Transition policies and incumbents' business models: From resistance and system failure to learning and adaptation

A thesis submitted to the University of Manchester for the degree of Doctor of Philosophy in the Faculty of Humanities

2022

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Abstract

The notion of transition policies has rapidly gained prominence because of its potential to accelerate transitions. Transition policies mostly aim to accelerate transitions by fostering the development and diffusion of sustainable technologies. However, for a complex and multifaceted issue such as climate change, an individual product or service cannot bring about the required transformational changes. While many sustainable technologies are off-the-shelf, many firms – especially incumbent firms – resist adopting those technologies due to the difficulties in inevitable changes that might happen in their business models. Incumbents’ business models could act as a source of inertia or transformational changes towards sustainability transitions due to their systemic nature, which includes incumbents’ main activities and interactions with their upstream and downstream value chains. The urgency of climate change and the severity of its consequences ask for transition policies to enable and urge incumbent firms to change their business models to be able to adopt sustainable technologies. A question of significance but relatively unexplored is how interactions between governments and incumbents affect socio-technical transitions towards sustainability. This question is answered in this doctoral thesis through three journal-format papers.

By addressing the research problem this thesis makes three main contributions. First, it systematically delineates the impact of transition policy mixes on incumbents’ business model adaptation strategies into a conceptual framework. Second, it provides a zoomed-in perspective on a failed transition policy mix to identify the underlying reasons behind its failure by considering the opinion of both policymakers and incumbent housebuilders. This helps to find the required features for a successful transition policy mix in an antithetic way. Third, this thesis moves beyond the historical examples of sustainability transitions and provides forward-looking insights into the current and future transition policies. By investigating the nature of policy failures in the ZCH failed transition, this thesis identifies the lessons that are relevant for the current and future ZCR transition policies in the UK. These contributions allow deriving policy implications regarding the design and implementation of transition policy mixes. Policymakers can accelerate transitions by bringing incumbents into the equation not only as resisting forces, but also as change agents with powerful resources that can provide transformational changes. However, to trigger this transformational change, policymakers should consider all the important elements of incumbent business models, i.e., their supply chain partners, key activities, capabilities, customers and their preferences, and their financial models.
Declaration

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Dedication

To Babaji
You are forever in my mind and heart…
Acknowledgements

I have imagined this day several times when it is time to write the acknowledgement. My PhD journey has been quite an adventure, from many moments of despair to the times I was dancing with joy. I have been fortunate to meet and interact with many incredible people who have supported and motivated me during this journey.

First, I would like to thank my main supervisor Prof. Jonatan Pinkse for offering insightful advice and giving me the independence to work and explore different paths. Also, I greatly appreciate my second supervisor, Dr John Rigby for allowing me to undertake this PhD and for being very supportive and patient right from the beginning.

I am thankful for the doctoral scholarship provided by the Alliance Manchester Business School that enabled me to conduct this research. I would like to express my deepest appreciation to the interviewees and experts from the academic environment, the UK Government policy experts, and housebuilder representatives who have provided their time and valuable input to guide and shape my research.

I have been blessed with my support group of colleagues and friends in Manchester. Sampriti Mahanty, Tausif Bordoloi, Oishee Kundu, and Mayra Morales Tirado. Especial thanks to Sampriti and Tausif for being the best friends one could ask for. Sampriti, my dearest friend, I am always indebted to you because of your relentless support whenever I was in trouble, either in my PhD or in my general life matters. Thanks for sticking by me in the most considerate way possible! Tausif, thank you for your expertise, your kindness, and your unwavering guidance during my PhD.

Lastly, but certainly not least, this PhD would have not been possible without the unconditional support of my family who deserves so much more than mere words. Maman Goli and Baba Joon, I don't know where I would be today if it wasn’t for you. Thank you for believing in me and unselfishly supporting me in achieving my dreams. I’ll never be able to repay your kindness and love. Mamani, my lovely grandma, thank you for the prayers which have been always my spiritual strength to move forward. My siblings, Maryam, Majid, and Reza, thank you for being my best friends and for listening to my worries, sharing my joys, and reassuring me on tough days. My love goes to my niece and nephew, Fatemeh and Ali. I love your pure souls and cheerful smiles. And finally, to Amir, thank you for brightening my life with your existence and for bringing your love and support to the last days of my PhD journey.
Chapter 1. Introduction

1.1. Introduction

I come from the historical city of Yazd in Iran where the ancient architecture of ‘Wind-catchers’, ‘Sunken courtyards’ and ‘Qanats’ rely on natural forces to provide comfort and utility to buildings in the middle of a desert-like climate. I was fascinated by the sustainable technology of wind-catchers and worked on it for my master’s dissertation, which opened a window for me to know more about ancient and modern sustainable technologies in buildings. When I started this PhD project, I wanted to bring together my interest in sustainable technologies and buildings. However, based on my personal observations, academic papers, patents, and grey literature on sustainable technologies, I realised that the buildings in the real world are far from being sustainable. Why are there very little attempts in building sustainable homes in spite of the availability of numerous sustainable technologies? What is the role of governments in bringing innovations on paper to reality? That became the inspiration for this PhD.

This chapter starts with the context of this research (Section 1.2) followed by the research problem (Section 1.3). Then it discusses the research questions and the thesis format (Section 1.4). Next, the philosophical orientation is discussed in Section 1.5 and the target audiences are discussed in Section 1.6. The chapter ends by providing the structure of the thesis in Section 1.7.

1.2. Context

Over the past few decades, climate change has been the centre of attention in political debates and research agendas. Interventions to tackle the urgency and severity of climate change issues are no longer being considered optional. From the Kyoto Protocol in 1997 to the Paris Agreement in 2015 and the most recent COP26, there has been a consensus among all nations that interventions in various forms such as policies, technologies, funding, and changing practices are needed to tackle the climate change crises before the planet has passed a tipping point. Sustainable technology has become a crucial site for confronting these crises. In the wake of the climate crisis, there have been claims that go as far as saying “sustainable technologies
can save the world”¹. To this end, various policy measures and instruments (i.e., transition policies) have been introduced on global, national, and regional levels to foster the development and diffusion of sustainable technologies in different sectors and, consequently, accelerate the transition to a more sustainable world (Kemp, 1994).

Notwithstanding the efforts that are being made to accelerate the sustainability transition, it can be safely said that the rate of transition is slow. Despite breakthroughs in sustainable technologies, it is important to recognise that change, or transition of any system, is complex and is underpinned by uncertainty, power struggles, conflicts, and crisis. Moreover, technology does not refer so much to individual products and processes, rather it is the entire sociotechnical systems—a configuration of products, processes, services and infrastructures, regulations, skills, preferences, expectations, and actors (e.g., producers, suppliers, policymakers, users) that fulfil societal needs such as energy, food, or mobility provision. These elements are aligned and fine-tuned to each other, making them a system. Therefore, the transition policies that aim to implement or diffuse such technologies need to be designed in a way that can induce transformational change in the entire socio-technical system.

