Sustainable construction

"Less bad is not good enough"

(McDonough & Braungart, 2003)

Ivan Baartmans

P5 Presentation

2013

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PERSONALIA

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Second mentor: ir. R. Oostdam

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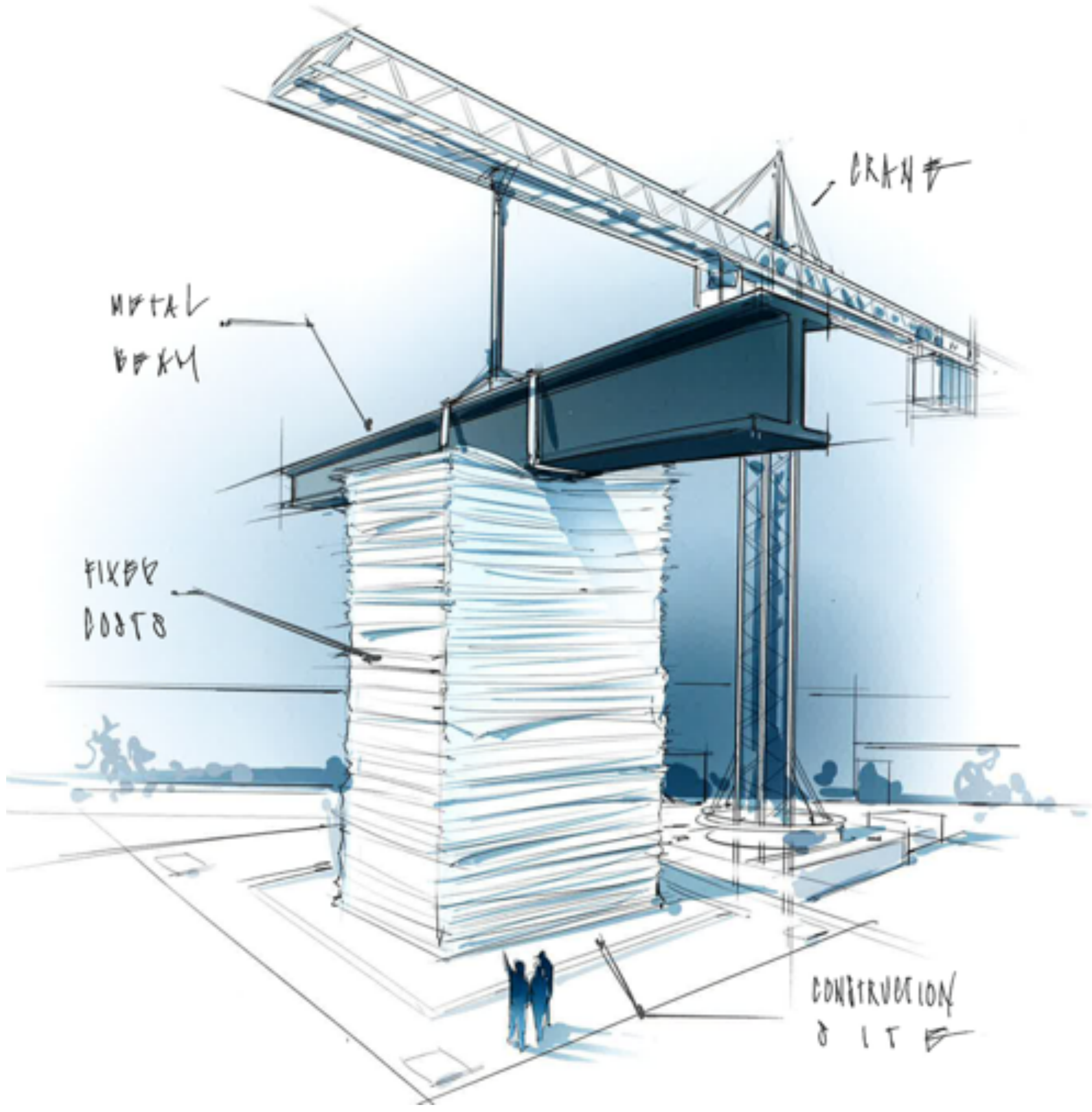
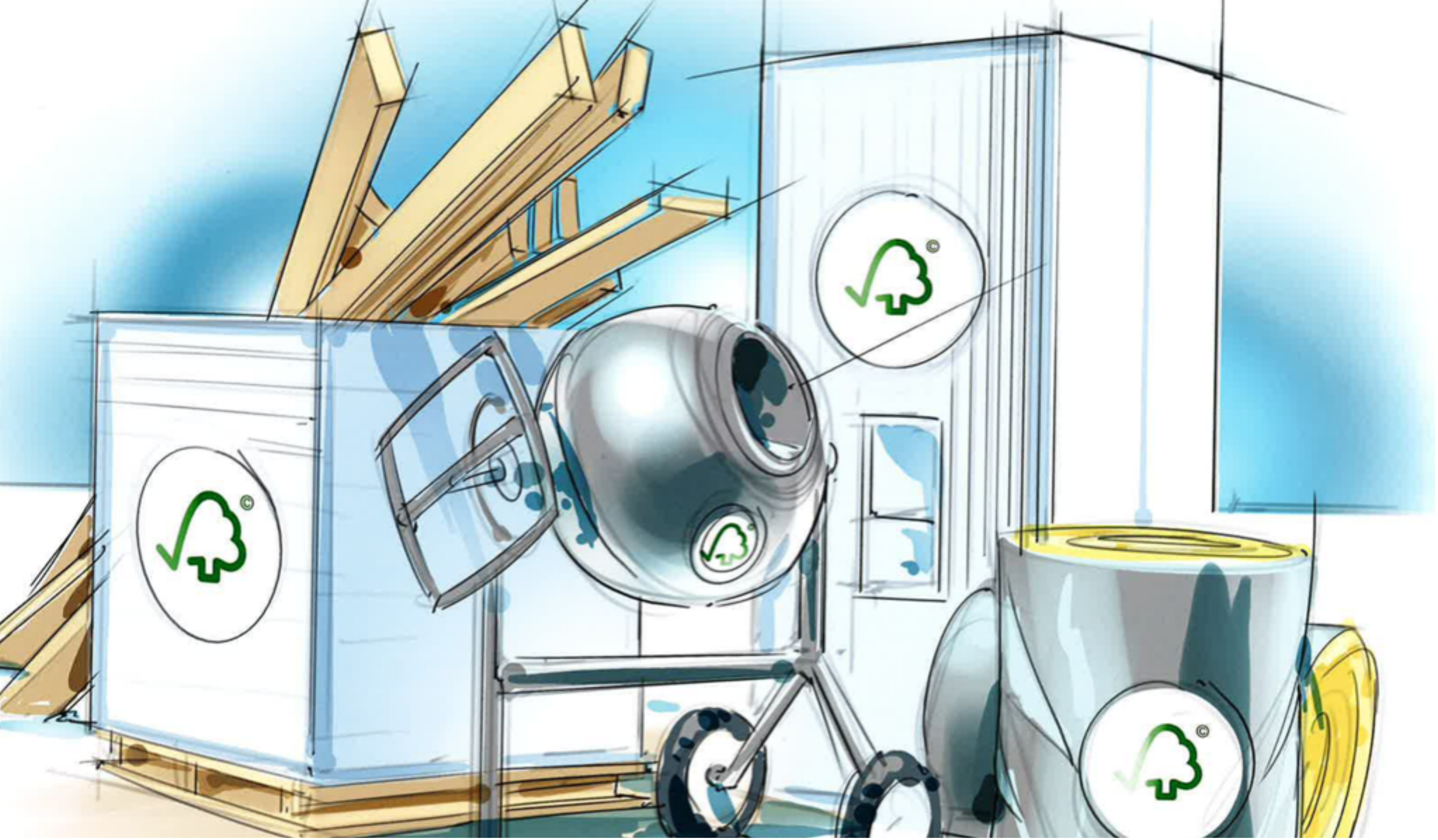




01 Research design

Problem analysis

The construction industry different approaches and is dealing with a number of problems

There are various definitions and assessment methods for sustainability. However, no definitions is related to the construction process

GPR GEBOUW

LEED FOR HOMES

cradletocradle

breeam nl

Problem statement

There is not one clear definition of a construction process and no clear improvement in the construction process with respect to sustainability.

This leaves the construction industry as a large resource consumer and polluter

Research questions

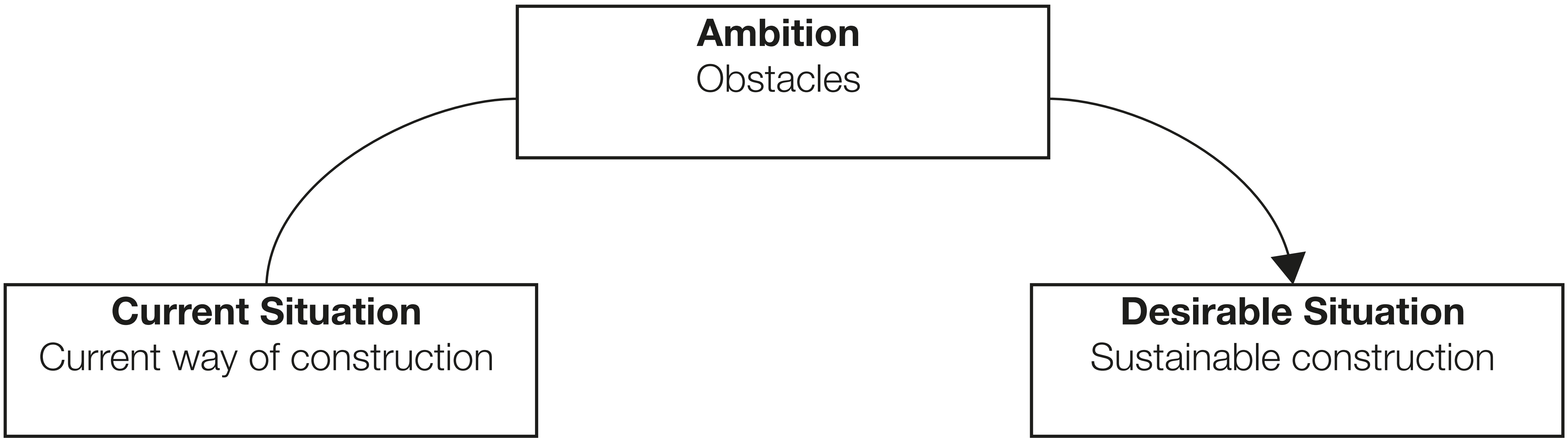
Main research question

How can a sustainable construction process be defined and how can the sustainable construction process be achieved?

This question contains various sub-research questions which consists of different parts, namely:

1. Defining a relationship between elements in a sustainable construction process
2. Assessing obstacles sustainable construction
3. Achieving sustainable construction

Research design



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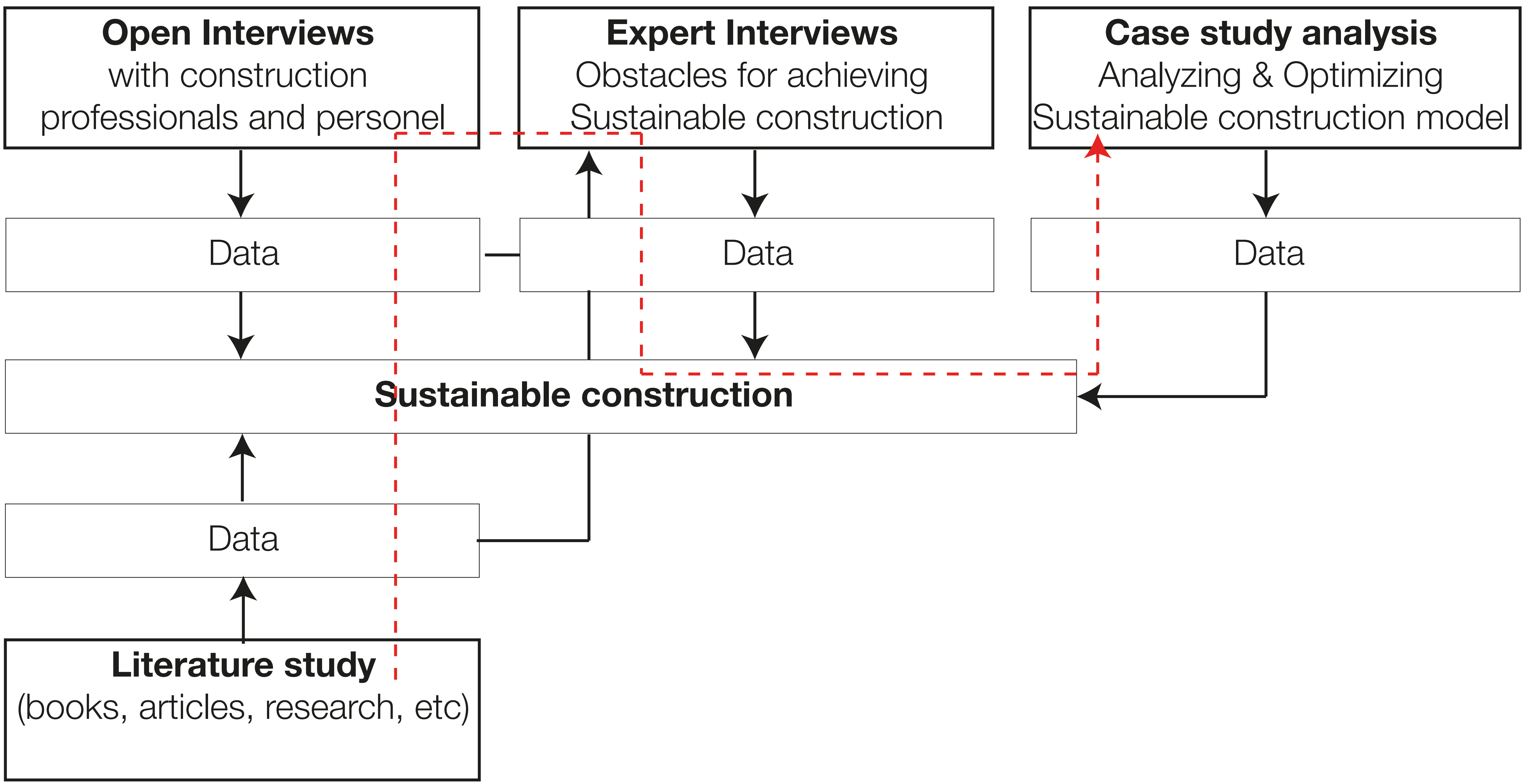

02 Current construction process

Construction history

Before

- Construction method dependable on the availability of materials, local climate and cultural life style

Industrial revolution

- Allowed new materials to be manufactured in factories and transporting them all over the world

Now

- Almost every material all over the world is used and the possibilities are endless

Construction history

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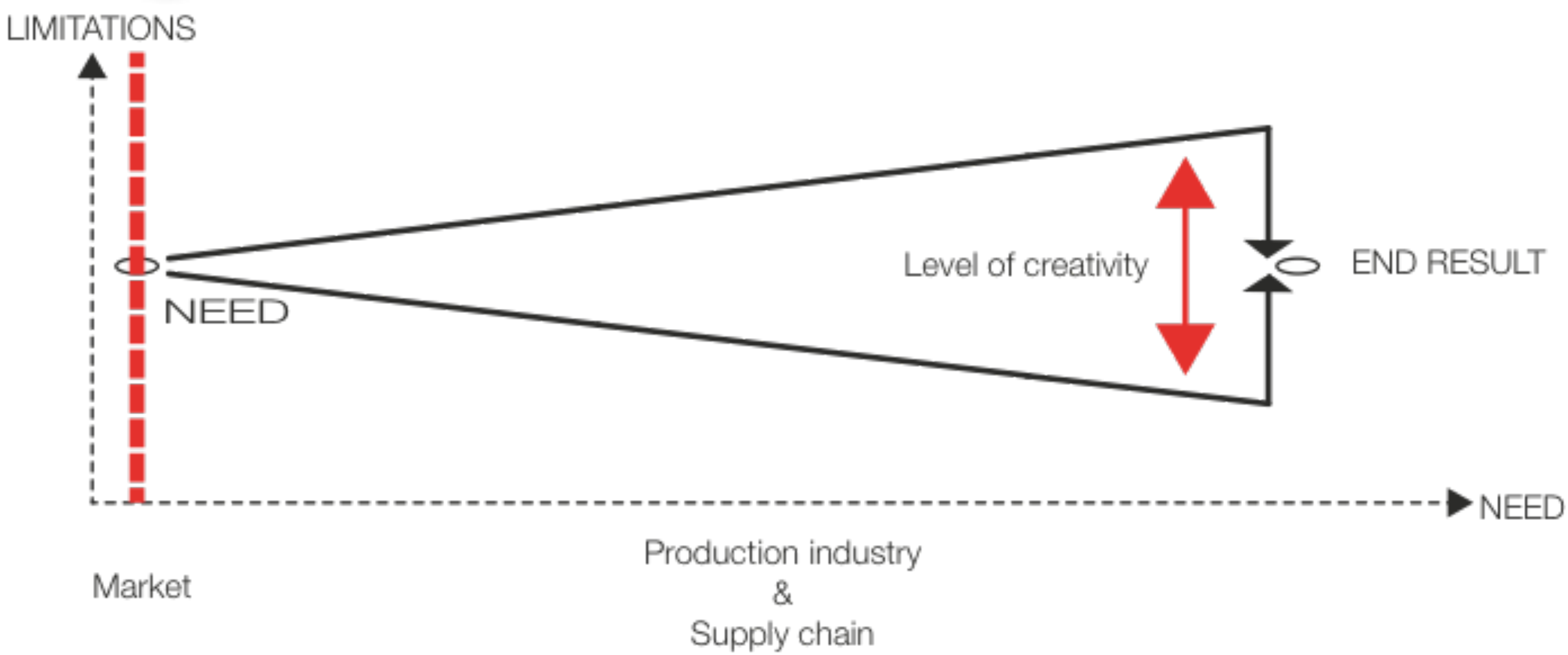
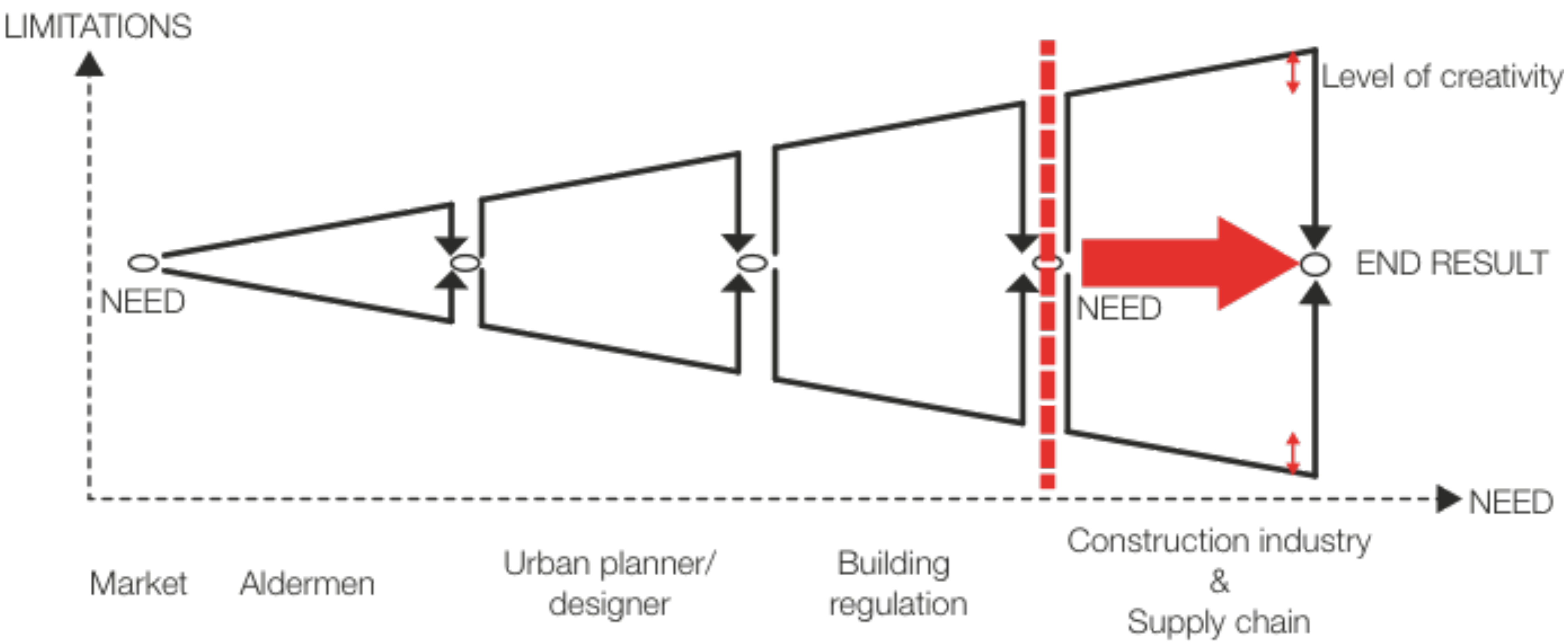
Level of creativity

Production
industry



Level of creativity

Construction industry



Define construction process

“Construction technology is the application of applied sciences in order to enhance productivity and quality of its products. The nature of the construction activities (performed by labor) involves, the place where construction work is to be carried out and the time available for construction work are the four factors that determine the effective construction process”

