Toward Sustainable Investments

Integrating Embodied Carbon Reduction in Investment Decision-Making by Using a Discounted Cash Flow Model

Ruben Schmitz – 5470587
19-01-2024
P5 Presentation

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2. RESEARCH METHOD
3. LITERATURE STUDY AND EXPLORATORY INTERVIEWS
4. CASE STUDIES
5. DISCUSSION & LIMITATIONS
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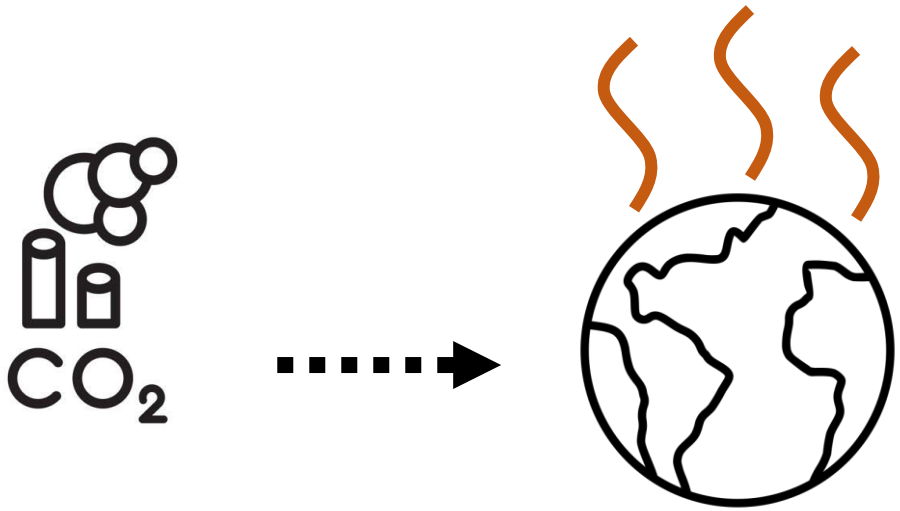
01 | INTRODUCTION

Background



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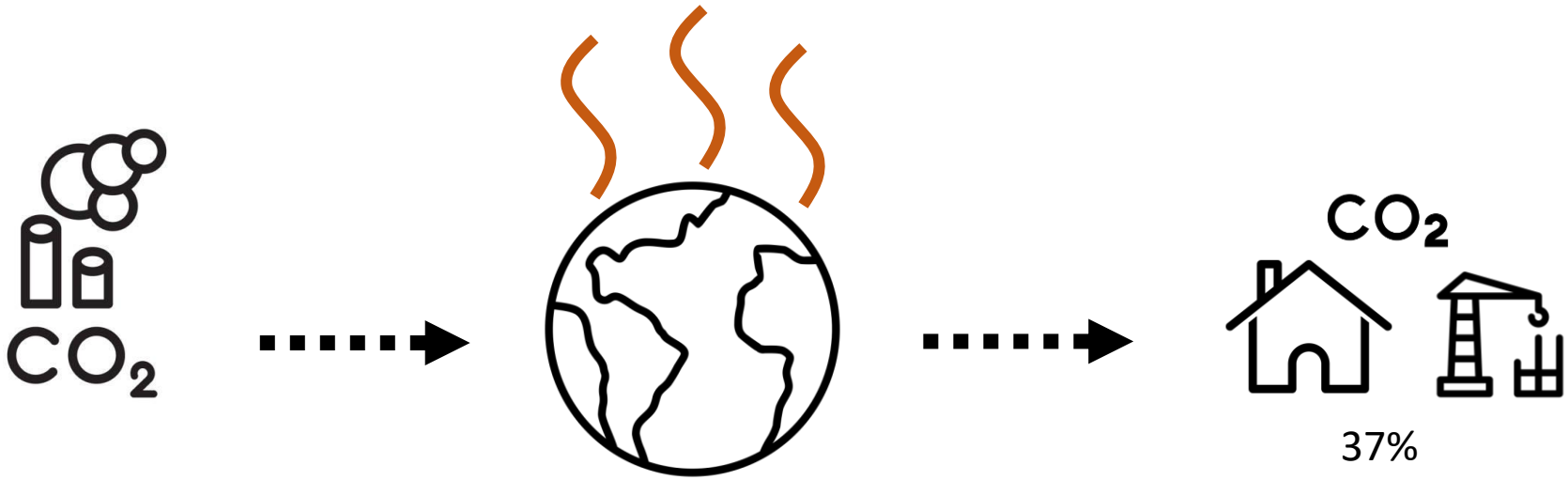

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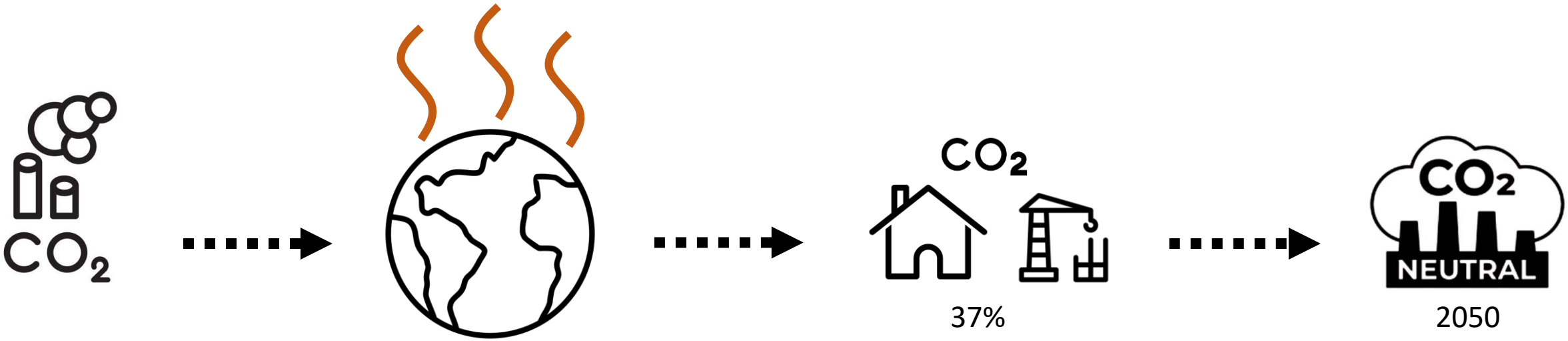

Research context

Carbon emission in buildings

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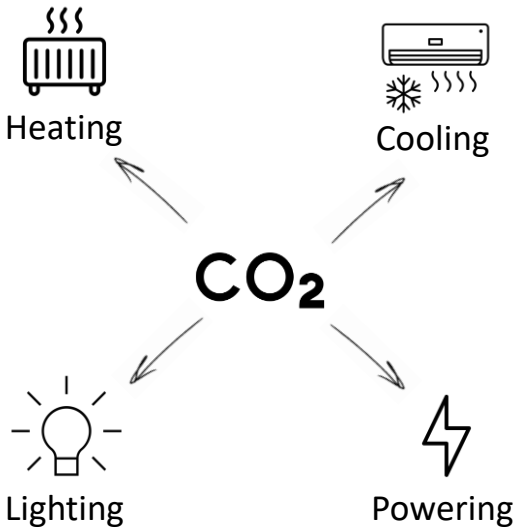
Carbon emission in buildings

Operational carbon:



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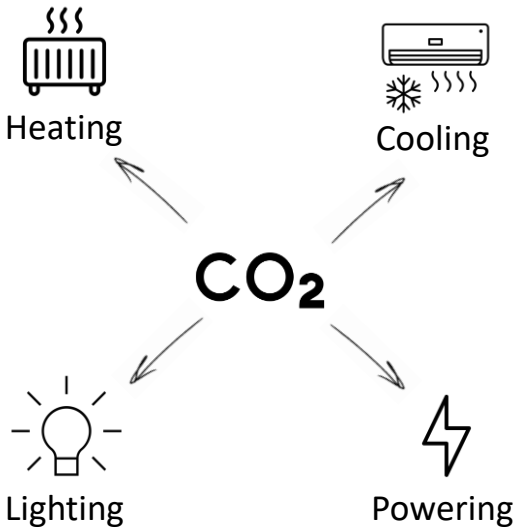

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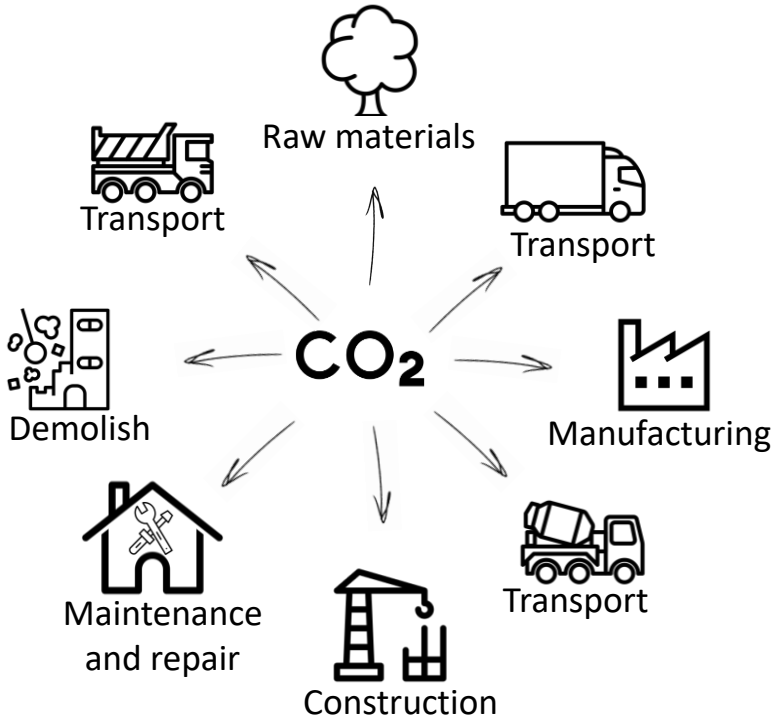

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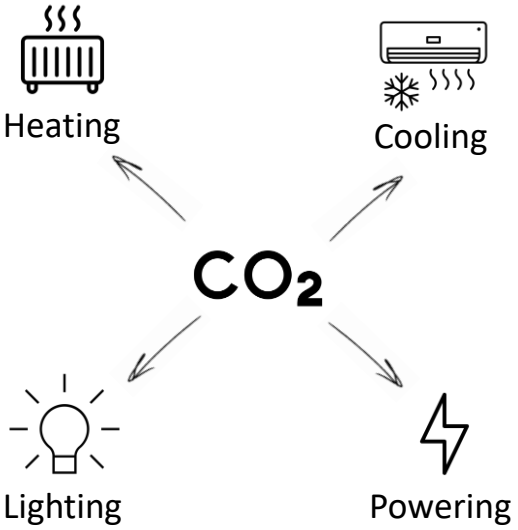

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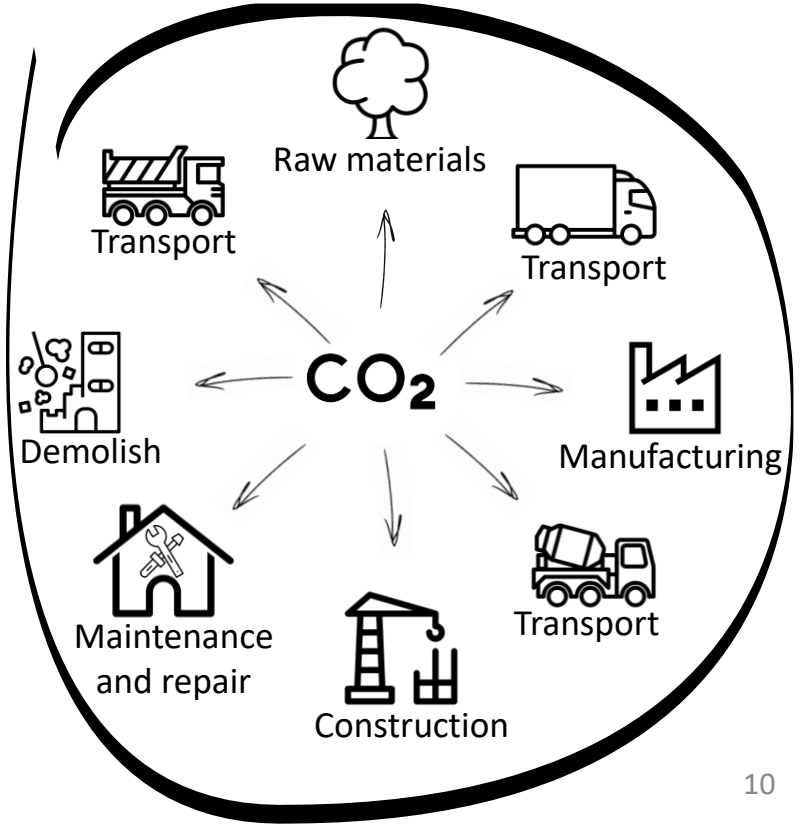

Problem statement

- Hardly any residential buildings meet the requirements
- Problems related to large-scale reduction
- Financial barriers
- Limited research from perspective of an investor

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Lack of understanding:
“how to incorporate the reduction of **embodied carbon** into **investment decision-making** of an **investor**.”

Research context

Investment decision-making process of an investor

Step 1: Setting a strategy

Step 2: Establishing return/risk objectives

Step 3: Forecasting and evaluate expected costs returns

Step 4: Assessing investment risk

Step 5: Making a risk-adjusted evaluation of the forecast costs and returns

Step 6: Implementing accepted proposals

Step 7: Auditing operating performance

Research context

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Discounted Cash Flow (DCF) model

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Legend:
Holding Period (HP) = period of time investors expect to hold the investment before selling it.

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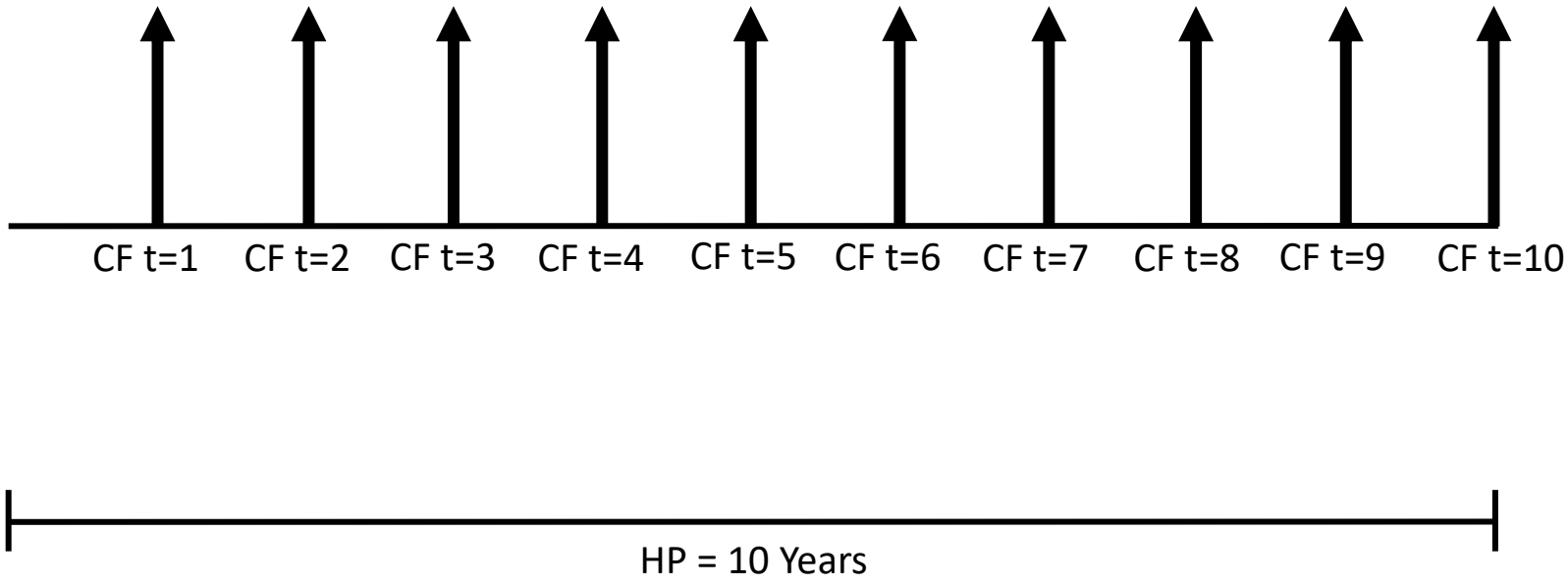

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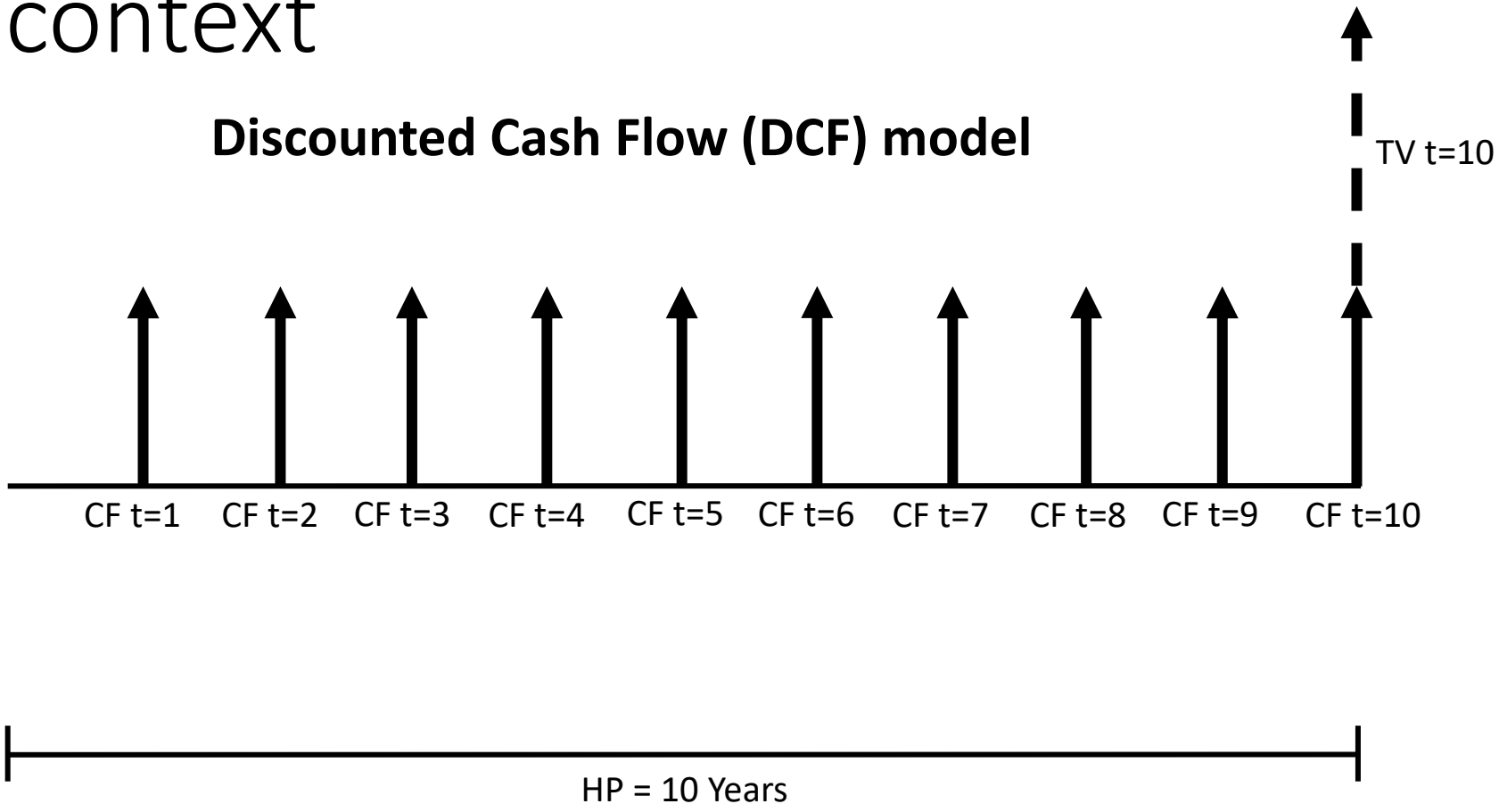