This doctoral research builds on the premise that this slow rate of transition can be attributed to the narrow technocratic focus of transition policies. This technocratic focus is also ironic in some ways because sustainability transitions as a concept call for asking the ‘big questions’ and bringing about systemic change (Köhler et al., 2019). While many sustainable technologies are off-the-shelf, many firms – especially incumbent firms – resist adopting those technologies due to the difficulties in inevitable changes that might happen in their business models. Incumbents’ business models could act as a source of inertia or transformational changes towards sustainability transitions due to their systemic nature, which includes incumbents’ main activities and interactions with their upstream and downstream value chains. Existing business models within a socio-technical regime form cognitive and structural barriers to sustainability transitions by their dominant logic, rules, and structures which lead to path dependencies and fear of cannibalisation (Bohnsack et al., 2014, Bidmon and Knab, 2018). Although incumbents can hamper transitions through their business models, they also have the power to influence transformations by changing, adapting, or innovating their business models.

¹ BBC Click: Can Tech Save The World
The urgency of climate change and the severity of its consequences ask for transition policies to enable and urge incumbent firms to change their business models to be able to adopt sustainable technologies. A recent example of the importance of policies and regulations on firms’ business models is the news about Shell losing a lawsuit in a Dutch court and being under pressure to change its business model to reduce its carbon emissions\(^2\). This thesis is designed to investigate transition policies from a different perspective rather than technological innovations alone. In this research, incumbent firms are considered as one of the main actors in transitioning towards sustainability and their business models are selected as the unit of analysis.

1.3. Research problem

Sustainability transitions refer to the complex, long-term transitions of conventional resource-intensive systems to more sustainable modes of production and consumption (Geels, 2004). This transition requires profound changes in a systemic way that includes technologies, infrastructure, policies, industries and businesses, cultures and lifestyles known as socio-technical systems (Markard et al., 2012). Socio-technical systems include multiple societal actors that can be categorised – using the Multi-Level Perspective (MLP) –as regime actors (incumbents) or niche actors and are influenced by major forces in the landscape (Geels, 2011).

Transition literature usually considers incumbent actors as a source of inertia that resist any major changes happening in the regime. On the other hand, niche actors are considered innovation sources that trigger the main changes in a socio-technical system. While the literature on transition policies has dramatically expanded in the last decade to analyse the role of governments in accelerating sustainability transitions (Kivimaa and Virkamäki, 2014), it largely overlooked the role of incumbents in bringing about transformational changes towards sustainability. This is while incumbents generally have a greater capacity (in terms of knowledge, skills, finance, infrastructure, etc.) compared to niche firms to drive transitions (Trencher et al., 2021, Köhler et al., 2019). Therefore, not only incumbents and their business models can act as a source of inertia, but they also can be sources of change. In particular, there has been little research on the potential influences of transition policies on the incumbents’ business model to mitigate their resistance and support them as change drivers. This shortcoming is notable, given arguments that policy interventions may not have a tangible

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\(^2\) Financial Times (2021): [Dutch court orders Shell to accelerate emissions cuts](https://www.ft.com/content/180d9a06-bd68-43dd-a61e-06b50f1b5ade)
impact on sustainability transitions unless firms pursue new or modify their existing business models to adopt and commercialise sustainable innovations (Wellington et al., 2007, Adams et al., 2016). More recently there have been studies which reiterate that the role of incumbents and their business models in sustainability transition citing it to be “marginalised” (Morgunova and Shaton, 2022). This is attributed to the resistance of incumbents towards mitigating climate change and struggling with the threat of new entrants (Geels et al., 2016a). Studies have called for a deeper investigation of incumbents and their capabilities to contribute to change (Steen and Weaver, 2017). In this thesis, this is done specifically from a business model perspective to provide a more diverse picture of incumbents and their capability to bring about transformational changes.

This research gap and problem have been summarised in Figure 1.1 below. As illustrated, the literature on sustainability transitions has investigated the transitions from different perspectives such as transition policies, technology innovation, and business models. There are many studies analysing the link between these strands of literature such as transition policies and technological innovations (Rogge et al., 2020, Sinsel et al., 2020), business models and technological innovations (Bohnsack et al., 2014, Bidmon and Knab, 2018), as well as the influence of incumbents and their business models on transition policies (Konrad et al., 2012, Hess, 2016). However, the influence of transition policies on incumbents’ business models (the yellow arrow in the figure) is not well studied. This research is focused on this specific link as the research problem.

Figure 1.1. Research gap
1.4. Research questions and thesis format

Underpinned by the context discussed earlier, the aim of this research is to gain a deeper understanding of the influence of transition policy mixes on incumbents’ business model adaptation. Following a critical review of the literature on sustainability transitions, transition policies, and business models (Chapters 2 and 3), this research explores the research aim through conceptual and empirical investigations resulting in three journal format papers, answering the following research questions.

- How can transition policies affect incumbents’ business models towards sustainability transitions?
- How can a transition policy mix be designed to support firms’ business model adaptation and innovations necessary to bring about transitions towards sustainability?
- To what extent do transition failures lead to learnings and new understandings of ways to accelerate sustainability transitions?

This research attempts to investigate the influence of transition policies on incumbents’ business models from conceptual and empirical perspectives. While the conceptual paper depends on the previous literature on transition policies, the two other empirical papers investigate the UK housing industry and housing policy to analyse two transition policies introduced by the UK government and their effect on incumbent housebuilders and their business models. The first question is answered through a combined literature review technique which leads to a conceptual framework depicting the influence of transition policy mixes on incumbent strategies towards adapting their business models. The second and third questions are answered in an empirical context, i.e., the UK housing industry. The UK housing industry is an interesting puzzle for three reasons: the country has strong strategies for climate change including transition policies to decarbonise residential buildings; the UK housing industry is dominated by few powerful incumbent housebuilders; the industry is conservative, and most of the houses being built are far from being sustainable. This empirical setting helps to scrutinise the conditions in which incumbents act as inertia or a source of change in response to transition policies. The second research question considers the UK Zero Carbon Homes (ZCH) policy mix introduced in 2006 and dismantled in 2015 as a failed case of transition policy. This empirical paper analyses the underlying reasons behind its failure and therefore highlights the crucial features that need to be taken into account for a transition policy mix.
The third research question is answered by comparing the ZCH policy mix with a recent transition policy in the UK, i.e., Zero Carbon Ready (ZCR). By comparing two housing transition policies at two different times in the UK, this research attempt to understand the extent to which policymakers and incumbent firms can learn from their previous transition experiences.

