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Transformative change through local networks

A case study on the 'Local Roadmap for a Climate Neutral Building & Construction Industry 2030' in Malmö, Sweden

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Abstract

With rapid urbanization and an increasing share of anthropogenic greenhouse gas emissions from cities, low-carbon urban transformations are critical for mitigating climate change. Local climate networks have been recognized for their potential to govern such activities. However, less is known about how such networks are implemented and managed as well as their capacity to accelerate transformative change. As previous research indicates, the potential of local networks for emission reductions in cities is relatively unknown. This thesis aims to address this research gap by exploring how local networks contribute to transformative change on the urban scale. This was done by conducting an in-depth case study on a local network within the building and construction sector in Malmö, Sweden: "*Local Roadmap for a Climate Neutral Building & Construction Industry in Malmö 2030*" (LFM30). A framework based on four central concepts of Transition Management – *collaboration*, *shared vision*, *experimentation*, and *learning* – was applied to guide the research. Through a qualitative content analysis, based on material from eleven semi-structured interviews and relevant documents and media files, it was found that LFM30 demonstrates many capacities identified as necessary to drive transformative change. This includes providing an arena for interaction and collaboration, building a common direction and joint goals, unlocking new funding possibilities, and stimulating learning and knowledge sharing. The results also show that the LFM30 network has influenced its members to ramp up their own climate efforts, including adopting stricter climate targets and recruiting new competence, but the degree to which this is happening is difficult to determine. Further, this thesis finds that new challenges emerge in network settings, which need to be acknowledged and dealt with. This includes to ensure the involvement of all relevant stakeholders and to establish effective practices for monitoring and evaluating actions taken by network members.

Keywords: Urban Network Governance, Local Networks, Transition Management, GHG Mitigation, Building and Construction Sector

Executive Summary

The role of cities in combating climate change has gained increased attention in the past decades. With rapid urbanization and an increasing share of global greenhouse gas (GHG) emissions coming from cities, low-carbon urban transformations are now considered critical for mitigating climate change. But while city responses have been positive in terms of increased climate ambitions, those ambitions have not been followed by the necessary level of climate action. One sector where this is manifested is the building and construction industry, one of the most energy-intensive, resource-intensive, and highest emitting sectors globally.

Local climate networks have been suggested as a potential solution to advance transformational change in cities. By bringing together multiple actors within a geographical area, local-level networks could play a role in accelerating urban climate action. However, less is known about how such networks are implemented and managed, as well as their capacity to accelerate the desired change. As previous research shows, few practical examples of functioning urban governing structures of this type have been found and the potential of local networks in driving GHG emission reductions in cities is still relatively unknown.

As such, **this thesis aims** to address these research gaps by exploring how local climate networks can contribute to low-carbon urban transitions. This is done by analyzing how one such network, the "*Local Roadmap for a Climate Neutral Building & Construction Industry in Malmö 2030"* (LFM30) in Malmö, Sweden supports and facilitates transformative change in the building and construction sector. To do so, the transformative capacity of LFM30 is examined using four key concepts from the academic literature on Transition Management (TM): *collaboration*, *shared visions*, *experiments*, and *learning*. Hence, this research will explore how LFM30 advances these concepts among the actors participating in the network. The following **research questions (RQs)** have been formulated to guide the work:

RQ1: How does LFM30 support *collaboration* among participating actors?

RQ2: How does LFM30 contribute to a *shared vision* among participating actors, and how do actors incorporate the shared vision in their organization?

RQ3: How does LFM30 facilitate *experimentation* among participating actors, and how do actors take part?

RQ4: How does LFM30 stimulate *learning* among participating actors, and how do actors include learning in their organization?

To answer the RQs, an in-depth **single case-study research design** was applied. Interviews with actors participating in LFM30 was the main data source used for data collection and was complemented with information from documents and media files. The data was reviewed and analyzed through qualitative content analysis in Nvivo. To guide the analysis, a theoretical framework was developed consisting of the four TM concepts (*collaboration*, *shared vision*, *experimentation*, and *learning*). For each concept, key elements were identified based on previous literature. Figure 0-1 provides an overview of the applied framework.

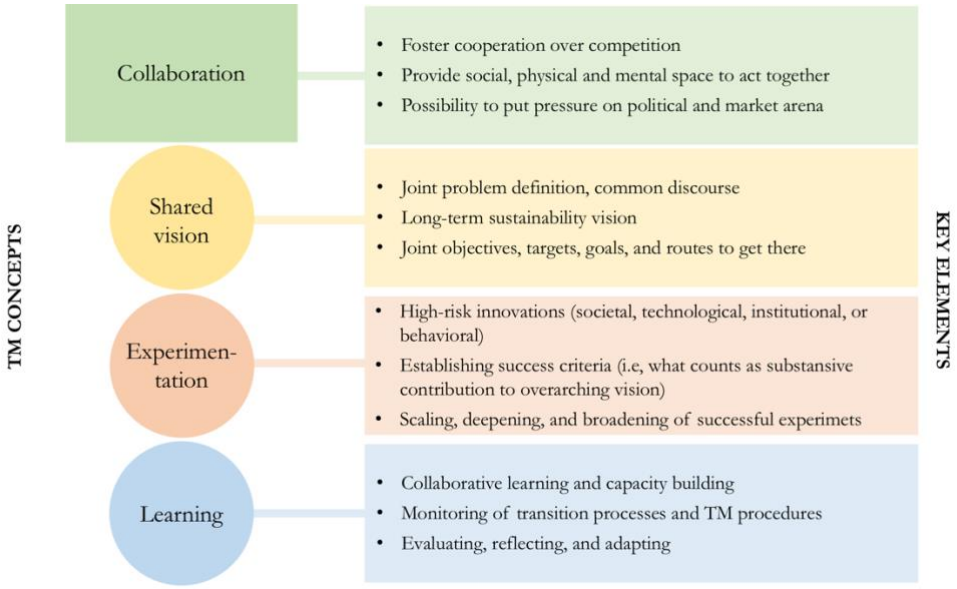

Figure 0-1. The four TM concepts and key elements per concept

In general, the **results** indicate that LFM30 demonstrates many of the elements identified as important by TM literature for driving change. Hence, the results suggest that network governance structures can play a role in accelerating low-carbon urban transitions. However, some concerns have also appeared in the analysis of the LFM30 network, including the future level of goal attainment and its ability to involve all actors who are needed to reach a climate neutral building and construction sector in Malmö, as well as those affected by the decisions taken within LFM30.

Findings relating to **RQ1** showed that a culture of transparency and willingness to share knowledge exists within LFM30. Further, LFM30 has been successful in provided actors, and individuals representing the participating actors, with a forum for discussing and acting together. For the building and construction sector, it seems as LFM30 and similar networks can increase collaboration among participating actors, and thereby help overcome low levels of integration between them.

Turning to **RQ2**, LFM30 appears to serve as a catalyst for higher climate ambitions among actors by establishing a common direction and shared vision that all agree upon. Moreover, the targets, objectives, and goals set by LFM30 seem to guide participating actors' short and midterm climate action. The methods and practices that have been introduced within LFM30 to reach these goals also resonate with what has been suggested from previous literature on transitions in the building and construction sector. On the more critical side, the process of defining a problem and creating a shared vision within LFM30 were not a result of deliberation among all participating actors. This increases the risk of a vision that corresponds only to the ideas of certain actors, potentially resulting in a transition that favors some over others.

In terms of experimentation (**RQ3**), LFM30 has unlocked new funding possibilities for actors to initiate and take part in (high-risk) innovations. While individual actors mainly initiate technological innovation projects, several of LFM30's structures and practices can be considered institutional innovations. Further, the results indicate that the criteria for determining whether experiments are successful should be expanded to also include learning objectives, and that evaluations of experiments could be improved. Finally, while deepening of experiments is observed through learning among actors, little scaling or broadening is currently occurring.

For **RQ4**, the main findings are that LFM30 provides several learning spaces and activities to stimulate knowledge sharing and dialogue, and that is has become a one-stop-shop for participating actors to find information. The findings also indicate that certain aspects of evaluation could be strengthened, including the evaluation of internal structures and practices within LFM30. To ensure this reflection contributes to transformative ideas being raised, discussed, and implemented, LFM30 must be considerate of what, which, and whose ideas that are accepted. Moreover, regarding how the participating actors include learning (from LFM30) in their organization, the results show that individuals representing their organization in LFM30 play an important role as knowledge distributors.

Several **recommendations** have resulted from the findings in this thesis. For actors engaged in LFM30, the following recommendations are made:

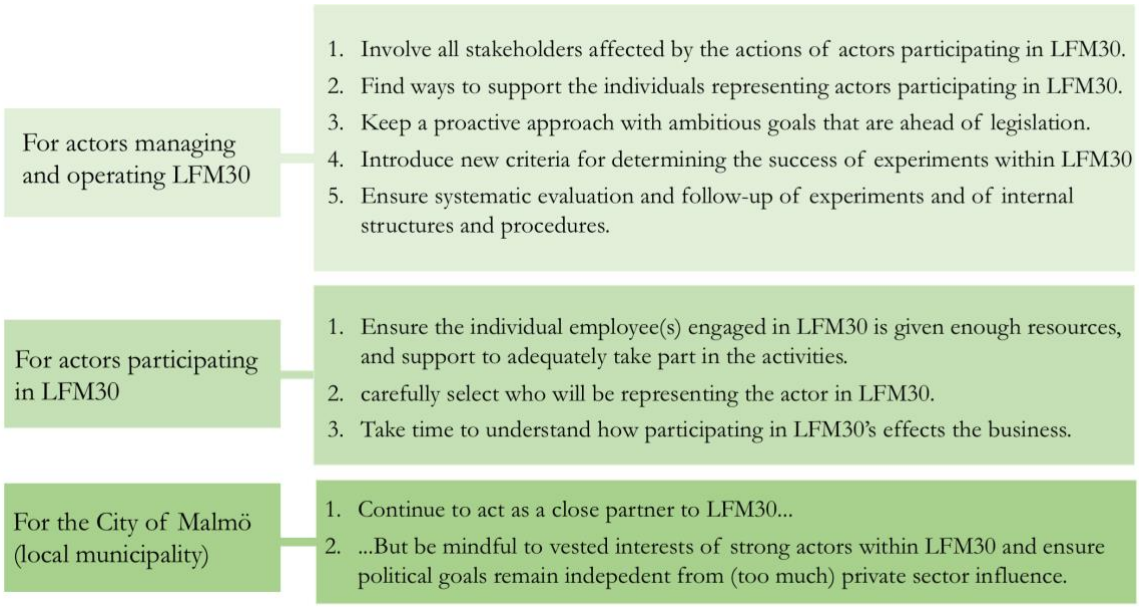

Figure 0-2. Specific recommendations to actors involved in LFM30

Further, this research has also shed light on issues that may be important to actors engaged in any local climate network. Five general recommendations concerning local networks are presented based on the lessons from analyzing LFM30:

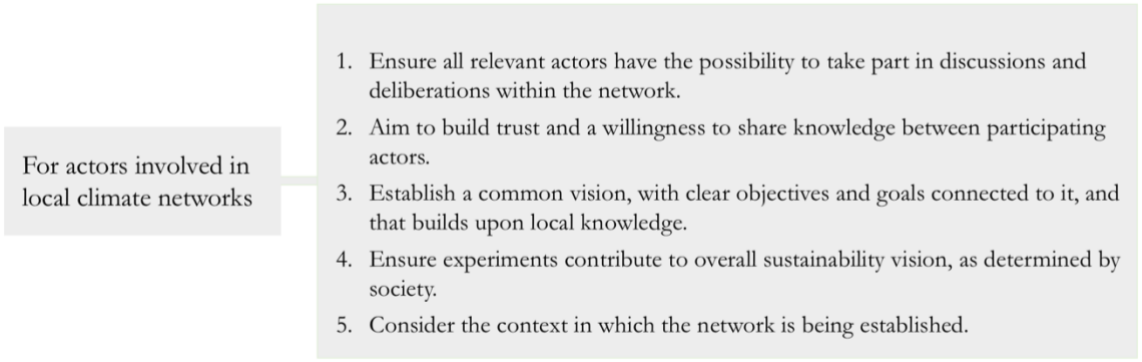

Figure 0-3. General recommendations to actors involved in local climate networks

To **conclude**, this thesis sought to contribute to academic literature on local networks and their ability to accelerate transformative change on the urban scale. The findings provide valuable learnings on the presence of transformative capacities within the LFM30 network and how the network supports GHG emissions mitigation efforts among the participating actors. But while LFM30 is suggested to have a significant role in realizing a transition to a climate neutral building and construction sector in Malmö, this thesis also showed that new challenges emerge in local network settings.

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Abbreviations

GHG - Greenhouse gas

IPCC – Intergovernmental Panel on Climate Change

LFM30 – Local Roadmap for a Climate Neutral Building & Construction Industry in Malmö 2030

MLP – multi-level perspective

NGOs – Non-governmental organization

SDGs – UN Sustainable Development Goals

TM – Transition Management

1 Introduction

The role of cities in combating climate change and providing sustainable lifestyles has gained increased attention in the past decades. And accurately so: urban areas produce an estimated 70% of GHG emissions, a share that is expected to increase by 2050 unless mitigation efforts are implemented (Intergovernmental Panel on Climate Change (IPCC), 2022). Further, close to 80% of the world's primary energy is consumed by urban areas (United Nations (UN), n.d.). Cities are also home to more than half of the world's population, a share that is predicted to rise to over two-thirds by mid-century (UN, 2018), making sustainability challenges in cities even more pressing. Indisputably, rapid and large-scale emission reductions in cities, through deep decarbonization and systemic change, are critical for reaching the Paris Agreement target of limiting global warming to a maximum of 1.5 degrees Celsius, while simultaneously achieving UN Sustainable Development Goals (SDGs) of the Agenda 2030 (IPCC, 2022).

Recent local-level responses have been encouraging. Local governments[1] from across the world have committed to rapid decarbonization strategies and in many cases, cities precede national governments with their ambitions (van der Heijden, 2018). For example, over 700 cities across the world have committed to reaching net-zero greenhouse gas (GHG) emissions by mid-century through the Race to Zero Campaign (C40 Cities, 2021). However, although displaying a positive move towards recognizing and beginning to address the climate impact of cities, the increased ambitions have not been followed by the necessary level of climate action (van der Heijden, 2019), illustrating a current inability in (local) societies to adequately address climate change (Wolfram et al., 2016).

One sector where this is manifested is the building and construction sector, one of the most energy-intensive, resource-intensive, and highest emitting sectors globally. Due to its heavy dependency on high-impact materials such as steel and cement, the sector accounted for 31% of global final energy demand and 21% of global GHG emissions in 2019[2] (IPCC, 2022). Mitigating the adverse impacts of the sector appears particularly important considering urbanization trends and the population growth expected in cities in the coming decades, with continued demand for new housing and built infrastructure as a result (IPCC, 2022). The building and construction sector also runs a high risk of 'locking in' unsustainable practices, mainly due to the longevity of the built environment and industry inertia (Lucon et al., 2014). Hence, shifting away from conventional to new, more sustainable modes of producing and managing the built environment in cities is critical for keeping the prospects of achieving the Paris Agreement alive. Further, the time between now and 2030 will determine the success of decarbonizing the building and construction industry (IPCC, 2022), highlighting the need for urgent action in this particular sector.

According to recent academic literature, large-scale GHG emission reductions within the building and construction sector are possible from solutions that already exist (see e.g. Mumovic & Santamouris, 2018; Van der Heijden, 2016). This is reiterated by the recent IPCC report, predicting that the potential of mitigation efforts could be up to 85% by 2050 in Europe and North America, compared to baseline calculations (IPCC, 2022). Further, mitigation efforts are also likely to yield other benefits, thereby contributing to the overall attainment of the UN SDGs (IPCC, 2022). But despite the high mitigation potential of existing solutions, large-scale

[1] In this thesis, the terms local government and municipality is used interchangeably.

[2] This number covers the building sector only.

implementation is lacking in practice, especially for tackling so-called embodied emissions[3] which have up until recently received limited attention (De Wolf et al., 2017; P. W. Newton & Rogers, 2020). Considering the barriers found in current research, realizing transformative change within the building and construction sectors arguably depends more on social aspects (e.g., organizational, institutional, and political aspects), rather than technical ones (Häkkinen & Belloni, 2011; P. W. Newton & Rogers, 2020; O'Neill & Gibbs, 2020).

To address complex societal challenges in urban areas, such as climate change, a large number of scholars have emphasized the formation of new governance structures (see e.g. Bulkeley, 2010; van der Heijden, 2019), This discussion has particularly highlighted the importance of collaboration among various actors functioning in the urban space, and follows a wider shift in how we understand and address climate change: from a global viewpoint to an urban and localized one (Bulkeley, 2021). Research on these new forms of urban governance structures seek to guide and steer multi-actor interactions toward a desired outcome (Nochta & Skelcher, 2020). Here, collaborative networks have been suggested to play an important role (Jordan et al., 2015; Wittmayer & Loorbach, 2016). By bringing together multiple actors within a geographical area and a certain field, local-level networks can play a role in creating space for climate action (van der Heijden, 2016; Wittmayer & Loorbach, 2016). Local networks, thus, offer a promising possibility for driving transformative change on the urban scale.

1.1 Problem Definition

In exploring ways to reap the benefits of the city context for delivering climate mitigation efforts, governance aspects of local level (city) transformations have recently become a more prominent research topic (Jordan et al., 2015; Köhler et al., 2019). But while new forms of governance structures are being developed and implemented in cities, the knowledge of the ability of such structures to deliver transformative change is still rather scarce (Bulkeley, 2021; Hölscher, 2020; Jordan et al., 2015). Existing literature has discussed what governance structures are being introduced on the urban scale and reached a consensus that a multitude of actors are involved in such processes, including local governments, public and private businesses, Non-governmental organizations (NGOs) and the civil society, and academia (Hölscher, 2020). However, limited focus has been given to if, and how, such structures are able to effectively accelerate sustainability transitions (Hölscher, 2020). Further, as noted in Jordan et al.'s (2015) review on the emergence of new climate governance, questions of capacity and de facto contributions appear to still be largely unanswered.

Urban transformations have received a lot of attention from the scholarly community and partitioners alike. However, research on the practical implementation of managing urban change processes, using networks and other new governance forms is still scarce (Rink et al., 2018). According to Rink et al. (2018), few practical examples of functioning urban governing structures of this type have been found, indicating that this approach is likely not a panacea for delivering transformative change on the urban scale. As seen in previous literature, they come with risks and weaknesses, including difficulties to maintain long-term interest and participation as well as low levels of monitoring (Jordan et al., 2015). A recent analysis of local networks to facilitate energy transitions in four European cities displayed a limited effect of the networks in terms of reducing GHG emissions, suggesting that these forms of local-level efforts appear to only contribute marginally to decarbonizing energy systems in cities (Nochta & Skelcher, 2020).

[3] Embodied emissions are emissions from the production of the building materials, that become 'locked in' in the finished building (De Wolf et al., 2017)

This highlights the need to open a discussion on how networks contribute to systemic transitions on the urban scale, as is also pointed out by Nagorny-Koring & Nochta (2018).

Hence, a better understanding is needed of how to practically manage network processes for low to zero carbon transitions in cities. This includes looking closer at their strengths and pitfalls, as well as trying to answer to what extent local networks contribute to transformative change on the urban scale. As Jordan (2015) points out, "it could be some time before the precise circumstances in which the new forms of governance are emerging and performing are sufficiently understood." (p. 981). Considering the shrinking window for successful climate change mitigation, and the growing expectations on collaborative governance structure as a potential solution for accelerating action, more research is needed on whether network governance is an appropriate approach.

The building and construction sector is in need of rapid decarbonization (IPCC, 2022; UN Environment Programme, 2021). Demands for new housing and infrastructure in urban areas are expected to grow as urbanization brings more and more people into such areas, making the urban scale increase in significance. And with a large mix of actors and stakeholders across the value chain and an inherent complexity of the building and construction processes (P. Newton et al., 2019), collaboration through networks appears particularly important for sustainability transformations to occur within the sector. But despite increasing attention in academic literature towards transitions in the building and construction sector, in-depth analyses of the urban scale are still scarce (Fastenrath & Braun, 2018), and limited research has been found on how networks can drive local-level transformation within this sector. This research project hopes to help close these gaps.

1.2 Aim and Research Questions

This thesis aims to explore how local climate networks can contribute to low-carbon urban transitions. This is done by analyzing how one such network, the "*Local Roadmap for a Climate Neutral Building & Construction Industry in Malmö 2030"* (LFM30) in Malmö, Sweden supports and facilitates transformative change in the building and construction sector. The focus is on the actors participating in LFM30 and how (if) the network influences their actions and efforts.

The analysis will be framed by literature on sustainability transitions, and more specifically the theory on Transition Management (TM). Based on this literature, the transformative capacity of LFM30 will be examined using four key concepts: *collaboration*, *shared visions*, *experiments*, and *learning*. The objective is to explore how LFM30 advances these concepts among the participating actors. To do so, the following research questions (RQs) will guide the work:

RQ1: How does LFM30 support *collaboration* among participating actors?

RQ2: How does LFM30 contribute to a *shared vision* among participating actors, and how do actors incorporate the shared vision in their organization?

RQ3: How does LFM30 facilitate *experimentation* among participating actors, and how do actors take part?

RQ4: How does LFM30 stimulate *learning* among participating actors, and how do actors include learning in their organization?

An in-depth case study of LFM30 will be conducted to answer these questions. In doing so, this thesis seeks to increase the knowledge of LFM30's role in realizing a transition to a climate-neutral building and construction sector in Malmö. To the knowledge of the author, no previous

studies have provided in-depth accounts of LFM30 or any other local collaborative initiatives with similar characteristics within the building and construction sector in Sweden. Thus, new knowledge on the LFM30 network can help practitioners who manage, participate in, or plan similar networks, specifically, and new forms of urban governance in general, within comparable contexts. Further, by applying concepts of TM as a framework for analyzing LFM30, this thesis also seeks to expand key concepts from the literature on TM to a novel setting, i.e., the LFM30 in Malmö, Sweden. As such, this study hopes to provide valuable contributions to research as well as practice.

1.3 Scope and Delimitations

The focus of this research is on one local climate network, LFM30, and its ability to advance a climate-neutral transition in the building and construction sector. The geographical boundary is the Swedish municipality the City of Malmö, which corresponds to the area defined by LFM30 itself (LFM30, 2019a). However, as presented in the analysis, LFM30 influences regional and national levels as well. When necessary, these levels are therefore also discussed. The data collection period was between February 2022 and April 2022. The collected data spans the full history of LFM30, from the initial discussion of setting up LFM30, which kicked off in 2018, until April 2022.

While the research could have been expanded to include additional cases in other countries, focusing on one case only made it possible to generate an in-depth and comprehensive analysis. However, only one specific case study has its limitations, and this thesis project does not claim to show general applicability of the findings and recommendations. Further, the impacts of LFM30 are context-dependent. LFM30 operates in a certain cultural and economic context (of Malmö, Sweden, Northern Europe), and the knowledge generated in this thesis should be used with caution if applied in other contextual settings.

The respondents who provided interview data to this study were chosen based on purposeful sampling aiming to collect a broad range of views. However, it should be noted that i) all respondents are engaged in the LFM30, ii) certain stakeholder groups are only represented by one individual, and iii) due to time limitations, not all relevant stakeholder groups have been engaged. These aspects can potentially skew the results in certain directions.

1.4 Ethical Considerations

This thesis research has not been funded by an external organization and no one other than the supervisor has been considered in a position to potentially influence the findings and outcomes presented in this thesis. Further, the Lund University criteria for research that requires an ethics board assessment has been considered, and no statement from the ethics committee was found necessary for this research.

Regarding ethical responsibilities to the interview respondents who contributed to this thesis, participation was entirely voluntary and verbal consent to record and store the interview data was obtained before all interviews. Before participating, all research subjects were informed of the purpose and intended outcomes of the study, as well as the methods used and their role as respondents. The risk of personal harm or disadvantage from expressing certain views or opinions of interest for this thesis study is considered low. Nonetheless, to reduce this risk, the names of respondents have not been disclosed. In general, only respondent information deemed necessary for the reader to understand the setting that each respondent operates within was disclosed. Finally, any direct quotes used in this thesis have been checked with the respondent in question.

All data has been processed and stored with consideration to common research practice. The material generated throughout this research, including interview recordings and notes, has been stored on a password-secured cloud database. This data can be accessed upon request.

1.5 Audience

This thesis aims to provide practical insights into how LFM30, a local network in Malmö, Sweden can accelerate climate efforts within the building and construction sector. Two main audiences have been identified to which this research could serve as valuable input.

Firstly, considering practitioners, the primary audience of this thesis, insights are useful to all actors involved in LFM30. The results are likely most interesting to the actors who work directly with LFM30, i.e., the management group and secretariat, but actors participating in LFM30 can also learn from this research. Findings from this research can help to better understand i) existing processes and structures within LFM30 and how they contribute to a climate-neutral building and construction sector, and ii) how participating actors engage with these processes and structures, and how they integrate them into their organizations. Thus, the findings can be used to guide decisions on adjustments or modifications of LFM30 (for internal decision-makers within LFM30) and decisions on whether to participate (for actors currently participating in, or considering joining, LFM30). Further, the results of this research bring valuable knowledge to practitioners who plan, implement, manage, or participate in a contextually similar local network aimed at advancing transformative (climate) action, both in the building and construction sector as well as in other sectors. This includes, amongst others, local policymakers, city officials, urban planners, business representatives, and NGO affiliates.

Secondly, this research aims to contribute to the scientific community by addressing identified research gaps within sustainability transition literature, a field that has been given much attention in the last decades. More specifically, this research feeds into the growing pool of literature on Transition Management (TM). By developing a TM framework and applying it to a novel case study, this thesis seeks to make theoretical contributions to TM literature.