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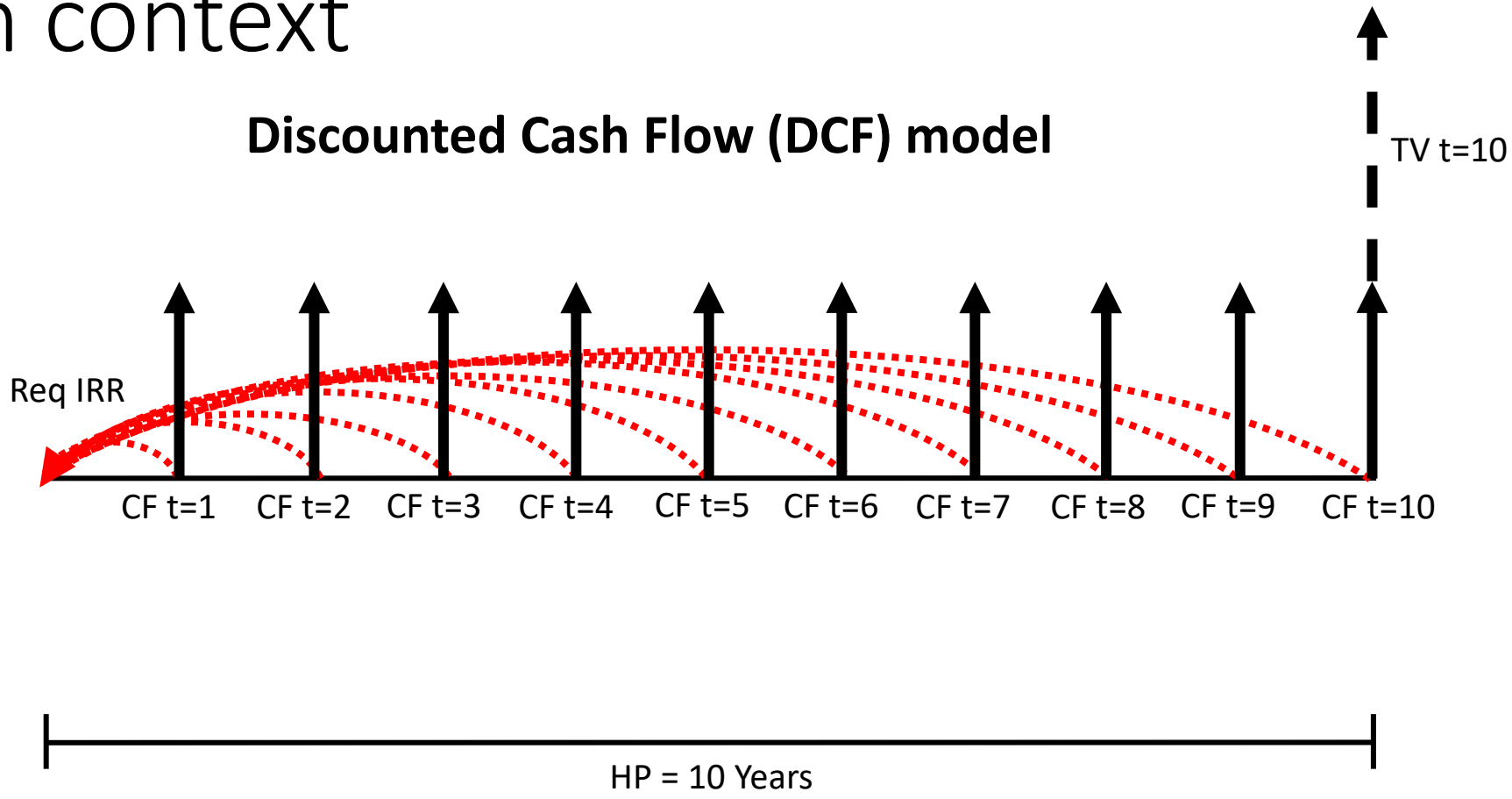

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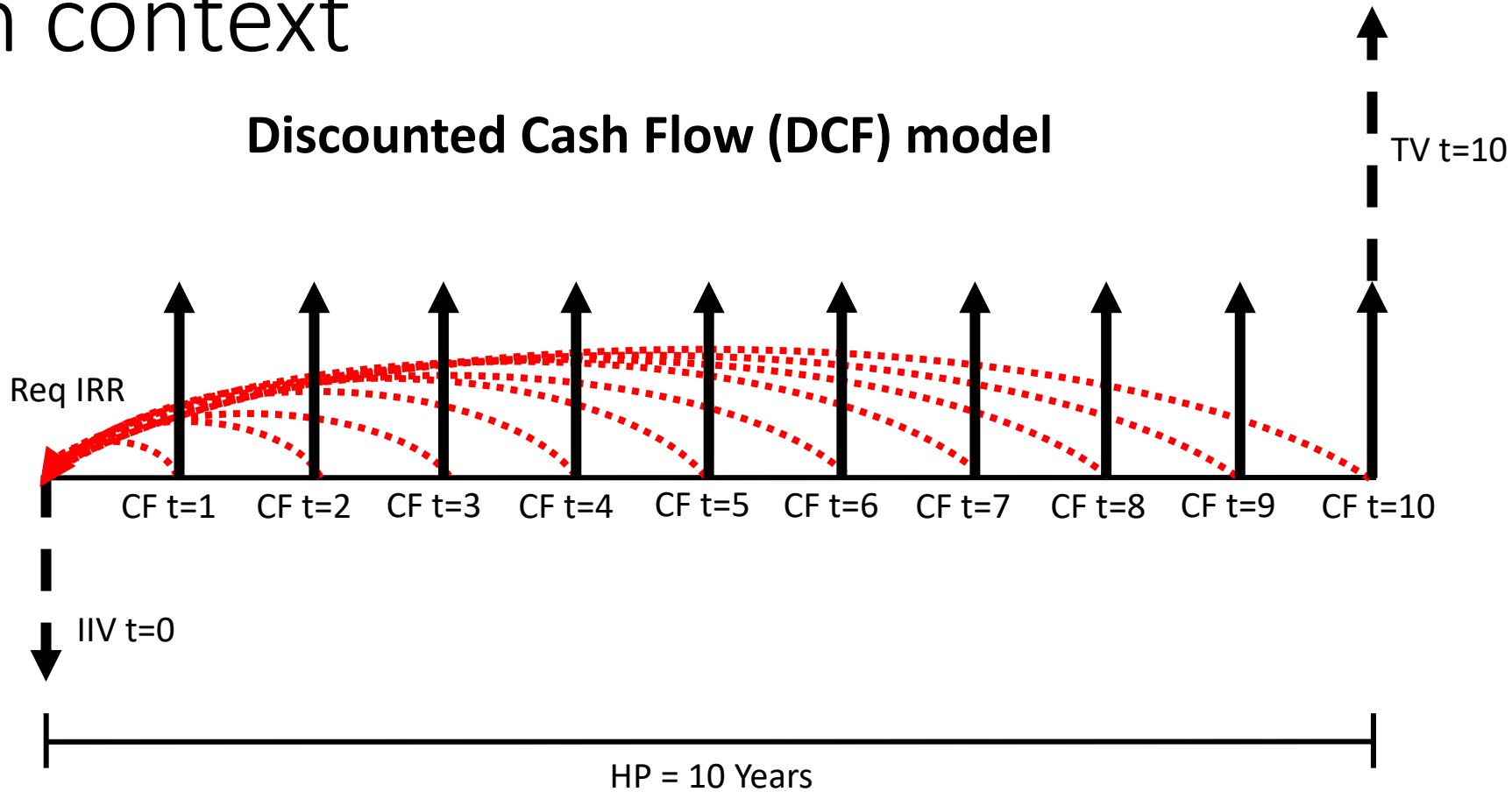

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Required Internal Rate of Return (Req IRR) = a number used to calculate the future costs and returns to present value.
Initial Investment Value (IIV) = the amount the investor can pay for the investment

Research question

“In what way does reducing embodied carbon in residential building projects impact the investment decision-making process from an investor's perspective?”

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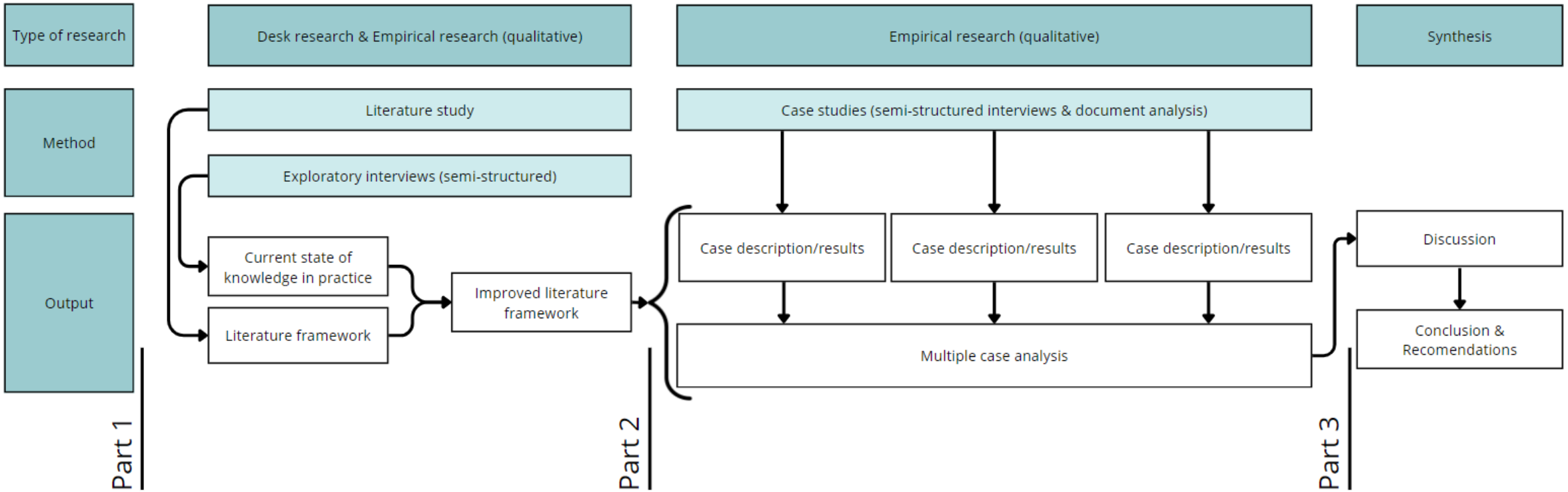
SQ4 - To what extent is (the reduction of) embodied carbon part of the investment decision-making process in the current practice?

SQ5 - What adjustments do investors make to the Discounted Cash Flow (DCF) parameters to reflect embodied carbon reduction strategies?

02 | RESEARCH METHOD

Research design



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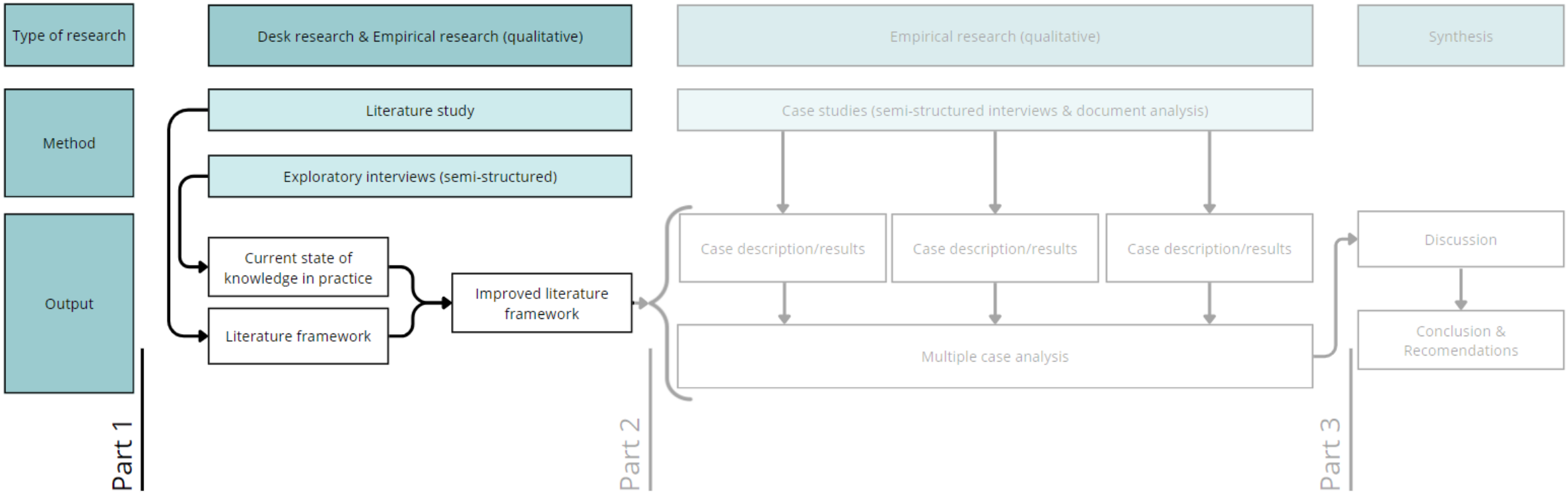

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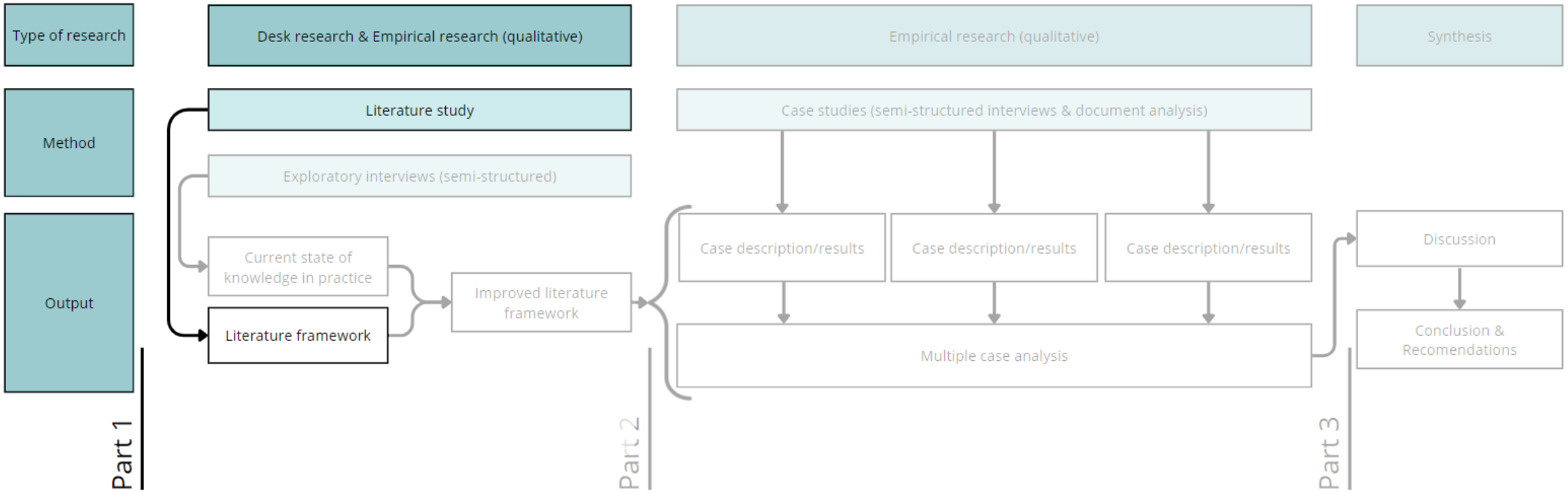

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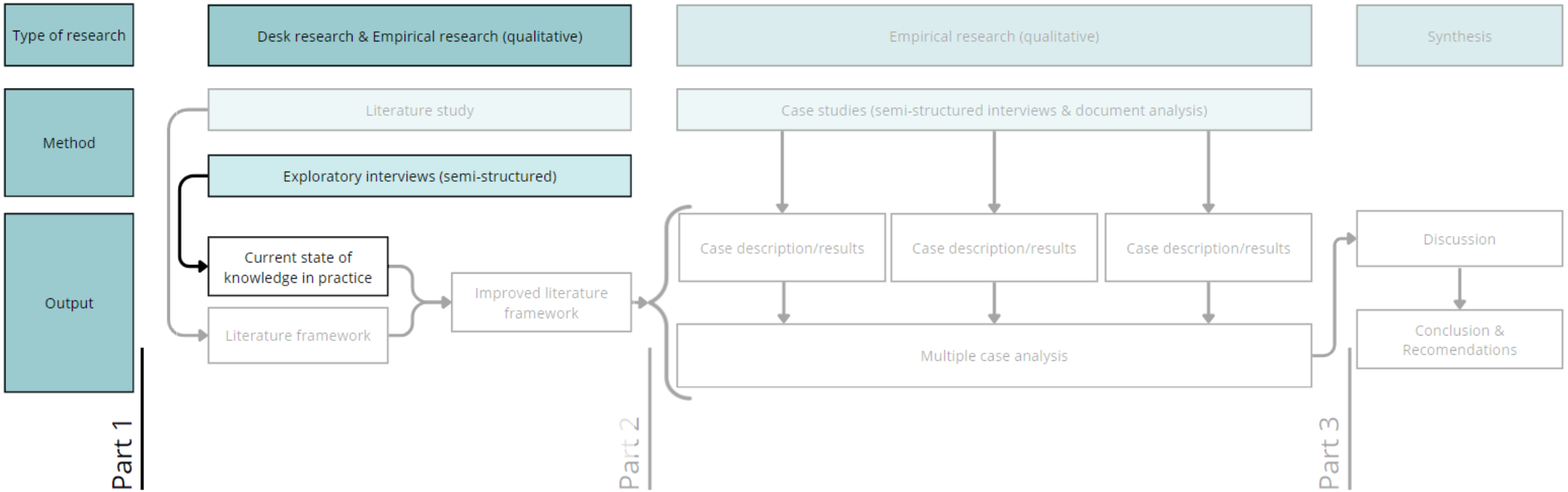

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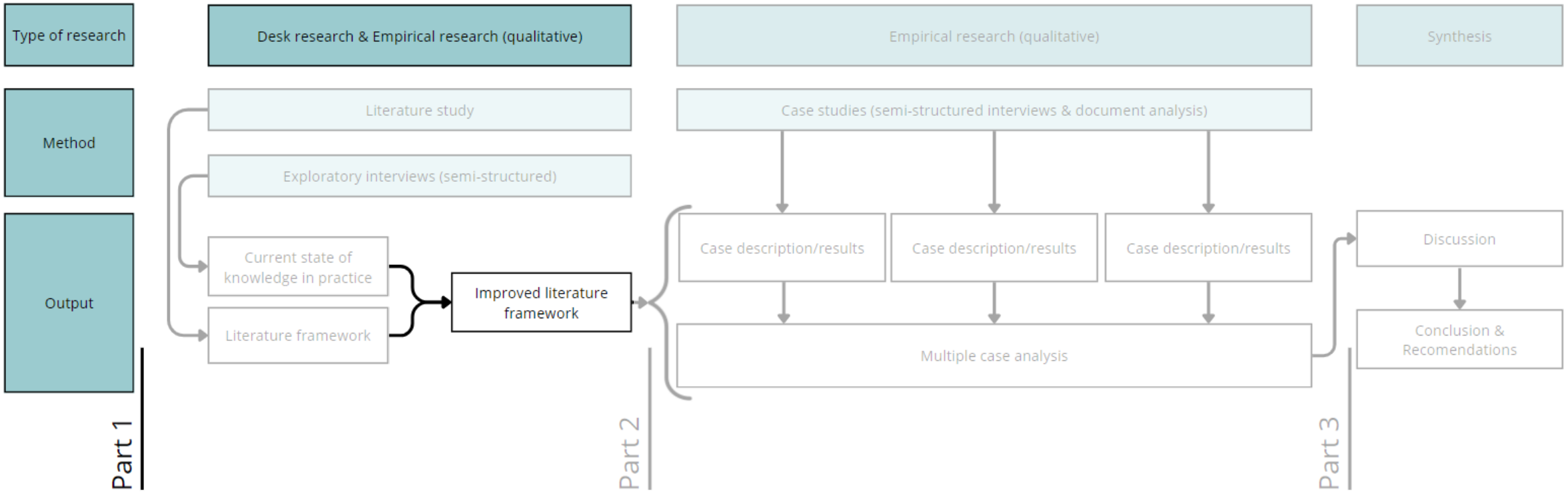

