



▲ Kantoorpanden op de Zuidas in Amsterdam Zuid. © ANP

## **Doek valt voor duizenden kantoren: geen energielabel, geen kantoor**

Tien jaar hadden kantooreigenaren de tijd om hun bezit milieuvriendelijker te maken. Nu de deadline nadert, voldoet nog altijd een op de drie kantoren niet aan de plicht om tenminste energielabel C te scoren. En dat gaat hun ook niet meer lukken.

Herman Stil 10-08-22, 09:30



▲ Kantoorpanden op de Zuidas in Amsterdam Zuid. © ANP

No energy label,  
no office

## Doek valt voor duizenden kantoren: **geen energielabel, geen kantoor**

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One-third (33,3%) of  
the offices does not  
comply, yet. They will  
not do so in time.

//

We hebben nog vrij weinig, te weinig gedaan. Ik heb dan vorig jaar, eind vorig jaar, een verduurzamings onderzoek laten doen, zeg maar voor energielabel. Dan zaten we op [energielabel] E en ik moet [energielabel] C hebben, zeg maar. Dus dat is niet goed, zeg maar.

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- Interviewee 5, Case 5

//

Het argument van dat verplichte label C, dat heeft natuurlijk heel veel zetten gegeven van: Jongens ... Mensen die zoiets hadden van: dat duurt nog wel 10 jaar en nu wordt die natuurlijk toch, ja, die moeten nu wel. Dus er moet nu geïnvesteerd worden.

//

- Interviewee 3, Case 3

//

Soms moet iets leiden tot dat laatste zetje. Kijk, en daarnaast moeten we gewoon mee naar de toekomst toe.

//

- Interviewee 1, Case 1

//

**We hebben nog vrij weinig, te weinig gedaan.** Ik heb dan vorig jaar, eind vorig jaar, een verduurzamings onderzoek laten doen, zeg maar voor energielabel. Dan zaten we op [energietabel] E en ik moet [energietabel] C hebben, zeg maar. Dus dat is niet goed, zeg maar.

//

- Interviewee 5, Case 5

**"We have done very little, too little."**

**"People who were like: that will take another 10 years and now, of course, it becomes, yes, they have to do it now."**

//

Het argument van dat verplichte label C, dat heeft natuurlijk heel veel zetten gegeven van: Jongens ... **Mensen die zoiets hadden van: dat duurt nog wel 10 jaar en nu wordt die natuurlijk toch, ja, die moeten nu wel.** Dus er moet nu geïnvesteerd worden.

//

- Interviewee 3, Case 3

//

**Soms moet iets leiden tot dat laatste zetje.** Kijk, en daarnaast moeten we gewoon mee naar de toekomst toe.

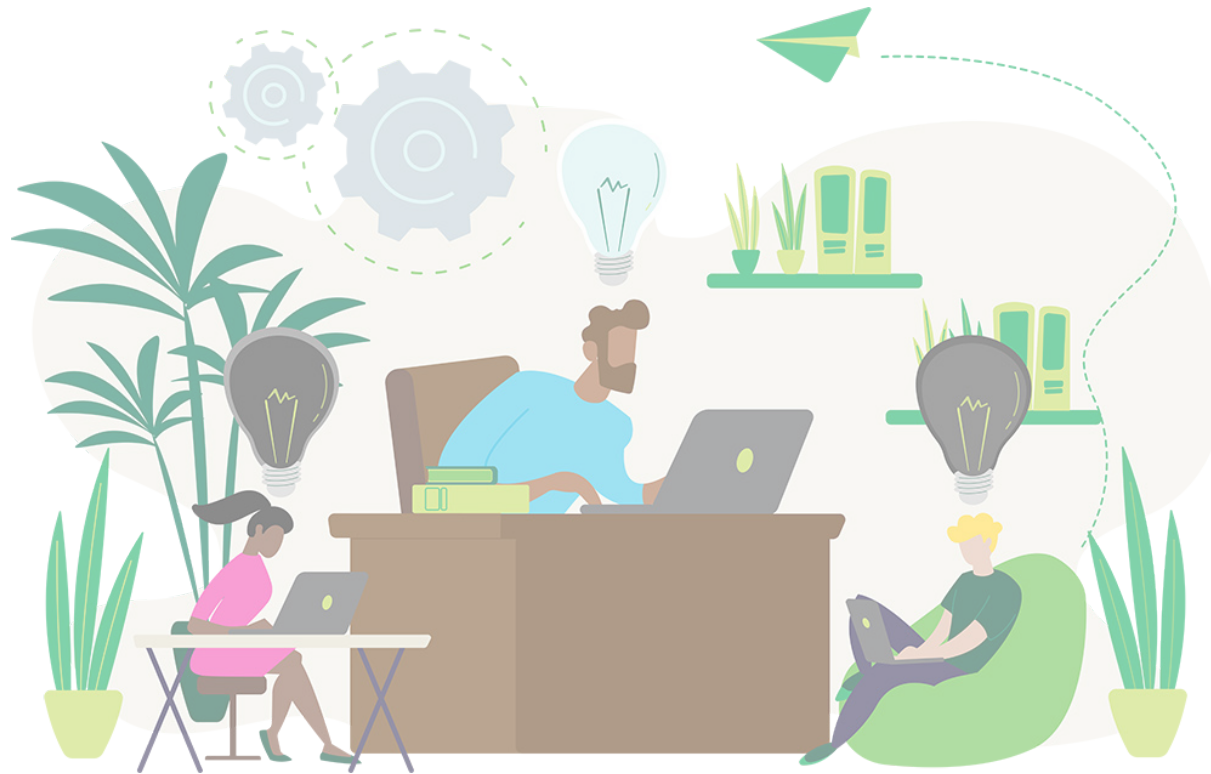
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**"Sometimes, something has to lead to that final push."**

- Interviewee 1, Case 1

# Energy-efficient and 'healthy' offices

An approach for office renovations focused on energy efficiency  
and Indoor Environmental Quality



# Contents



**Background  
research**



**Research  
design**



**Case  
studies**



**Results  
interpretation**



**Research  
conclusions**



**Advice  
report**

# Background research

Examination of available theoretical literature to 'kick-start' my graduation project.



# Context

We live in a world that focuses on...

# Context

We live in a world that focuses on...

**Regulations as  
triggers**

**'Green' buildings**

**Circularity**

**Sustainability**

**(Almost) energy-  
neutral buildings**

**Building certification  
systems**

**Renovation**

# Context

This is because:

**85%** of the EU's building stock is built before 2001 (220 million building units)

**85-95%** of the buildings that exist today will be standing in 2050

Most of these buildings are **not energy-efficient**

- » Fossil fuels for heating and cooling
- » Use of old technologies
- » Wasteful appliances

Buildings are responsible for:

**about 40%** of the EU's total energy consumption

**36%** of its greenhouse gas emissions from energy

# Context

In 2016:

- 40%** of the EU's building stock was covered by non-residential buildings
- 30%** of these belonged to public and private offices

**Renovation** of the existing building stock

- » Opportunity to redesign buildings
- » Fit the Climate Target Plan 2030

Climate Target Plan 2030 (European Commission):

- 55%** greenhouse gas emissions in the EU (compared to 1990)

# Context

Focus of European Commission lies on:

- » Strengthening the **information** for renovation
- » Strengthening the **legal certainty** for renovation
- » Strengthening the **incentives** for renovation

Energy Performance Certificate (EPC) or energy label:

- » Strengthening the information about **building performances**
- » Energy performance, share of renewables, and energy costs
- » Mandatory or minimum energy performance standards used as a **trigger** to increase renovation rates

# Context

But then...

## Energielabel C kantoren

*Gepubliceerd op: 29 oktober 2018* | *Laatst gecontroleerd op: 9 oktober 2023*

**Een kantoorgebouw moet minimaal energielabel C hebben. Dit betekent een energielabel met een primair fossiel energiegebruik van maximaal 225 kWh per m<sup>2</sup> per jaar of een energielabel met de letter C of beter. Voldoet het gebouw niet aan de eisen? Dan mag u het niet meer als kantoor gebruiken. Deze verplichting staat in het Bouwbesluit 2012.**

# Context

But then...

