

An integrated approach towards energy performance and circularity in buildings.

Nimmi Sreekumar | P5 | 9th July 2019



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OOST VRIES LANT

MONA





40%

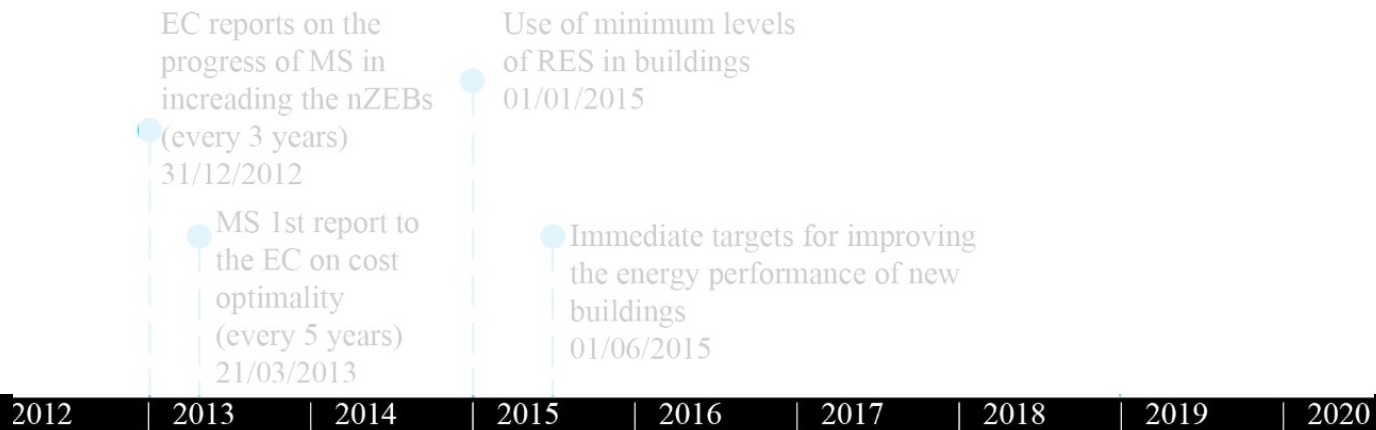
Waste from building
industry

50%

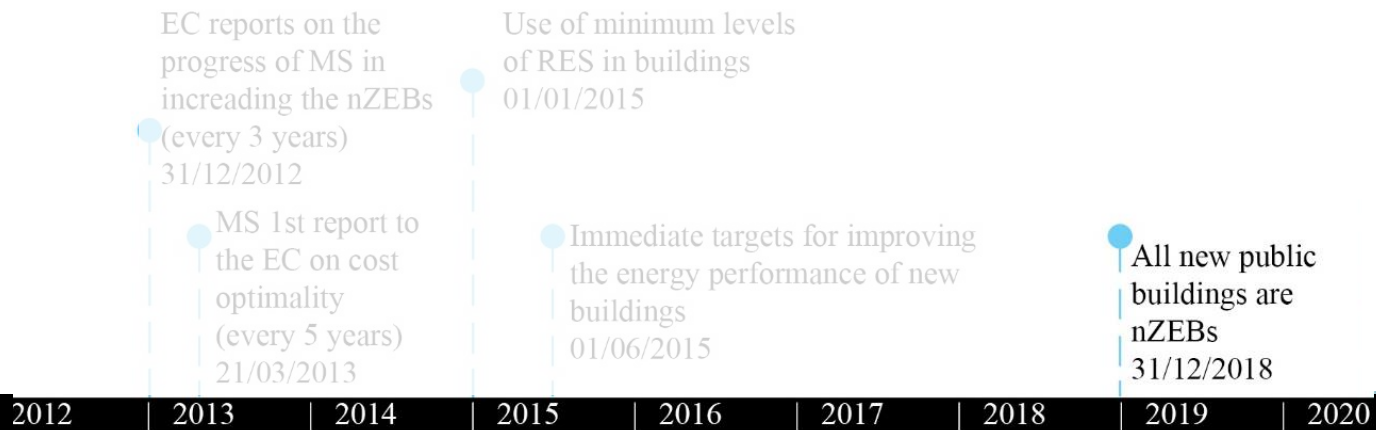
Energy consumption

40%

Raw material consumption

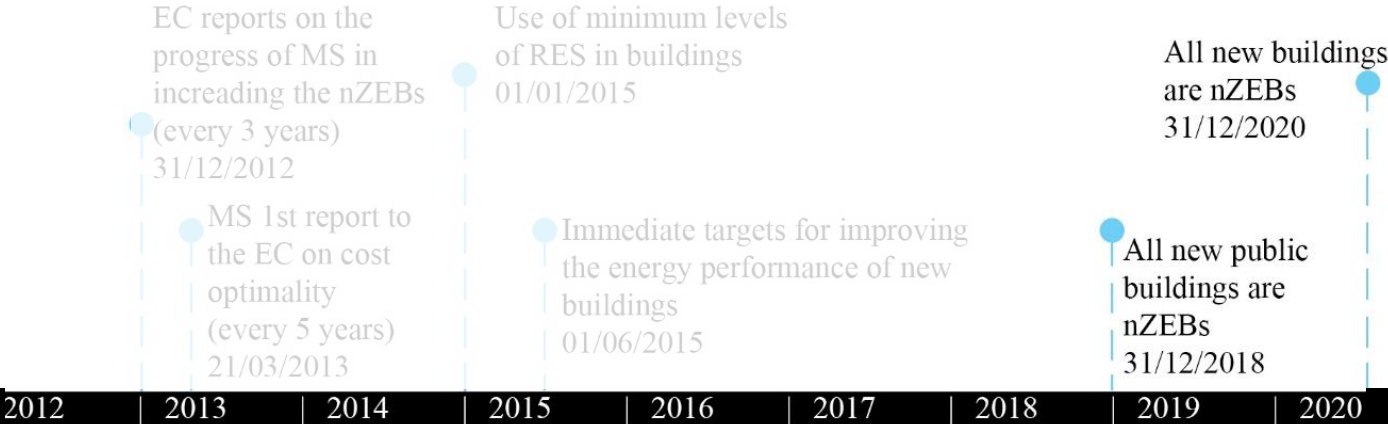


Key years for nearly Zero-Energy buildings (Directive 2010/31/EC) (Atanasiu et al., 2014) & Circularity



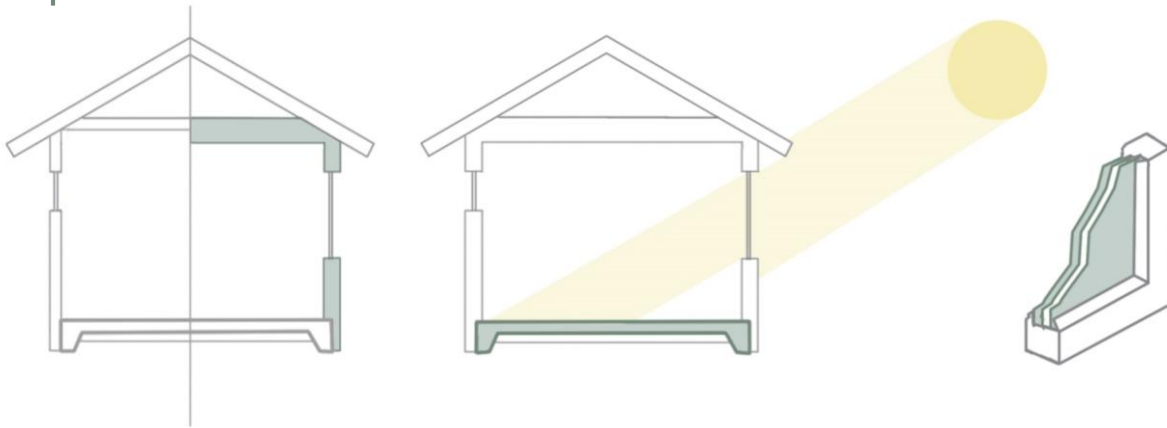
Key years for nearly Zero-Energy buildings (Directive 2010/31/EC) (Atanasiu et al., 2014) & Circularity

Energy performance

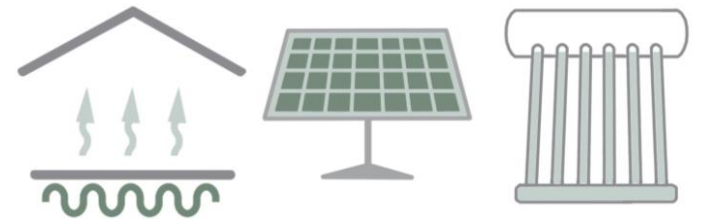


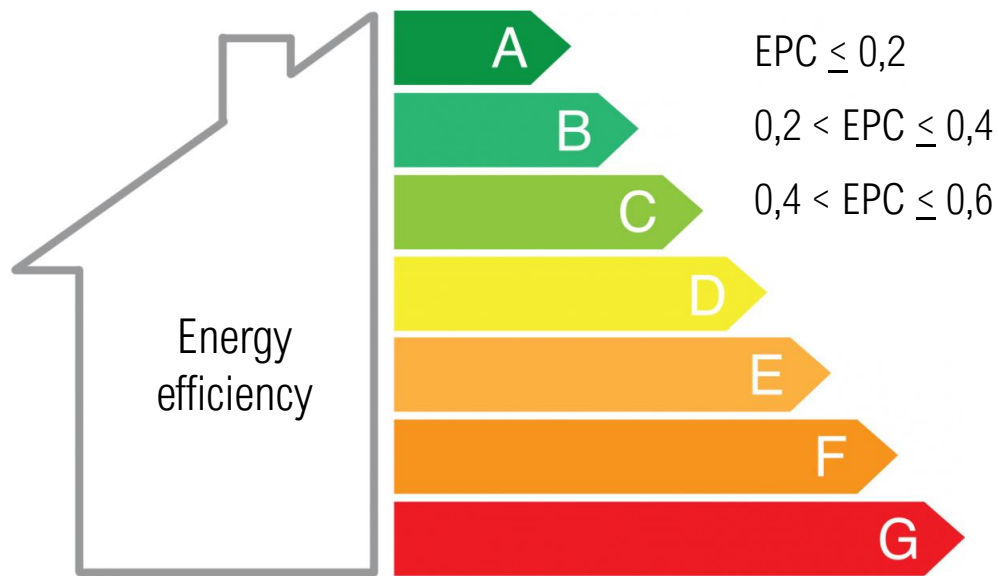
Key years for nearly Zero-Energy buildings (Directive 2010/31/EC) (Atanasiu et al., 2014) & Circularity

Reduce the demand



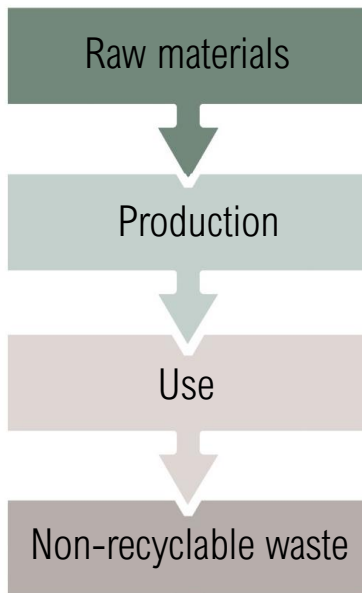
Use renewable energy (efficiently)



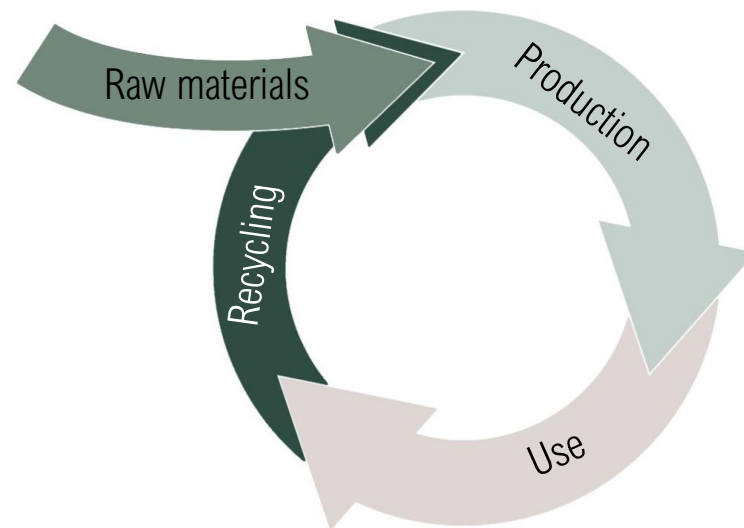


EPC regulations according to the EU directive

Linear economy



Circular economy

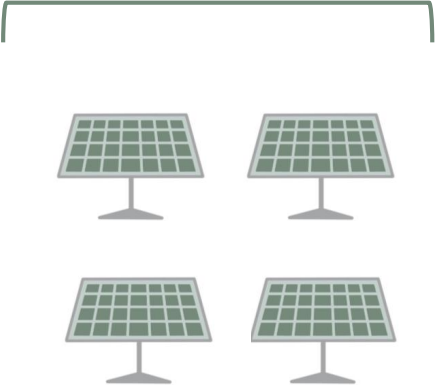


Transition from a linear consumption model to a circular model

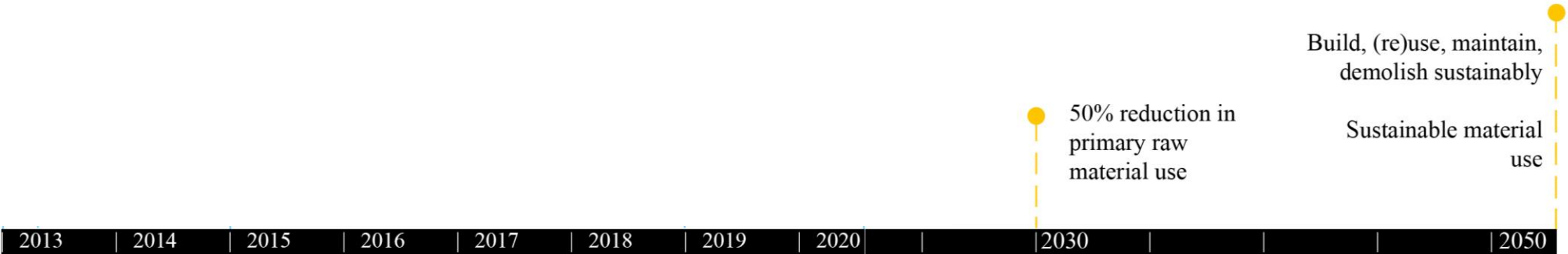
Reduce the demand



Use renewable energy



— Circularity ambitions



An EU Action plan for the circular economy

Research question

*“To what extent are **high energy performance** and **circular ambitions** combined and achieved in new buildings, and how can this performance be further improved?”*



Literature
summary



Assessment
method



Case study
assessment



Design
improvements



Conclusion
& Discussion





Honeybee



Trnsys



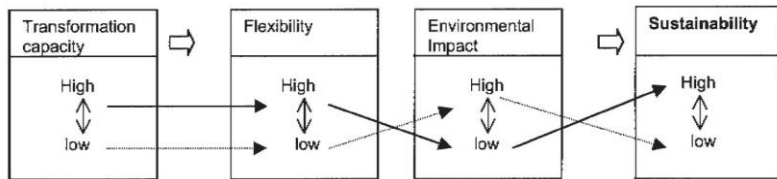
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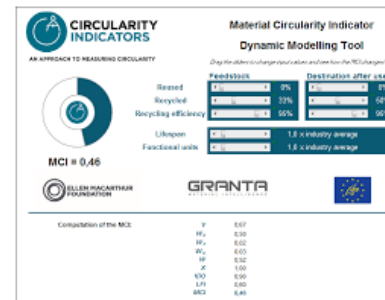
Enorm



GPR



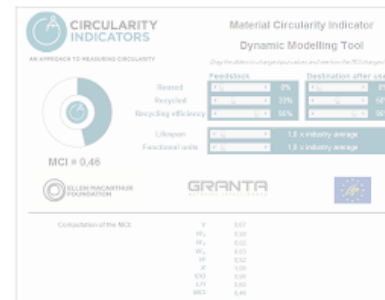
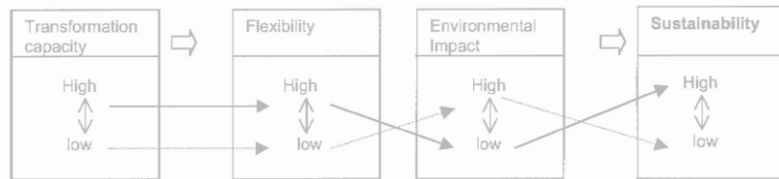
Elma Durmisevic's Disassembly potential

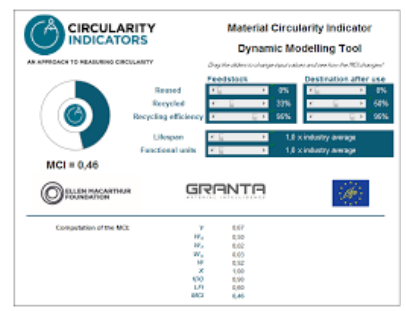
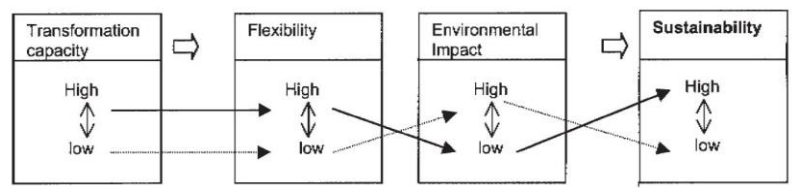


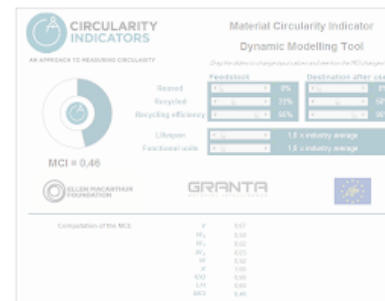
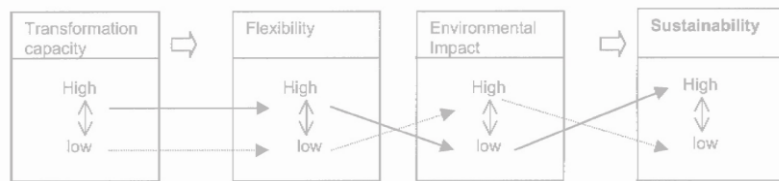
Material Circularity indicator



Metabolic Roadmap







Materials



Metabolic Roadmap
(metabolic.nl)

Strategies	Principles	Sub-strategies
Materials	Reduce	M1: Optimal material use
	Synergize	M2: Reutilization of products
	Supply	M3: Circular materials
	Manage	M4: Knowledge development and sharing



Metabolic Roadmap
(metabolic.nl)

Energy

Strategies	Principles	Sub-strategies
Energy	Reduce	E1: Minimize energy consumption
	Synergize	E2: Optimize energy demand
	Supply	E3: Sustainable and local energy
	Manage	E4: Knowledge development and sharing

Missing:

An assessment method that measures the energetic & circular performance of a building in an **integrated** way.