1.5. Philosophical orientation

The philosophical orientation determines the researcher’s set of beliefs, worldviews, and methods that influence the way they interpret their collected data and evidence (Morgan, 2007, Denzin and Lincoln, 2011). Many philosophical angles have been adopted by social scientists such as positivism, post-positivism, critical theory, constructivism (Guba and Lincoln, 1994), and pragmatism (Morgan, 2014). This research is based on pragmatism. There are two important aspects of the pragmatist philosophy. First, it sidesteps issues of truth and reality and accepts philosophically that there exist singular and multiple facts that are open to empirical inquiry, thus, providing freedom to the researcher from the constraints imposed by the dichotomy of post-positivism and constructivism (Yvonne Feilzer, 2010). Second, a pragmatist researcher is not bound by any specific method or technique and chooses the procedure that best meets their research objectives (Creswell and Poth, 2016). Underpinned by these two aspects, pragmatism enables a researcher to be flexible in their investigative techniques to address various research questions that arise (Onwuegbuzie and Leech, 2005). Thus, a pragmatic researcher is more likely to view research as a holistic endeavour that requires “prolonged engagement, persistent observation, and triangulation” (Lincoln and Guba, 1985, p. 301). Drawing from Eisenhardt (1989) a complex research problem is often addressed through multiple research questions, each with a unique research design which has been done in this thesis. By following a pragmatic philosophical orientation there is flexibility in choosing the research design which is appropriate for specific research questions, objectives, and context. It also allows to bring in the researcher’s own interpretations of collected data in the empirical papers.

1.6. Research audience

The primary group of audience for this doctoral research is the academics and practitioners of sustainability transitions and transition policies. This thesis provides a zoomed-in perspective of some micro-level dynamics happening in the socio-technical systems through sustainability.
It also brings a detailed empirical analysis of a sustainability transition programme and a transition policy mix. This may offer new lenses through which to specify, evaluate, and prioritise policy initiatives for accelerating transitions. The second group of audience is the academics active in the domain of business models and their role in sustainability transitions. Focusing on the incumbents and their business model, this thesis brings a systemic view to analyse the main actors involved with incumbents’ business such as manufacturers, suppliers, and customers and their interactions with incumbents. The third group of audiences are housebuilders and policymakers. Chapters 6 and 7 can bring insights into the challenges, barriers, and opportunities to accelerate the transitions in the UK housing industry through better designing and fine-tuning policy initiatives and measures.

1.7. Summary and thesis structure
This introduction provides a basic overview of the thesis and its structure which will be presented in the following chapters. Chapter 2 presents a theoretical background of the relevant literature on sustainability transitions, transition policies and business models. It also provides a critical reflection of the literature and explains the research questions and sub-questions. Chapter 3 relates to the first paper which conceptually analyses the influence of transition policies on incumbents’ business model strategies. Chapter 4 provides an overview of the research setting of the empirical papers which is the UK housing industry and housing policy. Chapters 5 and 6 empirically investigate the research questions by focusing on two transition programmes in the UK housing industry, i.e., ZCH and ZCR. Finally, Chapter 7 concludes the thesis by discussing the research contributions, limitations, and avenues for future research. Figure 1.2 illustrates the structure of the thesis.
Research aim: To gain a deeper understanding of the influence of transition policy mixes on incumbents’ business model adaptation

Chapter 2
- Sustainability transitions
- Governance of transitions
- Business models
- Critical reflection on previous literature
- Research gaps

RQ1: How can transition policies affect incumbents’ business models toward sustainability transitions?

RQ2: How can a transition policy mix be designed to support firms’ business model adaptation and innovations necessary to bring about transitions toward sustainability?

RQ3: To what extent do transition failures lead to learnings and new understandings of ways to accelerate sustainability transitions?

Chapter 3
Understanding the effects of transition policy mixes on business model adaptations: Literature review and conceptual framework

Chapter 4
Empirical setting: UK housing industry, UK housing policy, ZCH policy mix

Chapter 5
Transition policy mixes and incumbents’ business model adaptation: A co-evolutionary analysis of UK Zero-Carbon Homes

Chapter 6
Learnings from failed sustainability transitions: From zero carbon to zero carbon ready

Chapter 7: Conclusion

Figure 1.2. Thesis structure
Chapter 2. Theoretical Background

Figure 2.1. Chapter 2
2.1. Introduction

This chapter provides an overview of the extant literature on which this research is predicated. To address the overarching research question, this section draws on three main bodies of literature: (i) sustainability transitions, (ii) the role of government and policy interventions in sustainability transitions, and (iii) the role of firms (particularly incumbents) and their business models in transitions. By reviewing the criticisms and inherent limitations of the previous work on each strand of literature, this section discusses the knowledge gaps that drive the main research question. Section 2.2 provides the main insights on sustainability transitions and their theories – i.e., innovation systems and multi-level perspective – and critically discusses their strength and shortcomings. Section 2.3 reviews the role of government interventions and discusses how they can accelerate or hinder transitions. Section 2.4 reviews the role of incumbent firms and provides a nuanced perspective on the different mechanisms through which such firms can engage in sustainability transitions by adapting their business models to transition policies. Section 2.5 provides a critical reflection on the reviewed literature and Section 2.6 suggests some questions for the research.

2.2. Sustainability transitions

Sustainability transitions are a response to global sustainability challenges which require profound changes in technologies, infrastructure, policies, industries and businesses, cultures and lifestyles (Geels, 2011, Markard et al., 2012). It is a relatively new domain that refers to the complex, long-term systemic transitions of conventional resource-intensive systems to more sustainable modes of production and consumption (Geels, 2004). Transitions literature explores the changes in such systems through the lens of evolutionary theories that explain how changes occur in such systems over time (Bergek et al., 2008, Geels, 2006, Markard and Truffer, 2008).

Evolutionary theories have traditionally subscribed to the view that technological innovations are prime enablers of systemic transitions (Dosi, 1982, Geels, 2002, Kemp, 1994, Rip and Kemp, 1998). The starting point of this view is Nelson and Winter’s (1977) concept of ‘technological regime’, which signifies firms’ beliefs about what innovations are feasible or worthy of pursuit. The concept was later expanded by other scholars to include broader and systemic institutional and social aspects that shape innovation (Rip and Kemp, 1998, Freeman, 1988, Carlsson, 1997). As such in these theories, technological innovations play a central role
in shaping the socio-technical transitions. In this section, two evolutionary theories on sustainability transitions are discussed: innovation systems (IS) and the multi-level perspective (MLP). These theories, while distinctive, share some common features such as diversity, multi-dimensionality, co-evolution, and learning processes (Safarzyńska et al., 2012).

2.2.1. Innovation systems

The innovation system theory explores the process of the creation, diffusion, and use of knowledge from a systemic perspective (Carlsson et al., 2002). This theory highlights the complex non-linear interactions among multiple actors (e.g., firms, universities, government, NGOs, and financial organisations), a broader institutional framework (e.g., law, regulations, rules, technical norms), and formal and informal networks between them to develop and diffuse technological innovation (Carlsson and Stankiewicz, 1991, Bergek, 2002, Uriona and Grobbelaar, 2019). Based on differences in system boundaries such as industrial or geographical dimensions, innovation systems can be categorised into national (Sharif, 2006, Lundvall, 2007), regional (Cooke et al., 1997, Cooke, 2001), sectoral (Breschi and Malerba, 1997, Siva et al., 2017), and technological innovation systems (Bergek et al., 2008, Hekkert et al., 2007). These innovation systems differ in their level and unit of analysis as well as their definition of the institution.