Construction activities

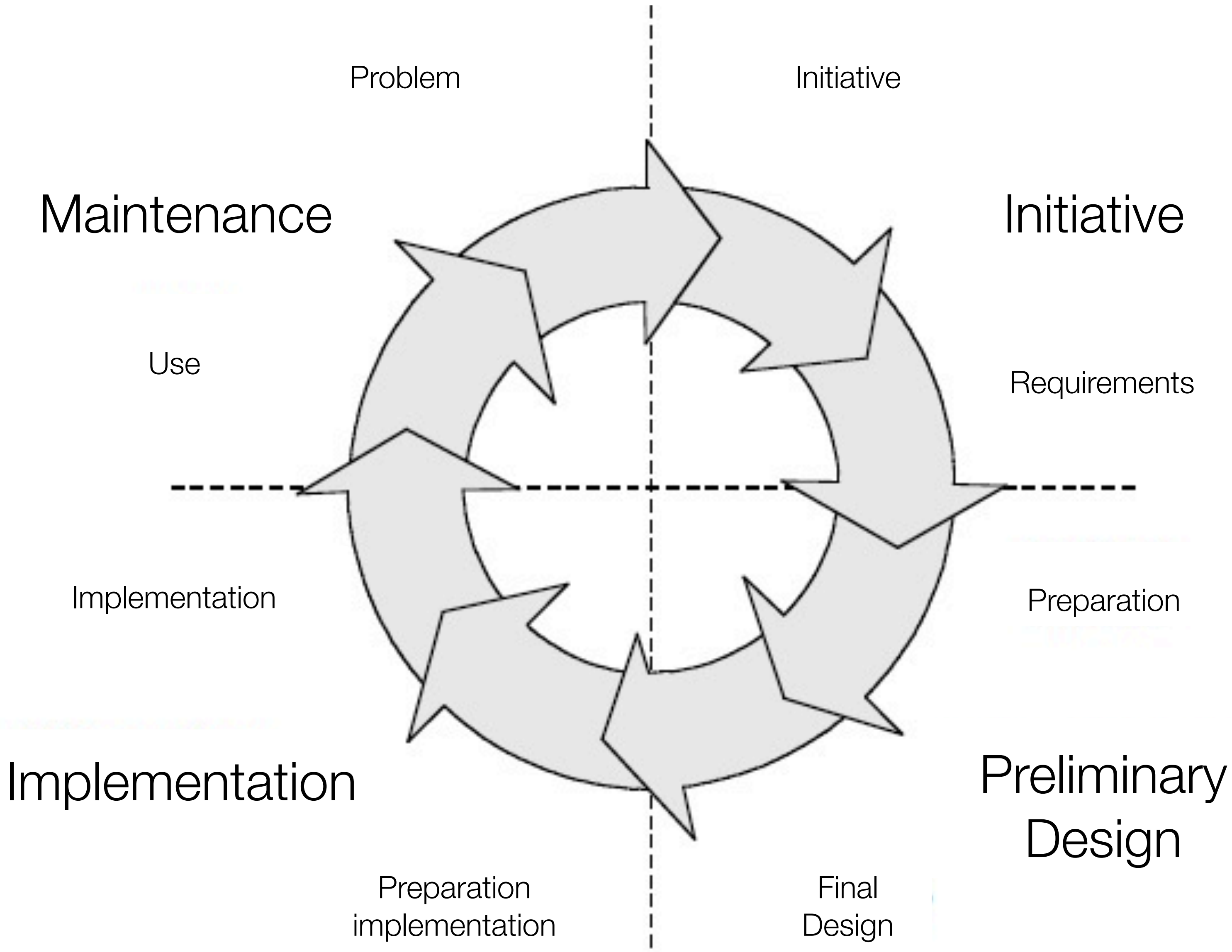
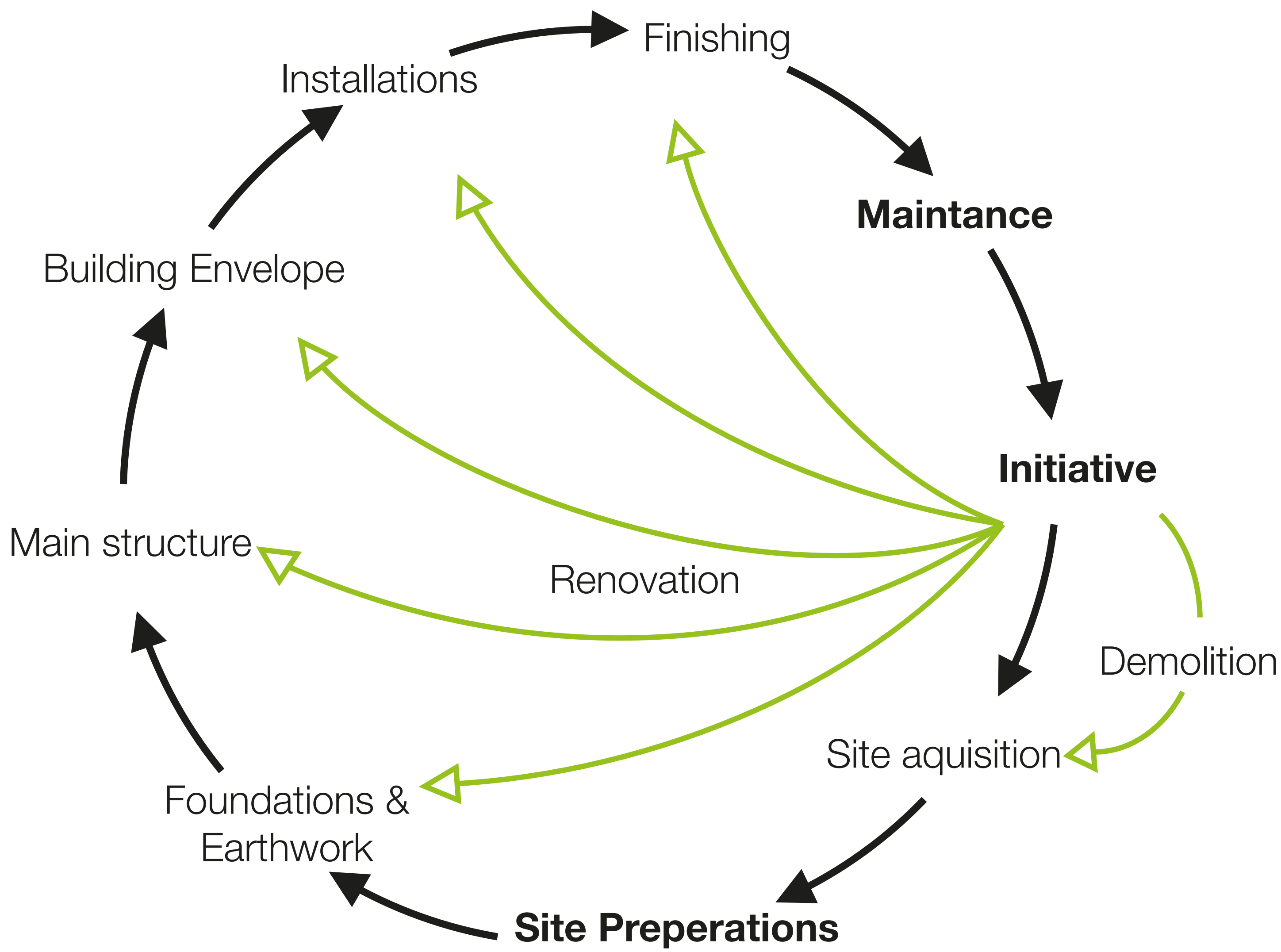


Figure 2-4: Property life cycle (Wamelink, 2009)

Construction activities



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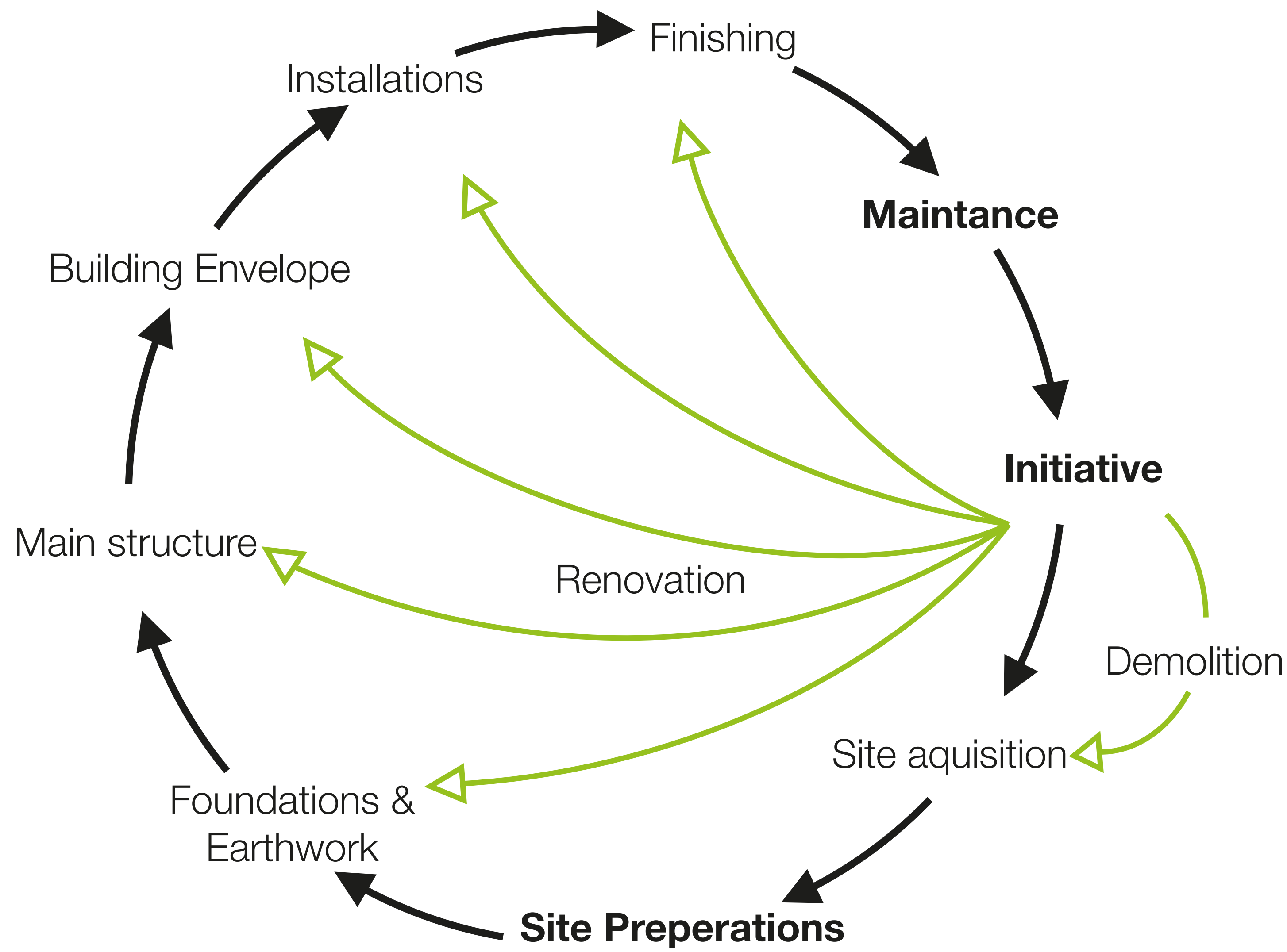
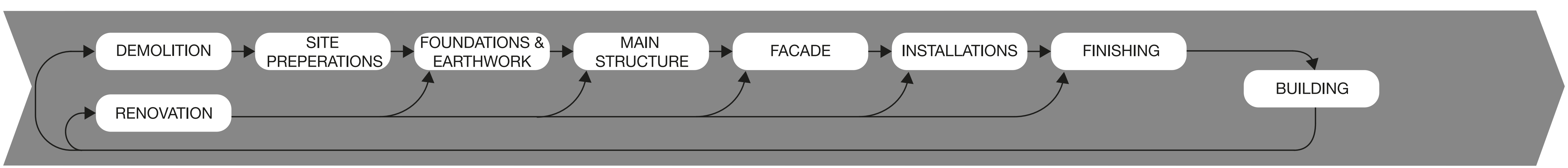


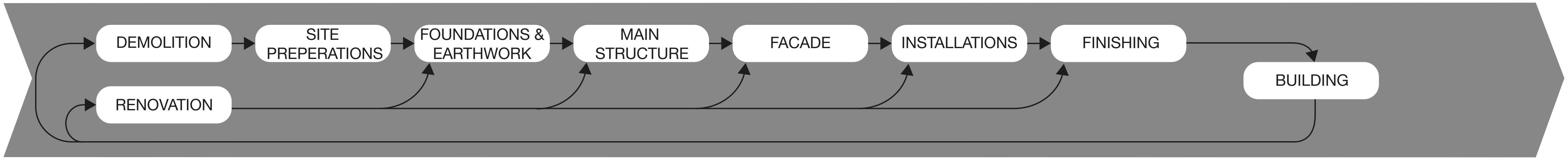


Current construction process

Process input

Supply feeder industry

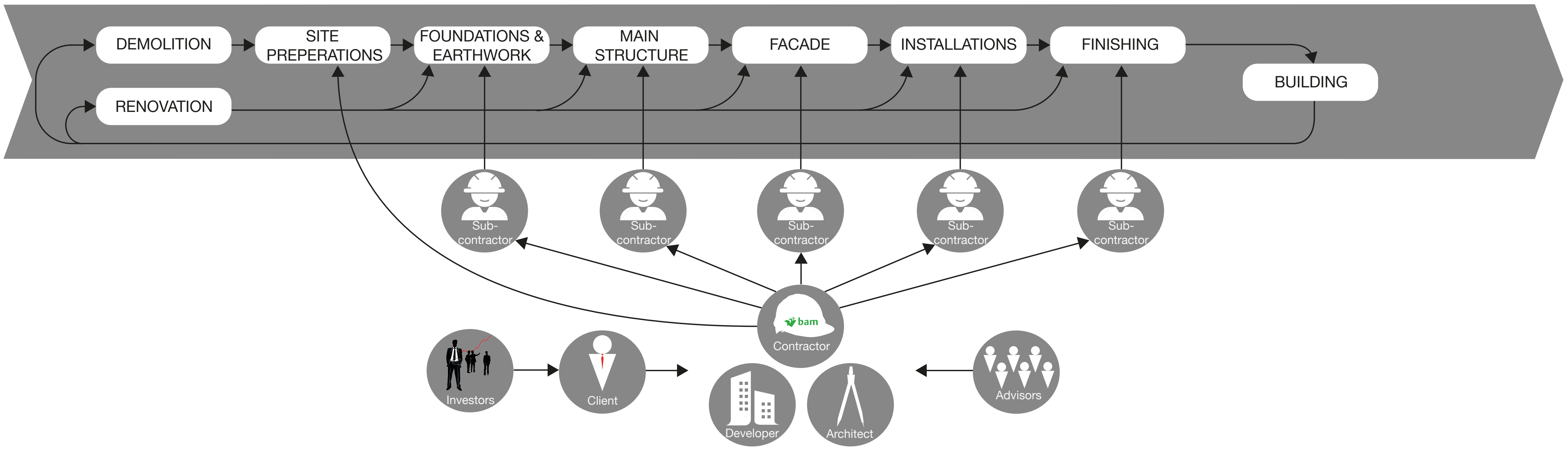
Process output



Main actors involved

Current construction process

Process input | Supply feeder industry | Process output



Main actors involved

Current construction process

Process input

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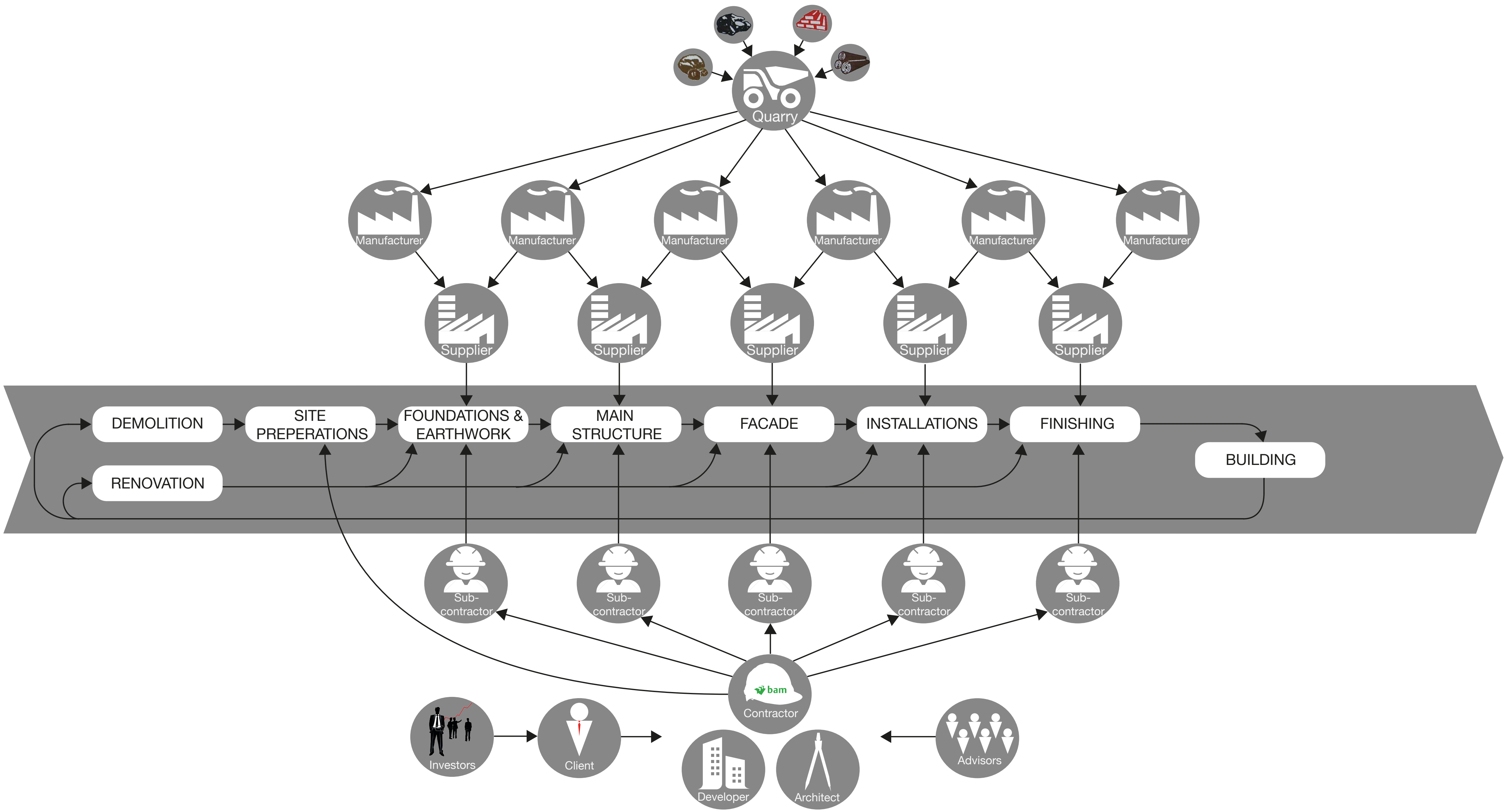

Main actors involved

Current construction process

Process input

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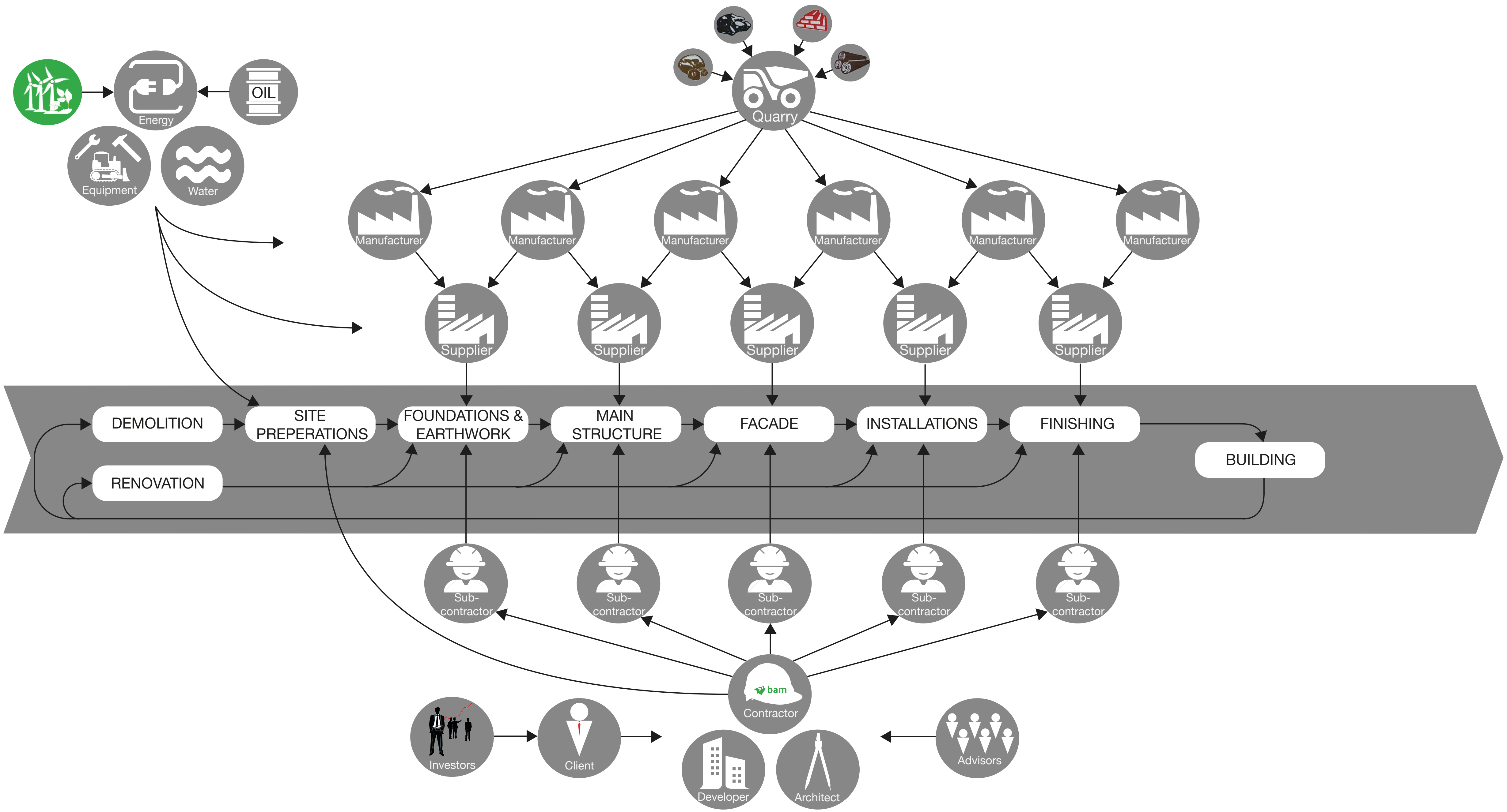

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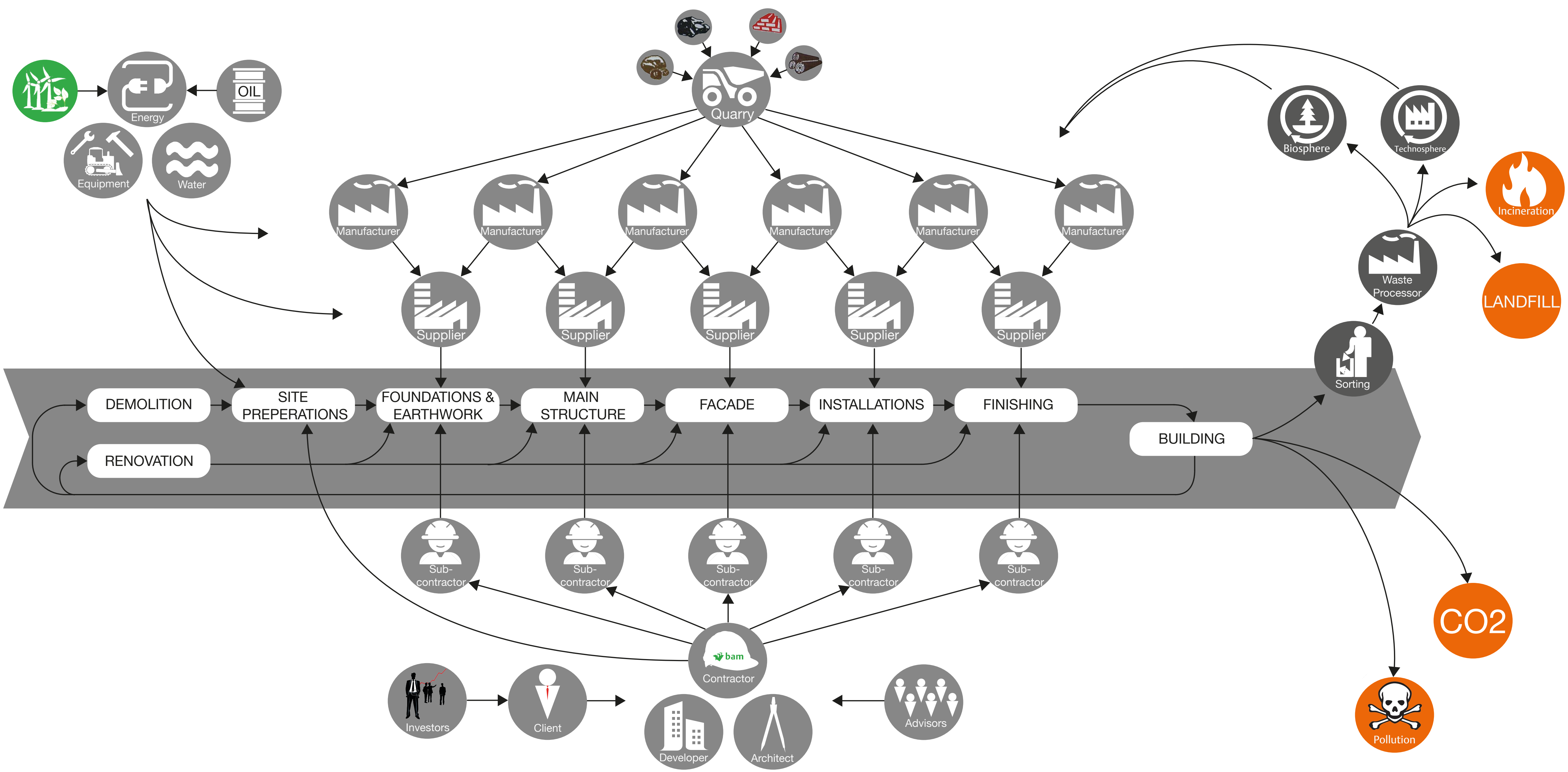

Main actors involved

03 Sustainable construction process

Historical development sustainability

Industrial revolution

- Hygiene measures were taking in the industrialized cities

Resource depletion

- Club of Rome present their report on: ‘The limitations to growth’

Now

- Brundtlands report on the common future and future generations

Next step

- Sustainable processes & products

Sustainability fundamentals

Problems current process

- Focus on ‘as cheap as possible’
- To much wastage
- Linear manner of thinking

Solution

- Cyclic manner of thinking

Philosophies

- Cradle - 2 - Cradle (C2C)
- Industrial ecology

Define sustainable construction

Constructing in such a way that meets the needs of the present without compromising the future needs of future generations and environment

Sustainable construction is about creating and recreating elements in the environment that also future generations would want to receive, use or inherit.

No clear definition

Construction that does not impact the environment (planet) and people, while making a profit.

No Opinion

Sustainable construction is more than energy and materials and involves social sustainability, this is the next step in sustainability

Sustainable construction is about sustainability and not about durability

Define sustainable construction

Construction that does not impact the environment (planet) and people, while making a profit.

