# Realizing a circular building economy: The case of smaller Dutch municipalities

Master's thesis for the Environment & Society Studies program

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# Preface

Dear reader,

Good to have you here! Nice to see that this thesis titled "Realizing a circular building economy: The case of smaller Dutch municipalities" caught your attention. This thesis is written to complete my graduation for the Master program Environment and Society Studies, with the specialization Local Environmental Change and Sustainable Cities. A requirement for the thesis is to combine it with an internship, which I did at the municipality of Lingewaard, with just below 50.000 inhabitants a smaller municipality in the East of the Netherlands.

Why Lingewaard? Throughout my studies I have analyzed various policies and briefs, from the UN to the EU and all the way to the local level. During these analyses, it was almost exclusively about the policy itself, its effects on society, and its relation to other policies. However, my curiosity grew on the internal processes of 'the government' and about the people that work there. Via a personal connection I found myself in Lingewaard, who were looking to write a new policy document on circular building economy. I was immediately enthusiastic about the topic and jumped on the opportunity.

If I am honest, writing the thesis was not always as easy and I definitely needed some time to find my role as an intern in the municipality and to get used to focusing on qualitative research rather than working with quantitative datasets or models. But having said that, I really enjoyed doing this research and learned a lot about the workings of a municipality, the concept of the circular building economy, and doing this type of research. Also, municipalities are not too bad. Yes, there is a lot of coffee, but there is also a lot of commitment and love in what they do, something that motivated me to contribute as well.

So, because of that, I want to give a huge thank you to my colleagues at the municipality of Lingewaard for taking the time to answer my questions. Specifically, I want to thank my colleagues at the Sustainability team for taking me under their wing and really making me feel part of the team. I also want to thank my supervisor Ingrid and my fellow students for the brainstorm sessions, advice and positivity. You know who you are, thank you!

Now, get yourself something to drink and make sure you sit comfortably. With just over 21.000 words, this thesis is relatively extensive, but I hope it keeps your interest and inspires you. Enjoy reading!

Marten Wildenberg
Nijmegen, December 2025

Key words:
Circular building economy; Barriers and enablers; Governance capacity; Modes of governance; Smaller Dutch municipalities.

# AI Statement

We live in a time where AI chatbots are increasingly part of our daily activities. So, this thesis could also not go without addressing this topic first. Radboud values individual development through personal brainstorming and writing about the thesis topic. Having said so, use of AI is allowed as preparation for the work conducted in the thesis, under the condition that the actual writing is one's own. With this statement, I want to take a moment to stress that in writing this thesis, AI has not been used beyond these conditions.

# Executive summary

This study examines how smaller municipalities in the Netherlands of up to 50.000 inhabitants can realize and stimulate a circular building economy that encompasses both buildings and public space. The municipality of Lingewaard (47.500 inhabitants) serves as a case study. Here, the first efforts towards a circular building economy are being made and the municipality therefore illustrates the challenges smaller municipalities face in embedding circular practices with limited resources and capacity.

## Theoretical framework

This study applies the framework by Pomponi and Moncaster (2017), which identifies six key dimensions of the circular building economy: governmental, economic, technological, environmental, societal, and behavioral. These dimensions are used to identify key barriers and enablers regarding circular implementation in Lingewaard as they provide a broad perspective on the system context. However, they provide only little insights into the governance capacities smaller municipalities need to overcome these barriers and seize the identified enablers. Mees and Driessen (2011) define governance capacity as "*the degree to which a public-private network of actors is able to resolve societal issues*" (p.253). They distinguish five capacities: legal, managerial, political, resource, and learning. Smaller municipalities typically have limited amounts of these capacities and therefore rely on collaboration with public and private partners. How this collaboration is framed is dependent on the mode of governance. Bulkeley and Kern (2006) identify four modes of governance which governmental actors can deploy. In this case, a municipality can realize a circular building economy through self-governance, or it can stimulate a circular building economy through governing by provision, authority, or through enabling. This thesis combines all three frameworks to analyze Lingewaard's context and approach.

## Barriers and enablers in Lingewaard

Interviews and informal conversations were conducted with four different stakeholder groups: municipalities, regional public organizations, market actors, and knowledge institutes. Their insights were used to identify the key barriers and enablers across the six dimensions for a circular building economy. These are presented in the Table below.

## Governance capacity and modes of governance

The current state of governance in Lingewaard shows strong politica commitment but is constrained by limited legal authority, resources and managerial capacity. National regulations discourage ambitious requirements, leaving municipalities dependent on collaboration and regional uniformity to gain influence. Internally, circularity is applied ad hoc, though the recent appointment of a policy officer signal growing momentum. Financial and human resources remain limited, making strategic management essential. Learning capacity exists but is fragmented because monitoring, evaluation, and actualization are not yet sufficiently embeddded. Improving human capacity, regional collaboration, and experimentation could strengthen this capacity.

*Table i. Key barriers and enablers for a circular building economy in Lingewaard.*

| Dimension | Barrier | Enabler |
|---|---|---|
| Governmental | Insufficient national regulation | The government has a duty of care |
| | Not having the lead in residential housing projects | Integrating circularity into the Environmental Planning Act |
| | Uncertainty and unfamiliarity regarding the Environmental Planning Act | |
| | Circularity is expressed as ambition, not yet as a policy | |
| | Lack of clarity and uniformity | |
| Economic | An unviable business case | Requesting a financial contribution for area development |
| | Limited municipal budget | Adjusted basis for determining land input value |
| | | The planning gain levy |
| | | Declining costs of circularity and an improved business case |
| Environmental | Difficulty in simultaneously tareting resource use and $CO_2$-reduction | Transition toward climate-resilient construction |
| Technical | Insufficient storage capacity | The development of a universal language |
| | An overly complex set of tools | A regional shared material depot |
| | Project processes are not yet aligned with circularity | Technological advancement continues |
| Societal | Circularity is not yet an integral part of project team operations | Learning from other regional projects and stakeholders |
| | Unclear division of roles between municipalities and the GMR | Enhancing knowledge within projects |
| | Unertainty within Lingewaard about market capabilities | Collaborations with housing corporations |
| Behavioral | Predominantly tradition working methods persist across all stakeholders | Beheavior as a central theme |
| | Business case feasibility is prioritzed over experimentation | Growing awareness among market actors |
| | | Circularity as a societal theme |

The modes of governance further illustrate the current state of governance, but also highlight future opportunities. In project where the municipality leads, such as social real-estate or civil works,self-governance allows it to set demands for circularity, even though this is currently not applied. In residential projects, however, its role is primarily facilitative, relfecting governing by provision, where conditions can be attached but not enforced. Authority is largely restricted by national regulations, though zoning and environmental plans provide leverage. Most promising seems to be governing through enabling, where the municipality acts as a connector and stimulator, fostering collaboration with regional partners, market actors, and knowledge institutes. This approach expands influence beyonf formal authority and empoweres collective action toward long-term sustainbility goals.

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*"Buildings should be like trees, and cities like forests. They should purify air, sequester carbon, produce oxygen, and provide habitat for countless species. In a circular economy, the built environment is not a burden on the planet but a participant in its regeneration, designed to continuously cycle materials, nutrients, and energy in ways that enhance rather than deplete the world around us."*

William McDonough, architect and sustainability pioneer

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# 1. Introduction

## 1.1 Problem statement

The building and construction sector consumes approximately 40% of global raw materials and contributes almost 40% of energy-related $CO_2$ emissions globally (World Economic Forum [WEF], 2024). These numbers show the inherently intertwined nature between the sector and climate change. With a growing urban population, these effects are expected to increase in the coming years as the demand for housing and urban facilities drives further use of already scarce resources and greenhouse gas emissions. This interplay stresses the limits of urban development centered around continuous economic growth, a notion that is not exclusive to the urban environment. It becomes more and more evident that the current linear take-make-dispose system is not sufficient to sustain development in the future (Merli et al., 2018). Concepts such as cradle-to-cradle have showed promising results but at the same time have proven to be insufficient to achieve radical, long-lasting impact.

More recently, the concept of circular economy has gained traction in both academic and policy circles as a way to close the material loop. There are many different definitions of what the circular economy entails (Kirchherr et al., 2017), but the general idea is that achieving a circular economy implies prioritizing resource use and environmental impact over economic growth (Lazarevic & Valve, 2017), allowing for the reduction of greenhouse gas emissions and reliance on material extraction (Hart et al., 2019).

## 1.2 Scientific and societal relevance

The circular economy reflects ambitions in line with Sustainable Development Goals (SDGs) 11 (sustainable cities and communities) and 12 (responsible consumption and production), both are often operationalized in the articulation of missions (Coenen et al., 2023). Most of these missions address technological solutions (Benachio et al., 2020) and much research has been conducted on the technical aspects of circularity, such as materials or waste (Çimen, 2021). However, developing and disseminating novel technologies is not enough to achieve a circular economy. Rather, a structural change in policy and regulation is needed as well (Charaf & Lu, 2021).

Academic literature tends to aim to identify barriers and enablers, and establish their importance through a systemic literature review of case studies (Benachio et al., 2020; Joensuu et al., 2020) or deliberation, for example by conducting interviews (Kirchherr et al., 2018). Such approaches are, however, criticized for being objective and leaving the subjectivity of different interpretations and meanings unattended (Hart et al., 2019). In other words, the frequency in which a barrier occurs in a review of case studies does not necessarily correlate with its importance (ibid.). What is considered important depends on the perceptions, interpretations, and framings of the specific context (Coenen et al., 2023). These can very drastically between projects and applications, which is why many definitions of the circular economy exist (Kirchherr et al., 2017; 2023).

The European Union (EU) has recognized the circular economy as a key approach to urban development (European Commission, 2022) and these ambitions have been adopted by the Dutch national government (Circulaire Bouweconomie, 2023). At the local level, however, these policies have been criticized for being too technocratic, expressing clear material ambitions and competitive goals, but limited mechanisms to promote stakeholder engagement (Corvellec et al., 2021). As a result, regulatory, cultural and sectoral barriers to realization arise (Springvloed, 2021). Much of the research on the local level to identify barriers and enablers has focused on metropolitan areas because of their economic and social importance (Cramer, 2020; Russell et al., 2020). In addition, only few studies take the extra step to discuss "how" and "what it takes" to implement a circular economy principles (Levoso et al., 2020), let alone explore the active role local governments can play in this (Dagilienė et al., 2021). As a result, there is a gap in scientific literature when it comes to the role of local municipalities to generate value to realize the circular building economy and the governance capacities needed to streamline the adoption of circular practices.

In order to relate relevant findings from literature to local level governance and to fill the gaps previously identified, this thesis will use the municipality of Lingewaard, the Netherlands, as a case study. Much like other similar municipalities in Netherlands, Lingewaard struggles with the uncertainty caused by vague and ambiguous policy and ambition from the EU and national level. The current building regulations in the Netherlands are not sufficient enough to reach the 50% circularity goal by 2030, let alone become fully circular in 2050. In addition, the Dutch government actively speaks out to oppose any additional (circularity) demands provinces and municipalities want to add, because the fast construction of affordable housing is deemed more important than the construction of high-quality housing for the future based on circular principles. This asks for an answer as to how smaller municipalities in the Netherlands can navigate the narrow road to high ambitions while having limited capacity to do so. This thesis uses the municipality of Lingewaard as a case study to identify the key factors and nuances at play in smaller Dutch municipalities in an attempt to bring clarity to the circular economy mission.

## 1.3 Research aim and research questions

The concept of circular economy has received much attention in the recent decade and there is also a growing interest in applying the concept to the built environment. Especially the construction and demolition sector has been a major field of research. As will be elaborated in Chapter 2, many of these studies have focused on the building process, basing their research on structural qualities, design, or construction phases. Articles analyzing the policy domain generally analyze the implications and opportunities stemming from supranational or national legislation. Only a few articles have taken the perspective of regional or municipal actors. The most important results in these studies have been the formulation of a research framework (Iacovidou et al., 2021) and a list of possible strategies municipalities can deploy (Hartley et al., 2023). The downside of these findings is that they lack application by municipal employees, nor do they specify how and in which situations they can best be applied (Levoso et al., 2021). In other words, there is a lack of practical frameworks to be used by policy developers. This thesis aims to fill this gap by answering the following research question:

*Main research question. How can local municipalities in the Netherlands, like the municipality of Lingewaard, enhance their governance capacity to realize and stimulate a circular building economy?*

The approach to answer this research question is three-fold. First, realizing a circular economy touches many different domains, also outside the regulatory and institutional setting of a municipality. To gain insights into each domain and the dynamics between them, the following sub-question is proposed:

*SQ1. What are the barriers for a circular building environment, and which enablers exist to overcome these barriers?*

Second, the circular economy is a broad topic that stretches beyond municipal borders. Operationalization occurs when the interests of municipalities align with those of other government organizations, market parties and other actors. Identifying which collaborations to form and how to form them is key. To explore the role and prospect of collaborations, the following, and final, sub-question is proposed:

*SQ2. Which other parties play a role in the realization of a circular building economy at the municipal level, and how can collaboration with these parties best be structured?*

Finally, this thesis aims to unravel the complexity of municipal governance and identify the various interconnected dynamics involved. The belief is that only then it becomes possible to identify the possibilities for the integration of circular economy goals. To this end, the following sub-question is proposed:

*SQ3. What are the current governance capacities of the municipality of Lingewaard relevant to the circular building economy, and how can they be enhanced?*

## 1.4 Structure of the thesis

This thesis will first provide a clear overview of the concept of circular economy by discussing the premises on which the circular economy is constructed, its limitations, as well as how the concept can be translated to the built environment. This part will be concluded with an overview of the barriers and enablers found in literature on the circular building economy. Second, a theoretical framework will be developed based on key elements of established frameworks. This theoretical framework is used as the basis for the research conducted in this thesis. Third, the methods used in this thesis are explained. Fourth, the case study of the municipality of Lingewaard is explored in more detail to provide the baseline of current governance and operationalization of the circular building economy. The remainder of this thesis will discuss the results in terms of barriers and enablers, governance capacities, and modes of governance. Here, it will provide insights into how smaller Dutch municipalities can realize and stimulate a circular building economy.

# 2. Literature review on the circular economy concept

The concept of circular economy grew from 'the new kid on the block' to a central 'buzzword' in policy, market, and academic circles. The results are ambitious plans across governance levels and the adoption of just as ambitious circular business models by market actors. Municipalities are handed the task of translating higher-level policies into elaborate but understandable strategies that are inclusive of a variety of dimensions, among which the built environment. This literature review will form a red-thread through these different points and create a broader understanding of the dynamics at play.

## 2.1 The rise and development of the circular economy concept

Circular economy is not a novel topic but rather an evolution from previous concepts that stressed the limitation of a linear production model based on finite resources. This thesis takes the notion of 'Spaceship Earth' by Boulding (1966) as the starting point of the discussion on the circular economy. Here, Boulding was among the first to argue that the Earth has limited resources and that "*man must find his place in a cyclical ecological system which is capable of continuous reproduction of material form*" (Boulding, 1966, p.7-8). How such a 'cyclical ecological system' should take form has been the topic of debate since. The discussion has seen various phases, which are often discussed in terms of 'Circular Economy 1.0' or 'CE 3.0' (Reike et al., 2018), and is now on the brink of 'CE 5.0' (Aivazidou et al., 2025).

The publication of the Club of Rome on the limits to growth (Meadows et al., 1972) served as a wake-up call that caused a shift in waste management. In order to formulate concrete strategies, the 3R concept of 'reduce, reuse, and recycle' gained increasing attention, marking the most important development of 'Circular Economy 1.0' (Reike et al., 2018). Some scholars have expended the concept to also include a fourth R that refers to the recovery of energy and materials from waste (Kirchherr et al., 2017). These 'R-principles', however, were unable to connect input and output measures, giving rise to the 'Circular Economy 2.0' that increasingly tries to link business and economic growth with the environment (Reike et al., 2018). The 'Circular Economy 3.0' was built on the approach by the Ellen MacArthur Foundation (2015), which also linked the environment with technology, but advocated for regeneration of natural systems in addition to regeneration of materials. From 2010 onwards, the framing changes to value retention, or "*strategies to extend resource life as a means to facilitate additional value extraction and reduce value loss and destruction*" (Blomsma and Brennan, 2017, p. 611).

As a result, Reike et al. (2018) propose a more nuanced 10R classification, to which Çimen (2021) adds an 11th R-principle. More recently, studies into 'Circular Economy 4.0' have researched the relationship between the circular economy concept and 'Industry 4.0', an umbrella term for the digitalization of industrial processes, leading to investigations into a smart circular economy paradigm (Bressanelli et al., 2022; Tsolakis et al., 2023). 'Industry 4.0' then acts as an enabler to circular economy operationalization by supporting lifecycle management strategies, digitizing practices, enhancing resource efficiency, and supporting sustainable business models (Rosa et al., 2019; Khan et al., 2021). New developments have

steered in the direction of 'Circular Economy 5.0' and 'Industry 5.0' to extend and complement these benefits also considering broader societal values in addition to industry applications (Atif, 2023; Aivazidou et al., 2025).

Throughout this historic timeline, various associated concepts to the circular economy were developed, such as industrial ecology, performance economy, closed-loop supply chain, cradle-to-cradle, industrial symbiosis, ecological modernization, and degrowth. For example, in linking economic growth with the environment, a parallel can be found between the circular economy and sustainable development. Defined as "*development that meets the needs of the present generation without compromising the ability of future generations to meet their needs*" (World Commission on Environment and Development [WCED], 1987, p.37), sustainable development emphasizes system thinking and frames environmental problems as economic opportunities (Blomsma and Brennan, 2017). Furthermore, by framing circular economy as a value retention mechanism, circular economy builds on each of these concepts and draws attention to their individual capacities as well as their interrelations (Blomsma and Brennan, 2017).

But where does this leave the circular economy concept? Despite the inclusion of 'broader societal values' to the nexus between circular economy and 'Industry X.0' concepts, it remains a rather industry-focused endeavor (Ávila-Gutiérrez et al., 2019; Tsolakis et al., 2023), which are highly focused on industrial supply chain management. As such, its application in the policy domain is uncertain. Nevertheless, also in this domain a slight shift in the conceptualization of circular economy can be observed. Where the R-principles focused predominantly on how to achieve circularity through specific actions, there is a growing realization to move beyond individual actions towards system thinking. Circular economy "*is not considered an end goal unto itself but a means to accomplish sustainable development*", needing a broad range of stakeholders to achieve it (Kirchherr et al., 2023, p.2).

## 2.2 The limitations of the circular economy concept

Despite showing promising characteristics, the concept of circular economy is not without limitations. The first point of critique relates to the objective of the circular economy concept, which has been named "*an ideological agenda dominated by technical and economic considerations*" (Corvellec et al., 2021, p.426) or "*a recent addition to the list of 'sustainababble'*" (Kirchherr et al., 2023, p.1239). The rationale behind this critique is that in its core, the circular economy is elusive. Korhonen et al. (2018) point to the thermodynamic, spatial, and temporal limits of the concept, arguing that a circular system still consumes resources and faces challenges of displacement over time. As a result, "*it is unclear how the concept of the circular economy will lead to greater social equity*" (Murray et al., 2017, p.376) and also the environmental benefit is highly doubted, with Miller et al. (2019) stating that "*the only difference from the linear model would be that the negative environmental impact will take longer*" (Miller et al., 2019, p.15). This highlights the potential pitfall of the circular economy in the negligence of potential environment and social tradeoffs and the pursuit of 'circularity for circularity's sake' (Harris et al., 2021) and emphasizes the need for systemic circular solutions (Papageorgiou et al., 2021).

In addition, efficiency gains, for example through technological advancements, could just as well drive increased consumption, often explained through the rebound effect (Berkhout et al., 2000; Castro et al., 2022), Jevon's paradox (Mayumi et al., 1998), and the boomerang effect (Mayer et al., 2005). Path dependencies and lock-in effects can occur when these advancements lead to retaining market positions (Korhonen et al., 2018). Ideally, the circular economy concept is developed as a result of dialogue between civil society, consumers, the private sector, and policy-makers (Brandão et al., 2020), but the truth is that it is almost exclusively being developed by practitioners, such as policy-makers, businesses, consultants, etc. (Korhonen et al., 2018). This has to fundamentally change to break the framing of the circular economy as a corporate-led model, as well as to address the critique of its inability to disrupt the status quo and reduce social inequalities and environmental pressures (Corvellec et al., 2021).