Circular building

Circular building



Circular building



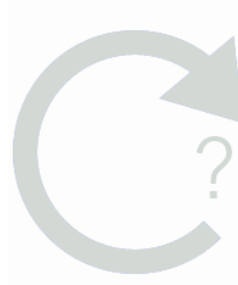
Circular building

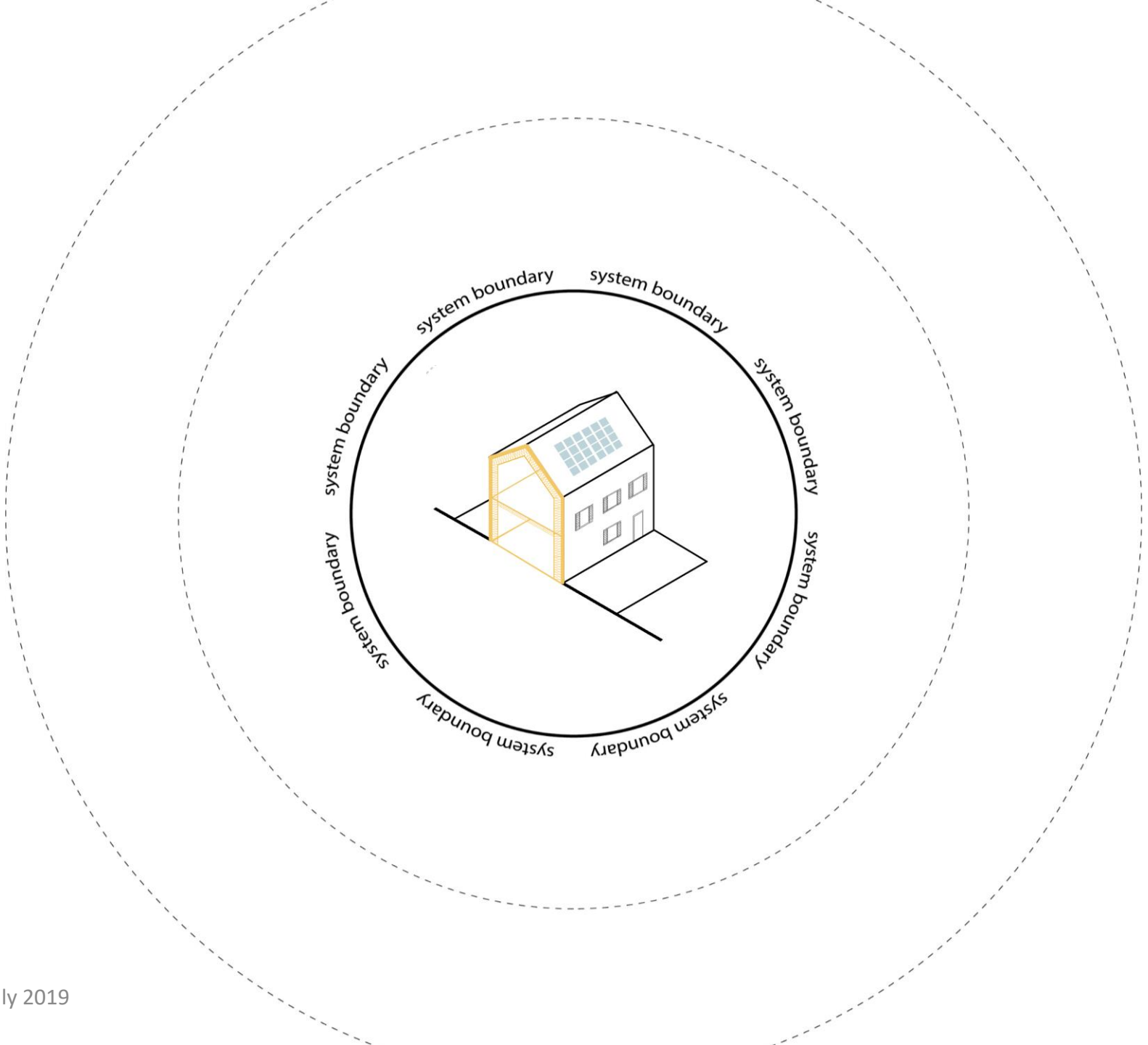


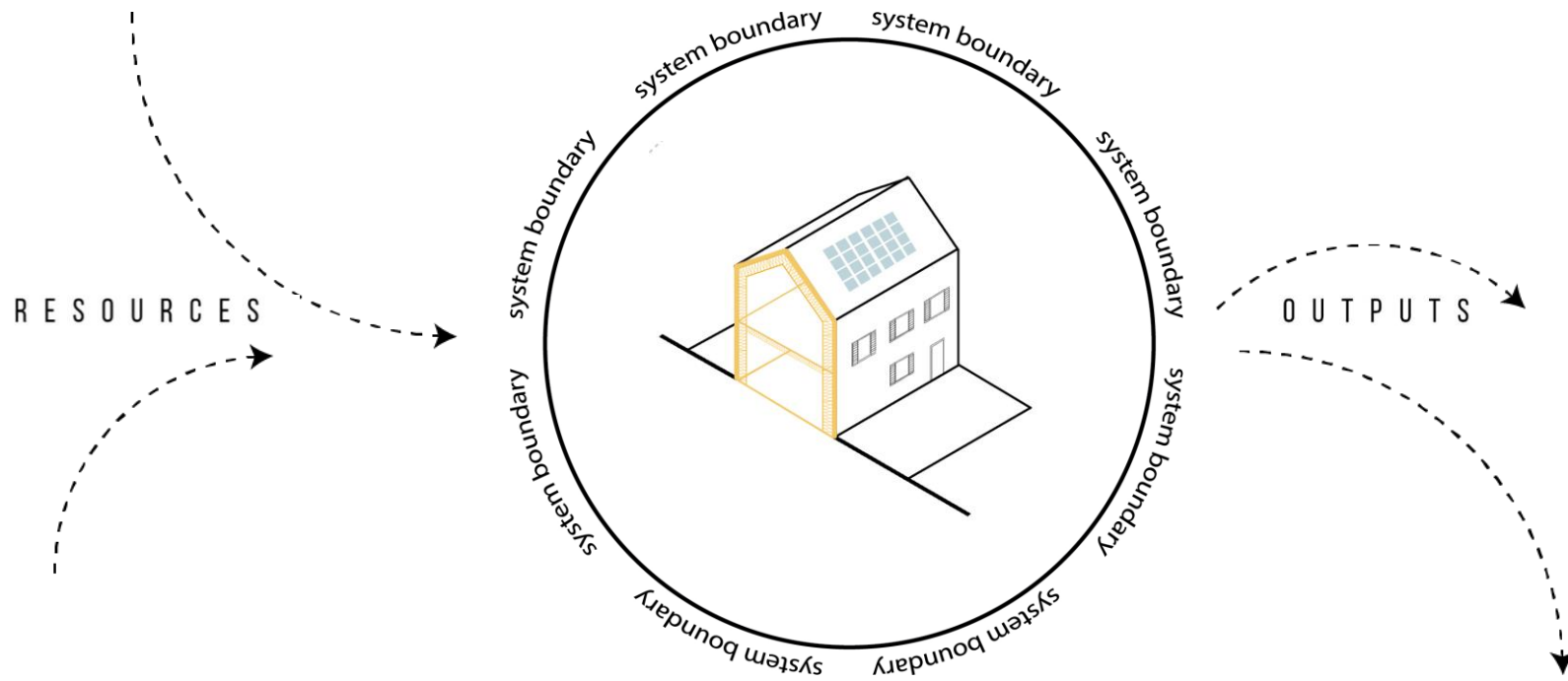
Circular building

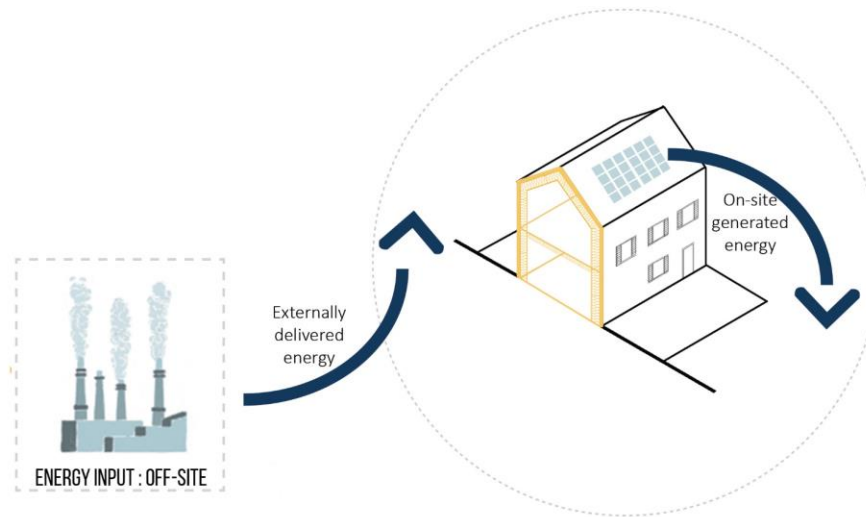


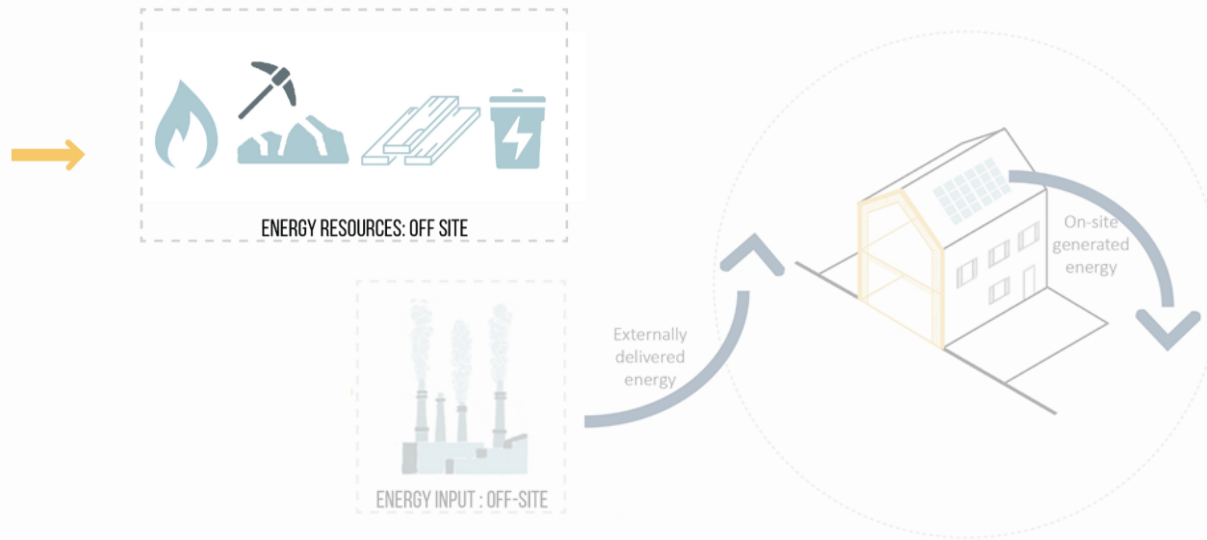
Circular building

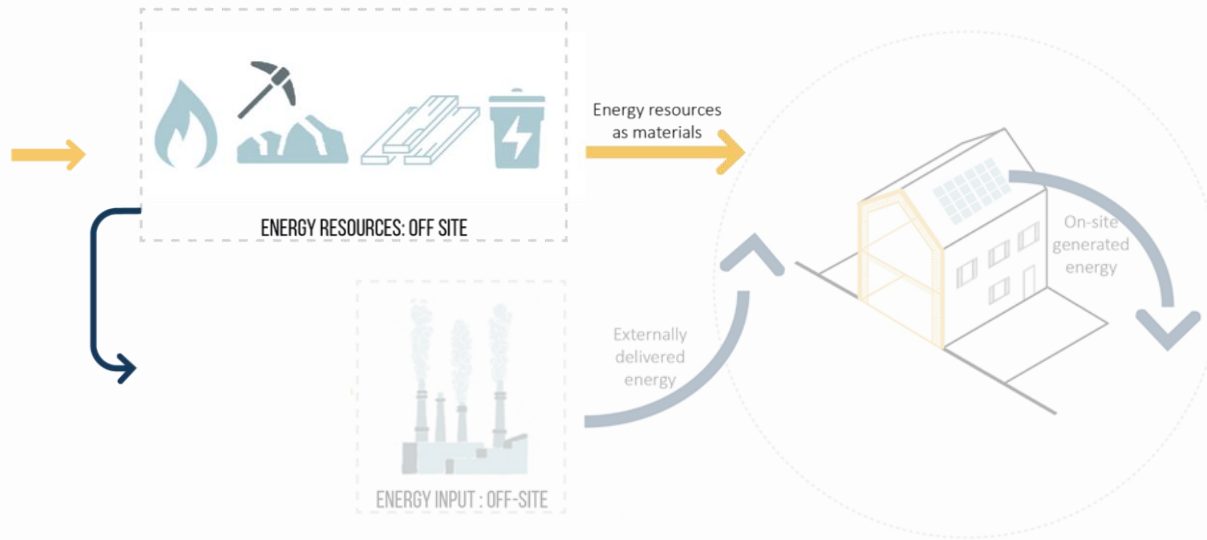








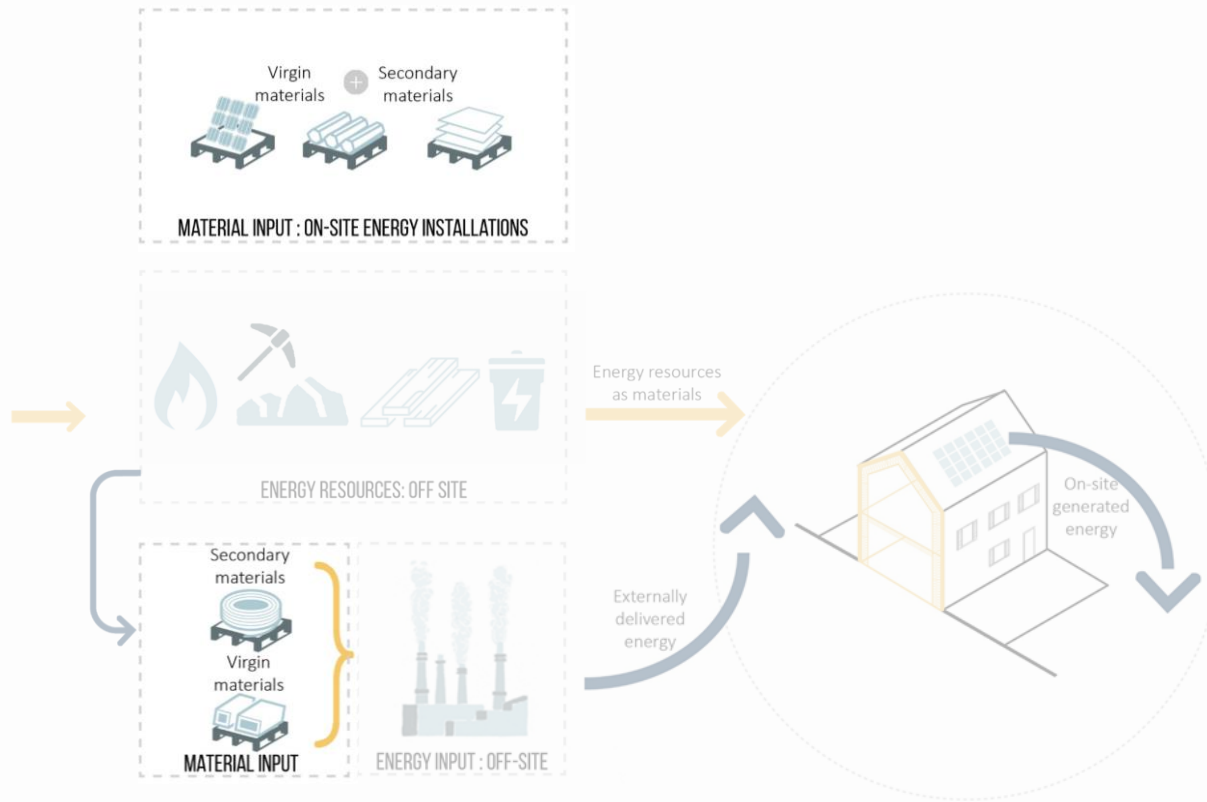




RESOURCES

BUILDING SITE

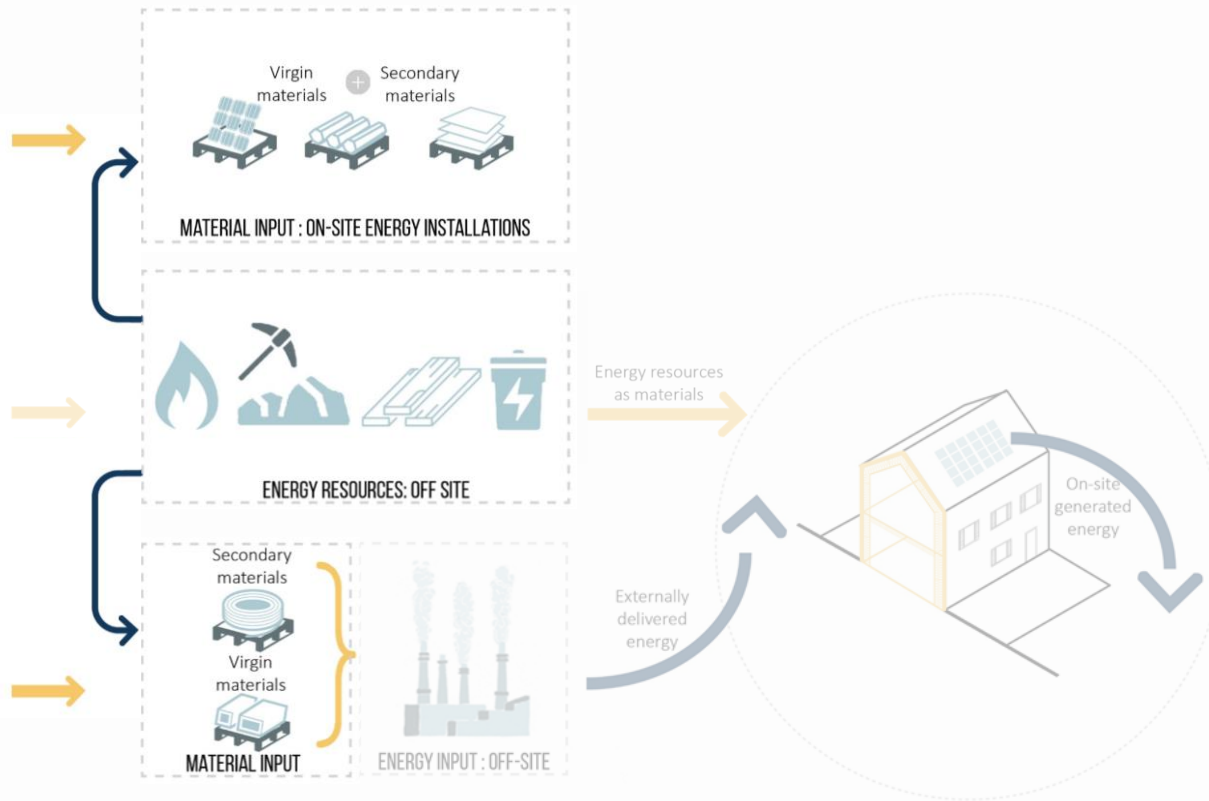
OUTPUTS



RESOURCES

BUILDING SITE

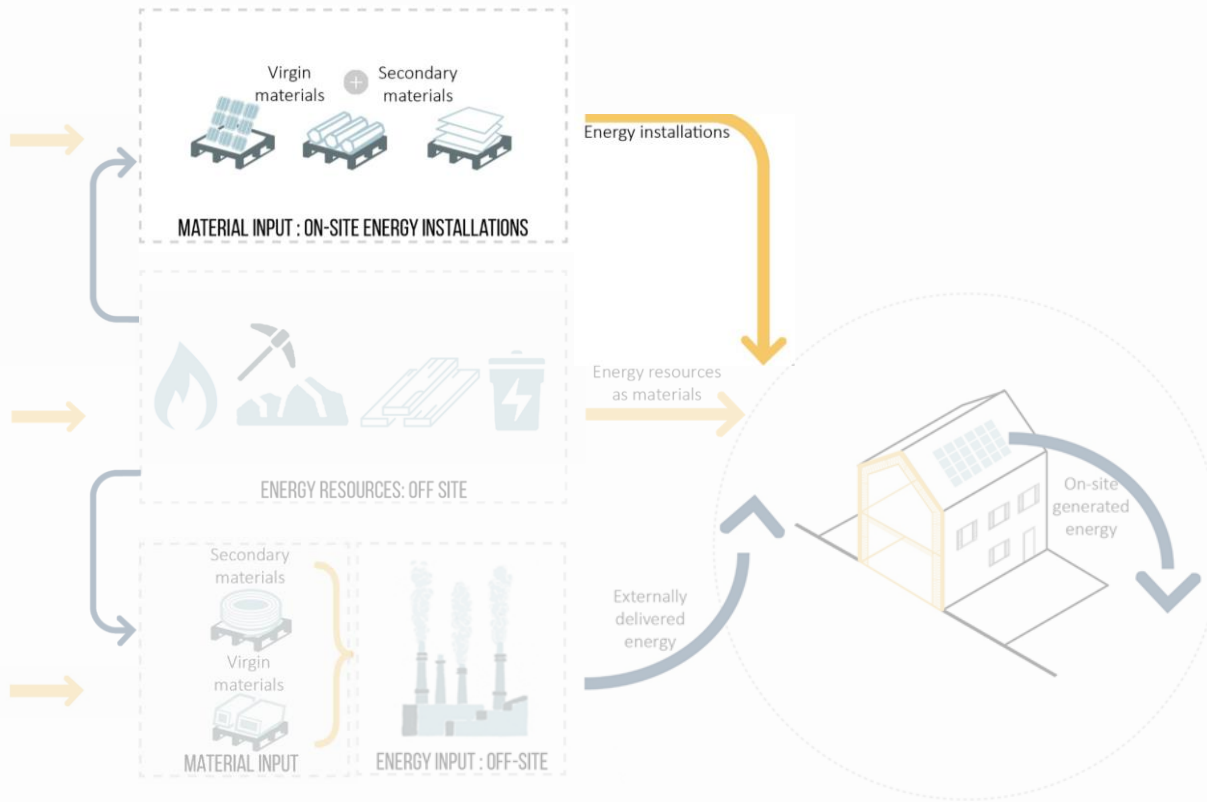
OUTPUTS



RESOURCES

BUILDING SITE