1.6 Disposition

The outline of this thesis paper is as follows: *Chapter 1* has provided an initial description of the problem this thesis seeks to address as well as the aim and the specific research questions that will be answered. It has also outlined the scope of this research project, ethical implications that have been considered during this study, and the intended audience. *Chapter 2* examines existing literature on sustainability transitions and Transition Management (TM), in general, and in relation to the urban context. The theoretical logic that will serve as the basis for the analysis, the TM framework and the four central concepts closely related to this framework – *collaboration*, *shared vision*, *experimentation*, and *learning* – are also described here. This is followed by *Chapter 3* where the research design, materials, and methods are outlined, and methodological choices explained. *Chapter 4* provides an overview of key characteristics of the city of Malmö, to contextualize and provide background to the case under study in this thesis: the LFM30 network. Further, the organizational structure of LFM30 is described briefly. *Chapter 5* presents the main research findings in relation to the research questions presented in Section 1.2. In *Chapter 6*, the findings are discussed and connected to existing literature. Here, limitations of the study are also discussed. Finally, *Chapter 7* presents the main conclusions of the thesis as well as the relevance of the findings in relation to practice and academia. Moreover, implications are highlighted, and recommendations resulting from the findings and the discussion are provided, together with potential avenues for future research.

2 Sustainability transitions in theory and practice

This chapter contains three sections. The first section provides a brief introduction to the literature on sustainability transitions, as well as an introduction to Transition Management (TM). As one of several research fields within sustainability transitions literature, TM focuses particularly on managing change processes and has been used extensively to both analyze and implement sustainability transitions (Loorbach et al., 2017). Second, transitions on the urban scale are discussed, including previous academic literature on governing urban sustainability transitions through TM practices. Third, the TM framework to be applied in this thesis to guide the analysis of how network governance may affect transformative change is described. In all sections, aspects of network governance in the sustainability transitions literature are emphasized.

2.1 Sustainability Transitions

2.1.1 Key Aspects of Sustainability Transitions

Research on sustainability transitions originates from the field of innovation studies, and more specifically the broadening of perspectives within innovation literature to address sustainable development issues (Smith et al., 2010). With the understanding of environmental problems as persistent complex societal problems, and that traditional governance mechanisms fail to properly address these issues, transitions research aims to conceptualize and explain how transformations (e.g., societal or sectoral) can be achieved through systems-driven approaches (see e.g. Grin et al., 2010; Köhler et al., 2019). Research on sustainability transitions has grown rapidly since the turn of the millennia and evolved into a "collective, productive and highly cumulative endeavor" (p. 2), with a broad range of views and analytical starting points regarding how transitions should be understood and managed (Köhler et al., 2019).

In general, sustainability transitions can be seen as fundamental transformations of structures, cultures, and practices towards more sustainable ways of production and consumption within a specific socio-technical (sub-)system (Loorbach et al., 2015; Markard et al., 2012). Socio-technical systems are complex networks of actors (individuals, organizations, governments, etc.), institutions (societal and technical norms, regulations, standards), physical artifacts, and knowledge (individual, scientific, organizational, and process knowledge): elements working together to deliver a specific service for society (Markard et al., 2012).

Socio-technical transitions, then, represent shifts in existing socio-technical systems, driven by far-reaching changes in technological, organizational, institutional, material, political, economic, and socio-cultural processes occurring in the same system (Markard et al., 2012). Sustainability transitions, in comparison, are intended, purposeful, and normative transitions of socio-technical systems, where the end goal is based on a collective idea of what sustainability entails (Grin et al., 2010; Markard et al., 2012). Hence, sustainability transitions of an existing socio-technical system are achieved when the system is altered in a direction that promoted a mutually desirable outcome.

Another main aspect of transition theory is the understanding of socio-technical systems as multi-level: consisting of niches (micro-level), regimes (meso-level), and the landscape (macro-level) (see e.g., Geels, 2002; Grin et al., 2010). The regimes and their actors represent the current pathways of development, the established status-quo of the socio-technical system. Without outside pressure or other unexpected events, this development is likely to be logical and incremental, following an anticipated trajectory (Grin et al., 2010; Markard et al., 2012). Hence, socio-technical regimes are "dynamically stable" (Grin et al., 2010, p. 21). At the regime level, incumbent institutions and organizations are portrayed as keen to maintain this stability, why

resistance to transformative change and innovation may often exist here (Grin et al., 2010). Recent research has, however, begun to question this view and found that incumbent organizations can play a role in accelerating transitions (Turnheim & Sovacool, 2020).

System transitions can occur through the destabilization of existing regimes, followed by a shift to a new one. Three potential mechanisms are considered to drive this shift: i) bottom-up through niche innovations, i.e., radical innovations developed in protected spaces (niches), that mature and break through the existing regime, ii) top-down through pressure from the landscape level, which represents long-term changes on a high, often global, level, and iii) within the regime itself through incumbent actors (Grin et al., 2010). Regardless of how transitions occur, it is clear that existing regimes play an essential and decisive role (Grin et al., 2010), which also explains why the 'meso'-level tends to be the primary level of analysis in transition research (Köhler et al., 2019). While the multi-level perspective (MLP) presented here is a specific transition framework, the concepts of niches, regimes, and landscapes are also prevalent across the literature on sustainability transitions.

Different theoretical frameworks have emerged within sustainability transitions literature. In Markard et al.'s (2012) review, four frameworks were found to be frequently applied within the field: multi-level perspective (MLP), technological innovation system (TIS), strategic niche management (SNM), and transition management (TM). While the literature on sustainability transitions has been both broadened and deepened since then, these frameworks are still considered to constitute the theoretical foundation of the field (Köhler et al., 2019). Despite differences in foci and level and area of analysis, the four frameworks have in common that they "adopt systemic views of far-reaching transformation processes of socio-technical systems" (Markard et al., 2012, p. 956), i.e. promoting sustainability transitions.

A key aspect in the literature of sustainability transition literature is network governance and the organic and often informal coordination of transformation such networks may provide. Scholars often use the term network governance in the context of urban climate mitigation (Khan, 2013), see Section 2.2.3.

2.1.2 Transition Management – a guide to managing and analyzing transitions

One research approach used to understand, manage, and analyze sustainability transitions is Transition Management (TM). TM as a string of literature evolved in the Netherlands in the early 2000s (Grin et al., 2010), and has since received wide scholarly attention as a potential source of frameworks and toolkits for analyzing and strategically and practically managing transitions towards an agreed state of improved sustainability (see e.g., Loorbach, 2010; Loorbach et al., 2017). Further, TM literature can be applied to analyze or guide transitions on multiple levels: the societal system, the sub-system, or the project level. Different activities and processes will therefore carry different meanings depending on the chosen system boundaries.

It was introduced as a new governance model in response to the failure of both top-down command-and-control government practices and liberal market approaches to deal with complex societal problems (Kemp et al., 2007; Loorbach, 2010). While recognizing that both command-and-control and market-based forms of governing are necessary, TM presents a third option – a middle way – based on multiplicity and reflexivity[4] (Kemp et al., 2007). This approach integrates key concepts of the governance literature: including participation, networks, and

4 Seen in this thesis as the ability of self-confrontation, being able to examine own behavior and learn from it.

interactions, and combines these with processes aimed at dealing with complex societal problems: learning, experimentation, adaptation, and adjustment (Grin et al., 2010; Loorbach, 2010). Further, the precise role of government (local, regional, or national) is not prescribed in transition management. Rather, it is context-based and varies depending on the transition to be achieved, as well as the phase and project within a transition process. Another key feature of the TM approach is that it aids in the development of sensitivity to the unpredictability of social transformation processes, making the involved actors better prepared to manage such processes (Loorbach et al., 2015). There are several features (tenets) that distinguish TM, see Table 2-1. Together, they illustrate a governance approach that recognizes complexity.

Drawing on both theory and practice, TM aims to influence the patterns, dynamics, and mechanisms that drive fundamental change in the cultures, structures, and practices of societal systems (Loorbach, 2010; Loorbach et al., 2015). In practice, TM literature focuses on "creating conditions under which the actions of autonomous agents somehow add up to contribute to a bigger whole" (Loorbach, 2014, p. 67). To succeed with this, TM literature stresses the importance of networks and network governance (Loorbach et al., 2015).

According to TM literature, transformative change can be realized by progressing through small but radical steps (i.e., a series of interventions), which influence the direction and speed of change towards a desired long-term societal outcome. Further, such steps should be based on learning and experimentation (see e.g. Grin et al., 2011; Kemp et that such al., 2007; Loorbach, 2010). As outlined by Rotmans et al. (2001), TM is about using long-term thinking for shaping short-term policy. Moving forward through small steps appears somewhat contradictory, especially as transitions aim to achieve fundamental change. However, the benefits of such an approach are multiple (Kemp et al., 2007):

- Each step seems doable, as it is perceived by affected actors as more subtle
- The costs of a certain step being a mistake are kept low, hence, actors dare to experiment
- It allows testing, assessing, and if needed, changing direction at an early stage, which helps limit lock-in of undesirable solutions
- It enables lessons learned to be used to inform further steps.
- It gives actors space and time to adapt to new structures and processes, rather than promoting immediate radical change that results in maximal resistance from the incumbent regime.

Table 2-1. Tenets of Transition Management

Tenets	**Description**
Multi-actor	Is dependent on collaboration and coordination between multiple actors, across different societal groups, which all have individual interest, capabilities, beliefs.
Flexible objectives	As the system changes in response to transition efforts, there might be a need to reformulate the objectives
Long-term processes	Transitions usually evolve over longer time-periods (at least 25 years), requiring long-term thinking to guide short-term goals
Timing	Timing of actions is important, and will determine the effectiveness of the efforts
Managing change processes	Content and process (of a transition) must be managed together, not as separate features. Further, the managing should come from inside the societal system intended for change.
Space for change	Actors need a secure space for building up alternatives to the existing regime

Source: Loorbach (2010)

Lastly, another key take-away from previous scholarly discussions on TM is the dependence depends on a formal democratic system for transparently recognizing and managing the risks associate with a TM-inspired transition strategy. Hence, context is important for determining the suitability of using the TM approach, and it cannot be considered a blueprint for achieving sustainability transitions (Loorbach et al., 2015)

2.2 Urban sustainability transitions

2.2.1 The City Context

Cities have gained a prominent role in the field of transitions studies (Köhler et al., 2019), from being a much less frequent scope of analysis compared to the country or international level (Markard et al., 2012). Undoubtedly, the continuing trend of rapid urbanization positions urban areas at the center of sustainable development challenges (Köhler et al., 2019), with urban resource use predicted to grow accordingly (United Nations Environment Programme & International Resource Panel, 2018). At the same time, cities are recognized for their ability to generate disruptive innovations: it is in cities where past large-scale societal transformations have been initiated (Hall, 1998). Urbanization, with a higher of people and activities in cities as a result, also provides an opportunity to increase resource efficiency and implement large-scale decarbonization efforts (IPCC, 2022). Hence, the city scale has become a crucial scene in which many contemporary societal challenges are materializing but also represents an arena for enabling the advancement of low carbon transitions (Bulkeley et al., 2011).

2.2.2 Characteristics of urban sustainability transitions

What characterizes urban sustainability transitions? According to Frantzeskaki et al. (2017), urban sustainability transitions refer to "fundamental and structural changes in urban systems through which persistent societal challenges are addressed" (p.1). As such, research linked to these issues lies on the borderline between transition studiesand urban studies. Needless to say, local municipalities carry a prominent role in realizing transitions within a given geographical setting, but recent developments illustrate how a myriad of new players have stepped in to influence (and advance) sustainability efforts in urban areas, through involvement in both specific projects and longer-term initiatives (Frantzeskaki et al., 2017). The governance aspect of urban sustainability transitions has become a more prominent research topic, drawing on issues on how to create successful modes of interaction between local governments and other stakeholders operating in the city (da Cruz et al., 2019). Such initiatives and structures are sometimes referred to as 'network governance', which is discussed further in the next section.

Luque-Ayala et al. (2018) reflect along similar lines, pointing to a shift in urban transition studies in the last decade: from focusing on emissions reductions through an 'extractive' model to an 'embedded' model where low carbon futures are discussed with regards to political realities and development pathways. This turn illustrates a new way of viewing transitions "not solely as technical, infrastructural or systemic shifts, but also as a way of thinking about collective futures, societal development and governing modes" (Luque-Ayala et al., 2018, p. 2). It is therefore necessary to acknowledge the multiplicity of actors interacting within the urban scale, and that urban sustainability transitions are complex processes of change (Frantzeskaki et al., 2017). However, the practical implementation of managing urban change processes, using networks and other new governance forms has just recently begun (Rink et al., 2018). According to Rink et al. (2018), few practical examples of functioning urban governing structures of this type have been found, indicating this approach is likely not a panacea for delivering transformative change on the urban scale. As seen in previous literature, they come with risks and weaknesses, including difficulties to maintain long-term interest and participation as well as low levels of monitoring (Jordan et al., 2015).

Further, Wittmayer & Loorbach (2016) point to three important features distinguishing urban scale transitions: i) geographic proximity (shorter distance between actors), ii) personal proximity (higher interest due to local ties to the location), and iii) institutional proximity (shared formal and informal institutions within the city). This ties into another important aspect: context and the fact that the specific circumstances that frame each case need to be considered in research on urban sustainability transitions. Recognizing place-specificity and the high dependence on the local context is stressed by Hansen and Coenen (2015) in their synthesis paper on the geography of sustainability transitions, and is further emphasized throughout TM literature (see e.g. Hölscher et al., 2016; Loorbach et al., 2015).

2.2.3 Governing Urban Sustainability Transitions

This research will focus on the application of TM literature on the urban scale and in the context of local-level networks. As mentioned above, TM emphasizes the role of urban network governance in realizing transitions. In essence, network governance is about fostering coordination between several societal actors, between which collaboration is necessary to solve certain problems (Klijn & Koppenjan, 2016; Nochta & Skelcher, 2020). By introducing new forms of network structures to govern transitions, network governance serves as a means to solve the challenge of conflicting interests among a set of interdependent actors, which need to cooperate to achieve low carbon transitions in urban areas (Khan, 2013; Klijn & Koppenjan, 2016; McCormick et al., 2013). One way to achieve this, i.e. to govern transitions, is by implementing TM practices (Nagorny-Koring & Nochta, 2018). And due to the characteristics of urban sustainability transitions, i.e., the presence of multiple actors with strong interests in a smaller geographical area (see above section), a networked approach to urban scale transitions appears to be particularly relevant.

The number of studies focusing on TM governance practices in the urban setting is steadily growing, from previously mostly concerning national-level transitions (Nagorny-Koring & Nochta, 2018), and can be categorized depending on their approach. Either they i) apply TM in an operational way and discuss learnings from implementing it (see e.g. Frantzeskaki et al., 2014; Frantzeskaki & Tefrati, 2016; Hölscher et al., 2016; Nagorny-Koring & Nochta, 2018), or ii) they use TM as an analytical lens to explore previous and current transitions in cities (see e.g. Khan, 2013; Nochta & Skelcher, 2020; Shiroyama & Kajiki, 2016). Common for both strings, however, is that they share a common emphasis on the need for collaboration between, and active engagement among, diverse stakeholders.

Looking first at the operational approach to TM, mixed findings appear to emerge. In their case-study analysis in Rotterdam's City Ports area, the implementation of TM practices led to positive outcomes in terms of vision building, target achievement, and partnership building. Potential reasons for the success mentioned by the authors were the timing of the intervention and the culture of collaboration among participating actors (Frantzeskaki et al., 2014). Oher positive contributions from implementing TM practices found in other articles were building a shared vision among actors (Frantzeskaki & Tefrati, 2016), mobilizing actors to create informal networks (Hölscher et al., 2016), and empowering participants to take action (Hölscher et al., 2016). However, as Hölscher points out, the empowering effects on participating actors appear to be rather short-term (Hölscher et al., 2016). Another important aspect raised by Frantzeskaki et al. (2014) is that implementation of TM practices results may result in higher uncertainty relating to delivery (outcome) and governing (steering). Nagorny-Koring & Nochta (2018) discuss lessons from two projects that have applied TM-inspired governance mechanisms in European cities. In contrast, they propose a bleaker outlook for TM in urban contexts and conclude that the short-term design of the studied projects limited their potential impacts. Further, they argue that how transitions can be practically managed (by multiple actors) in cities

through TM practices merits further attention, especially with respect to the implementation phases (Nagorny-Koring & Nochta, 2018).

Of the three articles in this literature review that have used TM as an analytical lens, only one (Shiroyama & Kajiki, 2016) delivers a largely positive picture of the contributions of TM practices. In their analysis of a Japanese city, Shiroyama & Kajiki (2016) found that both private sector members and city officials served as frontrunners to push for a transition and that they collaborated within networks. Further, pressure from individuals representing incumbent actors, both private and public, was recognized as a key driver for the transitions to occur. Together, these findings highlight the importance of individuals in transition processes (Shiroyama & Kajiki, 2016). The other two articles display a bit more skepticism toward TM and its network-based approach. From their study of energy transition networks in three European cities using network analysis, Nochta & Skelcher (2020) found that i) network forms of urban governance are not new but have rather been present for decades, and ii) that stronger presence of TM practices within the network did not appears to impacts emissions reduction rates in the cities. (Khan, 2013) highlights some positive outcomes of a networked approach to transitions in Växjö, Sweden, including possibilities to acquire external funding and the ability to mobilize actors from various backgrounds and sectors. Also, here, the aspect of individuals in driving change is mentioned (Khan, 2013). However, both Nochta & Skelcher (2020) and Khan (2013) argue that the TM approach may exaggerate the benefits of network structures for realizing urban transitions, and neglect the limitations such as low participation of certain societal groups and risks of corroborating existing structures in urban areas rather than changing them (Khan, 2013).

This short review illustrates a mixed outset for network governance-based TM approaches and justifies the need for more knowledge on its potential as a driver of transformative change in urban contexts. As concluded by Nochta & Skelcher (2020), there is a need "to open up a discussion on how these different types of network processes, and various combinations of them, can best contribute to low-carbon energy transitions in different cities" (p. 10).

Finally, it is worth noting the different roles of local governments in TM processes in the above case studies, and that this is not carved in stone. While some research points to the city government and its officials as leading actors in establishing and managing TM practices (Frantzeskaki & Tefrati, 2016; Hölscher et al., 2016), other studies found that the local governments not necessarily act as the main driver (Khan, 2013; Shiroyama & Kajiki, 2016). This aspect has also been studied by Ehnert et al. (2018), who found that strong political support increase the likelihood of transition processes being successful. Understanding which actors are in charge of TM practices, and the impacts of this on the transition, is important when analyzing TM cases.

2.3 Transition Management framework

In this thesis the transformative capacity of networks is analyzed using a theoretical framework based on TM. The framework builds on key concepts in the TM literature and focuses particularly on governance processes through the involvement of multiple actors. Four overarching concepts are used to form this framework: i) collaboration, ii) shared visions, iii) experimentation, and iv) learning. These concepts are central and frequently reoccurring concepts in the literature on TM: *collaboration* (see e.g., Kemp et al., 2007; Rip & Kemp, 1998), *shared visions* (see e.g. Grin et al., 2010; Kemp et al., 2007; Rip & Kemp, 1998)), *experimentation* (see e.g., Grin et al., 2010; Kemp et al., 2007; Loorbach et al., 2015; Marvin et al., 2018)), and *learning* (see e.g. Geels, 2002; Grin et al., 2010; Kemp et al., 2007; Rip & Kemp, 1998). Throughout previous literature, these concepts have been recognized as important for achieving transformative change in society. Further, this categorization of TM concepts has, for example,

previously been used to systematically review policy evaluations for energy efficiency in buildings in Sweden (Sandin et al., 2019) and to analyze urban approaches to energy efficiency in buildings in Malmö and Copenhagen (Lis, 2020).

The four concepts are discussed in detail in the following subsections (Section 2.3.1 – 2.3.4), by presenting the most important elements within each concept. This is based on key pieces of T literature (i.e., Grin et al., 2010; Loorbach, 2010; Loorbach et al., 2015), combined with supplementary sources focusing on these concepts. Lastly, Section 2.3.5 presents the framework guiding this thesis research and described how it will be applied.

2.3.1 Collaboration

Collaboration involves various actors who share a common interest or mutually depend on each other, and who acknowledge that objectives (individual or collective) can be better achieved jointly than separately (Grin et al., 2010). By bringing together actors from different societal fields and sectors (science, policy, civil society, and businesses), TM seeks to establish modes of governance that support and facilitate the development of "cooperative rather than competitive relationships" (Köhler et al., 2019, p. 8). In this process, it is important to clarify the interest and values of each actor and to reach compliance across all actors involved (Grin et al., 2010).

In practice, collaboration can take various forms. This is often context-based, with a strong link between suitable forms of governance and the characteristics of the social domain or sector in question (Grin et al., 2010). Within the TM framework, collaborative forms include networks, partnerships, coalitions, activity clusters, and working or project groups. Further, collaboration can be of formal or informal character, and the line between the two is usually quite blurry. Most often multiple informal collaborations, personal contacts, unofficial meetings and discussions, etc., exist within and between the formal settings (Grin et al., 2010).

Networks, partnerships, and coalitions are considered valuable because of their ability to provide participating individuals and organizations with "the mental, social and physical space to develop new ideas, common language, and ambitions, as well as new joint projects" (Loorbach et al., 2015, p. 53). In such a collective space, individuals and organizations are more eager to promote change than when action separately. Further, these spaces serve as a way for exercising pressure on political and/or market domains, intending to increase the uptake of processes and innovations that contribute to the long-term transition goal (Grin et al., 2010; Loorbach et al., 2015). Grin et al (2010) use the term 'societal movement' to explain the indented outcome of forming and acting in these kinds of collaborative modes and the 'space' they generate.

2.3.2 Shared Visions

The shared visions aspect is about creating a joint long-term vision for the result of the transition and developing goals and common strategies to reach the vision. Creating a shared vision provides a clear direction from all network participants, supporting joint efforts towards transformative change. The shared vision should be developed by gathering a small group of actors in a network setting, referred to as the *transition arena* (Grin et al., 2010; Loorbach, 2010). The actors involved in the transition arena should be frontrunners, i.e., pioneers and innovative niche- and regime players (Loorbach et al., 2015). Further, these actors should be "agents with capacity to generate dissipative structures and operate within these deviant structures" (Grin et al., 2010, p. 144). In theory, the transition arena provides "a semi-structured arena in which societal actors can collectively identify problems and solutions and discuss implementation" (Loorbach et al., 2015, p. 59). For this to happen, efforts need to be in place to ensure that all relevant stakeholders are included in the arena and involved in the envisioning process (Voß et

al., 2009). According to Voß et al (2009), previous studies suggest that powerful incumbents may end up controlling the transition arena on behalf of weak stakeholders, who tend to be underrepresented. Keeping in mind the different opportunities of different actors to participate is therefore important in creating a shared vision (Turnhout et al., 2020), and diversity of actors and openness to external ideas must therefore be maintained (Loorbach et al., 2015)

As highlighted by Loorbach (2015), the process of forming a transition arena most often begins with individuals convinced that fundamental change is necessary. Through discussion and interaction, the transition arena seeks to reach a joint perception of the problem, for all participating actors to reach a shared understanding of why a transition of the specific domain is necessary, and begins to develop a long-term sustainability vision (Loorbach et al., 2015). Key to the vision generation is the establishment of shared basic principles for how the desired societal outcome (in the specific context) should be defined, i.e. determining sustainability criteria that characterize a successful societal transformation, and an ambition to jointly move in this direction, while simultaneously keeping flexibility regarding short- and midterm solutions and strategies (see e.g. Loorbach, 2010; Loorbach et al., 2015). As Loorbach et al. (2015) point out, the underlying idea of this process is that a "collective understandings of the origin, nature, and dynamics of transitions in particular domains will enable actors to better anticipate and adapt to these dynamics to influence their speed and direction." (p. 49). Moreover, being tied by a common belief established within the group distinguished transition arenas from 'regular' actor networks, where organizations participate due to common interests (Loorbach et al., 2015).

An important feature determining the success of this process is the level of convergence of the participating actors' perceptions. To reach the necessary degree of convergence, and ultimately strike an agreement on the way forward, discussion, deliberation, and to some extent comprises is necessary (Grin et al., 2010). In creating a common discourse, attention should also be given to motivating actors to transfer it into their own operations and environments (Loorbach et al., 2015). Thus, the envisioning process is also important as it influences individual actors to behave differently by inspiring them to believe that their actions contribute to a larger cumulative influence on the system (Loorbach et al., 2015). Further, as detailed by Loorbach & Rotmans (2006), developing an encouraging vision can help mobilize social actors. However, the vision needs also to reflect the restraints of the existing societal system in terms of practically achievable change, i.e., the vision should not suggest a utopian, non-reachable future (Loorbach & Rotmans, 2006). A set of common questions to be discussed and answered within the *transition arena* illustrate the core purpose of the process (Loorbach et al., 2015): i) why a transition (what is the problem)?, ii) what are the sustainability criteria of the societal system when fundamentally transformed?, iii) What are the areas that require change, and what are the alternatives?

Based on the established vision, *transition pathways* should be developed together with a *transition agenda*. Transition pathways can be described as potential routes for reaching the sustainability vision, and multiple paths are necessary for this to happen (Loorbach, 2010). Further, the pathways can be of technological, institutional, or social character (Loorbach, 2010). Transition pathways for realizing a low carbon transition in the building and construction sector could, for instance, include increased use of wood in new buildings, zero-emission construction sites, energy efficiency measures, or a mindset shift towards preservation rather than demolition and new construction. The transition agenda, on the other hand, contains joint objectives and targets, as well as concrete actions and specific instruments to achieve the (short-term) objectives and contribute to changing society in the direction of the shared (long-term) sustainability vision (Loorbach, 2010). Hence, the transition agenda can be seen as a compass for guiding the transition process through multiple transition pathways (Loorbach, 2010). At this stage, more actors become involved, and new networks, coalitions, and partnerships are

formed under the main umbrella which is the shared vision of realizing a transition. Again, the success of this process relies on the ability of the actors involved to integrate the transition vision into their organization (Loorbach, 2010).

