Time for Timber

A research on policy instruments for a successful timber transition in the Metropole region Amsterdam

J. (Josefien) de Wind

TU Delft | Gemeente Amsterdam

Delft University of Technology
MSc Architecture, Urbanism and Building Sciences

P5 Master thesis | TU Delft | June 2022

Colophon

Time for timber
A research on policy instruments for a successful timber transition in the MRA

Personal

Name	Josefien de Wind
Student number	4471733
Email address	j.de.wind@student.tudelft.nl

University

University	Delft University of Technology
Faculty	Architecture and the Built Environment
Master track	Management in the Built Environment

Graduation project

Document	Master thesis report
Chairs	Urban Development Management Design and Construction management
First supervisor	Prof.dr. E.M. (Ellen) van Bueren *Urban Development Management, MBE*
Second supervisor	Dr. U (Udo) Pesch *Values, Technology and Innovation, TPM*
Third supervisor	Dr.ir. A. (Ad) Straub *Public Commissioning, MBE*
Daily supervisor	F. (Felipe) Bucci Ancapi, MSc. *Urban Development Management, MBE*
Delegate of the Board of Examiners	Ir. R.(Rodrigo) Ordonhas Viseu Cardoso

Graduation internship

Graduation organization	Gemeente Amsterdam
Graduation Mentor	Arjan Hassing

Preface

Seven years after leaving my hometown, Amsterdam, to study at the TU Delft, my student period has come to an end by writing my thesis at the municipality of this beautiful city Amsterdam again. As much as I enjoyed my time in Delft, my interest in the built environment around me quickly made me feel like I had outgrown it. We are living in a world that is constantly changing and cities provide a reflection for the challenges that society is facing. Each city has its own uniqueness and its' built environment tells a story about the history of all aspects f the city. Contributing to this storytelling by creating places that reflect the challenges of our society fascinates me. Two of the most pressing challenges that society faces are addressed within the topic of this thesis: the housing crisis and the climate crisis. Using timber as a construction material seems like a promising solution to these challenges, or at least part of the solution. By diving into this topic, this thesis embodies my ambition for sustainability, and hopefully contributes to the story that is engraved in the built environment of Amsterdam, the city that has such a special place in my heart.

The sustainability and circularity transition that is slowly taking place within the built environment make sme really enthusiastic, however, this enthusiasm gave me a hard time converging and demarcating the topic. I would like to thank my supervisors, Ellen van Bueren, Ad Straub and Udo Pesch for guiding me through this process. I can imagine the frustration when -two weeks after a fruitful supervision- I showed up with a new research idea for the 10th time. As Ellen said 'You want to research everything, but that's not possible!'. The fact that I had a big supervision team sometimes made it even more difficult to gain a clear focus, however, the availability to this broad range of knowledge allowed me to conduct research that touches upon different disciplines. I would like to thank in particular Felipe Bucci Ancapi, my daily supervisor who has been involved from February on. Your patience and guidance helped me to finally understand what it means to conduct research and set up theoretical and analytical frameworks (it was about time, after 7 years of studying). My stubbornness must have tested your patience, hopefully you still have enough energy to cope with the words 'timber transition' for another half year (but I think your energy level won't be the problem). Furthermore, I would like to thank team CTO Sustainable from Gemeente Amsterdam for allowing me to conduct my research in their team. Even though my research sometimes felt a bit separated from your project, I had a great time in your team, the stimulating environment allowed me to gain valuable insights and you were always open for questions! Lastly, I would like to thank all the interviewees for making it possible to carry out this research. The interviews in which you shared your experiences and opinions led to valuable insights and showed me the importance of this topic!

On a personal note, I would like to express my thanks to Lucas Kroes, who has been my external supervisor during my thesis process. I really appreciate all your help and guidance, as you voluntarily spent hours on going through my thesis and brainstorming with me about it. And last but not least, I would like to thank my parents and close friends for always believing in me. This was particularly important for me as I sometimes have the tendency not to do so myself.

Only rests me to say, I hope you will enjoy reading this thesis. Hopefully I will inspire some of you to move to a timber house someday!

Josefien de Wind
Rotterdam, June 2022

Abstract

The Paris Agreement set goals to minimize global warming by reducing CO^2 emissions. In the Netherlands, the Paris Agreement is translated into policies that aim for circularity and sustainability at different governmental levels. These policies are directed at the sustainability transitions within different fields, such as the built environment. The construction sector is responsible for high levels of CO^2 emissions, however, there is a big housing shortage in the Netherlands and the aim is to construct 900.000 new houses by the end of 2030. This challenge requires a transition to a more sustainable way of constructing, to stay below the critical threshold of 1.5 °C global warming. The transition from traditional housing constructions to timber constructions can arguably be a solution to this challenge. To accelerate this transition, the Metropole Region of Amsterdam (MRA) has written a covenant that aims to construct 20% of the total housing production in the MRA by timber, by 2025. This is a high ambition, as currently only some pilot projects are constructed out of timber. While the covenant might give body to this transition in the MRA, there are still a lot of questions about how different policy instruments can foster the timber transition in the MRA. Many studies have been conducted on transitions and innovation policies, and affluent policy instruments for the transition of innovations are presented in literature. However, literature lacks in presenting how a combination of different policy instruments can foster a sustainability transition. This research, which is case study based, therefore researches the different policy instruments that are or can be implemented to foster the transition of timber constructions in the MRA. The literature study presents the theories that make up the theoretical framework and give a deeper understanding of the concepts that are used. The empirical research consists of a document analysis, a stakeholder analysis, interviews with stakeholders and an expert session for validation. The stakeholders within the empirical research are stakeholders that are actively involved in the timber transition in the MRA. This research finally gives answer to the question *'How can a combination of policy instruments foster the transition to timber housing constructions in the MRA?'.* It contributes to the existing literature on policy instruments for transitions by providing concrete methods and an operationalization of the analytical framework for the development of a combination of policy instruments for the timber transition. Furthermore, this research provides policymakers with recommendations on the development of a combination of policy instruments for the timber transition, as well as for sustainability transitions in general. Lastly, this research contributes to broadening the knowledge on the timber transition, as much is yet unknown and there is a great demand for more knowledge on this topic.

Key words | timber constructions, transition, sustainability transition, innovation policy, policy instruments, policy mixes

Executive summary

Introduction

Environmental pressures and high sustainability ambitions have led to the emergence of a circular economy (CE) approach. The built environment (BE) is a sector that is responsible for high emissions and causes many waste streams. To fit within the CE approach, the use of timber as a construction material is promising, as timber is a renewable construction material and suits itself well to be used in a circular manner. The Metropole Region of Amsterdam (MRA) has emphasized the importance of the use of more timber as a construction material by the development of the covenant 'Green Deal: Houtbouw'. This covenant is signed by governmental and non-governmental stakeholders in the MRA, with the aim to increase the use of timber constructions for the new built housing production in the MRA to 20% in 2025.

Besides elaborating on the agreements that are aimed to be achieved, the covenant describes the need for more research on the changing regulations that are required for timber constructions. The focus on regulations is emphasized by the Planbureau voor de Leefomgeving (PBL). In the recently published ICER report (Integrale Circulaire Economie Rapportage), it is stated that more pressure and coercion ('drang en dwang') is needed to establish a transition towards a circular economy. However, literature emphasizes the need for the implementation of a combination of different policy instruments by governments to foster sustainable transitions.

Problem statement

There is little knowledge on how a combination of policy instruments can be used to foster a transition of the built environment towards the circular economy

Goal

By using the case study of the timber transition in the MRA (Green Deal), gain a better understanding of the combination of policy instruments that can successfully foster the timber transition.

The main research question of this study is:

'How can a combination of policy instruments foster the transition to timber housing constructions in the MRA?'

The main research question is supported by the following six sub-questions:

SQ1. What are the most relevant characteristics of a circular built environment?
SQ2. What is the role of timber constructions in advancing the transition towards a circular built environment?
SQ3. What policy instruments can foster sustainability transitions?
SQ4. Who are the most important stakeholders that are actively involved in the transition towards timber constructions in the MRA?
SQ5. Which policy instruments are necessary for an effective timber transition?
SQ6. What is the effect of the current policies on the transition towards timber constructions?

The conceptual research framework (Figure I) shows a visual representation of how the different (sub-)questions relate to the problem statement.

Background theory

The literature review presents an overview of relevant theories and concepts on a circular built environment (CBE), timber constructions and their contribution to a CBE and policy

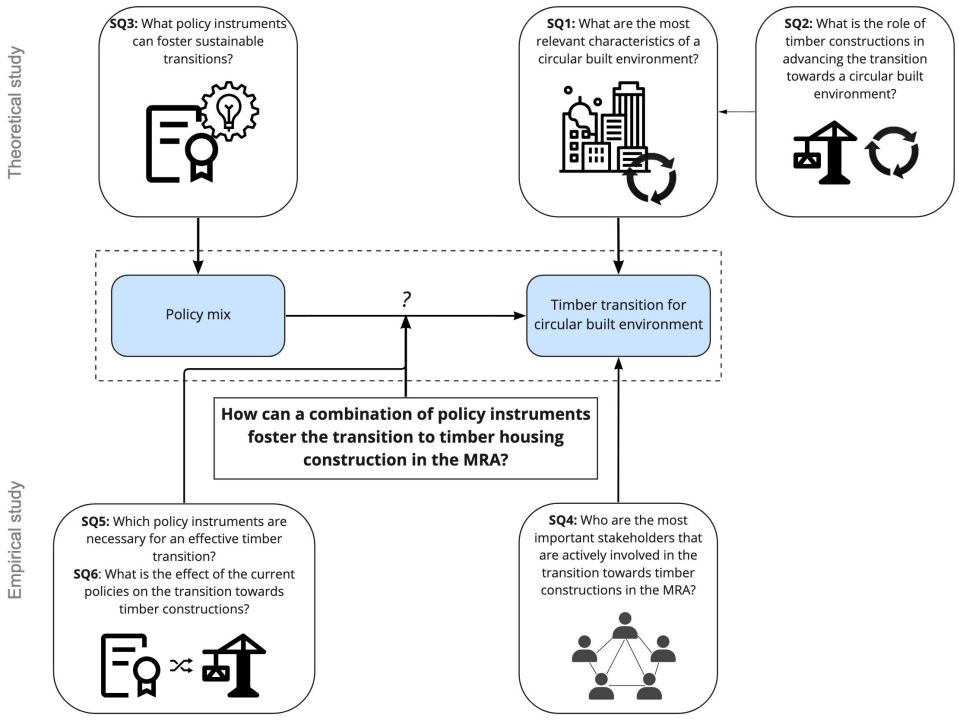


Figure I: Conceptual research framework

instruments. Sub-question 1, 2 and 3 are answered with the findings of the literature review.

Circular built environment and timber constructions

The BE is an important element of cities as sociotechnical-systems. As the BE is responsible for 40% of global CO2 emissions and uses 44% of materials globally, significant environmental impact reductions can be made by changes in the BE. A circular building is a building that is designed, planned, built, operated, maintained, and deconstructed in a manner consistent with CE principles. Strategies that are supposed to lead to a resource-efficient BE are systems innovation, performance management and resource efficiency. A transition towards a different construction method is therefore required for the BE to contribute to the CE. Timber constructions contribute to a circular built environment as, in the first place, this renewable material leads to reduced CO2 emissions compared to materials like steel and concrete (enhance natural capital), and, secondly, to the optimization of global resources as timber replaces the use of finite resources by renewable resources.

Policy instruments

The government has an important role in the transition to a circular future by the implementation of regulations, guidance, and top-down policies on different governmental levels (Yu et al., 2022). To date, policies normally resort to a series of policy instruments. There are different kinds of policy instruments and policy instrument classifications. A well-cited definition of policy instruments by Verdung (1998) is:

> *"A set of techniques by which governmental authorities wield their power in attempting to ensure support and effect (or prevent) social change." (Verdung, 1998, p. 50)*

Thus, a policy instrument is a tool to achieve a set of ideas or a plan that has been agreed upon by a governmental or political party.

Theoretical framework

A technology thus develops within a complex surrounding of set rules. However, as society changes over time, this means that the technologies within this system can also change over time. According to Rotmans et el. (2001), a transition is

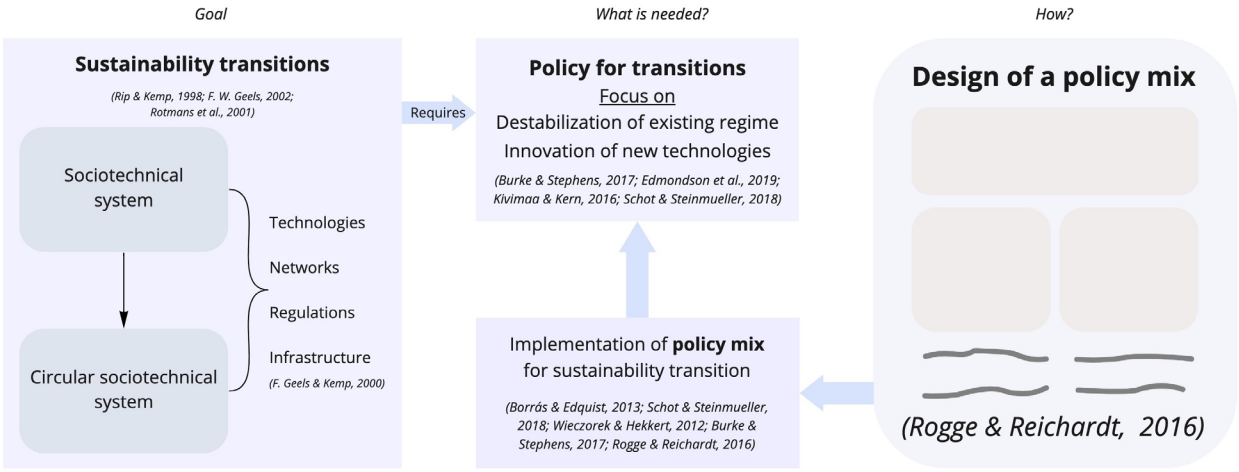


Figure II: Theoretical framework

a gradual process that implies a structural change of society. Both social and technical elements should be brought together to shape the system. The cumulation of dynamics in the system is required for the system to get momentum, expand and start the change process. As this is a complex process, innovation policies and transformative governance that leads to a transformation of the system are required to achieve sustainable innovations. Policies for sustainability transitions need to focus on both the destabilization of incumbent regimes, and innovation of new technologies. However, a transition of the BE towards a CE requires high efforts as, according to Yu et al. (2022), the fragmented character of the BE makes it difficult for policymakers to develop CE policies for this sector. A combination of different policy instruments, a policy mix, is important to fully shift towards a CE. Furthermore, policies for circular development are layered on top of existing structures, which should be kept in mind during the design and implementation. Figure II shows how the different theories that are presented relate to each other.

Analytical framework

Rogge & Reichardt (2016) present a method to design a policy mix for sustainability transitions. This has been translated into a framework, that forms the basis for the analytical framework. Figure III shows the analytical framework that consists of building blocks and assessment criteria for the development and assessment of a policy mix (combination of policy instruments).

The operationalization of the analytical framework leads to the structure of the empirical research and the different research methods that are used.

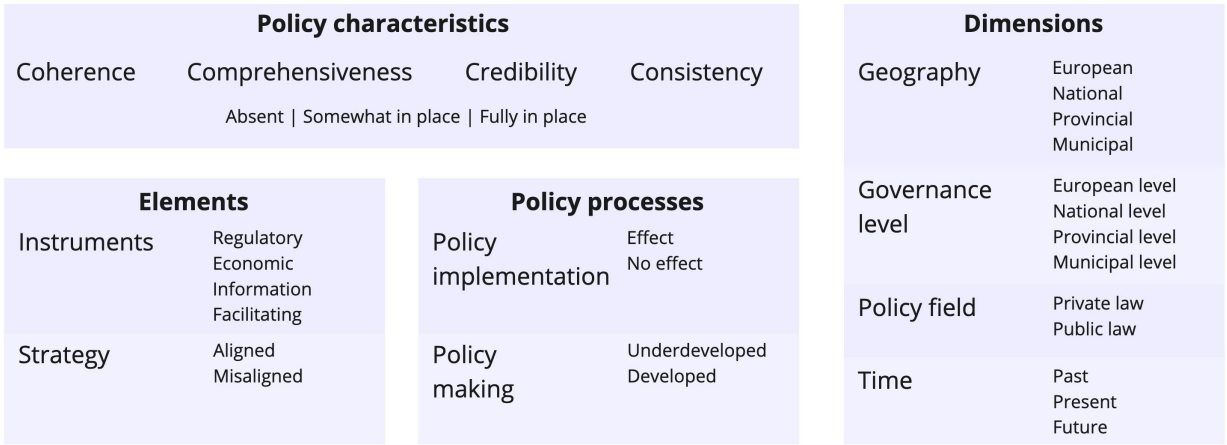


Figure III: Analytical framework

Research methods – case study based

The methods that are used for the empirical study are a stakeholder analysis, a case study analysis, semi-structured interviews, and an expert session. The different research methods lead to a high level of validity. As this study is case study based, the research methods are introduced by a description of the case study, the 'Green Deal Houtbouw', As argued in the introduction, the goal of the is to construct 20% of total new built housing production in the MRA by timber in 2025. The covenant sets a vision, goal, and some general and concrete agreements to reach the intended goals. Sub-question 4, 5 and 6 are answered with the findings of the empirical research review.

Findings

The most important findings from the different empirical studies are summarized.

Stakeholder analysis

The main findings for non-governmental stakeholders:

- In general, these stakeholders have the capacity, and are attracted, to implement the proposed policy plans. However, unexpected events or other barriers might lead to incompliance.
- Staatsbosbeheer, knowledge institutes and banks & institutional investors might have lower capacities and/or are less attracted to implement the policy plans, due to different reasons.
- The main barriers for stakeholders to comply are related to financial problems, regulatory limitations, a lack of knowledge and problems within the supply and demand and/or supply chain.

The main findings for governmental stakeholders:

- The municipality and national government have most regulatory instruments that can be used for the timber transition, the province has mainly facilitating and information instruments.
- While these stakeholders generally have high capabilities, conflicting interests and inconsistency might lead to long and complex policy making procedures
- Inconsistency can occur between or within the stakeholders, it can lead to topics being neglected or hinder policy implementation.

Document analysis

- The covenant presents limited information instruments for governmental stakeholders, economic instruments are completely lacking.
- The covenant is a complex policy proposal, as it has a broad geography level, while being aimed at both governmental and non-governmental stakeholders. Furthermore, the MRA does not have legal authority.
- The coherence, consistency and credibility of the policy mix can be assessed somewhat in place.
- The lacking connection to other policy sectors might lead to incoherence of the agreements to policies in other domains.
- The comprehensiveness is argued to be absent as the covenant does not cover all policy fields and lacks in expressing its coherence and consistency.

Interviews

The main findings for non-governmental stakeholders:

- Regulatory instruments that are implemented on municipal and national are perceived to be most necessary, facilitating and information instruments follow, economic instruments are not favored
- Most of these instruments are existing instruments that need to be used in a different way, some require new regulations (new

instruments).

- Regulatory instruments are perceived to have most effects, both positive and negative.
- Instruments that are implemented on municipal level have most effect.

The main findings for governmental stakeholders:

- Regulatory instruments are perceived to be most necessary, facilitating instruments follow. The national government should mainly implement regulatory instruments.
- All governmental levels should implement facilitating instruments.
- Facilitating instruments are perceived to have most positive effects, regulatory instruments are perceived to have most hindering effects.

After the data collection, the expert session is conducted to validate the research results.

Conclusion

How can a combination of policy instruments foster the transition to timber housing constructions in the MRA?

The different analysis that are conducted in this research show the complexity of the timber housing construction transition, due to the nature of the policies, the involved stakeholders, and the existing policy landscape. Firstly, the different research methods confirm and validate the need for more regulatory instruments for the timber transition. However, combinations of policy instruments are advised to be implemented, rather than individual policy instruments. Secondly, the findings emphasize the importance of facilitating instruments to achieve more successful effects. However, assessing the characteristics of the combination of policy instruments that is/will be in place is important for the policy mix to be successful. This requires market research to understand the needs and barriers of the non-governmental stakeholders, better communication between the governmental stakeholders to avoid wrong expectations, personal interests or misaligned strategies, but also better communication within one governmental organization, to avoid misalignment and lack of responsibility.

The deductive use of the analytical framework limits the findings to the theoretical concepts that are used. Out of the scope of the research methods, the findings are supplemented with concrete examples from the interviews, of the policy instruments that are needed, and some other focus points, for a successful timber transition, see figure IV.

Recommendations

For policymakers in general

- Understand the needs and interests of the stakeholders who are involved
- More emphasis on regulatory instruments
- Understand the importance of facilitating instruments
- Collaboration between different governmental powers
- Use the operationalization of the AF as a theoretical background for policy development

For policymakers in the timber transition

- Adjustment of the current policy mix (regulatory instruments)
- Do not limit the implementation of policy instruments to the current regulations
- Implement more facilitating instruments
- Design the policy instruments based on the stakeholders needs and interests
- Improve consistency in policymaking and policy implementation

Future research

- Complementing theories on policy mixes for sustainable transitions to better connect to transition theories
- Another case study
- The timeline of different policy instruments (after a transition)
- Decision-making models for policy instruments for transition implications

Concluding recommendation in relation to my internship at Gemeente Amsterdam

- Complement the currently used research method with systematic market-based research that will add on the current method
- Use the operationalization of the analytical framework, as presented in this research

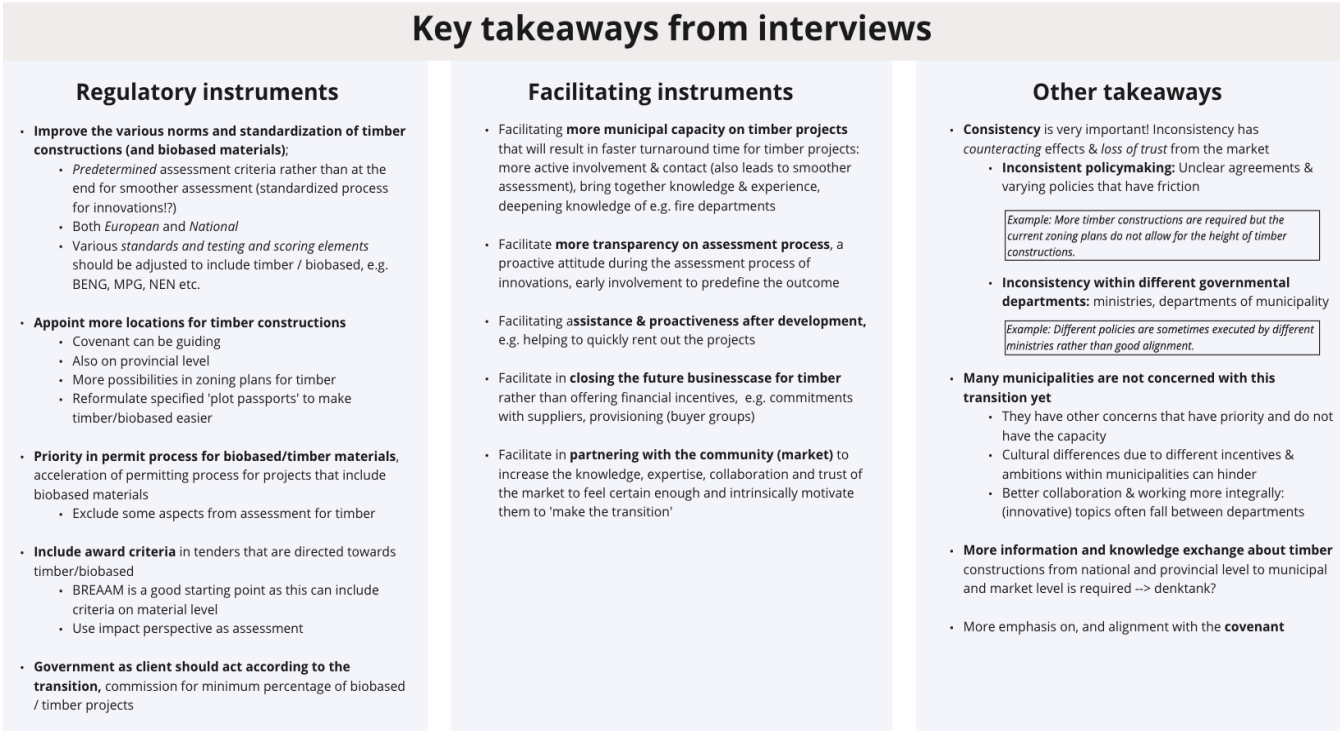


Figure IV: Key takeaways from the interviews

Table of content

Graphic index

List of figures

List of tables

Abbreviations

AF	Analytical framework
BE	Built Environment
CBE	Circular Built Environment
CE	Circular Economy
CLT	Cross Laminated Timber
Glulam	Laminated wood
HSB	Houtskeletbouw
LVL	Laminated Veneer
Prefab	Prefabricated
SA	Stakeholder Analysis
ST-systems	Sociotechnical systems
TF	Theoretical framework
TT	Technological transitions

PART I
INTRODUCTION

In this part, the research topic will be introduced by elaborating on the context, the problem statement and the goal of this research. The main research question and sub-questions that support in answering the main research question are presented. At the end of the introduction, the structure of the report shows visually how this thesis is structured. After the introduction, the reader will have an understanding of the context, goal and content of this research.

1. Introduction

1.1 Context

Global temperatures are rising due to anthropogenic impact on earth. The Paris Agreement, a legally binding global change agreement signed by 190 countries, sets out a framework to try to limit global warming to 1.5 °C (European Commission, 2019). To stay within the maximum global heating of 1.5 °C, Greenhouse gas emissions need to be reduced to net zero by the end of this century (Rogelj et al., 2015).

Circular economy

The high pressure on the environment and the ambitions of the Paris Agreement have led arguably to the emergence of a Circular Economy (CE) approach. CE is a term that has emerged in the last few years and is being used more and more. The subject is not only used by experts, but there is also a growing interest among businesses to incorporate CE in their strategies as well (Nobre & Tavares, 2021). The meaning of a CE has changed a lot during the past years due to new possibilities and research on the subject. But what does it entail? Well-known among scholars in the research field of a CE is the Ellen McArthur Foundation, who contributed to the development of knowledge on the CE in Europe and around the world. They define a CE as:

> *"... an economy that provides multiple value-creation mechanisms which are decoupled from the consumption of finite resources." (MacArthur et al., 2015, p. 46)*

This definition is based on three main principles, namely preserve and enhance natural capital, optimize yields from resources in use and foster system effectiveness (MacArthur et al., 2015).

While the Ellen McArthur Foundation presents a business approach to a CE, many scholars started defining the CE from a scientific stance. CE is a sustainability approach to contest the environmental challenges. It is aimed to generate sustainable production and consumption that will positively impact the climate and lead to economic growth. The CE is grounded in the idea that the economic system is cyclical and regenerative rather than linear (i.e., make-use-dispose), like the current economic system. It goes beyond the traditional idea of recycling in which degraded materials are used with a lower quality, by developing high value material cycles, also known as up-cycling. Furthermore, the CE entails the use of renewable and regenerative sources (Korhonen, Nuur, et al., 2018). A CE can be defined as:

> *"Circular economy is an economy constructed from societal production-consumption systems that maximizes the service produced from the linear nature-society- nature material and energy throughput flow. This is done by using cyclical materials flows, renewable energy sources and cascading-type energy flows. Successful circular economy contributes to all the three dimensions of sustainable development. Circular economy limits the throughput flow to a level that nature tolerates and utilises ecosystem cycles in economic cycles by respecting their natural reproduction rates" (Korhonen, Honkasalo, et al., 2018, p. 3)*

Different CE strategies

All over the world, the circular economy approach is becoming more widely known, and also in the Netherlands, a CE approach has been set up. To reach the goals of the Paris Agreement, the 'Uitvoeringsprogramma Circulaire Economie 2021-2023' has been set up to guide the Dutch national transition towards a CE. It includes national targets and action points for all sectors to work together on a CE (Het ministerie van Infrastructuur en Waterstaat, 2021).

The 'Uitvoeringsprogramma Circulaire Economie 2021-2023' focusses on three main themes, namely

putting more focus higher on the R-ladder, create a system change from linear to circular, and lastly creating impact by focusing on raw materials.
The report consists of five transition agendas, of which one is the circular building economy. This transition agenda focusses on several things. Renewable construction materials should be promoted by the inclusion of biobased materials in the national environmental performance calculations. Furthermore, the use of concrete should decrease, and consequently lead to a net zero sector in 2030 (Het ministerie van Infrastructuur en Waterstaat, 2021).

Governmental parties on different authority levels have set up their own ambitions to comply with these national ambitions. Province Noord-Holland has set up the 'Actieagenda Circulaire Economie 2021-2025', in which the urgency of the national ambition is translated in ambitions for the province. They have set up different stategic and operational goals that should lead to the province being 100% circular in 2050. These goals are aimed at more circular entrepreneurship and innovation, raw materials and the provincial organization (Provincie Noord-Holland, 2021).

Also on municipal level, the national ambitions are translated into action plans. The municipality of Amsterdam wrote the strategy document 'Amsterdam Circulair 2020-2025 – Innovatie- en uitvoeringsprogramma 2020-2021' that complies with the national ambitions. They aim to work towards strengthening of the circular innovation ecosystem in a broader context of the metropole region of Amsterdam (MRA). This strategy document focusses on the role of the municipality in fostering the circular economy in three value chains, namely 'food and organic waste streams', consumption waste streams' and 'built environment' (Gemeente Amsterdam, 2020).

CE in the built environment

The circular economy documents that have been discussed, all include action plans for the transition of the built environment. The built environment (BE) is an important focus point for the transition as it is currently responsible for 40% of global CO2 emissions and uses 44% of materials globally (Metropoolregio Amsterdam, 2021). As the construction industry is a main contributor to global emissions and waste streams, a change in the construction sector is needed to stay below the maximum of 1.5 °C global heating.

The shortage on the housing market and the high emissions of the construction sector seem to lead to the Dutch housing market facing a paradoxal challenge. On the one hand, the construction sector is responsible for high emissions that need to be lowered to stay below the global warming limits. On the other hand, there is a big shortage on the Dutch housing market which has led to the ambition of the government to construct almost 900.000 new houses until 2030 (Rijksoverheid, 2021). To meet this housing demand while staying below the critical threshold of maximum 1.5 °C global heating, a new, more sustainable way of constructing is required. Constructing in timber, a biobased material, could be a possible solution to this societal challenge. Timber constructions do not only emit less CO2 than constructions from traditional materials like steel and concrete, but timber also captures CO2 which leads to a reduced atmospheric CO2 pool (de circulaire bouweconomie, 2021). Furthermore, timber constructions are suitable for prefabrication (prefab). Prefab timber elements have a short manufacturing time, which reduces labor intensity and nuisance on the construction site. By using detachable elements, the timber elements can be used in a circular way as they can be detached and reused when the building does not fit the users' demands anymore (Pakhuis de Zwijger, 2021).

Despite these advantages, currently only 2% of new houses are constructed out of timber (de circulaire bouweconomie, 2021). An example of a timber construction project can be seen in Figure 1. Housing associations, big players in the Dutch housing sector, seem to be hesitant to make the transition to timber constructions (Kuys & van den Bergh, 2019). They argue that cross laminated timer (CLT) is not yet a 'proven concept', there is not enough knowledge, and they prefer construction with materials that they know: "We won't use exotic techniques". Furthermore, arguments like affordability and lack of knowledge due to reorganization and outsourcing are put on the table. While yet a lot is unknown and some people seem to be hesitant towards the use of timber, there is also a movement of people that aim to transition towards the usage of timber constructions.

Figure 1: HAUT in Amsterdam (Pakhuis de Zwijger, 2021)

Timber construction covenant

The timber construction transition has become more clear by the covenant 'Green Deal Houtbouw, Duurzaam uit de crisis', that has been written by the MRA, which captures the ambition of metropole region Amsterdam to increase the use of timber constructions in the housing stock. As highly urban areas like the MRA put a lot of pressure on the environment, while being dependent on the construction sector, major steps can and should be made in this region. This covenant presents the aim to construct a minimum of 20% of the housing stock by timber by 2025 (Metropoolregio Amsterdam, 2021). The covenant is signed by public parties, private parties and knowledge institutes in the MRA that declare to be willing to work on the communal goal of the covenant to reduce CO2 by transitioning towards timber constructions. The different parties that signed the covenant can take up different roles in this transition process. Knowledge institutes can conduct research and provide knowledge to foster this transition, private parties can implement timber by making investments in this construction method and public parties can take a big responsibility as they can take the lead by generating example. Public parties can act upon the public law by providing the right regulations and incentives for this transition to happen as well as the private law by taking a commissioning role by commissioning timber construction projects.

As the municipality of Amsterdam is one of the most important governmental parties that have signed the covenant, their role in living up to the ambitions of the covenant is important. In addition to their governmental powers, they are a major municipality with prestige that can set as an example to other municipalities. It is therefore important for the municipality of Amsterdam to have a good understanding on how to make use of the governmental authority to foster the timber transition.

The Planbureau voor de Leefomgeving (PBL) recently published the ICER report (Integrale Circulaire Economie Rapportage) in which they stated that more pressure and coercion ('drang en dwang') is needed to establish a transition towards a circular economy. A tool for policymakers to establish change is by implementing policy instruments. To be able to understand what is meant by this statement, a defintion of a policy instrument is presented. An instrument can be defined as:

> *"a tool or device", "a way of achieving or causing something" (Cambridge Dictionary, 2021b)*

A tool can be defined as:

> *"a set of ideas or a plan of what to do in particular situations that has been agreed to officially by a group of people, a business organization, a government, or a political party" (Cambridge Dictionary, 2021a)*

According to these definitions, in this context, a policy instrument can be considered:

> *A tool to achieve a set of ideas or a plan that has been agreed upon by a governmental or political party.*

Thus, according to the PBL, to establish change, it is argued that besides the 'soft' measures that have mainly been implemented up until now, 'hard' measures that have been missing in this transition are needed to make steps (Hanemaaijer et al., 2021). '

Looking from this perspective to the timber transition in Amsterdam, it is implied that governmental parties should implement 'harder' measures to foster the transition to a timber construction sector in Amsterdam. However, not yet much is known about the policy instruments that can be implemented to foster the timber construction transition. The covenant 'Green Deal Houtbouw' is aimed to shape the playing field for this transition to happen as it has brought together and aligned a group of frontrunners that is willing to put effort in this transition. However, the covenant is just a first step in this transition as timber is not yet an established construction material and, therefore, much more is needed for this transition to develop.

1.2 Problem statement

As stated in the context, sustainability transitions are required for global temperatures to stay below the critical threshold of 1.5 °C global warming. As a response to the global Paris Agreement, the National state of the Netherlands has set up a national ambition document and strategy. In line with these national ambitions, provincial and municipal level ambitions have been set to promote a CE. A recurring theme within these circular ambition documents is the BE, as this sector has a high environmental impact. A transition to a (more) circular BE includes the use of biobased materials like timber. In line with the circular ambitions, the MRA has therefore set up a covenant to promote the transition to timber constructions.

Two exploratory interviews were conducted to understand the context of the research and demarcate the scope of the study. These interviews were open conversations rather than structured interviews. Based on these explorative interviews with a knowledge expert on the timber transition in general , and a knowledge expert on the timber transition in MRA , some barriers for the timber transition to take place have been found. These barriers are elaborated on shortly to understand the problem statement of this research.

Following E1[1] and E2[2], the current policies, specifically regulations, are not incentivizing market parties to initiate timber constructions. They argue that the municipality of Amsterdam has the possibility to impose requirements that favor timber constructions when they organize a tender. However, these kinds of requirements are still rare in such tenders. Furthermore, the municipal department of

[1]Explorative interview with E1 (See Appendix A3) (23-11-2021) about the barriers for the transition for a timber building company

[2]Explorative interview with E2 (See appendix A3) (7-12-2021) about the general barriers and implications for

urban development is merely acquainted with timber constructions. The physical dimensions of timber constructions are different than traditional constructions and therefore the dimensions of the plot can differ. However, lack of knowledge causes the urban developers to not consider these different dimensions which makes it difficult to design timber constructions on plots that are originally designed for traditional constructions. Also, the ground and development department of the municipality is relatively conservative and therefore stays behind in the timber construction transition. This department writes tenders and makes the lease contracts. However, due to lack of knowledge, they do not implement incentives in their policies to build with timber on the different plots that they have at their disposal (E1, 2021; E2, 2021).

E1 (2021) and E2 (2021) furthermore argue that one of the biggest barriers relating to the timber transition is a lack of knowledge. There are many stakeholders, both at demand and supply side, that have little knowledge and unknown makes unloved. Lack of knowledge among different stakeholders in the project process hinders the transition. For example, esthetical committees often lack knowledge about the possibilities of timber constructions and therefore do not approve designs. Routine and knowledge must be built up to make the transition successful. An example of knowledge distribution is a special organization that visits quality insurance commissions to inform them about timber constructions so they will be more likely to approve timber constructions in the future. However, steps must be made to achieve a broader public, for example also a change should be achieved on the demand side. The municipality can play a major role in this culture change and knowledge distribution.

The maze of existing policies (and their instruments) as well as lack of knowledge among the many different stakeholders of timber projects can make it difficult for policymakers and frontrunners of a transition to find their way in shaping such transition. Köhler et al. (2019) argues that public parties should play a central role in sustainability transitions as they are responsible for the normative directionality, while non-governmental parties have limited impetus to change the social good. Therefore, this research focusses on the policy instruments that should be implemented by governmental parties to foster a sustainability transition.

While the main responsibility lies on public parties, literature lacks in presenting a concrete explanation about the different policies that should be implemented for transitions to happen, and especially the timber construction transition. Also the action perspective is often underexposed: the how, why and when of the implementation of policy instruments should be elaborated on more for governmental stakeholders, to better understand how they can shape such a transition. This research is demarcated by the timber construction transition in the MRA as object of the transition, the stakeholders that have signed the covenant as involved stakeholders and policy instruments as a tool to foster the timber construction transition.

1.3 Research goals and objectives

As stated above, the goal of this research is to provide a research on the policy instruments that should be implemented by governmental parties to foster the timber transition in the MRA. To achieve this goal, an analysis of the involved stakeholders within this transition, the effects of the implemented policy instruments and an analysis of the policy instruments that are necessary for this transition, are conducted. In the first place, a literature review is conducted to gain a deeper understanding of the concepts that are related to this research and form the basis for the theoretical framework (TF). The specific objectives of this research are:

- Gain a deeper understanding of the different stakeholders that are involved in the timber transition in the MRA
- Provide an analysis of the covenant 'Green Deal Houtbouw' that is based on the analytical framework
- Identify and analyse the effects of the implemented policy instruments in relation to the timber transition / covenant.
- Identify and analyse the instruments that are necessary within the timber transition / covenant
- Provide a proposal on how a combination of policy instruments can foster the timber transition in the MRA
- Provide recommendations for policymakers on policy instruments for sustainability transitions, for policymakers for the timber transition in specific, for the municipality of Amsterdam and for further research.

1.4 Deliverables

The outcome of this research provides a proposal on how the different (combination of) policy instruments can foster the timber transition within the MRA. The following deliverables are provided in this research:

- A document analysis of the covenant 'Green Deal Houtbouw' (MRA, 2021), it demarcates this research as it is the policy mix proposal for the timber transition in the MRA.
- A stakeholder analysis of both the governmental and non-governmental stakeholders that have signed the covenant 'Green Deal Houtbouw'. This stakeholder analysis contributes to an assessment of the political feasibility and the implementation of ideas and possible solutions.
- Results from interviews with governmental stakeholders to better understand the different policy instruments that can be implemented on different authority levels to foster a transition.
- Results from interviews with non-governmental stakeholders to better understand the effect of the different policy instruments that are implemented, and the policy instruments that are required, within the timber transition in the MRA.
- Results from an expert session that aim to validate the findings and therefore contribute to the validity of the research
- Concrete findings that give more meaning to the analytical findings to make the findings more understandable and provide valuable information to governmental stakeholders. This can be examples of specific policy instruments or key takeaways from the preceding analytical data.

2. Research questions

In this chapter, the main research question that has followed from the problem statement is presented. Furthermore, the different sub-questions that are used to answer the main research question are introduced. Both theoretical and empirical research is used to answer the different sub-questions. The reasoning and importance of the research questions is expressed by the societal and scientific relevance of this research. At the end of this chapter, the structure of the whole report is presented.

2.1 Main research question

The main research question of this research is:

'How can a combination of policy instruments foster the transition to timber housing constructions in the MRA?'

The theoretical research model that illustrates the research question is presented in Figure 2.

2.2 Sub questions

To answer this main research question, sub-questions are answered to make the research consistently structured.

SQ1. What are the most relevant characteristics of a circular built environment?

SQ2. What is the role of timber constructions in advancing the transition towards a circular built environment?

SQ3. What policy instruments can foster sustainability transitions?

SQ4. Who are the most important stakeholders that are actively involved in the transition towards timber constructions in the MRA?

SQ5. Which policy instruments are necessary for an effective timber transition?

SQ6. What is the effect of the current policies on the transition towards timber constructions?

2.3 Conceptual model

The conceptual research framework (Figure 3) shows how the different sub questions relate to the conceptual model and how the results of the different sub questions provide in answering the

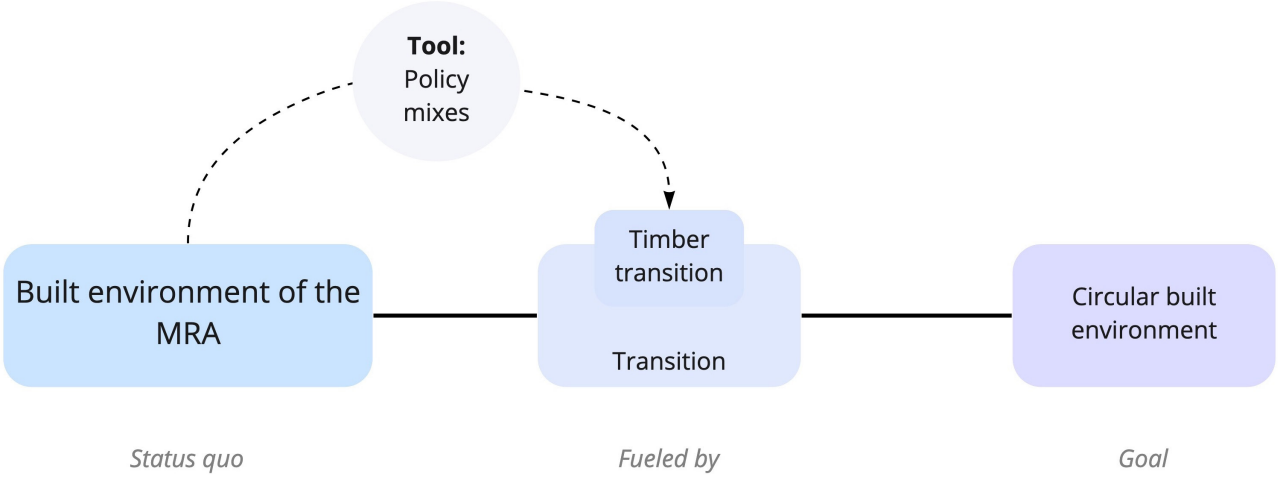


Figure 2: Theoretical research model

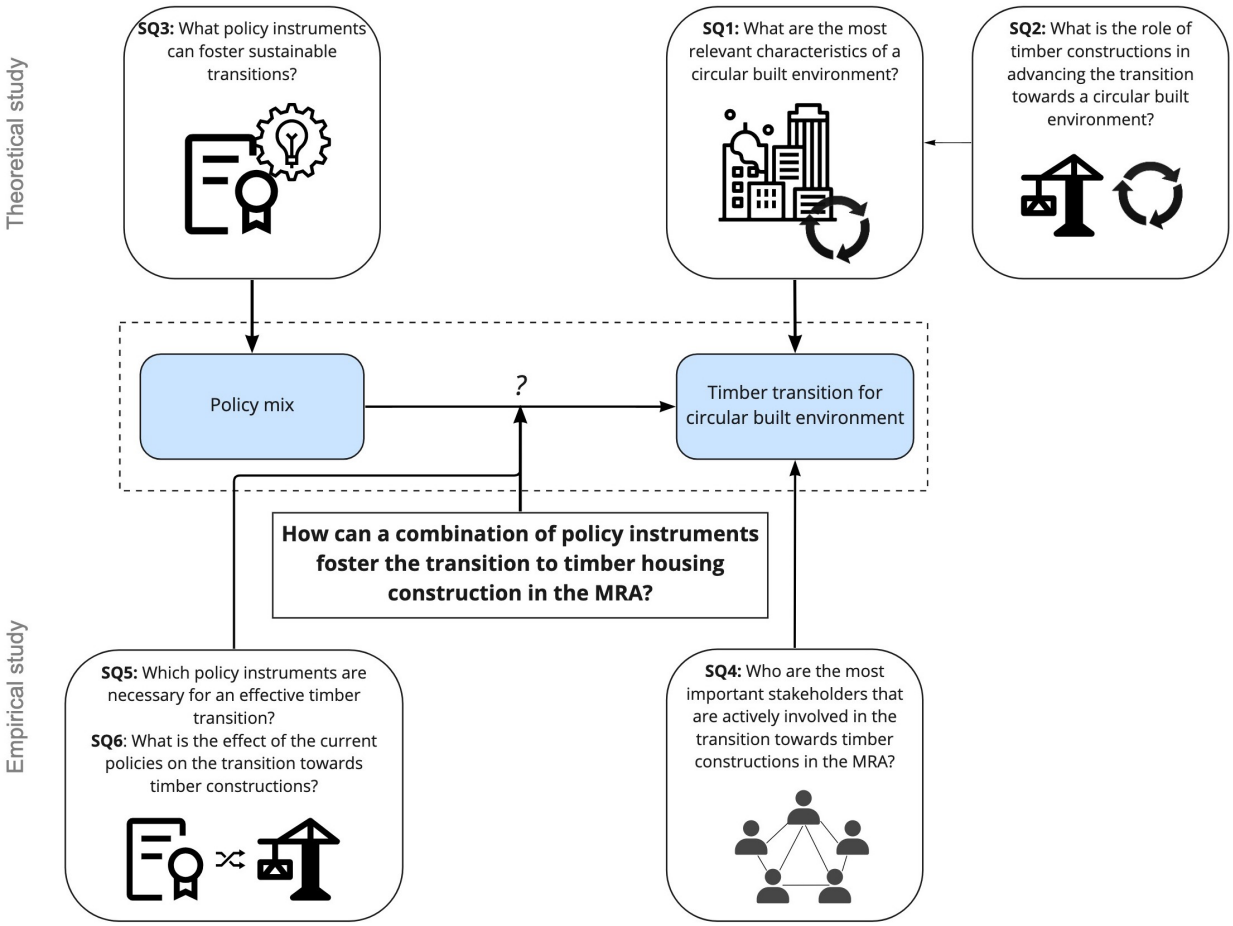


Figure 3: Conceptual research framework

main research question. The first three research questions are answered by literature, while the last three questions are answered by empirical research.