Published in  
2018

## Energielabel C kantoren

Gepubliceerd op: 29 oktober 2018

Laatst gecontroleerd op: 9 oktober 2023

Minimum of EPC class C for office buildings by January 1st 2023

**Een kantoorgebouw moet minimaal energielabel C hebben.** Dit betekent een energielabel met een primair fossiel energiegebruik van maximaal 225 kWh per m<sup>2</sup> per jaar of een energielabel met de letter C of beter. Voldoet het gebouw niet aan de eisen? Dan mag u

**het niet meer als kantoor gebruiken.** Deze verplichting staat in het **Bouwbesluit 2012.**

Building should be closed if the obligation is not met in time

Published as an amendment to the 2012 Building Decree

# Context

When it comes to offices, we live in a world that shows an emphasis on...

# Context

When it comes to offices, we live in a world that shows an emphasis on...

**Mental health**

**Hybrid/Remote working**

**Staff shortage**

**Job satisfaction**

**Health and well-being**

**High workload**

**Sick leaves**

# Context

If office buildings should be renovated to **obey the EPC class C regulation** and the office world shows an emphasis on its **employees** and their health, well-being, and satisfaction, how are we supposed to **manage** that?

# Problem statement

If office buildings should be renovated to **obey the EPC class C regulation** and the office world shows an emphasis on its **employees** and their health, well-being, and satisfaction, how are we supposed to **manage** that?

My first thoughts:

- » Can both worlds be **combined**?
- » If so, **how** can and should they be combined?
- » What is **already** known and available?

# Problem statement

For office renovations, the focus lies on:

- » Improving **energy efficiency** by retrofitting energy saving or energy-efficiency measures

For an emphasis on employee's health, well-being, and satisfaction, the focus lies on:

- » The **quality** of the workplace and its environment

# Solution?

Indoor Environmental Quality (IEQ):

- » Focus on **four main aspects**: thermal and acoustic comfort, indoor air quality, and adequate levels of lighting
- » Insufficient IEQ can **negatively affect** occupants' physical and psychological health
- » This impacts their levels of satisfaction and comfort and, thus, their **work output and productivity**
- » IEQ is regulated through **several building service systems**: HVAC systems, lighting systems, and intelligent control systems

# Solution?

Current office renovation practices to reach EPC class C:

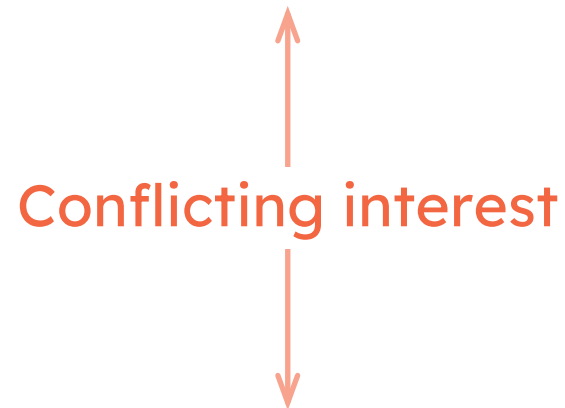
- » Focus on the **reduction of energy consumption** of a building

But... improving building service systems to increase the IEQ of an office building requires **more energy consumption**

# Solution?

Current office renovation practices to reach EPC class C:

- » Focus on the **reduction of energy consumption** of a building



But... improving building service systems to increase the IEQ of an office building requires **more energy consumption**

## Solution?

//

**Most buildings are  
either comfortable or  
energy efficient.**

//

- Shahzad et al., 2017

# Solution!

//

**Member States should support energy performance upgrades of existing buildings that contribute to achieving a healthy environment.**

//

- European Parliament and the Council of the European Union, 2018

# Solution!

In order to enhance:

- » Office renovations that **contribute to** achieving a healthy environment for its employees

It is important to:

- » Intervene in the **decision-making processes** of initiators of office renovations

In order to:

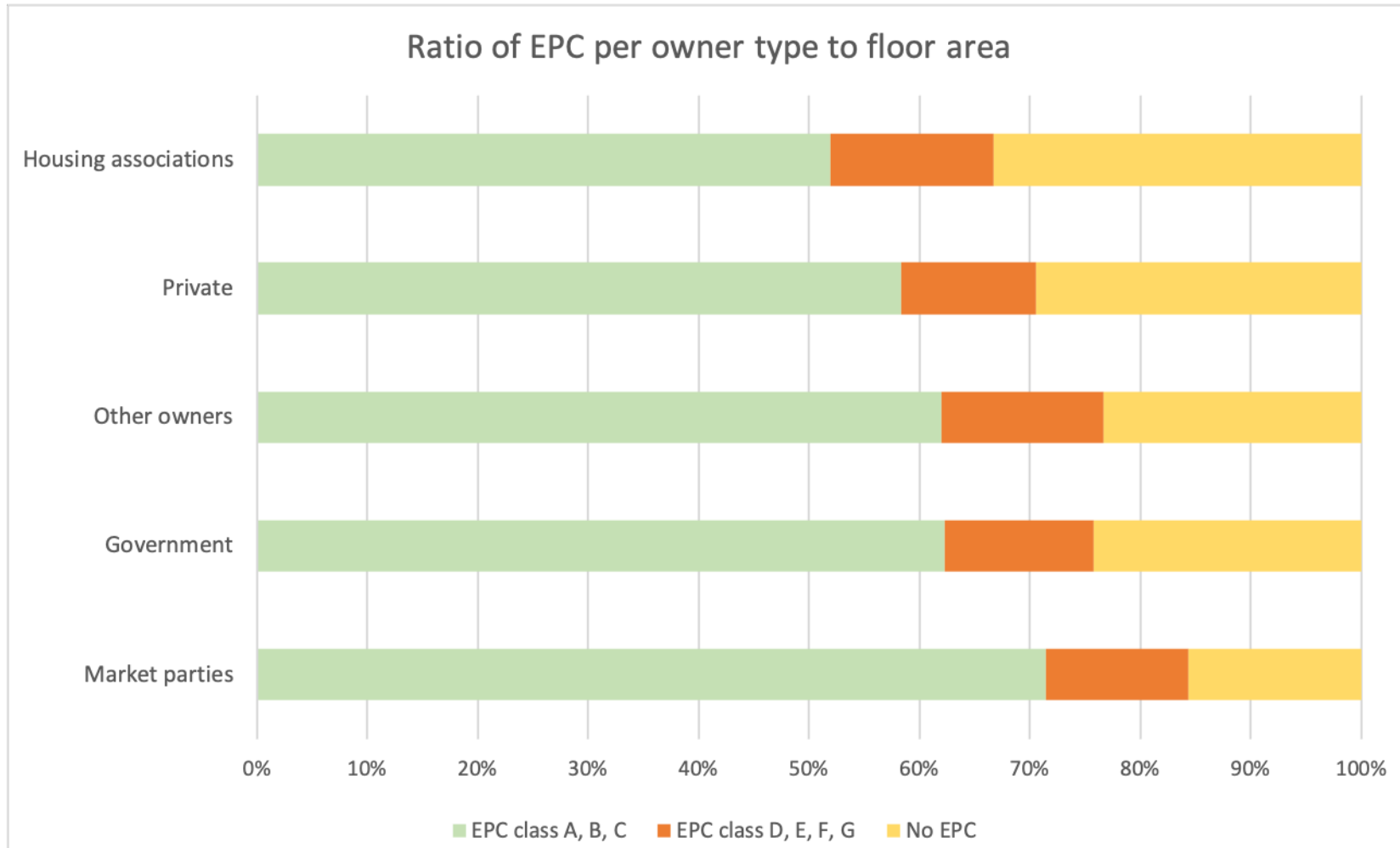
- » Raise awareness on the **impact of IEQ** on office users
- » Raise awareness on the **conflicting interest** between office renovations and IEQ
- » Get them interested in **investing in both** energy-efficient and healthy offices for their employees