Within TM, creating a shared vision and joint goals and targets is recognized as necessary to outline why, where, and how societal transitions are achieved. Without practical action, however, the elements of vision generation and goal determination will be of little value (Grin et al., 2010). Hence, experimentation is required.

2.3.3 Experimentation

The next central concept within the TM framework is experimentation. Experimentation builds on the idea of acting without complete knowledge of the outcome and thereby offers a way to explore alternative means to existing structures and procedures (Bulkeley, 2021). Thus, experimentation is a means to move towards a transition while also acknowledging uncertainty in the transformation process.

The general aim of transition experimentation is to initiate high-risk innovation projects which can contribute to improving the knowledge within the societal system (Grin et al., 2010; Loorbach, 2010). At the experiment level, individual aspiration or promising technological advancements typically drive action (Loorbach, 2010). Involving and engaging first movers with the desire and potential to run such high-risk experiments is therefore important. Further, it is necessary to cultivate a multiplicity of transition experiments within the system that is to be transformed. By initiating a range of complementing experiments that all carry the potential to contribute to the established sustainability goals, a pool of experiments emerges, and from which lessons can be learned (Grin et al., 2010). Thus, experiments of all sizes and scopes can play an important role in driving a transition, which is highlighted by Bulkeley & Castán Broto (2013).

What is an experiment? From their review of over 600 urban climate change experiments in 100 cities, Bulkeley & Castán Broto (2013) conclude that experimentation can include a wide range of different measures or interventions with the overarching goal of promoting innovation towards a certain goal, i.e. the vision and the established transition agenda. Innovation, in turn, is defined by Loorbach (2010) as "including all societal, technological, institutional, and behavioral practices that introduce or operationalize new structures, culture, routines, or actors" (p. 170). Hence, experiments can take various forms and can be initiated by, and impact, different actors, and areas of a societal system. Experiments are also context-dependent, and different societal systems will provide different possibilities for (different) experiments to emerge. In practice, experiments usually occur in the form of innovation projects or programs, which take place during a specific and often shorter time period (Loorbach, 2010). Further, they normally occur on the micro (niche) level.

Experiments should be conducted by actors involved in the transition process. Preferably, these experiments should be collaborative efforts taking place within the network(s) of actors that has been established in the transition arena. By doing so, the direct involvement of frontrunners, the most important actors, can be ensured. Also here, this can include both regime actors and newcomers (Loorbach & Rotmans, 2006). But giving actors within the transition arena large influence over the experiments is not risk-free. As noted by Bulkeley (2021), the experimental character of experiments might be confined by these actors, who prefer the status quo. To prevent this from happening, criteria need to be formulated to assess the experiments. The criteria assist in determining whether the experiment significantly contributes to the transition visions, which should align with the overall sustainability goals of the societal system, and for selecting future experiments to pursue (Loorbach, 2010). To secure societal implications are

considered in setting up evaluation criteria, they should be discussed among all actors participating in the transition process (Voß et al., 2009).

Another key aspect of transition experiments is to ensure the deepening, broadening, and scaling of successful experiments. Experiments are considered successful if they fulfill the established criteria and contribute to the transition challenge (Loorbach, 2010). To drive transformative change, such experiments should be deepened (embedded), broadened (translated), and scaled (implemented at the meso (regime) level) (Bosch-Ohlenschlager, 2010; Grin et al., 2010; von Wirth et al., 2019). Deepening is about ensuring learning from experiments among actors within the local context, broadening reflects repeating experiments in different contexts, and scaling concerns implementing experiments at the regime level (Bosch-Ohlenschlager, 2010; Grin et al., 2010). Broadening and scaling can be quite challenging, as experiments tend to be place-specific (Bulkeley & Castán Broto, 2013; von Wirth et al., 2019). To create experiments that are successful in a certain context and that can be replicated in other contexts, Von Wirth (2019) highlights the need for modularity and flexibility in the design of experiments.

2.3.4 Learning

The concept of learning reappears throughout the large body of literature on sustainability transitions. Within TM literature, learning is closely linked to reflexivity, which in practical terms refers to the "monitoring, assessments and evaluation of ongoing policies, and ongoing societal change" (Loorbach, 2010, p. 170). Reflexivity is about collectively reflecting upon the transition processes underway and allowing these lessons to guide the next steps. The action of reflecting can be supported by providing encouraging contexts and promoting information sharing among participating actors (Grin et al., 2010). Further, a reflexive approach is necessary to prevent (new) lock-ins and to enable the exploration of new ideas and trajectories (Loorbach, 2010). Finally, to have a transformative effect, reflexivity must be embedded in the TM governance processes, not appear as a separate feature functioning beside (or after) these governance processes (Grin et al., 2010; Loorbach, 2010).

So-called double-loop learning should also be present, where learning influences the strategies, approaches, and coalitions that actors pursue, and not only the instruments and techniques used to realize these features (which is referred to as single-loop learning) (Grin et al., 2010). Findings in previous literature suggest that the extent to which double-loop learning occurs, i.e., the depth and width of learning, depends on the composition and nature of social networks (Grin et al., 2010): "networks that were broad and contained outsiders provoked more second-order learning" (p. 83). This is also emphasized by Vos (Voß et al., 2009), who argue that marginalized actors should be included in the learning processes. The necessity of facilitating capacity building among transition participants is also highlighted (Loorbach et al., 2016).

Two learning processes are highlighted within TM literature: i) monitoring of the transition processes (to understand the context), and ii) monitoring of the TM procedures. Monitoring of transition processes is related to physical changes in the societal system, while monitoring of the TM procedure concerns factors such as goal attainment and share of successful activities (Loorbach et al., 2015). In other words, monitoring of transition processes concerns general changes occurring to the societal system that could accelerate or slow the desired transformation, while monitoring TM is about ensuring that the behavior of involved actors, the transition agenda, and the transition experiment contribute to the established goals (Grin et al., 2010). Due to difficulty in monitoring TM procedures, objectives to assess the implemented actions and transition experiments, as well as learning goals, which can be measured and monitored, should be explicitly formulated (Loorbach & Rotmans, 2006). In practice, TM procedures should be monitored and evaluated to see if they have achieved the formulated objectives. If not, an analysis of why this is the case is necessary. Further, this is important to

ensure that TM features do not get lost during the practical management of transitions (de Geus et al., 2022; Voß et al., 2009). According to Voß et al., (2009), previous literature suggests this is often the case, and that TM in practice tends to end up closer to usual policy conduct than what is indented in TM theory. The lessons from monitoring and evaluating TM procedures should then be used to adjust the TM strategy, the shared vision and the experiments to be pursued (Loorbach & Rotmans, 2006). This process of adapting the TM features is one example of how reflexivity appears in practice.

2.3.5 A TM framework to analyze networks

A framework based on the four overarching TM concepts – *collaboration*, *shared visions*, *experimentation*, and *learning* – will be used in this thesis to analyze the transformative capacity of LFM30. This framework focuses on collaboration and the basic assumption is that collaboration, through participation in networks, is a central condition for action towards transformative change to occur. Further, collaboration is seen as a prerequisite for generating shared visions, for planning and executing experiments, and for promoting learning processes. The conceptual framework applied in this study is visualized in Figure 2-1.

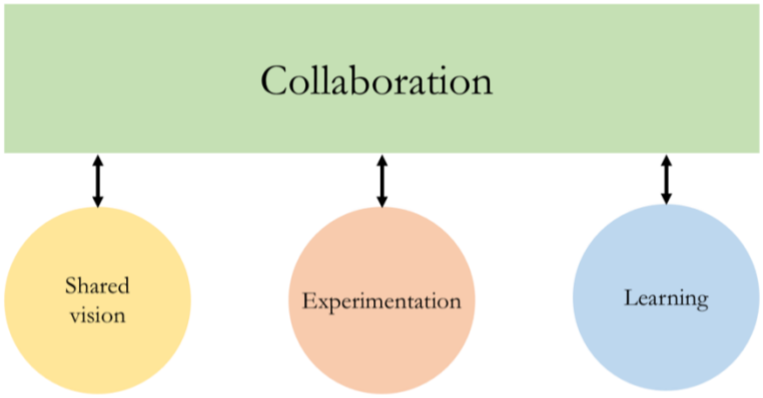

Figure 2-1. The TM framework applied in this thesis

Source: Own illustration

The analysis of this thesis seeks to examine how the LFM30 network supports *collaboration* (RQ1), contributes to a *shared vision* (RQ2), facilitates *experimentation* (RQ3), and stimulates *learning* (RQ4) among participating actors. Further, the purpose of the research is to study how individual actors participating in LFM30 integrate and implement the shared vision (RQ2), experiments (RQ3), and learning activities (RQ4) established by LFM30 into their own organizations. To practically guide the analysis and to answer the RQs of this research, twelve key elements relating to the four TM concepts have been identified (three per concept). They are shown in figure 2-2. Further, Appendix I provides a summary of the twelve key elements, the TM instruments relating to each element, and their potential implication to individual actors participating in LFM30.

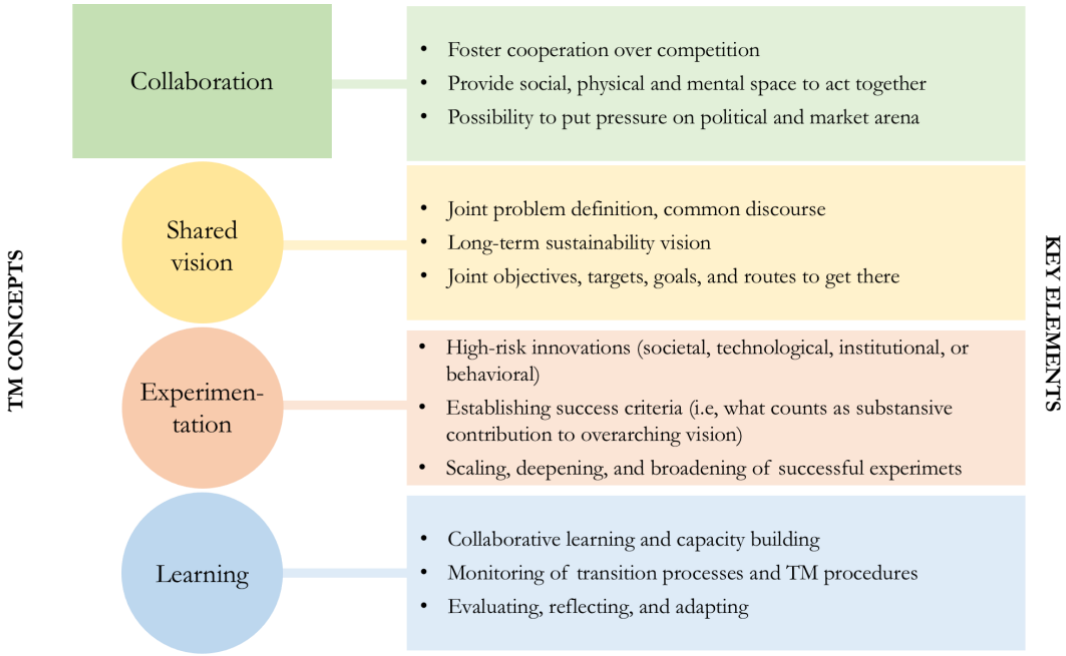

Figure 2-2. The four TM concepts and key elements per concept

Source: Own illustration and elaboration, based on Grin et al. (2010), Loorbach (2010), and Loorbach et al. (2015)

3 Methodology

This chapter outlines the research design, materials, and methods applied in this thesis project. It begins with an introduction to the research approach and a brief discussion of the philosophical worldview adopted in this thesis. The research design (case study) is then presented, followed by a description of methods used for collecting, analyzing, and interpreting the data. This chapter intends to provide a guide on the research procedure and explain the logic behind methodological choices.

This thesis project follows an exploratory qualitative research approach. A key feature of exploratory studies is that the phenomenon under study has received little prior attention and that the researcher, therefore, "seeks to listen to participants and build an understanding based on what is heard" (Creswell & Creswell, 2018, p. 27). Overall, this study aims to expand the knowledge on how LFM30 contributes to transformative change in the building and construction sector in Malmö. To achieve this, an in-depth case study on LFM30 was conducted, looking specifically at the four concepts of TM and twelve identified key elements (See Section 2.3.5). While not covering all features of importance to drive transitions, which would arguably be a difficult task considering the extensive and highly differentiated scholarly output within TM, the four concepts and the twelve identified elements provide a theoretical frame for analyzing the LFM30, with the goal of generating new knowledge on how these concepts are promoted and facilitated by LFM30.

Interviews with actors participating in LFM30, as members or in other capacities, served as the main input, combined with secondary data from relevant documents and media. An overview of the research design, data sources, and methods for data collection and analysis is presented in Table 3-1. As advocated by methods scholars (see e.g. Blaikie, 2009; Creswell & Creswell, 2018), qualitative research processes should emerge through multiple iterations. Hence, the procedures of data collection, analysis, interpretation, and result write-up were carried out simultaneously throughout the thesis project.

Table 3-1. Overview of research approach, design, and methods

Research approach	Exploratory qualitative
Research design	Single case-study
Methods for data collection	Semi-structured interviews and desktop research
Methods for data analysis	Qualitative content analysis
Philosophical worldviews	Constructivist and pragmatist

Source: Own elaboration

In qualitative research it is important to ensure both validity, i.e., the accuracy of accounts, results, conclusions, and justifications presented in a research study (Maxwell, 1996), and reliability, which relates to ensuring the findings are stable and consistent (Creswell & Creswell, 2018). Regarding qualitative validity, various strategies mentioned by Creswell & Creswell (2018) were applied to assess and enhance the credibility of the findings presented in this thesis, including triangulation of data (using both primary and secondary data sources relating to LFM30), providing rich descriptions of LFM30 and its contexts, and self-reflection on any potential research biases being brought into the study, see for instance section 6.2 on reflections on the study results. Transparency in the research process is essential to improve qualitative reliability (Yin, 2018). To ensure reliability in this study, the author has continually documented the research processes, set up and used detailed protocols for data collection, and frequently

checked for errors in the gathered data, as suggested by Yin (2018). Further, it is worth noting two points on the role of the researcher in this study. First, the analysis and interpretation of the collected data can be affected by the background experiences of the researcher. This is especially the case for interview data, where the researchers' language and expressions likely impacted the way respondents chose to answer questions. Another aspect to consider is the researchers' interpretation of interview responses and how explicit results are derived from implicit meanings in the collected data. To better capture these nuances, short notes were taken during the interviews, and follow-up questions were asked if there was any uncertainty in an interview response. Second, this research process has been iterative, and improvements and adjustments have been made as the research has evolved. For example, the interview guide was tested, adjusted, and adapted as the researchers' understanding of what issues were the most interesting grew larger.

Lastly, philosophical worldviews clarify how the researcher perceives the world, i.e., the dominating beliefs held by individual researchers (Creswell & Creswell, 2018). This study is predominantly constructivist in the sense that it aims to develop an understanding of the phenomenon (case situation) by relying on respondents' opinions. While the approach is mainly constructivist, this research project could also be categorized within the pragmatic worldview. As this study aims to also generate practical recommendations for practitioners, it resonates with the logic behind pragmatism in being concerned with real-world problem solving and transformation (Frey, 2018).

3.1 Research Design: Case study

The research was conducted using a single case study design. Being a qualitative research design, with an emphasis on exploration and interpretation, case studies can help generate a holistic 'real-world' understanding of a complex issue (Creswell & Creswell, 2018). Two main reasons explain the decision to conduct a case study. First, qualitative case studies are useful when the research aims to describe a contemporary social phenomenon (Yin, 2018), such as LFM30. Second, a case study design supports the use of various data sources, allowing for multiple perspectives and explanations to emerge (Yin, 2018). As this thesis aims to develop a better understanding of one entity (LFM30), the case study design was chosen based on its potential to support an in-depth analysis of a specific issue.

The case under study in this thesis is LFM30 in Malmö, Sweden (see Section 4.2 for a thorough description). The decision to study this case was purposeful: an appropriate method when the "objective is to achieve the greatest possible information on a given problem or phenomenon" (Flyvbjerg, 2006, p. 229). The case selection was based on the novelty and potential impact of LFM30. The LFM30 was the first of its kind in Sweden (LFM30, 2019a) and has a large number of participating actors (202 actors, as of 9 April 2022 (LFM30, n.d.-c). Further, it has received a significant amount of media attention[5]. As such, the LFM30 can be considered an 'extreme', or unusual, case, using Flyvbjerg's (2006) classification. Studying the LFM30 may therefore generate distinct findings, which can be useful in the formation of similar initiatives in other cities with similar social and economic contexts.

The difficulty of generalizing case studies, and subsequent validity concerns, are often mentioned as criticism of this research design. This is particularly the case for single case study research (Yin, 2018). However, as argued by Flyvbjerg (2006), case studies are fundamental for gaining a scientific understanding of a certain phenomenon, which is done by providing detailed

[5] "LFM30" was mentioned 187 times in Swedish newspapers and magazines between 1 January 2019 and 28 February 2022, according to a search on *Retriever Research Media Archive* (Retriever Research, 2022)

descriptions (Creswell & Creswell, 2018). Hence, case studies have an important role in increasing the scientific body of knowledge within a certain field (Flyvbjerg, 2006), as long as they include in-depth accounts of the event under study. And compared to multiple case study designs, single case studies are superior when seeking a more thorough understanding of one event (Gustafsson, 2017). Along those lines, this research aims to illustrate the specific characteristics and features of LFM30, rather than reach generalizability.

3.2 Research Methods

3.2.1 Data Collection

Two kinds of data were used in this thesis: respondents' opinions (primary data) and document and media files (secondary data). The respondents' opinions were collected from actors participating in LFM30 through semi-structured interviews and relevant documents (program statements, method reports, and result and assessment reports) and media (video files) were found through desktop research. The data collection process is outlined in Figure 3-1. The use of multiple methods is encouraged in qualitative research, as it provides a more holistic view of the issue under study (Harrison et al., 2017). Further, triangulating the data by combining multiple sources helps improve the internal validity of the study (Creswell & Creswell, 2018). Observations through participating in meetings were also considered for data collection and would have been an appropriate method for gaining a firsthand experience of the discussion within LFM30, as well as a possibility for exploring topics that participants are reluctant to answer in an interview setting (Creswell & Creswell, 2018). But due to the short time period for data collection in this thesis project, and a lack of suitable meetings to join during this period, no observations of this kind were collected.

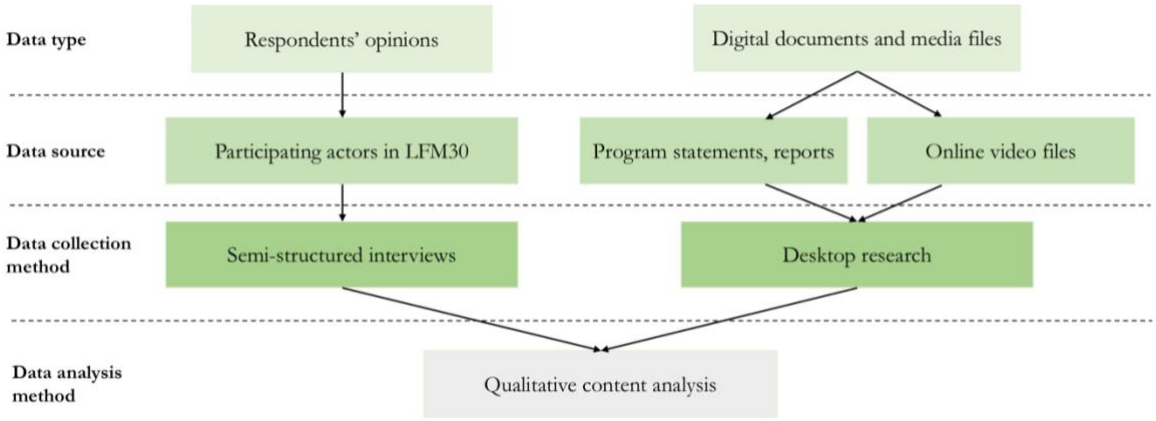

Figure 3-1. Overview of data collection process

Source: Own illustration

Interviews

The interview respondents were selected based on purposeful sampling, as is normal when conducting qualitative research (Creswell & Creswell, 2018). The initial set of respondents was developed by first identifying central actors based on the level of engagement and actor roles within LFM30, and then through a discussion with the thesis supervisor. Further, a snowballing technique was used, i.e., interview respondents were asked to recommend other individuals they identified as interesting to interview. The aim was to interview key actors with in-depth knowledge of LFM30, rather than to achieve broad representation across LFM30 participants. Therefore, the ambition was to find interview respondents within the secretariat, the LFM30

board and management group, the six working groups, representatives from each actor group, and the City of Malmö, See Figure 4-2 on the organizational structure of LMF30 in Section 4.2.3. Since the working groups are run by member actors, respondents engaged in the working groups could also represent a specific actor group. After a manual search process, combined with snowballing, about 20 people closely involved in LFM30 were identified as potential interview candidates.

In total, 11 semi-structured interviews[6] were conducted between March 1, 2022 – April 28, 2022, using open-ended questions. Semi-structured interviews are particularly useful to understand complex phenomenon, and "creates openings for a narrative to unfold, while also including questions informed by theory" (Galletta, 2013, p. 2). Further, the approach of lightly guiding the conversation through open-ended questions, rather than firmly controlling it, is recommended in case study interviews (Yin, 2018). The questions were designed based on the theoretical framework described in Section 2.3, and the interview guide can be found in Appendix II. The interviews were conducted in semi-natural settings, meaning that individuals are asked about activities in which they (naturally) engage, and their perceptions and attitudes (Blaikie, 2009).

To ensure all respondents openly shared their knowledge and perception, participation was based on anonymity. Therefore, only the respondents' role and the actor group the respondent represents is disclosed (see list in Appendix III). The average interview time was about 45 minutes. The majority of LFM30 actors work with Swedish as their first language. To limit the risk of misunderstandings and/or any language barriers between the respondents and the researchers, the interviews were held in Swedish. All interviews were conducted on a digital meeting platform and were recorded in full. The audio files were then manually transcribed into text documents.

The main reason for conducting interviews was to gather first-hand accounts from actors participating in LFM30. But there are some limitations to interviews that need to be managed. First, the respondents' perception of the interview situation may result in response bias, which occurs when participators answer in a way they feel is proper or correct rather than replying truthfully (Creswell & Creswell, 2018). In this study, response bias might emerge due to reluctance among LFM30 participants to voice negative views. The risk of response bias can be reduced through well-designed questions, research transparency, and ensuring participants' anonymity and integrity, measures which were considered while planning the interviews. Second, misunderstandings between interviewer and respondent can lead to incorrect data, and in the end misleading findings and conclusions. This was partly dealt with by conducting the interviews in Swedish, which was the working language of all respondents.

Document and media review

Document and media file review was conducted to complement the interviews and to help generate an in-depth understanding of the LFM30. The use of secondary data sources was beneficial for contextualizing the interview responses. Further, they contributed to strengthening the views of the respondents and provided new empirical insights in areas not covered by interviews. The selection of documents to include was guided by the focus of the RQs – to study how LFM30 can support transformative change by advancing *collaboration*, *shared visions*, *experiments,* and *learning* among the participating actors. Through a review of the LFM30 webpage, and by asking the respondents for specific documents to review, four publicly available documents were identified as most relevant to help answer the RQs. Another

[6] Ten individual interviews and one interview with a group of two respondents

document from the City of Malmö was included to understand how the municipality engages with climate-neutral building and construction. See Table 3-2 for a list of documents used in this analysis. Additionally, multiple video files were used to collect data. Similar to the documents, the video files were included to complement the primary data source and to increase triangulation. The videos were found on LFM30's official YouTube channel and were selected based on their expected level of value to the research project. All but one of the videos were promotional video interviews with actors participating in LFM30. The exception was a video explaining LFM30. A full list of video files included as data input to this research is available in Appendix IV.

Table 3-2. List of documents

Document name, year (English title)	**Document type**	**Author**	**Date accessed**
Så utvecklar vi tillsammans en klimatneutral bygg- och anläggningssektor i Malmö, 2019 (How we collectively develop a Climate Neutral Building and Construction Industry in Malmö)	Program statement	LFM30	2022-01-20
Redovisning LFM30: Resultatkonferens 2021, 2021 (Result reporting LFM30: Results conference 2021)	Monitoring report (result report)	Holmgren, A. (LFM30)	2022-03-22
Beräkning och redovisning av LFM30:s metod för klimatbudget (version 1.6), 2021 (Calculation and Accounting - LFM30's Method for Climate Budgeting (version 1.6))	Method report	Holmgren, A. & M. Erlandsson (LFM30)	2022-03-22
Översikt LFM30:s klimatlöfte (version 1.6), 2022 (Overview LFM30's Climate Promise)	Method report	Holmgren, A., J. Nilsson, & M. Erlandsson (LFM30)	2022-03-22
Återrapportering Budgetuppdrag 2019 – Förslag strategi för klimatneutralt byggande 2030, 2019 (Proposal for a strategy for Climate Neutral Construction by 2030)	Strategy report	City of Malmö	2022-04-07 (by mail)

Source: Own elaboration

When including document and media files as sources for data collection, there is a need to be mindful of certain limitations, such as the documents being inaccurate, subject to reporting bias reflecting the document authors' views, or off limits to public access (Creswell & Creswell, 2018; Yin, 2018). The documents under study in this thesis were public and easy to access and the event of inaccurate information and/or reporting bias was reduced by reviewing official and proposedly reliable documents only.

3.2.2 Data Analysis and Interpretation

The data was analyzed following a qualitative content analysis method. This method is characterized by the systematic classification of text data into codes or categories, and the subsequent identification of themes and patterns following this classification (Creswell & Creswell, 2018; Hsieh & Shannon, 2005). The step-by-step overview of data analysis provided by Creswell & Creswell (2018, pp. 193–195) guided the process of structuring and analyzing the collected data. Following the common qualitative approach, this procedure included gathering and organizing the data, categorizing, and labeling it with specific terms (i.e., coding), finding broader themes, and in a final stage developing overarching patterns.

