

# Energy-efficient and 'healthy' offices

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



# Colophon



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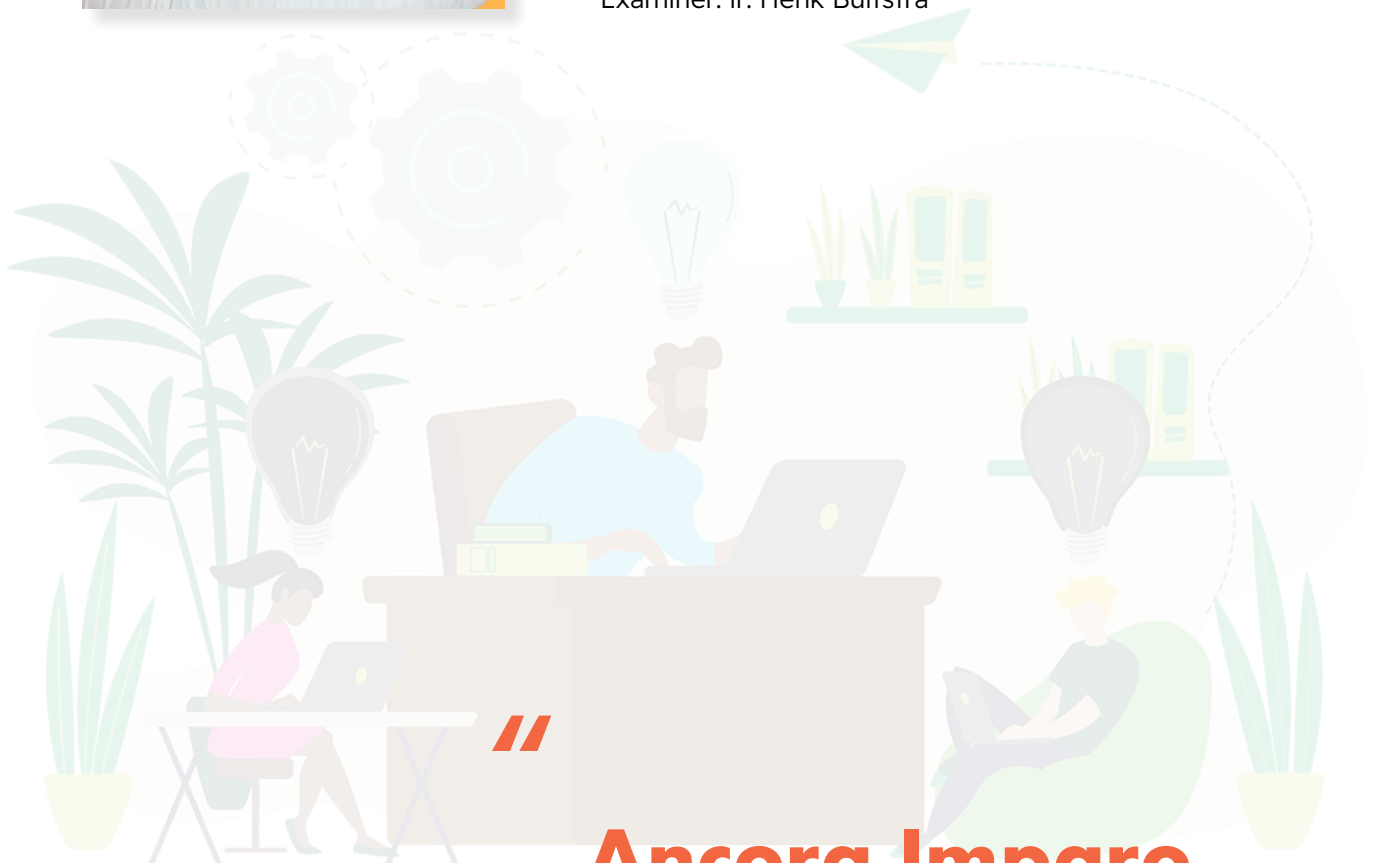
***Graduation***