The second point of critique relates to the 'definitial quagmire' (Corvellec et al., 2021). Kirchherr et al. (2017; 2023) found a multitude of circular economy definitions and Reike et al. (2018) identified 38 different R-principles in literature. In addition, other sets of circular economy principles, such as by the Ellen MacArthur Foundation or Ghisellini et al. (2016), refrain from using 're-' words and instead include a variety descriptions of processes and objectives (Papageorgiou et al., 2021). Variation is also seen in policy circles, where the 3R strategies by the European Union and the United Nations have different meanings (Vermeulen et al., 2018). Because of the dynamic and constantly changing nature of the circular economy, it is unlikely that an universal definition will ever be formulated (Korhonen et al., 2018). Yet, at the same time, the multitude of approaches to the conceptualization of circular economy forms a barrier to its implementation (Kalmykova et al., 2018).

These limitations show the uncertainty of the circular economy concept in terms of long-term effectiveness. Most importantly, however, the discussion exposes the potential inability of the concept to represent a solution to the issues it is said to be a solution for. This is best illustrated by Fuller (1996) in his book *Operating Manual for Spaceship Earth*, where he compared a problem-solving endeavor to a shipwreck:

> *"… if you are in a shipwreck and all the boats are gone, a piano top buoyant enough to keep you afloat that comes along makes a fortuitous life preserver. But this is not to say that the best way to design a life preserver is in the form of a piano top. I think that we are clinging to a great many piano tops in accepting yesterday's fortuitous contriving as constituting the only means for solving a given problem" (Fuller, 1969, p.9).*

In other words, who is to say that the new framing of circular economy as an umbrella concept is not another ambitious set of principles that remains unsuccessful to result in widespread action, like the approaches on which it is based? Or, as Cullen (2017) argued, "*without careful explanation of limits and the circumstances in which it can succeed the [Circular Economy] repackages [Industrial Ecology] principles in a reductive manner*" (Cullen, 2017, p.485). But implementation is uncertain (Corvellec et al., 2021) because of many barriers that exist in a variety of domains (Hart et al., 2019). Overcoming these barriers is

detrimental for circular economy to evolve from a well-intended paradigm to a reality of systemic transformation. But as the circular economy gains attention, the status quo remains untackled, suggesting that the current framing of the concept leans more towards denial rather than seeing the potential of circular economy as an opportunity (Boin et al., 2009). The question that remains is under what conditions the circular economy concept can succeed and break out of this merely theoretical rhetoric. This thesis aims to provide an answer to this question related to operationalizing a circular building economy at the local level.

## 2.3 Translating circular economy to the built environment

Due to circular economy being applied in a variety of contexts, the concept can also be interpreted in many different ways. According to a literature review on the concept of circular economy in the construction industry, the most cited definition is that of the Ellen MacArthur Foundation (Benachio et al., 2020). They define a circular economy as an economy that is "*restorative and regenerative by design, and aims to keep products, components, and materials at their highest utility and value at all times*" (Ellen MacArthur Foundation, 2015, p.3). Other definitions are proposed by Lacy and Rutqvist (2016), Geissdoerfer et al. (2017), Korhonen et al. (2018), and Kirchherr et al. (2017). The latter, cited by researchers in multiple domains, proposes a definition that links circular economy to sustainable development:

> *"A circular economy describes an economic system that is based on business models which replace the 'end-of-life' concept […] in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial, parks), and macro level (city, regional, nation, and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations (Kirchherr et al., 2017, p.224-225).*

In the context of the built environment, this implies a change from a linear take-make-dispose system towards a circular construction and demolition system that internalizes closed circles of slow material flows and enables a decoupling of resource use and environmental impact from economic growth (Lazarevic and Valve, 2017). But also here many different interpretations exist. Pomponi and Moncaster (2017) define circular buildings as "*a building that is designed, planned, built, operated, maintained, and deconstructed in a manner that is consistent with CE principles*" (Pomponi and Moncaster, 2017, p.711). More elaborately, Leising et al. (2018) define the approach of the circular building environment as "*a lifecycle approach that optimizes the buildings' useful lifetime, integrating the end-of-life phase in the design and uses new ownership models where materials are only temporarily stored in the building that acts as a material bank*" (Leising et al., 2018, p.977). According to Benachio et al. (2020), these definitions lack an explicit focus on the complete life cycle of a building, which is why they propose to define the circular building economy as "*the use of practices, in all stages of the life cycle of a building, to keep the materials as long as possible in a closed loop, to reduce the use of new natural resources in a construction project*" (Benachio et al., 2020, p.5).

While all these interpretations share a fundamental shift from linear to circular systems, they differ in their level of detail, prioritization of characteristics (design, life cycle stages, economy), and their application across different levels (macro, meso, micro). However, with the shift in focus from principles towards a system perspective, the definition of the circular economy gains a new form as well. The previously presented definition by Kirchherr et al. (2017) emphasizes the central role of business models and therefore can be argued to have an industrial focus. As such, it lacks consideration for a broader system, including the stakeholders and their capabilities. In order to fill this gap, Kirchherr et al. (2023) replicated their earlier study and formulated a new, more temporary definition of the circular economy:

> *"The circular economy (CE) is a regenerative economic system which necessitates a paradigm shift to replace the 'end-of-life' concept with reducing, alternatively reusing, recycling, and recovering materials throughout the supply chain, with the aim to promote value maintenance and sustainable development, creating environmental quality, economic development, and social equity, to the benefit of current and future generations. It is enabled by an alliance of stakeholders (industry, consumers, policymakers, and academia) and their technological innovations and capabilities" (Kirchherr et al., 2023, p.4).*

The aim of this thesis is to identify and address policy implications for municipal governments regarding the construction and demolition sector. For that, it is important to establish an operational definition of circular economy (Corona et al., 2019), but none of the above definitions seem 'perfect'. The definitions specific to the built environment are too specific in that they emphasize the building in itself rather than the entire process. In addition, despite being an improvement on the earlier definition, the second definition by Kirchherr et al. (2023) might be too broad in the sense that it lacks specificity for applications in the context of this thesis. However, under the assumption that no universal definition to the circular economy can be formulated (Korhonen et al., 2018), this thesis uses the aforementioned definition by Kirchherr et al. (2023) as the operational definition in this research. While doing so, it recognizes that the definition is not specific to the construction and demolition sector, but because of the generalizability of the definition this discrepancy is assumed not to interfere with the analysis.

## 2.4 Barriers and enablers to a circular building economy

The first sub-question of this thesis asks about the barriers for a circular building economy and the enablers that could be used to overcome these barriers. Over the past decade, a growing body of literature has addressed this question, reflecting the growing interest in the topic. This paragraph aims to analyze a selection of studies in order to identify the barriers and enablers most relevant to this thesis (Table 1, 2). The majority of the selected studies focus on the circular building economy, specifically the construction sector and waste management. In addition, several studies with a more general scope on the circular economy have been selected as they highlight dynamics that shape construction and waste practices. The combination ensures that the analysis captures a wider set of barriers and enablers.

*Table 1. Barriers to a circular building economy, retrieved from literature.*

| Barrier | Meaning in practice | Sources |
|---|---|---|
| Economics and market | | |
| High upfront costs and a weak business case | Circular solutions often require higher initial investment with uncertain payback | Adams et al. (2017); Campbell-Johnston et al. (2019); de Jesus & Mendonça (2018); Cainelli et al. (2020) |
| Low virgin material prices | Cheap linear input makes secondary materials less competitive | Campbell-Johnston et al. (2019); Kirchherr et al. (2018) |
| Market immaturity for secondary materials | Limited supply, quality variability, lack of trust in reclaimed components | Campbell-Johnston et al. (2019); Purchase et al. (2022) |
| Regulation and policy | | |
| Regulatory gaps and misalignment | Inconsistent standards, permitting hurdles, liability/warranty uncertainty | Ancapi et al. (2022); Giorgi et al. (2022); Hossain et al. (2020); Morel (2021); Russell et al. (2020) |
| Short-term tendering and procurement models | Lowest-price focus, split incentives, lack of whole-life value | Campbell-Johnston et al. (2019); Hossain et al. (2022) |
| Technical and design | | |
| Lack of circular design concepts | Limited design-for-disassembly, modularity, adaptability | Adams et al. (2017); Hossain et al. (2020); Joensuu et al. (2020) |
| Data scarcity and traceability issues | Missing material hostories, poor documentation, absence of digital passports | Giorgi et al. (2022); Hossain et al. (2020); Purchase et al. (2022) |
| Performance and liability uncertainty | Concerns about warranties, insurance, technical reliability of reused materials | Giorgi et al. (2022); Morel (2021) |
| Behavioral and organizational | | |
| Low awareness and hesitant culture | Risk aversion, preference for linear practices, lack of demand | Adams et al. (2017); Campbell-Johnston et al. (2019); Kirchherr et al. (2018) Manuro and Tavares (2023) |
| Skills and knowledge gaps | Limited competencies in circular design, methodlogies (e.g. LCA), deconstruction planning | Adams et al. (2017); Hossain et al. (2020); Giorgi et al. (2022) |
| Collaboration | | |
| Fragmented value chains and poor collaboration | Disconnected stakeholders, isolated decision-making, unclear roles | Adams et al. (2017); Hossain et al. (2020); Giorgi et al. (2022); Purchase et al. (2022) |
| Operational and logistics | | |
| Fragmented supply chain and logistics constraints | Deconstruction, sorting, reverse logistics, complex storage and maintenance | Adams et al. (2017); Hossain et al. (2020); Purchase et al. (2022) |

*Table 2. Enablers to a circular building economy, retrieved from literature.*

| Enabler | Meaning in practice | Sources |
|---|---|---|
| Economics and market | | |
| Secondary material markets and quality standards | Marketplaces, certification, grading systems to build trust | Purchase et al. (2022); Giorgi et al. (2022) |
| Business models for product-service and take-back | Leasing, service models; reverse supply chains | de Jesus and Mendonça (2018); Hossain et al. (2020) |
| Whole-life costing a circular indicators | Metrics (e.g. LCA) reveal long-term value | Hossain et al. (2018); Joensuu et al. (2020) |
| Regulation and policy | | |
| Policy instruments and public procurement | Standards, mandates, green procurement, fiscal initiatives | Ancapi et al. (2022); Giorgi et al. (2022); Kircherr et al. (2018) |
| Urban circular economy initiatives and collaborations | City-level pilots, municipal support, regional programs | Russell et al. (2020); Campbell-Johnston et al. (2019) |
| Technical and design | | |
| Digitalization | Tools for design, assessment and traceability | Chen et al. (2022); Hossain et al. (2020) |
| Circular design strategies | Design-for-disassembly, modularity, adaptability, material optimization | Adams et al. (2017); Joensuu et al. (2020) |
| Behavioral and organizational | | |
| Capacity building and guidance | Training, guidelines, best-practice repositories | Adams et al. (2017); Giorgi et al. (2022) |
| Awareness raising and cultural change | Campaigns, education, leadership commitment | Kirchherr et al. (2018); Manuro and Tavares (2023) |
| Collaboration | | |
| Collaboration platforms and stakeholder coalitions | Multi-stakeholder networks, material hubs, partnerships | Campbell-Johnston et al. (2019); Rusell et al. (2020) |
| Operational and logistics | | |
| Material hubs | Systems for collection, sorting, and redistribution of materials | Hossain et al. (2019); Purchase et al. (2022) |

# 3. Developing a theoretical framework

The shift in the theorization of the circular economy from various R-categorizations towards a system perspective calls for the development of new tools and guidelines for circular economy implementation and analysis. To this end, a variety of research frameworks and indicators have been developed but this development is relatively new and the theoretical implications as well as practical contributions are not always clear (Hossain and Ng, 2018). In order to provide a better understanding of the differentiations between frameworks and indicators, this chapter discusses a number of scientific articles selected based on their perceived relevance to the research question and to the broader discussion on a circular building economy.

## 3.1 Backbone methodologies to circular economy assessment

The starting point of this discussion on a framework for a circular economy are the three "backbone methodologies" (Corona et al., 2019, p.5): life cycle assessment (LCA), material flow analysis (MFA), and input-output analysis (IOA). First, LCA is a standardized method that can be used to assess the associated impacts of a product's life cycle. The method focuses on the environmental impacts from resource use and is therefore often complemented by other methods such as life cycle costing (LCC) or social life cycle assessment (SLCA) to assess the economic and social impacts, combined forming a life cycle sustainability assessment (LCSA) (Larsen et al., 2022). In the context of circular economy, these approaches can be used to quantify and evaluate both the benefits and impacts of implemented strategies (Corona et al., 2019), but they require substantial amounts of data and time (Elia et al., 2017). Second, MFA considers the state and changes of material flows in a system (Brunner and Rechberger, 2016), and in the context of circular economy is applied for accounting or modelling purposes (Corona et al., 2019). Application of MFA is, however, limited because, besides the quantity of materials used, it does not provide information about the quality, nor does it incorporate all environmental impacts (Elia et al., 2017). Third, IOA was developed for economic purposes but has also been extended to include environmental characteristics (Donati et al., 2020) or combined with other approaches, such as the LCA (Genovese et al., 2017), to overcome shortcomings of IOA applications at product level (Corona et al., 2019). However, none of these 'backbone methodologies' proved to be sufficient to encompass the entirety of what a circular economy entails.

## 3.2 The development of a circular economy framework

### 3.2.1 A general, overarching framework

The framing of the circular economy as a systemic problem requires assessment frameworks that inherently incorporate the entirety of the system rather than through a combination of methods. To this end, the Ellen MacArthur Foundation (EMF) proposed the ReSOLVE framework, which distinguishes between "*six actions that businesses and governments can take in order to transition to a circular economy: regeneration, share, optimize, loop, virtualize, and exchange*" (EMF, 2015, p. 9). This framework has been adopted to form circular business

*Figure 1. Six dimensions for building research in a circular economy (Pomponi and Moncaster, 2017, p.715).*


models (Jabbour et al., 2019) and has also been applied in the construction sector (Torgautov et al., 2021). Other frameworks emphasize the various barriers and opportunities to a circular economy, for which the foundation was paved by Pomponi and Moncaster (2017) with their identification of the six pillars to researching a circular building economy: governmental, economic, technological, environmental, societal, and behavioral (Figure 1). Another approach is the integrative, cascading, resource-based framework proposed by Desing et al. (2020), which highlights the planetary boundaries and how these influence society and economy. None of these approaches, however, has been able to form an operational tool to systematically analyze the circular economy concept in the built environment (Çimen, 2021). Rather, various attempts have tried to develop a framework for specific research applications, such as construction design (Munaro et al., 2022), construction management (Hossain et al., 2020), or specific material applications such as wood or steel construction (Jahan et al., 2022; Pinto et al., 2019). Overall, the application of aforementioned frameworks serves the purpose of guiding circular practices rather than guiding research or policy formulation.

### 3.2.2 A framework for technological considerations

Another common angle of research on the circular building economy is the application of a construction framework based on technological considerations. Çetin et al. (2021) developed a framework to identify digital technologies with the highest potential to enable a circular economy in the built environment across life cycle phases. Although single individual technologies can be labeled as most promising (Chauhan et al., 2022), it is important to note that many of these technologies are interdependent of each other and that these interactions "*demonstrate leveraged capabilities towards achieving circular economy goals*" (Çetin et al., 2021, p.24). Examples are the use of artificial intelligence for its

problem-solving (Darko et al., 2021), decision-making (Yu et al., 2022a), or optimization potential (Ghoreishi and Happonen, 2020), adoption of building information modelling (BIM) (Charaf, 2022), and the internet of things (IoT) as an enabling technology (Rejeb et al., 2022). Related, Guzzo et al. (2022) proposed a system dynamics-based framework to provide a modelling-oriented approach to circular economy transitions. Studies on (digital) material passports show promising developments (Jensen et al., 2023), but benefits can only be obtained when design and implementation are well-coordinated (Langley et al., 2023).

### 3.2.3 An assessment framework

The benefit of digital technologies and frameworks supporting the use of these technologies, however, primarily lies in industrial applications whereas their usability in the policy domain remains rather uncertain. Thus, there is a need to provide policy- and decision-makers with supportive indicators, indices, and assessment frameworks to better evaluate and monitor the transition to a circular economy (Papageorgiou et al., 2021). However, what to measure in order to assess circular economy remains unclear due to the many definitions of circular economy that exist (Moraga et al., 2019). Moreover, the term 'indicator' can also be interpreted in different ways (Papageorgiou et al., 2021). Nevertheless, there is a general understanding that the use of indicators can serve as a supporting tool for policy- and decision-makers looking to evaluate and measure the circular economy (Saidani et al., 2019).

'Circularity indicators' differ depending on the system level (Kristensen and Mosgaard, 2020), meaning they can be divided into macro-level (cities, regions, nations), meso-level (businesses, industrial, symbiosis), and micro-level (organization, products, consumers) indicators (Saidani et al., 2019). As such, they relate to the definition of the circular economy proposed by Kirchherr et al. (2017) and to the 'backbone methodologies' discussed in Chapter 3.1. This thesis will not take a deep dive into the many circularity indicators, for that it refers to several studies conducted for this purpose (Moraga et al., 2019; Saidani et al., 2019; De Pascale et al., 2021). Rather, zooming in on the built environment, several studies have proposed a set of indicators for circular city implementation, but these generally do not provide enough information "*about how these policies can be operationalized through instruments to implement a [Circular Built Environment]*" (Ancapi et al., 2022, p.2-3).

## 3.3 The role of governance

The previous discussion highlights that there are various frameworks for analyzing the circular economy concept. However, the overarching conclusion is that many of these frameworks and tools are designed for research application and not specifically for the formulation of policies. A small body of literature explores this gap of which the majority of studies focus on the supranational level of the EU (Kirchherr et al., 2018). Here, circular economy is often described in terms of resource efficiency and, as such, related to resource policies. Several studies in this direction highlight the benefit of a carefully designed policy mix prioritizing shorter loops (Milios, 2018) and learning (Domenech and Bahn-Walkowiak, 2019; Hartley et al., 2023). More specific to the construction and demolition sector, several studies presented frameworks to analyze the implementation process of circular economy

policies, either presented as a list-structured policy framework (Mahpour, 2018) or as variations of policy cycles (HaitherAli and Anjali, 2024; Yu et al., 2022b) based on the transition management cycle (Loorbach, 2010; Frantzeskaki et al., 2012).

Studies like these highlight the role of governance in the realization of a circular economy. A commonly used definition sees governance as "*a government's ability to make and enforce rules, and to deliver services*" (Fukuyama, 2013, p. 350). However, as will further be discussed in this Chapter, the realization of a circular economy is not solely a governmental affair, especially at the local level. To this end, this thesis uses a more inclusive definition for governance, to mean "*the interactions among structures, processes and traditions that determine how power and responsibilities are exercised, how decisions are taken, and how citizens or other stakeholders have their say*" (Graham et al., 2003, p. 2).

### 3.3.1 Environmental governance

Governance can take many different forms, and what constitutes 'good' or 'bad' governance often depends on the field of application (Fukuyama, 2013). In the context of the circular economy, the concept most closely aligns with environmental governance, which analyzes "*how decisions related to the environment are made and whether resultant policies and processes lead to environmentally and socially sustainable outcomes*" (Bennett and Satterfield, 2018, p.6). This perspective is relevant because the circular economy is not limited to resource efficient or waste management alone. Rather, it requires a broader understanding of how institutional arrangements, policy frameworks, and stakeholder interactions shape environmental outcomes. By adopting the aformentioned definition of environmental governance, this thesis emphasizes these political and societal dimensions of the circular economy as well as its relationship with other environmental challenges.

### 3.3.2 Policy integration

Regardless of the field of application, the dynamic and constantly changing nature of the circular economy concept means that its operationalization spreads across multiple policy fields. A single policy cycle, therefore, does not provide sufficient support for research purposes. The need for policy integration then becomes evident, but a framework for policy integration in the context of the circular economy has yet to be proposed. Policy integration, or integrative governance, can be defined as:

> *"a political process that entails actors and agencies, coordinating across different policy subsystems, the coherent combination of instruments from different policy sectors, as well as arrangements for their consistent implementation and evaluation to address different dimensions" (Cejudo and Trein, 2022, p.11).*

Tosun and Lang (2017) identify four forms of policy integration: (1) encouraging other domains to adopt policies that benefit the objectives of a certain policy domain; (2) when two or more policy domains adopt mutually beneficial policies; (3) promoting policy objectives through cooperation and sharing of expertise; and (4) by assessing (and

addressing) implications arising from policies in other domains. Similalry, other studies identify dimensions of policy integration (Candel and Biesbroek, 2016) and interative governance (Visseren-Hamakers, 2018) that each focus on different aspects that tie to their specific application. For each application, and therefore also policies on the circular economy, it is important to account for the political dynamics that shape the integration processes (Cejudo and Trein, 2023).