The transcribed interview and video file material was manually coded and categorized into themes through an iterative process of several rounds. Coding was conducted in NVivo, a data analysis software to structure and ease the coding of data. While key concepts from the theoretical framework (see Section 2.3) formed the general outline of the coding structure, other codes were generated from the collected information. Thus, some codes were predetermined, and some were developed throughout the processes of reading and synthesizing the data. This allowed for establishing findings that directly related to the applied framework, as well as more unexpected ones. The coding structure was established in Swedish and translated to English at the end of the analysis process. In that way, new interview data, which was gathered in Swedish, could be easily integrated throughout the research process. The final coding structure used for writing the findings can be found in Appendix V.

In the final step, the overall findings were summarized and connected to the existing body of literature. Here, the findings are interpreted and related to the applied theories, i.e., key concepts from TM literature. These arguments can be found in the discussion and conclusion sections, which also includes recommendations, limitations of the study, and suggestion on potential strings of future research.

4 The building sector and LFM30

4.1 Transitions in the Building and Construction sector

Compared to other high-impact sectors, sustainability aspects of the building and construction sector[7] gained the attention of policymakers at a relatively late stage. At the beginning of the 2000s, most countries did not have a well-coordinated policy plan to encourage the shift to a more sustainable built environment (Rohracher, 2001). In the first wave of efforts to support the uptake of more sustainable building practices, common measures included mandatory requirements such as building codes and planning legislation (Van der Heijden, 2016). According to Van der Heijden (2016), these measures succeeded in providing a safe built environment but did little to promote one characterized by a low carbon footprint.

More recently, a new governance agenda has emerged within the building sector, with increased attention to instruments that rely on self-organization among concerned actors and that encourage voluntary compliance over regulatory enforcement: certifications and classifications, informative measures, financial instruments, and different kinds of accelerating or bridging interventions. In an analysis of new mechanisms to govern a low carbon transition in the building sector in Australia, Asia-Pacific, and Europe, Van der Heijden (2016) delivers a rather bleak outlook: the new wave of instruments exhibits the same limitations as traditional ones do, and do not advance a large scale transition to low carbon buildings. The instruments under study in Van der Heijden's (2016) analysis were geared toward frontrunners and failed to "explore how they can move from leaders to other players in the construction and property sectors." (p. 582) and further "At the end of the day it is relevant that the masses make a change, and not the leaders only." (p. 582)

Academic research on transitions in the building and construction industry has picked up in recent years. Since Rohracher's (2001) early contribution to the technical transition to sustainable construction practices from a socio-technical perspective, the scientific body of literature focusing on this issue has developed (see e.g., Fastenrath & Braun, 2018; Harrington & Hoy, 2019; P. W. Newton & Rogers, 2020; O'Neill & Gibbs, 2020; Passer et al., 2020). While Rohracher (2001) stated that the composition and characteristics of the sector – highly fragmented, cost-dependent, and labor-intensive, with a low innovation rate and strong market influence among incumbent actors – makes it inherently resistant to change, recent research has, besides this, also pointed to a lack of collaboration and interaction between actors throughout the building and construction process (Hürlimann et al., 2022; P. W. Newton & Rogers, 2020). Further, as stated by the IPCC (2022), current obstacles to decarbonizing the building and construction sector are the lack of institutional capacity, organizational context, and appropriate governance structures.

Fastenrath & Brown (2018) and O'Neill & Gibbs (2020) look specifically at less successful cases of transitions in the building and construction sector in Brisbane (Fastenrath & Braun, 2018) and the UK (O'Neill & Gibbs, 2020). In Brisbane, the slow-paced transition was found to depend on three main issues: i) the presence of a policy-industry lock-in, in which both sides considered the other to be the appropriate first-mover, ii) limited presence of bottom-up initiatives and lack of change agents at this level, resulting in difficulties to scale up niche innovations, and iii) strong opposition to change from existing market actors, i.e., 'regime resistance' (Fastenrath & Braun, 2018). Along similar lines, O'Neill & Gibbs (2020) argue that

[7] Defined in this thesis as all building construction, including new buildings and facilities as well as the renovation, repurposing, or extensions of existing buildings and facilities. Further, it includes the operations and maintenance of existing buildings and facilities

regime actors likely contributed to hindering a transition from taking place in the UK by promoting solutions that required low levels of system change.

Considering the barriers found in these papers, realizing sustainability transitions within the building and construction sectors arguably depend more on social aspects (e.g., organizational, institutional, and political aspects), rather than technical ones (Häkkinen & Belloni, 2011; P. W. Newton & Rogers, 2020; O'Neill & Gibbs, 2020).

Existing literature has attempted to provide some guidance on necessary features for successful sustainability transitions in the building and construction sector. In an early contribution, Hill & Bowen (1997) introduced a number of process-oriented principles to reach sustainable construction. Many of these are still highly relevant and are reiterated, and to a certain degree updated, in more recent studies. Amongst others, they include: involving all relevant and potentially affected actors, not only frontrunners (Van der Heijden, 2016), promoting interdisciplinary collaborations and multi-stakeholder partnerships (Fastenrath & Braun, 2018; P. W. Newton & Rogers, 2020), applying a holistic life-cycle approach which accounts for both embodied and operational GHG emissions (Passer et al., 2020), and adopting clear and transparent targets, objectives, evaluations, and adaptions to manage progress (Harrington & Hoy, 2019). Introducing carbon budgets for projects or building complexes as design targets (Passer et al., 2020), and using carbon accounting instruments that go further than existing (national) requirements and reporting schemes (P. W. Newton & Rogers, 2020) are other recommendations to spark transformative change in the sector. As one may notice, some of these aspects recur throughout the wider body of literature on sustainability transitions in general, and TM in particular.

Depending on the openness of regime actors towards transformative change, they can serve as either 'transition agents' (facilitators) or 'transition detractors' (obstructors) (Fastenrath & Braun, 2018). This calls for a better understanding of the ideas, motivations, and visions of such actors (Fastenrath & Braun, 2018; O'Neill & Gibbs, 2020). Further, while the building sector has received increasing attention in the academic literature on transitions, in-depth analyses on the urban scale are still scarce (Fastenrath & Braun, 2018). This is important, as approaches to low carbon transitions in this sector not only vary across locations and climates, but the local context also determines the conditions for what level of transition is possible. Acknowledging the place dependency of urban scale low to zero carbon building transitions can therefore help paint a more detailed picture of the transition process under study, and thus merits further investigation (Fastenrath & Braun, 2018).

As described above, collaboration and multi-stakeholder partnerships are key to transformative change in the building and construction section. In the text below the network of LFM30 is presented.

4.2 Case study: LFM30

LFM30 is a local industry-led climate initiative and network to accelerate the transition to a climate-neutral building and construction sector[8] in Malmö and to promote the implementation of Agenda 2030 (LFM30, 2019b). LFM30's mission is to serve as a geographical testbed for experimenting with measures that promote climate neutrality within the sector (Holmgren et al., 2022). Further, it complements the roadmap for fossil-free competitiveness in the building and

8 Includes all new construction of buildings and facilities, as well as renovation, repurposing, building extensions, maintenance and operations of buildings and facilities (LFM30, 2019b)

construction sector that has been set up nationally and works together with other climate initiatives on local, regional, and national levels (Holmgren et al., 2022).

To understand the context of LFM30, this section begins by presenting key characteristics of Malmö in relation to the building and construction sector. Some of the events leading up to are then shortly outlined. Lastly, an overview of LFM30 and the organizational structure of the network is presented.

4.2.1 A primer on Malmö – home to LFM30

Malmö is a Swedish city located at the southern tip of the country. With a population of just above 350 000 people it is the third-largest, and the fastest-growing large city (>200 000 inhabitants) in Sweden (Malmö Stad, n.d.-a). In the past half-century, the city has gone through a transformation from an industrial to a post-industrial city, where jobs focused on goods manufacturing have been replaced by those that provide services (Malmö Stad, n.d.-c). In particular, Malmö has attracted a lot of IT- and game-developing companies, alongside other kinds of service-providing companies (Malmö Stad, n.d.-c). The transformation has also resulted in an influx of on the one hand younger people (20-25 years old), and on the other hand people with higher educational backgrounds (Malmö Stad, n.d.-c).

Table 4-1. Key characteristics of Malmö

Location	Southern tip of Sweden, region of Skåne
Population in 2021	~350 000 people
Expected population by 2031	~400 000 people (about 15 % increase from 2021)
Future building and construction demand	28 500 new homes in the coming 10-15-year period
Share of Malmö's GHG emissions from the building and construction sector	~20 percent
Climate goals for the building and construction sector	Climate-neutral by 2030 (same as LFM30)

Source: LFM30 (2019b); Malmö Stad, (n.d.-a, n.d.-b); Stadsbyggnadsnämnen, (n.d.)

The shift from an industrial to a service-based city has coincided with a growing track record within urban climate efforts and the city has been globally recognized for its sustainability-oriented development approach[9]. This is seen in several urban development projects within Malmö. At the beginning of the 2000s, while hosting the housing exhibition Bo01, Malmö developed a new city district in the Wester Harbour with an ambitious environmental profile, including renewable energy generation and rainwater recycling systems, as well as attention to green spaces and promoting biodiversity (*Bo01, Malmö, Sweden*, n.d.). Two more recent high-profile urban sustainability projects in Malmö are Ekostaden Augustenborg and Sege Park.

[9] Amongst other: Sustainability named Tree City of the World by Food and Agriculture Organization of the United Nations (FAO) in three consecutive years (2020-2022), Urban Mobility Planning Award in 2016, named one of the most innovative cities in the world according to the Organization for Economic Cooperation and Development (OECD) in 2015, the European Commissions' European Green Capital finalist in 2012 & 2013 (Malmö Stad, n.d.-d, 2022)

By 2031, Malmö is expected to host almost 400 000 people (Malmö Stad, n.d.-b). The ongoing and predicted population growth will require thousands of new homes, new services, and expanded infrastructure throughout the city. For the past ten years, however, an average of 1 900 homes have been built each year, while the population has increased by about 5 000 (Malmö Stad, n.d.-b). This has led to a rather large housing deficit. As a response, the city is planning for 28 500 new homes in the coming 10-15 years (Stadsbyggnadsnämnen, n.d.). Further, demand for renovation and repurposing of both housing and commercial buildings will contribute to more construction projects within the region (Stadsbyggnadsnämnen, n.d.)

The building and construction sector contributes to approximately one-fifth of Malmö's total carbon footprint (LFM30, 2019b). Next to energy and transport, building and construction is one of the major contributors to GHG emissions in Malmö and has been selected as a prioritized area for climate action within the city (LFM30, 2019a). Taken together, meeting new and growing construction needs while rapidly reducing GHG emissions from the building and construction sector, as outlined in LFM30 (see below), is set to be a challenging task.

The local government has therefore recently reviewed and adopted a goal for urban development, that "Malmö by 2030 will be Sweden's most environmentally friendly and efficient city.", and further "All building and construction shall be characterized by long-term thinking, smart energy solutions, and materials adapted to the surrounding environment" (LFM30, 2019a, p. 2). The City of Malmö, through the urban planning office (Swedish: Stadsbyggnadsnämnden), has also adopted its own strategy for climate-neutral building and construction in the city (Stadsbyggnadsnämnen, n.d.), which corresponds closely with the aim of LFM30.

4.2.2 Background to LFM30

In 2018, Fossil Free Sweden (Swedish: Fossilfritt Sverige), a Swedish Government-backed initiative to support Swedish industries to become climate neutral by 2045, published a roadmap for a fossil-free and competitive construction and civil engineering sector in Sweden (LFM30, 2019b). The roadmap was established by Fossil Free Sweden in collaboration with The Swedish Construction Federation and a group of industry actors and formulates specific targets for the sector. By 2030, the industry is expected to have reached a 50 percent reduction in GHG emissions, compared to 2015 levels. By 2045, net-zero GHG emissions are to be achieved (Fossilfritt Sverige, 2018).

At the same time, an initial probing was conducted by the City of Malmö to explore ways to implement the national strategy for a climate-neutral building and construction sector on the local level (LFM30, 2019b). Among others, Sustainable Construction South (Swedish: Hållbart Byggande Syd), a member association for promoting environmentally conscious construction in south Sweden, took part in these initial dialogs (LFM30, n.d.-b). This sparked further discussions among actors in Malmö, which ultimately led to establishment LFM30.

4.2.3 Structure of LFM30

LFM30 was launched in May 2019 and brings together actors from the entire building and construction value chain in a network setting; developers (public and private), contractors, consultants (technical, engineers, architects), material suppliers, transport and delivery companies, energy suppliers and resource management companies, and banks, as well as NGOs, academia, and other relevant stakeholders. It is managed by participating industry actors, in close collaboration with the City of Malmö, NGOs, and academia (LFM30, 2019b). As of 9 April 2022, 202 actors were part of the initiative (LFM30, n.d.-c). Figure 4-1 shows the number of participating actors per actor group, according to the classification used by LFM30. Not surprisingly, actor groups central to the building and construction sector (e.g., developers and

property owners, contractors, and material suppliers) have stronger representation than those that are not (e.g., banks and transport and delivery companies).

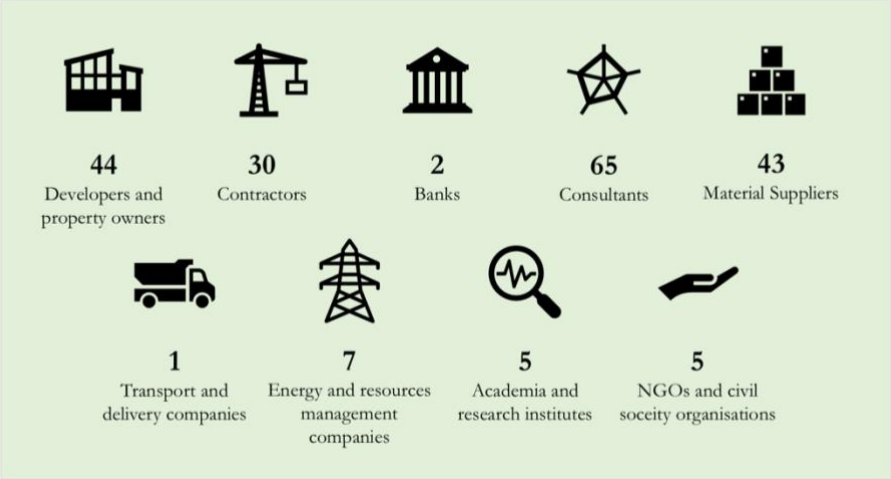

Figure 4-1. Number of participants in LFM30, per actor group

Source: Own illustration, based on data from LFM30 (n.d.-c)

When becoming a member of LFM30, actors are obliged to sign the *LFM30 climate promise*, "To implement Malmö's roadmap and objectives for a climate-neutral building and construction industry in our own organization or business" (LFM30, 2019a, p. 4). This pledge of reaching climate neutrality by 2030 is significantly stricter than the national one (climate neutrality by 2045) (Fossilfritt Sverige, 2018). To achieve this, all actors participating in LMF30 agree to take actionable steps toward climate neutrality and to continuously measure and communicate their progress transparently and according to a reference guide established within LFM30. Climate neutrality is defined within LFM30 as when the sum of emissions, expressed as CO_2e and calculated based on life-cycle analysis (LCA), and the sequestration of emissions, by nature or technical solutions, is zero (i.e., net-zero). When the sum is larger than zero, climate neutrality can be reached by compensation of at least the corresponding amount of GHG emissions (Holmgren & Erlandsson, 2022). A novel method for climate calculations has been developed for this purpose, in close collaboration with academia (see more in Section 5.4). A core principle of LFM30 is technical and material neutrality (Holmgren et al., 2022), meaning that potential emissions reductions, and not preferences, should guide decisions and implemented actions.

The overall ambition of LFM30 is to gradually thoughted the requirements that must be met by the participating actors, i.e., a step-by-step approach to lower the climate impact from activities related to building and construction processes, while simultaneously promoting continuous learning (Holmgren et al., 2022).

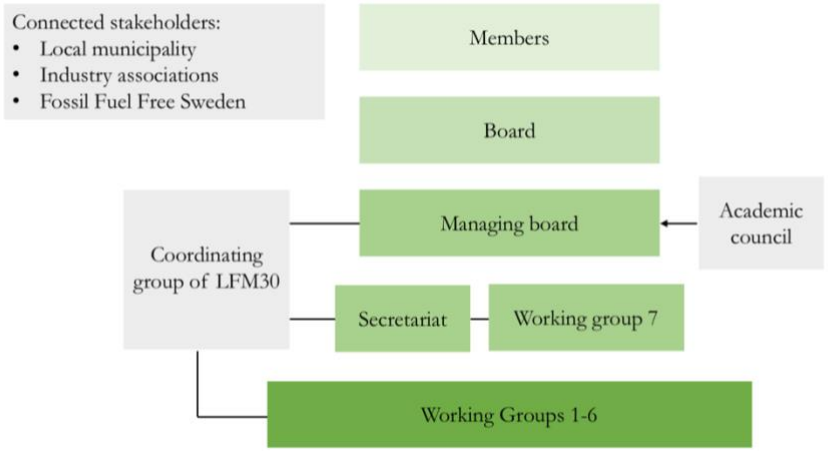

Figure 4-2. Organizational structure of LFM30

Source: Own illustration, based on LFM30 (n.d.-a)

The organizational structure of LFM30 is presented in Figure 4-2. The participating actors, i.e., the members, have collective decision-making power. The operational work of LFM30 is managed through its secretariat and the management board. Further, much of the practical work within LFM30 is conducted in working groups and their committees. The working groups correspond to six strategic focus areas established from the start of LFM30, all with objectives attached to them (LFM30, 2019b). Selected objectives for each focus area are presented in Figure 4-3. Each of the working groups is headed by a group leader from one of the developers participating in the LFM30 and includes a representative from academia (so-called topic expert). An additional working group – Working Group 7: *knowledge and communication*, was set up at a later stage, meaning a total number of seven working groups are currently operating.

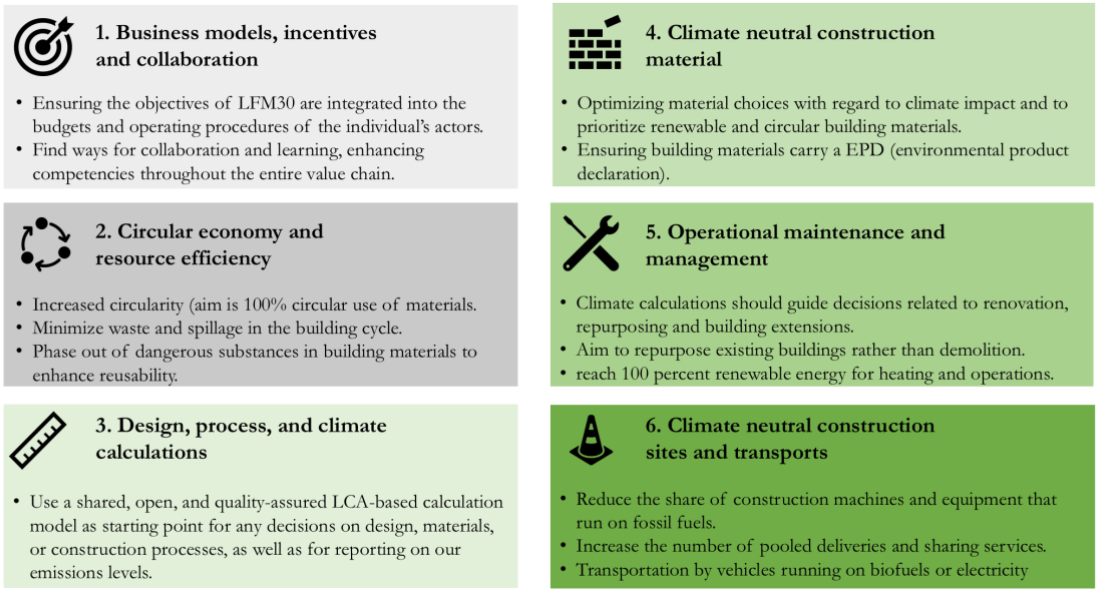

Figure 4-3. Six strategic focus areas (and working groups)

Source: Own illustration and elaboration, based on data from LFM30 (2019b)

5 How LFM30 promotes a climate-neutral building and construction sector in Malmö

This chapter presents the findings and analysis of the collected data throughout this thesis project, using the TM framework presented in Section 2.3. The findings are categorized and presented following the four concepts of the theoretical framework (collaboration, shared vision, experimentation, and learning) the key elements that have been identified for each concept (Section 5.1 – 5.4). This structure aligns with the four RQs that this research seeks to answer:

RQ1: How does LFM30 support *collaboration* among participating actors?

RQ2: How does LFM30 contribute to a *shared vision* among participating actors, and how do actors incorporate the shared vision in their organization?

RQ3: How does LFM30 facilitate *experimentation* among participating actors, and how do actors take part?

RQ4: How does LFM30 stimulate *learning* among participating actors, and how do actors include learning in their organization?

Further, a section on three other factors highlighted by the collected data material as important for the (in)ability of LFM30 to drive transformative change (Section 5.5) is included. Further, a synthesized summary of the results relating to each RQ is found in Appendix VII

5.1 Collaboration

Collaboration rests on the idea that certain complex problems can be better solved by joint efforts than by separate ones (Grin et al., 2010). In TM, collaboration among actors from different fields and sectors is emphasized to successfully deliver sustainability transitions (Köhler et al., 2019; Loorbach et al., 2015). This section presents how LFM30 supports collaboration among participating actors related to the key elements of collaboration that were found in TM literature, and which are listed in table 2.4. As this thesis focuses on the network aspects of LFM30, collaboration is given a central role in the analysis. Hence, features of collaboration will also reappear in the sections on shared visions (5.2), experimentation (5.3), and learning (5.4).

The power of a strong network – cooperation over competition

In this study, LFM30 is understood as a local network for accelerating action within the building and construction sector in Malmö. As stated by one of the respondents, the importance of collaboration to drive change is central to LFM30:

> "A cornerstone in LFM30 is an ambition to make a difference, to make a difference right here and right now, and we believe that this is best accomplished together." (Respondent 4, 22 March 2022).

The unique structure and size of the LFM30 network is mentioned by several respondents (Respondents 1, 2, 6, 7, 8, 10 & 11-2). LFM30 has successfully managed to achieve a broad representation of actors across the building and construction value chain who have powerful positions to influence the development of the sector (Respondent 6), and who all promise to work towards LFM30's overall vision and goals (Respondents 2, 7 & 10). Further, all necessary actor groups are participating in LFM30 (see Section 4.2.3), even those that usually are not represented in these contexts (Respondent 10). The actors who develop and own property have,

however, been given a central role in LFM30, which is due to their central position in the building and construction value chain. This setup tells the developers 'if you do not do it – nothing will happen' (Respondent 10).

A few respondents stressed that the solutions and measures required to reach climate neutrality in the sector are too complex for a single actor to deliver and call for collaborative action (Respondents 1 & 10). Without LFM30, many of the actors across the building and construction value chain in Malmö would not have met, and not had the opportunity to discuss climate efforts within the sector (Respondent 1). This is especially true for organizations acting **on** the periphery of the building and construction sector, such as producers of specific building components or providers of certain services. Within LFM30, these actors have found a channel to connect with developers and contractors, who are more central actors in the sectors (Respondent 1).

In practice, much of the work in LFM30 takes place in the six working groups, each for one of the six focus areas (see Section 4.2.3), and their committees (in total about 30) (Respondent 5). Hence, it is here much of the exchange between actors occurs. A coordination group has also been established to oversee the work of the working groups, meeting once a month (Respondents 1 & 8). The coordination group aims to ensure alignment between the working groups and the LFM30's overall goal. The ambition is to make this a dynamic and iterative process: the coordination group discusses broader issues relating to the working groups and their progress, each working group then proceeds with their work, and at an upcoming meeting reports back to the coordination group which discusses future steps (Respondent 1).

A few respondents mentioned that they have entered business relationships due to their involvement in LFM30 (Respondents 8 & 10). This indicates that LFM30 contributes to new partnerships and business opportunities among and between the participating actors. For two actors who have not yet seen such benefits, the main reason was an absence of projects currently underway in which they have had the chance to partner with other actors, not a lacking willingness to do so (Respondents 7 & 9).

Further, several respondents point out that LFM30 has managed to successfully build a culture that emphasizes cooperation, transparency, and a willingness to share knowledge among the actors (Respondents 2, 3, 4, 5, 8 & 10; Video 1). As such, LFM30 has created a rather unique ecosystem of collaborating actors across the entire sector, regardless of where in the value chain the actor operates (Respondent 4). One respondent explains this by referring to the special culture in Skåne (the region where the City of Malmö is located), which is characterized by openness and knowledge-sharing between organizations (Respondent 5). Overall, the collaborative approach within LFM30 appears to be quite rare in the building and construction sector, which is usually characterized by a high level of competition between actors (Respondents 3 & 8).

> "Developers usually focus on their own business and do not share business secrets, a lot because all surrounding actors are considered competitors. But when it comes to climate action, my experience is that it is easier for actors to work together, much because of LFM30." (Respondent 8, 5 April 2022)

To contradict this view, two respondents mention that discussions relating to costs of specific materials, actions or measures can still be quite sensitive (Respondents 8 & 11-1). However, according to one of these two respondents, this was a bigger problem at the beginning of LFM30. As LFM30 has progressed, a stronger sense of collaboration appears to have emerged (Respondent 11-1).