MSc Architecture, Urbanism and Building Sciences  
Track: Management in the Built environment

Design and Construction Management  
Energy transition in the existing building stock

***Supervisors***

First supervisor: Dr. Queena Qian  
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**Ancora Imparo**  
*(I am still learning)*



**- Michelangelo, 87 years**

# Preface

As there is a large emphasis on the energy-efficiency of existing and newly constructed buildings nowadays, it has become common practice to renovate buildings that are not energy-efficient yet. Governmental obligations are focused on encouraging building owners to renovate and take sustainability for their property into consideration. Recently, the Dutch government mandated office owners to obtain a minimum of EPC class C for their office properties. In an era marked by a growing emphasis on the health and well-being of employees of an organisation, it is important to embark on renovation practices that are focused on energy-efficiency and an upgrade of the quality of the indoor environment in workplaces. The term Indoor Environmental Quality (IEQ) is important to remember and get yourself familiar with as it becomes vital in the renovation of office buildings.

This report on office renovations is a comprehensive guide intended to equip you with valuable insights, strategies, and recommendations for embarking on a journey toward a greener and healthier workplace. Whether you are an office and business owner seeking to improve the environmental footprint of your office, an advisor tasked with overseeing renovation projects, or an individual interested in the transformative potential of sustainable and healthy office spaces, this report is designed to provide you with the knowledge and tools necessary to navigate the complexity of office renovation with a mindset focused on energy-efficiency and a healthy indoor environment.

Within these pages, you will find an exploration of the conducted research that is associated with this advice report. The conclusions of this research are presented concisely. Furthermore, this report will offer practical advice on how to initiate, plan, and secure office renovation projects with a strong focus on energy-efficiency and employee health and well-being. For a more detailed understanding of the research that preceded this advice report, I refer to the repository\* of Delft University of Technology, where the research report is published under the name *“Energy-efficient and ‘healthy’ offices: An approach for office renovations focused on energy-efficiency and Indoor Environmental Quality”*.

It is my hope that this report serves as a valuable resource, empowering you to make informed decisions and take meaningful steps toward transforming your office into a more energy-efficient and healthy environment. By embracing the principles outlined herein, you can not only reduce your organisation’s ecological footprint but also create a workspace that fosters productivity, innovation, and employee satisfaction.

Enjoy reading,

**Anja van der Ham**

\* <https://repository.tudelft.nl/>

## Associated research

The research that is associated with this advice report aimed to answer the following research question: “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?”. In order to answer that question, several sub questions have been answered by means of a case study research method. The case study projects that have been studied were selected by pre-determined case selection criteria. The cases encompass owner-occupied office buildings that have been renovated, or are scheduled for renovations in the near future. By undertaking the case study research method, it was possible to analyse the decision-making processes of the office owners prior to making a decision upon their renovation practices. This has led to the identification of motivations and barriers in relation to the energy-efficient renovations that are executed or planned for implementation. Additionally, the office owners of owner-occupied offices are triggered to consider IEQ aspects and their consequences. This relates to the fact that recent scientific studies showed that the IEQ aspects (indoor air quality, thermal and acoustic comfort, and adequate levels of lighting) can negatively affect the health and well-being of office occupants when these aspects are inadequately dealt with. Additionally, the cognitive function and productivity of office occupants is affected by these aspects as well. Therefore, it is important to consider and implement this advice report in office renovation practice. This guides the decision-making process prior to the office renovations into the right direction of considering renovation practices that can increase the energy efficiency and IEQ in tandem.

## Research conclusion

As a conclusion of the research, a schematic overview is created which illustrates the decision-making process prior to renovation. Different phases in this process are identified: Become aware, Getting interested, Gaining knowledge, Consider options, and Make a decision. Figure 1 shows the decision-making scheme as derived from the executed research.