National innovation systems (NIS) establish the boundary of the nation/country under analysis as the system boundary and analyse and compare the role of firms, institutions, and networks in motivating technological innovations at a national level (Suominen et al., 2018). A national innovation system involves the vision of the technological development of a country, its required competence and expertise, and allocated resources for its implementation (Lall, 2002). Regional innovation systems are less complex compared to NIS (Suominen et al., 2018) and study innovation systems from a sub-national perspective (Cantner et al., 2010, Arogyaswamy et al., 2008). This theory “observes the ways in which different sectors or even clusters interact with the regional governance and innovation support infrastructures as well as the national and global levels” (Cooke et al., 1997, p. 476). A sectoral innovation system is described as “a set of products and the set of agents carrying out market and non-market interactions for the creation, production and sale of those products” (Malerba, 2002, p. 248). While these three innovation system theories consider formal institutions such as regulations and industrial standards, technological innovation systems also consider informal institutions such as social
legitimacy within socio-technical systems (Hoppmann, 2013). Technological innovation systems (TIS) are used to study the dynamics of an innovation system with a specific focus on the emergence and growth of a new technological field and its industry (Markard et al., 2015). This theory is mainly used to identify the shortcomings of developing a specific technology and provide policy recommendations for its acceleration (Jacobsson and Karltonp, 2012, Hendry and Harborne, 2011). In addition to this categorisation, another strand of literature on innovation systems called ‘system functions’ has focused on the activities within the system which contribute to the development and diffusion of innovations (Bergek et al., 2008). This approach highlights the actual achievements within the system and identifies the poor performances that might lead to system failures (Jacobsson and Bergek, 2004).

Although innovation systems, particularly TIS, were not designed for transition studies in the first place (Carlsson et al., 2010), they are considered a key theory/framework in transition studies. This brings about some criticisms around their implications explaining transitions such as a lack of consideration of incumbents’ resistance and structural inertia within the system as well as the interactions of multiple technologies in different socio-technical systems (Geels and Verhees, 2011, Smith and Raven, 2012, Kern, 2015). However, Markard et al. (2015), by acknowledging these shortcomings, argue that innovation systems are capable of explaining the other key processes in socio-technical transitions, have the theoretical means to deal with strategic moves of actors, and have the potential for further theoretical elaborations of transitions.

2.2.2. Multi-level perspective
The multi-level perspective (MLP) is a descriptive middle-range theory of socio-technical transitions, combining ideas from evolutionary economics, the sociology of innovation and institutional theory (Rip and Kemp, 1998, Geels, 2002). It explains transition dynamics in three analytical levels: niches, socio-technical regimes, and landscape developments. Niches are protected spaces in which innovations are nurtured by new entrants and entrepreneurs. Socio-technical regimes are deep structures of socio-technical systems, representing the dominant rules and including different sub-regimes such as policy, science, technology, market, industry, and culture that co-evolve with each other (Geels, 2002, Geels, 2006). The landscape represents the exogenous context of a socio-technical system and is beyond the actors’ direct influence but influences the regime. The landscape is mostly stable or slowly moving, but sometimes it
includes rapid external shocks such as wars or oil price fluctuations (Geels, 2011, Hannigan, 2014, Hoffman, 1999).

MLP provides a fine-grained analysis of real-world niche momentum, existing regime dynamics, its sources of inertia, different socio-technical dimensions, multiple actors, and institutions (rules and norms) which guide actors’ perceptions and activities (Geels, 2004, Geels, 2011, Turnheim et al., 2015). This theory goes beyond a single cause or driver in transition as it includes multiple dimensions at different levels which link up with and reinforce each other. The framework assumes that radical innovations emerge in niches (micro-level) which provide the seeds for systemic change and build up internal momentum. These innovations move from niche level to socio-technical regimes by taking advantage of the windows of opportunities resulting from external pressures from landscape developments and the destabilisation of socio-technical regimes. The inclusive nature of MLP has made it a popular framework to analyse and describe technological change and sustainability transitions. Many scholars have used this theory from different perspectives to elaborate on the interactions between regimes and niche actors. This includes their collaborations (Geels et al., 2016b), conflicts (Hess, 2016), and the role of intermediaries in aligning their developments (Kivimaa, 2014, Bidmon and Knab, 2018).

2.3. Governance of transitions

From the Kyoto Protocol in 1997 to the Paris Agreement in 2015, there has been a consensus among all nations that government intervention is needed to tackle the significant issue of climate change before the planet is passed a tipping point. However, little progress has been made in designing and implementing public policies that effectively address climate change. The urgency of this crisis asks for a transformative large-scale and long-term change – beyond incremental progress. Socio-technical transitions to sustainability have been proposed by academics in the last two decades to investigate the process of this transformation, its required conditions, and the barriers to achieving it (Kemp, 1994).

The general consensus among transition theories is the significant role of government interventions through politics, policymaking, and policies in transitioning socio-technical systems (Markard et al., 2016a, Kern, 2012, Weber and Rohracher, 2012, De Laurentis, 2015, Cimato and Mullan, 2010). Policies are considered an integral part of the institutional structures
that make up socio-technical systems (Geels, 2002). While analytical considerations of policy were rare in early transitions research, recent years have witnessed an increase in both theoretical and empirical investigations of policy in the context of sustainability transitions. This includes studies on the co-evolution of policy and socio-technical systems (Hoppmann et al., 2014) and politics of transitions (Markard et al., 2016b, Meadowcroft, 2011, Schmidt and Sewerin, 2017). In this section, first transition management (TM) is described as a sustainability transition theory with the main focus on governance, then transition policies and policy mixes are discussed followed by theories on policy failure and policy learning.

2.3.1. Transition management

Transition management is a policy-oriented transition theory rooted in governance studies and complexity science (Köhler et al., 2019). This literature underlines the role of governments and policies in exerting long-term strategic intervention – 25 years or more – to achieve a systemic change (Loorbach, 2007). It scrutinises how governments can ‘influence, coordinate and bring together actors and their activities so that they reinforce each other to such an extent that they can compete with dominant actors and practices’ (Loorbach and Rotmans, 2010, p. 239).

Transition management follows Schumpeter’s creative destruction (Schumpeter, 2010) in which the government seeks to achieve transitions by destabilising the existing socio-technical regime, while at the same time supporting niche-level innovations (Kemp et al., 2007, Smith and Stirling, 2010). In this theory, considering existing dynamics within a system is of importance for the policymakers and other involved actors to be able to modify their goals and practices to maintain the alignments between long-term visions and short-term practical challenges (Meadowcroft, 2009).

One of the most popular frameworks in transition management has been proposed by Loorbach and Rotmans (2010) which guides policymakers to shape transitions in a four-phase cycle: (1) strategic activities for identifying the problem and developing visions for the desired future and transition pathways; (2) tactical activities to form agendas and develop more specific plans through coalitions and collaborations among actors, preferably with investment commitments; (3) operational activities to implement the strategies through on-the-ground activities such as innovation experiments and demonstration projects; (4) reflexive activities through monitoring and evaluation and learning from the past three phases (Loorbach and Rotmans, 2010). Reflexive activities are vital in transition management as the complexity of transitions along
with the technological, economic, and political uncertainties require continuous experimentation, reflection, and learning (Kemp and Loorbach, 2006).