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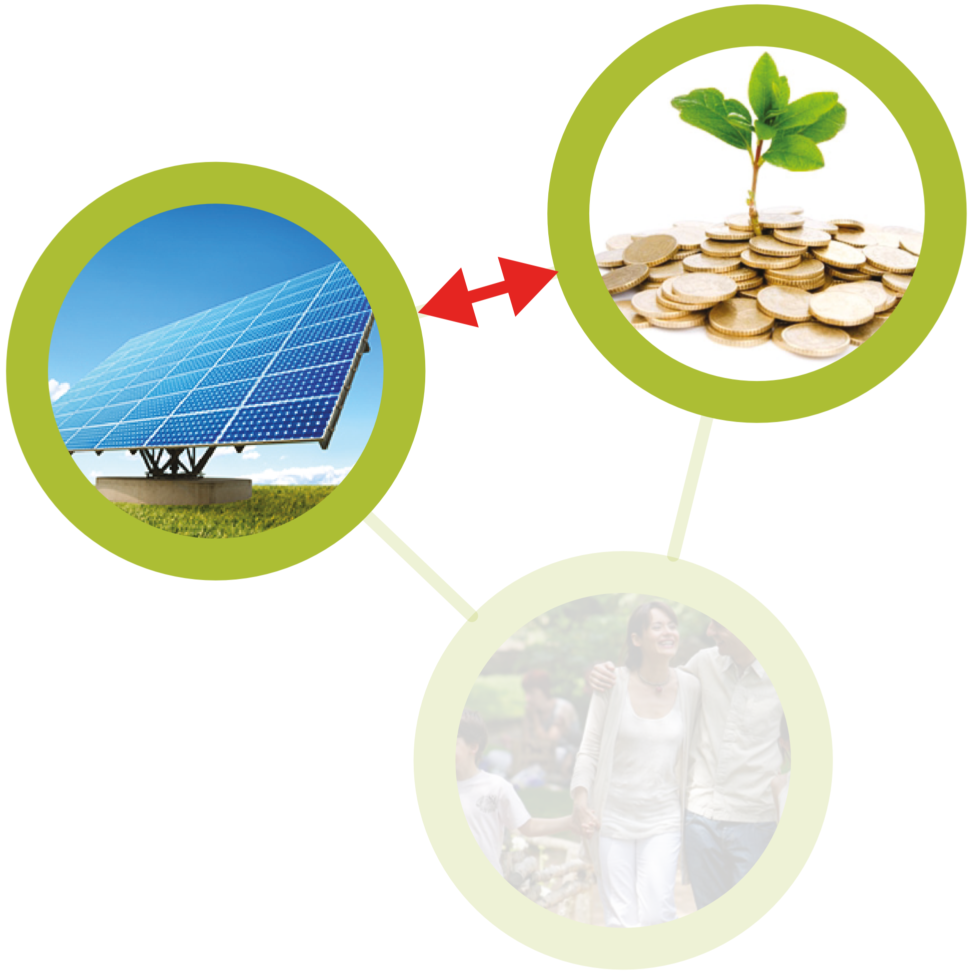

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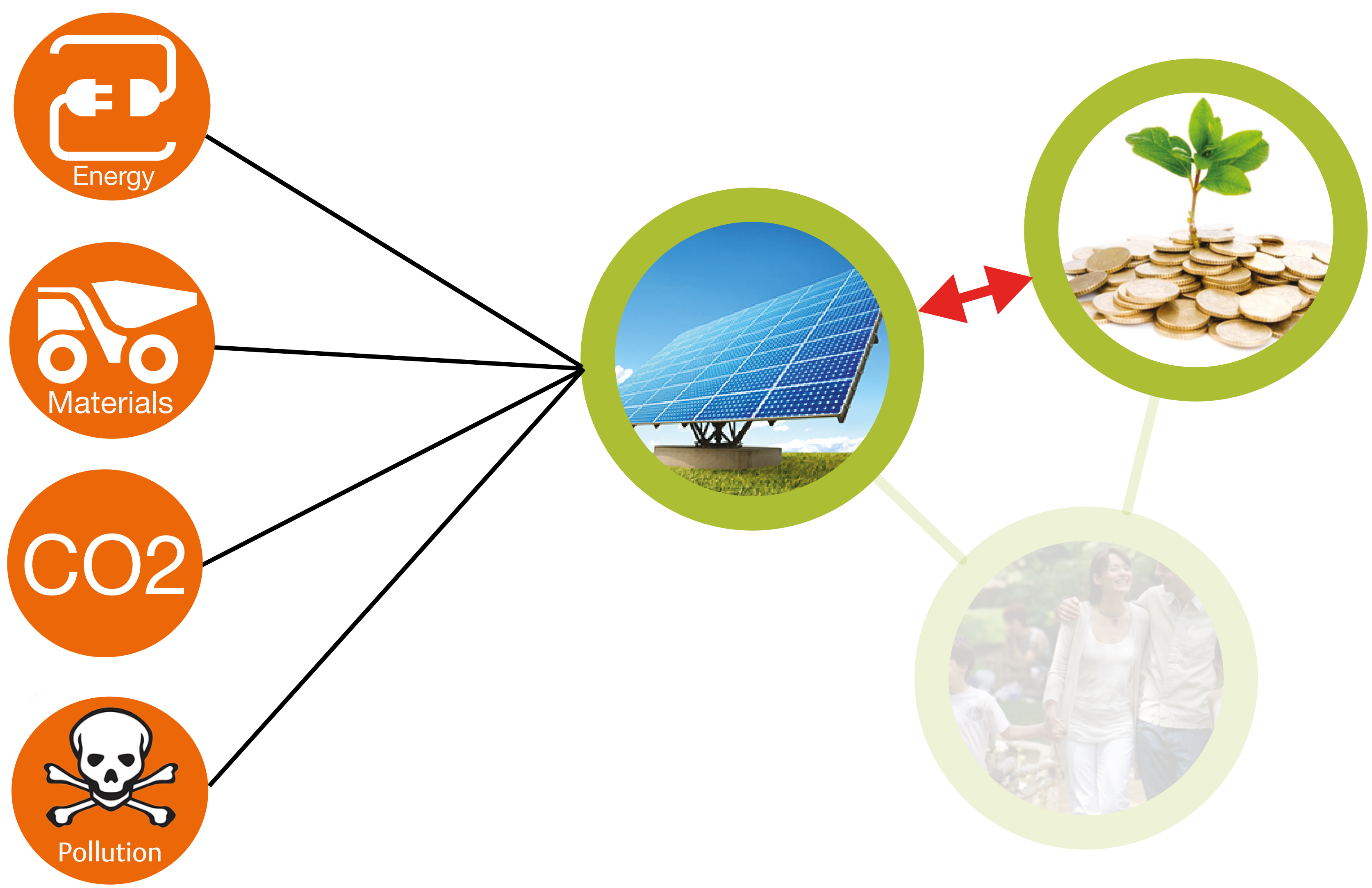

Sustainability tools

Ladder of Lansink

Trias Ecologica

Input
- Reduce the demand
- Use sustainable sources
- Use endless sources responsibly

Output
- Reduce (prevent wastage)
- Reuse waste at highest possible level
- Recycle waste responsibly

Sustainability tools

Ladder of Lansink

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- Reduce the demand
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- Reduce (prevent wastage)
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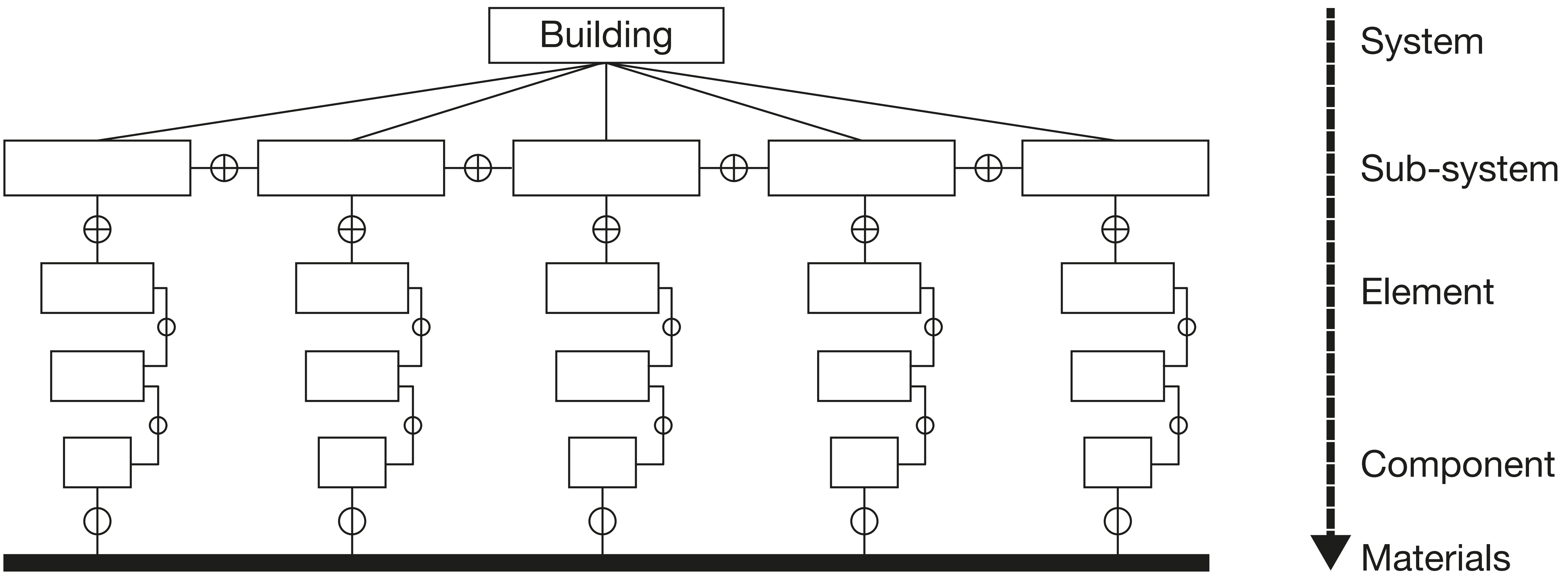
System levels



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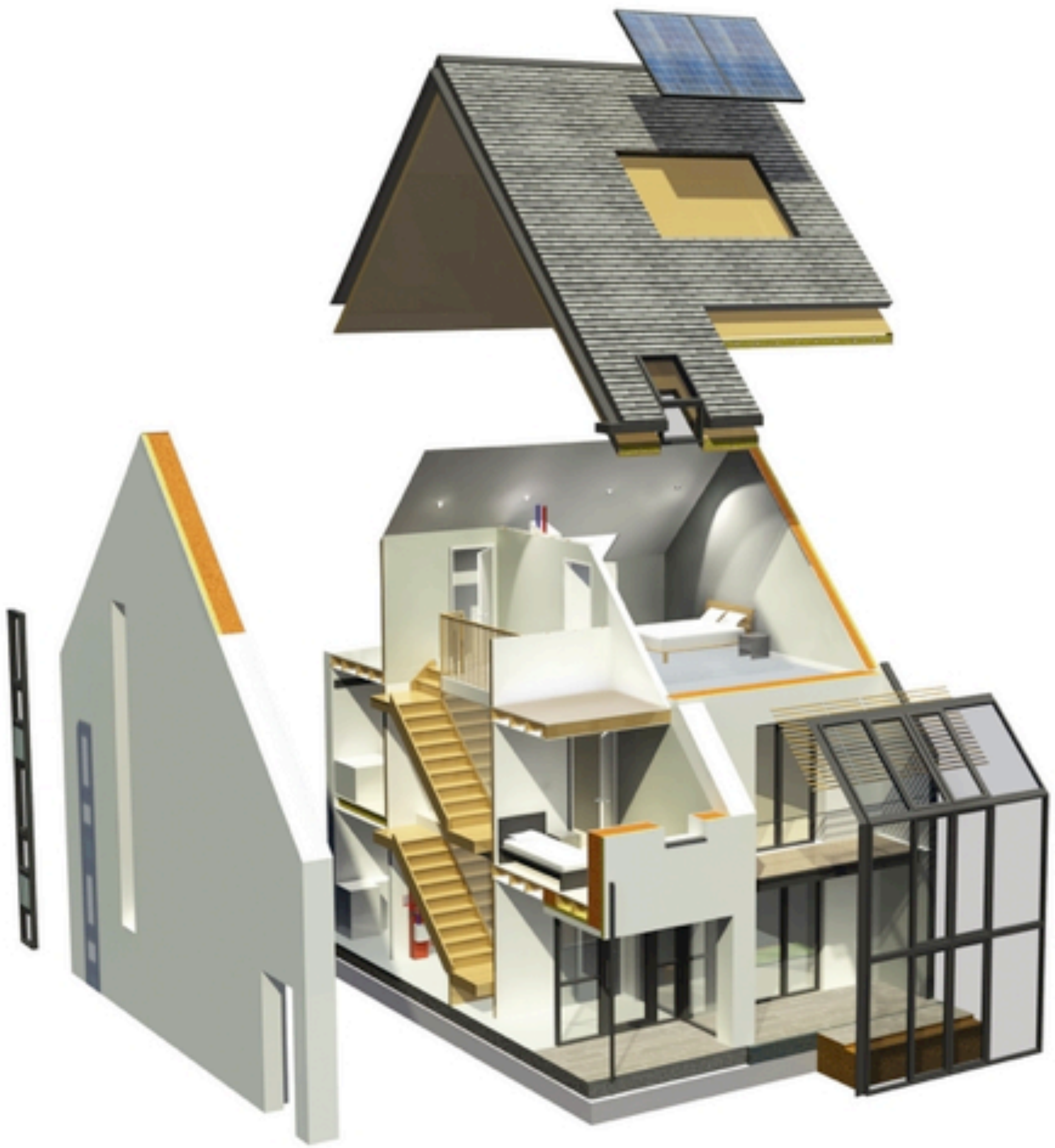


System

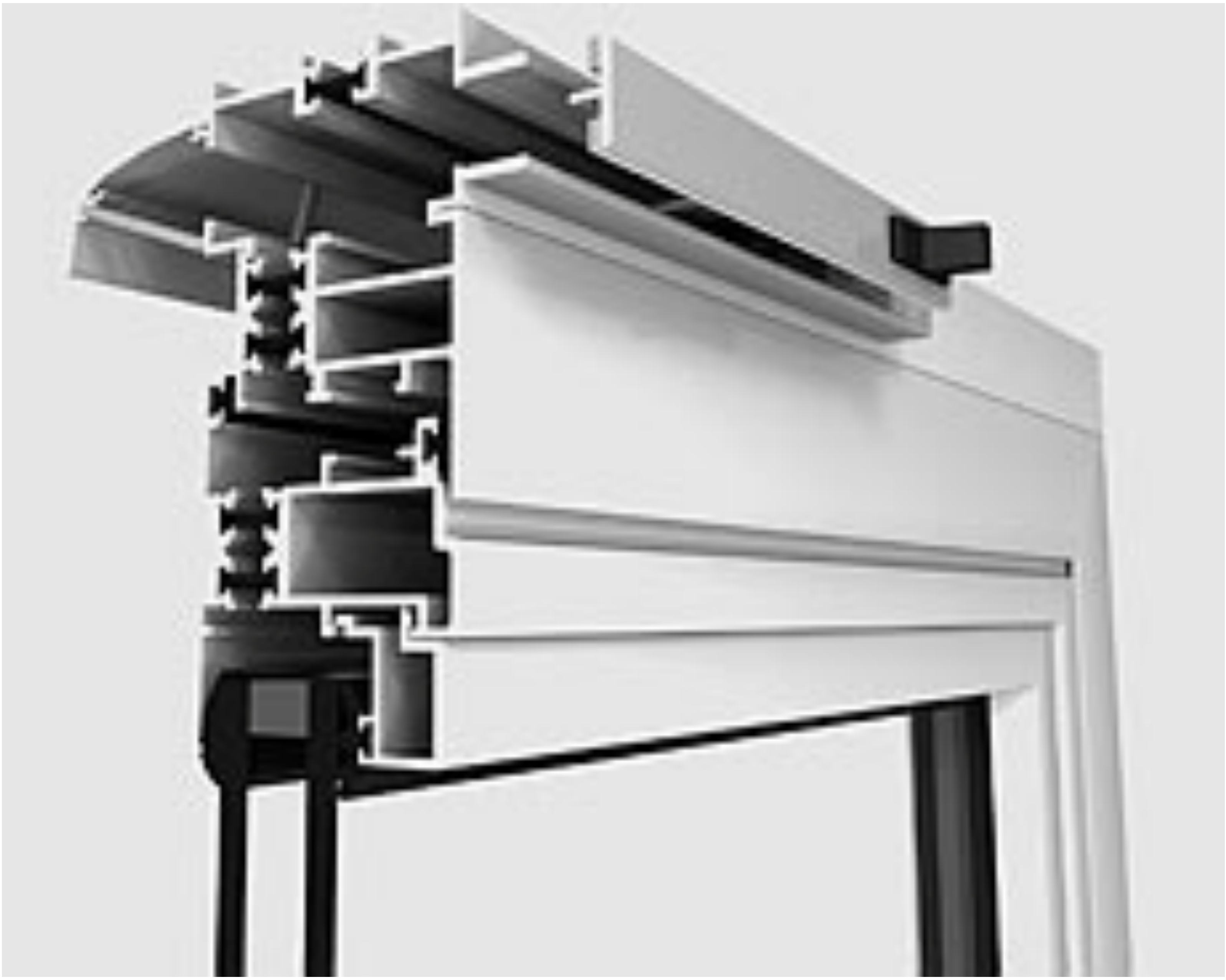
Sub-system

Element

Component

Materials

System levels



- System
- Sub-system
- Element
- Component
- Materials

System levels

- System
- Sub-system
- **Element**
- Component
- Materials

System levels

- System
- Sub-system
- Element
- **Component**
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System levels