### 3.3.3 Transformative governance

What remains in certainty despite the complexity of policy integration is that circular economy policies link with other sustainability issues, such as the Sustainable Development Goals (SDGs) of sustainable cities and communities (SDG 11) and of responsible consumption and production (SDG 12) (Coenen et al., 2023). Realizing these and other SGDs requires transformative change, which can be defined as "*a fundamental, system-wide reorganization across technological, economic, and social factors, including paradigms, goals and values*" (Díaz et al., 2019, p.14). Taking this perspective, transformative governance then refers to "*the formal and informal (public and private) rules, rulemaking systems and actor networks at all levels of human society that enable transformative change*" (Visseren-Hamakers et al., 2021, p.21). Integration, along with inclusivity, adaptability, transdisciplinary, and anticipation, constitute as transformative governance when implemented in conjunction, operationalized in a specific manner, and focused on addressing the indirect drivers underlying sustainability issues (Visseren-Hamakers and Kok, 2022). Because of the system-wide orientation of both integrative and transformative governance, they hold potential for applications in circular economy research, but such an approach is yet to be developed. Perhaps this is because of the inherently societal focus of transformations, whereas the circular economy is often discussed in a wider system context, and thus better addressed from a transition perspective (Visseren-Hamakers et al., 2022).

## 3.4 The need for collaborations

Central in the transition towards a circular economy is "*the involvement of all actors of the society and their capacity to link and create suitable collaboration and exchange patterns*" (Ghisellini et al., 2018, p.11). Several of the frameworks discussed in the previous paragraphs incorporate this need for multi-stakeholder collaborations (Jabbour et al., 2019; Chauhan et al., 2022). Moving to circular economy in the construction and demolition sector, however, there is no framework to manage "*the complexity of the diverse project stakeholders along with their conflicting and differing interests and expectations*" (Çimen, 2021, p.24). The potential for collaboration is dependent on the interests and perspectives of involved stakeholders (Douglas et al., 2020), which can change over time and therefore require feedback loops to be reincorporated into policy and business model formulation (Chauhan et al., 2022). Important to note is that the two should be developed simultaneously, rather than separately, for example through public-private partnerships between the government and construction stakeholders (Munaro and Tavares, 2023). These partnerships can combine the strengths of regulatory and organizational capacities of public actors, and innovation, investment, and operational capacities of private actors (Owojori and Okoro, 2022).

### 3.4.1 Collaborative governance

But also in terms of collaborations within the circular economy transition, a suitable framework is lacking. Again, moving outside the scope of the circular economy, this thesis could turn into a variety of theories, including theories for co-creation, public value management, public innovation, collaborative governance, network governance, strategic management, and digital era governance (Torfing et al., 2021). For the purpose of this thesis, the theory behind collaborative governance is believed to offer potentially beneficial insights. Collaborative governance can be defined as:

> *"The processes and structures of public policy decision making and management that engage people constructively across the boundaries of public agencies, levels of government, and/or the public, private and civic spheres in order to carry out a public purpose that could not otherwise be accomplished" (Emerson et al., 2012, p.2).*

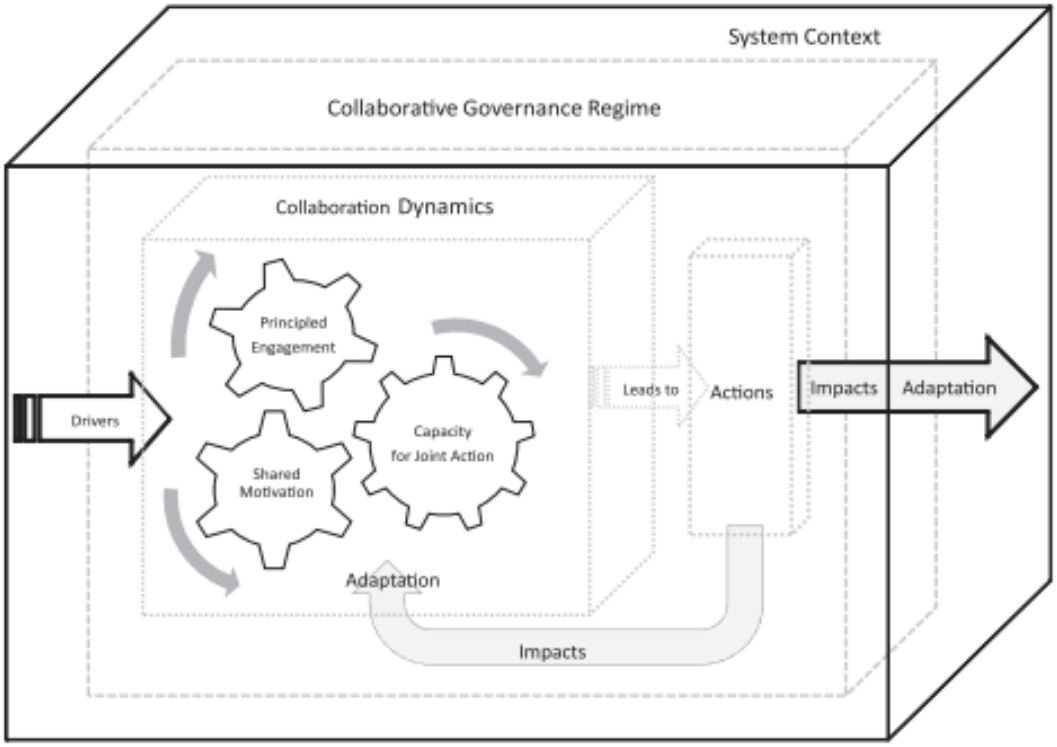
This definition is broad and as such can be applied in a variety of contexts, arrangements, and partnerships (Emerson et al., 2012). In addition, from the definition stems the ability to bring together public and private stakeholders to define problems and design and implement joint solutions (Torfing and Öberg, 2024). The consideration of problem definition is particularly important in the context of the circular economy, as many definition exist (Kirchherr et al., 2023) and the formulation of an operational definition is key for successful implementation (Corona et al., 2019).

Ansell and Gash (2008) propose a framework to analyze collaborative governance of which the outcome is shaped by starting conditions, institutional design, and facilitative leadership. In this context, the starting conditions represent the system conditions in which collaboration can occur. In case of the circular economy at the municipal level in the Netherlands, these conditions are not static but change over time. Emerson et al. (2012) address this limitation through their Integrative Framework for Collaborative Governance (IFCG), which views the system context as a dynamic space influenced by external conditions (Figure 2). This framework highlights three collaboration dynamics (principled engagement, shared motivation, capacity for joined action) that help unify fragmented visions and capacities to enable stakeholders to overcome barriers. This approach is highly suitable for this thesis as the realization of a circular economy at the municipal level requires dialogue both internally and with external stakeholders (principled engagement), a mutual understanding and commitment (mutual motivation), and backing of multiple types of capacities (capacity for joined action).

### 4.3.2 Considerations

The use of the IFCG can complement other frameworks by addressing their shortcomings in governance capacity, local applicability, and stakeholder coordination, making it a suitable tool for application in this thesis. However, coordination for collaboration can be quite

*Figure 2. The Integrative Framework for Collaborative Governance (Emerson et al., 2012, p.6).*




and it could be that the municipality does not have the capacity to perform this coordinating task. This shifts the discussion to the role of power in construction and demolition projects, which should be carefully considered. Furthermore, 'capacity for joined action' refers to institutional, leadership, knowledge, and resource capacity, but as the next paragraph will elaborate, different forms of capacity exist. Finally, it should be noted that the collaboration dynamics within one municipality can vastly differ from the dynamics in another (neighboring) municipality, leading to limited possibilities for learning and generalizability. Altogether, a potential framework requires more exploration.

## 3.5 Establishing capacity for a circular building economy

As the starting point of the discussion on the circular economy , this thesis quoted Boulding (1966), who talked about "*a cyclical ecological system which is capable of continuous reproduction of material form*" (Boulding, 1966, p.7-8). In addition, the operational definition of a circular economy by Kirchherr et al. (2023) states that a circular economy "*is enabled by an alliance of stakeholders […] and their technological innovations and capabilities*" (Kirchherr et al., 2023, p.4). This paragraph will further emphasize the importance of 'capacity' and its relevance in determining "what it takes" to operationalize a circular building economy (Levoso et al., 2020).

### 3.5.1 Capacity for realization

Central in the IFCG is the capacity for joined action. Of the various forms of capacity that exist in literature, this thesis is primarily concerned with 'governance capacity', which can be defined as "*the ability of societal actors to work together in order to solve collective problems*"

(Dang et al., 2015, p.1155). Recent studies on the governance of the circular economy have focused on the national and supranational scale (Flynn and Hacking, 2019), for example in proposing a Governance Capacity Framework to offer standardized indicators (Koop et al., 2017), or by proposing categorizations of governance capacities (Lodge and Wegrich, 2014; Arts and Goverde, 2006; Dang et al., 2015). The focus on the national and supranational level led to the neglect of enabling conditions for local level implementation (Ddiba et al., 2020). As a result, it is not commonly established what constitutes governance capacity in the context of the circular economy.

A different approach is to take the perspective of environmental governance. Both Visseren-Hamakers et al. (2021) and Van der Molen (2018) distinguish between several types of governance approaches to highlight (among others) environmental governance capacities. The downside of these approaches is that they are too broad and do not offer the practical insights needed to analyze the realization of the circular economy at the local level.

To overcome the lack of a clear categorization of governance capacities for governance of the circular economy, this thesis uses the categorization by Mees and Driessen (2011), who identify five key governance capacities of cities to adapt to climate change through urban planning (Figure 3). Governance capacity is defined as "*the degree of which a public-private*

*Figure 3. Framework for analyzing governance capacity (Mees and Driessen, 2011, p.258).*

*network of actors is able to resolve societal issues"* (Mees and Driessen, p.253). This definition encompasses the same governmental and societal interactions as highlighted by the definition of environmental governance and collaborative governance. In addition, the circular building economy can be considered an approach to mitigate climate change and directly relates to urban planning. As such, the categorization proposed by Mees and Driessen (2011) is deemed applicable and will further be explained in Chapter 6.

### 3.5.2 Modes of governance

Related to the notion of governance dimensions is the study conducted by Bulkeley and Kern (2006) on the role of municipalities in climate change mitigation policy, in which they developed a typology of four main modes of governance. Christensen (2021) showed how these modes of governments, often as a combination of all four, can be applied by municipalities to support the operationalization of the circular economy. The difficulty lies in determining feasible approaches beforehand, as this is dependent on a multitude of factors and involves collaborations between policy-makers and developers (Smedby and Quitzau, 2016). This thesis uses the following definitions (Bulkeley and Kern, 2006, p.2242) and descriptions (Christensen, 2021, p.3):

1. *Self-governance, defined as the capacity of a municipality to govern its own assets and activities. This mode of governance is often described as governing the municipality as a company, focusing on activities that take place within the legal boundaries of the municipal organization.*

2. *Governing by provision, defined as governance through the provision of services and resources. This mode of governance often involves governance through municipality-owned agencies and companies in, for example, wastewater, utilities, heating companies, transport companies and waste companies.*

3. *Governing by authority, defined as governance using authority, such as regulation. This mode of governance involves governing through rules and enforcement, including direct and economic regulation (rules, taxes, tariffs, etc.), but also through planning activities that are legally binding on companies and citizens.*

4. *Governing through enabling, defined as governance through facilitating, coordination, collaboration and encouraging. This mode of governance can take many diverse forms, spanning from formal partnerships to informal community engagement.*

### 3.5.2 Power in governance and collaborations

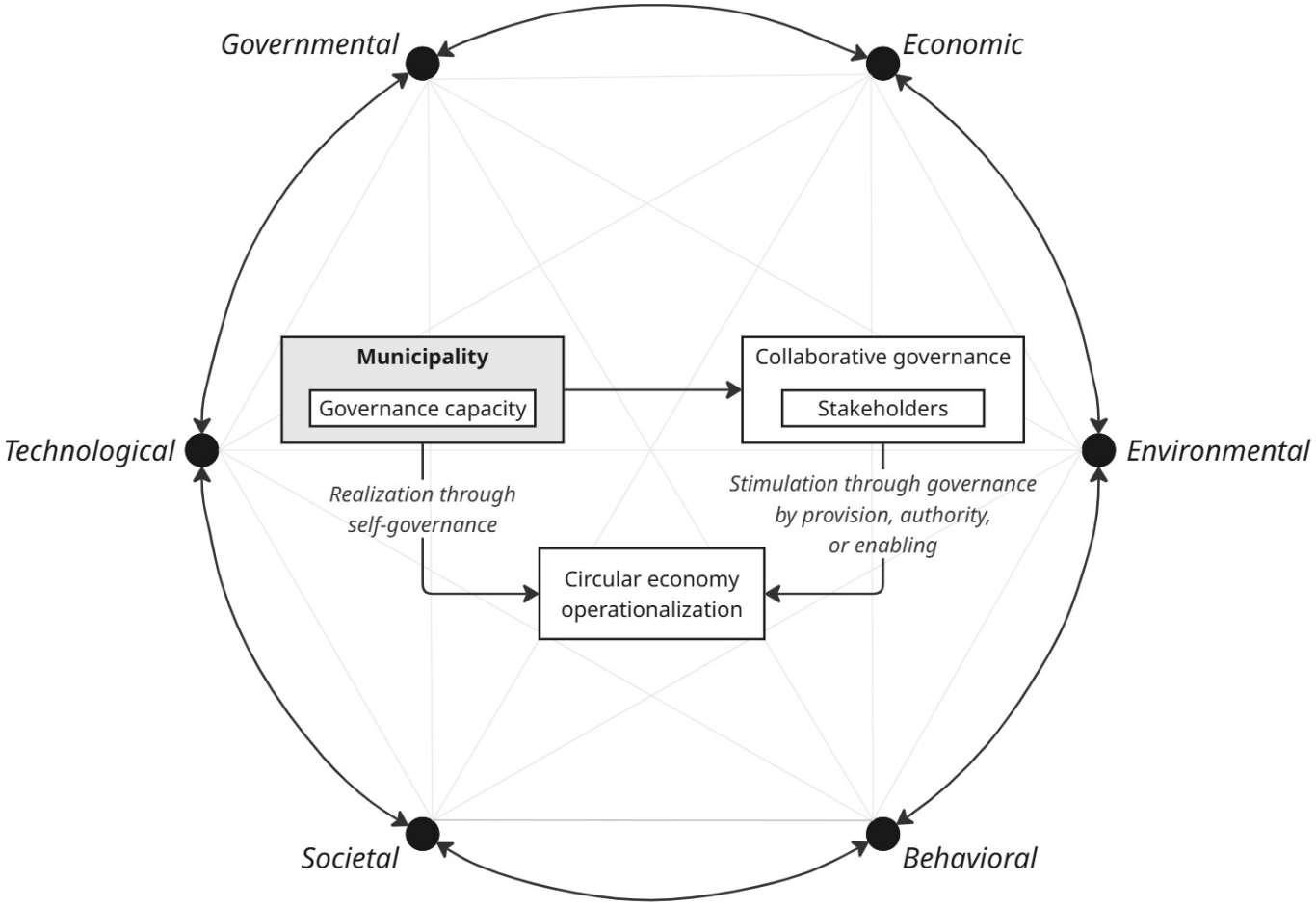
A reoccurring theme, both directly and indirectly, in the discussion on governance and collaborations is the notion of power, particularly the distribution of power. It relates to transition theory concerning the power of a regime, to the regulatory capacity of municipalities, as well as to the governance by authority discussed above. In addition,

transformational change, and therefore also transformative governance, is inherently political, meaning that power relations will shift when a transformation occurs (Visseren-Hamakers et al., 2021). Power, however, is not commonly included in studies on circular economy but can be an important factor in construction or demolition projects where governmental ambitions can collide with the profit-minded outlook of developers.

## 3.6 Theoretical framework for municipal governance analysis

The discussion so far in this Chapter has demonstrated the complexity of the circular economy concept and its application in the built environment. Multiple influences and considerations are present and interact in such a way that the circular economy becomes fragmented across applications, levels, and contexts. Trying to find 'best practices' becomes difficult because frameworks are applied in different contexts, with different considerations in mind, and yield insights that are often context-specific. Nevertheless, this final paragraph aims to find the red thread through all frameworks and considerations and combine the most important elements towards a theoretical framework for municipal governance analysis. This framework, presented in Figure 4, is believed to provide a useful tool for both scientific and practical applications towards a circular building economy.

*Figure 4. Theoretical framework for municipal governance analysis (by author).*



The framework integrates four complementary elements. First, the six dimensions by Pomponi and Moncaster (2017) – governmental, financial, technical, environmental, social, and behavioral – are used to provide the overarching context in which a municipality operates and thus also in which a circular building economy must be realized. Second, the emphasis on the importance of multi-stakeholder collaboration is derived from the IFCG (Emerson et al., 2012). Third, because the focus of this thesis lies on municipalities as key actors, the framework adopts the governance capacities by Mees and Driessen (2011), which highlights the ability of public-private networks to resolve societal issues, such as the circular economy, at the local level. Finally, the modes of governance by Bulkeley and Kern (2006) are integrated to offer insights into strategic approaches municipalities can deploy to realize or stimulate circular practices in the built environment. Together, these four elements form a comprehensive framework that captures the systemic, collaborative, and strategic dimensions necessary for operationalizing a circular building economy.

# 4. Methodology

## 4.1 Research philosophy

Any thesis builds on the worldview and assumptions of the researcher. These underlying beliefs shape how questions are framed, how data is interpreted, and ultimately how knowledge is constructed. As such, understanding the philosophical perspective helps both the researcher and reader to assess the coherence, validity, and implications of the study. Guba and Lincoln (1994) selected a sequence of three questions that, when answered, articulate what the study is about and identify the boundary conditions an answer to one questions sets for answering the following questions. Moon and Blackman's (2014) guide to understand the philosophical basis for social sciences is used to answer each question.

First is the ontological question, which reflects the understanding of the world: does one reality exist (realism) or multiple (relativism)? In previous chapters, this thesis highlighted how the barrier and enablers of the implementation of circularity policies at the local level is dependent on context specific factors, such as local governance capacities, resource availability, and stakeholder perceptions. These can vary across cities, regions, and countries, suggesting that multiple different situations, multiple realities exist, implying a relativist ontology (Moon and Blackman, 2014). However, for each individual situation, only one reality exists. This is the reality that consists of the capacities, barriers, enablers, and collaborations this study aims to unravel. Because of the locational differences and the evolving nature of the concept of circular economy itself, this thesis assumes a change in the nature of the one reality is possible, thus adopting a structural realist ontology (Moon and Blackman, 2014).

Second is the epistemological question on how to create knowledge. It concerns the relationship between the knower and what can be known. On the one hand, this thesis aims to discover objective truths about the circular building economy to get a general understanding of the concept. However, to uncover the possibilities at the local level and answer the main research question, it is key to gather and interpret stakeholder perspectives. As such, knowledge is created through interaction between the researcher and stakeholders, which aligns with constructionist epistemology (Moon and Blackman, 2014). Having said so, these stakeholders are likely to speak from personal experiences, meaning that the gathered knowledge is partially shaped through subjectivism (Guba and Lincoln, 1994).

Finally, the third question reflects the methodological question, which differentiates between the application of the research (to predict, to understand, to emancipate, to deconstruct, or all of them) and whether knowledge is acquired deductively or inductively. According to Guba and Lincoln (1994), constructivism is linked with a hermeneutical methodology, but Moon and Blackman (2014) oppose this as they link hermeneutics with objectivism, suggesting the creation of knowledge is deductive and generalizable. However, each municipality is its own unique case of factors and capabilities, so, although knowledge is deductive, it is not generalized. Therefore, this thesis takes a constructivism methodology, framing circularity as a concept shaped by individual perspectives and local conditions that must be understood to evaluate the system (Moon and Blackman, 2014).

## 4.2 Research strategy: a case study approach

This thesis adopts a case study approach to explore how local level governments navigate the challenges of implementing circular economy policies within a broader system context. This approach allows for an in-depth examination of the governance processes and systematic barriers associated with circular economy policies, which are often embedded in technocratic and productivism narratives (Genovese and Pansera, 2020). Furthermore, it allows to analyze the "how" and "why", which is particularly interesting in a context of multiple actors, institutions, and dynamics, which is the case for the municipality of Lingewaard. European, national, provincial, and regional policies and ambitions dripple down to the local level where municipalities have to find ways to implement and achieve them. By adopting a case study approach it becomes possible to identify potential barriers by such top-down policy influence, in addition to barriers and enablers at the local level.

