Green talks

on the built environment

Biobased and Circular Economy discourses, visions, and practices in the Dutch construction sector

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Abstract

Circular Economy (CE) and Biobased Economy (BBE) models are considered crucial to reducing waste, pollution, and the use of materials in the construction sector. Recent sustainability literature suggests that these socio-economic models have a *transformative potential* (Ghosh et al., 2021; Hermans et al., 2016) in socio-technical transitions. This research analyzes the discourse and ambitions of the Dutch Government and organisations promoting CE and BBE principles in the construction sector. In addition, circular discourses and ambitions were examined and compared with the perceptions and practices of biobased innovators. This study, based on qualitative methods, attempts to clarify what obstacles arise in adding circularity to the Dutch built environment.

First, through the Critical Discourse Analysis (CDA) (Wodak & Meyer, 2001; Calisto Friant et al., 2020) methodology, the ambitions of the Dutch government concerning CE and BBE were gathered and assessed. Subsequently, the levels making up the Dutch construction sector were presented through the Multi-Level Perspective (MLP) (Geels, 2006). Moreover, drawing from the MLP on system innovation and the transformative innovation policy (TIP) framework (Ghosh et al., 2021), an interview guide was designed. Semi-structured interviews with CE and BBE experts and stakeholders were conducted. Finally, the results of the interviews were matched with the ambitions advanced by policy documents.

Compared to the ambitions, circular and biobased applications in the Dutch construction sector are modest and face complexity in entering the market. Moreover, unfamiliarity, negative assumptions, standardized supply chains and practices constitute limitations in the implementation of the CE and BBE in the construction sector. However, CE and BBE discourse are increasingly adopted in business communication. Nonetheless, government-led intervention in policy and regulation is deemed necessary to promote BBE and CE principles.

Understanding the divergences between policy ambitions and material practices is essential for evaluating and improving the transition path towards sustainability. This research demonstrates that MLP and CDA methodologies are helpful in revealing matters of power and values in discourses. This research's theoretical and analytical implications may be useful for more researchers involved in the evaluation of sustainability transitions.

Keywords:

Multi-level Perspective, Critical Discourse Analysis, Sustainability transition theory, Circular Economy, Biobased Economy, Construction Sector

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1. Introduction

Growing environmental awareness in recent decades has increased the emphasis on changing production and consumption patterns. As a response, new economic discourses and rationales are increasingly influencing the discussion on economic growth, material extraction and greenhouse gas (GHG) emissions (Calisto Friant et al., 2020).

In recent years, the concept of circular economy (CE) became a prominent position to reorganize the economic system in a way compatible with sustainable growth (Arruda et al., 2021). Yet, the CE concept still lacks a clear definition and implementation strategies.

A growing number of companies are nowadays adopting business strategies based on the CE concept. Businesses may adopt circular approaches for several reasons, such as material and energy efficiency, material reuse, and fostering positive brand engagement. Indeed, companies that engage in sustainable and circular strategies could benefit from a wider social and economic return (Korhonen et al., 2018).

However, scientific literature on CE points out that CE policy objectives mainly focus on enhancing resource efficiency and product design, engaging less with the material properties and reprocessing technologies necessary to close the material loops (Corvellec et al., 2021). Nonetheless, the concept of CE is increasingly influencing governments' political and economic strategies. This influence can be observed in the policy framework of the Dutch Government, which implemented a 'bioeconomy' strategy in 2007, with a follow-up in 2012, and announced in 2016 a plan to achieve a fully circular, biobased economy by 2050 (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2016).

Biobased Economy (BBE), a sub-sector of the CE, refers to economic activities involving the use of biomass and biobased materials to produce energy, goods and services (Israël-Hoevelaken et al., 2020). The fundamental idea of BBE is that products or services derive from biological or compostable substances. Therefore, there is a belief that BBE can contribute to reducing greenhouse gas (GHG) emissions and avoiding environmental pollution.

According to its proponents, and in line with the framework of the multi-level perspective (MLP) on system innovation, the circular and biobased economy models hold the *transformative potential* to move away from the carbon-based economy (Geels, 2006; Kuckertz, 2020; Ghosh et al., 2021).

This thesis aims to understand the relationship between ambitions and practices associated with the *transformative potential* of the CE and BBE within the context of the construction industry in the Province of Utrecht.

Therefore, following the MLP concerning sustainability transition, Chapter 5 delves into the different perspectives and discourses of construction sector' actors regarding the circular and biobased economy. Furthermore, in Chapter 6, I inform about the applications of biobased materials in construction and the existing (legal and financial) tools to expand their market. Subsequently, in chapter 7, through the analysis of interviews with innovators and experts, based on the theoretical model of the transformative innovation policy (TIP) (Ghosh et al., 2021), I present further information regarding their experiences in the stages of innovation.

Qualitative research methods, such as critical discourse analysis (CDA) and semi-structured interviews, were used in this research. The first method was used to analyse policy documents and reports concerning CE and BBE. Moreover, the interviews explored the perceptions of biobased innovators and experts concerning the transformative potential of BBE for the construction sector.

This research intends to inform local and national policymakers about the status, evaluation and requirements for upscaling the circular and biobased economy. Besides, on a societal level, this study draws attention to the use of sustainability communication under the lens of power and discourse (Leipold et al., 2019).

2. Context and Research Question

According to its proponents, circular business models reduce costs, increase revenues, manage risks, and provide possibilities to contribute to a transition to sustainability (Corvellec et al., 2022).

The transformative potential of the circular and biobased economy is attractive due to its prospective material savings and emission avoidance. Nonetheless, it is essential to look at sector-specific challenges and possibilities to understand the implementation of the circular and biobased applications. Therefore, this research project focuses on circular and biobased innovation for the construction sector in the Province of Utrecht, Netherlands.

The construction sector in the Netherlands requires considerable amounts of raw materials, energy and water and is also accountable for noteworthy waste and CO_2 generation (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2016). In addition, the goal of building another million houses in the coming ten years in the Netherlands

raises questions concerning the strategies to achieve a sustainable built environment (Bouwagenda, 2017).

The Dutch Government demonstrated awareness concerning the practices of the construction industry, stressing its environmental impacts. However, the government implies that the market assumes its responsibilities in the pursuit of circularity and sustainability (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2016, p.61). Nevertheless, the CE in the Netherlands is a hot topic. A growing number of Dutch companies and organisations are consciously (or unconsciously) committed to this new economic model. The Netherlands Environmental Assessment Agency (PBL) counts 85.000 'circular' activities affecting 420.000 jobs in 2019 (Rood & Kishna, 2019).

Although these numbers indicate an increase in the interest for a transition towards a CE, the Dutch Government simultaneously creates several obstacles due to their regulations, laws and constraining policies (Bastein et al., 2013, in Wessels, 2020). In addition, much research and innovation are in line with the current system. For example, the majority (66%) of the 1,900 innovative circular companies in the Netherlands focus on recycling (Hanemaaijer et al., 2021). Over half of Dutch scientific articles mention recycling (or recovery) in their subject description, but few of the other circularity strategies (Türkeli, 2020). Many innovation projects supported by RVO's (Netherlands Enterprise Agency) instruments also have a technological character and focus on recycling (Hanemaaijer et al., 2021).

Furthermore, Dutch Provinces, NGOs, higher education institutions and centres for expertise have been collaborating and producing a growing number of data, ideas and visions about circularity in the built environment. For example, to improve circularity in the Utrecht region, local municipalities and non-governmental organisations joined forces to establish a partnership called Alliantie Cirkelregio Utrecht (2019). This organisation outlined several steps to achieving a (local) circular economy by 2050. Since then, the coalition has taken steps to propel the mission of circularity (Alliantie Cirkelregio Utrecht, 2019). In 2017, the Raw Materials Agreement was signed. The Raw Materials Agreement allegedly aimed to outline how the region/country could use renewable sources such as biomass or fully utilise products (e.g. high-value product reuse) to strengthen the circular mission (Alliantie Cirkelregio Utrecht, 2019). In 2018, the Province of Utrecht signed new agreements to affirm its mission toward circularity. Then in 2019, the Alliantie published a manifesto outlining the next steps for pursuing a circular economy (Alliantie Cirkelregio Utrecht, 2019).

To analyse the relationship between the expectations and the practices of the circular and biobased economy in the region of Utrecht, I first conducted a policy critical discourse analysis (CDA). In addition, I examined the current socio-technical system of the construction sector through the multi-level perspective (Geels & Schot, 2007). The overview offered by these approaches allows tracing reasons to engage in biobased and circular discourses and practices for different levels of actors in the system.

Scientific literature suggests that the "discourse, expectations, affective responses, and participation in emerging fields are mutually constituted, and develop a model that shows these interconnections" (Grodal and Granqvist, 2014, p.139). Thus, this thesis expands the understanding of expectations and discourses concerning CE and BBE by incorporating stakeholders and innovators' perspectives and beliefs. Drawing from interdisciplinary research, this approach informs about the complexity of discourses and ambitions concerning the transition towards a circular and biobased economy.

Therefore, the question that led to this research project is:

How are the ambitions of the Dutch Government concerning the transformative potential of circular economy and biobased innovation perceived by the construction sector's stakeholders?

Additional research subquestions have also been formulated:

1. *How do different actors in the construction sector elaborate and adopt CE and BBE discourses?*
2. *Which instruments influence the adoption of biobased and circular materials in the construction sector?*
3. *Which strategies, according to biobased innovators, can promote the implementation of biobased and circular models?*

The main goal of this research is to understand the different perspectives of actors in the construction sector concerning the ambition and the actual state of the transition towards a circular and biobased economy. For this reason, MLP elements help identify the actors and their viewpoints on sustainability transitions. In fact, to evaluate the transition process in the construction sector, it is fundamental to observe how (different) actors' discourses shape a circular vision and create public expectations.

In parallel, the second goal is to identify the drivers for the successful -or not- application of circular strategies in the construction industry. Through CDA and interviews insights, I show how the opportunities and limits of the circular framework interweave with the rhetoric of sustainability and the market orientation of the CE in the Dutch context.

