

# Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences



## Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners ([Examencommissie-BK@tudelft.nl](mailto:Examencommissie-BK@tudelft.nl)), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Maria Fernanda Villalba Muñoz
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Studio		
Name / Theme	Energy transition in the existing building stock	
Main mentor	Queena K. Qian	MBE-DCM
Second mentor	Erwin Mlecnik	MBE-REM
Argumentation of choice of the studio	Through the MBE core courses, I developed an interest in the sustainability aspect of the built environment. I had already learned a little about circularity but had zero experience in energy-related topics. Therefore, I considered that it was an opportunity to learn something new that could be useful after graduation, considering that the energy transition of the building stock is a trendy subject around the world, especially now with the current energy crisis.	

Graduation project	
Title of the graduation project	Energy transition in the retail sector: Revealing decision-making behaviours for Energy Efficiency Retrofits (EER) of shopping centres
Goal	
Location:	The Netherlands
The posed problem,	Given that the building sector is responsible for 36% of the global energy consumption (United Nations Environmental Programme, as cited in Santamouris & Vasilakopoulou, 2021) and 27% of the global CO <sub>2</sub> emissions (IEA, 2022a), the energy transition of the building stock is one of the most important issues to tackle in the current climate and energy crisis. If unaddressed, these values will continue to rise in the upcoming decades due to the increasing population growth, required surface area, rising demand for energy services, and the economic growth of developing countries (Santamouris & Vasilakopoulou, 2021). Moreover, this situation is unsustainable as fossil fuels are limited and its supply revolves around complex and fragile geopolitical relationships (Murphy, 2016). Now more than ever, the building sector requires to detach from fossil-fuel dependency and accelerate the pace of the energy transition of the stock to reduce the socioeconomic impact that both crises have brought to the environment, health, economy, and social well-being of people around the world (IEA, 2022b; Liang et al., 2016).

	<p>To achieve it, many programmes and strategies have been developed at both international and national levels. Such as the Paris Agreement at the international level, the EED and EPBD Directives of the European level, the Dutch Climate Agreement, the Energy Agreement for Sustainable Growth, and a Building Decree adjustment at the national level. However, despite the efforts made in the World and the Netherlands for the energy transition of the building stock, policies and research have been mainly focused on housing, leaving the non-residential building stock lacking in keeping up an adequate pace and in need of additional efforts to catalyse its transition.</p> <p>The non-residential sector represents 25% of the remaining global building stock, in which retail has the highest percentage of floor area in Europe, with 28% (Economidou et al., 2011), and the highest share of non-residential energy consumption (28%) (Haavik et al., 2014). Furthermore, within the retail sector, shopping centres are the building typology that represents the highest energy retrofit potential as they hold one of the highest specific energy demands for non-residential building stock and because, in western Europe, they are part of an already mature market with an existing old building stock that needs to be renovated in the upcoming years (Lollini et al., 2017). However, despite its potential, data gathered from previous research have demonstrated that the complex multi-stakeholder governance structure of these buildings makes the decision-making process for an EER difficult as it relies on the achievement of consensus within the parts (Ma et al., as cited in Liang et al., 2016). Several barriers have already been identified in the literature about this issue. These include barriers such as lack of knowledge, misplaced incentives, split incentives, asymmetric information, lack of regulations, among others. Yet, they are scattered and not identified within the decision-making process and the complex governance system of a shopping centre. Therefore, this research aims to reveal stakeholders' behaviours during the EER within a process perspective, finding the interrelationships between the different parties involved during the different steps of the process, and giving light on the areas that need to be addressed in order to guarantee a smoother process.</p>
<p>research questions and</p>	<p><b>“How can retail owners support a better decision-making process to steer EERs of shopping centres?”</b></p> <p>To answer this research, the following research sub-questions are anticipated:</p> <p><b>[SQ1]:</b> What is the state-of-the-art of energy efficiency retrofit of shopping centres?</p> <p><b>[SQ2]:</b> How is the EERs' decision-making process of shopping centres taking place?</p>