# Research scope

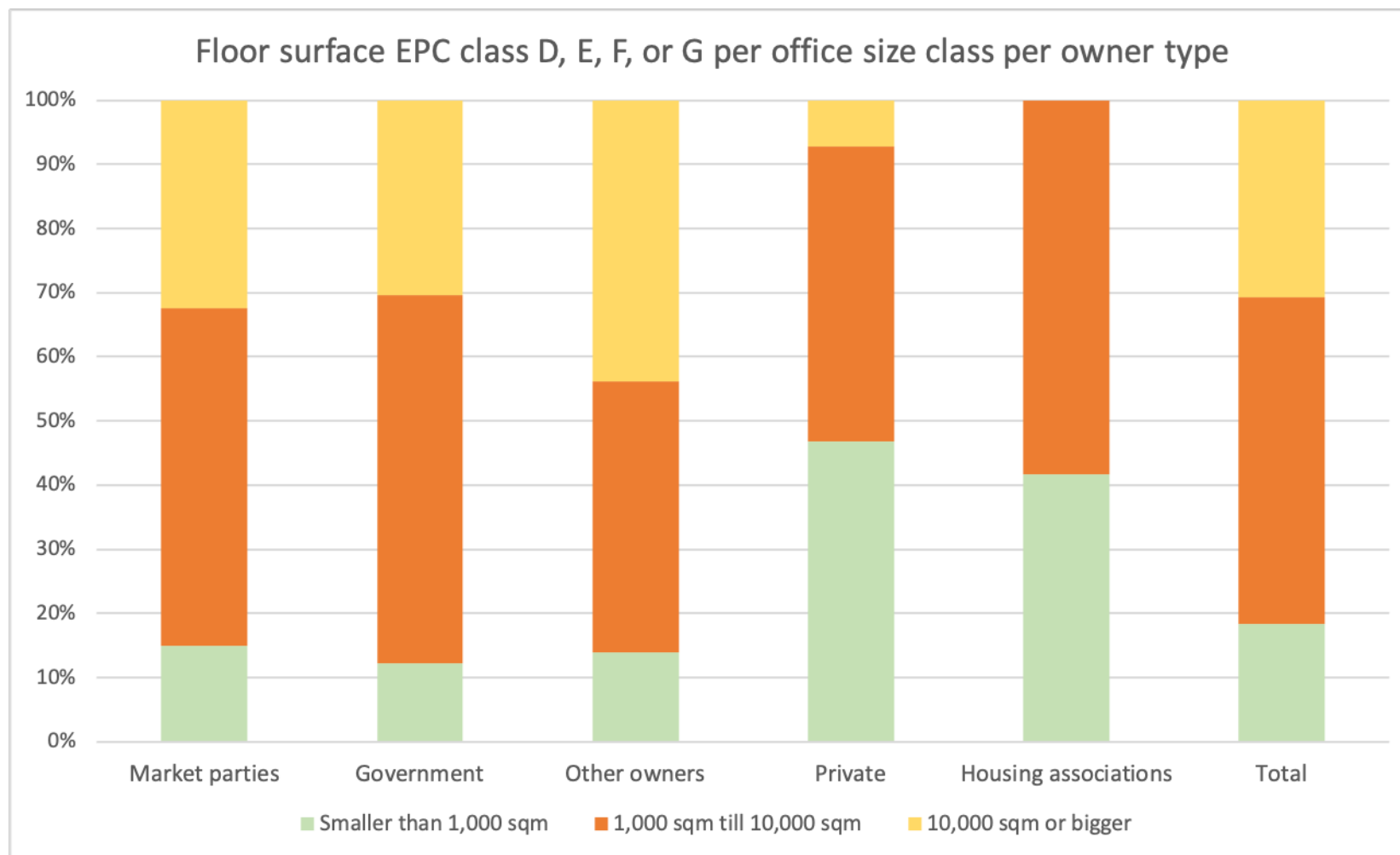
Research of **Kadaster (2022)**:

- » Examination of the total Dutch office building stock
- » Concretise exact numbers of buildings that are in need of renovation
- » Concretise owner types and regional differences
- » Target group determined based on relative biggest renovation task still to be completed

# Research scope



# Research scope



# Research scope

Research of **Kadaster (2022)**:

- » Relatively, the biggest challenge is concerned with the smallest office size class (<1,000 sqm) for the private owner-occupied office buildings

The **main barriers** in the decision-making process of owners of owner-occupied buildings:

- » Lack of knowledge and information
- » Funding

Information deficit and knowledge group should be **covered** with this research

# Research questions

*How can the renovation decision-making process, prior to renovation, of private owners of Dutch owner-occupied office buildings be guided with a focus on improving energy efficiency and Indoor Environmental Quality (IEQ)?*

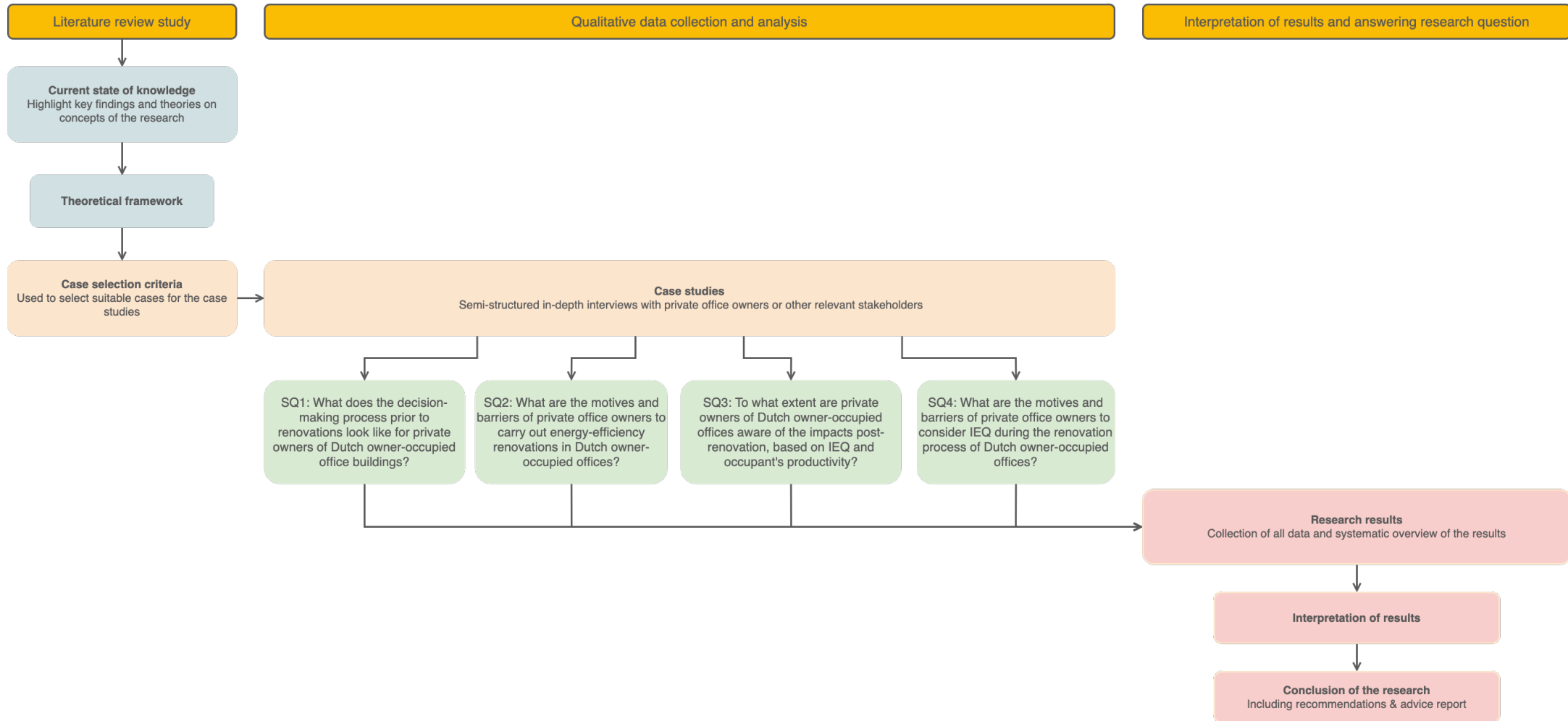
1. What does the decision-making process prior to renovations entail for private owners of Dutch owner-occupied office buildings?
2. What are the motivations and barriers of private office owners to carry out energy-efficiency renovations in Dutch owner-occupied offices?
3. To what extent are private owners of Dutch owner-occupied offices aware of the impacts post-renovation, based on IEQ and occupant's productivity?
4. What are the motivations and barriers of private office owners to consider IEQ during the renovation process of Dutch owner-occupied offices?
5. What are specific elements and critical moments in relation to the different identified phases of the decision-making process prior to renovation of private owners of Dutch owner-occupied office buildings?