3. Theoretical framework

The main focus of this literature review is the relationship between the sustainability transition theory and the circular and biobased economy framework. I draw attention to this theoretical background because CE and BBE principles are prominent in the debate on system innovation (Suchek et al., 2021).

First, I present the multi-level perspective (MLP) on system innovation (SI) (Geels & Schot, 2007) by defining the elements that constitute this theory. Scientific literature suggests that the MLP offers analytical tools to study sustainability transitions and allows to identify the shifting dynamics between the societal spheres.

Secondly, I provide an overview of the recent literature on the circular and biobased economy, highlighting possibilities, challenges and limits in current debates. In addition, I inform about the CDA methodology and its contribution to environmental policy research.

3.1 Multi-level perspective on system innovation

In the last years, a growing number of policymakers and institutions working in science, technology, and innovation started sharing a consensus over the need to address contemporary challenges such as environmental change, environmental pollution and growing inequality and not just focus on economic growth (Ghosh et al., 2021). Furthermore, theorists working in the sustainability transition field suggest observing these challenges as the interconnectedness of various socio-technical systems (Schot & Kanger, 2018).

Through the MLP on system innovation, our socio-economic system can be observed as a complex multi-level framework (Geels & Schot, 2007). The MLP (Geels, 2005a; Smith et al., 2010; Grin et al., 2010; Markard et al., 2012) aims to explain large-scale and long-term shifts – occurring over fifty years or more – from one socio-technical system to another. According to Geels and Schot (2010), levels can be depicted as heterogeneous socio-technical configurations which adopt different approaches to coordinating and structuring local practices. This perspective implies that levels also differ in stability and size (Wessels, 2020).

The basic components of the multi-level perspective on system innovation are niches, regimes and socio-technical landscape. The dynamics between dominant socio-technical regimes and niches are at the core of the MLP on socio-technical transitions. (Schot & Kanger, 2018). The emerging disruptive phenomenon of niche innovation is considered to have a *transformative potential* in the shifting dynamics between levels. A *transformative potential* can include political, economic, environmental, medical and social issues (Olsson, 2020).

3.1.1 Socio-technical Landscape

The concept of landscape indicates "the exogenous environment shaping both niches and regimes" (Schot & Kanger, 2018, 1051). Examples of landscape pressures could be globalisation, urbanisation and anthropogenic climate change, as well as events such as wars, environmental disasters, and economic crises (Schot & Kanger, 2018). In the context of this research, the socio-technical landscape is identifiable with the societal pressure on reducing CO_2 emissions related to the construction sector, limiting the use of raw materials, and reducing the amount of waste and water consumption (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2016).

3.1.2 Regime Level

According to the definition of multi-level perspective, regimes can be defined as shared semi-coherent (i.e. relatively stable and aligned) sets of rules or routines directing the behaviour of actors on how to produce, regulate and use technologies within a certain socio-technical system (Schot & Kanger, 2018).

A socio-technical regime consists of systems of leading organisations that operate in a stable manner, such as companies, regulations bodies, institutions, and supporting organisations (Geels & Schot, 2007). Regimes are the meso-level of the multi-level perspective. Loorbach and Rotmans (2006) state that the meso-level is filled in by social norms, interests, rules, and belief systems that manage the strategies of the companies, organisations, and institutions and that govern the policies of the political institutions. The meso-level is controlled by networks, communities and organisations (Rotmans et al., 2001).

Several studies concerning sustainability transition and sustainable management suggest that desirable changes are hampered by the lock-in of socio-technical regimes (Arthur, 1989; Cecere et al., 2014). Regimes depend on mutual dependencies between actors, alignment between rules of various kinds, and the "hardness" of material networks (Geels, 2004).

Avelino (2017) noted that the recent system transition research has widened its perspective on power to include neoGramscian political economy concepts on hegemonic power and resistance deriving from the regime. Indeed, from the perspective of power relations, the transition literature conceptualises regime stability as the result of active resistance by current actors. For example, powerful, influential actors may use their power and resources to suppress innovations through market control or political lobbying (Geels, 2004). This idea resonates with the perspective on the asymmetries in power relations stemming from inequalities in actors' influences (Koistinen et al., 2022).

Following the multi-level perspective model, the linear economy model could be associated with the current socio-technical regime. In a linear economy, economic growth is bounded to a endless use of materials, often non-renewable, which are in turn coupled with financial flows (Oliveira et al., 2021).

3.1.3 Niche Level

Compared to dominant regimes, niches are spaces where new actors, shielded by market pressure, can gradually develop technologies, emerge through applications and become mature enough to enter the market (Schot & Kanger, 2018).

Academic literature suggests that, as the performance of radical innovations is initially low, they emerge in 'protected spaces' to shield themselves from mainstream market selection. Protection is often provided in terms of subsidies, by public authorities or as strategic investments within companies (Geels, 2004). Niches may have the form of small market niches with specific (high-performance) selection criteria or the structure of technological niches (Geels, 2004).

Niches are essential for system innovation because they provide spaces for learning processes (e.g. technical requirements, user preferences, public policies, symbolic meanings) (Geels, 2004). Furthermore, according to the theory, thoroughly shielded niches might deviate from the rules in the existing regime. When there might be uncertainty about technical design, rules and applications, niches provide space to embrace a learning process.

The niche level examined in this research is represented by biobased and circular innovations, which are applications derived from renewable sources that help reduce CO_2 emissions and move away from a linear economic paradigm.

3.1.4 Transformative Potential

The concept of *transformative potential* is central to this thesis because it describes the condition of uncertainty and transformation occurring in a system. This concept is beneficial in defining the conditions and the status of the emerging change, allowing for measurement, monitoring and (partial) comprehension of a phenomenon (Oliveira et al., 2021). In the case presented in this research, under the pressure of the socio-technical landscape and the demand for more sustainable production and consumption, the Dutch Government advanced high ambitions concerning the possibilities of a fully circular economy by 2050.

Recent literature concerning sustainability policy indicates that there is a belief that circular and biobased economies hold a socio-technical *transformative potential*. The transformative potential offered by a transition towards a circular and biobased economy could be seen as an opportunity to substitute linear business strategies, energy-intensive material use, and consumption patterns. However, recent studies in the field of transformative innovation policy (TPI) highlighted several key failures that hinder transformative change (Diercks et al., 2019). This literature suggests that a socially and environmentally beneficial CE and BBE transition requires changes in policy settings and intended innovation programs for its diffusion (Kuckertz, 2020).

In light of this framework, the MLP can be a valuable tool to confront the mismatch among ambitions, approaches, and achievements in sustainability transition fields.

3.2 Circular Economy

3.2.1 Introducing CE

The concept of Circular Economy (CE) arose in the 1970s from the idea of reducing the use of raw materials for industrial production, and it has proved to be potentially relevant to various fields (Arruda et al., 2021). The CE framework suggests a change in the "extraction-production-disposal" paradigm of the linear economy, which is currently employed in the industrial environment (Arruda et al., 2021).

The concept of CE has gained legitimisation to address the issue of sustainability in government policies such as those of the European Union (Völker et al., 2020; European Commission, 2011); in addition, it has been implemented as a national development strategy in China (Winans et al., 2017; Zhu et al., 2019), Africa (World Economic Forum (WEF), 2020), and the United States (ReMade Institute, 2021), as well as for a growing list of businesses and local governments (Corvellec et al., 2022).

Although there is no single commonly recognised definition of the term "circular economy", different definitions share the basic idea of dissociating natural resource extraction and use from the economic output, reaching increased resource efficiency as a major result (Mavropoulos & Nilsen, 2020). In the last decades, multiple definitions of CE have been developed, resulting in the term meaning different ideas to different actors (Kirchherr et al., 2017, Van den Berghe & Vos, 2019).

This could be a consequence that the concept and its application have been mainly developed and driven by its users, that is, policymakers, businesses, business associations and other stakeholders (Korhonen et al., 2018). Therefore, the circular economy builds on a varied collection of scientific and other academic concepts, such as "ecological economics, industrial ecology, cradle-to-cradle design, […] performance economy, biomimicry, eco-efficiency, resilience science, natural capitalism, and cleaner production" (Korhonen et al., 2018, p. 39). Over a hundred definitions of circularity have been developed by scholars, companies and institutions (Kirchherr et al., 2017).

3.2.2 Critical Discourse Analysis of CE policymaking

Uncovering the socially constructed context of the written and spoken word is the objective of discourse analysis (Cardno, 2018; Fairclough, 1989). Since the mid-1990s, critical discourse analysis (CDA) has received growing recognition and attention as conceptual framework in social studies and related fields. In addition, the approach has influenced the tradition of social studies in terms of methodologies, issues and practices (Leipold et al., 2019). Environmental policy analysis has been studied through various discursive perspectives, reflecting the complexity of the field and its aims (Keller, 2012, in Leipold et al., 2019).

The primary reason to engage in CDA derives from the notion that discourse (including also non-textual data) does not exist independently and, therefore, cannot be analysed on its own (Fairclough, 1989). By adopting this method, the researcher can focus on what lies beyond language itself and reflect on the complex relationship between the social world and how language is used (Bryman, 2012; Paltridge, 2006 in Cardno, 2018).

Recent literature suggests that the "de-politicisation of the notion of sustainability" (Valenzuela & Böhm, 2017), and the concurrence of the idea of 'sustainable growth', represents an issue rooted in the way current political economy is constructed along the lines of the sustainability discourse (Stavrakakis, 2000; Alexander, 2009; Jessop, 2012; Coffey, 2016; Valenzuela & Böhm, 2017).

By employing the CDA methodology, Calisto Friant et al. (2020) provided analytical tools to examine CE typologies in policy frameworks. The study (Calisto Friant et al., 2020) identified four typologies of circularity discourses based on the perspective of technological innovation, ecological collapse and CE's sustainability and political concerns (2020).