Finally, the main feature of LFM30 is the individual responsibility of each actor to deliver on the climate promise (Respondents 2, 5, 8, 9 & Holmgren, 2021), see more in Section 5.2. One challenge of adopting a structure of actor responsibility is to ensure all actors contribute to their fair share of advancing LFM30 (Respondent 5) while keeping in mind that active participation is voluntary and that no single actor can be forced to spend time on developing LFM30 (Respondent 8). Participation solely as a symbolic action, i.e., greenwashing reasons, is mentioned as a real problem (Respondent 8). It is stressed that the level of ambition and participation among actors differs and that there are actors whose size and media exposure (from participating in LFM30) do not reflect their practical contribution to advancing LFM30 (Respondent 5). Personal relations, stimulating discussions, and learning, together with new business possibilities arising from active participation are suggested to create an environment where every actor takes their fair share of responsibility going forward (Respondent 5).

Providing social and physical space to act together

Another benefit from LFM30 appears to be that individuals focusing on climate issues within the participating organizations have gained a forum for discussing and acting together. Several respondents stress that there was a need for a collaboration platform before LFM30 and that LFM30 has provided the sector with precisely this (Respondents 2, 4, 7, 8, 9 & 10). For instance, respondents mention new collaborations with partners in ways they would not have done otherwise (Respondent 7) and that LFM30 has opened new doors for contacting a colleague within the sector (Respondent 8). The exact forms of contact between actors vary, but it is evident that LFM30 has established a focal point for discussing and working with issues related to emissions reductions in the building and construction sectors. Two respondents provided a clear example of the need for a physical space to discuss challenges in the sector, and how LFM30 contributes to this (Respondents 10 & 11-1):

> "I went to Brussels to represent LFM30, on an invitation by material producers in Europe. They wanted to get a report on what is happening in Malmö, within LFM30. They said: 'As producers, we invest a lot of money in research and development, but we do not know which issues to solve because we are not present at the table when the issues are discussed'. They want to move from being a 'material provider' to 'solutions providers'. But the current barrier is that they are not involved in the process. If you can create that involvement, you have won a lot. For example, within LFM30 we are now discussing how material producers can become these solutions providers." (Respondent 10, 6 April 2022)

> "Understanding how our customers work is a very positive effect of participating in LFM30. Usually, it can be quite difficult to understand their dilemma and challenges. Now, instead, we get to understand and discuss their problems, and can contribute to creating solutions and services that make their operations better and more efficient." (Respondent 11-1, 28 April 2022)

Another important aspect is the role of the individuals working in the participating organizations in driving transformative change. One respondent stresses the critical role of individuals within the participating organizations and states that LFM30 is viewed as a valuable platform for these individuals (Respondent 4):

> "LFM30 is like a popular movement, nothing comes from the top. Instead, it is driven by individuals who manage and advance these issues in their respective organizations, and who feel that LFM30 contributes to synergies and the opportunity to reflect upon what other actors in the sector are currently doing." (Respondent 4, 22 March 2022).

However, one respondent argues that more work is needed to build a network with strong enough personal relationships for people to contact each other with minor questions or for informal knowledge-sharing purposes. This has improved, but there is still a way to go before they are comfortable enough to pick up the phone and call another individual within the network (Respondent 2).

A common view from the respondents is that LFM30 depends heavily on the commitment of individuals within the participating actors, from individual enthusiasts (Respondents 1, 4, 5, 7, 8, 9, 10 & Video 11). This is both a strength and a challenge to LFM30. On the one hand, it appears as if LFM30 has been very successful in establishing a willingness to contribute and promote change among the participating actors and individuals within these organizations. Relating to TM literature, LFM30 has been able to create a space for empowering individuals to drive collective action toward a low to zero-emission building and construction sector. As a few respondents note, if people engage voluntarily in the network, they are likely to want something out of it (Respondent 10).

> "I'm being pushed to keep going. It is like if you have cycled uphill for 20 years, and you reach the top and start going down, it starts going fast. There are people cheering me on and more actors that join [LFM30], but at some point, you need to put a lid on the ketchup bottle. It's a lot, but it's fun." (Respondent 5, 23 March 2022)

On the other hand, relying on individual enthusiasts can be problematic, and several challenges are reported by the respondents. First, it is difficult for the individuals to fully commit and prioritize LFM30 over other (more pressing) tasks (Respondents 9, 10 & 11-1). Second, it is difficult to control and manage participation, as individuals change jobs, take parental leave, or simply quit their involvement in LFM30. This increases uncertainty and makes it harder to ensure that deliverables are finished on time and that progress is made (Respondent 4). Third, there is an inherent imbalance in work efforts, where some individuals end up doing a lot more than others (respondent 8). Fourth, a small number of people are very important for the progress of LFM30 (Respondents 4 & 7). Hence, despite the large total number of actors participating in LFM30, there is still vulnerability to losing key individuals (Respondent 4).

This shows the dynamics between a difficulty to ensure commitment and a network characterized by strong commitment. According to Respondent 10, this is a complex contradiction that is often present in collaborative networks such as LFM30. An understanding of these conditions and that efforts within LFM30 might take time is therefore important. Further, the solution is probably not to hire more people or give people compensation for their efforts, but to continue to build a collective acceptance that everyone invests time for their benefit and the greater good (Respondent 10).

Opportunity to influence – main driver for joining LFM30

From the interviews, several factors were mentioned for why actors choose to participate in LFM30. Strengthening the company's strategic position in the market was the most common factor (Respondents 3, 6, 7, 9, 11-2), followed by the opportunity to contribute to, and influence, developments in the building and construction sector that are provided by LFM30 (Respondents 3, 6, 9, 11-2). Although not explicitly stated, gaining an opportunity to affect the political and market arena in a way that is beneficial for the own business appears to be an important driver for joining LFM30.

> "The biggest reason for being involved is this: either we participate and have the chance to influence and respond to future developments, or we stand on the sideline and observe, and instead see ourselves falling behind." (Respondent 6, 30 March 2022)

Other factors for joining LFM30 included the opportunity to learn from other actors (Respondents 7, 9 & 10, 11-2) and to collaborate with peers across the value chain that share the same attitude (Respondents 3, 8, 10 & 11-2) A few respondents also mentioned that LFM30 is action-oriented (Respondents 3 & 8), because several customers had joined (Respondents 7, 11-2), as well as the opportunity to lower costs (Respondent 3) as reasons for participating in the network.

5.2 Shared vision

The second area of interest in this study is to what extent LFM30 succeeds in establishing a shared vision among participating actors, as well as (if and) how individual actors integrate LFM30's vision into their own organization.

Creating a joint problem definition

The first step to forming a shared vision is to create a joint problem definition and a common direction, i.e., making sure all participating actors agree on why a sustainability transition is required and what the transition entails (Loorbach et al., 2015). This should be done by a *transition arena*, a small number of purposefully selected actors with a high willingness to drive transformative change (Loorbach et al., 2015).

In the early stages of establishing LFM30, beginning in December 2018, a core group was formed consisting of a small number of companies from the building and construction and the City of Malmö (Respondents 2, 4 & 5). The City of Malmö served as a facilitator of these preliminary discussions and the other actors – larger developers and contractors with a strong presence in the Malmö geographical area – were invited based on prior dialogs and previous interest in the issue (Respondent 2). In total, a group of 5-6 actors formed the initial constellation for establishing LFM30 (Respondent 4). Within this group, it also was evident actors were curious and willing to try a path without knowing where they would end up (Respondent 2). This group of actors can be recognized as LFM30's initial transition arena, and the selection was seemingly purposeful. Getting these actors on board was a crucial factor, together with considering which actors are important for other actors to have in the room for the discussion to be fruitful (Respondent 2). From the understanding of the researcher, the actors that participated at the early stage were all considered 'regime' actors. While this is not necessarily an issue, the TM framework emphasized that transition arena actors should be willing to challenge the status quo, and that regime actors might be reluctant to take on such a role (Grin et al., 2010). However, the actors in the transition arena that instigated LFM30 appear to have been frontrunners, and to have shared a willingness to push for change (Respondents 2 & 4). One example of this comes from Respondent 2, who described one of the actors in the transition arena:

> "One actor has a clear idea of how important this shift [to climate neutrality] is. [The actor] was a good motivator and made a big difference in offering meeting space and facilitating the early efforts. We would have not been where we are without this person." (Respondent 2, 18 March 2022).

Using a snowballing technique, more and more actors were invited to a series of workshops and further discussions to help establish LFM30. Simultaneously during this process meetings were held with the political leaderships (local government) in the City of Malmö (Respondent 2).

When LFM30 was launched in May 2019, there were about 30 participating actors (Respondent 2). The group of companies affiliated with LFM30 when it was launched can be viewed as a second transition arena. By then the transition arena had grown larger but most likely still consisted mainly of frontrunners who were committed to transforming the building and construction sector.

With the transition arena established, the next step would be to develop a joint problem definition and a long-term sustainability (transition) vision. To understand how this was established in LFM30, it is necessary to consider the processes leading up to LF30. The background to LFM30 was several discussions on how to scale down Fossil Free Sweden's national action plan for a climate-neutral building and construction sector to the local level, i.e., the geographical area of Malmö (Respondent 5). These discussions were arranged by the organization 'Hållbart Byggande Syd' (Respondent 5). Among others, an open seminar on construction with wood was arranged, which caught the attention of Malmö's director of city planning (Respondent 5). This sparked an informal investigation by the city planning office to study if Malmö should adopt a wooden-building strategy as a measure to reduce GHG emissions from the building and construction sector (Respondent 2, 5). The conclusion was that any efforts to mitigate GHG emissions in Malmö should focus on the entire building and construction sector and all available materials, i.e., be technology-neutral, rather than focus solely on how to increase the share of wood in construction and building projects:

> "[There was a] need to link our strategy to what we wanted to address. We want to address carbon emissions, regardless of material. We want to use materials in ways that reduce our environmental impact. And we had missed an emission source the size of Malmö's entire transport sector, and that is very serious." (Respondent 2, 18 March 2022).

It seems as if the overarching problem definition was established early in the process of initiating LFM30. From the start, it was clear that the focus was on reducing GHG emissions from the building and construction sector, which had previously been overlooked within the City of Malmö. Hence, the problem definition was not discussed in-depth within the transition arena, as is advised in the TM framework (Loorbach, 2010). Discussions among the actors involved in the transition arena had, however, already taken place before the LFM30 transition arena. This appears to have contributed to a joint problem definition, and a strong common belief among the participating actors that their efforts can contribute to solving the problem, despite limited de-facto discussion in the transition arena.

Long-term sustainability vision

Next, the transition arena should also establish a long-term sustainability vision. In the case of LFM30, the long-term sustainability vision can be considered to correspond to the aim: a climate-neutral building and construction sector in Malmö by 2030. This vision appears to have been pre-determined when discussions in the transition arena began and was not a result of deliberation among the actors in the transition arena (Respondent 2). Rather, it was based on that the City of Malmö had signed Agenda 2030 and the Paris Agreement, in an attempt to convert the Paris Agreement to the local context (Video – LFM30 explainer). As pointed out by one respondent:

> "The aim was 'non-negotiable'. It was climate change that set the aim for LFM30." (Respondent 2, 18 March 2022)

Hence, no process for developing a long-term sustainability vision appears to have been present in the transition arena. But establishing LFM30 relied on the transition arena accepting this aim

as the 'shared vision'. When asked what they thought of the vision, actors in the transition arena responded positively (Respondent 4). Hence, the transition arena served as a kind of pressure test confirming that the proposed aim was appropriate and that the actors within the transition arena were ready to adapt it (Respondent 2).

The vision of LFM30 focuses on climate change and the reduction of GHG emissions in the building and construction sector. While not necessarily being an issue of concern, this one-sided emphasis on one aspect could increase the risk of overlooking other aspects of potentially equal or higher importance (Respondent 11-2). This is an inherent trade-off when seeking to reach ambitious results within one area. But it requires deliberation to avoid a situation where improvements in one area/aspect lead to (too) big negative effects in another area.

Joint objectives, targets, and short-term goals

To complete the forming of a transition strategy, joint objectives, targets, and goals need to be determined. According to the TM framework, this is done by developing transition pathways and transition agendas (Loorbach, 2010) (See also Section 2.3.2).

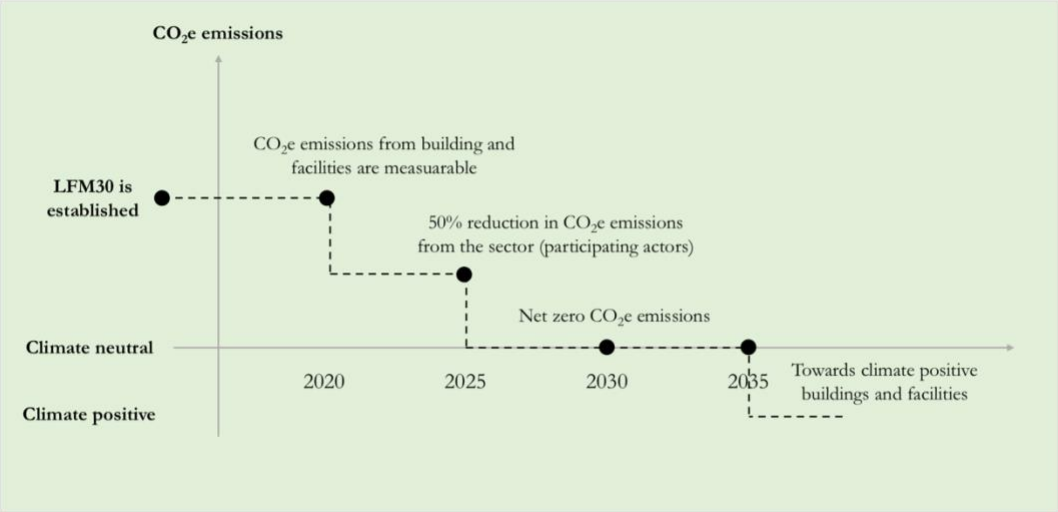

Figure 5-1. Overview of LFM30's climate promise

Source: Own illustration, adapted from LFM30 (2019b)

When establishing LFM30, setting up objectives, targets and short-term goals seems to have been where most of the discussions took place. When the participating actors had agreed that GHG emission mitigation in the building and construction sector was needed, and that collaborative action would create a greater impact, the questions changed from what, and why to how. Crucial questions were how to set up targets and objectives, how to establish a structure to manage efforts towards these short-term goals, and the requirements for each actor participating in LFM30 (Respondents 2 & 4). The main outcome of the discussions on the 'how'-issues was the so-called LFM30 *climate promise* (see figure 5-1). Hence, the climate promise can be understood as LFM30's *transition agenda*. According to one respondent, LFM30's climate promise is unique in its clear ambition to promote actionable measures:

> "The foundation of LFM30 is that it is action-oriented. Therefore, it was important to get the climate promise in place, making sure LFM30 does not become a coffee shop for discussing and sharing information." (Respondent 5, 23 March 2022)

While the long-term aim of reaching a climate-neutral building and construction sector in Malmö by 2030 serves as the umbrella of the climate promise, the climate promise also sets out targets and objectives for getting there (LFM30, 2019b). For example, all developers should have initiated at least one climate-neutral project by 2025. This project can be for either a building or a facility and can cover new construction, renovation, repurposing, or building extension (Holmgren, 2021).

Another feature of the climate promise is the requirement for all participating actors to annually measure, report and transparently communicate their alignment with the climate promise according to the LFM30 method for climate budgeting (LFM30, 2019b). Further, detailed objectives for each of the six strategic focus areas (see Section 4.2.3) are in place to reach the climate promise (LFM30, 2019b). Here also, the fact that LFM30 has established concrete actions plans for how to transform the sector is highlighted unique feature for LFM30 compared to other similar initiatives and networks and connects to the idea of creating *transition pathways* (see e.g., Loorbach, 2010):

> "What makes LFM30 stand out, I would say, is that we have jointly mapped the 'how to', on top of setting general goals and agreeing on what needs to be done." (Respondent 11-2, 28 April 2022)

Reporting is done on both the company level (annually) and individual project level (continuously). Reporting at the company level includes information on current and future expected emissions, as well as the strategy to implement efforts to reduce CO_2e emissions (Holmgren & Erlandsson, 2022). The requirements for what to include in company level reporting are updated and strengthened each year through discussions among actors (Respondent 5).

For reporting on the project level, LFM30 has introduced a separate method to calculate and complete climate declarations of buildings or facilities. This method is called LFM30's *climate budget* (see figure 5-2). The climate budget uses a life cycle analysis (LCA)-approach but focuses on the building and usage stage meaning it includes the entire life cycle of a building or facility[10]. As set out in the method for climate budget, all LCA and climate calculations conducted within LFM30 are made according to established national guidelines and standards[11] (Holmgren & Erlandsson, 2022). Further, LFM30's close collaboration with research and academia is highlighted as an important feature for validating the applied methods and measures (Respondents 1, 5 & 10).

[10] The life-cycle of a building or facility includes the building stage (A) the usage stage (B) and the final / end-of-life stage (C). LFM30's method for climate budget focuses on stage A and B (Holmgren & Erlandsson, 2022).

[11] National board of Housing, Building and Planning standards for LCA and IVL Swedish Environmental Research Institute's certified climate calculation

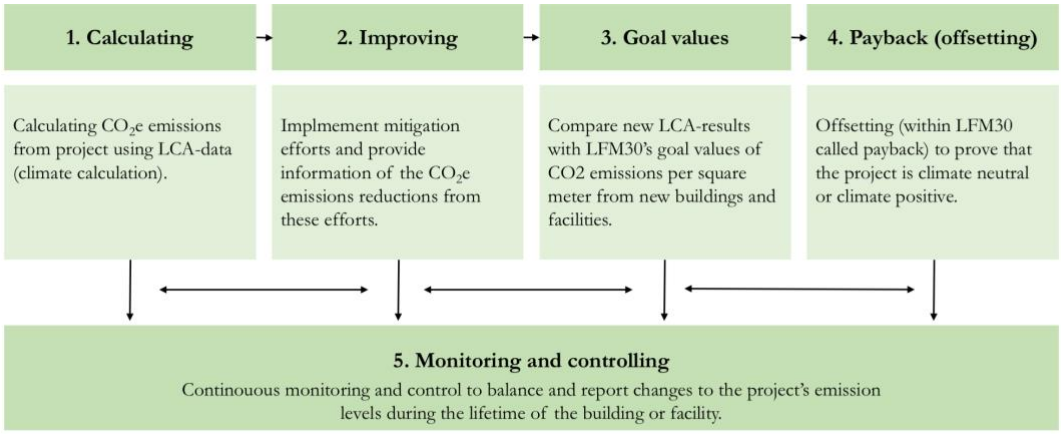

Figure 5-2. The LFM30 method for climate budget

Source: Own illustration, based on data from Holmgren & Erlandsson (2022)

LFM30's method for climate budgeting is unique as it goes beyond existing legislation. In Sweden, legislation on climate declarations only covers those buildings that apply for a building permit from 1 January 2022, i.e., new buildings[12] built after this date (Boverket, n.d.). Further, it only covers the first and second steps of LFM30's climate budget, where the second is voluntary (Boverket, n.d.; Holmgren & Erlandsson, 2022). Effectively, the national legislation therefore only mandates actors to report on GHG emissions from a project using a life cycle approach, without any requirements on mitigating those emissions, and without any maximum threshold value for emissions levels (Respondent 5). Mandatory legislative requirements for the second and third steps are not expected until 2027, but they might come sooner[13]. LFM30 has instead adopted goals values for CO_2e emissions per square meter of a building or facility based on the principle of the best available technology not entailing excessive costs, and that is set at a significantly lower level than the current average emissions from buildings and facilities (Holmgren & Erlandsson, 2022), see Appendix VII. Further, step four, payback of emissions (i.e., offsetting), can only be done once steps 1-3 have been fulfilled. This is to ensure credibility in the climate efforts of actors participating in LFM30. Also, at least 50% of the payback should be through credible CO_2e removal efforts[14], while the other half can come from payback through CO_2e mitigating efforts. However, payback of emissions will not be expected on projects started before 2025.

All in all, the climate budget developed under LFM30 for calculating and implementing efforts to lower CO2e emissions from buildings and facilities contributes to a common way of working among the participating actors. As highlighted by one respondent:

> "LFM30 sets the frame for collaboratively developing methods to ensure we calculate and measure our climate impact in the same way. This enables comparison between projects so that we compare apples and apples, and not apples and pears,

[12] Certain buildings are exempt from the national requirements of mandatory climate declaration, including buildings that will only be used for two years or less, industrial buildings, buildings smaller than 100 square meters, and buildings built by individuals for non-commercial use. Other reasons for exemption also exist.

[13] The Swedish government has recently asked the Swedish National Board of Housing, Building and Planning (Swedish: Boverket) to investigate whether mandatory threshold values could be implemented earlier than 2027 (Boverket, 2022)

[14] CO_2e removal efforts result in CO_2e being permanently removed from the atmosphere.

> where we discuss climate-optimized solutions and projects. A uniform method is required, and LFM30 contributes to that." (Respondent 8, 5 April 2022)

Integrating LFM30's vision and goals into individual organizations

Establishing a shared vision and collective goals and targets should aim to inspire actors to implement new efforts within their own operations. This was a key aspect when formulating LFM30's climate promise (Respondent 2). In LFM30, it is the responsibility of the participating actors to implement and promote actions that contribute to achieving a climate-neutral building and construction sector. Without increased efforts from the participants, no progress is made. LFM30's role, in turn, is to support such action (Respondents 5, 8 & 9). By participating in LFM30, actors promise to advance efforts in their own organizations to reach the targets. One such action is to align individual climate ambitions with the LFM30 vision:

> "It was very important that the local roadmap included a sentence stating that all actors promise to integrate [LFM30's climate promise] into their business plan, into their strategy. That they promise … to start a climate-neutral construction project by 2025 [for developers], … to be climate neutral and to be climate positive by 2035 because it is a hygiene factor for their business." (Respondent 2, 18 March 2022)

Several respondents noted that LFM30 has served as a catalyst for setting higher climate ambitions among the participating actors (Respondents 2, 4, 5, 6, 7, 9 & 10). Participation in LFM30 also appears to play a role in driving climate ambitions beyond the geographical scope of the City of Malmö. Over 50% of the organizations participating in LFM30 operate nationally. Some of these companies have adopted the same climate ambitions on the national level as for the local testbed LFM30 (Respondent 5).

How climate ambitions of individual organizations link to LFM30's climate promise differs. One actor aims to mirror the targets of LFM30 for all their operations (Respondent 6). Others have climate goals that affirm LFM30's vision but that do not align, i.e., they are not as tough as the LFM30 targets (Respondents 3 & 7). Two actors, with operations both within and outside of the geographical area of Malmö, have chosen to develop climate targets for the local scale that are more ambitious than their overall targets (Respondents 4 & 9). For these actors, Malmö has become an arena for developing and testing efforts to reduce emissions. This was also stated by another source (Video 8). The lessons from Malmö are then transferred to other geographical areas (Respondents 4, 9 & Video 8). This can result in accelerated emissions reduction within the entire organization:

> "It is not possible to advance climate action with different methods, but Malmö serves as the engine. […] What we learn in Malmö and from LFM30, affects all our operations. The solutions that we find effective and smart for Malmö are relatively quickly scaled to Lund, Helsingborg, and Copenhagen [cities close to Malmö where the actor has business]. These are the wider benefits of participating in LFM30, it drives climate efforts throughout the entire organization." (Respondent 4, 22 March 2022)

While the interview responses generally suggest that LFM30 has influenced the stringency of climate ambitions among participating actors, a few respondents note that it is difficult to determine the extent to which this can be attributed to participation in LFM30 (Respondents 7, 8 & 10), and one respondent states that their climate ambitions would have been the same regardless of their membership in LFM30 (Respondent 11-2). However, this actor includes LFM30 as an important stakeholder when mapping external stakeholder interests (Respondent 11-2). Hence, this is an example of indirect influence from LFM30 on an individual actor.

Practical actions to increase internal climate efforts also appear to be positively influenced at least in part due to participation in LFM30 (Respondents 2, 5, 6, 7, 9, 10 & 11-2). This includes introducing new positions and hiring new employees (Respondents 2 & 5), as well as acquiring new competencies (Respondent 2). Participation in LFM30 has also led to increased interest from the company's owner in climate issues and a realization of new business opportunities that emerge from new requests from the many developers participating in LFM30 (Respondent 5). Further, one actor stated that LFM30 has created leverage to advance climate issues internally and externally, and that participation has impacted their business strategy (Respondent 10).

A few respondents also note that not only the approach for integrating LFM30's vision and goals into the individual organization differs among participating actors, but also the extent to which the actors understand LFM30's vision and what it means to participate in the network in terms of how transitioning to a climate-neutral building and construction sector will affect their business (respondents 3 & 7). As suggested by a few respondents, some actors still might not know why they are participating in LFM30 (Respondents 7 & 11-2). Further, for actors operating nationally, their national climate ambitions and goals might be prioritized over the ones set out in Malmö, resulting in conflicting aims and potential trade-offs (Respondents 4 & 11-2). Another respondent is a bit suspicious of the fast increase of actors joining LFM30 and to what degree new actors adopt the goals and targets of LFM30 (Respondent 2). Although certain actors might be slower to align their own operations with LFM30's vision, the overall impact of LFM30 on the participating actor's climate ambitions is suggested to be positive (Respondents 4 & 5). A reflection from one of the respondents on how to improve the feeling of a common vision among the actors was to as often as possible repeat LFM30's purpose and overall vision, and to connect it to the Paris Agreement, the Agenda 2030, and Fossil Free Sweden's national roadmaps (Respondent 10).

> "The vision and goals of LFM30 are clear, but we must always remember to highlight them at the beginning of every meeting and activity." (Respondent 10, 6 April 2022)

5.3 Experimentation

Experimentation is about exploring future pathways by facilitating high-risk innovations, with the ultimate goal of moving towards a transition (Grin et al., 2010; Loorbach, 2010). This section presents findings on how LFM30 facilitates experimentation among participation actors and gives examples of some of the experiments mentioned in the collected material.