## 4.3 Research methods

### 4.3.1 Data collection

The first approach to data collection is document analysis. From the European to the local level, several policy documents have been published that could generate a general understanding of the circular building economy, recent trends, and involved stakeholders (Table 3). Having said so, this thesis is primarily based on data collection through semi-structured interviews (11) and informal conversations (14) with relevant stakeholders for a circular building economy at the municipal level (Table 4). The value of conducting interviews is that it provides the opportunity to uncover hidden nuances, underlying reasonings, and personal experiences that do not come forward in the policy documents (Knott et al., 2022). In this case, semi-structured interviews are used to gain a better understanding of background information and institutional perspectives, while leaving room to discuss the interviewees' personal views and experiences (Hammarberg et al., 2016). Because not all interviewees were open to a full scientific interview, these conversations are included as informal conversations. They add general information and context. In addition, nine events have been visited through which information and insights aided in the understanding of the circular building economy.

*Table 3. Overview of policy documents.*

| Institution | Document |
|---|---|
| European Union | European Green Deal (European Commission, 2019; 2020); Territorial Agenda 2030 (European Union, 2020) |
| Dutch government | Circular Economy 2023-2030 (Rijksoverheid, 2023); Integrale Circulaire Economie Rapportage (PBL, 2021a) |
| Province of Gelderland | Circular Economy Agenda 2025-2027 (Provincie Gelderland, 2023) |
| Groene Metropoolregio | Conceptual and Circular Construction (2024) |
| Gemeente Lingewaard | Startnotitie Circulariteit (Hermanussen, 2024); Programma Klimaat, Energie en Circulariteit (Kregtig and Andernach, 2025) |

*Table 4. Overview of semi-structured interviews and informal conversations.*
** Indication of an interview or informal conversation that was not recorded.*

| Interview | Organization | Role/department | Duration (hours) | Date (2025) | Setting |
|---|---|---|---|---|---|
| Interview 1 | GMR | Circularity coordinator | 0:58 | 25-02 | Person |
| Interview 2 | Municipality Doetinchem | Policy officer | 1:16 | 22-04 | Person |
| Interview 3 | Municipality Nijmegen | Policy officer | 0:45 | 23-04 | Person |
| Interview 4 | Municipality Lingewaard | Purchasing | -* | 24-04 | Person |
| Interview 5 | Radboud University | Researcher | 1:12 | 25-04 | Person |
| Interview 6 | Municipality Arnhem | Project manager | 1:21 | 07-05 | Online |
| Interview 7 | Radboud University | Researcher | 0:51 | 23-05 | Online |
| Interview 8 | Province of Gelderland | Coordinator | 0:58 | 26-05 | Online |
| Interview 9 | Market actor – civil | CEO | 0:43 | 03-06 | Online |
| Interview 10 | Market actor – civil | Coordinator sustainability | 1:07 | 03-06 | Online |
| Interview 11 | Province of Gelderland | Policy officer | 1:08 | 05-06 | Online |
| Inf. conv. 1 | Governmental actor | Environmental Plan | 0:30 | 10-02 | Person |
| Inf. conv. 2 | Governmental actor | Urban Plan | 0:23 | 10-02 | Person |
| Inf. conv. 3 | Governmental actor | Residential | 0:24 | 11-02 | Person |
| Inf. conv. 4 | Governmental actor | Civil engineering | 0:25 | 17-02 | Person |
| Inf. conv. 5 | Governmental actor | Policy | 0:20 | 17-02 | Person |
| Inf. conv. 6 | Governmental actor | Residential<br>Residential | 0:31 | 17-02 | Person |
| Inf. conv. 7 | Governmental actor | Social real-estate | 0:26 | 27-02 | Person |
| Inf. conv. 8 | Governmental actor | Land affairs | -* | 27-02 | Person |
| Inf. conv. 9 | Governmental actor | Waste | -* | 14-04 | Person |
| Inf. conv. 10 | Governmental actor | Maintenance | -* | 14-04 | Person |
| Inf. conv. 11 | Governmental actor | Sustainability | -* | 27-05 | Person |
| Inf. conv. 12 | Project developer | Residential | -* | 10-06 | Online |

All interviews were asked the same introductory questions as well as the same closing questions. The main interview questions were categorized using the classification by Pomponi and Moncaster (2017) – governmental, economic, technical, ecological, social, and behavioral – to maintain a clear structure within each interview. Not all questions were asked in all interviews, and not all questions were asked in the same sequence. The questions asked were dependent on the organization the interviewee worked in and the job description of the interviewee, speaking to his or her experience and knowledge. Table 5 presents a summarized overview of the questions asked in each interview.

### 4.3.2 Data analysis

All except one interview (Interview 7), which was conducted in English, were conducted in Dutch and have been translated to English. When possible, interviews and informal conversations were recorded and subsequently transcribed using GoodTape or through Microsoft Teams. In total, 10 interviews and 7 informal conversations have been recorded

*Table 5. Interview guide for interviews and informal conversations.*

| Introductory questions | Asked to | RQ(s) | Link to framework |
|---|---|---|---|
| o Could you shortly introduce yourself? | *All* | - | - |
| o Could you shortly explain what the organization you work for does, and what your role is in the organization? | | SQ2 | Weak link to collaborative governance |
| o What is your definition of the circular economy? And how do circular economy principles play a role in your work? | | MQ | Moderate link to dimensions |
| **Governmental questions** | | | |
| o In your opinion, to what extent do rules and regulation form a barrier for realizing a circular building economy? | *All* | SQ1<br>SQ3 | Moderate link to 'Governance capacity' |
| o Within your organization, which policy frameworks exist? And how did they develop? | *Municipalities, provinces* | SQ1<br>SQ3 | Strong link to 'Stakeholders' |
| o Is there room to set demands outside of existing policy and regulatory frameworks? | *Municipalities, provinces, researchers* | SQ1<br>SQ3 | Strong link to Collaborative governance |
| o According to you, who is responsible for solving the regulatory barriers? | *All* | SQ1<br>SQ2<br>SQ3 | Strong link to Modes of governance |
| **Financial questions** | | | |
| o In your opinion, what are the most important financial barriers to building in a circular fashion? | *All* | SQ1 | - |
| o Which financial incentives exist to stimulate circular construction and demolition? | *All* | SQ1<br>SQ2 | Strong link to Modes of governance |
| **Technical questions** | | | |
| o What techniques are currently being used to construct and demolish in a circular fashion? | *All* | SQ1 | Moderate link to 'Capacity' and 'Stakeholders' |
| o Which tools are currently being used to support the implementation of circular principles? Are these tools sufficient in doing so? | *All* | SQ1<br>SQ3 | Strong link to 'Governance capacity' and Modes of governance |
| **Environmental questions** | | | |
| o In your opinion, are there any significant environmental gains to be obtained through circular as | *All* | SQ1 | Weak link to Modes of governance |

| Environmental questions | Asked to | RQ(s) | Link to framework |
|---|---|---|---|
| opposed to traditional construction and demolition practices? | | | |
| **Social questions** | | | |
| o With which other organizations does your organization collaborate in the context of the circular building economy, and to what purpose are these collaborations set up? | *All* | SQ2 | Strong link to Collaborative governance and Modes of governance |
| **Behavioral questions** | | | |
| o In your opinion, how is the circular economy experienced in your organization and the organizations you collaborate with? | *All* | SQ1 SQ2 | Strong link to 'Municipality' and 'Stakeholders' |
| o To what extent are circular actions the result of policy or individual motivation? | *Municipalities, provinces* | SQ1 SQ3 | Strong link to 'Municipality', 'Governance capacity', 'Stakeholders' and collaborative governance |
| **Closing questions** | | | |
| o Which of the six dimensions do you find most important and why? | *All* | SQ1 | General understanding |

and transcribed. Notes have been taken from the remaining interview and informal conversations. Coding of the transcriptions and notes is done by hand, based on a set of predefined codes for each dimension of Pomponi and Moncaster's (2011) framework as well as for the five types of governance capacity identified by Mees and Driessen (2011), see Table 6. For this thesis, only the interviews have been used directly as results, while the informal conversations provide background insights, clarifications, and illustrative examples.

Each set of questions in Table 5 relates to the same dimension at the outside of the proposed framework in Figure 4. The 'Link to framework' collum highlights the link between the question and elements within the proposed framework. Note that these questions do not directly refer to the governance capacities. This is done intentionally to maintain structure in the interviews through the dimensions while capturing implicit insights regarding the governance capacities.

## 4.4 Validity and reliability

Validity concerns "*whether the means of measurement are accurate and whether they are actually measuring what they are intended to measure*" (Golafshani, 2003, p.599). In the context of this study, validity is ensured by aligning the research methods with the study's

*Table 6. Predetermined codes for each key theme.*

| | | | |
|---|---|---|---|
| **Governmental** | National policy frameworks<br>Local policy frameworks<br>Land policy & tendering | **Financial** | Business case<br>Municipal budget<br>Labor & material costs |
| **Technical** | Circular techniques<br>Material management<br>Tools and instruments<br>Measuring & evaluation | **Social** | Internal collaborations<br>Collaborations with:<br>- public actors<br>- market actors<br>- knowledge institutes<br>- residents |
| **Environmental** | $CO_2$ | | |
| **Behavioral** | Internal behavior<br>Behavior of:<br>- public actors<br>- market actors<br>- knowledge institutes<br>- society | **Capacity** | Legal<br>Managerial<br>Political<br>Resource<br>Learning |

aim to uncover the barriers and enablers for local governments in implementing circularity policies. Interview and focus group questions will be designed to extract meaningful insights directly related to governance dynamics and system structures, ensuring that the data accurately reflects the research question. In turn, reliability concerns "*whether the result is replicable*" (Golafshani, 2003, p.599). This will be addressed through consistent application of research procedures. The thesis will use a standardized approach in data collection and analysis, including interview guides, codebooks, and transcriptions, allowing future researchers to replicate the methodology. By integrating these validity and reliability considerations, this thesis ensures both accurate and trustworthy findings.

# 5. Case study description: Municipality of Lingewaard

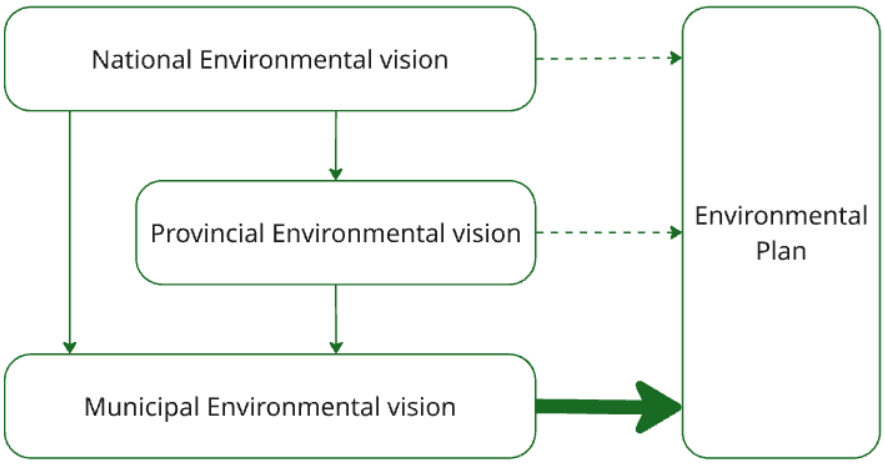
## 5.1 Municipal governance in the Dutch built environment

In order to understand the concept of a circular building economy at the municipal level, it is important to first understand how a municipality operates within the Dutch governance system. Historically, spatial planning in the Netherlands was governed by the Spatial Planning Act, which saw several reforms over time. The Act clearly outlined the roles of national, provincial, and municipal governments, with increasing decentralization with each reform (Roodbol-Mekkes & Van den Brink, 2015). The Dutch national government focuses on 13 national interests for which it takes responsibility (e.g. affordability, competitiveness), but outside these interests, "*local and regional authorities will be able to make their own policy decisions*" (Ministerie van Infrastructuur en Waterstaat, 2011).

Recently, in 2023, the Environment and Planning Act replaced the Spatial Planning Act. The decentralized structure was maintained, but rather than having multiple land-use plans, municipalities draft one environmental plan to provide a cohesive vision for all elements in the built environment. This plan not only includes traditional land-use plans (zoning) but also integrates regulations for infrastructure, sustainability, and public space (Overheid.nl, 2025a). Through legislative frameworks and the allocation of financial resources, national (and provincial) governments can impose certain conditions for the municipal financial plan, but municipalities remain primarily responsible for the environmental plan (Figure 5). This way, the decentralized model enables municipalities to tailor spatial strategies to local demographic, economic, and environmental conditions.

This decentralization of government in the Netherlands is important for this thesis because it shows that the responsibility to realize and stimulate a circular building economy for a large part falls to small municipalities. Yet, it also shows that higher level governments determine the boundary conditions in which the municipality needs to operate.

*Figure 5. Visualization of the Dutch Environmental Planning System (by author).*



## 5.2 Meta-governing the circular building economy

The ability of a municipality in the Netherlands to realize or facilitate a circular building economy is to a large extent determined by policies and regulations set by higher level governments. At the European Level, the circular economy forms a part of the Territorial Agenda 2030 that pushes for a just and green Europe (European Union, 2020). In more detail, the Paris Agreement and the European Green Deal set the ambition to reduce $CO_2$-emissions by 55% in 2030 compared to 1990 (European Commission, 2019) in which the circular economy plays a crucial role (European Commission, 2020). At the national level, the Dutch government builds on this narrative with the publication of the 'Circular Economy 2023-2030' policy agenda, in which the built environment is one of five key production chains with high $CO_2$-impact (Rijksoverheid, 2023). These plans generally link to a 6R-ladder developed by the Dutch government (PBL, 2021a)(Figure 7). In these plans, the importance of regional and local governments is repeatedly highlighted (PBL, 2021b), but the policy agenda is under development at this moment in time offering few concrete tools for provinces and municipalities. Because of this, the province of Gelderland, in which Lingewaard is located, drafted their own policy agenda till 2027 (Provincie Gelderland, 2023). Also here, the circular economy is highlighted, but the agenda takes it one step further and links the circular economy with topics such as climate change, biodiversity and the energy transition.

## 5.3 The municipality of Lingewaard

### 5.3.1 Socio-demographics

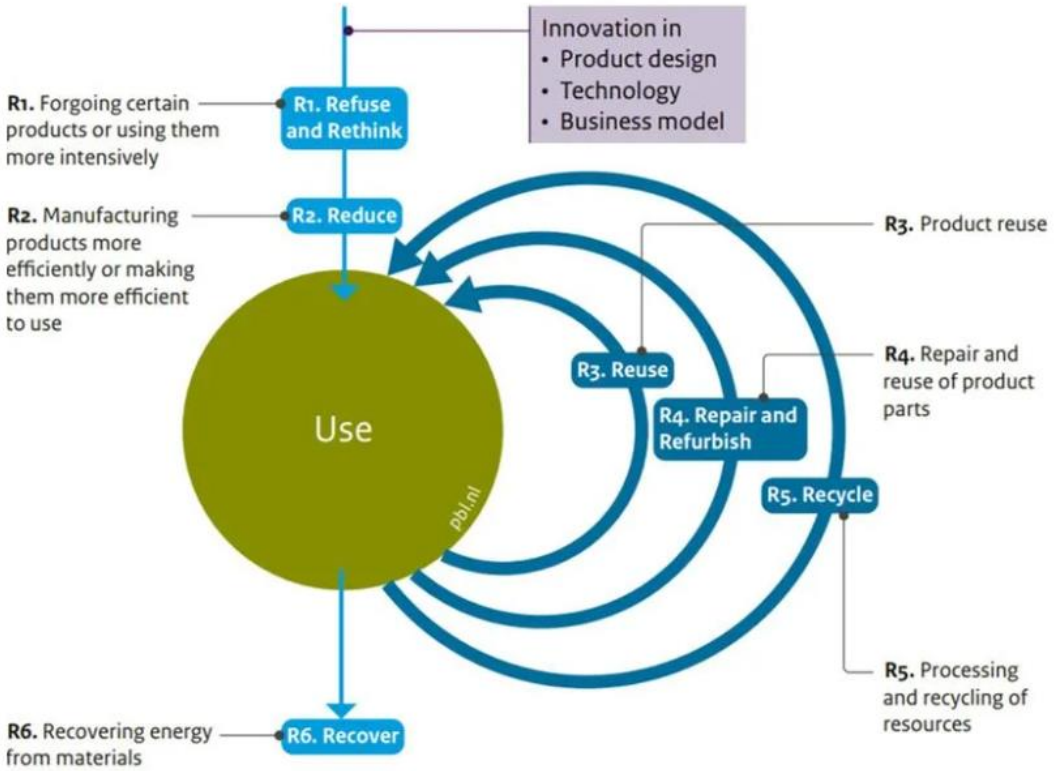
The municipality of Lingewaard is a small municipality in the East of the Netherlands with just over 47.500 inhabitants (Allecijfers.nl, 2025). It is located between the two larger municipalities of Arnhem and Nijmegen, and between the rivers Rhine and Waal (Figure 6). The municipality has seven main residential areas, of which the largest has over 20.000 inhabitants. In addition, it has two three main industrial sites. An important number is that the Lingewaard holds just over 20.000 dwellings, 73% of which is owner-occupied, 19% is social housing and 8% is free-market rental (Allecijfers.nl, 2025). Part of the 'Woondeal 2.0', the nation-wide attempt to construct more dwellings to mediate the housing crisis, Lingewaard aims to realize 1.889 dwellings by 2030 (Overheid.nl, 2025b).

### 5.3.2 Circular building economy in Lingewaard

In February 2024, the municipal council of Lingewaard voted in favor of the policy brief 'Circularity' (Hermanussen, 2024). In this policy brief, the municipality expressed their ambition to transition to a fully circular economy by 2050, in adherence with national goals, but also stated their limitation to address all themes and domains all at once. Rather, the policy brief favored an approach to first focus on the built environment because of two reasons: (1) this domain is responsible for 50% of resource use and 11% of national $CO_2$-emissions (Copper8 et al., 2024), and (2) the municipality has a relatively large influence on this domain through tenders and the issuance of permits. Later, the circularity ambitions of the municipality were reinforced by the adoption of the policy program Climate, Energy, and

*Figure 6. Map of the Groene Metropoolregio Arnhem-Nijmegen, with Lingewaard located centrally within this region (Groene Metropoolregio, n.d.).*


*Figure 7. R-ladder with strategies for circularity (PBL, 2021a).*



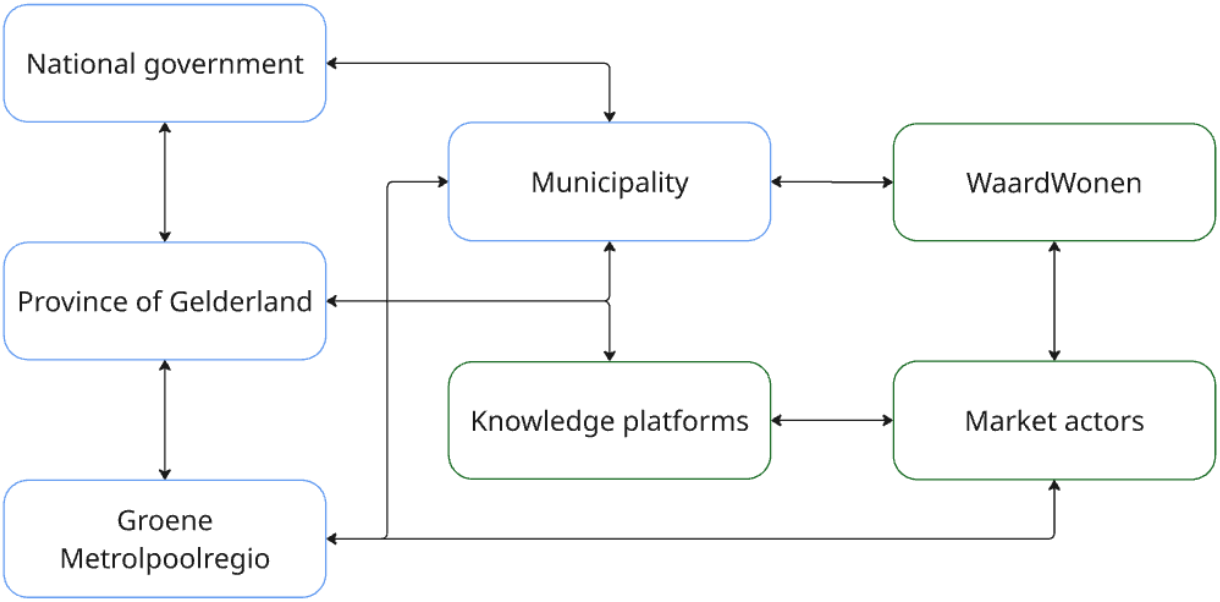
Circularity (*Klimaat, Energie en Circulariteit*)(Kregtig and Andernach, 2025). Through these developments, capacity has been cleared to work on a circular economy policy that is expected to be adopted early 2026. The high ambitions combined with recent developments make the municipality of Lingewaard an exemplary case study for the analysis of small municipal governance on the circular building economy.