The authors (Calisto Friant et al., 2020) differentiate CE discourses as **optimistic** and **sceptical** regarding the possibility of ecologic-economic decoupling, **holistic**, concerning the socio-political and ecological considerations, and **segmented** with a focus on resource efficiency and economic prosperity. Depending on their viewpoints on these societal issues, the four typologies imply different socio-political implications for CE (Calisto Friant et al., 2020).

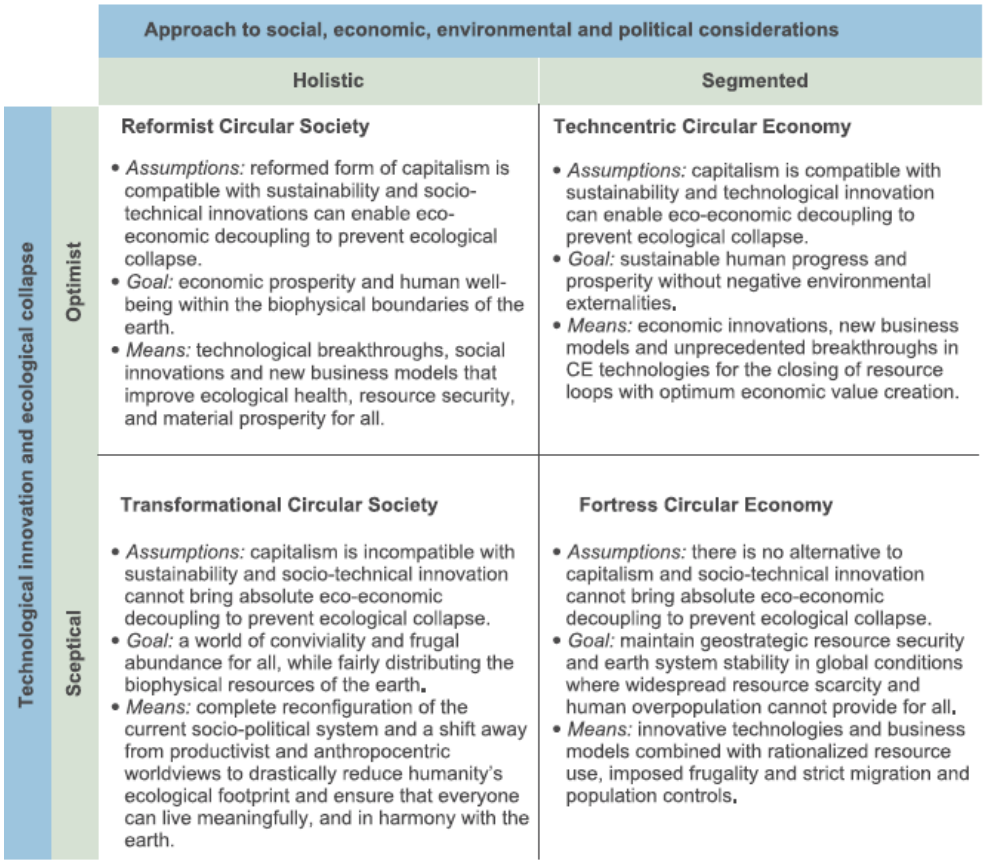

Fig. 1. Circular discourse typology (Calisto Friant et al., 2020)

Therefore, in the context of environmental policy, CDA might emerge both as a framework and as a methodology for mapping sustainability discourses.

This theoretical outline is relevant for this study because the analysis of CE and BBE ambitions implies identifying the variety of meanings and beliefs that different actors embed in these concepts.

3.2.3 Challenges of CE in the construction industry

Current literature suggests several key issues to achieving circularity in the built environment. For example, Schraven et al. (2019) identified several barriers to implementing circularity in the construction sector based on a social network analysis of the perceptions of supply chain actors. These are represented by a lack of incentives for actors toward circularity, lack of mutual interests among the supply chain actors, high uncertainties and risks of consistent supply, and clashes of perceptions at all levels in the supply chains (Schraven et al., 2019).

Moreover, limitations in material properties and the manufacturing and reprocessing technologies constitute another limit to closing material loops that appears to be disregarded (Velis & Vrancken, 2015, p. 774). Environmental dissipation (Cullen, 2017), contamination (Baxter et al., 2017), and degradation of materials (Parrique et al., 2019) set limits on the degree of circularity that the economy can achieve. In particular, critics point out that the circular economy fails to recognize and address the complexity of waste processing (Mavropoulos & Nilsen, 2020). Critiques highlight that waste awareness has a substantial impact on waste management and disposal (Korhonen et al., 2018), that recycling chains are unstable and show high degrees of uncertainty (Traven, 2019), that toxic wastes cannot be reprocessed (Johansson et al., 2020), that a significant proportion of waste is managed by the informal sector (Luthra, 2019; Zapata Campos & Zapata, 2013), and that energetic waste prevail both economic and environmental fields but is not included by recycling practices (Skene, 2018 in Corvellec et al., 2022)

In addition, the literature suggests that in today's global market, few products are manufactured, procured, disposed of, and recycled in the same geographic location, thus leading to massive relocation of resources across the globe (Skene, 2018). Therefore, reusing waste in new activities would require a local-global perspective and international commitment.

To conclude, implementing few remedial CE business practices, might strengthen current linear economy patterns and intensify socio-economic inequality by increasing overall market prices (Oliveira et al., 2021). Oliveira et al. (2021) indicate that this could lead to further wealth accumulation in the already developed economies, making CE a model in line with economic growth and enhanced materials consumption.

3.3 Biobased Economy

3.3.1 Introduction to the Biobased Economy

The biobased economy (BBE), or bioeconomy, is associated with far-reaching expectations regarding several sustainability-related policy aims, such as climate change mitigation, technological progress, energy security, environmental protection, employment and growth (Stegmann et al., 2020; Refsgaard et al., 2021). Consequently, over the past decade, the bioeconomy has received increasing political attention, with many countries and international bodies (such as the OECD and the EU) adopting strategies following this model (Gawel et al., 2019; Sacchi et al., 2021). For example, the European Commission identified the bioeconomy as an agreeable "production of renewable biological resources and the conversion of these resources and waste streams into value-added products, such as food, feed, bio-based products and bioenergy" (European Commission, 2012, p. 3). Furthermore, this socio-political concern is also reflected in academic and financial agendas, where the bioeconomy appears prominently as part of the current societal challenges (Gawel et al., 2019).

Drivers of the BBE include sustainability, economic opportunities, energy and raw materials savings. Furthermore, the advantages of a biobased economy are related to the improvement of the local and regional economy, particularly the agro-economy sector (Bos & Besseling, 2015). Biobased innovation (BBI) in the Netherlands depends on support through the top sector approach (Kwant, 2016). Therefore, market-driven research in the top sector and regional support for specific applications are characteristics of the Dutch BBE (Kwant, 2016). The Dutch Government has a vital role in the biobased market procurement. Environmental policy research suggests that governmental organisations are crucial in creating a suitable climate and stimuli for biobased products (Langeveld et al., 2016).

Moreover, current BBE literature suggests that sustainability has to be the fundamental notion guiding the transition towards the bioeconomy. If not, the bioeconomy would only imply substituting fossil resources for biobased resources without adding societal and ecological benefits and without contributing to climate mitigation and long-term structural change (Gawel et al., 2019).

The emerging BBE offers sustainable alternatives for producing energy, materials and transport fuels from bio-renewable biomass (Lynch et al., 2017). However, as Sanders et al. (2012) suggested, the BBE transition should be not only materially feasible and economically viable but also socially appropriate and adequate. Furthermore, for sustainable transitions like the BBE, it is fundamental to engage with various stakeholders, including the public, because

the emerging technologies actively involve technological innovations, political regulation and public expectations (Lynch et al., 2017).

3.3.2 Biobased Materials

Biobased materials are becoming available for more and more fields of application (Sanders et al., 2010). Besides biofuels and chemical compounds, biobased materials are relevant for the construction sector for the following product groups (PIANOo, n.d.):

- "Office buildings: building materials such as insulation materials, sheet materials, paint, cladding panels, and temporary construction facilities (e.g. tubing and piping)
- Packaging materials
- Preservation work: coatings and paint
- Landscaping: geotextiles, shielding (reed mats), binders, plant containers, tree anchoring, disposing of residual materials from landscaping maintenance
- Hydraulic engineering structures: geotextiles, erosion mats
- Cleaning: cleaning agents" (PIANOo, n.d.)

Transition literature suggests that the shift toward a sustainable bioeconomy necessitates innovation in technologies, methods and products. Moreover, research shows that biobased technologies, compared with fossil-based alternatives, need to improve (logistically and materially) to be appetible as market substitutes (Gawel et al., 2019).

Several studies suggest combining a gradual toughening of policies which increase the price of fossil fuel use with aiming to support innovative niche applications (e.g. green public procurement, incentives for testing). For example, Gawel et al. (2019) suggest that the development of the bioeconomy as "learning system" should be backed by a governance structure that consistently set stimuli for a sustainable transition path.

3.3.3 Sustainability and the Biobased Economy

Remarkably, the BBE, a sustainability intended project, has recently encountered a variety of sustainability critiques. Several scholars aimed to study the role of sustainability in the biobased economy. However, most of them criticise the prominent technological orientation, which often overweights BBE's environmental and socio-economic effects (Gawel et al., 2019).

Ramcilovic-Suominen and Pülzl (2018) pointed out that the discussion on the bioeconomy in the European Union is unbalanced in terms of sustainability goals. Under this lens, the economic factor outweighs the environmental and social features necessary for the achievement of the bioeconomy. Therefore, a holistic inclusion of the bioeconomy and its goals into the concept of "sustainable development" remains out of the discussion (Gawel et al., 2019).