Facilitation of, and actor participation in, experiments

A few respondents explicitly note that LFM30 is pushing experimentation within the building and construction sector (Respondents 5, 7 & 9). According to one respondent, LFM30 is at the forefront of the sector in terms of discussing and implementing (new) actions to mitigate GHG emissions from building and construction projects (Respondent 5). During the first year, LFM30 relied on already established methods and practices but has now evolved to take a leading role in accelerating climate action within the sector. However, the position as a frontrunner is temporary and could change going forwards (Respondent 5).

One way of facilitating experiments is by opening new funding possibilities (Respondents 4, 5, 7 & 10). Funding providers often premiere applications displaying collaboration between research, public entities, and the private sector. By participating in the LFM30 network, it has become easier for actors to initiate and establish project groups that can jointly apply for funding (Respondent 4). Since it started, LFM30 projects have obtained funding from both Vinnova (Sweden's innovation agency) and The Development Fund of the Swedish Construction

Industry (In Swedish: Svenska Byggbranschens Utvecklingsfond, SBUF), amongst others (Holmgren & Erlandsson, 2022).

On the other hand, several other respondents note that it is difficult to determine how and to what degree LFM30 has facilitated experimentation (Respondents 2, 3, 4, 6 & 8). Two main reasons for this are mentioned. The first relates to the fact that building and construction projects are developed and executed over several years, and that the period between starting new projects can be lengthy. Since LFM30 is still quite young (it was launched in May 2019), only a limited number of large-scale experiments have materialized until today (Respondents 2, 3 & 6). For example, the fulfillment of the objective to have all developers initiate climate-neutral construction projects by 2025 cannot be evaluated as most of these projects are yet to start. Two respondents stated that they have not initiated or been involved in any such project simply because no possibility has emerged during the (short) time they have been members of LFM30 (Respondents 7 & 9).

The second aspect is the difficulty in isolating the additional effect of LFM30, i.e., if experiments were conducted because of LFM30, or if they would have happened anyway (Respondent 4, 6 & 8). Understanding experiments as high-risk innovations, only innovation projects that would not have materialized without LFM30 should be considered experiments. In most cases, it is the actors themselves that initiate and manage the experiments. Because LFM30 often has a facilitating role it is difficult to know whether the actors would have implemented the experiments without LFM30: if they would be able to gather the necessary funding, find the right partners, etc. (Respondent 4).

For understanding how individual actors take part in experimentation, it is useful to examine current or past innovation projects conducted within LFM30. As Loorbach (2010) outlines, innovations can be viewed as societal, institutional, technological, or behavioral. In this research, this classification is not used in a strict matter. Rather, it serves as a compass to discuss the different innovations found in the collected material. Here, only institutional and technological innovations were identified, and why the innovation projects discussed below within these two groups.

Beginning with institutional innovation, several such innovation projects appear to be present within LFM30. One respondent stated that the structural setup of the LFM30 network, which puts collaboration and actor responsibility at the center, is in itself a type of institutional innovation project aiming to change the processes within the building and construction sector:

> "LFM30 is a kind of process experiment, where we try to find organizational structures step by step. This type of organizational process-thinking is actually highly innovative." (Respondent 10, 6 April 2022)

This was also reiterated by another respondent, who highlighted the novelty of the organizational structure of LFM30 (Respondent 5). In LFM30, the traditional role of a program manager as responsible for both knowledge-building and project management has been split between researchers, focusing on providing the best available knowledge and information, and LFM30 member actors, who share the responsibility for managing the projects and coordinating LFM30 activities. Having participating actors engage actively in managing LFM30 and then having researchers support with knowledge-building is considered an uncommon setup. The purpose of doing so is to engage actors who are (naturally) part of the building value chain. If the activities are coordinated by such actors, compared to a third-party actor, the likelihood of practically and economically viable and replicable climate solutions increases significantly (Respondent 5). This aligns with ideas in the TM literature of ensuring experiments take place

within the network(s) of actors that were established in the transition arena (Loorbach & Rotmans, 2006).

Further, the climate promise and the method for a climate budget that has been established within LFM30 can also be considered an institutional innovation. The climate budget developed by LFM30 is groundbreaking in terms of stringency and how to work towards reducing For example, no other example of using goal values (minimum threshold) to reduce GHG emissions from new construction of buildings and facilities, as well as for renovation, repurposing, or building extension is known to the authors of LFM30's method for climate budget (Holmgren & Erlandsson, 2022). Moreover, the goal values adopted in this process (step 3, see Figure 5-2) are beyond current legislation (Holmgren & Erlandsson, 2022), pointing to the novelty of institutional innovation within LFM30. Finally, the procedure of designing, testing, and improving the climate budgeting method was characterized by continuous exchange among the participating actors (Respondent 10). This indicates that the method has been created within, and approved by, the network itself (Holmgren & Erlandsson, 2022).

The respondents also mentioned several technological experiments that have been or are currently underway. While a complete overview of technological experiments that relate to LFM30 is not possible to extract from this study, due to a limited number of interviews, several experiments where actors participating in LFM30 either lead or take part were mentioned in the interviews (Respondents 3, 4, 5, 6, 7 & 9). The experiments are conducted on various phases of the building life cycle depending on the actor's role in the value chain and differ in size, cost, and duration for implementation. Examples of experiments either finished or underway were a project for testing new cement recipes for a construction project in two areas in Malmö, Sege Park (Respondent 5) and Hyllie (Respondent 9), GPS-tracking of trucks transporting goods within the City of Malmö to find better GHG emission values to use in calculations instead of standard values (Respondent 6), a project to investigate how to improve the use of biobased materials in the building and construction sector (Respondent 4), and a project on gaining a better understanding of heat loss rates in buildings (Respondent 7).

Establishing success criteria

Establishing success criteria is necessary for determining whether the experiment significantly contributes to the transition visions (Loorbach, 2010). In LFM30, criteria have been set up for the climate-neutral projects. The criteria take the form of goal values (threshold) for life-cycle GHG emissions per square meter that projects need to reach before they can use carbon offsetting as a means to become climate neutral (see Appendix VII). Hence, these criteria are practical in their design.

Except for the criteria on goal value in the climate declarations for specific projects[15] and the criteria relating to the fulfillment of LFM30's overall goals (if LFM30 as a whole is considered an institutional transition experiment), no other success criteria were found in the collected material. For example, no criteria for assessing the level of learning from specific experiments appear to have been set up.

Scaling, deepening, and broadening of experiments

The final element of experimentation looks at how successful experiments are scaled, deepened, and broadened. Scaling, i.e., the implementation of experiments at the regime level (Bosch-Ohlenschlager, 2010; Grin et al., 2010), can be seen to be the long-term plan of LFM30.

[15] Projects include new buildings or facilities, as well as projects related to renovation, repurposing, and building extensions

However, the scaling of experiments currently appears to be limited at this stage of LFM30, and practices introduced within LFM30 have not yet become standard in the sector. The reason for this is that many experiments are still in their early stages or have not been started (Respondent 2).

The deepening of experiments occurs when actors within the local context learn from the experiment (Bosch-Ohlenschlager, 2010; Grin et al., 2010). In general, aspects of deepening experiments do appear within LFM30, through different measures to share knowledge between, and build capacity among, the participating actors. This is important for creating continuity in the implementation of innovative measures that have been found through experimentation within LFM30 (Respondent 5). Learning aspects within LFM30 are covered in detail in section 5.4. This is covered in detail in section 5.4.

One of the aims of LFM30 is to pave the way for future initiatives and networks of a similar kind (Holmgren et al., 2022). This relates to the broadening of experiments, i.e., repeating them in different contexts (Bosch-Ohlenschlager, 2010; Grin et al., 2010). For example, the discussion of adopting a model like LFM30's has taken place in other locations (Respondents 4, 5 & 10). In such cases, the institutional experiment that LFM30 represents can trigger action in another context and ultimately serve as a guide for establishing new networks in such contexts. Here, knowledge transfer through collaboration with external actors is a central function (Holmgren et al., 2022). As stated by one respondent:

> "Many other municipalities have seen LFM30 as an accelerator to also become climate neutral by 2030. It is difficult to say what is the chicken and what is the egg, and these municipalities might have had similar thoughts before LFM30, but LFM30 has become a driving force for other municipalities to speed up climate change action." (Respondent 10, 6 April 2022)

5.4 Learning

The final TM concept under study in this analysis is learning. Learning is essential in TM theory, as it is through learning and adapting that existing structures, practices, and cultures of the current societal system can be altered (Loorbach et al., 2015). Learning is also a central feature of LFM30, as its main purpose is to support participating actors in a collaborative and continuous learning process (Holmgren et al., 2022). This section presents how LFM30 stimulates learning among the participating actors and to what degree these actors engage in monitoring, evaluation, and reflection within LFM30.

Collaborative learning and capacity building

The main task of LFM30 is to support its members in capacity and skills development within each of the six sub-strategies, to help the members meet their climate promise. For this purpose, several learning spaces and activities have been established, including inspirational events where best practices are shared and discussed, internal work within the working groups relating to each of the six strategic focus areas (see Section 4.2.3), and study visits (Holmgren et al., 2022). Figure 5-3 provides an overview of the learning opportunities within LFM30.

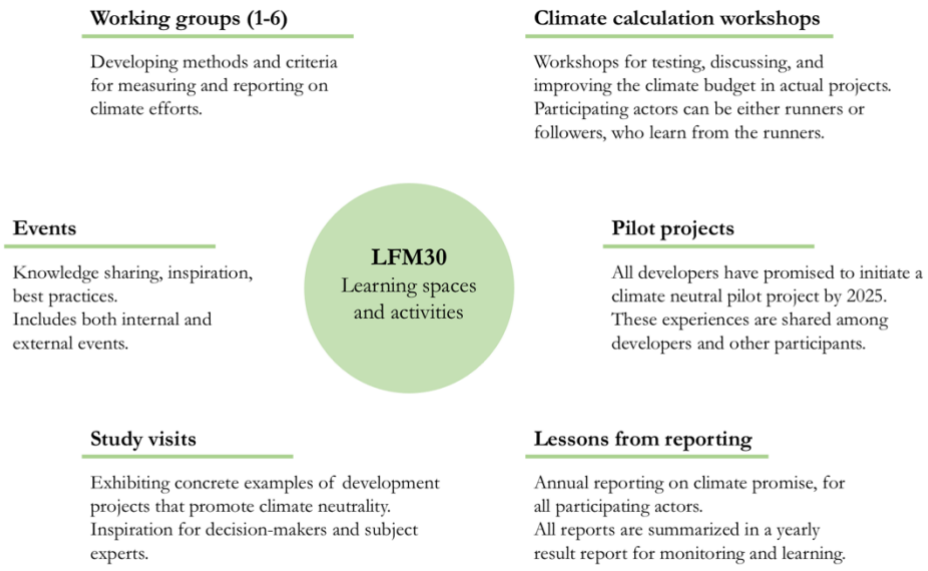

Figure 5-3. Selected learning spaces and activities within LFM30

Source: Own illustration, based on data from Holmgren et al., (2022)

Several respondents stress the value of knowledge-sharing among participants that has been enabled by the different learning spaces and activities (Respondents 4, 5, 7 & 8). According to a few respondents, LFM30 has contributed to a deeper dialogue between actors on which actions and working methods should be increased and which should not be used, or be altered, going forwards (Respondents 4, 5 &11-1).

Further, LFM30 has become an arena for gathering knowledge, prior experiences, and information in one place. Hence, previously scattered information has become more accessible (Respondents 7, 8 & 10). This is also part of the LFM30 secretariats' core mission (Respondent 1). One respondent mentions that this has led to a faster development curve than what would have been the case without LFM30, not only within the core business operations of the actors but also within other areas (Respondent 7, 10).

> "Without LFM30 we would have looked at each question isolated. For us, LFM30 is like a one-stop-shop for capacity development, within a wide range of different areas." (Respondent 10, 6 April 2022)

A few respondents point out that it is up to each actor to acquire the knowledge available within LFM30. This requires active participating, and the best and quickest way to tap into the available knowledge is to participate in one of the working groups, as it is there many of the practical discussions take place. Hence, actors who are actively involved in the working groups will have the best exchanges, learning experiences, and increased business opportunities (Respondents 8 & 10) This is a perk of investing time into LF30 (Respondent 8).

A number of practical challenges connected to knowledge sharing and learning in LFM30 were mentioned. One potential barrier is a weak willingness to share experiences among the participants (Respondent 10). Another respondent noted that participation is still not high enough for real capacity development to occur (Respondent 6). The respondent points to the low number of people present at the meetings of the working group he/she is involved in. Both

these challenges regard a type of free-rider problem. When actors participate to monitor what is happening in the sector, rather than contributing to advancing action, the level of fruitful knowledge exchange becomes more questionable (Respondents 6 & 10). However, the problem of free-riding seems to be balanced by the fact that active participation leads to a stronger learning experience and other benefits (Respondent 8). Lastly, one respondent mentioned the difficulty of establishing learning spaces and activities that suit all the actors. Here, LFM30 has the challenge to generate material that is relevant to all actors involved in the network (Respondent 11-2).

Another aspect to consider is how learnings from LMF30 are transferred internally within the participating organizations. A few respondents explicitly state that knowledge from LFM30 does trickle down into their organizations (Respondents 4, 7, 9 & 11-1). This was also highlighted in the evaluation sessions held in October 2021 (see below under Evaluating, reflecting, and adapting) (Holmgren, 2021). While none of these actors appear to have a standardized approach for internal knowledge distribution, examples of how this is done include information sharing at meetings (Respondent 11-1) and passing on seminar recordings (Respondent 9). Further, the importance of breaking down information from LFM30, making it accessible and relevant for the intended (internal) receiver, is highlighted by one respondent (Respondent 9). In terms of transferring knowledge from LFM30 into the participating organizations, the contact person in the organizations (and the ones interviewed in this study) has a crucial role in identifying and distributing relevant learning from LFM30.

Despite the many routes to learning offered within LFM30 and the efforts taken to spread knowledge and improve capacity within the participating organizations, one respondent points out that there is still a long way to go before all practitioners involved in the building construction process (e.g., LCA-specialists, procurement professionals, architects, construction planners, and project managers) become confident working according to LFM30 strategies and methods (Respondent 2). This capacity-building takes time but is underway and stimulated by LFM30.

Monitoring of transition processes and TM procedures

The first part of monitoring, i.e., monitoring transition processes is about studying general changes occurring in the societal system, and which have the potential to accelerate or slow the desired transition. In LFM30, this appears to be done primarily by participating and discussing in other forums which impact the building and construction sector. This includes Fossil Free Sweden and the Swedish Construction Federation.

The second part of monitoring, which is more in focus in this research, is related to how TM procedures contribute to goal attainment, including the transition agenda, activities, and transition experiments conducted within LFM30. In contrast to the monitoring of eternal transition processes, this kind of monitoring deals with internal procedures LFM30. The central instrument for monitoring TM procedures and the progress towards LFM30's goal, i.e., the climate promise, appears to be the annual reporting requirements. The results from this are compiled and presented at a yearly result conference, and published in an annual result report (Holmgren, 2021). Organizations that do not comply with the reporting requirements and deliver their reports on time are warned. After repeated warnings and no improvements, an organization may be excluded from LFM30 (Holmgren, 2021). Hence, the monitoring processes also lead to consequences for actors who fail to fulfill the requirements. For the reporting period 2020, four organizations failed to fulfill the requirements, and processes to exclude these actors were thus begun (Holmgren, 2021).

Overall, the result report for efforts and progress in 2020 acknowledges that efforts to measure GHG emissions from constructing buildings and facilities, adopt new policies and routines, and concrete efforts to reduce GHG emissions in their own organizations are being implemented by a majority of all participating actors (Holmgren, 2021). While some of the participating actors might have gone ahead with the efforts regardless of LFM30, the scale and speed of the current efforts would not have been possible without LFM30, according to the 2020 result report (Holmgren, 2021). This was also emphasized by some interview respondents (Respondents 3, 4 & 5). Further, as pointed out by a few respondents LFM30 has become a space for discussing current practices and possibilities to introduce new ones and thereby facilitates a shift away from the status-quo (Respondent 3, 9). In this regard it is more action-oriented than other climate initiatives focusing on the building and construction sector in Sweden:

> "What we do here leads to action, leads to something. Other initiatives can be all talking and no action, here [in LFM30] it is about both." (Respondent 9, 5 April 2022)

By requiring the participating actors to transparently report their efforts to contribute to a climate-neutral building and construction sector in Malmö the actors can be held accountable for their actions going forward (Respondents 5, 8 & 10). Further, the reported results also show how the different actor groups are performing and allow for comparison, within actor groups and between (Respondent 1). Hence, the annual reporting structure of LMF30 makes it easier to determine how the participating actors are progressing and if they are in line to fulfill LFM30's climate promise. As stated by one of the respondents:

> "Actors cannot be part of LFM30 as a greenwashing trick, there has to be proof of action." (Respondent 8, 5 April 2022)

A closer look at the results for 2020 shows that a large share of the participating actors responded to the main survey (83%). Among developers, an expected average reduction of GHG emissions (measured in carbon dioxide equivalents, CO_2e) of 29% for new construction of buildings by 2025 has been reported, compared to today (Holmgren, 2021). Assuming the same level of construction in 2025 as was reported in 2020 would then result in a nearly 60 000 tones CO_2e reduction (Holmgren, 2021). These calculations are based on several assumptions and are therefore not perfect. However, they do send a clear message that developers see rapid emissions reductions going forwards. More information on the results can be found in the result report for 2020, i.e., Holmgren (2021).

However, the result report for 2020 also notes that the LFM30 actors struggled to understand how to report on their climate promise (Holmgren, 2021). This is not too surprising, as the LFM30 reporting method is still new to the actors participating in LFM30 (Holmgren, 2021). Hence, many actors relied on the supporting efforts provided by the LFM30 managing group and secretariat (Holmgren, 2021). This was also confirmed by several respondents (Respondents 7, 8 & 10). Further, the templates were focused on developers and it was hard for other actors in the building sector to fill them out (Respondents 10 & 11-2). To address this, the result report for reporting year 2020 concluded that the reporting tools and templates need to become more intuitive and user-friendly (Holmgren, 2021). The improvements identified in the 2020 resulting report also suggest that reflection does exist within LFM30.

For reporting on the status of the climate promise in 2021, which was done during the spring of 2022[16], all reporting was conducted through a new digital platform. Some respondents answered that this was likely to make the process of both reporting and evaluating the reported results significantly easier, compared to the excel-based templates used during the first two years (for reporting on results in 2019 and 2020) (Respondents 8 & 10). This should also make it easier to follow the progress (or the inertia) of actors and actor groups in fulfilling the LFM30 climate promise.

The interviewees shed light on two other challenges relating to the climate promises of LFM30 actors. The first is the trade-off between on the one hand action and implementation, and on the other hand monitoring the results and effects of such action. It is not always clear where the emphasis should be (Respondent 4). The second is to find a reasonable level of monitoring within LFM30 (Respondents 4 & 9). LFM30 requires all participating actors to measure and communicate their progress but does not want to or have the resources to implement controls and analyses of all participants (Respondent 4).

Evaluating, reflecting, and adapting

While monitoring is crucial to determine if the desired transition is occurring and if TM procedures contribute to this transition, it is only useful if it is followed by evaluation, reflection, and adaption of what has been monitored (Loorbach, 2010). Regarding evaluation within LFM30, it is acknowledged by a respondent from the LFM30 secretariat that the evaluation and follow-up of structures and processes need to become more systematic (Respondent 1). This seems to align with levels of evaluation and reflection in the building and construction sector in general, which is suggested to, at least historically, have been quite low (Respondent 3).

LFM30 has, however, introduced a few measures for improving this. To include the participating actors in the evaluation and reflection of LFM30 practices, a set of roundtable discussions are intended to be held each fall. These discussions aim to evaluate the method for reporting on the climate promises, improve the criteria, tools, and templates used in the reporting and identify overall future improvement areas (Holmgren, 2021). Hence, the roundtables enable collective reflection as suggested in TM literature (see e.g. Loorbach et al., 2015). The first round of roundtables was held in October 2021.

One major challenge mentioned by LFM30 actors in these meetings was the difficulty in handling the demarcation of Malmö as a geographical area. The actors have different shares of operations in the City of Malmö, which is the geographical area of concern in LFM30, which has complicated the reporting process. Further, companies operating on the national level experience difficulty in integrating the national roadmap (Fossil Free Sweden's roadmap for a climate-neutral building and civil engineering sector by 2045) and the local one (LFM30) (Holmgren, 2021; Respondent 1). Other issues related to scoping and boundaries were also raised, as well as how to integrate the vision into each project plan (Holmgren, 2021).

Two practical examples where the processes for evaluation, reflection, and adaption are present when updating LFM30's calculation and reporting methods, and within the so-called climate cabins. The method document for how to calculate GHG emissions from building and construction projects, as well as existing buildings and facilities, according to LFM30's climate budget, and for how to report in line with LFM30's climate promise, are continuously adjusted and improved according to a transparent, iterative and participatory process (Holmgren &

[16] The results for 2021 were presented on the May 17, 2022. They were not included in this thesis study, as the period for data collection ended on April 28, 2022.

Erlandsson, 2022). Regarding the climate cabin, the outcomes of these programs are monitored through project-specific climate declarations. But other than providing a climate declaration, no structured processes to evaluate the efforts within the climate cabins were present (Respondent 8). For the latest program of this kind, however, processes for quality control, knowledge-sharing, and follow-up have been included (Respondent 8). This indicates that LFM30 has engaged in reflection and adaptation to improve its processes relating to the climate cabins.

Zooming out a bit, the entire structure of LFM30 has been subject to large changes since it started three years ago. Both the number of participating actors and activities held has grown significantly (Respondents 1 & 4). In this regard, LFM30 has been required to adapt to the new realities it has been facing (Respondent 5). As highlighted by one respondent, adaption is a natural part of LFM30:

> "We know we have a challenge; we have something we need to solve. We have established a vision and a goal. But we are continuously adjusting the map – how to get there?" (Respondent 4, 22 March 2022)

5.5 Other factors influencing LFM30 ability to drive change

The collected data has pointed to other actors influencing LMF30's ability to accelerate a transition to a climate-neutral building and construction sector in Malmö which do not fit into the frameworks used in this thesis, or which span over multiple concepts. As this study is exploratory and seeks to understand how LFM30 contributes to transformative change, it was considered appropriate to also present and acknowledge these factors.

Relationship with the City of Malmö

The local government in Malmö has been very clear in its support of LFM30 and has a key role as initiator and facilitator in the early stages of establishing the network and acts as an active partner to the network (Video 11). This support has been essential for building LFM30 to its current state (Respondent 2, see also Section 4.2 and Section 5.2). However, the City of Malmö does not engage as a participating actor. Two reasons explain this decision, one related to formalities and one relating to the signals the City of Malmö wants to convey to actors participating in LFM30. First, internal policies state that the City of Malmö should not be part of any so-called economic associations, which LFM30 is. Second, and more importantly, the city authorities want to separate participation in LFM30 from a belief that it leads to potential benefits for the individual actor, such as quicker building permits, better odds in land allocation processes, or other forms of discounts when agreeing on contracts with the City of Malmö (Respondent 2).

Currently, the City of Malmö has one representative on the managing board of LFM30 and engages in LFM30 in multiple ways (Respondent 2). The City has also adopted a strategy for climate-neutral building and construction in Malmö geographical area, with the same goals as LFM30 (Stadsbyggnadsnämnen, n.d.). Further, all companies publicly owned by the City of Malmö operating within the building and construction sector participate in LFM30 per their own initiative (Respondent 2).

Timing

Timing was also mentioned as an essential factor for the success of LFM30. According to two respondents, LFM30 kicked off when the window for such a climate initiative stood wide open (Respondents 2 & 4). At the same time, there was increased activity on the national level, and an eagerness to localize efforts in Malmö, combined with a strong will to make something happen. This could have not been predicted. Rather it was a fortunate case of aligning stars

(Respondent 2). However, actors engaged in the early stages of LFM30 were responsive to this opportunity and made sure something happened while momentum was there (Respondent 4).

Accelerating transformation beyond the geographical boundaries

The ability to transfer LFM30's structure and methods to other locations and regions is where LFM30 has its largest potential leverage (Respondent 5, Video – LFM30 explainer). Several respondents noted that LFM30 has already had an impact on advancing emission mitigation efforts in the sector nationally, by pushing for stricter regulation (Respondent 3), developing methods (Respondent 5), and paving the way through action-oriented measures (Respondent 9). Transferring the structures and methods of LFM30 to other locations could potentially save a significant amount of effort and resources, in terms of developing and setting up such initiatives.

There are, however, two challenges associated with copying LFM30 to other locations mentioned in the interviews (Respondents 1, 4 & 10). First, there is the risk of introducing LFM30 to other locations too quickly. Some respondents are concerned that LFM30 has not matured enough and the structure and method might therefore not yet be ready to be transferred to other locations (Respondent 4 & 10). This also connects to resources and the fact that it risks taking resources from continuing to develop LFM30 (Respondent 4). Second, there are contextual factors that need to be considered if the setup of LFM30 was to be introduced somewhere else (Respondents 1 & 4). That LFM30 appears to have been successfully implemented in Malmö does not necessitate that the same would be the case in another location, even if this location shared many contextual characteristics. As stated by one respondent:

> "There is an ongoing discussion on how LFM30 meets the demand in Malmö as well as in other cities with similar needs. It makes sense that other cities should not have to reinvent the wheel. However, it is important to consider what form LFM30 that can be transferred to another location and the context specificity of LFM30 and the process of implementing it in Malmö." (Respondent 1, 8 March 2022)

6 Discussion

In this chapter, the results of this thesis are interpreted and discussed against findings in previous literature, first in general (Section 6.1) and then relating to each of the identified TM concepts that shaped the analysis (Section 6.1.1 – 6.1.4). For each of these concepts, the main findings are reiterated and addressed in terms of their significance and possible contribution to current knowledge. The chapter ends with reflections on theoretical and methodological limitations of this study and their potential impact on the research findings (Section 6.2).