System

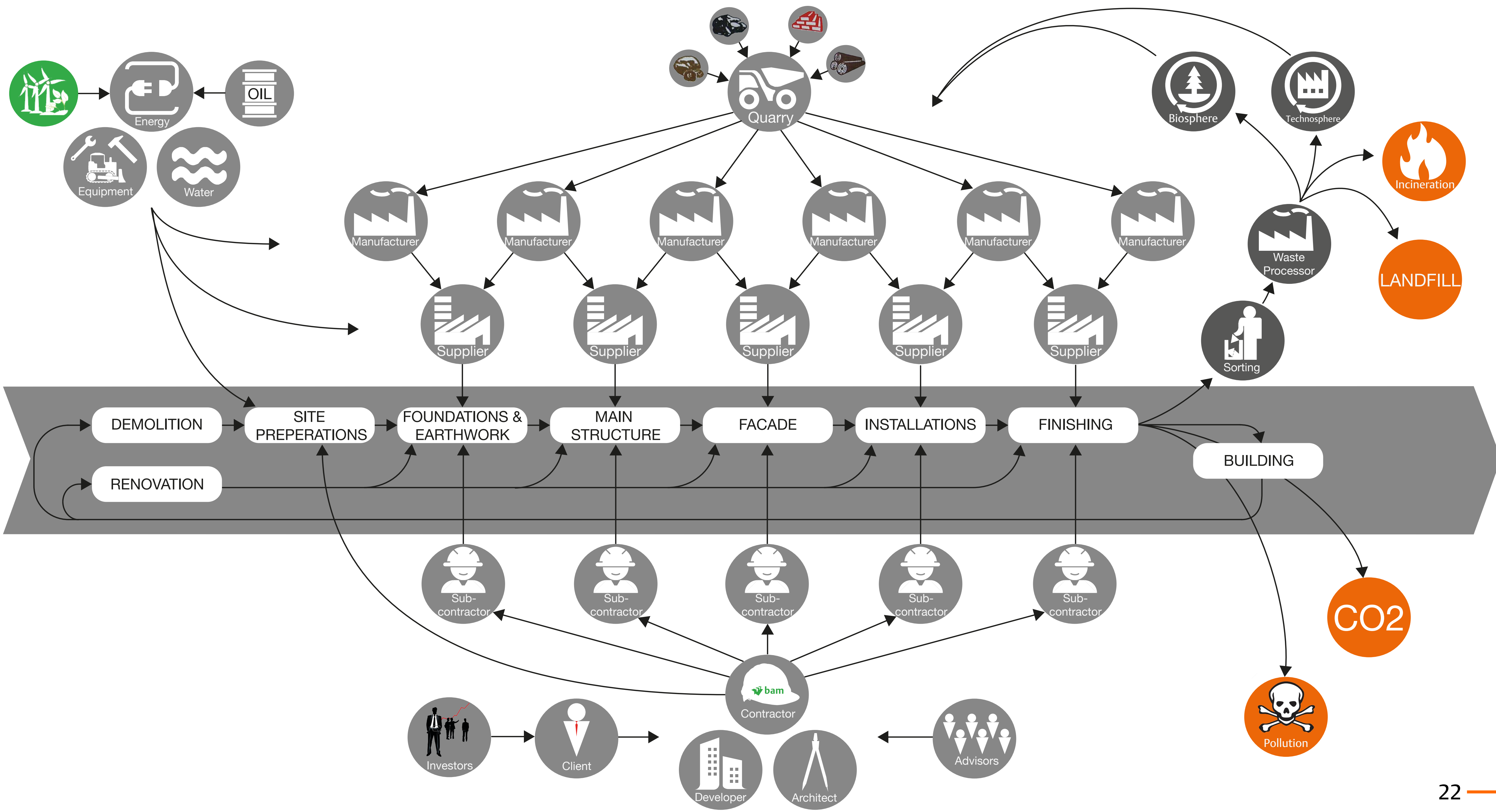
Sub-system

Element

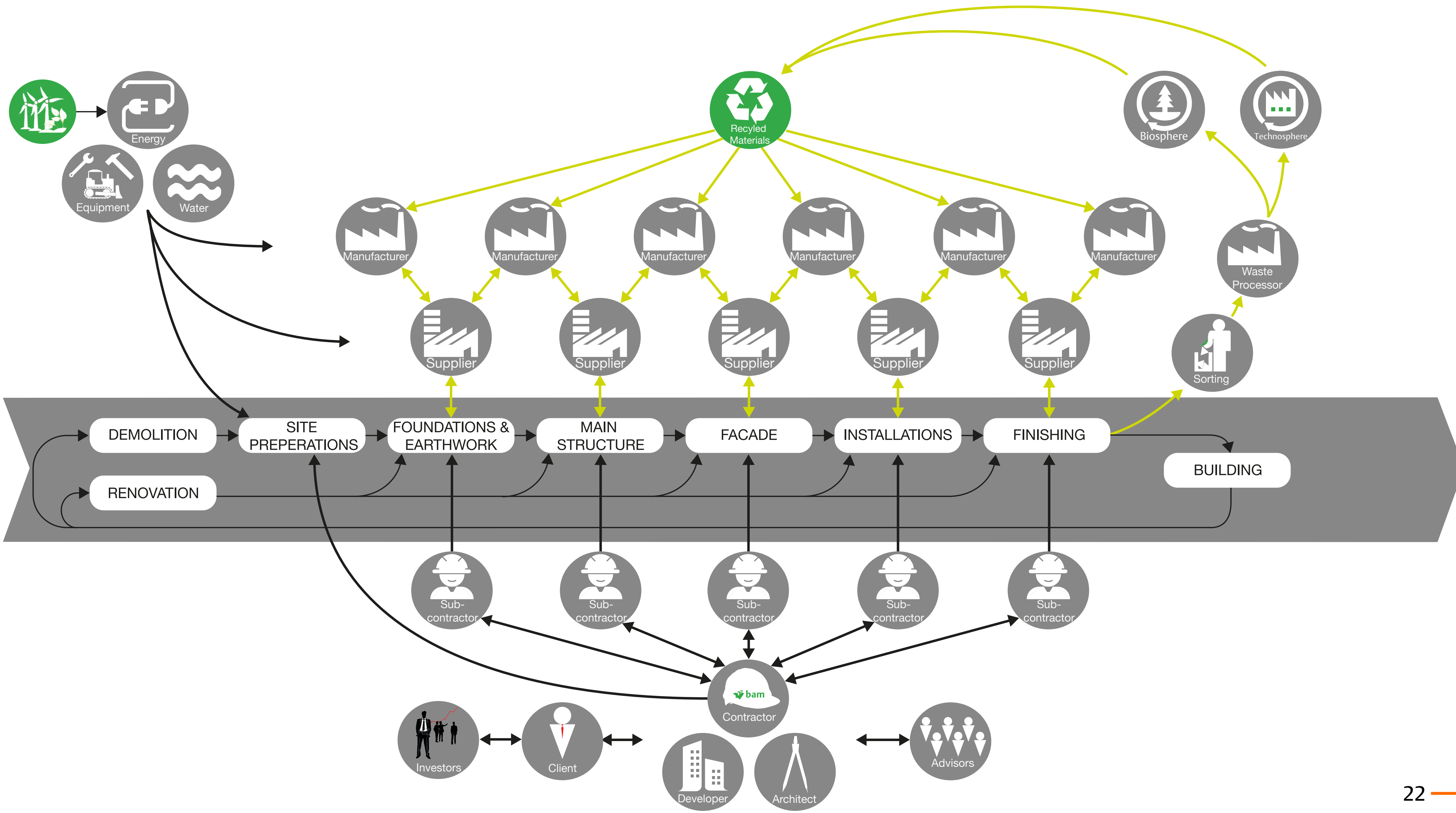
Component

Materials

Sustainable construction process

Sustainable construction process



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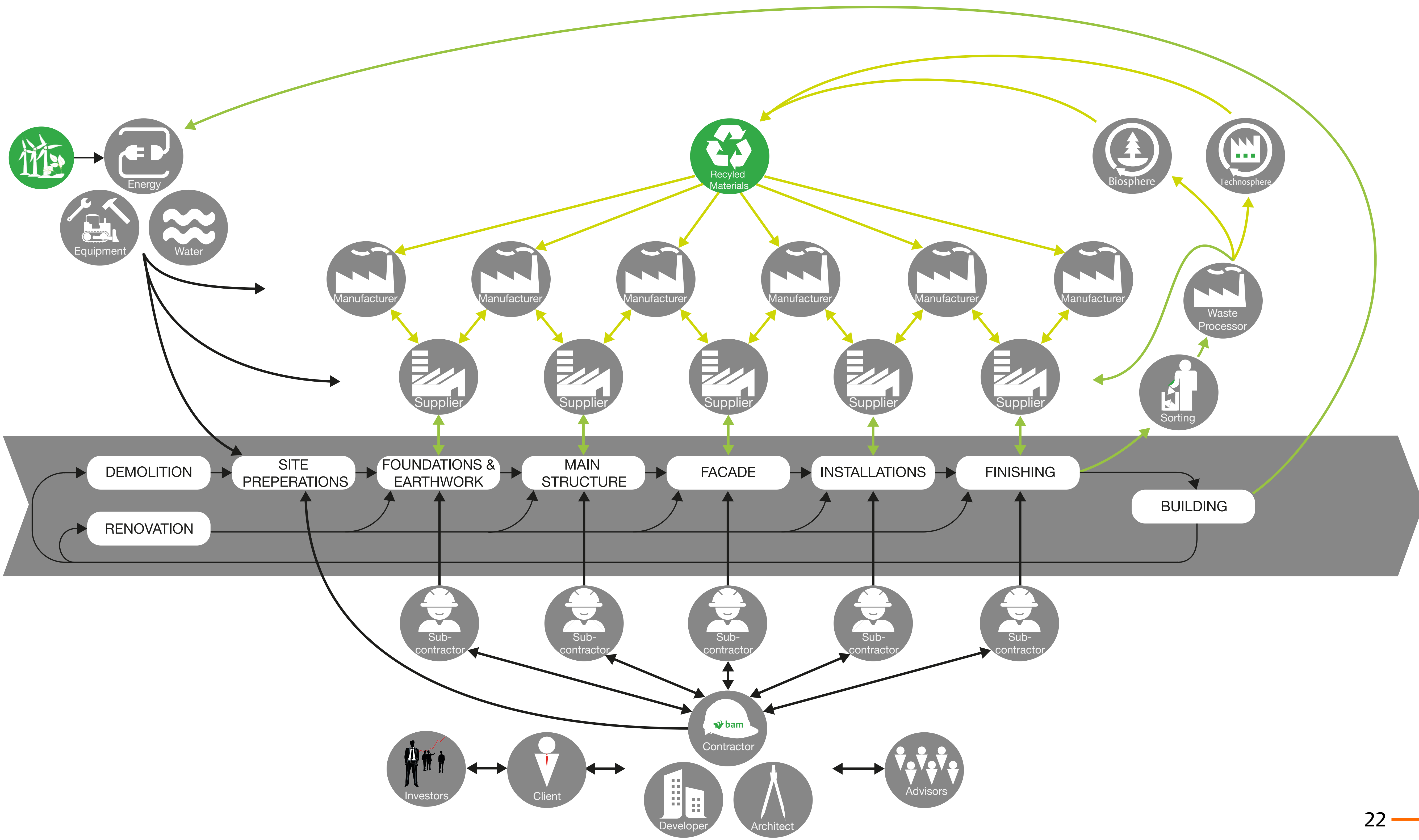

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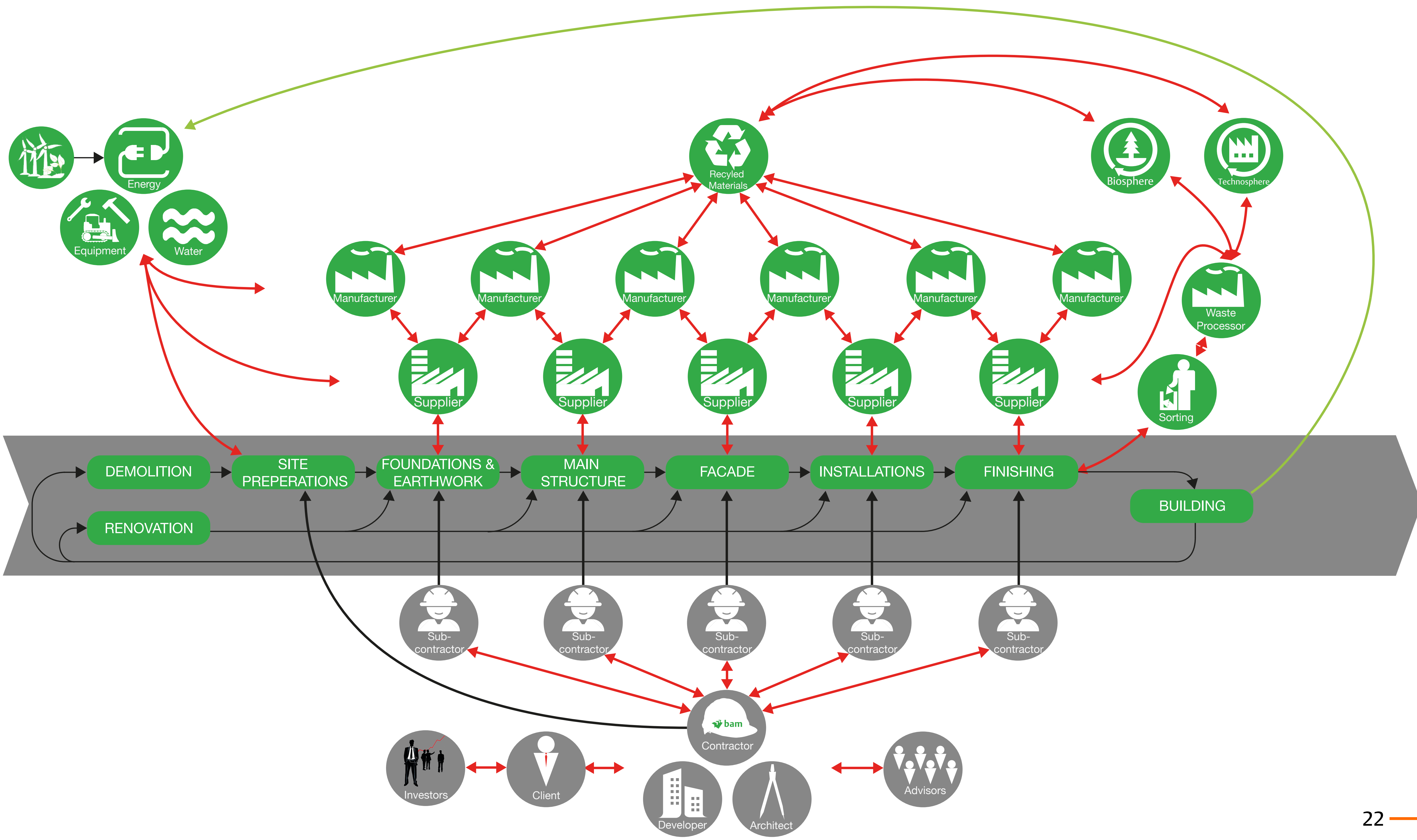

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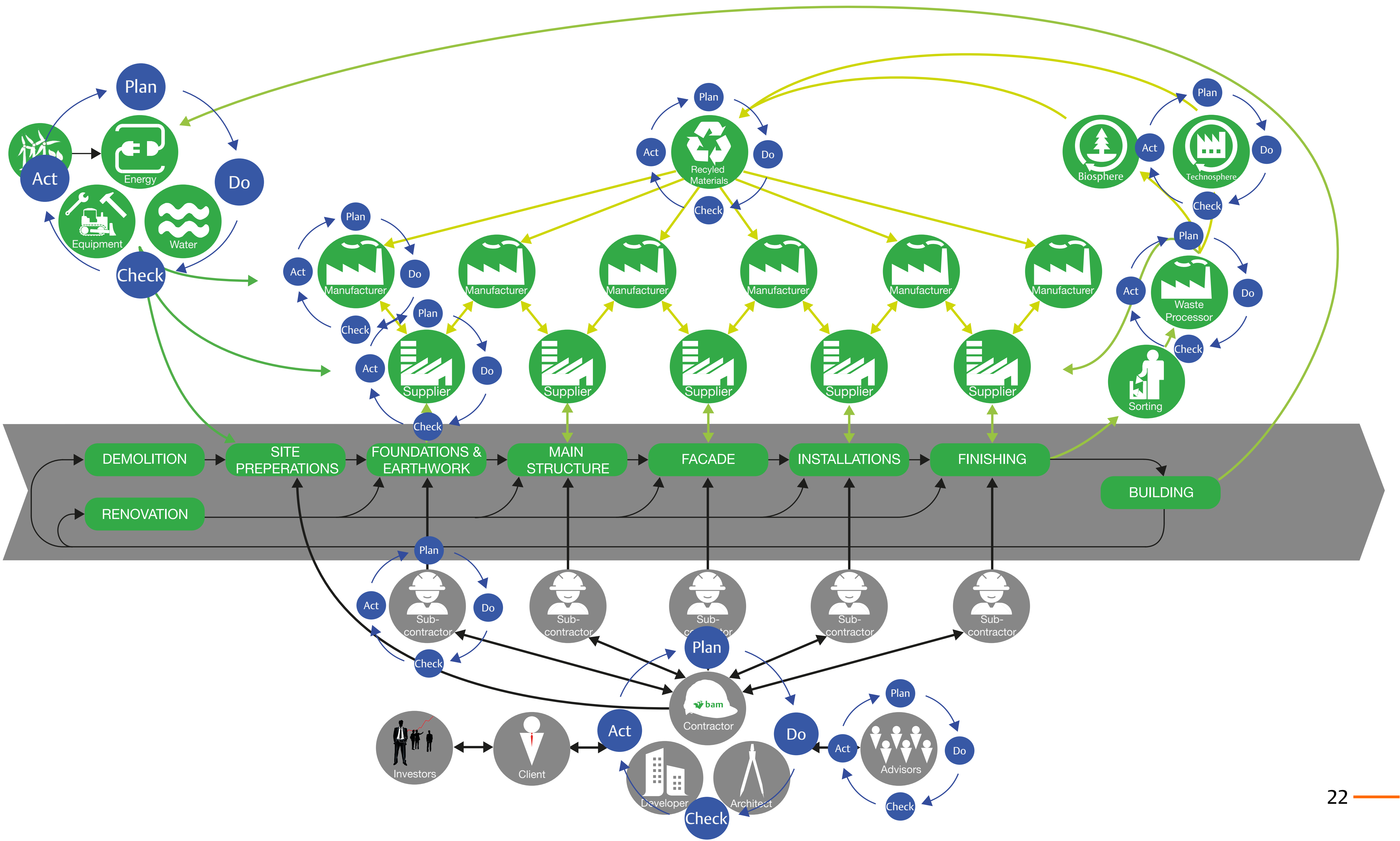
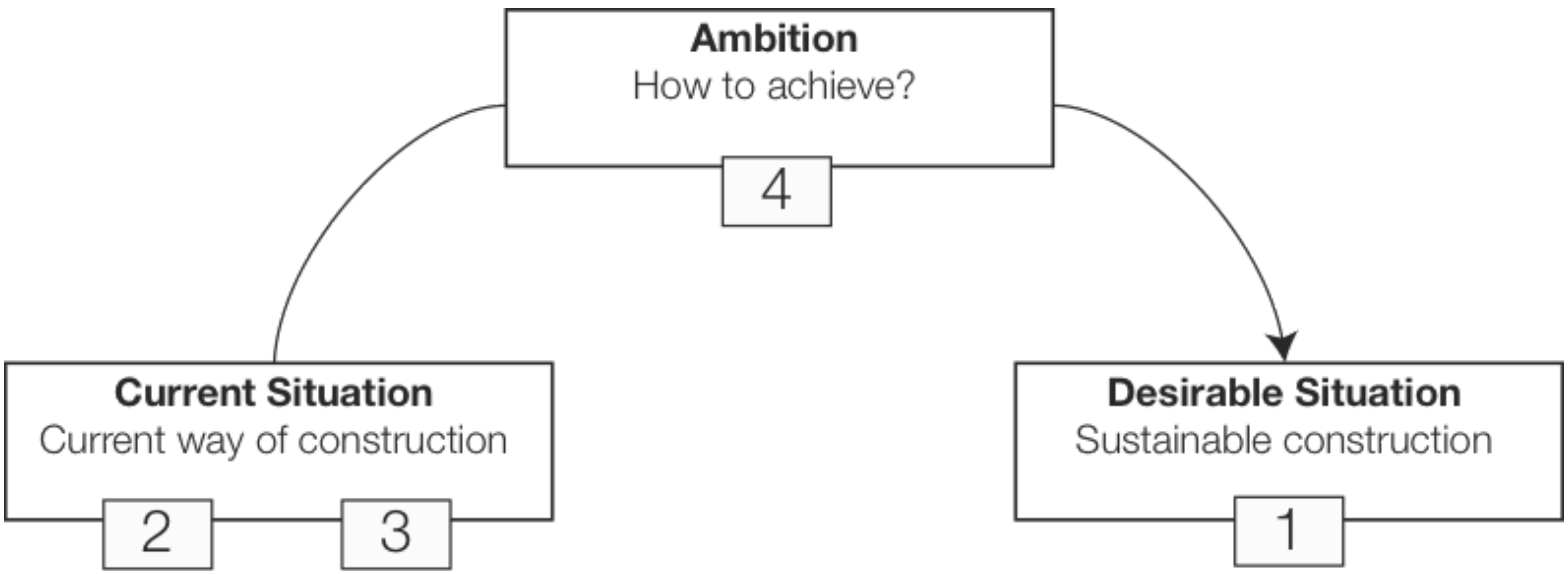


04 Obstacles sustainable construction

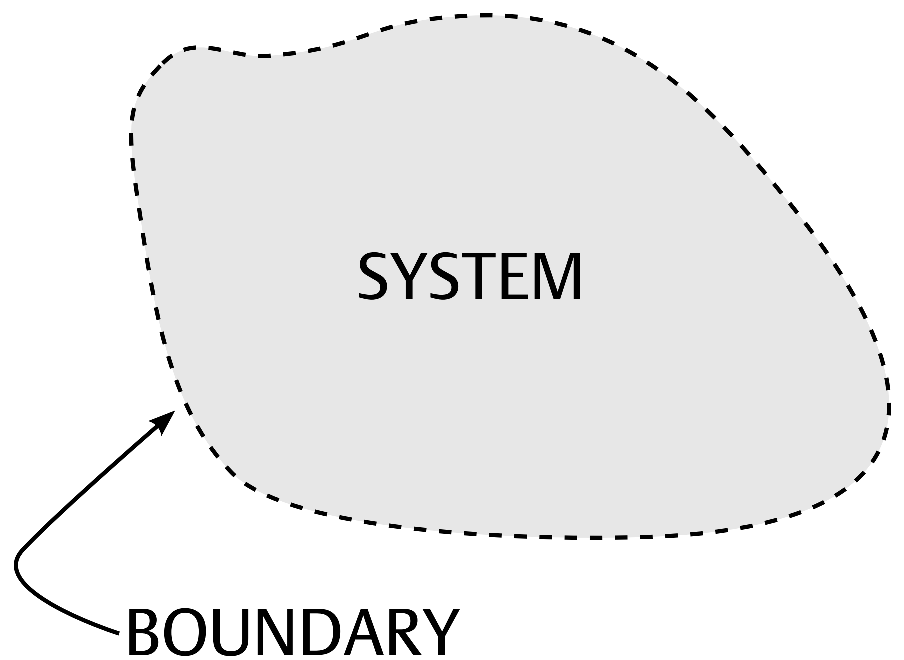
Research set-up



SWOT

SWOT

- Filtering of information
- Assessment of the strengths, weakness, opportunities and threats of the system concealed in the answers
- Finding the essence



	Strength	Weakness
Opportunity	Do the strengths influence the opportunities?	Do the opportunities have a relation to the weaknesses of the system?
Threat	Do the strengths minimize the impact of threats	Do the weaknesses influence the threats?

Strength

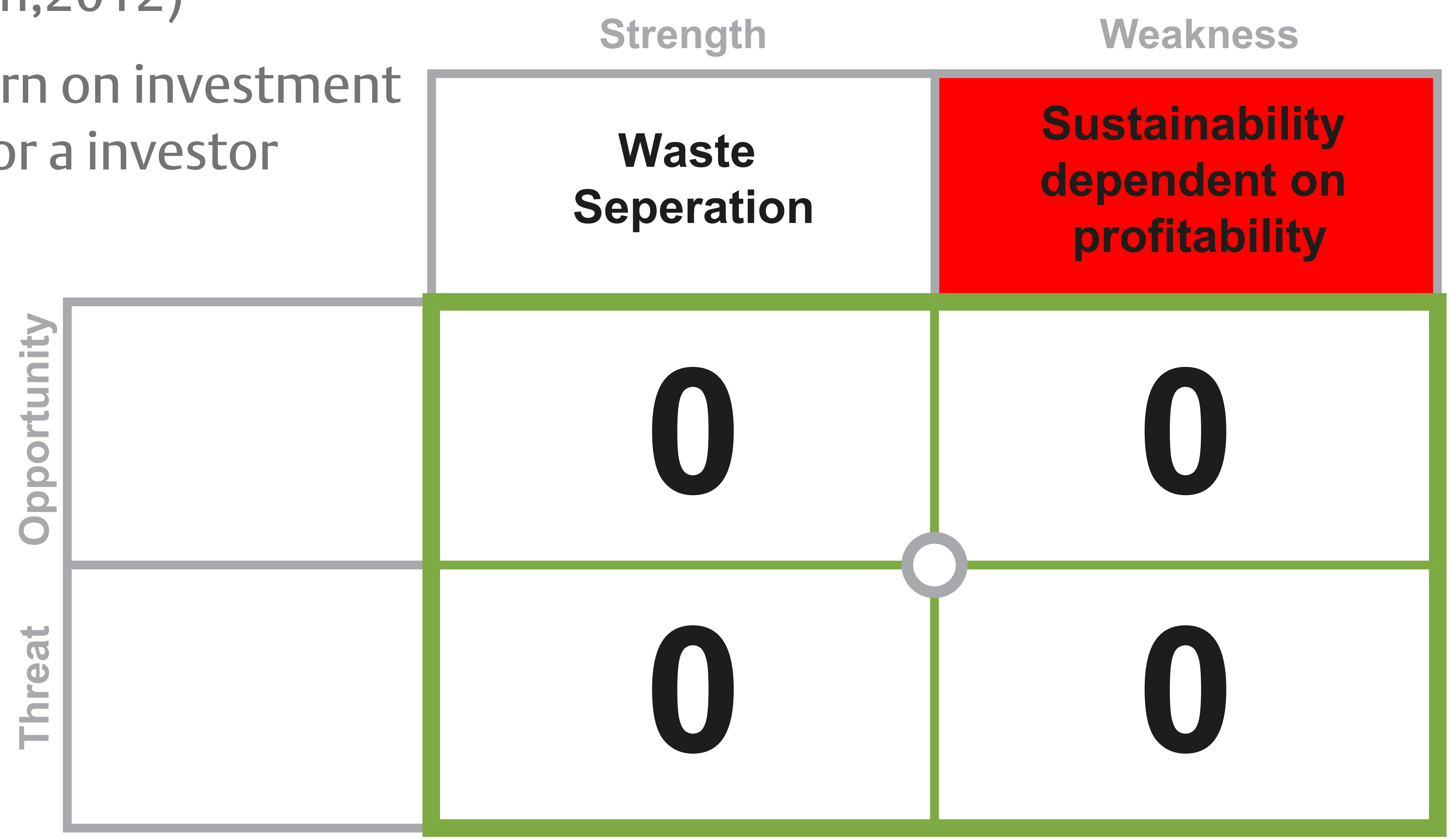
Quotes

- ‘We sort up to 94% of our waste’ (Heye,2012)
- ‘Waste separation is improving’ (Troost,2012)
- ‘Waste separation creates awareness’

Weakness

Quotes

- ‘We are sorting waste because the processors charge less for unsorted waste’ (v/d Hoeven,2012)
- ‘Energy has a return on investment that is attractive for a investor (Korbee, 2012)



Opportunity

Quotes

- ‘Demand for sustainability is growing’ (Haas, 2012)
- ‘There is more support for sustainability than 5 years ago’ (Troost, 2012)

		Strength	Weakness
		Waste Seperation	**Sustainability dependent on profitability**
Opportunity	**Demand for sustainability is growing**	**0**	**0**
Threat		**0**	**0**

Opportunity

Quotes

- ‘Demand for sustainability is growing’ (Haas, 2012)
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		Strength	Weakness
		Waste Seperation	**Sustainability dependent on profitability**
Opportunity	**Demand for sustainability is growing**	1	1
Threat		0	0

Threat

Quotes

- ‘Changing legislation means we have to change all the time’ (v/d Hoeven, 2012)
- ‘Legislation on energy is changing all the time’ (Korbee, 2012)

		Strength	Weakness
		Waste Seperation	**Sustainability dependent on profitability**
Opportunity	**Demand for sustainability is growing**	1	1
Threat	**Changing legislation**	0	0

Threat

Quotes

- ‘Changing legislation means we have to change all the time’ (v/d Hoeven, 2012)
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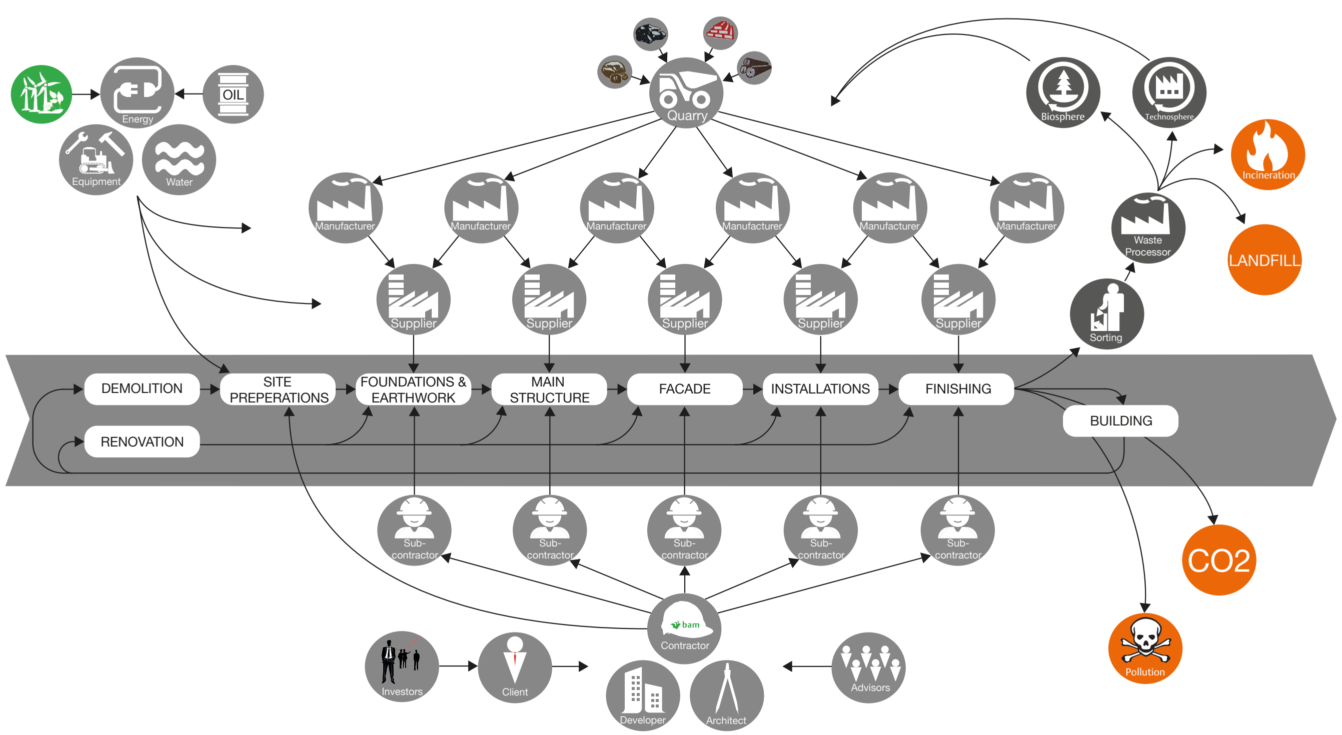
		Strength	Weakness
		Waste Seperation	**Sustainability dependent on profitability**
Opportunity	**Demand for sustainability is growing**	**1**	**1**
Threat	**Changing legislation**	**1**	**1**