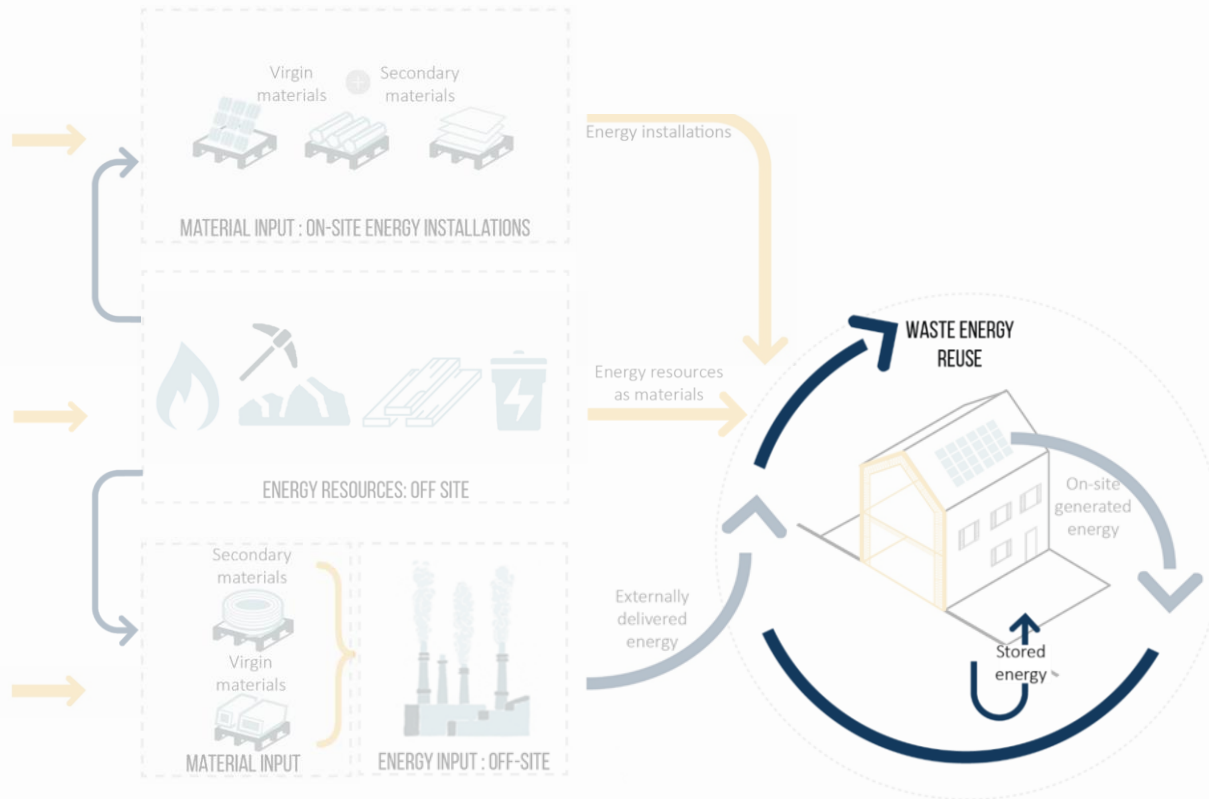
OUTPUTS



RESOURCES

BUILDING SITE

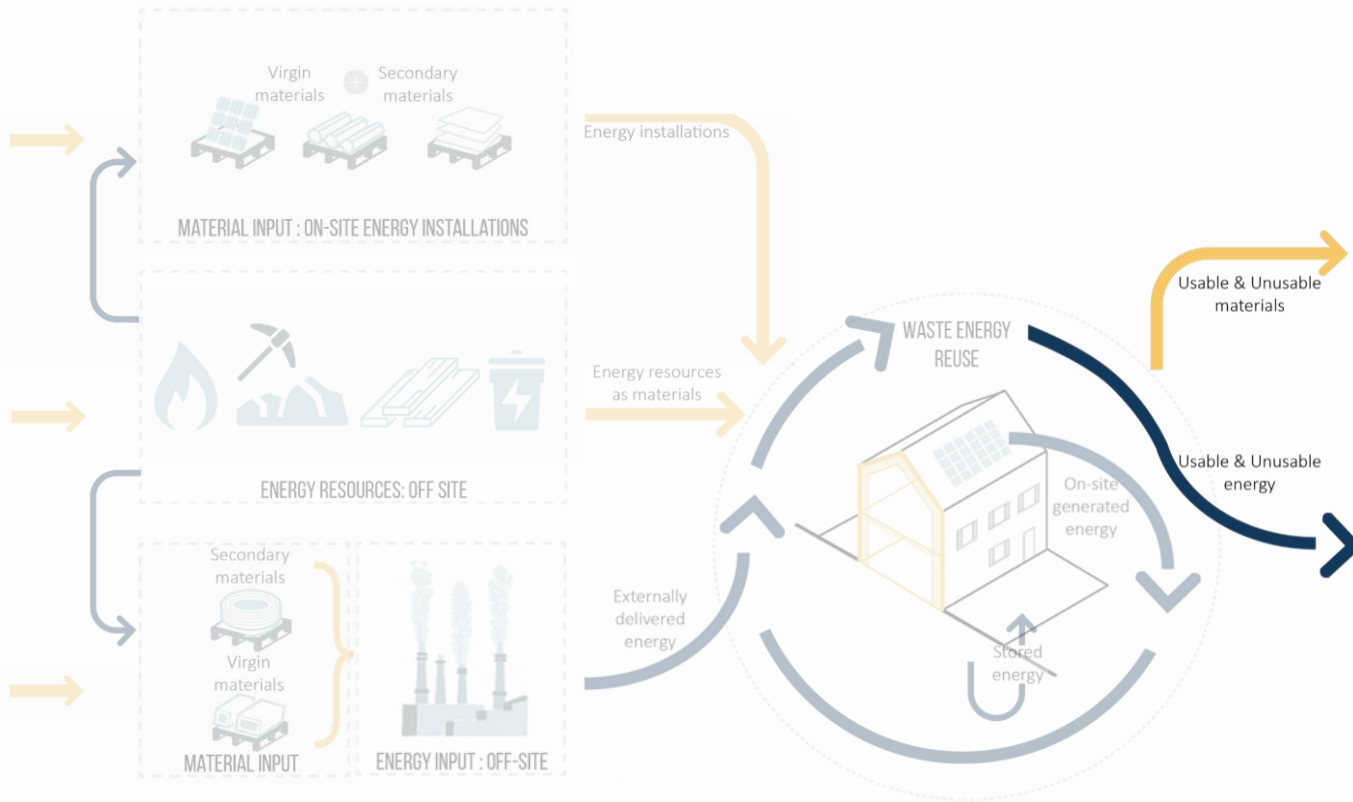
OUTPUTS



RESOURCES

BUILDING SITE

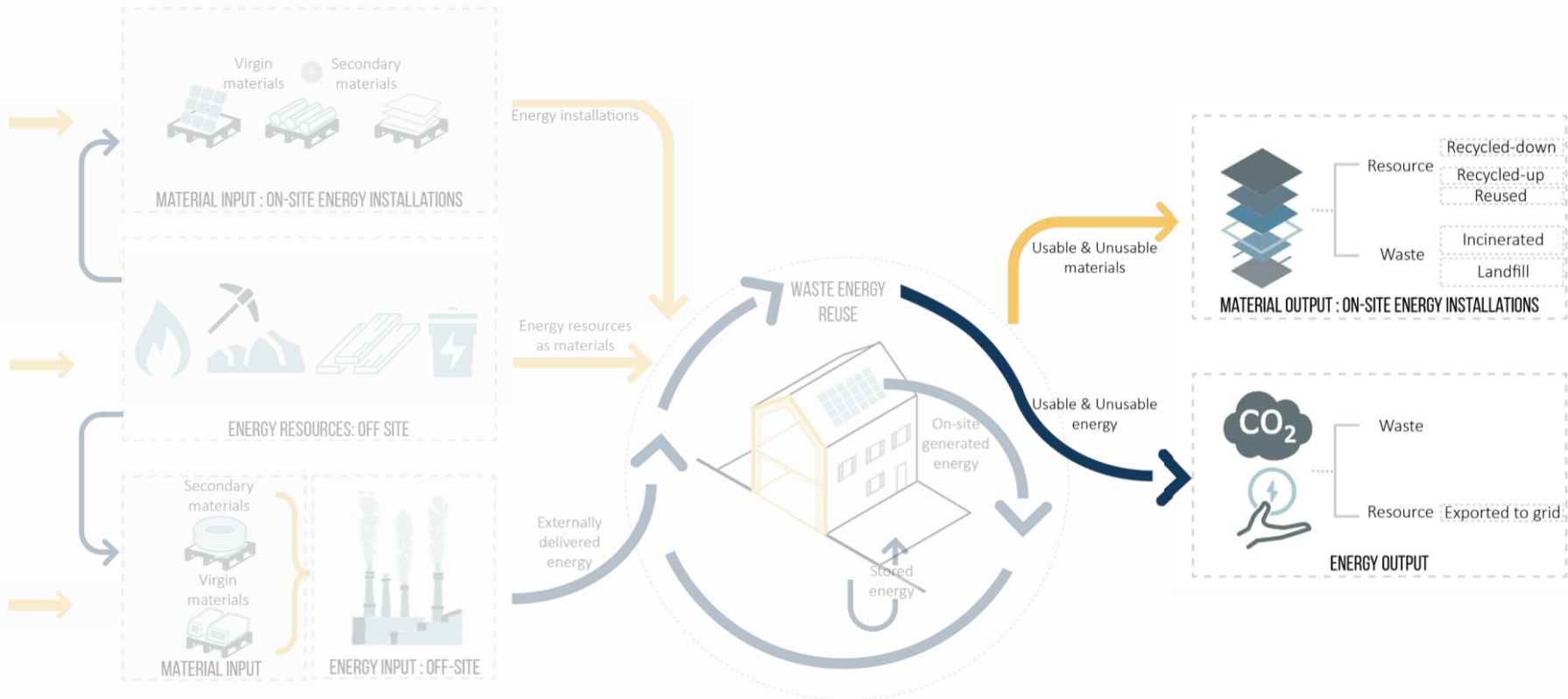
OUTPUTS



RESOURCES

BUILDING SITE

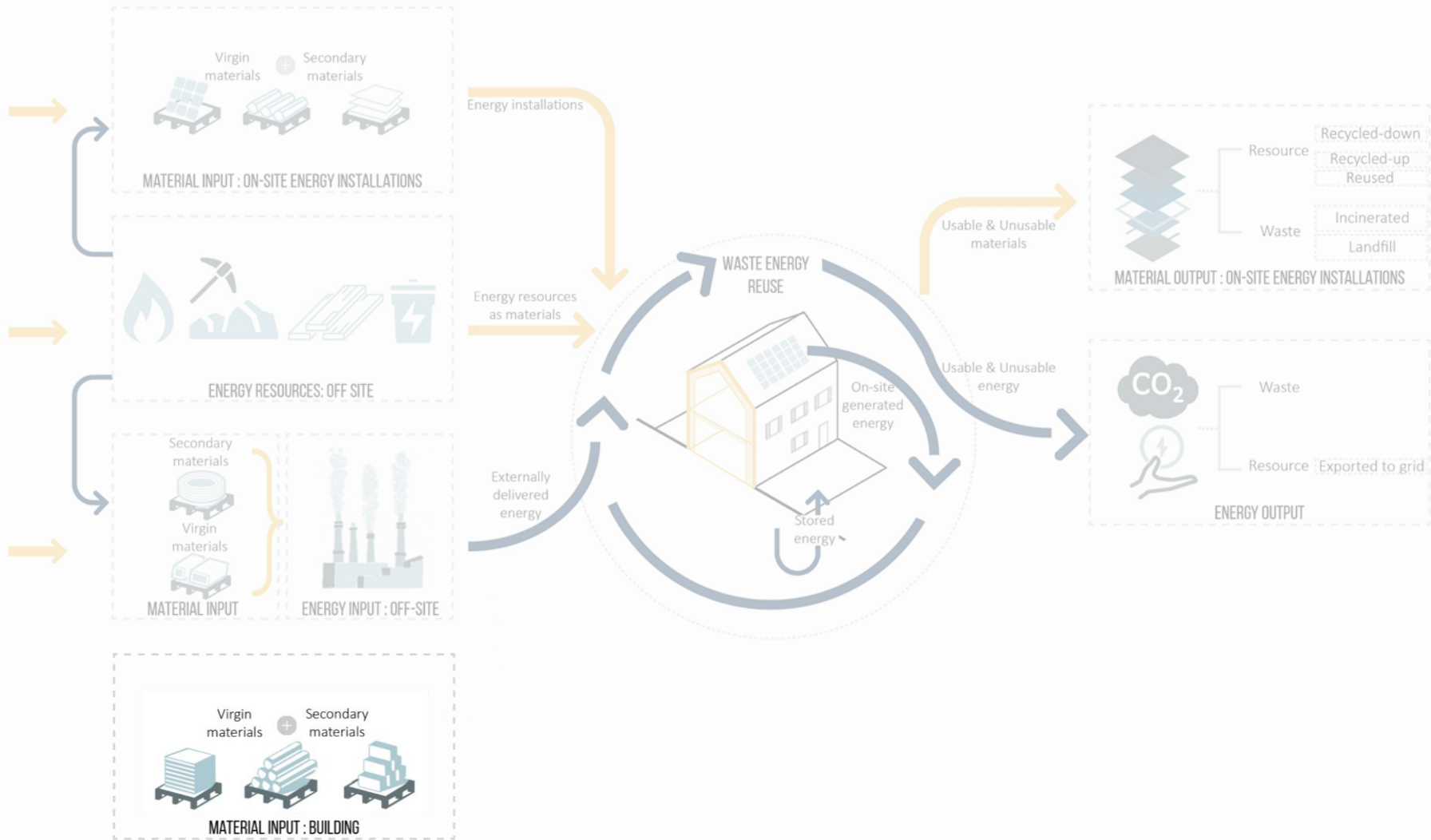
OUTPUTS



RESOURCES

BUILDING SITE

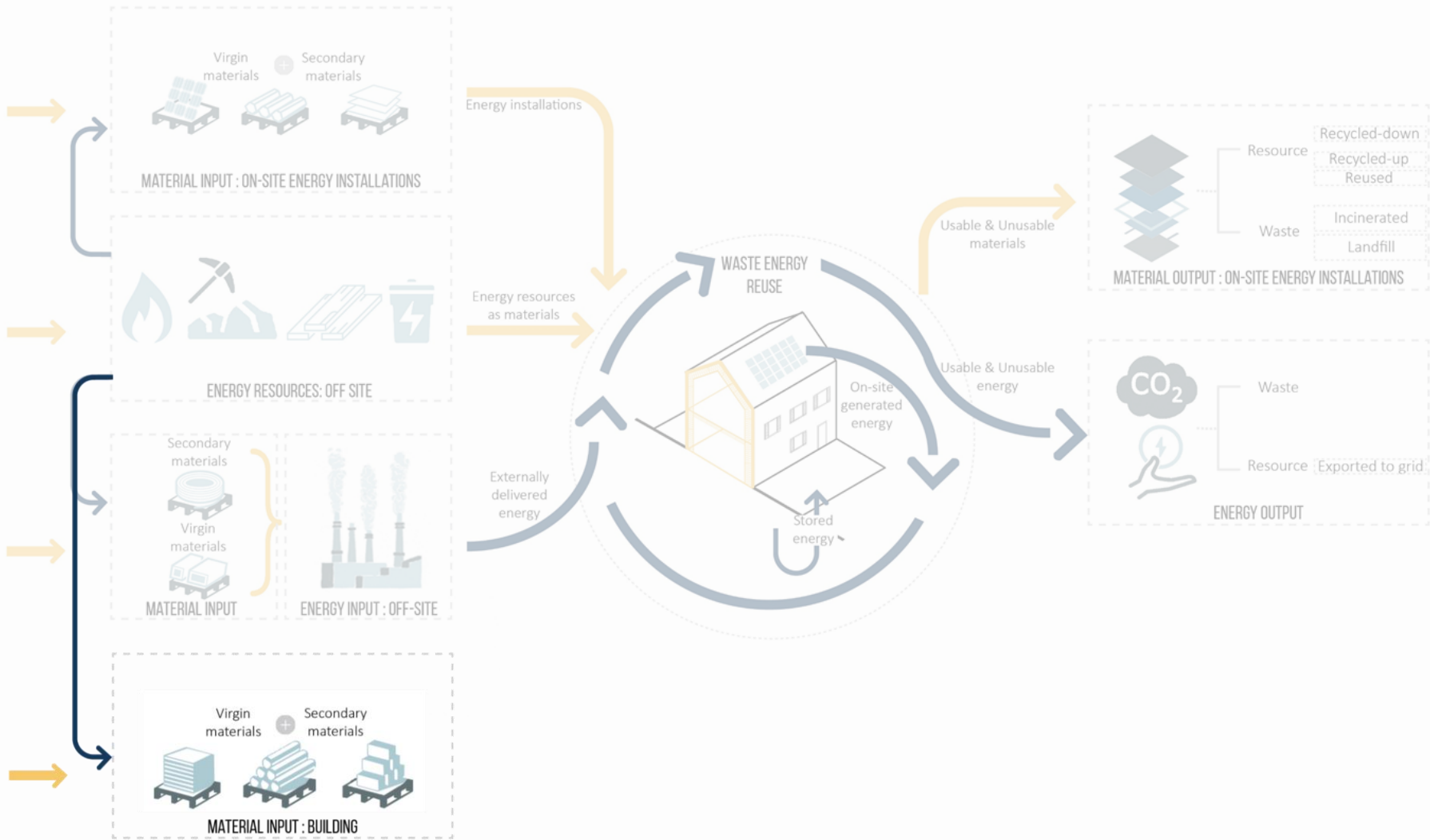
OUTPUTS



RESOURCES

BUILDING SITE

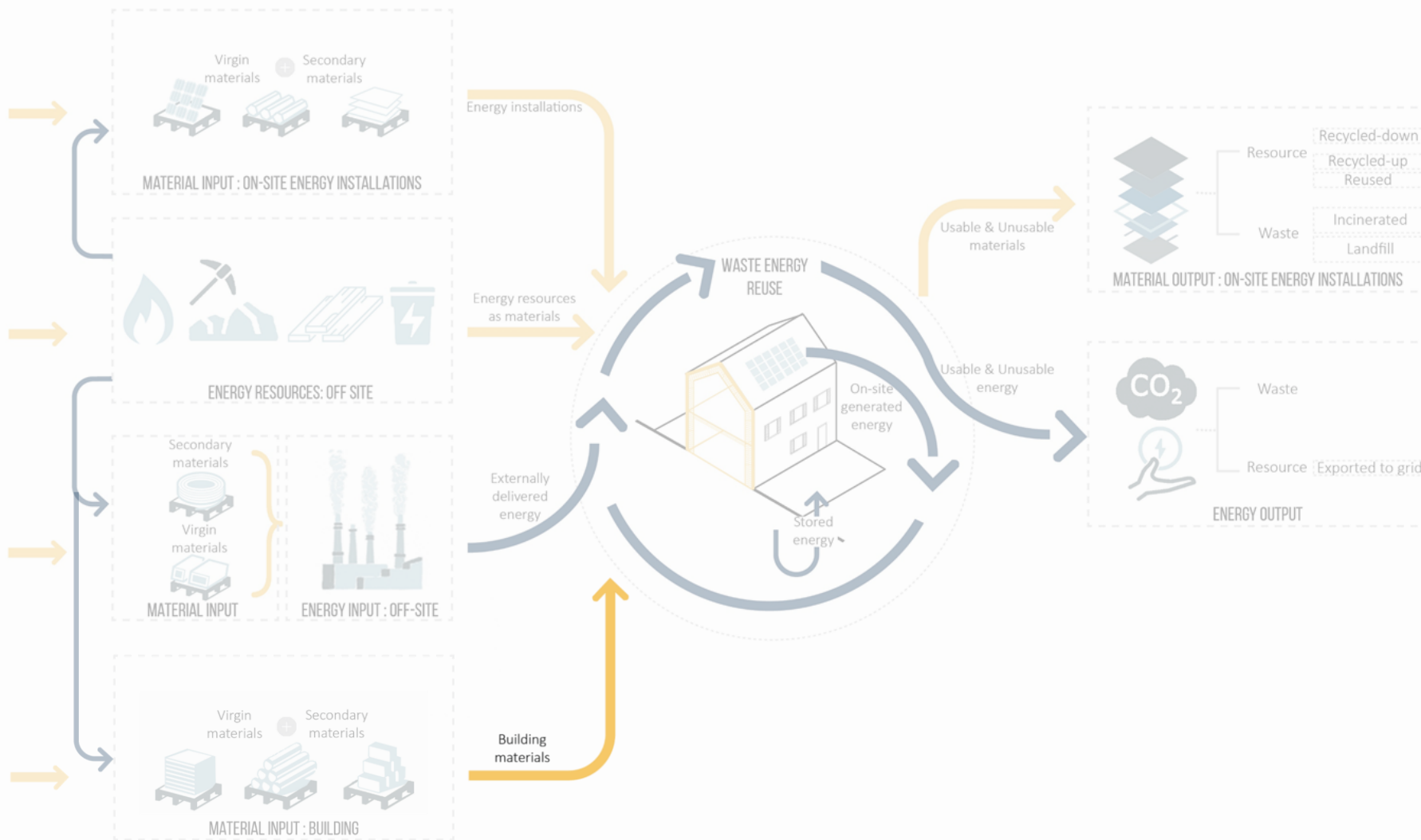
OUTPUTS



RESOURCES

BUILDING SITE

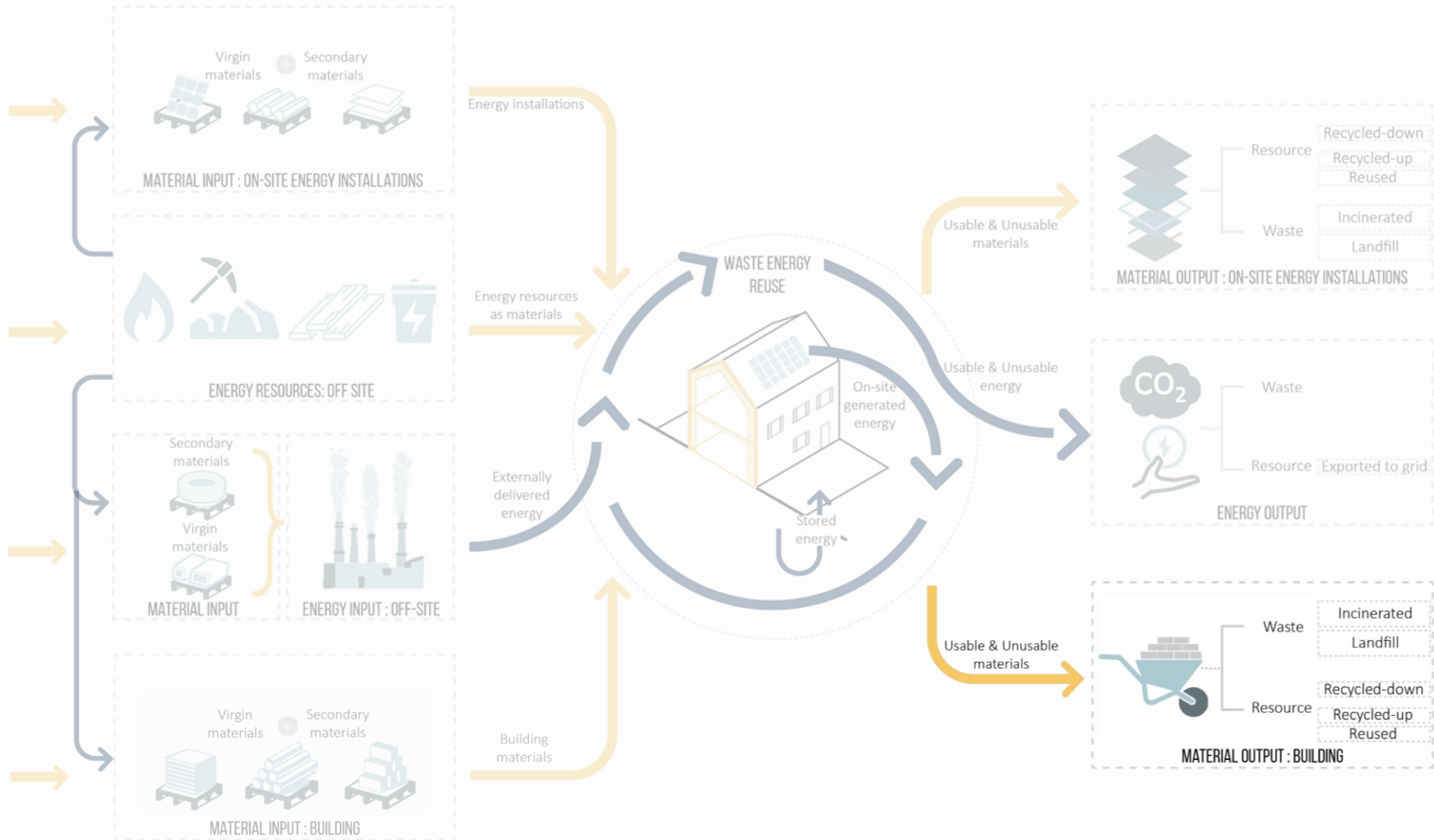
OUTPUTS



RESOURCES

BUILDING SITE

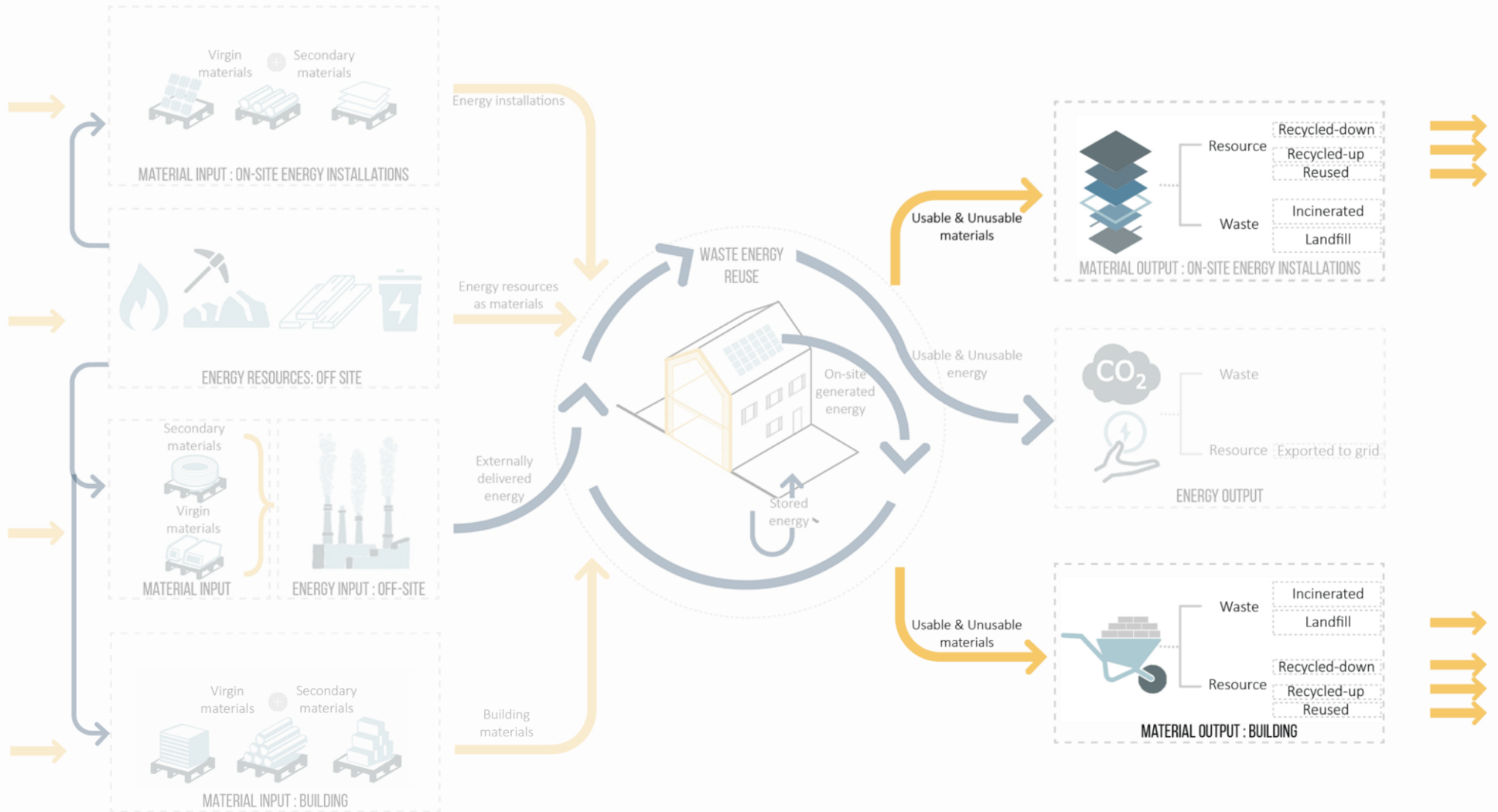
OUTPUTS

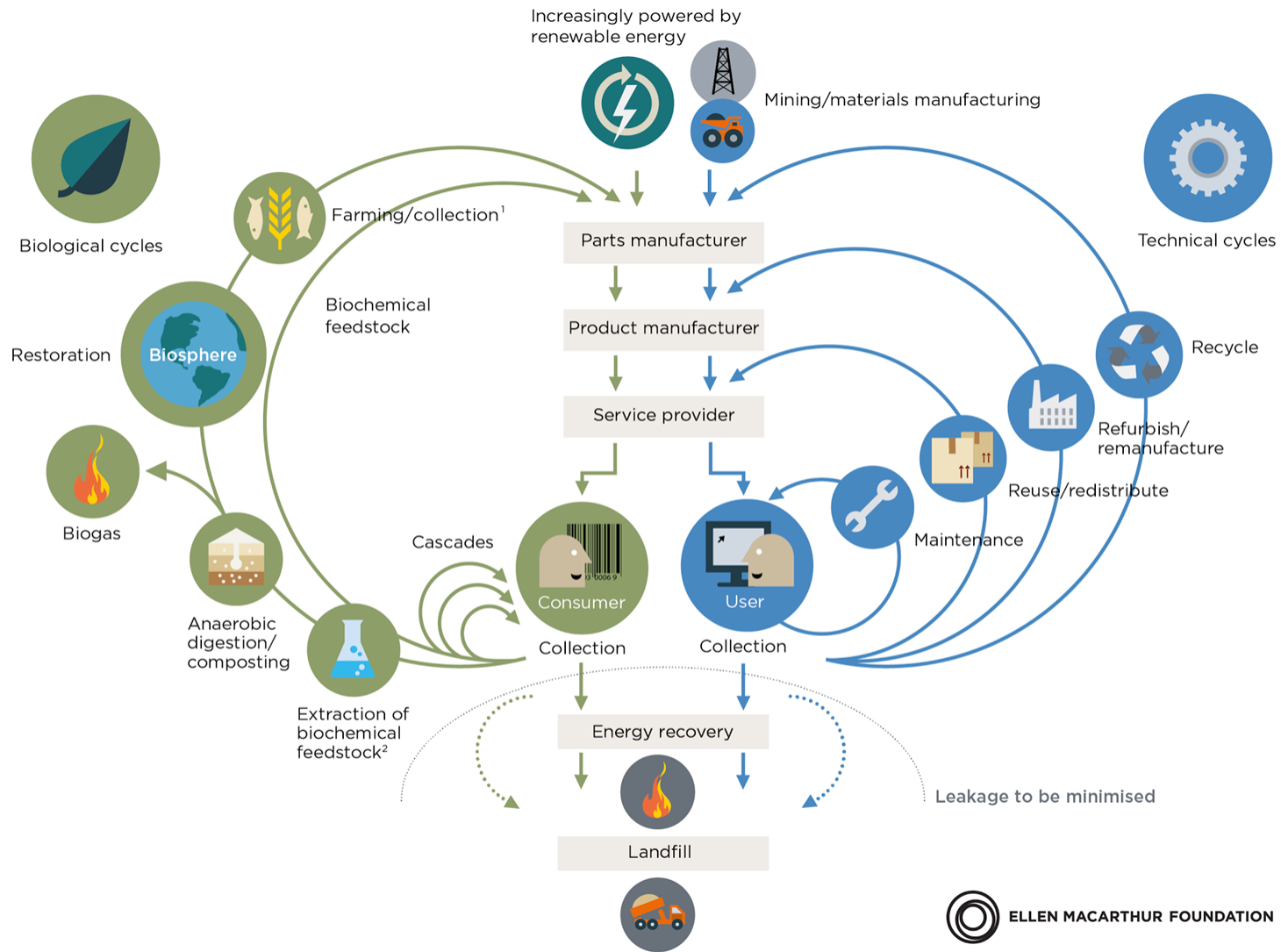