### 5.3.2 Stakeholder overview

In order to gain an understanding of the system in which the municipality of Lingewaard operates, a stakeholder analysis has been conducted to identify other relevant actors. A simplified overview of the findings is found in Figure 8. This overview is partially a result of the interviews and informal conversations conducted throughout this thesis. To clarify several of the stakeholders: 'Market actors' refers to both project developers and construction companies; 'WaardWonen' is the social housing corporation active in the municipality; the 'Groene Metropoolregio' (GMR) is a regional collaboration of governments and the province of Gelderland; 'Knowledge platforms' refers to organizations and educational institutions in the region that accumulate knowledge on circular applications to the built environment.

The overview presented in Figure 4 shows the symbiotic relationships between these stakeholders. The blue stakeholders represent governmental actors. The relationship between national, provincial, and municipal governments is discussed in Chapter 5.1. Furthermore, the municipality of Lingewaard is part of the GMR. For the realization of projects, the municipality contracts market actors or work closely together with developers or with the social housing corporation WaardWonen. The knowledge platforms operate parallel and in collaboration with governments and market parties, offering information and support. The relationships portrayed in Figure 4 are discussed in more detail in Chapter 6, in which the results of the interviews and informal conversations are analyzed.

*Figure 8. Stakeholder relations in a circular building economy in Lingewaard (by author)..*



# 6. Barriers and enablers

The aim of this research is to gain insights into the factors that influence the realization of the circular economy in the built environment in Lingewaard. This chapter presents the most important insights gathered from interviews and informal conversations with different types of stakeholders, categorized as barriers and enablers. The framework by Pomponi and Moncaster (2017) is used to structure the findings along the six key dimensions: governmental, economic, environmental, technical, social, behavioral.

## 6.1 Governmental dimension

According to Pomponi and Moncaster (2017), the governmental dimension is about how policies from different levels of government can support or hinder the implementation of circularity. By absence of a municipal policy framework specifically on circularity, this study distinguishes between national policy frameworks (Environmental Planning Act, Building Decree) and regional policy frameworks (Woondeal 2.0).

### 6.1.1 Key barriers

***Barrier 1:*** *Insufficient national regulation.*

In the Dutch housing sector, the Building Decree (*Bouwbesluit*) serves as the primary national regulatory framework. Within this framework, circularity is partially embedded in the Environmental Performance Building (*Milieu Prestatie Gebouw, MPG*), for which legal standards are set, but in some conversations it was mentioned that this standard was too low (Interview 2). In the time of writing this thesis, it became known that a stricter update of this standard will come into effect the 1st of July 2026 (RVO, 2025). However, it remains uncertain what the influence of this new standard will be on the housing and circularity ambitions at the local level. This is partly due to the MPG having several limitations that remain unaddressed (Interview 1, 2, 3, 6). In the civil engineering sector, no formal standards currently exist, although they are under development (Overheid.nl, 2025c).

***Barrier 2:*** *Not having the lead in residential housing projects.*

The Building Decree sets the minimal requirements for new construction. Municipalities can impose stricter standards when they own the land and act as the developer of the project (Interview 5). This is often the case for social real-estate, allowing municipalities to set circularity demands that exceed the Building Decree. In residential housing, however, land ownership in smaller municipalities like Lingewaard typically lies with private developers (Informal conversations). In these situations, the municipality plays a facilitating role. It collaborates with developers on the urban development plan and granting construction permits once the plan is approved (Interview 2, 5). While municipalities may attach conditions to this granting, such as above-statutory circularity requirements, these lack legal enforceability (Interview 6) and often cause delays (Interview 5). In addition, the Dutch national government actively encourages municipalities not to impose additional requirements beyond the Building Decree to accelerate the construction of housing and address the ongoing housing crisis in the Netherlands (Interview 6).

***Barrier 3:*** *Uncertainty and unfamiliarity regarding the Environmental Planning Act.*
The Environmental Planning Act came into effect in January 2024, granting municipalities greater autonomy to formulate regulations tailored to local needs. Many smaller municipalities faced significant challenges in preparing for its implementation. Both substantively and administratively, the process has proven complex, which each municipality essentially reinventing the wheel, which proves difficult for smaller municipalities due to limited personal capacity (Informal conversations).

***Barrier 4:*** *Circularity is expressed as ambition, not yet as a policy.*
The municipality of Lingewaard articulates their circular ambition with the publication of two reports and also signed the 'Woondeal 2.0'. While ambitions are abundant, the reports lack concrete strategies for achieving these ambitions. As a result, there could remain ambiguity regarding obligations and implementation (Interview 3 and 6; Informal conversations).

***Barrier 5:*** *Lack of clarity and uniformity.*
Both within the municipality and among market actors, there is confusion about the meaning of targets such as '25% circular by 2025' and '50% circular by 2030'. These targets are poorly defined at the national level, resulting in various interpretations, and applications, by lower level governments. In addition, there is uncertainty among construction companies whether investments will lead to better positioning in tenders needed to earn back the investment (Interview 10). This inconsistency and uncertainty pose a challenge to adopting or advancing circular practices: "*If you have no outlook, you cannot really invest*" (Interview 9). Developers also emphasize the importance of increased clarity and uniformity, so that regulations apply to the whole market (Informal conversations).

### 6.1.2 Key enablers

***Enabler 1:*** *The government has a duty of care.*
The Dutch constitution enshrines that the Dutch government has a duty of care to reduce greenhouse gas emissions and take necessary measures to combat climate change (CircuLaw, 2024). Circularity is an integral component of achieving these objectives (Informal conversations). Consequently, municipalities are obligated to take steps towards a circular building environment.

***Enabler 2:*** *Integrating circularity into the Environmental Planning Act.*
While the Building Decree largely defines the legal framework, municipalities have the option to impose additional requirements by incorporating circularity into their Environmental Planning Act (Interview 2, 6). This demands courage, expertise, and ambition (Interview 2), but knowledge platforms such as Circkelstad demonstrate its feasibility (Cirkelstad, 2025). However, for now, incorporating circularity into the Environmental Planning Act may be a step too far for Lingewaard as they, at the moment of writing, have not yet established an Environmental Plan. Nevertheless, it is evident that without changes at the national level, existing barriers persist: a developer may struggle to make their business case viable due to circularity demands and the national government encourages to not set any additional demands at the local level.

## 6.2 Economic dimension

According to Pomponi and Moncaster (2017), the economic dimension is largely about ownership models and the business case. In the context of this study, ownership is largely tied to the ability of a municipality to set demands beyond the Building Decree and is therefore discussed in Chapter 6.1 under the Governmental dimension. Instead, this chapter focuses on the business case, primarily on investments and surplus value, the municipal budget and changes in labor and material costs.

### 6.2.1 Key barriers

*Barrier 1: An unviable business case: "Circularity is more expensive and has no surplus value".*
Many actors see circularity as an additional demand rather than an integral part of a project. In the Netherlands, labor is relatively expensive, but (raw) materials relatively cheap (Interview 9). The resulting assumption is that circularity leads to higher costs. How much more appears hard to quantify. Estimates range between 5% and 10% additional costs (Interview 2, 3), but the only concrete example is found in the municipality of Lingewaard itself. A pilot in the reuse of paving stones showed that reuse could compete with the cost of new materials, but that it took more time and required storage (Informal conversation). Both are generally missing in projects. That being said, 7 of out 11 interviewees stated that when the residual value of materials and the societal benefits of $CO_2$-reduction are also considered, circularity does not have to be more expensive (Interview 2, 3, 5, 6, 7, 8, 10).

*Barrier 2: Limited municipal budget* .
In informal conversation with employees of the municipality of Lingewaard, the year 2026 is repeatedly described as a fiscal cliff year (*ravijnjaar*) alluding to future budget cuts. It is expected that the municipality has to adjust some ambitions when possible. Circularity will not disappear, but the question is how firmly the future policy will be enforced. The general preference appeared to be to construct housing with less circular materials rather than upholding stricter circular ambitions and risking not building at all (Informal conversations). Another complicating factor is that subsidies related to circularity are often aimed at market actors and not the municipality (Interview 2, 8, 9). Finally, although developers are unlikely to sell land, the limited budget prohibits the municipality from obtaining land for development themselves (Interview 5).

### 6.2.2 Key enablers

Commissioned by the GMR, Professor Erwin van der Krabben of the Radboud University investigated how a renewed land policy could contribute to accelerating and enhancing the sustainability of area development and existing buildings (Private document, obtained via GMR). The outcome of this study is a compilation of 18 policy instruments to be used at the municipal level. A subset of these collectively form an "*improved toolkit in development for enabling land policy*" (p.82). Based on the interview with Professor Van der Krabben (Interview 5), only one currently existing policy instrument could be of value for municipalities like Lingewaard. Future developments may present new possibilities, however.

***Enabler 1:*** *Requesting a financial contribution for area development*.
The Environmental Planning Act includes the Supplementary Track of land ownership. This allows municipalities, under strict conditions, to request financial contributions from landowners undertaking new spatial developments. The municipality of Arnhem, Erwin provides as an example, has incorporated this mechanisms into its land policy. In theory, such contributions could also be allocated to circularity within area development. However, these contributions compete with other potential allocations, such as recreational amenities or nature conservation.

***Enabler 2:*** *Adjusted basis for determining land input value*.
Municipalities are legally required to recover the costs of public infrastructure associated with area development from the developing landowners. The Ministry of Interior and Kingdom Relations (*Binnenlandse Zaken*) is currently exploring whether the cost calculation method can be revised to improve the municipality's position. This would enable municipalities to recoup a larger share of the costs related to public infrastructure, including circular applications.

***Enabler 3:*** *The planning gain levy*.
A planning gain levy is a one-time charge based on the increase in land value resulting from a change in land use designation within the Environmental Plan, which occurs when agricultural land is reclassified as 'construction land'. The planning gain levy supplements mandatory recovery mechanisms already available to municipalities. Future increases in land value resulting from sustainability investments remain untaxed. Although the introduction of the planning gain levy was included in the coalition agreement, its implementation details remain unclear. Depending on its final form, the revenues may potentially be used to support circular, area-based investments.

***Enabler 4:*** *Declining costs of circularity and improved business cases*.
Not part of the study. Despite a cautious stance from the market, circular innovations are emerging and the discourse on circularity is gaining momentum. Smaller municipalities play a substantial role in this (Interview 7). The result is that the costs of circular and biobased materials are decreasing relative to traditional materials (Interview 3) and that new calculation mechanisms are being developed that incorporate the residual value of materials (Programma Onderwijshuisvesting, 2025). Furthermore, uniformity in tenders, preferably regional, ensures that market parties can focus on a specific product and reduces the need for adjustments later in the project, both reducing the costs of the project (Interview 10).

## 6.3 Environmental dimension

Under the environmental dimension, the primary barrier identified is $CO_2$-emissions. Out of the 11 interviews, 7 emphasized the importance of adaptation of climate change and mitigation, as well as nitrogen-related concerns (Interview 1, 2, 5, 6, 9, 10, 11). While these topics play a significant role in project development, they do not have a direct relationship with circularity. Rather, circularity often competes with these and other factors within projects, necessitating continuous trade-offs which fall outside the scope of this study.

### 6.3.1 Key barriers

*Barrier 1: Difficulty in simultaneously targeting resource use and $CO_2$-reduction.*
Earlier in this document, the circular economy is linked to both resource consumption and $CO_2$-emissions. Although these domains overlap, it proves challenging in practice to effectively steer both dimensions simultaneously (Interview 1). The interviews do not explicitly reveal a definitive reason for this difficulty. It appears to be related to the scale and type of project. In civil engineering projects, $CO_2$-reduction plays a prominent role in the project phase, whereas for buildings nitrogen plays a more prominent role and $CO_2$ is considered across the entire life-span of a building, including the usage phase. This can lead to different considerations in terms of material use.

### 6.3.2 Key enablers

*Enabler 1: Transition toward climate-resilient construction.*
According to the European Green Deal, $CO_2$-emissions should be reduced by 55% by 2030 (compared to 1990 levels). In recent years, it has become evident that this target cannot be reached by continuing to focus on themes and targets in isolation. Instead, it is necessary to leverage the overlaps between them. The Province of Gelderland and the GMR emphasize this approach in their strategies for climate-resilient construction (Interview 1, 8). Such a holistic approach could facilitate the apparent competition between circularity and other themes and targets, as mentioned in various barriers in this chapter.

## 6.4 Technical dimension

The technical dimension encompasses several key areas: circular construction techniques (timber construction, biobased materials, design for disassembly), material management (material depots, material data), assessment tools (specifications), and measuring circularity.

### 6.4.1 Key barriers

*Barrier 1: Insufficient storage capacity.*
Both governmental and market actors emphasize that (temporary) storage is essential for the effective reuse of materials (Interview 3, 6, 9, 10). The successful use of digital marketplaces such as DuSpot or Insert also depends on this, "*although we sell most of our materials through traders or via the regular Marktplaats*" (Interview 9). Lingewaard is currently working on developing a material depot, but it remains uncertain whether sufficient space is available within the municipality (Informal conversations). One consideration is to facilitate reuse at the regional rather than local level. This option, however, requires serious considerations on collaboration: Who is the depot for? Who pays for it? Who manages it? (Interview 4).

*Barrier 2: An overly complex set of tools.*
Various tools exist to assess circularity in projects. The Environmental Performance of Buildings (*Milieu Prestatie Gebouw, MPG*), used for buildings, is the only mandatory tool, which has a threshold set in the Building Decree. However, several projects demonstrate that stricter requirements are already feasible (Interview 2, 3, 6, 8).

Criticism has emerged that the MPG does not adequately reflect circularity. For example, "*the MPG prefers a roof full of solar panels over the use of alternative materials*" (Interview 1), and its database is outdated: "*there are many new materials that cannot be measures*" (Interview 6). The Province of Gelderland confirms this: "*You cannot measure everything, simply because not all information is available, and what can be measured takes a lot of time and effort*" (Interview 11). Because of these and other shortcomings, a multitude of tools have emerged (Appendix 1). Each tool tries to capture the environmental performance of a material or building, but uses different parameters. The result is that project initiators across the region that want to embed circularity beyond the Building Decree are unsure which tools to use and market actors are hesitant to adapt their working methods to suit a certain tool because of this uncertainty (Interview 1).

***Barrier 3:*** *Project processes are not yet aligned with circularity.*
The integrated use of circular materials cannot be achieved overnight: It requires room for experimentation. Many project initiators lack experience with circularity and prioritize speed and cost-efficiency, which limits opportunities for market actors to innovate with new materials (Interview 10). Additionally, Building Decree requirements can hinder reuse in new construction as, for example, older doors might not meet current standards (Interview 9). On the other hand, not all market actors are equipped to mee specific circularity demands. Many smaller firms have not sufficiently invested in knowledge or equipment to comply with demands set by project initiators (Interview 10). To engage these actors, clarity is needed about the direction the municipality intends to go: "*then the contractor knows that if they do nothing, they will lose clients*" (Interview 10).

### 6.4.2 Key enablers

***Enabler 1:*** *The development of a universal language.*
The multitude of tools available has increased the need for a universal language that combines circularity with other policy objectives such as climate adaptation and energy. Greater uniformity in the demands set by project initiators and policy can enable more effective use of existing knowledge and provide the clarity needed to support further innovation (Interview 1, 3, 8, 10, 11). National initiatives, such as the $CO_2$ Monitor Netherlands, try to tackle these issues, but have not yet been able to effectively link circularity to $CO_2$ for buildings and public space (Platform WOW, 2025). In recent years, The New Normal (*Het Nieuwe Normaal*) has emerged into a broadly accepted standard for new buildings, existing buildings, demolition, and public space. It is embraced by both public authorities and market actors (Interview 9), but lacks uptake by smaller actors on the local level. The Circular Impact Ladder, developed by the GMR, aligns with The New Normal for new buildings, and as such provides a practical starting point for smaller municipalities like Lingewaard (Interview 1, 3, 8). Nevertheless, HNN uses the MPG, meaning that some of the previously mentioned downsides of the MPG remain.

***Enabler 2:*** *A regional shared material depot.*
Lingewaard is not the only municipality in the region aiming to establish a material depot. Municipalities such as Arnhem and Nijmegen are also exploring options (Interview 3, 6).

Collaborations in establishing a shared material depot could better align supply and demand across the region, but require important considerations (Interview 4, 9).

*Enabler 3: Technological advancement continues.*
"*There is a lot of potential for circularity, and better materials are available, but it needs to scale up and become more affordable*" (Interview 6). In order to do so, market actors, as innovators, need to be ensured demand in the future to earn back their investments (Interview 9, 10). Municipalities must therefore take the initiative, even if it means starting small, because "*a small step in construction can have a big positive impact*" (Interview 2).

## 6.5 Societal dimension

Interviews consistently emphasize that the first step in embedding circularity is to acquire knowledge. The municipality of Lingewaard does not need to reinvent the wheel but can learn from other stakeholders. Key aspects for collaboration include internal collaboration (project teams), partnerships with other public authorities (municipalities, GMR, ODRA, province), collaboration with market actors (developers, market consultations, tender alternatives), cooperation with housing corporations (e.g. WaardWonen), and engagement with knowledge platforms (e.g. Cirkelstad, Building Balance, Duurzaam Gebouwd).

### 6.5.1 Key barriers

*Barrier 1: Circularity is not yet an integral part of project team operations.*
Circularity requires both municipalities and market actors to change their working processes (Interview 2, 6). The municipality of Lingewaard recently developed an internal guideline on working together on projects with a clear role division. Initially, circularity will be included as one of the disciplines the project needs to adhere to. The question remains whether sufficient technical and organizational expertise is currently available for this advisory role, or whether a more connective and coordinating role is expected.

*Barrier 2: Unclear division of roles between municipalities and the GMR.*
The GMR has a purely advisory role, and actual implementation lies with the municipalities themselves (Interview 1). Especially smaller municipalities, however, have a hard time finding the GMR because of authority issues or mismatches in terms of knowledge or skills (Interview 1). Additionally, in recent years, the GMR has primarily collaborated with Arnhem and Nijmegen, the two larger municipalities, who know report being ahead of the GMR (Interview 3, 6). At the same time, smaller municipalities are not yet sufficiently advanced to the same level as the GMR. This represents untapped potential, but recent vouchers for assistance in civil engineering projects that the GMR has handed out to, amongst others, Lingewaard are a promising development (Interview 1).

*Barrier 3: Uncertainty within Lingewaard about market capabilities.*
Collaboration between the municipality and market actors is encouraged through GMR's knowledge tables and events, but can also occur via market consultations or construction teams. Applying these formats "*is important for the municipality to stay in touch with the*

*market: What is the market capable of? Are my demands realistic?*" (Interview 4). However, Lingewaard has made limited use of these formats, partly due to a lack of personnel and experience. Simultaneously, market actors are uncertain about the expectations of municipalities and other clients, which hinders further development.

### 6.5.2 Key enablers

***Enabler 1:*** *Learning from other regional projects and stakeholders.*
Circularity is a new topic, but Lingewaard does not need to tackle it alone. Municipalities such as Arnhem and Nijmegen already have policies in place, and the province has published an implementation agenda. All these parties expressed willingness in interviews to engage with Lingewaard and offer support. GMR's knowledge tables and local initiatives such as Via-T provide avenues for collaboration.

Additionally, various national platforms facilitate knowledge exchange, such as the City Deal for Climate-Resilient Area Development, which includes Arnhem, Nijmegen, and Doetinchem (Interview 2, 3, 6). Lingewaard does not need to participate directly in national events but can access a broad network of partners and expertise through regional connections.