Transition management has been used in different settings and governance levels (Hendriks and Grin, 2007, Kemp et al., 2007). Some scholars argue that managing transitions is a highly uncertain and chaotic process that is influenced by various socio-political issues (Lawhon and Murphy, 2012) and, therefore, no transition can be planned and coordinated from the beginning (Geels and Schot, 2007). However, it has been acknowledged that transition can be facilitated and re-oriented through indirectly influencing, adjusting, redirecting and guiding actions between all relevant actors in the system which can be achieved by governments (Loorbach, 2007, Meadowcroft, 2005). Transition management has also been claimed to be possible through developing certain properties such as enhancing adaptive capacity or reflexive learning through different policy instruments (Loorbach, 2010). Several analytical tools have been proposed to improve the design and implementation of such policies.

2.3.2. Transition policies

The complexities associated with sustainability as a public good call for policy interventions in shaping the directionality of sustainability transitions to make it an implementable reality. Consequently, a series of theoretical and empirical studies on the role of policies in transitions have been developed. Transition policies refer to government interventions to induce sustainability transitions and often coalesce with other classes of policies such as environmental or innovation policies (Borrás and Edquist, 2013, Del Río et al., 2010, Alkemade et al., 2011).

An innovation policy is “a measure taken by the government to influence innovation processes through changing or control institutions and the behaviour of target groups” (Li, 2013, p. 28). While innovation is also a key part of environmental policies, the focus of innovation policies and environmental policies are slightly different. The focus of innovation policies is on the overall rate of innovation that takes place at regional, local, national, or international levels. In contrast, the focus on environmental policies is the direction of such innovations to address environmental issues (Popp et al., 2010).
The literature on environmental policies considers two hurdles for innovations known as ‘the double externality problem’ which justifies governmental intervention: environmental externalities and knowledge market failure (Rennings, 2000, Jaffe et al., 2005). Based on this assumption, (i) the potential environmental side effects of economic activities such as pollution or depletion of natural resources constitute an ‘externality’ which is not sufficiently reflected in market prices (Baumol et al., 1988), and (ii) in a market economy, firms are not able to reach a certain desirable outcome in resource use because the social benefits of the environmental innovations outweigh their private benefits because such innovations are considered as a public good (Mrinal, 1990, Griliches, 1998). There are two possible avenues for policymakers to encourage the development of environmental innovations: “correcting the environmental externality and/or correcting knowledge market failures” (Popp et al., 2010, p. 878). In this project, transition policy is used interchangeably with innovation and environmental policies which pursue transformative sustainable changes in a socio-technical system.

Researchers have extended the study of transition policies by looking at the effect of different policy instruments on environmental innovation (Johnstone et al., 2010b, Rogge et al., 2011, Berggren and Magnusson, 2012, Bergquist et al., 2013, Nill and Tiessen, 2005, Christiansen, 2001, Ashford et al., 1985, Popp, 2003, Vollebergh, 2007, Jaffe et al., 2002, Fischer et al., 2003, Bergek et al., 2014, Kemp and Pontoglio, 2011). They have assigned different categories for policy instruments from technology-specific versus general instruments (Bergek et al., 2014) to economic versus regulation and information (Rogge and Reichardt, 2016), and command-and-control versus market-based, and voluntary policies (Bohnsack et al., 2015, Kemp and Pontoglio, 2011). Despite the different categorisations, these instruments have two mutually reinforcing roles to bring about transitions effectively: first, supporting and creating niche innovations and, second, destabilizing existing socio-technical regimes to create opportunities for innovation growth (Kivimaa and Kern, 2016).

Many studies compared the impacts of different instruments on the rate and direction of technological innovation to indicate the most prominent instrument to accelerate technological innovation. While some scholars claim that market-based policies and price mechanisms perform better and will have a greater impact over time (Jaffe et al., 2002, Jaffe et al., 2005), others believe regulatory and command-and-control policies are more effective in driving the development of low-emitting technologies (Greene, 1990). Bergek et al. (2014) argue that different types of instruments promote different types of innovation. For instance, general
economic instruments encourage incremental innovation, regulatory instruments enforce modular innovations, and technology-specific instruments support radical innovations. Another strand of literature, in contrast, has analysed the features of policy instruments in terms of their influence on innovations. These studies argue that features such as stringency and predictability of policies are more important than the nature of policy instruments in encouraging, mediating, and directing innovative compliance responses (Johnstone et al., 2010b, Rogge et al., 2011, Kemp and Pontoglio, 2011, Bergek et al., 2014, Yin and Powers, 2010). Sartorius and Zundel (2005, p. 2), by referring to Klemmer et al. (1999), note that:

“A successful and innovation-oriented environmental policy is characterised by a policy style that:

- Includes right from the beginning the relevant groups of actors in the definition of the policy targets,
- Takes into account that changes in the constellations of actors sometimes also require changes in the planned measures,
- Chooses suitable time paths,
- Handle the intended instruments flexibly, and
- Shows a certain continuity and predictability.”

The above discussions about the required characteristics of a successful transition policy are beyond an individual policy instrument. The complexity of transition and environmental programmes asks for a package of different policy instruments designed for a specific target, including all the main stakeholders, and having specific characteristics such as stringency, flexibility, and predictability. The transition literature calls such a package a ‘policy mix’.

2.3.3. Policy mixes

Turnheim et al. (2015, p. 240) argue that:

“Effective governance of transitions needs to be appreciative of complexity, uncertainty, emergence and asymmetries of power, it needs to mobilise deep analysis and timely data, and involve a broad variety of actors in processes of learning, experimentation, and adaptive adjustment as new facts and perspectives become available”.
Therefore, transitions towards sustainability require deep structural changes and ask for a combination of policy instruments, acting simultaneously or sequentially over time (Kivimaa and Kern, 2016, Trencher and van der Heijden, 2019, Rogge and Reichardt, 2016, Edmondson et al., 2018). Studying the interactions between different policy goals, instruments, and processes as a ‘policy mix’ – inspired by innovation system literature – has become an important strand to determine how policy might accelerate or hinder transitions (Flanagan et al., 2011a, Kivimaa et al., 2021, Rogge and Reichardt, 2016). Flanagan et al. (2011b) highlight the importance of studying policy mixes in sustainability transitions by indicating that the emergence of the policy mixes can be considered as a window of opportunity to deal with a messy and complex, multi-level, multi-actor reality.

The most basic definition of policy mixes is the combination of different policy instruments (Matthes, 2010, Guy et al., 2008). However, Flanagan et al. (2011b) argue that a policy mix is more than a simple package of instruments and stress the importance to study the process by which instruments emerge, interact and influence each other. Real-world policy mixes include multiple instruments in different policy fields, governance levels (vertical and horizontal), geographical regions, rationales, policy processes, and implementations (Kivimaa and Kern, 2016, Rogge and Reichardt, 2016, Flanagan et al., 2011b). Table 1 lists some of the main definitions of policy mixes proposed in previous studies.