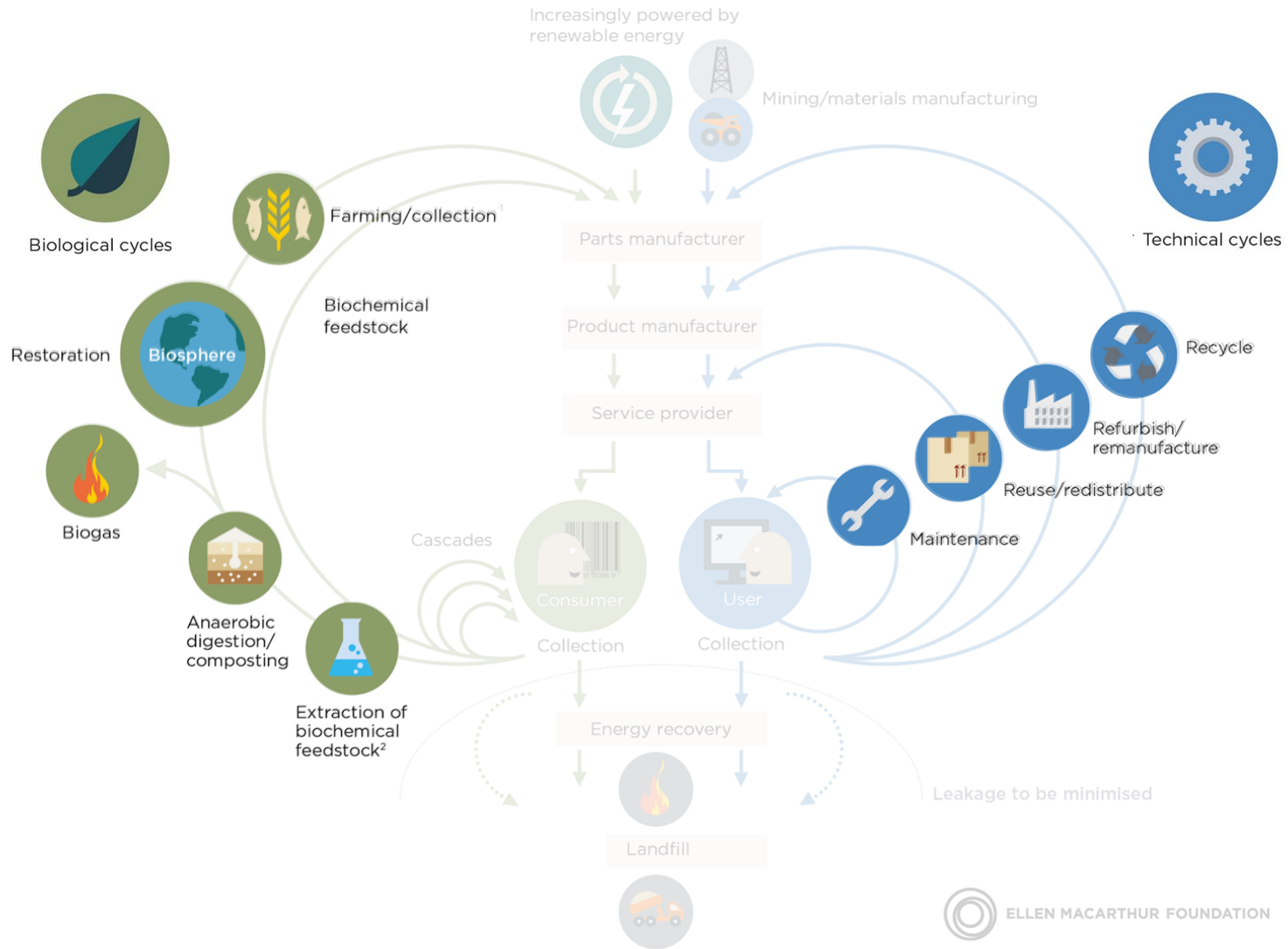
RESOURCES

BUILDING SITE

OUTPUTS



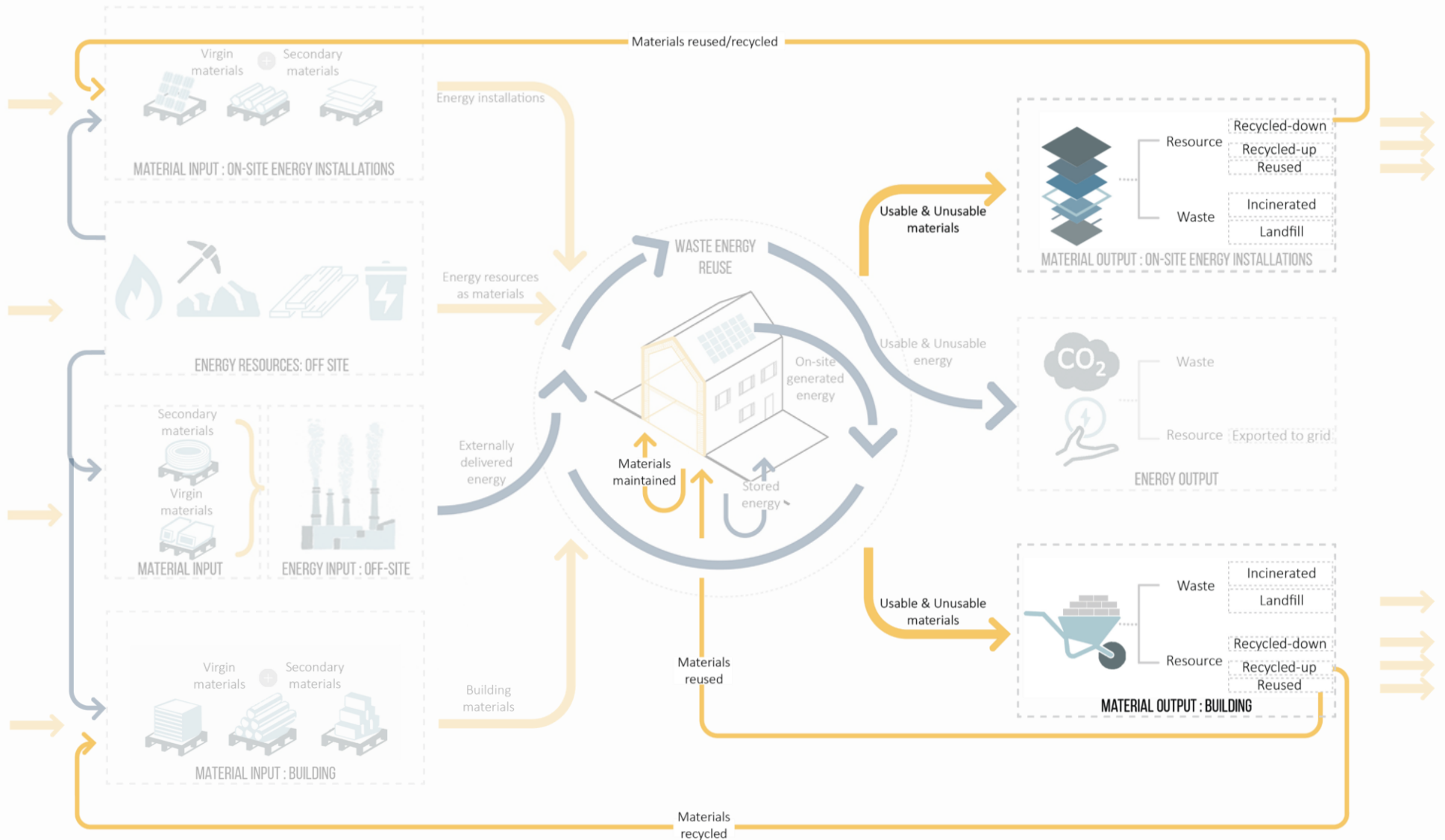




RESOURCES

BUILDING SITE

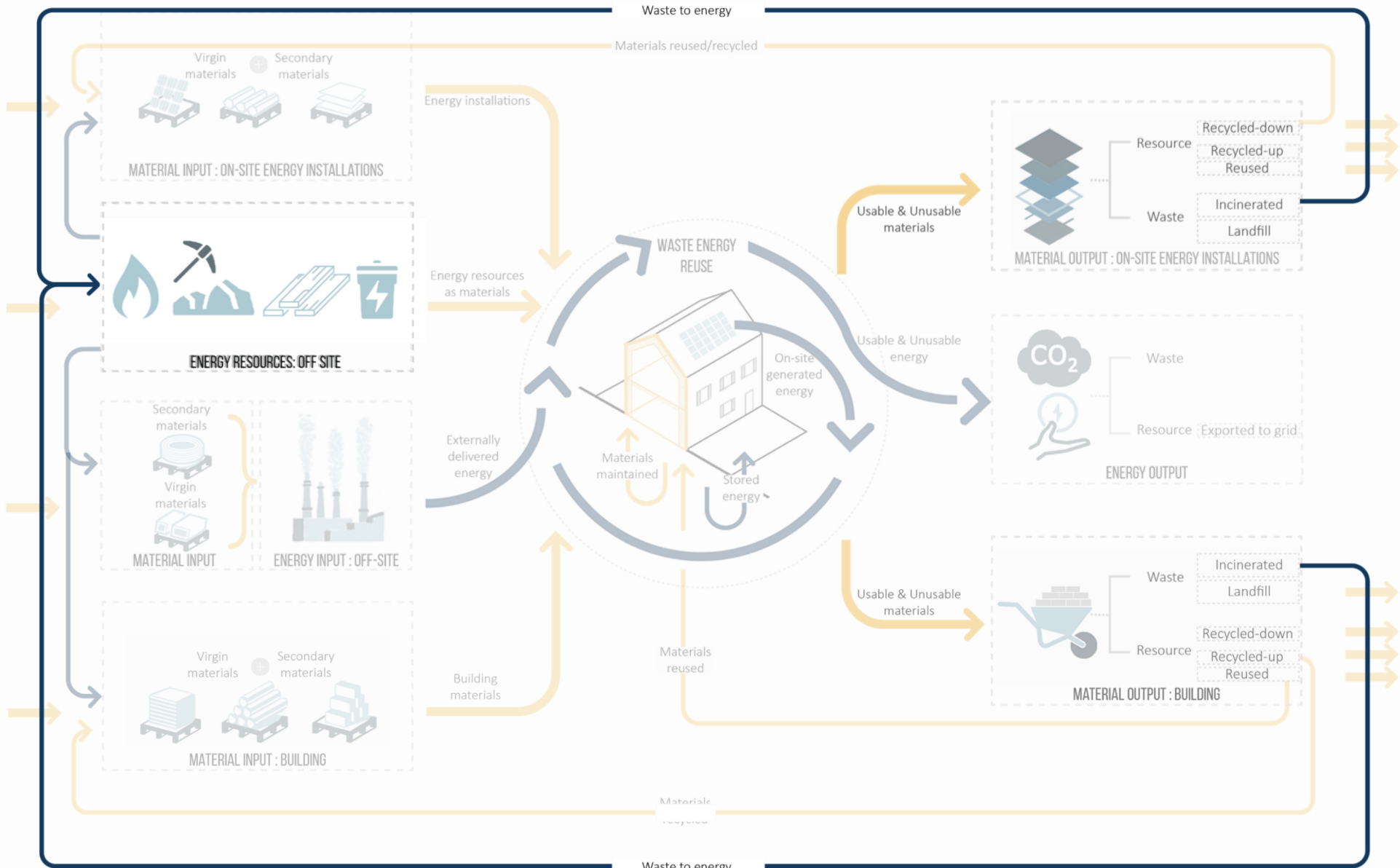
OUTPUTS

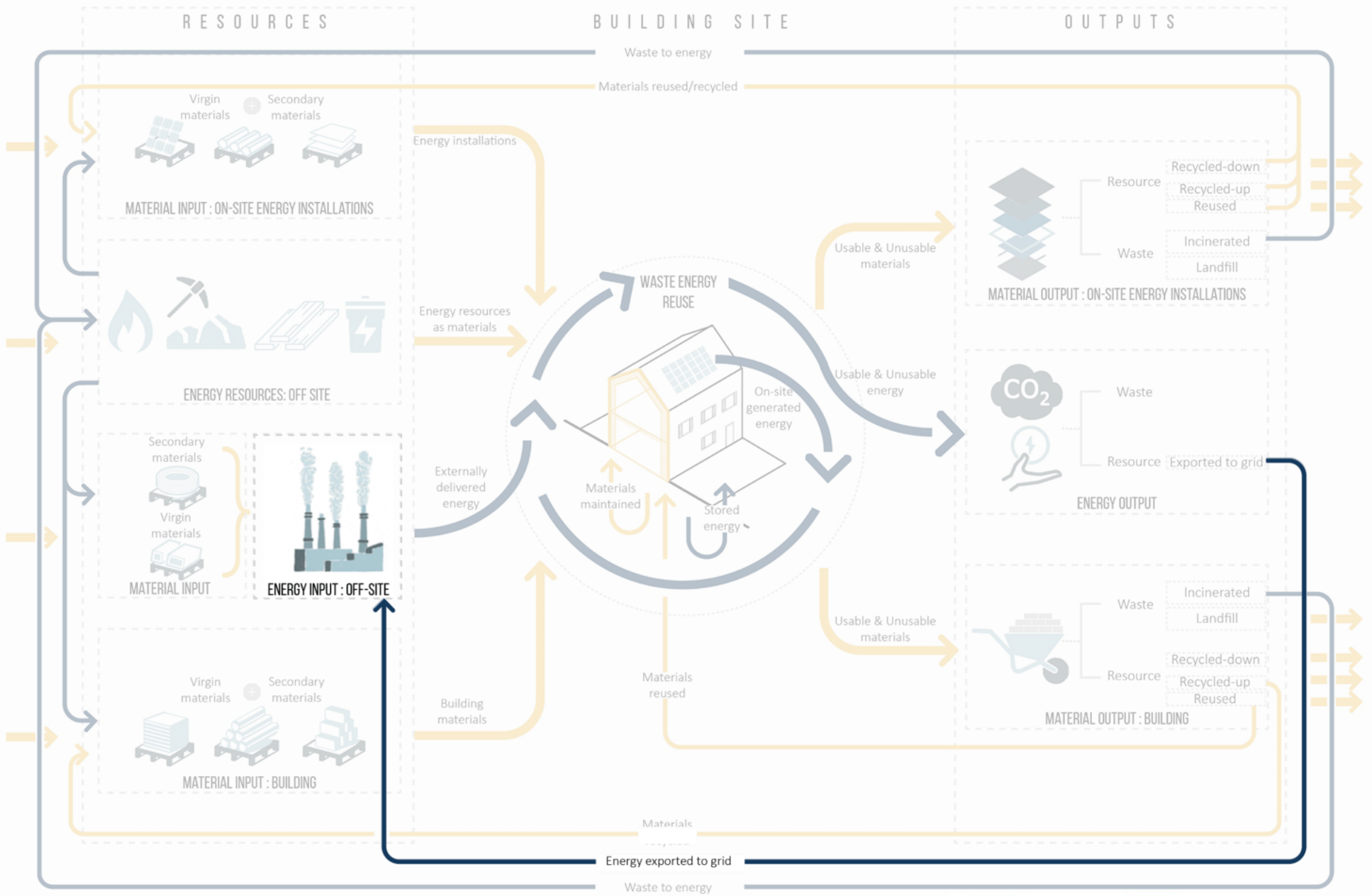


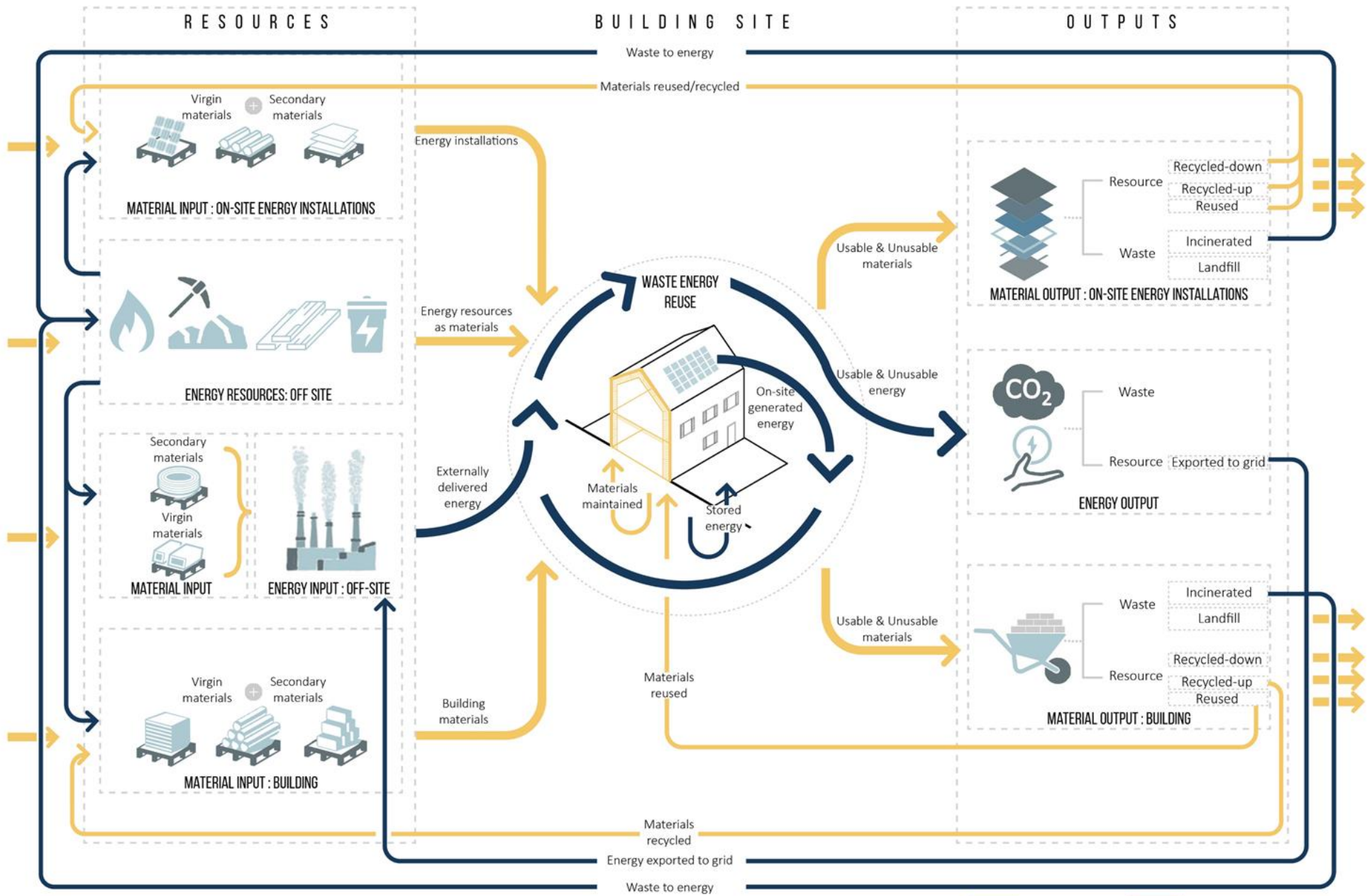
RESOURCES

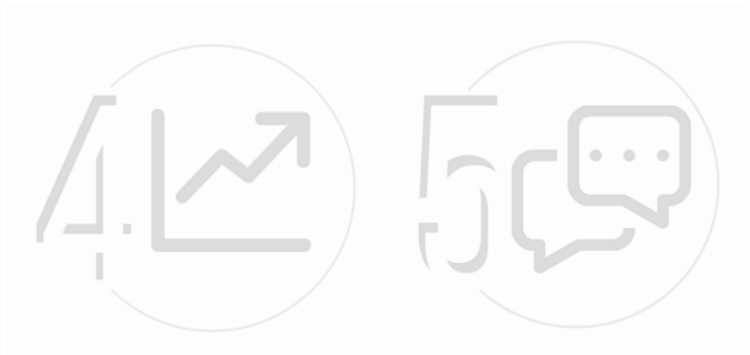
BUILDING SITE

OUTPUTS











Buiksloterham

Amsterdam
Centrum



Source: Zelfbeheer Bosrankstraat – Zondag CS Architecten



Case 01



Case 02

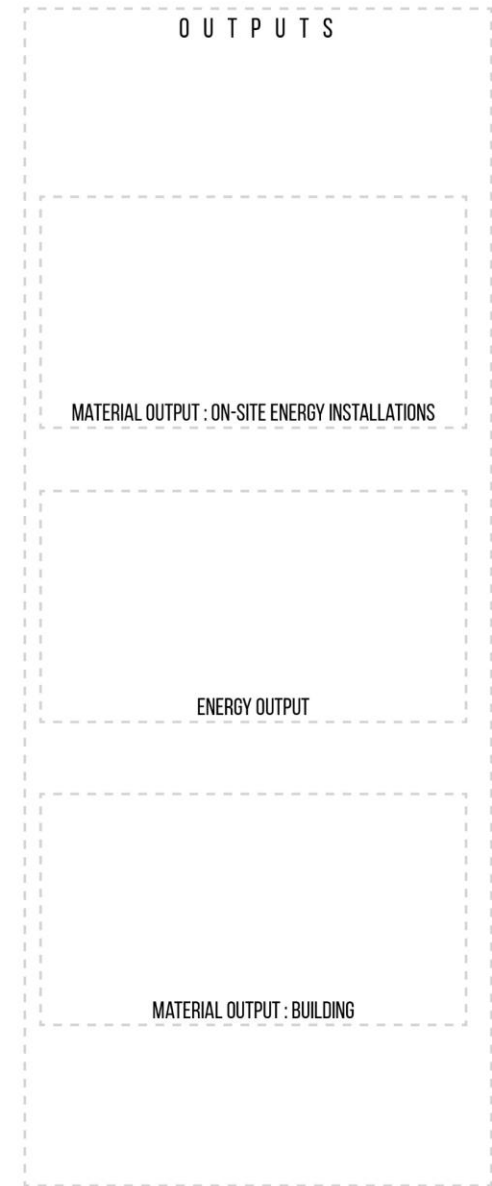
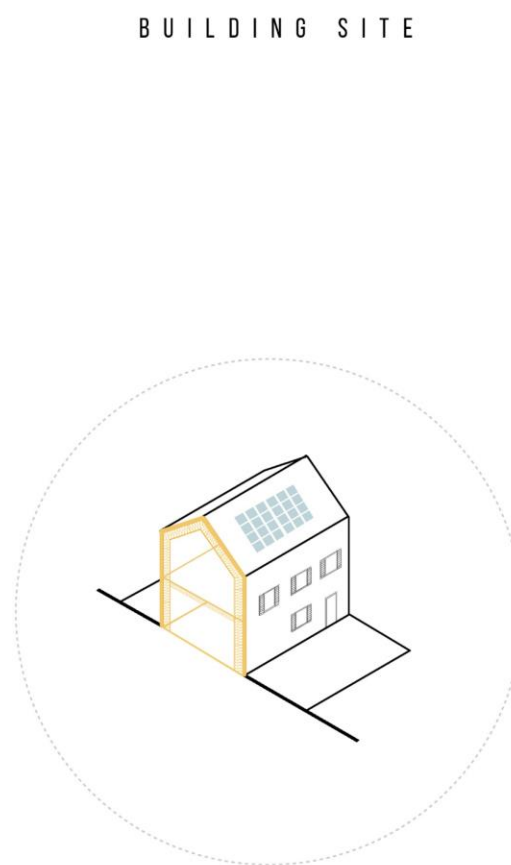
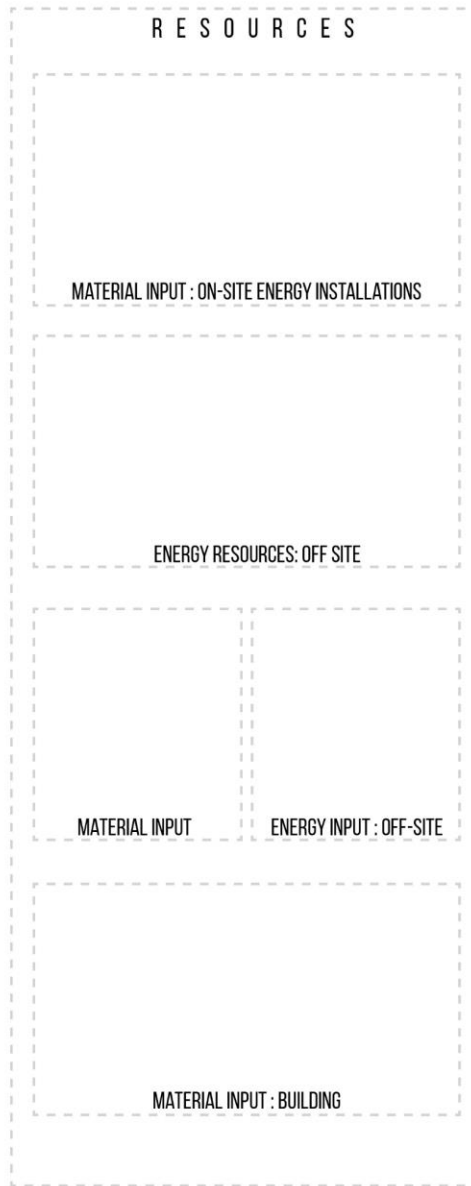