Learning from others can also occur during procurement, for example by using construction teams or other formats that offer contractors greater flexibility (e.g., RCC or SOK). Instead of delivering a design and specifications, the municipality engages with the contractor during the design phase. Market actors prefer these long-term collaborative contracts, as they allow for dialogue on circularity (Interview 9, 10). Due to limited experience, these procurement formats are still used infrequently, though their adoption is increasing (Interview 4). However, such contracts require more time from the client compared to standard specifications, making them not always the most suitable option. The Province of Gelderland currently aims for 20% collaborative contracts and 80% RAW specifications (Interview 11).

***Barrier 2:*** *Enhancing knowledge within projects.*
Perhaps the greatest challenge lies in internally disseminating the knowledge derived from (regional) collaborations to ensure that project members share a common understanding of the circular economy and its importance (Interview 2). In terms of organizational knowledge, there is much to learn from larger municipalities in the region, such as Arnhem and Nijmegen, who have already embedded circularity in their organization (Interview 3, 6). Knowledge platforms, both on regional and on national scale, can play a valuable role in this process through their networks (Interview 6).

***Barrier 3:*** *Collaborations with housing corporations.*
A key component of the housing task for municipalities is the provision of affordable (rental) housing. Collaborations with housing corporations are central to this effort. "*In Gelderland, several corporations are already making significant strides in circularity*" (Interview 8). Corporations possess substantial knowledge and expertise (Interview 5) and more frequently request circular practices compared to municipalities (Interview 9). Partnerships

between corporations are on the rise, with the Woco-to-Woco initiative in Doetinchem (Interview 2) and a similar initiative in Arnhem (Interview 6). These developments suggest that greater value may be derived from stronger collaboration with housing corporations.

## 6.6 Behavioral dimension

Behavior is repeatedly stated in interviews as the most important dimension (Interview 2, 6, 8), and is highlighted by others as one of the most important dimensions. This dimension encompasses the behavior within the municipal organization, the behavior of market actors, and behavior within society.

### 6.6.1 Key barriers

*Barrier 1: Predominantly traditional working methods persist across all stakeholders.*
Circularity is a relatively new concept, and experiences with its implementation are limited at the municipal level. A frequently cited barriers is the lack of widespread knowledge and understanding of circular principles. This may stem from reluctance, for example: "*We will deal with that in the next project*" (Interview 1). Or the willingness could be there, but is hindered by a lack of experience and time constraints by project managers (Informal conversations). There is also a lack of guidance: What is the circular economy? How does it relate to my role? What should I be aware of? (Interview 2). The municipality of Lingewaard does not have the personal capacity to provide this support internally.

*Barrier 2: Business case feasibility is prioritized over experimentation.*
Market actors tend to be risk-averse and profit-driven, their primary concern is the business case. Circularity is often viewed as an additional requirement unless mandated (Interview 3). This perception leads to a cautious stance. While the market is not inherently resistant to change, innovations must be framed in a way that aligns with viable business models.

### 6.6.2 Key enablers

*Enabler 1: Behavior as a central theme.*
Nearly all interviewees identify behavior as the most important dimension. Changing behavior fosters awareness and strengthens motivation to pursue transformation. Within the municipality, behavioral change requires support from both the directory board and the council, so it is important to get these people on board (Interview 3). By adopting and actively deploying circular policy, the municipality of Lingewaard can show its commitment, which can serve as a catalyst to all stakeholders (Interview 3).

*Enabler 2:Growing awareness among market actors.*
Although market actors remain somewhat cautious, the interviews clearly indicate that "*alternative thinking is gaining momentum: experimentation is increasing, and more is becoming possible*" (Interview 3). Many developers and contractors recognize the need for change and are already capable of contributing (Interview 6). "*Every reputable construction company now has a circular building concept ready to go*", otherwise they risk losing clients (Interview 8). However, project initiators rarely demand circular concepts such as circular

construction (Interview 9) or electric equipment (Interview 10). Future progress will therefore also require boldness from project initiators to experiment and go beyond the standard.

*Enabler 3: Circularity as a societal theme.*

The current discourse on circularity primarily focuses on municipal organizations and market actors. The municipality has a demonstrative role in showcasing what is possible (Interview 2). According to Dr. Iulian Barba Lata (Interview 7) from Radboud University, it is essential to broaden the discussion to include society as a whole, not just the front runners. Education fosters awareness, which increases demand and subsequently supplies. This creates a reinforcing cycle involving the municipality, the market, and society. Referring to the R-ladder, maintaining quality is essential for reuse. Greater awareness leads to better handling of (construction) waste, preserving material quality.

# 7. Governance of Lingewaard

The framework by Pomponi and Moncaster (2017), as presented in the previous chapter, provides a categorized overview of the most important barriers and enablers related to a circular economy in the built environment in Lingewaard. However, the framework does not offer insights into the governance of addressing the barriers, seizing enablers, and dealing with overlaps and frictions between the dimensions. This thesis proposes the addition of two governance frameworks to overcome this limitation. First, the Governance Capacity Framework by Mees and Driessen (2011) identifies five governance capacities – governmental, financial, technological, environmental, social, behavioral – that could be analyzed in order to identify what is needed in the governmental organization of Lingewaard to overcome barriers and capitulate on the enablers. Second, the framework by Bulkeley and Kern (2006) is used to discuss what modes of governance – self-governance, governing by provision, governing by authority, governing through enabling – could best be deployed by the municipality of Lingewaard to realize and stimulate a circular building economy.

## 7.1 Governance capacity

### 7.1.1 Legal capacity

Mees and Driessen (2011) interpret legal capacity as "*those formal regulations and policy principles which urban planning has at its disposal*" (p.254). In this thesis, this type of capacity is primarily linked with the governmental dimensions, but does also appear in the discussion on the other dimensions.

The results show that the current regulations in the Netherlands, or rather the absence of ambitious regulations, form an important barriers to the realization of a circular economy in the built environment. This is especially the case for residential housing projects where the municipality has a facilitating role. The national government actively discourages above-statutory requirements, and the regulations are insufficient to spur material innovation. The slow uptake of several materials in the MKI and MPG calculations and the inability to reuse materials due to dimensions deviating from the Building Decree are exemplary for this.

Municipalities have limited influence on national regulations. One possible legal action a municipality could take is setting demands for the granting of permits, but these are not legally binding. Another example is to set demands for development via de new Environmental Planning Act, but this is too complex for smaller municipalities. Having said so, these downsides could (partially) be overcome through collaboration with other governmental actors or knowledge institutes. In any approach, uniformity, preferably on a regional scale, is needed to develop a clear vision and set an example to market actors.

### 7.1.2 Managerial capacity

According to Mees and Driessen (2011), managerial capacity refers to "*the extent of integration … into urban planning, the extent of collaboration with other policy sectors, and*

*the use of integrative management tools as a means for effective governance*" (p.255). In this thesis, this type of capacity primarily emerges in the discussion on the technological, behavioral, and societal dimension.

The municipality of Lingewaard has limited organizational capacity to systematically address circularity. Currently, circularity is applied on a project-by-project and ad-hoc basis and there is no (internal) guidance. The appointment of a policy officer represents an important step toward an integrated approach, but it remains questionable whether a single policy officer is sufficient to address the broad circularity challenge. To embed circularity, increased awareness and knowledge sharing are needed between policy officers, project leaders, and other staff. This requires a collective and integrative approach to project-based work. Internally, the municipality has set the first steps in this direction as a separate, organization-wide initiative. Perhaps the policy officer could play a role in extending this effort externally.

### 7.1.3 Political capacity

Mees and Driessen (2011) break political capital down into three aspects: (1) Accountability as "*a key requirement of any governance arrangement*" (p.255); (2) Political will, which "*is necessary for gaining the societal support to develop and implement … policies*" (p.255); and (3) Leadership, which is needed to promote change. In this thesis, these aspects are primarily discussed in the governmental, social, and behavioral dimensions.

Judging based on these three aspects, political capital in Lingewaard is substantial. Despite the absence of clear and ambitious national regulation, the municipality of Lingewaard is making serious effort to draft a circular policy briefly and adopting circularity within projects. Subsequently, there is political will to place circularity high on the agenda, which is proven by the adoption of several policy documents. It is also expected that circularity will remain on the agenda despite budget cuts and new municipal elections in 2026. Where realization is starting to gain momentum internally, political and administrative support is a prerequisite to enroll this further. This resembles the third aspect of leadership, which is also needed to navigate the competition between circularity and other domains, such as financial feasibility or climate adaptation and mitigation.

When accountability, political will, and leadership are absent, a municipality is likely to take a risk-averse approach, which does not inspire market actors to innovate. However, innovation is precisely what is needed to convince municipalities and other governmental organizations to take a more daring and ambitious approach. This forms a barrier that might not be solvable without national interference.

### 7.1.4 Resource capacity

Resource capacity "*contains critical aspects in the form of economic, human, and knowledge resources*", which are needed to deal sufficiently with governance issues (Mees and Driessen, 2011, p.256). Resources are primarily discussed in the financial, social, and behavioral dimensions.

Within the municipality of Lingewaard, the availability of resources is limited. The most important limitation is that the municipality typically does not own land, making it difficult to impose above-statutory circularity requirements. Furthermore, the budget is limited, partially because of the approaching budget cuts in 2026. While the municipality's knowledge on circularity is not necessarily missing, the municipality primarily lacks sufficient human capacity to structurally guarantee circularity in projects. Collaborations with other governmental organizations can help pool resources and deploy them more efficiently. However, this also requires additional capacity (and resources), which is lacking in the first place. Because of this vicious cycle, strategic management of the available capacity and resources is crucial, meaning the municipality needs to choose its battles.

### 7.1.5 Learning capacity

Learning capacity has the ability to deal "*with uncertainty and the presence of continuous learning processes*" (Mees and Driessen, 2011, p.257). In this thesis, this type of capacity is primarily linked with the behavioral dimension and to a lesser extent with the social and technological dimensions.

In Lingewaard, the learning capacity is present, but fragmented due to a shortage of personnel capacity to handle learning tasks. There is a willingness to learn from local and regional projects, however, a systematic approach is lacking as monitoring, evaluation, and knowledge sharing are not yet (sufficiently) embedded. This is partly due to a lack of clarity about what to monitor and the absence of reliable monitoring tools. In addition, contacts with the GMR are deemed valuable, but are only utilized to a limited extent.

Structured reflection, policy evaluation, and the exchange of best practices are necessary to increase learning capacity. Regional collaboration can contribute to the development of structured learning processes. Behavioral change is essential in this regard: daring to experiment and letting go of traditional routines is necessary to gain new insights and to integrate these insights into policy and project processes.

## 7.2 Modes of governance

### 7.2.1 Self-governance

Bulkeley and Kern (2006) define self-governance as "*the capacity of local government to govern its own activities*" (p.2242). This thesis showed that the capacity of the municipality of Lingewaard to 'self-govern' is dependent on whether the municipality is 'in the lead' in projects. As part of the discussion on the governmental dimension, this thesis discussed that for civil engineering and social real-estate the municipality is always in the lead, meaning they can set above-statutory circularity demands. This can be considered self-governance as it is way for the municipality to achieve their circularity ambitions through own activities, for example through prevention (R1), reduction (R2), or reuse (R3) of materials. Opposed, the municipality has a facilitating role in residential real-estate projects. As a result, the municipality of Lingewaard cannot set above-statutory demands and self-governance is limited to the granting of permits.

In addition, self-governance also requires that circularity is internally organized and embedded. Interviews highlighted the importance of formulating a clear definition of circularity, stimulating awareness among colleagues, and integrating circularity into existing work processes. The KEC-program in Lingewaard is a good first step in this direction, because it shows circularity is not an additional ambition, but part of an integral vision. Furthermore, the municipality of Lingewaard can strengthen self-governance by documenting experiences, creating an internal knowledge bank, also including mapping material flows, and periodically updating policies and formats. By doing so, Lingewaard becomes a learning organization that continuously improves its own activities.

### 7.2.2 Governing by provision

Building on the discussion in the previous paragraph, the facilitating role of the municipality in residential real-estate projects is an example of governing by provision. Bulkeley and Kern (2006) define this mode of governance as "*the shaping of practice through the delivery of particular forms of service and resource*" (p.2242). In the facilitating role, the municipality provides the service of adjusting the environmental plan as part of the Environmental Planning Act, thereby enabling developers to legally construct housing units. As previously discussed in this thesis, municipalities may attach specific circularity conditions to this service, but these conditions are not legally binding and as such hold no merit for actual realization.

Another potential service is the establishment of a material depot for temporary local storage of waste materials. Interviews consistently identified the absence of such facilities as a significant barrier to material reuse. Given that the municipality of Lingewaard possesses knowledge of both the materials required across projects and their respective timelines, a depot could facilitate more efficient coordination and distribution of second-hand materials. This benefit would be amplified if the depot were also accessible to market actors.

Provision also includes offering practical support to internal project teams. The municipality of Lingewaard can achieve this by preparing accessible information documents that summarize policies and available instruments, but also through organizing training and guidance by itself or through organizations such as the GMR, Cirkelstad or Building Balance. In this way, Lingewaard provides the necessary resource and services to enable project teams to apply circularity effectively.

### 7.2.3 Governing by authority

Governing by authority is defined by Bulkeley and Kern (2006) as "*the use of traditional forms of authority such as regulation and direction which persist despite reforms*" (p.2242). The amount of authority the municipality of Lingewaard has depends on the type of project. For residential real-estate, the primary form of regulation is the Building Decree, which is a national regulation that municipalities need to enforce but cannot deviate from. However, as discussed in Chapter 5, municipalities are responsible for drafting environmental plans, which stipulate how land can be used. Through these plans, a municipality can impose zoning restrictions. This forms the only authoritative power of the municipality of Lingewaard in residential real-estate projects and also the basis of providing the service of adjusting this

plan and issuing a permit for construction. For other types of projects, such as social real-estate or civil works, the municipality has more room to set regulation themselves.

Authority also extends to the development of a circular policy with uniform standards and use of instruments, aligned with regional partners. A SMART formulation of circularity can enable monitoring of progress, for example through % material reuse or $CO_2$-emissions, the latter also allowing for linking circularity to other policy domains. Then, governing by authority becomes not only about enforcing regulations, but also about creating local and regional frameworks that guide and structure operationalization of the circular economy.

### 7.2.4 Governing through enabling

According to Bulkeley and Kern (2006), governing through enabling "*refers to the role of local government in facilitating, co-ordinating and encouraging action through partnership with private- and voluntary-sector agencies, and to various forms of community engagement*" (p.2242). In other words, this mode of governance highlights the municipality's capacity to act as a connector rather than a regulator. This thesis showed that fostering collaborations between other governmental organization, market actors, and knowledge institutes is one of the, if not the most important task for a municipality to realize and stimulate circularity. It increases internal knowledge and capacity, which allows the municipality to govern by stimulation and partnerships that empower other stakeholders to take collective action. In this way, the municipality might also be possible to increase their influence in residential real-estate projects by cultivating cooperation and shared responsibility for long-term sustainability goals.

Enabling also includes actively gathering knowledge from regional partners, corporations, and knowledge institutes, while also sharing Lingewaard's own experiences. Through participation in discussions, such as the knowledge tables by the GMR, or contribution to joint solutions, such as a regional material depot, enabling becomes a fundamental mode of governance for Lingewaard to stimulate circularity both locally and regionally.

# 8. Discussion

## 8.1 Positioning in literature

### 8.1.1 Barriers and enablers

Chapter 2.4 outlined key barriers and enablers to a circular building economy based on existing literature. This thesis builds on those findings by addressing the local governmental context, using the municipality of Lingewaard as a case study. Most barriers and enablers identified locally reflect more specific elaborations of those in literature. However, the case study introduces new factors and expands the discussion to include the environmental dimension, which is largely absent in literature. Opposed, the operational and logistics theme from literature is not separately discussed in the case study, but rather integrated in the technological dimension. The following discussion compares barriers and enablers from literature and this thesis, organized by thematic categorizations (Table 1, 2). These categories broadly align with the six dimensions proposed by Pomponi and Moncaster (2017), though some factors are classified differently due to thematic overlaps.

Regulation and policy (Governmental dimension / Technological dimension)
Regulatory gaps and misalignment, found in literature, were also prominent in Lingewaard. The case study showed that these barriers originate at the national level, where ambiguity and unambitious policies restrain further development. Additionally, short-term tendering practices, another barrier found in literature, also persists in Lingewaard as the municipality prioritizes financial indicators over qualitative ones. Opposed, enablers show differences. While literature emphasizes policy instruments and public procurement as enablers, the case study reveals that the multitude of complex standards in the Netherlands can create confusion. Both sources agree on the importance of collaboration as a key enabler for realizing a circular building economy.

Economics and market (Economic dimension)
Literature identifies high upfront costs, low virgin material prices, and immature secondary markets as major barriers. All three are also mentioned in the interviews, especially those with market actors (Interview 9, 10). The case study adds the barrier of a limited municipal budget, which affects its ability to purchase land and lead projects. Also here, the enablers differ more notably. Both sources stress the importance of viable business models and how these can be improved, for example by incorporating long-term value. However, the case study also highlights the interplay between policy and economics, revealing enablers beyond market mechanisms, which are typically mentioned in literature.

Technical and design / Operational and logistics (Technological dimension)
Literature focuses primarily on practical factors, such as design, digitalization, and performance. While digitalization was mentioned in interviews, several interviewees mentioned that there are sufficient design and performance options already available in both civil engineering and construction. Both sources emphasize the need for materials hubs to facilitate reuse.

Collaboration (Societal dimension)
In terms of collaborations, an important distinction can be made between internal and external collaboration. The literature focused exclusively on external collaboration. Although the interviews also highlighted the importance and potential benefits of collaborations with other municipalities and market actors, they also highlighted the importance of internal collaborations to embed a circular way of working within the organization.

Behavioral and organizational (Behavioral dimension)
Barriers such as traditional culture, stakeholder hesitation, and knowledge and skill gaps are consistent across both sources. According to literature, addressing these barriers requires capacity building, which the case study showed could be achieved through training and collaborations. One interview (Interview 7) noted the municipality's role in raising public awareness, a theme underrepresented in both sources, suggesting a missed opportunity for broader cultural alignment.

### 8.1.2 Framework and policy cycle

Through the discussion governance capacity and modes of governance in Chapter 7, this thesis proposes a series of policy recommendations for smaller municipalities in the Netherlands to stimulate and realize a circular building economy. These recommendations could also be framed differently to reflect other scientific contributions. For example, they could be presented as a list-structured framework (Mahpour, 2018), as a policy circle (HaitherAli and Anjali, 2024; Yu et al., 2022b), or as input for a revision of an integrated governance framework (Tosun and Lang, 2017; Visseren-Hamakers, 2018). Of these possible applications, framing the findings as a policy cycle seems most suitable, as it can be used as a practical tool for scientific purposes as well as for practical application by policy officers.

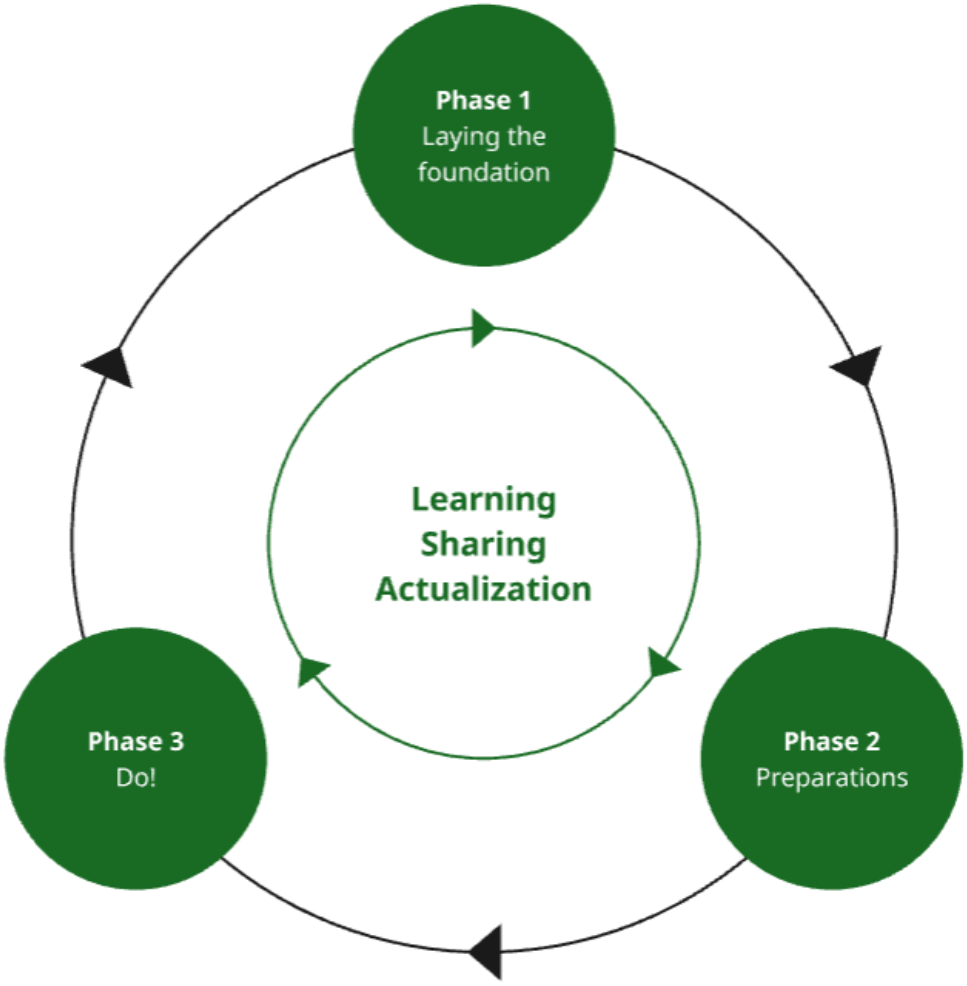
Figure 9 presents the proposed policy cycle, in which the recommendations are grouped in phases (Appendix 2). These phases are not necessarily sequential, but they do follow a clear progression. The path to a circular built environment begins with laying the foundation. The focus here is primarily on acquiring knowledge, preferably anchoring this internally, and raising awareness. Phase 2 involves integrating circularity into work processes as preparation for practical implementation. While this is not a prerequisite for implementing circularity, it is necessary for constant implementation. In phase 3, circularity is realized.