<table>
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<th>Reference</th>
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<tr>
<td>Kern and Howlett (2009a, p. 395)</td>
<td>Complex arrangements of multiple goals and means which, in many cases, have developed incrementally over many years</td>
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<tr>
<td>Boekholt (2010, p. 353)</td>
<td>The combination of policy instruments which interact to influence the quantity and quality of R&amp;D investments in the public and private sectors.</td>
</tr>
<tr>
<td>Borrás and Edquist (2013, p. 1514)</td>
<td>A set of different and complementary policy instruments to address the problems identified’ in a national or regional innovation system.</td>
</tr>
<tr>
<td>Rogge and Reichardt (2016, p. 1622)</td>
<td>A combination of the three building block elements [policy strategy &amp; instrument mix], processes and characteristics, which can be specified using different dimensions.</td>
</tr>
<tr>
<td>Bahn-Walkowiak et al. (2017, p. 164)</td>
<td>A specific orchestration of well-matched packages of elements and instruments within a given and evolving institutional framework</td>
</tr>
<tr>
<td>Ghazinoory et al. (2019, p. 366)</td>
<td>A combination of policy tools that interact with each other and affect the quality and quantity of R&amp;D investment in the public and private sectors.</td>
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</table>
In general, policy mixes are complex arrangements of multiple policy instruments in different domains which interact over a certain objective and develop and evolve incrementally over time (Rogge and Reichardt, 2016, Kern and Howlett, 2009a). Rogge and Reichardt (2016) propose a framework in which policy mix elements include policy strategies (policy objectives and principal plans), and instrument mix (policy instruments, their goals, type, and design features). These elements have different characteristics and are designed and implemented (policy process) through different dimensions (Figure 2.2).

The strengths of the policy mix perspective are wide-ranging. This approach facilitates attention to policy instrument interactions and their impacts on policy mix objectives; links policy objectives and goals to required actions and their implementation; enables the investigation of effects of different policies on the direction and pace of policy objectives; supports forward orientations to political targets by creating visions of the future; and covers different levels of governance and different levels of socio-technical transition studies (Rogge and Reichardt, 2016, Grubb et al., 2017, Gorissen et al., 2018). Policy mixes, other than sustainability transitions, have been explored in different fields such as business R&D (Montmartin et al., 2018), energy policy (Kim and Park, 2018, Gawel et al., 2014, Lindberg and Governance, 2019), resource efficiency (Trencher et al., 2019, Wilts and O'Brien, 2019, Bahn-Walkowiak et al., 2017), higher education (Capano et al., 2019), and bio-economy (Ladu et al., 2019).
2.4. Business models
As discussed, transition literature sees incumbents as a significant source of inertia for sustainability transitions. According to Lowes et al. (2017), incumbents are existing actors within a socio-technical system who are big players in the market, likely to be involved with old technologies and unsustainable practices, and have the capacity to affect system change. These powerful established actors have the ability, too, to prevent radical changes in the socio-technical regime from other actors such as niche-level firms or policymakers. One of the main sources of incumbents’ resistance to change is their established business models. Recent studies identify incumbents’ existing business models as their main reason/source of inertia that “hamper transitions by reinforcing the current system’s stability” (Bidmon and Knab, 2018, p. 903). However, business models can also be the main source of transformational change as they include the main activities of incumbents’ businesses from partnerships with their suppliers to their relationships with their customers. Transformational changes in business models can bring about radical system innovations within a socio-technical system. The transformation of Ørsted from oil and natural gas businesses to offshore wind power is an interesting example of a radical business model change towards sustainability.

In recent years, substantial attention has been paid to business models in the academic world. A simple search of this phrase in the Scopus database reveals that since 1968 there have been almost 36 thousand articles published in peer-reviewed articles, conference proceedings, books, and reviews in which the notion of a business model is mentioned.3 In this section, different views on business models – static, dynamic, and sustainable – are reviewed and discussed.

2.4.1. Static view on business models
While the concept of the business model has been used fragmentally since the 1960s (Keenan, 1961, Cook, 1968, Friedman, 1971, Schaefer, 1979), it started gaining momentum with the advent of the Internet in the mid-1990s and applications in information systems and e-Business (Amit and Zott, 2001, Ghaziani and Ventresca, 2005, Gordijn and Akkermans, 2001). This literature expanded further by moving to three large strands of research: strategy (Casadesus-Masanell and Ricart, 2010, Zott and Amit, 2010), entrepreneurship (Osterwalder and Pigneur, 2010).

3 The phrase “business model” was searched in title, abstract, and keywords of the articles in Scopus database on 4th December 2021.
2010), and innovation and technology management (Chesbrough and Rosenbloom, 2002). All these strands of literature shared one common ground – they looked at business models from a static point of view.

The static view of business models is mainly focused on providing conceptual, textual, or graphical descriptions to define business models, their elements, and their building blocks. There is a ‘plurality of perspectives’ about the definition of business models (Klang et al., 2014, p. 454) which is reflected in the various dimensions assigned to business models (Schneider and Spieth, 2014). Casadesus-Masanell and Ricart (2010, p. 196) interpret business models as a reflection of firms’ realized strategy and define business models as “the logic of the firm, the way it operates and how it creates value for its stakeholders”. Amit and Zott (2015, p. 331) define business models as “a system of interdependent activities performed by a focal firm and its partners and the mechanisms that link these activities together”. The activities are the engagement of human, physical, and capital resources within the local firm or its stakeholders such as customers and vendors. Richardson (2008, p. 135) states that a business model is “a conceptual framework that helps to link the firm’s strategy, or theory of how to compete, to its activities, or execution of the strategy”. Demil and Lecocq (2010b, p.227) define business models as “the articulation between different areas of a firm's activity designed to produce a proposition of value to customers”.

Many studies provide a business model ontology to conceptualise and formalise its components, relationships and semantics (Osterwalder, 2004). Osterwalder et al. (2005) categorise different business model types and describe nine constituent ‘building blocks’ under four main pillars: product/value proposition, financial aspects, customer interface and infrastructure management. Richardson (2008, pp.138) highlights three main elements of business models: value proposition, value creation and delivery, and value capture. Saebi et al. (2017, emphasis added) argue that the common components of business models are “the firm’s value proposition and market segments, the structure of the value chain required for realizing the value proposition, the mechanisms of value capture that the firm deploys, and how these elements are linked together in an architecture”.

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Despite all the different perspectives on the business model definition, they all share some basic features. Zott et al. (2011, emphasis added), by reviewing business model literature, identified four emerging themes within business model literature:

“(1) [...] the business model is a new unit of analysis that is distinct from the product, firm, industry, or network; it is centred on a focal firm, but its **boundaries are wider than those of the firm**; (2) business models emphasize a **system-level, holistic approach** to explaining how firms “do business”; (3) the activities of a focal firm and its partners play an important role in the various conceptualizations of business models that have been proposed; and (4) business models seek to explain both value creation and value capture”.

In general, a business model provides a ‘system of activities’ (Zott and Amit, 2010) and connects firms’ marketing, strategy, operations, and underlying finance. The value proposition indicates the embedded value within a firm’s product or service. Value creation refers to the creation of the product or service and firms’ upstream relationship with suppliers and how they are structured and managed. Value delivery refers to delivering the product or service to the customers and indicates firms’ downstream relationship with customers. And value capture refers to the financial model and the distribution of costs and benefits among involved actors in a firm’s business model (Boons and Lüdeke-Freund, 2013).