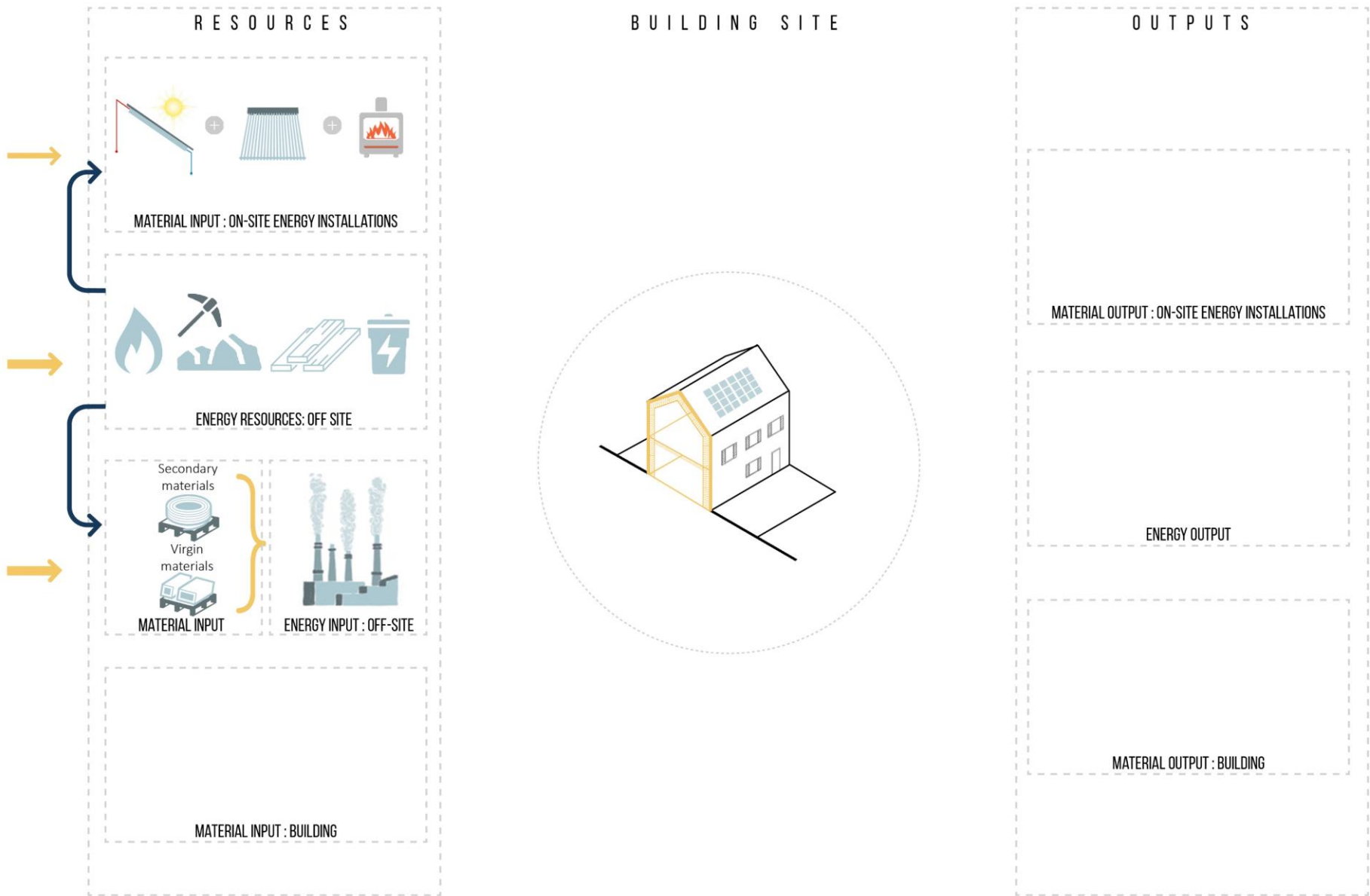
Case 03

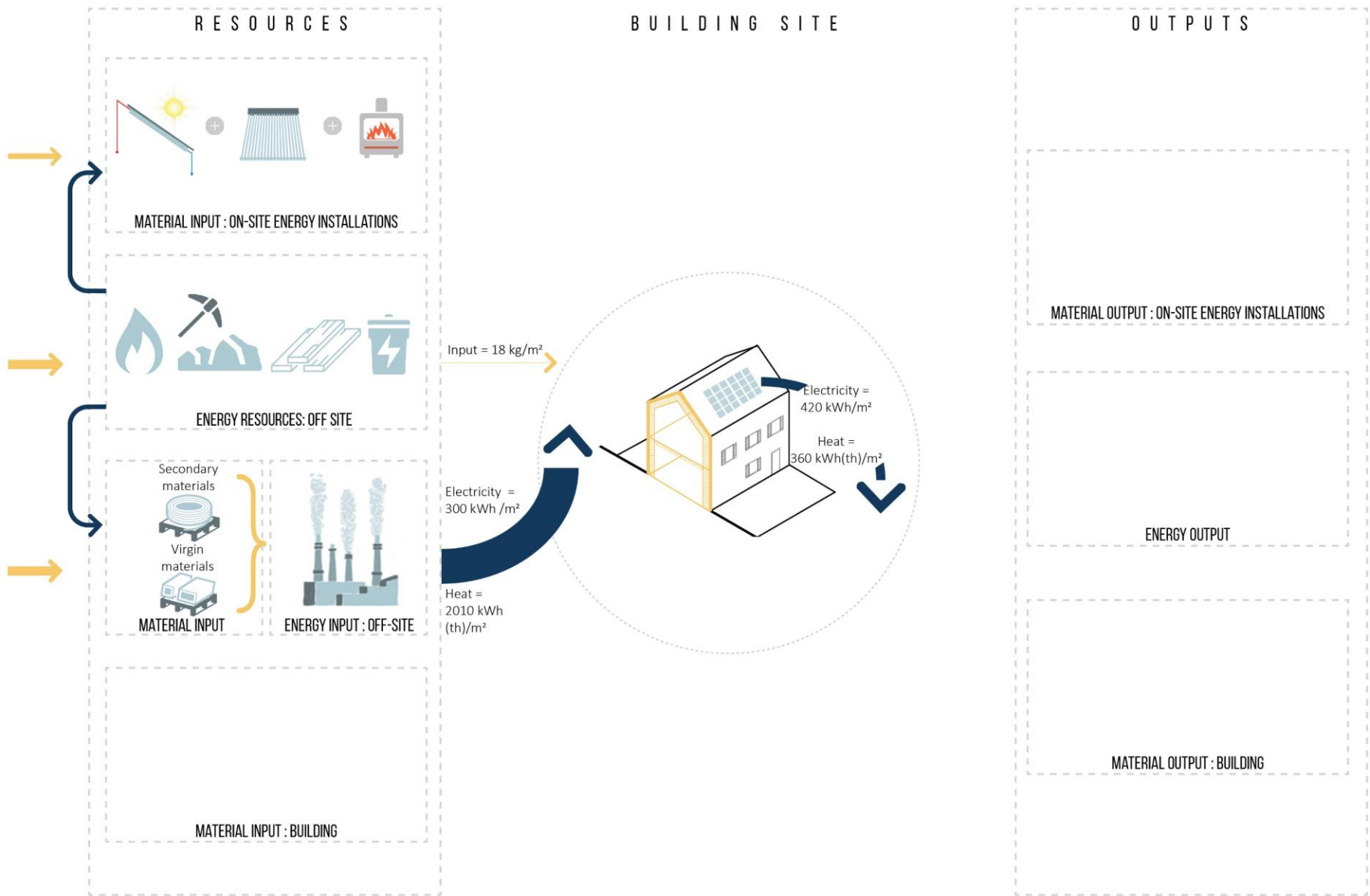


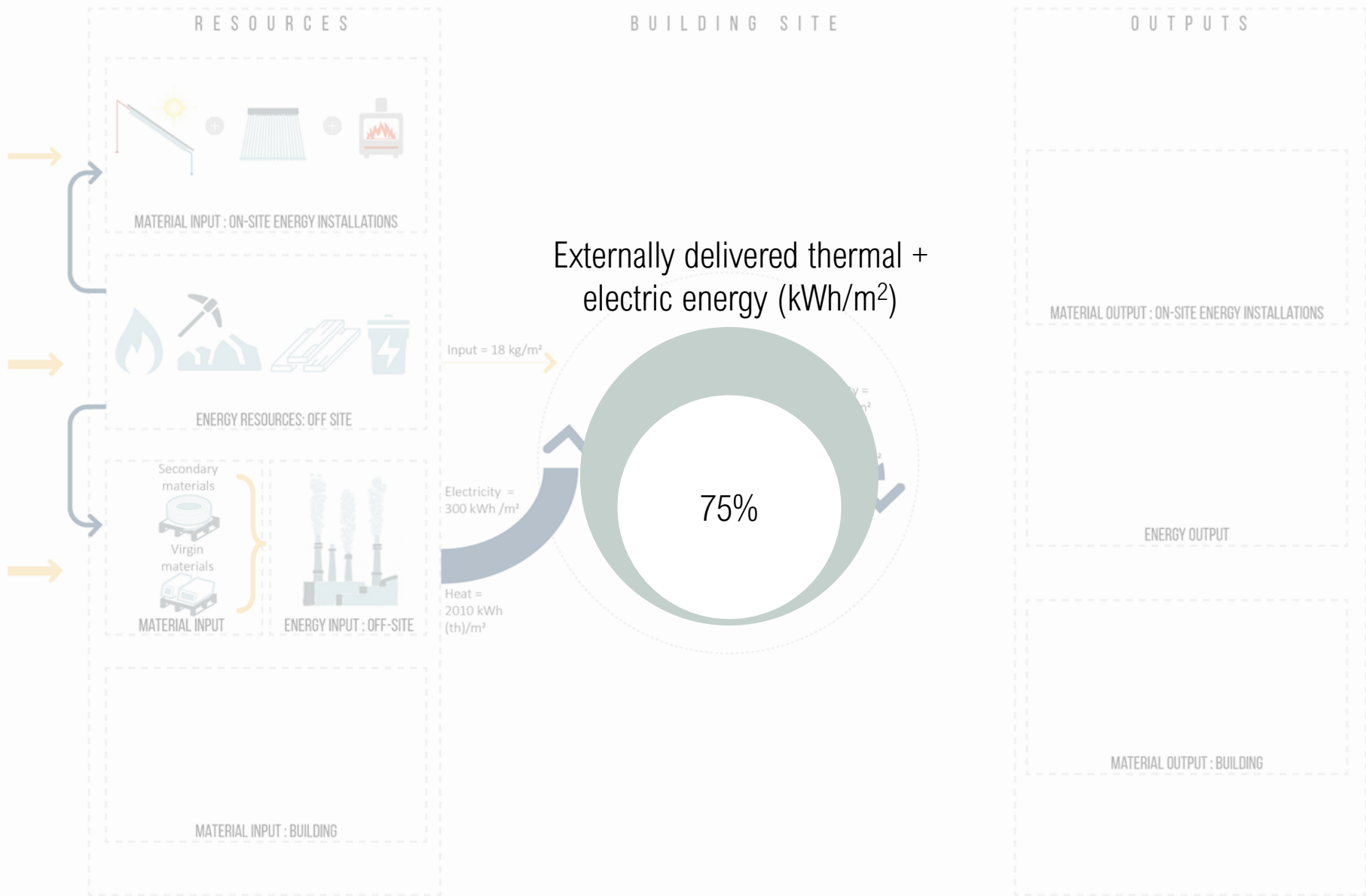
Case 01

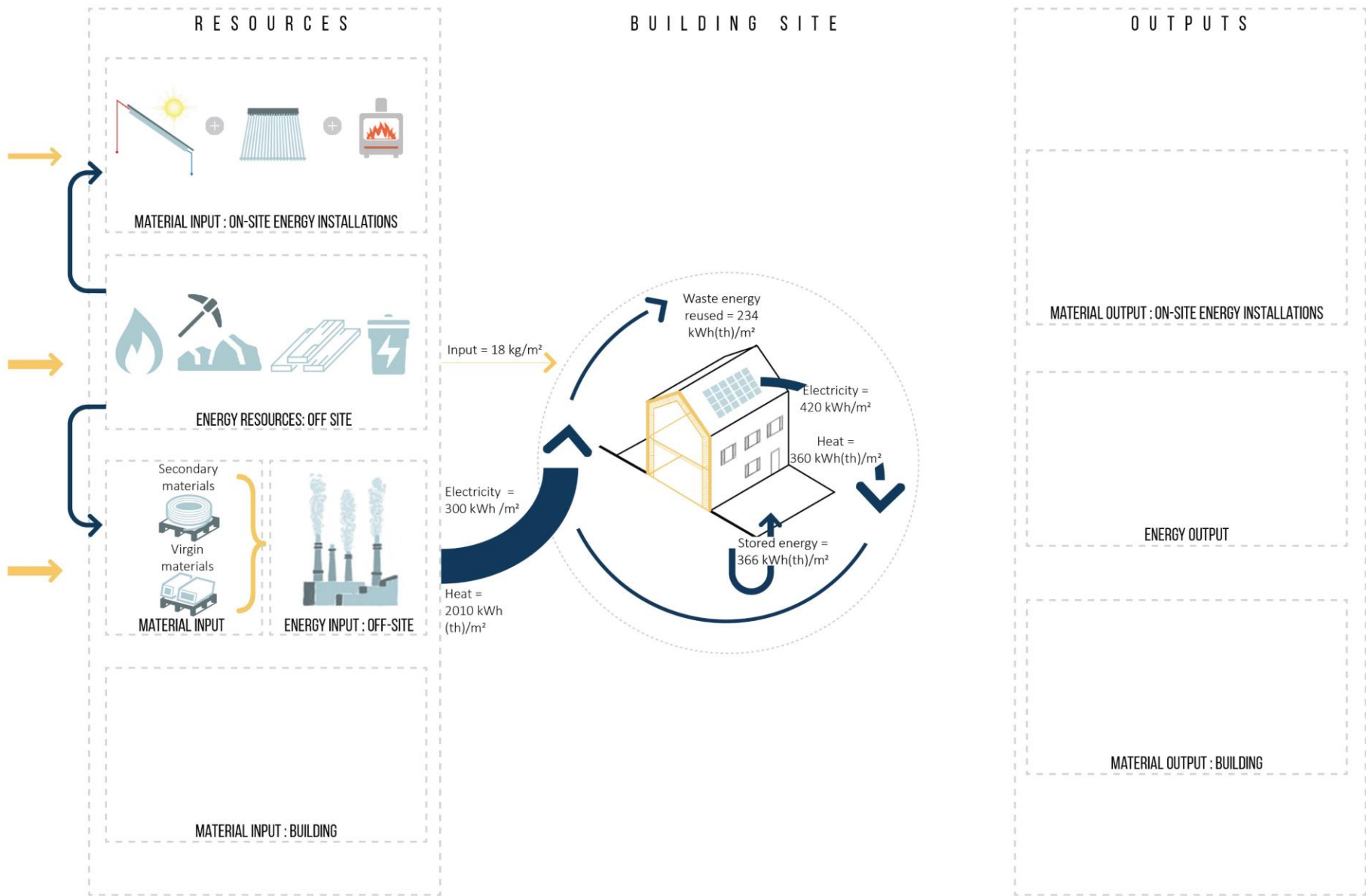








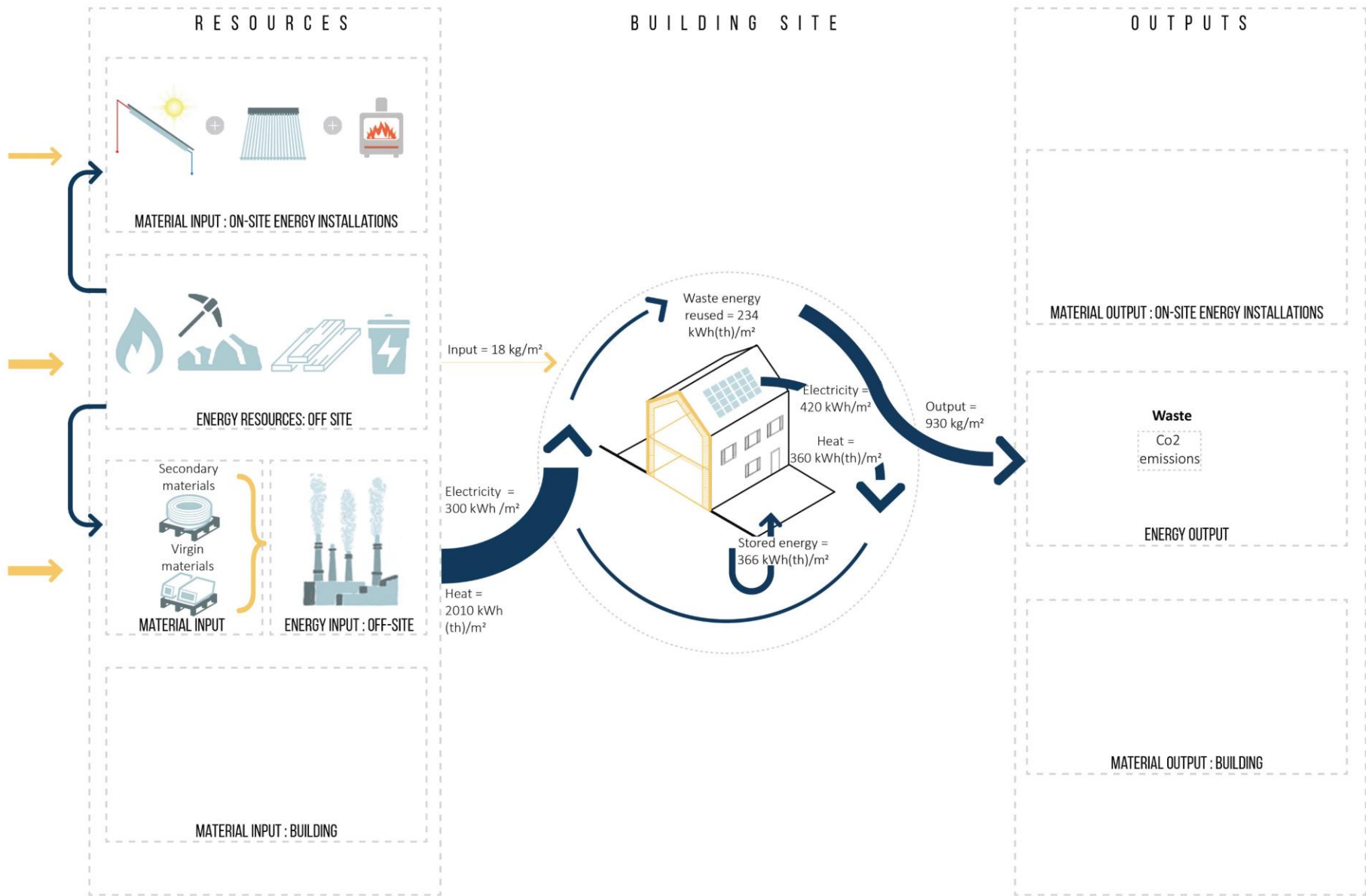




Waste / materials downcycled

Material flows

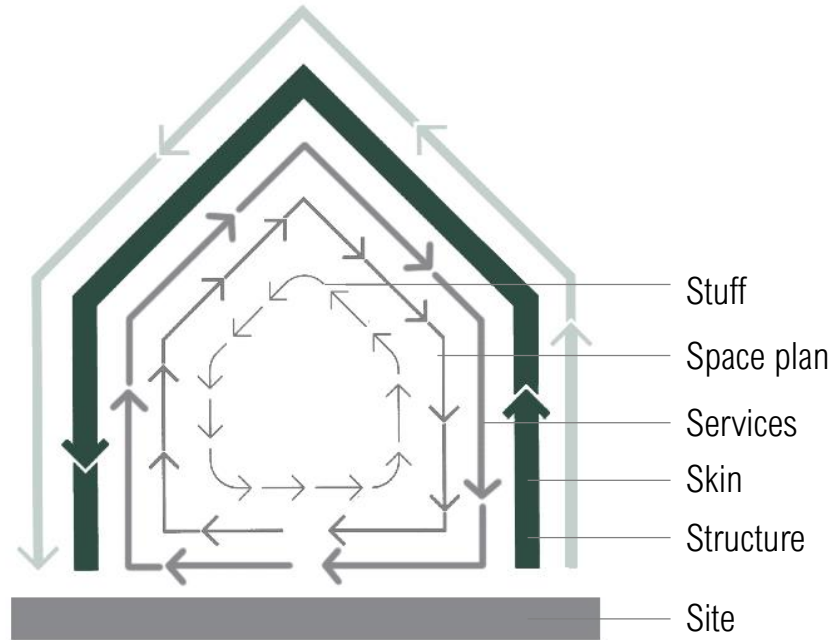
Energy flows



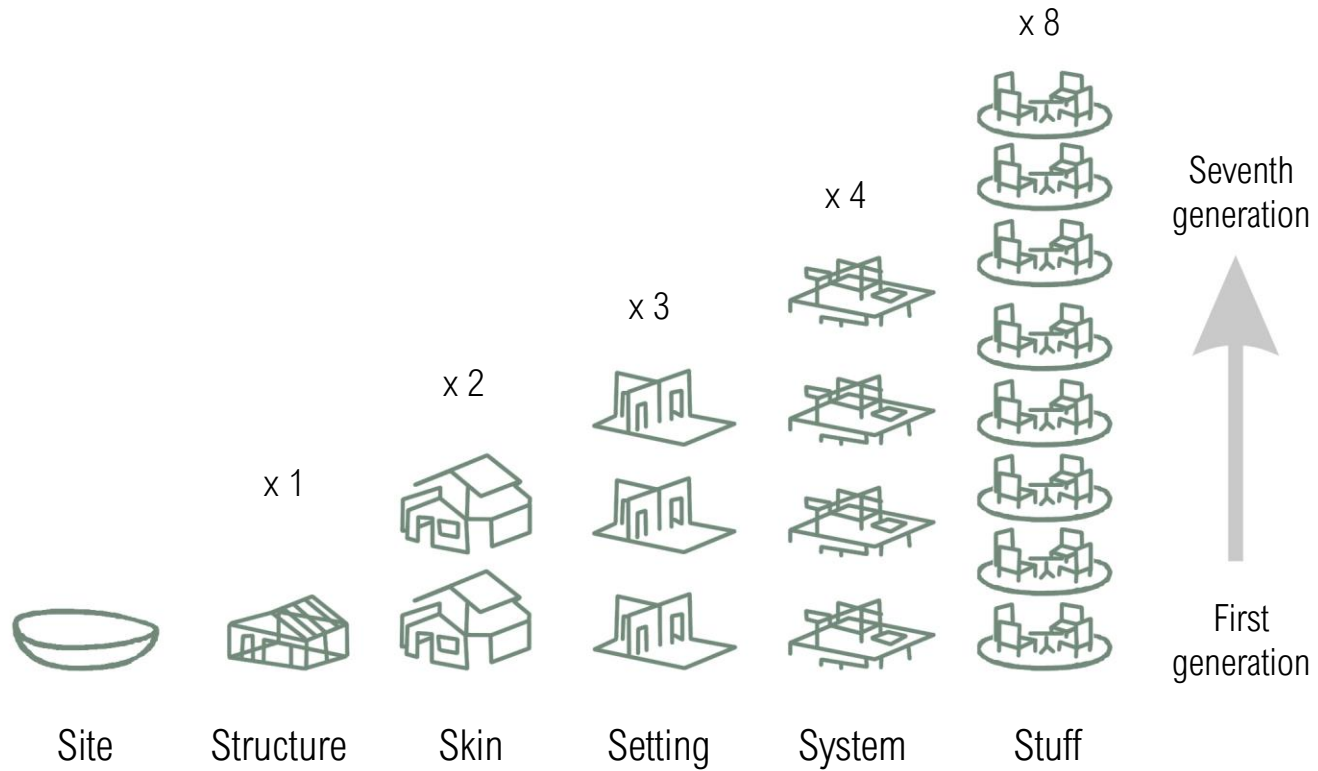
Waste / materials downcycled

Material flows

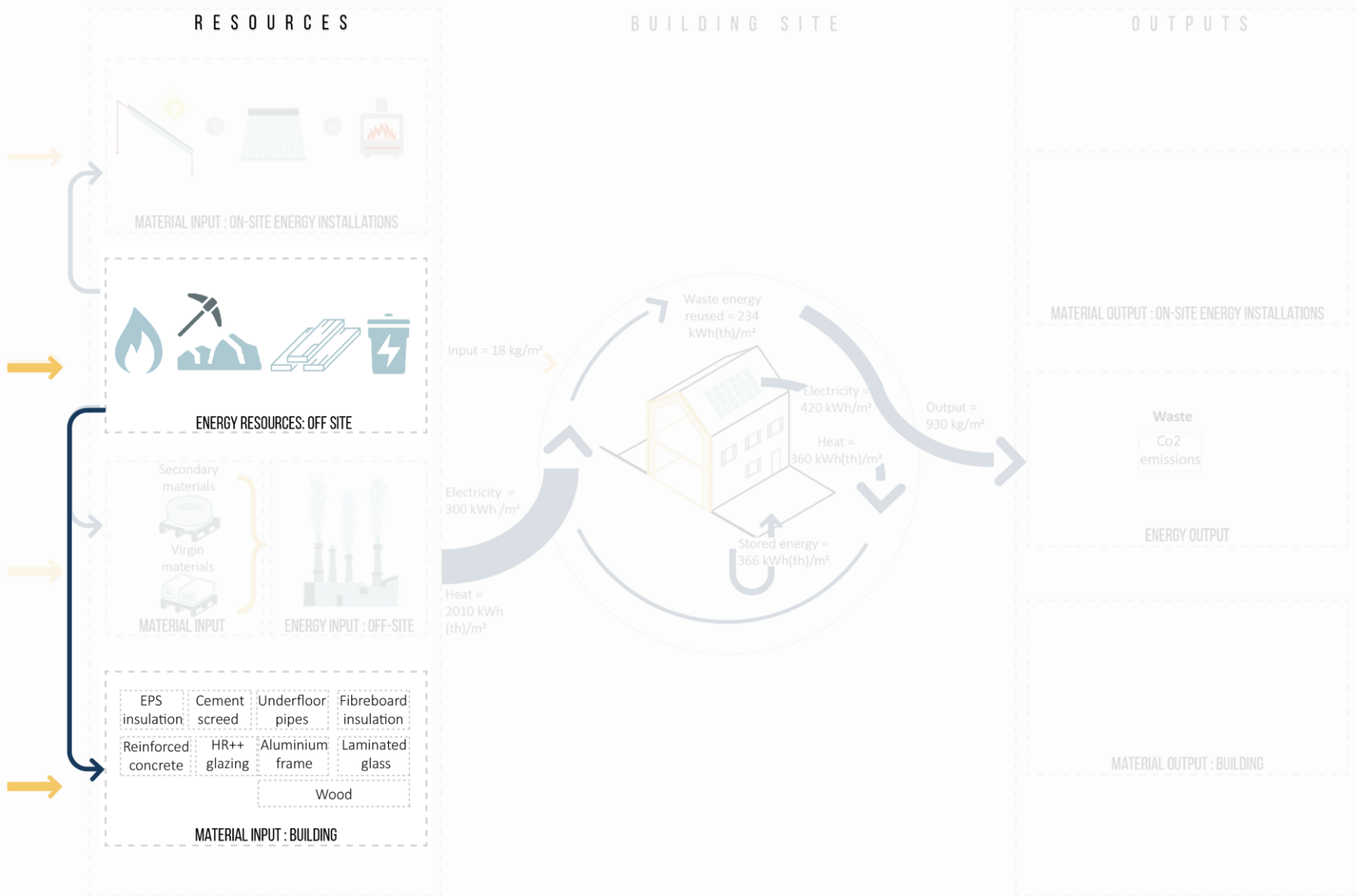
Energy flows

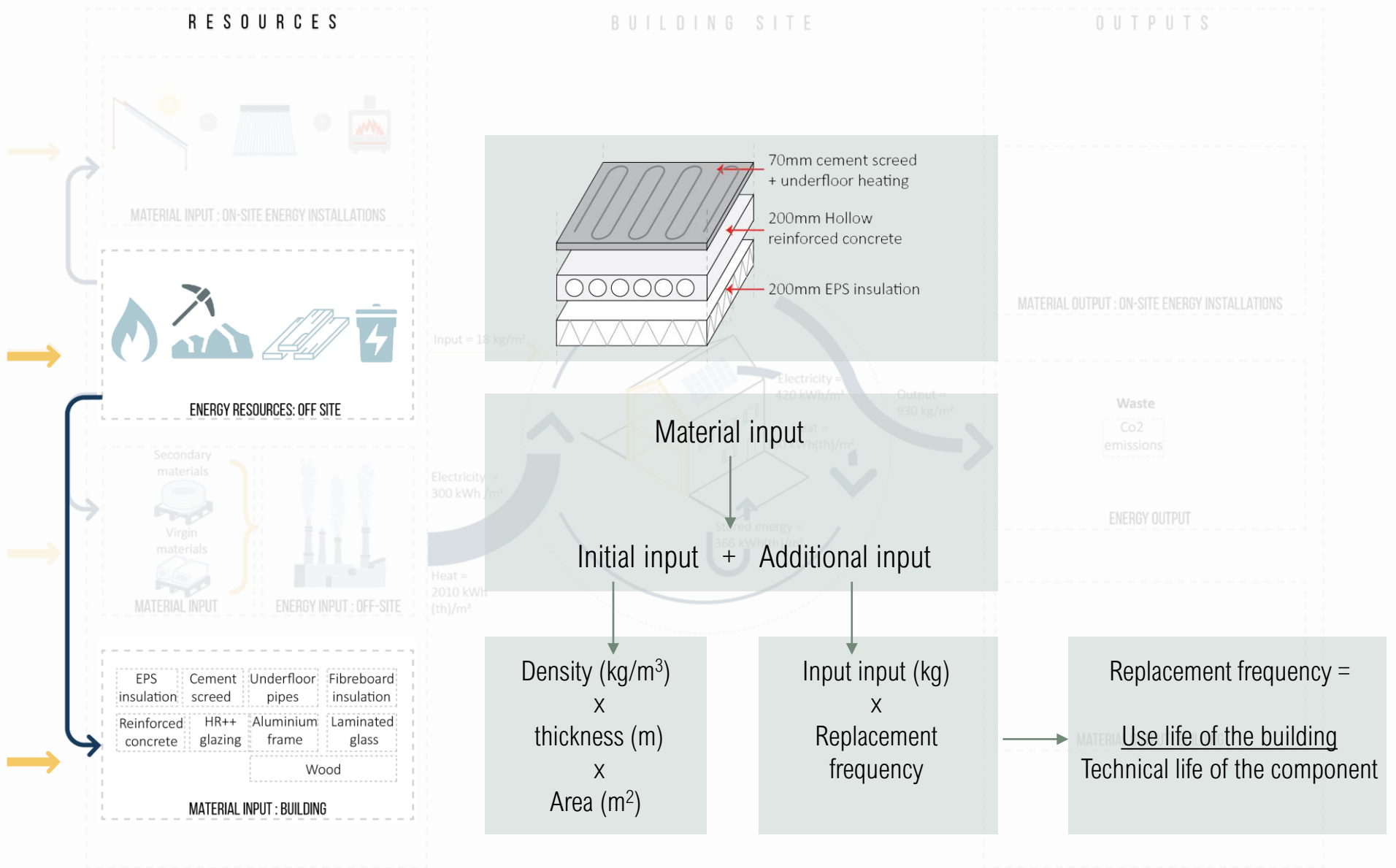


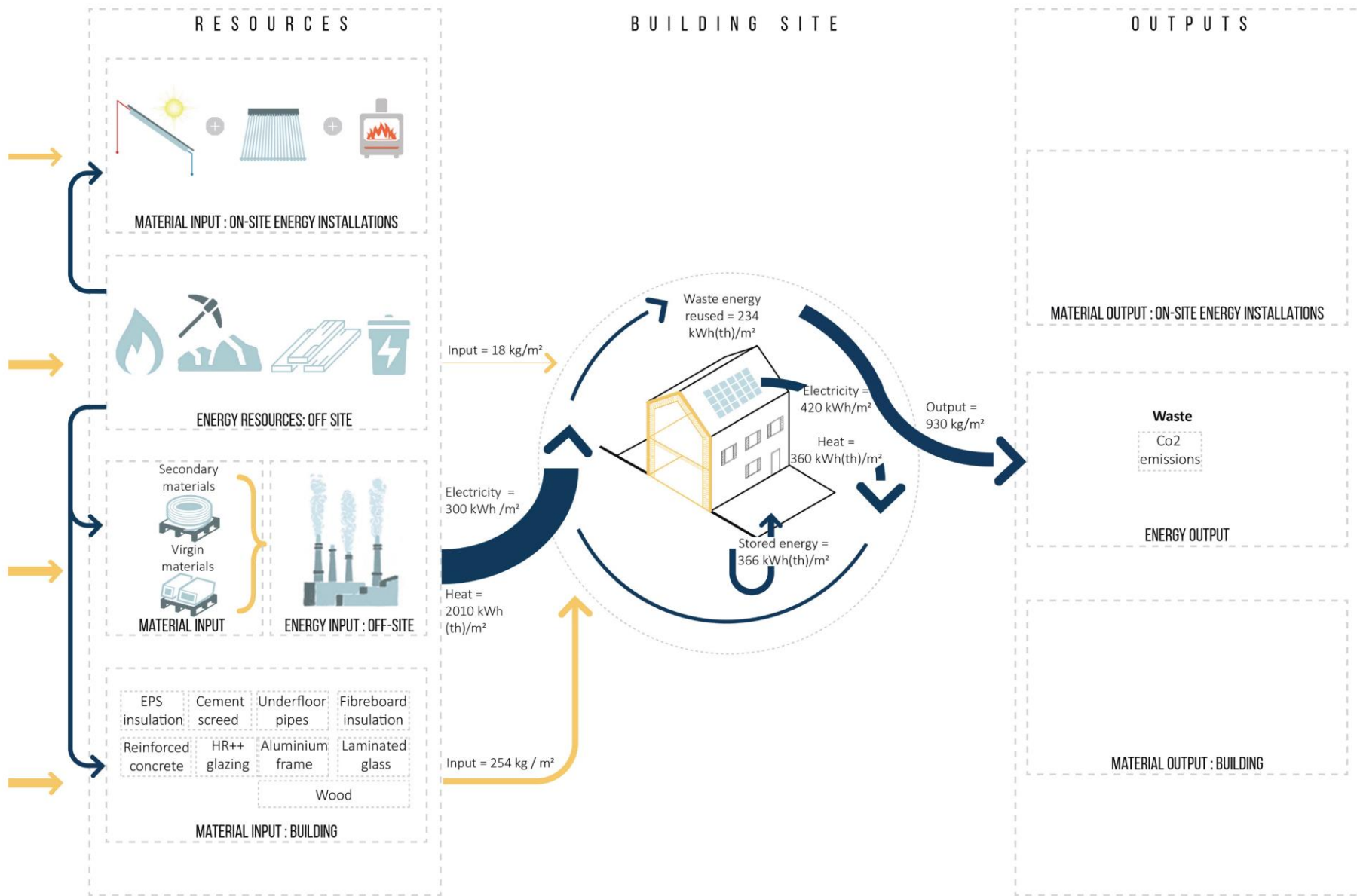
Shearing Layers by Stewart Brand

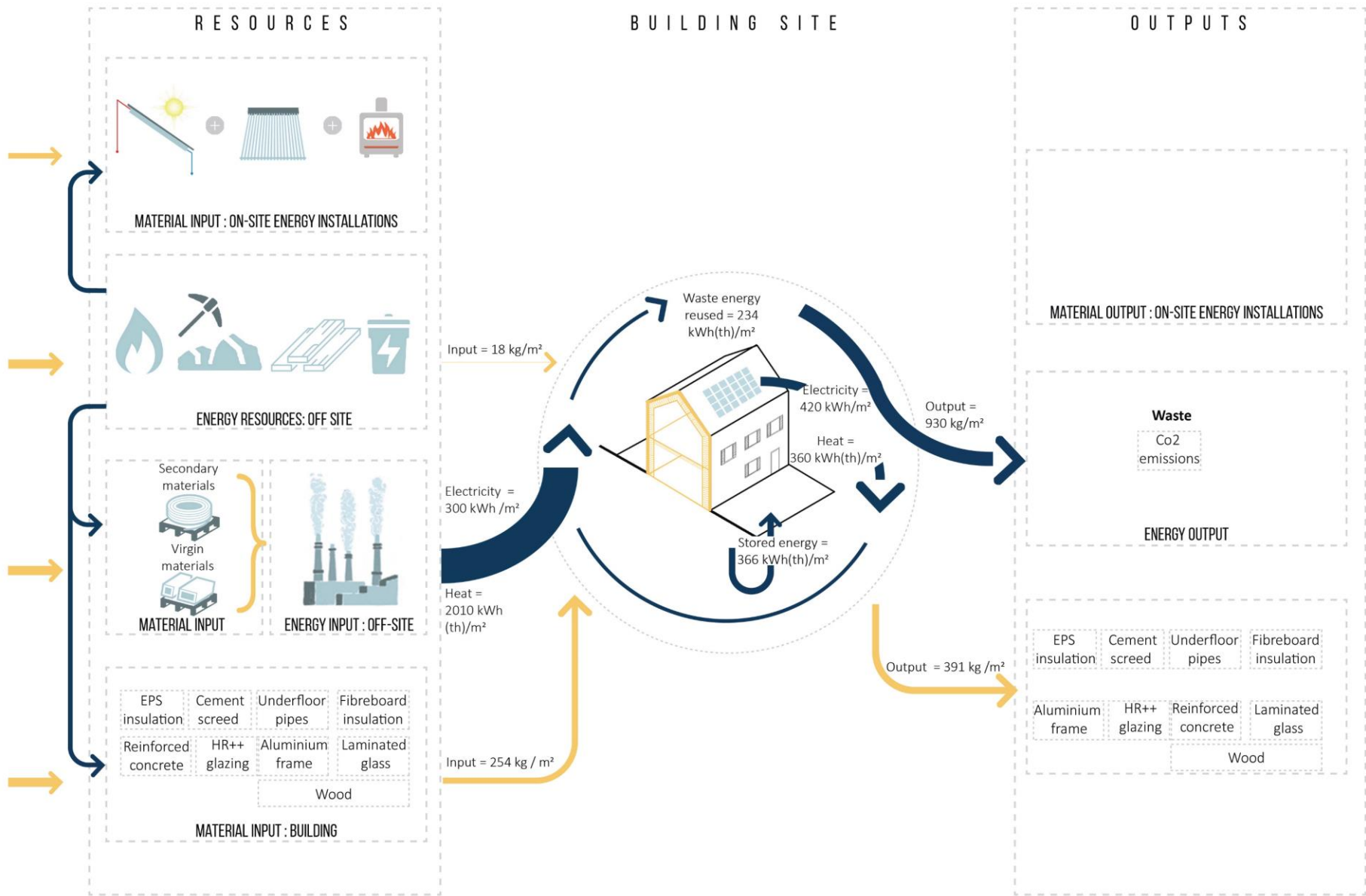


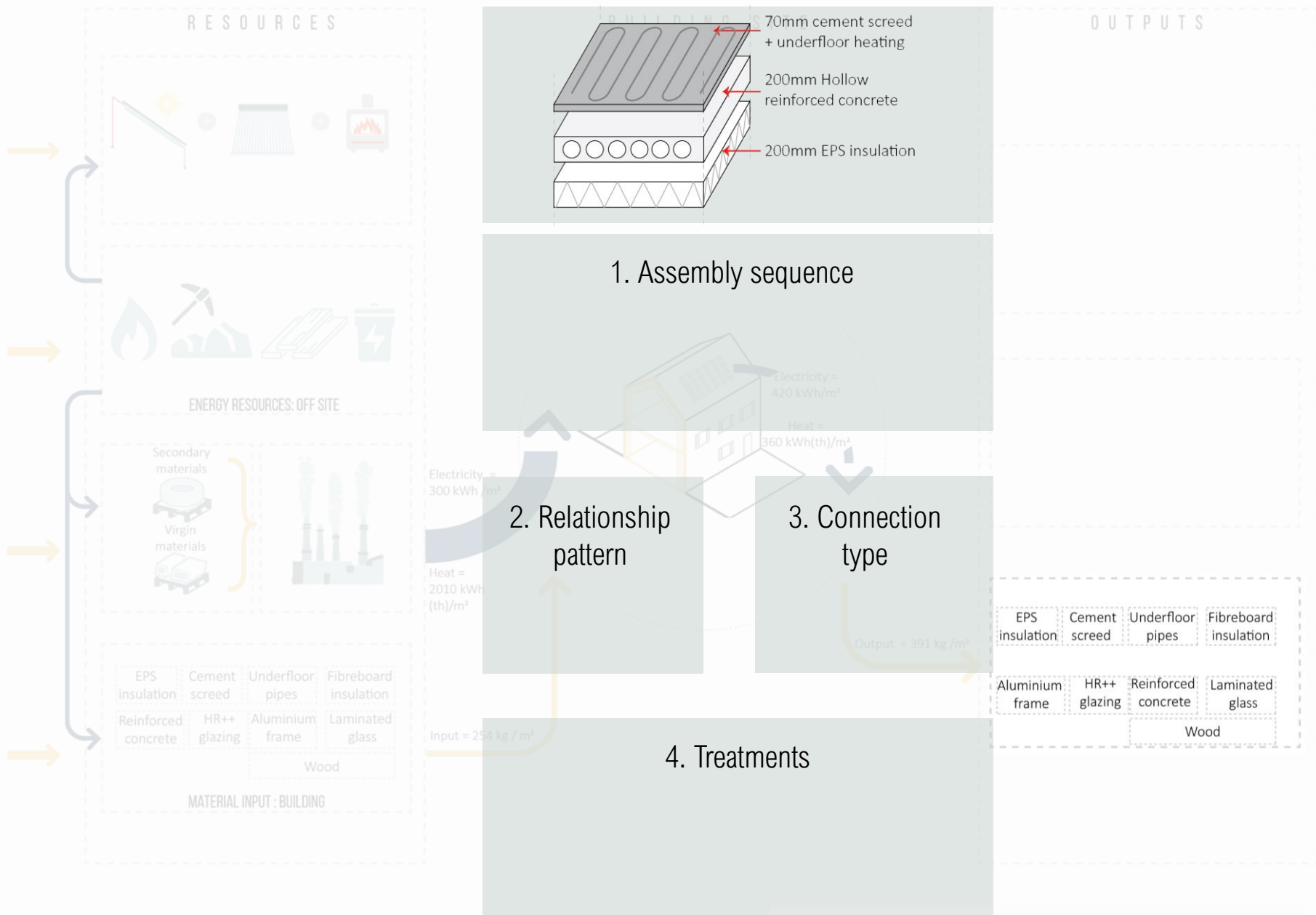
Transformation potential of the different shearing layers (Anne-Marie Rakhorst, [www. Duurzaamheid.nl](http://www.Duurzaamheid.nl))