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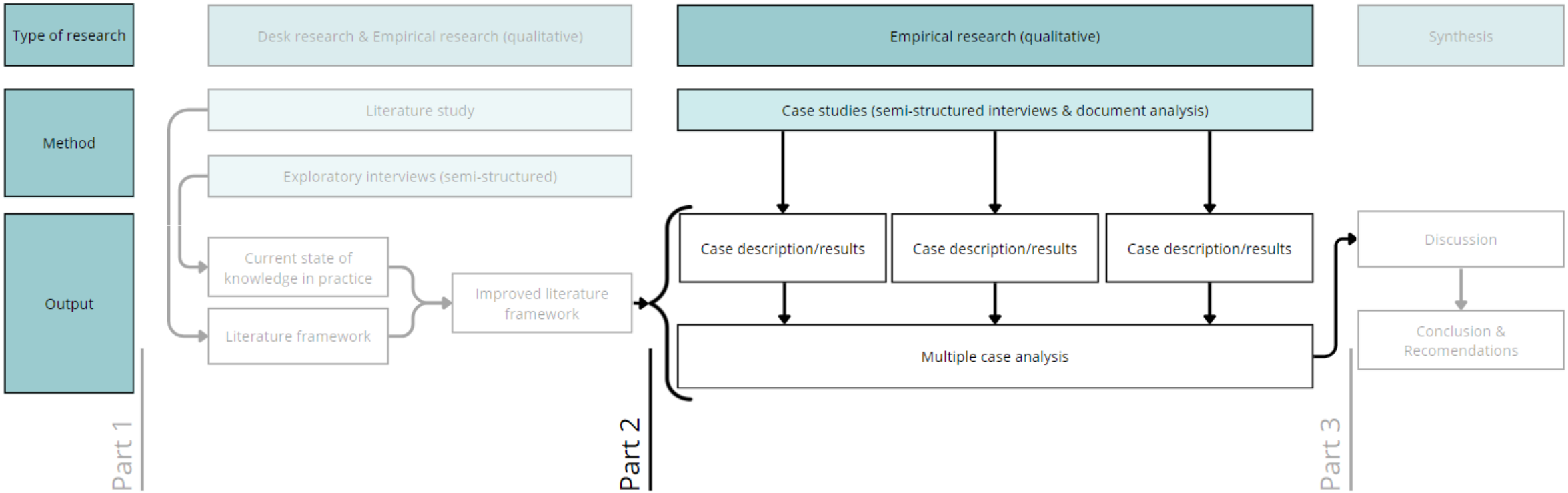

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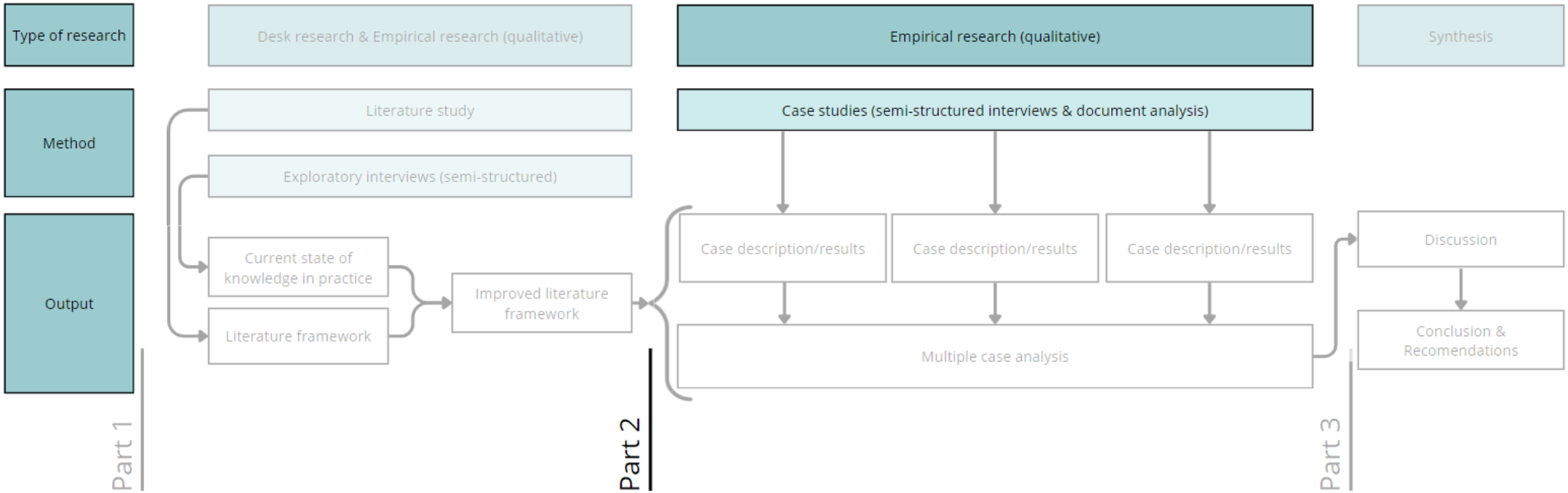

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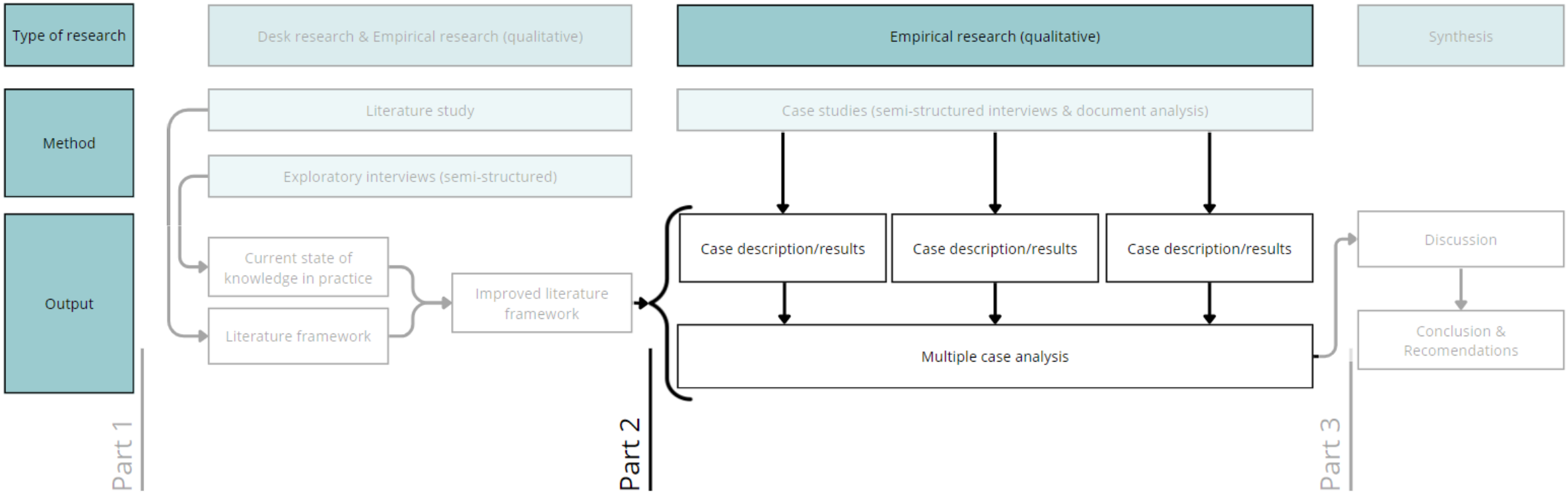
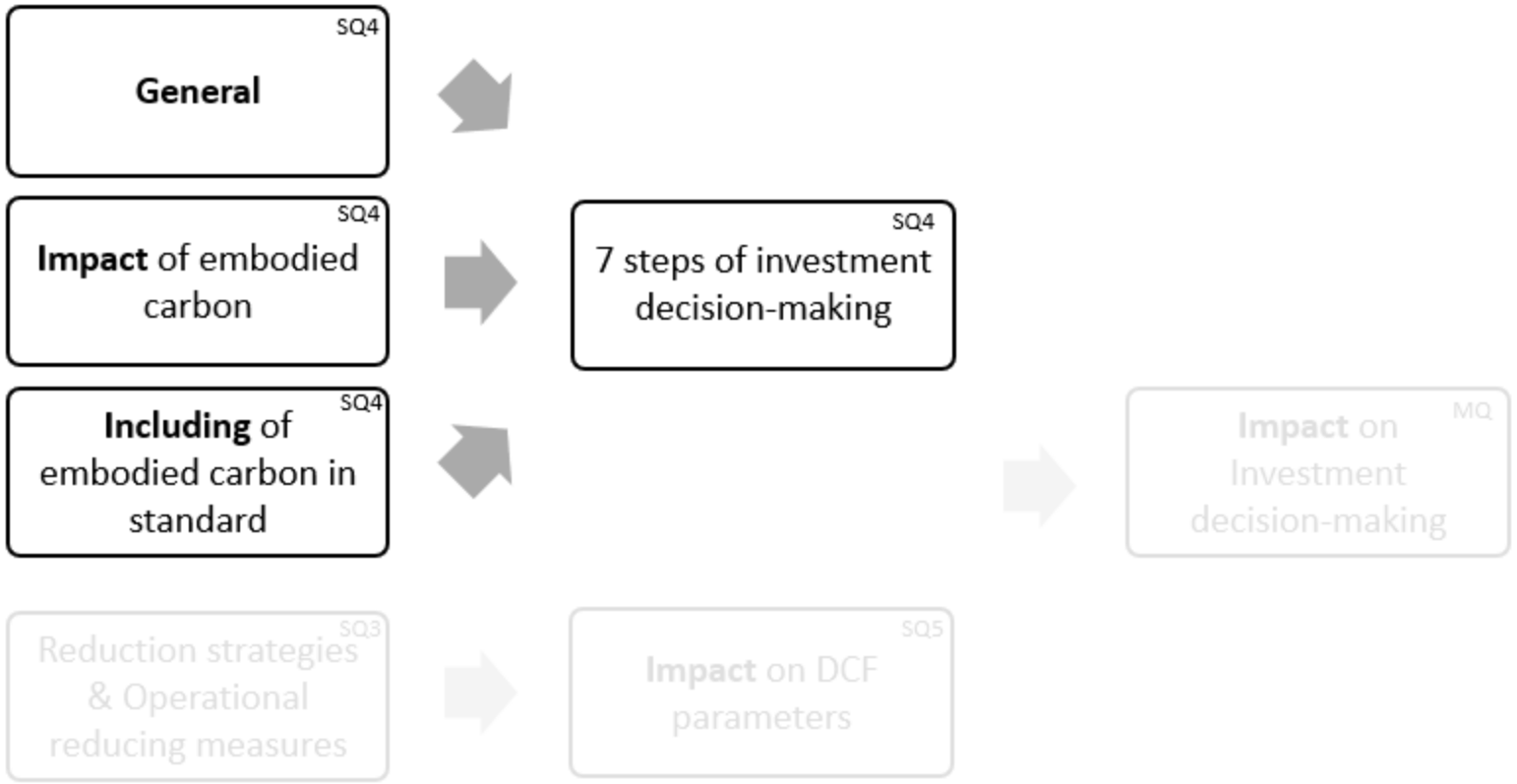


Case results



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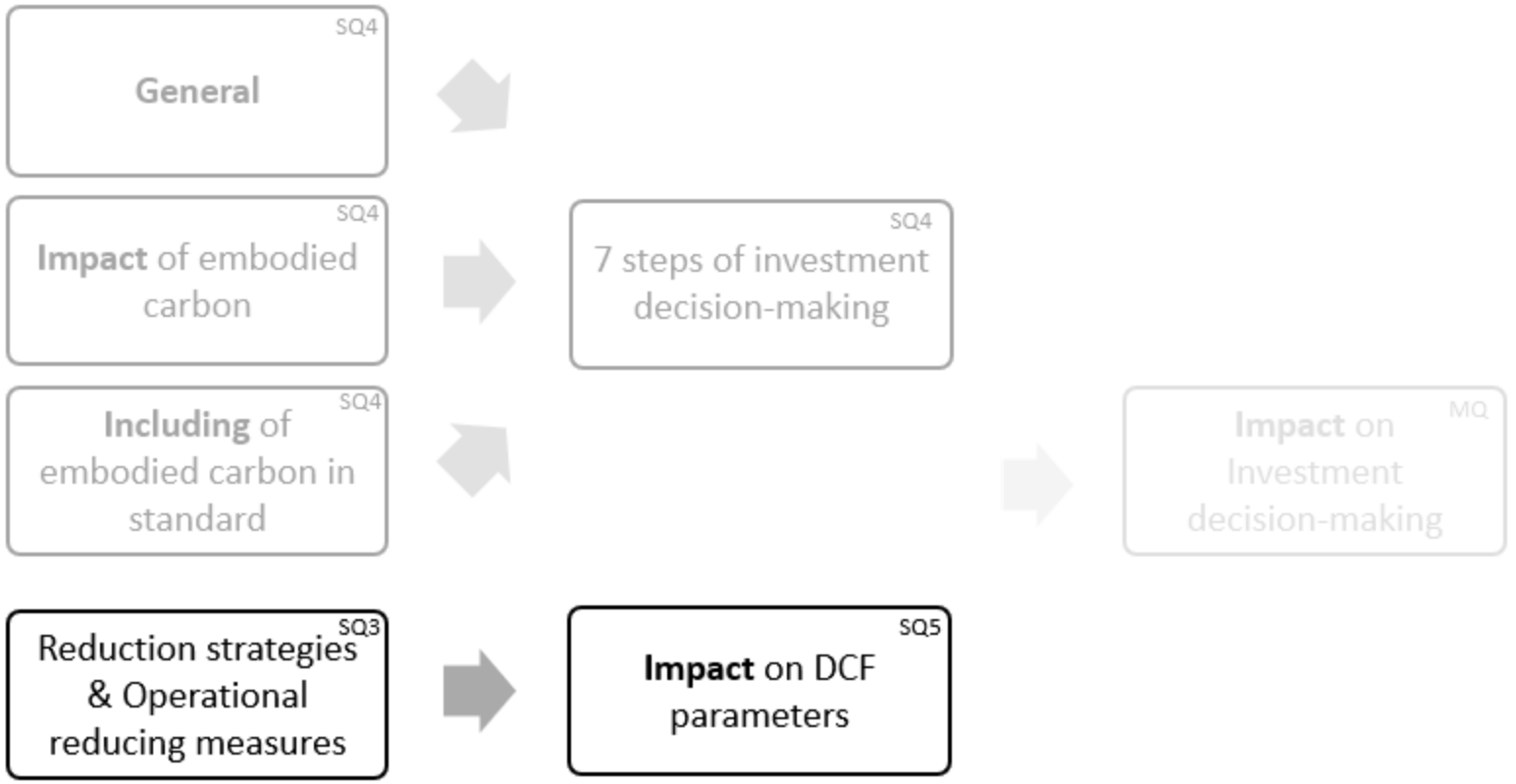

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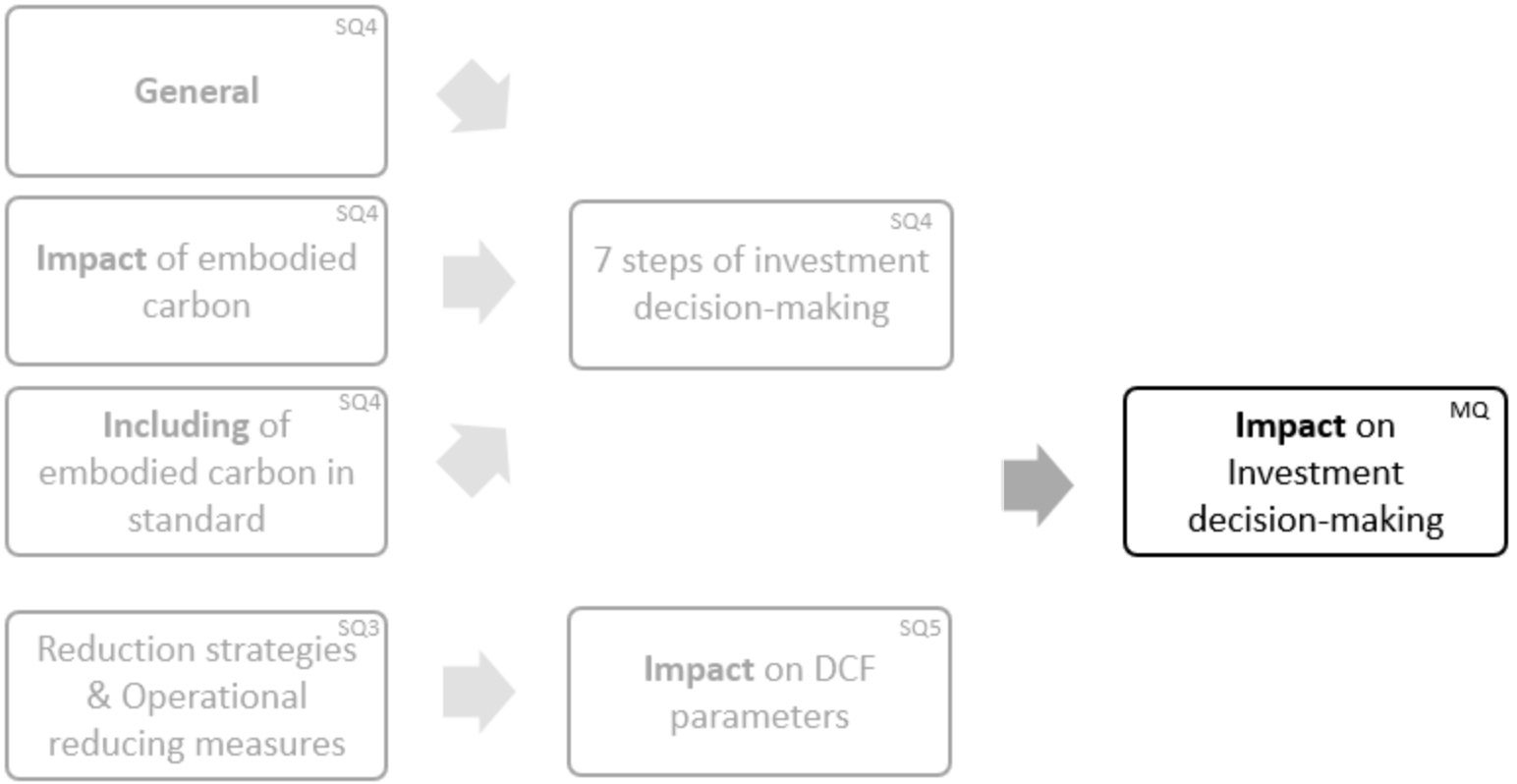