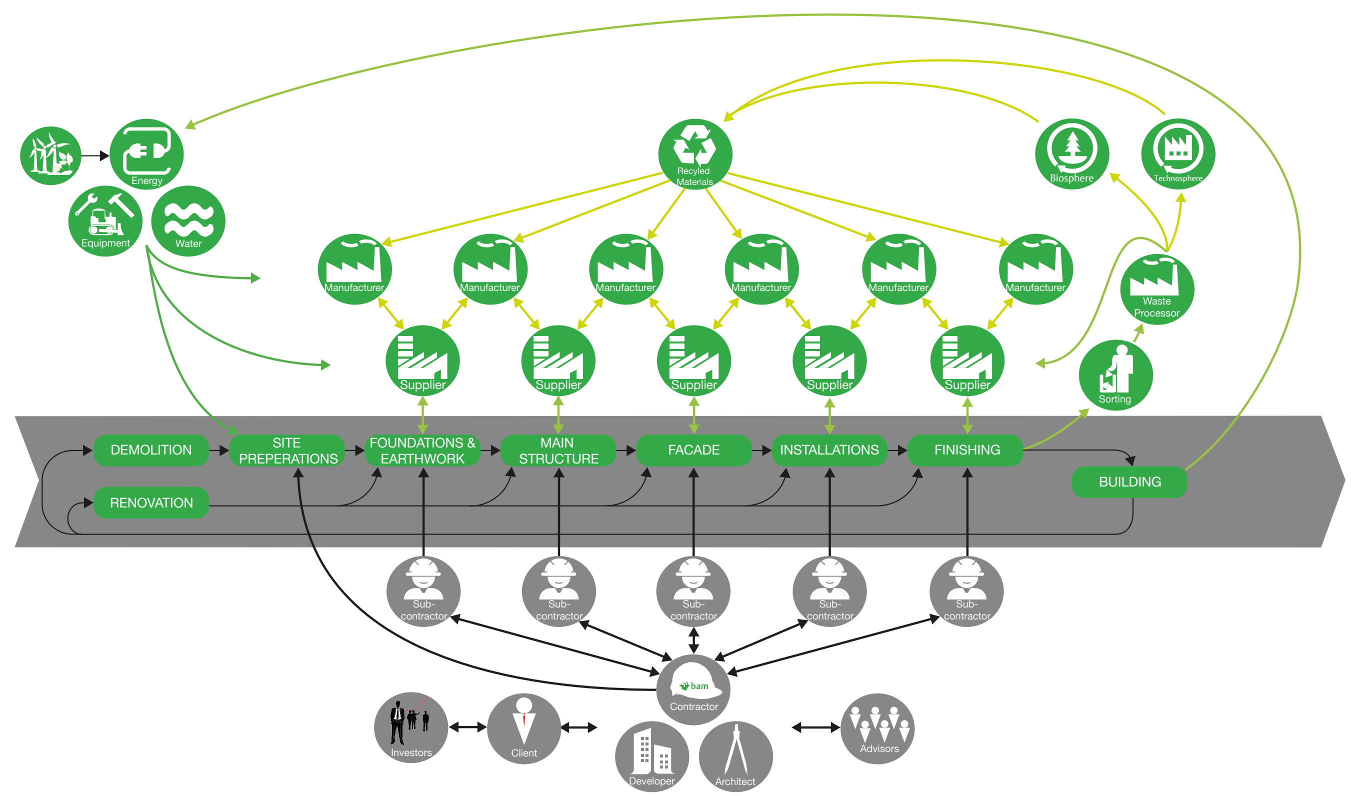
SWOT analysis

External / Internal	Strengths 1: Waste seperation (finacially attractive)	Strengths 2: Various materials with high recycling percentages	Strengths 3: Various bio-sphere materials used in a sustainable way (FSC wood)	Strengths 4: Design reduces materials needed	Strengths 5: Various methodologies and tools can contribute towards sustainable construction	Weakness 1: Bad communication between main actors	Weakness 2: Not enough commitment towards sustainability within the process	Weakness 3: Sustainability dependent on profitability (return on investment)	Weakness 4: Dependent on the time the contractor is involved or from the demand of the client	Weakness 5: Construction workers not educated enough	Weakness 6: Sustainable labels used as unjustified definition for sustainability	Weakness 7: Dependability (for equal competition) lies on legislation	Weakness 8: Not asking the right (sustainable) questions	Weakness 9: Decreasing level of sustainable ambition as the project progresses	Weakness 10: Not learning from other industries/companies (abroad)
Opportunities															
1 Best value procurement	0	1	1	1	0	0	0	1	1	0	0	1	1	1	0
2 Corporate social responsability	1	1	1	1	0	0	1	1	0	1	0	0	0	1	1
3 Demand for sustainability is growing	1	1	1	1	0	0	1	1	0	0	1	1	1	1	0
4 Some aspects of sustainability have a return on investment potential (Like energy)	1	0	0	1	1	0	1	1	1	0	0	1	1	1	0
5 Supply chain integration	0	0	0	0	1	1	1	1	1	0	0	0	1	1	1
6 Use feedback (Better communication)	0	0	0	1	1	1	1	0	0	1	0	1	1	0	1
Threats															
1 Predetermined sustainability (Client or labels)	0	0	0	1	0	0	1	1	1	0	1	1	1	1	0
2 Changing legislation/regulations	1	0	1	0	0	0	0	1	0	0	0	1	0	1	0
3 No legislation for materials	0	0	0	1	0	0	1	1	0	0	0	1	0	0	0
4 Focus on 'energy' leaves 'material depletion' in the shadows	1	1	1	1	0	1	1	1	1	0	1	1	1	0	0
5 Return on investment models of aspects are not viable anymore	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0
6 Bad financial situation organizations (Economical Crisis)	0	0	0	1	0	0	1	1	1	0	1	1	0	1	0

Main obstacles

- Profitability
- Commitment
- Labels used as unjustifiable definition for sustainability
- Difference in linear and cyclic thinking





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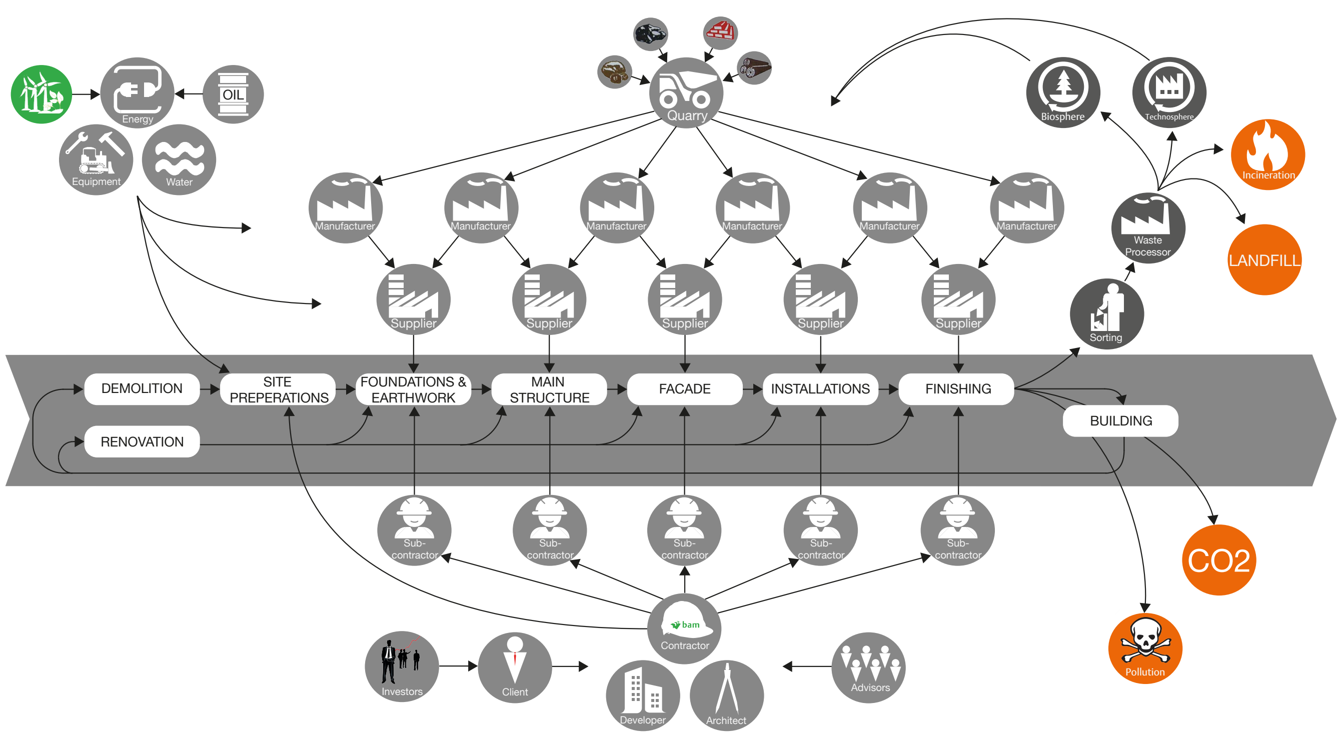

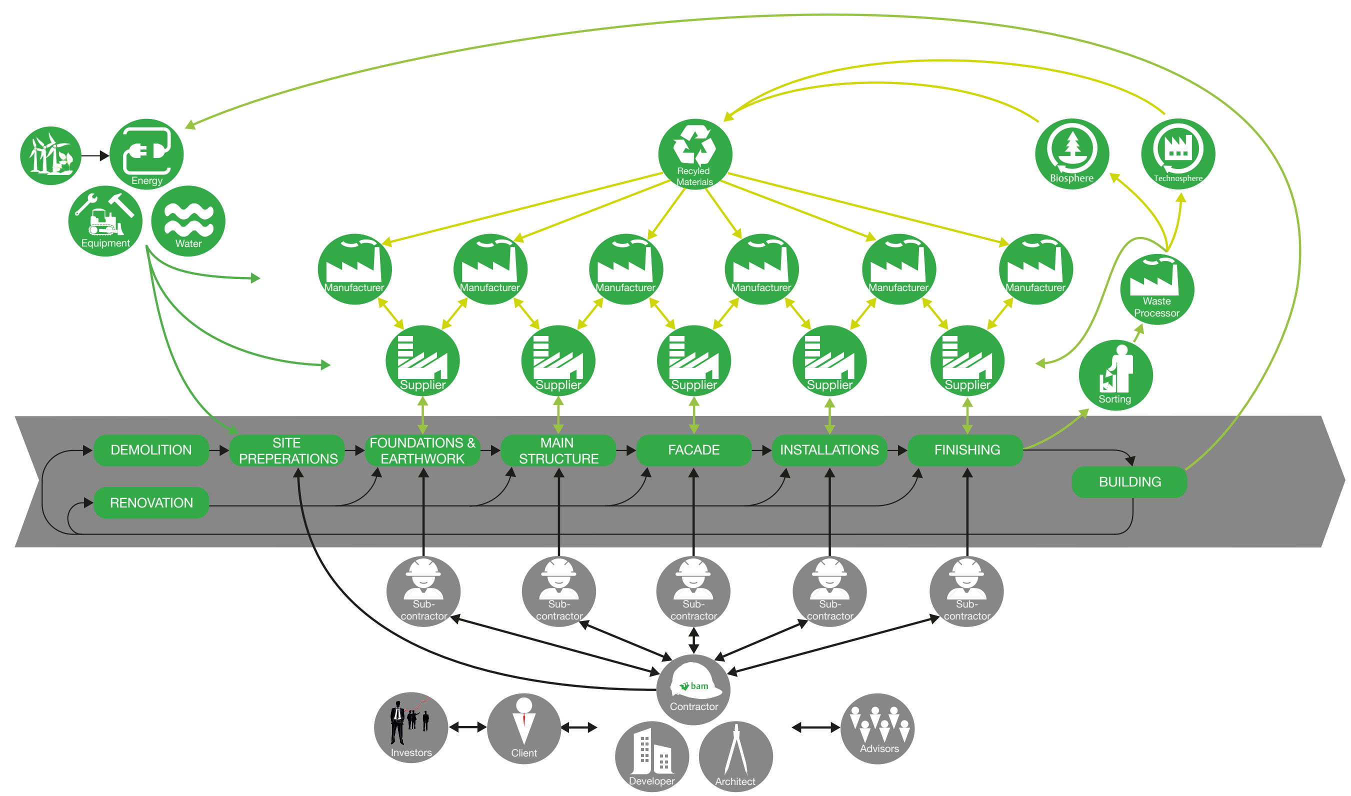

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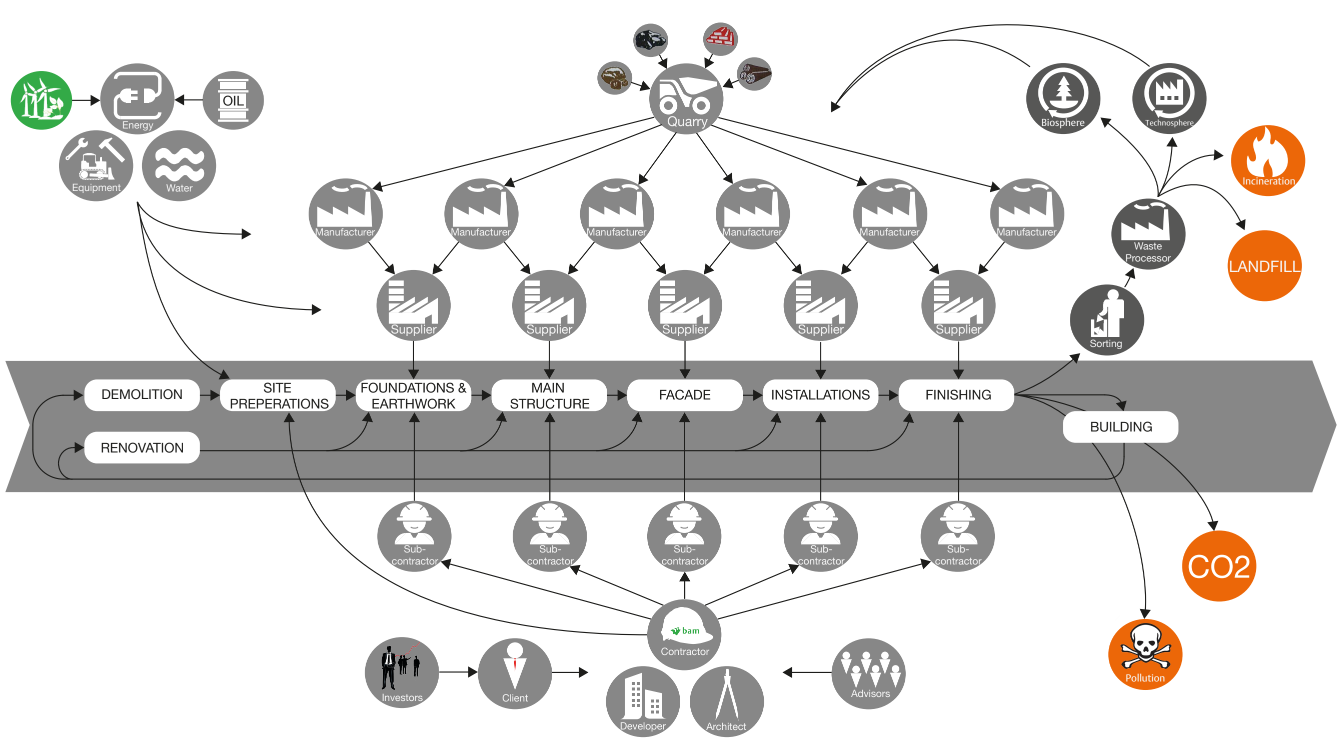

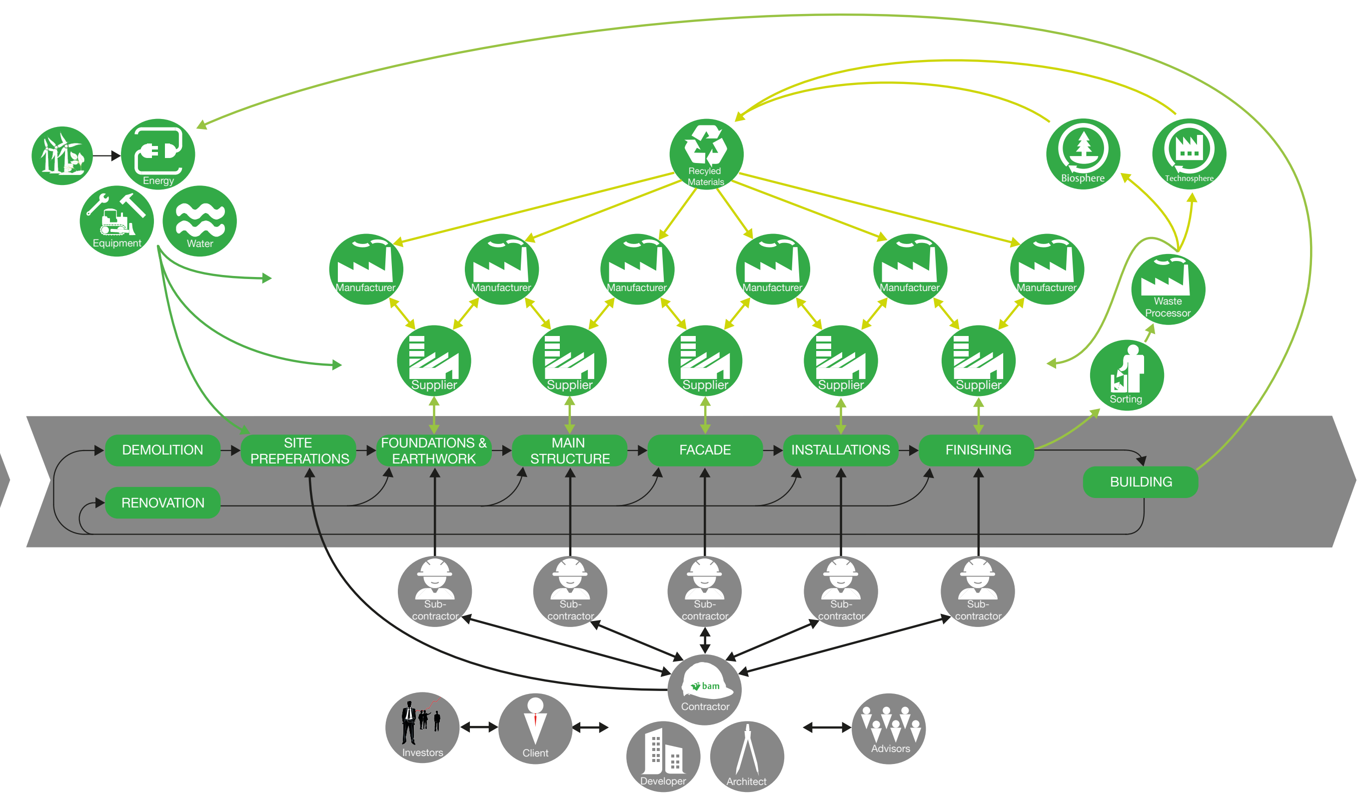

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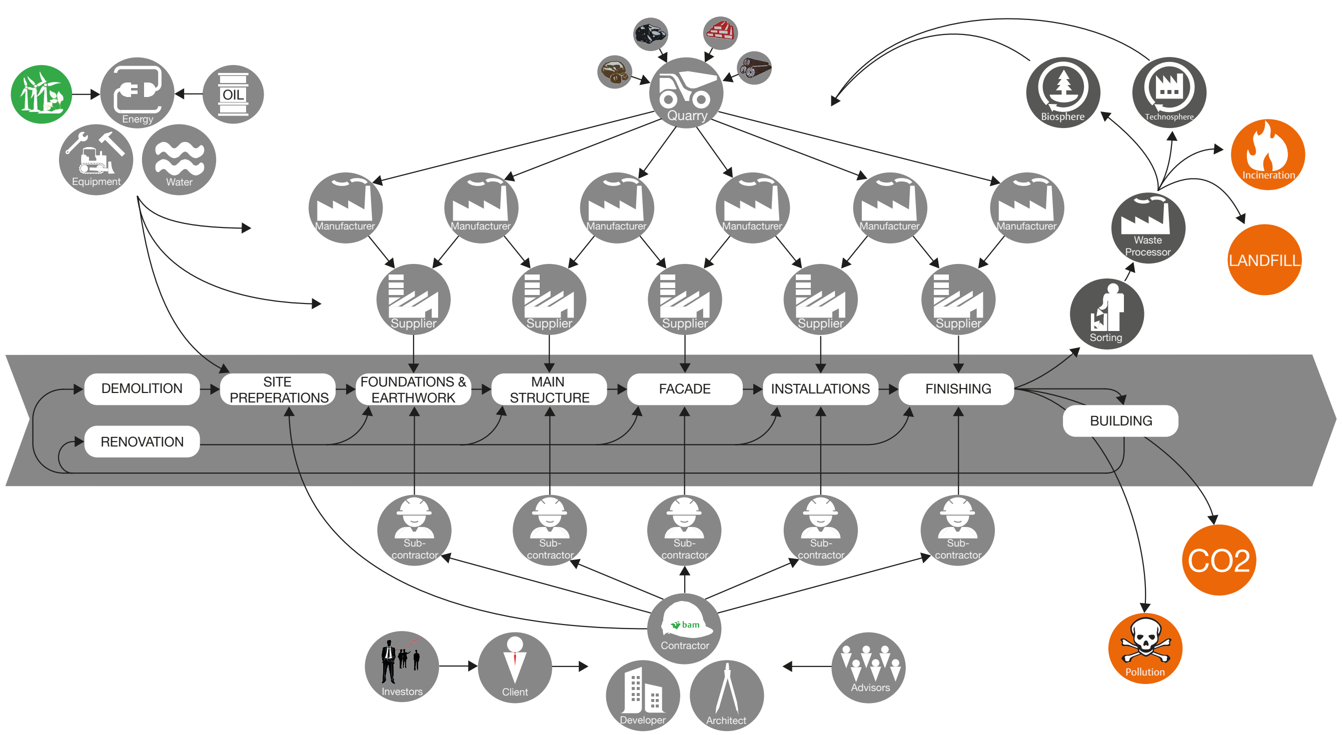