2.4 Relevance

2.4.1 Societal relevance

To comply to the Paris Agreement and the circular ambition, sustainability transitions should be accelerated in multiple sectors. As sustainability transitions are a public good, private parties will most likely not take responsibility for owning problems which makes public parties responsible for the normative directionality and the promotion of these transitions. Public parties can take their responsibility by the implementation of different instruments that are within their power (Köhler et al., 2019). The role of public, governing parties can be broad as many different instruments can be used. However, little is yet known about the implementation of different policy instruments to promote sustainability transitions, as well as the action perspective of these policy instruments. The action perspective describes the why, how and when of the implementation of the policy instruments.

This research contributes to policymakers' understanding of the implementation of instruments to foster sustainability transitions. It specifically focusses on the transition of timber constructions in the MRA, as timber constructions are important in the transition to a circular built environment, and the 'Green Deal Houtbouw' from the MRA demarcates the timber transition in the Netherlands. This research provides recommendations on the implementation of instruments for the timber transition, which are generated based on the perspective of governmental and non-governmental stakeholders. As this research is spatially demarcated by the MRA, the results provide a deeper understanding on the perceived effect (by the market) of the current policies, as well as the perceived necessary instruments (by the market), which is valuable for governmental stakeholders in the MRA. Research on the

necessary policy instruments for the timber transition is furthermore valuable in achieving the aims that are set out by the covenant 'Green Deal Houtbouw'. When possible, the results are generalized so they can be applied to other urban areas in the Netherlands as well. However, specific policy instruments might not always be generalizable.

The results furthermore contribute to the development of the tool 'CircuLaw' that the municipality of Amsterdam is currently developing. This tool provides policymakers on different governmental levels with a collection of the possible juridical measures that can be implemented when they want to start a circular transition. However, knowledge is lacking on the action perspective of these measures: how, why, and when should a policy instrument be implemented? This research contributes to the development of this action perspective by elaborating how different policy instruments can foster the timber transition in the MRA. Furthermore, the operationalization of the analytical framework that is used in this research can provide a theoretical background for the toolmakers and provide them with guidelines on the design of policies for sustainability transitions, which can be applied to many different cases.

Furthermore, the operationalization of the analytical framework that is developed during this study can be helpful for policymakers to develop a combination of policy instruments that successfully foster a sustainability transition.

2.4.2 Scientific relevance

This research has a scientific relevance by contributing to the implementation of policy instruments for sustainability transitions for the built environment. This research contributes to research on the relation of a circular economy to the built environment, innovation policies, policy mixes and policy instruments for transitions. The knowledge that is gained in this research is useful for other sustainable transitions and policymaking for sustainable transitions, and therefore adds to the scientific knowledge of sustainability transitions and innovation policies combined. Many studies have been conducted on transitions, however the role of policy instruments during these transitions is not sufficiently addressed to date. Especially the role and implementation of policy instruments for sustainability transitions within the context of the built environment is currently underexposed and a relatively new subject in literature. This research also aligns with the aim of the Circular Built Environment Hub (CBE Hub) at the Faculty of Architecture and the Built Environment of TU Delft, as it provides new insights to the relation of the circular economy, the built environment of cities, and their governance. Furthermore, this research touches upon the why, how, and when of the implementation of policy instruments for the transition for timber constructions by operationalizing theories on policy mixes for sustainability transitions.

2.5 Structure of the report

In the following part of this research, a literature review is presented to gain a better understanding of the relevant literature. This study results in the TF that is presented at the end of the chapter. This TF presents theories that are relevant for this research, which enable to analyze and interpret the data and answer the research questions. Therefore, an analytical framework (AF) and operationalization of this AF is presented. At the end of this part, the methods for the empirical study will be presented. The second part of this research presents the results from the empirical study. The third part of this research presents the outcomes of the empirical research, which consists of a stakeholder analysis, a document analysis, and the results of the interview data. The last part of this research consists of a synthesis of this research, which consists of an interpretation and discussion of the data, presents a conclusion which gives answer to the research questions, addresses the recommendations, and finalizes with a reflection of the research process and planning.

Figure 4 presents an overview of the structure of the report.

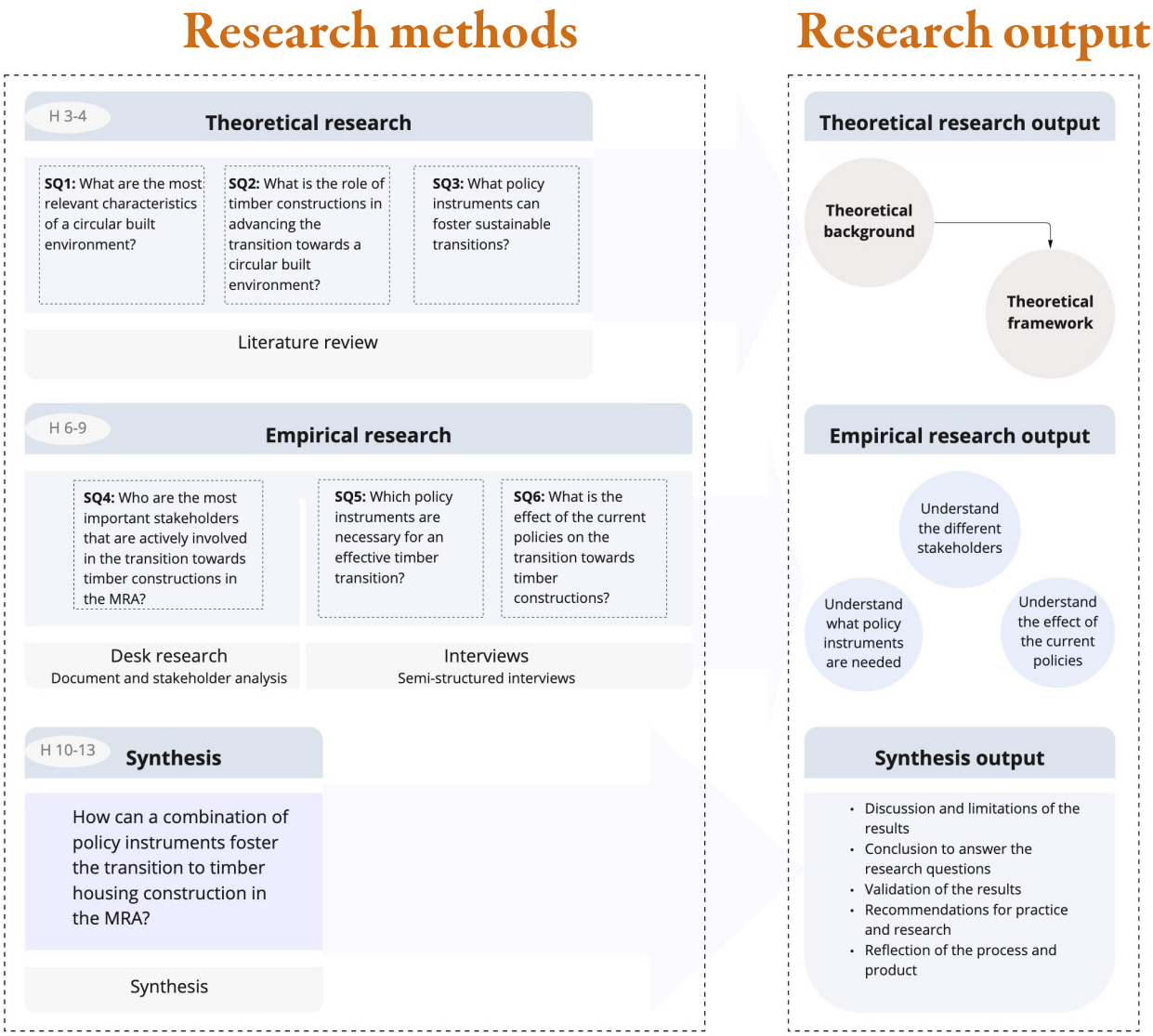


Figure 4: Overview of the structure of the report

PART II
THEORETICAL STUDY

In this part, the theoretical background that is required to understand the remaining research is presented. This part starts with a literature review that presents some important concepts, after which the theoretical framework elaborates on the theories that are used within this research. The theoretical framework ends with the analytical framework and its operationalization, which is the basis for the empirical study.

3. Literature review

The literature review presents an overview of relevant theories and concepts on a circular built environment (CBE), timber constructions and their contribution to a CBE and policy instruments. These definitions are helpful in understanding the remaining research.

The literature review has been conducted using an inductive approach, in which observed data leads to a theory about the phenomenon of interest (Bryman, 2012). Inductive research searches for systematic patterns that can be generalized (Blaikie & Priest, 2000). Interpretive research designs (inductive), like this literature review, gives an in-depth insight in the concepts of the research subject. As this type of study generates a theory as outcome of the study, the research should not be limited in finding implications and not-expected issues. Therefore, a narrative review approach is most likely to be used for an interpretative epistemology (Bryman, 2012). In this narrative research approach, the process of the research and the scope of the topic have not been predefined. To be able to collect relevant literature that exists about the topics, snowballing was used. In snowballing sampling, data that is relevant for the research questions is collected, after which other data that is suggested by the initial data is used. Multiple sources are used until saturation of the topic has been reached. When using this technique, it is important to not be biased and include all sources that seem to be relevant for the research (Bryman, 2012). The relevant papers have been selected based on citation tracking (forward snowballing) and selecting referenced papers (backward snowballing) (Wohlin, 2014).

Sub-question 1, 2 and 3 are answered with the findings of the literature review. Table 1 shows how the different parts of this literature review are used to answer sub-question 1, 2 and 3.

3.1 Circular built environment

Due to the technologies that make us capable of creating a BE, cities have developed partially as clusters of our BE. Cities account for 81% of the total global consumption and are responsible for 75% of greenhouse gas emissions thus cities contribute and are affected by climate change. However, not only climate change effects impact cities, global impacts like pandemics, conflicts, migration, and globalization have noticeable

Table 1: Methods and operationalization per sub-question for the theoretical study

RQ: How can a combination of policy instruments foster the transition to timber housing construction in the MRA?

Sub-questions	Method	Operationalization
SQ1: What are the most relevant characteristics of a circular built environment?	• Literature review	Snowballing to collect relevant literature on the built environment in relation to a circular economy.
SQ2: What is the role of timber constructions in advancing the transition towards a circular built environment?	• Literature review	Snowballing to collect relevant literature on the implementation of timber constructions and its' relation to the built environment as contribution the a circular economy.
SQ3: What policy instruments can foster sustainable transitions?	• Literature review	Snowballing to collect relevant literature on different types of policy instruments for sustainable transitions.

consequences on the urban ecosystems (Williams, 2021).

The transition of cities to become more sustainable and resilient and less reliant on global impacts is therefore urgent. Cities are complex sociotechnical systems that consist of many elements, as can be seen in Figure 8 (p. 32). Therefore, it is important to analyze how the different elements that shape these cities are responsible for its vulnerability and unsustainability. One of the main contributors to the current urban problems is the BE, which is an important element of cities, and the scope of this research. The BE is responsible for 40% of global CO2 emissions and uses 44% of materials globally (Metropoolregio Amsterdam, 2021). As the BE has a major contribution to the environmental impacts on our planet, significant environmental impact reductions can be made by changes in the system. The transition of the BE is therefore important in the urban sustainability transition.

A way to proceed with such transition in the BE is circular city development. Williams (2021) claims that adaptive capacity of both the urban community and its ST-system is required to ensure that cities become resource efficient, ecologically regenerative, and resilient. To make this transition possible, a circular approach is required. It is important to understand how the BE as a physical form of the cities play a role in the sustainability transition. The city can be seen as the physical context in which transitions take place, while the BE within a city is one of the objects of transition. While the city is an intangible, conceptualized part of an environment that is difficult to change directly, the BE as built object, is more adaptable to change and can be influenced by actors more easily (Nielsen & Farrelly, 2019). Therefore, the focus of this study is on the transition of the BE within cities, to be more specific, the circular transition of the BE. Yet, what does a circular BE entail? In a circular system, the focus shifts from a linear system in which resources are thought as being infinitely available towards the reuse, recycling and recovery of resources to make the system closed-looped, thus circular (Williams, 2021). The principles of a circular economy are grounded in an improved management of resources (Pomponi & Moncaster, 2017). As the construction and demolition of the building sector consists mainly of components that are no longer needed after the end-of life, they can be considered waste and are responsible for the acceleration of the devastation of ecosystems. The European Union therefore shifted an interest in the resources from waste materials from the construction sector (Munaro et al., 2020). While the transition towards a CE is mainly focused on the production of short-term products, the BE consists of many different components that have different, and often long life-spans. Therefore, the current average lifespan of building component is relatively short, as they fail to be used in a circular way, as a result, buildings are often demolished when they do not meet the needs of the users anymore. The construction industry lacks incentive to design for reuse (Munaro et al., 2020; Pomponi & Moncaster, 2017).This makes the transition towards a circular BE complex. One can consider a circular building as a building that is:

> *"...designed, planned, built, operated, maintained, and deconstructed in a manner consistent with CE principles." (Pomponi & Moncaster (2017, p. 711)*

However, one should be careful when applying the principles of a CE to a BE, due to its long lifetime and composition of different elements within buildings. Munaro et al. (2020) argue that research on the CE practices in the BE is still understudied. Literature mainly presents the different concepts in relation to each other. For example, the concept of CE can be applied to multiple levels, when using a systemic approach to analyse the BE: the micro-level, which indicates building components, the meso-level, which indicates buildings and the macro-level, which indicates urban agglomerates. From a CE perspective, research to the BE should be mainly focused on the macro-level, as this touches upon most research disciplines (Pomponi & Moncaster, 2017). However, while an analysis

of the whole BE requires a focus on the macro-level when using a systemic approach, Geels (2004) argues that the focus of analysis within transitions research should be on the meso-level when using a systemic approach, as this level indicates buildings. Industrial and modular buildings, which are units on the meso-level, have the possibility to reduce the construction costs by 50% compared to temporary construction methods. This would also mean a reduction in material usage, both on the short and long term (Munaro et al., 2020).

When conceptualizing the BE as an object of transition rather than the exogenous landscape of a transition, the spatial characteristics of this transition can aid in the implementation of sustainable transition strategies, which is elaborated on in the next paragraph. However, the challenge of a transition with the BE as object of change is the multifunctionality of the system. Transition studies have been mainly focused on one sectoral system, such as energy systems or urban transport. However, the BE consists of many different sectoral systems, which influence, and are influenced by dynamics in the BE. During a transition, the rules, routines and institutions of all these different sectors should be integrated to come to a holistic transition of the BE. Urban actors can play a major role in the transition of the BE as they have to work together to integrate the different sectors in one outcome (Nielsen & Farrelly, 2019). Bringing together the multiplicity of this BE during a transition requires a holistic perspective in which the different dimensions of a transition are considered. Pomponi & Moncaster (2017) define a framework that consists of six research dimensions that are indicated by literature as equally important in the aim to meet sustainability goals. These dimensions are environmental, technological, economic, societal, governmental, and behavioral. They further indicate that research into the role of policy measures to promote circularity should be conducted, as this is missing in the current research on circularity. Murano et al. (2020) agrees on this by arguing that more support from public agencies, regulation and legislation to promote the transition to a circular use of buildings is crucial for the transition. They furthermore conclude that a CE strategy and CE tools for the BE should be adopted mainly during the early design stages, as this stage is most crucial for the performance during the lifetime of a building.

Ness & Xing (2017) present a conceptual model for a resource-efficient built environment, that is driven by some key strategies. This model aims to bring together many different dimensions and sectors to eventually promote a CE within the BE. These three strategies are systems innovation, performance management and resource efficiency. They can be used to identify the intended synergies between key elements in urban systems and will lead to the desired resource-efficient BE by using less input than the generated output. They are therefore supposed to lead to a resource-efficient built environment. Networks of actors, resources and instruments are the key elements within a ST-system. Taking a system approach can lead to synergies between the different actors and their CE goals in the BE (Ness & Xing, 2017).

SQ1: What are the most relevant characteristics of a circular built environment?

The BE is an important element of cities as ST-systems. As the BE is responsible for 40% of global CO2 emissions and uses 44% of materials globally, significant environmental impact reductions can be made by changes in the BE. The BE is, compared to cities, a more tangible object that, arguably, can be influenced by actors more easily than cities. A definition of a circular built environment is still lacking in literature, however, literature presents different approaches in which the BE and the CE are related to each other.

A circular building is a building that is designed, planned, built, operated, maintained, and deconstructed in a manner consistent with CE principles.

These principles can be applied to the micro, meso and macro-level of systems and elements. While the BE can be categorized in the macro-level due to its complexity and consistency of elements within many different sectoral systems, transition literature focusses the analysis of transition research on the meso-level, which is more tangible. During a transition, the rules, routines and institutions of these different sectors should be integrated to come to a holistic transition of the BE. This requires integration of the different sectors by the urban actors that operate in them. There are different dimensions that are important to transition towards a sustainable BE, namely the environmental, technological, economic, societal, governmental, and behavioral dimension. Furthermore, strategies that are supposed to lead to a resource-efficient BE are systems innovation, performance management and resource efficiency. These strategies, and thus a CBE, should be achieved by setting up networks of actors, resources and instruments.

3.1.1 Timber constructions

3.1.1.1 Application of timber in constructions

While timber is an ancient building material, the application of this material has been developed and improved highly over time and since the mid 1900s, the first industrial and serial timber wood frame projects came into existing. Currently, there are many different types of timber construction systems in which timber is used as bearing structure. All these timber construction types can be applied in an industrial and/or prefab manner. The most important types are cross laminated timber (CLT) and timber framing constructions (Houtskeletbouw, HSB) (Luijkx et al., 2021). According to van der Lugt (2021), the high-quality performances of the mass timber construction systems can be used to replace abiotic materials in the bearing construction. As mass timber construction systems have a predictable behavior in case of a fire, the fire resistance can easily be achieved.

Both types (CLT and HSB) can be used for modular constructions. Besides these construction types, timber can also be applied as laminating technique, for which laminated veneer lumber (LVL) and laminated wood (glulam) can be used (Luijkx et al., 2021). The different techniques will be elaborated on:

- CLT: CLT consists of three or more layers of cross-glued wood slats that form massive constructive elements. These panels can be up to 20 meters long and 3 meters broad, with a thickness of 500 mm, which gives them a high strength, stability and stifness. The inside of the panels can either be exposed or finished with plasterboards. When using CLT, extra layers should be included to the construction to add thermal- and noise insulation, as well as fire resistance (Luijkx et al., 2021).
- HBS: HBS can be applied to constructions up to 6 floor layers. It is composed of spuce/pine wood beams that can be up to 5 meters long. The beams can either be bearing or non-bearing. As the beams are slim, the construction is light weight and does not take up a large amount of space, in comparison to heavier construction methods like concrete. This construction method should be used in combination with cladding the different types of insulation (Luijkx et al., 2021).
- Modular constructions: Modular constructions and premade modules that are complete housing units that can be assembled on site against or on top of each other. This construction method reduces the on-site construction period, as well as the design period, as the modules are ready made designs. However, this limits the freedom for design. The modules can consist of both CLT and HSB, but can also be combined with other construction methods (hybrid) insulation (Luijkx et al., 2021).
- Glulam: Glulam beams consist of wooden slats that are glued in parallel, rather than crosswise (like CLT). Glulam is mainly used for wooden trusses up to 30 meters span width. It can be combined with HBS and CLT (Luijkx et al., 2021).
- LVL: LVL consists of multiple thin veneer layers of pine/spruce wood with a thickness of a few mm that are glued in parallel or crosswise.

The LVL-elements can be used for floors and roofs and are able to realize large spans up until 20 meters (Luijkx et al., 2021).

3.1.1.2 Contribution to circular built environment

As argued before, the building industry is responsible for major emission rates. Currently, cement production accounts for 8% of global CO2 emissions (ARUP, 2019). Moreover, the (linear) construction industry is a major contributor of greenhouse gasses. The Betonakkoord, signed by many Dutch parties, tries to contribute to this decrease by reducing 30% of CO2, coming from the concrete sector, by 2030 (van Veldhoven et al., 2018). As the Dutch government aims to become circular by 2050 (Rijksoverheid, n.d.), this reduction will by far not be enough to become completely circular. Therefore, transitioning to timber constructions as main construction material for the housing market is claimed to be animportant step to reach this goal. Timber is a renewable material that removes CO2 from the atmosphere, and when burned for biomass energy after end-of-life, it results in net-zero carbon emissions (ARUP, 2019; Vermeulen et al., 2020). When the timber is reused for other purposes after the end-of-life for its first lifetime, the captured CO2 will not be released, which makes the usage of timber materials even more attractive. Timber constructions can therefore contribute to CBE transition in two ways. Firstly, timber can be implemented as a circular construction method, secondly, the main advantage of timber as construction material is that it captures CO2 and is renewable as it can be regrown in forests. Furthermore, the production process of timber can have a high efficiency and can be designed for durability. According to the ReSOLVE framework, it contributes to the CE by different actions: Regenerate, Share, Optimise, Loop and Exchange (MacArthur et al., 2015).
Timber constructions need to comply to FSC-, PEFC- STIP- or Keurhout certificates, to secure sustainable management of forests (Luijkx et al., 2021), this ensures that the forests are protected and not more wood is felled than grown in the forests. Timber usage has a major effect on measurement tools like BREEAM (the Building Research Establishment Environmental Assessment Method) and LEED (Leadership in Energy and Environmental Design), that positively recognize the embodied CO2 benefits of timber within their calculations. BREEAM is an environmental, social and economic assessment method for assets in the built environment (BREEAM, 2022). LEED is a global certification that is based on the assessment of multiple sustainability achievements (USGBC, 2022).
However, in the Netherlands, the embodied CO2 is not included in the measurements yet, which sometimes even leads to timber constructions scoring lower on environmental assessments than traditional constructions (Pakhuis de Zwijger, 2021).

3.1.1.3 Other benefits of timber constructions

Besides the contribution of timber to a circular built environment, the implementation of timber also brings along other benefits. Firstly, timber does not only emit less CO2 than traditional construction materials, but also emits less nitrogen. The light weight of timber combined with its high strength furthermore make it one of the most efficient construction materials that exists and as it is a flexible material, it is even capable to absorb shocks from earthquakes. The light weight of timber also makes it suitable for prefab, which leads to less emissions during construction and quicker and better assemblage of the elements. This lowers the nuisance on site for the local residents and can contribute to a quick supply of the high housing demand (van der Lugt, 2021). This industrial application of timber also leads to less nitrogen emissions, as less equipment and construction on site is needed. Secondly, a benefit of timber constructions is the healthy indoor climate that it generates. The perceived comfort and wellbeing of spaces increases by the use of timber, and it generates

a comfortable and constant indoor climate. Wood absorbs moist from the air, based on the humidity, which leads to a pleasant indoor climate regarding the humidity level. Furthermore, it decreases the stress level of the end-users as the natural materials leads to higher productivity and more wellbeing. The increase of regulated timber production can also lead to a decrease of deforestation of tropical forests. As the use of timber is regulated and certified in the Neteherlands, the business case for sustainable forestry increases which will lower the demand for uncertified tropical timber (van der Lugt, 2021).

3.1.1.4 History

Timber has been a widely used construction material all throughout history (ARUP, 2019). In the classical period, the Romans used wood for their bridges and apartment blocks, and in the Middle Ages, wood constructions made a revival for urban buildings. During the 16th century, wood became scarcer as it was used for other purposes as well. However, during the 18th century, the developing iron and steel production replaced wood as a construction material due to its strong and resistant properties. While in Europe, the transition to iron and steel had been made, in the USA this happened around 200 years later, in 1850. Around this period, concrete entered the market in the USA and took over the construction market. Fire safety regulations and durability issues further restricted the use of timber as a construction material in some countries and led to a certain image of timber constructions. The potential of timber structures nowadays therefore needs to be assessed carefully. This questionable image of timber is further fed by the idea that timber leads to deforestation. However, sustainable forestry is ensured in Europe through national regulations. Furthermore, tropical deforestation has other reasons then the production of timber for the construction sector. Using more tropical timber would even lead to more sustainable tropical forestry, as the production of timber is always certified, while the deforestation of tropical wood by other causes is often not certified and regulated (AMS institute, 2021).

3.1.1.5 Housing production

The total housing production in 2017 consisted of 62.000 new houses, of which only 2.360 have been constructed with a timber construction (Figure 5). This small amount is mainly realized in private commissioning by small contractors (Oldenburger & van den Briel, 2020). While the use of timber constructions and the interest in timber by major developers has increased in the past years, the amount of timber constructions compared to traditional construction methods is still relatively low.

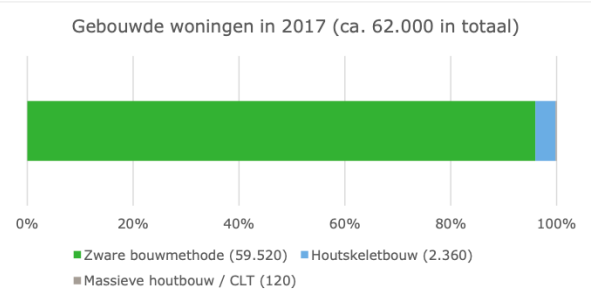


Figure 5: Total housing production and production of timber houses in 2017 (Oldenburger et al., 2020)

One dwelling that is constructed by timber requires approximately 30m3 wood. The increase of houses constructed by timber therefore requires a high availability of materials. In Europe, 38% of the surface area consists of forests, of which more than half is certified wood, which comes down to approximately 35 billion m3 wood that is suitable for timber constructions. Furthermore, the new Green Deal of the EU has ambitious plans for the further increase of forests. The timber that is, and will be, generated by these forests will be sufficient to supply for the future demand for timber by the Dutch housing market, which is 4 million m3 of timber. The current timber supply is even enough to satisfy the current European housing market demand for timber. However, the external demand for European timber and the future expected growth requires the European forest capacity to become more climate resistant and growth further in a sustainable manner. However, this will lead to resilient forests and increase the European CO2

capture storage, which can be considered a positive side effect (van der Lugt, 2021).

3.1.1.6 Costs

Currently, the average costs for timber construction are often higher than traditional construction, as it is a relatively new method and processes are not yet standardized, as opposed to other contemporary construction methods, that are standardized and optimized during years of experience (Vermeulen et al., 2020). According to Luijkx et al. (2021), especially CLT projects have higher costs than traditional projects. However, the shorter construction period of timber constructions can bring along financial benefits. Van der Lugt (2021) furthermore argues that the high prices for timber can partly be explained by the pandemic, as this led to a low production capacity and a higher demand for timber by individuals. The prices are already lowered and will most likely stabilize in 2022.

While timber is currently often more expensive than traditional materials, scaling up the use of timber as construction material will lead to lower costs. It can already be seen that constructions with timber modules are cheaper than timber on-site constructions, as the light materials decrease transportation costs and the prefab methods lead to a decreased construction time (Luijkx et al., 2021, van der Lugt, 2021). Furthermore, including the negative environmental externalities in project calculations will lead to traditional constructions being way more costly. According to Luijkx (2021) building with timber will not change the maintenance costs, as these are based on the facade materials, window frames and technical installations. What is more, timber constructions will have a higher residual value as the elements are easily reusable. Vermeulen (2020) claims that due to the growing supply of timber construction, its further optimization of the production processes and the increasing price of traditional construction, a cost reduction of 30% in 10 years is realistic.

3.1.1.7 Structural performance, laws and regulations

Like every construction, timber constructions must comply with applicable laws and regulations (Luijkx et al., 2021). Fire risks must be taken into consideration and the construction must be built fire-resistant. While some might think that a timber construction is flammable, there are good methods to comply with the fire regulations. Also energy performances need to be met, in specific the BENG-requirements. BENG (bijna energieneutrale gebouwen) requirements are energy requirements that all new buildings in the Netherlands have to comply to since 2021 (Rijksdienst voor Ondernemend Nederland, 2022). Timber constructions seem to be able to comply with these regulations. Furthermore, regulations regarding living comfort should be met. As timber constructions are lightweight and have a low mass, they have a low heat capacity and heat up and cool down quickly. This should be taken into consideration in the design phase. Also airtightness, humidity management and noise insulation should be considered to comply to regulations. Both ground bound housing and apartments can be constructed by different types of timber constructions. However, in any case, the building should comply to the laws and regulations. HBS can generally be used for buildings up to six floors, while CLT can be used for high-rise buildings. Timber construction is suitable for topping up existing buildings (Luijkx et al., 2021).

The characteristics of the materials will define the construction details in the design phase. However, using CLT will lead to the need of extra materials to comply to the required performances. This can also lead to over dimensioning of timber constructions compared to traditional constructions.

SQ2: What is the role of timber constructions in advancing the transition towards a circular built environment?

As argued before, the building industry is responsible for high emissions and a transition towards a CBE can foster a general transition towards a circular economy. The temporary construction methods like concrete and steel, that are generally used for the BE, produce many waste streams and the production of concrete has high CO2 emissions. Furthermore, buildings within the current BE are generally designed for its current use and are demolished when they do not fulfill the users' needs anymore. However, many elements within the built environment have a longer lifetime than is currently made use of. A transition towards a different construction method is required for the BE to contribute to the CE. Timber is a renewable material that captures CO2 from the atmosphere and the production of timber emits way less CO2 than the production of materials like steel or concrete. It does not only capture CO2, it also emits less CO2 which makes it a good alternative for other construction materials like steel or concrete regarding its environmental effects. Besides, it has a lot of benefits like lower nitrogen emission due to less on-site construction, quicker assemblage of housing, and the indoor climate is perceived to be more comfortable. Furthermore, timber is specifically useful for the design of reusable buildings. The timber elements can easily be detached and used in a demountable manner. Therefore, it contributes to the reuse of materials and reduces the use of finite natural resources.

To conclude, timber constructions contribute to a circular built environment as in the first place, this renewable material leads to reduced CO2 emissions compared to materials like steel and concrete (enhance natural capital), and arguably to the optimization of global resources as timber replaces the use of finite resources by renewable resources.

3.2 Policy instruments

As this research investigates the possible policy instruments and mixes that can be implemented in the transition towards timber constructions, this section gives an introduction on what policy instruments are. Different policy instrument types and classification methods for policy instruments are presented, as it is crucial to understand the different types of policy instruments to be able to design policy mixes. At the end of this chapter, sub-question 3 is answered.

SQ3: What policy instruments can foster sustainability transitions?

Following Colander & Kupers (2014) in their work on complexity and public policy making processes, the relation between the state and the market can be described as symbiotic and coevolving. Rather than looking at the market and government as two opposing entities, they can be seen as complementary. While a government has the strong position to exercise power, controlling the market to do things might not always be the best solution. The real strength of a governmental party lays in encouraging the market to exhibit a certain behavior. The government should create a set of norms, rules and laws to set up a competitive environment in which not one party takes full control. A government structure in which more top-down governance, rather than bottom-up market solutions are implemented, is created by a bottom-up approach in which the society has chosen for more top-down regulation. In any case, the government has an important and special role as they have the power to influence the rules that define the system. The role of the government can be seen as the guideline for market action. Governments have the ability to open up spaces in which market individuals can guide their own actions. However, total control by the government is utopian in complex societal systems, because people generally always try to use governments to benefit themselves. Therefore, the role of the government is to influence the system dynamics by working in parallel with its culture. The market and the government should support each other, and different functions can be delegated to one another. Understanding the complexity of the government's role and being aware of the inclusion of the importance of bottom-up initiatives is crucial when designing policy to change the system (Colander & Kupers, 2014). Governments also have the responsibility to safeguard the

common good as well as gain societal support for the measures that are implemented. The development of public administration theory in the 20th century led to a more comprehensive way of triggering desired social changes (Cramer, 2022). The government has an important role in the provisioning of regulation and guidance to strive for a circular future, as top-down policies are the driving force to accelerate transitions. This includes the implementation of policies and regulations on different governmental levels (Yu et al., 2022). To date, policies normally resort to a series of policy instruments. There are different kinds of policy instruments and different categorizations can be found in literature. A well-cited definition of policy instruments by Verdung (1998) is:

> *"A set of techniques by which governmental authorities wield their power in attempting to ensure support and effect (or prevent) social change." (Verdung, 1998, p. 50)*

While there are different methods for the classification of policy instruments, it can be difficult to classify policy instruments that have been implemented as they are generally implemented in a policy mix (Brans & Wayenberg, n.d.; Burke & Stephens, 2017; Rogge & Reichardt, 2016). However, some relevant classifications are elaborated in this chapter. First, some widely used classifications are presented, after which a new environmental policy instrument classification and a classification for circular city development is presented.

3.2.1 Threefold classification of policy instruments

Verdung (1998) proposes a threefold classification of policy instruments which is widely used and the most accepted classification, namely regulations, economic means and information, based on the popular expression of the stick (to force), the carrot (to pay or let pay) and the sermon (to persuade). This can be translated to regulatory instruments, economic, and information or soft instruments.
Regulatory instruments define the social interactions, such as those of the market, by legal tools. They are obligatory instruments that show the authoritative, hierarchical side of the regulations and give mandate to act according to the rules and directives (Borrás & Edquist, 2013; Verdung, 1998).

Economic instruments can involve giving or taking away material resources. They can effect social change through incentives, for example encouraging specific activities by allocating financial support, as well as disincentives, such as taxes or tariffs to restrain specific activities. However, economic instruments are not always obligatory: is a free choice whether one wants to take action based on the instruments or not, as one can also pay the taxes by doing specific activities. The resources for economic instruments can be both monetary as non-monetary (Borrás & Edquist, 2013; Verdung, 1998).

Lastly, compared to regulatory and economic instruments, soft ones do not have binding effect, and therefore are not obligatory, nor do they give direct incentives or disincentives for the governed subjects. They provide information by transfer of knowledge and recommendations to persuade the subjects without obligations. It is the subjects' own choice whether to follow the recommendations or not (Borrás & Edquist, 2013; Verdung, 1998).

3.2.2 Four kinds of policy instruments

While the classification of Verdung (1998) seems to be widely used in the field of environmental policy (Acciai & Capano, 2019), it only consists of three instrument types. Another classification of policy instruments (Hood, 1983), that is often used in literature, consists of four types of instruments which are based on

different measures for policy intervention, which arenodality, authority, treasury, and organization (van Vught & de Boer, 2015). According to Hood, the different policy instruments that a governmental party can use are built on one of the four sources of action. First of all, governmental parties are in the center of information flows and therefore can use instruments that are built on this information resorting to nodality. Furthermore, governmental parties can use their legitimate authority to achieve objectives, as well as their access to financial resources. Lastly, governmental parties have the ability to provide and facilitate the society with public services in order to achieve objectives (Hood, 1983).

The different sources for governmental action require different actions and resources. These can be seen in Table 2.

Measure for governmental action	Required action	Required resource
Nodality	Communication	Credibility of governmental party
Authority	Legal provisions	Legal status of standing
Treasure	Exchange of resources	Keeping the expenditure capacity high enough
Organization	Taking direct action	Having enough capacity

Table 2: Hoods (1983) classification of policy instruments

This classification of different types of policy instruments can be compared to the threefold classification of Verdung (1998), which can be seen in Figure 7 at the end of this chapter. In this comparison, nodality equals information equals sermons; authority equals regulations equals sticks; treasure equals economic means equals carrots. The last classification of Hood, organization, is additional to the traditional threefold classification of Verdung (1998), but best fits the soft instruments of Verdungs traditional classification as it is not financial nor regulatory in nature, however it is still different from the information-based instrument as it is not about communicating information.

3.2.3 New Environmental Policy Instruments (NEPI)

As discussed above, the NEPI is a distinction of non-regulatory environmental policy instruments that received a lot of attention during the 1990's and 2000's. A classification can be made that consists of the regulatory command-and-control instruments, market-based economic instruments, informational/educational instruments and voluntary agreements (Bengtsson et al., 2010).

Command and control instruments are instruments that can mandate or prohibit something and are combined with a monitoring system to regulate performance. These instruments can either be standards that need to be complied with or restrictions or bans that limit undesired actions. While these instruments can have big impacts, they are often paired with high compliance costs and standardization does not easily allow for deviation. Furthermore, they give little incentive to change behavior (Bengtsson et al., 2010).

Economic instruments encourage specific actions by the implementation of economic incentives, to reflect the environmental costs in products and actions. This can either be done by the polluter pays principle, in which the costs are internalized through taxes, or stimulate specific clean behavior by the implementation of subsidies and tax reductions (Bengtsson et al., 2010).

Information instruments can either be an instrument in which the government provides information to stakeholders, or instruments in which the government requires stakeholders to provide them with information. These instruments are aimed at the provision of more information on environmental subjects. However, these instruments generally do not generate major changes and require the involved stakeholders to be highly aware of environmental issues (Bengtsson et al., 2010).

The last instrument of the NEPI distinction is voluntary agreements (VA), which is about

making commitments to improve performances positively for the environment. Different types of voluntary agreements can be made, among which VA's that have a legally binding character, however it should be understood that these agreements are more flexible than regulatory instruments. Literature on environmental policy instruments argues that these instruments do not have a high level of efficiency and are therefore not encouraged to be used (Bengtsson et al., 2010).

This classification of different types of new environmental policy instruments can also be compared to the threefold classification of Verdung (1998), which can be seen in Figure 7 at the end of this chapter. In this comparison, informational instruments equal information equals sermons; regulatory (command-and-control) equal regulations equals sticks; economic (market-based) instruments equal economic means equals carrots. The last instrument type within the New Environmental Policy Instrument classification, voluntary agreements, is additional to the traditional threefold classification of Verdung (1998) but can be considered a combination between information and regulatory instruments, as it is about making agreements (regulatory) but it is a soft instrument in nature (information).

3.2.4 Policy instruments for circular city development

Williams (2021) presents three circular processes that are fundamental to enable circular city development, namely looping, ecological regeneration and adaptation (Williams, 2021). Looping actions are about changing the linear system by closing the processes (e.g., R-ladder). Ecological regenerative actions are about the regeneration of the ecosystem in the urban environment (e.g., ecosystem services provision, blue and green infrastructures). Adaptive actions are about building the city in such a way that it is capable to adapt to change (e.g., co-creation, collaborative planning). To make these actions possible, Williams (2021) presents a set of levers for circular city development, which consists of regulation levers, provisioning levers, capacity building levers and financial incentive levers, see Figure 6. These levers can arguably be understood as policy instruments, resorting to the above-mentioned policy instruments classifications for comparison, see Figure 7 at the end of this chapter.

The classification by Williams (2021) is a selection of tools that has been collected through several European case studies and is the first comprehensive set of levers for circular city development that has been collected. As the built environment is particularly an important element within cities, especially in the circular transition of cities, this collection of levers is interesting in the scope of this research and therefore included in the comparison of different classifications of elements.

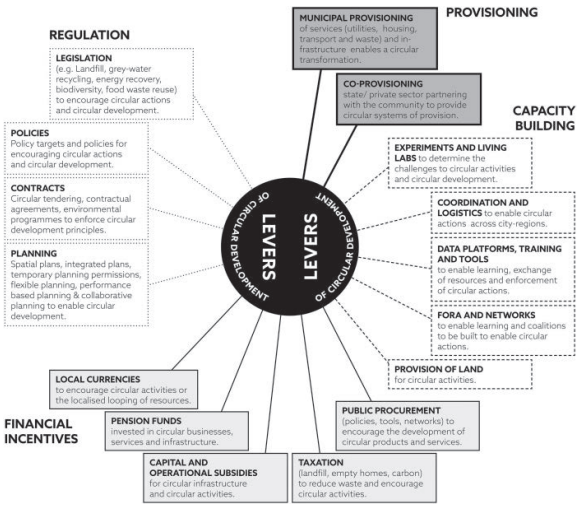


Figure 6: Levers for circular city development (Williams, 2021)

Regarding regulatory tools, temporary planning permissions can be used for the experimentation of circular activities. However, the integration of this activity on a bigger scale then the experiment can be difficult as the permission is temporary. Systematic permissions for circular activities throughout the city might be better to scale

up the activity. However, instruments can also be implemented to foster circular development in general throughout a city. For land that is publicly owned (so by the municipal authority), planning is the main instrument for circular development, the execution of these plans can be achieved by legal instruments like contractual agreements. To offer room for adaptable spaces and have freedom for experimentation, flexible and collaborative planning can be applied rather than fixed plans (Williams, 2021).

Instruments that provide economic (des)incentives can also be implemented for the development of circularity. Taxes can be implemented to reduce the use of undesired materials or methods and subsidies can be support the use of circular materials or methods. Another valuable instrument is public procurement to encourage the development of circularity (Williams, 2021). However, this is only relevant at the city level when cities have the power to procure public developments.

Capacity building consists of information and facilitating instruments like knowledge exchange, formation of networks, increasing awareness and establishing platforms for circular development (Williams, 2021).

The last type of lever by Williams (2021) is provisioning, in which the provisioning by the municipality can be done in a circular manner. Co-provisioning, in the form of public-private partnerships or the like, and the inclusion of bottom-up developments can also be used to increase support.

The classification of policy instruments for circular city development as given by Williams (2021) can be compared to other classification types, as can be seen in Figure 7. This comparison has been made as Williams (2021) has been the first to classify policy tools for the transition towards a circular city.

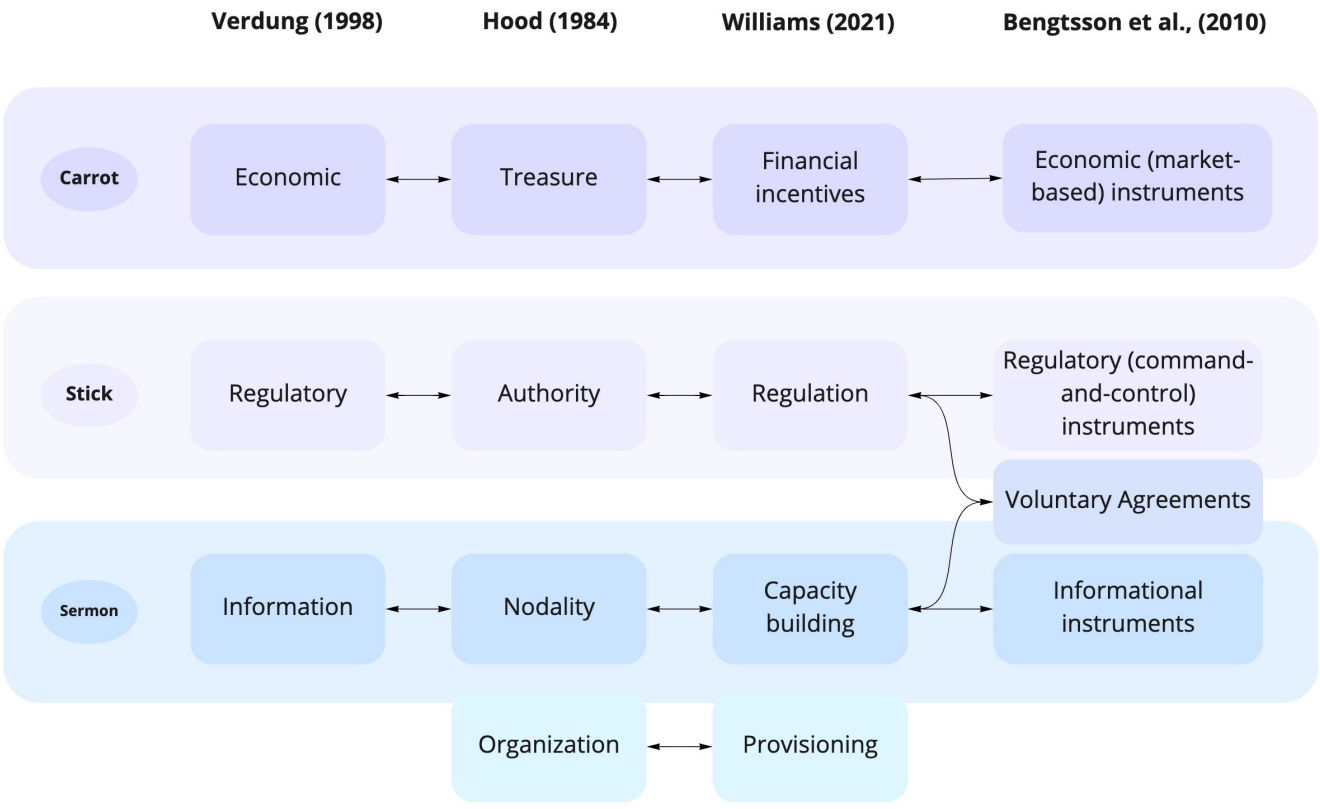


Figure 7: Comparison of different classifications of policy instruments

In this comparison, the regulatory and authority instruments are compared to the authority lever of Williams, as these are obliged, legislative and regulating instruments. The Economic and treasure instruments are compared to Williams' financial levers, as these are the instruments that require (monetary) resources. The last two categories of Williams are more difficult to compare to the other classifications, as they embody something slightly different. Capacity building includes the exchange of information and knowledge and therefore compares to information and nodality; however, it also includes taking action and could therefore be compared to the organization instrument by Hood. Lastly, the provisioning lever by Williams is about providing governmental services to private parties. It could therefore be compared to organization as it includes instruments that require governmental action.