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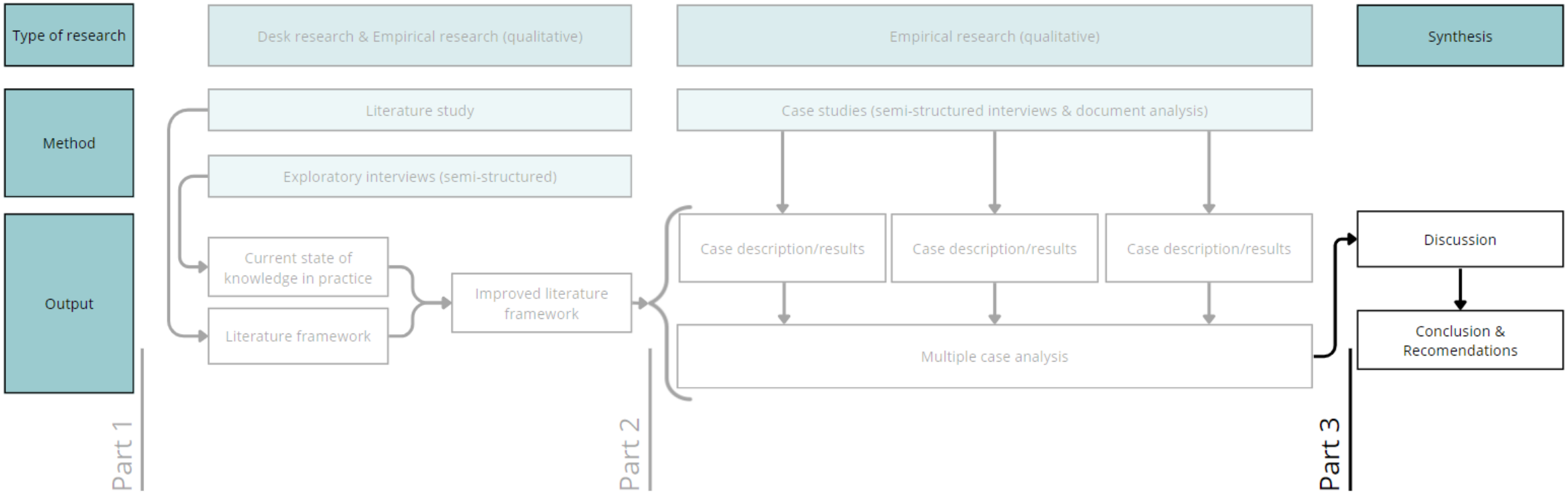
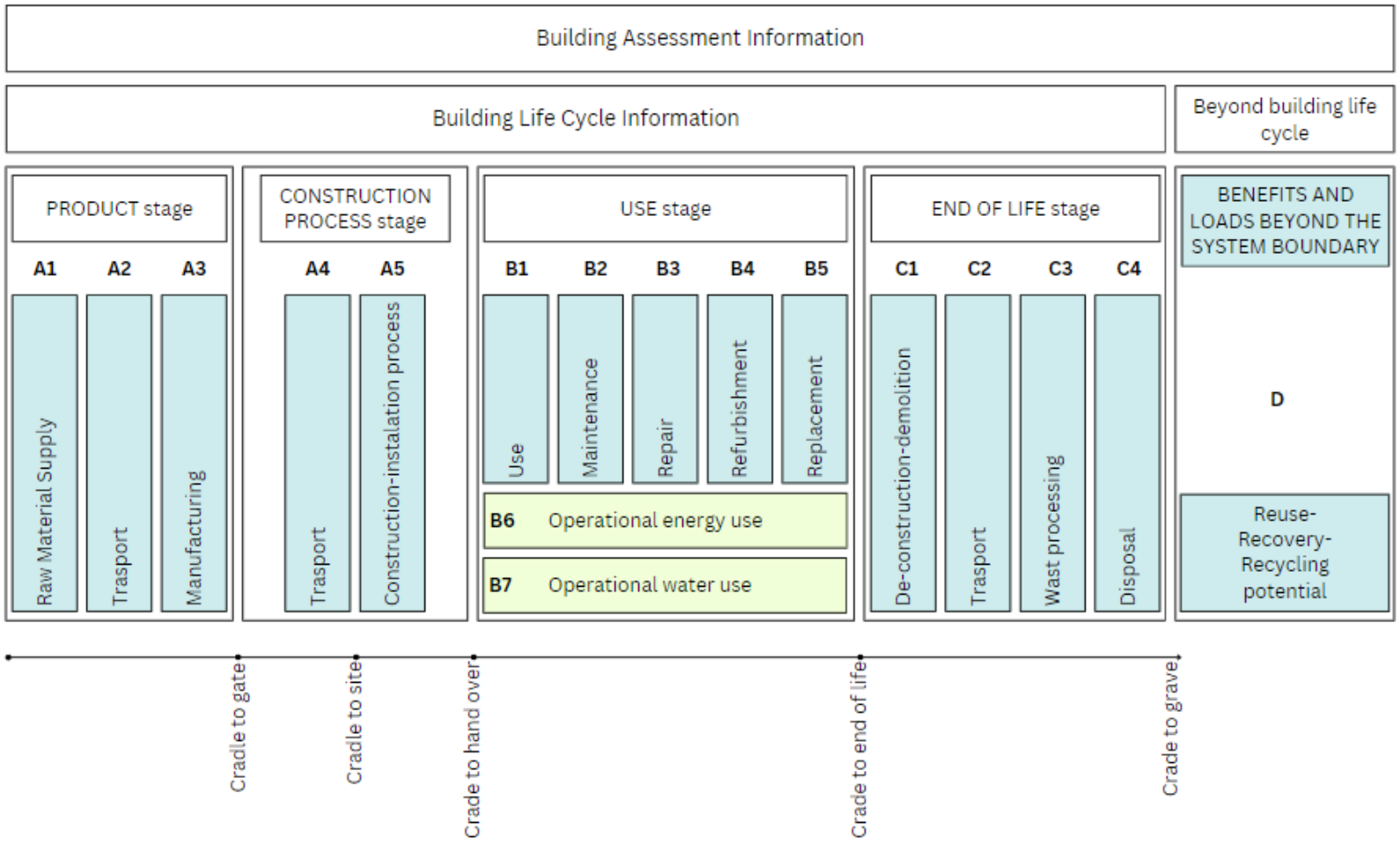


03 | LITERATURE STUDY AND EXPLORATORY INTERVIEWS

Quantifing embodied carbon

Literature study

Life Cycle Assessment (LCA)



Quantifing embodied carbon

Literature study

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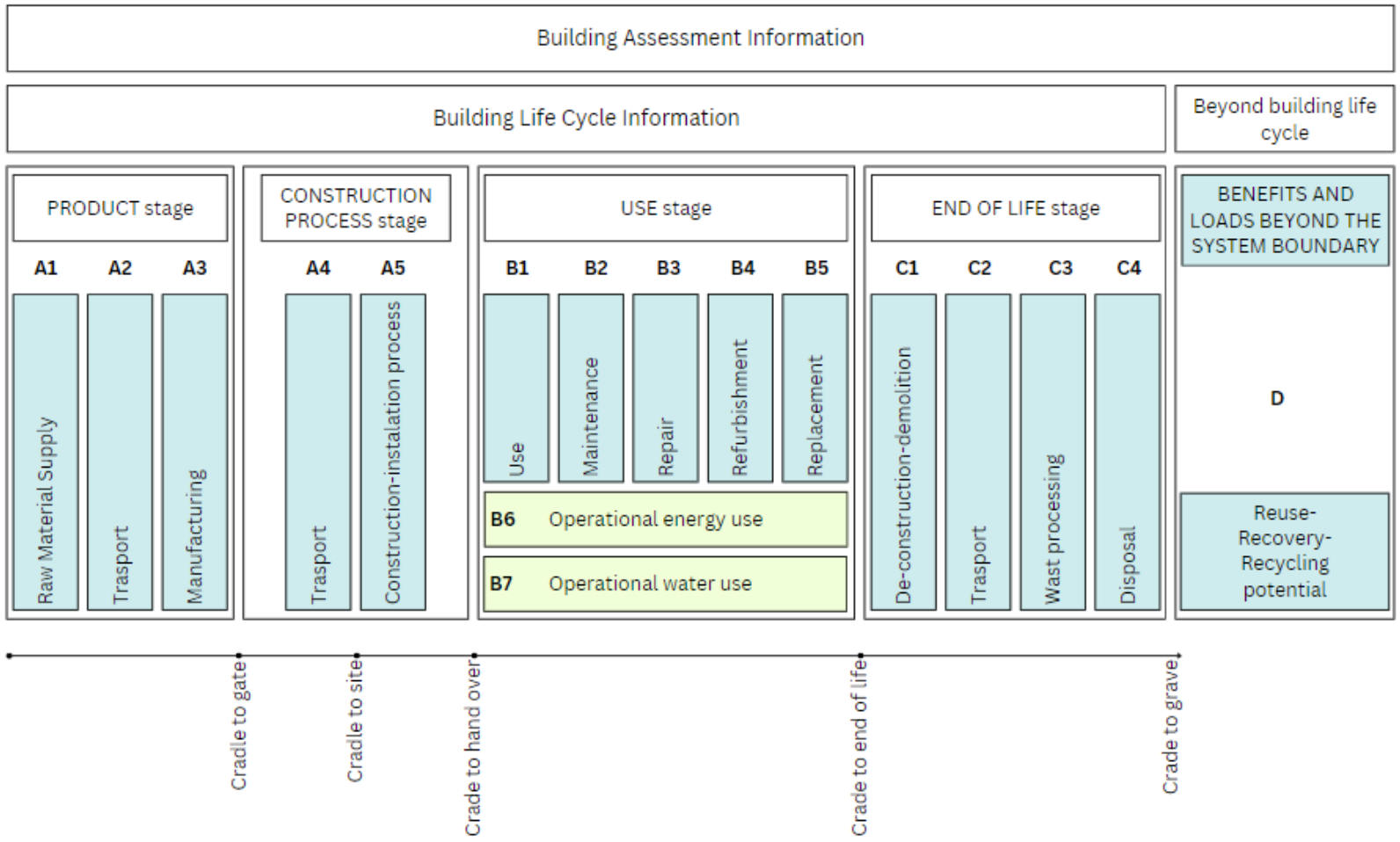

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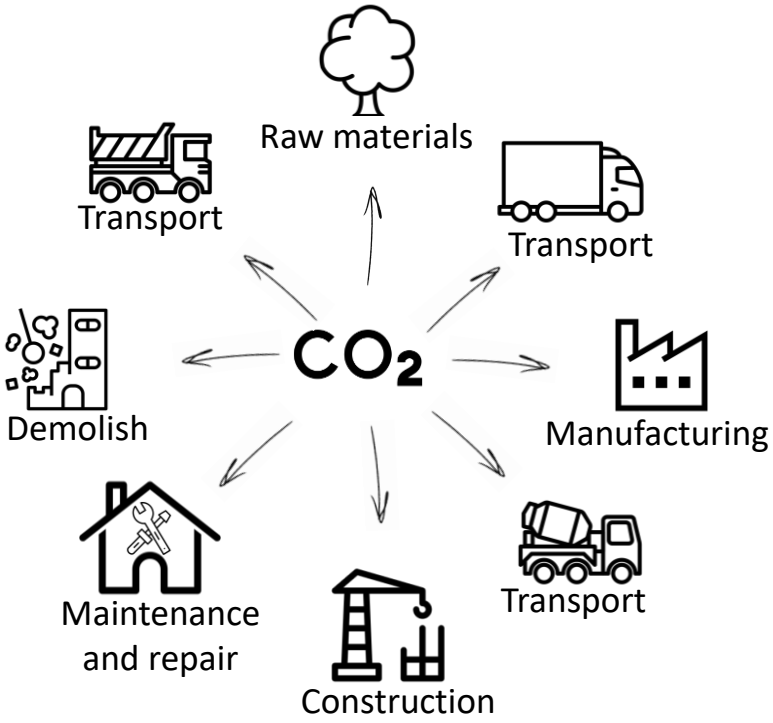

Regulations
Literature study

Environmental
regulations

Sustainable finance
regulations

Regulations
Literature study

Environmental
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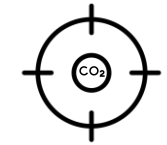
- European Green Deal and the Dutch Climate Agreement



- Environmental Performance Building (MPG)

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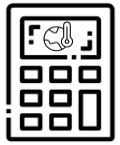

Sustainable finance
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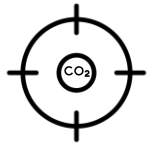

- Environmental Performance Building (MPG)

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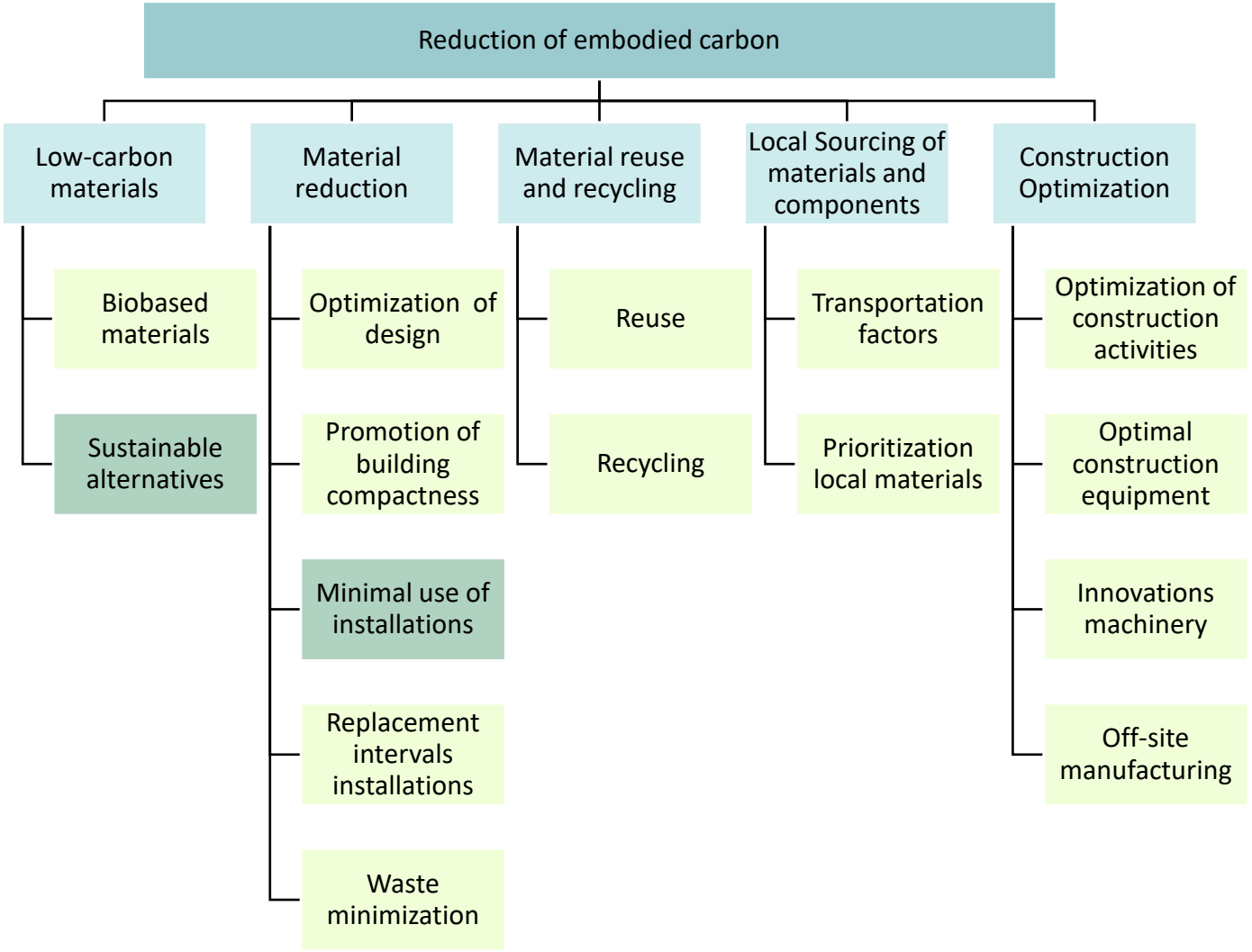
Sustainable finance regulations

- Sustainable Finance Disclosure Regulation (SFDR) and upcoming Corporate Sustainability Reporting Directive (CSRD).

- The EU Taxonomy

Embodied carbon reduction strategies

Literature study

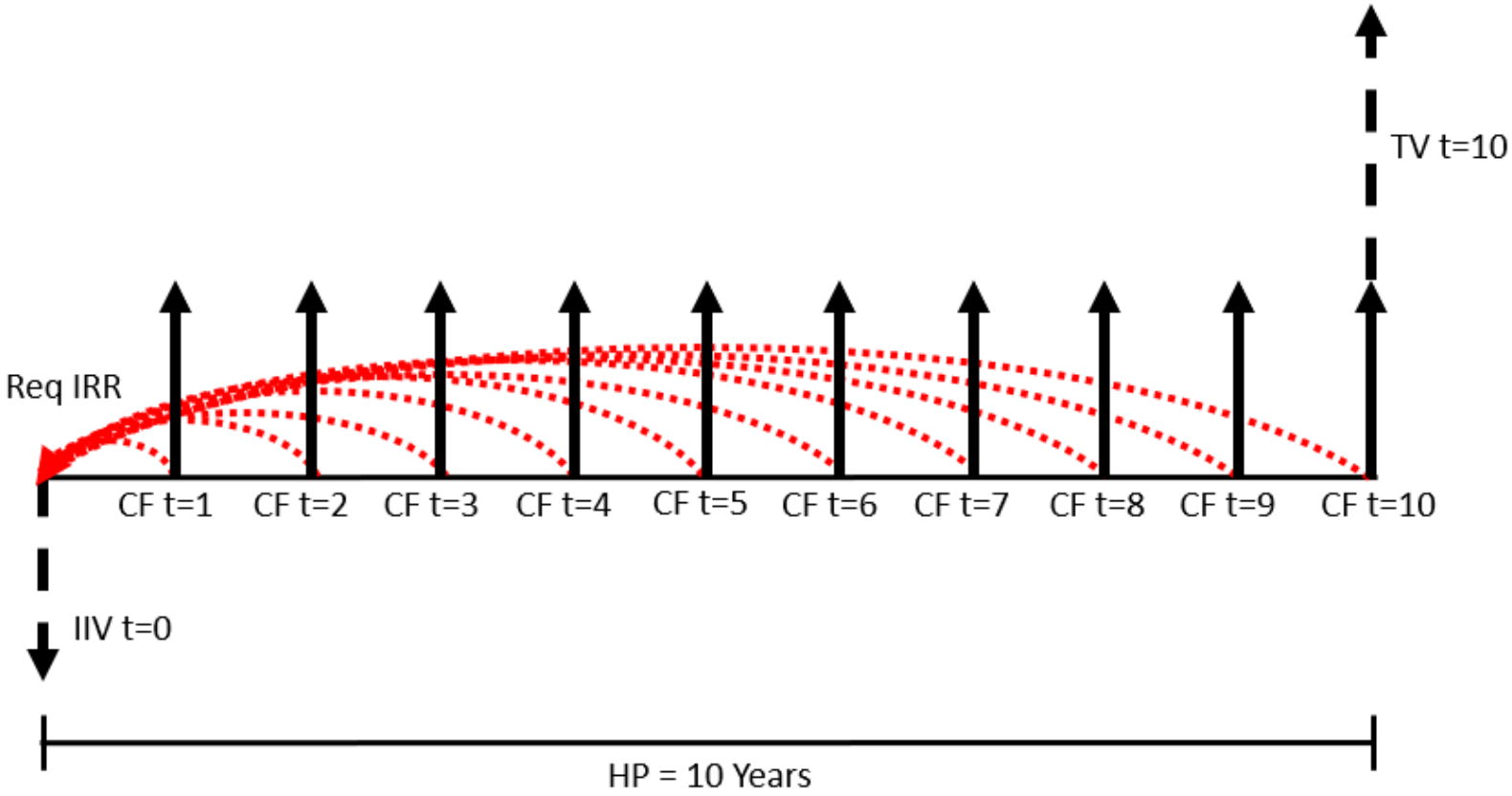


Legend:

- Reduction strategies
- Operational measures from literature
- Operational measures added from exploratory interviews

