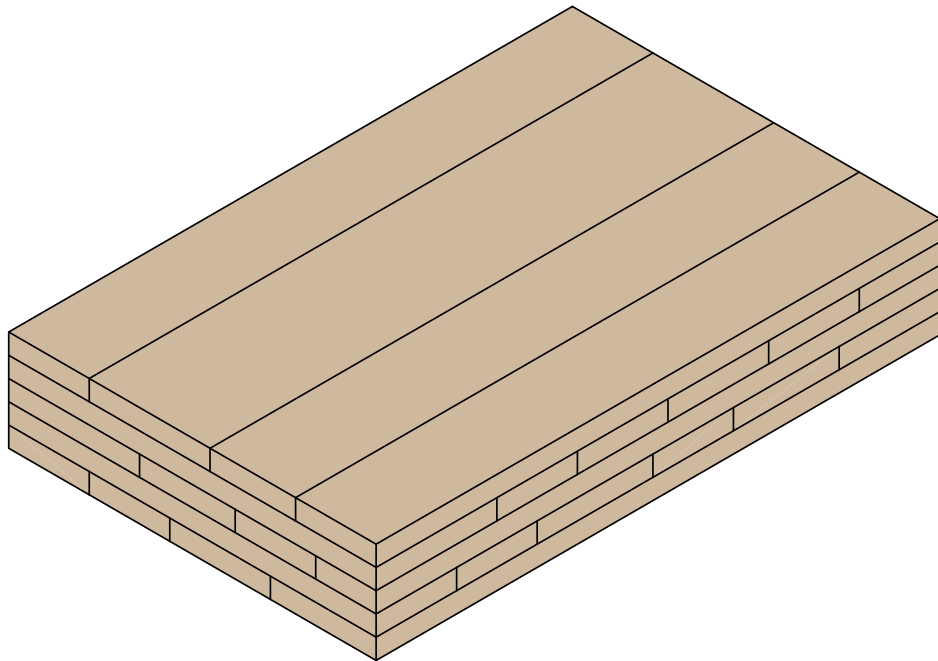


CLT SCENARIOS

CLT SCENARIOS

6 scenarios:

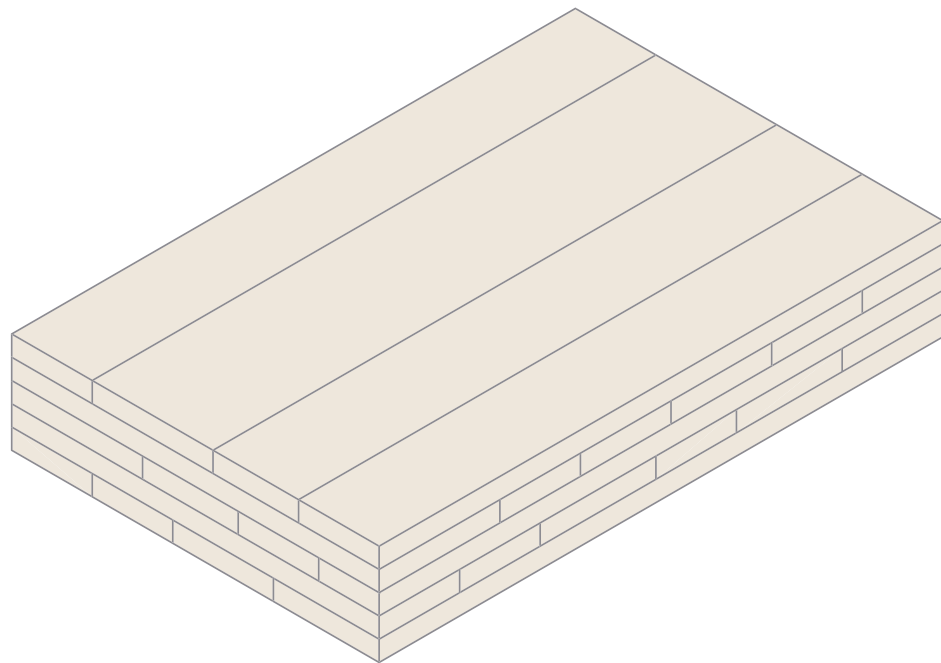
S1: Whole panel



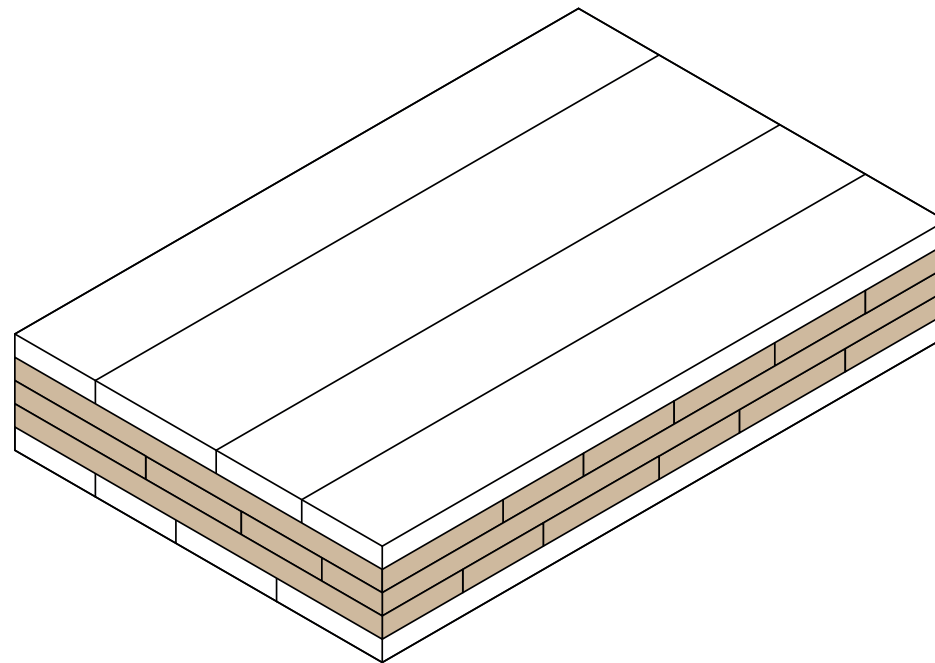
CLT SCENARIOS

6 scenarios:

S1: Whole panel



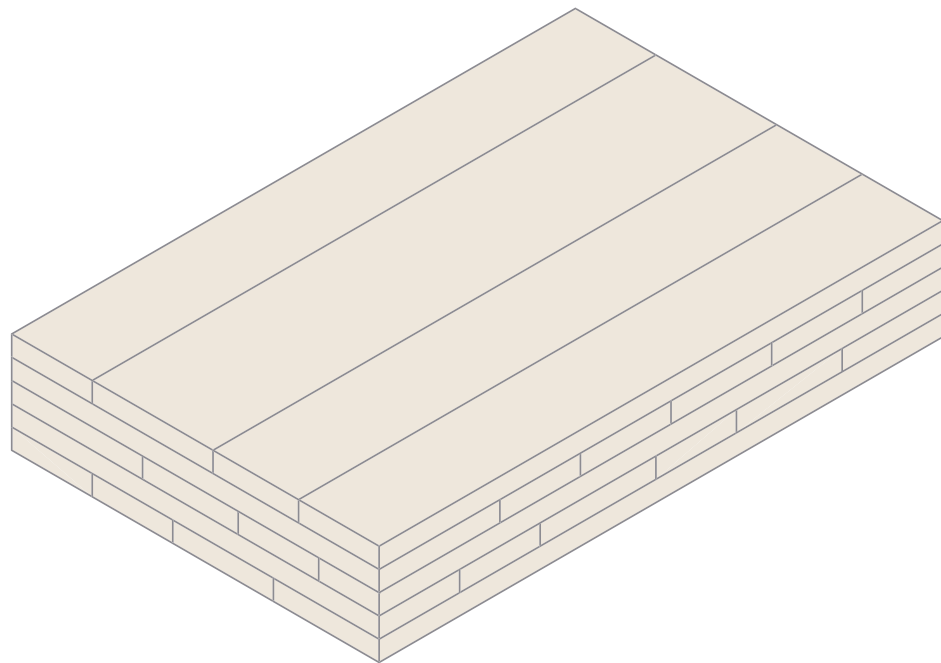
S2: Inner layers



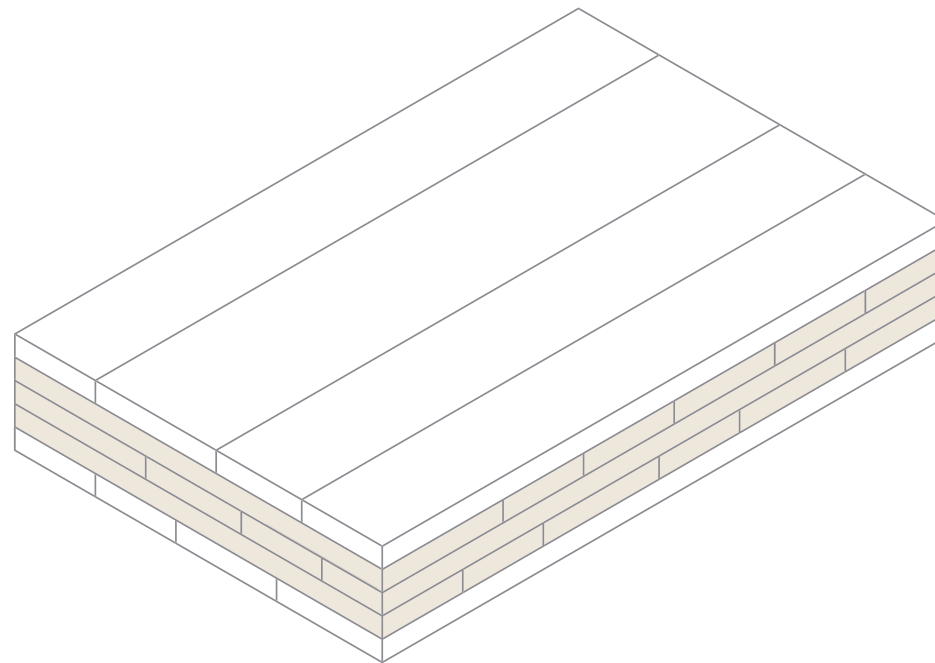
CLT SCENARIOS

6 scenarios:

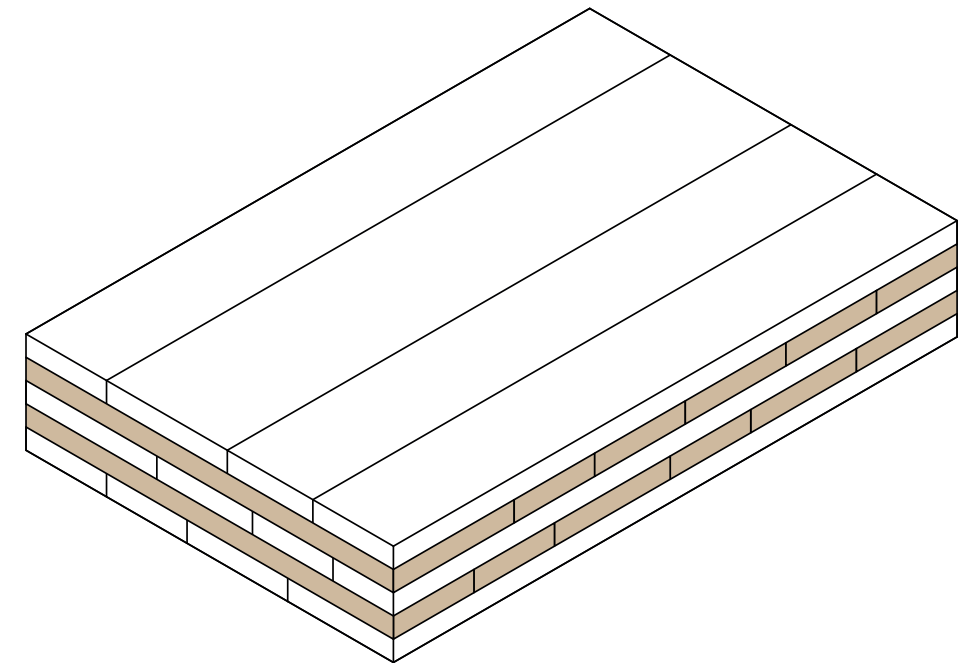
S1: Whole panel



S2: Inner layers



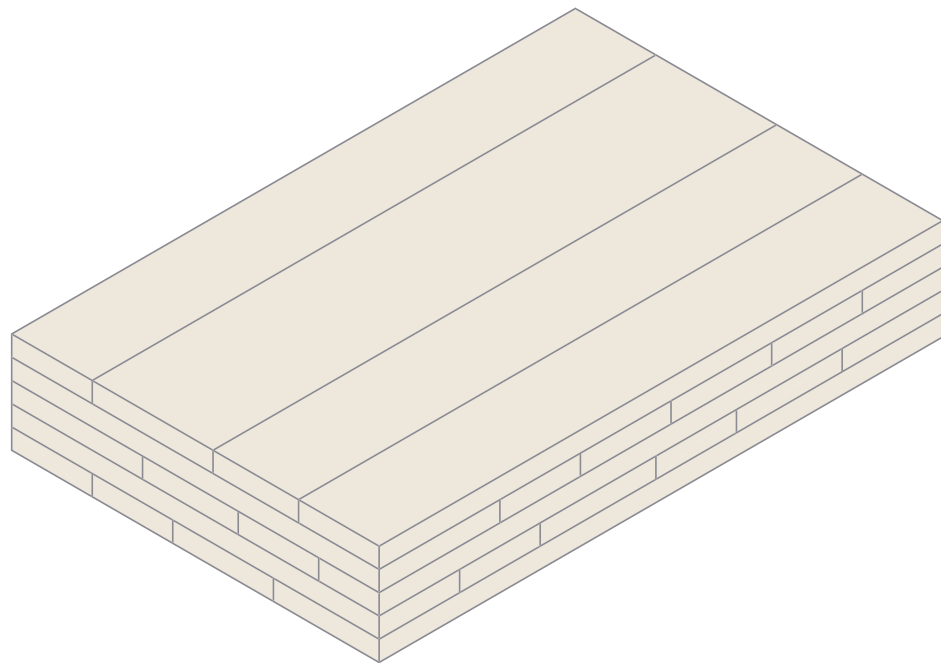
S3: Transverse layers



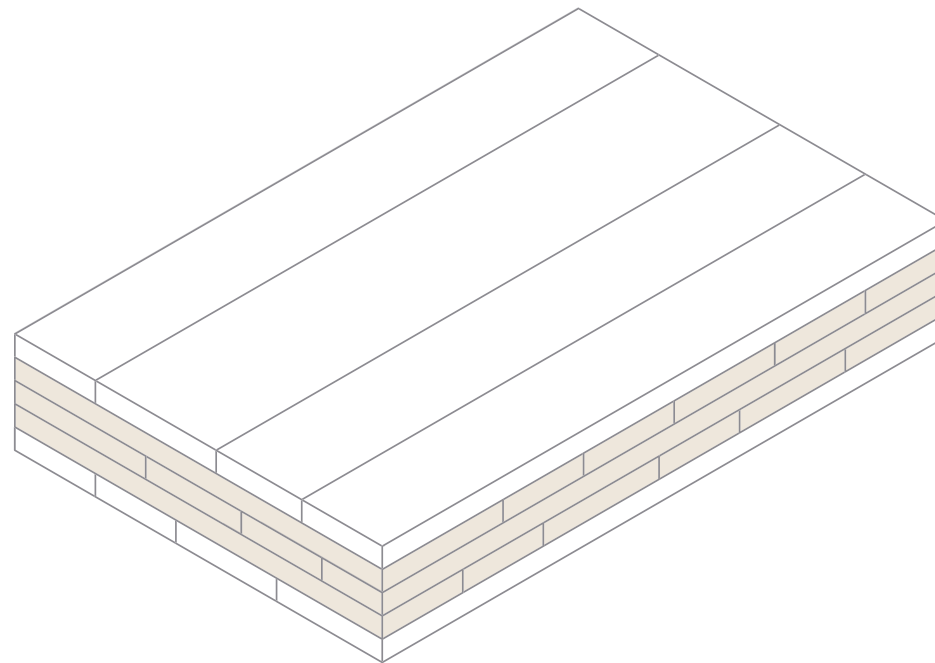
CLT SCENARIOS

6 scenarios:

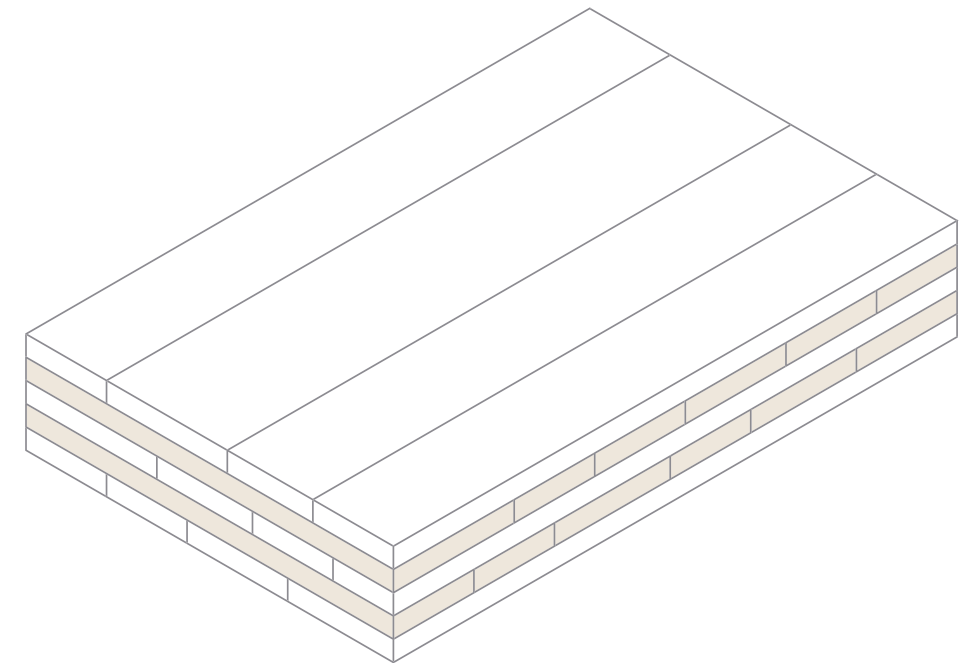
S1: Whole panel



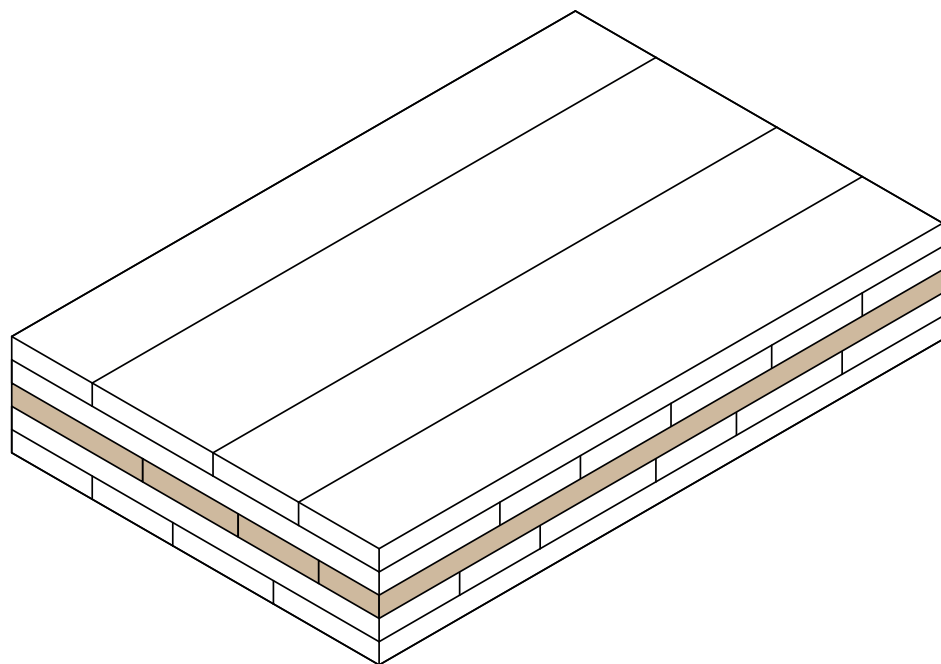
S2: Inner layers



S3: Transverse layers



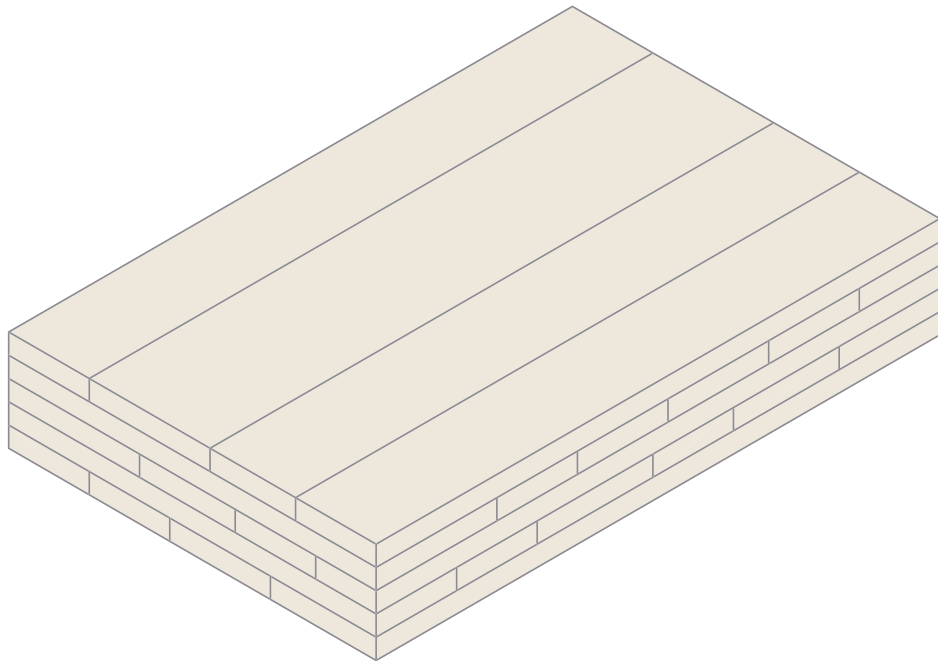
S4: Middle layer



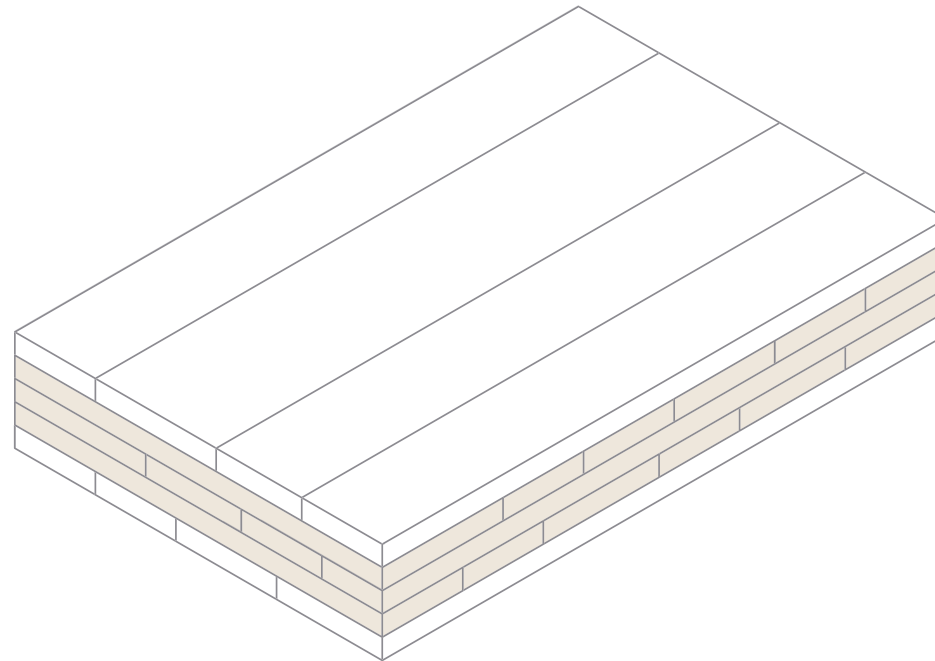
CLT SCENARIOS

6 scenarios:

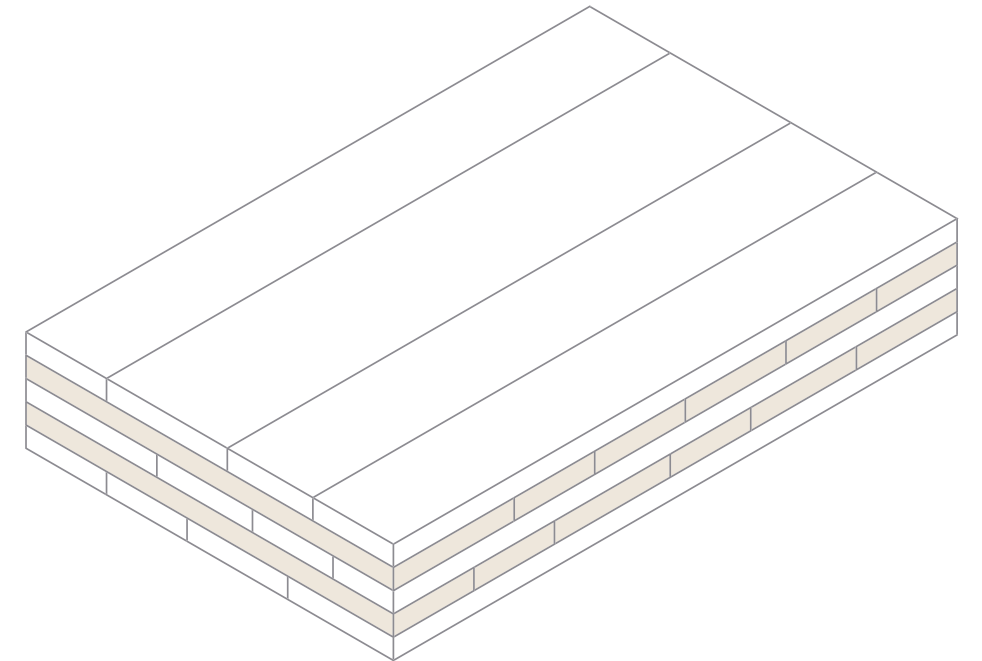
S1: Whole panel



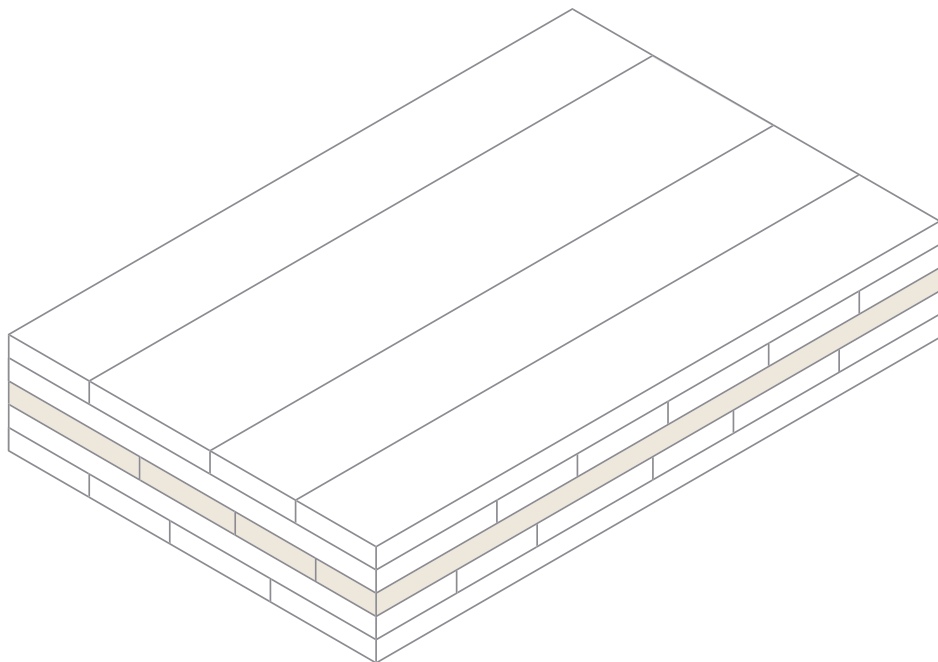
S2: Inner layers



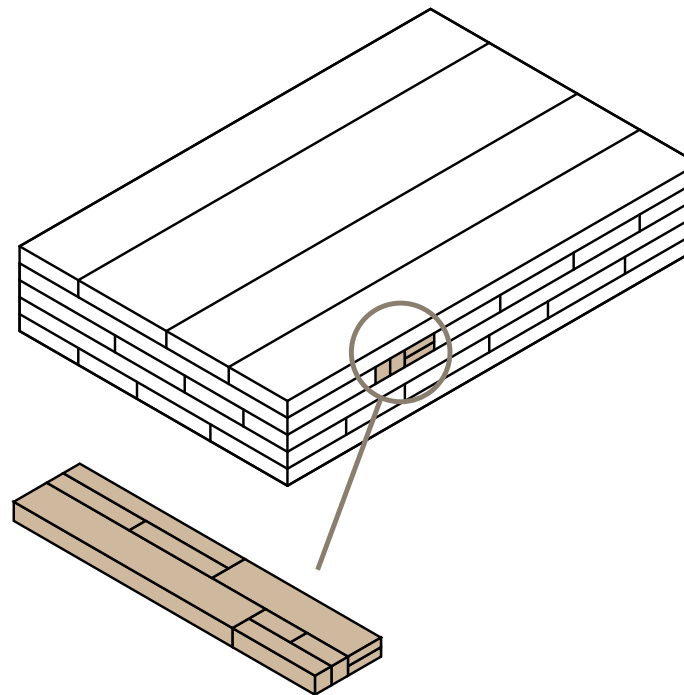
S3: Transverse layers



S4: Middle layer



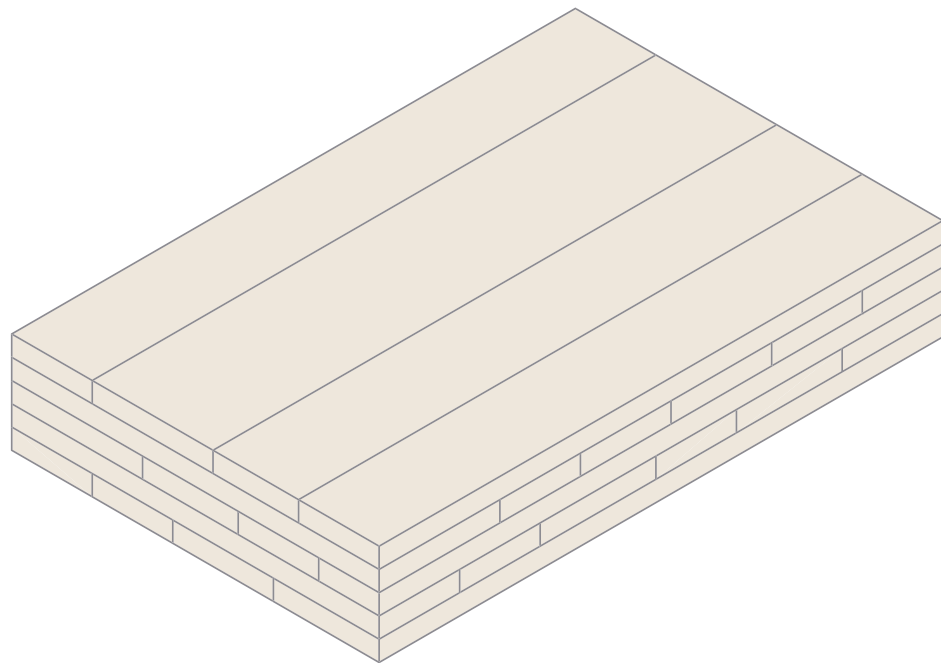
S5: Mixed small pieces



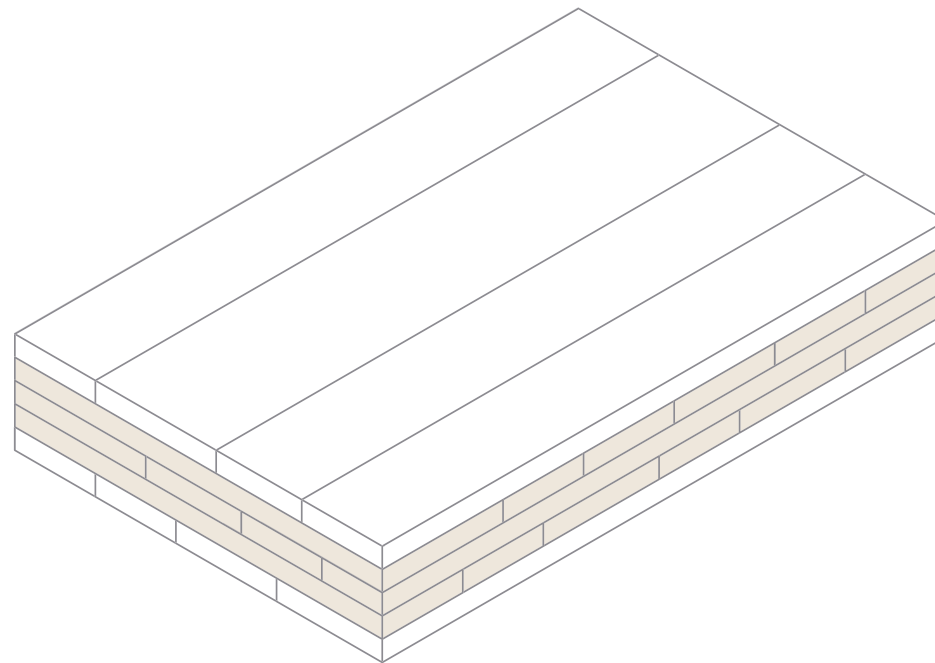
CLT SCENARIOS

6 scenarios:

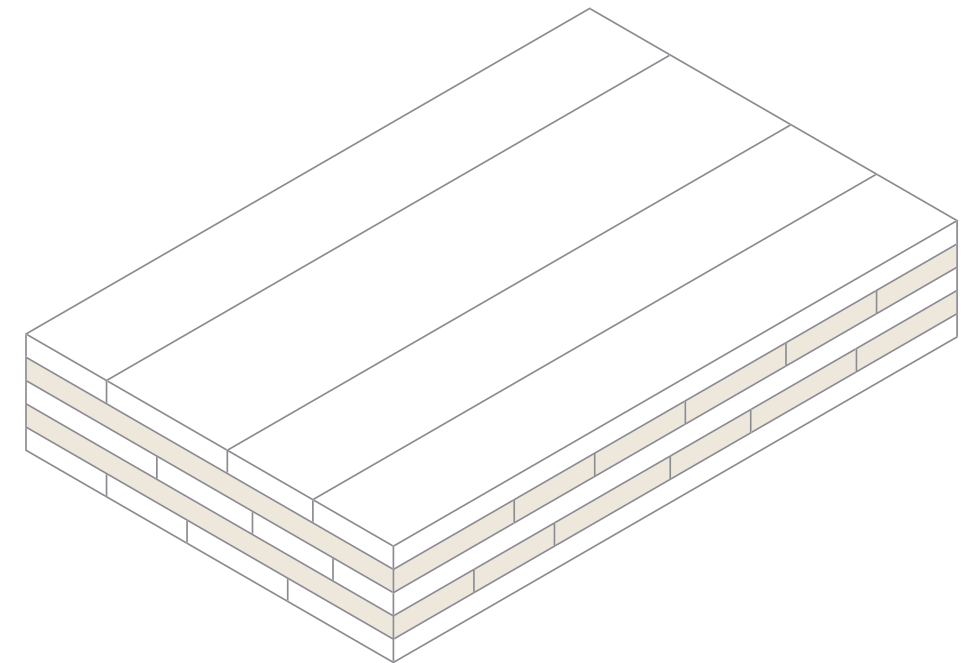
S1: Whole panel



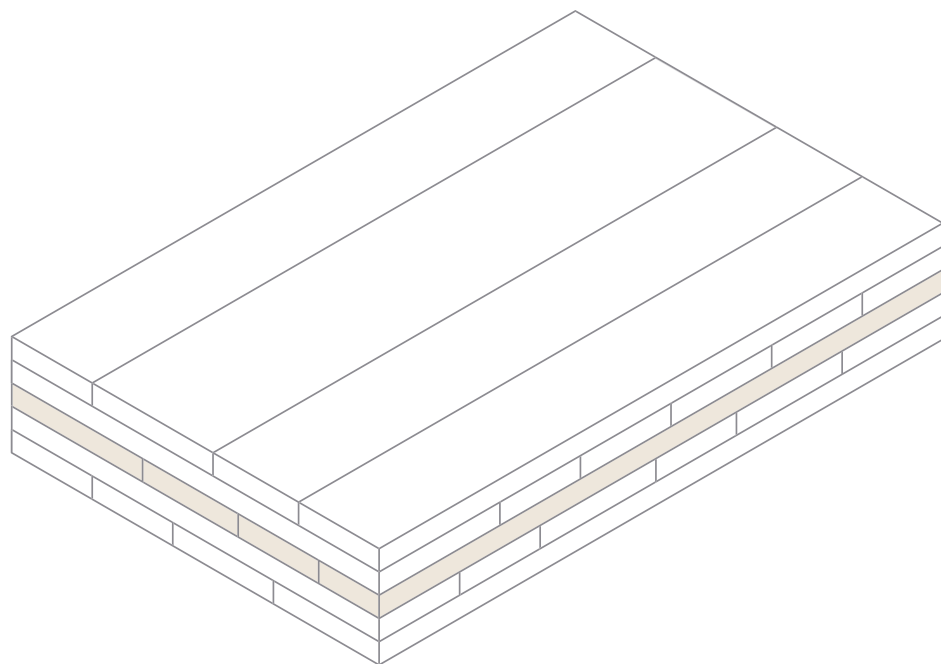
S2: Inner layers



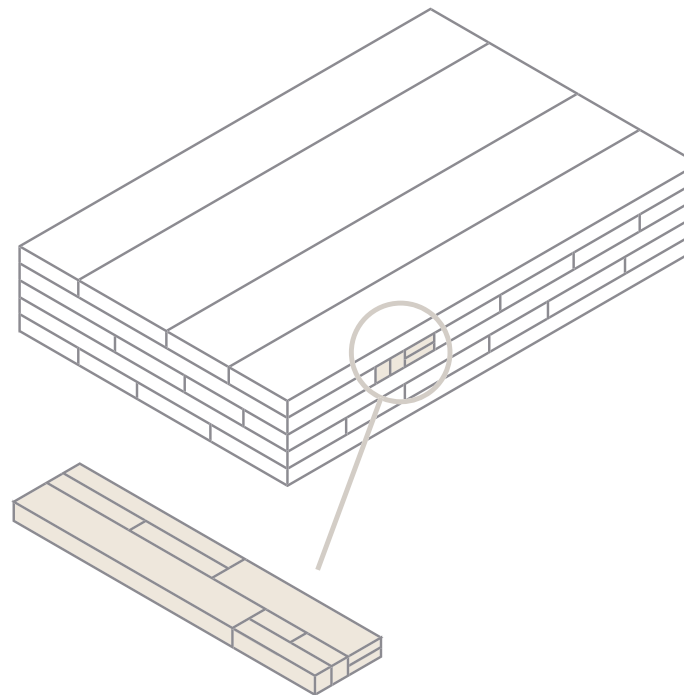
S3: Transverse layers



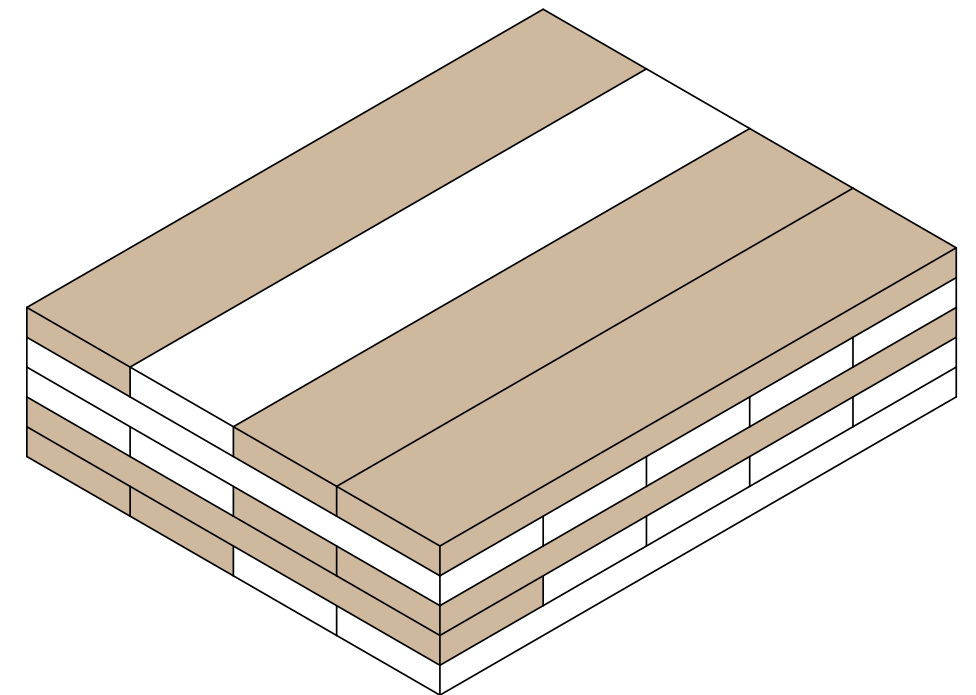
S4: Middle layer



S5: Mixed small pieces



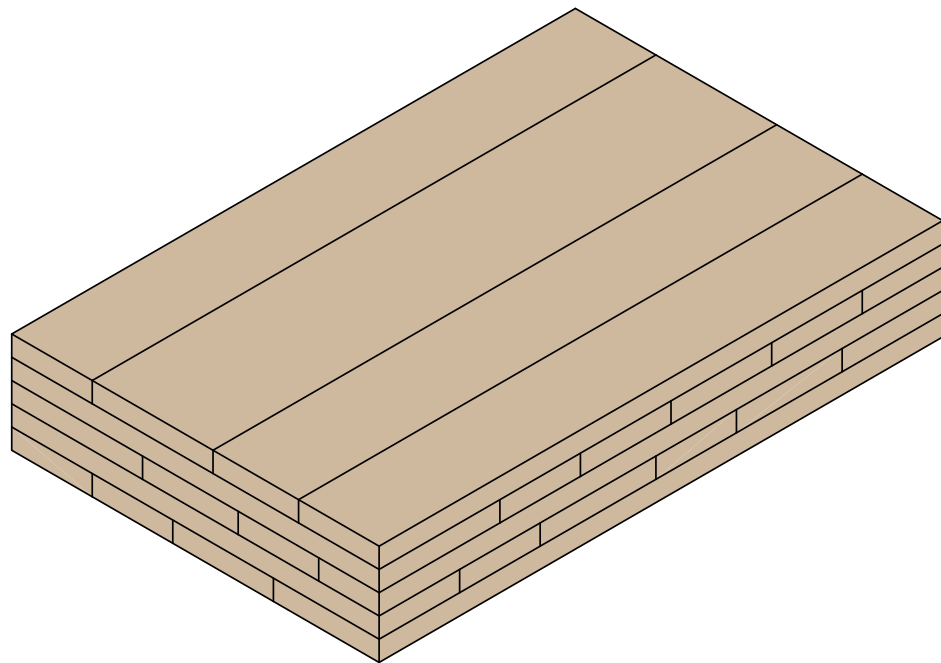
S6: % of Scrap wood



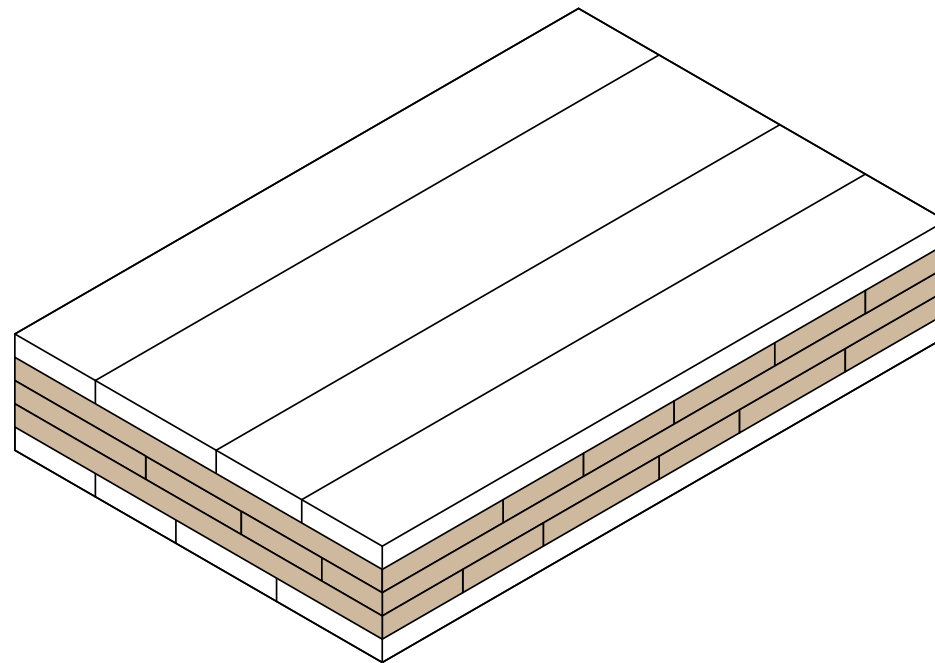
CLT SCENARIOS

6 scenarios:

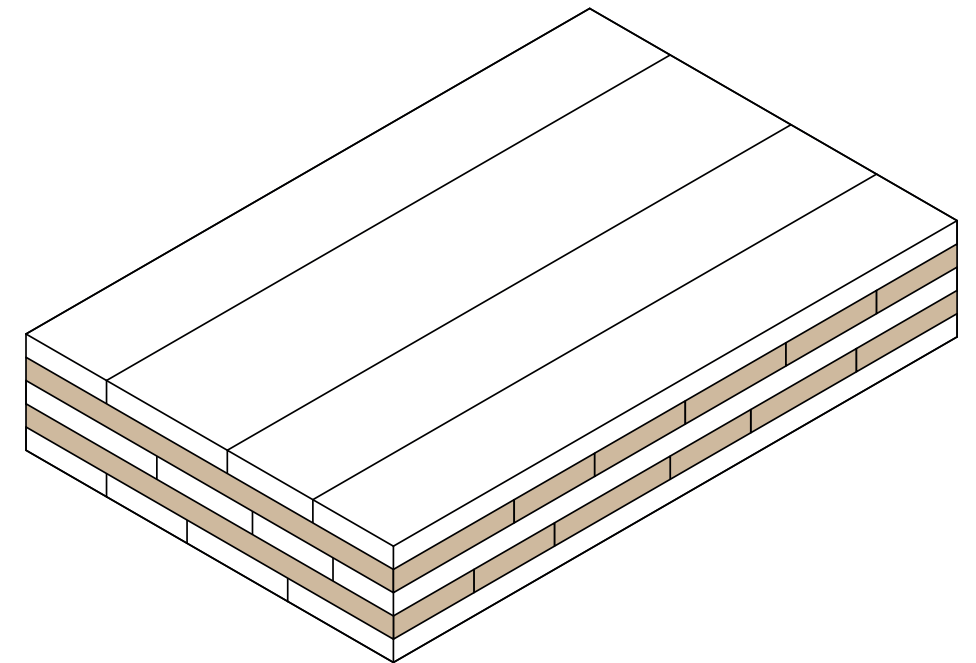
S1: Whole panel



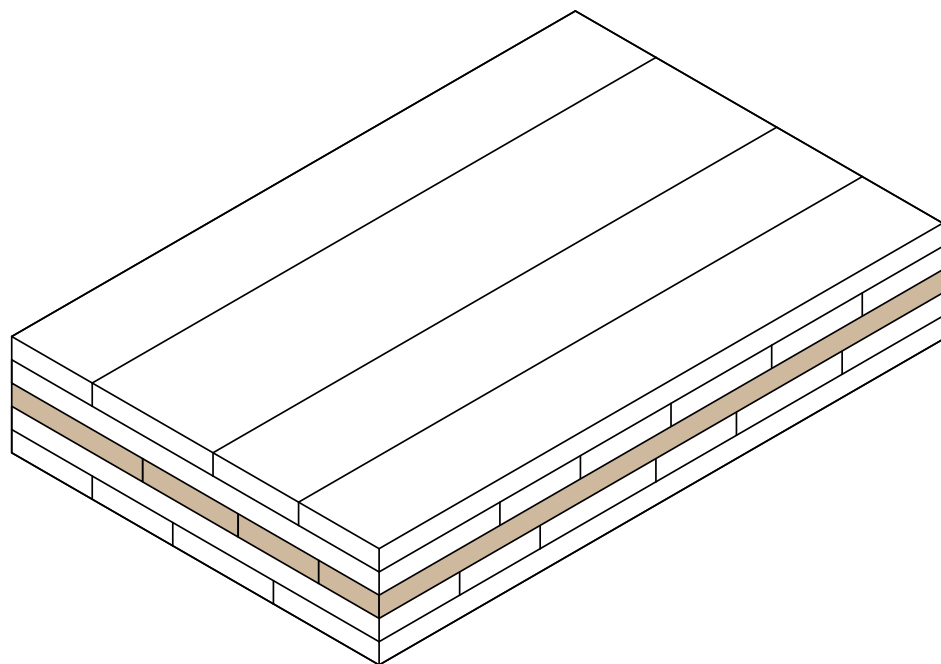
S2: Inner layers



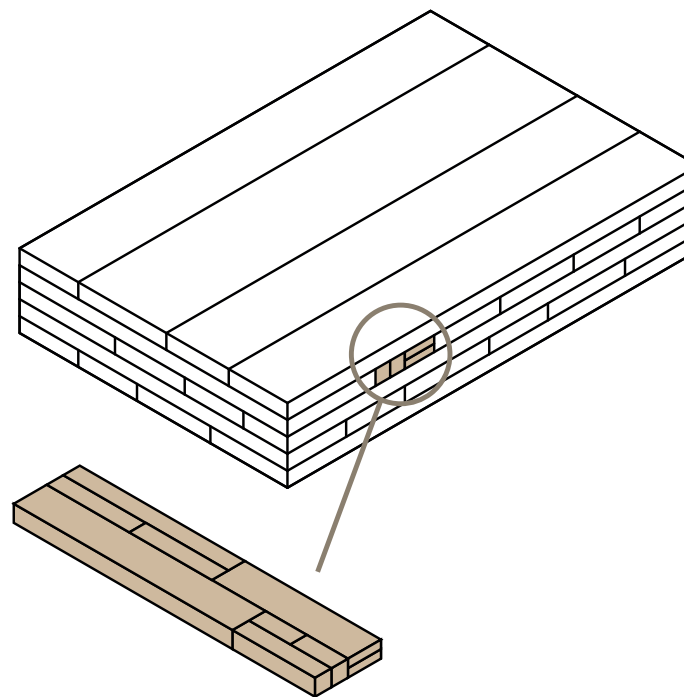
S3: Transverse layers



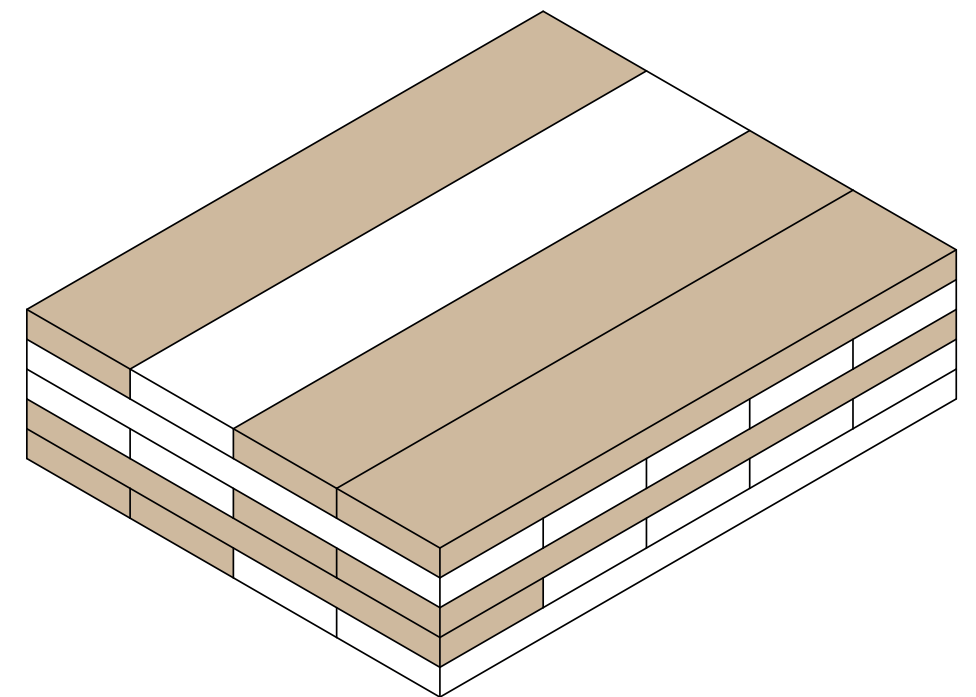
S4: Middle layer



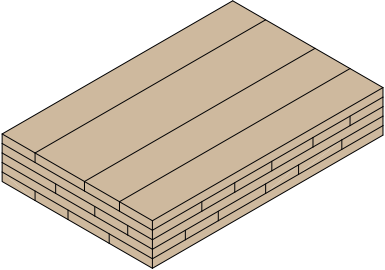
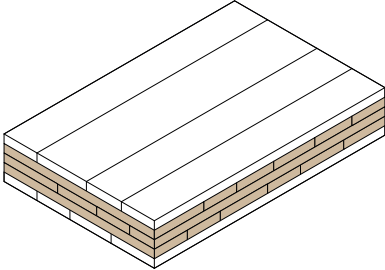
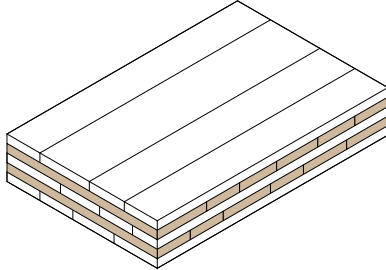
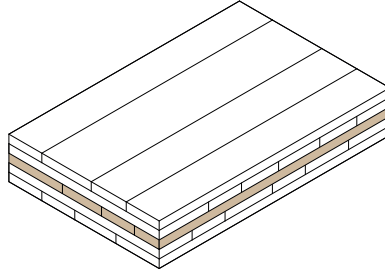
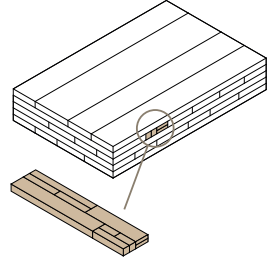
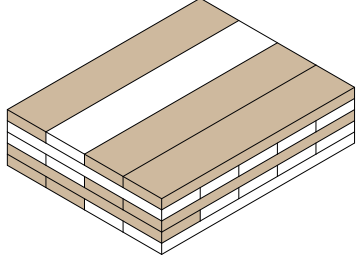
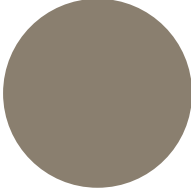
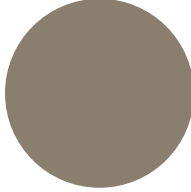
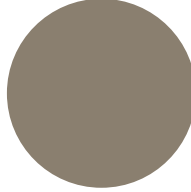
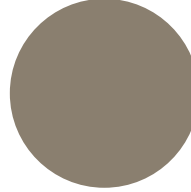
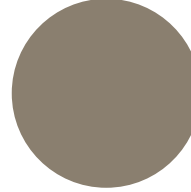
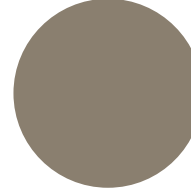
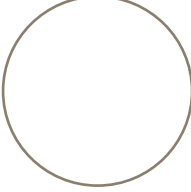
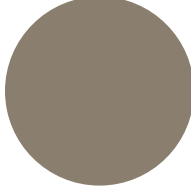
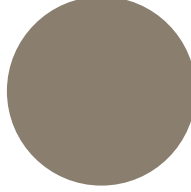
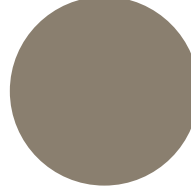
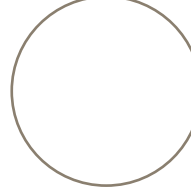
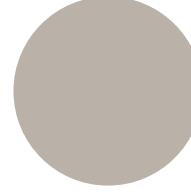
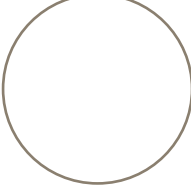
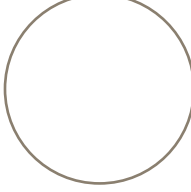
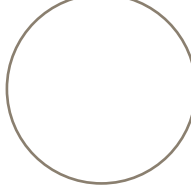
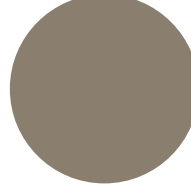
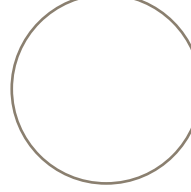
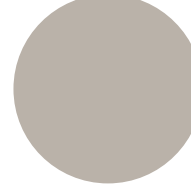
S5: Mixed small pieces



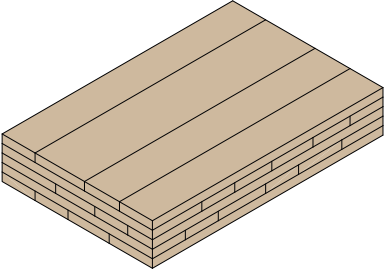
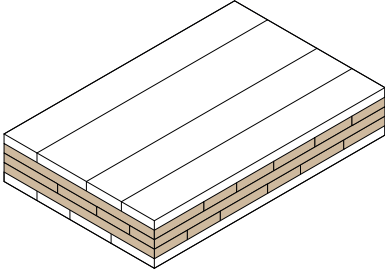
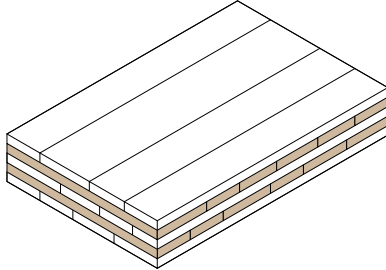
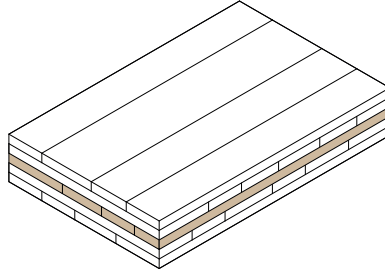
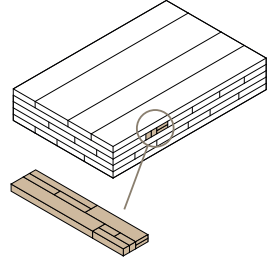
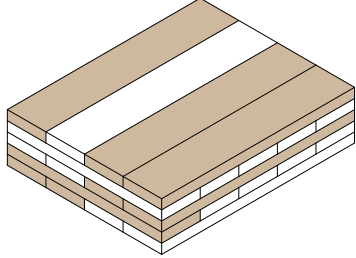
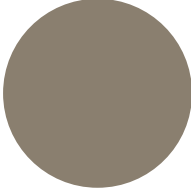
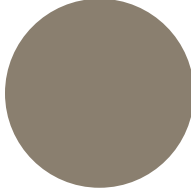
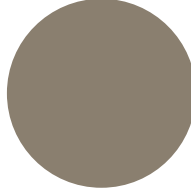
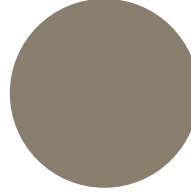
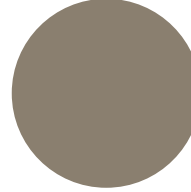
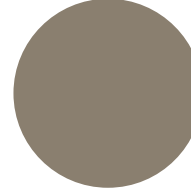
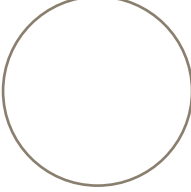
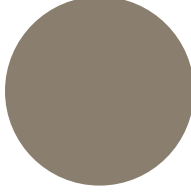
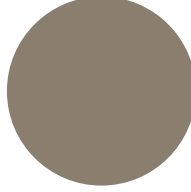
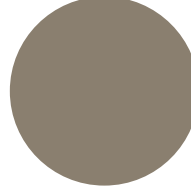
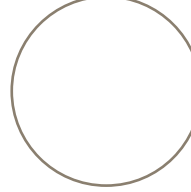
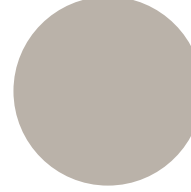
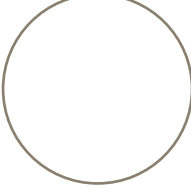
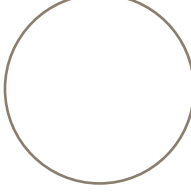
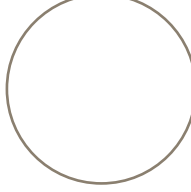
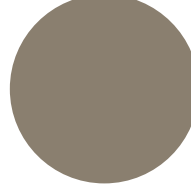
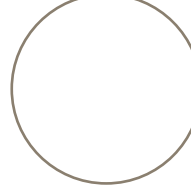
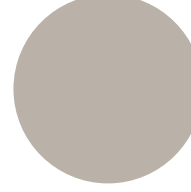
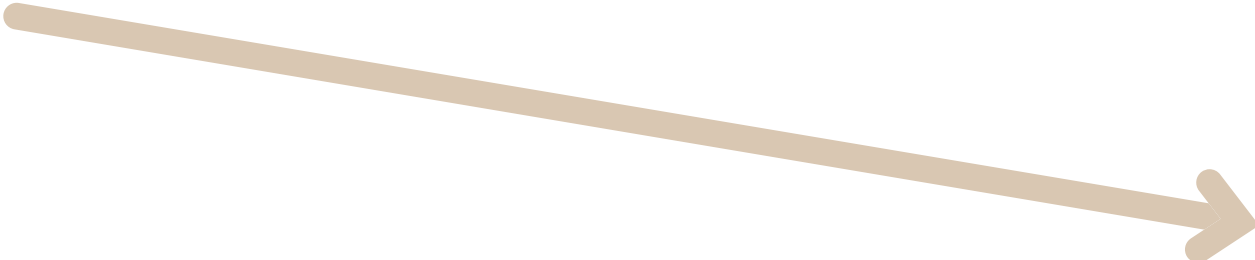
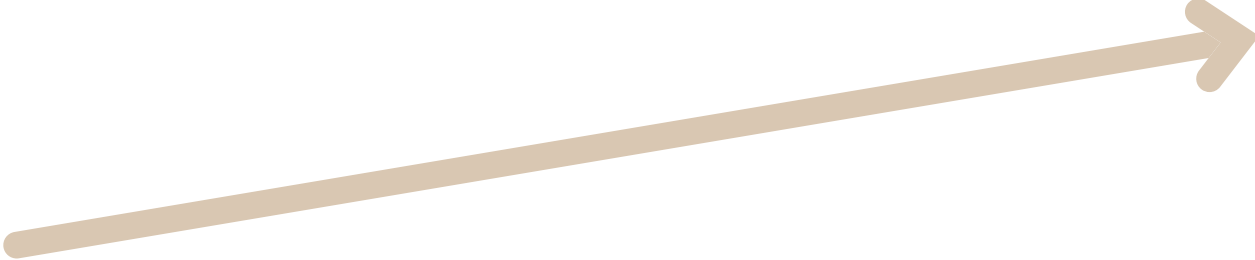
S6: % of Scrap wood



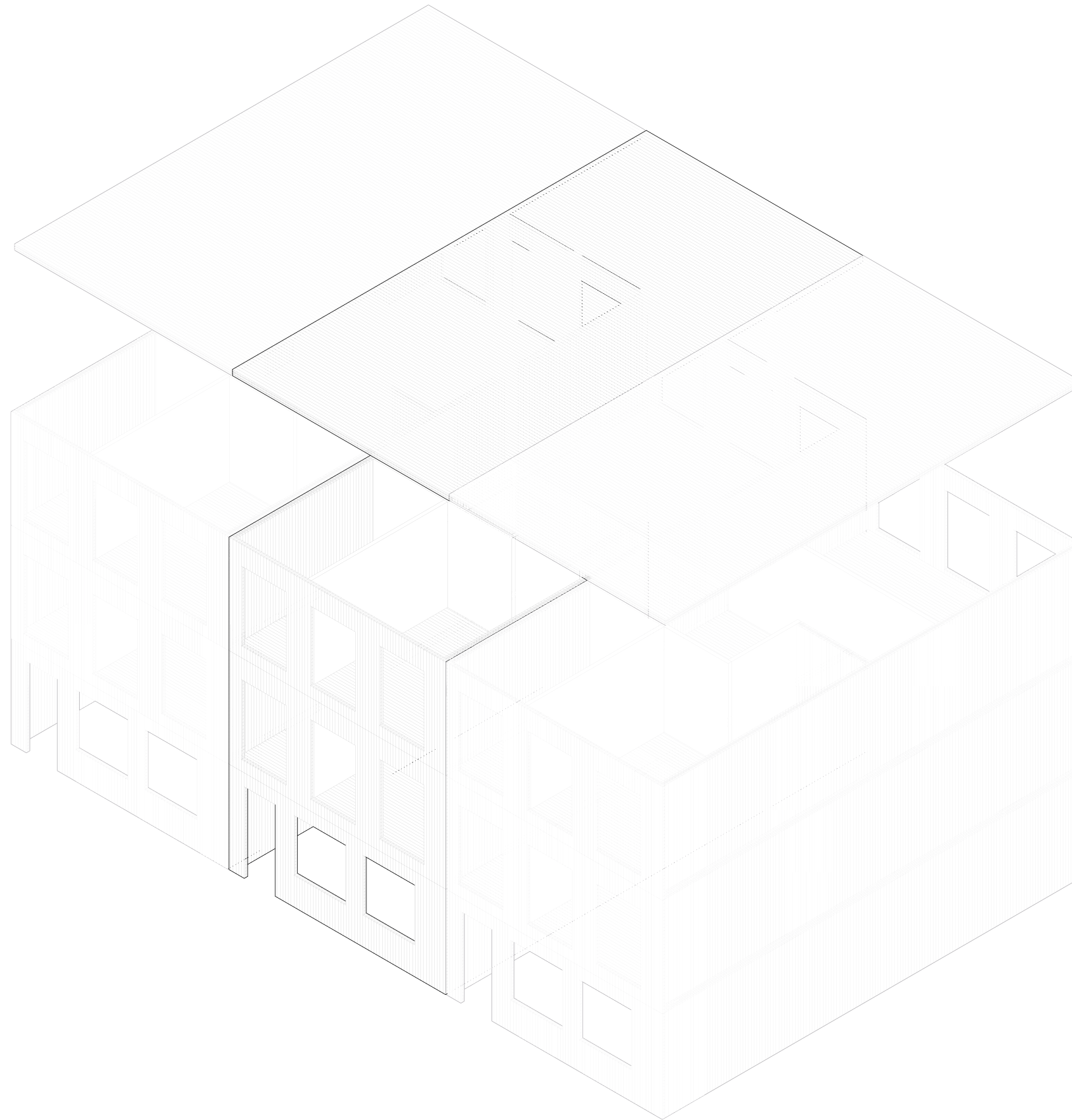
COMPARISON SCENARIOS

	S1: Whole panel	S2: Inner layers	S3: Transverse layers	S4: Middle layer	S5: Mixed small pieces	S6: % of scrap wood
						
Non load bearing walls						
Load bearing walls						
Floors & Roofs						

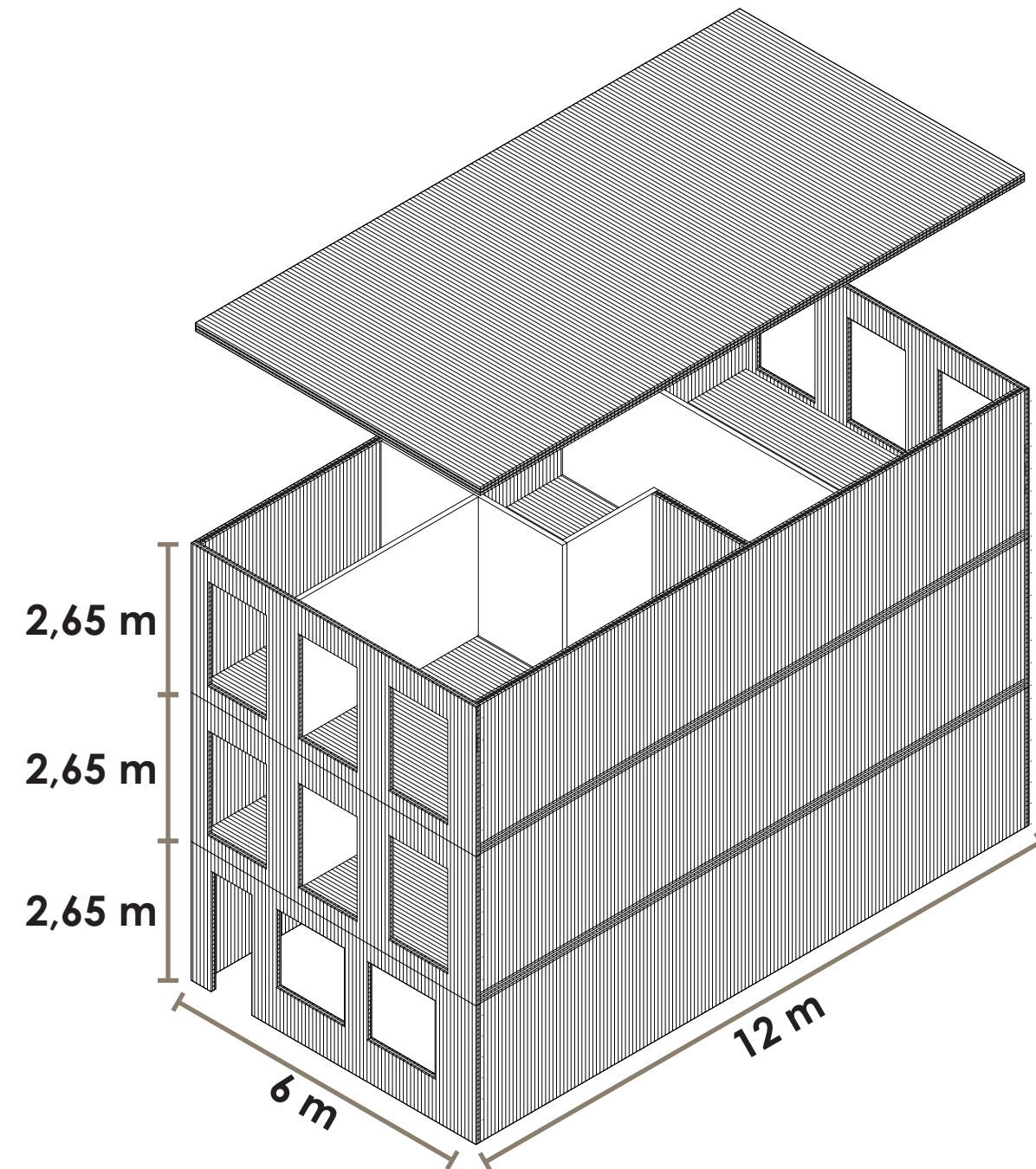
COMPARISON SCENARIOS

	S1: Whole panel	S2: Inner layers	S3: Transverse layers	S4: Middle layer	S5: Mixed small pieces	S6: % of scrap wood
						