# Research design

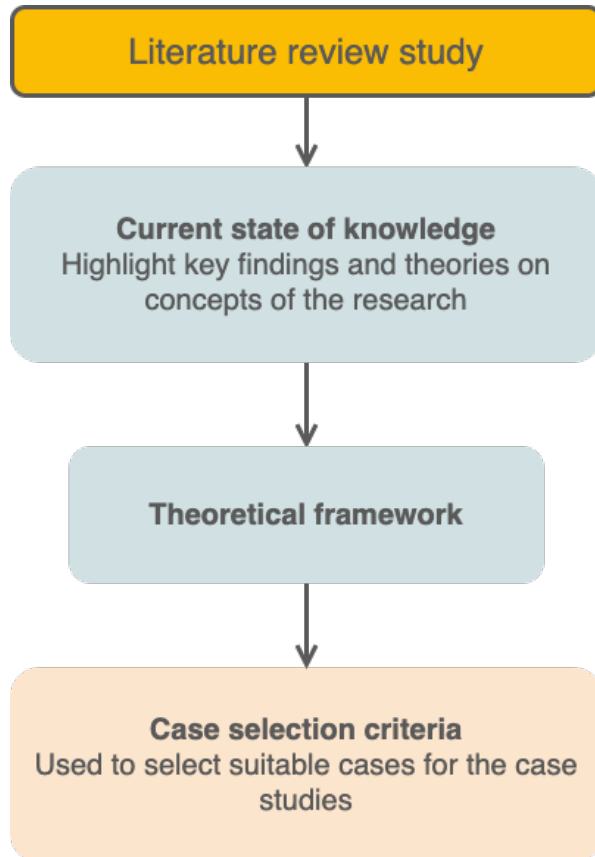
Used research methods and the selection of suitable case study projects.



# Research design



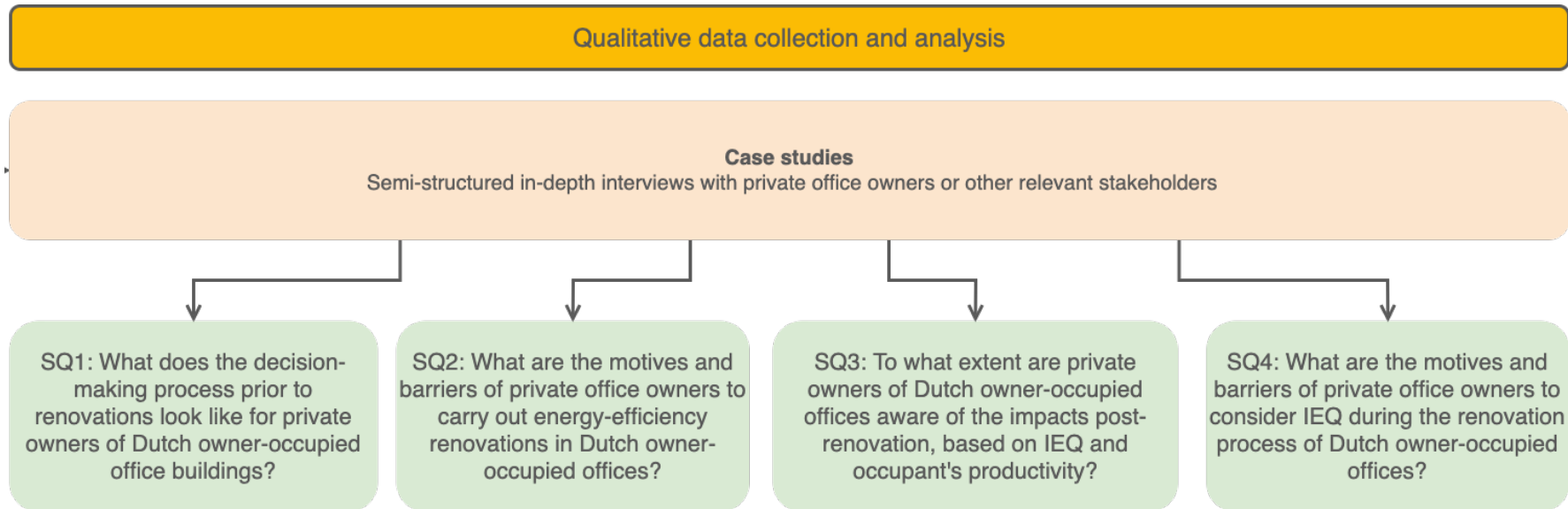
# Research design



Literature review study:

- » Dutch office market
- » Involved stakeholders in office renovations
- » Energy Performance Certificates for offices
- » Decision-making process prior to renovations
- » Office renovation practices focused on energy efficiency or Indoor Environmental Quality
- » The impact of Indoor Environmental Quality on office users

# Research design



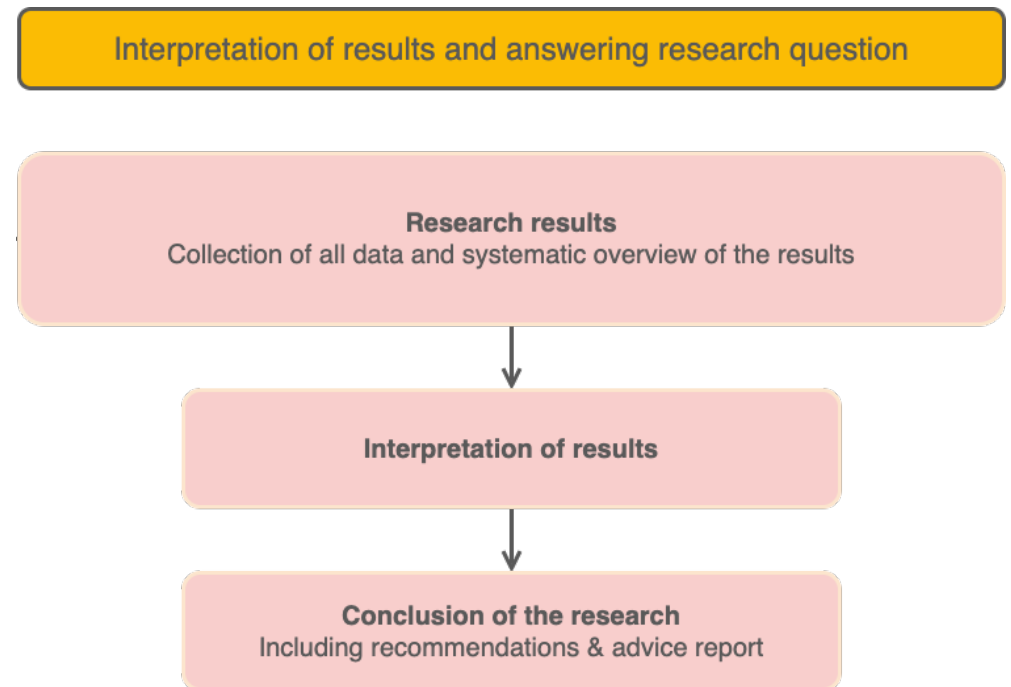
Qualitative data collection and analysis:

- » Case studies
- » Semi-structured in-depth interviews with private office owners or other relevant stakeholders
- » Office buildings that are already renovated or are going to be renovated in the near future

# Research design

Interpretation of results and answering research question:

- » Analysing the conducted interviews
- » Find common definitions, steps, and considerations in decision-making process
- » Extensive discussion of the research results
- » Generalise findings to draw up conclusions



# Case selection criteria

Based on concepts and themes of **theoretical framework**:

- » Additional criteria added to allow generalisation in later stages as the variety of the entire target group should be aimed to be covered

Theme	Criteria 1	Criteria 2	Criteria 3
Construction year	< 1900	1900 - 2000	> 2000
EPC class "jump" (in relation to construction year)	Unknown / G or F → C (relative "big jump")	Unknown / F - D → C or > C (relative "big jump" or "small jump")	Unknown / D - A → > C (relative "small jump")
Decision-making phase (Project phase)	Planning (Become aware, Getting interested, Gaining knowledge, Consider options/Forming an opinion)	Implementation (Making a decision/Goal Setting Module)	Post-renovation
Stakeholders (Advisor)	External advisor	Advisor in-house	
Stakeholders (Project team)	Presence of project team	Absence of project team	
Renovation practices focused on Indoor Environmental Quality	Yes	No	
Renovation practices focused on energy-efficiency	Yes		
Building type	Mixed-use	Individual	
Number of employees	0 - 20	20 - 60	60 - 100

# Case studies

Conducting case studies of office renovation projects to gather necessary information for the research.



# Case study projects



**Case 1**  
Office building Krimpen aan den IJssel 1



**Case 2**  
Office building Gouda



**Case 3**  
Office building Moordrecht

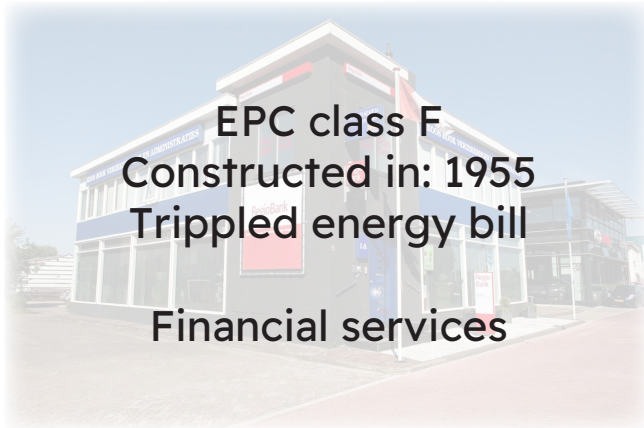


**Case 4**  
Office building Rijen



**Case 5**  
Office building Krimpen aan den IJssel 2

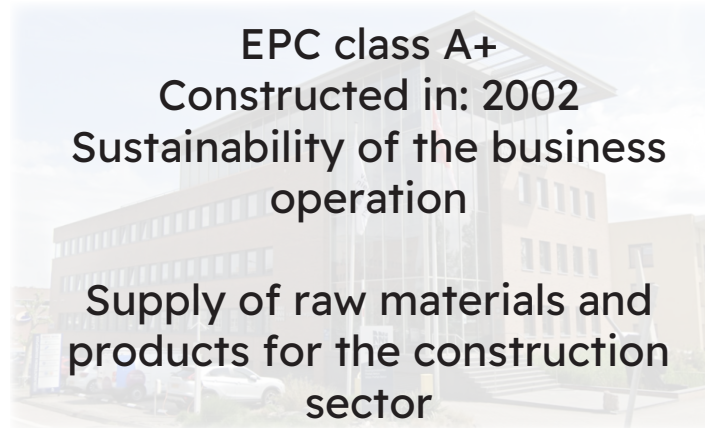
# Case study projects



EPC class F  
Constructed in: 1955  
Tripled energy bill  
Financial services

## Case 1

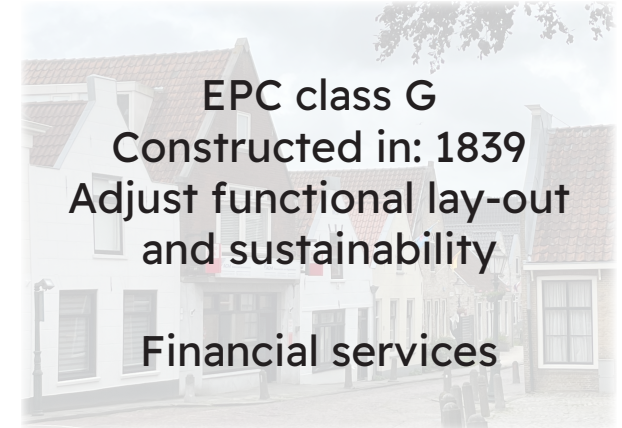
Office building Krimpen aan den IJssel 1



EPC class A+  
Constructed in: 2002  
Sustainability of the business  
operation  
Supply of raw materials and  
products for the construction  
sector

## Case 2

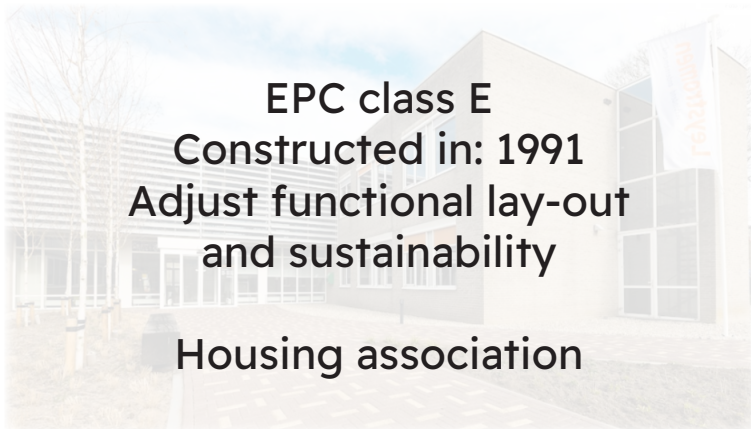
Office building Gouda



EPC class G  
Constructed in: 1839  
Adjust functional lay-out  
and sustainability  
Financial services

## Case 3

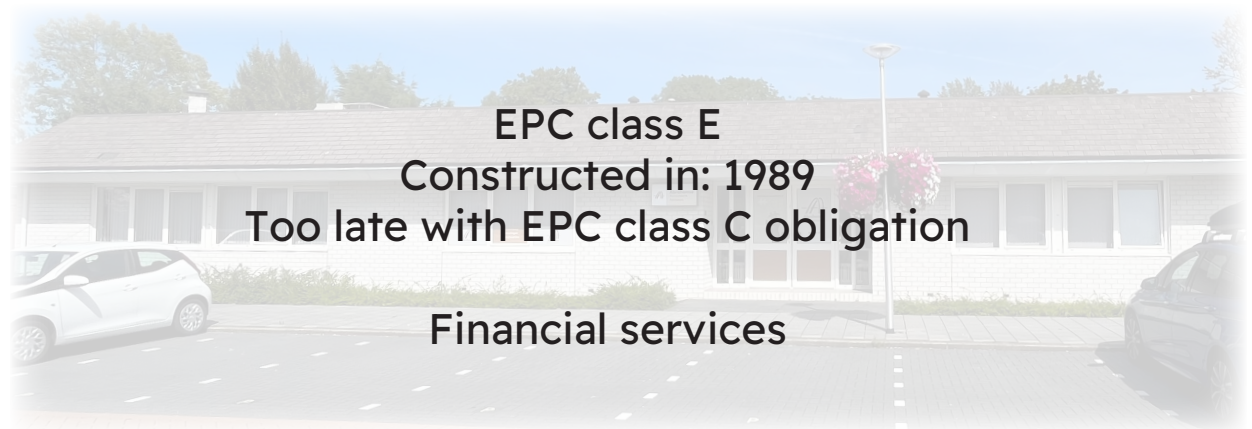
Office building Moordrecht



EPC class E  
Constructed in: 1991  
Adjust functional lay-out  
and sustainability  
Housing association

## Case 4

Office building Rijen



EPC class E  
Constructed in: 1989  
Too late with EPC class C obligation  
Financial services