DCF-parameters

Literature study



DCF-parameters

Literature study

Holding period	Cashflow		Terminal value	Required IRR
National tax law	Initial property value	Construction time	GEY (Gross exit yield)	Government bonds
National depreciation systems	Land value	Interest factor for construction	Cashflowt+1	Inflation
Market conditions	Rent/m2	Loan	Depreciation Factor	Property law
Type of investment	NLA (Net Lettable Area)	Amortization	Vacancy value (NFA)	Demand and supply
	GFA/NLA ratio	Interest rate on loan	Value growth of vacancy value (NFA)	Local market
	Nominal annual rent increase	Depreciation factor	NLA (Net Lettable Area)	Tenant credit worthiness
	Inflations	Tax rate		Multi/single let
	Vacancy rate	GIY (Gross initial yield)		Period to expire of leases
	Mutation rate	Carbon credits		Accessibility
	Other income	Carbon offsetting		Sustainability
	Operation expenses	Carbon tax		Building Obsolescence premium
	Capital expenditures			

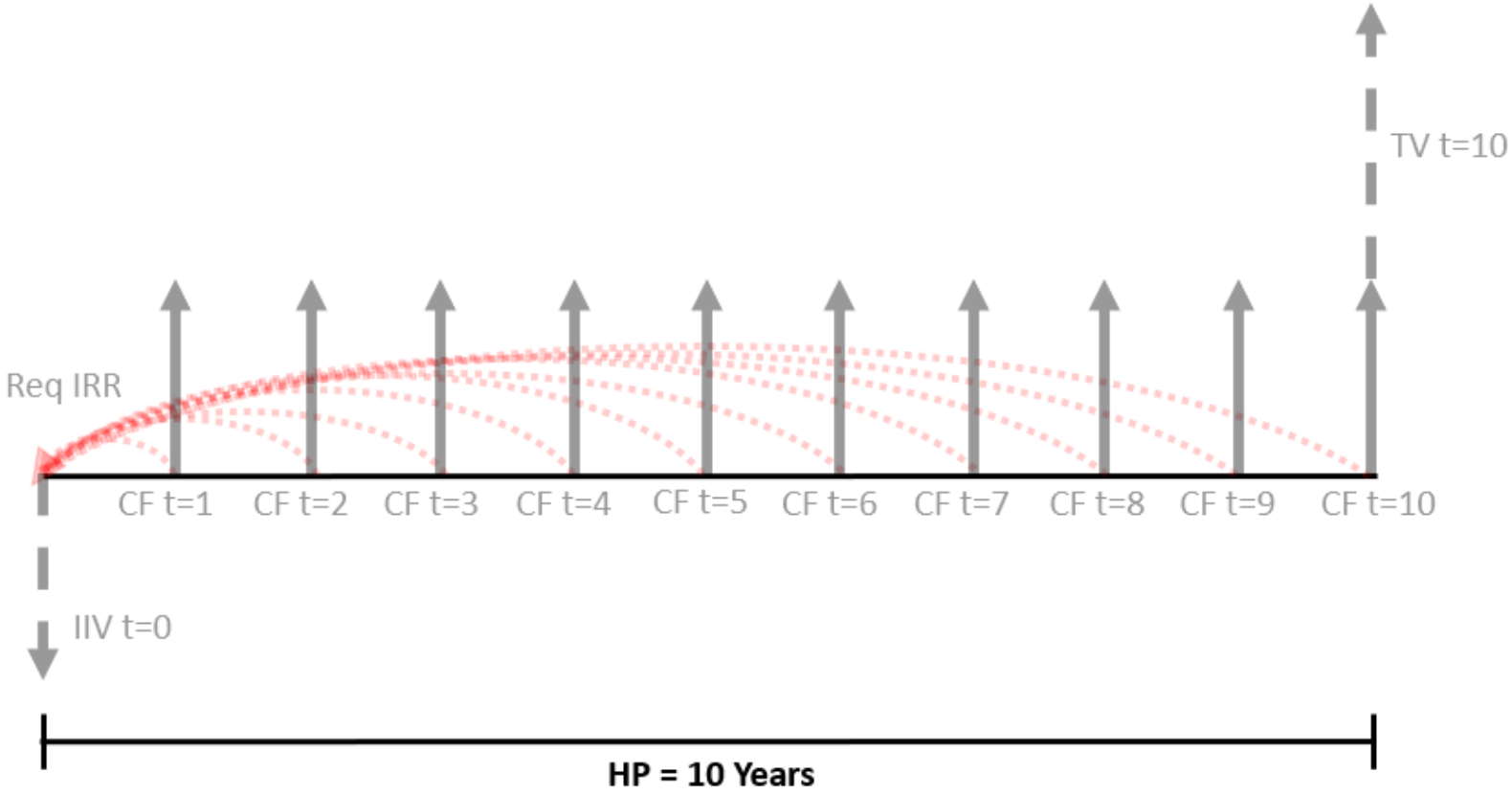
Legend:

Parameters from literature

Parameters added from exploratory interviews

DCF-parameters

Literature study



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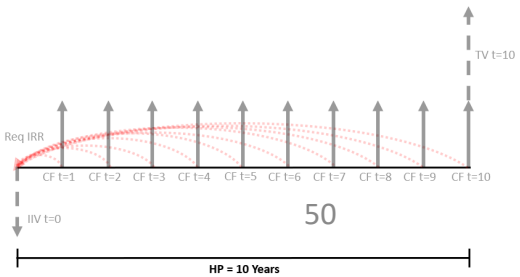

DCF-parameters
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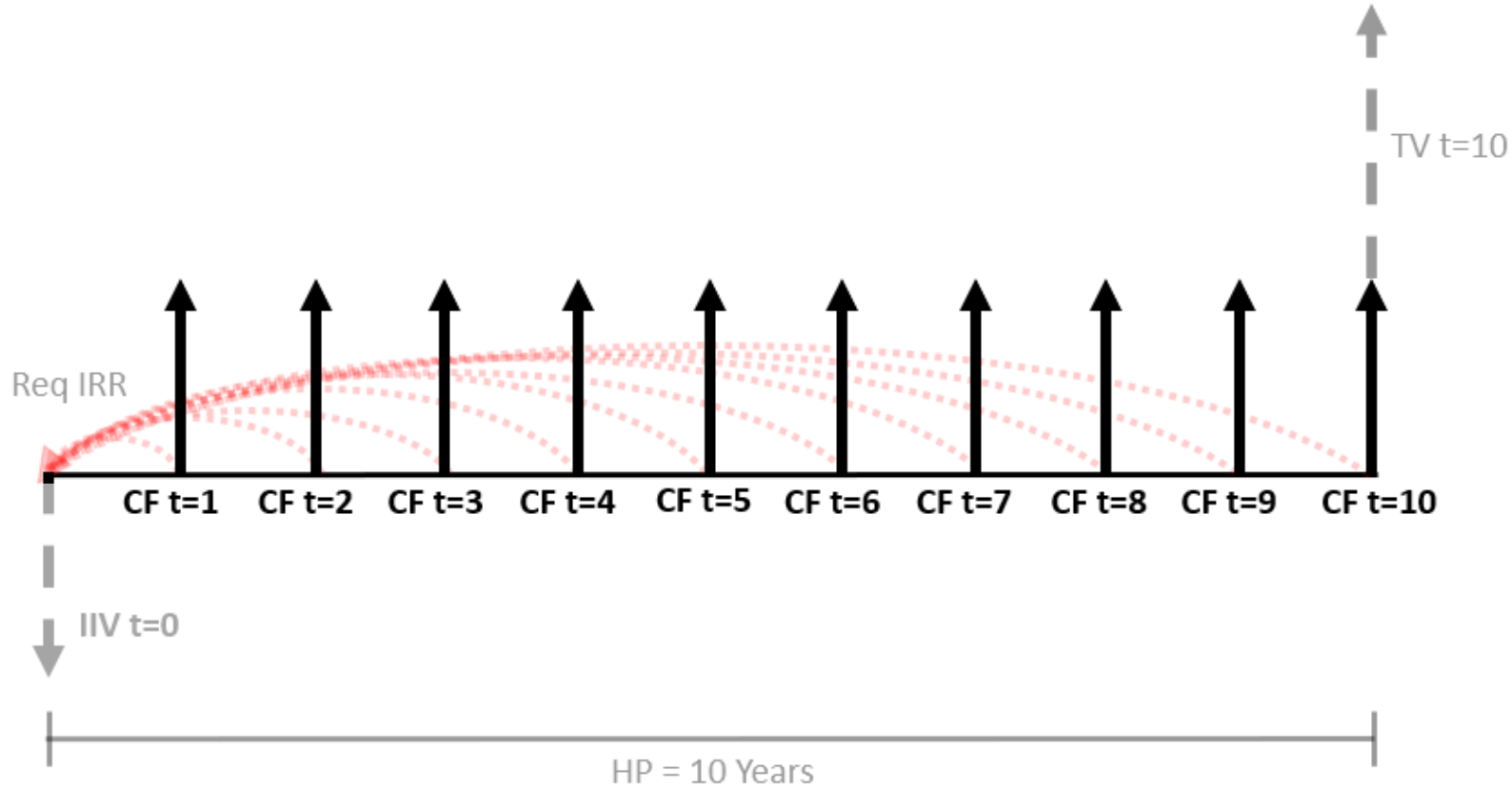

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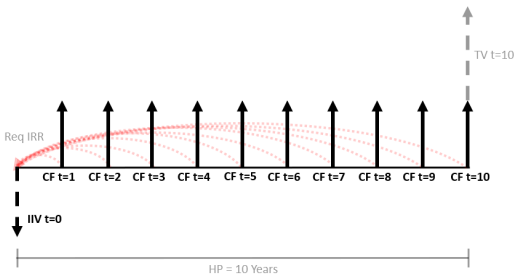

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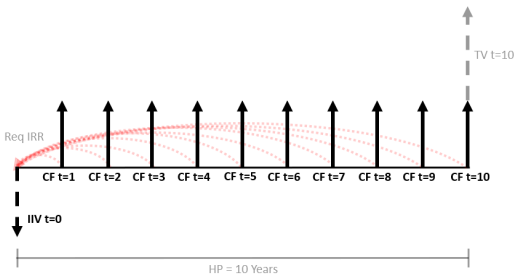

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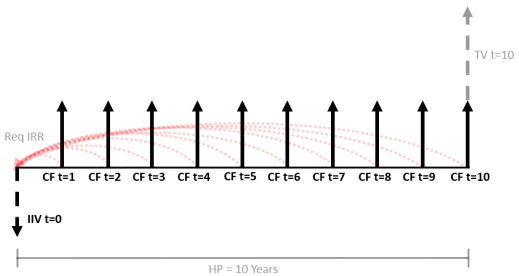

DCF-parameters

Literature study

Holding period	Cashflow		Terminal value	Required IRR
National tax law	Initial property value	Construction time	GEY (Gross exit yield)	Government bonds
National depreciation systems	Land value	Interest factor for construction	Cashflowt+1	Inflation
Market conditions	Rent/m2	Loan	Depreciation Factor	Property law
Type of investment	NLA (Net Lettable Area)	Amortization	Vacancy value (NFA)	Demand and supply
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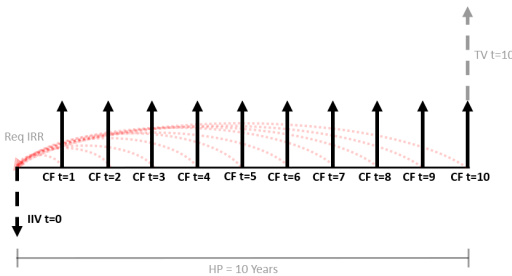
	Inflations	Tax rate		Multi/single let
	Vacancy rate	GIY (Gross initial yield)		Period to expire of leases
	Mutation rate	Carbon credits		Accessibility
	Other income	Carbon offsetting		Sustainability
	Operation expenses	Carbon tax		Building Obsolescence premium
	Capital expenditures			

Legend:

Parameters from literature

Parameters added from exploratory interviews



DCF-parameters

Literature study

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Legend:

Parameters from literature

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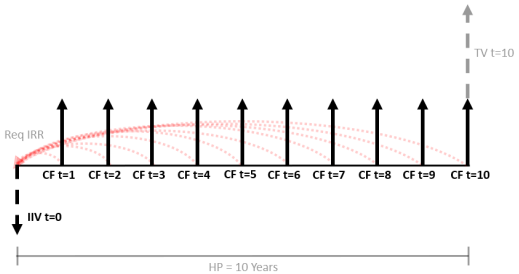
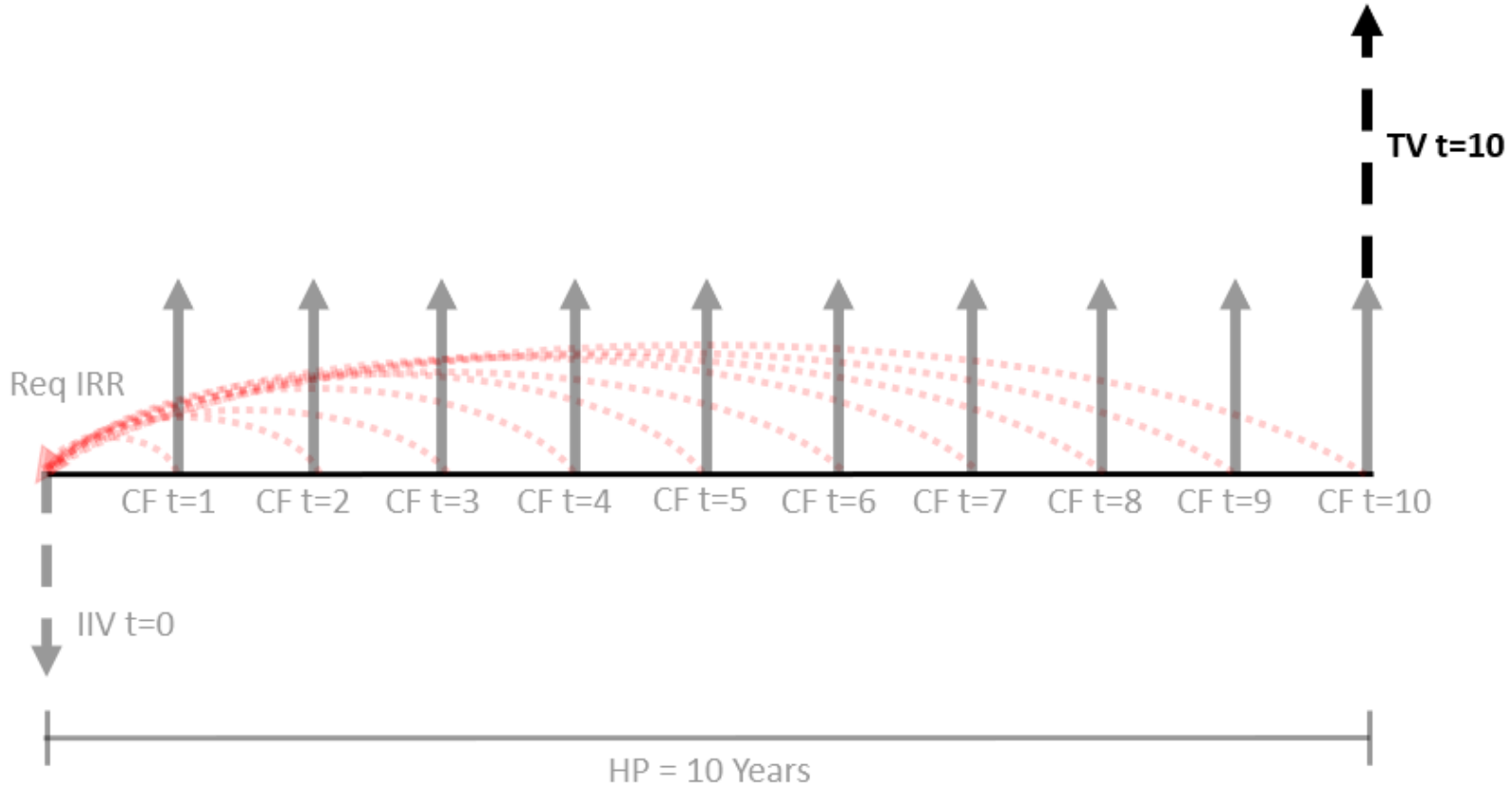


DCF-parameters

Literature study



Terminal Value (TV) = expected value at which the building can be sold at the end of the holding period.

Legend:

Parameters from literature

Parameters added from exploratory interviews

DCF-parameters

Literature study

Holding period	Cashflow		Terminal value	Required IRR
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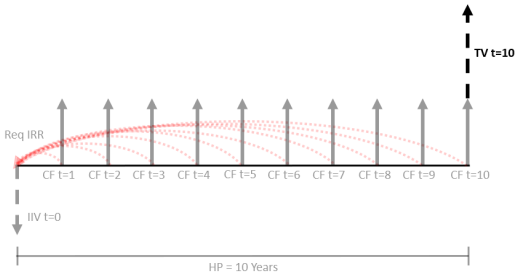
Legend:

Parameters from literature

Parameters added from exploratory interviews



DCF-parameters

Literature study

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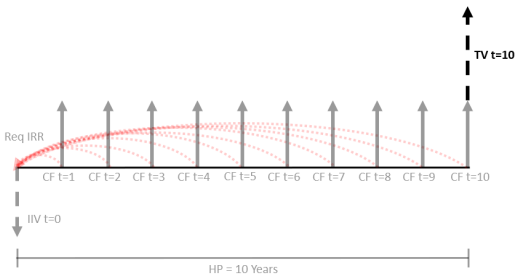
Legend:

Parameters from literature

Parameters added from exploratory interviews



DCF-parameters

Literature study

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Legend:

Parameters from literature

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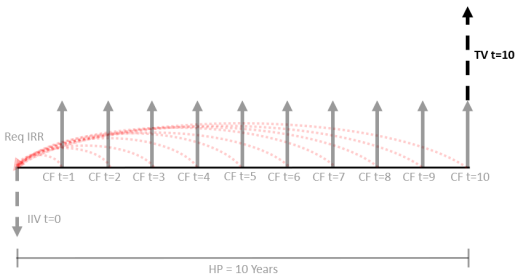
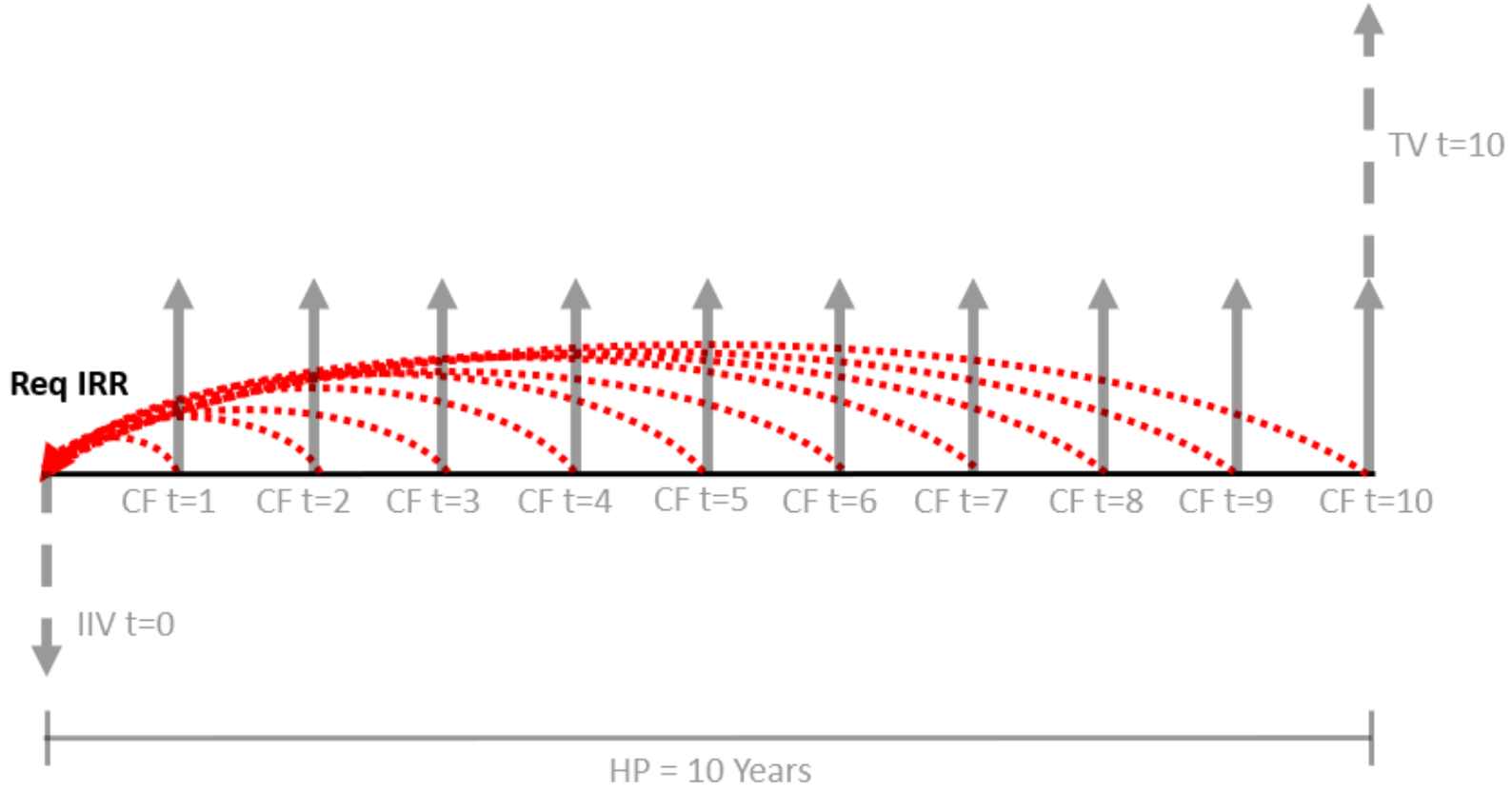


DCF-parameters

Literature study



Required Internal Rate of Return (Req IRR) = a number used to calculate the future costs and returns to present value.