### 2.4.2. Dynamic view on business models

The dynamic view of business models concerns the changes related to business models, offering new ways to create and capture value (Casadesus-Masanell and Zhu, 2013). This literature comprises two main research strands. The first strand – often known as business model innovation – explores the creation of new innovative business models as commercialisation tools to disrupt the market (Chesbrough and Rosenbloom, 2002, Shin and Park, 2009, Aspara et al., 2010). Mitchell and Coles (2003, p. 17) define business model innovations as replacements in a company’s business model to “**provide product or service offerings to customers and end-users that were not previously available**”. According to this strand of literature, pioneered by Chesbrough (2007), innovating a company’s business model is beyond technological innovations. Business models are not just a tool to commercialise and
transport technological innovations to the market and can be the focus of innovation themselves.

Foss and Saebi (2017, p. 216) define business model innovations as “designed, novel, and non-trivial changes to the key elements of a firm’s business model and/or the architecture linking these elements”. Business model innovations are described either as innovations in the core activities of companies (Zott and Amit, 2007, Demil and Lecocq, 2010a) or in the process of designing new business models to generate or secure sustainable competitive advantage (Wirtz and Daiser, 2018). Lindgardt et al. (2012) consider business model innovations as the reinvention and innovation of two or more elements of a business model to deliver value in a new way. Schneider and Spieth (2014) assert that to execute a business model innovation, at least one of the three business model dimensions – i.e., value offering, value architecture, and revenue model – should be innovated.

The second strand of literature – business model evolution, change, transformation, or adaptation – studies the changes in existing business models as a response to external triggers (Cavalcante et al., 2011, Frishammar and Parida, 2019, Denoo et al., 2021, Corbo et al., 2018, Biloslavo et al., 2020). Saebi et al. (2017, p.569) entitle the changes in existing business models as ‘business model adaptation’ and define it as “the process by which management actively aligns the firm’s business model to a changing environment, for example, changes in the preferences of customers, supplier bargaining power, technological changes, competition, etc.”. Business model adaptation, based on an evolutionary view, is an organisational learning process in which organisations experiment with their business models in order to adapt to uncertainty and change (Denoo et al., 2021). Saebi et al. (2017) distinguish business model adaptations from business model innovation by two features. First, the novelty implied in business model innovation is not a necessary requirement for business model adaptations. Therefore, business model adaptations may or may not involve business model innovation as their possible outcome (Snihur et al., 2021, Saebi et al., 2017). Second, while the cause of change for business model adaptations is external, business model innovations may be a response to both internal and external factors.

Business model adaptation can be seen as a great challenge to firms – especially for incumbents – as it may require them to change all or several essential elements of their business such as value propositions, value delivery, and value capture (Aspara et al., 2013). Furthermore,
barriers such as managerial resistance (Chesbrough, 2010b) and ambiguity and uncertainty of external factors (Pinkse and Groot, 2015, Kennedy and Bocken, 2020, Osiyevskyy and Dewald, 2015) could make business model adaptation a time-consuming, expensive and risky process.

2.4.3. Sustainable business models

Sustainability transitions include fundamental changes in the business world (Esty and Winston, 2009). To mitigate the risks and also benefit from the opportunities arising from such transitions, firms need to provide advanced processes, products, or services that are successful in mainstream markets and achieve both environmental and social goals (Schaltegger and Wagner, 2011, Sommer, 2012). This requires a change in firms’ core business and their underlying business models towards sustainability. According to Clark and Charter (2007), a transformation of industrial systems and business models is necessary for transitioning to a more sustainable mode of production and consumption. Therefore, business models are important instruments to reduce the social and ecological impacts of firms and support the societal transition to sustainability (Boons and Lüdeke-Freund, 2013, Bocken et al., 2014, Bolton and Hannon, 2016, Sarasini and Linder, 2018).

There is a rapidly growing body of literature on sustainable business models (SBM), leading to a series of review articles (Boons and Lüdeke-Freund, 2013, Schaltegger et al., 2016b, Bocken et al., 2019) and special issues across journals from different disciplines such as Journal of Management Development (2011), European Business Review (2011), Journal of Cleaner Production (2013), and Organization and Environment (2016, 2020). SBMs include different forms of values along with economic values for a broader range of stakeholders (Bocken et al., 2013). According to a literature review by Boons and Lüdeke-Freund (2013), a sustainable business model should offer ecological, social, and economic values through its products and/or services, it should follow sustainable supply chain management in its infrastructure, it should enable its customers and other stakeholders to take responsibility for production and consumption systems, and it should distribute economic costs and benefits equitably among its involved actors through its financial model. Geissdoerfer et al. (2018) argue that firms with a sustainable business model either incorporate concepts, principles, or goals that aim at sustainability, or integrate sustainability into their business model elements, i.e., value proposition, value creation, value delivery, and value capture.
Many different definitions have been proposed for sustainable business models. Schaltegger et al. (2016a, p. 4) propose a general definition for sustainable business models as follows:

“A business model for sustainability helps describing, analysing, managing, and communicating (i) a company’s sustainable value proposition to its customers and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social and economic capital beyond its organizational boundaries”.

Bocken et al. (2014), by considering the triple bottom line in business models, introduce a sustainable business model archetype, describing the grouping solutions to build up business models for sustainability. These archetypes are: maximising material and energy efficiency, creating value from waste, substituting with renewables and natural processes, delivering functionality rather than ownership, adopting a stewardship role, encouraging sufficiency, re-purposing the business for society/ environment, and developing scale-up solutions.

2.5. Critical reflection

Transition studies and their related theories, while providing popular frameworks for explaining system change and evolutions, are subject to a wide range of critiques. First, transition studies usually take a ‘zoom-out’ approach to provide an overall overview of the transition. This might lead to overlooking the role of agency, political drivers, and actor dynamics within system transitions. An increased appreciation of dynamics between different actors within a socio-technical system – including the way in which their different and conflicting interests might affect transitions – can enrich the analysis of transition processes (Jackson et al., 2014). In particular, more studies on the strength of lock-in mechanisms, conflicts and their determinants within different actors are needed to provide a more precise analysis of tensions, and coordination solutions (Klitkou et al., 2015, Köhler et al., 2019, Smink et al., 2015).

Second, while all the transition theories acknowledged the central role of public policy in transitions (Markard et al., 2016, Weber and Rohracher, 2012, De Laurentis, 2015), they are often limited to a single policy instrument rather than a wider policy mix (Köhler et al., 2019). Yet, it is almost impossible to analyse the impacts of a specific policy instrument because it is
Transition policies and incumbents’ business models: From resistance and system failure to learning and adaptation

Intermingled with and influenced by other sets of policies, especially in the case of complex issues such as sustainability transitions (Kivimaa and Kern, 2016, Trencher and van der Heijden, 2019, Rogge and Reichardt, 2016, Flanagan et al., 2011b). Studying and evaluating the interplay of different policy goals, instruments, and processes in a policy mix format is of crucial importance to analyse the ways in which policies facilitate, hinder, or accelerate transitions (Reichardt et al., 2016). Combining transition theories with other social science fields such as policy change and organisational theories can help understand different dimensions of transitions (Köhler et al., 2019).