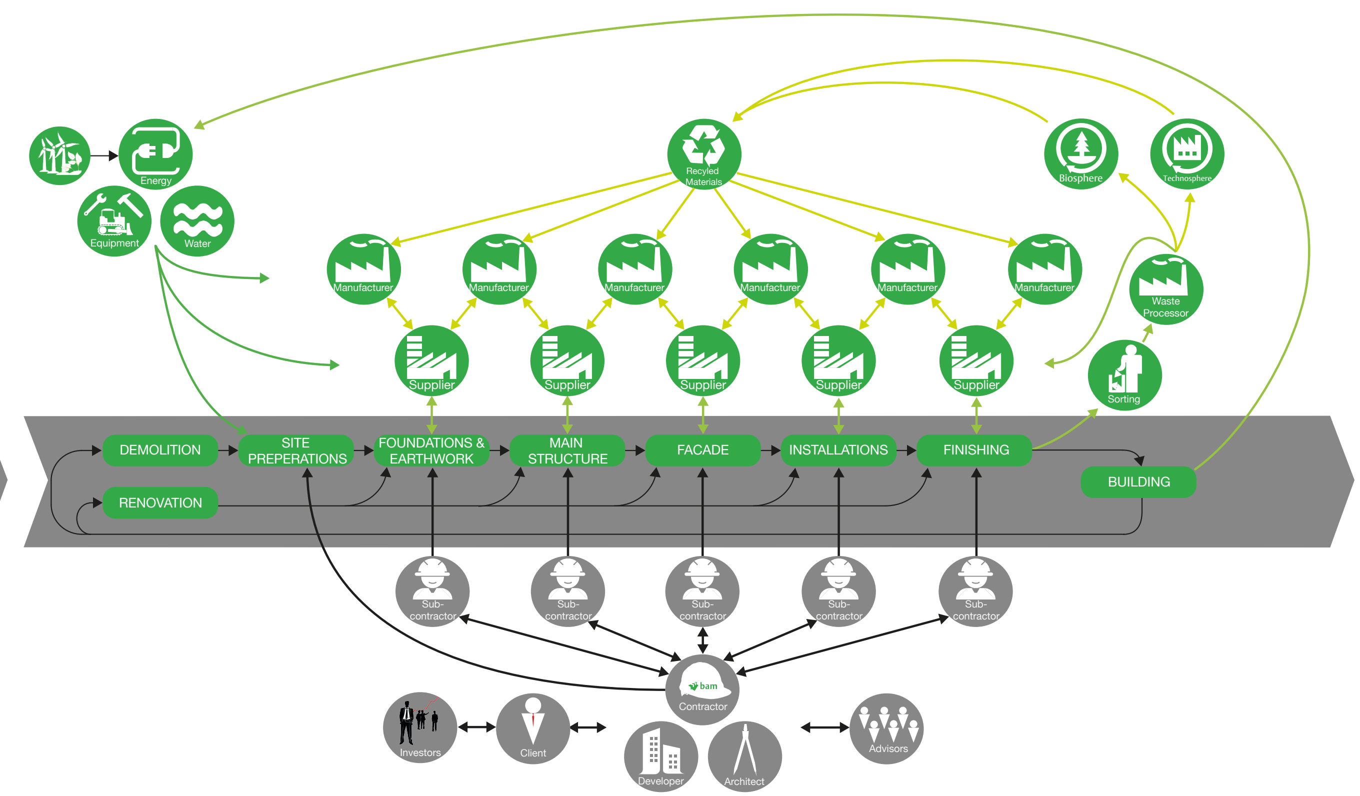

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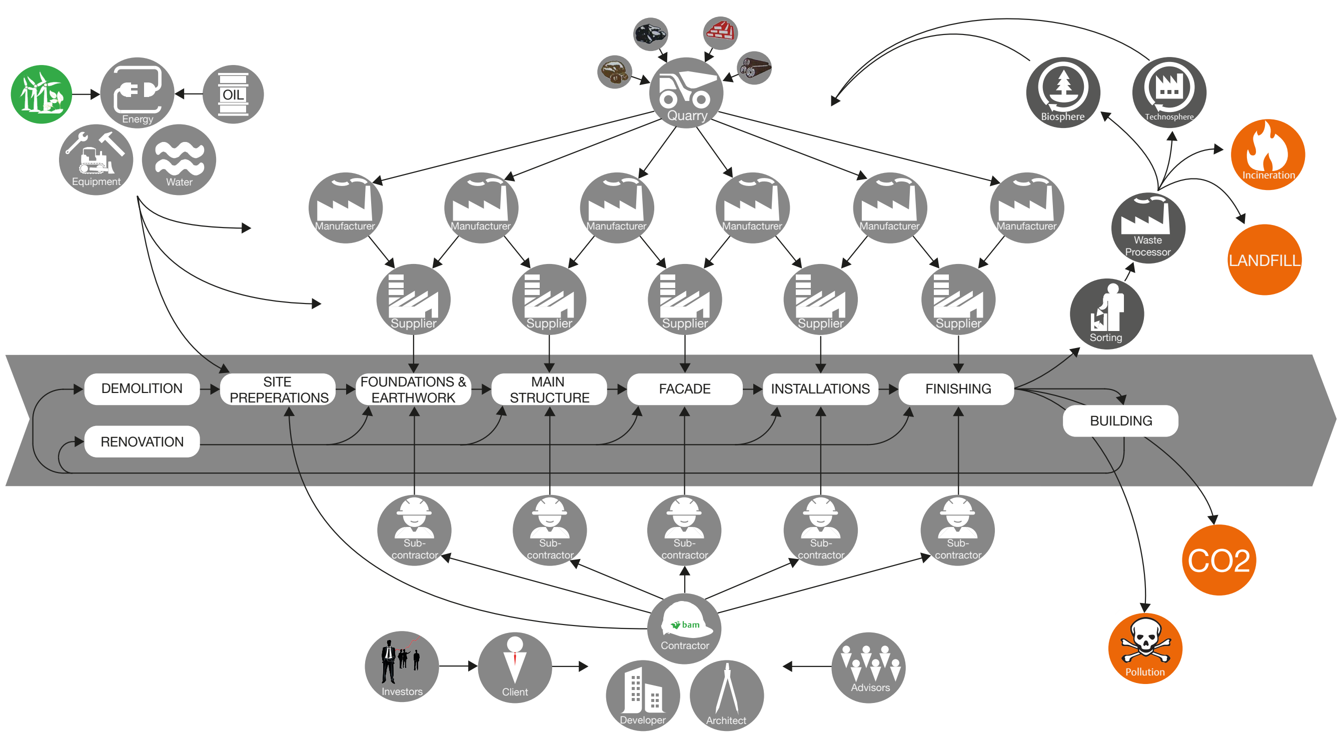
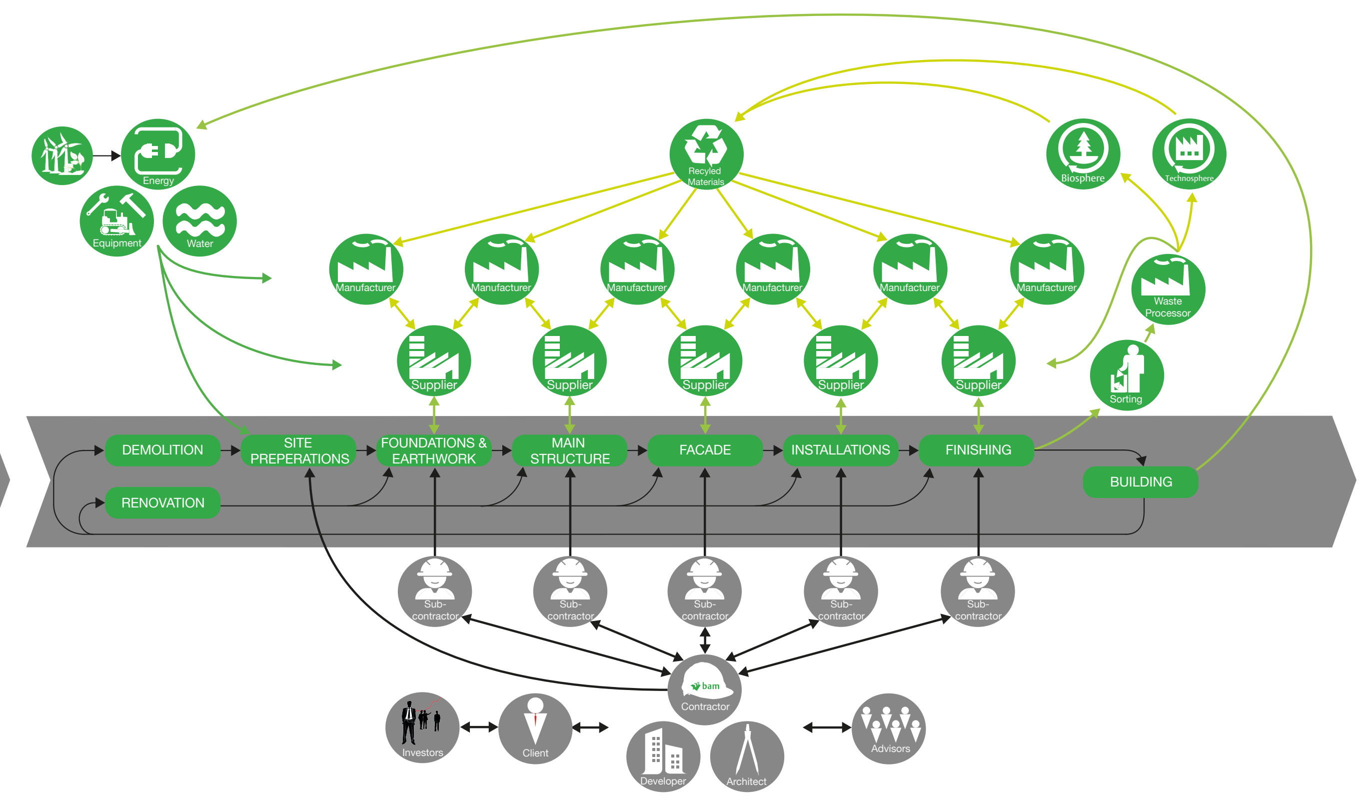
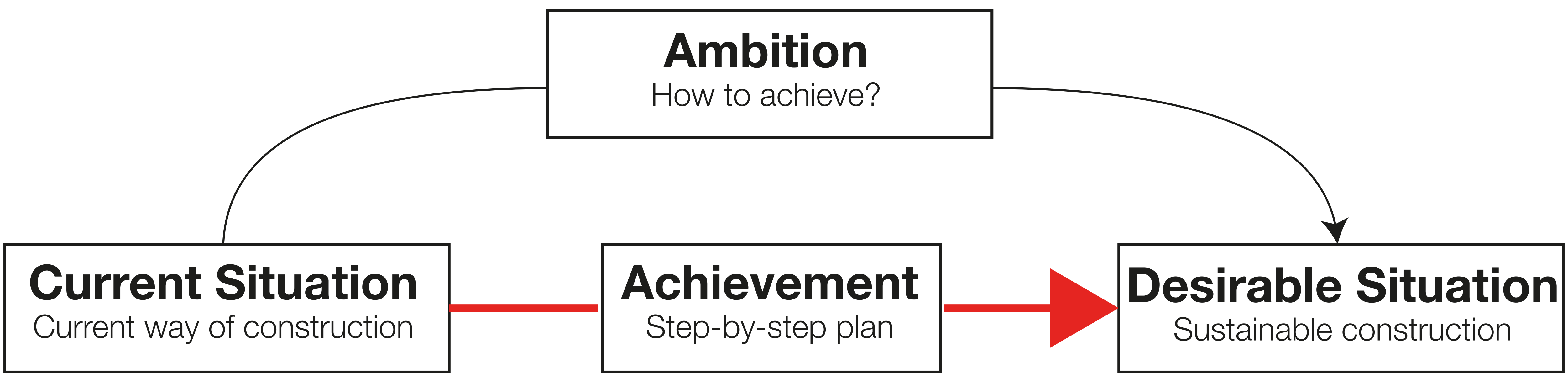




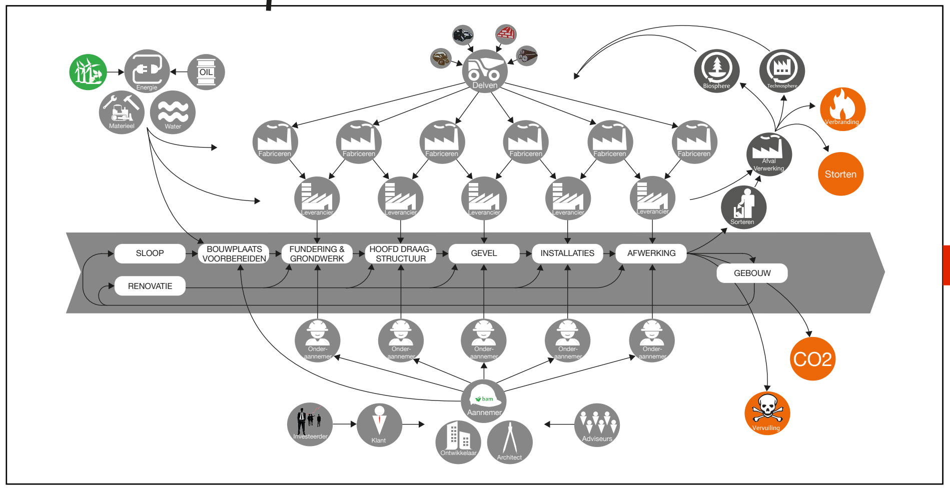
05 Implementing sustainable construction

Developing a solution



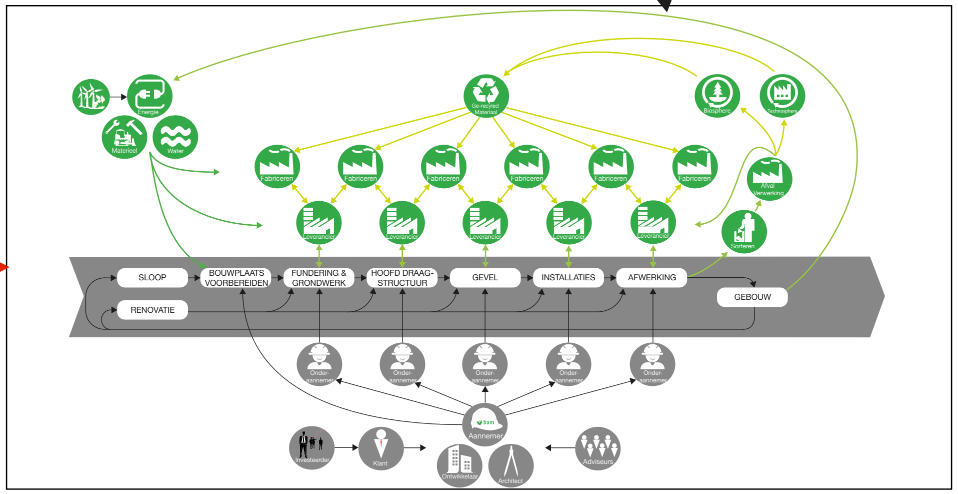
Developing a solution

Obstacles



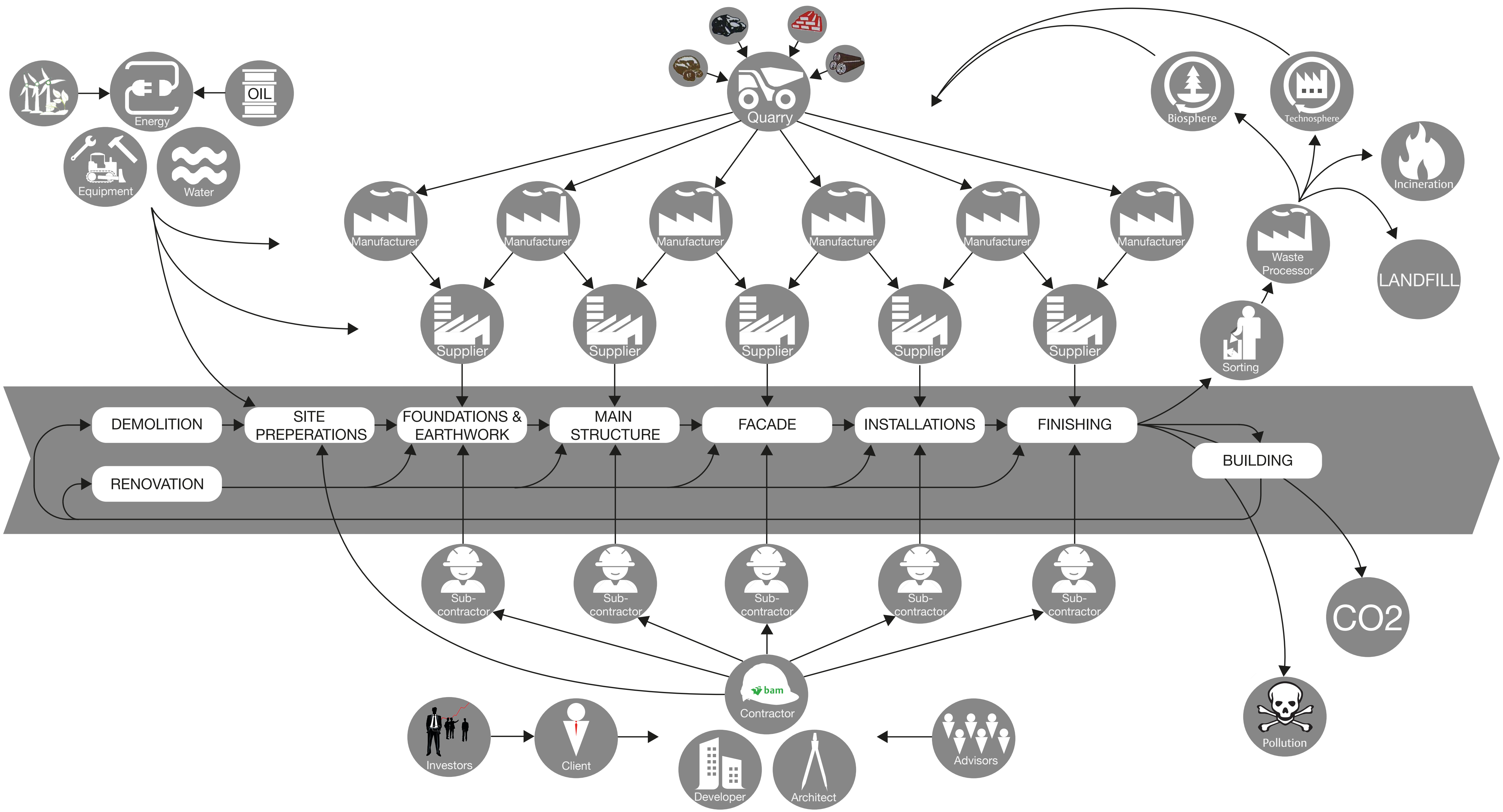
The current construction process

Step-by-step plan



The sustainable construction

Step 1: Scoping - element of choice



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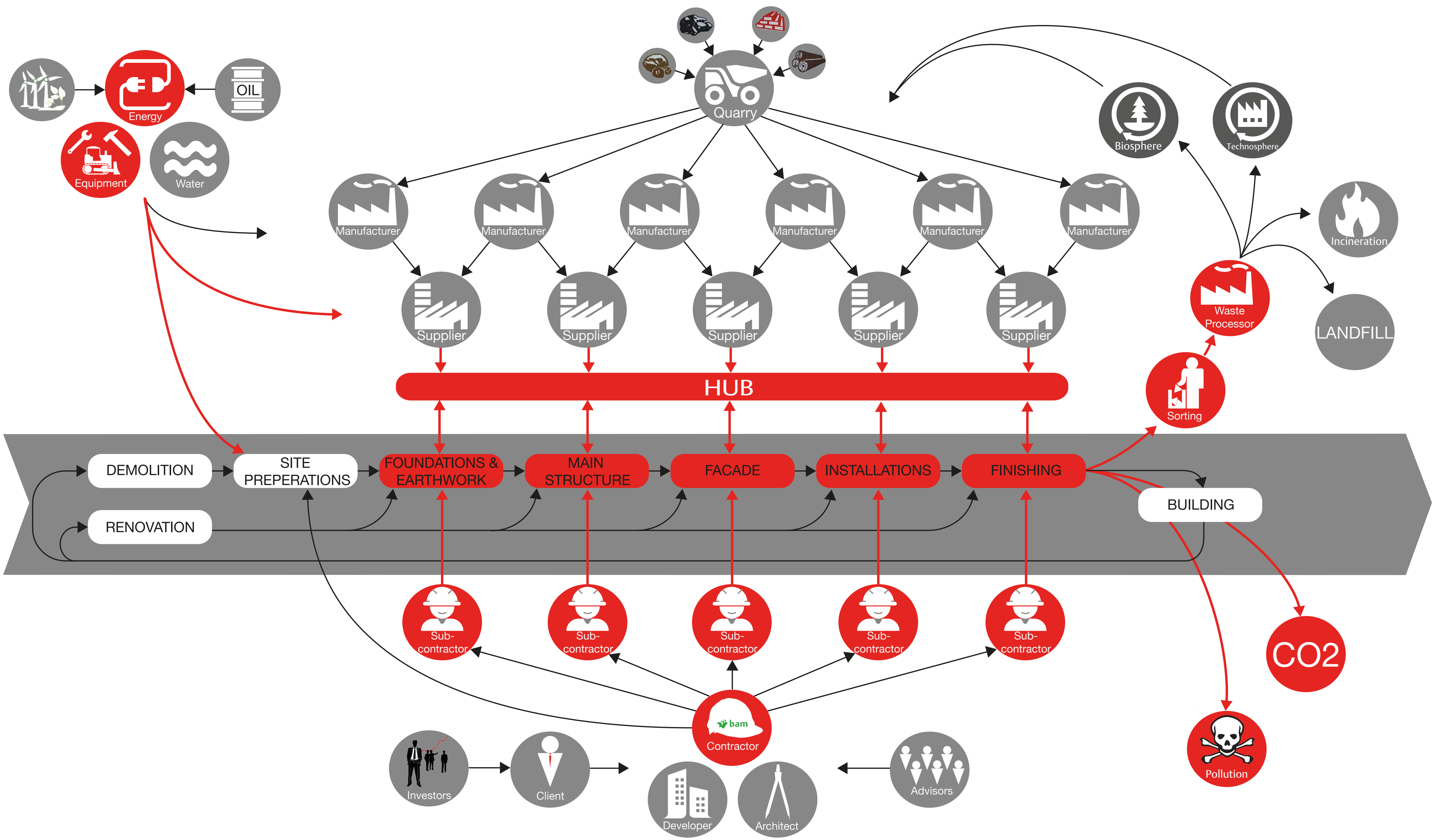
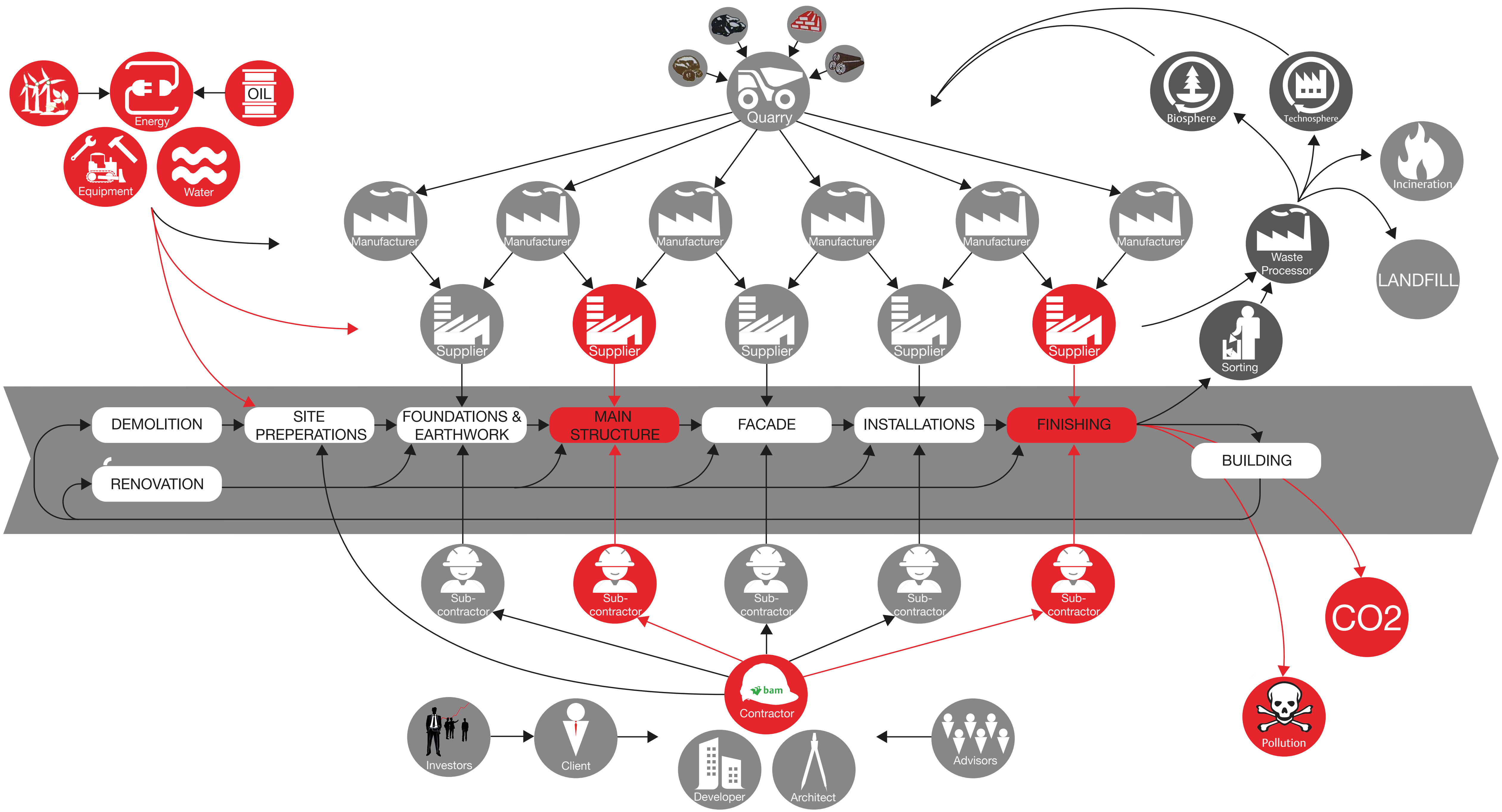