6.1 Discussion of findings

The aim of this thesis was to explore if, and how, LFM30 contributes to transformative change in the building and construction sector in Malmö, focusing on the network aspects of LFM30. It must be noted that LFM30 was not established through a process guided by TM. However, as TM focused on aspects of network governance, it was considered appropriate to apply a framework based on TM literature to study LFM30's strengths and limitations in driving transformative change, as well as how it can potentially be improved.

In general, the findings indicate that LFM30 has in place many of the elements identified in TM literature, and which serves as the analytical framework in this study. This would suggest that LFM30, at least to some degree, carries transformative capacities. The subsequent question then is whether the change brought forward by LFM30 is transformative enough, i.e., if it will lead to the fulfillment of the goals set up within LFM30. This proved hard to determine from the analysis in this thesis and more time is required before an evaluation of LFM30 is possible.

Further, the findings signal that LFM30 promotes a climate-neutral building and construction sector in Malmö through many different interventions and actions, distributed across many different actors. This is in line with the emphasis within TM literature on steering transitions through a multitude of incremental, but directed, interventions, i.e., small but radical steps in a desired direction (Grin et al., 2010; Kemp et al., 2007). This is recognized as an important approach to allow for 'doable' action, and to limit resistance among existing regime actors (Kemp et al., 2007). As the findings show, LFM30 has been able to get a wide variety of actors on board and many of the largest actors within the building and construction sector in Malmö (i.e., existing regime actors) are directly involved in the network, indicating that LFM30 has successfully limited resistance from these actors. Rather, some of the leading market actors are the ones managing LFM30 and thereby help drive change in the sector. This contradicts findings from Fastenrath & Braun (2018) who pointed to regime resistance as one reason for failure in transitioning the building and construction sector in Brisbane. Instead, as suggested in previous research by Turnheim & Sovacool (2020), the results of this thesis, therefore, point to incumbent actors as having a potential positive role in driving transformative change.

Another important aspect found in previous literature is that instruments implemented to govern low-carbon transitions in the building sector have often been geared toward frontrunners (Van der Heijden, 2016). With its large number of participating actors, it appears as if LFM30 has engaged a broader set of actors than only frontrunners. However, for certain actor groups within LFM30 where the number of participating actors is limited to just a few, it is likely that these actors are indeed frontrunners. Hence, the LFM30 network needs to also attract laggards for the goal of a climate-neutral building and construction sector in Malmö to become reality.

6.1.1 Collaboration

The findings illustrate the broad range of actors participating in LFM30, across the entire construction and value chain, combined with participation from academic institutions as well as

a solid and well-functioning relationship with the City of Malmö (i.e., the local government). The importance of including a wide range of actors was reiterated by most respondents, confirming that a multiplicity of stakeholders within the urban space should be engaged in urban scale transitions (see e.g., Frantzeskaki et al., 2017). Moreover, it is recognized that the complexity of the challenge to reach climate neutrality in the building and construction sector in Malmö requires close collaboration among actors throughout the value chain. This corresponds to one of the core ideas of TM: to find collaborative ways to tackle complex, persistent problems (Grin et al., 2010). Further, previous literature on transitions in the building and construction sector has pointed to a lack of collaboration and interaction between actors throughout the construction process (Hürlimann et al., 2022; P. W. Newton & Rogers, 2020). As the findings in this study suggest, LFM30 has assisted to bridge this challenge.

Several respondents state that LFM30 has fostered a culture of transparency and knowledge-sharing, and high levels of trust between the network actors. This indicates that the development of LFM30 relies on the contextual setting, and in a wider sense that attention to context-specificity is necessary for any analysis of urban transitions. Thereby, findings in previous literature (see e.g., Hansen & Coenen, 2015; Hölscher et al., 2016; Loorbach et al., 2015) is reiterated.

The findings also point out that LFM30 has been able to provide a space – a local focal point – to accelerate climate action in the sector in Malmö. As highlighted by the respondents, the participating actors have gained a forum for discussing and acting on the issues of concern in LFM30. This is important for two reasons. First, it can contribute to a better understanding between actors of their respective challenges. In this way, actors throughout the value chain may jointly find solutions to existing barriers in delivering low to zero-carbon products and services. Second, and perhaps more importantly, it can help prevent suboptimal solutions from being adopted in the first place. As the building and construction sector is sensitive to long-term lock-ins, limiting the risk of high carbon-emitting practices being implemented today will have long-standing effects on the emissions levels in the sector.

Further, the interview responses discuss the critical role of individual commitment from representatives of the participating actors for LFM30 to succeed. One reason for the high levels of individual commitment within LFM30 may be strong interest and feeling of personal involvement for issues on the local level, due to the proximity to what the individuals consider home. Stronger engagement due to personal ties to a location has been one of the three key features identified by Wittmayer & Loorbach (2016) as characterizing urban scale transitions. The findings show that relying on individual commitment comes with both positive and negative effects. On the positive side, individual commitment generates consensus among the people involved that LFM30 should lead to action, or else it is considered a waste of time. On the other hand, it leads to higher levels of uncertainty regarding deliverables. As people might have other priorities, it becomes difficult to systemize work and progress within LFM30. Moreover, the importance of individual commitment for driving transformative change has been discussed in the literature on TM (Khan, 2013; Shiroyama & Kajiki, 2016). In general, however, it is not given a prioritized role as a key condition for driving transformative change. But as the findings in this study show, more attention should probably be directed to understanding the individuals representing LFM30 members and how to support them in their work.

Another issue related to collaboration is the potential influence of a network on its surroundings. The possibility to influence the market and political area was one of the main reasons for actors to join LFM30. This aligns with TM literature, which highlights the ability to do so as an important factor for sustainability transitions to be realized. However, previous

literature emphasizes that these arenas must be influenced in a way that promotes processes and innovations that contribute to the overarching transition vision (Grin et al., 2010; Loorbach et al., 2015). If the participating actors truly align their ambitions and goals with LFM30's vision, i.e., a climate-neutral building and construction sector by 2030, a win-win situation emerges where the actors contribute to the transition goals by growing their own businesses/operations. However, if these are not fully aligned, LFM30 can easily become a means for participation actors to influence the political and market arenas for boosting vested, individual interests. Which of these two directions dominate LFM30 today is difficult to discern, but the character of future climate (in)action from participating actors should provide more answers to this. Further, those who manage LFM30 must stay attentive to attempts from individual actors to promote their interests over the collective interest of the network.

6.1.2 Shared vision

The findings suggest that several TM instruments have been used in LMF30 to build a shared vision among the participating actors, including i) a transition arena at the early stages of LFM30, ii) a transition agenda (the LFM30 climate promise), and iii) transition pathways (demonstrated by the different strategic focus areas). Hence, without using the TM approach as a guide when establishing LFM30, it appears as if several features were still adopted in the process. For example, actors who were part of the initial transition arena appear to have been frontrunners with the capacity to generate dissipative structures and with the power to initiate change, and who also were convinced that change was necessary. This is an important prerequisite for transitions to occur, according to the TM literature (Loorbach, 2010; Loorbach et al., 2015) In general, following the theoretical framework used in this study, LFM30 can be considered successful in creating a shared vision among its participating actors.

However, a few findings contradict the generation of shared visions as prescribed by literature on TM. First, the common problem definition and overall vision were pre-determined, and were not a result of deliberation within the transition arena, as TM calls for (Loorbach, 2010). Relating to Grin et al. (2010), there seemed to be little space for discussions, disagreements, and compromises when deciding on the problem definition and the vision. Somewhat surprisingly, this did not appear to challenge the acceptance of either the problem definition or vision among actors in the transition arena. Two reasons for this might have been that earlier discussions had occurred in other forums predating LFM30 and the homogeneous group of actors involved in the transition arena, consisting exclusively of incumbent businesses in the building and construction sector and officials from the City of Malmö. The composition relates to the second issue of concern: the exclusion of certain actor groups in establishing LFM30 and its vision. A critique against TM has been the low participation of marginalized actors and that powerful regime actors with dominant perspectives can hi-jack the discourse, resulting in transition procedures that promote vested interests of these few actors over societal goals of transformation (de Geus et al., 2022; Loorbach et al., 2015; Voß et al., 2009). LFM30 is an industry-driven network, and therefore most participants are businesses. But the building and construction sector affects, and is affected by, multiple other societal stakeholders. While LFM30 engages closely with some of these groups, other appears to have been largely left out. For example, little civil society representation is found in LFM30, and measures to include a wider range of opinions (see e.g., Voß et al., 2009) do not seem to be implemented. The context of Sweden, with its formal democratic system, can to some degree ensure all voices are heard in society and strong ties to the local government appear to have given LFM30 a robust license to operate. But to deliver transformative change as stipulated in TM literature, i.e., that resonates with the societal idea of sustainability, LFM30 will need to engage also with those this stakeholder group. One way to do so would be to open and revisit the discussion on problem definition and vision together with actors who have not previously had the chance to voice their ideas or perspectives.

Further, joint goals, objectives, and targets have been set up under the umbrella of the LFM30 climate promise. This corresponds to TM literature (see e.g. Loorbach, 2010), as well as literature on transitions in the building and construction sector (Harrington & Hoy, 2019), who stress that clear and transparent goals, targets, and objectives need to be present for transition processes to be successful. Other practices implemented within LFM30, including the introduction of carbon accounting, carbon budgeting, and specific emissions criteria that go beyond legal requirements have also been suggested by other scholars as appropriate instruments to guide transitions (P. W. Newton & Rogers, 2020; Passer et al., 2020). By requiring climate calculations based on an LCA approach, which means both embodied and operational emissions from buildings and facilities are included, LFM30 pressures its members to implement efforts directed to both these aspects. Both de Wolf et al. (2017) and Passer et al. (2020) have called for such an approach to adequately address the embodied GHG emissions, which have received less attention in the past. Thus, when analyzing the LFM30 network against recent research on sustainability transitions in the building and construction sector, many features and aspects necessary to achieve transformational change appear to be present in LFM30.

Loorbach et al. (2015) highlight that common direction and visions need to trickle down into the actor's own organization for TM change to occur. The findings show this is at least in part the case within LFM30, as actors within the network have set higher climate ambitions due to LFM30. One explanation for this could be that LFM30's vision was well-anchored among local actors. This is seen within TM literature (see e.g., Loorbach et al., 2015). As stated by the respondents, it has been important that all participating actors promise to implement efforts in their own organizations that contribute to LFM30's climate promise. Hence, the network has served as a catalyst for increased climate ambitions. Further, the climate promise in LFM30 has resulted in a mobilization to collectively pursue tangible goals and targets. This is seen as another benefit of network structures. However, results in terms of substantial GHG emissions reductions are not yet seen within the building and construction sector in Malmö, and time will tell if LFM30's goals and targets result in tangible climate action by all participating actors.

Finally, it is worth discussing the role of the municipality in creating and upholding LFM30's shared vision. As reported in the findings, the City of Malmö had a strong facilitating role in the establishing phase of LFM30. This indicates that although the network is managed largely by industry actors, the local government has played a part in realizing LFM30. This confirms that collaboration between private and public (and other societal groups) is a success factor for establishing structures contributing to urban climate efforts. Once LFM30 was up and running, the City of Malmö chose to step back and take a more supporting role.

6.1.3 Experimentation

In terms of experimentation, several institutional and technological innovation projects were found taking place within LFM30. Looking closer at institutional innovation projects, respondents stated that the entire LFM30 model and the structures and methods established within the network can be considered ongoing institutional innovation projects. Understanding LFM30 as a large institutional experiment and drawing lessons from its progress can provide valuable insights into how alternative (and more sustainable) practices and structures can be developed in the building and construction sector, as is the core purpose of experimentation (Bulkeley, 2021).

The multiplicity of experiments found from the interviews and the document review resonates well with the idea that a pool of transition experiments is required to reach transformative change present in TM literature (Bulkeley & Castán Broto, 2013; Grin et al., 2010). Taken together, seemingly small, and incremental innovation projects all play an important role and should therefore be encouraged within LFM30 alongside bigger experiments. At the same time,

behavioral and societal innovations were not found in the collected data. One explanation could be that incumbent firms (who largely make up the LFM30 network) rather promote solutions that require low levels of systems change over solutions that do (O'Neill & Gibbs, 2020). By focusing on technical innovation, the structures of the system can be mainly held the same. But behavioral and societal innovation for example rethinking our ideas of how to use buildings and homes (societal innovation) and reconsidering living habits (behavioral innovation), should also be encouraged within LFM30. Not only are such innovations considered important for GHG emissions reductions in the building and construction sector to materialize (IPCC, 2022), but including them would increase the breadth of innovations within LFM30 and make the pool of potential ways toward climate neutrality even bigger.

According to TM, literature experiments are high-risk innovation projects that do not occur under normal circumstances (Grin et al., 2010; Loorbach, 2010). Part of answering RQ3, therefore, included finding out if the innovation projects within LFM30 could be considered high-risk or not, i.e., if they would have happened without the presence of LFM30. From this viewpoint, the most prominent way LFM30 facilitates experimentation among the participating actors is through increased possibilities of external funding for innovation projects. Several respondents stated that external funding for innovation projects had been granted due to collaboration within LFM30 and would therefore not have occurred without the network. For the innovations that are driven by actors individually or by bilateral partnerships, it is harder to conclude whether they are a result of participating in LFM30 or not. Further, LFM30 and its members do not act in a vacuum. Many other societal stakeholders engage in similar ways with the issues and challenges LFM30 aims to address. In the case of experimentation it therefore becomes hard to know the direction of these effects. Another issue limiting the understanding of experimentation within LFM30 is the time aspect. Due to the recent establishment of LFM30 and the long project timeframes in the building and construction sector, only a few large-scale technological experiments have materialized so far.

Further, having in place jointly established criteria for determining the success of experiments is highlighted in the TM framework (Loorbach, 2010). In LFM30, few such criteria were found to be present. Hence, there are few established 'truths' for when experiments should be considered as successful. As outcomes from experiments should guide decisions going forwards, the lack of criteria to determine if outcomes are positive or negative may hinder decision-making based on previous lessons. Being a core principle of TM, the lack of success criteria may therefore affect both the performance and societal legitimacy of interventions implemented within LFM30. Reflecting the earlier point on the importance of individual commitment and capacity, specific criteria relating to individual and/or actor learning may be introduced to determine whether the outcome of an experiment is successful.

It is also worth discussing the criteria that are currently in place. Today, the main criteria in LFM30 cover emissions reductions from a building or construction project per square meter of gross habitable floor. But while this measure accounts for emissions in relation to the area of what is built, renovated, repurposed, or extended, an absolute measure accounts for emissions regardless of the size of what is built. To reach a climate-neutral building and construction sector, large-scale GHG emissions reductions in absolute terms will be arguably required, not relative reductions.

6.1.4 Learning

The results indicate that learning spaces and activities within LFM30 have contributed to higher learning among the participants, combined with higher levels of knowledge-sharing between participants. The respondents also highlight that LFM30 has become a one-stop-shop for information on climate issues within the building and construction sector in Malmö. This shows

how networks can help stimulate a learning environment, from which the new knowledge can be used to initiate new climate action. Further, ensuring knowledge is transferred from LFM30 and taken up by the participating actors appears to rely heavily on the individuals responsible for representing the actors in LFM30. According to the respondents, these individuals have an important role as knowledge distributors. Hence, they can be seen as intermediate actors between LFM30 and the organizations they are representing. Despite being mentioned by several respondents, this aspect is given little attention in the literature reviewed for this thesis. As mentioned in Section 6.1.1, focusing on the individuals representing the participating actors, rather than the actors as an organizational entity raises new aspects to consider for building successful transition networks, including how to encourage and support those individuals. In terms of learning, how networks can better help individuals to successfully transfer knowledge developed in the network to their respective organizations becomes an important question that merits more consideration in urban climate networks.

Another central issue of learning according to TM literature is reflexivity. Reflexivity is about collectively reflecting upon the transition processes underway and allowing these lessons to guide the next steps (Grin et al., 2010; Loorbach, 2010). Networks with a high degree of reflexivity are thereby more responsive and receptive to new ideas, which increases adaptability within the network. The findings from this research show that several signs of reflexivity are present in LFM30, including monitoring and evaluating (through a publicly available and transparent annual result report), reflecting (through roundtable discussions), and adjusting (through updating criteria, improving the network structure, etc.). These features align well with TM literature on how to ensure reflexivity. However, the findings also indicate two areas where reflexivity could be improved. First, evaluation is currently mainly related to progress towards the goal, rather than evaluating LFM30's processes. Hence, evaluation should be broadened to also include whether structures and processes of the LFM30 network are optimally designed and implemented. Second, systematic evaluations of experiments are largely missing in LFM30. This is required to ensure future decisions are guided by previous lessons learned (see more in Section 6.1.3).

Further, while measures for reflection and continuous improvement are employed in LFM30, one should consider what kind of reflections that are discussed and socially accepted by the network participants. The central question is if the reflections are confined to the existing regime or if radical reflections on efforts within LFM30 are welcome. TM literature does emphasize the need for transformative change through small steps (see e.g. Grin et al., 2010; Kemp et al., 2007; Loorbach, 2010), but without allowing for transformational ideas to be discussed within networks aiming to deliver transitions, these setting could find themselves contributing regular change rather than radical. Again, an approach to tackle this issue would be to include actors that usually are not able to voice their perspectives in the learning process, as advocated by Voß et al. (2009).

To conclude, learning spaces are present in LFM30, and monitoring, evaluating, and learning appear to be embedded in the structures of the network. This resonates well with the notion of learning in TM literature (see e.g., Grin et al., 2010; Loorbach, 2010). However, this is an ongoing process and can be improved going forward.

6.1.5 Relating to other aspects of importance to LFM30

The findings chapter also included three other aspects mentioned by the respondents as influential to LMF30's ability to accelerate a transition: political support, timing, and geographical scope of LFM30.

First, regarding *political support*, the findings show that the City of Malmö plays an important role in the success of LFM30. This was especially the case in the initial phase of LFM30, where the local government served as a facilitator. This is in line with the findings of Ehnert et al. (2018), stating that networks or coalitions with strong support from the local government have a higher potential to drive transitions. It is also worth noting that although the City of Malmö is not an official member of LFM30, it has adopted similar goals for the building and construction within the geographical area of the city. The relationship between LFM30 and the City of Malmö illustrates a close collaboration between the private sector and public authorities. Further, the convergence of goals has likely created stronger leverage for both 'sides' to implement climate efforts and appears to be a powerful approach for promoting action within this area. However, the City of Malmö must be cautious of the interest of private actors, rather than the most favorable societal outcome, being turned into political goals. This required active and influential participation from the local government.

Second, *timing* is important to consider. As the findings show, there was a window for establishing LFM30 that coincided with actors in Malmö being ready to act. This timing issue is naturally harder to plan for and can appear to be an arbitrary aspect of steering transformative change as well-planned transition initiatives can fail due to bad timing, and vice-versa. Nevertheless, it calls for attentiveness to acting when the opportunity emerges. Proactive efforts to prepare for the right time to act might also affect the outcome (Loorbach, 2010). Before LFM30, there were other forums for discussing climate action in the building and construction sector in the Skåne region, of which Malmö is the largest city (See section 4.1). Hence, actors interested in these issues might have already had informal and formal personal connections with each other. This could have made it easier to act when the opportunity showed up.

Third, in terms of *geographical scope*, the findings indicate that LFM30 has been able to influence mitigation efforts in the sector nationally and in other Swedish regions, by acting as a frontrunner and beginning to affect discussions on new regulations. It is also by accelerating sector transformations beyond the geographical scope of Malmö that LFM30 has the highest leverage in terms of GHG emissions reductions. Hence, it provides a good example of how local action, in this case in the form of the LFM30 network, can influence national-level decision-making. But here too, context matters. Only because LFM30 appears to be driving climate action in Malmö does not necessarily mean the methods and structure of the network could do so in other regions, or on the national level.

6.2 Reflecting on the results of study

This section provides reflections on theoretical and methodological limitations relating to the research conducted in this thesis, and how they might influence the findings.

6.2.1 Theoretical reflections

This thesis used a TM framework to analyze LFM30 and its ability to contribute to transformative change. Four TM concepts and twelve key TM elements were identified to guide the analysis. Further, the applied framework emphasized collaboration, viewing it as a central aspect for shared visions, experiments, and learning to emerge. Thereby it provided a useful frame for studying the network aspects of LFM30. Overall, the use of TM as seen in this thesis illustrates that collaboration may have an overarching role in the ability of networks to drive transitions. While already an essential concept in TM literature, this study suggests that collaboration could be given an even more prominent role in TM-oriented research by looking at networks and other collaborative urban governance structures.

However, the theoretical choices naturally influenced the categorization and interpretation of the findings. This was seen in four main ways. First, the collection of data and presentation of the findings are linked almost exclusively to the four concepts and their corresponding elements. Because the interview questions were formulated based on the theoretical framework, the choices of the researchers affected the information collected from the data sources. To tackle this potential response bias, interview respondents were also asked more general questions on LFM30 and whether they had any other comments or reflections. Moreover, findings from the collected data that did not connect to these elements, but which could potentially have had an important role in understanding how LFM30 contributes to transformative change, might have been overlooked. This is understood as a general limitation of applying specific frameworks to seemingly multifaceted structures such as LFM30. The risk of leaving out significant findings was reduced by allowing for findings outside of the four TM elements. These additional findings were presented in Section 5.5.

Second, it is important to recognize that TM theory is by no means all-encompassing in terms of understanding sustainability transitions. Rather it is one approach out of many. Using other theories or perspectives to understand LFM30's efforts and abilities to drive transformative change would lead to different analytical foci and most likely different results than those found in this thesis. For example, applying the multi-level perspective (MLP) from (Geels, 2002) would have increased the focus on the interactions between actors on niche, regime, and landscape levels.

Third, the TM framework as used in this thesis study does not adequately include aspects of what skills and capacities participating organizations, and the individuals representing these organizations should possess for accelerating transformative change. One could argue this is present in the TM framework, for example in describing which actors should be part of the transition arena (i.e., frontrunners "with capacity to generate dissipate structures […]" (Grin et al., 2010, p. 144), but recent literature points out that previous applications of the TM have not focused on identifying the necessary skills and capacities (Frantzeskaki, 2022). Additionally, the findings of this thesis identified individual commitment as a crucial factor for the success of LFM30. Gaining a deeper understanding of the required capacities and skills needed to manage the transition prescribed by TM, and how networks like LFM30 can help build such abilities, therefore appears highly relevant. This is acknowledged as a limit in the way the TM framework is applied in this thesis, which has not given much attention to the capacities and skills of the actors participating in LFM30. Going forwards, capacities and skills should perhaps receive a more prominent role in future TM-focused studies, as is done in for example Frantzeskaki (2022) and Hölscher et al. (2020).

6.2.2 Methodological limitations

Several limitations relating to the methodological choices of this thesis should also be discussed. First, LFM30 is a recently established and ongoing climate network, which has grown considerably since its initiation in 2019. Because of these, there is little stability in the network. And while LFM30's positive impact was highlighted by a majority of the respondents; it was difficult to identify the impacts of LFM30 in terms of GHG emission reductions in the building and construction sector. This will likely become clearer as time passes, allowing for longitudinal analysis of LFM30. Connected to this is also the charm of novelty currently surrounding LFM30. As the network is still new and exciting, the perceived benefits might feel bigger than they turn out to be. This could lead to biased positive interview responses. In this sense, it could be too early to study LFM30. On the other hand, previous TM literature has called for more research on ongoing cases of transitions, as opposed to studying historical transitions.

Second, the selection of interview respondents also affected the findings. The respondents only represent a limited number of all participating actors and certain actor groups were not represented at all in the study. Hence, this thesis cannot claim to provide a complete picture of how participating actors view and take part in LFM30. Further, the respondents were selected based on their knowledge and involvement in LFM30. This was deliberate by the researcher, to gain a deeper understanding of LFM30 and its effects on the participating actors. But this strategy can be argued to only capture the view of actors with strong convictions that LFM30 is beneficial, potentially resulting in skewed responses from the interviews. Triangulation served to reduce the risk of this affecting the study findings. However, one caveat was that two of the interview respondents had also been involved in authoring some of the documents used to gather data. Interviewing actors in the periphery of LFM30, for example, actors who have newly joined or who are not actively contributing to LFM30, would likely have generated a different result.

Finally, the focus on one case study affects the generalizability of the findings in this thesis. One way to overcome this is by describing the context in rich detail. Therefore, a background section on Malmö and its previous accounts relating to urban climate action was provided. However, there appear to be highly specific factors in the case study that limits its generalizability. The political support for LFM30 (and other climate efforts), the collaborative culture present within the building and construction sector in Malmö, and the significance given to the timing of establishing LFM30 are three such factors. Moreover, the economic and cultural realities of Swedish society likely impacted the findings in this thesis, suggesting that transferability to another context with largely differing characteristics may be limited.

7 Conclusions

The purpose of this thesis was to explore the capacity of LFM30 to contribute to transformative change in the building and construction sector in Malmö, focusing on the network aspects of LFM30. To reach this aim, a framework based on TM literature was applied to analyze LFM30's ability to support *collaboration* (RQ1), contribute to a *shared vision* (RQ2), facilitate *experimentation* (RQ3), and stimulate *learning* (RQ4) among participating actors. Further, the aim was to explore how individual actors participating in LFM30 integrate and implement the shared vision (RQ2), experiments (RQ3), and learning activities (RQ4) established by LFM30 into their own organizations.

The overall results presented in the findings indicate that LFM30 demonstrates many of the elements identified as important by TM literature to drive transformative change. This suggests that the LFM30 network possesses transformative capacities relating to *collaboration*, *shared visions*, *experimentation*, and *learning*. Moreover, it shows that network governance structures can have a potential role in driving low-carbon urban transitions. However, some concerns have also appeared in this study of the LFM30 network, including the future level of goal attainment and its ability to involve actors who are needed to reach a climate-neutral building and construction sector in Malmö, as well as those affected by the decisions taken within LFM30. Further, the findings suggest that increased attention should be directed to the individuals who engage in LFM30 on behalf of the participating actors. Reaching a better understanding of how to support and empower these individuals seems important for improving LFM30's transformative capacity going forward.