The main critique warns that the bioeconomy pursues the commercial use of life for the "neoliberalization of nature" (Birch et al., 2010, p. 7), which aims to legitimise a "regime of accumulation against major sociopolitical and ecological challenges" (Goven & Pavone, 2015). In addition, Gawel et al. (2019) highlight that a sustainable bioeconomy is only feasible if all three sustainability dimensions are respected and if synergies between these spheres can be achieved. This way, all the pillars are simultaneously preserved, allowing to reach an optimal systemic balance (Gawel et al., 2019).

In the beginning, the sustainability discourse emerged to tackle the negative social and environmental consequences of worldwide industrialisation and the absence of regulation within "neoliberal economic policies" (Crouch, 2012; Shamsul Haque, 1999 in Valenzuela & Böhm, 2017). Thus, the debate on sustainability was about acknowledging un-sustainability (of particular industrial processes and materials) as a fact ignored by advocates of economic growth (Valenzuela & Böhm, 2017). Nowadays, however, political and financial forerunners appropriate of the term 'sustainability', arguing that rapid economic growth can be reached whilst preserving environmental and social wellbeing (Magretta, 1997). This shift of meaning and purpose is based on the positivization of the concept of sustainability, no longer a tool of denounce, but an opportunity for 'green growth'.

From this perspective, the pledge for sustainability can be seen as a communication strategy that can be used to express awareness of socio-environmental concerns. Indeed, relevant literature suggests that sustainability can also be embraced as a crucial business driver, particularly in terms of the supply chain and brand legitimisation (Dauvergne and Lister, 2013; Seuring et al., 2008). By providing sustainable goods and services, influential companies become more attractive as they promote their market capabilities in the contemporary economy (Valenzuela & Böhm, 2017).

In conclusion, the biobased and circular economy might bring positive environmental and social enhancements. Nonetheless, it is important to examine the way sustainability discourse is framed and whether CE and BBE practices are actually implemented.

4. Methodology

This research followed qualitative research methods. Two main approaches have been used to carry out this study.

The first method consists of critical discourse analysis (CDA) (Fairchlough, 1989; van Dijk, 1993; Avelino, 2017). This approach was adopted to investigate policy reports issued by the Dutch Government, the Province of Utrecht, and municipal offices about environmental policies, CE, and BBE in the construction sector. Policy text is the content of the policy document and requires analytical activity (Wodak & Meyer, 2001). Therefore, policy text needs to be subjected to detailed data analysis, especially in qualitative research where the issue is not the mere counting of words but the questioning of the text as one searches for relevant information.

As Bell and Stevenson (2006) emphasise, we need to interrogate the text to find out why it is structured or framed in a particular way. Questions about the purposes and the values that underpin the policy discourse should be advanced. In fact, it is necessary to look behind and beyond the words to draw inferences that may link to theories about the policy field and consider both what is said and what is not (Cadno, 2018). It is also essential to consider how the policy could be interpreted from a variety of standpoints. This kind of deep, detailed textual analysis is the work of the qualitative researcher (Silverman, 2006).

In addition, to strengthen the practice of this research method, the author must inform about its positionality, subjectivity and biases (van Dijk, 1993; Mullet, 2018). In this case, by adopting the MLP theory and a critical literature review on CE (Calisto Friant et al., 2020), the author of this study encourages a reflection concerning sustainability, power and discourse, as the context of CE and BBE presents asymmetries in power relations.

Nonetheless, a particular challenge of qualitative content analysis is that there are no simple guidelines for data analysis (Elo et al., 2014) and that deciding what matters as evidence and how to present that evidence to substantiate claims results in a complex task (Greckhamer & Cilesiz, 2014).

The second research method used in this research consists of semi-structured interviews. This method allows gathering specific knowledge about a determined issue by collecting and analysing qualitative data (Magaldi & Berler, 2020). The main focus themes of the discussions were biobased innovators' perspectives (as involved niche's actors in the BBE and CE field) and the ambitions of governmental and other non-governmental bodies concerning the transition towards a CE and BBE in the Province of Utrecht.

Drawing from Ghosh et al. (2021) paper on sustainability transitions, an interview guide was designed (Appendix 1). Following the interview guide, seven in-depth, semi-structured interviews with various CE stakeholders were conducted. The number of interviews was limited by two main considerable factors: the circumscribed geographic area of the study (Province of Utrecht); the limited availability of respondents.

Although a relatively small sample size, the interviews can be considered significant since all interviewees are experienced professionals and experts who shared representative information about the internal operations of their companies. A table with an overview of the respondents is presented in Appendix 2.

The sampling of participants is given by their experience and involvement in the circular and biobased economy in the Province of Utrecht. Moreover, the different roles of the research participants in the research context allow us to illustrate different perspectives on the development of the circular and biobased economy. Research participants included 'grassroots' innovators (niche level), individuals working in BBE business or R&D department within a government organisation, BBE experts and NGO researchers.

Interviewees were contacted through email. After the first contact, interviews were held online using MS Teams. With permission and informed consent, all interviews were recorded. The discussions had an approximate duration of 30 minutes to 1 hour. Consequently, the interviews were transcribed verbatim with Otter.ai software. Finally, the interviews were coded on MS Word; Fig.2. (4.3) illustrates the code tree that emerged from the interviews.

Before the end of the research project, I organised a focus group (June 22, 2022) with the previously interviewed biobased innovators and experts to share viewpoints and reflections on the results of the research. Insights from the focus group are also included in the study.

The following section contains the availability of data and the main topics of the interviews.

4.1 Data availability

Secondary data, mainly from policy documents and organisations' reports, were used to outline this research's context, the background information and triangulate interview insights. The following documents have been included in the CDA approach:

- Dutch Government and Utrecht Province CE and BBE policy briefs
- Construction sector stakeholders' CE and BBE reports

These documents provided the necessary information to analyse and interpret the discourses, visions and ambitions for the transition toward a circular economy in the construction sector.

4.2 Data collection

Following the paper of Ghosh et al. (2021) on assessing transformative outcomes, an interview guide to gathering insights from actors construction sector has been developed. The questions in the interview guide align with the stages of transformative innovation policy (TIP) and touch upon different influential issues in the context of innovation and sustainability transitions research. This model aims to guide interventions and evaluate TIP by looking at the stages of the interaction of the niche, regime and landscape level.

The data gathered from semi-structured interviews with biobased innovators and relevant regional stakeholders were used to trace the perspectives and the beliefs of the actors operating in the field of circular construction in the Province of Utrecht.

The topics included in the discussions covered:

- Biobased Innovators' perception of the CE and BBE policy framework
- Innovators’ expectations and ideas concerning BBE potential in the construction industry
- Necessities and limits of Biobased Innovations applications
- Experts and NGOs’ perspectives on CE in the construction industry

4.3 Methods of data analysis

Qualitative data is non-numeric information such as interview transcripts, notes, audio recordings and text documents. CE policy text and reports, following CDA methodology, were examined and catalogued to outline the ambitions, visions and framework of the Dutch CE transition. This step was particularly complex as it required analytical exercise in the identification of discourse in its textual representation (Calisto Friant et al., 2020). Consequently, the enquiry was guided by the analytical tools Calisto Friant et al. (2020) proposed in identifying and classifying CE discourses.

Parallelly, recorded interviews (raw data) have been transcribed and consequently analysed in this study. The first step of the interviews’ analysis was developing and applying codes. Subsequently, the interviews were examined following the themes advanced by the interview protocol. In fact, the structure of the interview guide allowed for categorising the main topics and cataloguing the nodes.

Moreover, additional codes were developed while making sense of the data (Strauss & Corbin, 1994). The second step of the interview analysis involved axial coding, where I could observe interconnections and links between categories of nodes; this step allowed creating a structure to catalogue the interview data. The last step of data analysis included selective coding, which is valuable to formulate a narrative and support the research results (Strauss & Corbin, 1994). The following image illustrates the resulting coding tree.

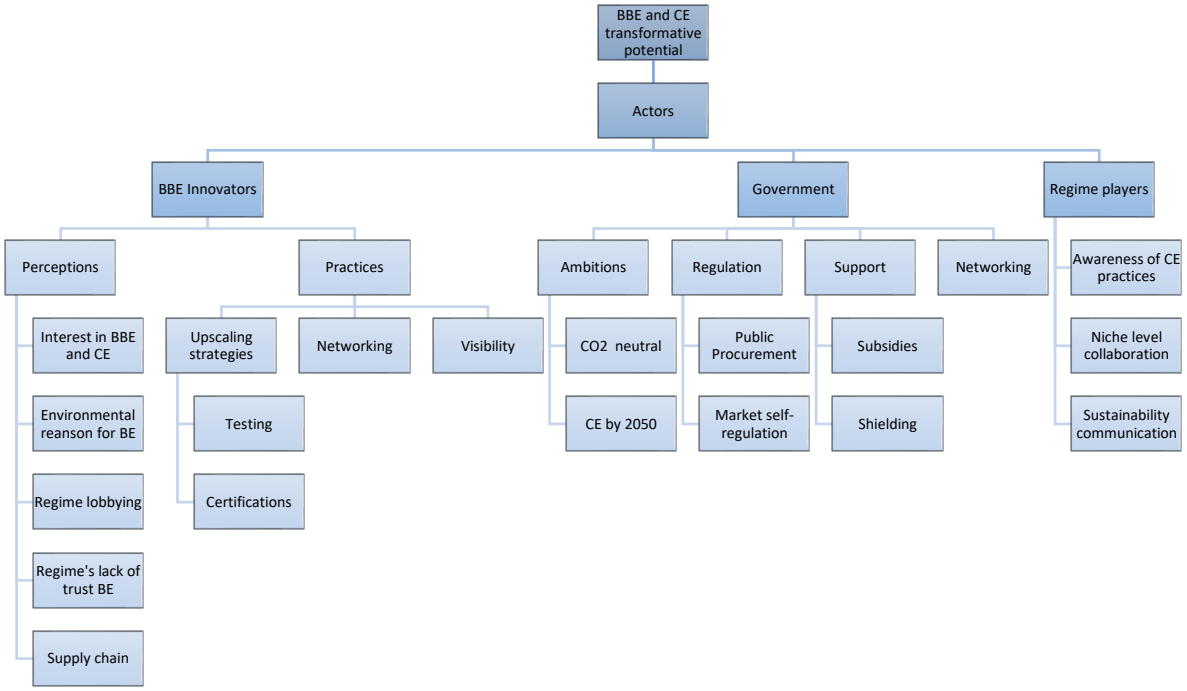

Fig. 2. Interviews' code tree

5. The transition towards a biobased and circular construction sector

In this chapter, through the multi-level perspective (MLP) on system innovation, the elements and the conditions that comprise the shift towards the CE in the Dutch context will be presented and analysed. The following subsections, built upon policy CDA and the insights from the interviews, will show how the process of circular innovation is prompted and withheld by different actors and stakeholders in the construction industry.