Legend:

Parameters from literature

Parameters added from exploratory interviews

DCF-parameters

Literature study

Holding period	Cashflow		Terminal value	Required IRR
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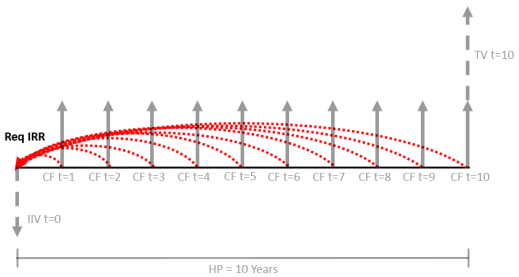
Legend:

Parameters from literature

Parameters added from exploratory interviews



DCF-parameters

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Legend:

Parameters from literature

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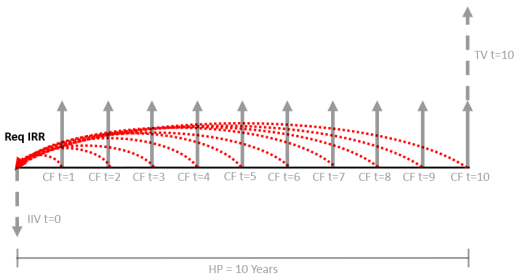

DCF-parameters

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Legend:

Parameters from literature

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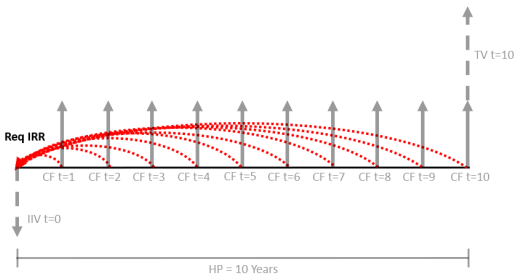

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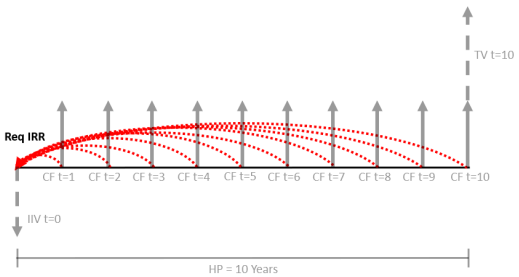
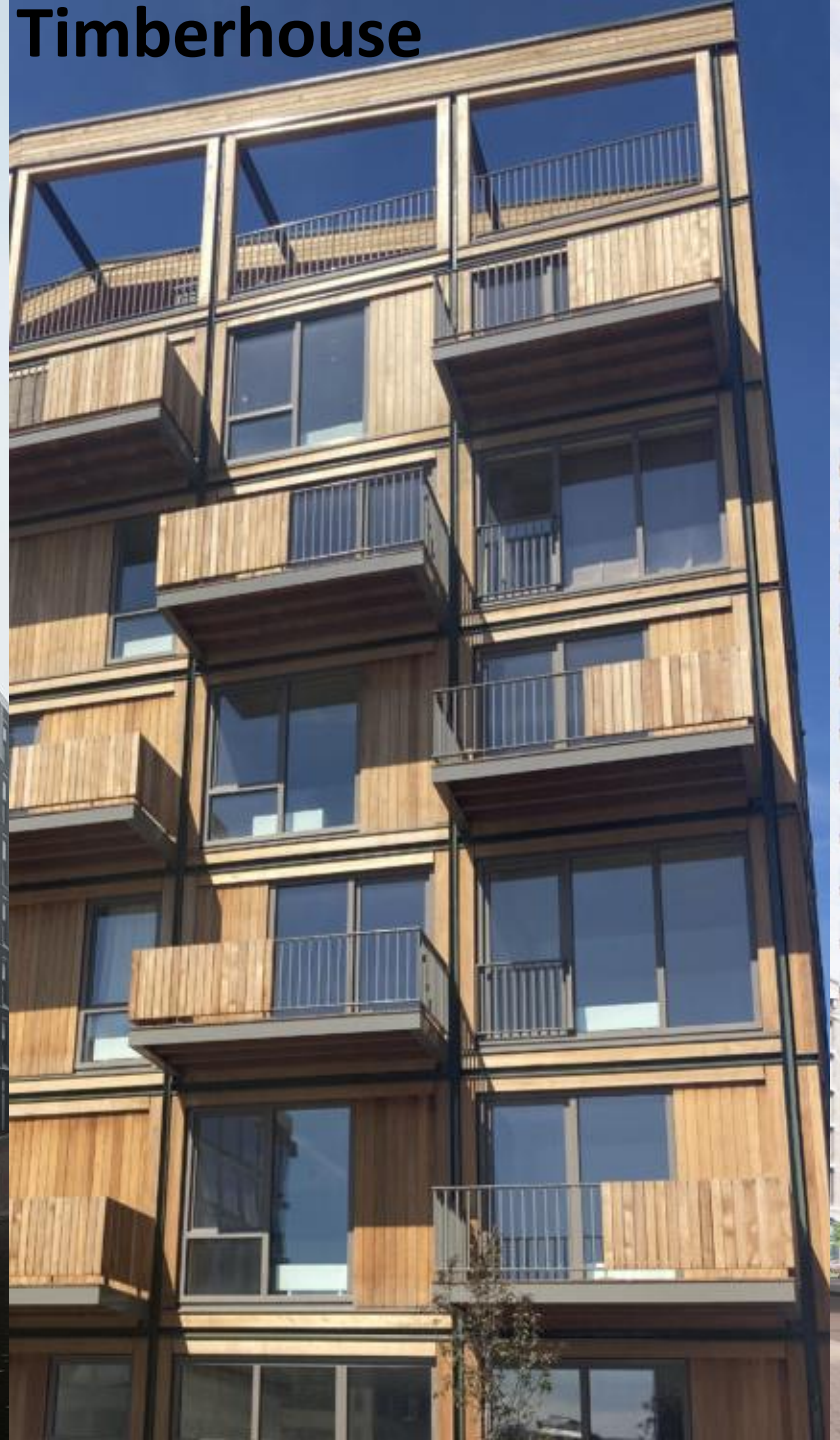
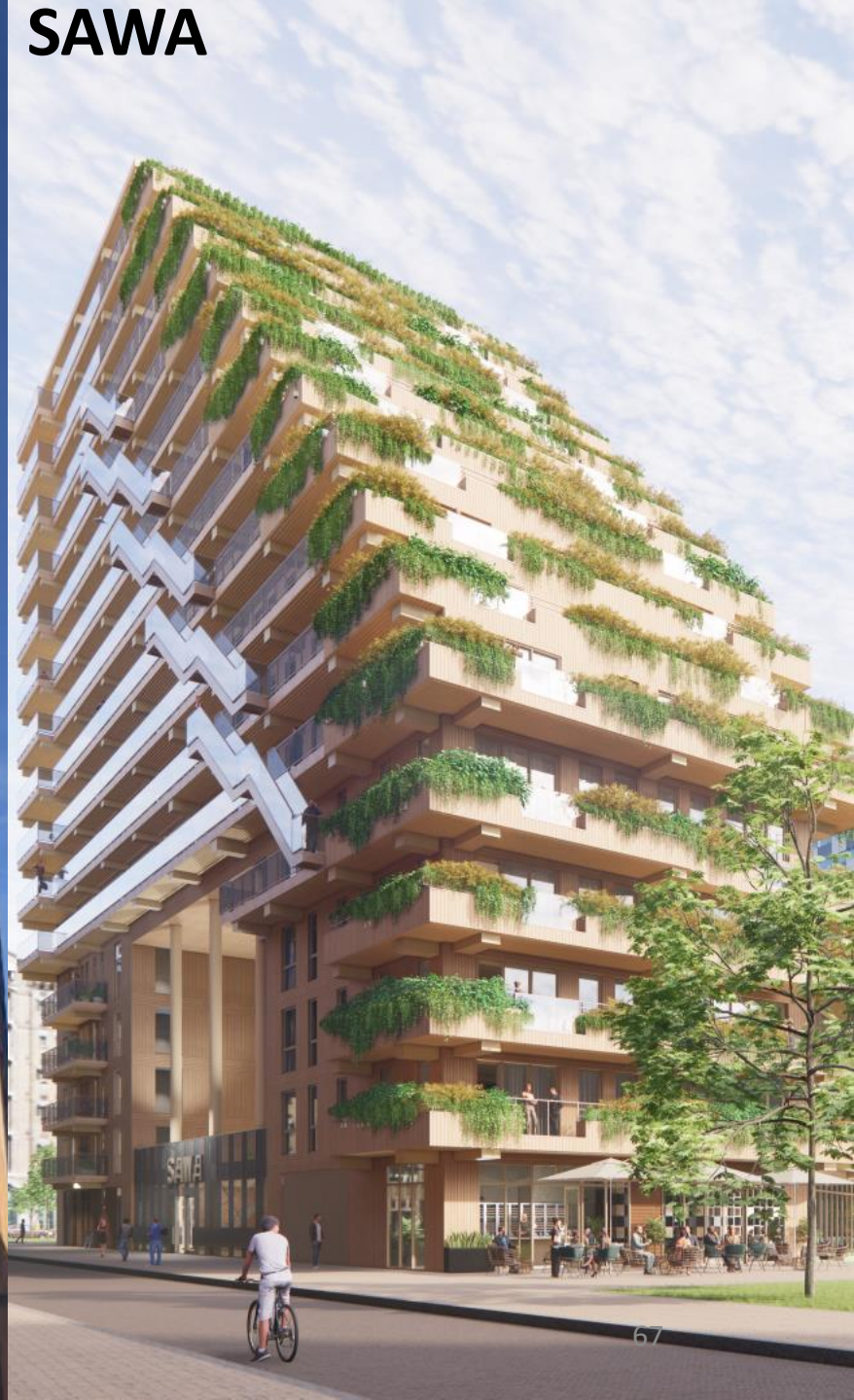


04 | CASE STUDIES


Jonas


Timberhouse


SAWA

Jonas

Characteristics of Jonas	
Size:	29,950 m^2 GFA
Apartments:	190 mid-market
Design:	2017
Construction time:	3 years
Investor:	Amvest
MPG score:	0.67 euro/m^2 GFA
PPm:	300 CO_2-eq. per m^2
Construction:	Cast-in-place recycled concrete
Exterior facade:	Zink
Interior and roof facade:	Wood

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Interior and roof facade:	Wood

Jonas

Characteristics of Amvest	
Type of investor	Institutional investor
Funding	External shareholders (pension funds and insurance companies)

Jonas

Characteristics of Amvest

Type of investor Institutional investor

Funding External shareholders (pension funds and insurance companies)

Holding period	Cashflow		Terminal value	Required IRR
National tax law	Initial property value	Construction time	GEY (Gross exit yield)	Government bonds
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	Operation expenses	Carbon tax		Building Obsolescence premium
	Capital expenditures			

Timberhouse

Characteristics of Timberhouse

Size:	1.974 m^2 GFA
Apartments:	22 private sector apartments
Design:	2019
Construction time:	6 months
Investor:	Coltavast
MPG score:	0,56 euro/m^2 GFA
PPm:	unknown
Carbon storage:	414 tons CO_2
Construction:	Wooden modular units with a concrete core

Timberhouse

Characteristics of Coltavast

Type of investor	Private investors
Funding	Family offices, both own money and loans.

Timberhouse

Characteristics of Coltavast

Type of investor	Private investors
Funding	Family offices, both own money and loans.

Holding period	Cashflow		Terminal value	Required IRR
National tax law	Initial property value	Construction time	GEY (Gross exit yield)	Government bonds
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	Operation expenses	Carbon tax		Building Obsolescence premium
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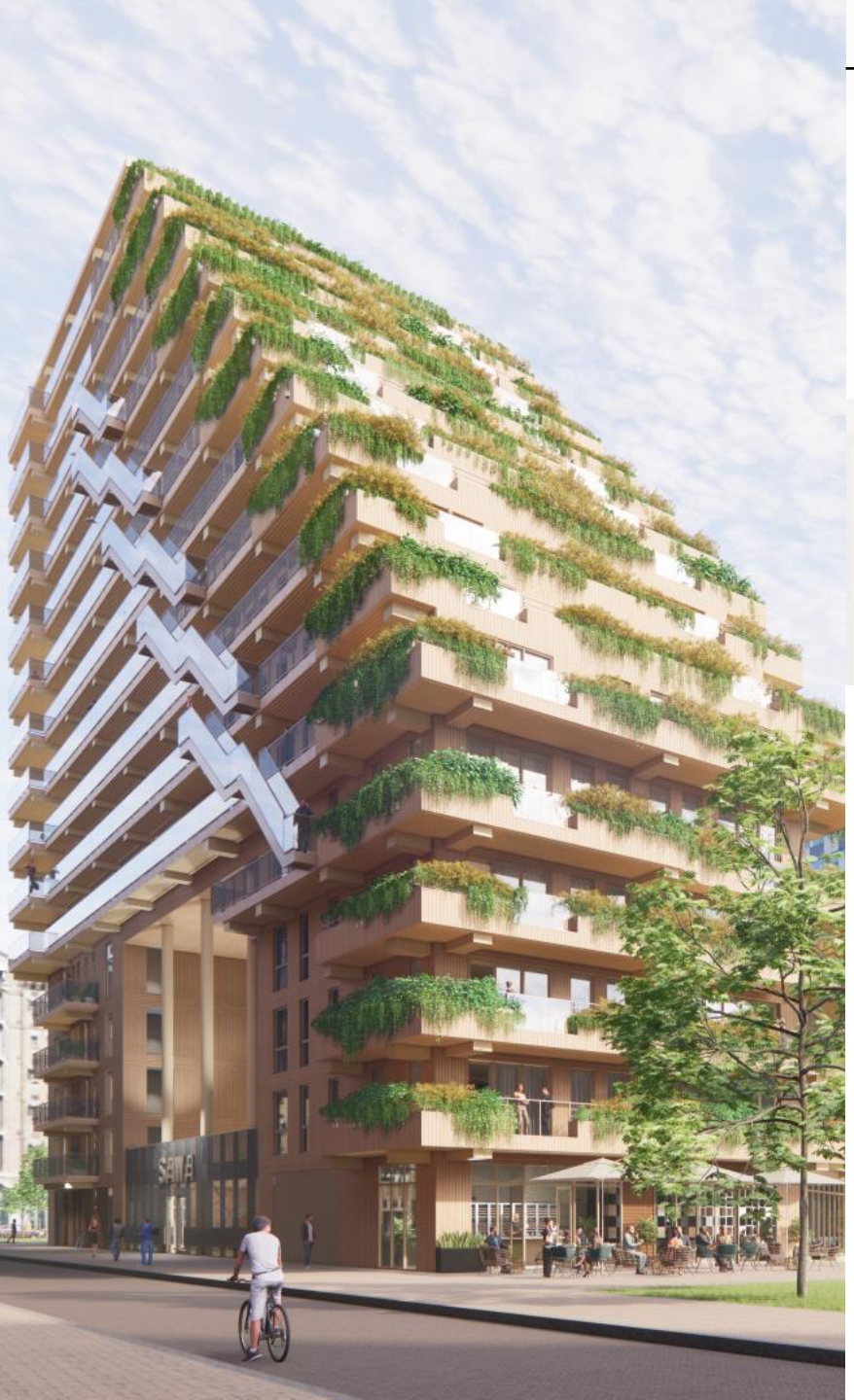


Characteristics of SAWA	
Size:	12.000 m^2 GFA
Apartments:	22 mid-market
Design:	2019
Construction time:	2 years
Investor:	Focus on Impact
MPG score:	0,60 euro/m^2 GFA
PPm:	unknown
Carbon storage:	5000 tons CO_2
Construction:	Hybrid (concrete and Wood)

Characteristics of Focus on Impact

Type of investor	Private investors
Funding	Family offices, both own money and loans.

Characteristics of Focus on Impact

Type of investor Private investors

Funding Family offices, both own money and loans.