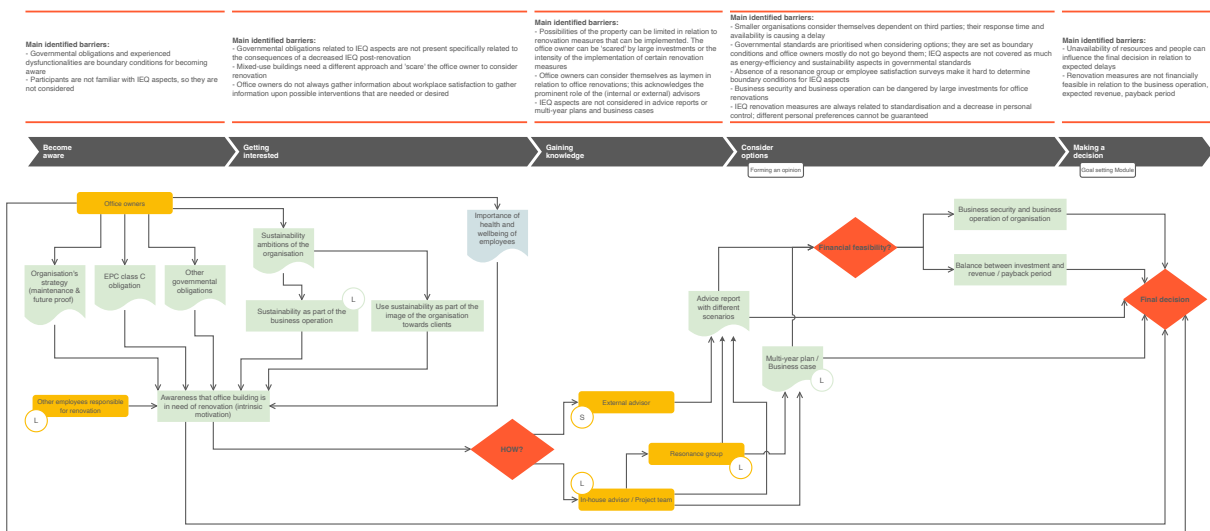


Figure 1. Decision-making scheme based on research results. Own work.

This decision-making scheme shows three benchmark moments which were considered of great importance in the decision-making phases. Through an extensive discussion and interpretation of the benchmark moments, it was possible to summarise the research results even more and illustrate the most important barriers, stakeholders, and measures, in relation to the benchmark moments. This is shown in figure 2 on the following page.