There has been a debate among scholars about the implementation of regulations as environmental policy instrument. On the one hand, the relevance of rule-based instruments is important to create incentives to comply to the rules. However, authorities often implement these regulations with little knowledge on the specific technical implementation of the regulations and the implementation of regulatory policy instruments requires regulatory strategies that enforce specific regulations. The implementation of regulations requires knowledge on monitoring and evaluation. While during the 1990's and 2000's, the focus shifted from regulatory instruments to the New Environmental Policy Instruments (NEPI), which were non-regulatory policy instruments. The idea was that offering room for the market by informing them would lead to more self-regulation and flexibility for the market to move beyond regulations. However, voluntary agreements seem to be more effective when they are combined with certain regulations that enforce actions. Therefore, the last decades, there has been a shift from the usage of single policy instruments towards the use of policy mixes. It seems to be apparent that policy mixes are required for environmental purposes rather than single policy instruments (Pacheco-Vega, 2020). Rather than implementing individual policy instruments, sets of policies or policy mixes are generally implemented (Burke & Stephens, 2017; Pacheco-Vega, 2020; Rogge & Reichardt, 2016). Section 4.2 elaborates on the design and implementation of a policy mix for sustainability transitions.

An answer to sub-question 3 is provided on the next page.

SQ3: What policy instruments can foster sustainability transitions?

Literature presents different ways to classify policy instruments. One of the most well-known policy instrument classifications is the classification of Verdung, that consists of regulatory instruments, information instruments and economic instruments. While the classification of Verdung (1998) seems to be widely used in the field of environmental, it is the only presented classification that consists only of three instrument types. During history, many other classifications of policy instruments have been made, that often consists of more than three types.
For example, the widely known classification method of Hood, that consists of four instrument types which are based on the different measures for policy intervention. This classification might be suitable to use in the context of sustainability transitions, however it is one of the oldest classifications and the relevance of such an old classification system is questionable. The last decades, literature also presents classifications for policy instruments in the context of sustainability. For example, the classification of Williams, which consists of four instrument types which are comparable to the classification of Hood. However, this classification of levers is based on a few case studies and therefore does not have a high degree of external validity. The new environmental policy instruments (NEPI) classification also consists of four instrument types. This NEPI classification is a well-known classification in the environmental policy literature. However, the NEPI classification contains one instrument type that is not recommended to use: the voluntary agreements.

A comparison of these different instrument classifications and limitations that have been provided by literature gives a classification of four policy instruments that can foster sustainability transitions. This classification consists of the well-known classification of Verdung (1998) and adds to this with a fourth instrument, namely 'facilitating', which aims to capture the essence of the instrument types 'organization' (Hood, 1984) and 'provisioning' (Williams, 2021). By facilitating instruments, instruments in which direct action or commitment to improve performances, and that are required to facilitate a specific service in favor of the environment are meant. Facilitating instruments can be considered the instruments that are needed to facilitate a specific governmental action. So to give a concise answer to SQ3:
a classification of four instrument types can be used to foster sustainability transitions, namely regulatory instruments, economic instruments, information instruments and facilitating instruments. Facilitating instruments are needed for sustainable transitions due to the complexity of the transition that requires governmental support, in which the traditional classification method falls short.
However, for sustainability transitions, a combination of different policy instruments should be implemented, rather than individual instruments.

4. Theoretical framework

The theoretical framework presents relevant theories that are used during this research and form the basic knowledge to conceptualize and interpret the research results. Firstly, the meaning of a technology within a sociotechnical system and sustainability transitions is presented according to theories from literature (section 4.1). Secondly, policy mixes for sustainability transitions are explained (section 4.2). At the end of this theoretical framework, the important definitions are described. The third section (section 4.3) presents the analytical framework that is the results of the theories as presented in this theoretical framework. The operationalization of this analytical framework forms the basis for the empirical research, of which the methods will be described in the next chapter

4.1 Sustainability transitions

This section uses theories on sustainability transitions to build the TF. As this research concerns the transition of a technology within a sociotechnical system (ST-system), literature on the different aspects of these definitions is used within the TF. After this, literature on transitions of ST-systems is presented.

4.1.1 Technologies within a sociotechnical system

During history, the meaning of 'technology' has shifted from arts and crafts to artefacts that emphasize purposeful inventions. In the first place, technologies might seem like a set of tools, however, technologies should be contextualized as a part of the social world we live in. Different conceptualizations of technology are available. However, the traditional view of technologies as tools and skills, lacks definition as they do not cover the technological system behind such technologies, thus leaving room for individual bias over the tools concept. Therefore, technologies can best be characterized as configurations that work (Rip & Kemp, 1998). Rip and Kemp (1998) argue that the development of conceptualization of technologies develops within social environments, which can be called regimes or technological regimes. They describe a regime as:

> *"... the rule-set or grammar embedded in a complex of engineering practices, production process technologies, product characteristics, skills and procedures, ways of handling relevant artifacts and persons, ways of defining problems—all of them embedded in institutions and infrastructures. Regimes are intermediaries between specific innovations as these are conceived, developed, and introduced, and overall sociotechnical landscapes." (Rip and Kemp, 1998, p. 338)*

A technology thus develops within a complex surrounding of set rules. However, as society changes over time, this means that the technologies within this system can also change over time.
The eventual configuration, purpose, and system dynamic of a technology after some time might be significantly different than the initial concept. Predicting the directions and development pathways of a technology is a difficult task (Rip & Kemp, 1998). As little is certain about future developments, technologies must prove themselves during their development pathway. Technological developers must believe in the technology and try to link their expectations to that of others to align the technology with that what is expected (Schot, 1998).

Technologies are never isolated skills or tools but are embedded in sociotechnical systems (ST-systems) or configurations (Rip & Kemp, 1998; Geels, 2002). ST-systems are systems that fulfill societal needs and do not only consist of technologies, but also require networks, regulations, and infrastructures to function (F. Geels & Kemp, 2000). Changes in technologies result in the shift of one ST-system to another (F. W. Geels, 2002). When this system change happens, it is referred as a transition. A transition can thus be described as a set of interrelated changes in several areas: technology, structure, institutions, behavior,

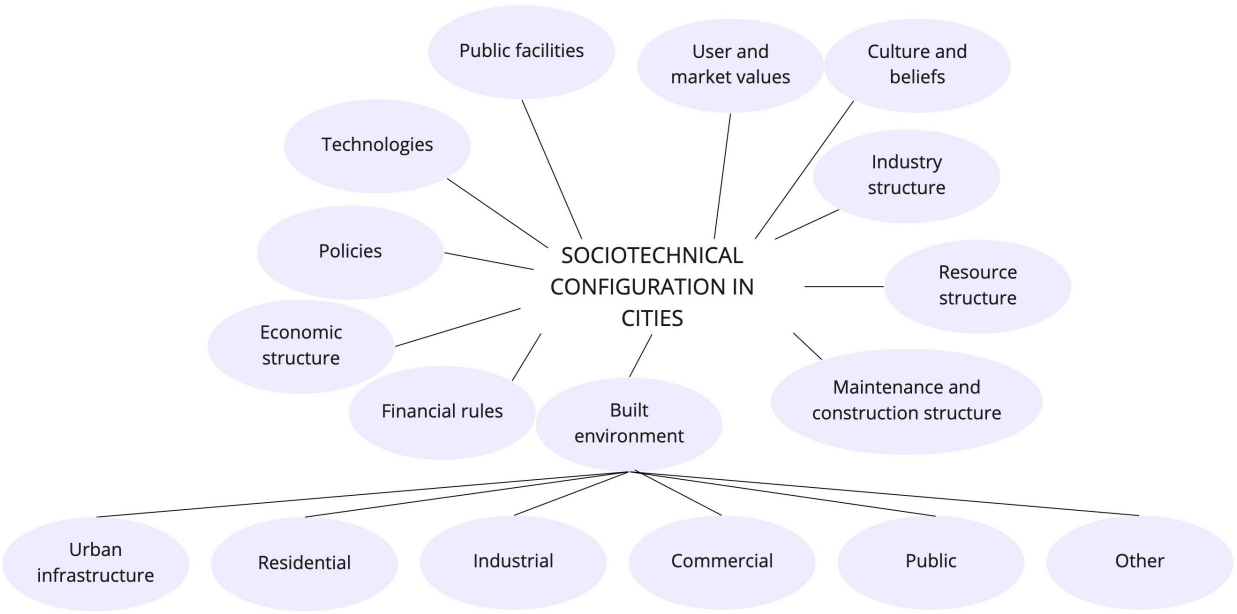


Figure 8: ST-system of a city (own image based on Geels, 2002)

culture and intentions (F. Geels & Kemp, 2000). As the ST-system consists of many elements, both social and technical, changes of one element can result in changes of other related elements within the network (F. W. Geels, 2002). An example of a ST-system with some of the different elements can be seen in Figure 8.

Geels (2004) contributes to the literature of ST-system definitions by elaborating on the user side. He argues that the focus of ST-system research has mainly be put on the development of technologies, the supply side, while the diffusion and use of technologies as part of the user side should be emphasized more, as socio-technical systems do not function on themselves, but are shaped and dependent on human actors. These human actors can be divided in social groups, forming the user environment. Interaction of the ST-system and the human environment is important and works in two directions. The behavior and activities of the actors lead to the elements and linkages of the ST-systems, while the ST-systems form a context for our actions and shape our perceptions and activities. The author does not only suggests the inclusion of the user side, but he also adds a third dimension to create an analytical distinction of ST-systems, actors and the rules and institutions that guide the perceptions and activities (F. W. Geels, 2004). The interactions between these three dimensions can be seen in Figure 9.

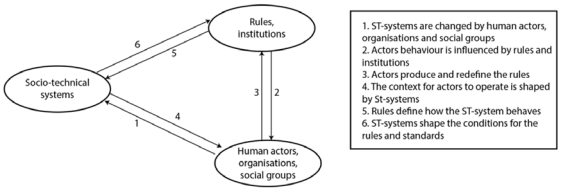


Figure 9: The three interrelated analytical dimensions (own image based on Geels, 2004)

While Geels (2004) suggests an analytical distinction between ST-systems, actors and rules/institutions, one could look at ST-systems from an even broader perspective by seeing them as embedded in sociotechnical landscapes (ST-landscapes). According to Rip & Kemp (1998), a ST-landscape encompasses the overall societal context wherein ST-systems are embedded. It is shaped by geography, economics, industrial ecology, philosophy, sociology, and culture. Changes in the ST-landscape are happening at a relatively slow pace. Technological transitions or trajectories are embedded within the overarching ST-system transformations and are shaped by the existing ST-landscape (Rip & Kemp, 1998; F. W. Geels, 2002). Therefore, when studying technological transitions, a ST-system must inevitably be part of the analysis for optimal performance of the technology over time. Therefore, sociotechnical change has an

evolutionary character: variation and selection by its environment will define how the technology is developed and/or changed. This makes it hard to predict the outcomes beforehand. However, there are possibilities to influence these changes and guide them in specific directions, this can particularly be done by governmental bodies and policymakers (Rip & Kemp, 1998).

Geels (2002) defines technological transitions (TT) as:

> *"...technological transformations in the way societal functions such as transportation, communication, housing, feeding, are fulfilled. TT do not only involve technological changes, but also changes in elements such as user practices, regulation, industrial networks, infrastructure, and symbolic meaning." (Geels, 2002, p. 1257)*

TT are therefore the change from one ST-system to another ST-system. According to Rotmans et el. (2001), it is a gradual process that implies a structural change of society. However, as ST-systems are complex and include many elements, these changes often have hard time to break through (F. W. Geels, 2002).
Nelson and Winter (1982) term the evolution of improvements of technologies within a specific technological regime, namely 'natural trajectories'. These trajectories are related to considerable improvements within this regime. Natural trajectories hold an underlying body of knowledge, but are also often complemented with other trajectories, as the development often happens in multiple domains (Nelson & Winter, 1982; Kemp et al., 2001), as a quintessential characteristic of complex systems.

The multi-dimensional character of transitions requires transitions to happen in the multiple associated domains (Kemp et al., 2001). However, while Nelson and Winter talk about the trajectories in the context of engineering practices, also social groups should be included in the transition trajectories. The inclusion of social groups provides the sociotechnical regime in which the transition happens (F. W. Geels, 2002). Both social and technical elements should be brought together to shape the system. The cumulation of dynamics in the system is required for the system to get momentum, expand and start the change process. Several processes like product improvement, complementary innovations and cost reduction should eventually give enough momentum for the old system to be replaced by the new one (Geels, 2004; Rip & Kemp, 1998).

4.2 Policy mixes for sustainability transitions

This section presents policy mixes as an analytical framework. Firstly, the description and design of a policy mix is elaborated on. Secondly, policy mixes for a CBE and methods to design transition policies are described.

4.2.1 The design of a policy mix

Rather than implementing individual policy instruments, sets of policies or policy mixes are generally implemented (Burke & Stephens, 2017; Pacheco-Vega, 2020; Rogge & Reichardt, 2016). According to Pacheco-Vega (2020), a policy mix can be implemented to serve multiple purposes as it can help to target multiple populations and different angles and sub-sectors of one policy. In the literature on policies for innovation, the term 'policy mixes' is often referred to, rather than individual policy instruments. Policy mixes can be implemented to improve the overall effectiveness of a policy goal. Combining many different definitions gives the interpretation of a policy mix as a complex combination of policy instruments that evolves over time and impact both the public and the private sector (Rogge & Reichardt, 2016). It could be the result of a coherent policy mix design, but most of the times it is the result of years of layering policies (Nykamp, 2020). Thus, such combinations may result in collaborating policy instruments that can foster transitions or

inconsistent policy instruments that can hinder them (Nykamp, 2020). According to Rogge & Reichardt (2016), a policy mix is not only about the interaction of instruments, also the processes for developing and implementing the instruments, as well as their interaction. The authors present a clear explanation of the policy mix that is based on a combination of three buildings blocks, namely elements, processes, and characteristics. The elements are defined by the processes, and both the elements and processes can be described by their characteristics, Figure 10 shows a synthesis of the different building blocks and the dimensions by which they can be described.

The building block elements consist of the policy strategy and the instruments. The policy strategy consists of the objectives and plans to achieve the objectives. A policy strategy has a long-term perspective (Rogge & Reichardt, 2016). Policy goals can be set to assess whether the policy instruments serve as a means for the desired outcome. Drawing insights from the ST-system change literature, Burke et al. (2017) uses three goals for the assessment of congruence between goals and instruments within a specific case. These goals (resist, reclaim and restructure) can be described by the intended policy outcome, after which the relation of the different policy instruments with the different goals can be assessed. This method links the transition goals of the ST-system change to the policy instruments that are used in the system. Assessing the implications for each goal and recognizing gaps and insufficiencies will improve the efficiency of the policy mix (Burke & Stephens, 2017). The policy mix can be assessed by comparing how consistent they are with the policy objectives. Edmondson et al. (2019) contribute to this with a framework to assess the effects of the policy decisions on the socio-technical system and vice-versa. However, a strategy on itself is not enough to achieve the desired change: it needs to be operationalized by concrete tools. Policy instruments are such concrete tools helping to achieve the objectives. While the strategy aims for overarching objectives, instruments are associated with goals. Combining instruments will lead to an instrument mix, which can consist of core instruments and complementary instruments. Instruments within an instrument

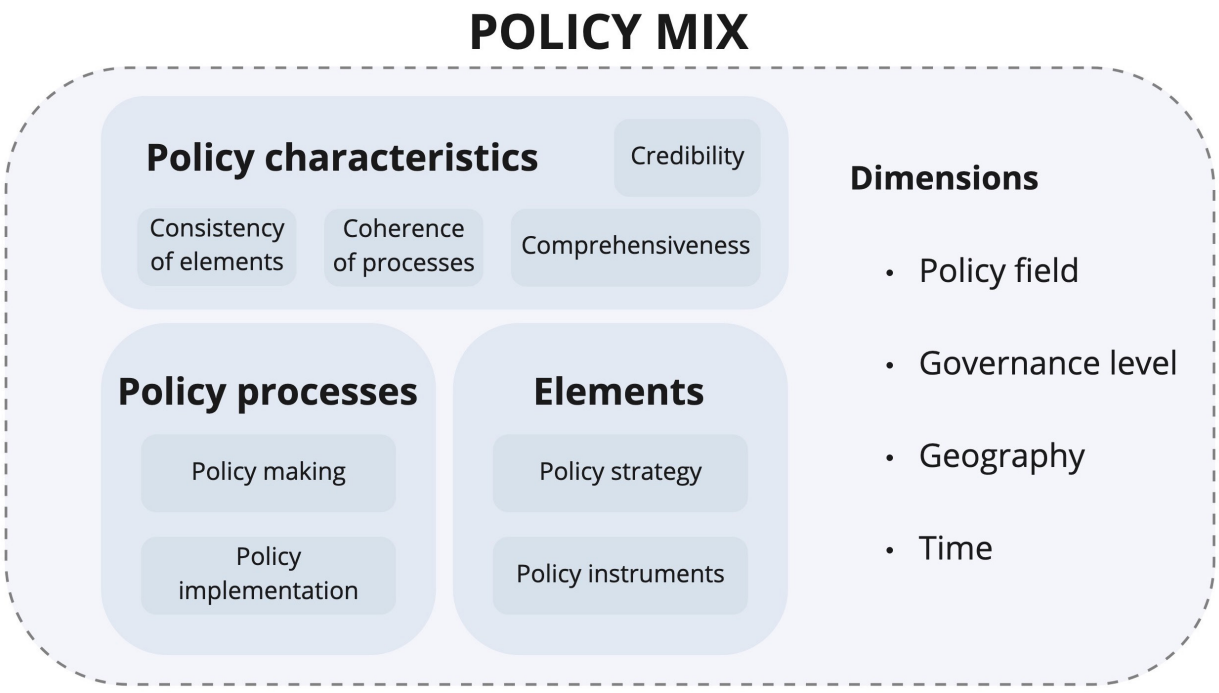


Figure 10: Different building blocks of a policy mix (own image based on Rogge & Reichardt, 2016)

mix have interdependencies and interactions that influence each other's outcomes and the policy objectives. Therefore, it is important to align the instruments in such a way to achieve positive interaction outcomes or synergies (Rogge & Reichardt, 2016).

The second building block, according to Rogge et al. (2016) is the policy process. A policy process or cycle determines the building block 'elements' and its changes over time, and is governed by the government as primary agent. It has a reactive nature as it involves learning through analysis of problems and experimentation through each cycle. Processes are shaped by the context and shape the setting of the policy strategy and design of the instrument mix. Policy processes consist of both policy making and policy implementation.

- For policy making, iterative processes of monitoring and evaluating are crucial, as well as agenda setting and aligning the policy objectives with the instruments (Rogge & Reichardt, 2016).
- A correct policy implementation is required for policy instruments to reach their full potential. Policy making and implementation have an important role in the eventual effects of the innovation as it influences the credibility and design of the policy mix and instruments (Rogge & Reichardt, 2016).

The last building block consists of the characteristics of the policy mix, which is descriptive for the policy mix as a whole. This building block consists of four categories, namely the consistency of the elements, the coherence of the processes, the credibility, and the comprehensiveness (Rogge & Reichardt, 2016). According to Pacheco-Vega (2020), standards and criteria for cohesion and consistency should be created to be able to optimize the design of the policy instruments that form the instrument mix.

- Consistency denotes the extent of alignment of the elements within the policy mix to achieve the policy objectives. Consistency can be found in the policy strategy, the instrument mix and the instrument mix with the policy strategy. Conflicting objectives in the strategy, inconsistency and negative interactions in the instrument mix and the inability of the policy strategy and instrument mix to work together all hinder the achievement of the policy strategy (Rogge & Reichardt, 2016).
- Coherence characterizes the policy making and implementation processes across different policy fields and governance levels, the capabilities of the policymakers and the behavior of the actors. Coherence can be achieved when the processes of policy making and policy implementation are contributing to the overall strategy and goal. Coherence should be in place across different levels of policy fields and governance levels, by integration across different policy sectors and coordination between different governance levels. Due to the complexity of these different layers, actors and policy fields, it is unlikely to obtain complete policy coherence and consistency, however, the aim is to strive for maximum consistency of the policy mix by maximizing the process coherence (Rogge & Reichardt, 2016).
- Credibility describes the believability and reliability of the policy mix including its elements and processes. Commitment from political leaders is important to achieve credibility. It has an essential role in the accomplishment of the policy objectives (Rogge & Reichardt, 2016).
- Comprehensiveness measures the extensiveness of the elements and processes. It determines whether the instrument mix covers the barriers in all systems by generating a technology-push, a demand pull and systemic changes. Furthermore, the instruments should be a good operationalization of the strategy (Rogge & Reichardt, 2016).

These three building blocks can be further described based on dimensions that seizure the interaction space, namely the policy field, governance level,

geography, and time. The policy field determines the policy domain in which the policy mix takes place, the governance level refers to both the horizontal and the vertical government level, the geography describes the concrete space from which the policy mix is originated, and the time describes the time over which the policy mix develops (Rogge & Reichardt, 2016).

4.2.2 Coherence within the policy mix

As argued by Huttunen et al. (2014), policy coherence is crucial in sustainability transitions. Policy coherence is described as the consistency of goals, instruments and other policy-related signals. It is facilitated by policy integration, which is about the implementation of policy goals and instruments in policy domains. Policy coherence also includes the effects of policy on stakeholders' decisions. The authors propose three dimensions for the analysis of coherence: internal, external and temporal. A vertical assessment is about the consistency of the goals, instruments and implementation within one domain, while a horizontal assessment looks at the coherence of policies between different domains (Kemp et al., 2005; Huttunen, Kivimaa & Virkamäki, 2014; Rogge & Reichardt, 2016). The first assesses external policy coherence while the latter assesses internal policy coherence. Temporal policy coherence is assessed by the consistency and predictability of policies over time (Huttunen et al., 2014).

4.2.3 Policy mixes for transitions

Transition processes are path dependent, meaning with the emergence of corresponding policy mixes concerned with complex interactions (Nykamp, 2020). Schot & Steinmueller (2018) introduce a way of framing innovation policies that addresses the sustainability and societal issues in a more integral manner than the yet existing framing methods (innovation for growth framing and the national systems of innovation framing). This framing implies that ST-system transformation is required to achieve sustainable innovations. A technological solution is never developed in a vacuum. A new technology that shifts the regime also brings about social, behavioral, and technological shifts, this is called a socio-technical system transition (section 4.1) and it requires transformative governance (Schot & Steinmueller, 2018).

Sustainability transitions seen from a changing ST-system perspective require on the one hand, the destabilization of existing regimes and, on the other hand, the space for innovative alternatives to be developed. Policies for sustainability transitions therefore need to focus on both the resistance and destabilization of incumbent regimes and locked-in systems, as well as the innovation of new technologies (Burke & Stephens, 2017; Edmondson et al., 2019; Kivimaa & Kern, 2016; Schot & Steinmueller, 2018). Actors in the incumbent regime can be hesitant towards change and believe that change is possible within the yet existing frameworks. The prevailing ST-system consists of prevailing regulations, cognitive lock-ins and values and cognitive and normative rules. Transformative governance should aim to layer the new policies in a productive way with the yet existing policies (Schot & Steinmueller, 2018). However, according to Nykamp (2020), due to the complexity of policy processes, it is inadequate to think that policymakers on their own are equipped with the required knowledge and instruments to apply an effective policy mix. Rogge & Reichardt (2016) also state that it is a difficult task. They argue that full coherence and consistency of policy instruments and processes are extremely difficult to achieve due to the complexity of the system which often comes with resistance of regime actors, path dependency, lock-in and conflicting interests. The selection of policy instruments should be based on the problems that are identified in the system, as they should solve the problems and their causes (Borrás & Edquist, 2013; Schot & Steinmueller, 2018; Wieczorek & Hekkert,

2012)

4.2.4 Policy mixes for a circular built environment

As policy mixes can be used for transitions, they can also be used in the transition to a CE. However, a transition of the BE towards a CE requires high efforts from the involved stakeholders. Policy documents can serve as strategies to shape these efforts (Bucci Ancapi et al., 2021). According to Yu et al. (2022), the fragmented character of the BE makes it difficult for policymakers to develop CE policies for this sector. As construction products can differ highly in their spatial and lifetime dimensions, regular policy instruments fall short in developing a CE in this sector. Supportive policy instruments should be developed, however, there is a lack of regulatory frameworks that are effective for CE policy-making. As most policy efforts regarding the CE are limited to reuse and recycling, a systematic CE transition is not yet being achieved. The main functions of CE policies as presented in literature are aimed at the provisioning of financial support for circular behavior in the long-term, the implementation of economic incentives for the use of second hard material and the implementation of standardized assessments for quality assurance of second hand materials. However, policy instruments that are aimed at multiple life-cycle phases of the circular implementation should be developed to create a closed-loop value chain, rather than instruments that are focused solely on one project life-cycle. Focusing on subsidy policy instruments can arguably foster the secondary material market and is therefore important in closing the loop. However, a combination of different policy instruments, a policy package, is important to fully shift towards a CE that is not waste centered, but focused on a built environment without waste. (Yu et al., 2022).

While different policies can be implemented to generate a circular development pathway, it is important to consider the existing strategies and development pathways (Williams, 2021). Like all new policies, policies and strategies for circular development are layered on top of existing structures, which should be kept in mind during the design and implementation. Furthermore, synergies between different circular actions can be achieved by taking a holistic perspective.

Governments often use the concept 'circular economy' for efficiency optimization rather than the adoption of a new way of thinking. As the adoption of a circular economy as a new way of thinking requires fundamental change, some barriers need to be overcome by changing the technical, social and institutional processes (Cramer, 2022). As argued in section 4.1, changing these processes can be related to changing the ST-system.

Definitions from the theoretical framework (see figure 11 on the next page)

Sociotechnical system = systems that fulfill societal needs. They do not only consist of technologies, but also require networks, regulations, and infrastructures to function.

Technological transitions = Technological transformations in the way societal functions such as transportation, communication, housing, feeding, are fulfilled. TT do not only involve technological changes, but also changes in elements such as user practices, regulation, industrial networks, infrastructure, and symbolic meaning. Nowadays, technological transitions are symbiotically related to sustainability and should therefore be called 'sustainability transitions'.

Policy mix = A complex combination of policy instruments that have evolved over time and impact both the public and the private sector

Transition policy = Policies for sustainability transitions need to focus on both the resistance and destabilization of incumbent regimes and locked-in systems, as well as the innovation of new technologies.

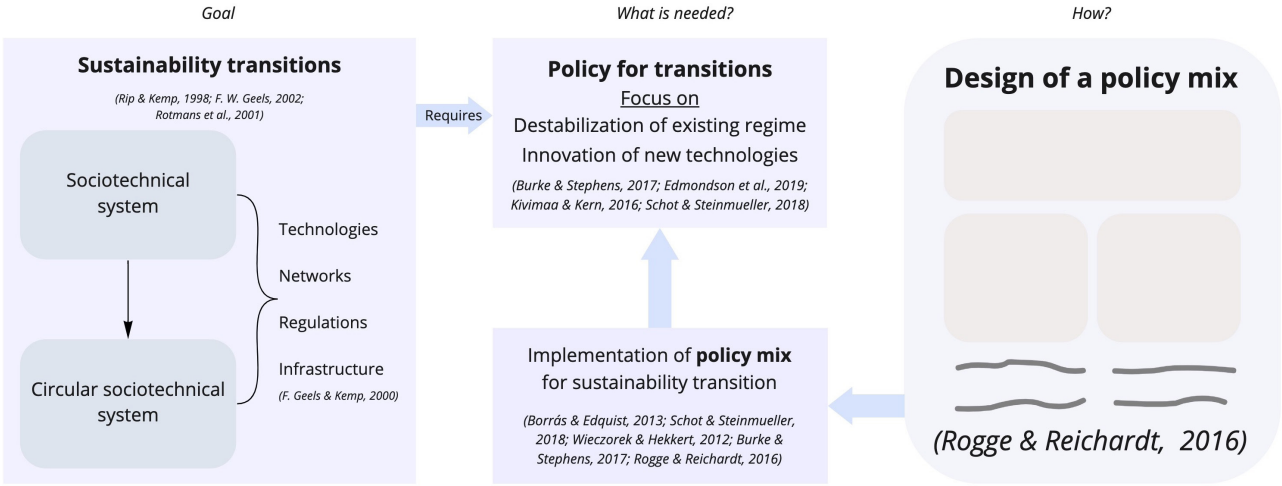


Figure 11: Theoretical framework

4.3 Analytical framework

The AF for the operationalization of the empirical research is based on the theory of Rogge & Reichardt (2016) that presents a framework that consists of building blocks to design policy mixes for sustainability transitions. The different building blocks in the framework consist of several items, which have been assigned with different assessment criteria per item, which forms the AF that can be seen in Figure 12. The approach that includes assessment criteria is used, as this makes it possible to objectively assess the policy mix for the timber transition in the MRA in a consistent manner.

The theory as discussed in the TF (section 4.2) describes how a policy mix is compiled by the different building blocks and the dimensions that can be used to describe such a policy mix. For the design of the AF in this research, the dimensions of a policy mix as presented by Rogge & Reichardt (2016) are considered to be the fourth building block, see Figure 12.

This section will first elaborate on the different assessment criteria that are used in this research, as shown in Figure 12, to get a better understanding of their meaning and logic to use them. After this, the approach to operationalize the AF is presented.

Figure 12: Analytical framework that is based on the theory of Rogge & Reichardt (2016)

4.3.1 'Elements' assessment criteria [instruments & strategy]

The building block 'elements' describes the instruments that the policy mix consists of and whether these different instruments are aligned with the intended strategy of the policy mix. This is the most tangible building block of this framework as it is related to the content of the concerning policy mix. See Figure 13 for an explanation about the assessment criteria and why these assessment criteria have been used.

4.3.2 'Policy processes' assessment criteria [policy implementation & policy making]

The building block 'policy processes' is descriptive for the building block 'elements': it describes the processes behind the implementation and making of the policy instruments (part of the building block 'elements'). See Figure 14 for an explanation about the assessment criteria and why these assessment criteria have been used.

4.3.3 'Dimensions' assessment criteria [geography, governance level, policy field, time]

The building block 'dimensions' is descriptive for the building block 'elements' and the building block 'policy processes': they describe the different dimensions of the policy processes that belong to the elements within the policy mix. See Figure 15 for an explanation about the assessment criteria and why these assessment criteria have been used.

4.3.4 'Policy characteristics' assessment criteria [coherence, comprehensiveness, credibility & consistency]

The building block 'Policy characteristics' is descriptive for the whole policy mix rather than individual items/building blocks: they describe the characteristics of the policy mix, it is therefore a holistic assessment of the whole policy mix. All policy characteristics are assessed with the same labels. See Figure 16 for an explanation about the assessment criteria and why these assessment

Building block for policy mix

Elements

Item	Assessment criteria	Why?
Instruments	Regulatory Economic Information Facilitating	This assessment is based on the classification of policy instruments as presented in section 3.2 (lit. review on policy instruments, as this classification forms the theoretical background knowledge for this research. Furthermore, this classification is based on different relevant articles on policy instruments for sustainable transitions, which is also the topic of this research.
Strategy	Aligned Misaligned	This assessment is based on whether there is alignment or misalignment with the strategy as presented in the 'Houtbouw convenant'. This research focusses on the policy mix to foster a timber transition in the MRA, for which the convenant sets the scene. Therefore, the strategy of the covenant will be used as baseline to assess the strategies of different elements.

Figure 13: Assessment of elements of a policy mix

Building block for policy mix

Policy processes

Item	Assessment criteria	Why?
Policy implementation	Effect No effect	This assessment is based on whether the implemented policies have effect on the intended strategy. As the strategy of the houtbouw covenant defines the strategy of the policy mix in this research, it will be assessed whether different implemented policies have effect or no effect on the strategy of the houtbouw covenant.
Policy making	Underdeveloped Developed	This assessment is based on whether a specific policy instrument is yet (being) made or not. The the process of policymaking is always developing in the aim to achieve the strategy of the policy mix. Therefore, it is assessed whether a specific policy instrument is yet developed (thus implemented) or underdeveloped (not (yet) implemented).

Figure 14: Assessment of policy processes of a policy mix

Building block for policy mix

Dimensions

Item	Assessment criteria	Why?
Geography	European National Provincial Municipal	This assessment is based on the level where the policy instruments and strategy (elements) of the policy mix are implemented. It is therefore descriptive of the elements, as well as the policy processes. All levels from European to local (municipal) are included as assessment criteria.
Governance level	European level National level Provincial level Municipal level	This assessment is based on the level where the policy instruments and strategy (elements) of the policy mix are made. It is therefore descriptive of the elements, as well as the policy processes. All levels from European to local (municipal) are included as assessment criteria, however, the regional level MRA is left out, as this level has no governmental authority.
Policy field	Private law Public law	This assessment is based on the policy domain. While there are many different ways to interpet the policy field, one possibility is to distinguish between public and private policies. This assessment has been chosen as the law domain is the most basic indication of the field where policy processes and elements are happening.
Time	Past Present Future	This assessment is descriptive for the elements and policy processes, as it assesses the temporal dimension of both building blocks. Past indicates an effect/no effect of elements in the past, present indicates elements that have currently (no) effect and future indicates elements that should (not) be implemented. In all of these temporal assessments, the policy making can either be developed or under developed.

Figure 15: Assessment of the dimensions of a policy mix

Building block for policy mix

Policy characteristics

Item	Assessment criteria	Why?
Coherence Comprehen-siveness Credibility Consistency	Absent Somewhat in place Fully in place ↓	This assessment is based on whether the different characteristics of the policy mix as a whole are in place or not. The theory of Rogge & Reichardt (2016) describes the different characteristics and gives concrete examples of these characteristics. The assessment of the building blocks 'elements', 'processes' and 'dimensions' make it possible to assess the characteristics of the policy mix as a whole. As the assessment of the different characteristics can be complex and requires explanation to understand the nuances, it is difficult to assess these characteristics with criteria. Therefore, the criteria that are used in this research are objective assessment criteria that indicate whether the characteristic is in place. However, more explanation should be provided when assessing the characteristics of a policy mix.

Figure 16: Assessment of policy characteristics of a policy mix

4.4 Operationalization of the analytical framework

To use the AF within the empirical research, a stepwise approach can be followed. This stepwise approach can be seen in Table 3. This figure shows the different steps that should be taken, what these steps entail, how these steps should be conducted and the operationalization of these steps to conduct the empirical research. The different methods that are presented in this figure will be elaborated on in chapter 5 (Research methods).

Table 3: Stepwise approach for the operationalization of the analytical framework

Step	What?	How?	Research operationalization
1	Definition of a sustainable transition topic and demarcation of the context to be researched	A description of the topic to gain a deeper understanding of the transition topic and the status of the transition.	Case description
2	Analysis of the different stakeholders that are involved in the sustainable transition topic	A stakeholder analysis of the important stakeholders to understand their interests, needs, and behavior.	Method: • Stakeholder analysis
3	Analysis of the (proposed) policy mix for the sustainable transition topic	A case study analysis that assesses the (proposed) policy mix based on the analytical framework.	Method: • Case study analysis
4	Definition of the relation of the different (non)existing policy instruments to the strategy of the (proposed) policy mix for the sustainable transition topic	Assessment of: • The building block '**elements**' to make an inventory of the different policy instruments and their (mis)alignment with the transition topic. • The building block '**processes**' to define whether those elements should be developed or are yet developed. For the developed elements whether they have effect or no effect. • The item '**time**' (within building block 'dimensions') to define whether the element and process have happened in the past, present or will happen.	Method: • Interview analysis
5	Definition of the specificities of the different policy instruments of step 4	Assessment of: • The remaining items of the building block '**dimensions**' to define the specific dimensions of the policy instruments. • The building block '**policy characteristics**' for the policy mix that is created by the preceding steps.	Methods: • Interview analysis
6	Synthesis of the results, answering the main research question	An interpretation of the results: • Evaluation of research design and limitations. • Give meaning to the results by contextualization and synthesis of different research methods. • Data triangulation to reject or confirm the arguments.	Discussion, conclusion, recommendations, validation and reflection

PART III
METHODOLOGY

In this part, the different research methods that are presented in the stepwise operationalization of the analytical framework (Table 3) are elaborated. As this research is a case study, the case is first presented as this sets the scene for the research. After this, the different qualitative empirical research methods are presented.

5. Research methods

This chapter elaborates on the methods that are presented in the operationalization of the AF which can be found in the preceding chapter. First, the research design that is based on this operationalization is presented. This research design presents the different methods that are used per sub-question of this research. This chapter then presents a description of the case study, namely the 'Green Deal Houtbouw', as the operationalization of the empirical research starts with a case description (see Table 3), After this case study, which 'sets the scene' for the empirical study, the different research methods that are part of this study are explained in more detail. First, a method for a Stakeholder Analysis is presented, after which the method for the case study Analysis is presented. Then, the used method to conduct and analyze the interviews is presented. Lastly, the method for the expert session, which supplements the research with a high level of validity, is presented. Table 4 presents the different methods that are used to answer the different research question of the empirical research part of this study.

5.1 Research design

This research has a qualitative nature. Qualitative research prioritizes content over quantification and measurement (Bryman, 2012). It helps to understand the nature and interactions of variables and gives answer to the 'what' questions rather than the 'how' questions. It is used to create a holistic perspective of the complexity of human behavior (Black, 1994). Qualitative research is often focused on aspects of social reality like interactions, and often includes aspects of peoples' behavior, furthermore it takes place in natural settings as studies processes rather than static objects (Bryman, 2012). This research therefore fits the qualitative research approach.

The empirical research consists of both primary and secondary data. Primary data is data in which the researcher is responsible for collecting it, while secondary analysis consists of data collected by other researchers (Bryman, 2012). The case study analysis and stakeholder analysis use secondary data, the interviews are primary data.

This research is conducted by using a combination of an inductive and deductive research approach.

Table 4: Methods and operationalization per sub-question for the empirical research

RQ: How can a combination of policy instruments foster the transition to timber housing construction in the MRA?

Sub-questions	Method	Operationalization
SQ4: Who are the most important stakeholders that are actively involved in the transition towards timber constructions in the MRA?	• Stakeholder analysis	Stakeholder analysis by Bryson (2004) that uses multiple techniques, for 2 groups: - Governmental stakeholders - Non-governmental stakeholders
SQ5: Which policy instruments are necessary for an effective timber transition?	• Semi-structured interviews	- Semi-structured interviews with 2 stakeholders from each of the stakeholder types that can be found in the case study. - Interviews are conducted via MS Teams, after which they are transcribed and analyzed through Atlas TI.
SQ6: What is the effect of the current policies on the transition towards timber constructions?	• Semi-structured interviews	

First, an inductive approach is used conduct the literature review, as explained in chapter 3, after which a deductive approach is used for the analysis of the empirical research. A deductive approach can be used to either confirm or invalidate the theories that have been set up during the inductive research. Therefore, concepts that are drawn from literature are used within this research approach. However, this approach might limit the results of the research as the analysis is limited to the specific concepts that are drawn from literature. While this approach might limit the results, it does give guidance to the research and makes qualitative research that concerns a social topic more measurable than when using an inductive approach. The use of semi-structures interviews can lead to a wide variety of results that can contain a high level of subjectivity of the participants. The use of a deductive approach can be helpful in overcoming a subjective interpretation of the data. Therefore, the concepts that are presented in the inductive literature study are used to operationalize the analysis of the deductive study (Bryman, 2012). This operationalization can be found in section 4.4.

5.2 Step I. Case study description: Green Deal Houtbouw Duurzaam uit de crisis

The 'Green Deal Houtbouw Duurzaam uit de crisis' is a covenant that is aimed at the transition of timber constructions in the metropole region of Amsterdam (MRA) between 2021-2025. The aim is to have at least 20% of the entire housing production in the MRA built in timber from 2025 onwards. By signing the covenant, the different parties declared that they will promote the increase in scale of timber constructions as indicated in the covenant. The transition to timber constructions is important in the bigger picture of the MRA agenda 2020-2024, due to several reasons. The increase of timber constructions will improve the living environment, leads to more use of biobased, renewable materials, and can improve the efficiency of the construction sector and its economic viability. This requires a close cooperation between public and private parties to make use of each other's expertise. Transparency, a considerable effort from all parties involved and a pioneering spirit is a requisite for this transition (Metropoolregio Amsterdam, 2021). This covenant is relevant for this research as it serves as a context for this research as it is the case study that is subject of the empirical research.

The feasibility of the covenant is supported by setting yearly targets which can be used to measure the progress of the transition. Furthermore, some locations will be assigned for timber constructions and the parties that have signed the covenant commit to one timber construction project yearly from 2022 on. From the government it is expected that the regulations will be adjusted in favor of timber constructions: creating a levelled playing field for timber in the MPG calculations and including timber constructions in the 'Bouwbesluit' (Metropoolregio Amsterdam, 2021).

- The covenant sets some criteria to what a timber construction entails, to be able to define which buildings can be considered timber constructions. These criteria are:
- For houses with ground-level access, at least 80% of the volume is bio-based;
- For stacked houses beneath 10 storeys, at least 65% is bio-based;
- For stacked houses above 10 storeys, at least 50% is bio-based;
- Timber for the timber construction preferably comes from Europe and is assembled in Europe;
- The timber is at least 70% FSC mix and/or 70% PEFC certified.

The covenant sets a vision, goal, and some

general and concrete agreements to get to the intended goals.

5.2.1 Vision

An acceleration of the timber construction transition in the MRA is required and will contribute to the acceleration of the housing production, as well as an increased sustainability and industrialization of the construction sector. Both public and private parties should invest in this transition to make it feasible to scale up timber constructions and lower emissions from the construction sector. After all, improving the construction economy in terms of circularity is something that matters all and is endorsed by all.

5.2.2 Goal

As argued above, the goal of the covenant is in 2025 to construct 20% of total new built housing production in the MRA by timber, which can be translated to 3.000 timber housing constructions per year. Another goal of the covenant is to accelerate the housing production by the increase of more industrialization and efficiency in the construction sector, for which timber is a suitable construction material. A transition to more timber constructions will furthermore make the construction site more appealing to future generation construction workers. To make these goals clearer, intermediate steps for each year until 2025 are presented.

5.2.3 Agreements

Several agreements have been set up that are directed at the different stakeholders that have signed the covenant.

Some general agreements have been made about the demarcation of the transition and the biggest questions that are currently there. Firstly, both public and private parties will provide locations and development positions for timber housing constructions. These projects have a diversity of typologies and locations. All parties are committed to commissioning, preparing or executing at least one pilot wood construction project each year from 2022 onwards. Secondly, all parties have their own responsibility in the active involvement of knowledge sharing on all aspects of timber constructions. This requires investments in building expertise and making new routines. Also regulations must be adjusted to be in favor of timber constructions and create a level playing field. New methods of standardization for timber constructions are required to make responsible assessments. Thirdly, an integral approach that takes into consideration the whole supply chain of timber constructions should be used to assess to the costs. It can be assumed that the costs will lower and stabilize on the long-term.

Also, some agreements have been made to tackle some important issues related to the timber transition. Firstly, the stakeholders will put in their efforts to realize high quality timber construction projects that satisfy the traditional quality norms and standards. Furthermore, the stakeholders will make agreements on the demand and supply of timber constructions to promote continuity of the transition. Investments are needed to realize enough facilities that supply timber. Moreover, communication strategies have been set up to promote the communication of timber both towards professionals, as well as the bigger audience, which will make timber constructions more accessible on all levels. This transition also requires education of different levels: new construction methods, but also new research to this new topic is required. Lastly, new construction methods that are related to timber constructions, like prefab assemblage in factories, require new working facilities and new forms of employment. Location should be appointed for the development of new working facilities.

The different activities and results have been assigned to the different stakeholders that have signed the covenant. Yearly evaluation of the covenant and the different tasks within the covenant is required to enlarge the feasibility of the different goals.

5.2.4 Action plan

An action presents concrete actions for public and private stakeholders in 2020 to coordinate the transition of timber constructions. This action plan has set out an approach based on a set of five themes:

1. Locations; appointing locations for the realization of timber constructions
2. Knowledge around timber constructions; actively developing and sharing knowledge around timber constructions
3. Regulations; adjusting national laws and regulation to promote timber constructions
4. Business case; clarify how timber constructions can become a financially attractive business case
5. Communication strategy; Building a strategy to promote timber constructions among different parties

5.2.5 Stakeholders

The stakeholders that have signed the covenant can be categorized in different stakeholder types, which can be seen in Figure 17

5.3 Step II. Stakeholder analysis

A stakeholder analysis (SA) has been conducted to get a better understanding of the stakeholders that are actively involved in the timber construction transition in the MRA. The stakeholders are selected based on the case study (see section 5.2, case study description). These stakeholders are assumed to be actively engaged in the timber transition and the policy change cycle, and therefore have experience and knowledge of the subject. They can be considered the frontrunners of this transition.