## Case 5

Office building Krimpen aan den IJssel 2

# Interviews

Conducting interviews:

- » Five stakeholders
- » Semi-structured and in-depth interviews
- » Interview protocol
- » Gain insights in their decision-making processes
- » Motivations, barriers, considerations, and involved stakeholders

		Business profile of organisation	Function in organisation	Function during renovation
<b>Case 1</b> Office building Krimpen aan den IJssel 1	<i>Interviewee 1</i>	Financial services	Co-partner	Initiator
<b>Case 2</b> Office building Gouda	<i>Interviewee 2</i>	Supply of raw materials and products for the construction sector	Sustainability manager	Advisor
<b>Case 3</b> Office building Moordrecht	<i>Interviewee 3</i>	Financial services	Owner	Initiator
<b>Case 4</b> Office building Rijen	<i>Interviewee 4</i>	Social housing association	Project developer	Project manager of project team
<b>Case 5</b> Office building Krimpen aan den IJssel 2	<i>Interviewee 5</i>	Accountancy	Owner	Initiator

# Research results

Results formulation based on sub questions of the research:

1. What does the **decision-making process prior to renovations** entail for private owners of Dutch owner-occupied office buildings?
2. What are the motivations and barriers of private office owners to carry out **energy-efficiency renovations** in Dutch owner-occupied offices?
3. To what extent are private owners of Dutch owner-occupied offices **aware of the impacts post-renovation**, based on IEQ and occupant's productivity?
4. What are the motivations and barriers of private office owners to **consider IEQ** during the renovation process of Dutch owner-occupied offices?
5. What are **specific elements and critical moments** in relation to the different identified phases of the decision-making process prior to renovation of private owners of Dutch owner-occupied office buildings?

# Research output

## Main identified barriers:

- Governmental obligations and experienced dysfunctionalities are boundary conditions for becoming aware
- Participants are not familiar with IEQ aspects, so they are not considered

## Main identified barriers:

- Governmental obligations related to IEQ aspects are not present specifically related to the consequences of a decreased IEQ post-renovation
- Mixed-use buildings need a different approach and 'scare' the office owner to consider renovation
- Office owners do not always gather information about workplace satisfaction to gather information upon possible interventions that are needed or desired

## Main identified barriers:

- Possibilities of the property can be limited in relation to renovation measures that can be implemented. The office owner can be 'scared' by large investments or the intensity of the implementation of certain renovation measures
- Office owners can consider themselves as laymen in relation to office renovations; this acknowledges the prominent role of the (internal or external) advisors
- IEQ aspects are not considered in advice reports or multi-year plans and business cases

## Main identified barriers:

- Smaller organisations consider themselves dependent on third parties; their response time and availability is causing a delay
- Governmental standards are prioritised when considering options; they are set as boundary conditions and office owners mostly do not go beyond them; IEQ aspects are not covered as much as energy-efficiency and sustainability aspects in governmental standards
- Absence of a resonance group or employee satisfaction surveys make it hard to determine boundary conditions for IEQ aspects
- Business security and business operation can be endangered by large investments for office renovations
- IEQ renovation measures are always related to standardisation and a decrease in personal control; different personal preferences cannot be guaranteed

## Main identified barriers:

- Unavailability of resources and people can influence the final decision in relation to expected delays
- Renovation measures are not financially feasible in relation to the business operation, expected revenue, payback period