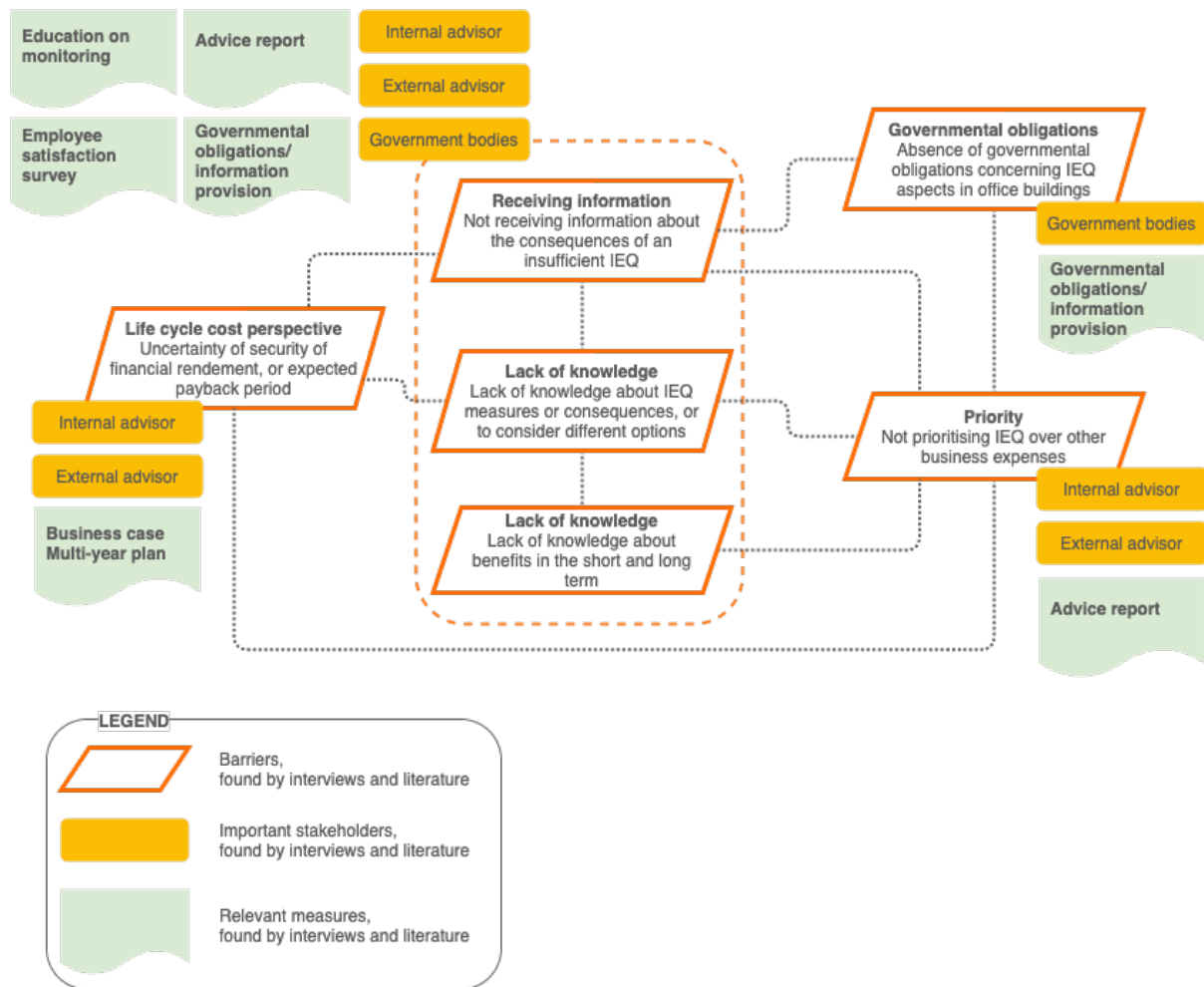


Figure 2. Summary of the result interpretation, focused on enhancing IEQ considerations during decision-making processes prior to office renovations. Own work.

Above illustrated figure guided the establishment of key strategies and considerations as indispensable content for this advice report. These key strategies and considerations are elaborated based on different recommendations for the several decision-making process phases. Additionally, the recommendations are discussed in relation to different important stakeholders of office renovation projects in the following section, starting from the following page.

# Recommendations for an office renovation based on energy efficiency and Indoor Environmental Quality

The recommendations are listed per decision-making phase in relation to different stakeholders.

## Become aware & Getting interested

### The government bodies

Several governmental regulations have been put into action, or are planned for the coming years, in relation to energy efficiency and compliance with the Climate Target Plan 2030. However, the importance of a healthy indoor environment in offices is often neglected in governmental standards or obligations. It might not be necessary to use such standards or obligations in order to ensure the implementation of a healthy indoor environment, but it is important to provide office owners with sufficient information about the consequences of an inadequate IEQ in their office building. Besides, listing the benefits of renovation practices focused on an enhancement of IEQ in office buildings can trigger the office owners and raise their awareness on the topic.

### The office owner

Being an office owner, it is important to monitor the user satisfaction among occupants of office buildings regularly. When the office building is owner-occupied, it is even more important to monitor the user satisfaction, as it also illustrates the employee satisfaction, and overall job satisfaction. Each of these aspects are valuable for the organisation and can provide insights in possible workplace upgrades that are needed. If you are an office and business owner and you consider your organisation as 'small' and have a passive attitude towards feedback of your employees, it is important to implement an employee satisfaction survey. You might consider your 'threshold' for feedback on the workplace environment as low, but it might be a matter of being used to how the office and its workplaces functions. The fact that something works does not always mean that there is no room for improvement.