Kern et al. (2019) argues that the effectiveness of change can better be measured when the behavior of the target group is known. Research also shows that the driver for the preference of instruments among citizens is mainly based on the individual factors rather than context-related factors (Kern et al., 2019). Therefore, conducting a stakeholder analysis among the stakeholders that are involved in the policy change cycle is an important tool to be able to understand their role in the policy change cycle.

Literature offers many different methods for conducting a SA. The method that is used in this thesis, is a SA that is presented by Bryson (2004). This method is aimed at stakeholders in public and nonprofit management to ensure long-term viability of policies, plans and programs (J. M. Bryson, 2004). This method is a systematic approach for the analysis of stakeholders and is often used when mapping stakeholders in projects within the built environment.

Why this method?

Problems often have an interconnected nature

Figure 17: Categories of stakeholders that have signed the Green Deal Houtbouw convenant

in which many groups or individuals are involved. The long-term viability of policies, for example, requires the right coordination of stakeholders for it to be effective. Satisfaction of stakeholders should be set as a criterium to achieve success. A stakeholder analysis can help in identifying the different solutions and assessing the political feasibility (J. Bryson, 2004). Bryson (2004) argues that for a policy to be useful, there should be political support and knowledge on how to solve the issue that the policy is aimed at. A SA can be used to identify these problems and understand how political support can be gained, especially when many stakeholders are involved and affected by the policy while there are many different stakeholders who have different responsibilities. Furthermore, a SA can be especially useful when there is not yet general acceptance about the public value or common good of a subject.
The timber transition involves many stakeholders that have different expectations and responsibilities. Furthermore, the timber transition serves the common good as it is part of the circular transition to reduce CO2 emissions. While the environmental benefits of timber are known, there is not a general tendency towards the use of timber as it might not always be beneficial for individual interests on the short-term. Therefore, there is not yet a general acceptance about the public value or common good of this subject. A SA is particularly suitable for this policy change cycle due to the complexity of the problem.

Conducting a stakeholder analysis that fits the purpose of the study is useful to assess the political feasibility and the implementation of ideas and possible solutions. While many stakeholder identification and analysis techniques can be found in literature, not much is known about which technique should be used for which situation. Bryson (2004) presents different techniques that can be used once the stakeholders have been identified, and groups them in four categories, that correspond with different stages of policy change processes that is related to the implementation of a policy or plan: the policy change cycle. The different techniques correspond with the different phases of the policy change cycle. The first step consists of techniques for problem or issue formulation (1), then proposal development, review and adaptation (2), after which techniques for policy or plan implementation are presented (3), and lastly a technique for participation planning for monitoring and evaluation (4) is presented. As the case study for this research is the covenant which has just been implemented and will last for the next five years, it is not yet possible to conduct the last step of the SA: participation planning technique, which is related to monitoring and evaluating the policy change cycle. Therefore, this step has not been conducted.

5.3.1 **Step 1-** Problem or issue formulation

Why, and how does it add?
The method of Bryson (2004) provides a good overview of the different stakeholders, which is important to understand their roles, expectations, interests and decisions.

The stakeholder classification of Mitchell et al. (1997) can be used to identify different types of expected behavioral patterns and can help in understanding the principle of who and what really counts. It can furthermore help in understanding why certain stakeholders behave the way they do and make predictions about whether the stakeholder will attempt to gain its missing attribute, which is helpful in understanding what policy instruments are needed to influence this (un) desired behavior.

The first step is focused on gaining a better understanding of the interests and expectations of the stakeholders, both individual and in relation to each other.
The basic stakeholder analysis technique that is presented by Bryson (2004) elaborates on the stakeholders' expectations, perspectives, requirements, influences and contributions.

After this, the stakeholders are assessed based on their level of power, legitimacy and urgency. By attributing these characteristics to the different

stakeholders, different classes of stakeholders can be distinguished. In this classification, the different combinations of the attributes power, legitimacy and urgency lead to different stakeholder types, which can be seen in Figure 18. It should be kept in mind that the three attributes are objective perceptions, and they are variable as they can change over time The attribute power is assessed by the existence of symbolic, physical and/or material/financial power. The attribute legitimacy can be defined as a general perception that the stakeholders' actions are desirable for the project. Lastly, urgency is about the degree to which the stakeholders' requirements call for immediate action and how critical the relationship to the project is for the stakeholder (Mitchell et al., 1997).

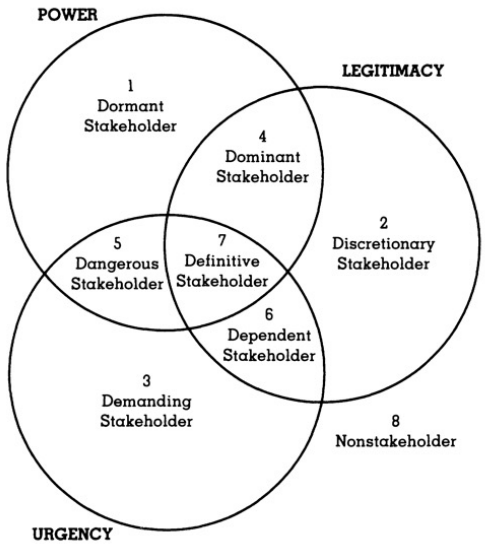


Figure 18: Stakeholder typology by Mitchell (1997)

5.3.2 **Step 2-** Proposal development, review and adaptation

Why, and how does it add?
This technique of Bryson (2004) is particularly suitable when there is a focus on making the implemented proposal or policy successful. A policy can be attractive, while it does not match up with stakeholder capacities. Therefore, this technique is useful to assess whether these two are aligned. If there is a mismatch, it might be possible that some responsibilities need to be changed. This helps to understand how the proposal is perceived by the stakeholder, based on their capacities, and what policy instruments might be needed.

After problem formulation, techniques for proposal development, review and adaptation can be applied. These techniques are aimed at analyzing the amount of support from the stakeholders during the proposal, review and adoption of the policy.

A technique that can be used for this is making a policy attractiveness versus stakeholder capability grid. In this grid, the likelihood of the stakeholders to successfully implement specific policies is being assessed. To fill out this grid, the policy attractiveness as well as the stakeholders' capabilities should be assessed based on some criteria (J. Bryson, 2004).

5.3.3 **Step 3-** Techniques for policy or plan implementation

Why, and how does it add?
The technique of Bryson (2004) makes clear what is required of the stakeholders during the implementation of the policy. Having a clear understanding of this might help in understanding what policy instruments are needed to achieve this and how the implementation of the policy can be successful.

Policy implementation requires stakeholder support for the policy to be effective. To gain a better understanding of what is required during the implementation or development of a policy, a policy implementation strategy development grid can be developed. This technique builds on the information that has been gained during the previous analyses. It can be helpful in setting up action plans for the policy implementation that fits the stakeholders' interests and resources (J. Bryson, 2004).

5.4 Step 3. Case study analysis

As presented in the operationalization of the analytical framework, the case study analysis is step 3 of the operationalization of the AF and follows the SA. The case study analysis is an analysis of the (proposed) policy mix for the sustainable transition topic of this research, namely the timber transition in the MRA. The case study description (section 5.2) describes in more detail the content of this policy mix proposal.
The AF is used for this empirical analysis: the building blocks of the proposed policy mix will be assessed based on the predefined assessment criteria as presented in section 4.3.

5.5 Steps IV and V. Interviews + analysis

During the empirical research, 21 semi-structured interviews have been conducted. Semi-structured interviews are focused on the interviewees' own perspectives and his/her point of view on the subject. The interviews are conducted with the different stakeholder types that have signed the covenant (see section 5.5, Research methods for the interviews). The interview is flexible enough for the respondents to give answers to subjects that are emerging during the interview. A semi-structured interview has an interview protocol that the researcher can hold on to, however, questions that are not included in the interview protocol can also be included during the interview when other topics are emerging (Bryman, 2012) (Appendix A1) Furthermore, it is important that the interviewee feels comfortable during the interview and knows that there are no right or wrong answers, as the interview is about the personal experiences and perceptions of the interviewee. The process is flexible, and the interview can change based on what the interviewee deems important (Bryman, 2012). After the first round of interviews, the questions are adjusted as some questions did not lead to the required answers while some intended data was not collected by asking the initial questions. Furthermore, some questions have been added to make sure that the data, that has been collected, is useful to answer the research question. As the interviewee has signed the informed consent, the interview is recorded. After the interview, the conversation has been transcribed, and the data is collected anonymously. The interviewee is allowed to withdraw from the interview at any time. The preceding statements are also included in the informed consent (Appendix A2) The anonymous list of interview participants can be found in Appendix A3.

5.5.1 Interview analysis

The interviews are analyzed by using the analytical framework. Step 4 of the operationalization of the AF (Table 3) is about defining the relation of the different (non)existing policy instruments to the strategy of sustainable transition topic, which is the covenant in this research. Step 5 is about the more detailed specification of the policy instruments from step 4.

The data has been analyzed through deductive coding. In deductive coding, the assumptions from the theory are used during the analysis, to be able to test the theory. For deductive coding, a premade coding scheme is used, in which the codes that have been made before starting the analysis, has been applied to the interview transcripts (Chandra & Shang, 2019). To be able to analyze the data that is collected with the interviews, AtlasTI, a qualitative data analysis program, has been used. In AtlasTI, folders (building blocks) have been created that consist of codes (items within the building blocks) and subcodes (assessment criteria). A complete overview of the different codes that have been used can be seen in Appendix B1.

As the interviews are conducted with a semi-structured approach, the collected data varies per interview. Furthermore, the knowledge of the interviewee has influence on the data and how it is presented. As not all interviewees are knowledgeable enough to talk about the concepts that are used in this research, the raw interview

data is not suitable for the assessment that is based on the analytical framework. For the deductive approach of this empirical research, the data should be made measurable. Therefore, the collected interview data is first translated in data that is suitable for this assessment. In the interview transcripts, different (non)existing policy instruments are recognized, collected from the transcripts, and translated in a useable short explanation. This results into an inventory of different policy instruments per interview that are suitable for the analysis.

During the analysis of the collected policy instruments, it seemed apparent that five possible relations could occur. These relations can be described by different assessment criteria. The different relations, as well as the assessment criteria that are used to describe those different relations, are presented in Figure 19.

From the classifications as presented in figure 19, it can be concluded that the instruments are either **necessary** (1, 2, 3) or they have an **effect** (4 & 5).

1- A non-existing activating instrument - NECESSARY

This relation describes a policy instrument that does not exist yet but is needed and would be stimulating for the strategy of the covenant/transition. The policy making is assessed '*underdeveloped*' as this instrument is not yet developed. The policy instrument is not yet implemented thus this item is not assessed. The strategy is assessed '*misaligned*' as this instrument is not existing thus not aligned to the covenant. As this concerns an instrument that is needed but not now existing, the time will be assessed '*future*'.

2- An activating instrument that is not yet fully in place or being developed - NECESSARY

This relation describes a policy instrument that is under development or proposed to be implemented as it is needed and will be stimulating for the covenant/transition. The policy making is assessed '*underdeveloped*' as this instrument is not yet developed. However, when the policy will be implemented, it is aimed to have effect on the covenant/transition. Therefore, the policy implementation is assessed '*effect*'. The strategy is assessed '*aligned*' as this concerns an instrument that will be aligned to the covenant/transition. As this concerns an instrument under development that will be implemented, the time will be assessed '*future*'.

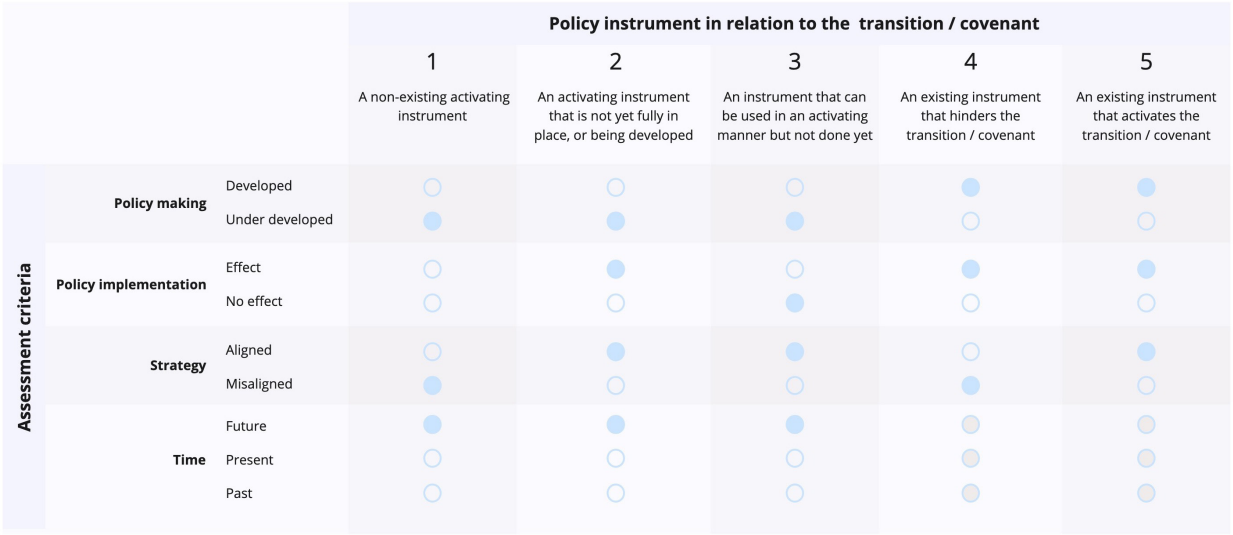


Figure 19: Assessment of the different building block items to describe different relations of policy instruments to the covenant

3- An existing instrument that can be used in an activating manner but is not done so yet - NECESSARY

This relation describes an existing policy instrument that can be used to stimulate the covenant/transition but is not yet used in that manner. As this concerns an existing instrument that should be further developed to have a stimulating effect on the covenant, it is currently not developed to have effect, thus the policy making is assessed '*underdeveloped*' and the policy implementation can be assessed '*no effect*'. Once the instrument is used in the right manner, it can activate the covenant/transition and the strategy is therefore assessed '*aligned*'. The time is assessed '*future*' as the instrument is currently not used in an activating manner.

4- An existing instrument hinders the transition / covenant - EFFECT

This relation describes an existing policy instrument that hinders the covenant/transition. The policy making is assessed '*developed*' as this instrument is yet developed. As it is developed and the implementation of this instrument has effect, the policy implementation is assessed '*effect*'. The strategy can be assessed '*misaligned*' as the instrument is not used in a manner that is aligned to the covenant/transition. Lastly, the time depends on whether the data is about an event in the past, a current event, or a future event.

5- An existing instrument that activates the transition/covenant - EFFECT

This relation describes an existing policy instrument that activates the covenant/transition. The policy making is assessed '*developed*' as this instrument is yet developed. As it is developed and the implementation of this instrument has effect, the policy implementation is assessed '*effect*'. The strategy can be assessed '*aligned*' as the instrument is used in a manner that is aligned to the covenant/transition. Lastly, the time depends on whether the data is about an event in the past, a current event, or a future event.

Once the relations between the different policy instruments and the covenant/transition have been defined, the remaining assessment criteria can be assigned to the different policy instruments (step 4 of the operationalization of the analytical framework).

5.6 Expert sessions

As this study is a qualitative research, judgement against several criteria is advised to increase the quality of the study. According to Bryman (2012), validity of a study can be increased by respondent validation, in which the findings from the document analysis, stakeholder analysis and interviews are either confirmed or rejected. The method for this validation is an expert session with experts on the subject, who were also people with whom the research has been conducted. These sessions are aimed at a confirmation that the findings are in line with the views of these experts. As it might be debatable whether a participant is able to respond on the findings, it is important to clearly present the findings, without leaving room for interpretation, so the respondents have a good understanding of what is meant by the results. Therefore, the important findings from the different empirical studies are presented in clear statements, that are explained and discussed during the expert sessions. These expert sessions will provide insights about the usefulness, relevance, and accuracy of the research results. This adds to the validity of this research. Data triangulation is established in this study, as different methods are used to study the subject.

5.7 Data plan and ethical considerations

Different sources have been used for the data collection of this research, among which both primary and secondary data. As the data provided by this research is open for other researchers, this project adheres to the FAIR Guiding Principles.

This means that the data of this research should be Findable, Accessible, Interoperable and Reusable (Wilkinson et al., 2016).

- **Findable:** The research is findable via the Educational Repository of Delft University of Technology, via https://repository.tudelft.nl/. On the Educational repository, this thesis is linked to keywords that make the research findable.
- **Accessible**: All data that has been collected is held by the author. Access to the data that has not been published in this research can be requested by contacting the author. However, sensitive information that has no permission to be shared, is not shared and will not be shared. All data is collected according to the codes of conduct, transcripts are clearly structured, and all data is handled with care. The interview data is stored anonymously, as stated in the informed consent that has been signed by all participating interviewees. Furthermore, confidential use of the data has been guaranteed (Wilkinson et al., 2016).
- **Interoperable**: The used language of this thesis is English as this is language is broadly applied for knowledge representation (Wilkinson et al., 2016). While the findings of the interviews are presented in English, the interviews are conducted in the native language of the interviewees, namely Dutch. This leads to a better understanding between the interviewee and interviewer, gives more nuance to the interview and improves the communication.
- **Reusable**: All sources that are used during this research are referred to by using the APA 7th reference style. Furthermore, all used methods are presented to guarantee transparency and reusability.

PART IV
CASE STUDY

In this part, the results of the empirical research are presented. Step 2 up until 6 of the operationalization of the AF are conducted in this part. The empirical research consists of three parts, namely the SA, the document analysis, and the analysis of the interview data. The SA and the document analysis are both descriptive analyses of the case study 'Green Deal Houtbouw Duurzaam uit de crisis'. The SA is conducted by using the method of Bryson (2012) and the document analysis uses the AF for analysis. After these analyses, the interviews are analyzed by using the AF as presented.

6. Stakeholder analysis

The different stakeholders that have signed the covenant and can therefore be considered to be actively involved in the timber transition, are analyzed. The SA is divided in two parts, firstly a SA of the non-governmental stakeholders is conducted, after which a SA of the governmental stakeholders is presented. The case study that is the subject of this research is the context of the SA: the transition towards timber constructions in the MRA. As the focus of this research is on policy instruments, this SA is a simplified version of what Bryson (2012) introduces. Due to the scope of this research, this analysis is limited and aims to provide a general understanding of the most important stakeholders that are involved in the timber transition in the MRA. In the discussion section, it is discussed to what extent the outcomes of the SA are aligned to the interview data.

At the end of this chapter, sub-question 4 is answered.

SQ4: Who are the most important stakeholders that are actively involved in the transition towards timber constructions in Amsterdam?'

6.1 Non-governmental stakeholders

6.1.1 **Step 1-** Problem formulation

The different types of non-governmental stakeholders that have signed the covenant are analyzed in this section. To increase the understanding of the stakeholders' behavior, a limited summary of the different stakeholder types describes their roles, powers, interests, needs and knowledge is presented.

Project developers

Last year, 200 project developers signed a manifest that argued that timber constructions are the future (Agro & Chemie, 2021). Many project developers are making steps in this transition and some companies are expanding their production to timber constructions by realizing production facilities for timber constructions (BAM, 2021). While many developers are becoming more knowledgeable about timber constructions, there still seems to be a lack of knowledge and specific knowledge on timber is required within developing companies (Uijen & Andringa, 2021). Especially for smaller companies it is harder to join the transition due to lack of resources. The availability of more knowledge, the inclusion of the benefits of timber in the environmental assessments and more investments in timber are required for developers to be able to make the transition. As project developers generally aim to make as much profit as possible, this is an important factor for them. On the other hand, project developers should contribute to the transition by sharing their knowledge and experiences on timber constructions. Furthermore, they should be able to think about the long term when realizing projects, instead of acting upon short term financial goals.

(Developing) contractors

Currently, contractors often won't choose timber as a construction material as they do not have experience and the required knowledge to implement this material (Vermeulen, 2020). However, the contractors that have signed to covenant have committed to implement timber in their construction projects. Therefore, more knowledge on the changing supply chain is required (Bronsvoort et al., 2020). They need to have enough financial resources and knowledge to be able to implement timber. Furthermore, an increase of knowledge about the technical implementation will help contractors in accelerating the implementation of timber. On the other hand, contractors can contribute

to the knowledge on timber by sharing their experiences and learned lessons. More openness, sharing knowledge and collaborating with other stakeholders will lead to an increased efficiency in the timber construction sector.

Institutional investors

As the costs for timber constructions are currently higher than traditional construction costs, there is a need for investors with a long-term vision, that want to participate in sustainable pioneering and dare to take risk (Bronsvoort et al., 2020). These are exactly the types of investors that have signed the covenant, as they are committed to invest in the transition.

They have a responsibility in making agreements with developers about the possibilities to invest in timber construction projects. To stimulate timber, they are expected to invest in timber projects and companies in the timber supply chain that require investment costs. This requires their long-term vision rather than a focus on short term profits. Furthermore, they need to think about offering guarantees for investments on timber projects. As this stakeholder wants to have certainty about their investments, they aim to gain knowledge about the subject of investment. Furthermore, companies that need investments from this stakeholder are likely to share knowledge to convince this stakeholder. Therefore, they have a reasonable amount of knowledge. They expect the transition to accelerate as their investments will benefit from a higher demand to the product. At the same time, this stakeholder is willing to use its resources for this acceleration.

Housing associations

As housing associations have a big portfolio, they can have a big influence on the housing market and its timber transition, by appointing projects that will be developed in timber. Many housing associations already made steps in the transition, for example by joining forces and joint purchasing (Georgius, 2021). As housing associations generally have a high offset of houses, they are capable to quickly gather a lot of knowledge on timber constructions. Furthermore, as they are non-profit organizations, they are expected to work together and share the gained knowledge. However, the implementation of timber constructions can be difficult for housing associations, as timber is currently still more expensive than traditional construction methods (duurzaamgebouwd.nl, 2020). They are their own investors but need to keep the rents as low as possible. Therefore, concessions might need to be made to make it possible to keep the rents low. For example, a timber housing project for social housing can be combined with more expensive apartments to make the initial investments feasible.

Knowledge institutes

Knowledge institutes aim to contribute to the climate challenge by conducting research and studies that should result in more knowledge on how to lower anthropogenic emissions. They expect the transition to a more sustainable construction method to happen as they are aware of its importance. This stakeholder generally has a high level of knowledge on the topic as they conduct research. However, a big part of the knowledge on this topic comes from practical experiences, which this stakeholder is lacking. Therefore, practical knowledge and scientific knowledge should be combined to increase the overall understanding of timber constructions. Knowledge institutes can play a role in provisioning the scientific knowledge to accelerate the transition. Knowledge should be developed about, among others, changed requirements for timber constructions, risks (to lower the risk perception), the methods to work with the new materials and the changed supply chain (Bronsvoort et al., 2020).

Timber builders

The timber builders are generally relatively new stakeholders that are innovative frontrunners. As their cor business is about the innovative product that needs to undergo a transition, they are most lilely ahead of many other stakeholders regarding knowledge and ambitions. Different types of this stakeholder exist. The timber builders that have signed the covenant are stakeholders that

design and develop timber constructions, as well as stakeholders that develop their own timber housing elements. This stakeholder is knowledgeable on the practical implementation of timber, mainly in the design and development phase, as they have practical experience. By increasing their -still immature- knowledge about the material itself, and the possibilities of implementation, they contribute to the development of the transition by supplying the knowledge and development of the process. However, they also benefit from an increased demand as this gives them the opportunity to improve development by more experience. Some timber builders developed their own production methods which can be relevant to the general development of timber constructions. Therefore, the existence of timber builders is important in this transition.

Architects

The transition to timber constructions forces architects to design in a different way then designing a tradition construction. Not only the construction changes, but the whole ambiance of a timber building is also different, and this is something that architects need to learn how to work with. While some architects might have experience in designing with timber, for many of them, the new application types of this material are yet unknown. This requires them to gain knowledge about designing with timber, but also to share their gained experiences and knowledge on timber designs to contribute to the transition. More knowledge on how to design in timber, but also how to design a modular building, should be made available (Bronsvoort et al., 2020). Architects can furthermore have an important role in the public acceptance and general interest in timber, as a timber building can promote the likeability of the material.

Banks

In general, this stakeholder has little knowledge on specific (investment) topics like timber. However, financial investments require well informed decisions. Therefore, this stakeholder should conduct financial research into possible juridical frameworks and formats to make informed choices on buying timber and handing out loans. To stimulate the transition, they should not make it financially more difficult to take out loans or premiums for timber than for traditional constructions. Furthermore, they can contribute to the transition by investing in projects that help to accelerate the development of timber. Some banks are already investing in research on timber be make better informed investment choices and be able to know how they can contribute in the best possible way.

Engineering- and consulting firms

This stakeholder might be the one that has most knowledge, as they have gained knowledge both from practical as scientific sources. With knowledge as one of the major barriers in the timber transition for many actors, engineering and consulting firms are, together with knowledge institutes, important in the development of more knowledge. Their role can be facilitating technical support, advice on the supply chain or financial advice to developers, architects, contractors, and clients. An important part of knowledge development comes from experience. Therefore, engineering- and consulting firms should be hired for timber consulting projects to gain experience and have the possibility to develop knowledge. Furthermore, they can educate employees to become timber experts.

Umbrella organizations

Umbrella organizations in this context are often foundations that act as independent organizations to foster the transition to a circular economy. They aim to foster the transitions by being a facilitating actor between private and public parties and providing financial and knowledge resources for circular initiatives (C-creators, 2021; Cirkelstad, 2022). They expect different parties to work together and share resources to foster the transition, without

obligations or rules but based on mutual trust and collaboration. They facilitate these networks and resources in a transparent manner to foster the transition without making profit out of it. Therefore, they require other stakeholders to be open and collaborate. As this stakeholder is an independent stakeholder that is highly involved in the transition, they have a considerable amount of knowledge. However, they might lack on sector specific knowledge as they have an overarching role. They influence the transition by sharing knowledge, making connections, offering financial aid or other required resources.

And more - staatsbosbeheer

Staatsbosbeheer has also signed the covenant. The main task of Staatsbosbeheer is to ensure sustainable forestry and the capacity to process the produced timber. This stakeholder wants to increase the inland production of timber. Together with developers, they are currently enlarging the forests and setting up programs to increase the production (Tissink, 2021). Enlarging the inland production of timber will contribute to the transition by making timber more accessible. More production means cheaper products, which will positively influence the transition. However, there should be enough demand to timber to make the production feasible. Therefore, developing parties higher up in the supply chain should join the transition and keep the demand up. However, this stakeholder they might not be capable to realize the enlargement of forestry areas for timber, as they are bounded to the provincial zoning plans. Besides, this stakeholder is not concerned with the construction sector and has little knowledge about the market. This might make it difficult for this stakeholder to respond to the market. While the ambitions of this stakeholder are high, they are dependent on many other stakeholders which limits their influence.

The different types of non-governmental stakeholders that are described above can be assessed based on their level of power, legitimacy an urgency, as explained in section 5.3 (Research methods for the stakeholder analysis) as can be seen in Figure 20. Awareness of the missing attributes of the different stakeholders can be helpful in predicting whether the stakeholders will attempt to gain the missing attributes.

6.1.1.1 Preliminary remarks

Based on the assessment of the attributes and the description of the different stakeholders, an expectation of the stakeholders' behavior can be made. Not all stakeholders have the goal to gain the attributes that they are missing and are therefore not expected to try to gain these attributes. There are two types of stakeholders that might aim to gain the missing attributes. While it is not expected that these attempts will lead to negative effects, it is important to pay attention to the (changing) behavior of the stakeholders during the whole implementation period of the covenant.

- Banks and institutional investors. As banks and institutional investors have power attributes by financial investments, it can be possible that they will try to gain the attribute urgency, to give more urgency to their investments. As they require their investments to pay off and increase in value, they might put urgency on the transition, which could lead to a high pressure on the development of timber constructions. However, by signing the covenant, the banks and institutional investors have deliberately chosen to make investments in timber. Urgency might therefore manifest itself in their participation to knowledge development and higher valuation of timber in assessments.
- Umbrella organizations might aim to gain the attribute urgency. As their goal is to accelerate the transition, they might put pressure on the transition to meet their goals with a high level of urgency. However, as the internal ambition of the umbrella organizations is related to a circularity transition, which is in line with the timber transition, this attempt will not affect the timber transition negatively. By lobbying and more knowledge sharing, they might try to gain the attribute urgency.

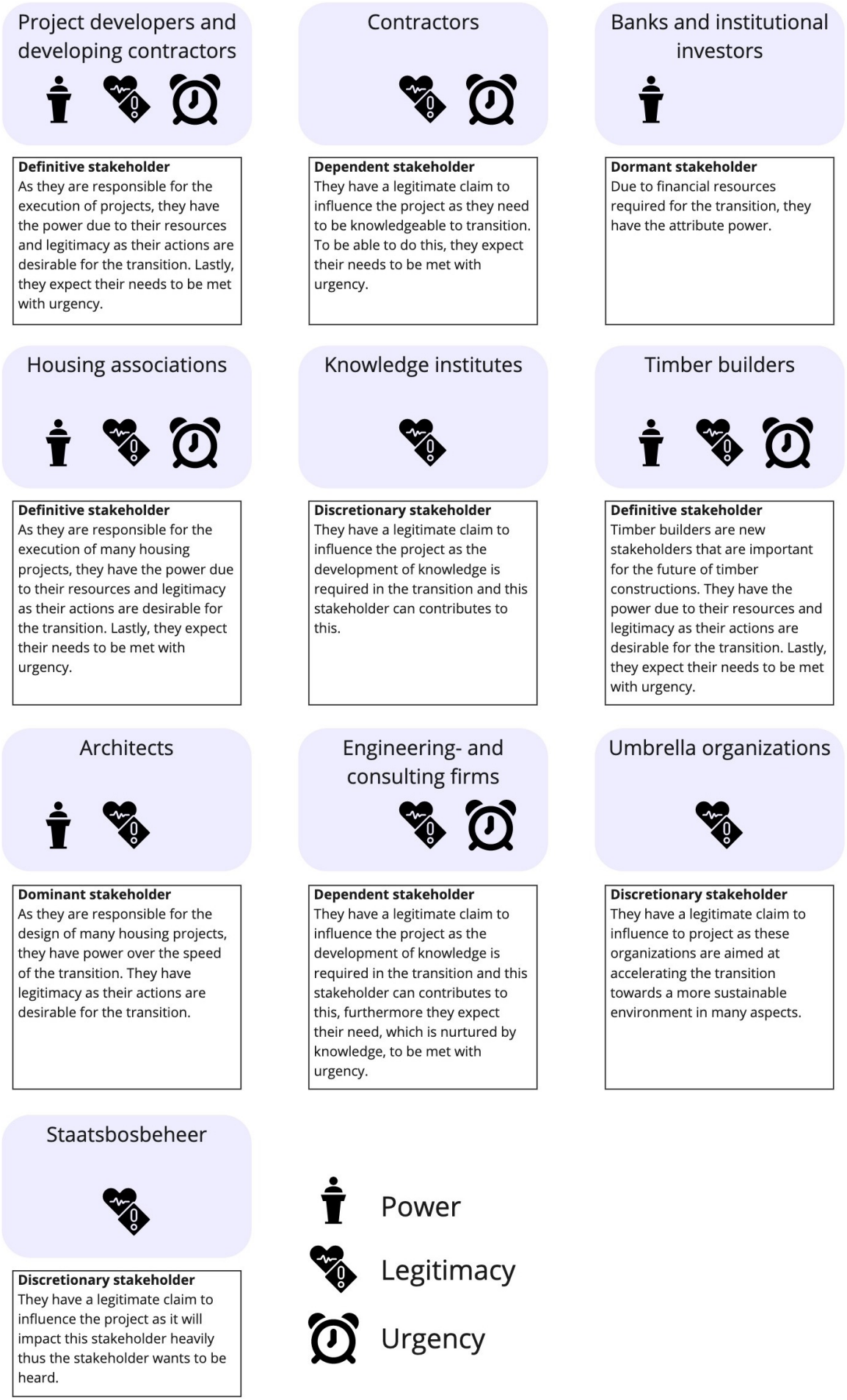


Figure 20: Assessment of the non-governmental stakeholders based on their level of power, legitimacy an urgency

6.1.2 **Step 2-** Proposal development, review and adaptation

A policy attractiveness versus stakeholder capability grid has been made for each non-governmental stakeholder to be able to assess whether the policy is likely to be implemented by the different stakeholders, based on their capacities and the attractiveness for the stakeholders to implement the policy plans or proposals. The criteria for assessment of the attractiveness are based on the level of alignment of the stakeholders' capabilities to the vision, goal, general agreements and issues that are agreed upon to be solved, as presented in the covenant 'Green Deal Houtbouw'. The vision, goal and agreements of the covenant 'Green Deal Houtbouw' are described in section 5.2 (Case description)

As this SA is not the main topic due to the scope of this research, this step of the SA has been a simplified version, as it normally requires a lot of knowledge to be able to properly fill in the grid. The preceding knowledge has led to an estimation of how the grid should be filled in, but it should be kept in mind that this grid is therefore still open to more development and refinement. The grid can be found in Appendix C1. Some general preliminary remarks that can be concluded from this grid and the gained knowledge about the stakeholders are presented.

6.1.2.1 Preliminary remarks

In general, the capacities of the non-governmental stakeholders that have signed the covenant are high enough to be able to implement the proposed plans. This can be explained by the fact that the stakeholders have been involved in the development of the different concrete action plans. This has led to a set of action plans that the stakeholders have agreed on to be capable enough to implement. However, there are still some concerns regarding the capabilities and attractiveness to implement the plans:

- While the attractiveness and the capabilities of most stakeholders might be high, implementation of the plans still requires effort. There are no consequences for not complying to the agreements within the covenant. Even though the stakeholders have signed the covenant and thereby declared that they will put their effort to successfully achieve the agreements in the proposal, this is not a guarantee that they will truly do this. It might be possible that a stakeholder has signed the covenant with other intentions, e.g. greenwashing or being passively involved only to receive knowledge but not contribute to the agreements. Also unexpected events like financial or organizational problems within the stakeholders' organization might lead to incompliance to the covenant.
- Staatsbosbeheer: The ambitions of the covenant are attractive for Staatsbosbeheer in multiple ways. They strive for sustainable forestry, which is one of their ambitions that is in line with the transition to timber constructions and the covenant. They aim to protect the nature and the decrease of traditional construction materials will contributing to lower CO2 emissions, which is beneficial for the environment. However, while the proposal is in line with their own ambitions, they do not have many capabilities for the implementation. In the first place, because there is not a lot of land available in the Netherlands to be transformed into forest areas. Staatsbosbeheer does not have the legal power to decide which land will be transformed to forest areas, they only have rights to maintain the land that they own, which is limited. The low authority of Staatsbosbeheer and her diverse range of tasks, that might have other priorities, makes the capacity for implementing the ambitious agreements low for this stakeholder.
- Knowledge institutes: They are closely involved in research & development of innovations, which makes the attractiveness of the covenant high for them. However, they have a low capacity to comply with the agreements. A large part of the knowledge development concerning timber constructions is built up from practical

experience. Although some agreements fit well with the capacities of knowledge institutions, there are some agreements that are difficult for them to comply with. The knowledge that developers have, for example, is often not shared, while this is precisely the valuable knowledge for application in practice. The means to obtain knowledge, that they can share in their turn, are therefore limited for this stakeholder.

- Banks and institutional investors: On the one hand, these stakeholders have high capabilities to implement the proposal, as they provide financial resources. However, even though they have signed the covenant and thereby declared to comply to the agreements, an investment in timber constructions offers less certainty to this stakeholder. There can be many unforeseen aspects (e.g., Covid, conflict in Ukraine, etc.) that can lead to price fluctuations, and given that the current application of this product is still relatively new, investors might be more attracted investments that offer a higher level of certainty.

6.1.3 **Step 3-** Techniques for policy or plan implementation

For this step, a better understanding of what is required of each stakeholder during the implementation and development of the covenant has been developed. As different action plan elements are presented in the covenant, these elements are used to develop the policy implementation strategy development grid for the different stakeholders. Looking at the implications for the implementation strategy gives a better understanding about where there might be barriers for the implementation of the timber transition. While some of these implications seem to be within the responsibility of the stakeholder itself, other implications are outside their scope and therefore require either development within the ST-system, or governmental support. For example, regulatory restrictions or financial issues are implications for which the implementation of governmental policy instruments could contribute to the development of the strategy.

On the other hand, understanding how the influence of the stakeholders contributes to the development of the strategy implementation is valuable to understand which elements are still lacking and how the governmental parties can contribute to this. A table with the policy implementation strategy development grid can be found in Appendix C3.

6.1.3.1 Preliminary remarks

The implications for the implementation of the strategy can be categorized in implications that are related to financial problems, regulatory limitations, a lack of knowledge and problems within the supply and demand and/or supply chain. Apparently, the currently implemented policy instruments are not targeting these implications sufficiently. When governmental instruments for the transition of timber constructions are implemented, they can be directed at overcoming these implications to match the needs of the stakeholders. The policy instruments that are included in the AF can be implemented to overcome these implications. Specific instruments are not necessarily related to specific implications. E.g., information instruments can be used to increase knowledge in to supply chain, which will eventually lead to lower costs to overcome financial barriers. However, financial barriers can also be overcome by using economic instruments like offering subsidies. It is important for governmental policymakers to carefully assess which policy instrument should be implemented when they design a policy mix. The policy mix building blocks can be helpful in the design of the right policy mix.

6.2 Governmental stakeholders

Similar to the SA of the non-governmental stakeholders, an analysis of the governmental stakeholders has been conducted. In October 2021, the covenant is signed by 14 municipalities, two provinces and the national state. In this SA, the municipality of Amsterdam is subject of analysis, as the 14 different municipalities differ a lot and they cannot be considered as one stakeholder in the analysis.

6.2.1 **Step 1-** Problem formulation

As described in chapter 5 (Research methods), first the method of Bryson (2004) has been used to provide a good description of the different stakeholders, based on some important points. After this, the problem formulation technique by Mitchell et al. (1997) has been used to assess the stakeholders' levels of power, legitimacy and urgency.

National state

In line with the Paris Agreement, the national state has set up an approach to guide the Netherlands towards a CE. This transition requires a change from circular to linear in multiple systems, among which the BE. The ministry of internal affairs has set up the program 'Strategische Verkenning over Biobased Bouwen', in which the aim is to work on the transition towards biobased buildings, together with the involved stakeholders. One of the results of this program is the development of the 'City Deal Circulair en Conceptueel Bouwen', in which the transition of biobased constructions is one of the three main action lines. Different departments of the national state are involved in this City Deal, which makes the national state an important player within this transition (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.). As this stakeholder has invested in the development of this transition, they expect the other involved stakeholders to be invested as well. Furthermore, they expect the transition to scale up to a level where 50% of the new built constructions will be built out of biobased materials in 2040. While having high expectations, this stakeholder also has a high level of influence which needs to be used in this transition. For example, national regulations need to be adjusted to make it easier to build in timber.

The national state consists of many departments and conflicting interests might occur. While there is a major interest within the national state to facilitate the transition, conflicting interests and bureaucracy between different departments is possible and can make it difficult to implement specific regulations to foster timber. As there is a pressing housing shortage, some ministries might be more interested in cheap constructions to quickly facilitate in the housing shortage. It is therefore important for the national state that all departments work together, and their visions and ambitions are aligned towards their mutual interests, especially because their interests can work reinforcing (e.g. industrial production of biobased housing to accelerate ánd sustain the housing market).

Province (Noord-Holland and Flevoland)

The province often provides municipalities with knowledge and has a facilitating role in transitions. Due to this educational role and their broad knowledge on innovations, they seek to make the transition and have set up action agenda's that present strategic and operational goals for a CE. They aim to educate municipalities on the necessity to transition towards timber constructions. Together with the municipalities, they can set up provincial housing agreements that include the construction of timber, however, while provinces help in determining the boundaries of expansion for urban areas, they are not responsible for the zoning plans within municipalities that give more specificity to the urban areas. However, they can influence and contribute to the transition by appointing suburban areas for the production of timber as a construction material (Metropoolregio Amsterdam, 2021).

Municipality (Amsterdam)

There can be a big difference in the sustainability ambitions between different municipalities. The municipality of Amsterdam is a progressive municipality that has placed the topic of circularity high on the agenda. The municipalities that have signed the covenant expect the transition to be successful and expect all stakeholder to participate actively in this transition. The past few years, some (iconic) timber constructions have been developed in the municipality of Amsterdam, which led to an increased level of knowledge within the municipality. The projects that are developed have often led to an interaction between the municipality and the project team, which has led to an increase of knowledge on the project process and everything that is involved with it, for both parties. As the municipality of Amsterdam has some ground in possession, they can aim for the development of timber constructions by setting out tenders with high circularity requirements on their grounds. Furthermore, the municipality can provide market parties with knowledge about timber constructions to stimulate them to develop more timber projects. To further accelerate the transition, more regulatory requirements can be implemented by the municipality that contribute to the implementation of more timber projects.

The different types of governmental stakeholders that are described above can be assessed based on their level of power, legitimacy an urgency, as can be seen in Figure 21. Awareness of the missing attributes of the different stakeholders can be helpful in predicting whether the stakeholders will attempt to gain the missing attributes.

6.2.1.1 Preliminary remarks

Based on the assessment of the attributes and the description of the different stakeholders, an expectation of the stakeholders' behavior can be made. Not all governmental stakeholders have the goal to gain all attributes as indicated in Figure 21, thus are not expected to do so.

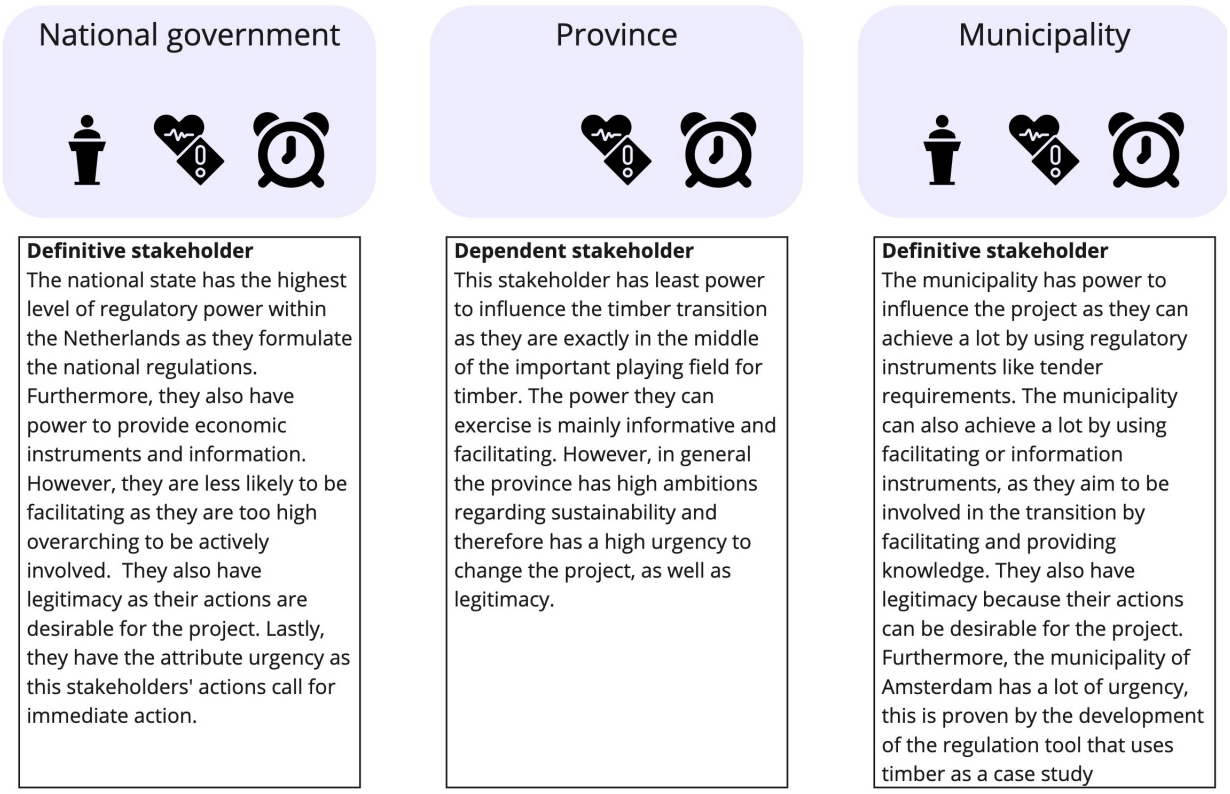


Figure 21: Assessment of the governmental stakeholders based on their level of power, legitimacy an urgency

- The province has the least power to influence the project as they don't have a lot of regulatory instruments that can be used to promote the timber transition and not a lot of regulatory power in urban or municipal areas, which makes it difficult for this stakeholder to influence urban transitions. The other governmental stakeholders have different types of instruments that can be used to promote the timber transition and have more power within the urban areas. The distribution of powers between the different authority levels is consistent, pre-known and all levels have their own responsibilities and position within the structure. Therefore, the province is not likely to try to gain the attribute power.

6.2.2 **Step 2-** Proposal development, review and adaptation

A policy attractiveness versus stakeholder capability grid has been made for each governmental stakeholder to be able to assess whether the policy is likely to be implemented by the different stakeholders, based on their capacities and the attractiveness for the stakeholders to implement the policy plans or proposals. The criteria for assessment of the attractiveness are based on the level of alignment of the stakeholders' capabilities to the vision, goal, general agreements and issues that are agreed upon to be solved, as presented in the covenant 'Green Deal Houtbouw'. The vision, goal and agreements of the covenant 'Green Deal Houtbouw' are described in section 5.2 (Case description)

As this SA is not the main topic due to the scope of this research, this step of the SA has been a simplified version, as it normally requires a lot of knowledge to be able to properly fill in the grid. The preceding knowledge has led to an estimation of how the grid should be filled in, but it should be kept in mind that this grid is therefore still open to more development and refinement. The grid can be found in Appendix C2. Some general preliminary remarks that can be concluded from this grid and the gained knowledge about the stakeholders are presented.