Non load bearing walls						
Load bearing walls						
Floors & Roofs						
Scrap wood content					Varies	Varies
Suitability Components						Varies

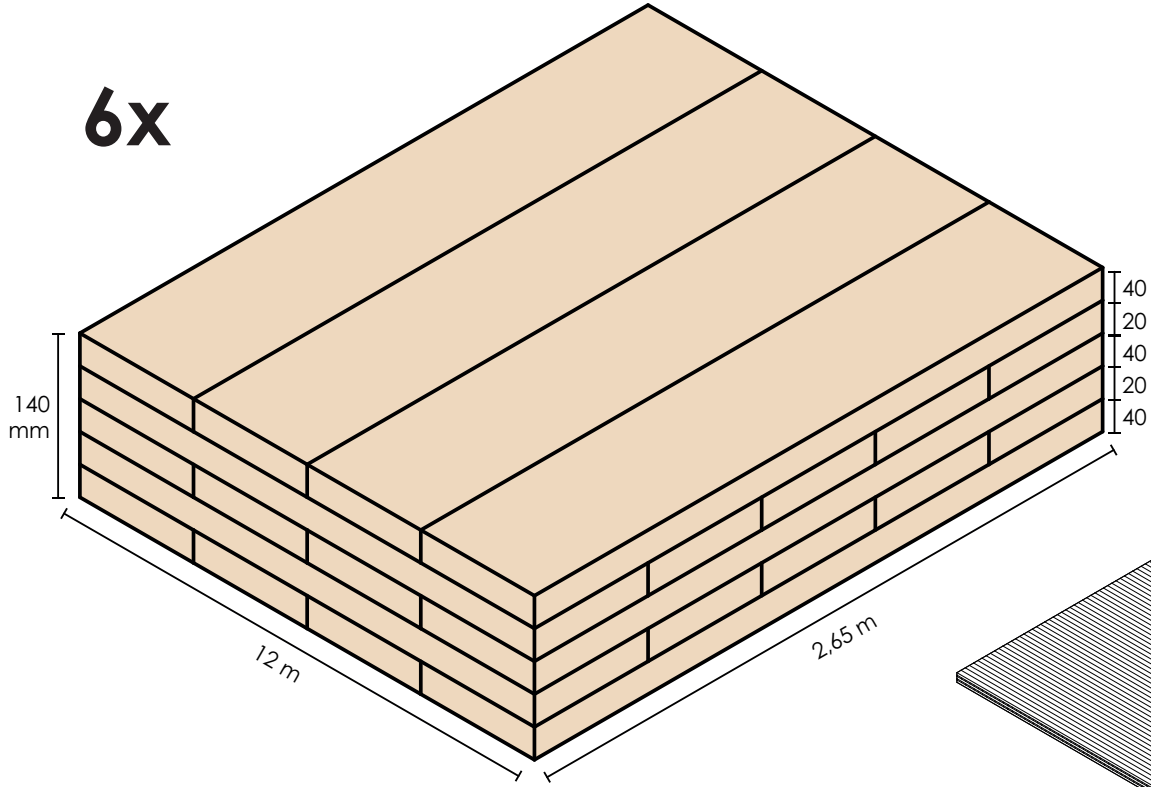
CASE STUDY: CLT



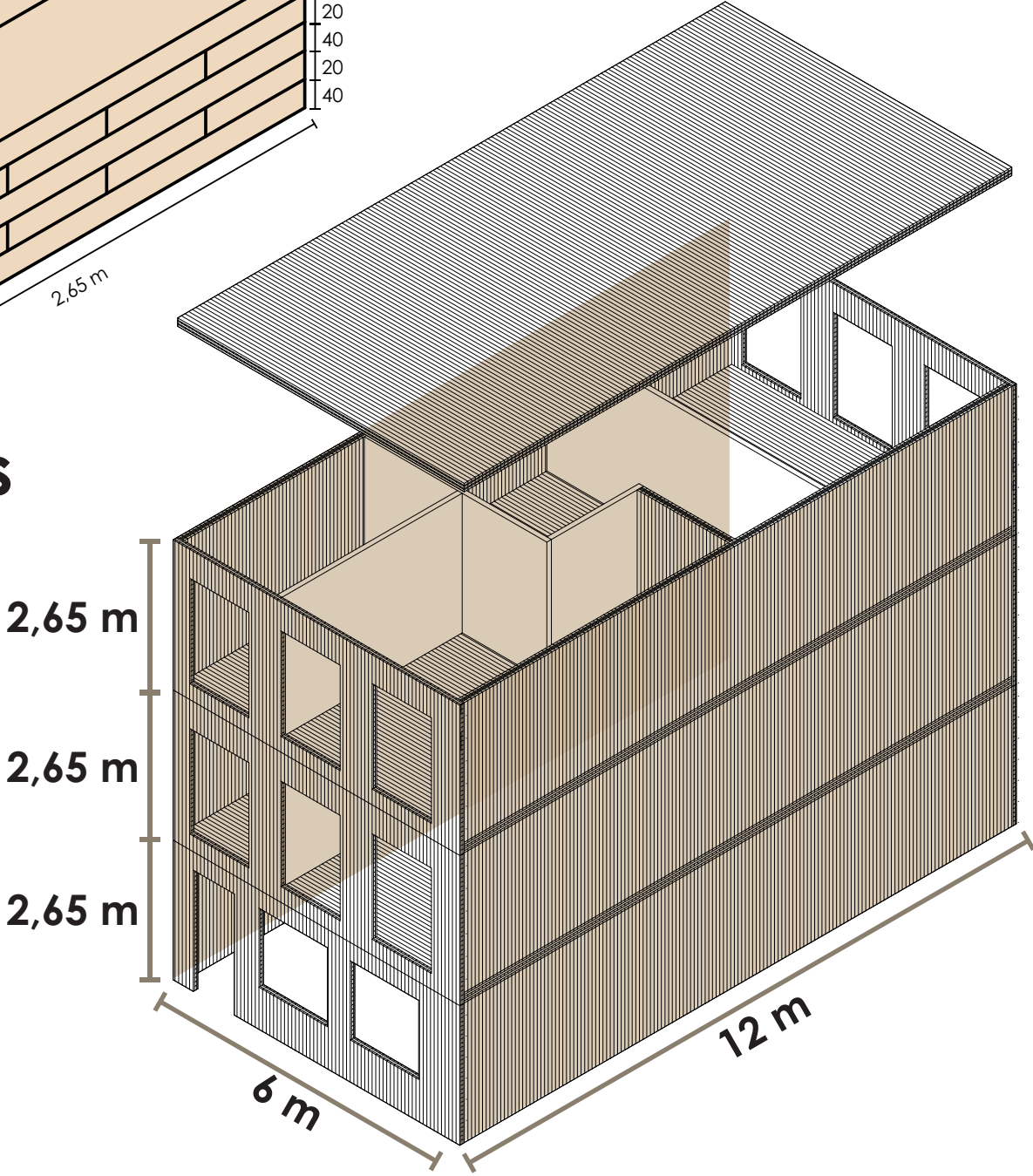
CASE STUDY: CLT



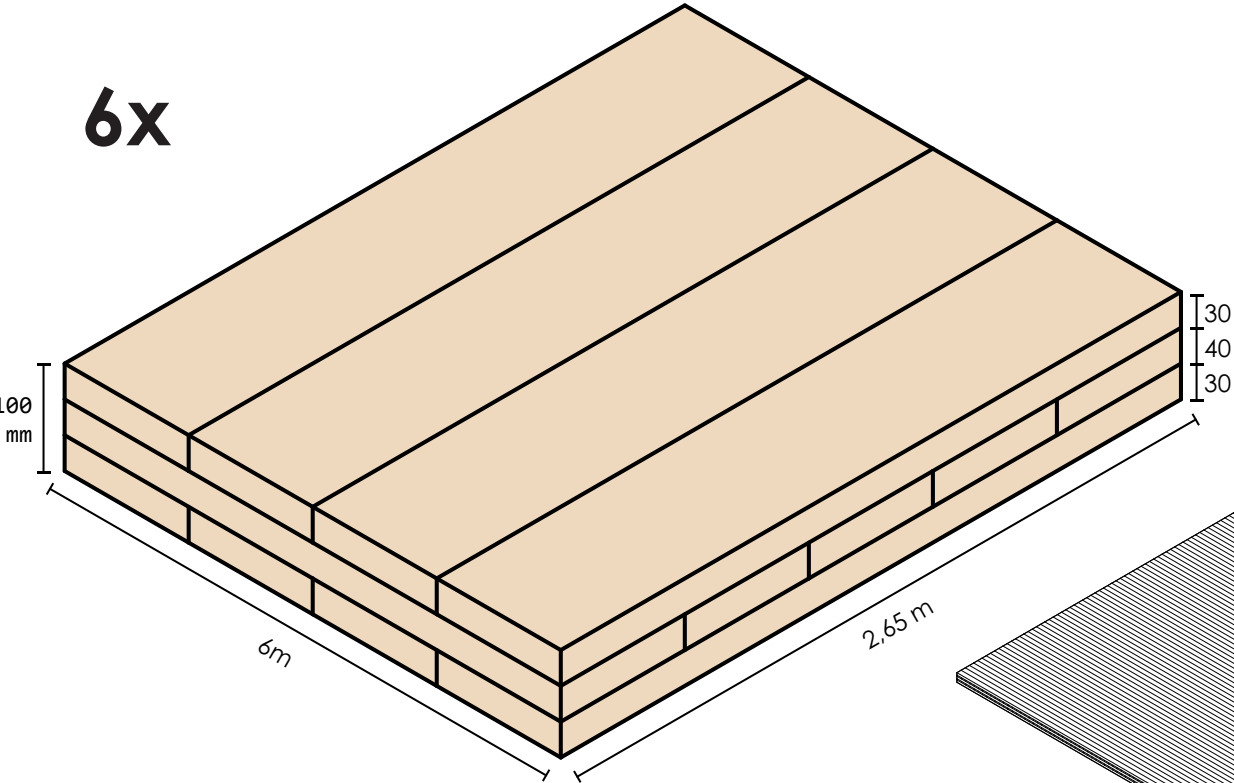
CASE STUDY: CLT



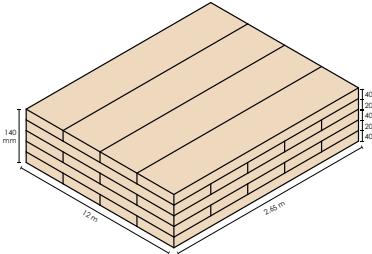
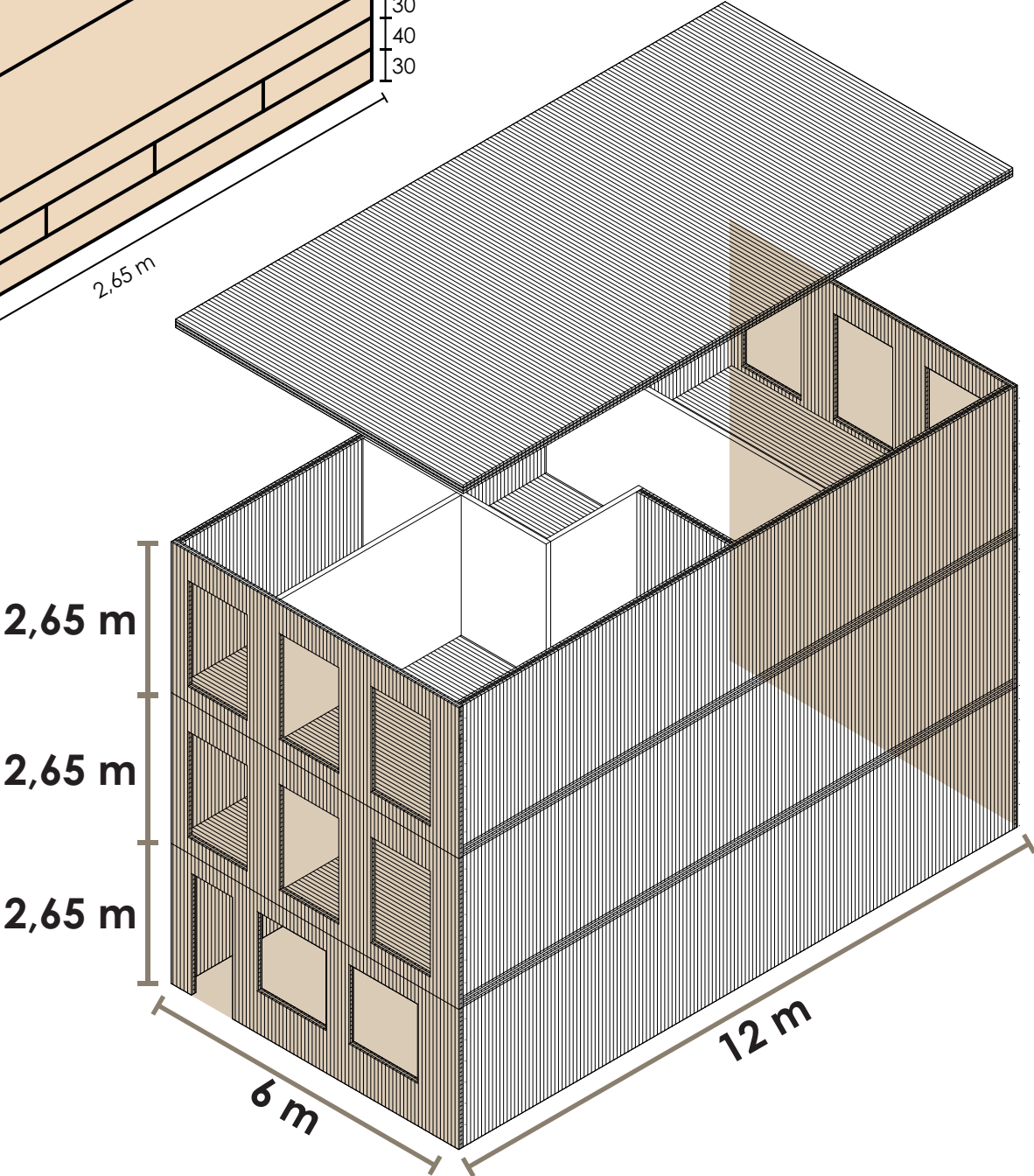
**Partition wall panels
load bearing**



CASE STUDY: CLT

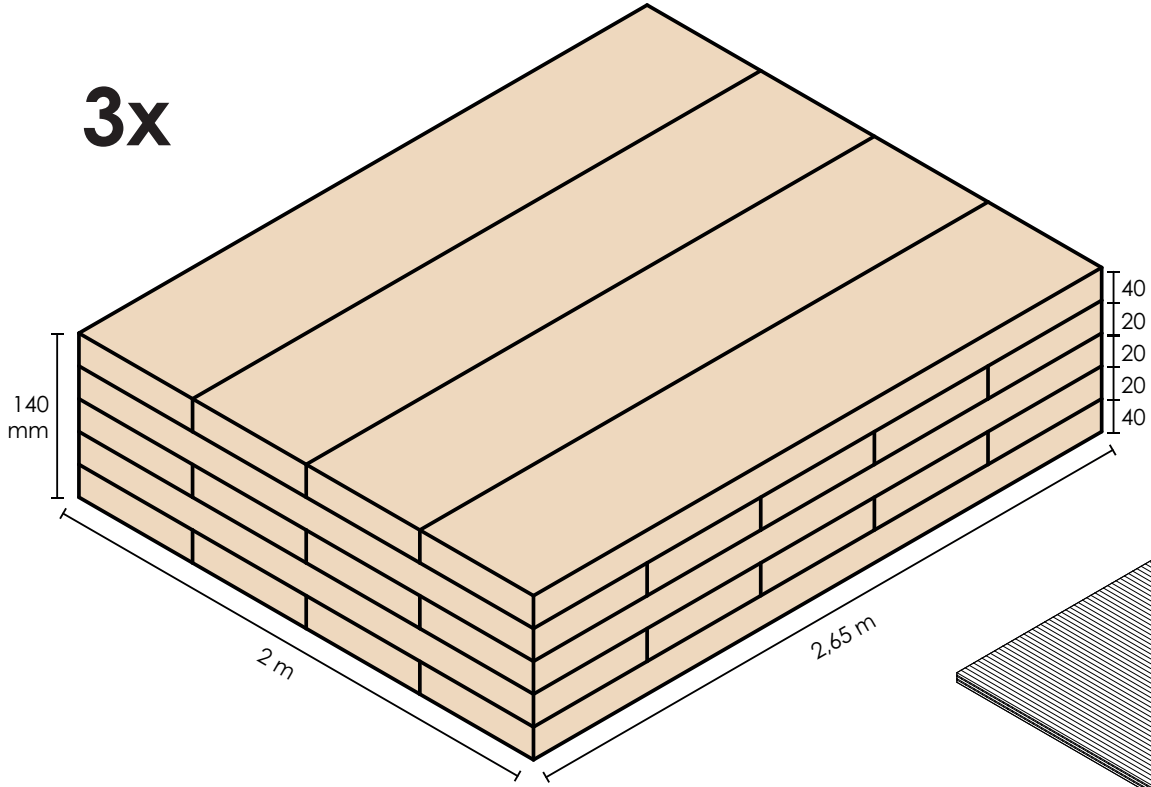


Façade wall panels
50% openings

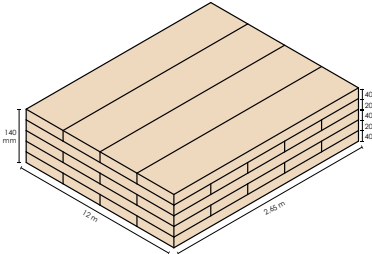
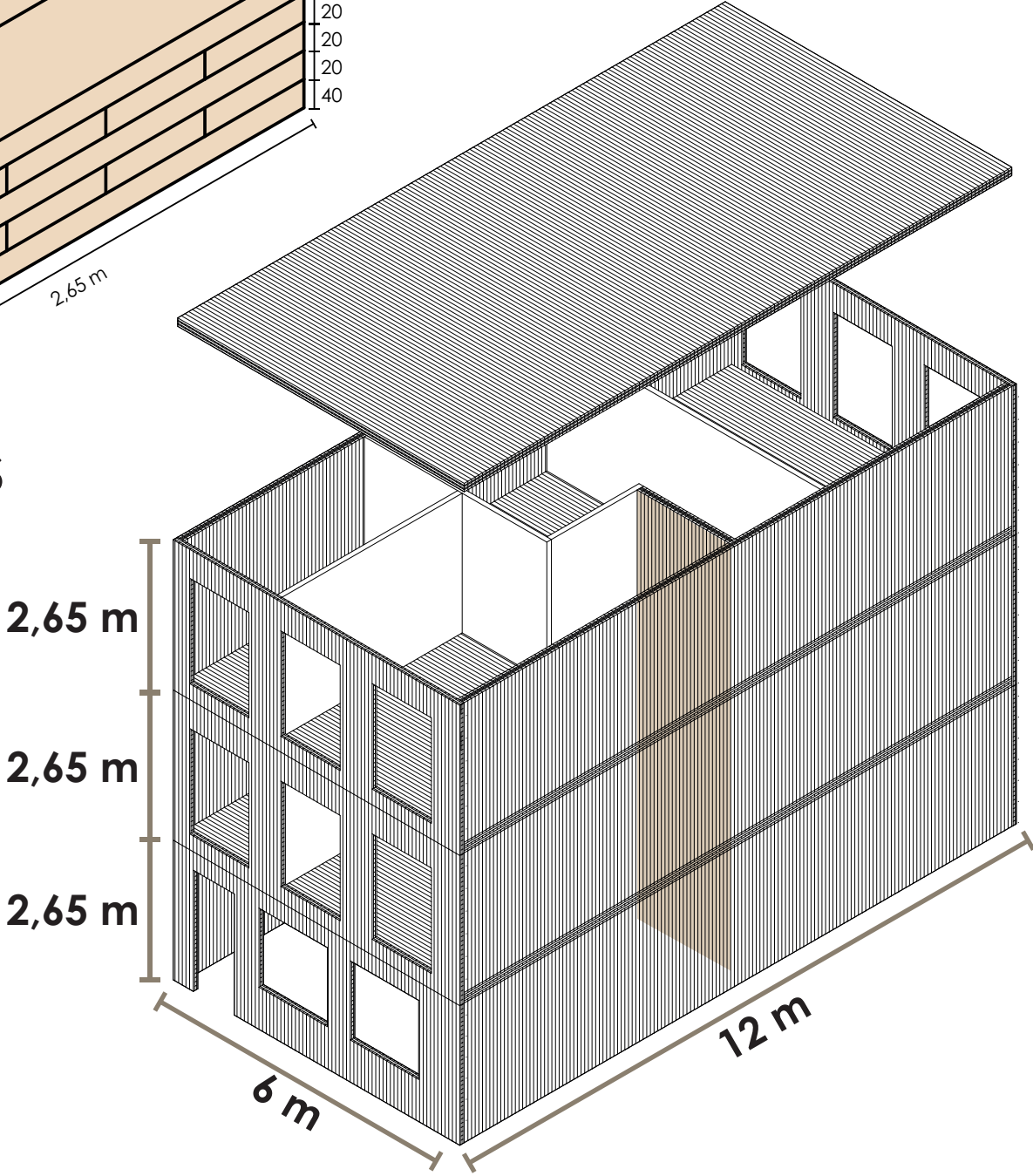