5.1 The Socio-Technical Landscape for the transition to circular construction

Socio-technical transitions are complex processes that involve a variety of circumstances and actors. According to Geels (2006), the landscape of the socio-technical transition can be identified as the macro-level perspective, which refers to conditions of the wider exogenous environment (Wessels, 2020). Examples of societal influences are environmental issues, globalisation and cultural changes. Ecological concerns and the discourse of sustainable development are central in the case of the transition toward a circular economy in the Dutch construction industry.

In the last decade, the Dutch Government started researching and advancing proposals aiming to shift specific sectors of the economy to a CE agenda. Several areas of intervention were examined, and suggestions to circularly improve these processes were outlined (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2016).

In this sense, the institutionally led plan to shift towards a circular economy can be seen as a response to the macro-level and societal pressure. Nonetheless, to enrich and articulate the vision of system transition, the MLP on system innovation encourage to include the role of non-governmental organisations and other experts in the societal sphere. NGOs, social movements, higher education institutes and a growing number of organisations are also involved in the transition path towards sustainable construction. These movements use their expertise and influence to contribute to the development of a circular discourse for the built environment.

5.2 Construction sector's regime level

An essential ingredient for achieving a CE in the Netherlands is making the built environment sustainable. '*De Bouwagenda*' (2017) envisages the construction of one million new, energy-neutral houses in the next ten years (Bouwagenda, 2017). Even if such a housing plan is not

totally new in the country (e.g. the VINEX policy envisaged the same purpose (Galle & Modderman, 1997)), the renewed ambitions of circularity and sustainability (macro-level dynamics) have stimulated a new discussion on the values and practices of the construction industry.

The construction industry is central in the shift towards CE due to its generation of considerable amounts of pollution, waste, and use of raw materials on a national level (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2016; Savini, 2019). Despite the recognition of the sector's impact, it is necessary to observe the government-led intention to sustainably build one million dwellings nationwide over the next ten years.

5.2.1 CE according to the Dutch Government

The national CE plan '*A Circular Economy in the Netherlands in 2050*' (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2016) identifies the construction sector as one of five priority transition themes (the others being Biomass and food, Plastics, Manufacturing and Consumer Goods).

To present and advance the Dutch CE strategy, the policy paper (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2016) mentions concepts such as 'natural capital', 'biomimicry', 'cleaner and environment-friendly technologies and industrial processes'. Yet, as Calisto Friant et al. (2020) pointed out adopting CDA methodology, these concepts are significant indicators of CE discourses. Thus, by linking the strategies of the Dutch Government to the typologies of CE discourses (Calisto Friant et al., 2020), it is possible to recognise a hybrid and principally positive CE discourse. According to Calisto Friant et al. (2020), a hybrid discourse might include elements of multiple CE typologies, as discourses convey shades and nuances. Drawing from this perspective, the Dutch CE policy discourse can be associated with elements of the *Technocentric Circular Economy* and the *Reformist Circular Society* (Fig. 1.). These typologies of CE frameworks include the compatibility of CE with capitalism and trust in strategies focused on innovation and growth to achieve it (Calisto Friant et al., 2020).

Moreover, the Dutch transition towards CE stems from a public-private approach, where the Government provides a playing field, and the construction sector assumes its own responsibility (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2016, p.61). Therefore, to date, national policy has principally focused on facilitating circular initiatives and on the establishment of a broad partnership of stakeholders within

society. For example, the promotion of CE was prompted by sponsoring knowledge development and driving stakeholders on the basis of voluntary agreements (such as the Concrete Agreement Netherlands and the Plastics Pact NL) (Hanemaaijer et al., 2021).

5.2.2 Construction Sector's stakeholders

Recently, the concepts of sustainability and circularity have been broadly adopted by actors and organisations in the construction sector. It is possible to observe that the pressure from the socio-technical landscape heavily influenced the framing and marketing of new construction and renovation projects in the Netherlands. Terms like '*CO_2 neutraal'* (carbon neutral), '*toekomstbestendig*' (future proof), and other definitions related to circular ambitions are progressively more often included by construction companies and governmental bodies when promoting new projects (Carra & Magdani, 2018; Heijmans, 2019; Jones & Comfort, 2018).

Most of the prominent construction companies in the Netherlands, supported by NGOs and higher education institutions, developed a framework focused on biobased and circular principles. This strategy involves reporting and publishing evaluations on the state of the circularity of their business. Common strategies implemented by construction companies to align with CE principles include decarbonising both the embodied and operationalisation phases and managing waste and water (e.g. Heijmans, 2019; Jones & Comfort, 2018).

The inclusion of environmental performance labels and green certification schemes is also increasingly adopted by key construction players to present environmental guarantees and promote a positive environmental image of the company (Gergaud, 2014; Salzman, 1997). As interviews suggest, in the construction sector, labels are an important assessment method since they provide information about the performance of buildings and improve the communication between contractors and customers (Ìnterview 6). Nonetheless, attention should be paid to each adopted eco-label and assessment procedure. In fact, the differences between assessment methods of each label could be strategically used by businesses to target a specific sustainability criterion for their project (Kurnaz, 2021).

In this subsection, I traced a relation between the Dutch Government's CE ambitions and the typology of CE discourse. Moreover, I presented the construction sector's response concerning the aim of circularity in the built environment. In conclusion, I highlighted a relation between the societal pressure (socio-technical landscape) and both government CE strategy and construction companies' discourses (regime actors).

5.3 Niche Innovators

Drawing from the MLP, niches can be understood as the micro-level element of the innovation system, which are considered radical spaces of innovation (Schot & Kanger, 2018). In the Dutch construction sector, there is growing attention toward innovative biobased materials and circular business practices, which could be regarded as 'niche innovations'. Special attention has been paid to biobased materials (mainly deriving from grass and wood and fibres) and from the possibility of material cascading (the sequential (re)use of resources for different purposes) offered by these categories of products (NMU, 2021).

Biobased innovators share the interest and the goal of reducing CO_2 emissions and shifting towards a more sustainable material supply in the construction sector (Interviews 4 & 5). Biobased materials have many potential applications in construction, including insulation material, wall panels, construction site fences, roofing, and interior and design applications. Furthermore, biobased innovation in the construction sector is associated with a positive socio-environmental connotation due to the carbon absorption properties of grass and wood (Interviews 4 & 6).

According to governmental policy documents, the innovative applications developed by the niche players have a transformative potential to modify the current construction sector and its practices gradually. Nonetheless, as Geels (2006) suggested, it is necessary to look at the stages and phases of innovation pathways to unlock the transformative potential of system innovations. In the Dutch biobased context, a growing number of niche innovators are experimenting and employing their materials in the construction sector. In this playfield, biobased innovators encounter opportunities and limiting factors.

5.4 Observations

The Netherlands is regarded as one of the frontrunners in circular and biobased innovation. Through the lens of the CDA methodology, the Dutch CE framework can be linked to positivistic and segmented attitudes with respect to sustainability issues.

The construction industry is a network chain full of different stakeholders and actors with a common goal: reducing CO_2, pursuing economic growth and adding circularity to the supply chain (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2016). The regime is characterised by a noticeable area of tension between the establishment and the upcoming order, which creates a barrier for frontrunners to implement

innovations. This barrier is represented by the strong lobby behind the construction sector, which slows down the current legislation. In this way, the transition is being held back (Wessels 2020).

However, the landscape (macro) level can exert social pressures on the usual practices of the regime in the form of climate awareness, developing CE frameworks and including an ecological product design. In addition, the regime is pressured by the niche level, the latter being a breeding ground for a few innovative technologies. Nonetheless, several communication strategies of regime players have recently included 'alternative' discourses advanced from the landscape and niche level. This situation causes regime actors to adopt sustainability operationalisation and communication strategies which, while improving some construction practices, are still in practice mainly based on a linear economic model.

6. Biobased materials in the Dutch construction sector

Drawing from the triangulation of interviews and policy documents, this chapter delves into the material and socio-economic factors that influence the upscaling of biobased applications. Legal and economic incentives for adopting biobased materials in the construction sector are deemed both opportunities and limiting factors for biobased applications.

6.1 Sustainability of Biobased Materials

One opportunity to overcome the reliance on fossil fuels and address climate change is the adoption of renewable raw materials from agriculture and forestry for manufacturing and using biobased products and services (Sanders et al., 2010).

A biobased product is usually characterised by the biobased carbon percentage or the biobased content. Biobased materials derive entirely or partially from biomass materials, which means they are (primarily) made from renewable resources. The most employed types of biomass are wood, natural fibres, plant oils and starch (Narra et al., 2017). However, partially biobased products may also contain non-biobased materials. This means that they are biobased but not bio-degradable. According to legislation, in those cases, the biobased claim should be accompanied by quantifying the biobased content (Narra et al., 2017).

Furthermore, the sustainability of biobased products depends on multiple factors, such as supply, production process and design, transport, and suitable choice of disposal option. Life Cycle Assessments (LCA) and environmental product labels (such as controlled third-party eco-certifications) provide consistent information for a growing variety of products. Several assessment methods and certification schemes inform and measure a biobased material's environmental impact (Broeren et al., 2017).