6.2.2.1 Preliminary remarks

Both the attractiveness and the capabilities of the governmental stakeholders are high enough to implement the proposal. However, the attractiveness is lowest for the national state, as this stakeholder has many interests and within the organization, conflicting interests can occur. This might lead to long and complex policy making procedures. However, the capabilities to implement the proposal are highest for this stakeholder as the national state has the highest power and therefore the most capacity to implement policies or plans compared to the other governmental stakeholders. The province has the least capabilities to implement the proposal as they are the governmental stakeholder that has least direct power within urban areas and therefore have the lowest level of influence on urban transitions.

6.2.3 **Step 3-** Techniques for policy or plan implementation

During this step, a better understanding of what is required of each stakeholder during the implementation and development of a policy has been developed. As different action plan elements are presented in the covenant, these elements are used to develop the policy implementation strategy development grid for the different stakeholders.

Looking at the implications for the implementation strategy gives a better understanding about where there might be barriers for the implementation of policy instruments for the timber transition. Assessing how these implications rely to the action plan elements can give a better understanding of whether the action plan elements (as given by the covenant 'Green Deal Houtbouw') are feasible and helpful to overcome these implications. Mismatches between the implications and the action plan elements might require the implementation of different instruments or other action plan elements of the governmental stakeholders. A table with the

policy implementation strategy development grid can be found in Appendix C4.

6.2.3.1 Preliminary remarks

One of the implications that accounts for all the different governmental stakeholders is the compliance to other governmental levels. One governmental stakeholder does not operate in a vacuum and there are always different regulations that need to be complied to. However, inconsistency between different stakeholders can make the processes difficult and might hinder the implication of the different action plan elements. It might also lead to certain topics falling between the different authority levels, as there is no mutual agreement on whose responsibility it is.

6.3 Preliminary conclusion

The method of Bryson (2004) has been used to conduct a descriptive analysis of the different governmental and non-governmental stakeholders that have signed the covenant. It seems that all stakeholders that have signed the covenant are important in the transition in their own manner. The triple helix collaboration between public, market and educational parties set up the covenant and all type of parties are required to align to the strategy of the covenant to be able to realize the intended agreements. In general, almost all non-governmental stakeholders are capable to realize the agreements that are included in the strategy of the covenant as they have had a say in the making of the policy mix. However, some stakeholders have lower capabilities as they do not have a high level of influence and/or power to achieve the agreements. Furthermore, the policy mix is generally attractive for the stakeholders as these stakeholders intend to be actively involved in the timber transition. As the importance of the triple helix collaboration is stipulated, it is important that all stakeholders are able to adhere to the agreements. Therefore, during the implementation of the policy mix, the different implications of the stakeholders should be taken into account, as these can be possible barriers for adherence to the agreements.

Regarding the governmental stakeholders, the assessment of their involvement is more difficult, as the different stakeholders often consist of multiple departments. Considering the departments that have strategies that are aligned with the covenant, the policy mix is attractive to be implemented. Their capabilities can be considered high enough, however, misalignment between different departments within one stakeholder (e.g. ministries within the national state) can lead to lower capabilities. Therefore, coordination of strategy alignment between, and within, the different governmental stakeholders, is crucial for the policy mix to be implemented.

7. Document analysis

In this chapter, the case study document is analyzed as being a policy mix, by using the AF (section 4.3). The different items within the building blocks are analyzed, which led to a descriptive analysis. The chapter ends with the analysis of the different characteristics of the policy mix.

The covenant 'Green Deal Houtbouw' is analyzed based on the AF that is presented in section 4.3. The different building blocks of the AF are used for the analysis of this document.

Together with the covenant, an action agenda has been published that presents the more concrete actions that should be taken to achieve the goal of the covenant. These actions require an intermediate evaluation after half a year and can be actualized based on the results of this evaluation. While the covenant is aimed at 2025, yearly evaluations will lead to a new version of the covenant each year. The analysis of this research has been conducted on the currently available versions of the 'Actieplan Houtbouw' and the 'Houtbouw Covenant' that are both written in 2021.

The covenant 'Green Deal Houtbouw' can be considered s a document that contains a proposal for a policy mix that consists of both governmental and non-governmental policy instruments. This policy mix proposal is analyzed by using the analytical framework: the different building blocks of the covenant 'Green Deal Houtbouw' are elaborated on.

7.1 Elements

7.1.1 Strategy

The strategy of the covenant is shortly described by an elaboration of the vision, goal, general agreements, and issues that are agreed upon to be solved in the covenant, see Figure 22. The vision is translated in a tangible goal, which is to be achieved by complying to the general agreements and agreeing to solve some issues

This strategy is translated in concrete activities that are in line with the overall strategy. The stakeholders that have signed the covenant are accountable for the implementation of these activities.

7.1.2 Instruments

As argued in the strategy, the covenant elaborates on different concrete actions for all stakeholders which they can be held accountable for to comply with, to reach the goal that is presented in the strategy.

As these actions are concrete techniques by which a change is attempted to achieve, these actions can be seen as the instruments to achieve the goal within the strategy. From this perspective, it

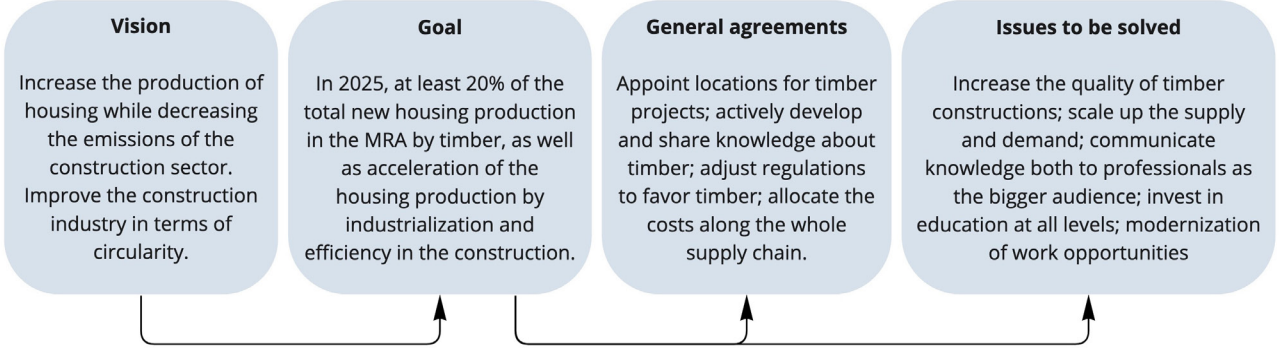


Figure 22: Summary of the vision, goal, general agreements, and issues that are agreed upon to be solved of the covenant 'Green Deal Houtbouw'

Table 5: The different instrument types as presented in the covenant, categorized per instrument type

	Governmental	Non-governmental
Regulatory instruments	• Develop public law enforcement to be able to require timber (state) • Include the CO2 storage of biobased materials in the MPG calculations (state) • Ensure regulation at EU level on sustainable forestry (state) • Actualize the regional housing agreement (province) • Make room for multifunctional forest in the regional plans (province) • Appoint locations for timber (municipality) • Align tender/land lease requirements with the covenant (municipality)	• Agree on the volume of timber to be delivered by European timber producers (timber builders) • Agree on delivery of specific timber products to accelerate the procedures (timber builders) • Realize 3 new multifunctional forest areas in the MRA (Staatsbosbeheer)
Economic instruments		• Positively value timber in the request to contractors (developers) • Positively value timber by using sustainability/life cycle scores (investors) • Include timber in the program of requirements (investors, housing corporations) • Include timber as a prominent required investment product (investors) • Apply the same guarantees and insurances for timber as for traditional construction (bank) • Development of new frameworks to make timber more manageable to buy (banks) • Invest in educational trajectories for timber (knowledge institutes)
Information instruments	• Increase the internal expertise about timber by knowledge sharing (municipality) • Ask developers for LCA calculation that includes the storage of CO2 (municipality)	• Work with open-source principle to help others in the scale up (developers, contractors, architects) • Increase knowledge on timber and used materials (contractors) • Talk with funds about allocating budged for timber investments (investors) • Active participation in innovation programs (developers, investors, housing corporations) • Convince clients about the advantages of timber (architect, engineers) • Publish about own projects via diverse channels (architects, engineers) • Share knowledge via media- and expertmeetings (knowledge institutes) • Debunk fabels by providing more knowledge (knowledge institutes) • Share expertise to positively influence the market and the public opinion (engineers) • Contribute to the development of knowledge and improvement of regulation (engineers)
Facilitating instruments	• Use the City Deal Circulair en Conceptueel Bouwen to stimulate timber and ensure effective knowledge transfer (state) • Stimulate timber in the environmental visions (municipality) • Facilitate own organization to be able to realize the covenant (municipality) • Positively value market project proposals that include timber (municipality)	• Appoint locations for timber (developers, contractors, housing corporations) • Develop at least 1 timber project (developers, contractors, investors, housing corporations) • Positively respond to initiatives of timber projects (developers) • Facilitate employees with education on timber to be able to realize the covenant (developers, contractors) • Facilitate capacity to invest in education (knowledge institutes) • Using expertise to retrain the construction with timber (knowledge institutes) • Facilitate enough capacity to reach the 20% goal (timber builders) • Develop timber products and housing concepts (timber builders) • Facilitate the realization of a sawmill for timber processing (Staatsbosbeheer) • Facilitate the development of the supply chain of timber (Staatsbosbeheer) • Facilitate objective advice that is aimed at sustaining the construction industry (engineers)

can be argued that the covenant elaborates on the implementation of different instruments, both by governmental as non-governmental stakeholders. A summary of the different instruments, ordered per instrument type, that are presented in the covenant, can be seen in Table 5. The classification of policy instruments that is presented in chapter 4 (Theoretical framework) is used for this analysis.

7.2 Policy processes

7.2.1 Policy implementation

The covenant was signed in October 2021 and are implemented until October 2025. As the covenant is implemented during a conference, the implementation had sufficient attention and the stakeholders that have signed the covenant from the beginning on have been aware of the implementation of the covenant. The policy proposal therefore is in effect and the stakeholders that have signed have agreed on it. By signing the covenant, the stakeholders declare that their mutual goal is to promote the scale up of timber constructions, as indicated in the covenant. The MRA is not an official governance level in the Netherlands, thus they do not have the authority to implement regulatory instruments. The covenant is therefore solely an agreement and is not legally binding. Therefore, a high level of trust and expectation towards each other is required within this agreement. The mutual wishes and ambitions of the stakeholders should be aligned with the strategy as presented in the covenant to be aligned within the agreement. The action plan that is additional to the covenant presents an approach along five

action lines that are required to be followed in a triple helix collaboration (public parties in the MRA, knowledge institutes, and private parties), to achieve the desired results. Specific stakeholders are appointed to be leading for the different action lines and it is indicated which other stakeholders are important for this action. All stakeholders have agreed on the different responsibilities per stakeholder, that have been set up in list of the concrete actions (see case study description, section 5.2). Complying to these actions requires a new approach and different implementation of existing working methods. Each stakeholder is expected to contribute by setting up an individually completed growth scenario directed at 2025 and actively participate in sharing knowledge. Furthermore, commitment to the covenant can only be achieved by continuous collaboration, making use of each other's mexpertise and transparency (Metropoolregio Amsterdam, 2021). Regarding financial resources to be able to implement the policy proposal, it might require high initial financial resources to comply to the agreements, however it is expected that these costs will both deliver return on investments and become lower in the coming years. No statements have been made yet about the proceeding of the timber transition after 2025, which is currently the end date of the covenant.

7.2.2 Policy making

The covenant is the translation of the timber construction ambition of the MRA, that has been decided in the Green Deal Houtbouw during the State of the Region at decemer 2, 2020. This same collaboration will be continued during the implementation phase. The Director Build-in-Wood Metropolitan Region Amsterdam is the program leader and the Circular construction and project manager at C-creators is the secretary of the program team Timber constructions of the MRA (houtbouw, 2022). The covenant has been made in an intensive 'triple helix' collaboration between governmental stakeholders, knowledge institutes and market parties: together, these parties came to a long list of agreements, both general as well as per stakeholder. Even though the ambitions are high, the stakeholders agreed on these specific agreements. While the policy proposal is currently implemented and in effect, there is still room for evaluation and improvement of the content, thus the policy making process has not ended yet. Each year, evaluation will lead to adjustments of the covenant, which might also lead to the addition of new instruments within the covenant.

7.3 Dimensions

7.3.1 Geography

The covenant is aimed at the timber transition in the MRA, thus the geographical dimension of it can be seen as the MRA (metropole region of Amsterdam). 14 municipalities have signed the covenant thus the geographical dimension can be indicated by those 14 municipalities. However, the provinces of Noord-Holland and Flevoland also have signed the covenant, thus the geographical dimension could also be interpreted to the borders of these provinces. Moreover, the national state has also signed the covenant. As their actions have consequences throughout the Netherlands, the geographical dimension could also be interpreted as all throughout the Netherlands.

7.3.2 Governance level

In the first place, the covenant is aimed both at governmental and non-governmental stakeholders, who have both signed the covenant. However, the covenant includes policy instruments for governments on different governance levels: municipalities, provinces, and the national state. As the MRA is not a governmental level in the Netherlands, they are not included in the definition of the governance levels of this policy mix analysis.

7.3.3 Policy field

The covenant itself is not binding, as the MRA does not have regulatory power as it is a region and not an administrative governance level. Therefore, the agreements within the covenant are not binding

regulations. Signing the covenant is an act that us based on private law regulations for the different government levels that have signed the covenant. As there are no binding agreements, signing the covenant is an act between civil parties.
The different agreements and actions that are aimed at the different governmental levels that have signed the covenant concerns an act between individuals. However, the covenant contains proposals for instruments that are both public-law and private-law instruments. These instruments can be categorized in different policy fields. However, as the strategy of this covenant is aimed at environmental, climate and economic (housing market) goals, the specific instruments within the covenant are within the climate, environmental, and economic policy field.

7.3.4 Time

The timeline of the covenant is five years, however, this does not mean that the proposals for the implementation of certain instruments will be limited by five years: once certain instruments have been implemented, they do not have a bounded timeline.

7.4 Policy characteristics

7.4.1 Coherence

As argued in the introduction, the use of timber fits within the different policy strategy documents that have been implemented on different governmental levels. The MRA came to the covenant 'Green Deal Houtbouw' due to the oppressive housing shortage in the MRA region on the one hand, and the circular economy strategies implemented by the different authority levels on the other hand. Figure 23 (Bucci Ancapi, 2022) shows how the Covenant Green Deal Timber Constructions fits within the circular policy landscape of Amsterdam. This framework presents a temporal assessment on the horizontal axis, against a vertical axis that presents the different strategies within one domain.

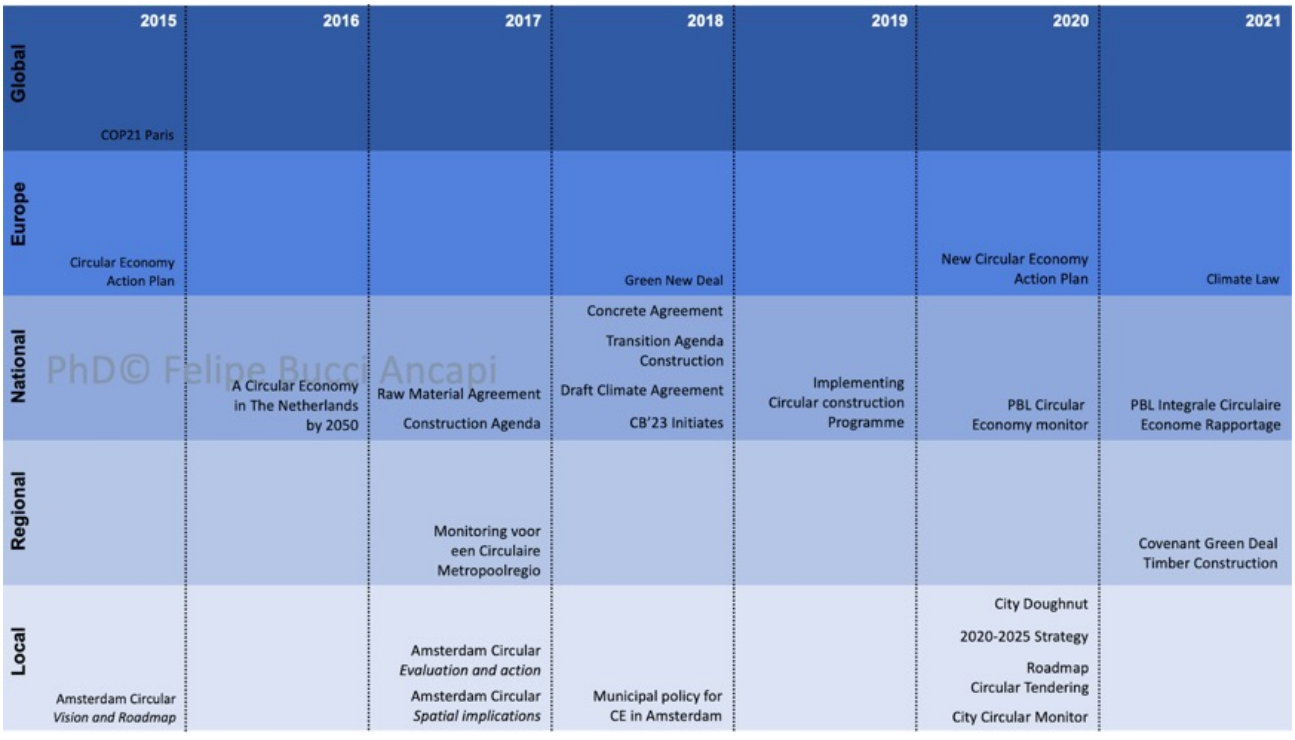


Figure 23: Policy Landscape Circular Amsterdam (Bucci Ancapi, 2022)

For policy coherence, it is important to enable policy integration by generating a holistic perspective across multiple sectors, and to achieve coordination by alignment between the different public organizations. Both of these criteria can be assessed in this case. It can be argued that policy coordination is being achieved, as the different strategy document across different public levels are aligned, as can be seen in Figure 23. However, the assessment of policy integration is difficult, as this requires an assessment of all policy strategies across multiple sectors to be able to make a comparison. However, the covenant 'Green Deal Houtbouw' lacks in explaining its relation to other policy sectors. Assessing the coherence also requires an assessment of the vertical consistency. As the covenant 'Green Deal Houtbouw' seems to add value to the policy objectives and strategies that are implemented on other governmental levels, rather than counterproductive. The coherence based can be assessed somewhat in place

7.4.2 Comprehensiveness

Assessment of the comprehensiveness of the covenant is speculative, as the covenant has just been implemented which makes it difficult to look at it from retro perspective. However, comprehensiveness is determined by the degree to which the instrument mix addresses all market systems. As can be seen in Table 5, the covenant does not include any economic instruments for the governmental stakeholders. However, it is argued in the covenant that high initial costs might be a challenge for the timber transition. Furthermore, besides the required percentages of houses constructed in timber in 2025, no assessment criteria that are aimed at the environmental or economic performances have been provided. Due to the lack of operationalization of economic instruments and assessment criteria for performance of the covenant, the covenant can be assessed absent.

7.4.3 Consistency

Consistency of a policy mix is defined by alignment of the different elements and achievement of the objectives. As the policy implementation of the covenant has recently started and the covenant contains future objectives, it is hard to assess the consistency of the elements to the objectives of the strategy. While the instruments might seem to be supportive for the strategy of the covenant, it is not yet known whether the objectives within the strategy will be achieved, nor whether the different instruments are conflicting to the strategy or might lead to trade-offs. However, the consistency of the instrument mix can be assessed. As the policy instruments within the mix seem to be reinforcing rather than being counterproductive, they can be assessed as being consistent. However, it is important to keep monitoring the effects of the implementation, to become aware of inconsistencies ahead of time. The consistency of the covenant can be assessed somewhat in place.

7.4.4 Credibility

The credibility of a policy mix is defined by its believability and reliability. Commitment and support from political leadership increases the credibility. As different governmental stakeholders, among which many municipalities, two provinces and the national state, have signed the covenant, as well as a wide variety of market parties, credibility of the covenant is ensured. Furthermore, knowledge institutes like AMS institute, the TU Delft and many others have joined the realization of the covenant. The AMS institute even facilitates the realization of many action lines which increases the credibility as it provides a scientific-based perspective of the actions within the covenant and the timber transition. However, the covenant has been implemented very recently, the general opinion and believe of people is not yet known. The credibility can be assessed somewhat in place.

7.5 Preliminary conclusion

The case study 'Convenant Green Deal Houtbouw' has been analyzed based on the different building blocks of the analytical framework. It follows step 3 as presented in the operationalization of the AF (see section 4.4), as it shows an analysis of the proposed policy mix for the sustainable transition topic. It is therefore a analysis that describes the building blocks 'elements', 'policy processes' and 'dimensions' of the policy mix. The building block 'elements' presents the strategy of the transition subject of this research, and is therefore be used within the interview analysis as well. The different policy instruments that are presented in the covenant are aimed at both governmental and non-governmental stakeholders. It can be noted that there are limited information instruments for governmental stakeholders, economic instruments are completely lacking. The building block 'policy processes' is difficult for this policy mix proposal as the covenant has recently been implemented thus effects are hard to measure. Furthermore, the policy making is a continuous process that is still under development. Lastly, the building block 'dimensions' describe the different measurable features of the covenant. This assessment stipulated the complexity of the covenant, as it has a broad geography level, while being aimed at both governmental and non-governmental stakeholders. Furthermore, the covenant is initiated by the MRA, however, this is not an official governance level thus this stakeholder does not have legal authority to enforce regulations.

After the description of these building blocks, the building block 'policy characteristics' of this policy mix proposal is analyzed, based on the content of the preceding building blocks. The coherence, consistency and credibility of the policy mix can be assessed somewhat in place. However, the covenant lacks in defining its position within other policy sectors. This might lead to incoherence of the agreements to policies in other domains. Furthermore, the comprehensiveness is argued to be absent as the covenant does not cover all policy fields and lacks in expressing its coherence and consistency within and between different sectors, domains and governance levels.

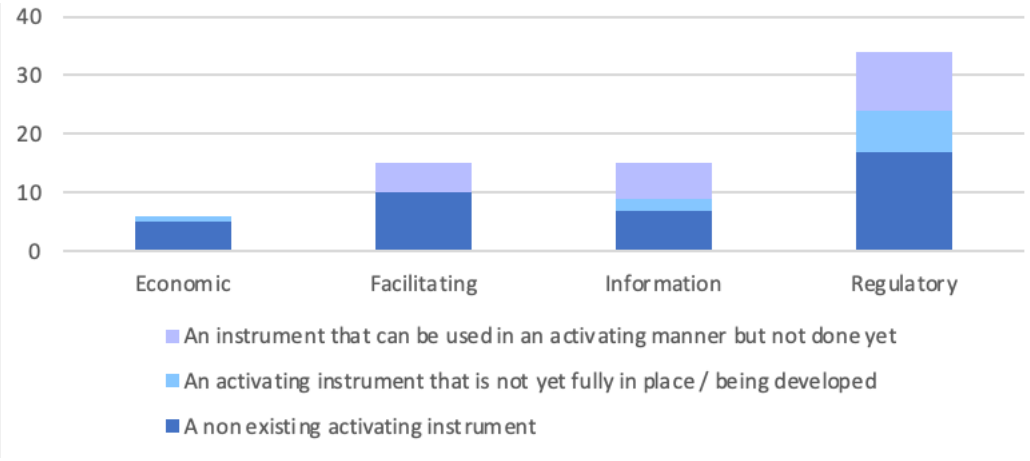


Figure 24: Instruments that are necessary to stimulate and activate transitions, according to the non-governmental stakeholders (y-axis represents the amount of times that an instrument along the x-axis is coded)

8. Interviews

In this chapter, step 4 and 5 of the operationalization of the AF (see section 4.4, Table 3) are conducted. This chapter first presents the results of the interviews analysis that follows the method as described in section 5.5 (Research methods for interviews). Figure 19 shows how different assessment criteria define different types of relations of the discussed policy instruments to the strategy of the covenant (presented in the document analysis. First, the results of the instruments that are necessary, as argued by the non-governmental and governmental stakeholders, are presented, after which the instruments that have effect, according to both stakeholders, are presented. These results will then be followed by an assessment of the policy characteristics of the different policy instruments that are discussed. The results of this chapter, together with the other research results, are used in the final part of this research, that presents the synthesis of the different results.

The findings of the interviews contribute to the answering of sub-questions 5 and 6.

SQ5: Which policy instruments are needed for the timber transition?
SQ6: What is the effect of the current policies on the transition towards timber constructions?

The data is presented in visual graphs that can partly be found in the appendices.

8.1 Policy instruments that are necessary

8.1.1 Non-governmental stakeholders

The results of the policy instruments that are perceived necessary for the timber transition by non-governmental stakeholders can be found in Appendix D1. According to these stakeholders, more regulatory instruments are necessary to stimulate and activate the timber transition (see Figure 24). Facilitating and information instruments come second, and economic instruments are not favored by the stakeholders. Most of these instruments are instruments that do not exist yet, however, also existing instruments are needed to be used in a different way to activate the transition. It is notable that there is a high need for new facilitating instruments as well.

An example of a non-existing regulatory instrument that has been discussed during the interviews:

Priority in the permit process for biobased materials to accelerate the project process.

An example of a regulatory instrument that is not yet fully in place or being developed, that has been discussed during the interviews:

National regulations for the inclusion of biobased/ timber materials in the MPG calculations.

An example of an existing regulatory instrument that needs to be used in an activating manner, that has been discussed during the interviews:

Tender requirements that are aimed at biobased materials or timber constructions.

An example of a non-existing facilitating instrument, that has been discussed during the interviews:

Continuous involvement from the government during timber projects, to smoothen the assessment procedures

The different instruments that are perceived necessary, mainly require implementation at national and municipal level (equally distributed). Only few of these instruments should be implemented on provincial level (Figure 34, Appendix D1).

When a distinction between the different stakeholder types is being made, developers, housing associations, architects and umbrella organizations are the stakeholders that require most regulatory instruments to be implemented. Engineering- and consulting firms and housing associations require most information instruments, knowledge institutes and housing associations require most facilitating instruments (Figure 35, Appendix D1).

8.1.2 Governmental stakeholders

The results of the policy instruments that are perceived necessary for sustainability transitions by governmental stakeholders can be found in Appendix D1. According to these stakeholders, more regulatory instruments are necessary to stimulate and activate sustainability transitions (see Figure 25). Facilitating instruments come second, economic and information instruments are not favored. Most of these instruments are existing measures that are not yet used in a manner that stimulates sustainability transitions, however, also new instruments should be implemented.

An example of an existing regulatory instrument that needs to be used in an activating manner, that has been discussed during the interviews:

The enforcement of circularity in regulatory instruments on National level by e.g. stricter regulations concerning building codes

An example of a non-existing regulatory instrument that has been discussed during the interviews:

Flexibility in zoning plans, as long as the impact of a project stays the same, to make innovations easier

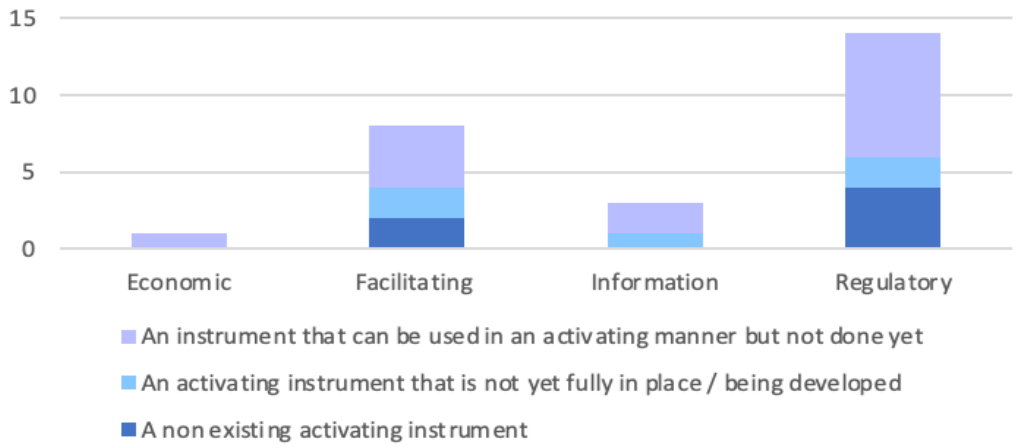


Figure 25: Instruments that are necessary to stimulate and activate sustainability transitions, according to the governmental stakeholders (y-axis represents the amount of times that an instrument along the x-axis is coded)

There is no consensus about the required implementation level of the different instruments that are perceived necessary. The municipality requires more instruments from the national level, the province requires more from the municipal level and the national state has no preference (Figure 36, Appendix D1).

When comparing the different stakeholders, it can be seen that all stakeholders require facilitating instruments. Besides these instruments, the national state requires mainly regulatory instruments, which the province is also aiming for. The municipality furthermore also requires information instruments (Figure 37, Appendix D1).

An example of a facilitating instrument that has positive effects, that has been discussed during the interviews:

The involved of the municipality during all project phases to be able to quickly respond and smoother the assessment process.

An example of a regulatory instrument that has positive effects, that has been discussed during the interviews:

The nitrogen regulations have a positive effect on the timber transition.

An example of a regulatory instrument that has negative effects, that has been discussed during the interviews:

The standardization that is used for assessments is not aligned with timber constructions.

8.2 Policy instruments that have effect

8.2.1 Non-governmental stakeholders

The results of the policy instruments that are perceived to have most effect on the timber transition by non-governmental stakeholders can be found in Appendix D2. They perceive regulatory instruments to have most effect. However, besides having positive effects, regulatory instruments are perceived to have most negative effects thus hindering the transition. Facilitating instruments are perceived to have most positive effects (Figure 26).

The different instruments that are perceived to have effect, are mainly implemented on municipal level. Some of the regulatory instruments are argued to be implemented on national level, while no implementation of regulatory instruments on provincial level is perceived (Figure 38, Appendix D2).

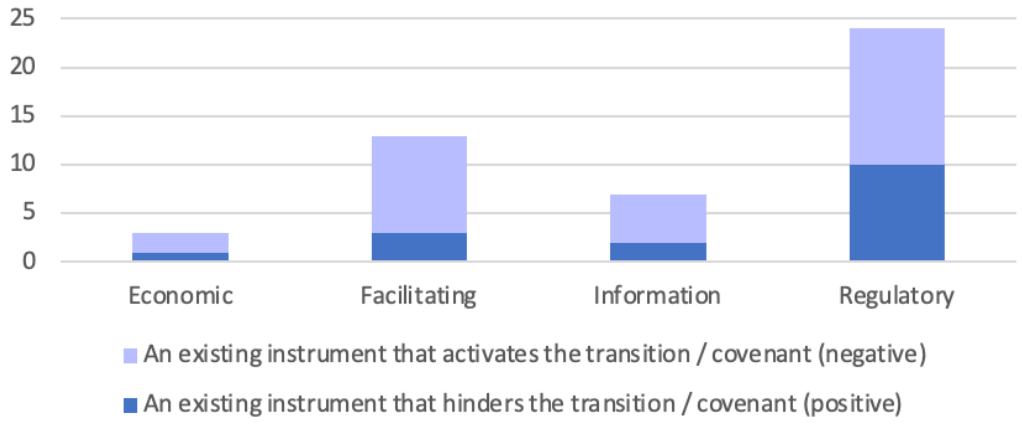


Figure 26: Existing policy instruments that have effect on the timber transition, according to the non-governmental stakeholders (y-axis represents the amount of times that an instrument along the x-axis is coded)

When a distinction between the different stakeholder types is being made, The architects, contractors, and engineer- and consultant firms perceive the regulatory instruments to have most effect on the timber transition. Engineer- and consultant firms in general perceive the most effects from policy instruments on the timber transition, while developers and timber builders perceive lease effects from the policy instruments Figure 39 (Appendix D2).

8.2.2 Governmental stakeholders

The results of the policy instruments that are perceived to have most effect on sustainable transitions by governmental stakeholders can be found in Appendix D2. According to these stakeholders, facilitating instruments are perceived to have the most positive effects and regulatory instruments are perceived to have most negative effects thus hindering transitions (Figure 27).

An example of a facilitating instrument that has positive effects, that has been discussed during the interviews:

Facilitation of workshops and bringing different stakeholders together by matching programs to facilitate connections for a mutual transition.

An example of a regulatory instrument that has negative effects, that has been discussed during the interviews:

Regulatory instruments can hinder circularity as the regulations label materials as waste. Regulations are often not aligned with innovations and can therefore hinder sustainability.

According to the different stakeholders, the different instruments that are perceived to have effect on sustainability transitions, are implemented by themselves (Figure 41, Appendix D2). There is no agreement on one implementation level on which the most instruments that have effect are implemented.

When a distinction between the different stakeholder types is being made, the municipality perceives facilitating and information instruments to have most effect, provinces and the national state perceive facilitating instruments to have most effect (Figure 40, Appendix D2).

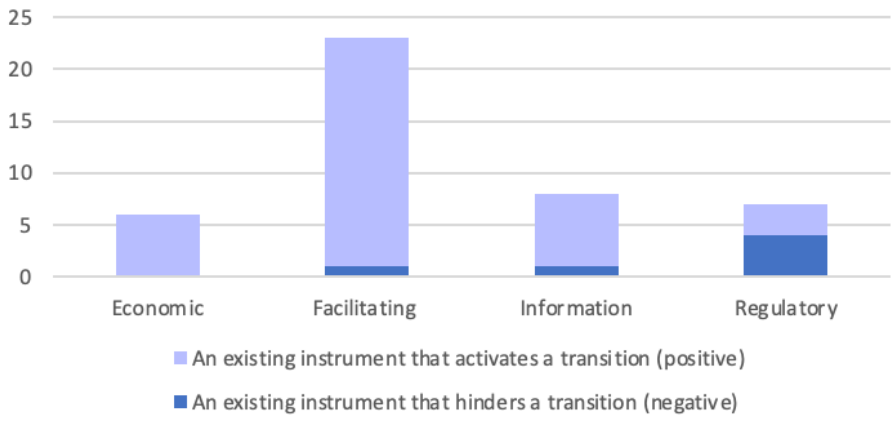


Figure 27: Existing policy instruments that have effect on sustainability transitions, according to the governmental stakeholders (y-axis represents the amount of times that an instrument along the x-axis is coded)

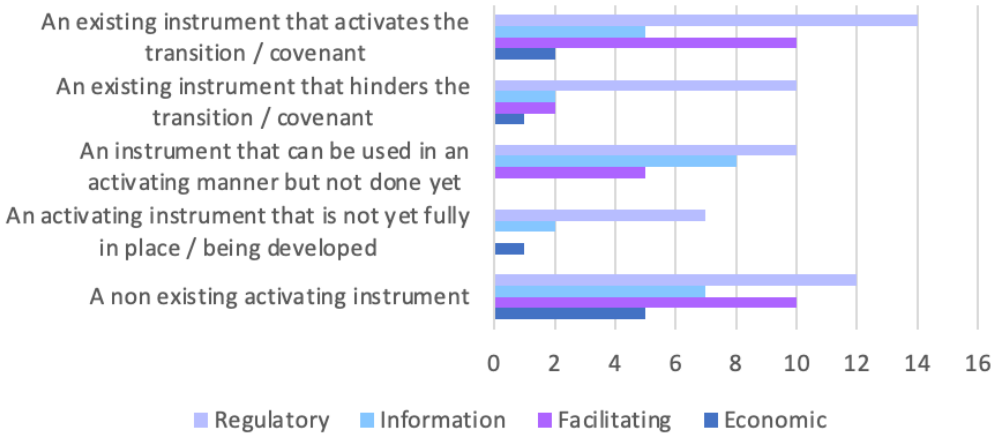


Figure 28: Relation of the policy instruments to the timber transition, according to the non-governmental stakeholders (x-axis represents the amount that the instrument is coded in the interviews and their relation to the timber transition / covenant is indicated on the y-axis)

8.3 Characteristics of the policy mix for timber transitions

The building block 'policy characteristics' of the different policy instruments that are discussed during the interviews, is described in this section. An assessment of the different policy characteristics is based on the assessment criteria (absent, somewhat in place, fully in place). The results are interpreted in chapter 10 (Discussion).

8.3.1 Consistency

The consistency captures the extent to which the instruments of the policy mix are aligned to the strategy. An overview of the different relations as described in the Research methods for the interviews (section 5.5, Figure 19), which are found during the interviews, can be used to describe the consistency, see Figure 28. As there are many instruments that are not consistent to the covenant (meaning: hindering existing instruments, existing instruments not used in activating manner and activating non-existing instruments), the extent of instruments that is misaligned to the strategy of the covenant is high and there seem to be a lot of missing instruments to achieve the strategy. The consistency can therefore be assessed 'absent'.

8.3.2 Coherence

Coherence is about the extent to which the policy making, and policy implementation are aligned to the strategy. Figure 29 shows the alignment of the policy making to the strategy of the covenant. This figure expresses the perceived misalignment in policy making (development of policies) to the strategy of the covenant.

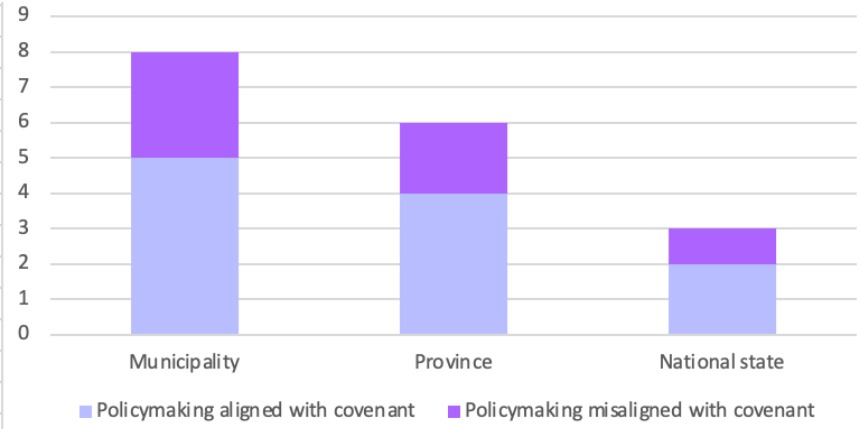


Figure 29: Alignment of policymaking to the timber transition/covenant (x-axis represents the amount that the policymaking in relation to the timber transition/covenant was discussed and by whom it is implemented is indicated on the y-axis)

Figure 30 shows the alignment of the policy implementation to the strategy of the covenant. This figure expresses the instruments that are implemented as a result of the covenant, that are perceived to be aligned to the covenant.

While some policymaking is perceived to be aligned to the strategy of the covenant, there is also policymaking that is misaligned to the covenant. Furthermore, the number of instruments that are implemented and aligned to the covenant is considerably low. The findings from the interviews seem to be aligned with the literature about coherence. Literature argues that while coherence is argued to be crucial in sustainability transitions, it is unlikely to achieve complete coherence due to the complexity of systems and the stakeholders that are involved. Therefore, the coherence can be assessed 'somewhat in place'.

8.3.3 Credibility

Credibility is about the extent to which the elements and processes are reliable and believable.
As the interviews have been conducted with stakeholders that have signed the covenant, it can be assumed that they believe in the covenant. During the interviews, the interviewees were asked why they have signed the covenant. There has not been one participant who was critical against the covenant, the general answer was that they see a lot of ambition in this transition and have trust in the future. The credibility can therefore be assessed 'fully in place'.

8.3.4 Comprehensiveness

Comprehensiveness can be determined by the degree to which the instrument mix addresses al market systems. Looking at the different types of instruments that have been implemented gives a clear idea of whether the different market systems are addressed. Figure 31 shows the different instruments that have been implemented. There is not an equal distribution between the different instruments. However, as the need for economic instruments is low, the absence of these instruments is not problematic. As the AF presents a limited amount of data and the policy mix has been implemented very recently, the assessment of the comprehensiveness of the instruments is difficult, the comprehensiveness is therefore assessed 'somewhat in place'.

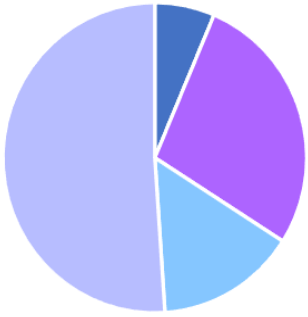


Figure 31: The different policy instruments that are implemented in relation to the timber-transition, according to the non-governmental stakeholders

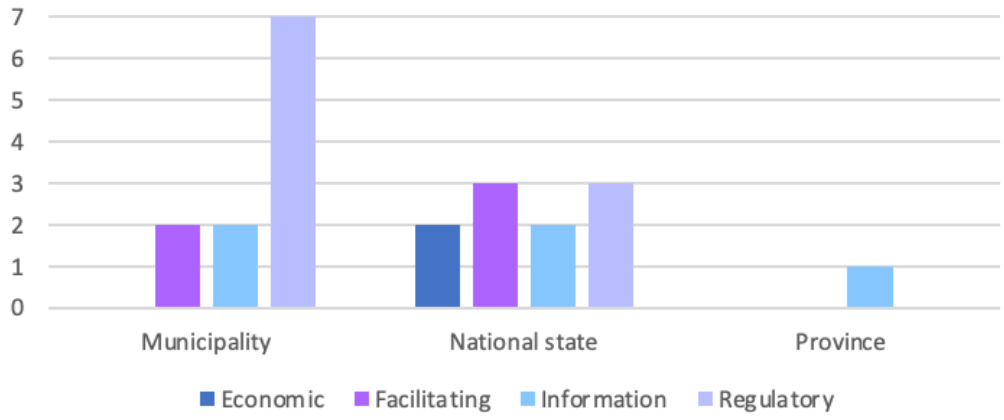


Figure 30: Implementation of different instruments that are implemented as a result of the policy mix (covenant) (x-axis represents the amount that the instrument is coded in the interviews by whom it is implemented is indicated on the y-axis)

9. Expert sessions

In this chapter, the expert sessions that are conducted to increase the validity of this study are presented. As argued in the research methods, expert sessions are conducted to establish respondent validation for the findings. The expert sessions consisted of experts within the timber transition in the MRA, which were also part of the preceding research. Multiple statements have been presented, that have either been validated or rejected by the experts. The statements are categorized based on different research outputs, namely: statements based on the used research approach (1), statements based on the stakeholder analysis (2), statements based on the document analysis (3) and statements based on the interviews (4). The different statements are presented, after which a short summary of the response to the different statements, as discussed during the expert sessions, is presented.

9.1 Research approach

- The different policy instruments vs. transitions as presented in the methods for analysis are representative for what is experienced in real life.
- The addition of facilitating instruments to the classification of instrument adds value for instruments for sustainable transitions

Summary research approach:
The relations that indicate existing relations are part of the research at Gemeente Amsterdam and therefore recognized. The experts also validate that there can be non-existing instruments. However, it is said that those instruments are often too difficult to implement as it requires a lot of changes in the current law system. Furthermore, the addition of facilitating instruments is perceived to add value to the definition of policy instruments. One of the barriers that has been experienced by policy makers is the difficulty in exactly defining what is needed for policy instruments to work, as policy instruments do not work in a vacuum. Furthermore, it is often experienced that people do not use the implemented instruments as there is no guidance or support from the government on how to use those instruments. The addition of facilitating instruments as an instrument type that facilitates the implementation of policy instruments is therefore truly an added value. According to the experts, it can be considered an instrument that is needed to make another instrument working: a combination of how the government does things, and how to implement other instruments. It was even argued 'you gave a name to something that was not defined yet'.

9.2 Stakeholder analysis

- The public and private parties who have signed the wood construction covenant are generally well placed to comply with the agreements as described in the covenant, given the involvement of these parties in drafting the agreements.
- The stakeholders that are less capable to implement the agreements are Staatsbosbeheer, knowledge institutes and banks & institutional investors.
- The biggest barrier for non-governmental stakeholders to transition to timber constructions is caused by the current laws and regulations.
- For governmental stakeholders that have signed the covenant, complying with the agreements can be difficult due to inconsistent policy making or implementation.

Summary stakeholder analysis:
There seem to be stakeholders that indeed have lower capacities to comply to the agreements. The lacking capacities for some stakeholders to implement the agreements are ought to be overcome. For example, the execution of project evaluations for 'Samen Versnellen' are important to gain and share more knowledge. Also, the increase of industrial manufacturing that will reduce the unforeseen bottlenecks that usually occur on the construction site, will lead to more certainty and therefore a higher capacity for some stakeholders to comply to the covenant.

Regarding the barriers for the transition, the expert indicates that there are more barriers for the non-governmental stakeholders to transition to timber constructions, besides the current law and regulations. It is rather a combination of factors stemming from a different way of working, causing legal, financial and organizational bottlenecks and the fact that there is not yet a demand from future residents. For the governmental stakeholders, inconsistent policymaking indeed plays a role in the transition. Inconsistent policy is policy that stems from various social tasks that the governments face, but which in implementation sometimes conflict. In addition, parts of the government have insufficient knowledge to facilitate the timber transition.