	<p><b>[SQ3]:</b> What are the barriers encountered during the decision-making process of EERs of shopping centres?</p>
<p>design assignment in which these result.</p>	<ul style="list-style-type: none"> <li>• Create a systematic overview of the stakeholders decision-making behaviours during EERs in shopping centres in the National and international context.</li> <li>• Draw lessons from national shopping centre cases and provide practical recommendations that can support them in their EERs journey.</li> </ul>

## Process

### Method description

To answer the research questions, an **exploratory qualitative research** has been selected. “Qualitative research supports the understanding of complex, dynamic, and multi-dimensional wholes” (Patton 1975, as cited in Sofaer, 1999). It allows to understand the context in which phenomena occur and identify and describe the patterns and events in which actors are involved (Sofaer, 1999).

The research is designed in three phases, involving a theoretical study, an empirical research phase, and finally a synthesis and conclusion phase.

#### Phase 1

The first phase concerns the theoretical study part of the research and focuses on answering SQ1. Through a desk research method, the literature review was conducted. This phase, presented in the previous chapter of this document, allowed to develop a comprehensive understanding of the state-of-the-art of energy efficiency retrofits of shopping centres from around the world, setting the basis for the subsequent empirical part of the research. Specifically, it led to the establishment of the selection criteria for the case studies and the development of a theoretical framework that will provide the guidelines to gather and analyse empirical data.

#### Phase 2

The second phase concerns the empirical part of the research and focuses on answering SQ2 and SQ3. The methods used to answer this question will be through case studies of shopping centres in the Dutch context by means of two rounds of semi-structured interviews. The semi-structured interviews will allow to validate the decision-making process compiled from literature and identify the underlying factors and behaviours that influence the decision-making process of an EER of shopping centres.

#### Phase 3

The third and final phase concerns the synthesis and conclusion of the findings. In this phase SQ4 and the main research question is answered. First, a cross-case study analysis will allow to synthesise the findings, which will be later validated in a focus group to answer SQ4. At the end of this phase, the research will conclude with the two main outcomes: a systematic overview of stakeholders’

behaviours, which will allow to identify the critical areas of improvement and produce recommendations to improve current decision-making mechanisms for EERs of shopping centres.

## Literature and general practical preference

The conducted literature review had two purposes. First, investigate the state-of-the-art of shopping centres in the Netherlands in terms of the type of ownership, size, building year, building form, function, and preferred renovation measures. This was supported to a larger extent by Strabo's database and the CommONE energy project on shopping malls, among other sources.

Second, develop the theoretical framework that will provide the basis for the empirical part of the research. It concerns the energy efficiency retrofit decision-making process and its interrelated barriers from the different stakeholders involved. The research borrowed and adapted Cagno et al. (2012)'s framework with other literature sources more specific to shopping centres. These included but were not limited to the works of Liang et al. (2016) and Ma et al. (2012).

## Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

The topic of this research relates to the theme studio of Energy Transition of the existing building stock as it looks into energy-efficient retrofits of retail builds in the Netherlands and explores stakeholders' behaviours to understand what are the barriers that are hindering the process and pin-point what are the areas of improvement to guarantee a smoother process.

Its relationship with the MBE lies across the disciplines of Real Estate Management (REM) and Design and Construction Management (DCM). It investigates the problematics of decision-making in strategic management for future-proofing building assets and also in terms of the design and construction process of a building retrofit.

Finally, it is related to the master programme MSc AUBS as it contributes to creating a more sustainable built environment, one of the main objectives of the programme.

2. What is the relevance of your graduation work in the larger social, professional and scientific framework.

The societal relevance of this research lies in supporting the acceleration of the energy transition of the building stock. This is not only relevant to support the efforts against climate change, but also highly relevant during the current energy crisis that has accentuated the need of the building stock to reduce its energy consumption and transition into renewable energy sources. This research considers that by investigating decision-making behaviours of EERs of shopping centres, the retrofit of this type of building stock of the sector can be catalysed.

The scientific relevance of this research lies in addressing the gap found in the literature review about stakeholders' behaviours for EERs in the retail sector. Analysing these behaviours will allow not only to map the specific drivers and barriers of each of the actors involved in the decision-making process, but

also to understand its interrelationships, providing valuable insight into which areas need to be addressed to mitigate these barriers in practice. The findings can benefit both professional practitioners in the field of asset management and policymakers.