The following paragraphs outline conclusions related to each research question. First, findings relating to RQ1 showed that a culture of transparency and willingness to share knowledge exists within LFM30. It also seems like LFM30 has successfully provided actors, and individuals representing the participating actors, with a forum for discussing and acting together. Further, actors participating in LFM30 see an increased possibility to influence the market and political arena as the biggest motivation for joining the network. In sum, the mobilization of many actors across the sector appears to have created a powerful and dynamic network. For the building and construction sector, in particular, LFM30 and similar networks can help overcome low levels of integration between actors, which has been identified as a barrier to low carbon transitions in the sector (Hürlimann et al., 2022; P. W. Newton & Rogers, 2020).

Turning to RQ2, LFM30 appears to serve as a catalyst for higher climate ambitions among actors by establishing a common direction and shared visions that all actors agree upon. Moreover, the targets, objectives, and goals set by LFM30 seem to guide participating actors' short and midterm climate action. The methods and practices that have been introduced within LFM30 to reach these goals also correspond to what has been suggested in other studies on transitions in the building and construction sector ((De Wolf et al., 2017; P. W. Newton & Rogers, 2020; Passer et al., 2020), indicating that LFM30 has features to deliver transformative change in place. On the more critical side, the problem definition and shared vision were not a result of deliberation among participating actors. Hence, the vision risks corresponding only to the ideas of certain parts of society, potentially resulting in a transition that favors some actors over others.

In terms of experimentation (RQ3), LFM30 has unlocked new funding possibilities for actors to initiate and take part in (high-risk) innovations. While the individual actors mainly initiate technological innovation projects, several of LFM30's structures and practices can be considered institutional innovations. The findings show that several different innovation projects are currently underway, but that behavioral and societal innovation appears to be lacking. Regarding criteria for determining whether experiments are successful, the results

indicate that the criteria should be expanded to also include learning objectives and that evaluations of experiments should be improved. Finally, while deepening of experiments is observed through learning among actors, little scaling or broadening is currently occurring. Achieving scaling and broadening of experiments could result in LFM30 contributing to large-scale impact also beyond its current geographical boundary (i.e., the City of Malmö).

For RQ4, the main findings are that LFM30 provides several learning spaces and activities to stimulate knowledge sharing and dialogue and that it has become a one-stop-shop for participating actors to find information. The findings also suggest that procedures to ensure monitoring and evaluation are in place, but that certain aspects of evaluation could be strengthened, including the evaluation of internal structures and practices within LFM30. To ensure this reflection contributes to transformative ideas being raised, discussed, and implemented, LFM30 must be considerate of what, which, and whose ideas are accepted. Moreover, regarding how the participating actors include learning (from LFM30) in their organization, the results indicate that individuals representing their organization in LFM30 play an important role as knowledge distributors. Again, this highlights that more attention should be given to the individuals involved in LFM30.

Lastly, as detailed in Section 2.2.3, several scholars have called for more research on the role of local networks in driving transformative change. This thesis aimed to contribute to expand the collection of literature studying this question. From the perspective of the researcher, the contribution comes in four main forms. First, by examining the transformative capacities of LMF30, recommendations on how to improve the network have been identified and presented. While transitions are context dependent, these suggestions may serve as input for practitioners engaged in other local climate networks. Second, the perceptions of actors participating in local climate networks, and how they engaged with the network, are examined in this thesis. By outlining the motivations, actions, and uncertainties of actors participating in LFM30, the findings contribute to a better understanding of factors determining the success or failure of one local network in driving transformative change. Third, this thesis has tested a framework consisting of four TM concepts on a novel case – the LFM30 network – that has not previously been studied. Thus, it has broadened the use of TM in applied research. Thereby, this thesis contributes to the pool of practically oriented research that uses TM as an analytical lens, and which helps build the theoretical conceptualizations of TM theory. The findings suggest that the LFM30 network is a suitable structure for accelerating sustainability transition in the building and construction sector in Malmö. Further, this thesis shows that networks can potentially influence participating actors to strengthen their involvement in climate efforts, but that the degree to which this is true can be hard to determine. In the case of LFM30, more time will have to pass before this can be answered. Fourth, while TM has previously been applied to examine network structures, the emphasis on collaboration in this thesis provides a new analytical focus. This proved useful in examining how LFM30 contributes to a climate-neutral building and construction sector and should be considered for studying similar cases in other locations and contexts. However, the findings suggest that certain aspects that were not included in this analysis should be given more intention in future research.

7.1 Recommendations for practitioners

7.1.1 Specific recommendations - for actors engaged in LFM30

To begin with, several specific recommendations can be made to actors engaged in LFM30. For actors taking part in managing and operating LFM30, the following recommendations are drawn from this thesis research:

1. Involve all stakeholders affected by the actions of LFM30 in the transition procedures within LFM30. This would not only increase the number of views and perspectives being discussed within LFM30 but may also result in new insights into which kind sustainability transition is wanted and desired. This could be done by introducing a reference group of civil society actors similar to the academic council assisting LFM30 today. This would also lead to higher reflexivity within LFM30.
2. Find ways to help individuals representing actors participating in LFM30 in their work with the network. In general, this is about understanding the needs of the individual representatives, and how LFM30 can best support them. Events and activities that create value for the individual rather than for the participating actor should be arranged. As this research shows, LFM30 has already been very successful in creating a space for individuals to discuss and interact around issues regarding climate action in the building and construction sector. However, the findings also indicate that individuals engaged in LFM30 still feel quite isolated at times. Hence, more can be done to encourage and support these individuals.
3. Keep a proactive approach and stay ahead of legislation, or else interest could lessen going forward. In continuing to push for change in the political and market arena, advantage can be taken to the unique position of the network. Further, the LFM30 network must also be attentive to the specific interests of individual actors. Not letting such influences affect the overall vision and goals of LFM30, and thereby making them more lenient or suitable to the interests of one or a few actors, will be important going forward.
4. Introduce new criteria for determining the success of experiments within LFM30, while keeping the criteria that are already in place. While current "hard" criteria based on numbers are important and should remain, supplementary criteria should also be introduced to understand to what degree the experiments help push the overall transition agenda. For instance, this could include criteria that relate to the level of learning achieved from an experiment. The 'hard' criteria can also be redesigned into absolute targets rather than relative ones.
5. Ensure systematic evaluation and follow-up. This should be improved both when assessing the outcome of experiments conducted within LFM30 and relating to the evaluation and follow-up of LFM30's internal structures and procedures.

Turning to actors participating in LFM30, i.e., the LFM30 network members, recommendations are as follows:

1. Ensure the individual employee(s) engaged in LFM30 are given enough time, resources, and support to adequately take part in the activities.
2. Connected to this, it is important to carefully select who will be representing the actor in LFM30, considering two main aspects. First, the person should be committed and interested in the issues managed by LFM30. Second, it should be someone who knows a little about a lot regarding climate efforts in the building and construction sector, and who can therefore identify, repackage, and distribute knowledge and information shared within LFM30 to the right recipient internally.
3. Take time to understand what committing to LFM30's climate promise means for their businesses. This looks different for all actors, depending on which actor group they belong to and their current level of climate efforts.

Lastly, for the City of Malmö, this thesis provides two main recommendations:

1. Continue to support LFM30 in the same capacity as today, that is as an active partner.
2. But be mindful of the vested interests of strong actors within LFM30. The convergence of LFM30's and the City of Malmö's goals has likely created a stronger momentum towards

reducing GHG emissions in the building and construction sector. But it is nevertheless important that the local government stays alert to attempts from powerful actors to influence societal goals for their own benefit.

7.1.2 General recommendations - for actors engaged in local climate networks

This research has also shed light on several issues to be considered by any actor engaged in local climate networks. Hence, the recommendations presented below are more general in their character.

1. Ensure all relevant actors can take part in discussions and efforts, according to their own ability. Further, it is important to be mindful of differing interests among network participants as well as external stakeholders, and that decisions are based on deliberation and compromise.
2. Aim to build trust and a willingness to share knowledge between participating actors.
3. Establish a common vision, with clear objectives and goals connected to it. These should acknowledge and build upon local knowledge.
4. Ensure experiments contribute to the overall path towards sustainability transition, by including both 'soft' (e.g., learning target) and 'hard' (e.g., GHG emission reduction target) criteria for determining the success of experiments. Regarding 'hard' criteria, considered adopting criteria based on absolute target levels rather than relative ones.
5. Consider the context in which the network is being established. Several factors can potentially affect the success of the network, including existing debate on the issues, political support, timing, current levels of knowledge, and culture and economic aspects

7.2 Recommendations for future research

The recommendations for future research can be split into two streams: further in-depth research on the LFM30 case in Malmö, or widening the scope to examine other case studies, single or multiple, and in other locations.

Zooming in on areas for future research directly relating to LFM30, the first recommendation for future research is to follow up on the performance and success of LFM30 after a certain number of years. Both 2025 and 2030 are important milestones in LFM30 with clear goals connected to them. Future studies could assess whether LFM30 successfully achieved its goals and examine what aspects drove success or failure. Hence, a longitudinal approach would be interesting to apply in future studies. Replicating the study in this thesis at a later stage could also generate interesting findings. By comparing results between the two studies, one would gain insights into how LFM30 and the relationship with participating actors had developed. This would contribute to the scientific knowledge on how networks evolve over time, depending on changes in internal and external circumstances. Other possible areas for future research could be to focus more closely on certain aspects that have only been briefly touched upon in this thesis project. The aim of this study was broad, and each of the four TM concepts can be studied in closer detail. Issues that merit further attention include, for example, i) politics of sustainability transitions connected to local networks and the relationship between the City of Malmö, LFM30, and other levels of political decision-power and ii) how capacity building, through learning activities within LFM30, trickles down into the participating organizations and how this can be improved.

Further, the scope of this research was delineated on actors who already participate in LFM30. Compared to literature on sustainability transition, many of these actors can be considered frontrunners with a high ambition to deliver climate action and contribute to transformative

change. An interesting area for future research would instead be to study actors that have chosen not to participate in LFM30, or who have been part of the network and then chosen to opt-out. Such research could ask which barriers exist for non-participating actors to join and what the reasons were for certain actors to leave LFM30. This would lead to valuable insights on how LFM30 can drive transformative change in the entire sector, including among actors and actor groups that are more reluctant to voluntary commitments.

A final avenue of future research looking specifically at LFM30 could be to apply quantitative methods to analyze the network. For example, LFM30 could be analyzed using quantitative network visualizations, a method used by Nochta & Skelcher (2020) to study energy networks in European cities. Here, new knowledge on relationships and links between actors within LFM30 could be gained, which would be helpful to guide new interventions to strengthen the network. Quantitative research could also be done by surveying all LFM30 members on their perception of LFM30 and how it contributes to a climate-neutral building and construction sector in Malmö. Such a research design could provide interesting findings by allowing for comparison between different actors and actor groups across different variables such as level of participation in LFM30, size of firms, investments into climate action, level of climate ambition/strength of climate goals, etc.

Turning to possible avenues of further research on case studies beyond LFM30, an interesting area would be to compare changes in GHG emissions from the building and construction sector in Malmö against other Swedish municipalities where no network like LFM30 has been in place. This could indicate whether LFM30 has had a role in transforming the sector in Malmö. To give time for LFM30 to develop and influence the sector, a few more years should pass before a study of this kind takes place. However, contextual factors of the studied municipalities would have to be considered and controlled for in such research. Lastly, the framework applied in this thesis could be used to analyze local networks in different locations and/or regions, both within and outside of Sweden, as well as networks that have existed for a longer period of time. By emphasizing collaboration, the framework used in this study contributes to broadening the understanding of TM as an analytical lens. Applying it to other local network cases would increase the empirical insights on mechanisms of transitions from a TM perspective. It would be particularly interesting to compare local networks in highly differing contextual settings, including different economic, cultural, and political characteristics.

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To conclude, this research project sought to provide valuable learnings on the presence of transformative capacities within the LFM30 network and how the network supports GHG emissions mitigation efforts among the participating actors. While LFM30 is suggested to have a significant role in the realization of a climate-neutral building and construction sector in Malmö, this thesis also showed that new challenges emerge in local network settings. Mirroring Rink et al. (2018), networks are likely not a panacea for transformative change on the urban scale. They do, however, help actors overcome many challenges for transitions in the local context, as well as in the building and construction sector.

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Appendix I – Summary of TM concepts and elements

This table outlines key elements and TM instruments related to each concept in the TM framework, and their potential implications to individual actors. The concepts and the identified key elements for each concept served as the theoretical framework for the analysis in this thesis.

TM concept	Identified key elements in TM literature, related to each TM concept	Key TM instruments (if applicable)	Potential implications for individual actor/organization
Collaboration	Cooperation over competition	Networks, coalitions, and partnerships	Share knowledge and experience Increased complexity
	Provides social and physical space to act together		Increased willingness to contribute and participate
	Possibility to put pressure on political and market arena		Stronger influence and leverage Requires resources and capacity
Shared Visions	Joint problem definition, common discourse	Transition arena	Participating actors are tied by common belief, and understand that their actions have an impact Discussions, disagreements, and compromises
	Long-term sustainability vision		Inspiration and empowerment Integration into daily environment Difficulties to adopt and/or adhere to vision
	Joint objectives, targets, goals, and routes to get there	Transition pathways and Transition agenda	Strategy to guide short- and midterm action Balance individual and common interests
Experimentation	High-risk innovations (societal, technological, institutional, or behavioral)	Transition experiments	Possibility to test new innovations, reducing risk Includes uncertainty
	Establishing success criteria (i.e., what counts as substantive contribution to overarching vision)	n.a.	Discuss criteria and establish criteria Potential to affect level of criteria
	Scaling, deepening, and broadening of successful experiments	Transition experiments	Possibility to transfer own solutions and innovations Willingness to adopt other solutions and innovations
Learning	Monitoring of transition processes and TM procedures	Transition processes is societal system TM procedures (transition agenda, activities, and transition experiments)	Recognizing and reacting to societal system changes Establish and/or comply to monitoring system (measure and report progress on TM procedures), leading to increased accountability of actions

	Evaluating, reflecting, and adapting	n.a.	Taking part in reflection on processes and procedures, forming new actions and criteria Adjusting and re-adjusting practices
	Collaborative learning and capacity building	n.a.	Actively share knowledge and learn from other (but how much to share?)

Source: Own elaboration,, based on Grin et al. (2010); Loorbach (2010); Loorbach et al. (2015)

Appendix II – Interview Guide

Introduction (opening):

- What is your function within the organization and within LFM30?
- What were the main reasons for your organizations to join LFM30?
- What are the major advantages and disadvantages of participating in LFM30 (if any)?
- In you view, how does LFM30 contribute to a climate neutral building and construction sector in Malmö?

1. Overall participation/collaboration:

- How do you engage within the LFM30? Active member? Passive? Others?
- Has there been any change in your organization since joining LFM30?
    - Any new partnerships or network interactions?
    - Has this been due to LFM30? Would it have been done anyway?

2. Shared Visions:

Explainer: To accelerate transitions (Swedish: omställning), research highlights the importance of creating a shared vision and common objectives, targets, and goals, setting out what is to be achieved short- and long-term. Within LFM30, the long-term vision is a climate neutral building and construction sector in Malmö by 2030.

- In your view, how has
- Is the long-term vision of LFM30 used/incorporated into your organization?
    - If yes, how is it used/incorporated?
    - If no, why not?
    - Has this affected your organization? How?

Explainer: Within LFM30, short-term goals have also been set: annual measuring of climate impact, halfway to climate neutrality 2025 etc.

- Are the short-term objectives, targets, and goals of LFM30 used/incorporated into your organization?
    - If yes, how are they used/incorporated?
    - If no, why not?

- (Question to the initiating organizations specifically, i.e., who answered they were part of establishing LFM30 from the start. Was there a process to establish:
    - i) a/the problem definition and
    - ii) developing the long-term vision?
        - If yes, how was this process structured and managed? Who participated, which actors were driving forces?)

3. Experimentation:

Explainer: Another area highlighted in research to create conditions for testing innovations and new solutions that otherwise would not have been tried. This can be technical innovations as well as organizational or behavioral ones, which in some way contribute to new methods or approaches.

- In you view, how does LFM30 facilitate the implementation of innovation projects among the participating actors?
- Has your organization been part, or do you plan to, of any innovation projects linked to LFM30?
    - If yes, which ones? Why those?
        - Do you know if these projects have established specific criteria to be assessed against?
    - If no, why not?
    - Has this affected your organization? How?

4. Learning:

Learning and reflection is also seen as an important pillar in research on change processes. This is both about knowledge sharing, but also about evaluating, reflecting and adapting current processes to better achieve the adopted goals.

- In you view, how does LFM30 stimulate learning among the participating actors?
- Has your organization actively participated in learning activities linked to the LMF30?
    - If yes, which ones? Why those?
    - If no, why not?
    - Has this affected your organization? How?

- Do you know of existing processes to monitor, evaluate, and reflect on the progress of LFM30?
        - If yes, are the lessons learnt from such findings embedded in LFM30 and has the direction of LFM30 been adjusted based on such finding?)

Concluding remarks:

- Is there anything further you wish to add?
- Is there anyone else you think I should talk to?
- Are there any other documents you think I should include in my study?

Appendix III –List of interview respondents

Respondent number (code for in-text referencing)	Actor Group	Role	Interview date and length
1	LFM30 Secretariat	Project Manager	8 March 2022, 31 minutes
2	Local Municipality (City of Malmö)	Urban Planning Specialist	18 March 2022, 49 minutes
3	Material Supplier	Market & Project Manager	21 March 2022, 41 minutes
4	Developer	Head of Environment	22 March 2022, 49 minutes
5	Contractor	Head of Sustainability	23 March 2022, 48 minutes
6	Transport and Delivery Company	Business Developer	30 March 2022, 42 minutes
7	Energy Supplier	Sustainability Specialist	31 March 2022, 37 minutes
8	Consultant (management)	Sustainability Consultant	5 April 2022, 37 minutes
9	Developer	Head of Project Development	5 April 2022, 29 minutes
10	Consultant (architect)	Business Development Manager	6 April 2022, 53 minutes
11-1 & 11-2	Material Supplier	Logistics Manager (11-1) & Environmental and Sustainability Manager (11-2)	28 April 2022, 47 minutes

Appendix IV – List of video files

Video number (code for in-text referencing)	Title	Link (URL)	Publish date (access date)
1	LFM30 Medlemmarna | Alexandra Rosenqvist, Beijer Bygg AB	https://www.youtube.com/watch?v=gLxN3S8AVRA	14 June 2021 (30 March 2022)
2	LFM30 Medlemmarna | Fredrik Nilzén, hållbarhetschef på Swedbank	https://www.youtube.com/watch?v=neutkwQ75To	27 April, 2021 (30 March 2022)
3	LFM30 Medlemmarna | Henrik Björk, hållbarhetsansvarig på Optimera	https://www.youtube.com/watch?v=HTe0DfaBCws	3 May, 2021 (30 March 2022)
4	LFM30 Medlemmarna | Viktor Sundberg, avdelningschef på Swerock	https://www.youtube.com/watch?v=dzyQ9710sik&t=1s	14 juni, 2021 (30 March 2022)
5	LFM30 Medlemmarna | Åse Togerö, Senior Green Development Manager på Skanska	https://www.youtube.com/watch?v=5Ea_U75Qx9c	14 June 2021 (30 March 2022)
6	LFM30 Medlemmarna | LFM30 Maja Manner, affärs- och hållbarhetsstrateg på AFRY	https://www.youtube.com/watch?v=J5UOrQ98oyM	14 June 2021 (30 March 2022)
7	LFM30 Medlemmarna | Jenny Wahl, drift- och teknikchef på Wihlborgs Fastigheter	https://www.youtube.com/watch?v=8xxX7-i2_dY&t=1s	14 June 2021 (30 March 2022)
8	LFM30 Medlemmarna |Jonas Larsson, Stena	https://www.youtube.com/watch?v=DeFqNhYAFws	22 June 2021 (30 March 2022)
9	LFM30 Medlemmarna |Mia Gustafsson, marknads- och kommunikationschef på HSB	https://www.youtube.com/watch?v=TyZB58N0usc	23 June 2021 (30 March 2022)
10	LFM30 Medlemmarna | Urban Blomster, marknads- och affärsutveckling, Södra.	https://www.youtube.com/watch?v=hEFnAV8vvkU	29 July 2021 (30 March 2022)
11	LFM30 – En klimatneutral bygg- och anläggningssektor i Malmö	https://www.youtube.com/watch?v=FynyFHdCdv4	21 April 2021 (17 March 2022)

Appendix V – Final code structure

- **LFM30**
  - What is LFM30
- **Collaboration**
  - Responsibilities of the participating actors
  - Motivations to join LFM30
  - Involvement among the participating actors
  - Practical collaboration within LMF30
    - Communication between actors
  - Power of network setting
- **Shared vision**
  - Problem definition
    - Establishing the problem definition
  - Long-term shared vision
    - Establishing the vision
    - Integrating LFM30's vision into the participating actors
  - Joint objectives, targets, and goals
    - LFM30's climate promise
    - Practical efforts from participating actors
- **Experiments**
  - Kind of experiment (high-risk innovation)
    - Societal
    - Institutional
    - Technological
      - Pilot projects conducted by the participating actors
    - Behavioral
  - External funding
  - Success criteria
- **Learning**
  - Learning spaces and activities
  - Capacity building and knowledge sharing
  - Monitoring
    - Of specific projects
    - Of LFM30's processes and methods
  - Evaluating and reflection
    - Follow-up and reflection
    - Adaption and adjustment
- **Other aspects**
  - Geography Malmö vs others
  - Role of City of Malmö (local municipality)
    - Relationship City of Malmö – LFM30
  - Timing

Appendix VI – Synthesis of findings

The below table presents a synthesis summary of the findings relating to each TM concept and the key elements relating to each concept.

TM Concept	Key TM elements of each concept	Key findings
Collaboration	Cooperation over competition	- Broad representation of actors across the entire building and construction value chain. - Culture of transparency and a willingness to share knowledge, but ambition to contribute differs among actors. - Some information is still sensitive to discuss, mainly relating to costs.
	Provides mental, social, and physical space to act together	- Actors have gained a forum for discussing and acting together, a local focal point for climate efforts. - Individuals working for participating actors are empowered to contribute and can find synergies among each other. - Voluntary commitment is essential for LFM30 to develop but increases uncertainty of progress.
	Possibility to influence political and market arena	- Powerful and influential actors are participating in LFM30. - Strengthening strategic position and contributing to, and influencing, sector developments were two of the most important factors for joining LFM30.
Shared Visions	Joint problem definition, common discourse	- Transition arena was formed at an early stage and consisted of powerful incumbents, who shared a willingness to push for change. - The problem definition was established prior to the process of initiating LFM30 and was not discussed in-depth within the transition arena. - However, there appears to be strong common belief among participating actors that their efforts can contribute to solving the problem.
	Long-term sustainability vision	- The vision appears to have been pre-determined and was not a result of deliberation in the transition arena, but the transition arena played a role in accepting the 'shared vision'. - LFM30 has served as a catalyst for higher climate ambitions among actors, both within and outside of Malmö's geographical scope, but it is difficult to determine the attribution of LFM30. - Actors have taken different approaches to link their climate ambitions to LFM30's vision.
	Joint objectives, targets, goals, and routes to get there	- Short- and midterm action is guided by the LFM30 *climate promise*, requiring actors to measure, report and communicate their alignment with LFM30's goals. - Transition pathways have been established in each of the six strategic focus areas, and corresponding working groups. - LFM30 has contributed to new climate efforts among actors, which differ in type of measure and their potential influence.
Experiments	High-risk innovations (societal, technological, institutional, or behavioral)	- LFM30 has unlocked new funding possibilities for actors to initiate (high-risk) innovations. - Technological and institutional (high-risk) innovations appear within LFM30.

		- In fact, LFM30's structure and main features (climate budget and climate promise) can be categorized as institutional innovation(s). - It is difficult to isolate the effect of LFM30 on the level of experiments implemented by actors as many factors play in.
	Establishing success criteria	- Goal values for GHG emissions from projects claimed to be climate neutral, i.e., specific building or construction projects. - In general, few criteria have been found in LFM30 for determining whether experiments significantly contribute to the transition vision.
	Scaling, deepening, and broadening of successful experiments	- Little scaling of experiments in currently occurring, many experiments are still in early stage. - Deepening of experiments is observed through learning measures. - LFM30 experiments have potential to be broadened to other locations and contexts but has not yet fully materialized.
Learning	Collaborative learning and capacity building	- Knowledge-sharing and deeper dialog between actors has been enabled by LFM30's learning spaces and activities, but low participation in working groups can limit collaborative learning. - LFM30 has become a one-stop-shop for information. - Individuals play an important role as knowledge distributors.
	Monitoring (of transition processes and TM procedures)	- Transition processes are monitored by participation and discussions in other forums where LFM30 actors also participate (Fossil Free Sweden, Swedish Construction Federation etc.). - TM procedures are mainly monitored through mandatory annual reporting on individual efforts to reach LFM30's goals. - Actors need to prove their efforts, which increases accountability.
	Evaluating, reflecting, and adapting	- Evaluation of practices within LFM30 should become more systematic. - Annual round-table discussions serve as a space for collective evaluation and reflection on LFM30 practices. - LFM30 has evolved a lot since its establishment in 2019, and adaption has been a natural part of this process.

Appendix VII – Criteria (goal values) within LFM30

The table shows current goal values for life-cycle GHG emissions per square meter (CO_2e/m^2 of gross habitable floor). Currently goal values exist for new construction of the following buildings: Commercial buildings, apartment buildings, detached houses, and parking garages. They apply until 2025.

Type of building	**Goal value (CO2e/m2 of gross habitable floor)**
Commercial buildings	270
Apartment buildings	216
Detached houses	171
Parking garages	170