Become aware

Getting interested

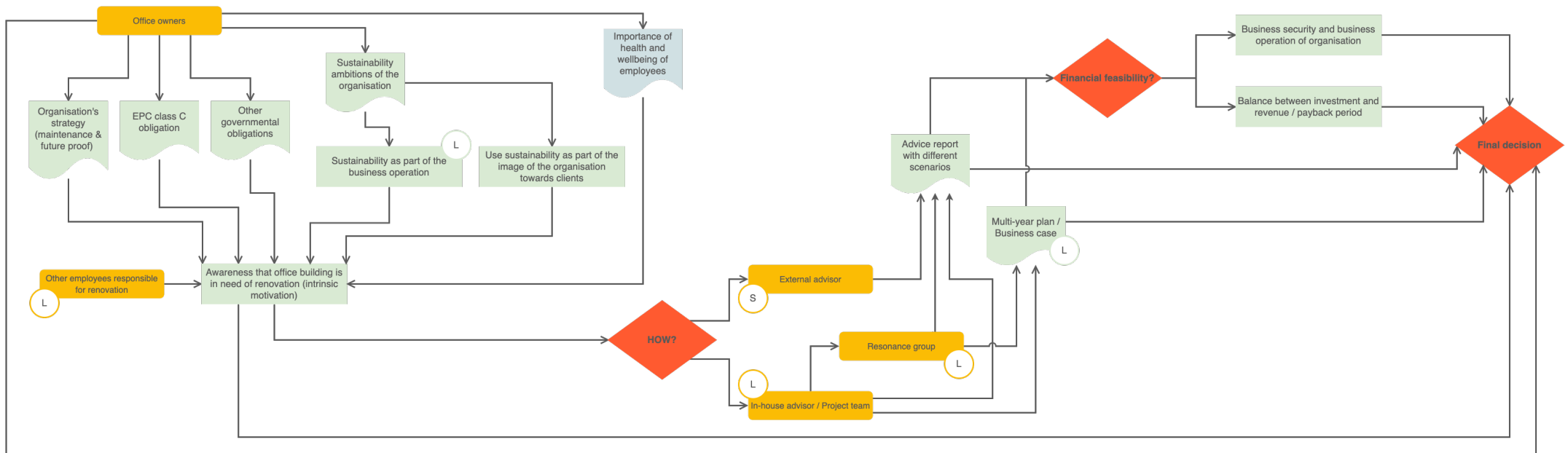
Gaining knowledge

Consider options

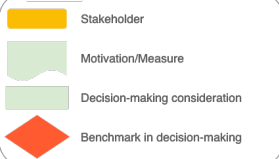
Making a decision

Forming an opinion

Goal setting Module

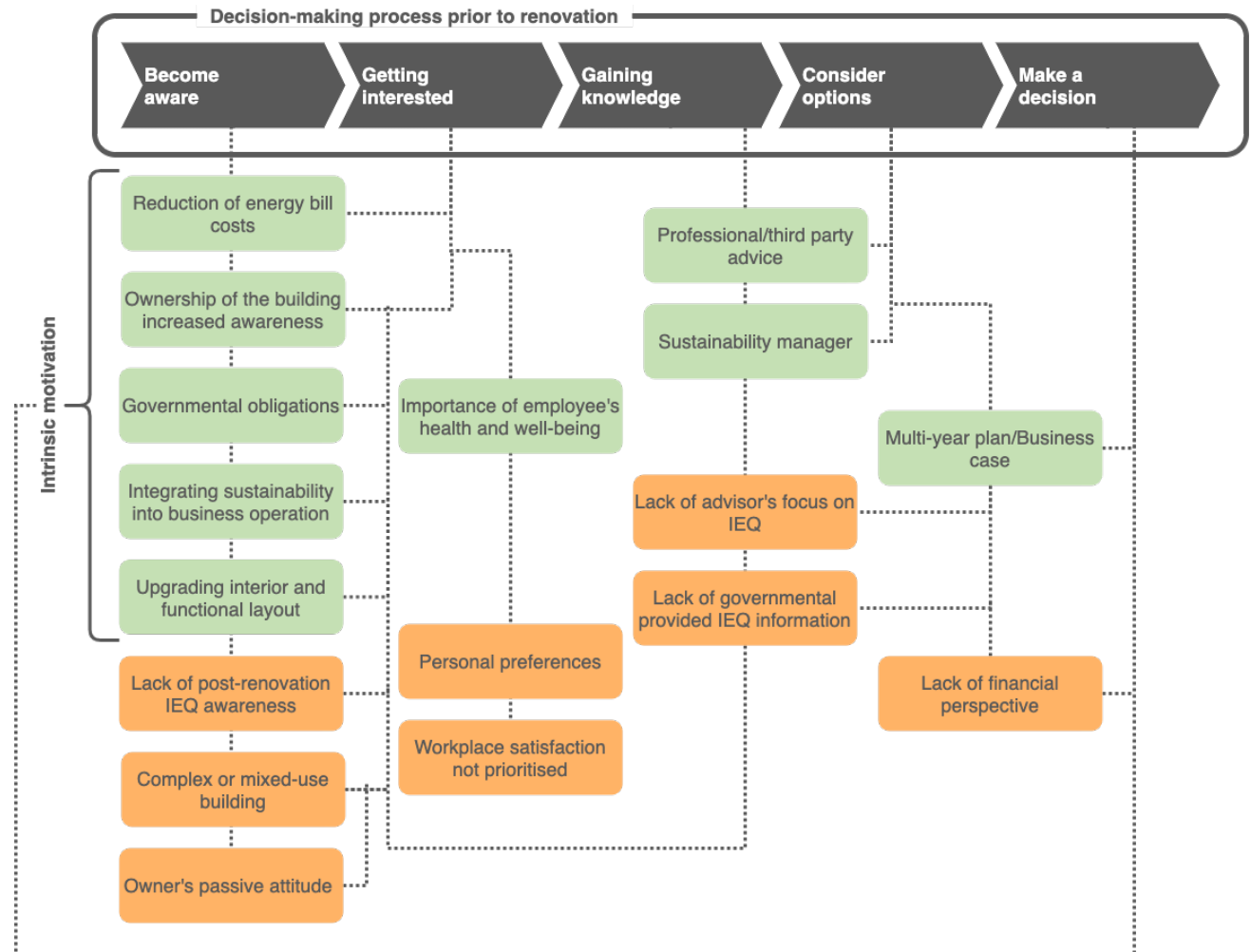


## LEGEND



# Research output

- » Decision-making scheme based on research results
- » Analytical framework
- » Both used to discuss and interpret the research results



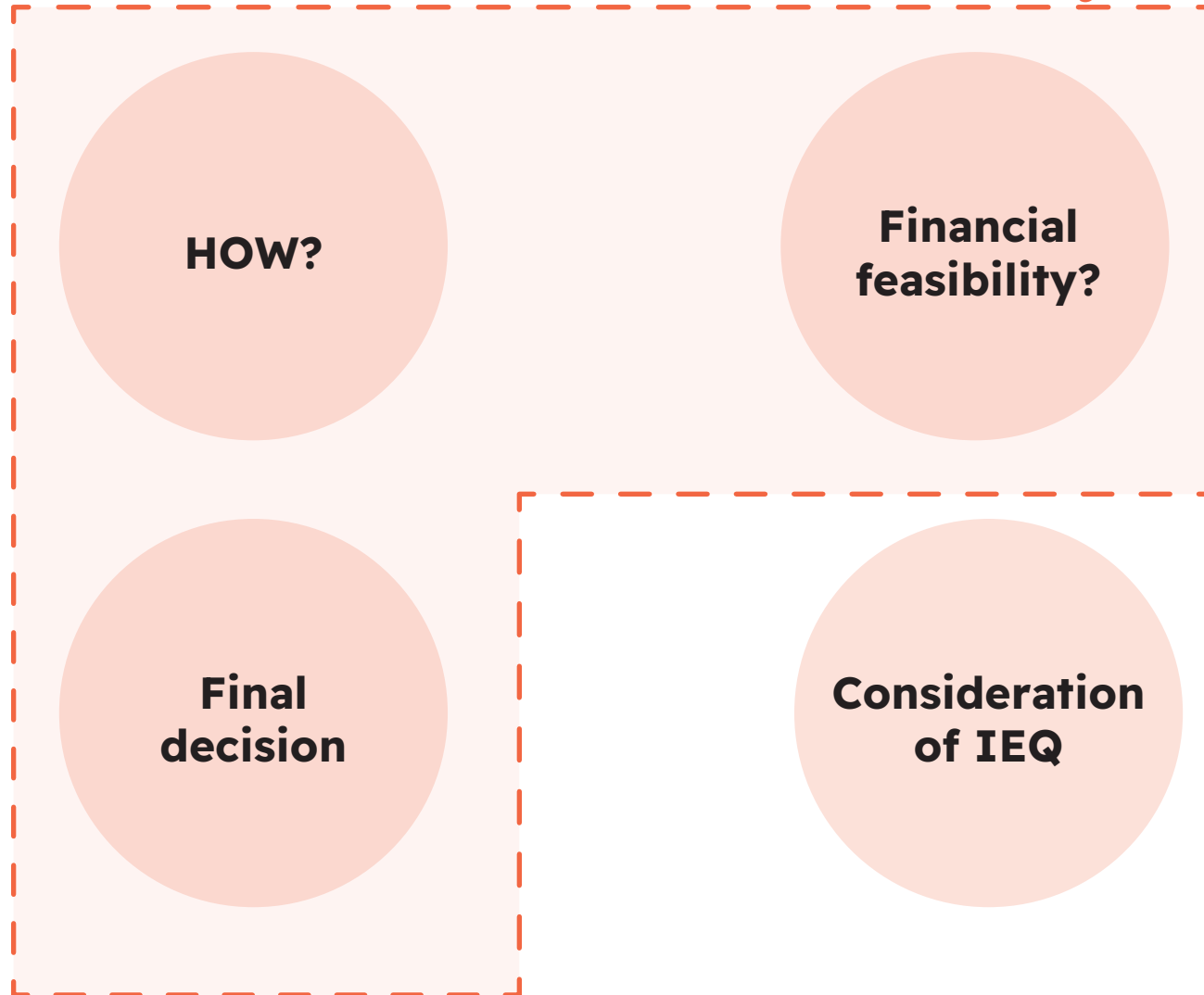
# Results interpretation

'Translation' of all the collected data in order to draw relevant conclusions to answer the research questions.



# Interpreting results

*Benchmark moments of decision-making scheme*



# Interpreting results

## HOW?

### “How are we going to do that and where do I start?”

- » Fear for large investments
- » Start of renovation process with hesitance because of governmental obligation
- » Prominent role of an advisor (internal or external) for provision of renovation options
- » Smaller organisations: office owner and external advisor
- » Larger organisations: office owner together with internal advisors (project team), end-user representation (resonance group)

# Interpreting results

## Financial feasibility?

### Apprehension regarding the potential need for substantial financial investment & threat to business security

- » Smaller organisations: large investments can threaten their business security
- » Uncertainty and fear regarding the timely return on investment
- » Contemplation of retirement in some cases
- » Lack of life cycle cost perspective of investments
- » Financial investment decision weighed against expected payback period, expected revenues, reduction of operational costs
- » Smaller organisations: absence of multi-year strategies, or similar
- » Larger organisations: financial feasibility assured through business case or multi-year plan

# Interpreting results

## Final decision

### Final decision, as made by the office owner

- » Always related to the awareness that the building is in need of renovation
- » Triggered by organisation's strategy for the office building, a governmental obligation, or sustainability ambitions of the organisation
- » Advice report and multi-year plan or business case influence the final decision
- » Impact of financial feasibility