9.3 Document analysis

- The covenant lacks in presenting economic instruments for the transition, as well as assessment criteria for the realization of the ambition & goal
- The covenant lacks in operationalizing the goals, as there are no concrete agreements about the assessment of the achievement of the goals.
- The covenant falls short in embedding the proposals in current policies. It does not address how current policies can be used, or get in the way, of implementing the covenant.

Summary document analysis:
The expert agrees on the statements. However, it is argued that the design of the covenant that is described in these statements might be a deliberate choice, as the question from the initiators of the covenant had been: 'How far can you go in identifying and working out the bottlenecks, if you want to bind parties to you in a covenant?' The starting point was a coalition of the willing, a commitment to enter into a process in which many subjects still had to be worked out. On the one hand this was to avoid scaring off the stakeholders and causing them not to sign the covenant, and on the other hand it was because the knowledge was not yet available and had to be worked out with the stakeholders together. This raises the question of whether the covenant is 'inadequate' or whether it is a deliberate choice not to elaborate on these points to enable the stakeholders to commit to the covenant.

9.4 Interviews

- Regulatory instruments are mostly necessary for the timber transition. However, they are often perceived hindering so it is important to be very careful when implementing a regulatory instrument.
- For sustainability transitions in general, besides regulatory instruments, facilitating instruments are also very important.
- The necessary regulatory instruments for the timber transition are mostly required to be implemented on national & municipal level. On provincial level, facilitating instruments should be implemented.

Summary interviews:

There is agreement on these statements. While regulatory instruments are advised by research institutes, it is often unknown in what way they should be implemented. However, if you do not make regulations, personal interests of individuals will take the overhand as there is no common goal. Setting a goal can make regulations clearer and help in defining their boundaries. Thus, making regulations more explicit is helpful as this prevents individuals to follow their personal interests through difficult detours in the existing regulations. There is a general belief of the importance of regulatory instruments to achieve change, thus also sustainability transitions. However, just implementing regulatory instruments is difficult, it is perceived that there is much more that needs to be implemented to make those instruments work. The insights of this study, that are gained during the market research, are valuable, as it shows the importance of facilitating instruments from another perspective than the perspective of a policymaker. Based on these findings, it can be argued that regulatory instruments are really needed, but they need to be put into context and made understandable for the market to be able to respond to it. Putting a measure into context is one of the biggest challenges. During the expert sessions, the importance of the facilitating instruments has been emphasized. Getting a better understanding of facilitating instruments and acknowledging that these are necessary for other instruments to work is the first step for better policymaking for sustainability transitions. The addition of facilitating instruments can also be in the format of an advice about the implementation for instruments and providing suggestions for policymakers on how to make the implementation of an instrument concrete. Furthermore, it is agreed that the national and municipal level are most important for the implementation of regulations. Provinces have little authority. Norms are often defined at national level and permits are often regulated by municipalities. Provinces can conduct forestry, but there is little surface available in the Netherlands, thus this is not feasible. Provinces can facilitate the growth of knowledge institutes and appoint locations where modular (timber) buildings can be assembled.

PART V
SYNTHESIS

In this part, the results of the empirical research are presented. Step 2 up until 6 of the operationalization of the AF are conducted in this part. The empirical research consists of three parts, namely the SA, the document analysis, and the analysis of the interview data. The SA and the document analysis are both descriptive analyses of the case study 'Green Deal Houtbouw Duurzaam uit de crisis'. The SA is conducted by using t

10. Discussion

In this chapter, meaning has been given to the findings of the empirical research. First, an interpretation of the findings is presented. To be able to present a thoughtful conclusion and recommendations following on the discussion, the limitations of the research are addressed at the end of this chapter. This includes an overview of concrete examples for the policy instruments that are discussed, as the deductive approach limits the findings in addressing the specific content of the policy instruments. Lastly, the quality of the research is discussed by elaborating on the validity and reliability.

10.1 Interpretation of results

The interpretation of the findings from the different empirical study methods helps in answering SQ4, 5 and 6. The different topics that these sub-questions touch upon, are therefore discussed in this interpretation. First, the important stakeholders will be discussed, then the policy instruments that are necessary for a timber transition are addressed, after which the effect of the implemented policies is discussed.

10.1.1 Important stakeholders

While the results from the interviews is limited by the deductive coding approach, the content of the interviews can be used for a deeper analysis. The SA presents the main characteristics of the important stakeholders that are involved in the timber transition. As the topic of the interviews with the non-governmental stakeholders was the timber transition as well, the findings from the interviews can be used to reflect on the findings from the SA. The different non-governmental stakeholders that are interviewed are discussed.

- **Project developers & developing contractors;** during the interviews, this stakeholder seemed to care a lot about their image by becoming a frontrunner and excelling in the development of timber constructions. Furthermore, they want to use the covenant to get in contact with investors that are willing to invest, or clients that have assignments. While these findings are in line with the findings from the SA, the lack of knowledge is not heavily discussed during the interviews. Apparently, this stakeholder does not experience a knowledge gap to be an important barrier. This stakeholder mainly requires regulatory instruments to be implemented, which suits their attitude: they do not need the government to facilitate or provide information, but rather more regulations to create a level playing field for timber.
- **Housing associations;** during the interviews, the importance to create more knowledge, and the possibility to collaborate and join forces within the transition was emphasized. This is in line with the findings from the SA. The interview findings furthermore show that this stakeholder perceives multiple instrument types to be important. These instrument types are aimed at creating a level playing field for timber. As this stakeholder does not always have the possibility to take big risks as their target group is social rent thus the rental returns are not very high, the implementation of timber can be difficult and there are more incentives to choose for other, cheaper materials that have less risks. Therefore, the creation of a level playing field is important for this stakeholder.
- **Knowledge institutes;** the knowledge institutes emphasize the importance of the transition, as the climate crisis and the housing crisis are urgent matters. They aim to contribute to these challenges by sharing theoretical knowledge and creating social value. These findings are in line with the SA. Also the interview findings are in line, as they require the government to implement facilitating and regulatory instruments, based on the research that they conduct.
- **Timber builders;** this stakeholder argues that the government should stimulate a higher demand for timber constructions from the

market. He also argues that a system change is needed to make an effective transition. This is in line with the SA, in which this stakeholder is presented as being a frontrunner with high ambitions. As this stakeholder is a frontrunner, they might not perceive a high need for the implementation of new instruments. However, the interviews show that this stakeholder perceives regulatory instruments to be necessary. This can be explained by their aim to develop a system change in the market.

- **Architects;** this stakeholder indicates that they need to rethink the possibilities for timber before each project, as each design is different and needs reassessment of the methods to use this construction material. Therefore, standardization from governmental stakeholders would be helpful to make it possible to comply to the regulations in an earlier phase. The interviews add on the SA by addressing the high ambitions and aims of this stakeholder to implement as much timber in their designs. The SA describes the importance of gaining more knowledge about the implementation of timber in architectural designs. The results of the interviews also indicate that this stakeholder requires more regulatory instruments, to make it easier to implement timber in an early phase in the correct way.
- **Engineering- and consulting firms;** this stakeholder seems to be very knowledgeable. They already underpinned the importance of timber constructions before the covenant had been set up, and require the government to initiate more action to accelerate the timber transition. However, the covenant really suits their ambition and vision, as it aims for more knowledge sharing to become more sustainable. This stakeholder requires more information instruments. This can be explained by the fact that they require the government to join this transition by more knowledge sharing as they have a high level of influence and can invest in more research to increase knowledge sharing.
- **Umbrella organizations;** both the SA and the interviews indicate that this stakeholder aims to bring knowledge and other stakeholders together by facilitating networks and resources. Due to the many contacts with other stakeholders, this stakeholder understands what is needed by the market and aims to collaborate in a triple helix collaboration to improve the conditions for timber to be implemented. The interview results show the perceived need of this stakeholder for regulatory instruments, as this stakeholder knows that the current regulations are often barriers for the transition, due to experience. This is in line with the SA.

10.1.2 Policy instruments that are necessary for an effective timber transition

In the introduction of this report, it is stated that the ICER report of the Planbureau voor de Leefomgeving has published a study that aims for more 'drang & dwang' (regulatory instruments), as this is ought to be needed to transition towards a circular economy. This is in line with the findings of the interviews in this study. The interviews with governmental stakeholders indicate that more regulatory instruments are necessary for a sustainable transition in general. However, this study focusses on the transition of timber constructions, which can be considered a sustainable transition. The findings from the interviews with non-governmental stakeholders show that, also for the timber transition in the MRA, more regulatory instruments are perceived to be necessary. Additionally, the document analysis shows that the covenant focusses mainly on the implementation of regulatory instruments by the governmental stakeholders. Lastly, the expert sessions confirm the need for regulatory instruments. This finding emphasized the importance of the tool that the municipality of Amsterdam is developing, which aims to provide policymakers with an overview

of the possible regulatory instruments that can be implemented to foster sustainable transitions.

However, as argued in literature, policy mixes rather than individual policy instruments are generally implemented for environmental purposes. The results of the different empirical studies are in line with the theories that are presented, as they show a wide variation of different policy instruments, rather than one individual instrument.

Besides regulatory instruments, especially the importance of facilitating instruments is emphasized. The governmental stakeholders perceive the facilitating instruments to be highly necessary, the non-governmental stakeholders perceive the facilitating instruments to have many positive effects for the timber transition. Therefore, this instrument type can be considered valuable in research on policy instruments for sustainability transitions. This instrument type has been added to the classification of Verdung (1998) by the author of this study, as the existing classifications seemed to lack policy measures that are important for sustainability transitions. The addition of facilitating instruments for sustainability transitions is highly valued by the experts during the expert sessions, as this instrument embodies the intangible aspect of policymaking that they did make explicit yet.

Related to SA

According to non-governmental stakeholder, the implementation of new facilitating and regulatory instruments (non-existing) seems to be necessary for the timber transition. An example of non-existing facilitating and regulatory instruments can be found in Chapter 9 (interview results). This is opposed to the results of the governmental stakeholders, who argue that existing instruments should be used in an activating manner to activate transitions. This emphasizes the different perceptions of the two stakeholder groups. The SA shows that both stakeholders have very different implications, thus needs. This difference can be explained by the implications and available resources of both stakeholders.

As argued in the SA, the governmental stakeholders are often implicated by regulations and laws of other governmental authorities. They are aware of the difficulty of policymaking and implementation, and therefore aim to look for solutions within their power, thus using the current regulations in an activating manner, rather than the implementation of new policies.

However, the non-governmental stakeholders often feel limited by the laws and regulations. As they are not policy experts, it might be harder for this stakeholder to look for the possibilities within the current law to establish a transition.

Understanding the implications of the stakeholders, and therefore their needs, is helpful in designing policies that will have a positive effect on a transition. Furthermore, alignment of the existing policy instruments to the non-existing policy instruments that are perceived to be necessary, might already answer to the need for some new instruments.

10.1.3 Effect of the implemented policy instruments on the timber transition

During the exploratory interviews at the start of this research, the current regulations were mentioned as being one of the main barriers for the transition to timber constructions. Also the 'Green Deal Houtbouw' emphasizes the importance of more research on the regulations to stimulate timber. The SA of this study indicates that one of the main barriers for many stakeholders to transition to timber constructions, are the regulations that are in place. Furthermore, the interview analysis makes clear that regulatory instruments have most negative effects on the transition. According to multiple sources, one of the main barriers for the transition seems to be the regulations, and the negative effects of the regulations seems to be undeniable for the transition to timber. The existing regulations

often do not offer room for innovations like timber and can therefore be hindering to such a transition. Literature emphasizes the importance of coherence in policy making, but also argues the complexity of achieving complete coherence. As there are often existing policies and policymaking is a process of layering, the policies that are in place often do not achieve complete coherency. In the case of the timber transition, incoherency is perceived as the implemented policy instruments are often outdated and there is not always room for innovations within these regulations.

The instruments that are perceived to have a positive effect on the transition are different for both stakeholder groups. It can be argued that there is a mismatch in the perception of effective instruments for transitions by governmental stakeholders and effective instruments for timber transitions by non-governmental stakeholders. While governmental stakeholders are mainly focused on the effect of facilitating instruments, non-governmental stakeholders perceive regulatory instruments to be most effective within the timber transition. The expert sessions validate that there is often a big difference in what the market wants and what is possible, but also what the government thinks that is needed. More alignment between those two stakeholder groups will benefit the development of policies.

Related to SA

The SA makes clear that the division of power between the different governmental parties is complex. A major barrier for the governmental stakeholders is that they must comply to the different regulations at different governmental levels, and the possibilities within the (public and private) law limit what is possible. Furthermore, this stakeholder has the authority to implement regulatory instruments, but due to conflicting interests, slow policy making processes and the existing policies that are in place, the implementation or adjustment of regulatory instruments can be difficult (often leading to incoherency). E.g., the municipality is limited by the national government, as they have a higher authoritarian power, while the national government in its turn, is hindered by conflicting policies. Governmental stakeholders might therefore be inclined to emphasize different instruments than regulatory instruments. Facilitating instruments are easier to implement and the resources that are needed for the implementation of this instrument are often available, which might explain the preference for this instrument by governmental stakeholders. However, the non-governmental stakeholders that are interviewed in this research can be considered 'frontrunners': they are ahead on other people as they already have knowledge on the needs for this transition and might have an idea about how the regulation can push the market. This might be the reason for this stakeholder group to be more positive about the effects of the regulatory instruments.

10.2 Limitations

10.2.1 Literature review

The snowballing sampling to collect relevant literature might result into a biased collection of literature. Even though the collected literature is extensive and all important or relevant papers are tried to be included, it might be possible that relevant papers are omitted.

Furthermore, the main theory from literature that is used to set up the AF is on policy instruments that aim to foster a sustainability transition. However, during the empirical research, it became clear that the theory on policy mixes by Rogge & Reichardt (2016) seemed to be lacking connection to the theories on sustainability transitions. The theories on sustainability transitions argue that a policy (mix) to foster sustainable transitions should be aimed at specific objectives (regime destabilization/innovation of niche). However, the theory of Rogge & Reichardt (2016) does

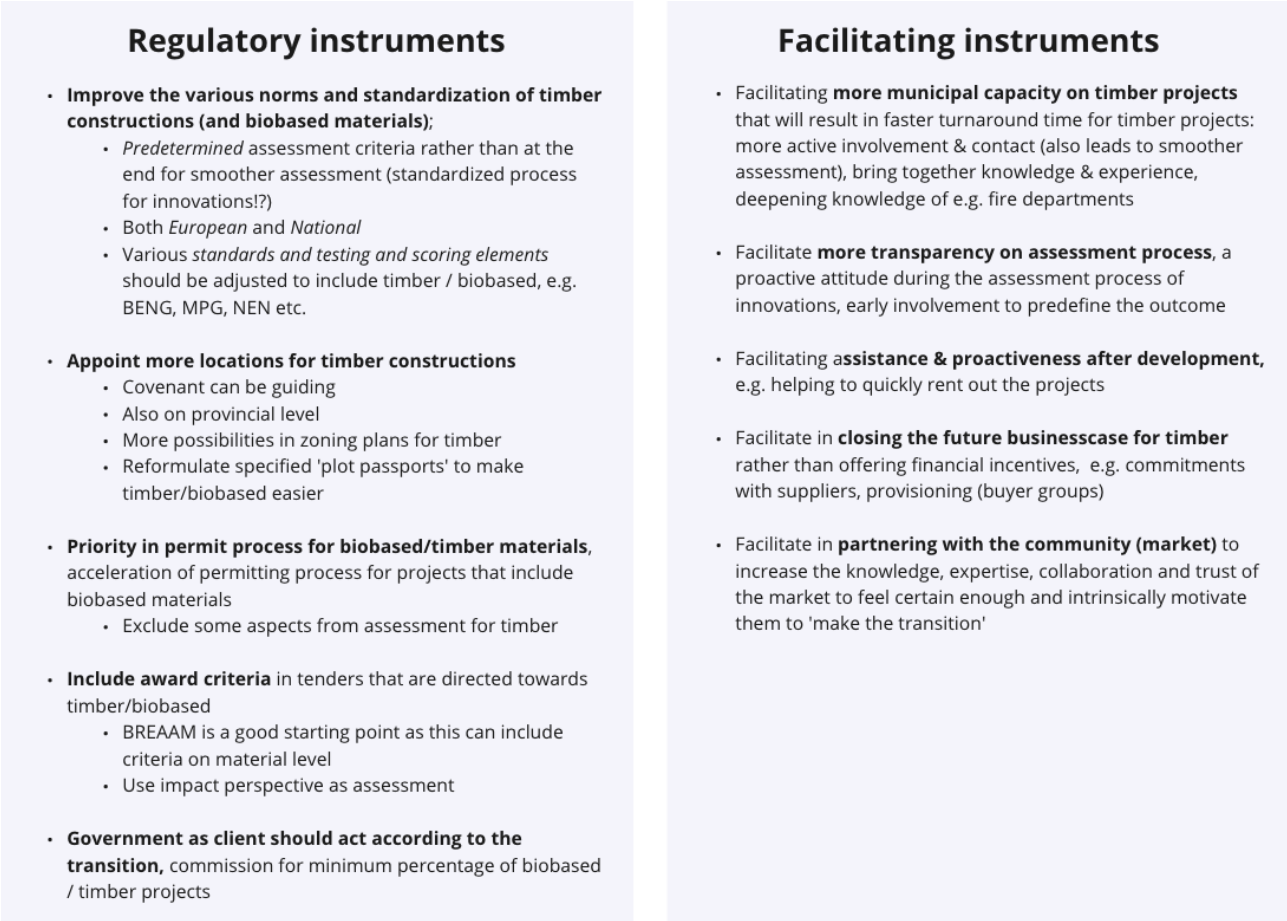


Figure 32: The most prevailing topics for regulatory and facilitating instruments, as found in the interviews

not discuss how it is related to the different policy objectives that are required for sustainable transitions. This limitation makes it difficult to assess the transition objectives of a policy mix that is developed according to the building blocks. By implementing the theory of Rogge & Reichardt in a case that is focused on a sustainability transition, the gap between literature on policy mixes and literature on sustainability transitions is aimed to be bridged. However, the connection between these two topics is still lacking. Chapter 13 (Reflection) presents a reflection on the use of the two theories.

10.2.2 Use of the analytical framework

First of all, one of the major limitations has been the time constraint. Studies on policies generally take a long time as this topic consists of long processes of which the effects are often only measurable after a long time. Therefore, the results of this study are limited as they capture a moment rather than changing processes over a timespan of years.

While the AF is a central topic and forms the basis of this research, the deductive approach that is used to analyze the empirical research also limits this research.

The use of a deductive approach has structured the research by providing guidance in the analysis process, and quantification of the results. As social subjects are highly influences by subjectivity, it is important to make the research process explicit, which can be achieved by using a deductive approach. However, this approach limits the analysis to the concepts that are presented in the analytical framework. To give the results more meaning and gain a better understanding of the content of the different policy instruments that are necessary, the most prevailing regulatory and facilitating instruments are collected from the interviews. Figure 32 presents a summary of the five most prevailing topics for regulatory and facilitating instruments.

Also the most prevailing barriers for the transition, as discussed during the interviews, are collected. These interesting findings (Figure 33) are valuable for policymakers in understanding how the market perceives the transition and what their

main barriers are. Just as the content of the instruments, the findings that are based on the AF lacks in presenting the context of these barriers.

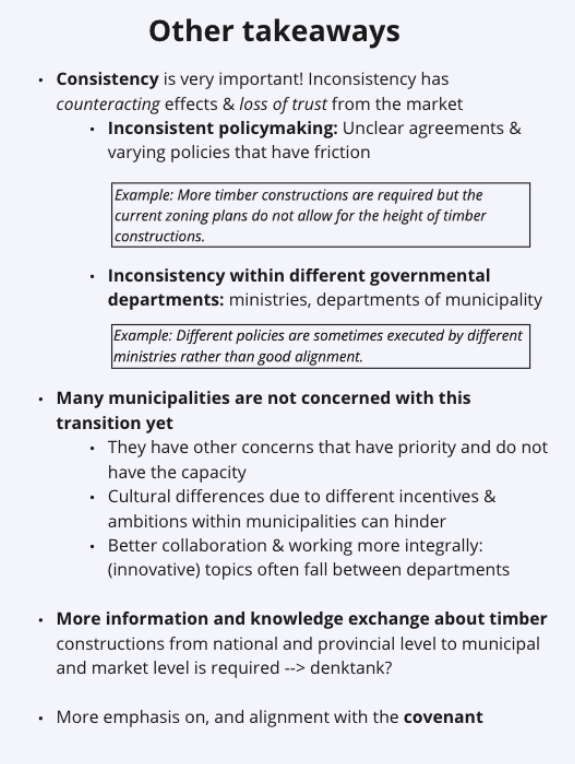


Figure 33: Key findings from the interviews about the barriers for the transition

The AF also lacks in its connection to transition literature. According to the literature on policy mixes for transitions, a policy mix for a sustainability transition needs to focus both on the resistance and destabilization of incumbent regimes and locked-in systems, as well as the innovation of new technologies. However, the policy mix building blocks of Rogge & Reichardt (2016) lacks in describing how a policy mix contributes to a transition, whether it is focused at destabilizing the regime or innovation of new technologies.

10.2.3 Stakeholder analysis

As argued in chapter 6 (Stakeholder analysis), due to the scope of the research, the execution of the SA is limited. As the method of Bryson (2004) fits the context of this research and provides a systemic approach, it seems suitable for this research. However, due to the extensiveness of this method, the execution is limited to make it feasible for this study. In this research, the SA tends to be a descriptive analysis that sets the scene and provides knowledge on the transition topic. Furthermore, the results from the SA can be questioned as they are highly influenced by the perception, perspective and background knowledge of the person who makes the SA.

10.2.4 Interviews

A major obstacle during the empirical research had been to get in touch with the interview participants. Eventually, not all required stakeholders have been interviewed as it was not possible to receive enough responses within the limited time of this research. The collected data is therefore not complete as not the same number of interviews have been conducted for all stakeholders. Interview data from two types of non-governmental stakeholders is missing, namely the institutional investors & banks, and Staatsbosbeheer. As these two are both stakeholders that are not directly involved in construction processes, the addition of results from their interviews might have led to completely different results than the interview results of the other governmental stakeholders. Furthermore, the economic instrument is really underexposed in the presented results. The inclusion of all stakeholders might lead to a different outcome regarding the economic instruments, especially because the banks & institutional investors are expected to be the stakeholders that are involved with economic instruments the most.

To make the data as comparable as possible, in results where participants were missing, the data is presented in a relative way instead of showing the absolute numbers.

10.3 Research quality

It is important that the quality of the research is judged by certain tests to ensure a robust research that presents a logical dataset. Case studies, the methods that have been used in this research, are generally tested against validity and reliability (Bryman, 2012; Yin, 1994). Four commonly used tests are construct validity, internal validity, external validity and reliability (Yin, 1994). The application of these evaluation methods and their related limitation within this research is described.

10.3.1 Reliability

Reliability is about the consistency of the measures and exclusion of the researchers' subjectivity (Bryman, 2012). The detailed methods for the operationalization of the AF describes how the data is collected and thereby ensures consistency in measuring and repeatability for replication of the research. Furthermore, the interview protocol ensures repeatability for the execution of the interviews. However, the exact same research can lead to different results, as the results are highly influenced by the subjectivity of the participants.

10.3.2 Construct Validity

Case studies consist of a high level of subjectivity, as this is inherent to human being. It is therefore important to develop the right set of measures to make the research choices and bias explicit. Using well defined concepts and identification of the right measures that match the concepts that are used in the research is important to achieve construct validity (Yin, 1994). As this research uses a systemic, deductive approach, in which the AF forms the basis for the empirical analysis, construct validity is guaranteed. Furthermore, the construct validity of the proposed research results is improved by the validation of the research results by expert sessions (Chapter 9). The use of multiple data sources establishes triangulation for the research results: literature review, document (case and stakeholder) analysis, interviews, and a validation session with experts.

10.3.3 Internal Validity

Internal validity concerns explanatory case studies and therefore is not relevant for this research (Yin, 1994).

10.3.4 External Validity

External validity is about making the study generalizable and defining when and how it can be generalized outside the boundaries of the case study. Duplication of the study can lead to an increased external validity (Yin, 1994). The sample size of the interviewees of this research is not big enough to be generic and the study is specified for its context and demarcated by the case study, which leads to results that are related to the specific research context. This would mean that the external validity is lacking. However, external validity can be established by predefining the conditions in which the research can be repeated to achieve the same results. While expert sessions are conducted to verify the results, more extensive research can be conducted to increase the external validity.

-

11. Conclusions

In this chapter, the research question is answered by processing the outcomes of the sub-questions, recognize the most important findings and substantiate how a combination of policy instruments can foster the transition towards timber housing constructions in the MRA. The different sub-questions are elaborated on during the literature and empirical research. This knowledge is used in this conclusion.

RQ: How can a combination of policy instruments foster the transition to timber housing constructions in the MRA?

To be able to understand the importance of timber within the transition towards a CE, the most relevant characteristics of a CBE and the role of timber constructions in advancing the transition towards a CBE are elaborated by a literature review (SQ1 and SQ2). The BE is complex and consists of elements within many different sectoral systems, an integration of these different sectors is required to successfully achieve a holistic transition. The most important dimensions that are important in the sustainable transition of a BE are the environmental, technological, economic, societal, governmental, and behavioral dimensions. The CE can be applied to different system levels of the BE. Transition literature mainly focusses on the transition of the meso-level. For the BE, conducting research on the application of a CE to the BE therefore requires a meso-oriented perspective. Therefore, circular transitions on the building level, such as timber, fit the CE approach in relation to a BE. Timber can be considered as circular construction material as it is renewable and can easily be used in a circular approach due to its feasibility for design for reuse.

Literature further elaborates on the different policy instruments that can foster sustainable transitions (SQ3). Different classification systems for policy instruments are presented, which enables to define a classification that can be used for sustainability transitions. This classification consists of four policy instruments: regulatory instruments, economic instruments, information instruments and facilitating instruments. Facilitating instruments is an instrument type that has been added by the author, as this seems to be relevant within the context of sustainability transitions.

The theoretical framework describes the complexity of a ST-system, as it consists of many different elements and network relations. A change from one system to another can be called a transition. These transitions are complex and never happen in a vacuum, therefore it requires transformative governance. Policies for sustainability transitions therefore need to focus on both destabilization of the regime, and innovation of new technologies. The fragmented character of the BE makes it difficult for policymakers to develop CE policies for this sector. Besides, it is important to keep the existing policies in mind during the design and implementation of transition policies, to avoid incoherency in the policy mix. Literature furthermore argues that a combination of different policy instruments should be implemented, rather than individual instruments, especially for sustainability transitions. A framework for the development of a policy mix for a sustainable transition is presented. The empirical results confirm the need for a combination of policy instruments, and further emphasize the importance of coherence with the existing policies.

The empirical research provides results that enables the answering of SQ4, SQ5 and SQ6. First, a SA has been conducted to be able to define the most important stakeholders that are actively involved in the transition towards timber constructions in the MRA (SQ4). The SA shows that the different non-governmental

stakeholders all have their own attributes and capabilities to contribute to the timber transition. As the use of timber requires new construction methods and different supply chains, the different non-governmental stakeholders are dependent on each other to successfully scale up the use of timber for constructions. Based on the SA, it can be argued that there is not one non-governmental stakeholder who is the most important, as they all have their own value in the transition. However, some stakeholders seem to have less capacity, or are not very attracted, to implement the policy plans. These stakeholders are Staatsbosbeheer, Banks and Institutional investors and Knowledge institutes, as explained in section 6.1 (Stakeholder analysis non-governmental stakeholders). The SA furthermore shows that the implications for the non-governmental stakeholders can be categorized in a few recurring themes, for which the implementation of policy instruments by governmental stakeholders might help to overcome those implications. The SA of the governmental stakeholders shows that the municipality and the national government are relatively more important for the timber transition than the provinces. While the provinces are valuable for the facilitation of knowledge, networks, workshops etc., the main implications of the timber transition as perceived by the non-governmental stakeholders are related to policy instruments for the municipality and the national government.

The findings from the interviews with the governmental stakeholders confirm these conclusions, as well as contribute to answering SQ5 (necessary policy instruments for an effective timber transition) by saying that it is mainly necessary that the municipality and national government implement policy instruments for sustainability transitions (see section 8.1, Figure 37). The interviews with non-governmental stakeholders also confirm this, as policy instruments from the municipality and the national government are mainly required for the timber transition (see section 8.1, Figure 34). These findings are furthermore aligned to the recently published ICER report of the PBL (Hanemaaijer, 2021), which argues that more regulatory instruments are needed for a transition towards a CE, as the interviews with the non-governmental stakeholders show that the implementation of regulatory instruments by the municipality and the national government have most effect on the timber transition (see section 8.2, Figure 38). Altogether, the results from the SA and interview results emphasize that there is a need for more regulatory instruments for an effective timber transition. These regulatory instruments are not only new instruments, but existing instruments should also be changed to stimulate timber transitions. According to the non-governmental stakeholders, the implementation of these necessary regulatory instruments is mainly the task of the municipality and the national government. Furthermore, information and facilitating instruments are perceived necessary by the non-governmental stakeholders. The governmental stakeholders agree on this finding as they positively evaluate the effect of facilitating instruments. The addition of facilitating instruments by the author of the research seems to be valuable, according to the results. Data triangulation validates the importance of these instrument types.
As the deductive method that has been used limits the outcomes as it does not include the specific content of the instruments that are discussed, a collection of important instruments has been gathered. An overview of the most prevailing regulatory and facilitating instruments makes the results more tangible and gives a better understanding of the specific instruments that are necessary for the timber transition. The expert sessions confirm the necessity of these instruments. The experts even gained new knowledge from the results and aim to use those results in their future work. This gives the findings a high value.

Lastly, the interview results together with the document analysis contribute to answering SQ6 (the effect of the current policies on the timber transition). To understand the effect of the current policies on the timber transition, it is important

to be aware of the difference in the perception of effective instruments by governmental stakeholders and non-governmental stakeholders. While governmental stakeholders perceive facilitating instruments to be most effective for sustainability transitions, the non-governmental stakeholders perceive regulatory instruments to be most effective within the timber transition. However, these regulatory instruments are not always stimulating for the timber transition: a major part of the regulatory instruments hinders the transition. Besides regulatory instruments, facilitating instruments are also often perceived to have a stimulating effect on the transition. Information instruments and economic instruments seem to have little effect on the timber transition.
Again, facilitating instruments seem to be a valuable addition to the instrument classification. Facilitating instruments are perceived to have positive effects and can therefore be considered important in sustainability transitions. The expert sessions confirmed the importance of facilitating instruments and complemented on the definition of the facilitating instruments by stating that it can be considered a combination of how the government does things, and how other instruments are implemented. It was even argued: 'you gave a name to something that was not defined yet'.

The effect of the covenant is difficult to assess, as the proposed policy instruments for the governmental stakeholders have not been implemented yet. However, the design of the policy mix can be assessed and compared to the instruments that are perceived to be necessary by the important stakeholders. The covenant proposes mainly regulatory instruments that should be implemented by governmental stakeholders. The main responsibilities of the proposed instruments are for the municipality and the national government, which is in line with the findings from the interviews, that show the need for regulatory instruments to be implemented by the municipality and the national government. However, the covenant does not include a proposal for the implementation of more information instruments, while this is perceived to be important by the non-governmental stakeholders. Reassessment of the proposal and including information instruments might lead to a more effective policy mix.

The preceding findings, discussion and conclusions are used to answer the main research question:

'How can a combination of policy instruments foster the transition to timber housing constructions in the MRA?'

The transition to timber housing constructions has proven to be complex due to the different factors that have been analyzed in this research. It is dependent on the nature of policies, the effectiveness of policies and interests and needs of stakeholders whether a certain mix of policy instruments fosters the transition successfully or not. Some findings of this research can be used to answer the main research question in more detail. It is argued, both by literature and the empirical research findings, that a combination of different policy instruments works better to foster a sustainability transition than the implementation of individual instruments. The expert sessions confirm the need for combinations of policy instruments as the market often does not respond to individual instruments, as they have too little context for people to know how to respond to it, or even know its existence.
Therefore, the assumption that a combination of policy instruments should be implemented to foster the timber housing constructions transition can be validated. To design a combination of policy instruments that fosters the timber housing transition in the MRA, there are a few important aspects to take into consideration. In the first place, regulatory instruments should be implemented as these instruments are mainly

necessary in transitions. Furthermore, the addition of facilitating instruments seems to be valuable to foster the transition to timber constructions. The combination of facilitating instruments and regulatory instruments can lead to a better implementation of the different instruments and achieve more positive effects. The facilitating instruments can be considered the 'how to' of the policy instruments.

However, it is important to conduct a thorough research on the instruments that should be part of the policy mix. The different barriers for stakeholders to make the transition should be considered, as well as the existing regulatory instruments that hinder the timber transition. Assessment and finetuning of the existing policies and policies that will be implemented, is required to gain the characteristics that need to be in place for a sustainability transition: coherence, consistency, credibility and comprehensiveness.

Furthermore, good communication between the different governmental stakeholders is important to achieve a combination of policy instruments that can truly be aligned with a policy strategy. Wrong expectations, personal interests or misaligned strategies can lead to incoherent policymaking. Lastly, the governmental stakeholders should be aware of misalignment within the organization, as this can lead to different perceptions of the needed policy instruments. Aligning the different actors within one governmental stakeholder should be included in the policymaking process to be able to design a combination of policy instruments that can foster the timber transition.

12. Recommendations

This chapter presents recommendations that are based on the findings of this research. First, some practical recommendations for policymakers are presented, furthermore some recommendations for policymakers in the timber transition in the MRA are presented, finally, recommendations are made for future research. Many of these recommendations can be used by Gemeente Amsterdam as well, therefore, at the end, a concluding recommendation in relation to the internship at Gemeente Amsterdam is presented.

12.1 For policymakers in general

¤ **Understand the needs and interests of the stakeholders who are involved**

Policymakers that aim to design a policy mix for a sustainable transition should invest in a deeper understanding of the stakeholders that are actively involved and are expected to participate in the transition. This interview findings shows that there can be a difference between the perception of policy instruments by governmental and non-governmental stakeholders, which is validated by expert sessions. As each transition has different specificities, research should be conducted to the needs and interests of the stakeholders that are actively involved in the specific transition case. Understanding the market gives valuable insights that a governmental stakeholder most likely does not see in the first place. Understanding the complications for the stakeholders allows for the development of policies that are aligned to the needs of the stakeholders who are involved in the transition.

¤ **More emphasis on regulatory instruments**

During history, there has been a shift in the perception of the usefulness of different types of policy instruments. Scholars point out the importance of a combination of policy instruments. This research confirms that within the use of a policy mix, there should be more emphasis on regulatory instruments for sustainability transitions, especially by municipalities and the national government. This finding is validated by triangulation of data that consists of literature, interviews, a case study and an expert session. However, it should be kept in mind that a combination of instruments is more effective than the implementation of individual policy instruments (see chapter 11, Conclusions).

¤ **Understand the importance of facilitating instruments**

Besides the implementation of regulatory instruments, facilitating instruments are also important for sustainability transitions. It is often argued by policymakers that people do not use the implemented instruments. Facilitating instruments can be used to put other instruments into context and make it understandable for the market. Gaining a better understanding of the importance of facilitating instruments and how they can complement other instruments can benefit the market response on the implemented policies.

¤ **Collaboration between different governmental powers**

The Dutch system that consists of three levels of governmental powers already exists for a long time, however, the empirical research shows that the expectations about the responsibilities, as well as the experienced effects of the implemented policy instruments, can be misaligned. When designing a policy mix for a sustainable transition, it can be helpful to reassess the responsibility for the implementation of policy instruments. The timber transition shows that most policy instruments are perceived to be implemented on municipal level. As the municipality is closest to the market, their policy implementation might be perceived

differently than for the other governmental levels. This perspective should be considered when implementing policies. Furthermore, alignment between and within the different governmental levels is important. The non-governmental stakeholders often perceive misalignment within the governmental stakeholders. The policymaking process should therefore not only be focused on the strategy of the policy mix and the policy mix in relation to the strategy. Alignment of, and within, different governments should be included in the policymaking process

- **Use the operationalization of the AF as a theoretical background for policy development**

The stepwise approach that is presented in the operationalization of the analytical framework can be valuable for policymakers during the development of policy instruments (for sustainability transitions). The different building blocks provide a holistic approach for a policy mix, in which the different dimensions, processes, elements and characteristics are discussed. It therefore provides clear guidelines for the development of a policy mix.

12.2 For policymakers in the timber transition

- **Adjustment of the current policy mix (regulatory instruments)**

Figure 32 (p. 86) shows the regulatory instruments that the non-governmental stakeholders perceive to be necessary for the timber transition. It is therefore recommended to use this data for the further development of a policy mix for the timber transition. Research on the adjustments of regulations and the implementation of measures to achieve those topics should be conducted. As the different recommended regulatory instruments might require a different implementation levels, a close collaboration between the different governmental authorities is recommended to foster the timber transition successfully.

- **Do not limit the implementation of policy instruments to the current regulations**

While some of the regulatory instruments that can be seen in Figure 32 (p. 86) can be implemented by using the current regulations in a different manner (e.g.: the inclusion of award criteria in tenders), some findings require regulatory instruments that are not yet existing. E.g. priority in permit processes for biobased/timber materials requires new regulations or adjustments to the current laws. For an innovation such as timber, policymakers should not limit themselves to the current regulations but look at other possibilities as well.

- **Implement more facilitating instruments**

As the findings emphasize the importance of facilitating instruments for the timber transition, these should be implemented. The expert session addressed the importance of the combination of facilitating instruments together with, for instance, regulatory instruments. Figure 32 (p. 86) shows the different findings from the interviews on the need for facilitating instruments. An inventory of these instruments and the regulatory/information/economic instrument that they are combined with, can be made. This inventory can help policymakers in the timber transition to better design the policy instruments for the market to be able to respond to the instruments.

- **Design the policy instruments based on the stakeholders needs and interests**

The stakeholder analysis shows the different complications for the non-governmental stakeholders to transition to timber constructions. It is recommended to further investigate these barriers and evaluate the different types of policy instruments that are necessary to overcome these barriers. It is furthermore recommended to design a policy mix for timber constructions, that includes the policy instruments that are perceived to be necessary by the non-governmental stakeholders. An overview of these main findings can be seen in Figure 32 (p. 86).

¤ **Improve consistency in policymaking and policy implementation**

As inconsistency leads to counteracting effects of the policies and loss of trust from the market, increasing the consistency is very important. Consistency should be achieved by making clear agreements and avoiding friction between different policies. Furthermore, consistency should be improved within governmental departments (e.g. ministries, municipalities)

12.3 Future research

¤ **Complementing theories on policy mixes for sustainable transitions to better connect to transition theories**

As argued in the limitations (chapter 10, Discussion) there is a gap between the theory on policy mixes for sustainable transitions, and theories on sustainable transitions. A recommendation for further research would be to complement the existing building blocks by Rogge & Reichardt (2016) with an additional building block/assessment criteria that can be used to measure the extent to which the policy mix contributes to a sustainable transition (e.g. destabilizing a regime, supporting niche innovations).

¤ **Another case study**

This research was focused on the transition of timber constructions. However, it might be interesting to conduct the same research, about the combination of policy instruments, on another case that is a sustainable transition. There are currently many transitions happening, and the transition towards a CE is still under development. There are many sectors in which the implementation of a CE in relation to that specific sector lacks scientific research. The results of this study are hard to compare, as there are not (yet) many other CE case studies like the one that is subject of this research. Applying the same research methods to another case might provide interesting insights and can be used for cross-sector learning insights.

¤ **The timeline of different policy instruments (after a transition)**

This study focused on the combination of policy instruments to foster the timber transition in the MRA, however, the findings do not present a recommended timeline of the policy implementation. As transition processes are long processes and the long-term consequences of the implemented policy instruments are unknown, a recommendation of the timeline will be based on assumptions and ex ante evaluation methods. However, in the future, it might be possible to conduct research on the temporal aspect of the implementation of the different policy instruments and design a timeline for policy implementation in addition to this research.

¤ **Decision-making models for policy instruments for implications during transitions**

This recommendation is in line with the previous statement, as research on the non-governmental stakeholders is recommended before designing a policy mix. As the implications might lead to barriers for stakeholders to commit to the transition and the set agreements, taking away the implications for these stakeholders is important. Decision-making models on the different policy instruments and combinations of policy instruments that are needed for specific barriers are required. The policy instruments that the stakeholders perceive to be most necessary are not always a direct translation of the implications they experience. Therefore, research on the policy instruments that are required for the different implications that can exist in sustainable transitions will contribute to the development of better policy mixes for sustainable transitions.

12.4 Concluding recommendation in relation to my internship at Gemeente Amsterdam

As this research has been conducted while completing an internship at Gemeente Amsterdam, a concluding recommendation is presented. As the internship was conducted at the project team for the development of the tool, this recommendation is directed at this team, rather than the municipality as a policymaker for the timber transition.

First of all, the research of Gemeente Amsterdam to collect the instruments for the tool, result in a collection of reinterpretations of the existing law to see what the current possibilities are. As the results of this thesis research are based on what the market needs, the results are not limited to what is possible within the existing law, but are based on the market demand. There seems to be a gap between the two results, as the results of this research present 'new' rules that are not possible to reinterpret within the existing law. Secondly, this research adds on the collection of measures of Gemeente Amsterdam as this research is not limited to regulatory instruments. The results of this research emphasize the importance of facilitating instruments, as they seem to be a valuable addition to the implementation and effectiveness of, for instance, regulatory instruments. The specific results of this research can be found in Figure 32, which shows the key findings from the interviews.

The two important different findings that follow from this market-based research, rather than a reinterpretation of the law by juridical experts, indicate that there is a gap in the collected research results. It is therefore recommended to complement the currently used research method with systematic market-based research that will add on the current method to be able to:

- Collect an overview of 'new' regulatory instruments that are needed by the market
- Gain knowledge about why some regulatory instruments are not used, and which facilitating instruments seem to be necessary for a successful implementation of the required effects

To be able to conduct this research, and gather results that are theoretically based, it is recommended to use the operationalization of the analytical framework, as presented in this research. This operationalization framework can help in multiple ways:

- This theoretically based approach can help the project team of Gemeente Amsterdam to systematically collect data that adds on the currently used method, and can be used for the development of the tool for different sustainable transition cases.
- This approach can be included in the tool as a roadmap for policy makers. It can provide policymakers that make use of the tool with a stepwise approach on how to systematically develop combinations of policy instruments / policy mixes for successful transitions.

13. Reflection

This final chapter describes the process, product and planning of the research that has been conducted. The chosen method and argumentation that are used to conduct this research, as well as an evaluation of the chosen method is explained.

13.1 Relation with master program

This research has been conducted as part of the master track Management in the Built Environment of the master program Architecture, Urbanism and Building Sciences at the TU Delft. One of the three sections within this master contributes to the knowledge development of Urban Development Management Design and specifically focusses on urban development (TU Delft, 2022). This research is conducted within the Urban Development Management section, which focusses on 'the development of instruments, principles and concepts for an integral urban area-based approach to contemporary urban challenges' (TU Delft, 2022). The subject of this thesis perfectly fits the description of the section. This study aims to provide research that is useful for the development of instruments for a circular transition of an urban area. As one of the most contemporary challenges are the climate crisis and overpopulation that leads to a pressing housing demand, the transition of the housing sector towards timber constructions is more needed than ever. Even though this research is mainly part of the Urban Area Development Management section, it also touches upon some subjects that are part of the Design & Construction Management section. The DCM section puts a focus on the collaboration between different stakeholders in construction processes to be able to anticipate to the different societal issues. The implementation of instruments for public-private collaborations is a topic that touches upon the subject of this thesis.

Initially, this research was supposed to be part of a Double Degree, in which the MSc Industrial Ecology would be the second master track. Due to circumstances, it was unfortunately not possible to conduct the research as a double degree thesis. However, this ambition led to the connection of this thesis with the faculty of Technology, Policy and Management, section Values, Technology and Innovation. Transition theories and policies for transitions and innovations are important research topics of this section that are related to the topic of this research.

13.2 Social relevance and transferability

The importance of changing the way that we use and make our built environment to a more future-proof approach can not be emphasized enough. Not only are we facing a big housing shortage, moreover, the current way of constructing is not feasible within the Paris Agreement. The development of timber as a construction material has already convinced some people of its importance and benefits. However, the complexity of the built environment requires more than a few people to realize a change in the system is needed. A system change requires many different dimensions to be changed. Therefore, governmental support and guidance within such a transition is essential. Within this transition, there is a lot of uncertainty about the role of the government, while their role is of major importance. More substantive knowledge on the role of the government, the policy making processes, policy implementation and policy instruments is required to ease and accelerate the change within the construction sector to use more timber as a construction material. This is further emphasized by the different people

that participated in this research. Everybody had a lot of interest in the outcomes of this research as many people agreed on the relevance of this topic and were happy to participate in this study. This research is mainly interesting for the following audiences:

- Policymakers: the discussion and conclusion of this research have led to valuable recommendations for policymakers on how a policy mix can successfully foster a sustainable transition.
- Policymakers: the findings provide valuable insights on what the market needs from the government to foster the timber transition.
- Policymakers: the operationalization of the analytical framework provides a valuable tool for the development of policy mixes for successful transitions.
- Gemeente Amsterdam: the discussion and conclusion of this research have led to valuable recommendations for the development of the tool by the municipality.
- Knowledge institutes: the discussion and recommendations of this research can be used to understand where knowledge is lacking thus which topics need more future research.
- Umbrella organizations: the findings, discussion and recommendations of this research can help to understand the performance of the system. They can provide their expertise where there is a need from the market that the government can/will not fulfill.
- Lay persons that will be involved with timber constructions: the findings and discussion of this research can help them to understand the different policy processes that they might run into.