Regardless of the phase, it is important to learn from the process, share new knowledge internally and externally, and update work processes, policies, and programs where necessary. By continuously applying, reflecting on, and improving, circularity can become an integral part of the internal, project-based workflow within small Dutch municipalities.

## 8.2 The circular economy from a transition perspective

This thesis has identified several frameworks, both on the circular economy concept as well as for application in the built environment, which offer ways to structure an analysis. However, it also highlighted that many frameworks fall short of discussing the "how" and "what it takes"

*Figure 9. The circular economy policy cycle (by author).*




to implement circular economy principles (Levoso et al., 2021). There are some that to some extent answer these questions (Mahpour, 2018; Hartley et al., 2023), but these lack concrete conclusions on the capacities needed by governments, especially on the local level. Rather than adding a governance perspective to circular economy frameworks, some scholars describe the shift from a linear to a circular economy as a transition, and approach the concept from a transition perspective (Ghisellini et al., 2016). Here, a transition is understood as "*a set of connected changes, which reinforces each other but take place in several different areas, such as technology, the economy, institutions, behavior, culture, ecology and belief systems*" (Rotmans et al., 2001, p.16).

Although frequently described as a transition, only few studies propose a transition framework specifically for research on the circular economy. Examples of those that have focus on business models (Scheepens et al., 2016; Chen et al., 2020) or accountability and responsibility (Di Vaio et al., 2023). As such, it remains uncertain whether a transition perspective could be valuable for research on the governance of a circular building economy at the municipal level. To this end, the remainder of this paragraph will explore several established transition frameworks and discuss their potential application. Within this discussion, a distinction is made between frameworks focusing on transition management and those focusing on the system context.

In terms of system context, the Multi-Level Perspective (MLP) proposed by Geels (2002; 2011), see Figure 10, can be a useful framework to analyze socio-technical transitions as it highlights the dynamic interactions between the landscape (socio-economic, cultural, political, and environmental factors), regime (dominant structures and practices), and niche level (protective space for innovations), and through that also the complexity of transitions.

The MLP approach is a viable option for application in this thesis because the dimensions of the landscape and regime level capture the six dimensions of a circular economy proposed by Pomponi and Moncaster (2017). This ensures that it can be used to identify barriers and the long-term outlook of the landscape level fits very well with the ambitions of a circular economy formulated by various levels of government. However, several critiques were raised concerning the application of the MLP in the circular economy context, most notably its inability to identify where policy interventions are needed (Iacovidou et al., 2021), in part because of "*interactions and dependencies involving multiple sectors […] which cut across several regimes and niches*" (Chizaryfard et al., 2020, p.476-477). The latter critique can be overcome by adopting a transformative governance approach (Visseren-Hamakers et al., 2022), which places the circular economy transition amidst a wider transformation including other transitions. This reflects the current situation of the circular building economy that is often addressed in conjunction with energy, nature-inclusivity, and sustainability transitions.

*Figure 10. The Multi-Level Perspective on transitions (Geels, 2011, p.28).*

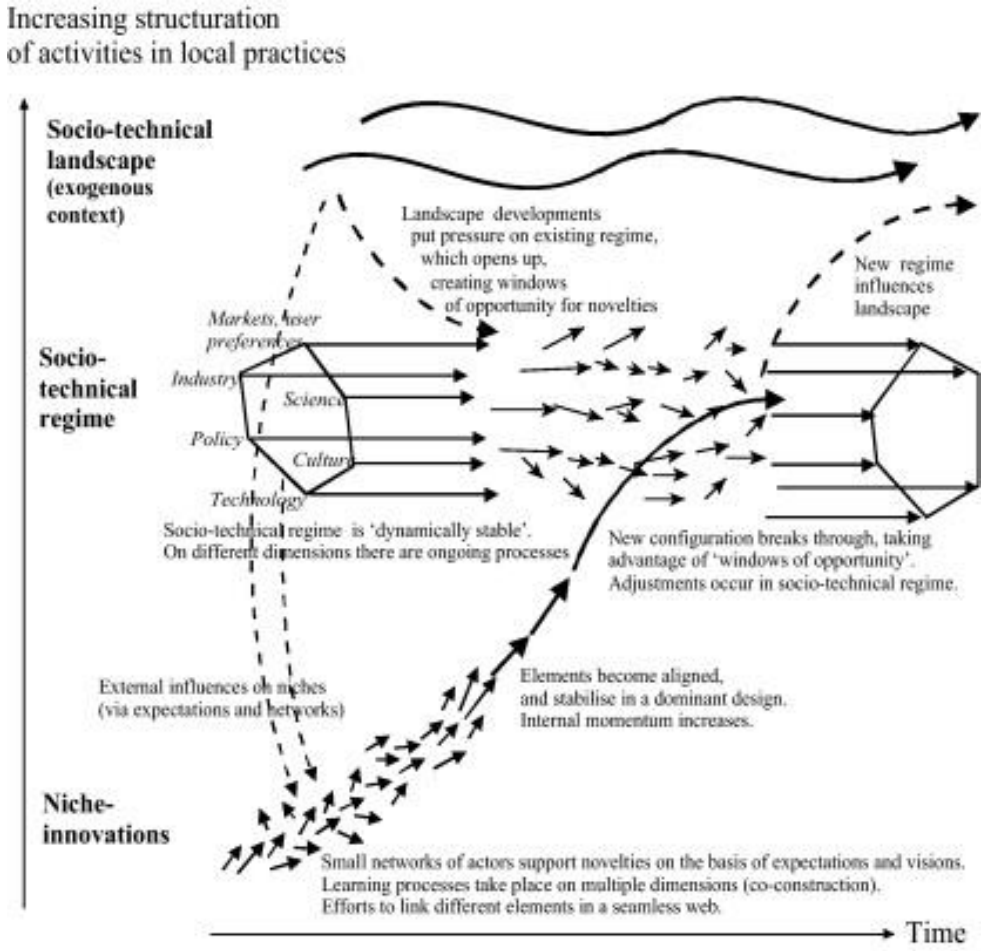
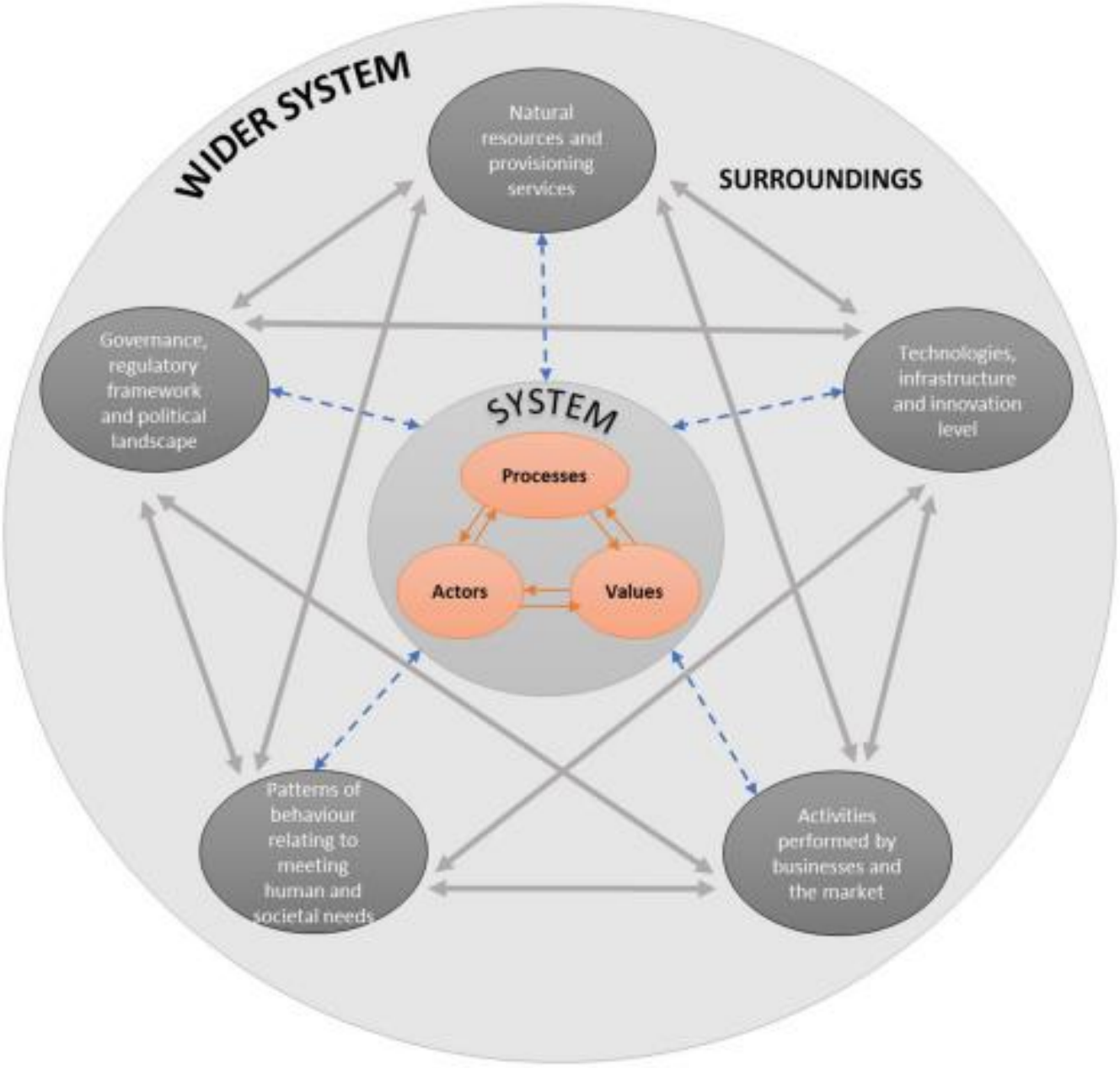


*Figure 11. The resource recovery system with its internal sub-systems, as situated within the external sub-systems that form the whole system of systems (Iacovidou et al., 2021, p.24792).*




Nevertheless, the first point of critique remains. As a response, Iacovidou et al. (2021) propose a resource recovery framework, as shown in Figure 11, which is based on a 'System in Systems' perspective, also suggesting that the resource recovery system is part of a wider set of systems, which the authors relate to the 'landscape' level of the MLP. Rather than including the six dimensions of the MLP regime, however, this framework includes three sub-systems: processes (production-consumption-management resource flows), actors (indirect and direct stakeholders), and values (environmental, economic, social, technical). The main benefit of this approach is that by analyzing the linkages between systems and sub-systems, the framework can be used to assess barriers and intervention points for a circular economy.

These approaches, however, are not the only transition frameworks. Related is the X-curve framework developed by Hebinck et al. (2022), which provides a more simplistic representation of transitions compared to the MLP and specifically designed to "*offer actionable support in understanding and developing governance practices for sustainability transitions*" (Hebinck et al., 2022, p.1010). When focusing on the role of technologies in transition, the technological innovation system (TIS) can be used to identify the barriers and enablers to implementation, and thus identify key policy issues (Bergek et al., 2008). Another approach to technological innovations is strategic niche management (SNM), which specifically focuses on understanding the early-adoption of technologies and their potential to sustainable development (Kemp et al., 1998; Schot and Geels, 2008).

Having said so, the MLP and resource recovery framework are believed to be the most applicable for the purpose of this thesis. Still, while both these frameworks provide valuable insights, they need to be further adapted to the local level context in order to form an analytical tool for this thesis. In itself, the MLP lacks a focus on resource flows and is generally applied in socio-technical transitions, whereas the focus of this thesis is on the policy domain rather than technological. In turn, the resource recovery framework misses the long-term outlook necessary for circular economy policy formulation. Specifically, adaptations need to ensure the integration of stakeholder dynamics, governance capacity, and practical interventions.

## 8.3 Personal reflection on the research

### 8.3.1 Reflection on the theoretical framework and research questions

Constructing the theoretical framework has been a challenging task. On the one hand, the literature review in Chapter 2 and Chapter 3 shows a vast scientific discussion on the topic of the circular economy and its application in the built environment. On the other hand, where the addition of a governance perspective is a novel approach, it also widens the scope of an already broad concept. Combining the essence of the circular economy with the addition of modes of governance and governance capacity proved difficult, yet also logical and therefore essential. Through the interviews and informal conversations it became clear that any progression towards a circular building economy is at least to some extent dependent on governance, whether it is through legislation, ambitions, or capacity. In Chapter 3, this thesis discussed various frameworks that could be used to research certain details of a circular building economy, but a holistic framework was missing. Through the case study of the municipality of Lingewaard, this thesis proved to fill this gap and showed the value of the proposed framework as a multifaceted and holistic framework to capture the complexity of circular economy governance on the local level.

This thesis asked the main research question: *How can local municipalities in the Netherlands, like the municipality of Lingewaard, enhance their governance capacity to realize and stimulate a circular building economy?* By combining elements of several frameworks into a single framework, this thesis was able to answer this question to a large extent. Through Pomponi and Moncaster's (2017) framework, the main barriers and enablers

for a circular building economy in the municipality of Lingewaard could be identified, thus answering SQ1: *What are the barriers for a circular building environment, and what enablers exist to overcome these barriers?*

Second, the IFCG by Emerson et al. (2012) helped to better understand stakeholder perspectives and collaborations. As such, it helped to answer the first part of SQ2: *Which other parties play a role in the realization of a circular building economy at the municipal level, and how can collaboration with these parties best be structured?* However, the second part of the question, regarding the structure of collaborations, could not be answered to the fullest extent. The current application of the IFCG in the theoretical framework is too general. More directly including the three integral components of the IFCG (principled engagement, shared motivation, capacity for joined action) could potentially overcome this limitation.

Third, the governance capacities by Mees and Driessen (2011) helped to identify how the barriers and enablers translate to the municipal organization and what is needed in terms of capacity. By combining governance capacities with the modes of governance by Bulkeley and Kern (2006), it became possible to translate these insights to concrete recommendations for the municipality of Lingewaard and answering SQ3: *What are the current governance capacities of the municipality of Lingewaard relevant to the circular building economy, and how can they be enhanced?* By answering this question, this thesis fills the gap in scientific literature by discussing the "how" and "what it takes" to implement circular economy principles (Levoso et al., 2020), especially at the municipal level (Dagilienė et al., 2021). Having said so, the final formulation of the results could be better visualized or structured to provide a simplified overview of the main findings and concrete policy recommendations.

### 8.3.2 Reflection on the methodology

This thesis deployed a research strategy of a case-study approach combined with interviews and informal conversations, meaning a qualitative methodology. Using a consistent set of interview questions across interviewees proved valuable in identifying differences in perspectives between them. At the same time, allowing space to explore certain questions or topics that aligned with the expertise of the interviewee in more depth also enriched the data, as it enabled interviewees to elaborate when deemed relevant to them.

However, the methodology was not without limitations. First, not all interviews could be included in the analysis, either because they were not recorded or because the consent form was not signed. Although this was mostly because the interviewees preferred this, in some cases it was due to personal shortsightedness. Having to include several interviews as informal conversations reduced the quality of the data. Second, obtaining data using interviews relies on the willingness of individuals to participate. Unfortunately, not all relevant parties could be interviewed. Most notably, the perspectives from the housing corporation are missing as well as personal insights from the national government.

# 9. Conclusion

With the adoption of the policy brief 'Circularity' and the program 'Climate, Energy, and Circularity', the municipality of Lingewaard clearly expressed their ambition for fully circular building economy by 2050. This thesis demonstrates that realizing this ambition requires a strategic, layered approach in which learning, collaboration, and actualization are essential. The seven dimensions highlighted in this thesis (governmental, financial, technical, environmental, social, behavioral, and capacities), show that circularity is multifaceted, shaped by both internal and external influences. Moreover, circularity intersects with other policy domains such as climate adaptation and mitigation, and the energy transition. These connections can reinforce each other, but also cause competition between, underscoring the need for strategic and deliberate decision-making by policy officers.

Through a discussion on modes of governance, this thesis offered concrete recommendations for smaller municipalities to internalize, realize, and stimulate the circular building economy. The accumulation of knowledge and awareness are at the core of realizing a circular building economy. With the right knowledge on technical, financial, and governmental feasibility, and the organizational capacity to act, circularity can be grounded in policy and the way of working of the municipality. Subsequently, circularity can be structurally applied in projects and, through experience and knowledge sharing, be scaled up to meet local, regional, and national goals over time.

This thesis proposed a framework to analyze the circular building economy context, identify how municipalities can move towards operationalization and what capacities are needed to do so. The framework offers stability and support for both researchers and practitioners looking to investigate the circular building economy at the municipal level. However, although it proved useful in formulating concrete recommendations, additionally visualizing the results as a policy circle (Figure 9) offers a more comprehensive presentation of the results. Highlighting three main insights.

First, it highlights that effective progress requires a combination of governance modes rather than reliance on a single approach. Second, the timeline of phases provides guidance for operationalization in policy, practice, and collaboration. Finally, the cyclical nature of the process emphasizes that learning, sharing and actualization evolve over time, meaning that perfect preparation is not a prerequisite for operationalization, but something that grows by doing.

Ultimately, Lingewaard's pursuit of circularity illustrates how smaller municipalities can pioneer to achieve systematic change. By embedding circular principles into governance and practice, they can demonstrate that the circular building economy is not a distant ambition, but a practical, evolving pathway towards resilience and sustainability across policy domains. As a municipality, you just have to dare to take the first step.

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# Appendix 1: Circularity instruments in Dutch context

The set of instruments for buildings and civil engineering projects consists of various measurement tools that can be used in tenders or project evaluation. Interviews revealed that the instruments used by municipalities and other clients in the region differ. This appendix discusses the most common measurement tools used within the region.

## Environmental Cost Indicator – MKI

For each material, a national value has been established that reflects the environmental burden of that material.[1] This is the Environmental Cost Indicator (MKI). The value is based on the results of a Life Cycle Analysis (LCA) of that material. In the so-called A1 dataset, 11 different environmental effects are considered. In the short term, the A2 dataset will be introduced, which includes 19 environmental effects.[2] Each of these effects is expressed in separate values, also called "shadow costs." These shadow costs are added together into a single figure: the MKI. The MKI is expressed in euros and represents the expected societal costs if the environmental effects had to be undone. In theory, these are fictitious costs, hence "shadow costs." The lower the MKI, the lower the environmental costs and the lower the environmental impact.

To realize infrastructure projects more sustainably, it can be decided to include the MKI alongside price as an award criterion. The impact of this depends on the contract form and the chosen weighting. It is common to give the MKI more weight than other award criteria and price. Depending on the ambitions set by the client, the multiplication factor varies.[3] The MKI value can then be applied as a "discount" on the bid price or added to the bid price. In both cases, a low MKI is favorable for the bidder. It is important to act uniformly within the organization in this regard.