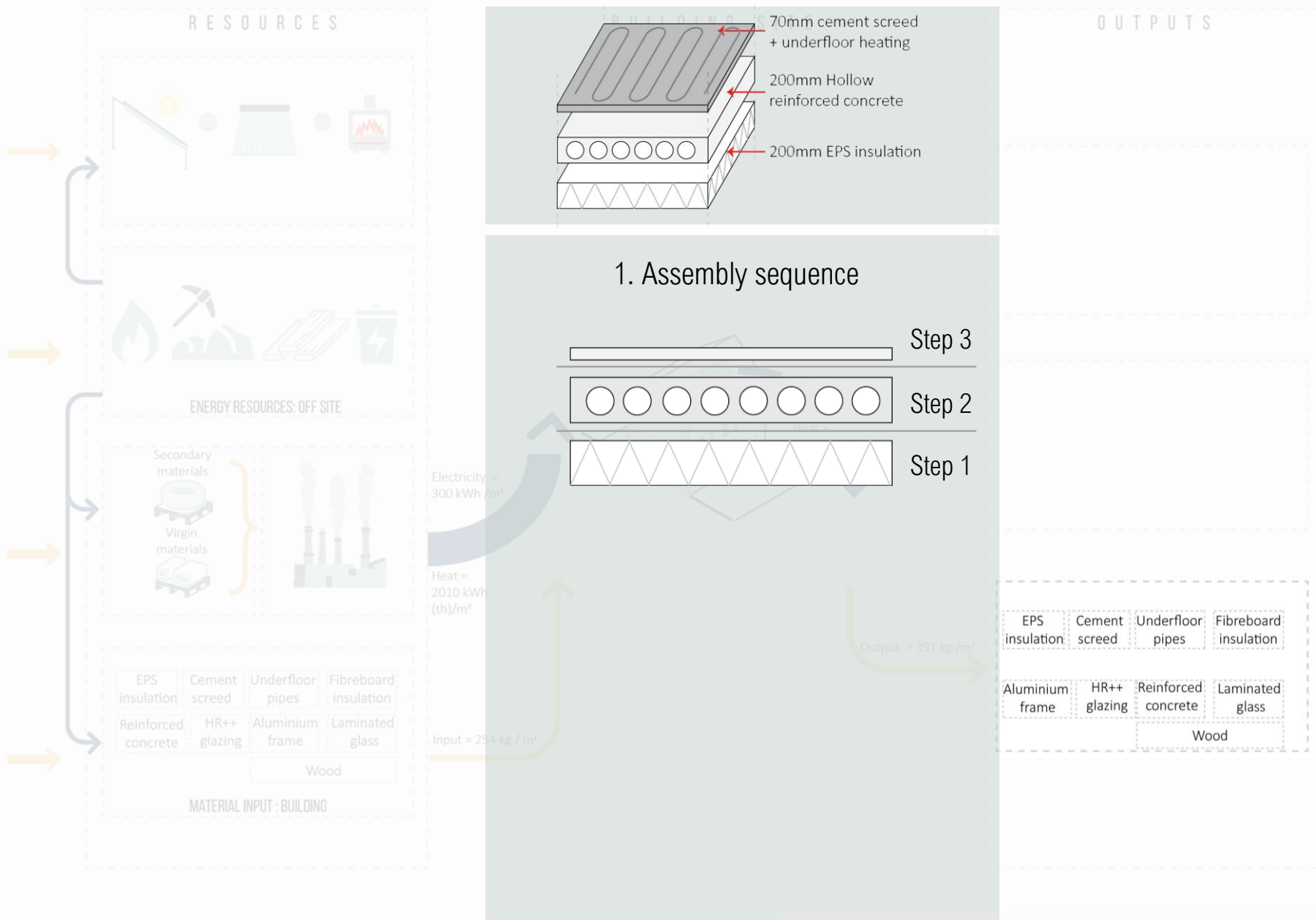


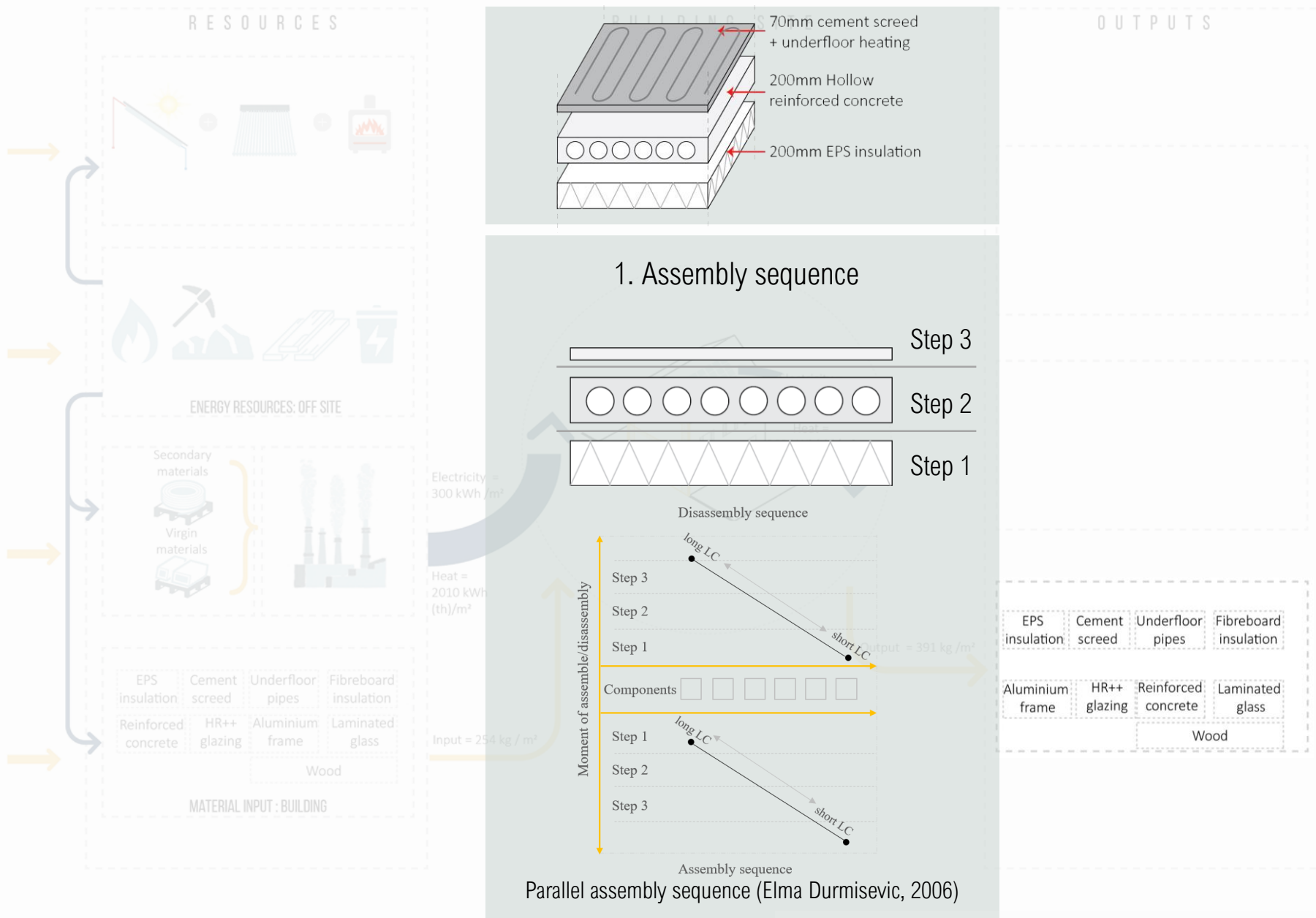


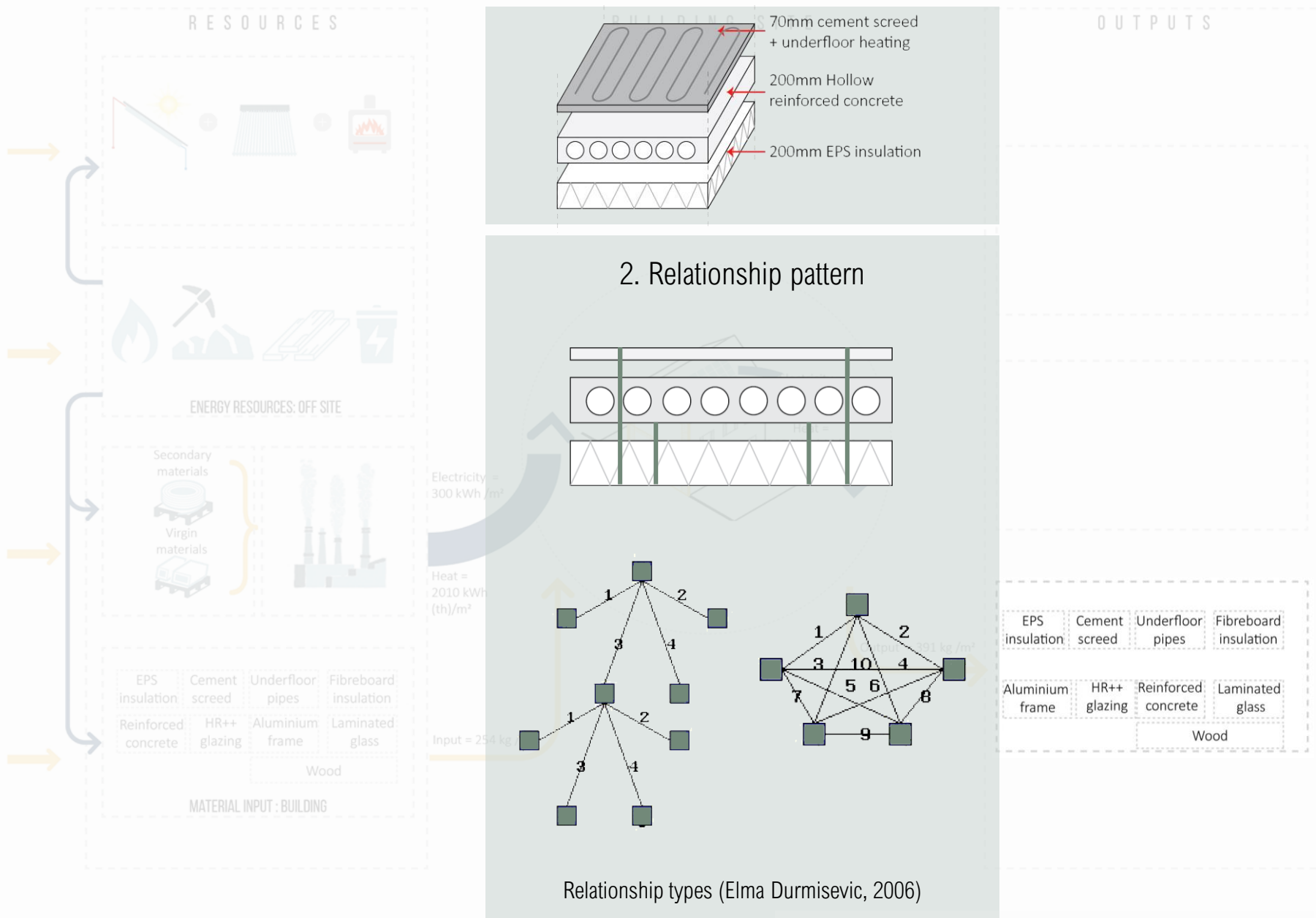


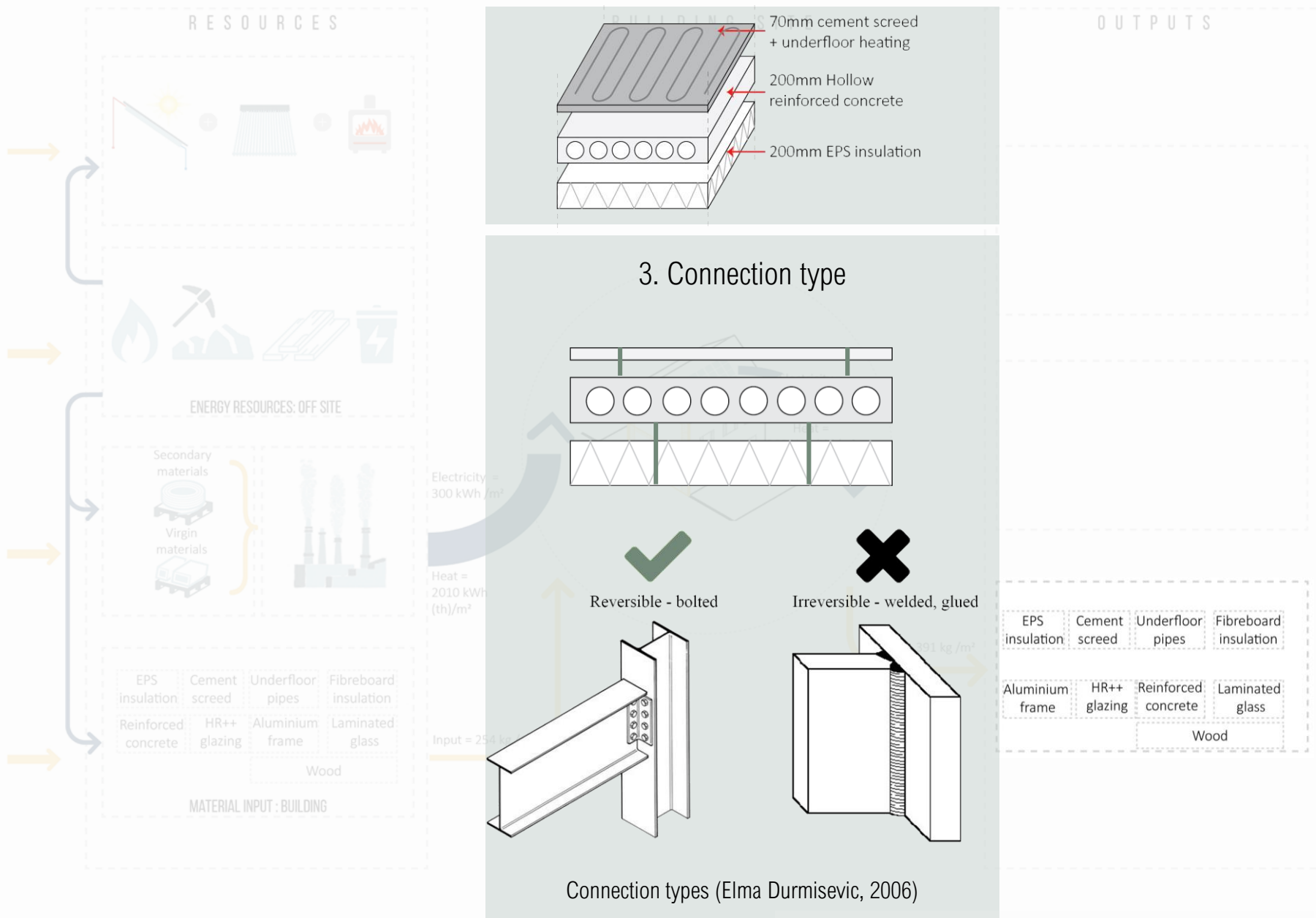


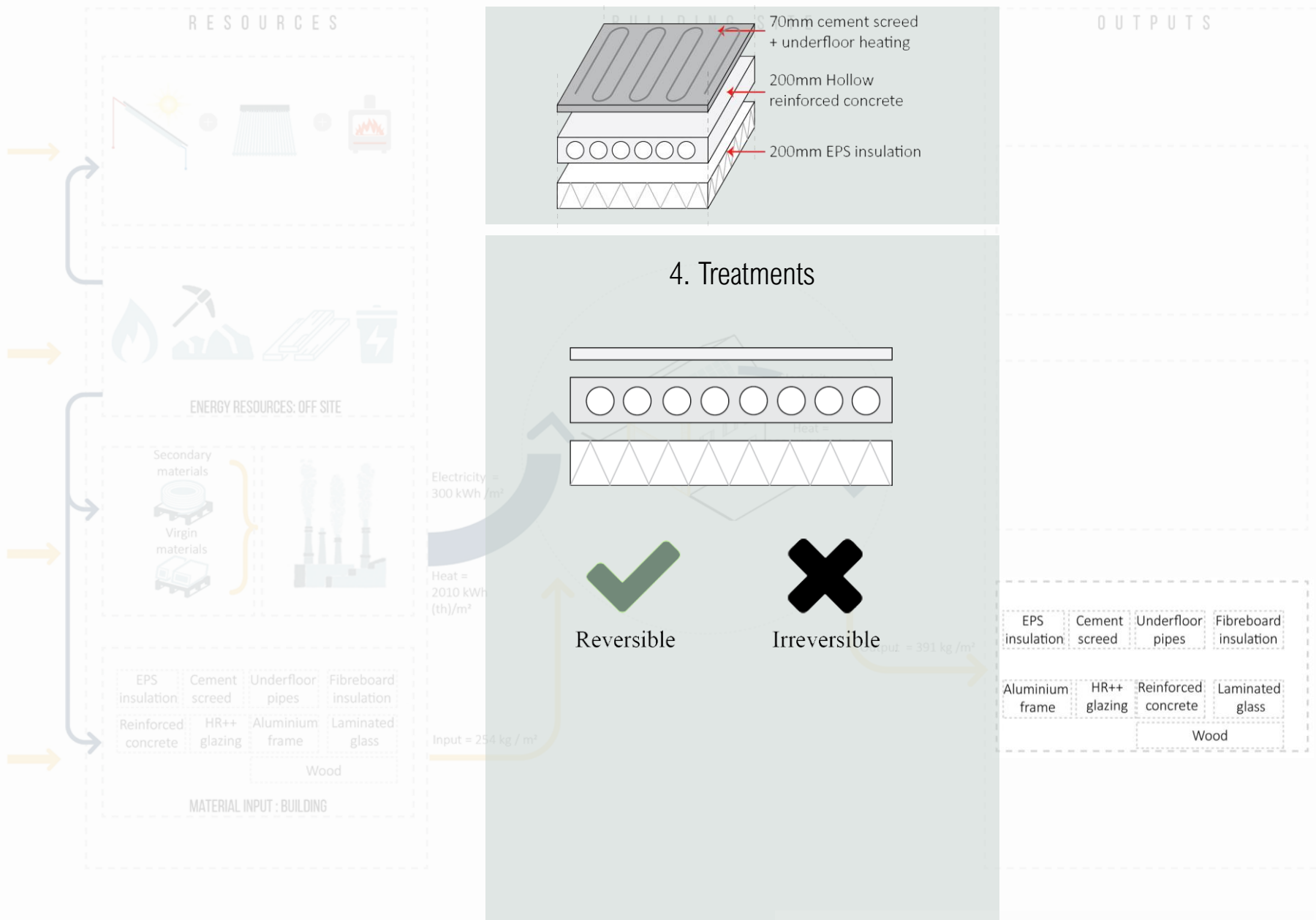


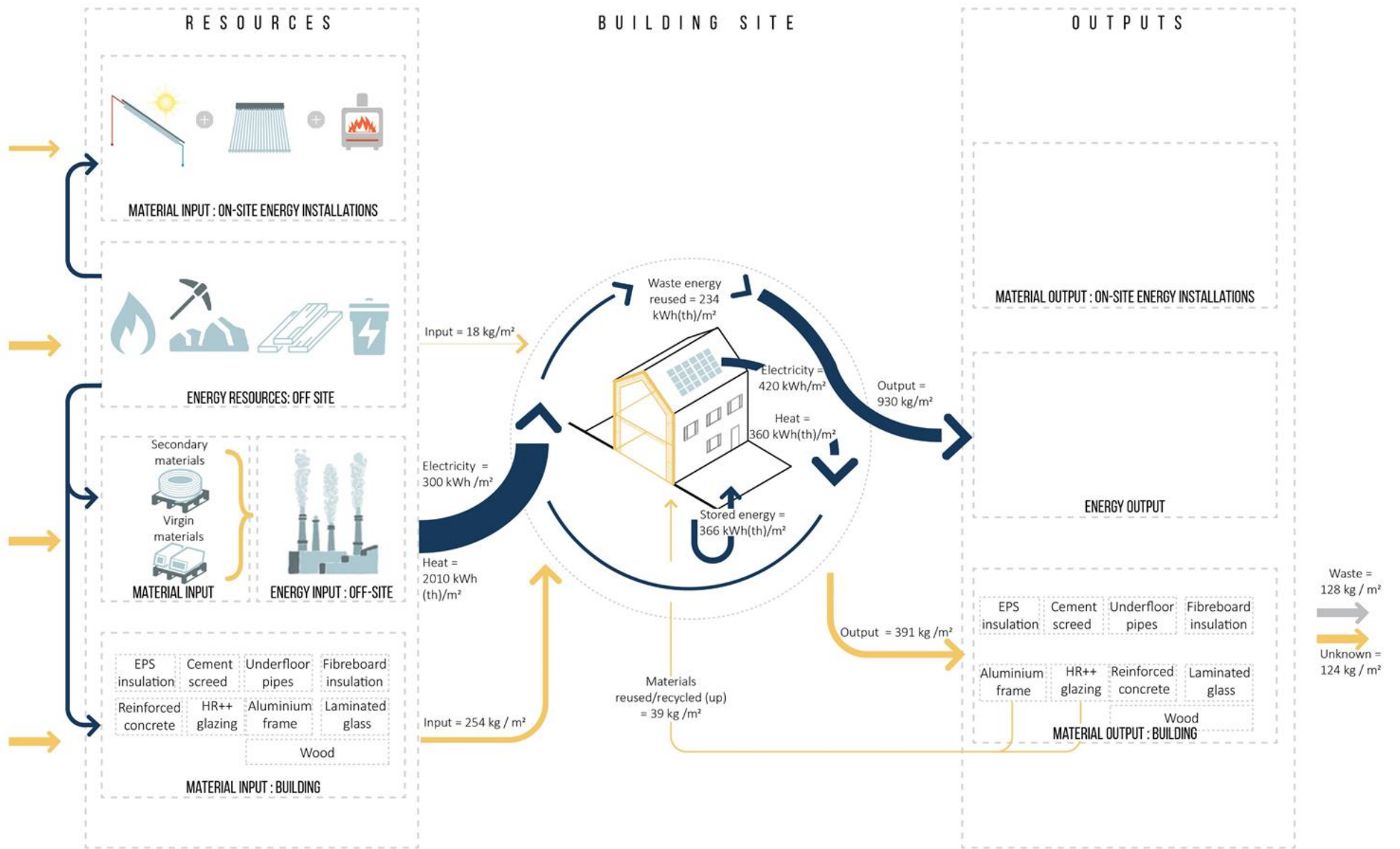








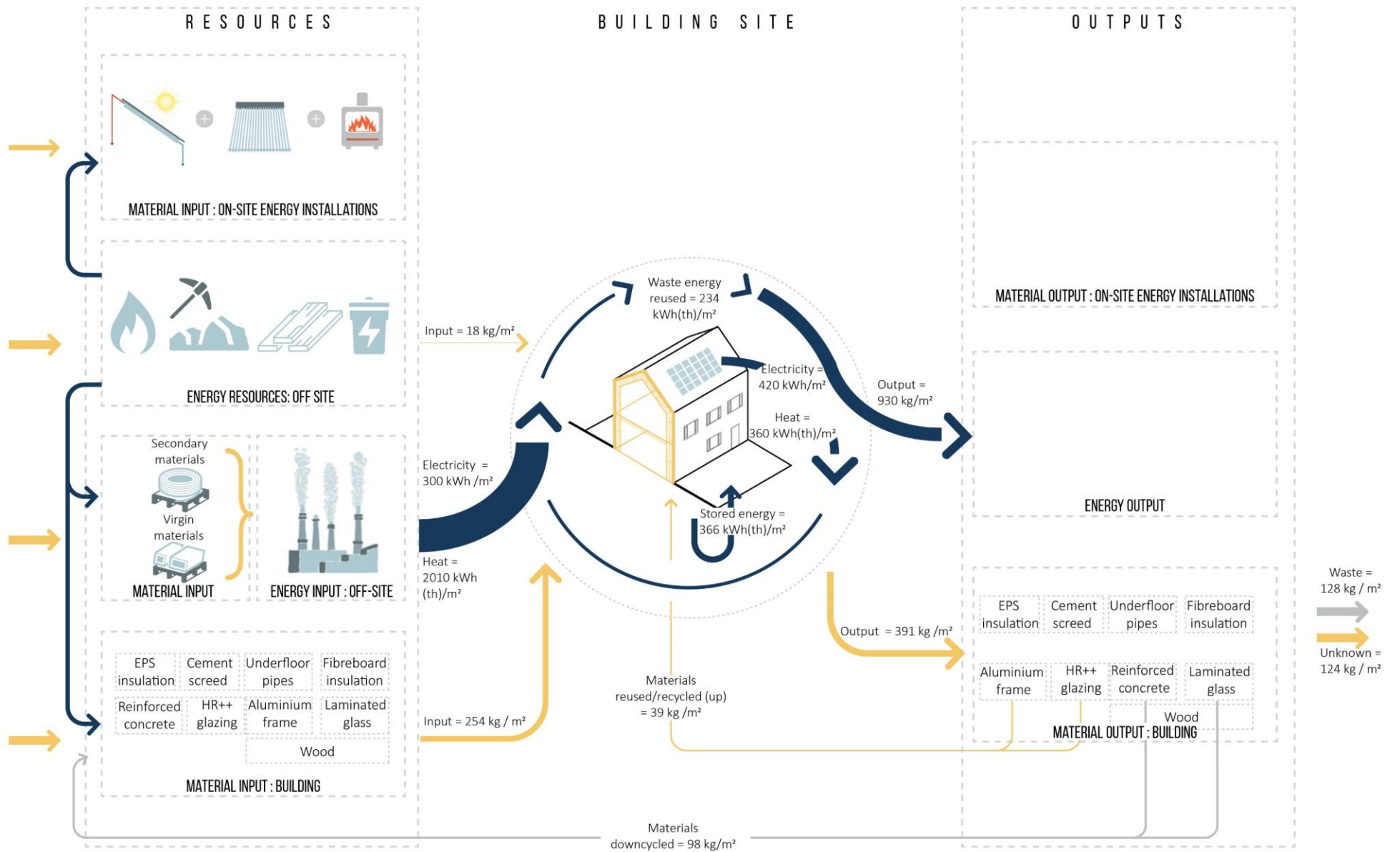




Waste / materials downcycled

Material flows

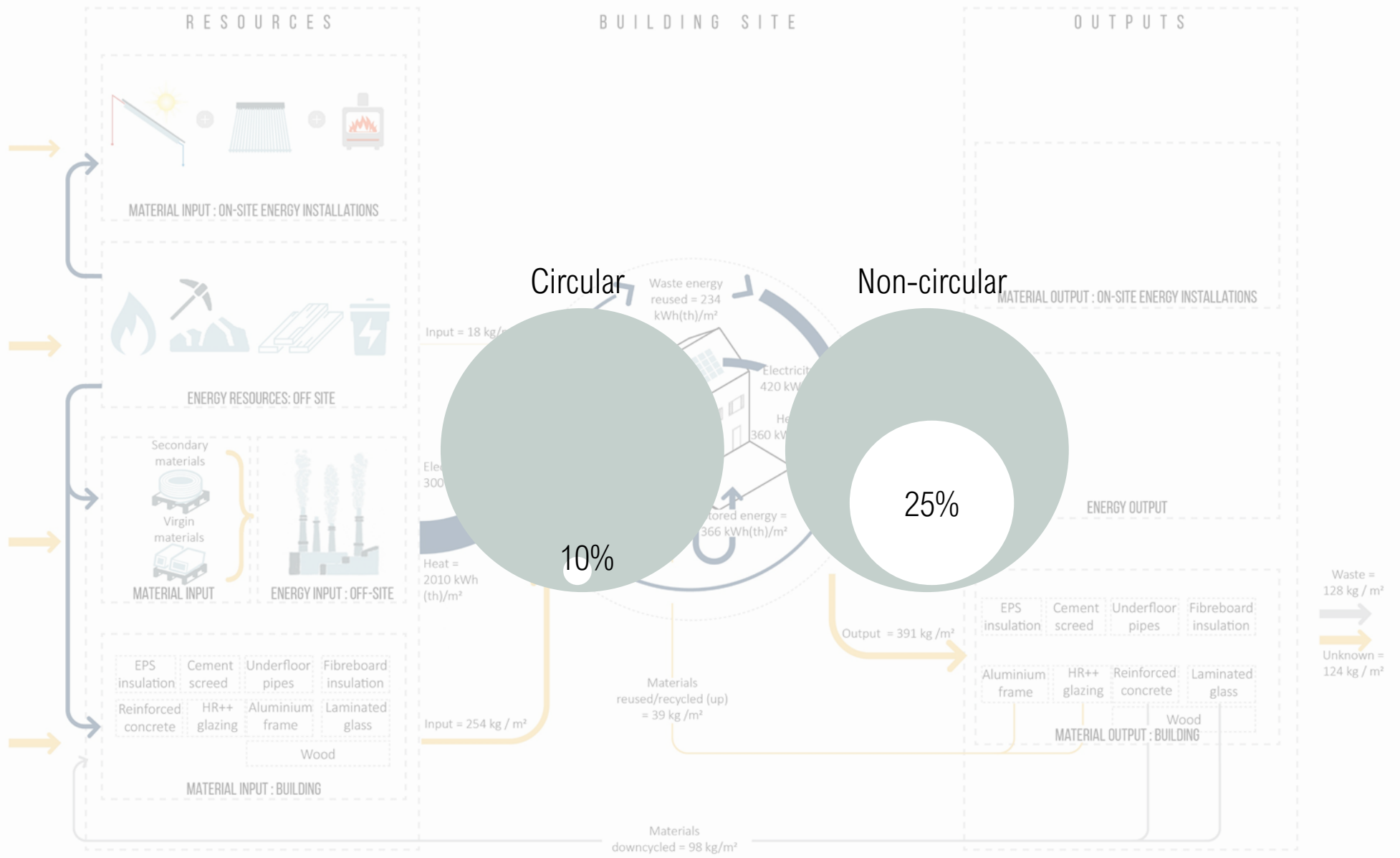
Energy flows