13.3 Scientific relevance

The relevance of this study can also be explained from a scientific stance. The transition to a circular economy (CE) is a relatively new subject, while the built environment (BE) is a slowly changing system. This means that not a lot of research has been conducted to the CE in relation to the BE. As the BE has a high level of complexity and consists of many different sub-systems, applying a concept like CE to the BE is complex and will most likely not cover all sub systems according to all scholars. Research to the policy instruments that can be used to foster an innovation that contributes to a CE in the BE is therefore valuable in the scientific field on CE transitions. The case study that has been used fits this specific research, as the case study demarcates a transition that has already started, thus existing knowledge is available, while the system has not yet changed, thus research still provides results on what is needed.

Furthermore, this research presents an operationalization of the design of a policy mix, which can be repeated and applied to any sustainability transition. The design of this operationalization ensures a high level of scientific relevance as this research is the first research to provide such an applied method for the development and/or assessment of policy mixes.
To ensure scientific relevance, the research aims to achieve a high level of reliability and validity. Reliability and validity are ensured in multiple ways, as elaborated on in Chapter 10 (Discussion).

13.4 Ethical issues and dilemmas

Some ethical issues and dilemmas have been encountered during the research. During the interviews, some sensitive information and personal issues came up. As the informed consent ensures anonymization of the data, the comments that reveal personal information is not included in the research, nor shared outside this research. The FAIR principles as elaborated on in the methods section are followed throughout the research.

13.5 Reflection on the approach

This research consists of two research phases, which can be more or less defined by the period before the P2 presentation, and the period after the P2 presentation. First, a literature review has been conducted, after which the qualitative empirical research that consisted of different techniques has been conducted. During the whole research, the main subject has changed from a focus on transition theories, to a focus on policy instruments (for sustainable transitions). This change has influenced the method that has been used during the literature review.

13.5.1 Literature review

Due to the chosen method (snowballing sampling), a lot of papers have been read. The disadvantage of this is that the literature review took a long time, and the process was not very efficient. Furthermore, reading a lot of papers made it difficult to demarcate the research as a lot of new ideas come into mind when reading all those papers. This iterative process furthermore let to an initially fragmented literature study, that required a lot of adjustments during the initial empirical research phase.

13.5.2 Two domains: policy theories and transition theories

During the literature review, the focus shifted from transition approach to a policy approach. The former theories appeared to be very complex and subject of many existing research studies. The scope of a thesis project seemed insufficient to capture the complexity of these theories within the scope of the research. However, as argued in the limitations (chapter 10, Discussion) the focus of this research on a sustainability transition, approached from a policy perspective, seems to lack in making a connection between the transition domain and the policy perspective. While the two theoretical domains are inherently connected and can be used to strengthen one another, the theory by Rogge & Reichardt does not suggest how it contributes to sustainable transitions. As argued in the recommendations, the building blocks by Rogge & Reichardt can be complemented with the inclusion of its contribution to sustainable transitions. This addition would be explanatory for how the policy mix contributes to a transition, by using the possible transition pathways that are described in the transition literature. Furthermore, making a connection between the two research domains can lead to valuable insights, as the way of thinking can be quite different in both domains. Where policy theories are often focused on the past/present, by looking at what is in place, transition theories are directed at the future, by looking what can/should (not) happen. It can be considered a conservative versus progressive way of thinking. A deeper connection between the two domains can lead to a holistic approach of policymaking for transitions, in which the somewhat conservative policy theories can be put in the context of the transition theories. This combination can lead to valuable insights in which both theories are strengthened.

13.5.3 Qualitative empirical research

Due to the long process to demarcate the theories for the literature review, the TF was still under development after the P2 presentation. This made the beginning of the empirical research difficult as a TF is needed to design robust empirical research. Therefore, in the beginning it was difficult to start conducting the interviews, as the content of the interviews should align to the TF. During the first weeks, the interview approach changed, due to the development of the TF: while the interviews were initially case based, they became stakeholder type based, as the case study became the context for the empirical research.

Using the Convenant Green Deal Houtbouw as a case study for the empirical research led to a well-defined case in which the different empirical methods seemed to fall into the right place. This improved coherence of the different

methods also led to more research validity by data triangulation. The methods that have been used to conduct the empirical research seemed to be suitable for the qualitative research. The data is collected in a consistent manner and the AF is used for consistency in data measuring. Therefore, there is a high level of reliability. However, repeating the same data collection in a few years might lead to other results as the context of the timber transition might have changed. This would mean that the external validity is lacking. Furthermore, the missing participants have led to missing data and therefore the results might not be completely representative. However, external validity can be established by predefining the conditions in which the research can be repeated to achieve the same results and be transparent about the data that is collected.

Reflecting on the used research methods, the outcomes, and the limitations of the use of these methods, it can be concluded that the empirical research is quite extensive. Rather than using one or two research methods, a lot of research methods have been used. However, this provides a high level of validity, which is especially valuable as some methods are lacking data in this research (e.g. missing interview participants, a simplified SA). Bringing together the different research methods has been a complex task, as the amount of gathered data was big and scattered. However, during the synthesis of the data, the operationalization of the analytical framework has been created which suddenly created a lot of coherence within the research. The complexity required a structured way of analyzing the data, which is translated in this stepwise operationalization. While the conclusions of this research are valuable for many stakeholders that are involved in sustainable transitions, the operationalization of the analytical framework might be one of the most valuable results from this report. The operationalization can be helpful for policymakers or researchers in a structured analysis or development of a combination of policy instruments

13.6 Personal process

This section consists of a personal reflection that describes how I experienced conducting this thesis throughout the last academic year.

As I was following a double degree (MSc Management in the Built Environment & MSc Industrial Ecology), I was prepared to conduct a 'double degree thesis'. As I knew some people who had combined two thesis projects into one big project within a double degree, I assumed that this would be approved for me as well. Therefore, I started searching for topics that would suit both masters, and contacting supervisors that would be interested in supervising a double degree thesis. This led me to Ellen and Udo as supervisor team, and the topic concerning niche experimenting for transitions in the urban context.
Unfortunately, a few weeks after the start of graduation lab, I received a letter from the board of examiners from Industrial Ecology that the double thesis application was not approved. At first, this really demotivated me: what is the point of doing a double degree when you are not even allowed to combine the two disciplines? However, soon I started to realize that it might have been for the better, as one thesis has already been a real struggle for me and I think it wouldn't benefit the results if I had to do conduct a bigger research in the same amount of time. However, I stayed with my topic and Ad joined my supervision team, first of all because the topic became specified to timber, secondly because I needed another supervision from the Architecture faculty.
Before starting this thesis, I was a bit nervous for it. Conducting research and scientific writing are not my strongest points and it always took me a lot of effort during previous courses. I often find it difficult to clearly communicate the aim of a study and to structure the report in a way that it is clear for others to understand what is meant and why specific choices are made. However, writing a thesis could also be a good way to really take the time to immerse myself in a subject that I really like and learn a lot from the research and writing process.

After a few weeks, I noticed that it was a big struggle for me to demarcate my research topic. I am by nature very curious, so I kept on collecting papers, theories and interesting topics, and felt like I needed to include everything in my thesis (what if I miss something important?). Paradoxically, I found reading papers very difficult and it took me a long time to go through all the literature that I thought might be of interest. During my P2, it became clear that the TF was still lacking, and more demarcation of the research was required.

After P2, I started my internship at the municipality of Amsterdam. Starting this internship gave me even more direction to the literature study and made me completely switch to the use of policy instruments in the TF. Because of the internship, I got more feeling for the subject and the weekly meetings with the project team helped in understanding the problems and struggles in the timber transition and policy instrument implementation. The internship at the municipality of Amsterdam also connected me with Felipe, due to his PhD research that consists of a casus at the municipality of Amsterdam. The addition of Felipe as my supervisor helped me a lot in this thesis project. He helped me to bring structure in my TF and set up the analytical framework. His involvement made the thesis process significantly better, as it finally felt like I was on a good track and doing something that might be interesting in the academic field.

I really enjoyed the process of conducting interviews, as it brings you in touch with a lot of different people, and many of them have very interesting stories. Even though I wasn't always very enthusiastic about the theoretical part of the process, the empirical part gave me a lot of energy and a feeling of urgency to change the problems that people experienced. During the analysis of the interviews, I found it sometimes difficult to stick to the AF and to not use all quotes or conversations that I found interesting but were not so interesting for the scope of this research.

My mentor team eventually became very big and I would have done this differently if I started again. Planning wise, it was difficult to bring everybody together, but also content wise, it felt difficult to keep everybody aligned.

During the whole process, I tried to meet with Ellen every few weeks. Sometimes, the thesis supervision came at a very good moment and I was able to show my progress clearly. I helped me to make a presentation to show what I had been doing. These supervisions were very helpful as Ellen provided me with useful feedback: her broad scientific knowledge could lead to interesting new insights or discussions about the topics that I presented. However, I did not always have make lot of progress, thus sometimes there was not a lot to show. Especially in the beginning, when I felt a bit lost, I didn't always make a lot of progress or know how to continue. This also resulted to the supervision session being less valuable, as I did not have a lot of input myself. However, it still helped me as I could work towards specific moments. Furthermore, Felipe and I met almost weekly, which helped me a lot in the whole structure of the thesis and research approach. I always tried to prepare what I had been doing and processed the feedback after our meetings. In the beginning, I felt really overwhelmed by the constructive feedback and changed I needed to make, however, the final period of this thesis process was a lot smoother due to his continuous feedback.

13.7 References

Acciai, C., & Capano, G. (2019). Policy instruments at work: A meta-analysis of their applications | Enhanced Reader. Public Administration, 99(1). https://doi.org/10.1111/padm.12673

Agro & Chemie. (2021, November 22). Transitie naar houtbow niet meer te stoppen.

AMS institute. (2021, November 21). Building in timber is bad for the environment. Fact or fiction?

ARUP. (2019). Rethinking Timber Buildings Seven perspectives on the use of timber in building design and construction. Retrieved from https://www.arup.com/perspectives/publications/research/section/rethinking-timber-buildings

BAM. (2021, October 27). BAM zet grote stap in hightech productie vernieuwende concepten met woonfabriek in Oudkarspel. Bam.

Bengtsson, M., Hotta, Y., Hayashi, S., & Akenji, L. (2010). Institute for Global Environmental Strategies Report Part Title: The four main types of policy instruments Report Title: Policy Tools for Sustainable Materials Management: Report Subtitle: Applications in Asia.

Black, N. (1994). Why we need qualitative research. Journal of Epidemiology and Community Health, 48, 425–426.

Borrás, S., & Edquist, C. (2013). The choice of innovation policy instruments. Technological Forecasting and Social Change, 80(8), 1513–1522. https://doi.org/10.1016/j.techfore.2013.03.002

Brans, M., & Wayenberg, E. (n.d.). Beleidsinstrumenten: theoretische perspectieven en keuzemodellen.

BREEAM. (2022, February 24). BREEAM - Sustainability Assessment Method.

Bronsvoort, E., Veldboer, T., Fischer, A., te Slaa, A., & Kaptein, T. (2020). Bouwen aan een houten toekomst Scenarios voor bouwen met klimaatpositieve materialen. www.circle-economy.com

Bryman, A. (2012). Social Research Methods (4th edition). Oxford University press.

Bryson, J. (2004). What to do when stakeholders matter: A guide to stakeholder identification and analysis techniques. https://www.researchgate.net/publication/228940014

Bryson, J. M. (2004). What to do when stakeholders matter: Stakeholder Identification and analysis techniques. Public Management Review, 6(1), 21–53. https://doi.org/10.1080/14719030410001675722

Bucci Ancapi, F. (2022, February 18). A Policy Coherence Framework for CIrcular Built Environment implementation. Advanced Metropolitan Solutions Institute.

Bucci Ancapi, F., van den Berghe, K., & van Bueren, E. (2021). A Policy Coherence Framework for Circular Built Environment Implementation: the Case of a Campus Development.

Burke, M. J., & Stephens, J. C. (2017). Energy democracy: Goals and policy instruments for sociotechnical transitions. Energy Research and Social Science, 33, 35–48. https://doi.org/10.1016/j.erss.2017.09.024

Cambridge Dictionary. (2021a). instrument.

Cambridge Dictionary. (2021b). policy.

C-creators. (2021). Stichting C-creators. Retrieved from Https://C-Creators.Org/Contact/over-c-Creators.

Cirkelstad. (2022). Cirkelstad is een beweging. Retrieved from Https://Www.Cirkelstad.Nl/over-Ons-2/.

Colander, D., & Kupers, R. (2014). Complexity and the art of public policy. Solving society's problems from the bottom up. Princeton University Press.

Cramer, J. (2022). Effective governance of circular economies: An international comparison. Journal of Cleaner Production, 343, 130874. https://doi.org/10.1016/j.jclepro.2022.130874

De Circulaire Bouweconomie. (2021, June 8). Nieuw: 'Rapportage Woningbouw in hout.' Retrieved from https://circulairebouweconomie.nl/nieuws/nieuw-rapportage-woningbouw-in-hout/

duurzaamgebouwd.nl. (2020, December 2).

Woningconcepten van de toekomst zijn van hout. Duurzaamgebouwd.Nl.

Edmondson, D. L., Kern, F., & Rogge, K. S. (2019). The co-evolution of policy mixes and socio-technical systems: Towards a conceptual framework of policy mix feedback in sustainability transitions. Research Policy, 48(10). https://doi.org/10.1016/j.respol.2018.03.010

European Comission. (2019, November 15). Paris Agreement. Retrieved from https://ec.europa.eu/clima/eu-action/international-action-climate-change/climate-negotiations/paris-agreement_en

Geels, F., & Kemp, R. (2000). Transities vanuit sociotechnisch perspectief.

Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. In Research Policy (Vol. 31).

Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. Research Policy, 33(6–7), 897–920. https://doi.org/10.1016/j.respol.2004.01.015

Gemeente Amsterdam. (2020). Amsterdam Circulair 2020-2025 Innovatie- en Uitvoerinsgprogramma.

Georgius, M. (2021, June 21). BrabantWonen: 'Met houtbouw veel meer mogelijk dan je denkt'". Aedes.

Hanemaaijer, A., Kishna, M., Kooke, M., Brink, H., Koch, J., Prins, A. G., & Rood, T. (2021). INTEGRALE CIRCULAIRE ECONOMIE RAPPORTAGE 2021.

Het ministerie van Infrastructuur en Waterstaat. (2021). Uitvoeringsprogramma Circulaire Economie 2021-2023.

Hood, C. C. (1983). The Tools of Government (1st edition). THE MACMILLAN PRESS LTD.

Huttunen, S., Kivimaa, P., & Virkamäki, V. (2014). The need for policy coherence to trigger a transition to biogas production. Environmental Innovation and Societal Transitions, 12, 14–30. https://doi.org/10.1016/j.eist.2014.04.002

Kemp, R., Rotmans, J., & van Asselt, M. (2001). more evolution than revolution: transition management in public policy.

Kivimaa, P., & Kern, F. (2016). Creative destruction or mere niche support? Innovation policy mixes for sustainability transitions. Research Policy, 45(1), 205–217. https://doi.org/10.1016/j.respol.2015.09.008

Köhler, J., Geels, F. W., Kern, F., Markard, J., Onsongo, E., Wieczorek, A., Alkemade, F., Avelino, F., Bergek, A., Boons, F., Fünfschilling, L., Hess, D., Holtz, G., Hyysalo, S., Jenkins, K., Kivimaa, P., Martiskainen, M., McMeekin, A., Mühlemeier, M. S., … Wells, P. (2019). An agenda for sustainability transitions research: State of the art and future directions. Environmental Innovation and Societal Transitions, 31, 1–32. https://doi.org/10.1016/j.eist.2019.01.004

Korhonen, J., Honkasalo, A., & Seppälä, J. (2018). Circular Economy: The Concept and its Limitations. Ecological Economics, 143, 37–46. https://doi.org/10.1016/j.ecolecon.2017.06.041

Korhonen, J., Nuur, C., Feldmann, A., & Birkie, S. E. (2018). Circular economy as an essentially contested concept. Journal of Cleaner Production, 175, 544–552. https://doi.org/10.1016/j.jclepro.2017.12.111

Kuys, D., & van den Bergh, A. (2019, October 20). Wat doen woningcorporaties met houtbouw? https://www.vpro.nl/programmas/tegenlicht/lees/artikelen/wat-doen-woningcorporaties-met-houtbouw.html

Luijkx, T., Kuindersma, P., Weterings, H., & Willems, M. (2021). Rapportage woningbouw in hout. Retrieved from https://circulairebouweconomie.nl/wp-content/uploads/2021/06/Rapportage-Woningbouw_in_hout-210607.pdf

MacArthur, E., Zumwinkel, K., & Stuchtey, M. R. (2015). GROWTH WITHIN: A CIRCULAR ECONOMY VISION FOR A COMPETITIVE EUROPE.

Metropoolregio Amsterdam. (2021). Convenant Green Deal Houtbouw Duurzaam uit de crisis.

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties. (n.d.). Programma Ruimte voor Biobased bouwen. Denationaleomgevingsvisie.

Mitchell, R. K., Agle, B. R., & Wood, D. J. (1997). Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts. In Source: The Academy of Management Review (Vol. 22, Issue 4). Retrieved from https://www.jstor.org/stable/259247

Munaro, M. R., Tavares, S. F., & Bragança, L. (2020). Towards circular and more sustainable buildings: A systematic literature review on the circular economy in the built environment. In Journal of Cleaner Production (Vol. 260). Elsevier Ltd. https://doi.org/10.1016/j.jclepro.2020.121134

Nelson, R. R., & Winter, S. G. (1982). An Evolutionary Theory of Economic Change.

Ness, D. A., & Xing, K. (2017). Toward a Resource-Efficient Built Environment: A Literature Review and Conceptual Model. Journal of Industrial Ecology, 21(3), 572–592. https://doi.org/10.1111/jiec.12586

Nielsen, J., & Farrelly, M. A. (2019). Conceptualising the built environment to inform sustainable urban transitions. Environmental Innovation and Societal Transitions, 33, 231–248. https://doi.org/10.1016/j.eist.2019.07.001

Nobre, G. C., & Tavares, E. (2021). The quest for a circular economy final definition: A scientific perspective. Journal of Cleaner Production, 314. https://doi.org/10.1016/j.jclepro.2021.127973

Nykamp, H. (2020). Policy mix for a transition to sustainability: Green buildings in Norway. Sustainability (Switzerland), 12(2). https://doi.org/10.3390/su12020446

Oldenburger, J., & van den Briel, J. (2020). Meer met Nederlands hout.

Pacheco-Vega, R. (2020). Environmental regulation, governance, and policy instruments, 20 years after the stick, carrot, and sermon typology. Journal of Environmental Policy and Planning, 620–635. https://doi.org/10.1080/1523908X.2020.1792862

Pakhuis de Zwijger. (2021, October 14). Houtbouw #7 De toekomst van houtbouw. Pakhuis de Zwijger.

Pomponi, F., & Moncaster, A. (2017). Circular economy for the built environment: A research framework. Journal of Cleaner Production, 143, 710–718. https://doi.org/10.1016/j.jclepro.2016.12.055

Provincie Noord-Holland. (2021). Actieagenda Circulaire Economie 2021-2025.

Rijksdienst voor Ondernemend Nederland. (2022, April 4). Energieprestatie indicatoren - BENG.

Rijksoverheid. (n.d.). Nederland circulair in 2050. Retrieved October 19, 2021, Retrieved from https://www.rijksoverheid.nl/onderwerpen/circulaire-economie/nederland-circulair-in-2050

Rijksoverheid. (2021, January 28). Doelstelling aantal nieuwe woningen in 2020 gehaald. Retrieved from https://ec.europa.eu/clima/eu-action/international-action-climate-change/climate-negotiations/paris-agreement_en

Rip, A., & Kemp, R. (1998). Technological change.

Roberts, H. (2021). Explorative interview.

Rogelj, J., Schaeffer, M., Meinshausen, M., Knutti, R., Alcamo, J., Riahi, K., & Hare, W. (2015). Zero emission targets as long-term global goals for climate protection. Environmental Research Letters, 10(10). https://doi.org/10.1088/1748-9326/10/10/105007

Rogge, K. S., & Reichardt, K. (2016). Policy mixes for sustainability transitions: An extended concept and framework for analysis. Research Policy, 45(8), 1620–1635. https://doi.org/10.1016/j.respol.2016.04.004

Schot, J. (1998). The usefulness of evolutionary models for explaining innovation. The case of the Netherlands in the nineteenth century. History and Technology, 14(3), 173–200. https://doi.org/10.1080/07341519808581928

Schot, J., & Steinmueller, W. E. (2018). Three frames for innovation policy: R&D, systems of innovation and transformative change. Research Policy, 47(9), 1554–1567. https://doi.org/10.1016/j.respol.2018.08.011

Tissink, A. (2021, December 20). Heijmans samen met Staatsbosbeheer aan de slag met hout. Retrieved from Https://Www-Cobouw-Nl.Tudelft.Idm.Oclc.Org/Duurzaamheid/Nieuws/2021/12/Heijmans-Werkt-Met-Staatsbosbeheer-Aan-Nieuwe-Houtbouwlijn-101301732.

TU Delft. (2022). Management in the Built Environment leerstoelen.Retrieved from https://www.tudelft.nl/bk/over-faculteit/afdelingen/management-in-the-built-environment/organisatie/leerstoelen

Uijen, E., & Andringa, M. (2021). Houtbouw, een gezonde belegging.

USGBC. (2022). LEED rating system | U.S. Green Building Council.

van der Lugt, P. (2021). Houtbouwmythes ontkracht het onderscheid tussen fabels en feiten. Retrieved from www.ams-institute.org

van der Zande, B. (2021). Explorative interview.

van Veldhoven, S., Wiebes, E., Schouten, C., Jonkind, J., van Tongeren, L., Koser Kaya, F., Eringa, P., van Vreeswijk, W., Buisman, J., van Leeuwen, M., Hol, G., van der Velden, J., Bork, J., van Roekel, E., Kloetstra, S., Barendregt, A., van der Berg, R., Buiter, R., van Roekel, E., ... Beukers, M. (2018). Betonakkoord voor duurzame groei. ``Retrieved from https://www.betonakkoord.nl

van Vught, F., & de Boer, H. (2015). Governance Models and Policy Instruments. In The Palgrave International Handbook of Higher Education Policy and Governance (pp. 38–56). Palgrave Macmillan UK. https://doi.org/10.1007/978-1-137-45617-5_3

Verdung, E. (1998). Policy Instruments: Typologies and Theories. In M. Bemelmand-Videc, C. Rist, & E. Vedung (Eds.), Carrots, Sticks, and Sermons: Policy Instruments and Their Evaluation (pp. 21–58). Transaction Publishers.

Vermeulen, M. (2020). Ruimte voor Biobased Bouwen.

Vermeulen, M., van der Waal, J., van Woerden, B., & Voorter, L. (2020). Ruimte voor Biobased Bouwen - strategische verkenning. Retrieved from https://www.tweedekamer.nl/kamerstukken/detail?id=2020D51432&did=2020D51432

Wilkinson, M. D., Dumontier, M., Aalbersberg, Ij. J., Appleton, G., Axton, M., Baak, A., Blomberg, N., Boiten, J. W., da Silva Santos, L. B., Bourne, P. E., Bouwman, J., Brookes, A. J., Clark, T., Crosas, M., Dillo, I., Dumon, O., Edmunds, S., Evelo, C. T., Finkers, R., ... Mons, B. (2016). Comment: The FAIR Guiding Principles for scientific data management and stewardship. Scientific Data, 3. https://doi.org/10.1038/sdata.2016.18

Williams, J. (2021). CIRCULAR CITIES; A Revolution in Urban Sustainability. Retrieved from www.routledge.com/

Wohlin, C. (2014). Guidelines for snowballing in systematic literature studies and a replication in software engineering. ACM International Conference Proceeding Series. https://doi.org/10.1145/2601248.2601268

Yin, R. (1994). Case study research: Design and methods: Vol. Volume 5 (2nd edition). Sage Publications Incorporated.

Yu, Y., Junjan, V., Yazan, D. M., & Iacob, M.-E. (2022). A systematic literature review on Circular Economy implementation in the construction industry: a policy-making perspective. Resources, Conservation and Recycling, 183, 106359. https://doi.org/10.1016/j.resconrec.2022.106359

PART V
APPENDICES

Appendices

Appendix A – Interview materials

Appendix A1 Interview protocol
Appendix A2 Informed consent
Appendix A3 Interview participants
Appendix A4 Expert session statements

Appendix B – Interview analysis

Appendix B1 Codes in AtlasTI
Appendix B2 Instrument relations coded in AtlasTI
Appendix B3 Code occurrence in AtlasTI

Appendix C – Stakeholder Analysis

Appendix C1 Attractiveness of policies versus stakeholders' capacities to implement policy plans or proposals grid of non-governmental stakeholders
Appendix C2 Attractiveness of policies versus stakeholders' capacities to implement policy plans or proposals grid of governmental stakeholders
Appendix C3 Policy implementation strategy development grid of non-governmental stakeholders
Appendix C4 Policy implementation strategy development grid of governmental stakeholders

Appendix D – Interview results (extra graphs)

Appendix D1 Interview results necessary policy instruments
Appendix D2 Interview results policy instruments that have effect

Appendix A1
Interview protocol

Semi-structured in-depth interview

Theme
The MRA aims to increase the construction of housing by timber up to 20% of all constructed housing by 2025. To make this transition happen, certain policy instruments can be applied by governmental stakeholders on different authority levels. While literature argues that policy mixes are required for transitions to happen, the right combination of policy instruments to foster a circular economy in the built environment remains unclear. Based on the timber transition as a case study, this research will contribute to this knowledge gap. Interviews with non-governmental stakeholders will give insight in how certain policies are perceived by the stakeholders and what the effect of the policies has been for them, but also which other policy instruments are necessary for them to transition to timber constructions. Furthermore, interviews with governmental stakeholders on different governmental levels will give insight in the combination of policies that is used to foster sustainable transitions. Besides contributing to the thesis research, the interview results will be used for the development of the tool of the municipality of Amsterdam: 'activating regulations for a circular society'.

Main research question of the thesis
'How can a combination of policy instruments foster the transition to timber housing construction in the MRA?'

Sub-questions to be (partially) answered by the interviews
SQ3: What policy instruments can foster sustainability transitions?
SQ5: Which policy instruments are necessary for an effective timber transition?
SQ6: What is the effect of the current policies on the transition towards timber constructions?

Goal
- Insight in the perceived effects / no effects of policy instruments in the transition to timber constructions by non-governmental stakeholders
- Insight in the policy instruments that are perceived to be necessary to transition to timber constructions by non-governmental stakeholders
- Insight in the perceived effects of the policy instruments in sustainable transitions by governmental stakeholders
- Insight in the policy instruments that are perceived to be necessary for sustainable transitions by governmental stakeholders

Interview characteristics
- Type of interview: semi-structured research review
- Interview style: behavioral interview
- Duration of the interview: 45 minutes

¤ Location: digital

Amount of interviews

¤ 21

Before the interview

1. **What to do?**

¤ Contact the interviewee via LinkedIn or email when available
¤ Introduce yourself
¤ Introduce the theme of the interview
¤ Sent informed consent and ask to sign and sent back
¤ Agree on a date and time for the interview
¤ Agree on a digital platform and sent invitation

2. **Prepare the interview:**

¤ Keep the protocol open / print out during the interview

Start of the conversation

Try to build a good relationship during the introduction with the interviewee. Be kind, show interest and try to empathize with his/her life.

Introduction

Introduction of the project:

¤ Binnen het project 'CircuLaw' van CTO innovatieteam werken we momenteel aan de ontwikkeling van een circulaire regelgevingstool. De tool is bedoeld voor circulaire beleidsmakers en moet hen in staat stellen om beter en makkelijker te navigeren in de huidige (en toekomstige) regelgeving. Het doel van deze tool is om het voor beleidsmakers overzichtelijk te maken welke fiscaal-juridische maatregelen er genomen kunnen worden om de transitie naar een circulaire economie te versnellen. De tool is opgebouwd uit verschillende casussen, waaronder houtbouw, om specifiek en doelgericht de belangrijke maatregelen per casus te achterhalen. In de toekomst kan een beleidsmaker dus gebruik maken van de tool door adhv bepaalde filters (bijvoorbeeld het bevoegdheidsniveau, de casus, het afbreukrisico etc) een overzicht te zien van de maatregelen die van toerpassing zijn.

Introduction of myself and my research:

¤ Ik doe de master MBE aan de TU Delft. Voor mijn afstuderen onderzoek ik hoe beleidsinstrumenten ingezet kunnen worden voor transities naar een circulaire gebouwde omgeving, en specifiek richt ik mijn onderzoek op de houtbouw transitie in de MRA. Ik heb literatuuronderzoek gedaan naar verschillende typologieën van beleidsinstrumenten, modellen voor het opstellen van een beleidsmix, en beleidsmixen ter bevordering van duurzame transities.Mijn onderzoek zal voor gemeente

Amsterdam bijdragen aan het handelingsperspectief van de tool: hoe kunnen de instrumenten het beste worden ingezet, welke instrumenten zijn er nodig vanuit de markt, wat zijn de bevonden effecten op de beleidsinstrumenten die al zijn geimplementeerd, hoe kan het beste een beleidsmix worden opgesteld om de houtbouwtransitie te bevorderen. Hiervoor interview ik zowel niet-overheidspartijen die het houtbouw convenant hebben ondertekend, als overheidspartijen die het houtbouw convenant hebben ondertekend. In de interviews met niet-overheidspartijen probeer ik erachter te komen welke maatregelen of instrumenten effect hebben gehad op hun ervaringen met houtbouw, en op wat voor manier. Verder probeer ik erachter te komen welke instrumenten voor hun nodig zouden zijn voor het bevorderen van houtbouw. Ook zal ik vragen stellen waarin ik u vraag over uw mening over de werking en effecten van het houtbouw convenant, gezien dit de casus van mijn onderzoek is. In de interviews met overheidspartijen onderzoek ik welke combinatie van beleidsinstrumenten geimplementeerd wordt ter bevordering van een duurzame transitie en wat de effecten daarvan zijn. Verder probeer ik erachter te komen welke instrumenten zij nodig achten ter verdere bevordering van een duurzame transitie Allereerst zal ik wat algemene vragen stellen, waarna ik naar uw ervaring over verschillende typen beleidsinstrumenten zal vragen.

- Say that I am interested in personal experiences and there is no good/wrong answer

- Privacy statement: say that the interview is confidential. The results will be anonymized and all data will only be used for research purposes.

- Ask if it is ok to record the interview

- Explain that the interview will take around 45-60 minutes

- Ask if the interviewee still has questions. If the interviewee has no questions and agrees upon everything, the interview can start.

Interview niet-overheidspartijen die het convenant hebben ondertekend

Tijdens de introductie een goede relatie met de geïnterviewde opbouwen. Vriendelijk zijn, interesse tonen, inleven in zijn/haar situatie. Ook uitleggen dat het interview uit meerdere delen is opgebouwd: de verschillende categorieën van beleidsinstrumenten (zoals door gemeente Amsterdam is ingedeeld) worden allemaal behandeld.

1. Algemeen

1.1 Kunt u wat over uzelf vertellen, wat voor werk doe je en wat komt daarbij kijken?
1.2 Waarom heeft uw bedrijf het houtbouw convenant ondertekend?

---

2. Juridisch (2.1 en 2.2 zijn voor verschillende typen stakeholders)

2.1 Juridisch voor banken, kennisinstituten en koepelorganisaties uit convenant

2.1.1 Zijn er in uw ogen bepaalde juridische maatregelen die het vermoeilijken om naar houtbouw over te stappen?

2.1.2 Moeten er door jullie bedrijf bepaalde vergunningen (anders dan regulier) aangevraagd worden voor het gebruik van hout voor houtbouw, zo ja, hoe wordt dit proces ervaren?

2.2 Juridisch voor overige stakeholders uit covenant (die in een houtbouw project hebben meegewerkt)

2.2.1 Was er tijdens eerdere ervaringen met houtbouw sprake van een aanbestedingsprocedure en hoe is dit ervaren?
2.2.1.1 Vanuit wie is de opdracht aanbesteed?
2.2.1.2 Wat waren de specifieke eisen in de tender? Had er ook iets anders dan een ontwerp met houtbouw gemaakt kunnen worden?

2.2.2 Hoe heeft u het proces van vergunningen aanvragen ervaren?

2.2.3 Zijn er momenten geweest dat het handelen van de overheid heeft mee/tegen gewerkt in de uitvoering van het project?

---

3. Informatief en faciliterend

3.1 Heeft de overheid voor jullie in enige vorm een voorzienende rol gespeeld in deze transitie naar houtbouw?
3.1.1 Ja, Bijvoorbeeld informatief, faciliterend; Bijvoorbeeld

informatie = resultaten van onderzoek delen (materialen, haalbaarheidsstudies, aanbestedingsvormen etc) of faciliterend = programma's opstellen, kennisprogramma's, adviseren

3.1.2 Zo nee: vind u dat er vanuit de overheid meer een verantwoordelijkheid ligt om dit te doen, of ligt dat meer bij de marktpartijen?

3.2 Gebrek aan kennis over houtbouw binnen verschillende delen van de keten zorgt ervoor dat het lastiger is om houtbouw op te schalen. Denk aan de gebruiker die minder snel voor houtbouw kiest maar ook onvoldoende kennis binnen de ketensamenwerking. Wat is er vanuit uw perspectief nodig van de overheid om bij te dragen in het oplossen van dit probleem?

4. Financieel economisch

3.1 Is er gebruik gemaakt van financiële hulpmiddelen vanuit de overheid om de houtbouw transitie te versnellen?

3.1.1 **Zo ja,** kunt u hier meer over vertellen?

3.1.2 **Zo nee,** is hier behoefte aan en zo ja aan welke financiële hulpmiddelen was behoefte?

5. Transitie gerelateerd

5.1 Wanneer heeft u voor het eerst over houtbouw gehoord?

5.2 Ziet u al iets terug van de beoogde effecten van het convenant?

5.2.1 Bijvoorbeeld netwerken of leereffecten

5.2.2 Wat is de reden hiervoor?

5.3 Hoe ziet u de lange termijn perspectieven van de houtbouw transitie voor zich?

5.4 Wat had u gedaan als de overheid geen beleidsinterventie rondom houtbouw had genomen?

5.4.1 Dus geen convenant

5.4.2 Afhankelijk van de juridische maatregelen: als deze ook niet in plaats waren

5.5 Bij welk overheidsniveau ligt naar uw mening welke verantwoordelijkheid als het gaat om het initiëren van een transitie?

6. Na alle vragen

6.1 Zijn er nog zaken die niet besproken zijn die u graag naar voren wilt brengen, of heeft u nog andere vragen?

Interview beëindigen

Bedankt voor het interview en het delen van uw ervaringen. Een korte conclusie geven van wat er gezegd is. Zeggen dat deelnemer contact kan opnemen bij vragen en hij/zij de toestemming kan intrekken wanneer gewenst. Opname stoppen.

Interview overheidspartijen die het convenant hebben ondertekend

Tijdens de introductie een goede relatie met de geïnterviewde opbouwen. Vriendelijk zijn, interesse tonen, inleven in zijn/haar situatie. Ook uitleggen dat het interview uit twee delen is opgebouwd: over beleid wanneer er vanuit de overheid een transitie op gang werd gezet en vervolgens over beleid wanneer private partijen aanvragen hebben gedaan om een innovatie te implementeren.

1. Algemeen

1.1 Kunt u wat over uzelf vertellen, wat voor werk doe je en wat komt daarbij kijken?

2. Vragen deel 1 - transitiebeleid vanuit overheid

2.1 Zijn er vanuit uw afdeling wel eens maatregelen genomen om een transitie van een duurzame innovatie te stimuleren?
- 2.1.1 Bijvoorbeeld: het verminderen van CO2 door meer elektrische auto's oid? Zo ja, voor welke innovatie?

2.2 Op wat voor manier houd u rekening met de lange termijn perspectieven wanneer u beleid maakt / aanpast?

2.3 Op wat voor manier denkt u na over het creëren van momentum voor de beleidsinterventie?

2.4 Hoe beslist u wat voor instrumenten gecombineerd kunnen worden voor het creëren van momentum?

2.5 Wat zijn de maatregelen/instrumenten worden er door u gebruikt/geïmplementeerd?
- 2.5.1 Zachte/harde en combinatie?
- 2.5.2 Wat voor hefbomen zijn gecreëerd?

2.6 Hoe is er gekozen voor deze maatregelen?

2.7 Hoe paste dit binnen de bestaande wet- en regelgeving?

2.8 Waren deze maatregelen van tijdelijke aard of permanent?

2.9 Hoezo is er gekozen voor permanent/tijdelijk en met wat voor soort wetgeving is dit gedaan?
- 2.9.1 Indien tijdelijk, is ervoor gekozen om dit uiteindelijk ook in een permanente maatregelen door te voeren, zo ja, hoe gaat dit in zijn werk?
- 2.9.2 Indien permanent, hoe is deze overgang gegaan?

2.10 Hoe zijn deze maatregelen ingevoerd?
- 2.10.1 In combinatie met andere maatregelen?
- 2.10.2 Op welk moment?
- 2.10.3 Wat waren de processen?

2.11 Is het effect van deze maatregel(en) nu al zichtbaar, en zo ja wat is het effect?

3. Vragen deel 2 – transitie/innovatie vanuit private partij

3.1 Wanneer er een marktpartij is die iets nieuws (een innovatie) wilt implementeren, hoe wordt hier dan met wet- en regelgeving op gereageerd?
- 3.1.1 Hoe gaat dat in zijn werk?

3.2 Worden er wel eens tijdelijke uitzonderingen op wet- en regelgeving gemaakt om bepaalde innovaties te stimuleren / ruimte te creeren voor bepaalde innovaties?

3.3 Wat als blijkt dat voor een bepaalde innovatie de wet- en regelgeving permanent verandert moet worden indien die innovatie gestimuleerd dient te worden?

4. Relatie met andere overheidsniveaus

4.1 Wat zijn, volgens u, de verschillende bevoegdheden per niveau als het gaat om het stimuleren van innovaties?

4.2 Heeft u overleg met beleidsmakers op andere niveaus wanneer u ziet dat er behoefte is aan vernieuwing?

4.3 Heeft u wel eens hinder ondervonden door de verschillende bevoegdheden per niveau, wanneer u beleid wilde schrijven?
- 4.3.1 Hoe gaat u hiermee om?

4.4 Hoe krijgt u specifieke veranderingen (bijvoorbeeld innovaties) in uw beleid wanneer dit niet aansluit op beleid van andere niveaus?

5. Na alle vragen

5.1 Zijn er nog zaken die niet besproken zijn die u graag naar voren wilt brengen, of heeft u nog andere vragen?

Interview beëindigen

Bedankt voor het interview en het delen van uw ervaringen. Een korte conclusie geven van wat er gezegd is. Zeggen dat deelnemer contact kan opnemen bij vragen en hij/zij de toestemming kan intrekken wanneer gewenst. Opname stoppen.

After the interview

Transcript

- After the interview, the audio recording will be transcribed

Analysis

- The transcript are loaded into AtlasTI
- Different codes are made for the 2 sets of interviews, these codes will be defined based on themes that seemed often occurring
- The transcript are coded with the codes that have been created
- The codes are used to analyze the interview data based on the theoretical and analytical framework.

Appendix A3
Informed consent

Geïnformeerde toestemming

Amsterdam, 22 februari 2022

Geachte heer/mevrouw,

Binnen het project 'activerende regelgeving voor een circulaire samenleving' van Gemeente Amsterdam werken we aan de ontwikkeling van een circulaire regelgevingstool. De tool is bedoeld voor circulaire beleidsmakers en moet hen in staat stellen om beter en makkelijker te navigeren in de huidige (en toekomstige) regelgeving. Het doel is om beleidsmakers handelingsperspectief te bieden door het aanwenden van fiscaal-juridische maatregelen en daarmee de transitie naar de circulaire economie te versnellen. Een van de casussen waarvoor een wetsanalyse is uitgevoerd is houtbouw.

Het onderzoek wat ik met mijn afstudeerstage verricht zal bijdragen aan het handelingsperspectief van de tool. Ik zal dus onderzoeken hoe bepaalde beleidsinstrumenten het beste ingezet kunnen worden, wanneer het beste moment is, op welke manier, en in combinatie met welke niet-juridische beleidsinstrumenten.

Als onderdeel van mijn onderzoek doe ik een inventarisatie naar de beleidsinstrumenten die zijn ingezet, of waar gebruik van is gemaakt, tijdens houtbouwprojecten die recentelijk zijn uitgevoerd of in uitvoering zijn. Ik ben benieuwd naar het verhaal van de bouwer, ontwikkelaar, ontwerper: hoe is er gehandeld/zal er gehandeld worden binnen de bestaande maatregelen en wat voor invloed heeft dit op het gehele proces gehad?

Dit onderzoek wordt uitgevoerd in het kader van een afstudeer onderzoek voor de master 'Management in the Built Environment' aan de TU Delft. Het onderzoek wordt begeleid door Ellen van Bueren, Universitair Hoofddocent, en Romy Snijders, zij werkt vanuit Dark Matter Labs mee aan dit project bij Gemeente Amsterdam.

Dit interview wordt gedaan door Josefien de Wind. Het interview duurt ca. 30 tot 45 minuten. Graag zou ik het interview op willen nemen om het achteraf uit te kunnen werken en te kunnen leren van uw ervaringen.

Vanuit de universiteit zijn de richtlijnen om nogmaals te vragen of u mee wilt doen aan het onderzoek bij de start van het interview, en of u het goedkeurt als het interview wordt opgenomen.. U krijgt dan de gelegenheid zich terug te trekken. Ook kunt u achteraf uw deelnamen intrekken zonder opgave van reden. U mag iedere vraag die ik stel weigeren te beantwoorden.

Als u mee doet, dan vraag ik u om uw handtekening onderaan deze brief te zetten en in pdf aan mij te retourneren. Ik zet dan ook mijn handtekening. Hiermee wordt ondertekend dat ik vertrouwelijk met uw gegevens en antwoorden om ga. Het interviewverslag wordt niet gedeeld met uw organisatie en zal anoniem worden uitgewerkt. Wanneer uw woorden worden aangehaald zal uw naam niet gebruikt worden en zal niet duidelijk zijn wie dit gezegd heeft. Uw naam- en contactgegevens zullen na afloop van het onderzoek vernietigd worden.

Als u vragen heeft over dit onderzoek, kunt u contact met mij opnemen: Josefien de Wind, j.de.wind@amsterdam.nl , 0642303283. Ook kunt u contact opnemen met één van mijn begeleiders: Ellen van Bueren (E.M.vanBueren@tudelft.nl) of Romy Snijders (romy@darkmatterlabs.orgmailto:c.j.vanoel@tudelft.nl).

Pagina 1 van 2

Geïnformeerde toestemming

Als u mee wilt doen aan dit interview, wilt u dan de onderstaande verklaring invullen en ondertekenen?

Met vriendelijke groet,

Josefien de Wind

In te vullen door de medewerker & studenten

Ik verklaar op een voor mij duidelijke wijze te zijn ingelicht over de aard, methode, doel en belasting van het onderzoek.

Mijn vragen zijn naar tevredenheid beantwoord.

Ik begrijp dat het geluids- en/of beeldmateriaal (of de bewerking daarvan) en de overige verzamelde gegevens uitsluitend voor analyse en wetenschappelijke presentatie en publicaties zal worden gebruikt.

Ik behoud me daarbij het recht voor om op elk moment zonder opgaaf van redenen mijn deelname aan dit onderzoek te beëindigen.

Ik heb dit formulier gelezen of het formulier is mij voorgelezen en ik stem in met deelname aan het onderzoek.

☐ **Graag ontvang ik aan het eind van het onderzoek een korte samenvatting van de resultaten van het onderzoek. Om deze reden verleen ik toestemming om mijn naam- en adresgegevens tot het eind van het onderzoek te bewaren.**

Plaats:

Datum:

_ _

(Volledige naam, in blokletters)

_ _

(Handtekening deelnemer)

'Ik heb toelichting gegeven op het onderzoek. Ik verklaar mij bereid nog opkomende vragen over het onderzoek naar vermogen te beantwoorden.'

[naam student]

_ _

(handtekening student)

Appendix A2

Interview participants

The anonymized interviews have not been included in this thesis and are kept by the author. Contact the author if you wish to receive more information about the interviews.

Explorative interviews

Role	Code
Expert 1, employee at timber company	E1
Expert 2, timber expert in MRA	E2

Non-governmental stakeholders

Role	Interviewee
Housing corporation 1	HC1
Housing corporation 2	HC2
Developer 1	D1
Developer 2	D2
Umbrella organization 1	UO1
Umbrella organization 2	UO2
Knowledge institute 1	KI1
Knowledge institute 2	KI2
Engineering- and consulting firm 1	EF1
Engineering- and consulting firm 2	EF2
Timber builders 1	TB1
Architects 1	A1
Architects 2	A2
Contractors 1	C1

Governmental stakeholders

Role	Code
National government 1	NG1
National government 2	NG2
Province 1	P1
Province 2	P2
Municipality 1	M1

Appendix A4
Expert session statements

Statements over stakeholder analyse

In de stakeholder analyse heb ik de verschillende typen (publieke en private) partijen die het convenant hebben ondertekend geanalyseerd op basis van een methode van Bryson (2014). Deze methode bestaat uit verschillende stappen, zoals bijvoorbeeld het beschrijven van de stakeholders; het bepalen van hun macht, legitimiteit en urgentie om een beleid in te voeren; het aangeven van hun capaciteiten om een beleidsplan in te voeren vs. de aantrekkelijkheid van het beleidsplan. Deze stakeholder analyse leg ik naast mijn interview resultaten om te kunnen onderbouwen waarom bepaalde stakeholders bepaalde elementen in de transitie belangrijk (of niet) achten, welke belangen ze hebben/waarom, waarom ze bepaalde beleidsinstrumenten nodig achten voor de transitie etc.