Moreover, in the Dutch construction context, specific sustainability indicators like the MKI (Environmental Cost Indicator) and the MPG-score (Environmental Performance Building) have been developed and increasingly adopted to implement and monitor construction projects (Milieuprestatieberekening, n.d.). However, despite the high ambitions of the Government and other institutions, only a small percentage of the materials used by the Dutch construction sector is currently biobased: approximately 2% is wood, while other biobased materials only account for 0.1% (WUR, 2022).

6.2 Scaling-up instruments for biobased materials

Scaling-up is an important phase in the transition theory, as it concerns identifying opportunities and barriers within institutional structures (Hermans et al., 2016). Niche actors employ strategies to upscale, such as testing and certifying products, creating and improving technologies, network building, advocacy and lobbying, and creating alternative visions and discourses (Hermans et al., 2016). Moreover, legal and economic instruments can influence the availability and the commercialisation of certified biobased materials in the Dutch construction sector.

6.2.1 Legal Instruments

Local municipalities have a central role in stimulating and supporting biobased material use. In the last years, the Dutch Government, alongside the EU guidelines, began supporting biobased and circular applications through Sustainable Public Procurement (SPP) (PIANOo, n.d.). Despite the renewed interest, the notion of public procurement as an innovation policy instrument is not new. Several studies in the 1970s highlighted the potential of public demand to stimulate innovation (Lenderink et al., 2019). Geroski (1990) suggested that public procurement could be a far more efficient instrument to stimulate innovation compared to R&D subsidies.

Sustainable Public Procurement implies paying attention to the environmental and social impact of public tenders as well as the price of the products, services or works in question (PIANOo, n.d). The SPP gives directives and guidelines to achieve sustainable procurement procedures. Through the SPP, national and local authorities can set targets for minimum requirements in public tenders (PIANOo, n.d.).

Nonetheless, although the Dutch Government advanced plans to increase the circularity and adoption of biobased materials in the built environment, according to one of the interviewed experts, the ambitions of the Government are sometimes mismatching the range of influence of the public authority. As he argued, in some cases, the Government promotes circular initiatives but doesn't necessarily have ownership and cannot influence the supply chain.

> *"And there's also a lot of interest from provinces and municipalities. And I also work as a mentor in the startup in residence program, which is together with the Province of Zuid Holland, as well as the Municipality of The Hague, and some*

Ministries. And what I do notice is that sometimes a municipality or province is initiating something that they don't have any ownership in. So it's one hand, it's good that they kickstart something and make something happen. But that is not where the impact is made. So what I've seen in the past is that when the Province of South Holland focused on the roadside grass, which is something they actually produce themselves, it is where they can make a big difference. Because then they really focus on something they are owning, they are owner of, and they can actually make a difference and connect this to a startup that's working on that material. So my view on that would be for these organisations to look at what they're doing themselves" (Interview 1).

From this passage, the respondent wants to convey that one fundamental factor for a successful biobased strategy is the ownership of the material and the willingness to pursue the application of biobased materials. According to the expert, biobased and circular ambitions might not be enough to ensure the successful realisation of sustainably-led construction projects (Interview 1). In addition, the regulations for Public Procurement differ from the private tender procedure. In fact, private tenders are still following the Building Decree (2012) and the environmental calculations based on the MPG and other material certification schemes (e.g. BREAM-NL, C2C).

Moreover, according to biobased innovators, local and regional authorities could request higher demands for triggering Sustainable Public Procurement. One of these, as commented by one of the interviewees, is to set a minimum percentage of biobased (and circular) materials in the projects.

"Well, they could prescribe in their zoning, their buildings, plumbing, and perhaps, that within a certain region, you would need to use 50 per cent biobased in a building or something. And maybe that line would shift more to 60 or 70 per cent over time. But that way, you also really create the demand for this, and then perhaps you don't need these subsidies for these tests, because the financial incentive to develop these things will arise from the demand side. I think that could also be a great way to stimulate more biobased materials. Definitely. Yeah. […] *I believe that the French already do this, but on the governmental, a nationwide level. They prescribed 50 per cent biobased, but I'm not sure in which situations. I believe that it is in multifamily housing, but I'm not entirely sure."* (Interview 5).

As described in this case, legal instruments might increase opportunities for biobased applications. The interviewee remarked that a vital driver for promoting biobased innovation and operationalisation stems from the legal intervention and an adequate legal framework designed by public authorities. This could be done by prescribing a minimum percentage of circular and biobased material in the zoning plans (Interview 5).

Alhola et al. (2018) demonstrated that public procurement could promote CE and related business models by setting criteria and requirements to help extend product durability and encourage the efficient use of recovered materials. However, specific regulatory frameworks still need to be implemented to promote CE. Therefore, CE strategies could be better enforced through relevant policies enacted by the local and central governments (Alhola et al., 2018).

6.2.2 Economic Instruments

The other main instrument to encourage biobased material adoption lies in granting subsidies for their use. Wageningen Food & Biobased Research, on assignment from the Dutch Ministry of Economic Affairs and Climate, composed a comprehensive list of biobased construction materials "*Catalogus biobased bouwmaterialen 2019"* (Biobased Building Materials Catalogue 2019) (VLAG et al., 2019) to support market purposes.

The contemporary version of the catalogue dates 2019 and is an update to the previous versions. According to the authors, this update is due to the increasing research, development and adoption of biobased materials in the construction sector. Moreover, listing all the biobased construction materials in one document could help overcome the unfamiliarity with biobased products in general (VLAG et al., 2019). In fact, this tool intends to inform the entire construction chain parties about the applications and possible biobased alternatives to traditional materials.

The list of biobased materials represents which materials are eligible for subsidies in their adoption through the MIA (Environmental investment deduction) and Vamil (Arbitrary depreciation of environmental investments) (VLAG et al., 2019). In addition, the materials in the list must meet third-party certified standards and testing procedures. When speaking with one of the biobased innovators, he mentioned that entering the list of biobased materials is a great advantage for biobased businesses. However, not accessing the list also creates bottlenecks for the scaling up of biobased companies.

> *"So then, for one year, I was on the list, and I could tell my customers if you buy my stuff, like buying a Tesla, you can redirect your payment from your tax. So for one year, that was all good. And then the second year, then... 'Yeah, I'm not really sure about your resin, and it's probably toxic.' So I then already one of my two products was taken off. And then another year later, I was completely off because it's a gap."* (Interview 4).

In this passage, the innovator shared a reflection concerning the functioning of the biobased catalogue, pointing out that until costumers and contractors can benefit from the subsidies in adopting a biobased product, they are encouraged to select it. On the other hand, when biobased products lack certification and, therefore, tax incentives, this becomes a limiting factor for their adoption (Interview 4). As the interviewee suggests, the economic uncertainty related to the fiscal incentives plays a vital role in opting -or not- for a biobased product.

In this chapter, I presented the Dutch construction bioeconomy context regarding biobased material properties and promotion instruments. Legal and economic drivers for the adoption of biobased innovation were analysed, and interview insights were reported in this section. Attention to the material aspect, comprehensive LCA of both biobased and traditional materials, and local regulations are perceived by biobased innovators as possible drivers for increasing the adoption of biobased materials in the construction sector.

7. Biobased innovators' perceptions

This chapter focus on the perceptions of biobased innovators concerning the current state of the circular and biobased transition in the construction sector. This perspective is meaningful because it represents the viewpoint of the niche level regarding the transformative potential of biobased applications. According to the transition theory, several factors are necessary for socio-technical system shifts (Geels, 2006). By touching on relevant themes of transformative innovation policy (TIP) literature, the following sections report innovators' perceptions, needs and beliefs.

7.1 Market shielding

Biobased innovators stated that providing information about their product's properties is a fundamental step toward entering the market. Nonetheless, to be able to show product specifics, innovators must assess their products through testing and certification schemes. Examples of this were mentioned by the managers of a construction fences company in Utrecht:

> *"Most part of our fence is made of wood, Douglas wood* […]. *And that's a type of wood that's very accessible in the Netherlands, and also very sustainable. It can be unbundled, and you don't need any wax or oils to make it durable for a long time. So it can last like 10 or 15 years without the need of any oils or something. So that's, that's very nice. And it's a very sustainable material, because it has the PEFC* (Programme for the Endorsement of Forest Certification) *certification. So that makes sure that they're the balance of threes in Europe is always the same.* […] *Well, luckily, we have a product that's very visible. So if you do a new project, we got a lot of attention with the product. So we got a lot of new requests, if we start a new project; like the municipality of Utrecht helped us a little bit especially with certification, kind of things to make sure that constructors can use our product very well."* (Interview 6).

The importance of testing and certifying a product can also be observed in the following passage concerning the bamboo beams.

> *"So I've been to China quite a few times. So I made a whole protocol of how I wanted to do all those testings: a bending test and a compression test and all those things. And those were the first beams, and I found out that it was quite strong. And then I brought a few testing beams, testing samples here, to Poland, and did some*

testing here by myself and also found out that it was quite strong enough. So yeah, that was, let's say, the first steps […] And first, you need a track record. So, from now on still, we have to do it on our own. We are currently testing in Germany for those sleepers. I know that as soon as we have the certification that we are suitable to go into the track, then things will change, because then people know, okay, he has a certified product. So you need to have your paperwork fully in order for large companies that they want to join you." (Interview 4).

The excerpts from these interviews are relevant because they demonstrate that obtaining data from testing grounds and certifications can support the adoption and consequent expansion of biobased applications. However, the two cases in the analysis have some differences. For example, the adoption of biobased construction fences was facilitated by the Municipality of Utrecht, which supported the innovators in the certification process (Interview 6). On the other hand, although the bamboo beams have been subject to multiple testing, the company's lack of certification did not result in large-scale product adoption (Interview 4).

Therefore, these insights suggest that national and local authorities have the tools (e.g. public procurement, proactive role in biobased and circular applications) to provide space for testing innovative materials and designs. Furthermore, these tools are vital in the shielding phase because they can stimulate the use of biobased materials and provide a favourable entrepreneurial climate for innovation trials.