6 x Partition panels

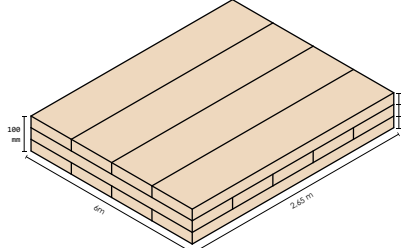
CASE STUDY: CLT



Stability wall panels

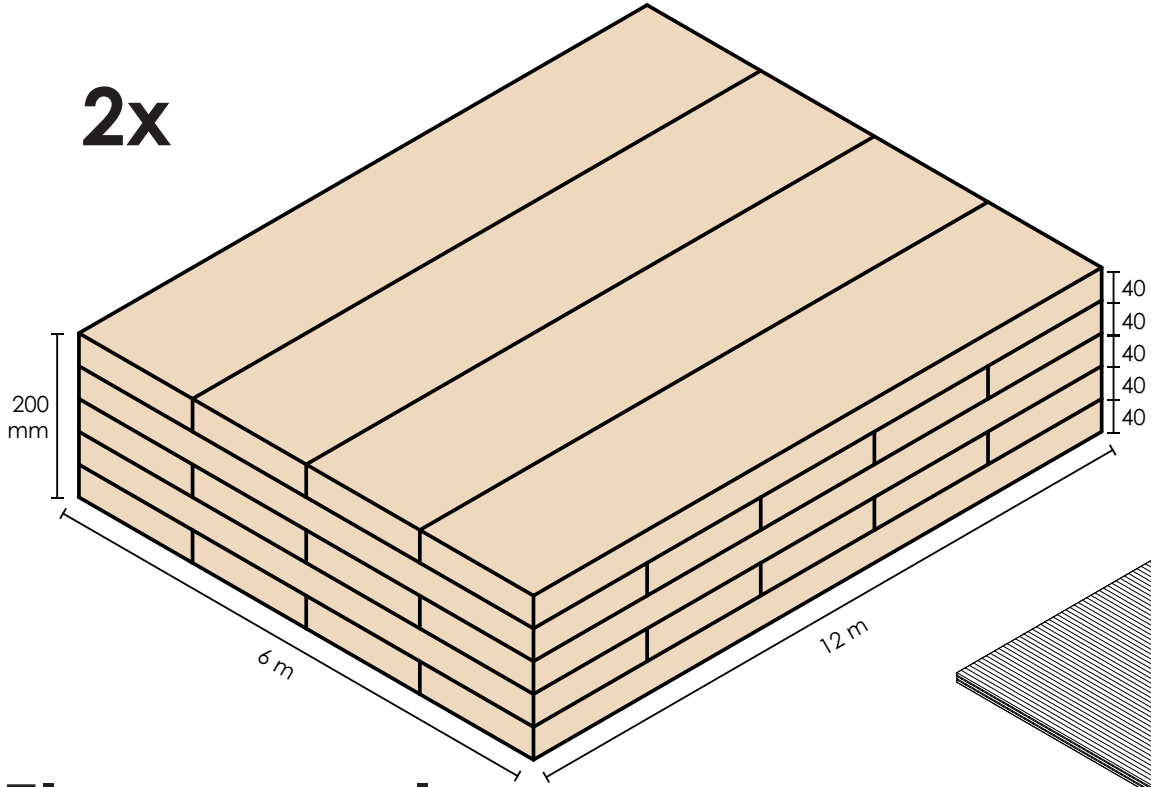


6 x Partition panels

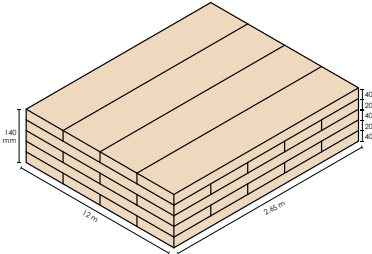
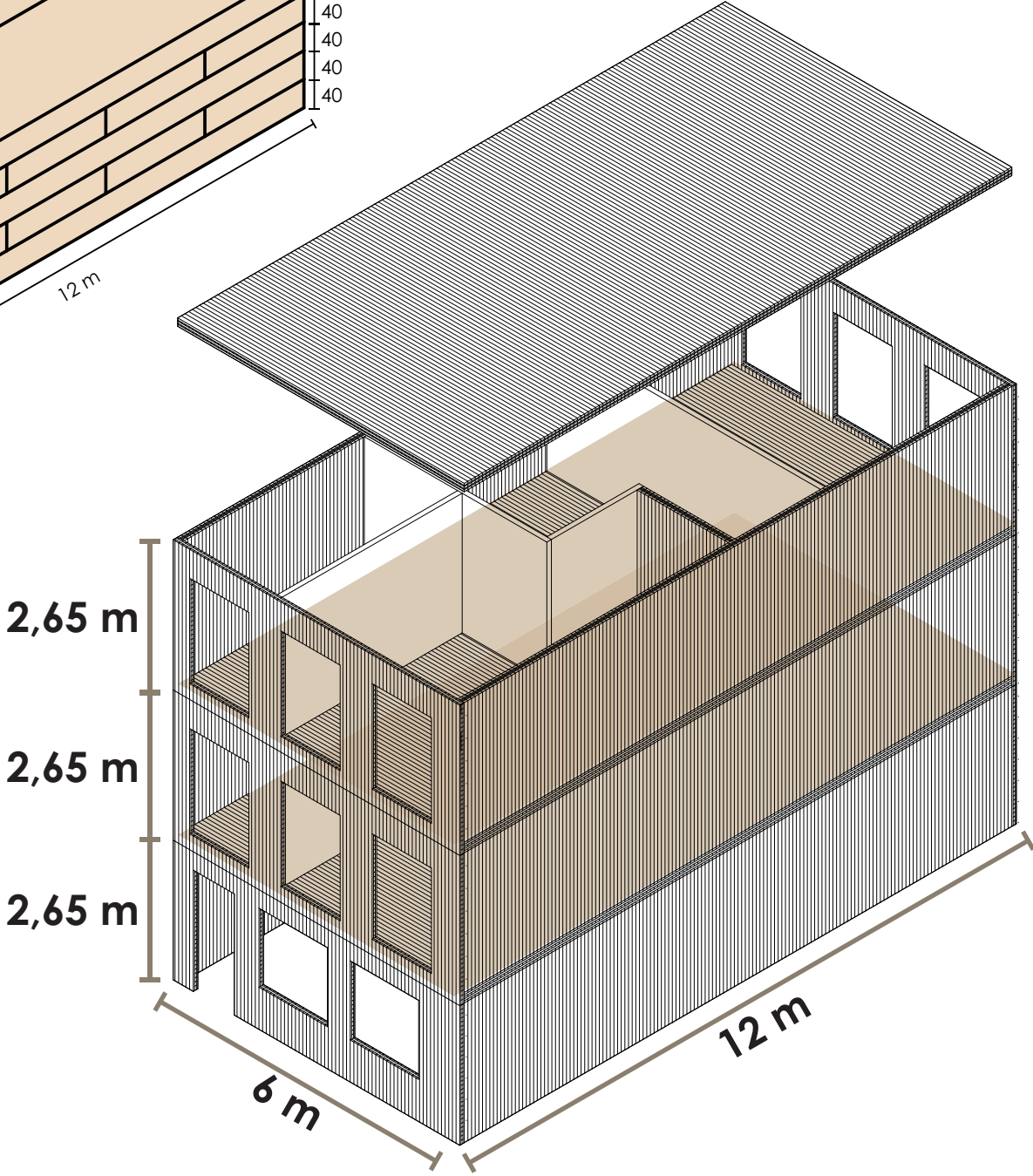


6 x Façade panels

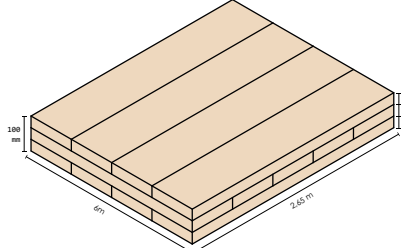
CASE STUDY: CLT



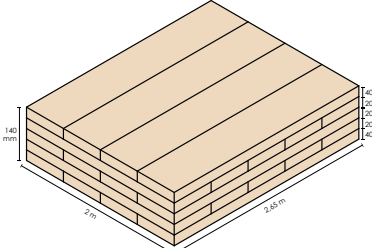
Floor panels



6 x Partition panels

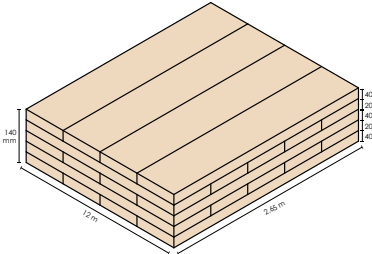
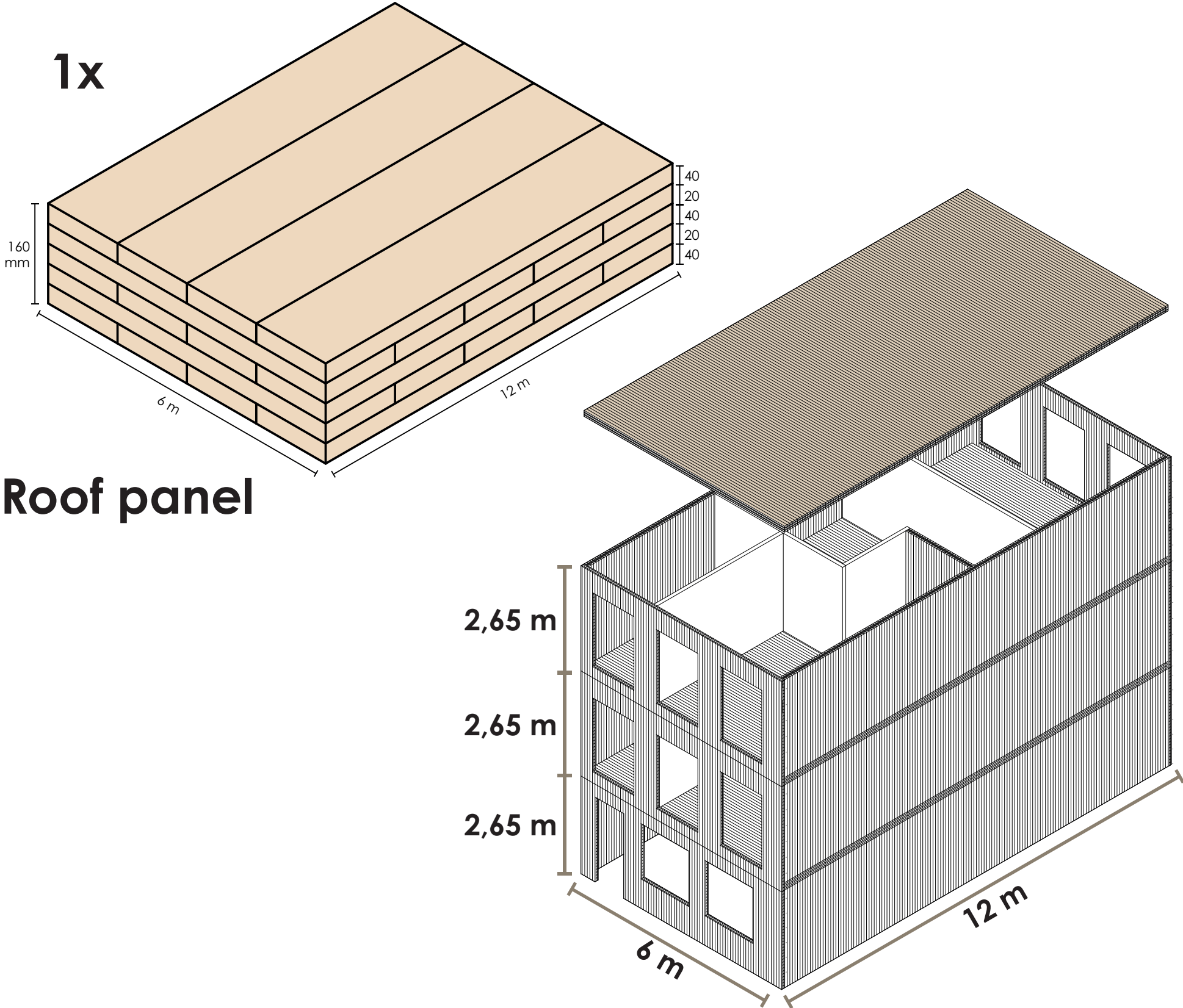


6 x Façade panels

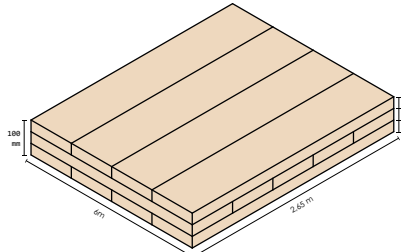


3 x Stability panels

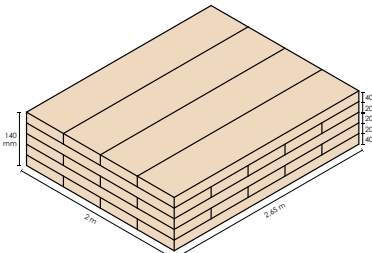
CASE STUDY: CLT



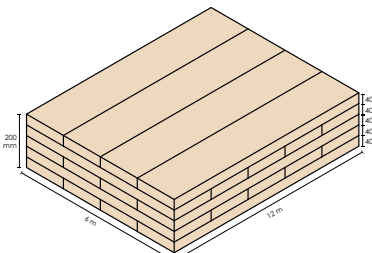
6 x Partition panels



6 x Façade panels

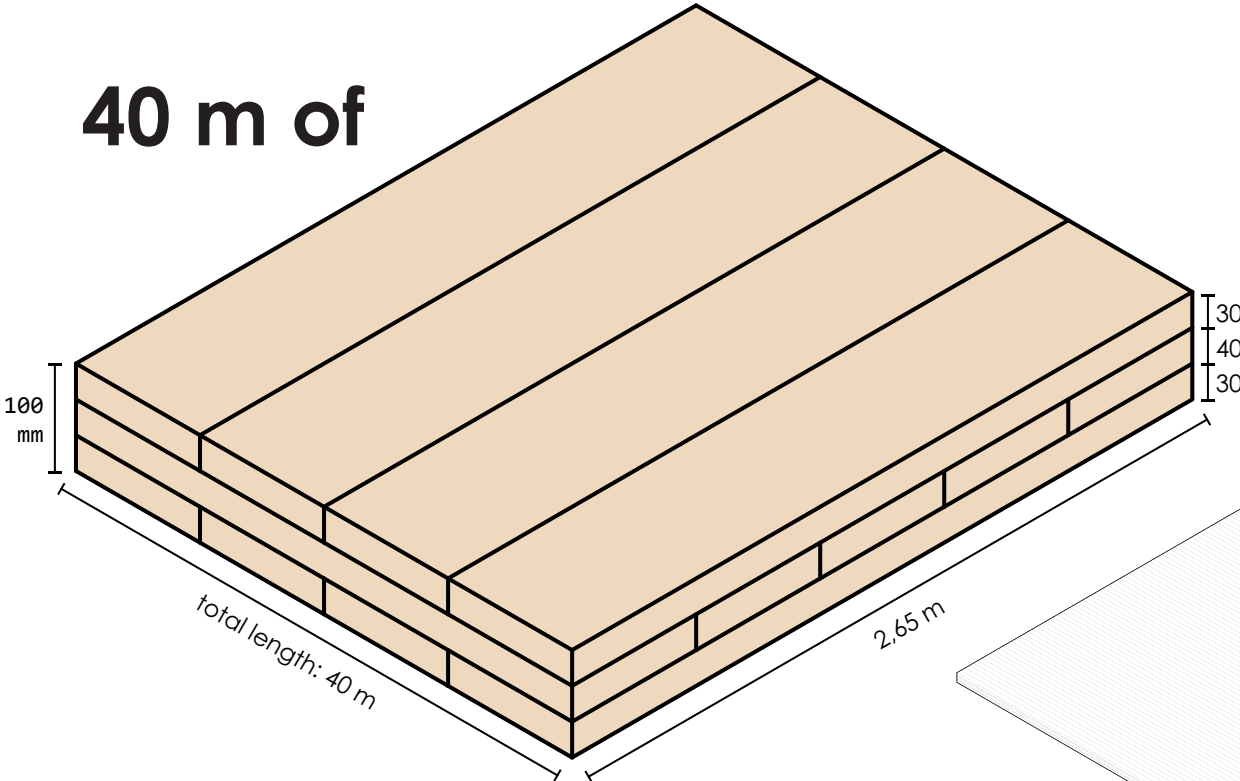


3 x Stability panels

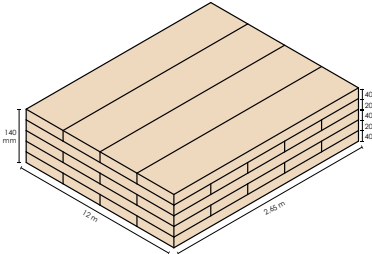
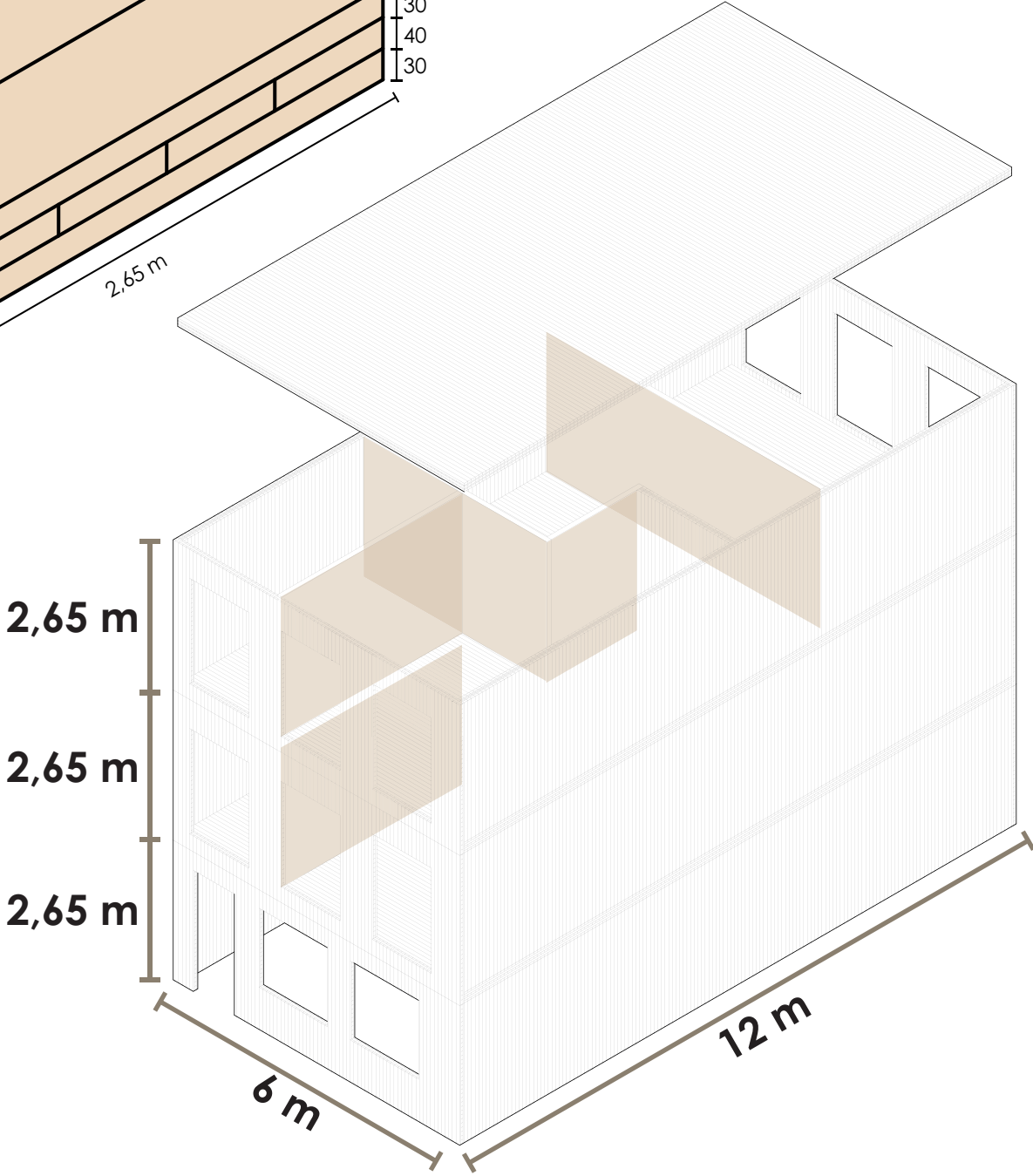


2 x Floor panels

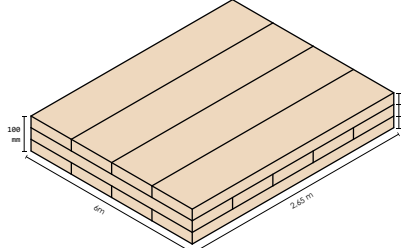
CASE STUDY: CLT



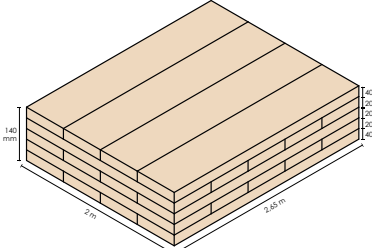
Internal wall panels



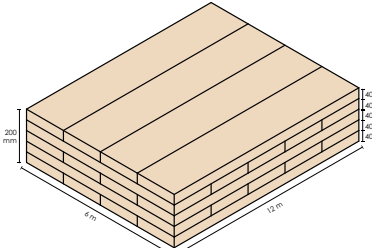
6 x Partition panels



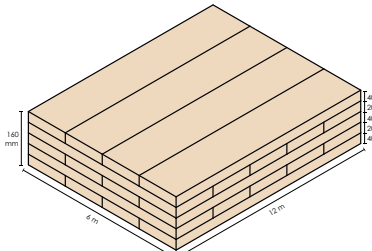
6 x Façade panels



3 x Stability panels



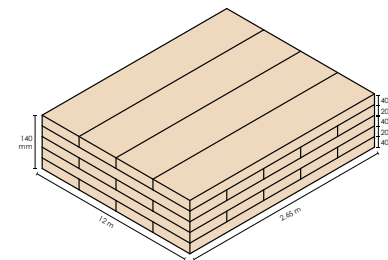
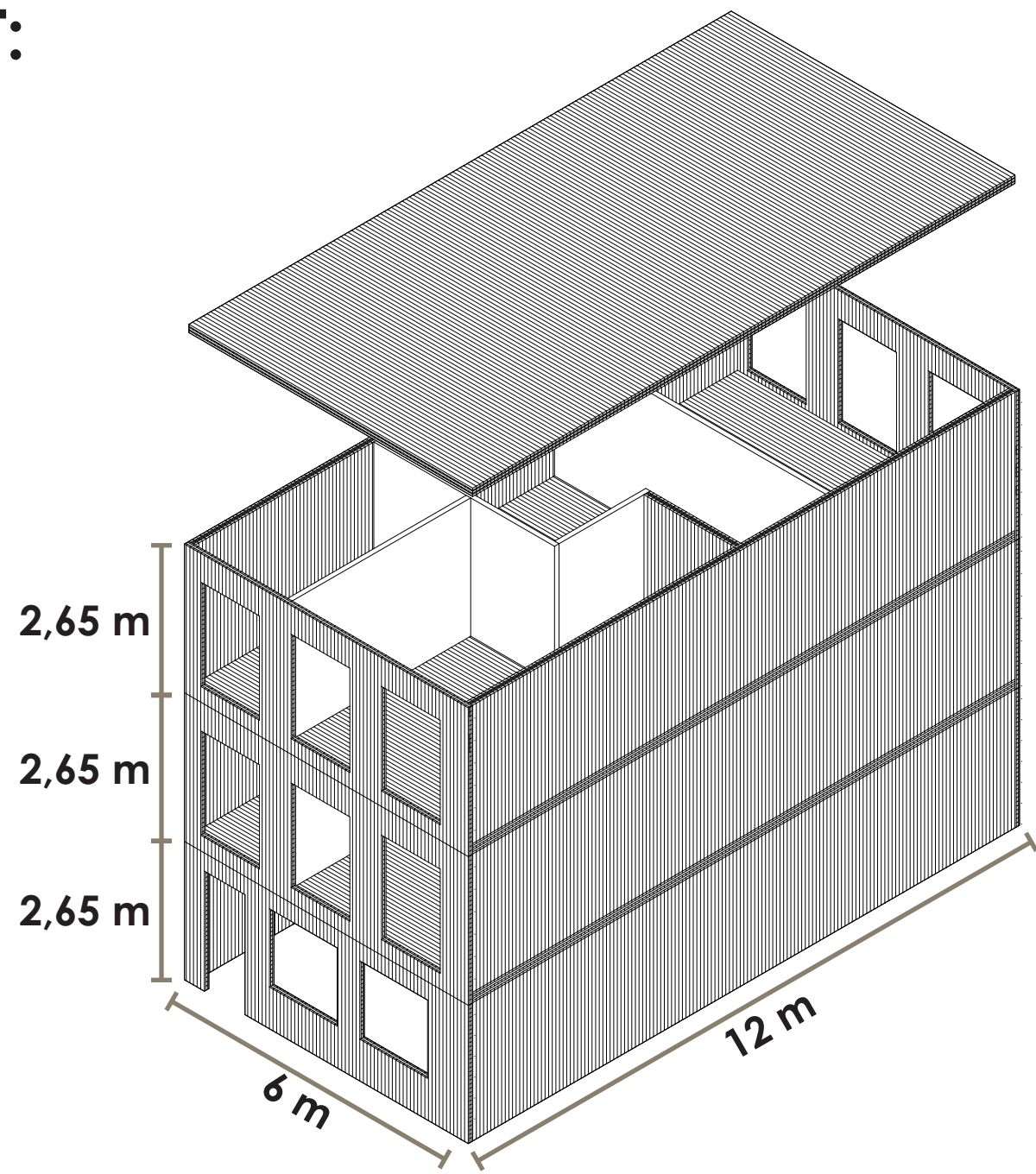
2 x Floor panels