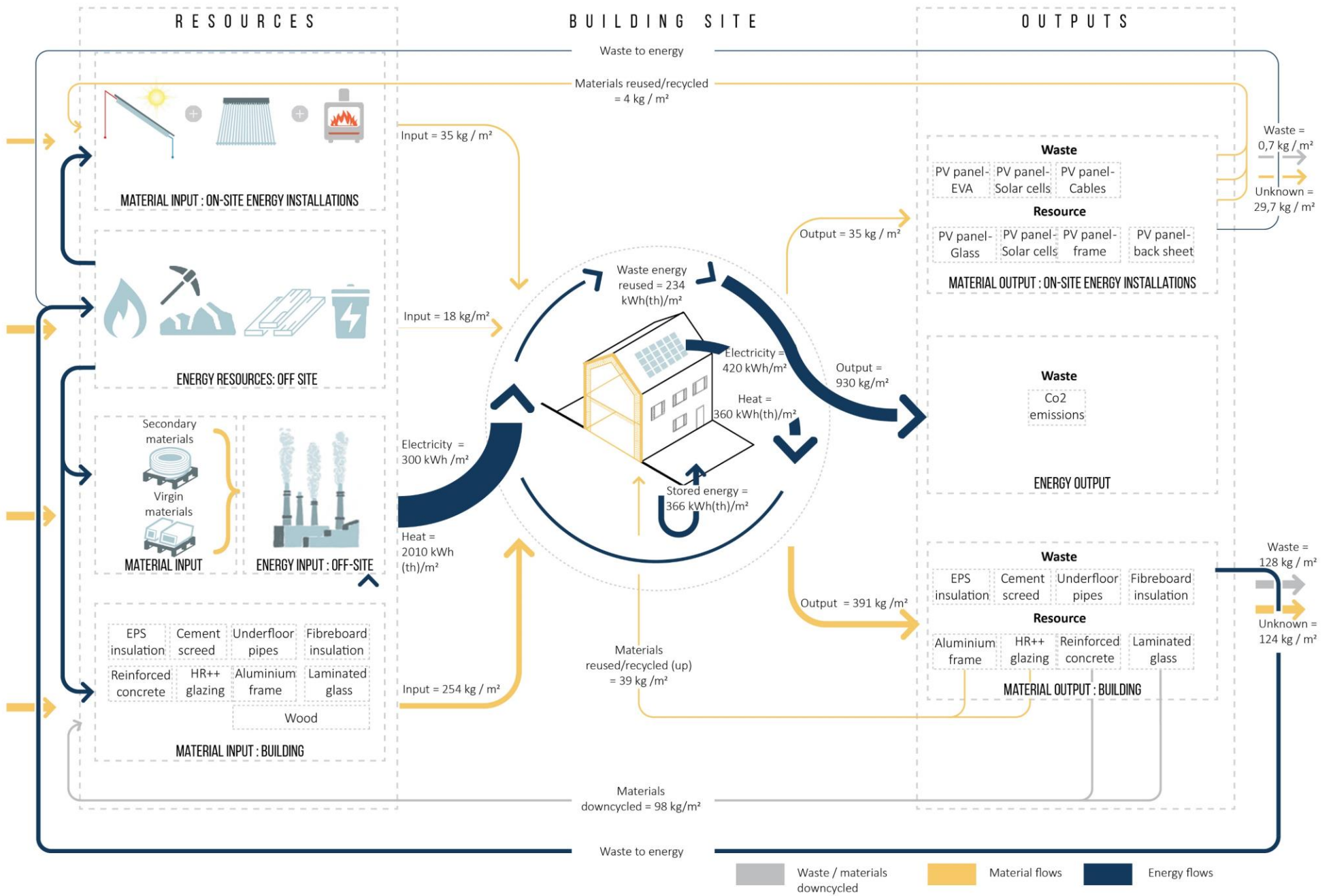


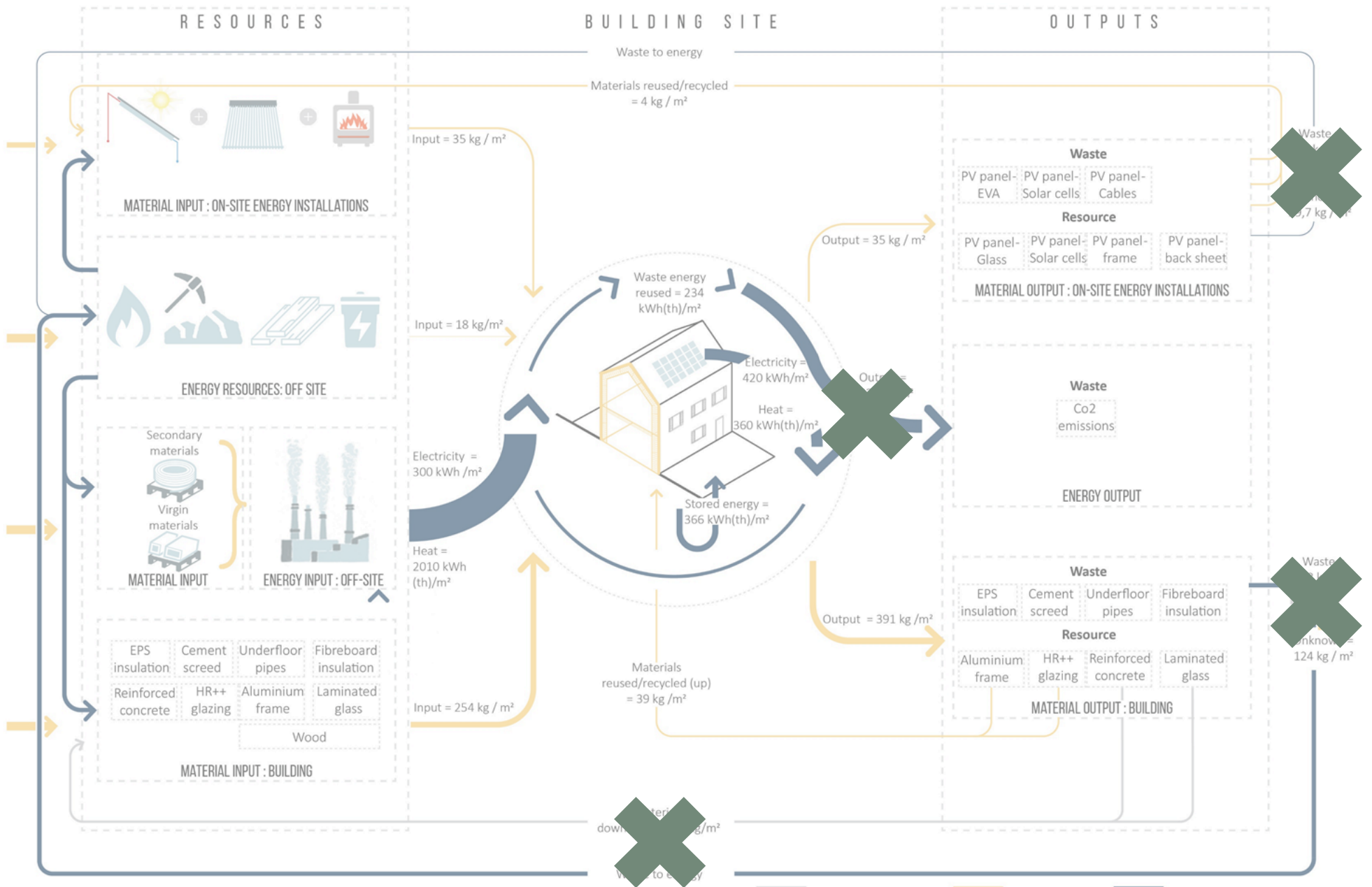
Waste / materials downcycled

Material flows

Energy flows

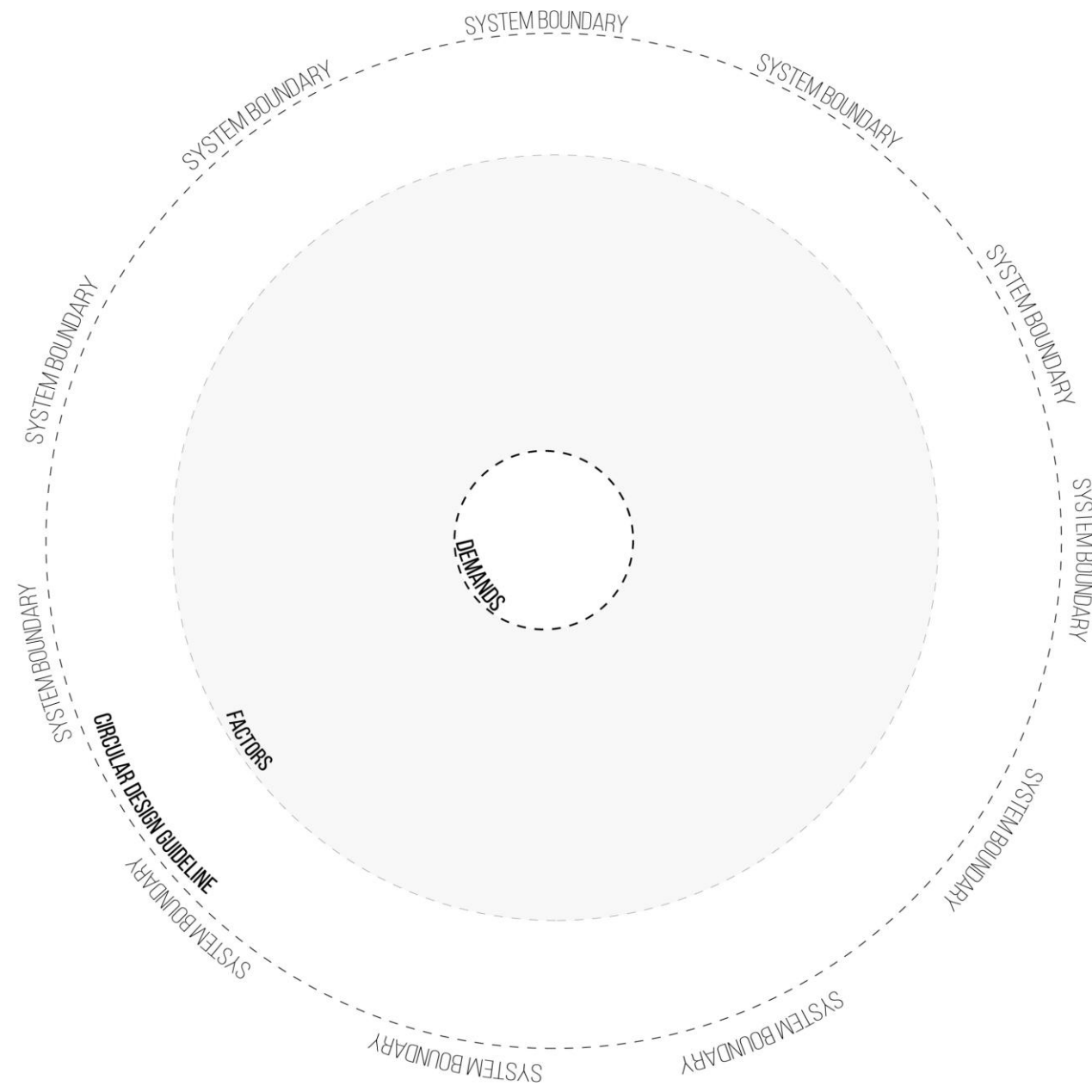
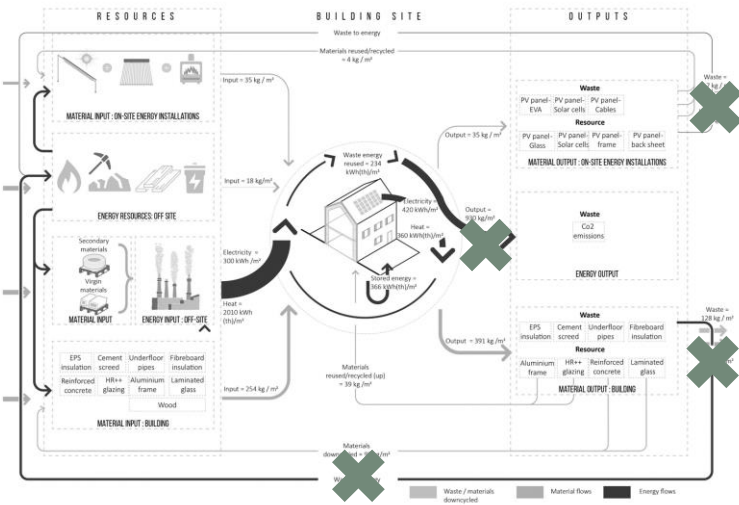


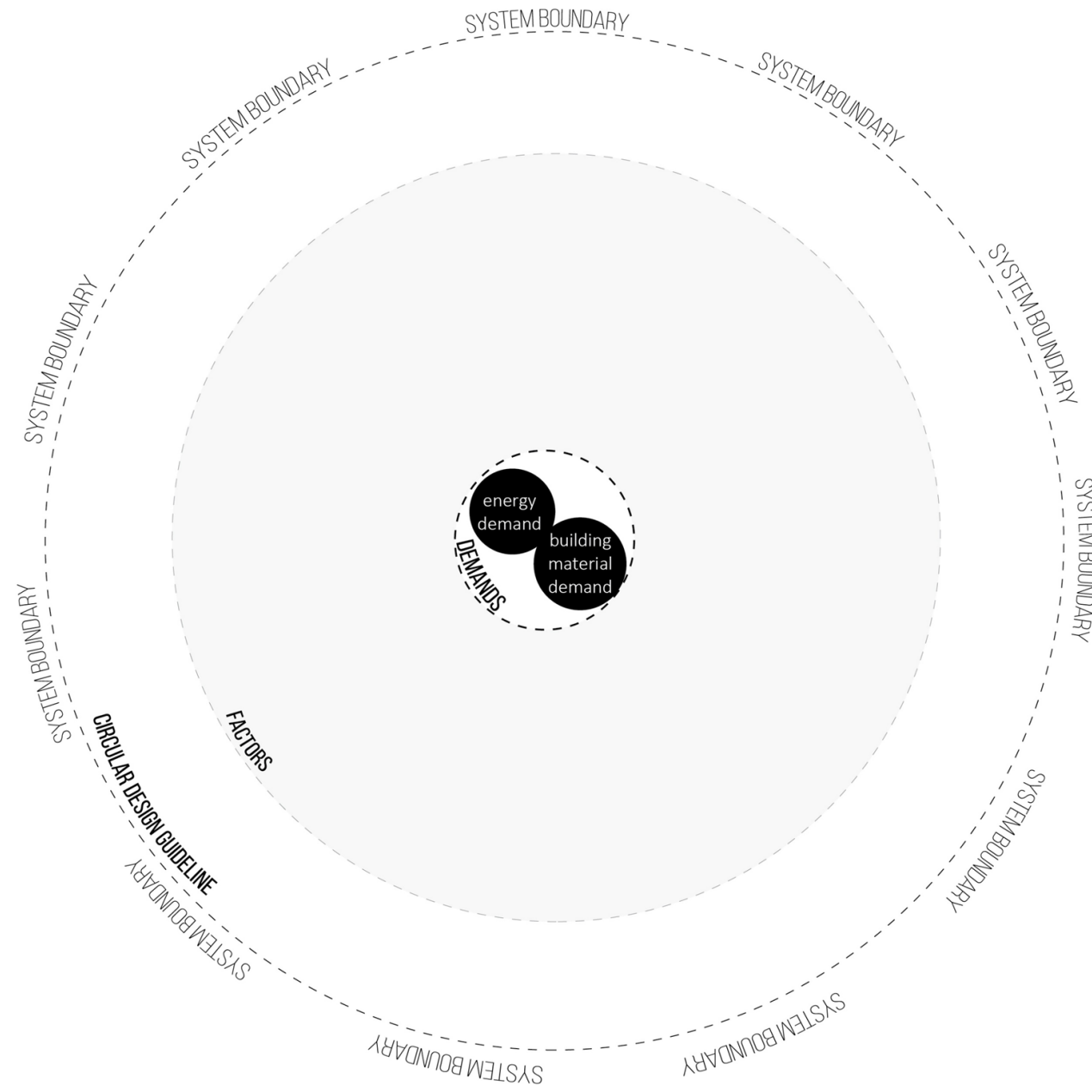
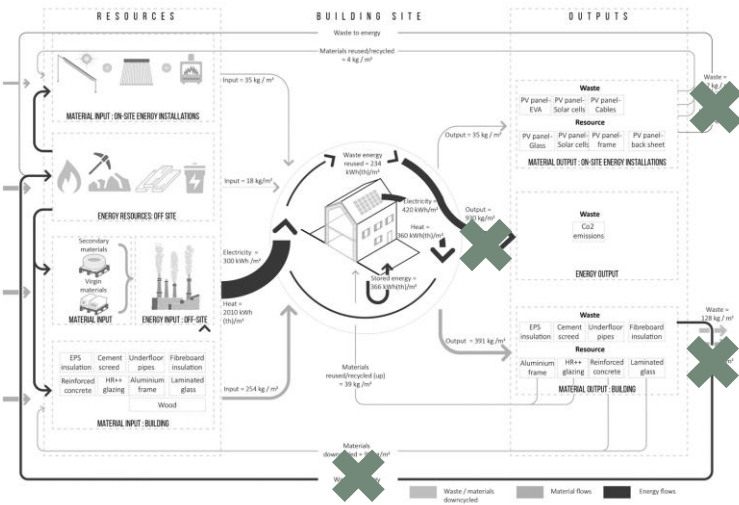


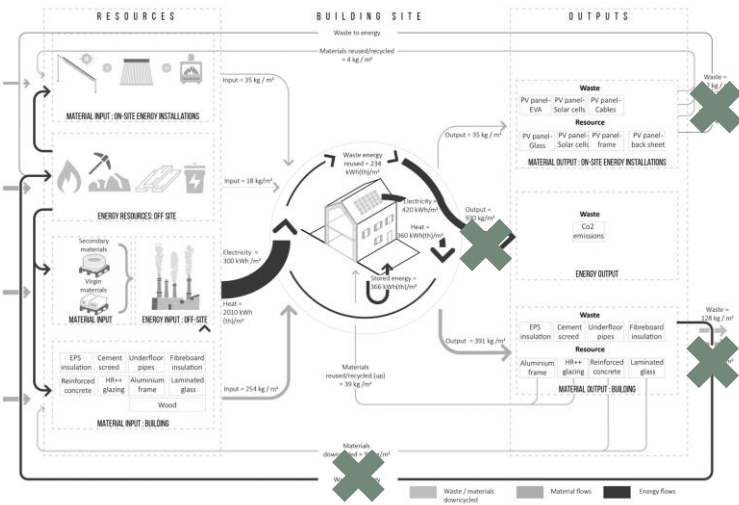


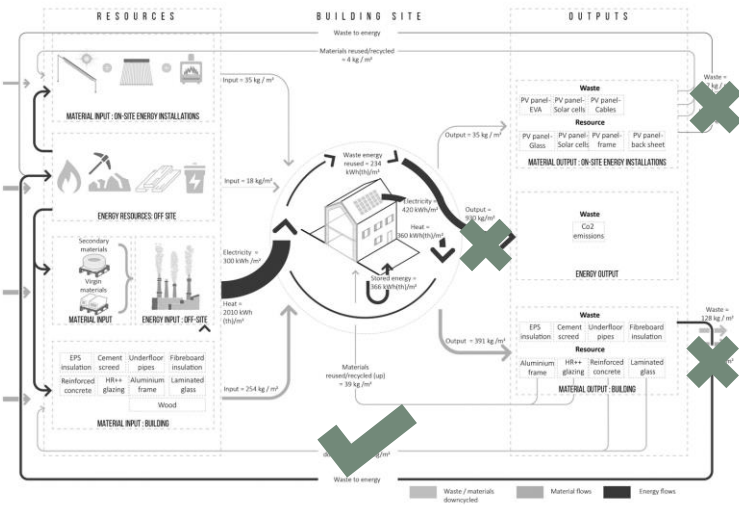
How can this performance be improved?