7.2 Learning

Successful innovation often requires trials and a learning process. Developing knowledge regarding a product requires technical examination and standardisation of the manufacturing method. Technical prototypes are the first stages of a new product. Prototypes serve to test the qualities of a given product and contribute to gathering information about it (Interviews 4 & 6). When prototypes achieve the required standards, the manufacturer can start looking for a market introduction. Biobased innovators mentioned that the learning process might need time and effort, especially when new and displaced supply chains are involved (Interviews 1, 4 & 5).

Moreover, in the context of learning, companies and local authorities might ask for support from universities and expertise centres (Interview 1). This collaboration offers research opportunities for biobased materials and possibilities to develop new business cases (e.g. from

resource recovery) (Interviews 2 & 3). The coalition with centres of expertise and education institutions can also contribute to gathering the data necessary to certify the biodegradability, environmental and social sustainability and circularity of a product (e.g. through LCA assessment and other environmental indicators).

7.3 Perception of network

To upscale biobased innovation, both the Dutch Government and the Province of Utrecht established coalitions and platforms to accelerate the CE transition. Facilitating the network between construction sector stakeholders is one of the main areas of influence of the Utrecht Province (Interreg Europe, 2021). Hence, the role of the institution, besides efforts to advance circularity guidelines, is mainly focused on network management and educational activities. According to this perspective, as the network grows, more knowledge about circular supply and biobased material will be shared to drive the market towards sustainability (focus group, June 22, 2022). Therefore, there is a belief that a market shift toward biobased innovation will emerge as more businesses become familiar with biobased products.

Interviews with biobased innovators and circularity experts reveal that networking is key for innovative products, especially for navigating bureaucratic procedures and supply chain structures (Interviews 1 & 6). However, other innovators mentioned that networking is only a thin layer necessary for unlocking the transition potential of biobased innovations. One of them mentioned:

> *The thing is, especially the last one* [networking], *is something that is used a lot. But as a matter of fact, we're not waiting for them. We find our way in. It's not a mission. Your company's got people from different directions. So that networking site and stuff are moving on, is not interesting at all. It's not a waste of time, but it's not interesting. And I can see that the Province brings that on all the time, and using their resources. Yeah. It's, in my opinion, less effective.* (Interview 7).

In this passage, the interviewee highlights that, among the assisting strategies that could be embraced, the Province often focuses on the role of networking, which is, according to the interviewee, 'less effective' than other approaches (e.g. creating demand for biobased products) for unlocking the transformative potential of biobased innovations.

7.4 Upscaling

The upscaling phase is crucial in the transition theory because it represents an innovation's 'acceleration' process (Ghosh et al., 2021). Upscaling requires a stable product with certified characteristics that is replicable and attractive to the market. Biobased innovators face several challenges in the upscaling process. The challenges often involve perceptions of safety and reliability. In addition, the attractiveness of biobased materials, which is also essential for upscaling, depends on environmental and psychological factors.

7.4.1 Preconceptions of safety and reliability of biobased materials

Since biobased materials and products are deemed less durable in the construction industry than commonly adopted materials, the innovators face several challenges in entering the supply market (Interviews 1 & 4). One of the interviewees emphasised that companies intending to use biobased materials for their projects demand a multitude of data, which, according to one of the interviewees, is not usually asked for traditionally employed materials.

> *"It's hard to know the lifetime before the end of the lifetime, you know; so new materials have a lack of evidence in that regard. So, builders want to know what's the lifetime. But for regular building materials, there are no rules and regulations in place around lifetimes. So they are not even matched against this evidence. So, with concrete, you don't have to prove anything. So, that's really, really weird. So that, again, is also just in terms of these preconceptions that make it quite complicated. Yeah, overall, I think adoption is increasing. So, there's more being used, especially like CLT (cross-laminated timber), or cellulose, insulation, wood, fiber insulation, as well as hempcrete."* (Interview 1).

In this excerpt from an interview with an expert in the biobased economy, the respondent highlights the tendency to question the durability and reliability of biobased materials compared to business-as-usual resources (e.g. concrete, steel). According to the interviewees, this is a double standard for biobased material since established materials do not receive the same amount of scrutiny (Interviews 1, 2 & 4). Nonetheless, the interviewee shared a positive reflection on the state of adoption.

Other biobased innovators also shared developers' preconditions of lack of trust towards biobased material. One interviewee explained that there is hesitation among developers and construction companies to use biobased materials because of concerns about the reliability and safety of the products.

> *"And what I learned, like, generally speaking, regarding biobased, is that often like external parties, and even the parties themselves will have quite some preconceptions around biobased materials. So, for example, that, that it rots away and you can, you have mice and stuff like that. So they have like, these preconceptions, or that it catches fire. And then they do extra research on that, or the lifetime is not as long as usual materials. So there are these preconceptions make it that a lot of extra research is being done into it. And a lot of organisations do that separately, so they don't look at each other's information. They just do it again. And then they found out, it's not a big problem, okay, it's not a big problem."* (Interview 1).

It can be deduced from the interview that developers' concerns are upheld by government regulations that have strict requirements for LCA and material properties. Often governments and businesses require further testing and research on biobased materials, causing the product to undergo extensive research, which delays its implementation (Interview 2). As a result, the lack of market and governmental trust in biobased materials can cause delays in market uptake and use, thus hindering the transformative potential of biobased innovations.

7.4.2 Environmental and psychological factors

One of the influential components for adopting biobased materials and circular processes stems from the positive environmental value attributed to them. Furthermore, this factor is significantly associated with a psychological dimension linking biobased materials and sustainability.

Although biobased materials are (clearly) not new, several applications and products have recently been developed using biobased innovations and technologies. One example of this is wooden fences for construction sites. In the following passage, the company manager explained why his business is growing and gaining attention from other parties in the construction sector.

> *"I think, three factors are the most important. The first factor is that we create a visible thing.* [...] *If you compare it to a regular construction fence, and a contractor has a construction site for several years, maybe; and it's very visible in like the city center. So, they realise, okay, we are like two years in the city center, we are constructing a big building. And a lot of people walking by and everybody don't like that we are building over here, because it's a lot of noise and a lot of dust and that kind of things. So, they realise, we have to do something about the environment that people are a little bit more enthusiastic about that we are building over here. And with a wooden city fence with planters, it looks a little bit more… Yeah, happier for the surrounding. So that's, that's one very important thing, that constructors, and also municipality, or retail owners, they realise… we have to do something about the environment."* (Interview 6).

This quote shows that a significant reason to adopt a biobased application stems from the psychological reaction of the public when dealing with a new construction site. The case of the biobased construction fences is exemplar because it shows the positive psychological influence of biobased applications. In addition, it is noteworthy considering that when a company adopts (even on a small percentage of the total material used for a construction site) biobased materials, it can benefit from the public perceptions of sustainability associated with the biobased materials and the circular economy discourse (Korhonen et al., 2018).

The second factor for the inclusion of the biobased materials mentioned by the innovator is the carbon retention properties of wood (Interview 6). Construction businesses can leverage this significant property of biobased materials to target the goal of decarbonisation in the construction phase (a prominent feature for gaining access to Sustainable Public Procurement tenders). The third factor stems from the return on the social impact that the company pursues by reintegrating people into the labour market (Social Return On Investment (SROI)); this feature can be shared with other construction stakeholders adopting the biobased alternative.

Understanding the values that underpin the application of biobased materials helps recognise the reasons to engage in biobased procurement. Hence, the use of biobased applications and circular principles should be observed in context-specific settings. In addition, targeted studies could strengthen the quantification of the environmental benefit of biobased and circular applications to avoid misleading communication practices that actually legitimise business-as-usual.

7.5 Opening up regimes

Upscaling also involves the interaction of the niche level, with its set of emerging rules, with the old set of values of the regime level. These interactions can turn into different relation outcomes between socio-technical levels (from competition to alignment) (Schot & Kanger, 2018).

As one of the interviewees pointed out, the strong influence of regime players, "the concrete and the steel lobby" (Interview 4), plays a decisive role in market dynamics. More interviewees and other qualitative studies concerning the Dutch construction context also pointed out that the construction sector is 'stuck in traditional processes and routines' (Rijk, 2020; Wessels, 2020; Kuipers, 2021). According to biobased innovators, these large-scale, influential market players can influence political forces in their direction, thus hindering the biobased economy's scalability and uptake.

Nonetheless, one of the biobased experts highlighted a particular relationship between the Government's circular ambitions and the current construction practices:

> *"And what I'm afraid of, is that they* [construction companies] *will also count things that can be reused in the future as being circular. And I think… I think that's a good thing. But then we're, we're still using virgin sources! So there, I mean, there's room in this definition. Because yeah, they don't want to make a decision on what the Government thinks is, because they just keep it vague; and it is vague. But I'm afraid that this would become the norm and that everyone is doing newly built with virgin materials. And because it can be reused, they are allowed to call it circular. And then, yes, we make the ambitions. Oh, so great. But then yeah, not for material usage. And then, and then because you build your mountable, you're also using extra materials for these connectors, for example."* (Interview 1)

According to the interviewee, the demand for growth in the construction industry (one million houses in the coming ten years) is a paradox within the circular model. This interviewed expert also suggested that the goal of achieving circular construction is not accurate when considering the rate of demolition and the material supply side. In support of this viewpoint, a study on two area development in Utrecht and Amsterdam (Van den Berghe & Vos, 2019) suggests that the lack of a clear definition of circularity, especially in reference to spatial planning and area development, allows several interpretations of the concept. On the one hand, this has advantages as different actors can explore the possibilities of circularity, but also disadvantages, that it can be used to influence the institutional setting without actual

implementation (Van den Berghe & Vos, 2019). Indeed, the nuances of the definition and the belief in the market's self-regulation led to the lack of regulations for implementing circular principles, thus weakening the concept of "circular" (Van den Berghe & Vos, 2019).