## Environmental Performance of Buildings – MPG

By law, it is mandatory to submit the Environmental Performance of Buildings (MPG) with every application for an environmental permit. The MPG is the combined score of all MKI values of the materials used in the building, divided by the lifespan of the materials and the gross floor area of the building.[1] Thus, the MPG reflects the environmental burden of a building, expressed in €/m²/year, from realization to maintenance to demolition. Again, the lower the MPG, the lower the environmental impact of the building. For the A1 dataset, the Building Decree legally requires an MPG of 0.8 for housing construction. This will soon be tightened to 0.5. When the A2 dataset comes into effect, a maximum MPG of 1.0 will apply for ground-based housing and 1.2 for multi-story housing.[2]

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[1] RVO. (2025). *MilieuPrestatie Gebouwen – MPG*. Rijksdienst voor Ondernemend Nederland. https://www.rvo.nl/onderwerpen/wetten-en-regels-gebouwen/milieuprestatie-gebouwen-mpg.

[2] LBP SIGHT. (2023). *Herziening mpg-score referentiegebouwen op basis van de herziene bepalingsmethodiek versie A2. Referenties woningen, kantoren en gebruiksfuncties zonder milieuprestatie-eis.* https://open.overheid.nl/documenten/f46750e9-d0cf-4103-a0c4-af5bf4ab6765/file.

[3] Piano. (2024). Stappenplan: Inkopen met de MKI. Het behalen van duurzaamheidsdoelstellingen in de GWW. https://www.pianoo.nl/sites/default/files/media/documents/2024-11/inkopen-met-de-milieukostenindicator-november2024.pdf.

By steering on MPG, the market is challenged to reduce the environmental impact of buildings. The Spring Agreement 2.0[4] (*Lente Akkoord*) identifies five strategies for this: (1) Reuse of existing materials and buildings; (2) Use of renewable materials, such as wood and biobased, and renewable energy sources; (3) Minimize environmental impact, also by using fewer installations or installations with smaller capacity; (4) Build for a long life cycle by using high-quality materials and flexible buildings; and (5) Build detachable buildings.

## The New Normal – HNN

Due to the many definitions of circular construction, The New Normal (*Het Nieuwe Normaal, HNN*) was developed by the knowledge platform Cirkelstad.[5] HNN serves as the common language in the field of circular construction, with achievable and ambitious circular performance targets. These objectives were developed in collaboration with clients and contractors. As a result, they are widely supported and desirable for both governments and market parties.

HNN distinguishes between different guidelines that create a uniform language for each type of project. Currently, HNN has four guidelines: new construction, existing buildings, infrastructure, and demolition. Work is also underway on a guideline for circular area development. In line with national agreements from Platform CB'23, HNN focuses on three themes: environmental impact, material use, and value retention. These themes are elaborated separately per guideline with indicators and objectives. Each indicator is categorized as a standard, an indication, or a concept. For standards and some indicators, performance levels are quantified. Both governments and market parties that join HNN agree to pursue these values. Because sustainability is broader than just circular construction, HNN also addresses other themes to determine the context in which circular performance is achieved. These themes are: energy, water, nitrogen, nature-inclusive, and climate-adaptive. In addition, "accelerators" are considered: qualitative aspects that can accelerate circular construction, such as social and management factors.

A critical view from the interviews is that HNN works with the MPG, which means that HNN shares the same drawbacks regarding a material database that does not include all (new) materials.

## Circular Impact Ladder

The Circular Impact Ladder (*Circulaire Impactladder*) was developed on behalf of the GMR to operationalize the agreements from the Woondeal within the region.[6] Specifically, it was developed to make circularity simple but still testable. It was created during the first versions of HNN but provides, instead of a general language, a practical tool to calculate the impact

[4] Lente Akkoord 2.0. (2025). *Woningbouw met een lage MPG. Wat leert de praktijk?* https://circulairebouweconomie.nl/wp-content/uploads/2023/10/Lente-Akkoord-Woningbouw-met-een-lage-MPG.pdf.
[5] Cirkelstad. (2025). *Circulaire ambities binnen handbereik.* https://www.hetnieuwenormaal.nl/.
[6] Groene Metropoolregio. (2022). *Circulaire Impactladder*. https://www.gmr.nl/media/g3hbpdtn/implementatie-document-hoe-dan-v18-update-mei-22.pdf.

of material use for new construction projects. In this calculation, the Impact Ladder uses various, but not all, indicators from HNN New Construction. As a result, the focus of the Impact Ladder is exclusively on circularity and not so much on sustainability (read: $CO_2$). Because it uses fewer indicators than HNN, the Impact Ladder is much easier to understand and use. Thus, both can be used side by side: HNN as a methodology and the Impact Ladder to concretely work toward the agreement of 25% industrial construction as included in Woondeal 2.0 and as a common basis at the regional level. The Impact Ladder can be used from the initiative phase of a project to explore which indicators can be steered per project, but also which projects have the greatest circular potential. The disadvantage of the Impact Ladder is that it scores on mass. By using a concrete foundation, the score automatically turns out higher than desired.

## Material Circularity Index – MCI & Building Circularity Index – BCI

The Building Circularity Index (BCI), like the MPG, is a tool to measure the sustainability of a building.[7] Within the MPG, circularity can lead to a lower MPG score, but circularity is not a prerequisite for a low score. The BCI score can be used to better steer circularity, because it includes the Material Circularity Index (MCI) alongside MKI and MPG. This allows consideration of responsible origin, future scenarios, and detachability of materials. The BCI score is therefore a combined score for the environmental impact and circularity of a building. The BCI score is determined based on the final design and expressed as a percentage from 0% to 100%. Here, 0% is fully linear and 100% fully circular. In general, a score of 60% or higher can be considered a good score.

## Municipal Practice Guideline Building – GPR Building

Originally developed by the municipality of Tilburg, the Municipal Practice Guideline Building (*Gemeentelijke Praktijk Richtlijn Gebouw, GPR Gebouw*) is now an independent digital instrument used to assess and improve the sustainability of buildings.[8,9] The sustainability of a building is based on five indicators: energy, environment, health, quality of use, and future value. By steering on these indicators, the GPR Building can be used for various sustainability themes, such as circularity, nature inclusivity, and climate adaptation or mitigation. Each indicator is scored from 1 to 10. The GPR Building score is the average of these scores. A good score is generally an average of 8.0 or higher.

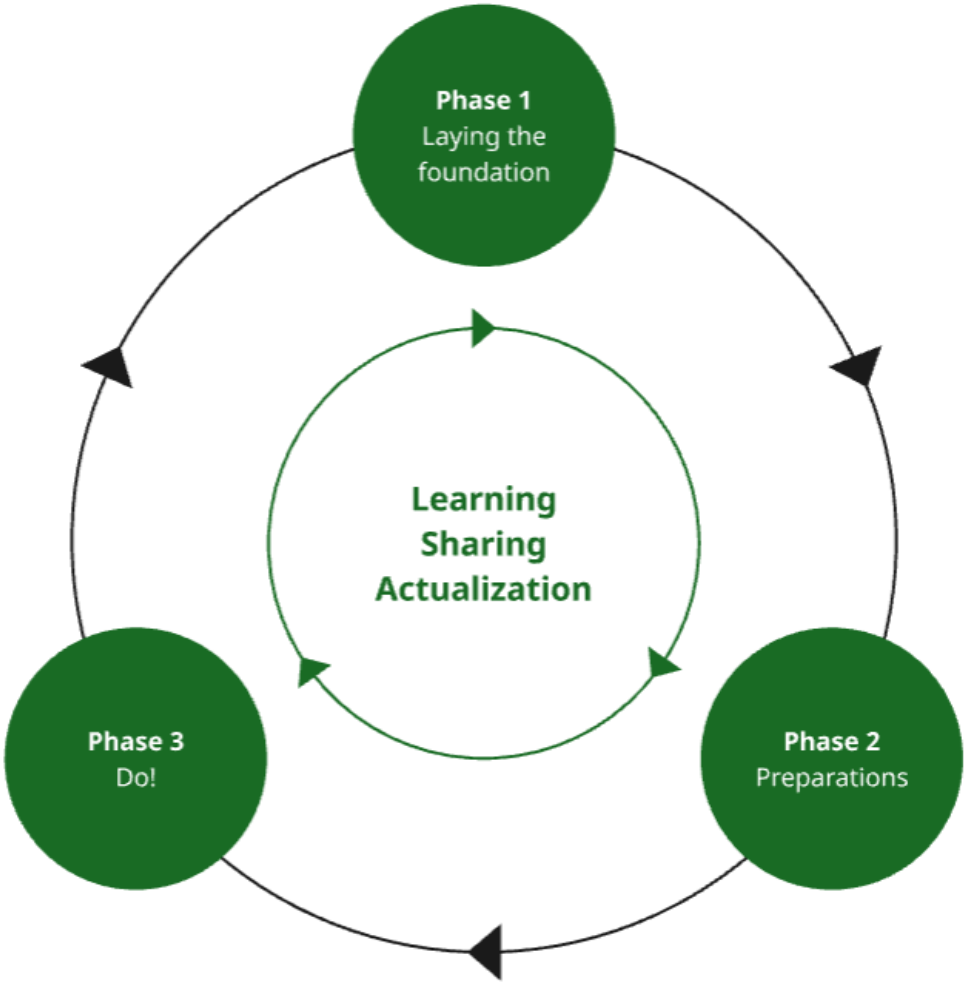
[7] Building Circularity Index. (2022). *Meetmethode Circulair vastgoed*. https://www.bcigebouw.nl/wp-content/uploads/2023/10/2022-Whitepaper-Building-Circularity-Index-V1.0.pdf.
[8] DGBC. (2025). *Gemeentelijk Praktijk Richtlijn Gebouw (GPR Gebouw)*. https://www.dgbc.nl/woordenboek/gpr-gebouw-gemeentelijke-praktijk-richtlijn-gebouw/.
[9] GPR Software. (n.d.). *GPR Gebouw*. https://gprsoftware.nl/applicaties/gpr-gebouw/.

# Appendix 2: Recommendations as a policy circle

The results of the research show that circularity within the municipality of Lingewaard is increasingly gaining attention, but its translation into structural implementation is still in its infancy. Based on six core themes and the administrative capacity of the municipality, this research has provided a comprehensive picture of the current situation, the barriers, and the opportunities. This chapter presents the recommendations, grouped into phases.

The phases and recommendations are not strictly sequential, but they do follow a clear progression. The path toward a circular built environment begins with laying a foundation. Here, the focus is mainly on acquiring knowledge and stimulating awareness. In Phase 2, circularity is integrated into work processes as preparation for practice. This is not a prerequisite for applying circularity, but it is necessary for structural implementation. In Phase 3, circularity is applied. Regardless of the phase, it is important to learn from the process, share new knowledge internally and externally, and update work processes, policies, or programs where necessary. By continuously applying, reflecting on, and improving circularity, it can grow into an integral part of the standard of Project-Based Working within the municipality of Lingewaard.

*Figure A2. The circular economy policy cycle (by author).*



## Phase 1: Laying the foundation

Before circularity can be applied as standard in projects, it must be internally supported and organized. This phase focuses on gathering information and creating awareness. In this way, an organization emerges that is ready to think and act in a circular way.

### 1.1: Acquire knowledge about circularity from other (regional) parties

Interviews provided a clear recommendation: start by gathering knowledge from other parties. This includes knowledge about circular and biobased materials, knowledge about different instruments and their application in, for example, procurement, or knowledge about integrating circularity into municipal working methods. First steps have already been taken, such as appointing a policy officer. However, efforts can certainly be expanded by engaging with (regional) partners. Municipalities such as Arnhem, Nijmegen, and Doetinchem have already gone through the initial phases. Conversations with municipalities in a similar phase, such as Duiven or 1Stroom, can also provide valuable insights. Additionally, consult the GMR about possibilities and the use of the Circular Impact Ladder. Look beyond municipalities as well, for example to housing corporations, which may also have extensive knowledge and experience in circular construction. Knowledge platforms such as Cirkelstad, Building Balance, Alba Concepts, and Duurzaam Gebouwd also form sources of information and networking. It is also advisable to expand current discussions with market parties via the GMR Knowledge Tables, for example by conducting a market consultation.

Action plan:

1. Assess the state of circularity among other (regional) parties through personal conversations, document analysis, and participation in (regional) meetings.
2. Establish contact with parties that have relevant experience.
3. Document lessons learned such as process steps, obstacles, unexpected developments, and solutions, and safeguard them in an accessible place.
4. Actively feed this knowledge back into Lingewaard's policy development by using lessons learned as input for policy, project documents, or procurement guidelines.

### 1.2: Stimulate awareness and knowledge sharing within the organization

Successful realization of a circular built environment requires that knowledge is widely shared within the organization. This begins with creating internal awareness. According to the interviews, it is important to engage colleagues from different teams and clusters in discussions: What definition of circularity do we as a municipality use? Why is it important? What does it mean for my role? Show that circularity stems from the municipality's duty of care. It is not an "extra," but rather a next step in developing an integrated approach that also addresses other topics such as climate and energy (KEC program).

At present, these conversations are taking place in preparation for policy. Later, they can be expanded into interactive knowledge sessions, for example about pilot projects: What is possible in terms of circularity? How can circularity be included in procurement? What costs

are associated with circularity? Initially, these projects will come from the region, but in time they can also be projects from the municipality itself.

Action plan:

1. Formulate a clear definition of circularity.
2. Select several relevant pilot projects in the region (see Chapter 4.3, footnote 35).
3. Organize knowledge sessions for relevant departments and project teams, with external guidance if necessary.
4. Actively collect input: what are the needs, concerns, and opportunities?

### 1.3: Map material flows

Referring to the R-ladder, the most circular option is prevention: Do we really need this road or building? This is a question that goes beyond circularity and relates to area visions and programs. While relevant, this question falls outside the scope of this research. This research focuses more on the reuse of materials (R3–R5). Currently, reuse of materials is considered sporadically and on a project-by-project basis. In civil engineering projects, reuse has traditionally been applied to save costs. To apply reuse structurally, it is important to have insight into which materials will become available in the future. Projects can then be aligned accordingly. This can be achieved through a material flow analysis, as carried out by the municipality of Arnhem. It is also important to follow developments around the national Circular Materials Plan, as this sets frameworks for demolition work, supervision, and enforcement.

Action plan:

1. Conduct a material flow analysis.
2. Follow developments around the national Circular Materials Plan.
3. Integrate the outcomes as input for future construction and demolition projects.

## Phase 2: Preparing for application in practice

In addition to gathering knowledge and creating awareness, it is necessary to anchor circularity in the municipality's policy and working methods. This creates an organization that is ready to think and act in a circular way in practice.

### 2.1: Develop circular policy with uniform frameworks

With the knowledge and insights from Phase 1, work can begin on policy for a circular economy in Lingewaard. The starting point for this is to formulate a SMART definition of circularity and set (interim) goals. Interviews revealed that uniformity in regulations and the use of instruments is essential to further develop circularity. It is therefore recommended to collaborate with other municipalities, and possibly housing corporations, when drafting policy. This does not mean that every municipality has the same policy, but that there is a uniform direction and joint alignment on the use of one or more instruments (MKI, MPG, BCI, the Circular Impact Ladder, Het Nieuwe Normaal). This is also important for monitoring circularity (seeA2.3.1), since objectives must be measurable through these instruments.

In addition to embedding circularity in policy, consideration can be given to embedding it in the Environmental Vision. Regardless of the instruments applied, it is important to leave room in policy for experimentation, both for clients and contractors.

Action plan:

1. Ensure a workable and SMART-formulated definition of circularity.
2. Collaborate with other municipalities in the region when setting goals and principles.
3. Record any agreements in a regional framework document.
4. Develop policy in line with uniform frameworks that fit the possibilities within Lingewaard, including (interim) goals and clear determination of instruments.

## 2.2: Integrate circularity into work processes

An important condition for realizing circularity is that colleagues do not see it as an extra ambition, but as part of an integrated vision. For this, it is important to identify opportunities to link circularity with current work processes and formats, such as project-based working and various programs. A first step toward integration has already been taken with the establishment of the KEC program, but circularity must be further elaborated within it. In the project-based working process scheme, circularity is currently one of the domains assessed in the design phase. However, it is important to look at opportunities for circularity even before the design phase. Within the project-based working scheme, circularity could, for example, be included as an assessment element in the intake or portfolio table, or as a fixed component in a project assignment or plan.

Action plan:

1. Evaluate the Project-Based Working Handbook, the current procurement guidelines, and other municipal programs.
2. Identify opportunities to integrate circularity: Where does circularity belong?
3. Make adjustments where necessary.

## 2.3: Facilitate support for project teams

Especially in the beginning, project teams will need practical support to effectively apply circularity. An information document provides an accessible summary of the policy and instruments Lingewaard intends to use when setting requirements and measuring performance. The municipality of Lingewaard has received a voucher for guidance from the GMR in a civil engineering project. The reconstruction of the Rijnstraat has been designated for this. For other projects, additional guidance will be needed externally, as the GMR has indicated it cannot provide this. Guidance can be sought from knowledge platforms such as Cirkelstad, Building Balance, Alba Concepts, or Duurzaam Gebouwd, depending on the project. To spread capacity, it may be wise to coordinate this guidance together with the Project Realization team, which has more insight into what is needed.

Action plan:

1. Draft an information document summarizing the key policy information on realizing circularity.

2. Use the voucher for guidance from the GMR in a civil engineering project.
3. Organize training and/or guidance on applying circularity, possibly in collaboration with the Project Realization team.

## Phase 3: Just start doing!

Phases 1 and 2 can be seen as preparation for the systematic application of circularity in projects. Perfect preparation is not a prerequisite for application. It is important to start from the beginning, even with limited knowledge, by looking for opportunities to apply circularity. Only by "doing" can opportunities arise to gain experience and learn from them. The municipality of Lingewaard has taken the first step in applying circularity by including the BCI in the tender for the Sallandstraat housing project. The challenge is to create momentum from this and maintain it. In whatever form, each project provides insights that can contribute to strengthening the internal safeguarding of circularity and, in the long term, improving policy. By monitoring, documenting, and learning, circularity can continue to grow with new insights and changing circumstances.

### 3.1: Monitor circular application and progress

By clearly defining circularity and instruments in policy, it becomes possible to monitor circularity. Depending on the objectives set, the level of detail for monitoring can be determined. For example, the MKI value in civil engineering projects and the MPG value in housing projects can (with proper guidance) be made relatively easy to understand. Municipalities such as Nijmegen and Arnhem already have experience with this. In contrast, objectives such as "X% reuse of materials" are much harder to measure, and this research cannot provide insights into that. However, it appears possible to steer on $CO_2$, as shown by the municipality of Nijmegen (via MKI) and contractors such as NTP. In this way, the link is made to future-proof construction and connecting multiple programs under the general heading of $CO_2$ reduction. This assumes that steering on $CO_2$ reduction automatically stimulates circularity.

Action plan:

1. Monitor progress (annually/project-based/etc.) based on the chosen indicators and objectives in policy.
2. In the long term, connect circularity with other municipal programs and adjust where necessary toward future-proof construction.

### 3.2: Document, share, and use experiences and successes

A learning organization requires actively recording experiences and using them. By documenting process steps, obstacles, unexpected turns, and solutions, a valuable internal knowledge base can be built. These insights can be fed back into municipal working methods and, in the long term, into policy updates. When collecting input from colleagues, it is important to provide feedback on why suggestions are or are not adopted. This strengthens involvement and transparency. By repeating this process periodically, for

example through regular meetings, knowledge remains up to date and collective learning capacity grows.

Action plan:

1. Develop a format for project evaluation.
2. Actively collect input from stakeholders, both internal and external.
3. Document lessons learned and store them internally in an accessible place.
4. Actively feed this knowledge back into policy, project formats, and procurement documents.
5. Repeat this process periodically to update knowledge and strengthen involvement.

### 3.3: Contribute to a regional knowledge infrastructure for circularity

Although circularity is a challenge for each individual municipality, it is also a theme that transcends municipal boundaries. In earlier phases, collaboration with regional parties was proposed to gather knowledge about the possibilities and application of circularity. By structurally applying circularity itself, the municipality of Lingewaard can also contribute to the regional knowledge infrastructure by actively sharing its own experiences and successes. This infrastructure consists of learning processes and open communication, but also of exploring joint solutions to circular challenges, such as a regional material depot or a circular craft center. Both can contribute to more efficient reuse of materials. Collaboration fosters trust and involvement, allowing circularity to grow into not only a local but also a regional transition.

Action plan:

1. Identify regional knowledge needs and existing initiatives.
2. Continue participating in the GMR Knowledge Tables (and join other initiatives).
3. Contribute to joint solutions for circular challenges.
4. Document and share successes and results with other parties in the region.