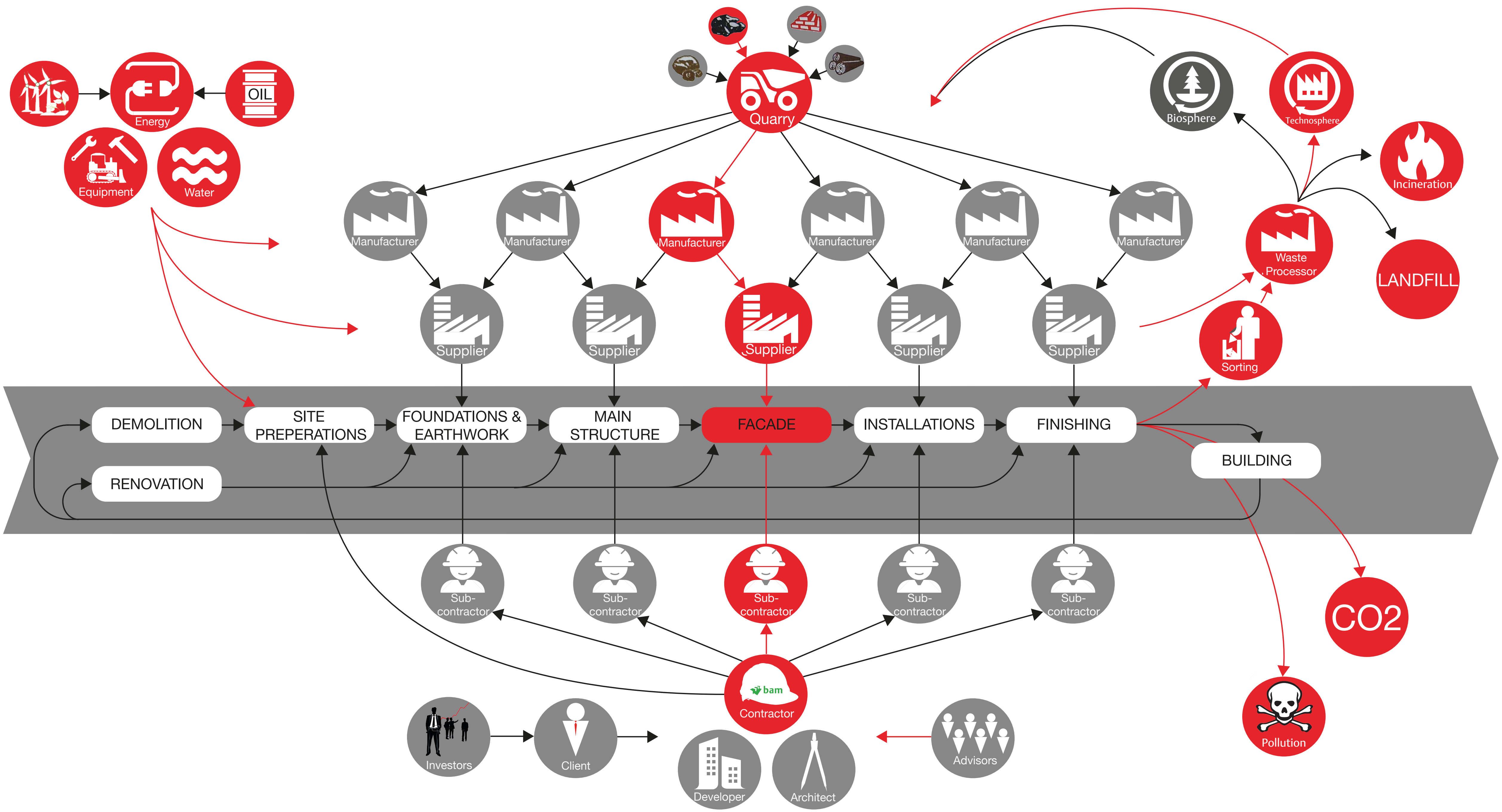
Smart building logistics

Step 1: Scoping - element of choice



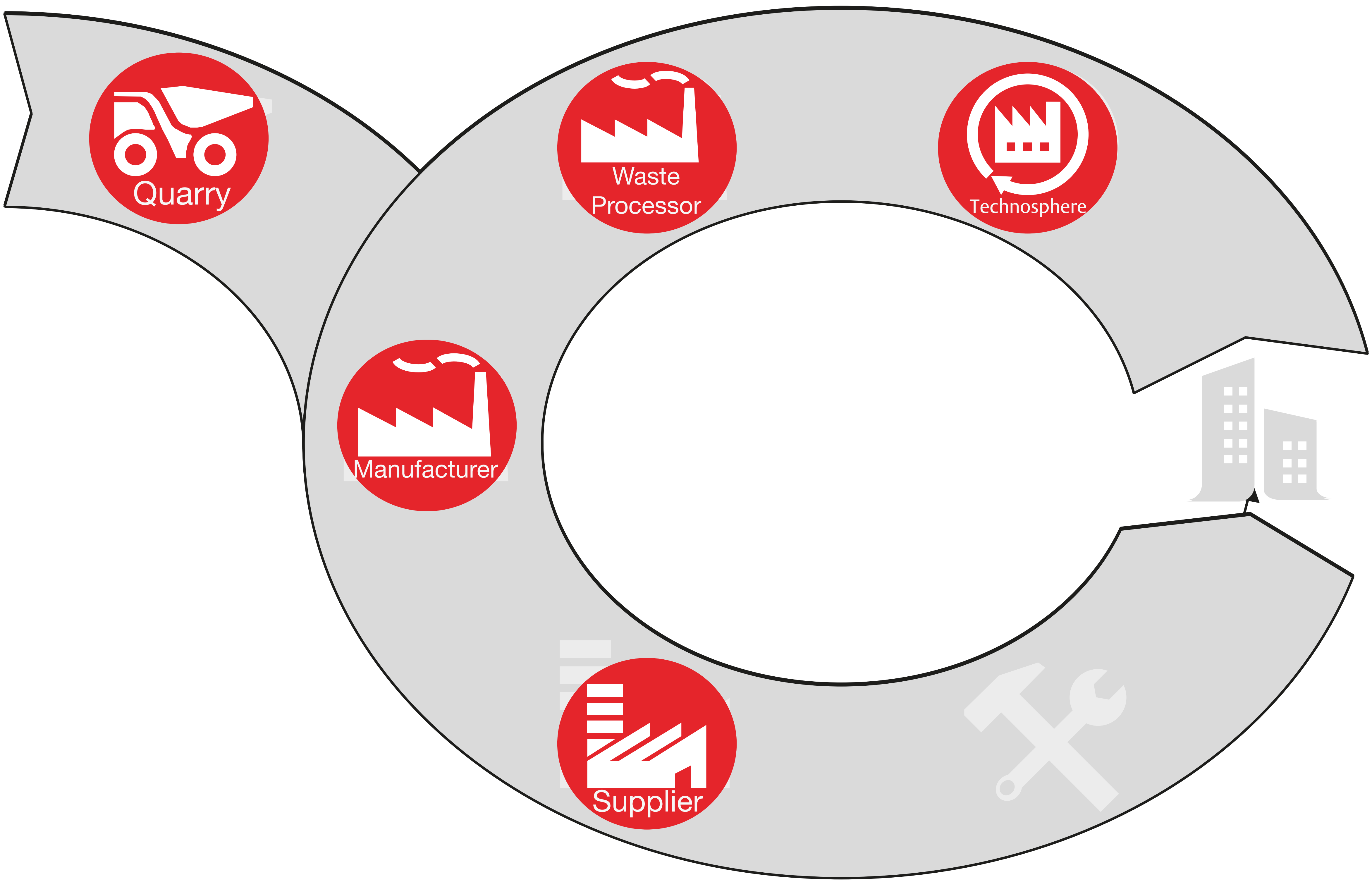
Dry heating

Step 1: Scoping - element of choice



Aluminum

Step 2: Detailing - from large to small



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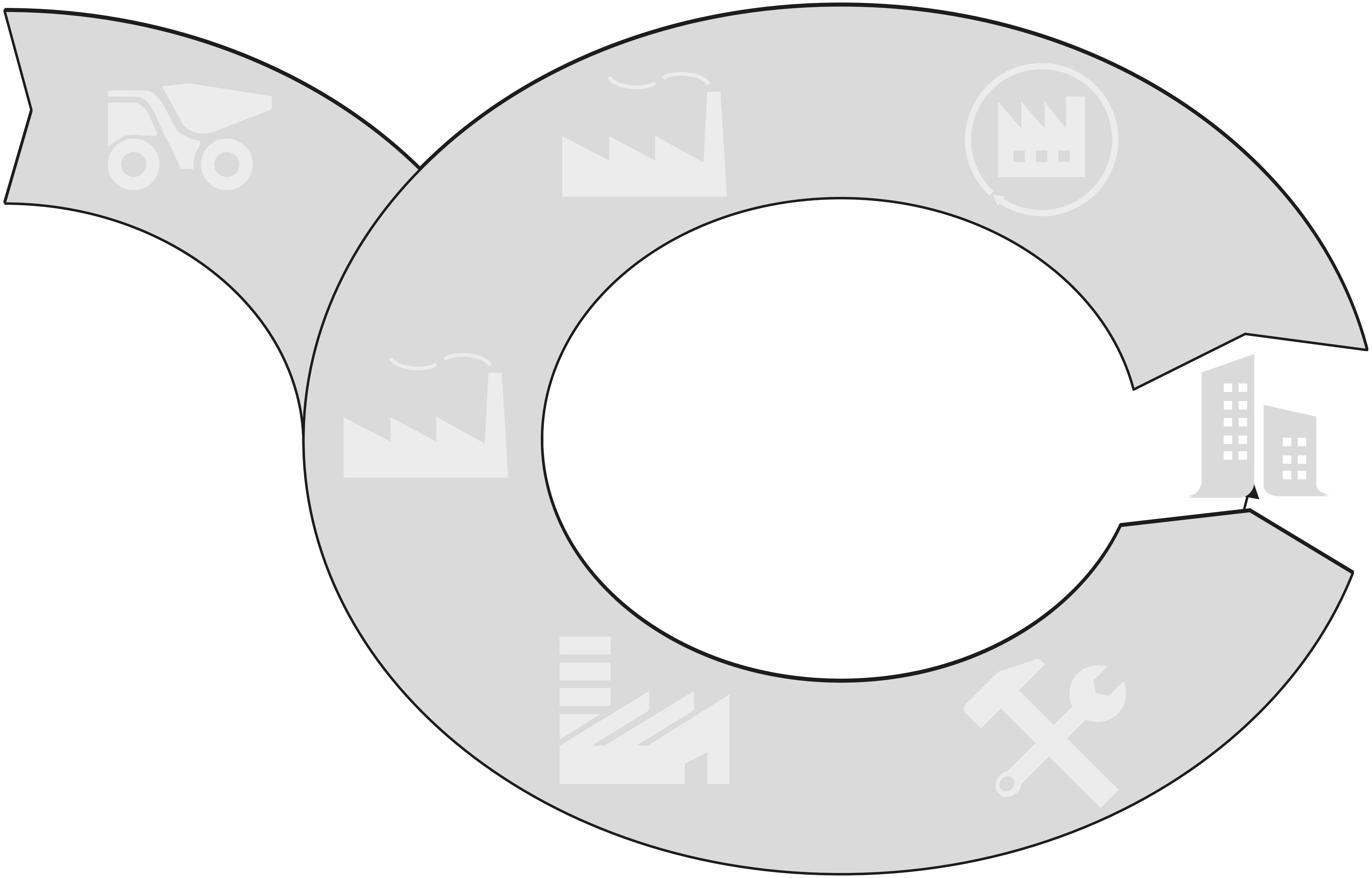
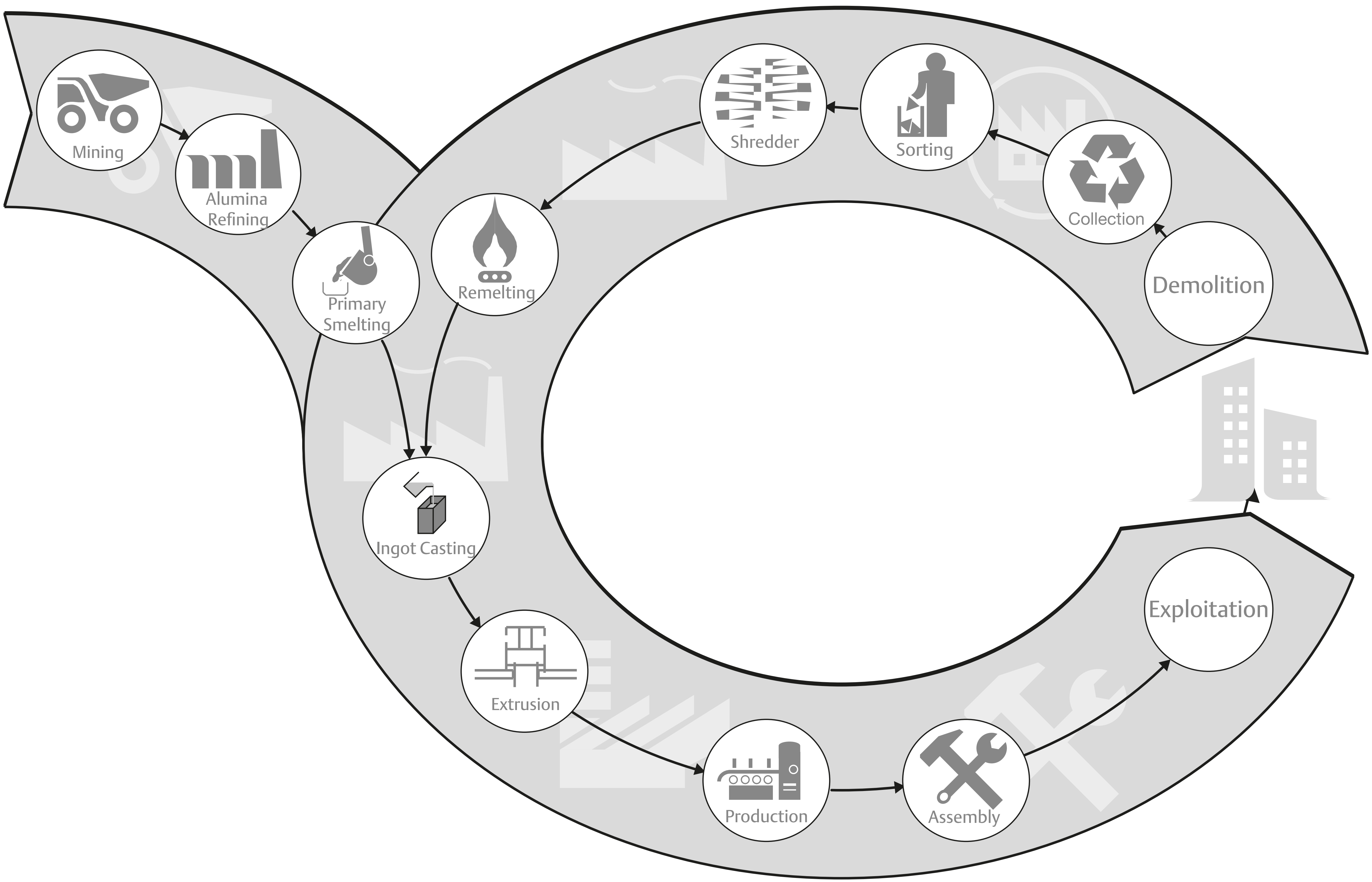
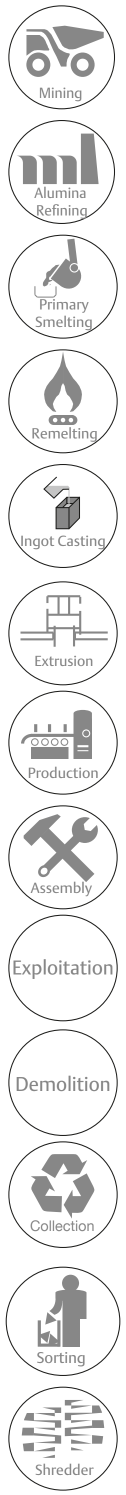


Step 2: Detailing - from large to small



Step 3: Quantification - impact on planet



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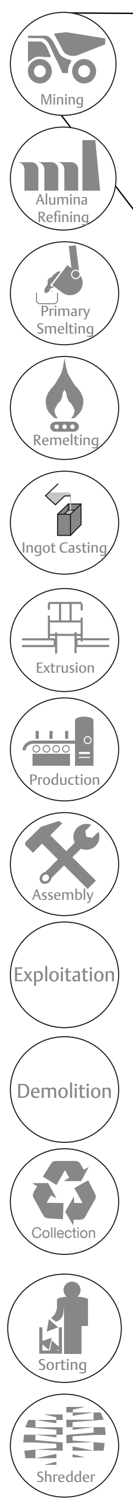
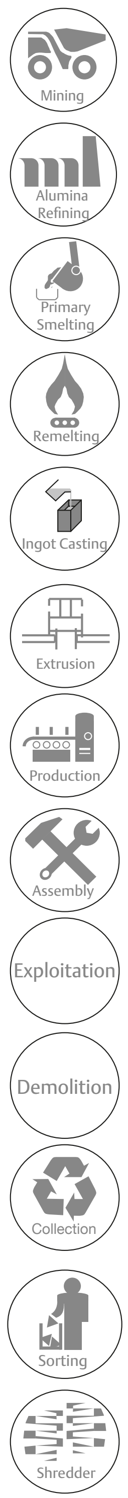
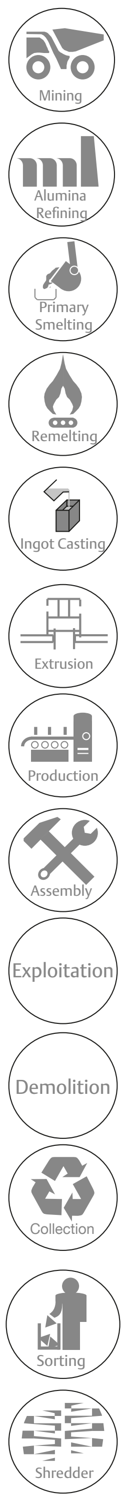


Selected	Materials (kg)		kWh/ton bauxite	Energy (kWh)	Fuel per tonne bauxite (kg)	Fuel usage (kg)	CO_2 (kg)
TRUE	Materials (Bauxite)	467,011	1.90	8,873	1.30	607	6,615
	Water usage (m3)	280					
	Waste materials	0					
	Total	**0**		**8,873**	**kWh**		**6,615**

Step 3: Quantification - impact on planet

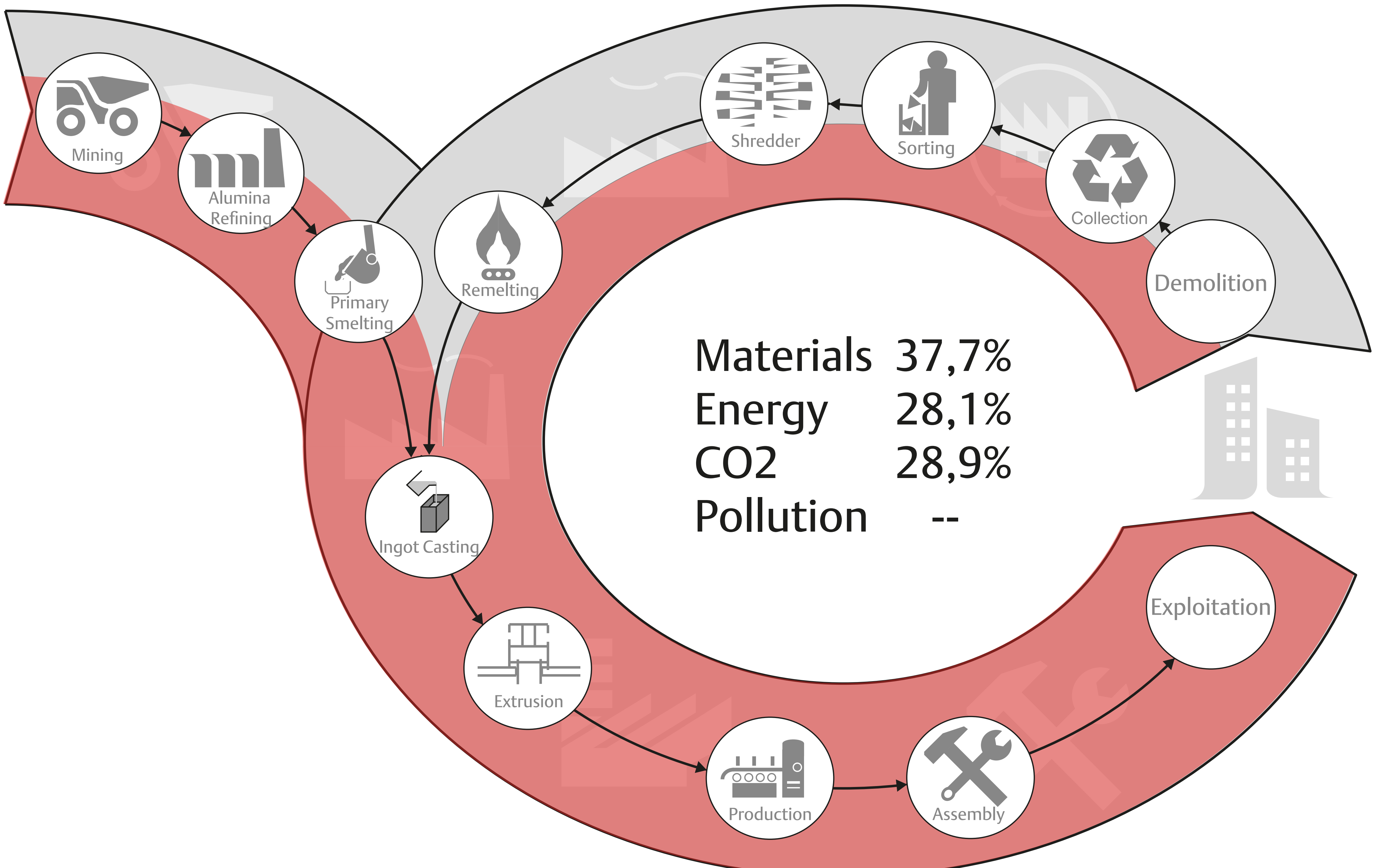


Step 3: Quantification - impact on planet



Task	100% New materials (kWh)	%	100% recycled materials	%	Current construction	%
Mining	8,873	1%	0	0%	5,324	0.5%
Alumina Refining	661,487	47%	0	0%	396,892	39.8%
Primary smelting (Electrolysis)	512,827	37%	0	0%	307,696	30.8%
Secondary melting	0	0%	131,234	32%	52,494	5.3%
Ingot Casting	46,836	3%	46,836	12%	46,836	4.7%
Extrusion	116,827	8%	116,827	29%	116,827	11.7%
Production	24,485	2%	24,485	6%	24,485	2.5%
Assembly on site	21,318	2%	21,318	5%	21,318	2.1%
Demolition	0	0%	33,500	8%	13,400	1.3%
Sorting	0	0%	11,938	3%	4,775	0.5%
Scrap preparation	0	0%	20,252	5%	8,101	0.8%
Total	**1,392,655**		**406,391**		**998,150** **100%**	