Op basis van de analyse zijn er een aantal statements naar voren gekomen die bevindingen uit de analyse presenteren. Een validatie/afwijzing van deze statements zal het uitkomsten van het onderzoek versterken.

Statement 1:
De publieke en private partijen die het houtbouw convenant hebben ondertekend zijn in het algemeen goed in staat (= ze hebben de juiste capaciteiten en het naleven van de plannen is aantrekkelijk voor de partijen) om de afspraken zoals beschreven in 'E.3 Concretisering per type betrokken partijen' (Convenant Green Deal Houtbouw: Duurzaam uit de crisis, 2021) na te leven, gezien de betrokkenheid van deze partijen bij het opstellen van de afspraken.

Statement 2:
Enkele typen partijen zijn minder goed in staat om de afspraken na te leven:

- Staatsbosbeheer heeft een lage capaciteit om de afspraken na te leven. De ambitie van de afspraken (realisatie van 3 nieuwe multifunctionele bosgebieden binnen 3 jaar in de MRA; realisatie van een technisch hoogwaardige zagerij voor houtverwerking faciliteren) is hoog en vereisen samenwerking met veel andere partijen. De lage bevoegdheid van Staatsbosbeheer en haar diverse takenpakket wat mogelijke andere prioriteiten heeft maakt de capaciteit voor het implementeren van de afspreken laag voor deze stakeholder.
- Kennisinstellingen hebben een lage capaciteit om de afspraken na te leven. Een groot deel van de kennisontwikkeling omtrent houtbouw wordt opgebouwd uit praktijkervaring. Alhoewel sommige afspraken goed passen bij de capaciteiten van de kennisinstellingen, zijn er afspraken die lastiger na te leven zijn. De kennis die bijvoorbeeld ontwikkelaars hebben, wordt vaak niet gedeeld, terwijl juist dit waardevolle kennis is voor de toepassing in de praktijk. De middelen om aan kennis te komen zijn dus beperkt voor deze stakeholder
- Banken & institutionele investeerders zijn weinig aangetrokken tot het naleven van de afspraken. Ondanks de beschikbare kennis die beweert dat houtbouw concurrerend is/kan zijn met traditionele bouwmethoden, kan een investering in houtbouw minder zekerheid bieden aan deze stakeholder. Er kunnen veel onvoorziene aspecten zijn (bijv. Covid, conflict in Oekraïne etc.) die kunnen leiden tot prijsschommelingen en gezien de huidige toepassing van dit product nog relatief nieuw is, zullen investeerders geneigd zijn eerder voor de zekere optie te kiezen.

Statement 3:
De grootste barrière voor stakeholders om over te stappen op houtbouw, is veroorzaakt door de huidige wet- en regelgeving.

Statement 4:
Voor overheidspartijen die het convenant hebben ondertekend kan het naleven van de afspraken lastig zijn inconsistent beleid voeren en maken. Inconsistentie kan zowel duiden op inconsistent beleid (dus wisselende regelgeving, tegensprekende regelgeving etc.) als inconsistentie tussen verschillende afdelingen (bijvoorbeeld in een gemeente, of verschillende ministeries op rijksniveau).

Statements over convenant green deal houtbouw

Op basis van een model uit de theorie (Design of a policy mix van Rogge & Reichardt, 2016) heb ik het convenant geanalyseerd. Hierbij zijn de voorstellen uit het convenant als beleidsmix beschouwd, en zijn de verschillende karakteristieken, elementen, processen en dimensies beschreven. Ook dit heeft geleid tot een aantal statements die gebaseerd zijn op de resultaten van dit onderzoek.

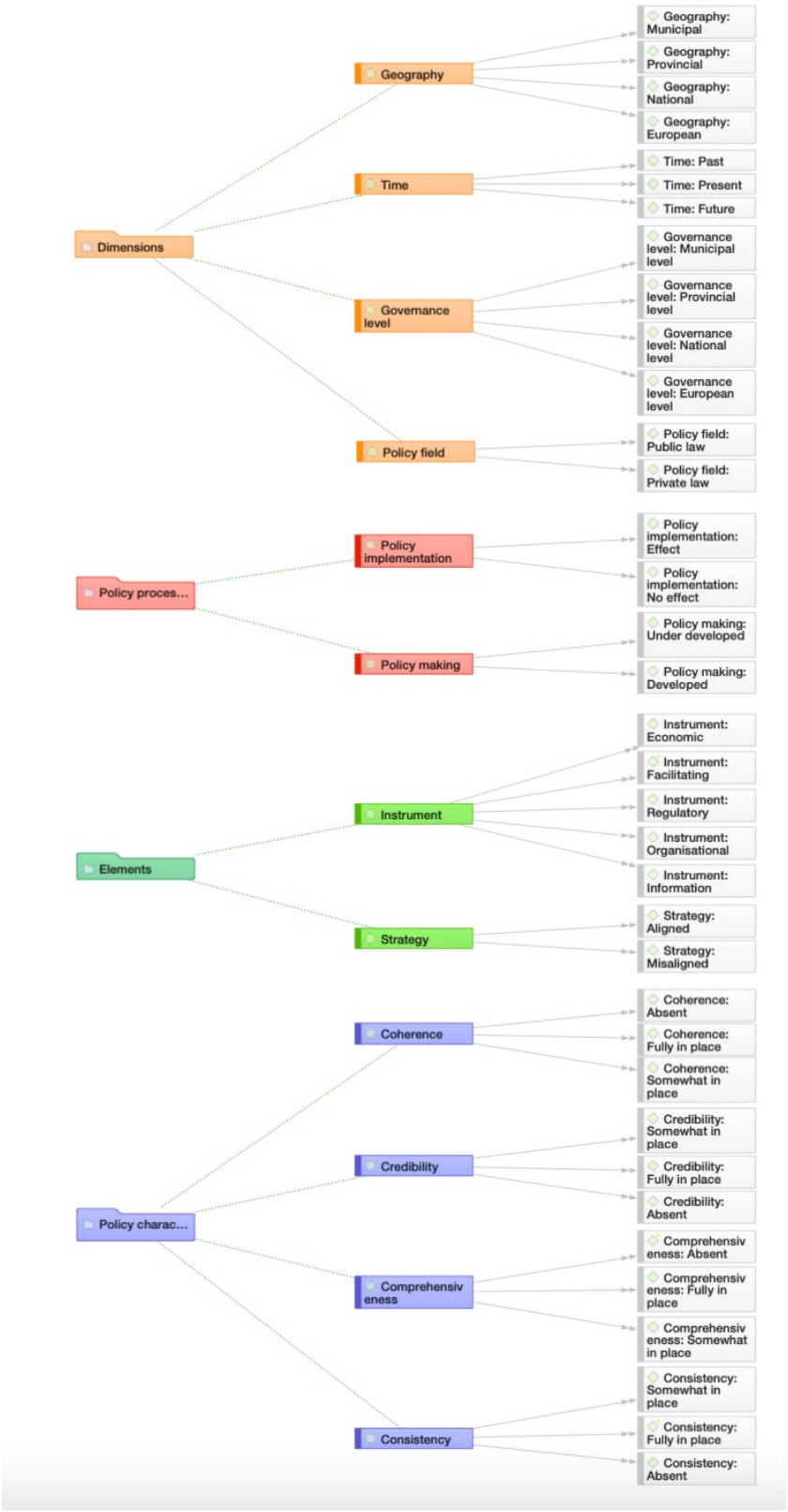
Statement 5:
De afspraken voor de overheidspartijen in het convenant schieten tekort in het presenteren van mogelijke economische instrumenten. Terwijl het convenant wel aanstuurt op verschillende informatieve en juridische instrumenten, zijn er geen financieel-economische instrumenten gepresenteerd.

Statement 6:
Het convenant schiet tekort in het operationaliseren van de beoordeling van de doelen. De gegeven 20% is nog niet erg concreet: wie zal deze beoordeling uitvoeren en op wat voor manier wordt deze beoordeling uitgevoerd? Verder wordt er ook niet ingegaan op de meetbaarheid van de gemaakte afspraken.

Statement 7:
Het convenant schiet tekort in de inbedding van de voorstellen in het huidige beleid. Er wordt niet ingegaan op hoe het huidige beleid gebruikt kan worden, of juist in de weg staat, voor de implementatie van het convenant.

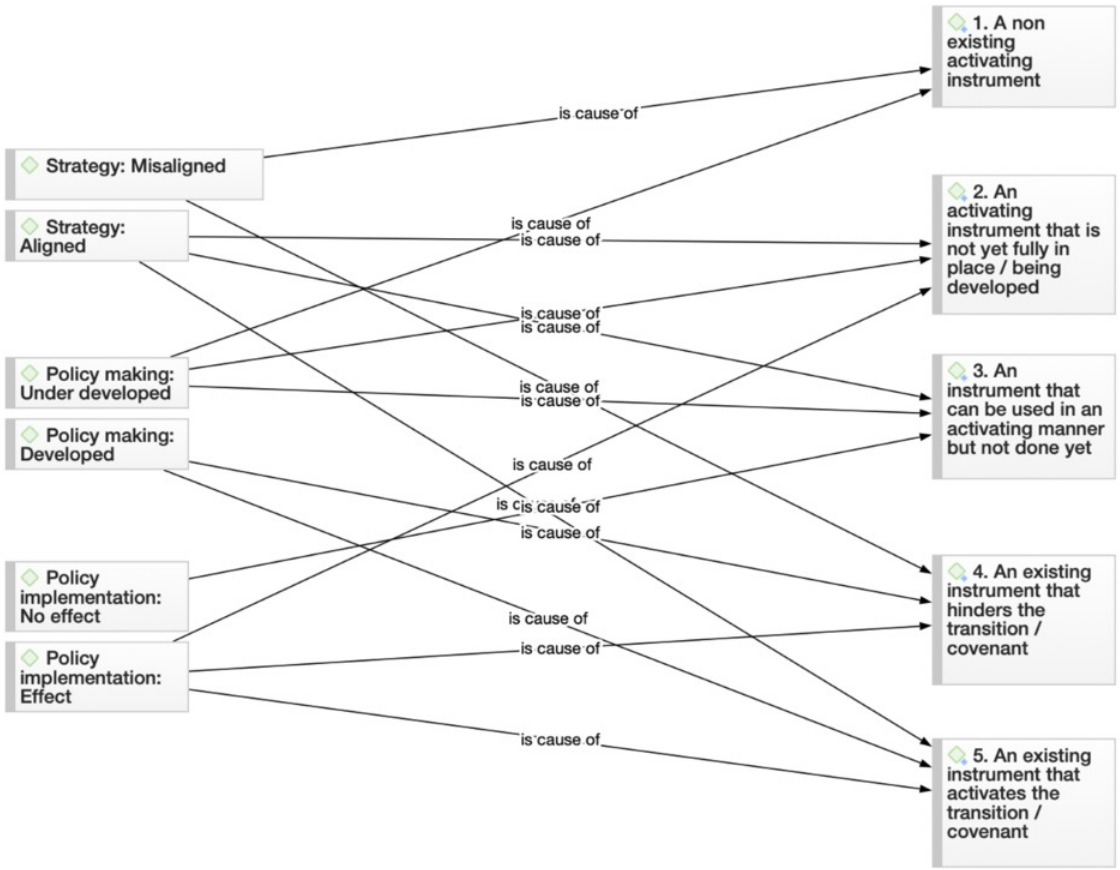
Appendix B1

Codes in AtlasTI



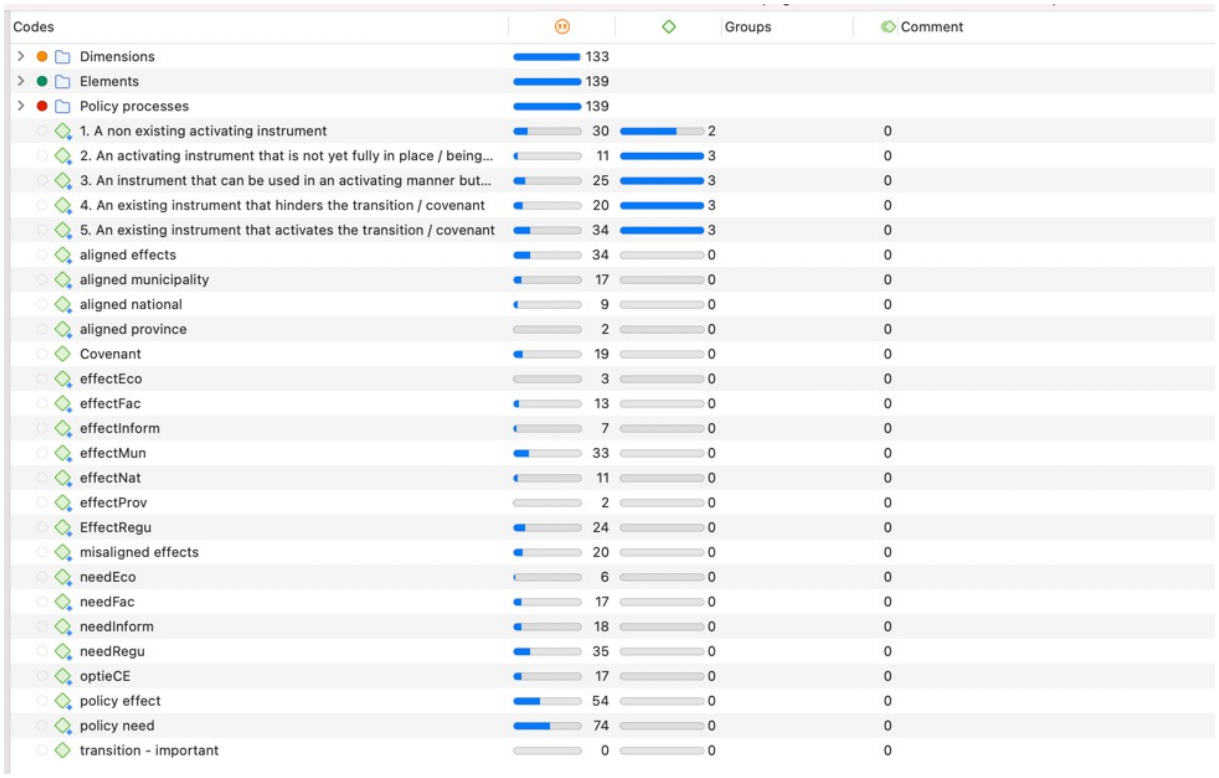
Appendix B2

Instrument relations coded in AtlasTI



Appendix B3

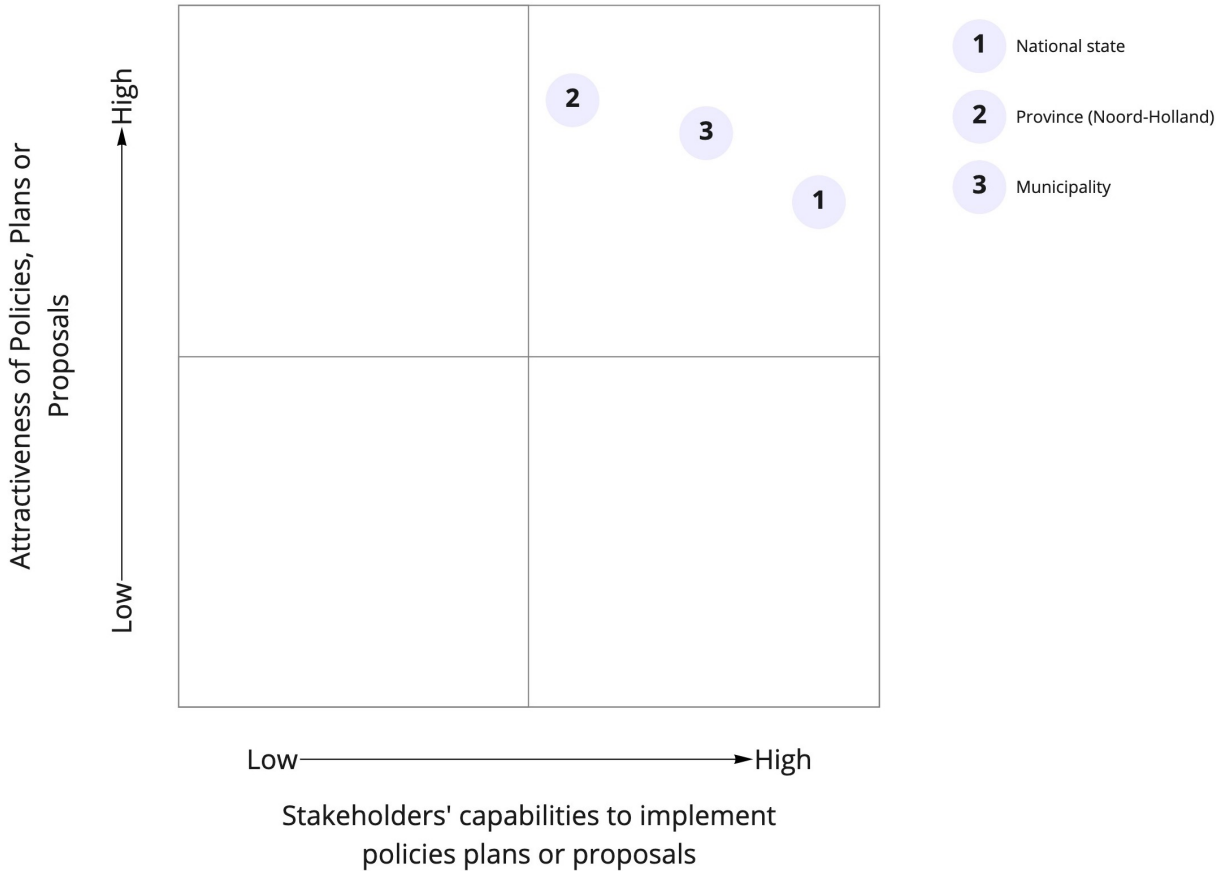
Code occurrence in AtlasTI



Codes		Groups	Comment
Dimensions	133		
Elements	139		
Policy processes	139		
1. A non existing activating instrument	30	2	0
2. An activating instrument that is not yet fully in place / being...	11	3	0
3. An instrument that can be used in an activating manner but...	25	3	0
4. An existing instrument that hinders the transition / covenant	20	3	0
5. An existing instrument that activates the transition / covenant	34	3	0
aligned effects	34	0	0
aligned municipality	17	0	0
aligned national	9	0	0
aligned province	2	0	0
Covenant	19	0	0
effectEco	3	0	0
effectFac	13	0	0
effectInform	7	0	0
effectMun	33	0	0
effectNat	11	0	0
effectProv	2	0	0
EffectRegu	24	0	0
misaligned effects	20	0	0
needEco	6	0	0
needFac	17	0	0
needInform	18	0	0
needRegu	35	0	0
optieCE	17	0	0
policy effect	54	0	0
policy need	74	0	0
transition - important	0	0	0

Appendix C1

Attractiveness of policies versus stakeholders' capacities to implement policy plans or proposals grid of non-governmental stakeholders



Appendix C2

Attractiveness of policies versus stakeholders' capacities to implement policy plans or proposals grid of governmental stakeholders

Appendix C3

Policy implementation strategy development grid of non-governmental stakeholders (1/2)

	Stake or interest	Resources	Action channels open to stakeholder	Probability of participation and manner of doing so	Influence - as a product of resources and participation	Implications for implementation strategy	Action plan elements
Timber builders	- Contributing to lowering CO2 emissions - Making profit by developing timber constructions	- In-house knowledge and experts - Timber from sustainable forestry - Factories for production - Capital bij investments	- Promoting timber constructions through development	- Developing knowledge about timber constructions and sharing this - Being contracted to participate in the development of a timber project	Being able to develop timber products requires capital, knowledge and materials. If they can develop, they can have influence on the production market of timber.	- Not enough demand - Not enough materials - Not enough people who are skilled enough to produce	- Sufficient production capacity for the 20% target - Develop timber products and concepts - Align with municipalities to deliver products for faster processes - Make agreements about the timber volume to deliver
Architects	- Making future-proof buildings - Be part of the newest technologies - Designing something iconic	- In-house expertise - General knowledge - Education	- Making a design based on the requirements of a client/developer - Applying to tenders	Getting the opportunity to develop a timber project will lead to a high probability to participate	The product of an architect speaks out a message to the world, being able to design timber projects leads to a high influence of their participation	- No assignments that allow for timber design projects - Not enough knowledge - Building code & regulations that limit design choices	- Convince clients to chose for timber - Share timber construction solutions open-source - Publish about timber on diverse channels
Engineering- and consulting firms	- Providing useful advice - Having in-house experts to be able to give advice - Receiving assignments from clients to be able to make profit	- In-house knowledge - Financial resources to develop knowledge - People	- Getting assignments that allow them to give advice - Publishing knowledge	Conducting research to timber constructions by being involved in timber construction projects (assignments) will increase the knowledge	Enough in-house knowledge and the opportunity to conduct research by being involved will lead to a high influence as it allows them to conduct research and develop new knowledge	- Not being involved in (interesting) timber projects - Not having the right in-house knowledge	- Actively convince clients to chose for timber - Sharing their expertise to influence the market - Publish about timber on diverse channels - Contribute to knowledge development - Providing objective advise to make the construction sector more sustainable without having to make concessions - Contribute to the public opinion on timber by being an independent advisor
Staatsbosbeheer	- Manage, maintain and develop nature reserves and landscapes - Promote recreation in their areas - Contribute to the production of environmental friendly, renewable products like timber	- Financial subsidies - Knowledge - Governmental support	- Deploying their reserves and areas - Facilitating other stakeholders in their interest	They can assign areas for the production of sustainable forestry, which will most likely be done as they aim to contribute to renewable materials	Deploying areas for timber production will have an influence, however not so much as this is only a fraction of the total timber supply in the Netherlands	- Activists protesting against forestry - Limited by the available areas - Not enough demand for timber	- Realize 3 new forest areas in the MRA within 3 years - Facilitate with market parties a highly developed sawmill within 3 years - Facilitate with partners the development of the timber supply chain

Policy implementation strategy development grid of non-governmental stakeholders (2/2)

	Stake or interest	Resources	Action channels open to stakeholder	Probability of participation and manner of doing so	Influence - as a product of resources and participation	Implications for implementation strategy	Action plan elements
Project developers and developing contractors	- Contributing to lowering CO2 emissions - Becoming a greener company - Becoming a frontrunner on the market	- Financial resources - Networks in the construction sector - Knowledge by experience	- Applying to tenders - Networking with other companies - Knowledge sharing	Getting the opportunity to develop a timber project will lead to a high probability to participate	Availability of resources is crucial to have influence: becoming an example project requires enough resources	- Financial implications by high initial costs - Building code & regulations that limit the project choices - Lack of knowledge - Not finding the right partners to supply	- Appoint locations for timber constructions - Value timber higher in subcontractor proposals - Positively take up initiated timber projects - Work with open-source principles to help each other in this transition - Facilitate employees in knowledge development
Banks and institutional investors	- Making profit - Investing money in something that will get returns - Investing in something that is 'green'	- Financial resources - General knowledge	- Making investments - Lending money	- Making investments in timber projects - Lending out money to stakeholders of timber projects - Financing in the development of the timber construction sector	Putting financial resources in the development of knowledge on timber and timber projects is crucial to have influence: this will stimulate the growth	- Not enough trust - Investments with uncertainty about the future returns - Not enough knowledge on what is the best investment within the timber sector	- Make own plans of requirements to stimulate timber - Discuss with funds and insurances about allocating budget for timber - Mark timber as more prominent in development requests and enlarge with 1 project per year - Higher valuation of timber by life cycle costing assessment - Active participation in innovation programs - Use the same warranties and insurances for timber as for traditional
Housing associations	- Developing enough housing for their target group - Maintaining their portfolio	- Financial resources from rent and subsidies - Governmental support - Network collaboration	- Adding specific buildings to their portfolio - Creating awareness among their tenants - Specific requirements for the development of new houses	By setting up requirements to the new houses that will be added t the portfolio, they will most probably participate	Having enough money to develop timber houses will lead to a high influence as they often have a big housing portfolio	- Tenants being critical towards timber houses - The development of timber houses being too expensive for their target group	- Mark suitable location for timber projects - Increase new built according to the covenant - Make own plans of requirements to stimulate timber - Value timber higher in development requests - Active participation in innovation programs
Knowledge institutes	- Stimulating the transition towards a circular economy - Developing knowledge on (transition) subjects	- Financial resources from governmental support - People - Data - In-house knowledge - General knowledge - Networks	- Developing knowledge on specific subjects - Sharing knowledge with the bigger audience - Involving in projects like the development of the covenant to gain and share knowledge	This stakeholder tries to be a frontrunner in research and development of knowledge on contemporary topics, therefore there is a high probability for this stakeholder to participate	By having enough financial support to be able to conduct research, this stakeholder will have a high influence by educating and sharing knowledge on all different levels through their networks	- Not enough financial support - No demand for knowledge sharing - No supply of resources like people and data	- Make knowledge available through media and expert meetings - Built capacity by investing in education - Develop and invest in training courses for modern timber at all levels - Actively refute fables by hosting a website - House of Skills uses network for retraining of the construction industry

Appendix C4

Policy implementation strategy development grid of governmental stakeholders

	Stake or interest	Resources	Action channels open to stakeholder	Probability of participation and manner of doing so	Influence - as a product of resources and participation	Implications for implementation strategy	Action plan elements
National government	- Becoming completely circular by 2050 - Improve living environment, environment and water - Improve accessibility - Stimulate innovations - Create participation jobs - Sustain international supply chains - Improve competitiveness (Rijksoverheid, n.d.).	- Power - Networks - Fiscal resources	- Using the public law (regulatory, financial and information instruments) to achieve things	The implementation of instruments to achieve the national ambitions can sometimes be difficult but will will be done to participate in the national ambitions	Participation of this stakeholder will have a high influence as they have a high level of power and their participation affects many	- Conflicting interests within the national state - Comply to European regulations - Bureaucracy makes it difficult to change things - Protests - Limitations of public and private law - Political color	- Facilitating public law instruments to realize the timber transition - Adjusting the MPG calculations to positively value timber in permit procedures - stimulate timber and knowledge exchange by using the City Deal - Ensure more effective European agreements for timber
Province	- Becoming completely circular by 2050 - Sustainable spatial development - Ensure a healthy living environment - Protect nature areas - Facilitate comfortable public transport and provincial infrastructure - Ensure good housing for all inhabitants - Facilitate enough employment - Check on the municipal wallet	- Power - Networks - Fiscal resources	- Using the public law (regulatory, financial and information instruments) to achieve things	The province has limited power to make specific decisions within municipalities. However by being a facilitator and sharing knowledge, they have a high probability to participate	Participation of this stakeholder will not have a high influence on all stakeholders. They will most likely influence municipalities by sharing knowledge and facilitate them with information about the transition.	- Limited capability to use instruments - They have limited authority in municipal areas - Comply to national regulations - Protests - Limitations of public and private law - Political color might be different than municipalities	- Actualize the regional housing agreement together with the municipalities - Make room in regional plans for the realization of new multifunctional forests
Municipality	- Becoming completely circular by 2050 - 50.000 new houses in 2025 - Keep the city attractive (affordable, accessible, livable) - Make a system leap in regional public transport - Invest in recreative use of green and water - Organize the city without fossil fuels (Gemeente Amsterdam, 2011)	- Power - Networks - Fiscal resources	- Using the public law (regulatory, financial and information instruments) to achieve things	If the municipality has the capacity to participate in the transition, there will be a high probability that they will participate. However not all municipalities have this capacity, and they are not capable to use any instruments to aprticipate	Setting restrictions for areas in the municipality has a high influence on the development of the transition and therefore has a high influence.	- Not owning enough land that can be put out for tenders - Not having enough fiscal resources - Not having enough human resources - Not having enough knowledge resources - Comply to national regulations - Protests - Limitations of public and private law	- Appoint minimum 1 location for timber projects per year - Include the promotion of timber in environmental visions - Make the tender requirements of their own ground aligned with the MRA covenant - Increase internal knowledge within MRA and with other municipalities - Increase feasibility of the implementation of the covenant within own organization - Positively value timber projects from market parties - Ask for environmental assessment with emphasis on CO2

Appendix D1

Interview results necessary policy instruments

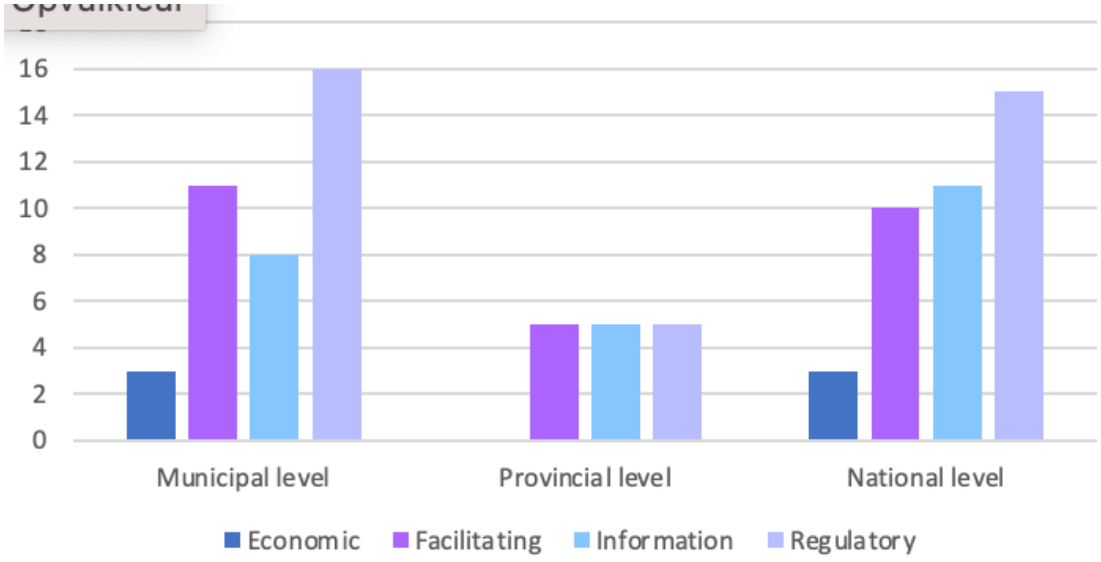


Figure 34: The required implementation level of policy instruments that are necessary for transitions, according to the different governmental stakeholders (y-axis represents the percentage that a specific implementation level is coded in the different interviews)

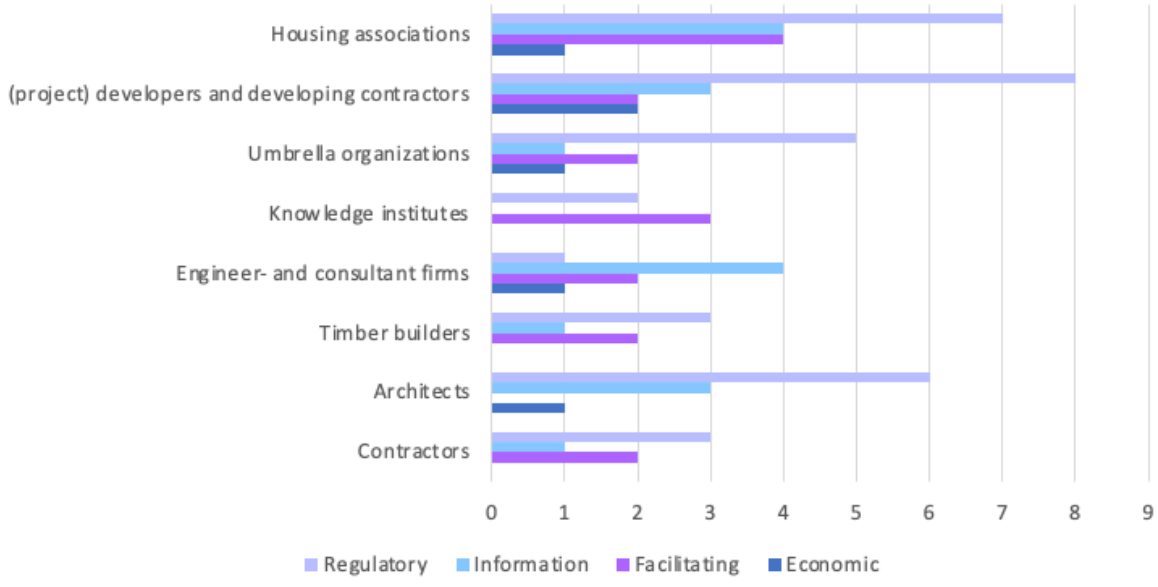


Figure 35: Existing instruments that are necessary for the timber transition, according to the different non-governmental stakeholder types (x-axis represents the amount that the existing instrument is coded in the interviews with the stakeholders that are indicated on the y-axis)

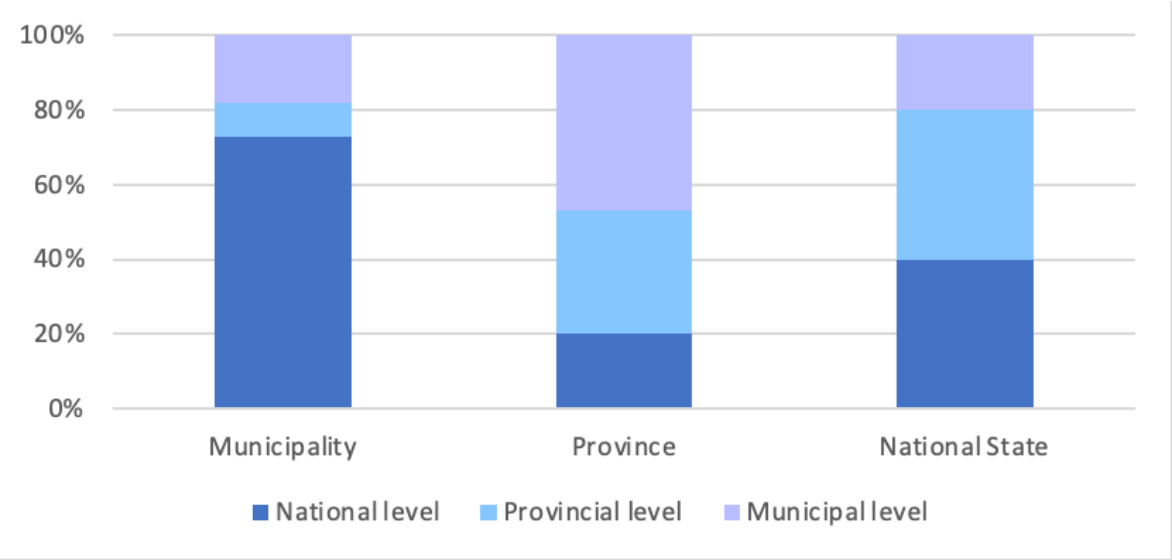


Figure 36: The required implementation level of policy instruments that are needed for sustainability transitions, according to the different governmental stakeholders (y-axis represents the percentage that a specific implementation level is coded in the different interviews as grouped on the x-axis)

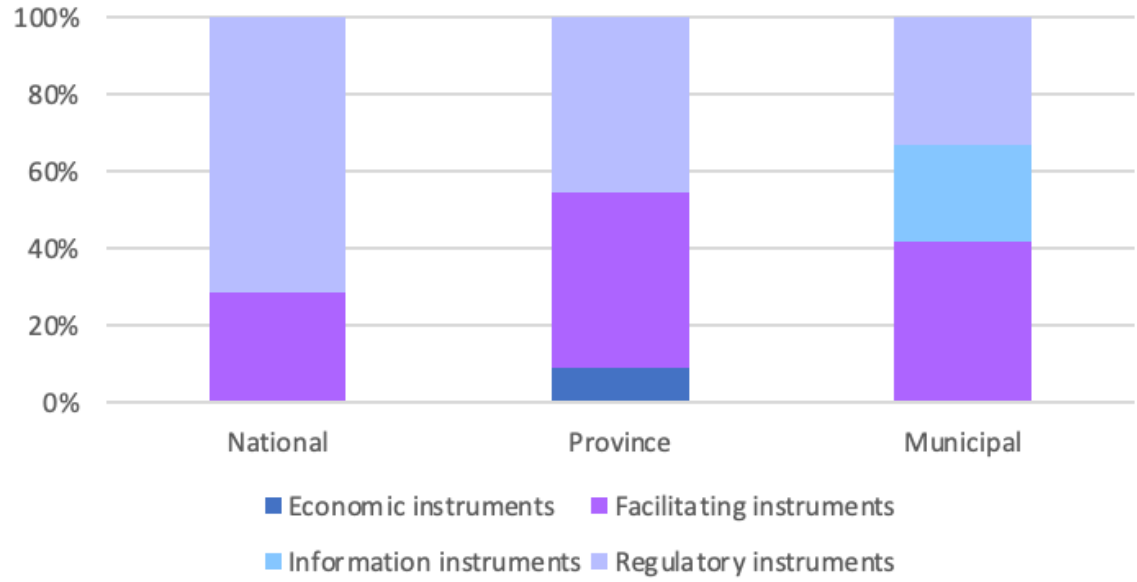


Figure 37: The different types of policy instruments that are necessary for sustainability transitions according to the different governmental stakeholders (y-axis represents the percentage that a specific instrument is coded in the different interviews as grouped on the x-axis)

Appendix D2

Interview results policy instruments that have effect

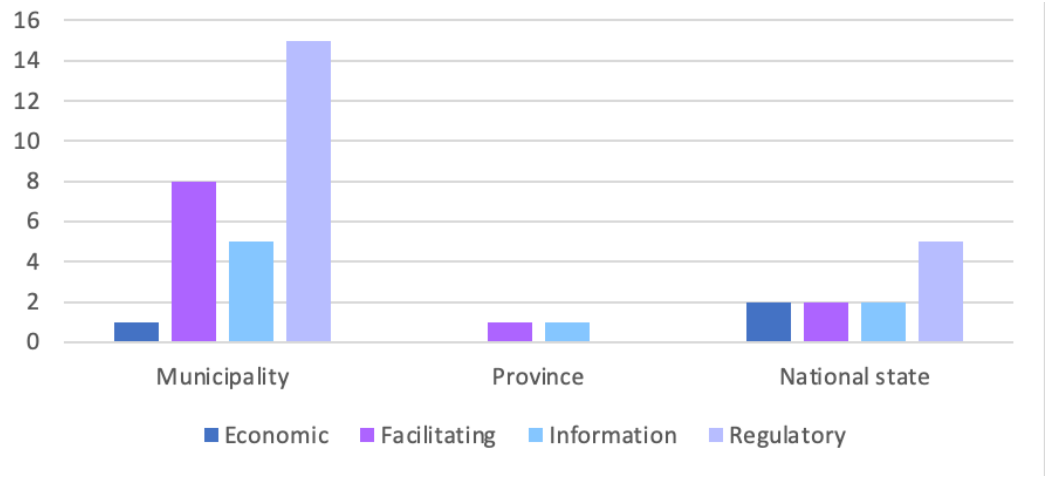


Figure 38: The implementation level of the different types of existing policy instruments that have effect on the timber transition (y-axis represents the amount that a specific instrument is coded and the y-axis represents by which level it is perceived to be implemented)

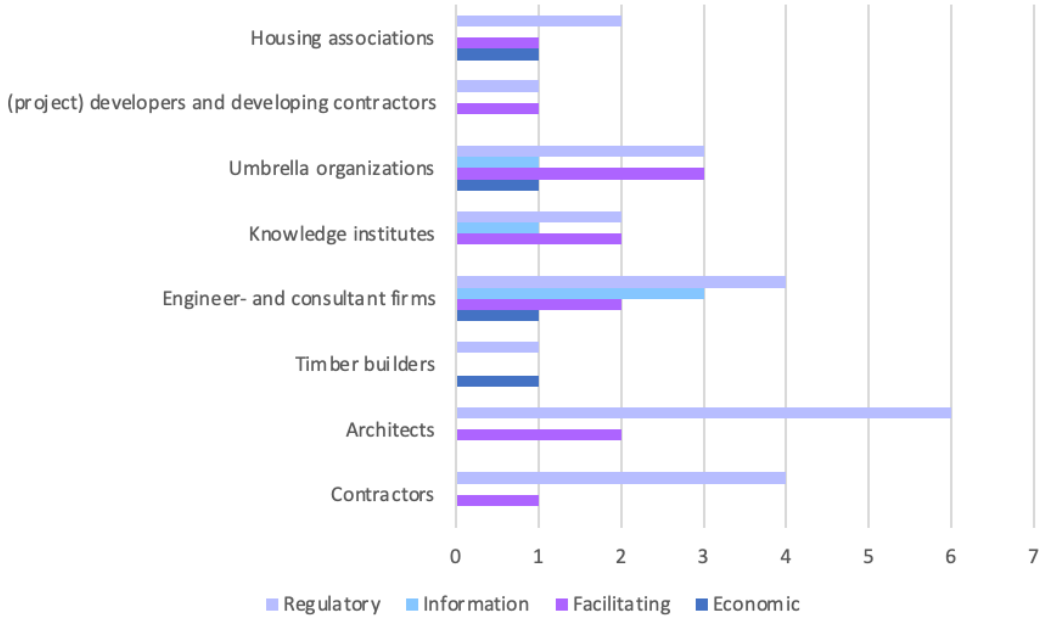


Figure 39: Existing instruments that have effect on the timber transition, according to the different non-governmental stakeholder types (x-axis represents the amount that the existing instrument is coded in the interviews with the stakeholders that are indicated on the y-axis)

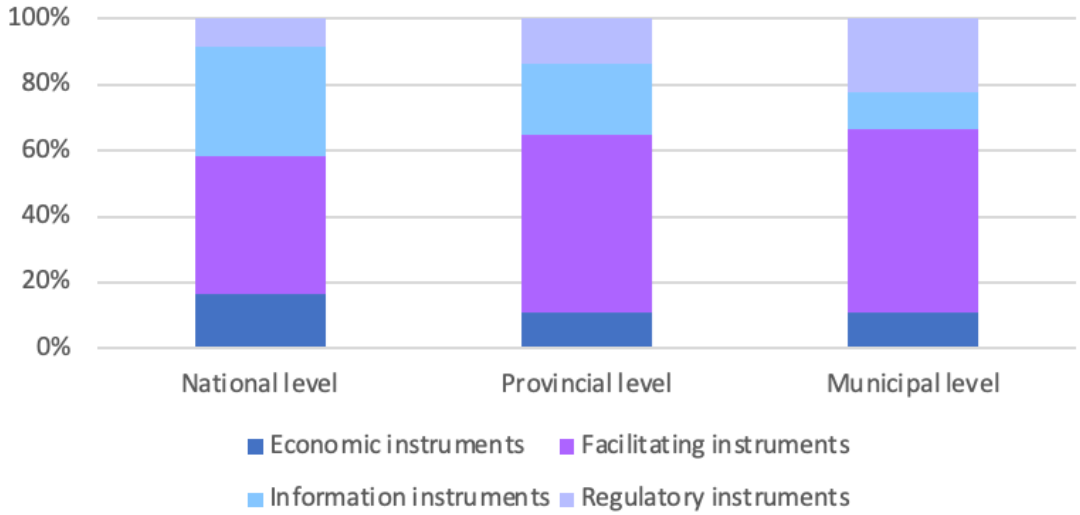


Figure 40: The different types of existing policy instruments that foster sustainability transitions according to the different governmental stakeholders (y-axis represents the percentage that a specific instrument is coded in the different interviews as grouped on the x-axis)

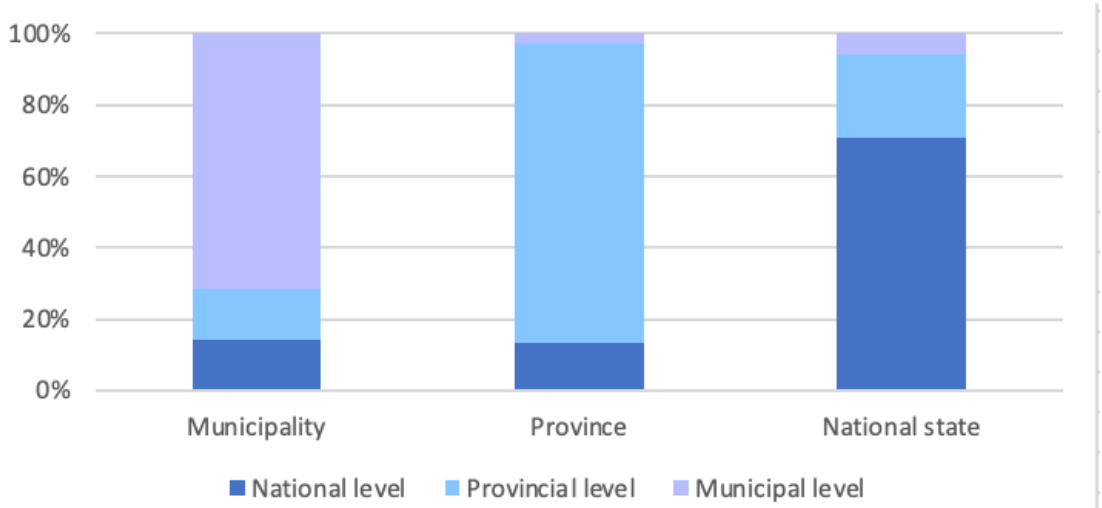


Figure 41: The implementation level of the policy instruments that have effect on sustainability transitions, according to the different governmental stakeholders (y-axis represents the percentage that a specific implementation level is coded in the different interviews as grouped on the x-axis)