# Interpreting results

## Consideration of IEQ

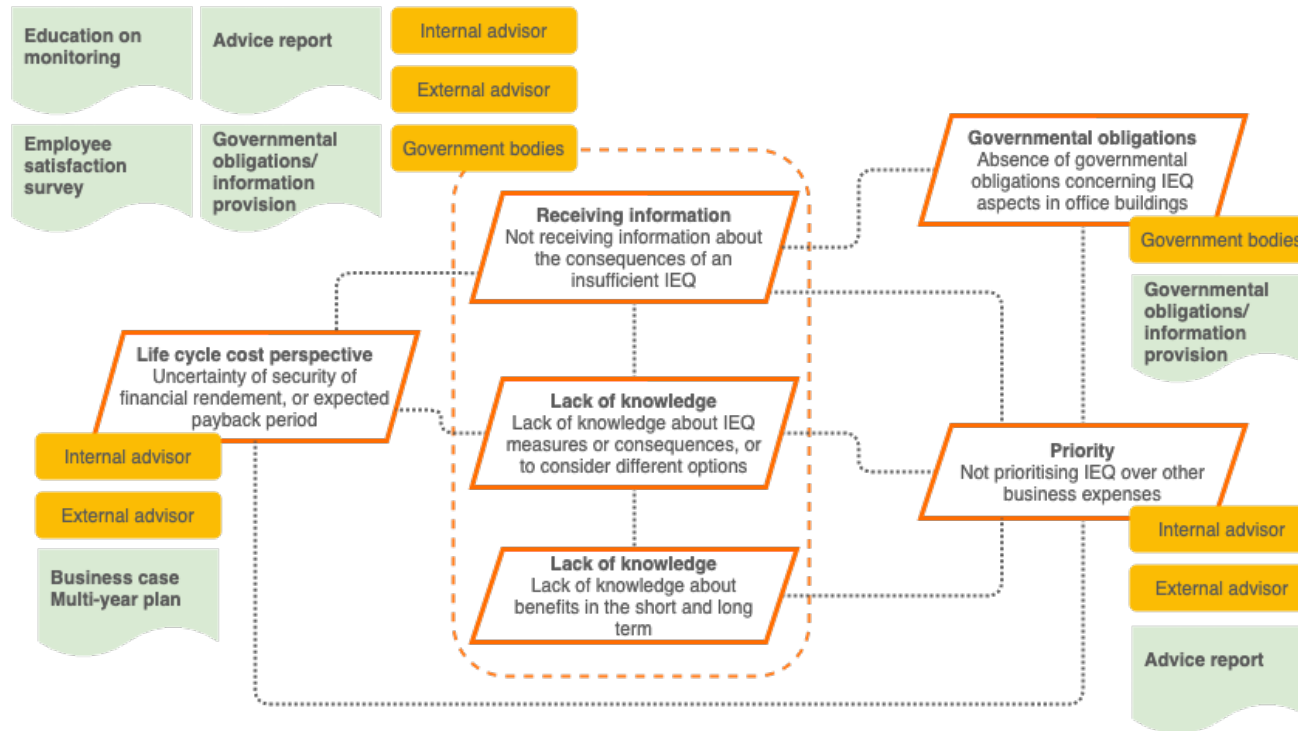
### Unfamiliar with concept and its consequences

- » Importance of health and well-being of employees is reported highly by all interviewees
- » Unawareness about overlap between energy-efficiency renovation

measures and IEQ renovation measures when implemented correctly (no-regret measures)

Renovation measure	Energy-efficiency consequences	IEQ consequences	Relative investment	Relative extensiveness
Upgrade/addition of insulation	Higher insulation coefficient (less heating loss, lower energy bill)	Improved thermal comfort, higher user satisfaction, less health related issues, higher productivity	€€€€	++++
Upgrade/install HVAC systems	Decrease in energy consumption by systems, lower energy bill	Improved air quality, improved thermal comfort, higher user satisfaction, higher productivity	€€€€	++++
Install LED lighting	Decrease in energy consumption by systems, lower energy bill	Improved lighting quality, higher productivity	€€€€	++++
Install smart monitors	Automatised regulation of temperature, or ventilation rates	Improved thermal comfort, improved air quality, higher user satisfaction, less health related issues, higher productivity	€€€€	++++

# Summary of results interpretation



# Research conclusions

Formulating an answer to the main research question and putting the results of the research into perspective.

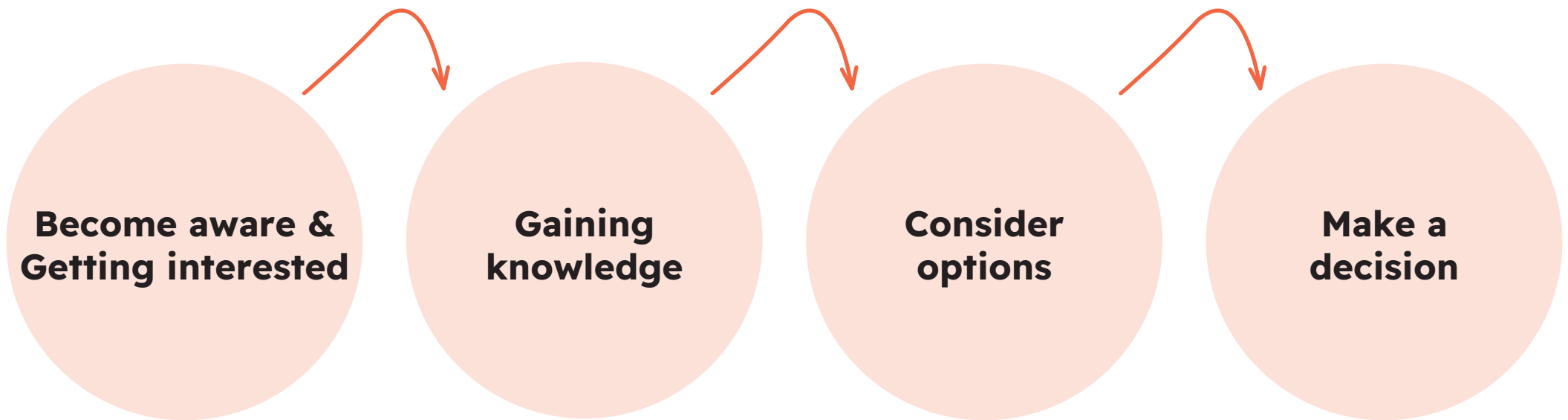


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**How can the renovation decision-making process, prior to renovation, of private owners of Dutch owner-occupied office buildings be guided with a focus on improving energy-efficiency and IEQ?**

//

# Answering the main research question



# Answering the main research question

**Become aware &  
Getting interested**

## **Raise awareness of significance of both energy efficiency and IEQ in office buildings**

- » Presence of governmental obligations: energy efficiency
- » Absence of governmental obligations: IEQ
- » Mandating WELL certification
- » Listing tangible values for the quality of indoor air in office buildings in the Dutch Building Decree
- » Provide owners with sufficient information regarding IEQ aspects and its consequences (education through government bodies, or labour unions)
- » Conduct employee satisfaction surveys

# Answering the main research question

**Gaining  
knowledge**

## **Prominent role of the advisor**

- » Shift in purpose of advisor: not only provide information about what is asked out, but educate office owners proactively on the consequences of renovation scenarios in relation to IEQ
- » Thus: education of advisors
- » Governmental steering: providing up-to-date information about IEQ and office users, based on recent studies
- » E.g. : *Programma van Eisen Gezonde Kantoren 2021*
- » Mandating, acknowledging, and publishing such guidelines or publications nation-wide (through government bodies, or labour unions)

# Answering the main research question

## Consider options

### Even more prominent role of the advisor

- » Role of the advisor does not stop after submitting the advice report with different renovation scenarios
- » Life cycle cost analysis
- » Not only consider initial investment, also long-term operational and maintenance costs
- » Multi-year plan or business case in collaboration with advisor
- » Conduct additional experts when needed

# Answering the main research question

**Make a  
decision**

## **Aiming at an integrated approach**

- » Consider energy efficiency and IEQ in tandem rather than as separate goals
- » No-regret measures

# Recommendations for further research

- » Conduct **longitudinal studies** to track the decision-making processes and outcomes over an extended period.
- » Conduct **in-depth and interdisciplinary IEQ-studies** to address the interconnected nature of office renovations with a focus on an enhancement of IEQ.
- » Conduct case studies on **different building and ownership types**.
- » Research the **impact of government regulations and financial incentives** in relation to office renovations.
- » Research **multi-stakeholder perspectives** in relation to office renovations.

# Advice report

Handing over my findings to 'the field' in order to enhance 'healthy' office renovations in the future.



# Graduation deliverable

- » Examination of the associated research and its conclusions
- » Addressing different stakeholders: government bodies, office owners, and advisors
- » Listing recommendations per decision-making phases in relation to the different stakeholders

## Energy-efficient and 'healthy' offices

Advice report for office renovations focused on energy-efficiency and Indoor Environmental Quality



# Questions

Ask me anything that was unclear or missing.