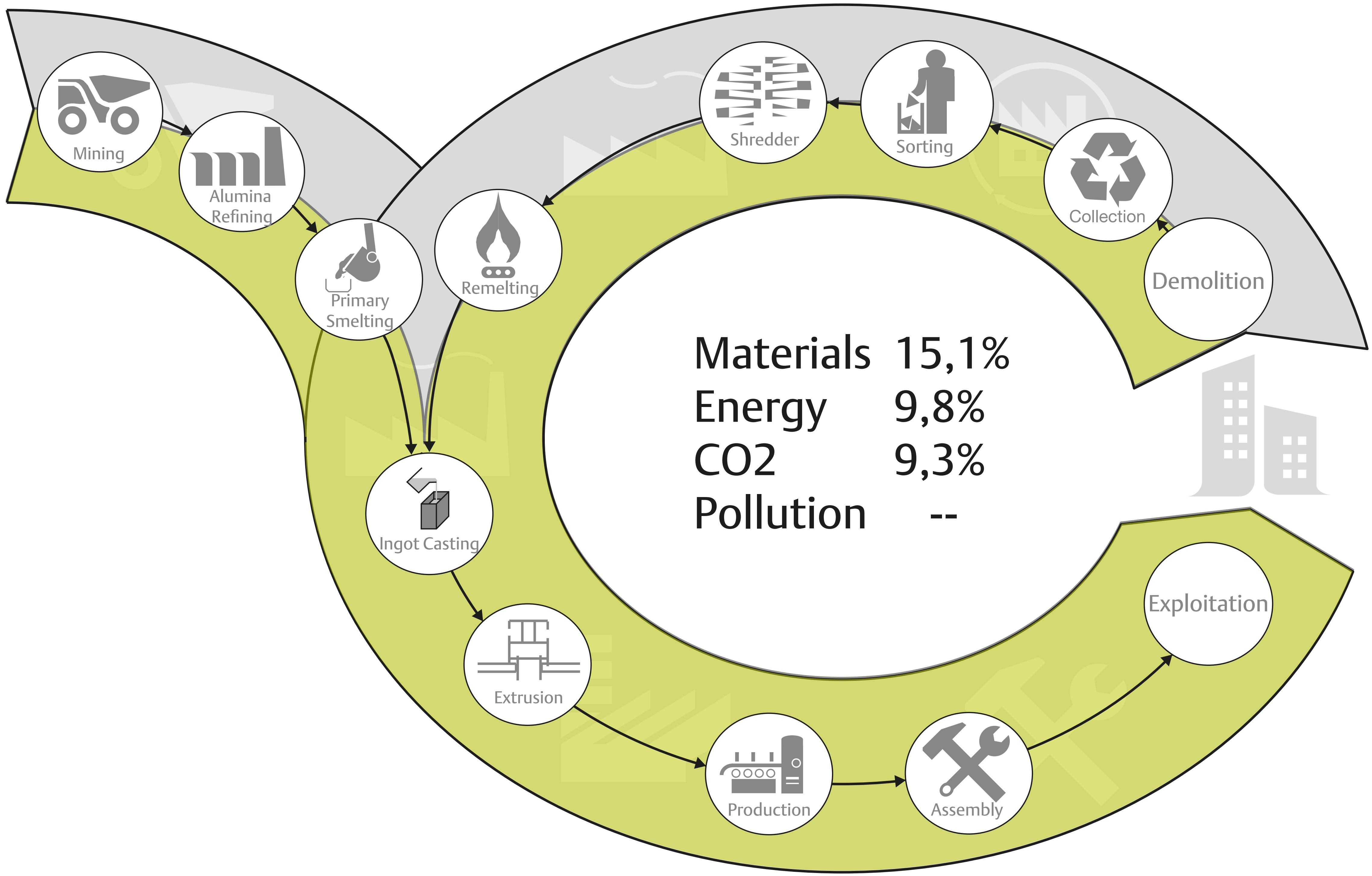
Step 4: Designing solutions - scenarios



Materials	37,7%
Energy	28,1%
CO2	28,9%
Pollution	--

Current status

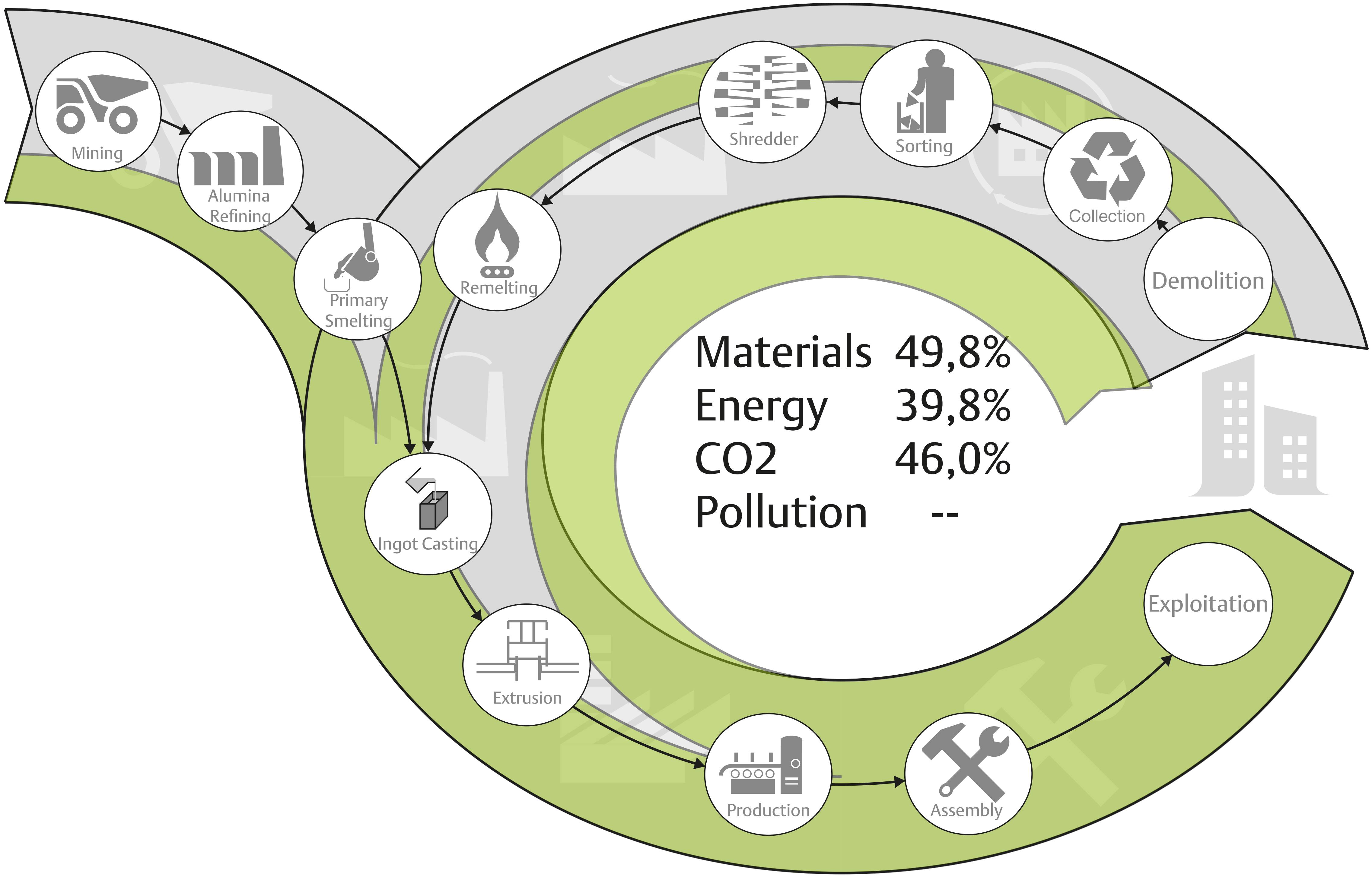
Step 4: Designing solutions - scenarios



Materials	15,1%
Energy	9,8%
CO2	9,3%
Pollution	--

10% extra recycling

Step 4: Designing solutions - scenarios



Materials	49,8%
Energy	39,8%
CO_2	46,0%
Pollution	--

50% reuse at element level

Step 4: Designing solutions - scenarios

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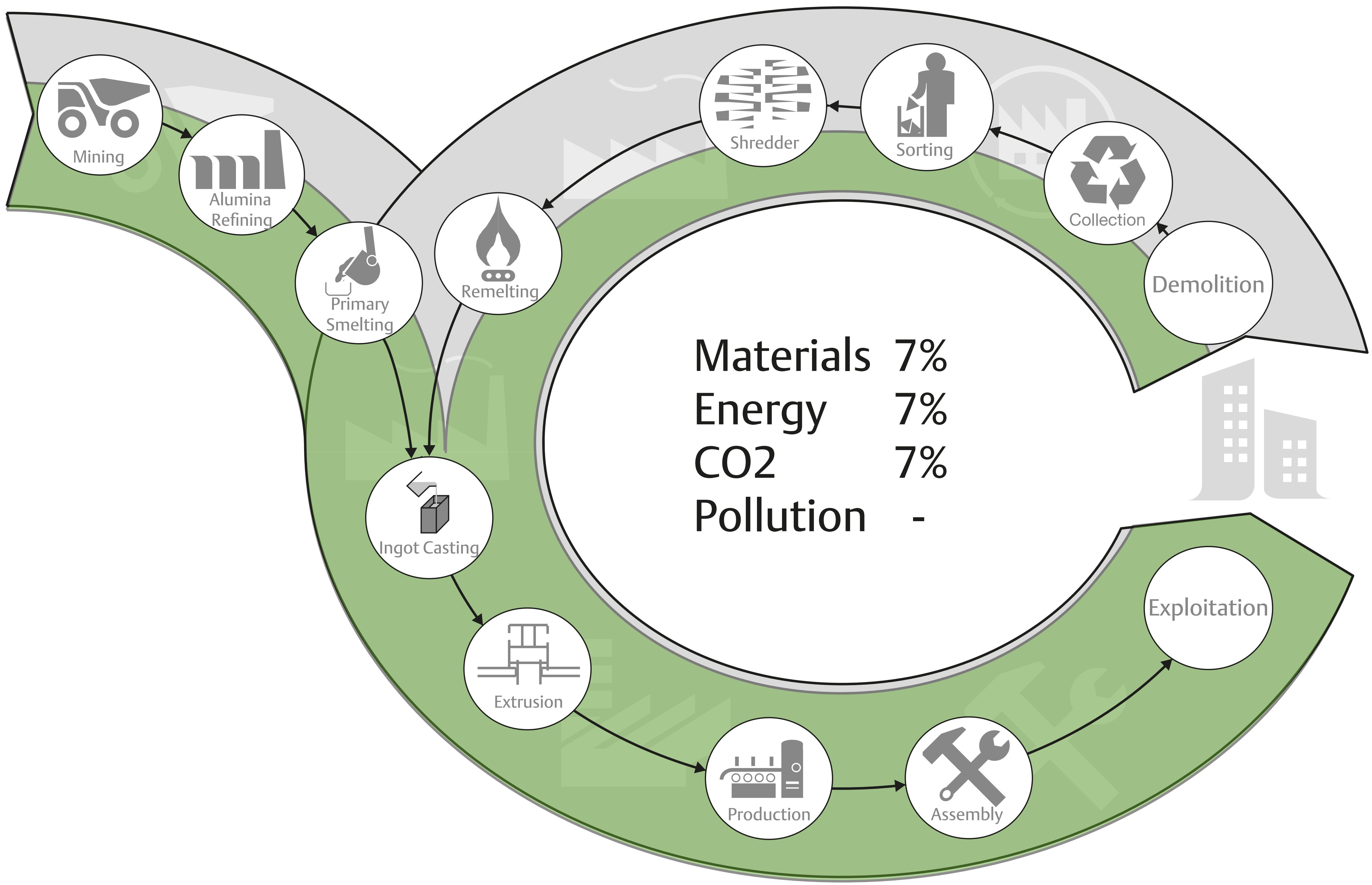


7% reduction of wastage

Step 5: Integration - expert meeting 1

All main actors of the processes are brought together to discus the technical and financial feasibility of the scenario's designed

Supply chain integration

- The ability to solve the technical and financial feasibility
- Innovation taking place
- Expert meeting perfect tool for supply chain integration

Critical points of succes

- Preventing circle-of-blame
- Keeping the group on subject (element of focus)
- Stimulate the group to 'think out of the box'

Example - aluminum supply chain

Step 5: Integration - expert meeting 1

For the aluminum expert meeting only one scenario was discussed, in this case the second scenario (reuse at element level)

Technical feasibility

- Standardization of aluminum elements
- Research into behavior of the materials
- Detachable concepts for joints
- Only reusable materials
- Recognition of materials through BIM
- Database for supply and demand (recyclers)
- Translation concepts towards investors (lease concepts)

Financial feasibility

- Reuse at element level 'Does not cost money!'

Step 6: Plan of approach - expert meeting 2

The next meeting will involve the translation of the technical feasibility points in the previous meeting into a detailed plan of approach

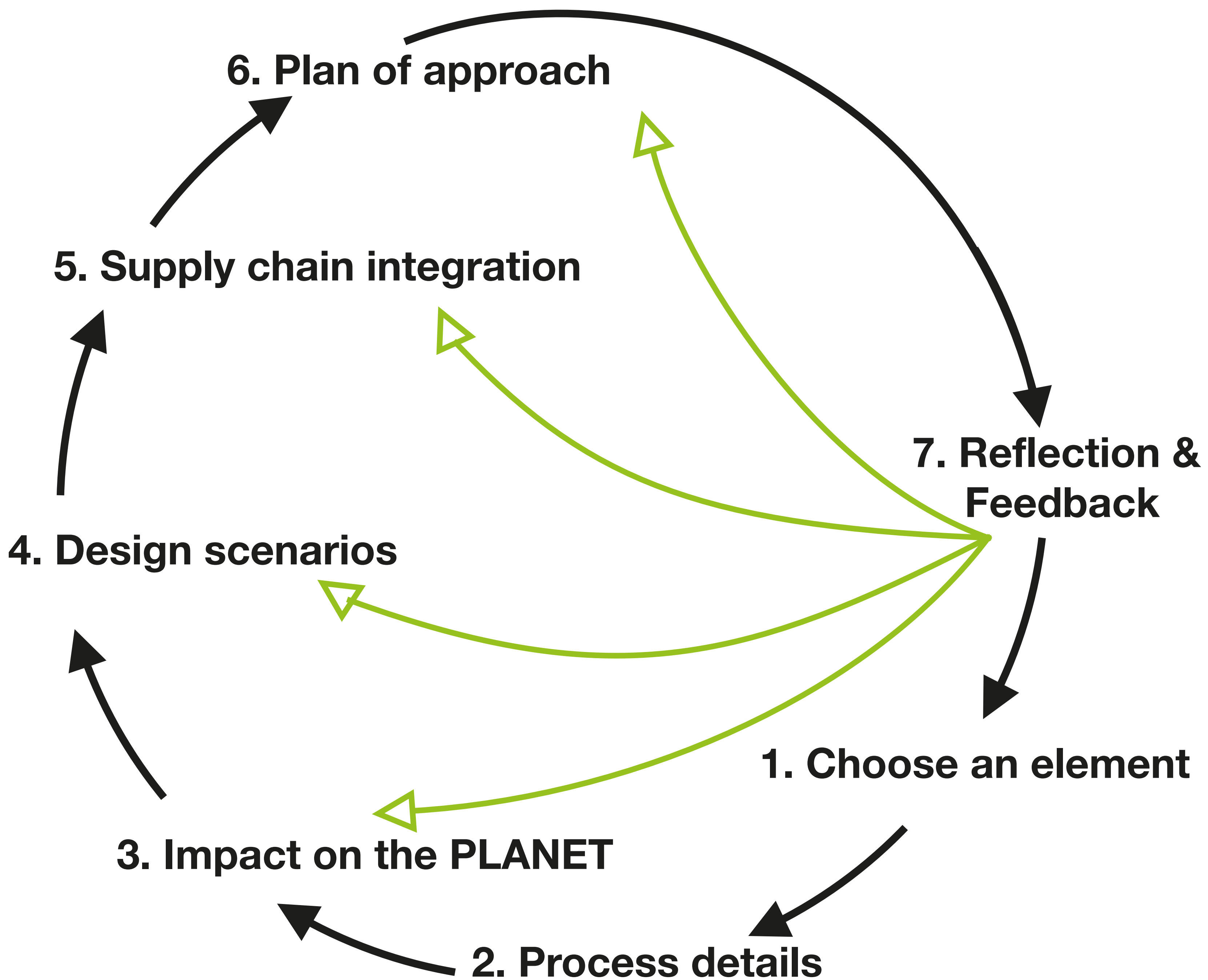
Goal

- Division of tasks
- Develop Critical Performance Indicators (CPI's)
- Make planning for the plan of approach
- ACTION!

Initiator

- The contractor

Step-by-step (cyclic) plan



06 Conclusions and recommendations

Conclusions

How can a sustainable construction process be defined and how can the sustainable construction process be achieved?

This question contains various sub-research questions which consists of different parts, namely:

1. Defining a relationship between elements in a sustainable construction process
2. Assessing obstacles sustainable construction
3. Achieving sustainable construction

Conclusions

1. Defining a relationship between elements in a sustainable construction process

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- History shows that sustainability is a countermovement to industrialization

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Conclusions

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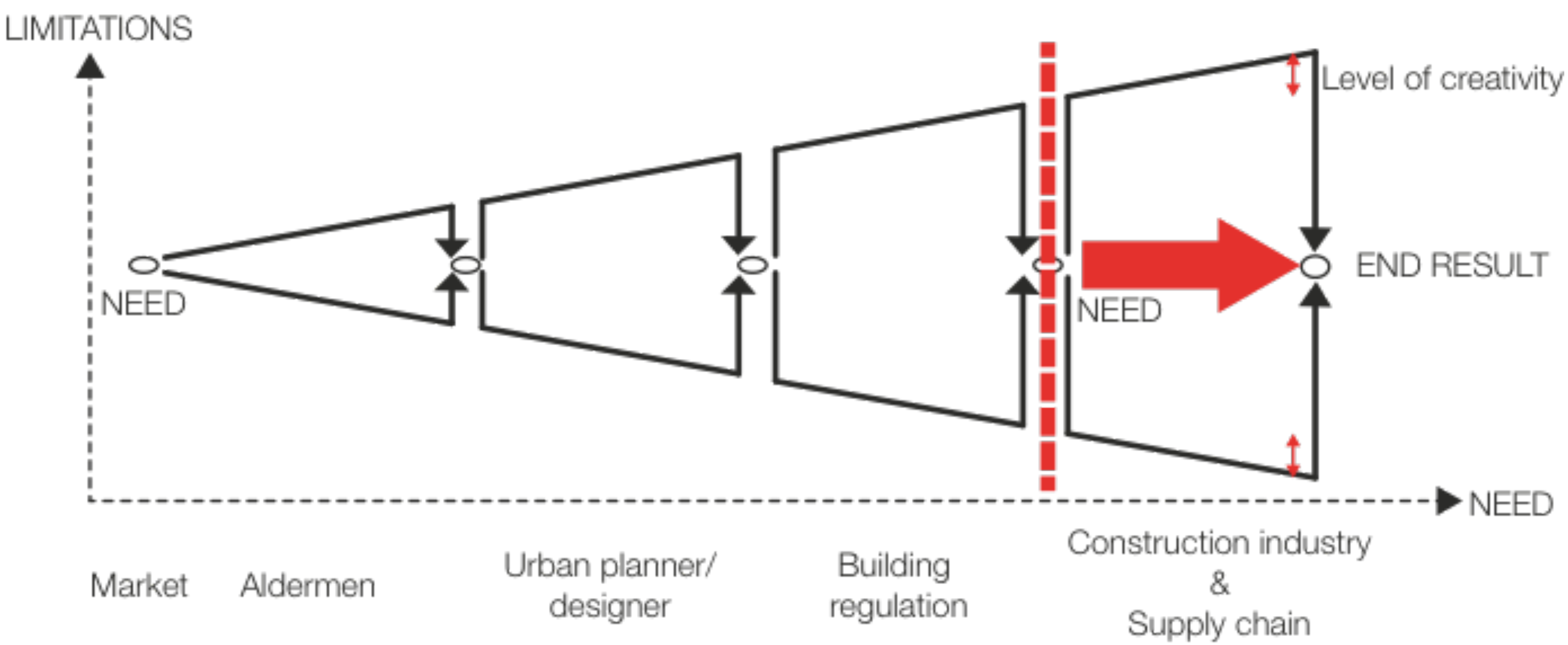

Conclusions

1. Defining a relationship between elements in a sustainable construction process

- History shows that sustainability is a countermovement to industrialization
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Conclusions

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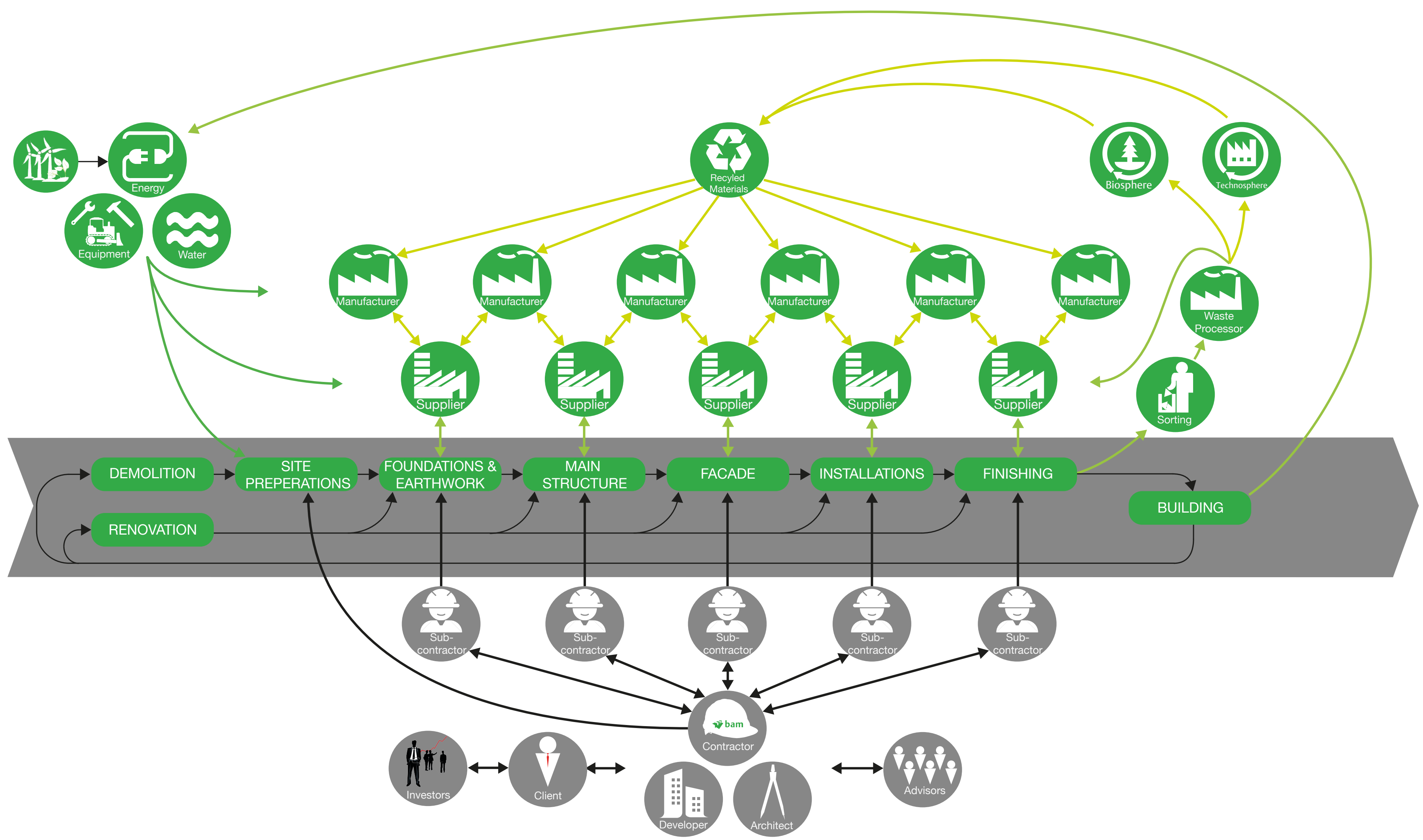

Conclusions

1. Defining a relationship between elements in a sustainable construction process

- History shows that sustainability is a countermovement to industrialization
- The construction process is different form the production and agricultural processes (less room for creativity)
- Construction that does not impact the environment (planet) and people, while making a profit

Conclusions

2.Assessing obstacles sustainable construction

The experts have provided four main obstacles for achieving sustainable construction

- Profitability element in sustainable initiatives is crucial
- Commitment is needed before profitability is proven
- Labels used as unjustifiable definition for sustainability
- Difference in linear and cyclic thinking

Conclusions

3. Achieving sustainable construction

The achievement of sustainable construction involves implementing the step-by-step plan and taking in consideration the obstacles

- Step-by-step plan (tool) is able to assess the technical and financial feasibility of sustainable construction initiatives
- Supply chain integration is taking place in the achievement and proves to be crucial for succes
- Thinking in a sustainable manner works, with the powerful foundations of the old process and additions of the new process

Recommendations

- Relate the defined sustainable construction process to the product produced by this process

- Research scope did not involve the product. New research question could be: What is the influence of the new process on its product?

- Test the second type of expert meeting in the step-by-step plan

- Introduce a pilot project for the step-by-step plan

Recommendations

- Labels, like BREEAM, should focus on the product and not on the process of construction
- Integration of the supply chain, however before this is a succes organizations need to understand process thinking - the lean methodology helps in organizing information and is needed before the supply chain is integrated
- Supply chains must become more transparent, taking initiatives like the expert meetings help in this process

Questions?!