## Gaining knowledge

### The advisor

The role of the advisor is prominent during this phase and the advisor should focus on proactively providing information and scenarios. Not only in terms of energy-efficiency upgrades but also the related IEQ consequences. This also means that the advisor should invest in education concerning IEQ aspects and consequences in office renovations. The advisor should make use of the information that is already known and published about this topic. Besides, there is already an existing tool available for advisors in the field of office renovation and new office construction projects. Have a look at the publication\* of Binnenklimaat, who have established a report focusing on determining requirements concerning indoor environmental quality in office buildings (Programma van Eisen Gezonde Kantoren 2021). This publication is aimed at renovation and construction projects that are not only energy-efficient, but also healthy, comfortable, and productivity-enhancing.

### The government bodies

As mentioned in relation to the role of the advisor in this decision-making phase, it is important for the advisor to keep oneself educated on topics as IEQ in relation to office renovations. As a governmental body, it is important to provide this education or available information to advisors, based on equal information provision among this labour group. Additionally, it can be helpful to use the publication of Binnenklimaat, see previous page, as

\* <https://www.binnenklimaattechniek.nl/document/pve-gezonde-kantoren-2021/>

a standard during office renovations. A similar implementation is used with the renovation and new construction of school buildings, as the Netherlands Enterprise Agency published a program of requirements for the sustainability of schools\*, focusing on aspects such as energy, air quality, temperature, lighting, and acoustics (Programma van Eisen Frisse Scholen 2021).

### **The office owner**

During this phase, it is important to gather information and gain knowledge on the topics of interest for the upcoming renovation. As an office renovation might not be related to the business operation of your organisation, it is recommended to hire an advisor who can inform you about possible renovation practices. However, it is important to determine requirements for the renovation outcome. What do you want to achieve? It is likely that the advisor will provide you information in relation to the questions that you are asking. Be explicit in the assignment for the advisor and emphasise the aspects that you consider important in your office building. And do not forget... you consider the health and well-being of your employees as very important.

## **Consider options**

### **The advisor**

During this phase it is important to illustrate the consequences of the different proposed scenarios to the office owner. The advisor has the knowledge and expertise to steer the office owner towards an integrated approach that is focused on the implementation of renovation practices that enhance energy efficiency and IEQ in tandem. By mapping the different scenarios by means of a multi-year plan, the office owner can become more secure of the financial investment that is needed for the renovation measures. However, not only financial benefits should be listed, also the benefits in relation to the IEQ are important to mention. Think of aspects that are tangible for the office owners; sick leaves, productivity, work output, and so forth. This makes it easier to create a sense that an increase in IEQ can also benefit the eventual business operation of the organisation.

### **The office owner**

During this phase, it is important to neglect the initial investment of renovation measures and, instead, focus on the short and long term benefits of all scenarios presented by the advisor. Renovation practices with higher initial investments might create more (monetary) benefits in the long term. Try to establish a multi-year plan, possibly in collaboration with a third party, to map out the financial investment and revenue stream. Also take the operational costs of the organisation into consideration, for example sick leaves.

## **Make a decision**

### **The office owner**

Lastly, of course, it is important to make a decision upon the implementation of renovation measures. Hopefully, you have taken the recommendations to heart in the previous steps of your decision-making process. In that case, I am sure you will take a well-advised decision, based on the right motivations. I hope you and your employees will enjoy your healthy workplace!

\* <https://www.rvo.nl/onderwerpen/verduurzaming-utiliteitsbouw/maatschappelijk-vastgoed/onderwijsgebouwen-po-en-vo>

## Acknowledgement

As a concluding part of this report, I want to express my gratitude to my thesis supervisors who have guided me along the process of the establishment of the research that preceded this advice report. Of course, without the interviewees of my case study projects, it would not have been possible to draw conclusions from the gathered data and information. I am extremely grateful that you have made your time available for participating in this research on short notice. My colleagues, thank you for giving me the opportunity to work part time during my final year of being a student. I am looking forward to the next steps in my career with confidence because of this. Lastly, I want to express my gratitude to my dearest family and friends who have been my support system throughout this journey. You were my listening ears and helping hands.