Consequently, the current socio-technical relation between niche and regime levels can be seen in its 'maturity phase' (Schot & Kanger, 2018). This perspective on socio-technical transition suggests that the new set of values (CE and BBE) would still continue to be shaped by the formerly dominant regime, which still exerts pressure on the system's structure and dynamics (Kuipers, 2021).

Nonetheless, under the pressure of the socio-technical landscape, regime players tend to adopt the discourses and (some of) the practices of the niche level to legitimise their business. For these reasons, a growing interest in circular and biobased applications recently characterised the construction sector; even so, the interviews and current reports suggest that the scale of the operationalisation is marginal compared to the ambitions of the Government.

7.6 Replicating & Circulating

As previously mentioned, biobased innovators suggested that to replicate and enlarge their market opportunities, public institutions could require a minimum percentage of biobased and circular materials in their zoning plans (*bestemmingsplan*). This could be done by setting mandatory agreements with builders regarding the choice of materials and supplies. Innovators see public procurement as a preferred tool to implement circularity and biobased principles because it reduces the competition with traditional construction materials. However, innovators mentioned additional motives that influence the competition. Some of these fall in the above-mentioned categories of safety and reliability; other reasons stem from an economic perspective. For example, one innovator emphasised:

> *"Yeah, but still, my customers say you're more expensive than tropical hardwoods. So why would I buy you? Yeah. Okay. So that's already one of the things that I run into being a startup that… if you're a startup, you are more expensive than, let's say, the bigger things that are already there. But, yeah, nevertheless, I still feel it's, it's a good thing. And I will continue with this."* (Interview 4)

Hence, the economic competitiveness of biobased materials is also linked to the supply chain. Research on path dependency and technological lock-in shows that technological superiority (e.g. more efficient or sustainable) or even management superiority does not guarantee market

success (Korhonen et al., 2018). This is because the technologies and business models that have achieved their leading position first (regime level) are usually sceptical of other new technologies or models (niche level).

Drawing from the multi-level perspective, the lock-in of the regime level should be analysed by including concepts of power and resistance. In fact, as Korhonen et al. (2018) suggest, businesses (regime players) tend to legitimise themselves and continue the old way of doing things rather than attempt into unknown futures. This outcome has fundamental implications for sustainability and business communication research.

7.7 Observations

In this chapter, I presented biobased innovators' perceptions regarding the state of the transition. Both opportunities and challenges for biobased applications in the construction sector were presented in this chapter. According to innovators and experts, the possibilities to upscale biobased applications depend on the institutional climate, access to certification and (fair) competition with traditional supply chains. From this perspective, the Government and local institutional actors result as crucial players in allowing upscaling and accelerating biobased applications. Nonetheless, shifting from the business-as-usual supply chain involves the disruption of current economic models and the change in psychological standpoint concerning biobased innovation.

8. Conclusion

This research informed about the different perspectives of actors in the construction sectors concerning the transformative potential of biobased innovation and the circular economy model. Through the MLP, the levels making up the socio-technical system were presented, and the actors' reasons for engaging in BBE and CE were also indicated. Nonetheless, interviews and policy analysis provided a variety of motivations for adopting CE and BBE discourses and practices.

Firstly, it is noteworthy that the ambiguity of the CE concept makes it possible to use it in multiple ways and serve multiple purposes. The Dutch Government has high ambitions concerning CE and BBE and their positive contribution to the construction industry. The shift towards a circular and biobased economy has become central in policies given the socio-technical landscape pressure (climate change, pollution, waste). Several national and regional strategies have also been advanced. For example, the Province of Utrecht and the Dutch Cabinet have been promoting knowledge development and networking strategies based on voluntary agreements. This approach fits in with the initial phase of the circular economy policy. However, voluntary and non-committal agreements will ultimately be insufficient to meet Government's bold ambition to shift to a fully circular economy by 2050 (Hanemaaijer et al., 2021). Drawing from Calisto Friant et al. (2020), it was possible to observe analogies between the Dutch Government's CE ambitions and a positive and hybrid CE discourse typology.

From the perspective of actors in the construction sector, there are multiple reasons to include the discourse of circular and biobased economies. The most prominent are efficiently maximising the use of materials and improving the socio-environmental image of the company itself. In fact, from the interviews, it emerges that engaging in circular strategies at the operationalisation and communication level improves the company's public image. In addition, interviewees suggested that adopting certified circular or biobased materials allows a company to obtain economic incentives through procurement schemes. Most of the respondents confirmed that the possibility of using certified biobased products to obtain tax discounts is a primary driver for their adoption. Nonetheless, besides attempts to sustainably innovate, interviews with practitioners and experts pointed out that the construction sector is held back to traditional processes and routines and that shifting to BBE and CE practices is considered risky and untrustworthy.

Biobased innovators, the niche level of the MLP, encourage a transition towards CE and BBE models deeming circular and biobased products positive for the environment compared to the traditionally supplied materials (e.g. concrete and steel). However, they observe social, economic and material limits for upscaling biobased and circular applications. In their perspective, the (legal and economic) instruments elaborated for the transition are considered to be inadequate with respect to the government's circularity ambitions. Therefore, biobased innovators suggest operating in legislation and regulations so that it no longer causes disadvantages for circular projects compared to the already established linear practices (e.g. virgin materials might be cheaper than recyclates, testing and standardised certification schemes for biobased materials).

Moreover, biobased innovators indicated that public authorities have a central role in adopting biobased materials since they can elaborate, implement and guide economic and legal instruments in the procurement process. Therefore, policy implementation is considered by biobased innovators by far the most influential area of intervention. For example, by acting as a proactive client, local authorities could increase the circularity and biobased requirements used in public purchasing and procurement or demand end-of-life management into high-quality reuse of materials.

Nonetheless, considering that the Government pursued market means for circular development instead of setting higher circularity requirements for procurement and tenders reflects a market-oriented political and economic ideology. Hence, to achieve the circular economy's desired social and environmental results, the Government and construction sector stakeholders should turn the circular vision into concrete goals.

However, several research limitations can be distinguished in this study. The first restraint concerns the number of interviewees, which was limited by the geographical area of the study and their availability. Even so, opting for qualitative analysis methods has allowed collecting valuable insights from the interviewees. In addition, another limitation could arise from the second methodological approach. Critical discourse analysis (CDA) is primarily a qualitative research method, and the replicability and rationality of the analyses cannot be established in precisely the same way as in quantitative approaches. Again, this is a consequence of the sampling choice and the author's positionality (Wodak & Meyer, 2001).

In conclusion, this research showed opportunities, limits and challenges for implementing the circular and biobased ambitions of the Dutch Government in the context of the construction industry.

Investigating why people do not always act according to their existing ambitions is valuable in understanding socio-economic contexts, not only in the construction sector but in various fields and levels. Hence, this research showed the necessity of examining the divergence between discourse and practices, focusing on actors' power relationships in the production and replication of sustainability discourses.

Further research will be essential in grasping the meanings and discourses embedded in environmental policies and reports to assess the status and practicality of a desirable sustainability transition.

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10. Appendices

Appendix 1: Interview Topic list Biobased Innovators

Opening Questions

1. Would you like to share your name and age?
2. What is the structure and mission of your organisation?
3. Can you explain what your innovation is?
4. How would you define biobased innovations?

Niche Construction

Shielding (starting off in 'protective spaces')

5. Where/How did you start your first trials and how successful were they? (ie Interest? Financial opportunity? By chance? or otherwise?)
6. Which is the scale of biobased applications in the region where you operate?
7. How did people get to know your business?

Learning

8. Since you started on this project what have been technical challenges and technical opportunities discovered through your innovation?
9. How do you measure and evaluate the effectiveness of your programs? Do you use any certification or indicator for sustainability/circularity?
10. In terms of the resources to support your business, have you had access to necessary equipment or materials? Have you been able to recruit skilled staff, or have you had to look elsewhere?

Networking

11. Who were crucial partners, individuals or organisations that supported you in the start?
12. In what ways have the province or NGOs or private companies or other biobased innovators supported or not supported you?
13. Is there a shared vision in the region/network which guides your development?

Regarding learning/networking, what do you need more?

Navigating expectations

14. Have you experienced some changes in your approach towards biobased product at some point? What and why did you change?

Acceleration

Upscaling

15. What is your relationship with other innovators? Do you share information or networks with other innovators?
16. Have you patented the product? What have been the hurdles to doing so?
17. Do you feel your company is prepared to expand? Why or why not?
18. What is needed for your innovation to expand (i.e. more financial support, more staff, more raw materials, cultural factors, learning factors, networks?)
19. Have you experienced competition with traditional products? How do you think the province can better support you in this?

Replicating & Circulating

20. What is the potential for expansion of your innovation? What are examples of applications?
21. What would be necessary for your innovation to spread or reach a larger target?
22. What could limit your efforts to upscale/expand?
23. Is there a specific issue or question you want to address with your innovation?

Support and embedding from stakeholders: Opening up and unlocking regimes

24. How do you source your material for your company? Who could support your efforts in acquiring the materials and how?
25. The province together with Cirkelregio Utrecht Natuur en Milieufederatie Utrecht and NMU and more involved stakeholders hope to support biobased innovators in the following ways: create demand for biobased products, link biobased innovators to partners and provide requested resources. In what ways has this network been successful in doing this or not been successful?
26. How would you support biobased innovators? / What support do biobased innovators need?
27. Are there connections to networks or people that you feel would be helpful in supporting your growth?

Appendix 2: Interviewee Overview

Interview Number	**Company**/Organisation	Job Title / Function (department)
1	Centre of Expertise Biobased Economy	Biobased Innovation Expert & Social Entrepreneur
2	Rijkswaterstraat	Policy Advisor
3	Hoogheemraadschap de Stichtse Rijnlanden	Circular Economy Business Developer
4	Biobased heavy-duty bamboo beams	Owner & Director
5	Modular Housing Design	Technical Designer
6	Biobased construction fences	Project Manager
7	Biobased fibers materials	CEO

Appendix 3: Fig.2 Interview Code Tree