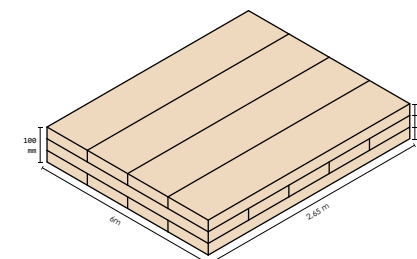
1 x Roof panel

CASE STUDY: CLT

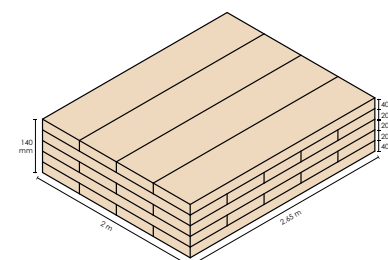
Total volume of CLT:
84,6 m³



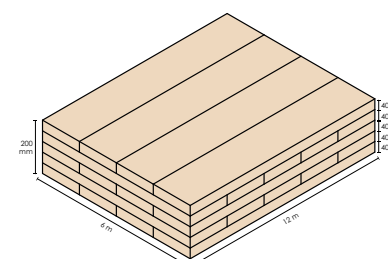
6 x Partition panels



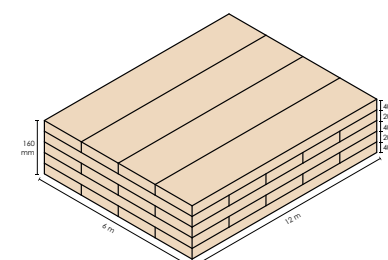
6 x Façade panels



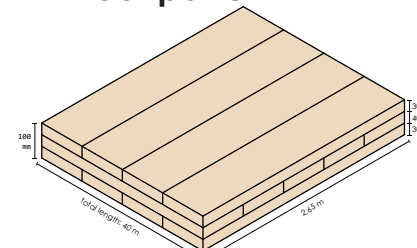
3 x Stability panels



2 x Floor panels



1 x Roof panel

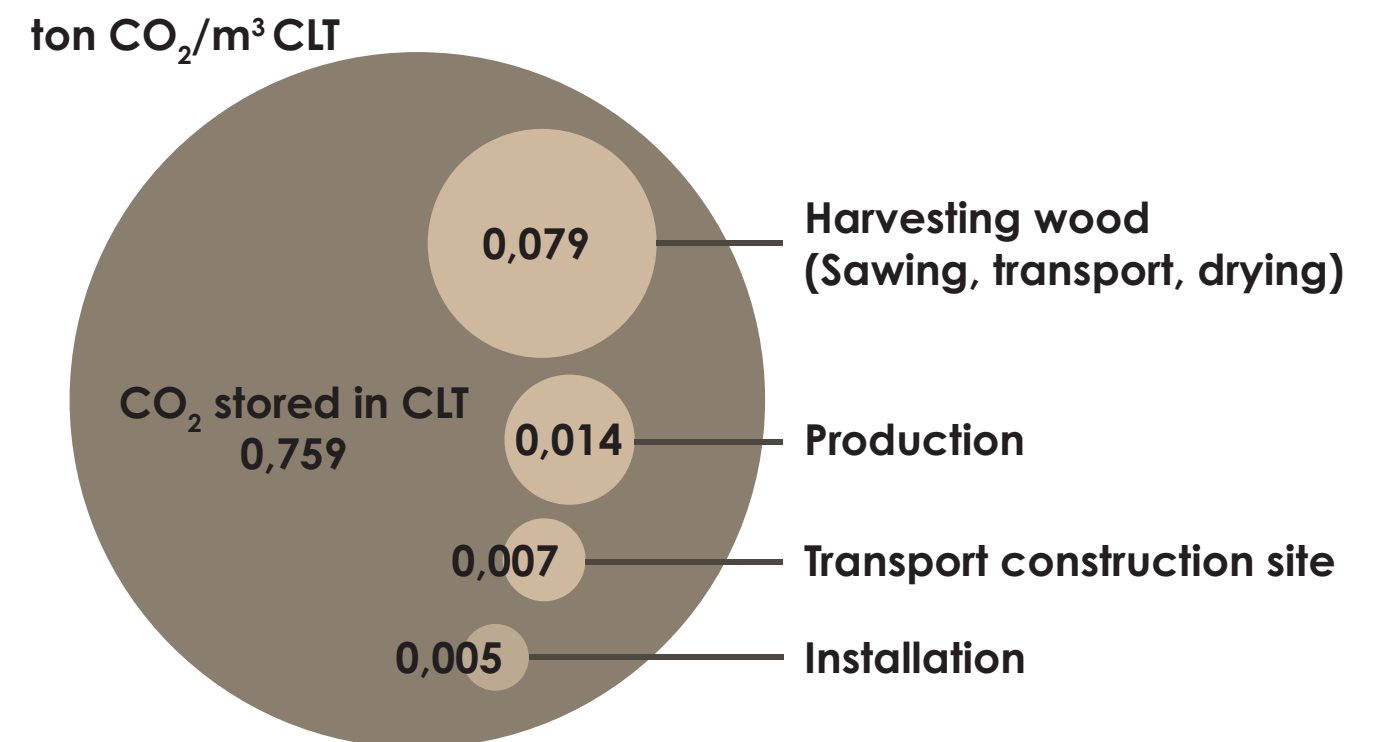


40 m of Internall panels

CASE STUDY: CALCULATIONS

CO₂ storage factor

0,759 ton CO₂/ m³ CLT



Source: (adapted from Van Der Lugt, 2021)

CASE STUDY: CALCULATIONS

CO₂ storage factor

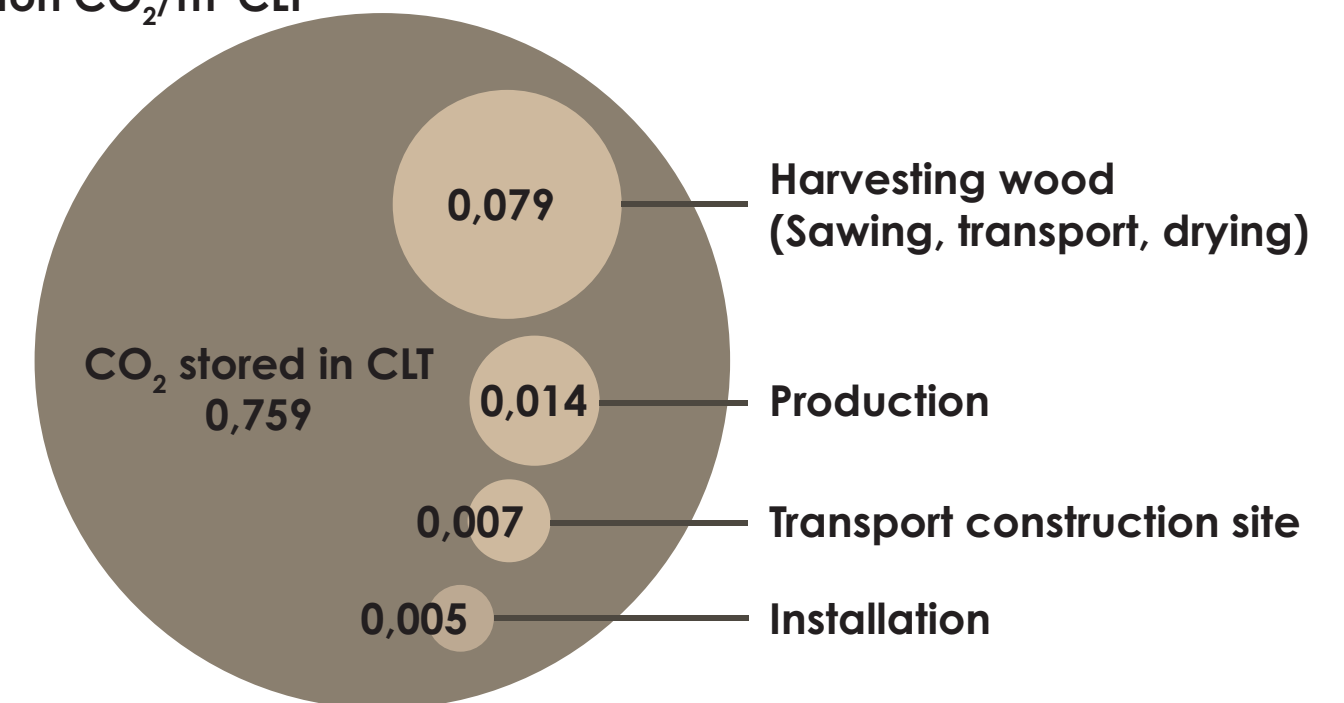
0,759 ton CO₂/ m³ CLT

-

**CO₂ emissions
production**

0,105 ton CO₂/ m³ CLT

ton CO₂/m³ CLT



Source: (adapted from Van Der Lugt, 2021)

CASE STUDY: CALCULATIONS

CO₂ storage factor

0,759 ton CO₂/ m³ CLT

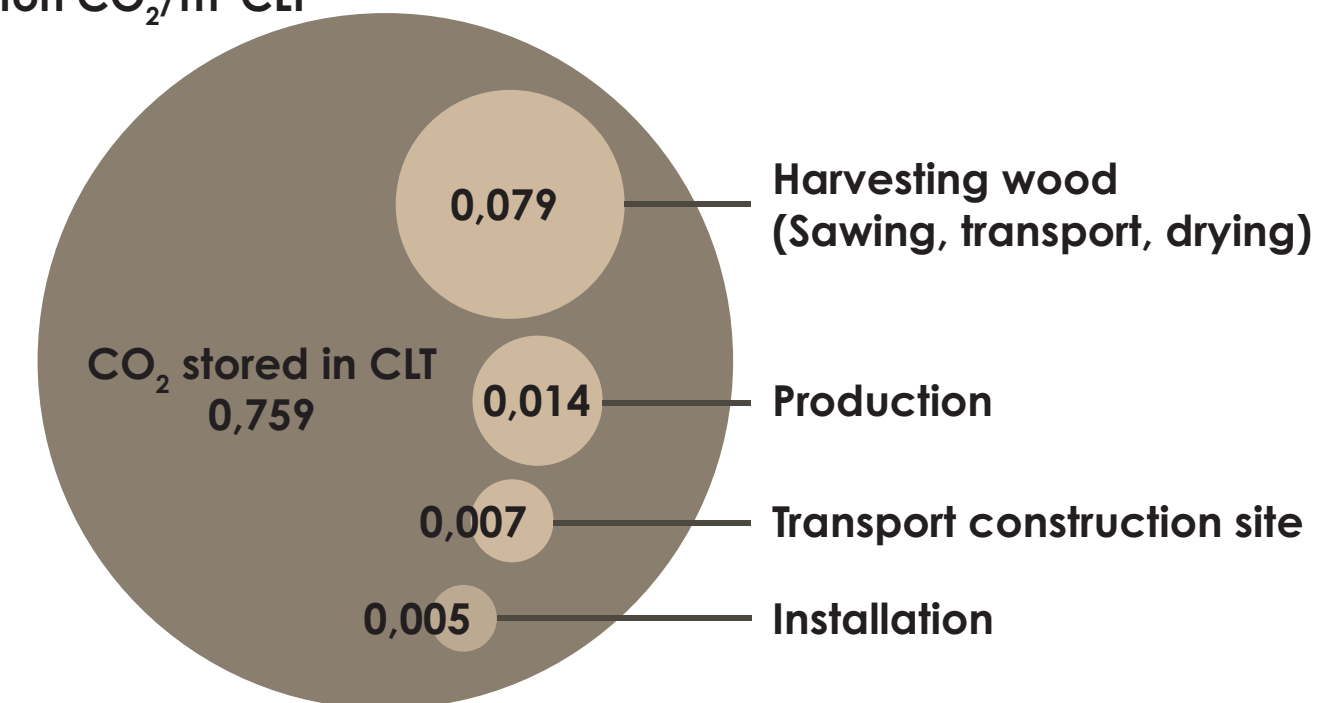
-

**CO₂ emissions
production**

0,105 ton CO₂/ m³ CLT

**= Saved CO₂ emissions
of virgin wood**

ton CO₂/m³ CLT



Source: (adapted from Van Der Lugt, 2021)

CASE STUDY: CALCULATIONS

CO₂ storage factor

0,759 ton CO₂/ m³ CLT

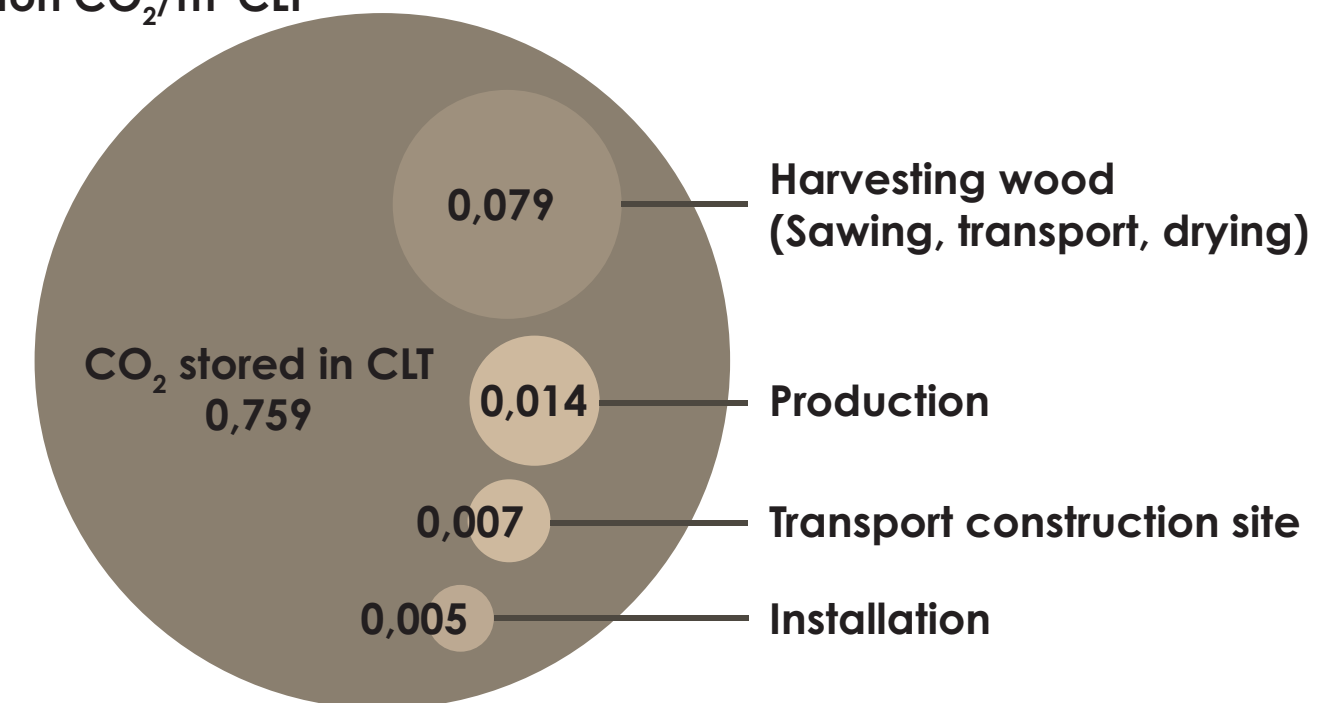
-

**CO₂ emissions
production**

0,105 ton CO₂/ m³ CLT

0,026 ton CO₂/ m³ CLT = **Saved CO₂ emissions
of scrap wood**

ton CO₂/m³ CLT



Source: (adapted from Van Der Lugt, 2021)

CASE STUDY: CALCULATIONS

$$\begin{array}{ccccc} \text{CO}_2 \text{ storage factor} & - & \text{CO}_2 \text{ emissions} & + & \text{CO}_2 \text{ savings} \\ & & \text{production} & & \text{substitution TBM} \\ 0,759 \text{ ton CO}_2 / \text{ m}^3 \text{ CLT} & & 0,105 \text{ ton CO}_2 / \text{ m}^3 \text{ CLT} & & 0,75 \text{ ton CO}_2 / \text{ m}^3 \text{ CLT} \end{array}$$