## CITED REFERENCES

- Barchi, G., Moser, D., & Lollini, R. (2018). Renewable Malls: Transforming shopping centres into flexible, decarbonized urban energy assets. *Urban Energy Transition*, 293-311.
- Cagno, E., Worrell, E., Trianni, A., & Pugliese, G. (2013). A novel approach for barriers to industrial energy efficiency. *Renewable and Sustainable Energy Reviews*, 19, 290–308.  
<https://doi.org/10.1016/J.RSER.2012.11.007>
- Colliers. (2021). *Sustainability efforts in the Dutch retail sector*. Amsterdam. Retrieved from <https://www.colliers.com/en-nl/research/verduurzaming-winkels-komt-niet-op-gang>
- Cushman & Wakefield. (2019). *EMEA Global cities Retail Guide - Netherlands*. Amsterdam. Retrieved from <https://www.cushmanwakefield.com/en/insights/global-cities-retail-guide/emea>
- European Commission. (n.d.). *Climate strategies & targets*. Retrieved October 2022, from European Commission: [https://climate.ec.europa.eu/eu-action/climate-strategies-targets\\_en](https://climate.ec.europa.eu/eu-action/climate-strategies-targets_en)
- Government information for entrepreneurs. (2022). *Make your office energy efficient by 2023*. Retrieved from Bussiness.gov.nl: <https://business.gov.nl/running-your-business/environmental-impact/making-your-business-sustainable/make-your-office-energy-efficient-by-2023/#:~:text=Does%20your%20office%20have%20to,use%20it%20as%20an%20office.>
- Haase, M., Skeie, K. S., & Woods, R. (2015). The key drivers for energy retrofitting of European shopping centres. *Energy Procedia*, 78, 2299-2303. doi:<https://doi.org/10.1016/j.egypro.2015.11.368>
- Haase, M., Woods, R., Mellegard, S., Skeie, K. S., & Lollini, R. (2017). *Main deliverables for deep retrofitting of shopping malls [Deliverable 2.5]*. Accademi Europea Bolzano. Bolzano: CommONEnergy project.
- IVBN. (2016). *Investment in retail property in the Netherlands: a European perspective*.
- Kuivjõgi, H., Uutar, A., Kuusk, K., Thalfeldt, M., & Kurnitski, J. (2021, October). Market based renovation solutions in non-residential buildings – Why commercial buildings are not renovated to NZEB. *Energy and Buildings*, 248. doi:10.1016/j.enbuild.2021.111169
- Liang, X., Peng, Y., & Shen, G. Q. (2016). A game theory based analysis of decision making for green retrofit under different occupancy types. *Journal of Cleaner Production*, 137, 1300–1312.  
<https://doi.org/10.1016/j.jclepro.2016.07.200>
- Lollini, R., Avantaggiato, M., Barchi, G., Belleri, A., Dipasquale, C., Pasut, W., . . . Gantner, S. (2017). *Guidelines on retrofitting of shopping malls [Deliverable D7.12]*. Accademia Europea Bolzano. Bolzano: CommONEnergy project.
- Ma, Z., Cooper, P., Daly, D., & Ledo, L. (2012). Existing building retrofits: Methodology and state-of-the-art. In *Energy and Buildings* (Vol. 55, pp. 889–902). <https://doi.org/10.1016/j.enbuild.2012.08.018>

Salm, S., Hille, S. L., & Wüstenhagen, R. (2016, October). What are retail investors' risk-return preferences towards renewable energy projects? A choice experiment in Germany. *Energy Policy*, 97, 310-320. doi:10.1016/j.enpol.2016.07.042

Seeley, C. C., & Dhakal, S. (2021, April 01). Energy and CO2 emission reduction potential from investment in energy efficiency retrofits in Bangkok, Thailand. *International Journal of Sustainable Energy*, 41(2), 164-183. doi:DOI:10.1080/14786451.2021.1906244

Sofaer, S. (1999). *Articles Qualitative Methods: What Are They and Why Use Them?*