Holding period

- National tax law
- National depreciation systems
- Market conditions
- Type of investment
- Exit scenario's

Cashflow

- Initial property value
- Land value
- Rent/m2
- NLA (Net Lettable Area)
- GFA/NLA ratio
- Nominal annual rent increase
- Inflations
- Vacancy rate
- Mutation rate
- Other income
- Operation expenses
- Capital expenditures
- Construction time
- Interest factor for construction
- Loan
- Amortization
- Interest rate on loan
- Depreciation factor
- Tax rate
- GIY (Gross initial yield)
- Carbon credits
- Carbon offsetting
- Carbon tax

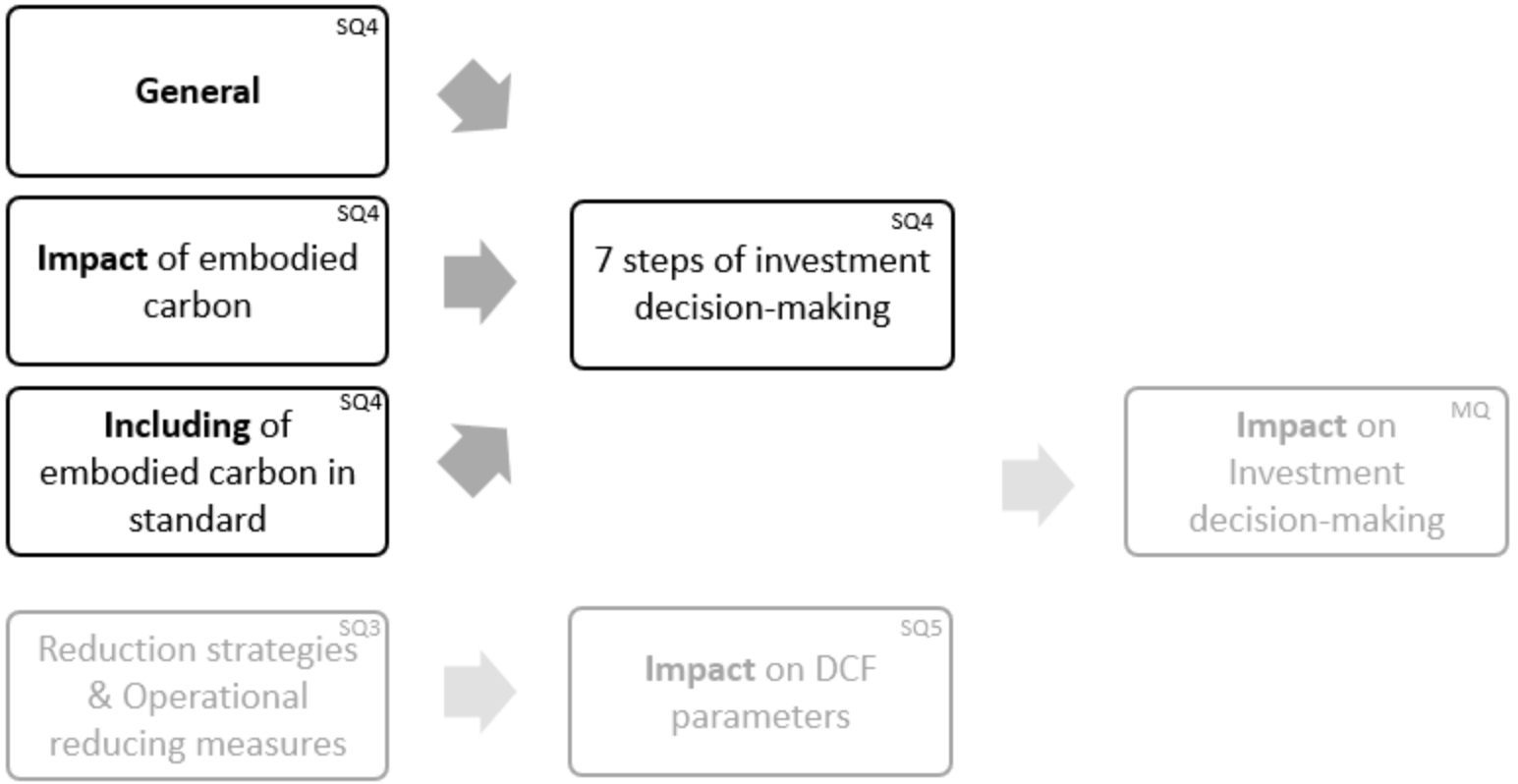
Terminal value

- GEY (Gross exit yield)
- Cashflowt+1
- Depreciation Factor
- Vacancy value (NFA)
- Value growth of vacancy value (NFA)
- NLA (Net Lettable Area)

Required IRR

- Government bonds
- Inflation
- Property law
- Demand and supply
- Local market
- Tenant credit worthiness
- Multi/single let
- Period to expire of leases
- Accessibility
- Sustainability
- Building Obsolescence premium

Embodied carbon within investment decision-making process



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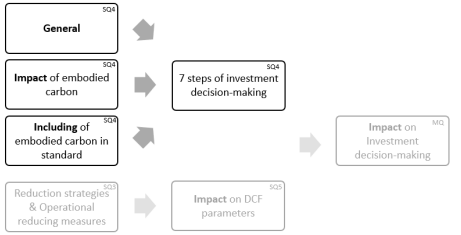
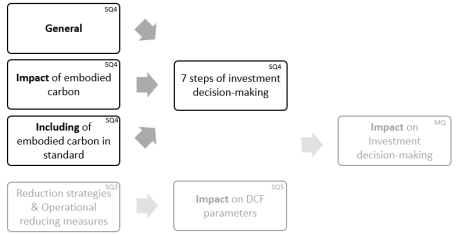


Steps
Step 1: Setting a strategy
Step 2: Establishing return/risk objectives
Step 3: Forecasting and evaluate expected costs returns
Step 4: Assessing investment risk
Step 5: Making a risk-adjusted evaluation of the forecast costs and returns
Step 6: Implementing accepted proposals
Step 7: Auditing operating performance

Embodied carbon within investment decision-making process

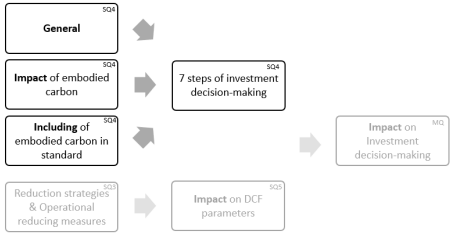


Steps	Jonas Impact	Amvest Included
Step 1: Setting a strategy		
Step 2: Establishing return/risk objectives		
Step 3: Forecasting and evaluate expected costs returns		
Step 4: Assessing investment risk		
Step 5: Making a risk-adjusted evaluation of the forecast costs and returns		
Step 6: Implementing accepted proposals		
Step 7: Auditing operating performance		

Legend:

- No impact at all
- Positive impact / included
- Moderate impact / semi included
- Negative impact / not included

Embodied carbon within investment decision-making process



Steps	Jonas	Amvest	Timber-house	Coltavast
	Impact	Included	Impact	Included
Step 1: Setting a strategy				
Step 2: Establishing return/risk objectives				
Step 3: Forecasting and evaluate expected costs returns				
Step 4: Assessing investment risk				
Step 5: Making a risk-adjusted evaluation of the forecast costs and returns				
Step 6: Implementing accepted proposals				
Step 7: Auditing operating performance				

Legend:

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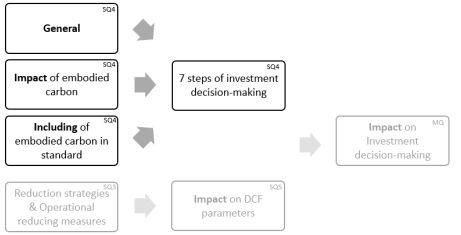
Embodied carbon within investment decision-making process



Steps	Jonas	Amvest	Timber-house	Coltavast	SAWA	Focus on impact
	Impact	Included	Impact	Included	Impact	Included
Step 1: Setting a strategy						
Step 2: Establishing return/risk objectives						
Step 3: Forecasting and evaluate expected costs returns						
Step 4: Assessing investment risk						
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Legend:
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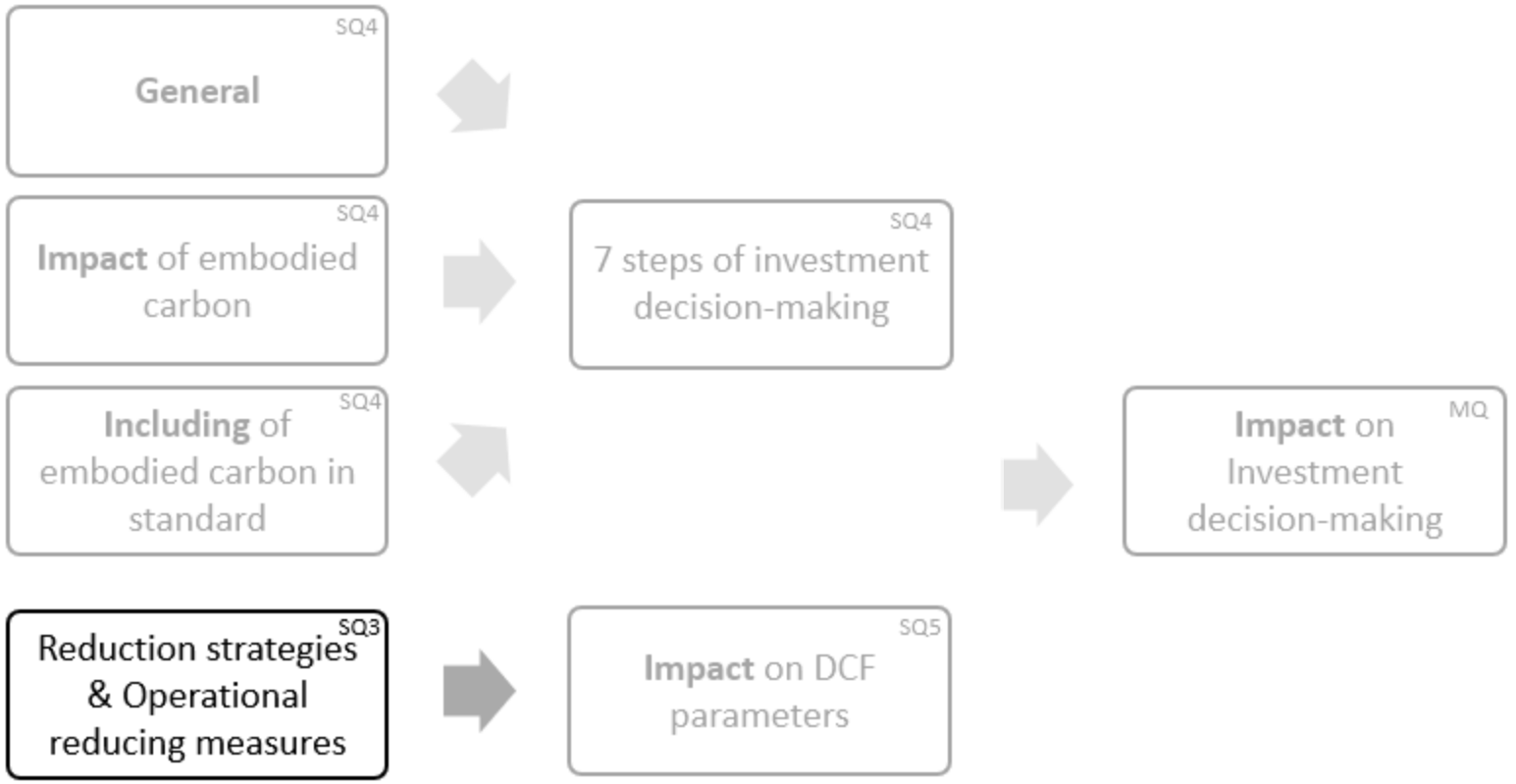
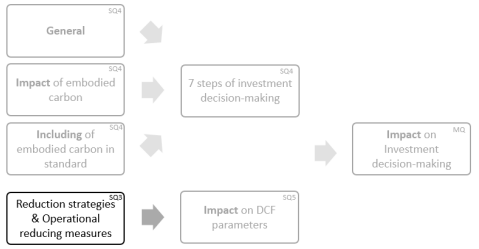
Applied reduction strategies



Applied reduction strategies

Reduction strategies	Operational measures
Low-carbon materials	Biobased materials
	Sustainable alternatives
Material reduction	Optimization of design
	Building compactness
	Minimal use of installations
	Replacement intervals installations
	Waste minimization
Material reuse and recycling	Recycling
	Reuse
Local sourcing of materials	Transportation factors
	Prioritization local materials
Construction optimization	Optimization construction activities
	Optimal construction equipment
	Innovations machinery
	Use of off-site manufacturing



Applied reduction strategies

Reduction strategies	Operational measures	Jonas
Low-carbon materials	Biobased materials	
	Sustainable alternatives	
Material reduction	Optimization of design	
	Building compactness	
	Minimal use of installations	
	Replacement intervals installations	
	Waste minimization	
Material reuse and recycling	Recycling	
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Local sourcing of materials	Transportation factors	
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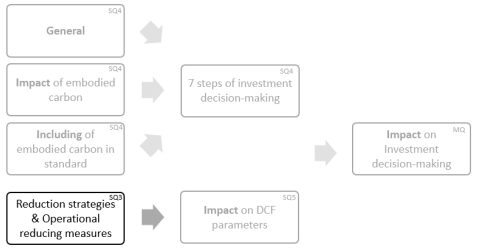
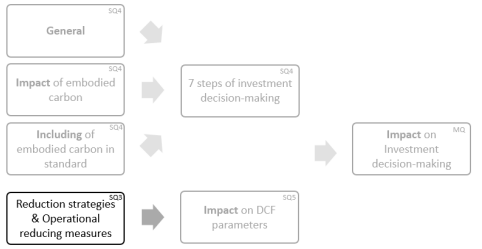


Legend:

- Used
- Partly used
- Not used
- Wood
- Construction & façade
- Ventilation type C
- Minimize packaging materials
- Recycled concrete
- Construction hub
- One transport movement
- Europe
- Automated factory
- Prefab
- Modular units

Applied reduction strategies



Reduction strategies	Operational measures	Jonas	Timberhouse
Low-carbon materials	Biobased materials		
	Sustainable alternatives		
Material reduction	Optimization of design		
	Building compactness		
	Minimal use of installations		
	Replacement intervals installations		
	Waste minimization		
Material reuse and recycling	Recycling		
	Reuse		
Local sourcing of materials	Transportation factors		
	Prioritization local materials	EU	EU
Construction optimization	Optimization construction activities		
	Optimal construction equipment		
	Innovations machinery		
	Use of off-site manufacturing		

Legend:

- Used
- Partly used
- Not used
- Wood
- Construction & façade
- Ventilation type C
- Minimize packaging materials
- Recycled concrete
- Construction hub
- One transport movement
- Europe
- Automated factory
- Prefab
- Modular units

Applied reduction strategies

Reduction strategies	Operational measures	Jonas	Timberhouse	SAWA
Low-carbon materials	Biobased materials			
	Sustainable alternatives			
Material reduction	Optimization of design			
	Building compactness			
	Minimal use of installations			
	Replacement intervals installations			
	Waste minimization			
Material reuse and recycling	Recycling			
	Reuse			
Local sourcing of materials	Transportation factors			
	Prioritization local materials	EU	EU	EU
Construction optimization	Optimization construction activities			
	Optimal construction equipment			
	Innovations machinery			
	Use of off-site manufacturing			

Legend:
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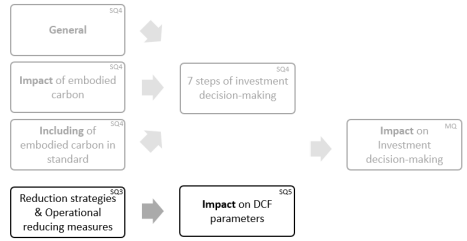
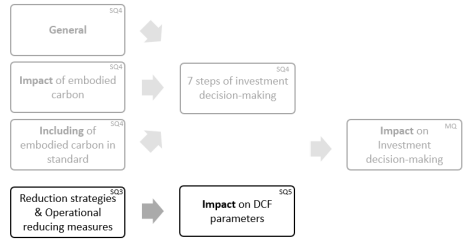
Impact of applied reduction strategies on DCF-parameters



Operational measures	DCF
Biobased materials	Holding period
	Cashflow
	Terminal value
	Required IRR
Optimization of design	HP, CF, TV & IRR
Minimal use of installations	HP, CF, TV & IRR
Waste minimization	HP, CF, TV & IRR
Recycling	HP, CF, TV & IRR
Transportation factors	HP, CF, TV & IRR
Prioritization local materials	HP, CF, TV & IRR
Optimal construction equipment	HP, CF, TV & IRR
Innovations machinery	HP, CF, TV & IRR
Use of off-site manufacturing	Holding period
	Cashflow
	Terminal value
	Required IRR

Impact of applied reduction strategies on DCF-parameters



Operational measures	DCF	Jonas
Biobased materials	Holding period	No impact
	Cashflow	No impact
	Terminal value	No impact
	Required IRR	No impact
Optimization of design	HP, CF, TV & IRR	No impact
Minimal use of installations	HP, CF, TV & IRR	No impact
Waste minimization	HP, CF, TV & IRR	No impact
Recycling	HP, CF, TV & IRR	No impact
Transportation factors	HP, CF, TV & IRR	No impact
Prioritization local materials	HP, CF, TV & IRR	No impact
Optimal construction equipment	HP, CF, TV & IRR	
Innovations machinery	HP, CF, TV & IRR	
Use of off-site manufacturing	Holding period	No impact
	Cashflow	No impact
	Terminal value	No impact
	Required IRR	No impact

Legend:

- Positive impact / Used
- No impact / Partly used
- Negative impact / Not used
- Wood
- Construction & façade
- Ventilation type C
- Minimize packaging materials
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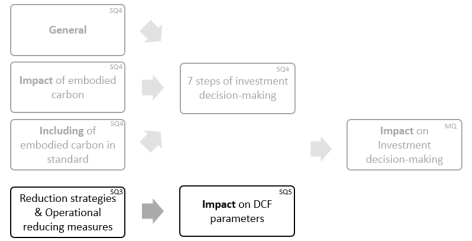
Impact of applied reduction strategies on DCF-parameters



Operational measures	DCF	Jonas	Timberhouse
Biobased materials	Holding period	No impact	No impact
	Cashflow	No impact	↑Initial property value; ↑Operational Expenses; ↓ Interest rate on loan
	Terminal value	No impact	No impact
	Required IRR	No impact	No impact
Optimization of design	HP, CF, TV & IRR	No impact	
Minimal use of installations	HP, CF, TV & IRR	No impact	
Waste minimization	HP, CF, TV & IRR	No impact	
Recycling	HP, CF, TV & IRR	No impact	
Transportation factors	HP, CF, TV & IRR	No impact	No impact
Prioritization local materials	HP, CF, TV & IRR	No impact	No impact
Optimal construction equipment	HP, CF, TV & IRR		No impact
Innovations machinery	HP, CF, TV & IRR		No impact
Use of off-site manufacturing	Holding period	No impact	No impact
	Cashflow	No impact	↓ Construction time; ↓ GLA/NLA ratio; ↓ NLA (Net Leasable Area)
	Terminal value	No impact	↓ NLA (Net Leasable Area)
	Required IRR	No impact	No impact

Legend:
- Positive impact / Used
- No impact / Partly used
- Negative impact / Not used
- Wood
- Construction & façade
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Impact of applied reduction strategies on DCF-parameters

Operational measures	DCF	Jonas	Timberhouse	SAWA
Biobased materials	Holding period	No impact	No impact	No impact
	Cashflow	No impact	↑Initial property value; ↑Operational Expenses; ↓ Interest rate on loan	↑Initial property value; ↑Operational Expenses; ↓ Interest rate on loan; ↑ Carbon credits
	Terminal value	No impact	No impact	↑ Value growth of vacancy value; ↑ Vacancy value
	Required IRR	No impact	No impact	↑Demand and supply; ↑Sustainability
Optimization of design	HP, CF, TV & IRR	No impact		
Minimal use of installations	HP, CF, TV & IRR	No impact		No impact
Waste minimization	HP, CF, TV & IRR	No impact		
Recycling	HP, CF, TV & IRR	No impact		No impact
Transportation factors	HP, CF, TV & IRR	No impact	No impact	
Prioritization local materials	HP, CF, TV & IRR	No impact	No impact	No impact
Optimal construction equipment	HP, CF, TV & IRR		No impact	
Innovations machinery	HP, CF, TV & IRR		No impact	
Use of off-site manufacturing	Holding period	No impact	No impact	No impact
	Cashflow	No impact	↓ Construction time; ↓ GLA/NLA ratio; ↓ NLA (Net Leasable Area)	↓ Construction time
	Terminal value	No impact	↓ NLA (Net Leasable Area)	No impact
	Required IRR	No impact	No impact	No impact

05 | DISCUSSION

Discussion - Literature findings

Holding period

- National tax law
- National depreciation systems
- Market conditions
- Type of investment

Cashflow

- ↑ Initial property value (GBCA, 2008)
- Land value
- ↑ Rent/m2 (Eichholtz et al., 2010; Miller et al., 2008; Pivo and Fisher, 2010 and Leskinen et al., 2020)
- NLA (Net Lettable Area)
- GFA/NLA ratio
- Nominal annual rent increase
- Inflations
- ↓ Vacancy rate (Fuerst and McAllister, 2011; Pivo and Fisher, 2010)
- Mutation rate
- Other income
- ↓ Operation expenses (Pivo and Fisher, 2010 & Leskinen et al., 2020)
- Capital expenditures
- Construction time
- Interest factor for construction
- Loan
- Amortization
- Interest rate on loan
- Depreciation factor
- Tax rate
- GIY (Gross initial yield)
- Carbon credits
- Carbon offsetting
- Carbon tax