**= Saved CO2 by substitution of traditional building materials
(concrete & steel)**

CASE STUDY: SCENARIO 0

Scenario 0: 100% virgin wood

CO₂ storage factor

-

CO₂ emissions
production

0,105 ton CO₂/ m³ CLT

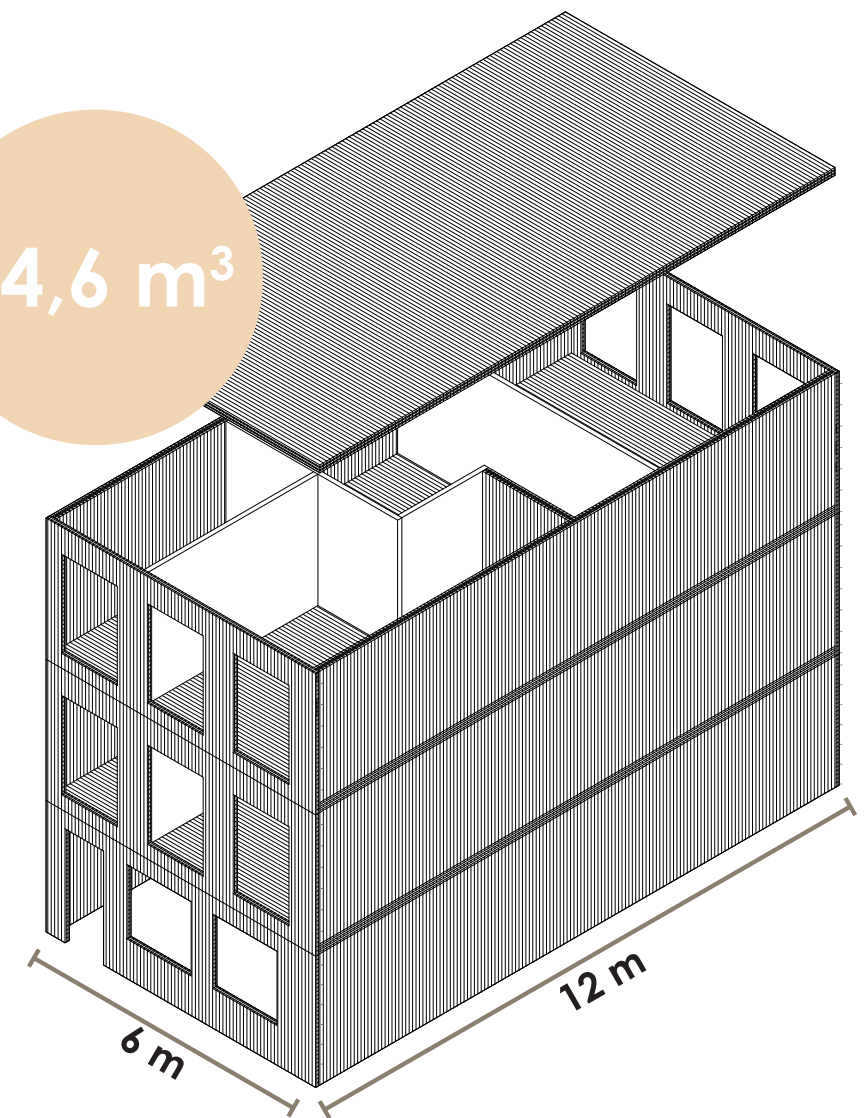
64,2

-

8,9

Total saved CO₂ = **55,3 ton CO₂**

84,6 m³



CASE STUDY: SCENARIO 0

Scenario 0: 100% virgin wood

CO₂ storage factor

-

CO₂ emissions
production

+

CO₂ savings
substitution TBM

64,2

-

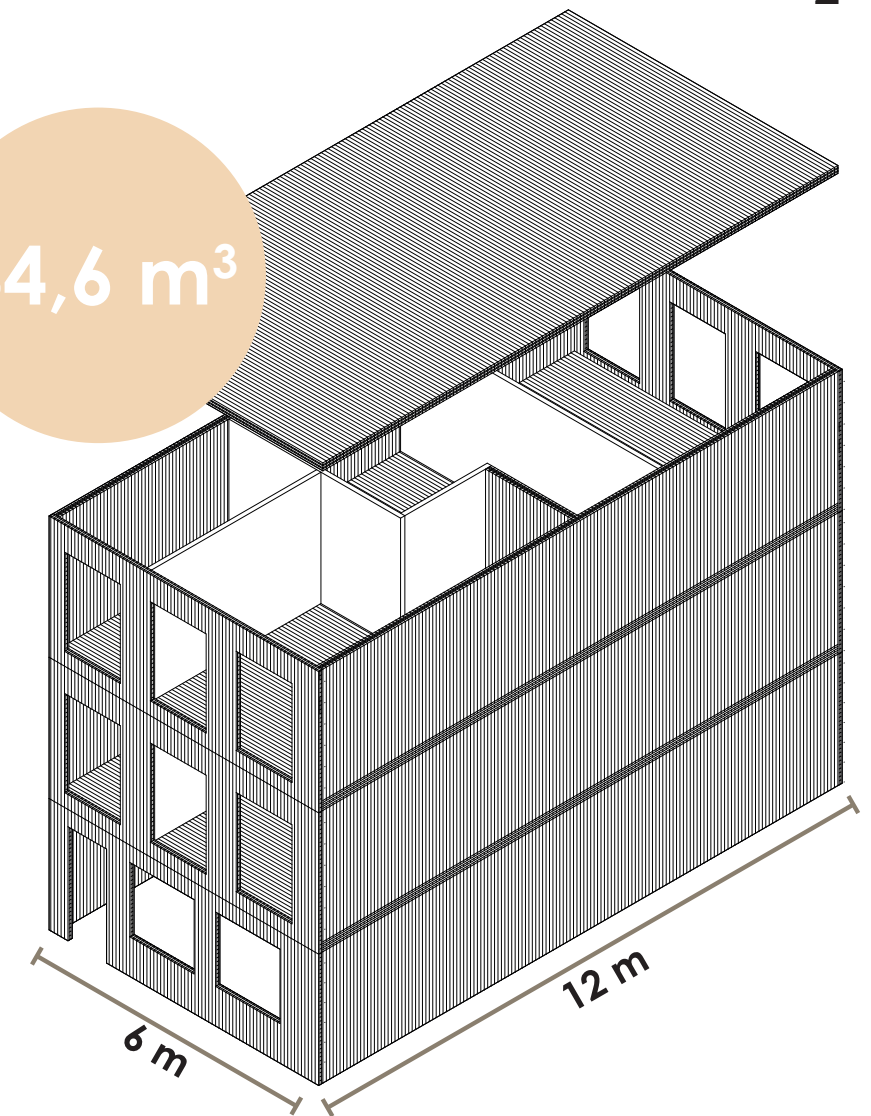
8,9

+

63,5 = **118,8 ton CO₂**

Total saved CO₂ = **55,3 ton CO₂**

84,6 m³



CASE STUDY: CALCULATIONS SCENARIOS

CO₂ storage factor

**CO₂ emissions
production**

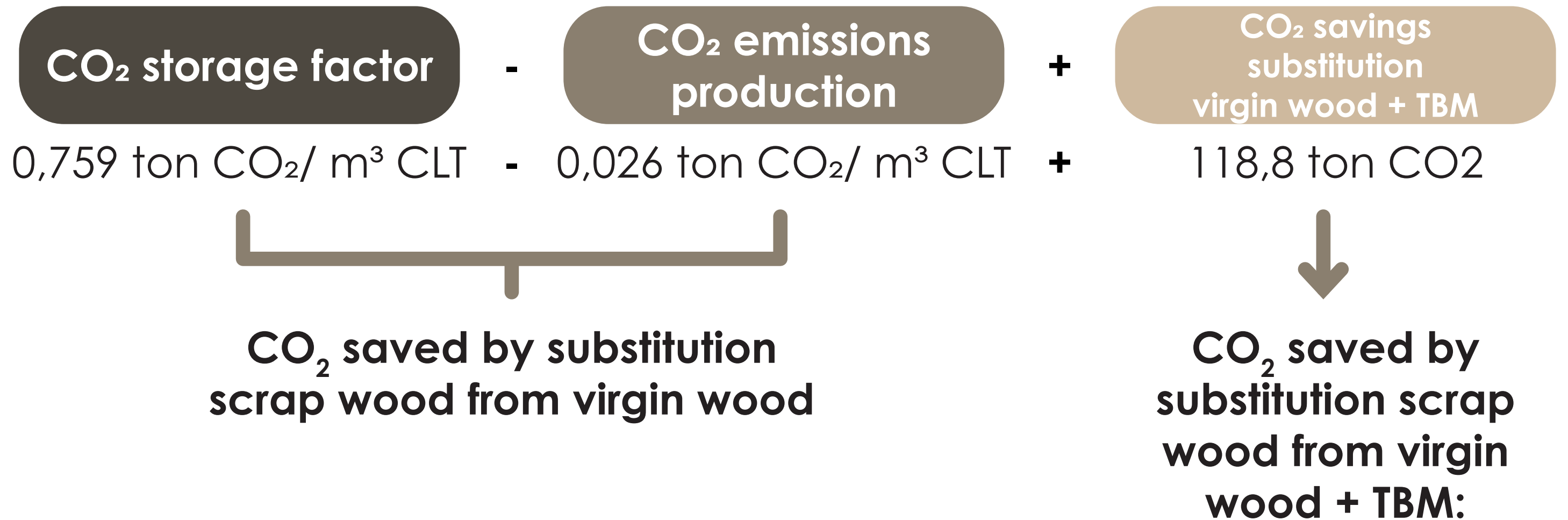
-

0,759 ton CO₂/ m³ CLT - 0,026 ton CO₂/ m³ CLT

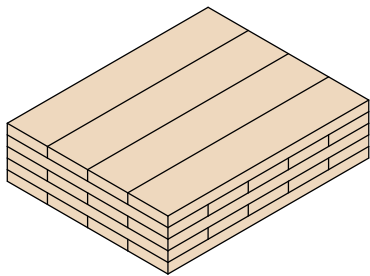
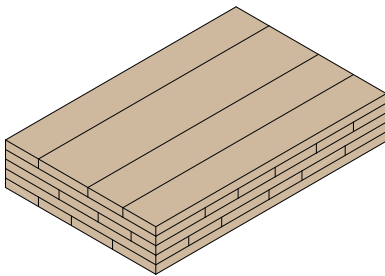
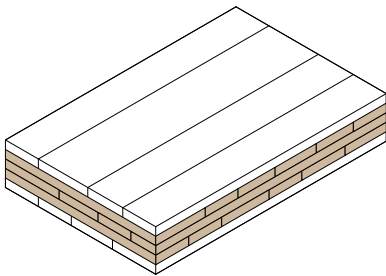
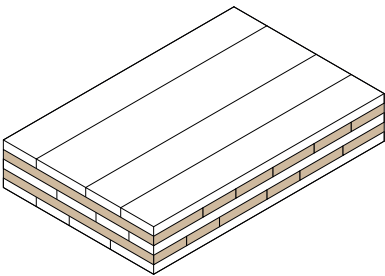
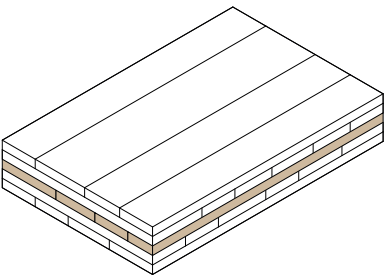


**CO₂ saved by substitution
scrap wood from virgin wood**

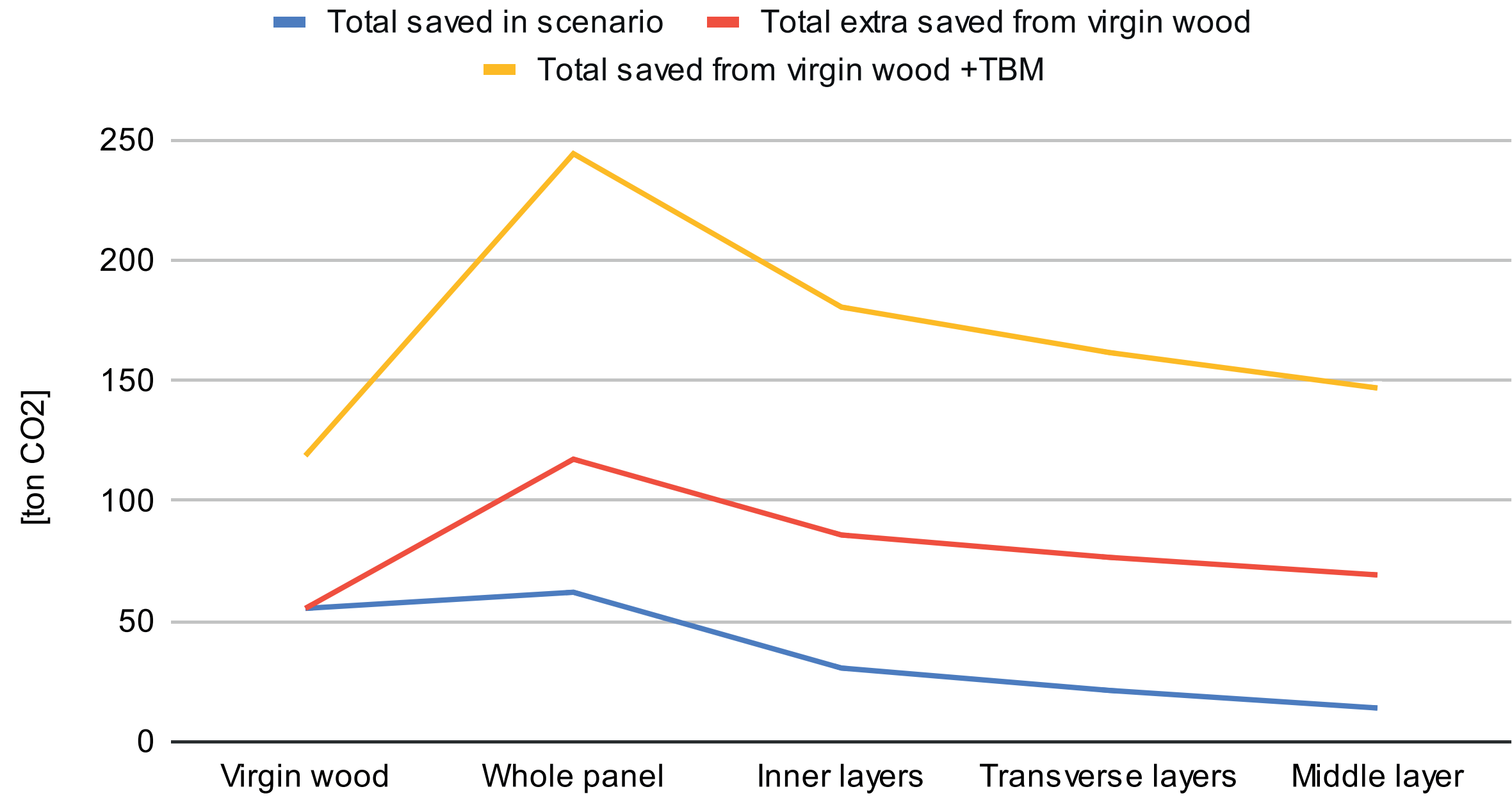
CASE STUDY: CALCULATIONS SCENARIOS



COMPARISON SCENARIOS

	S0: virgin wood	S1: Whole panel	S2: Inner layers	S3: Transverse layers	S4: Middle layer
					
Scrap wood [m³]	84,6 m³	84,6 m³	41,6 m³	28,8 m³	18,9 m³
CO ₂ storage [ton CO ₂]	64,2	64,2	31,6	21,9	14,4
Emitted CO ₂ Production [ton CO ₂]	8,9	2,2	1,1	0,7	0,5
Saved CO2 emissions sub virgin wood [ton CO ₂]	55,3	62,0	30,5	21,2	13,9
Saved CO2 emissions sub virgin wood + TBM [ton CO ₂]	118,8	180,8	149,3	140,0	132,7

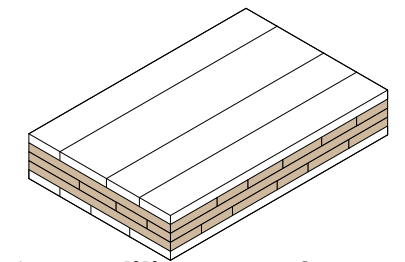
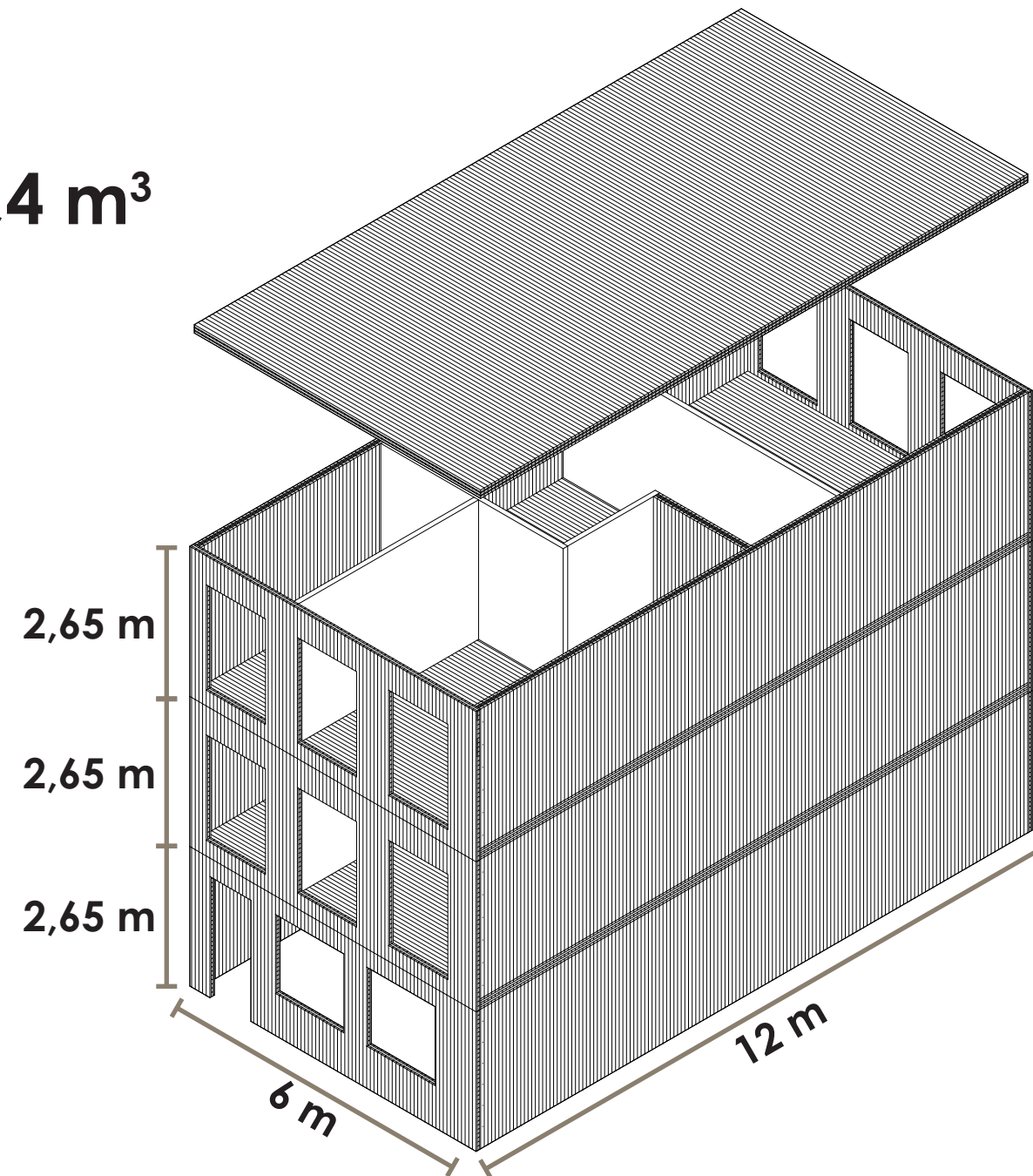
COMPARISON SCENARIO 1-4



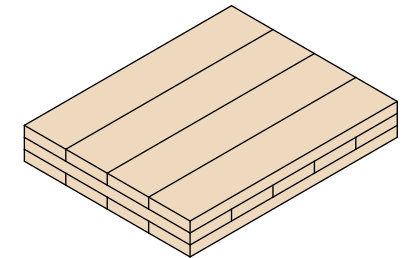
CASE STUDY: CLT

Total volume of CLT: 84,6 m³

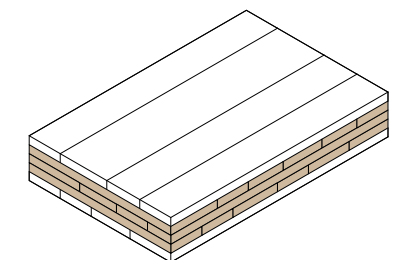
Total volume of scrap wood: 36,4 m³



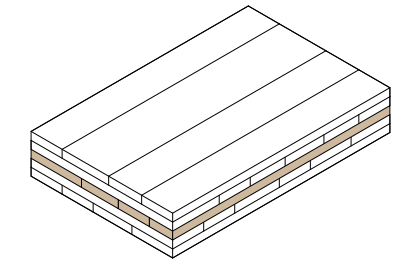
6 x Partition panels



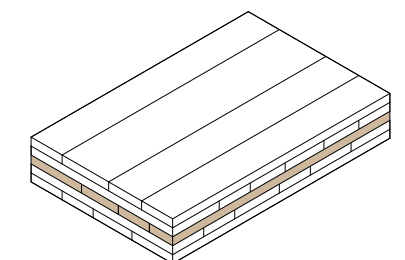
6 x Façade panels



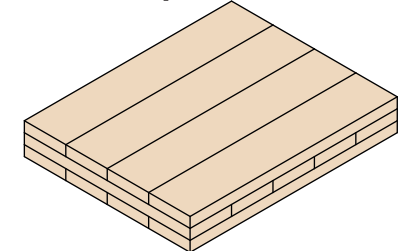
3 x Stability panels



2 x Floor panels



1 x Roof panel



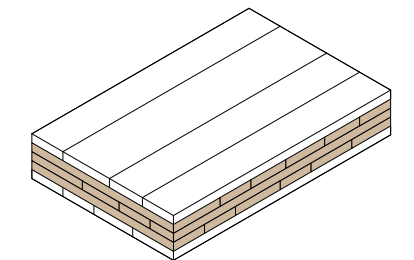
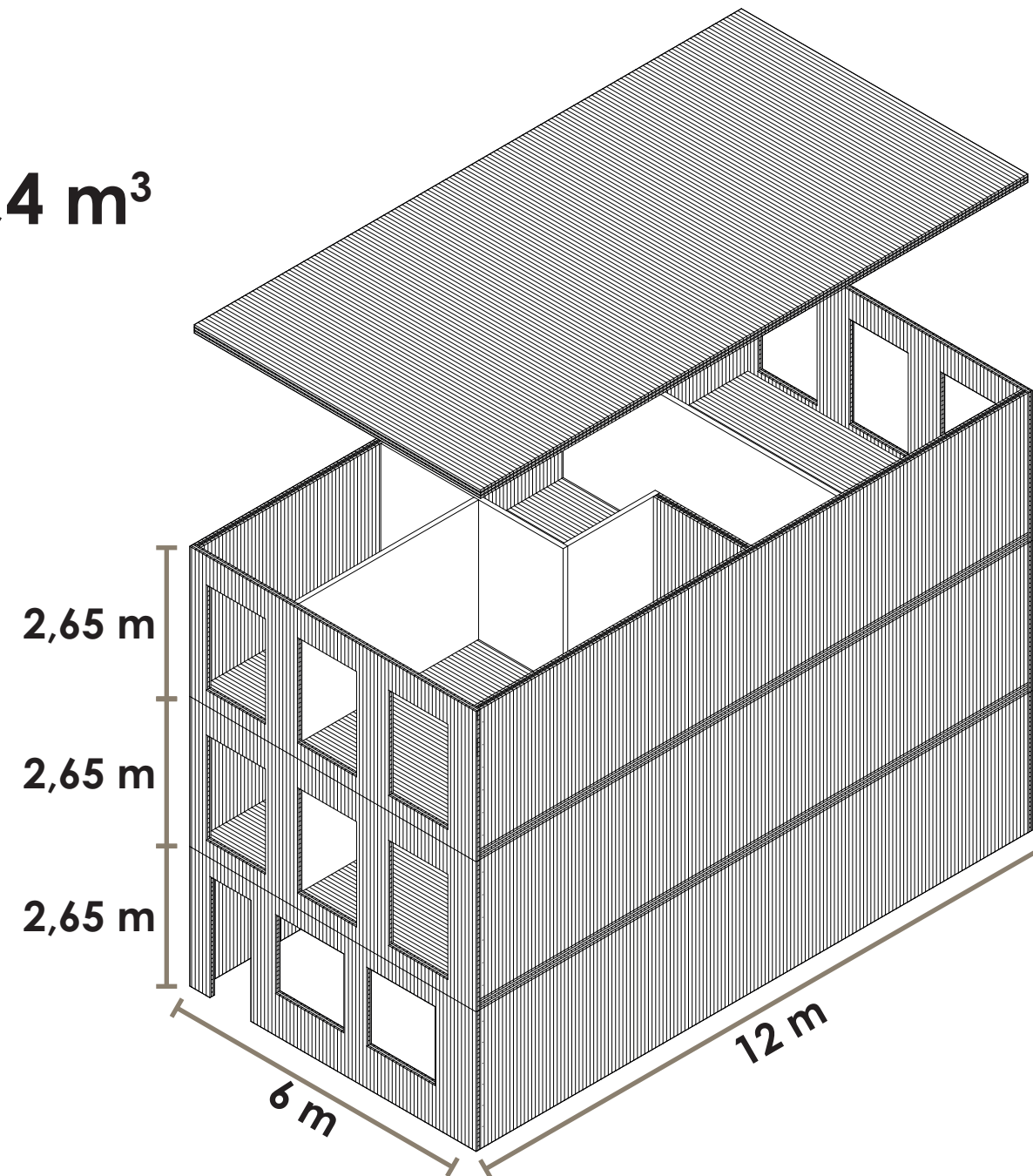
40 m of Internall panels