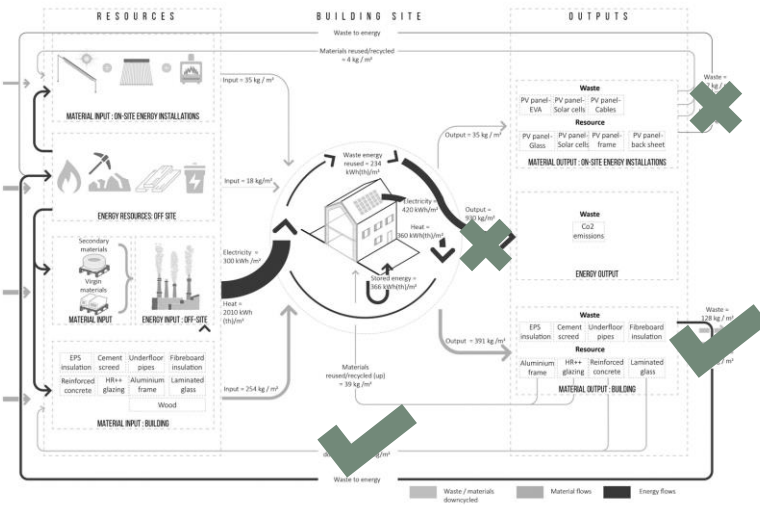


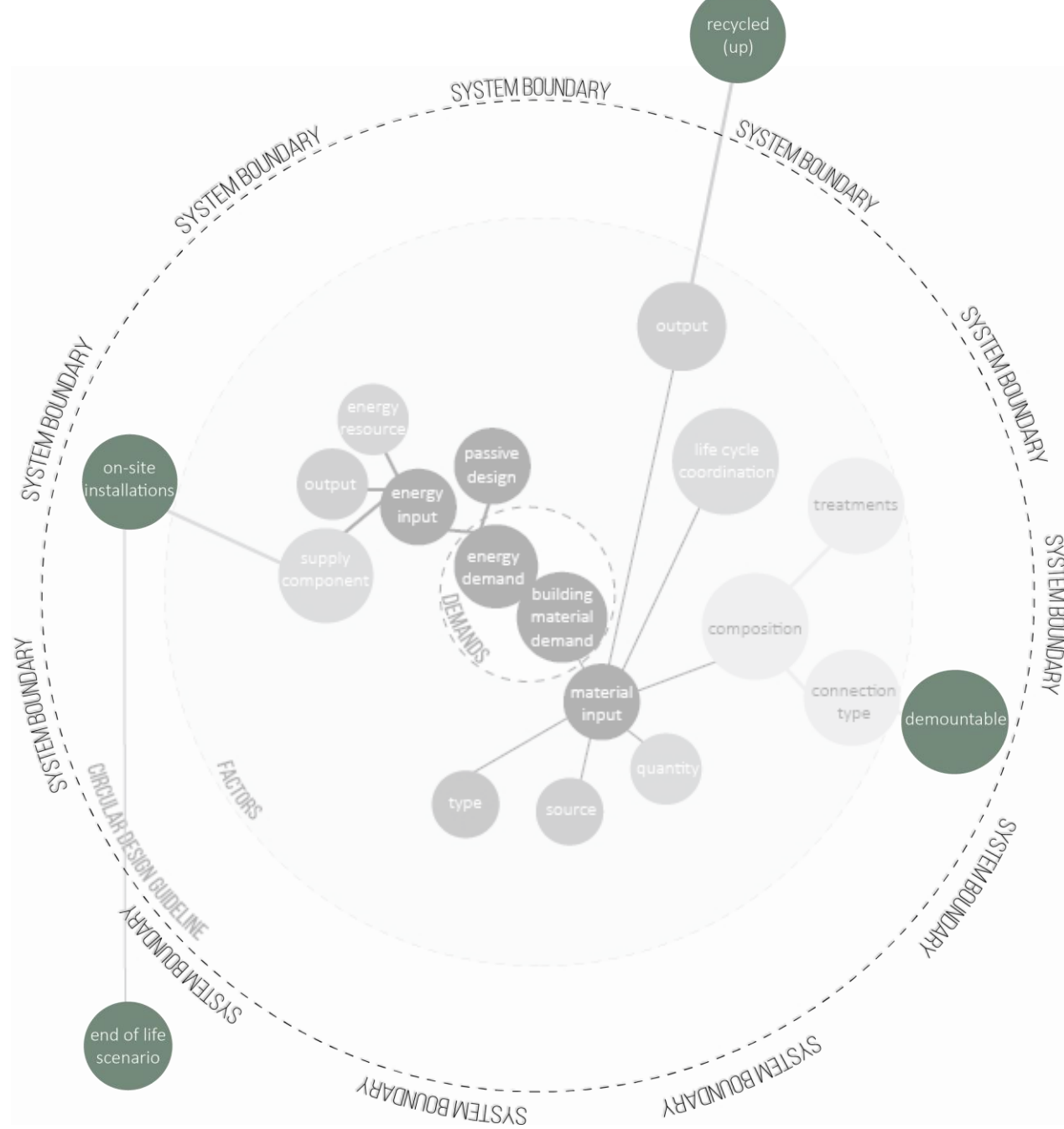
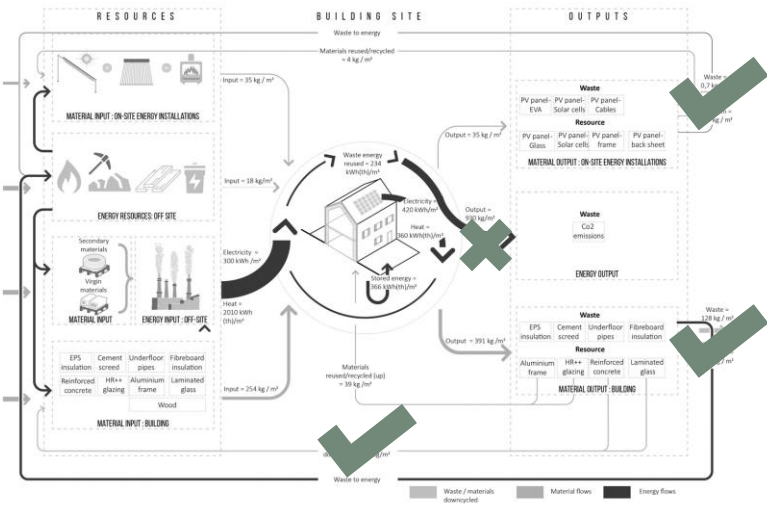


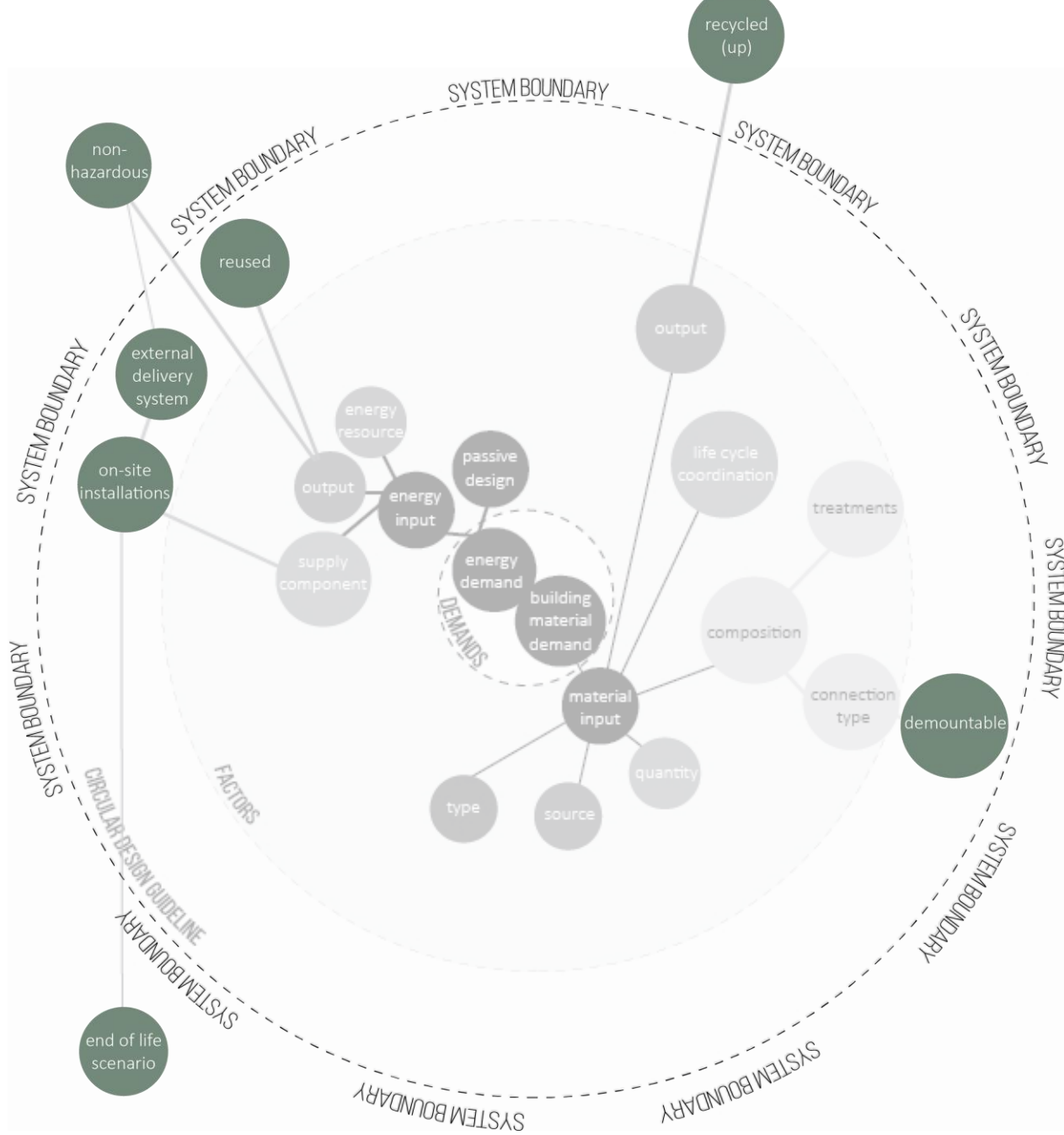
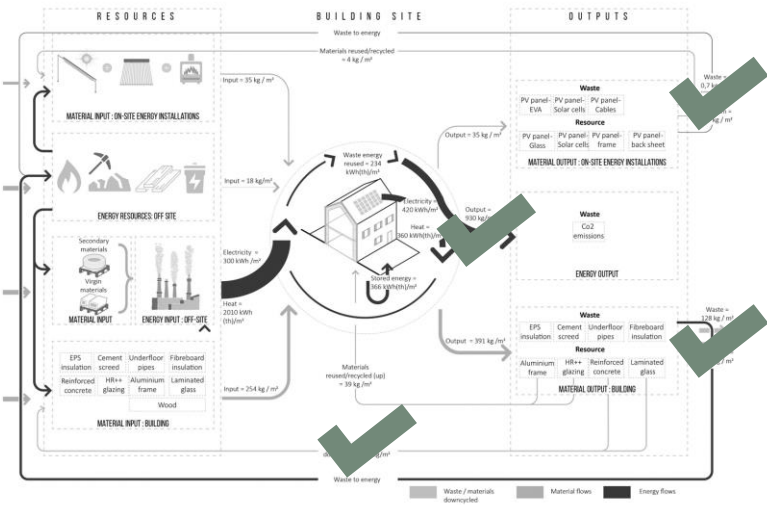




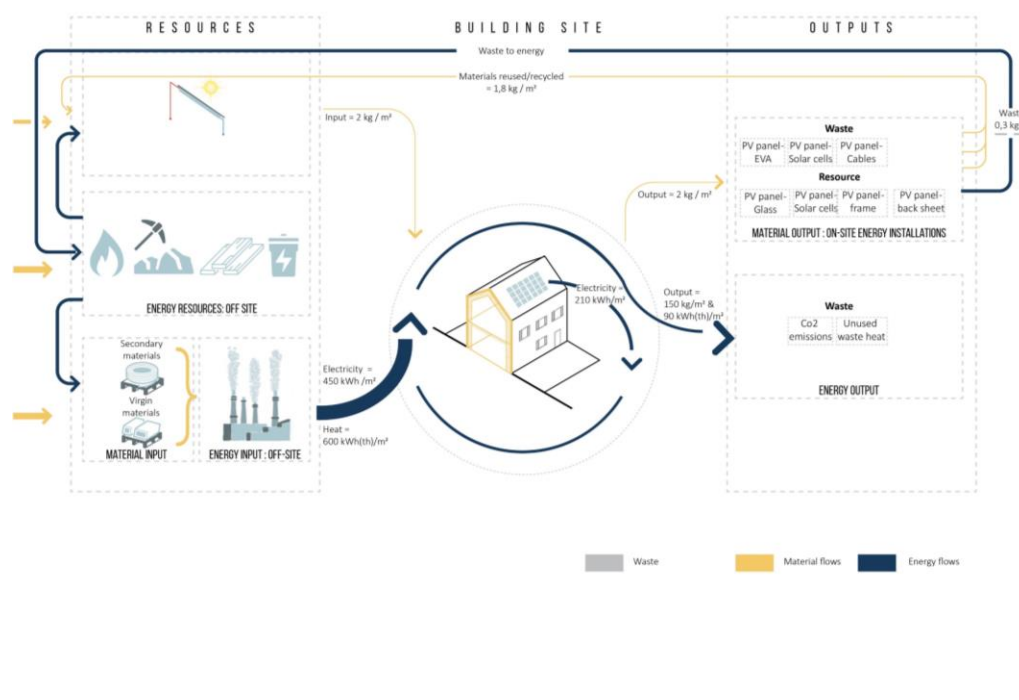
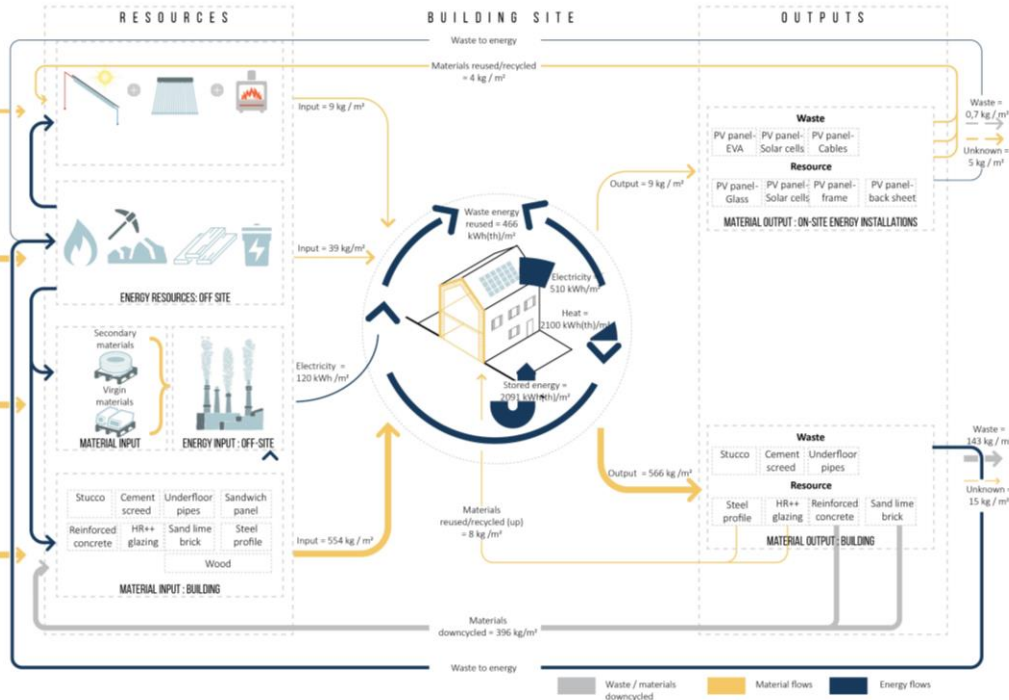




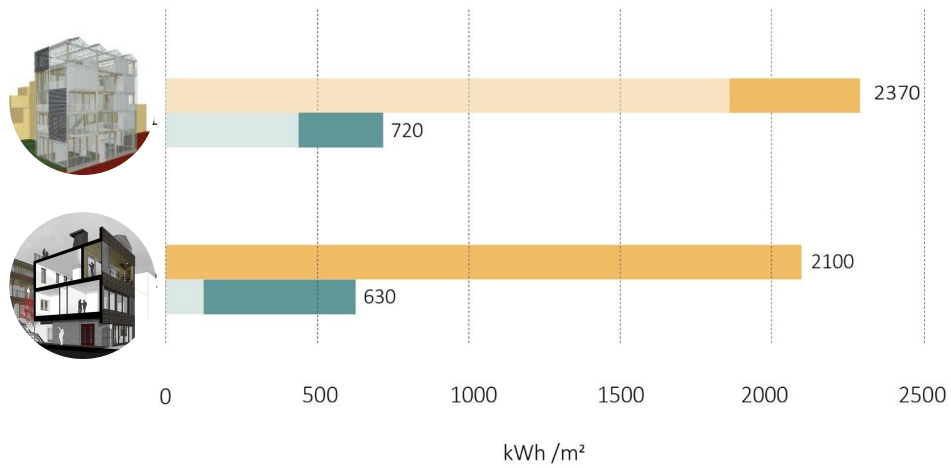




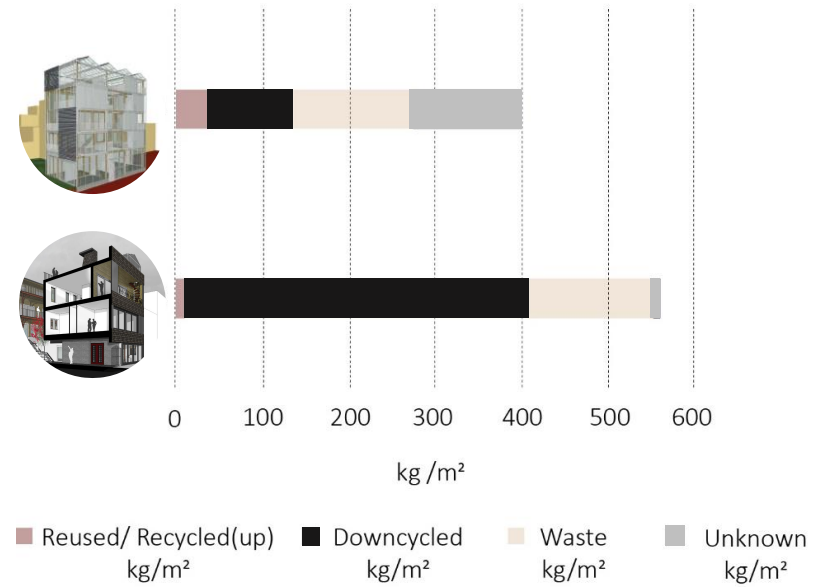




Energy input



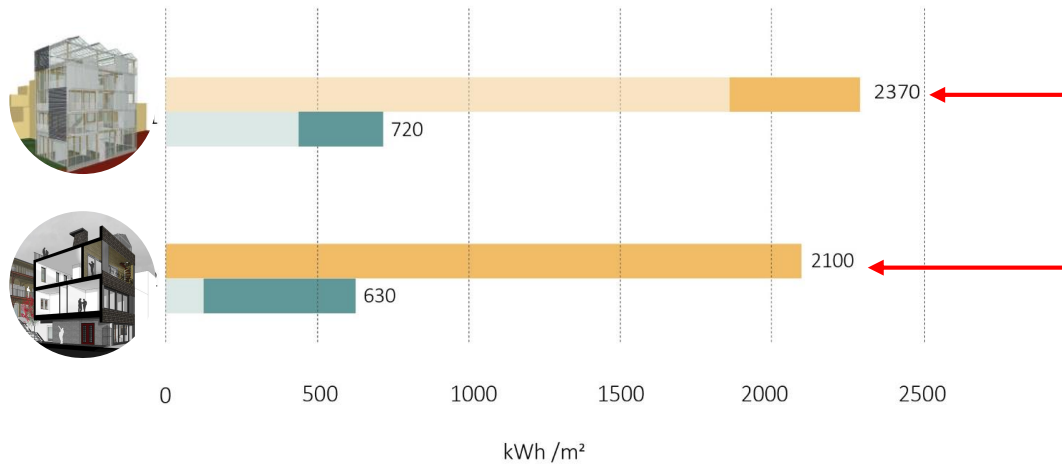
Material input - building



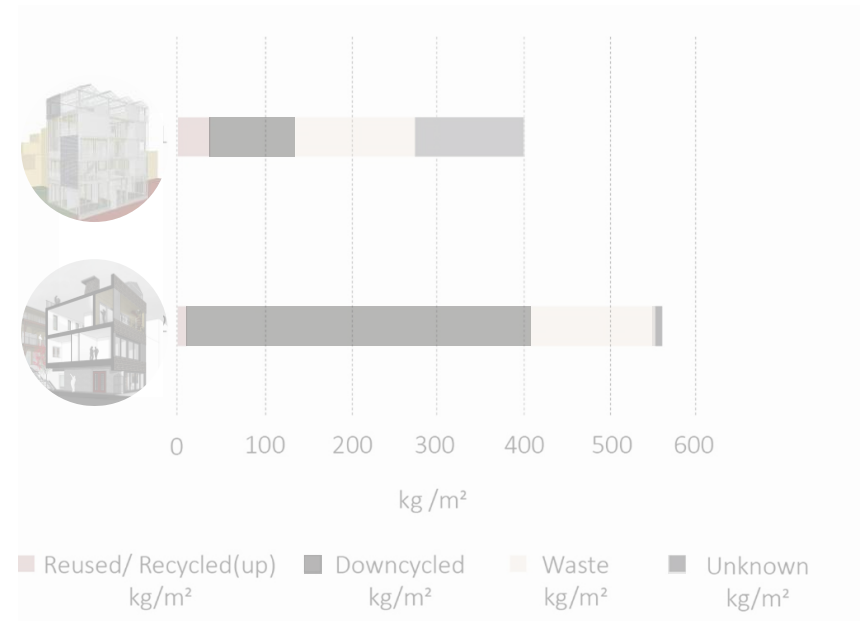
- Externally delivered thermal energy kWh(th)/m²
- On-site generated thermal energy kWh(th)/m²
- Externally delivered electrical energy kWh/m²
- On-site generated electrical energy kWh/m²

- Reused/ Recycled(up) kg/m²
- Downcycled kg/m²
- Waste kg/m²
- Unknown kg/m²

Energy input



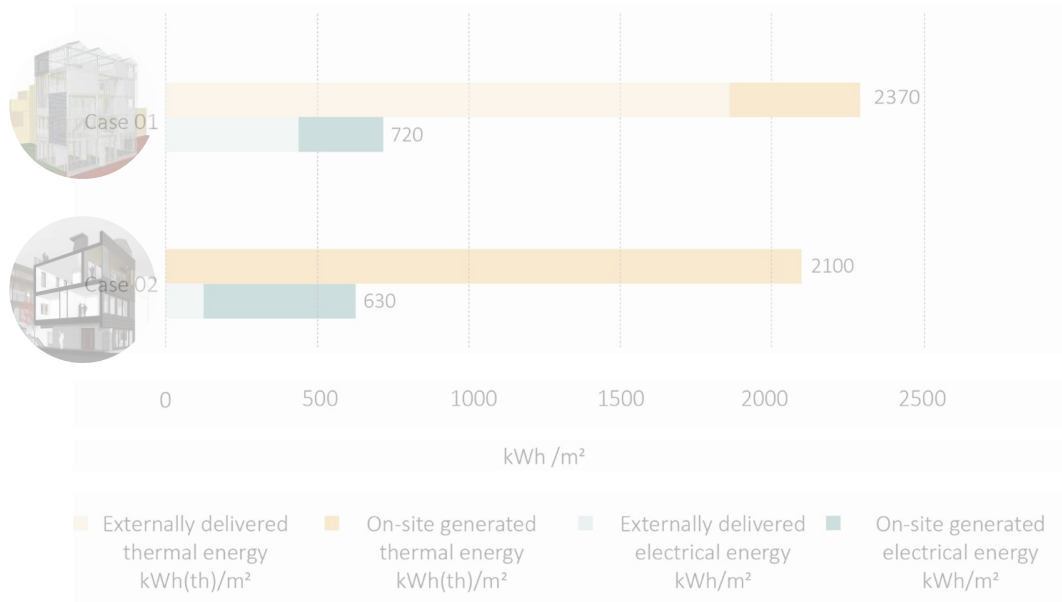
Material input - building



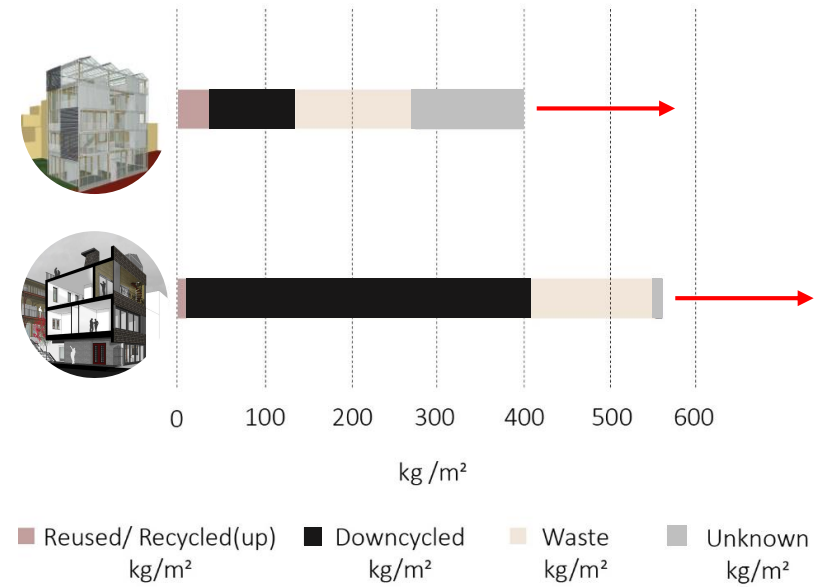
- Externally delivered thermal energy kWh(th)/m²
- On-site generated thermal energy kWh(th)/m²
- Externally delivered electrical energy kWh/m²
- On-site generated electrical energy kWh/m²

- Reused/ Recycled(up) kg/m²
- Downcycled kg/m²
- Waste kg/m²
- Unknown kg/m²

Energy input



Material input - building



- High energy and circular ambitions in the EU
- Lack of standardized measures & assessment criteria
- Legislative & Organizational barriers

- Assessment method that integrates the energetic and circular ambitions
- Addresses the synergies and trade-offs between the flows
- Design guidelines to improve the performance

- Holistic assessment with standardized scoring
- Test the assessment method widely with more building typologies
- BIM software
- Pricing incentives