↑ Terminal value

- GEY (Gross exit yield)
- Cashflowt+1
- Depreciation Factor
- ↑ Vacancy value (NFA) (Leskinen et al., 2020; GBCA, 2008))
- Value growth of vacancy value (NFA)
- NLA (Net Lettable Area)

↓ Required IRR

- Government bonds
- Inflation
- Property law
- ↑ Demand and supply (Eichholtz et al., 2010; Fuerst & McAllister, 2011; Pivo & Fisher, 2010)
- Local market
- ↑ Tenant credit worthiness (Ellison et al., 2007)
- Multi/single let
- Period to expire of leases
- Accessibility
- Sustainability
- ↓ Building Obsolescence premium (Fuerst and McAllister, 2011; Pivo and Fisher, 2010)

Legend:

Literature findings

Discussion - Support

Holding period	Cashflow		↑ Terminal value	↓ Required IRR
National tax law	↑ Initial property value (GBCA, 2008)	Construction time	GEY (Gross exit yield)	Government bonds
National depreciation systems	Land value	Interest factor for construction	Cashflowt+1	Inflation
Market conditions	↑ Rent/m2 (Eichholtz et al., 2010; Miller et al., 2008; Pivo and Fisher, 2010 and Leskinen et al., 2020)	Loan	Depreciation Factor	Property law
Type of investment	NLA (Net Lettable Area)	Amortization	↑ Vacancy value (NFA) (Leskinen et al., 2020; GBCA, 2008))	↑ Demand and supply (Eichholtz et al., 2010; Fuerst & McAllister, 2011; Pivo & Fisher, 2010)
	GFA/NLA ratio	Interest rate on loan	Value growth of vacancy value (NFA)	Local market
	Nominal annual rent increase	Depreciation factor	NLA (Net Lettable Area)	↑ Tenant credit worthiness (Ellison et al., 2007)
	Inflations	Tax rate		Multi/single let
	↓ Vacancy rate (Fuerst and McAllister, 2011; Pivo and Fisher, 2010)	GIY (Gross initial yield)		Period to expire of leases
	Mutation rate	Carbon credits		Accessibility
	Other income	Carbon offsetting		Sustainability
	↓ Operation expenses (Pivo and Fisher, 2010 & Leskinen et al., 2020)	Carbon tax		↓ Building Obsolescence premium (Fuerst and McAllister, 2011; Pivo and Fisher, 2010)
	Capital expenditures			

Legend:

Literature findings

Discussion - Contradict

Holding period	Cashflow		↑ Terminal value	↓ Required IRR
National tax law	↑ Initial property value (GBCA, 2008)	Construction time	GEY (Gross exit yield)	Government bonds
National depreciation systems	Land value	Interest factor for construction	Cashflowt+1	Inflation
Market conditions	↑ Rent/m2 (Eichholtz et al., 2010; Miller et al., 2008; Pivo and Fisher, 2010 and Leskinen et al., 2020)	Loan	Depreciation Factor	Property law
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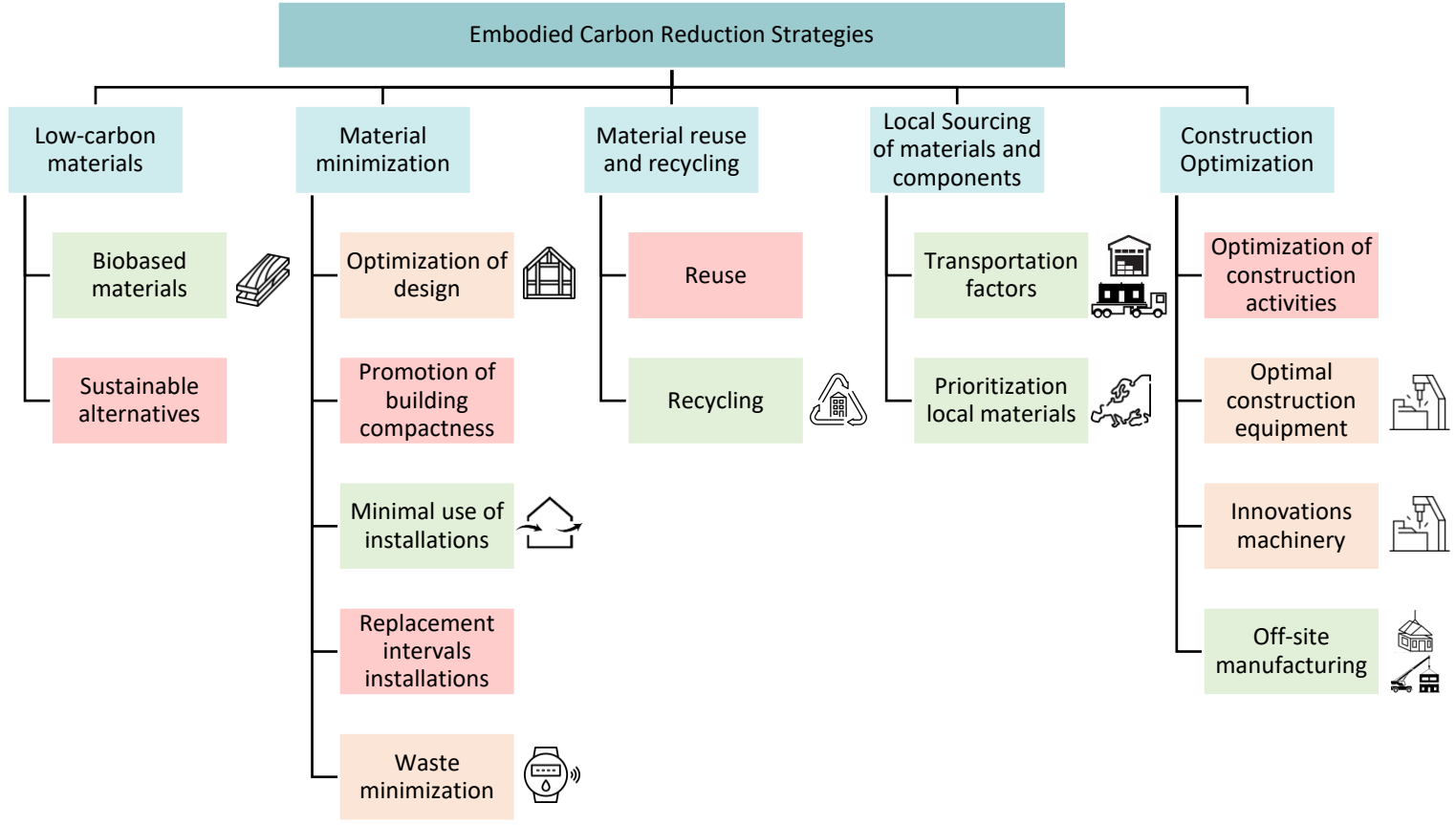
	Mutation rate	Carbon credits		Accessibility
	Other income	Carbon offsetting		Sustainability
	↓ Operation expenses (Pivo and Fisher, 2010 & Leskinen et al., 2020)	Carbon tax		↓ Building Obsolescence premium (Fuerst and McAllister, 2011; Pivo and Fisher, 2010)
	Capital expenditures			

Legend:

Literature findings

Discussion - New insights



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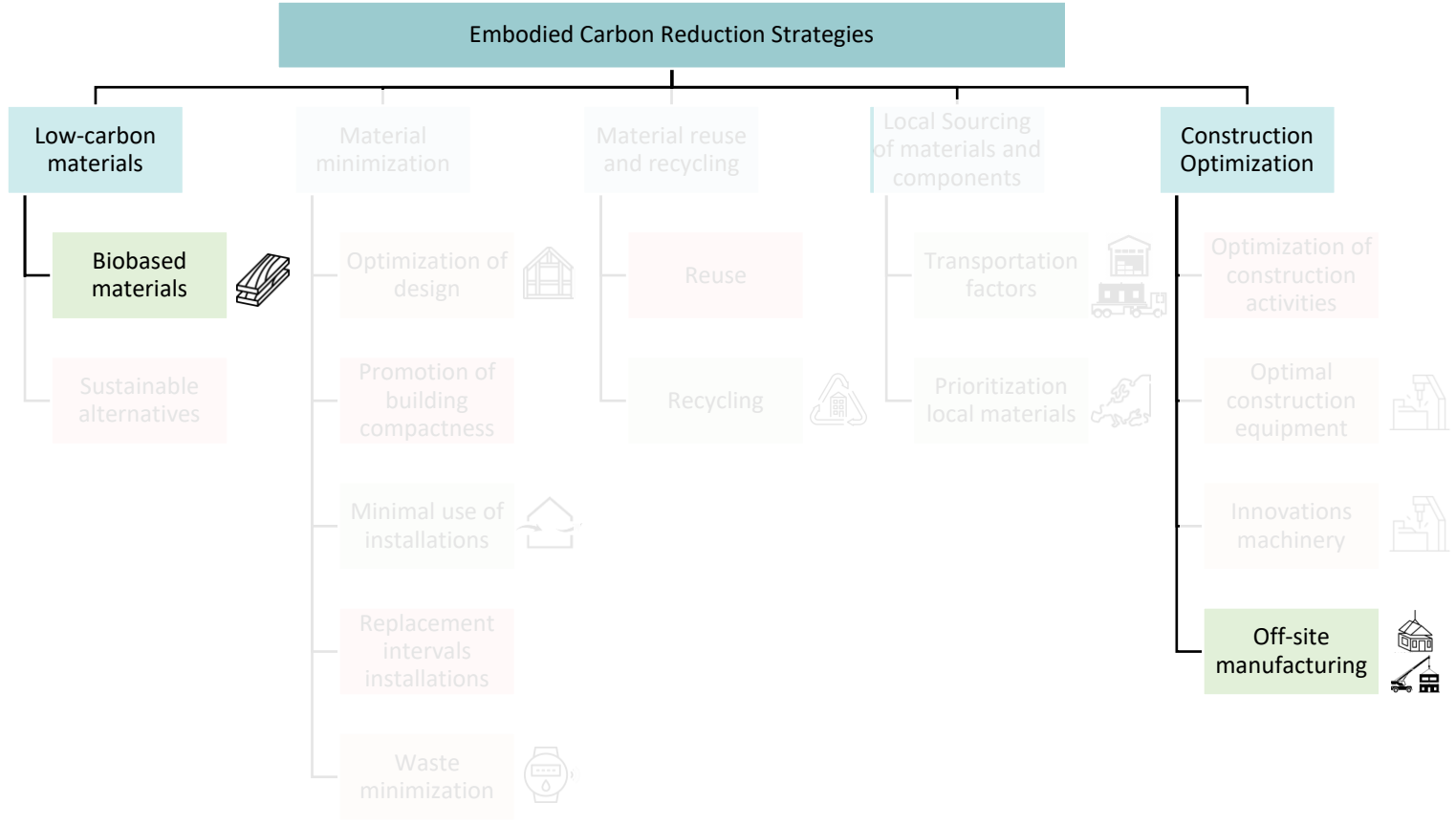
- Modular units

Discussion - New insights



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Discussion - New insights

Holding period	Cashflow		Terminal value	Required IRR
National tax law	↑ Initial property value	↓ Construction time	GEY (Gross exit yield)	Government bonds
National depreciation systems	Land value	Interest factor for construction	Cashflowt+1	Inflation
Market conditions	Rent/m2	Loan	Depreciation Factor	Property law
Type of investment	↓ GLA/NLA ratio	Amortization	Vacancy value (NFA)	↑ Demand and supply
	↓ NLA (Net Leasable Area)	↓ Interest rate on loan	↑ Value growth of vacancy value (NFA)	Local market
	Nominal annual rent increase	Depreciation factor	↓ NLA (Net Lettable Area)	Tenant credit worthiness
	Inflations	Tax rate		Multi/single let
	Vacancy rate	GIY (Gross initial yield)		Period to expire of leases
	Mutation rate	↑ Carbon credits		Accessibility
	Other income	Carbon offsetting		↑ Sustainability
	↑ Operation expenses	Carbon tax		Building Obsolescence premium
	Capital expenditures			

Legend:

- Positive impact
- No impact
- Negative impact
- Wood
- Prefab
- Modular units

Discussion - New insights

Holding period	Cashflow		Terminal value	Required IRR
National tax law	↑ Initial property value	↓ Construction time	GEY (Gross exit yield)	Government bonds
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	Capital expenditures			

Legend:
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Discussion - New insights

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	Inflations	Tax rate	Carbon tax	Multi/single let
	Vacancy rate	GIY (Gross initial yield)		Period to expire of leases
	Mutation rate	↑ Carbon credits		Accessibility
	Other income	Carbon offsetting		↑ Sustainability
	↑ Operation expenses	Carbon tax		Building Obsolescence premium
	Capital expenditures			

Legend:

- Positive impact
- No impact
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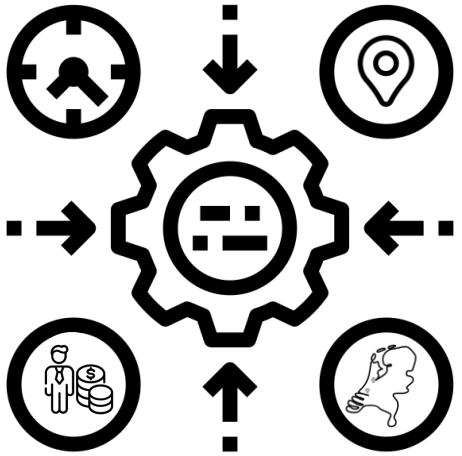
- Modular units

Limitations

Limited



Context

06 | CONCLUSION

Conclusion

“In what way does reducing embodied carbon in residential building projects impact the investment decision-making process from an investor's perspective?”

Conclusion

“In what way does reducing embodied carbon in residential building projects impact the investment decision-making process from an investor's perspective?”

Steps	Included	Impact
Step 1: Setting a strategy		
Step 2: Establishing return/risk objectives		
Step 3: Forecasting and evaluate expected costs returns		
Step 4: Assessing investment risk		
Step 5: Making a risk-adjusted evaluation of the forecast costs and returns		
Step 6: Implementing accepted proposals		
Step 7: Auditing operating performance		

- No impact at all
- Positive impact / included
- Medium impact / semi included
- Negative impact / not included

Conclusion

"In what way does reducing embodied carbon in residential building projects impact the investment decision-making process from an investor's perspective?"

Holding period	Cashflow		Terminal value	Required IRR
National tax law	↑ Initial property value	↓ Construction time	GEY (Gross exit yield)	Government bonds
National depreciation systems	Land value	Interest factor for construction	Cashflowt+1	Inflation
Market conditions	Rent/m2	Loan	Depreciation Factor	Property law
Initial investment	↓ NLA (Net Lettable Area)	Amortization	Vacancy value (NFA)	↑ Demand and supply
Type of investment	↓ GFA/NLA ratio	↓ Interest rate on loan	↑ Value growth of vacancy value (NFA)	Local market
	Nominal annual rent increase	Depreciation factor	↓ NLA (Net Lettable Area)	Tenant credit worthiness
	Inflations	Tax rate		Multi/single let
	Vacancy rate	GIY (Gross initial yield)		Period to expire of leases
	Mutation rate	↑ Carbon credits		Accessibility
	Other income	Carbon offsetting		↑ Sustainability
	↑ Operation expenses	Carbon tax		Building Obsolescence premium
	Capital expenditures			

Legend:
- Positive impact
- No impact
- Negative impact
- Wood
- Prefab
- Modular units

Conclusion

"In what way does reducing embodied carbon in residential building projects impact the investment decision-making process from an investor's perspective?"

"While this process is supported by regulations, and there is a growing demand for sustainable investments, there is still a lack of incentives to standardize the reduction of embodied carbon in the current investment decision-making process. This situation is further complicated by the significant uncertainty among investors regarding future income and expenses associated with reducing embodied carbon. In conclusion, significant steps must still be taken to achieve the goal of being carbon neutral by 2050. This requires further standardization and integration into all aspects of investment decision-making."

Conclusion

"In what way does reducing embodied carbon in residential building projects impact the investment decision-making process from an investor's perspective?"

"While this process is supported by regulations, and there is a growing demand for sustainable investments, there is still a lack of incentives to standardize the reduction of embodied carbon in the current investment decision-making process. ***This situation is further complicated by the significant uncertainty among investors regarding future income and expenses associated with reducing embodied carbon.*** *In conclusion, significant steps must still be taken to achieve the goal of being carbon neutral by 2050. This requires further standardization and integration into all aspects of investment decision-making."*

Conclusion

"In what way does reducing embodied carbon in residential building projects impact the investment decision-making process from an investor's perspective?"

"While this process is supported by regulations, and there is a growing demand for sustainable investments, there is still a lack of incentives to standardize the reduction of embodied carbon in the current investment decision-making process. This situation is further complicated by the significant uncertainty among investors regarding future income and expenses associated with reducing embodied carbon. In conclusion, significant steps must still be taken to achieve the goal of being carbon neutral by 2050. This requires further standardization and integration into all aspects of investment decision-making."

Recommendations for practice

Transparent communication

&

Dialogues with shareholders

&

Appraisers

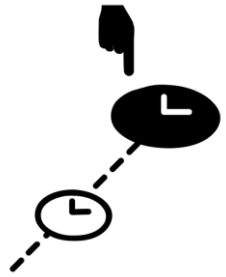
&

Incentives

/

Regulations

Recommendations for further research

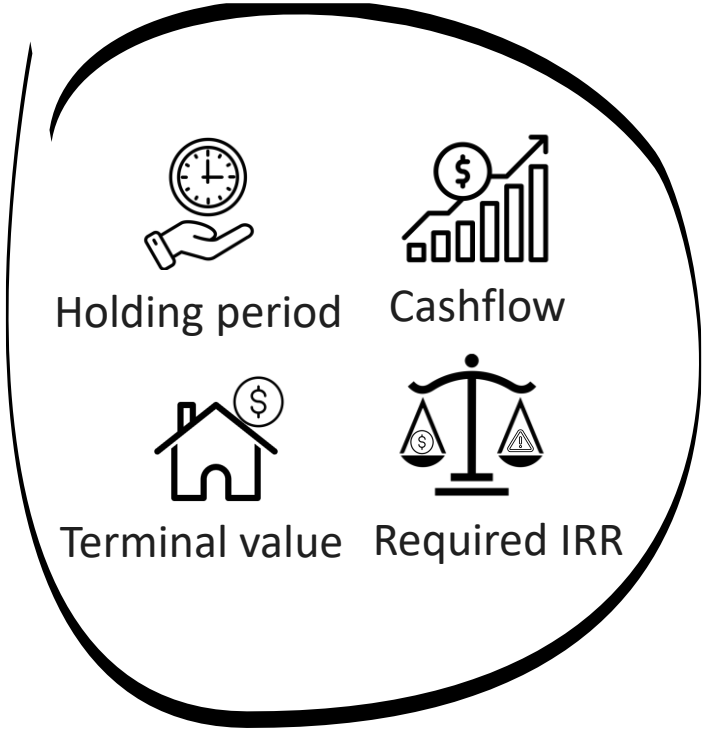


Current market conditions

Or

Office/retail market

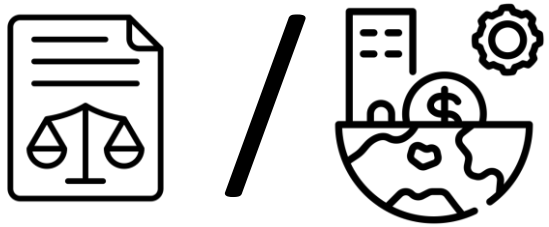
Or



Recommendations for further research

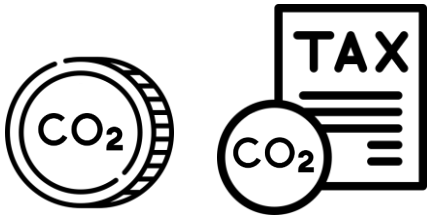
Appraisers

Or



Government / Market parties

Or



Carbon pricing

Or

Certificate

QUESTIONS?

Toward Sustainable Investments

Integrating Embodied Carbon Reduction in Investment Decision-Making by Using a Discounted Cash Flow Model