CASE STUDY: CLT

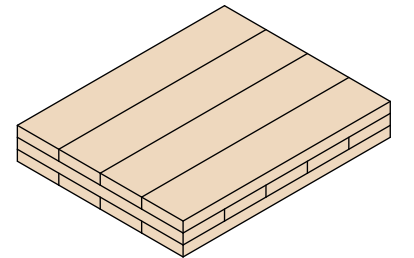
Total volume of CLT: 84,6 m³

Total volume of scrap wood: 36,4 m³

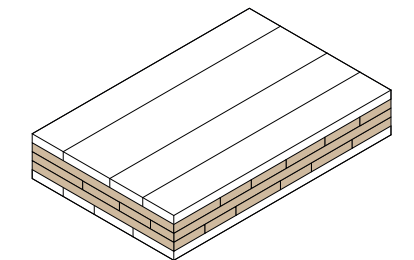
Savings virgin wood:
26,7 ton CO₂



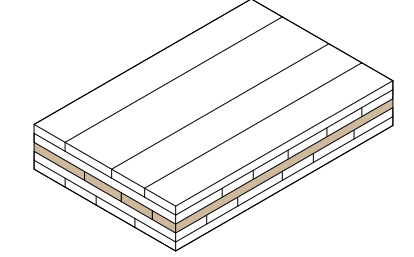
6 x Partition panels



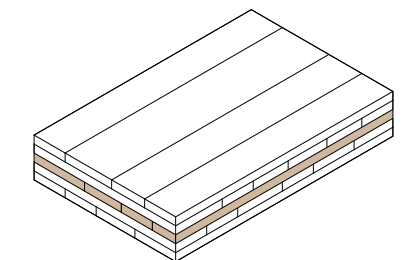
6 x Façade panels



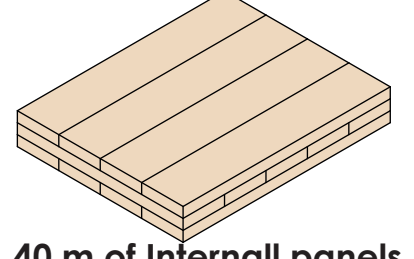
3 x Stability panels



2 x Floor panels



1 x Roof panel



40 m of Internall panels

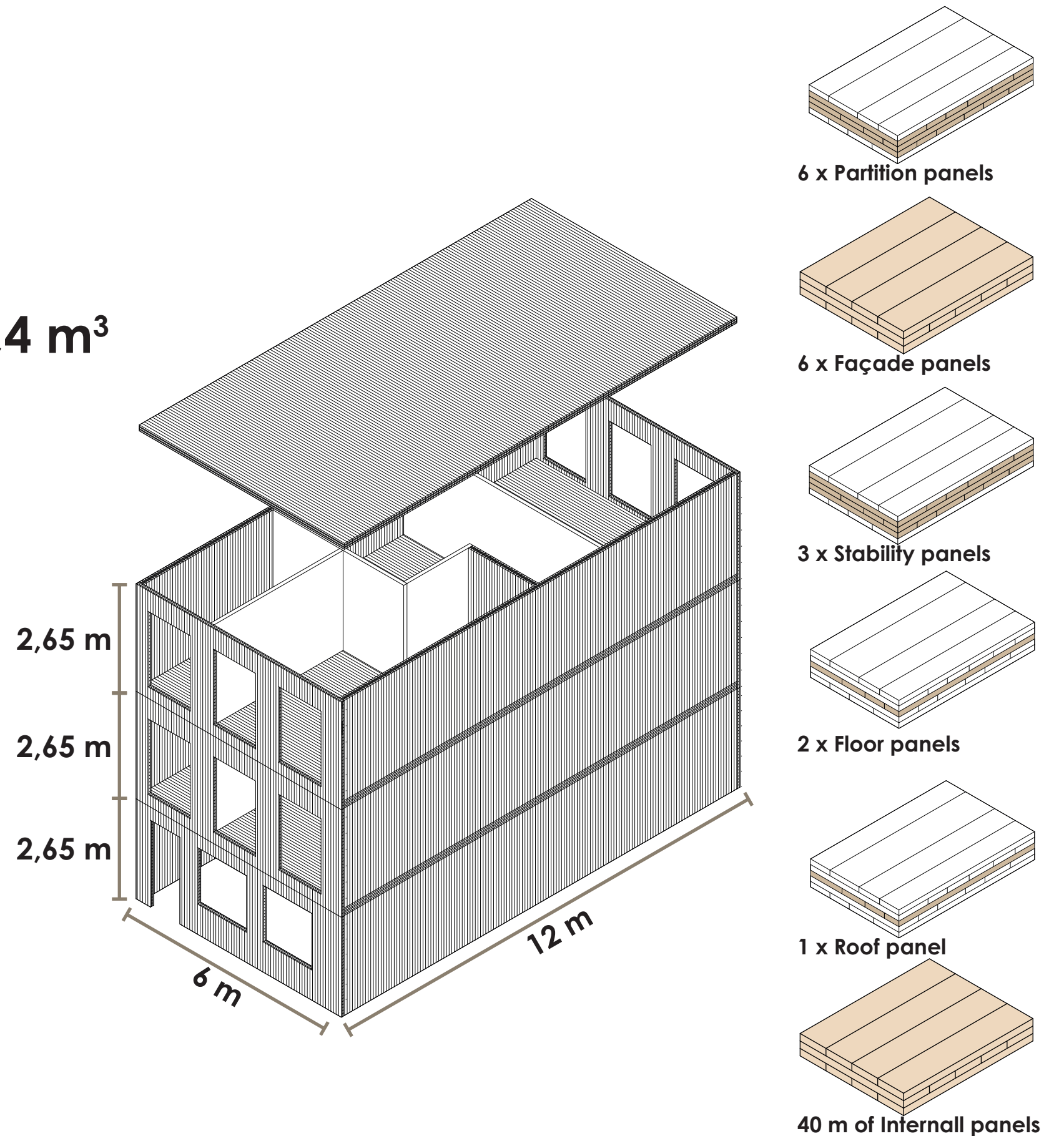
CASE STUDY: CLT

Total volume of CLT: 84,6 m³

Total volume of scrap wood: 36,4 m³

**Savings virgin wood:
26,7 ton CO₂**

**Total savings :
145,5 ton CO₂**



CASE STUDY: CLT

Total volume of scrap wood: 36,4 m³

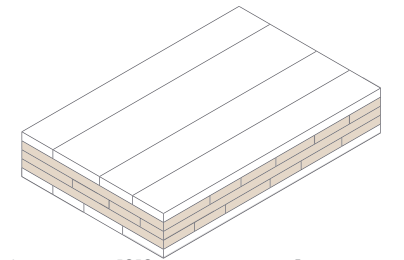
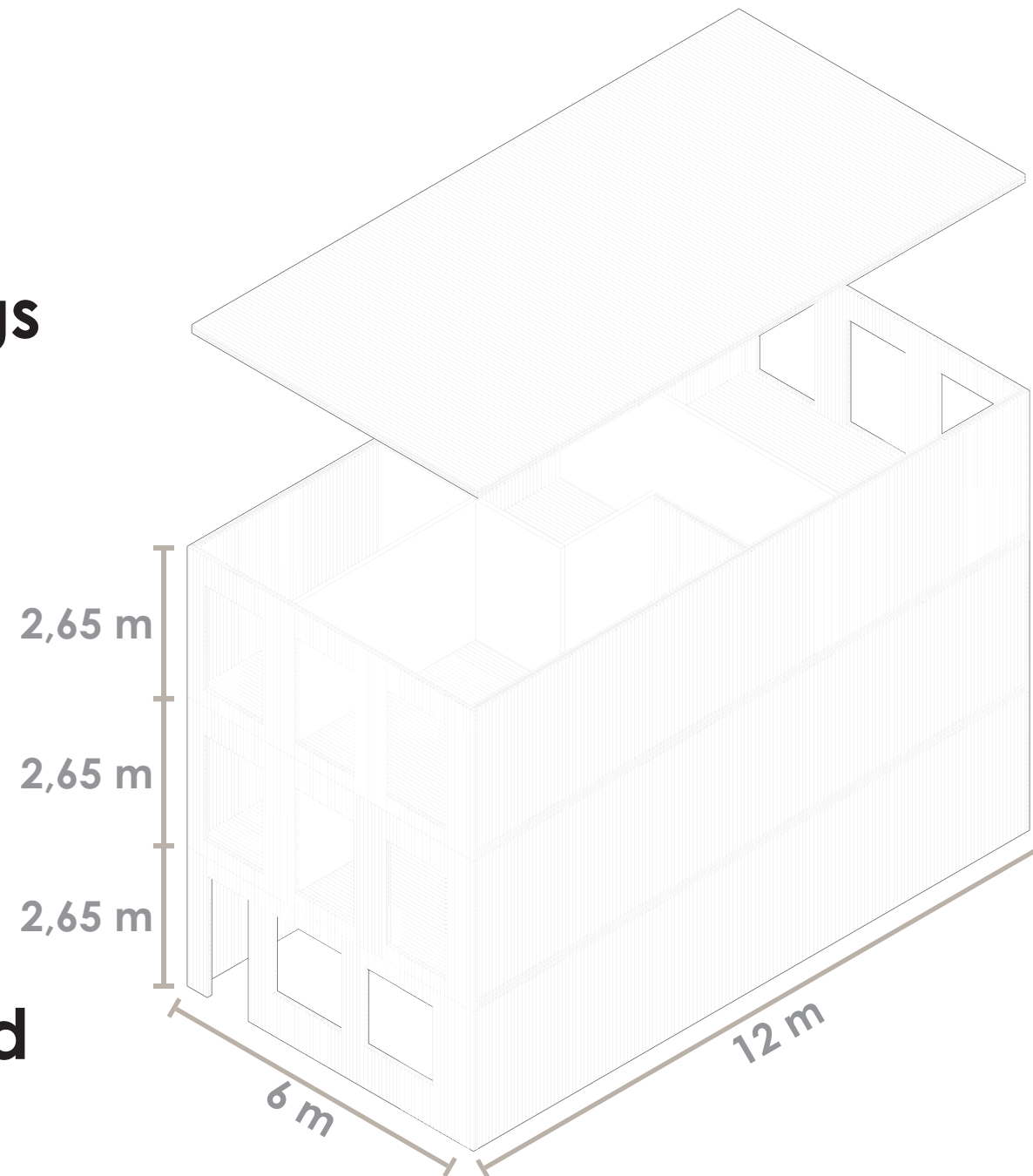
50% of

435 kton = 11.950 CLT buildings

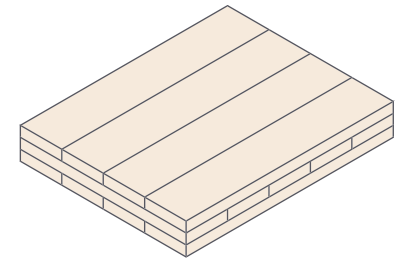


317 kton

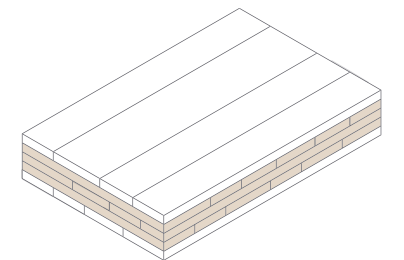
CO2 emissions saved



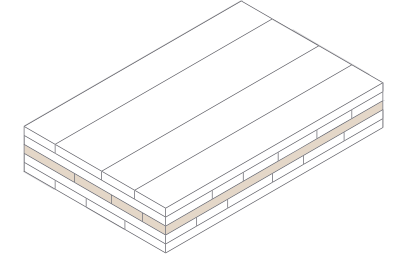
6 x Partition panels



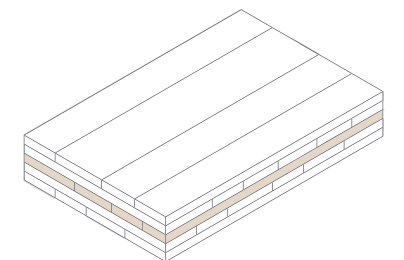
6 x Façade panels



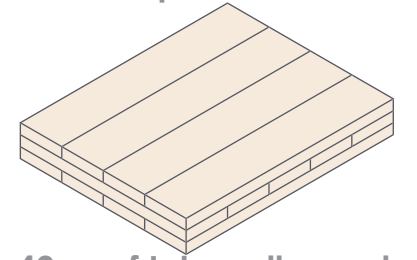
3 x Stability panels



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1 x Roof panel



40 m of Internall panels

CASE STUDY: CLT

Total volume of scrap wood: 36,4 m³

50% of

435 kton = 12.000 CLT buildings

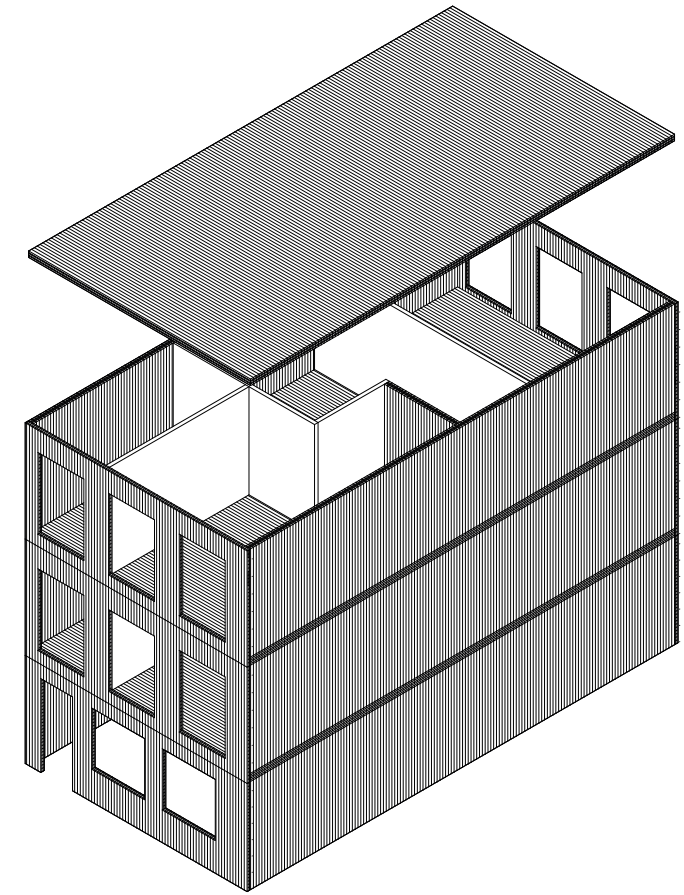


317 kton



Emissions of 16.000 households

CO₂ emissions saved



CASE STUDY: CLT

Total volume of scrap wood: 36,4 m³

50% of

435 kton = 12.000 CLT buildings

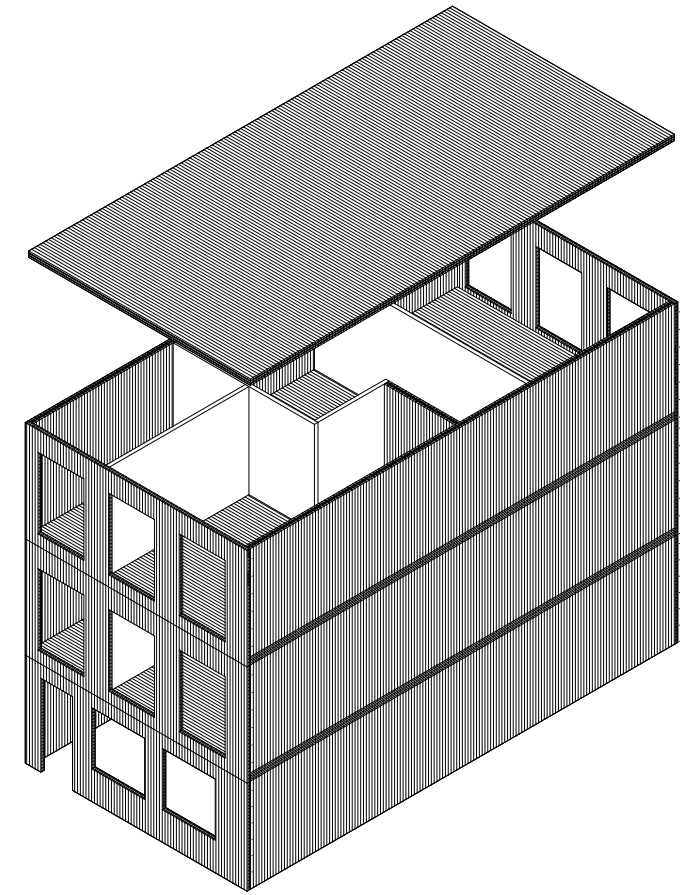


1,7
Mton



Emissions of 89.000 households

CO2 emissions saved
compared to traditional
building materials AND
virgin wood



CLT CONCLUSION

Substituting scrap wood into CLT panel:

- Long CO₂ storage

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- CO₂ emissions production < CO₂ storage
- Sustainability goals
 - Reducing CO₂ emissions
 - Fighting climate change
- Scenarios
 - suitability depends on availability and consistency
- 1 = best option
 - Amount of scrap wood
 - CO₂ saving
- 4 = most suitable

CONCLUSION

How can scrap wood be reused in the built environment and what is a suitable building product?



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- **Suitable building product: CLT**
 - Varying dimensions
 - Long lifespan = extended CO2 storage
 - Always saves CO2 emissions by using scrap wood
 - Overall decrease in CO2 emissions
 - Reduction of waste



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 - Long lifespan = extended CO2 storage
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- **Reusing scrap wood**

 - Reduces CO2 emissions
 - Fight climate change
 - Reduces waste production
 - Circular economy



RECOMMENDATIONS

Reflection

- Lack of certain information
- Why shouldn't we reuse scrap wood more?
- Every small step helps

Further/more detailed research on:

- Consistency of scrap wood
- Development of mechanical processes for:
 - identify wood species
 - sort scrap wood
 - remove metal from scrap wood
- Properties of the scenarios
- Development of legislation for reusing scrap wood

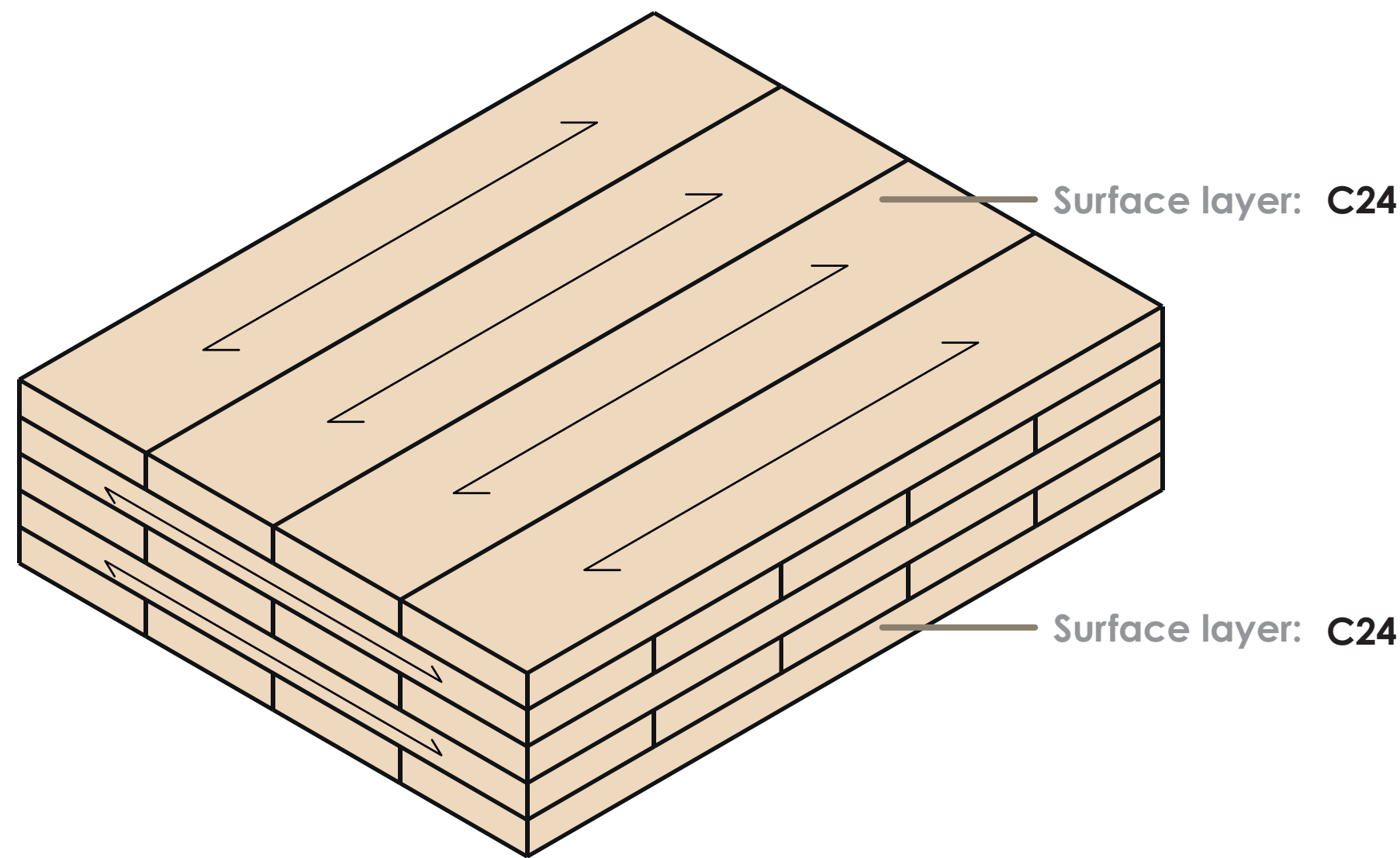




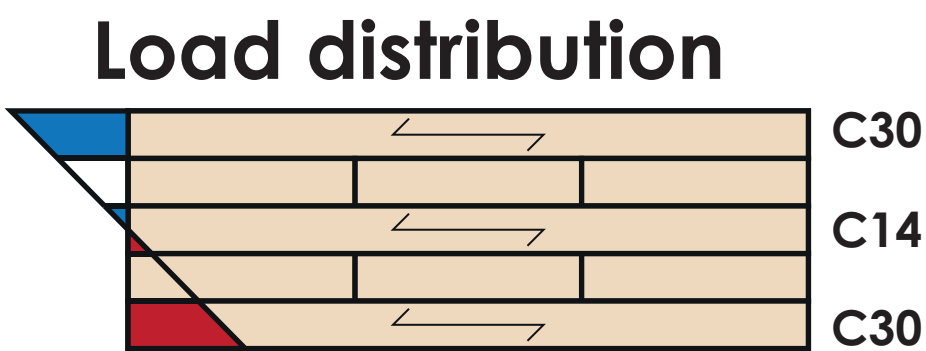
THANK YOU

CLT: STRENGTH CLASS

5 layer panel

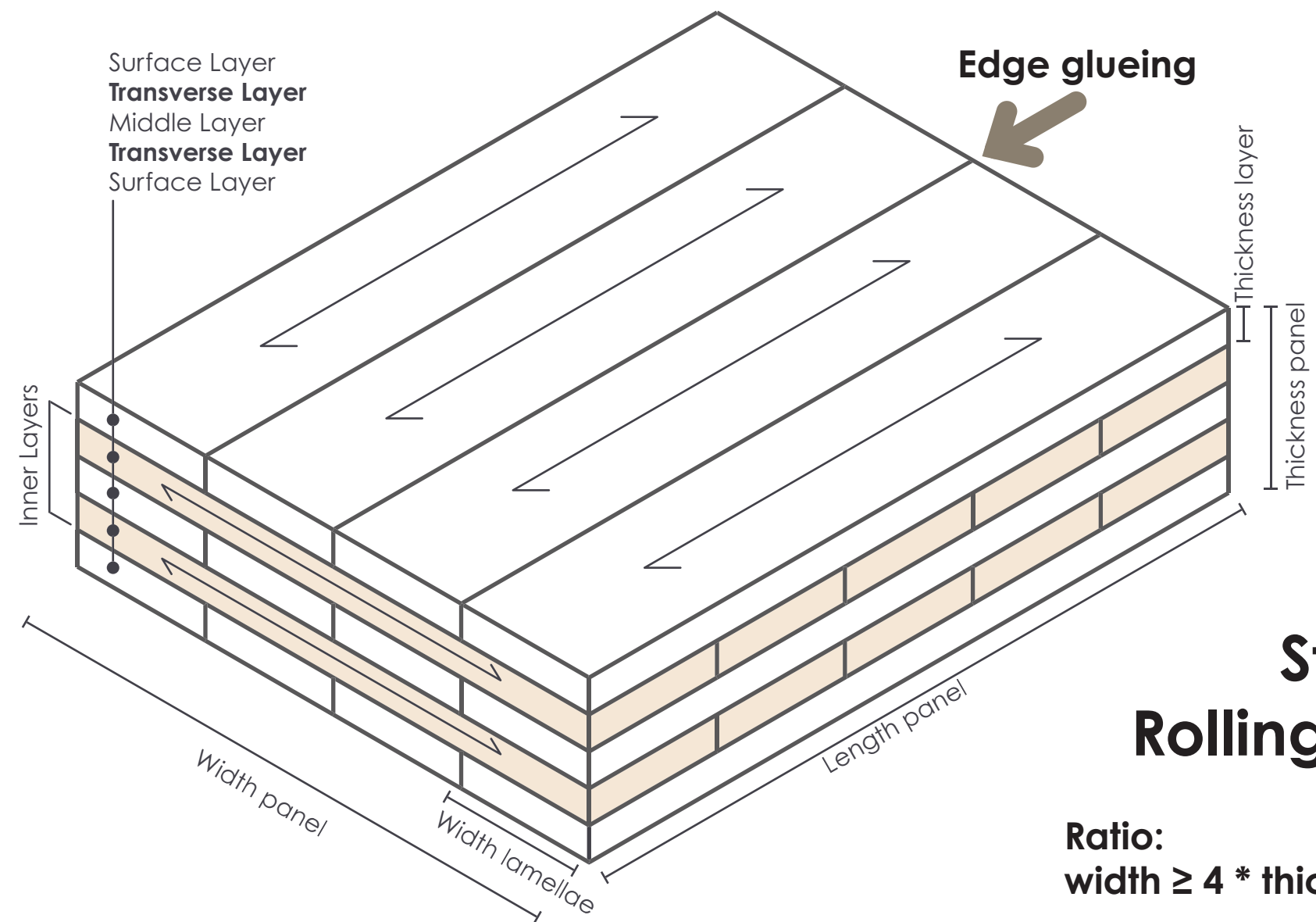


Strength class
Common: C24
Vary: C14 - C30 →



CLT: TRANSVERSE LAYERS

5 layer panel



**Strengthen:
Rolling shear strength**

**Ratio:
 $\text{width} \geq 4 * \text{thickness}$**