Third, sustainability transitions and policy mixes phenomena per se have not received much attention in terms of empirical evidence. Due to the complexity of real-world policy mixes which poses several challenges for policy analysts (Rogge and Reichardt, 2016), the number of empirical studies analysing the role of policy mixes on sustainability transitions and their impact on different stakeholders is scarce (Köhler et al., 2019, Jackson et al., 2014). For example, there is as yet little empirical research that attempts to examine how government interventions and institutions, in the form of policy mixes, can achieve the acceleration of socio-technical transitions (Sovacool, 2016) or how to ‘scale up’ niche-level experiments (Turnheim et al., 2018). Also, the need for a more forward-looking analysis of transitions instead of historical lessons has been stressed by recent scholars (Nilsson and Nykvist, 2016).

Fourth, there is the bias of displaying a greater focus on technology in transition theories (Foxon, 2011, Lawhon and Murphy, 2012). Although dissecting the socio-technical system and establishing solutions might be easier in a technology-centred analysis, it increases the risk of oversimplifying the other change drivers such as institutions and non-technological innovations. In a similar vein to sustainability transitions theories, the focus of transition policies is also on ‘technological innovation’. It is necessary to move towards frameworks that consider the implications of such policies on other aspects of sustainability transitions (Burger and Luke, 2017). As Fagerberg (2018) argues, technological innovations must be complemented by non-technological ones to drive structural changes and transitions towards sustainability. Therefore, all kinds of innovations, i.e. product, process and organisational innovations, are suggested as possible responses to achieve sustainability transitions (Schumpeter, 1934). Although transition management considers different actors within a system and highlights the importance of coordination between different stakeholders (Greenwood, 2012), it is also criticised for its ‘teleological’ character which does not consider
the plurality of ways to reach sustainability transitions (Berkhout et al., 2004). In transition literature, there is an impression that “there is a degree of inevitability about the process whereby tentative, mobile and elastic socio-technical configurations are seen to lead inexorably, through a cumulative sequence of stages, to lasting and increasingly largescale changes in a socio-technical regime” (Berkhout et al., 2004, p. 53). Therefore, non-technological solutions such as business model innovations/adaptations can be overlooked in transition management studies.

Fifth, the literature is being criticised for mainly looking at transitions from a bottom-up approach where innovations are usually driven by newcomer firms at the niche level and move to regimes through windows of opportunity (Trencher et al., 2021). This is also similar to business model literature, where many scholars pin their hopes on niche-level firms to introduce transformational business models (Hockerts and Wüstenhagen, 2010). These strands of literature view incumbents as unsustainable actors locked into their existing assets and institutions, either hindering innovations or innovating incrementally (Kivimaa et al., 2021, Geels, 2006). There is a growing interest in sustainability transitions studies in the ways incumbent actors react to transition policies by deploying various strategies such as lobbying, donating to political campaigns, or shaping public discourses (Fagan-Watson et al., 2015, Geels and Verhees, 2011, Hess, 2016, Konrad et al., 2012, Lindberg et al., 2018). Geels (2018, p. 230) argues that “existing regimes can provide formidable barriers for low-carbon transitions. Incumbent actors can resist, delay or derail low-carbon transitions.” Some studies consider path dependency in incumbents’ business models as their main source of inertia (Chesbrough and Rosenbloom, 2002, Bohnsack et al., 2014). However, there is a need to uncover why incumbents resist radical changes in the regime, how their business model plays a role in their response to transitions, and what needs to be done through transition policy mixes to mitigate this resistance and use their business models as a driver of change instead.

Lastly, the literature seems to disregard both technological and non-technological innovations made by incumbents in a socio-technical regime. This is while niche and grassroots innovations have rarely been powerful enough to bring transformative changes because of their fragmented nature (Scrase and Smith, 2009). Besides, given the urgency of the ecological crisis, there is not enough time for niche innovations to change the status quo rapidly enough. Instead, it is incumbents, because of their deeper financial, human, and intellectual capital, that have the potential to drive radical transitions (Trencher et al., 2021, Köhler et al., 2019). Although some
studies have shown that incumbents can reorient towards or engage with radical niche innovations (Berggren et al., 2015, Penna and Geels, 2015), what so far has been less well-studied is the influence of governmental intervention in incentivising or hindering incumbents to adapt their business models towards sustainability transitions. This is while business model innovations/adaptations are strongly associated with and influenced by political and regulatory structures in a socio-technical regime (Wells, 2013, Bolton and Hannon, 2016, Huijben et al., 2016). Moreover, the challenges of incumbents’ business model adaptations in response to transition policies/policy mixes is yet to be investigated. This is of great importance as incumbents play a key role in socio-technical regimes and have the resources to drive/hamper radical transitions (Trencher et al., 2021, Köhler et al., 2019).

2.6. Research questions

The above critiques and gaps form an unanswered question: how do interactions between governments and incumbents affect socio-technical transitions towards sustainability? Addressing this requires a zoomed-in approach in order to reveal the micro-level dynamics and co-evolutions between transition policy mixes and incumbents’ business models. Business models are selected as the unit of analysis because they entail broader regime elements such as firms’ interactions with technologies, partners, suppliers, customers, and society. According to Zott and Amit (2010), business models are activity systems that constitute the activities being performed, the structure of activities that determine how they are linked and sequenced, and the governance of activities that shows who performs them. A business model is like an analytical construct which allows building of a systemic perspective in a way that includes various elements of the socio-technical regime. A business model cannot be studied in a silo. Rather it is embedded in the larger socio-technical regime and provides a systemic perspective (Hekkert et al., 2007). The systemic scope of business models helps to scrutinise, explicitly or implicitly, the entire socio-technical regime and its transitions towards sustainability. Therefore, several sub-research questions can build the structure of this thesis and answer the overall research question by focusing on the two powerful actors in a socio-technical system: governments and incumbent firms.

Setting this agenda should start with the extant literature on the governance of transitions. Developing and relating research to existing extant literature is the building block of any research activity. There are several systematic literature reviews on sustainability transitions.
Transition policies and incumbents' business models: From resistance and system failure to learning and adaptation

(Van den Bergh et al., 2011, Markard et al., 2012, Susur and Karakaya, 2021) and business model literature (Boons and Lüdeke-Freund, 2013, Schneider and Spieth, 2014, Foss and Saebi, 2017). However, the literature on governance of transitions has been studied from different points of view such as by examining environmental policies (Smith and Kern, 2009), innovation policies (Schot and Steinmueller, 2018), transition policies (Kemp et al., 2007), the influence of a single policy instrument on transitions (Laribi and Guy, 2020), or policy mixes (Kivimaa and Kern, 2016). A semi-systematic review of this literature can help to build an overview of research progress over time, map all potentially relevant research patterns and theoretical themes, and identify potential knowledge gaps for further research (Snyder, 2019).

Also, as discussed above, the literature on transition policy mixes and business models is very fragmented and dispersed. A literature review will be needed to bring these two interrelated strands of literature together and shed light on the state-of-the-art academic output that explicitly or implicitly links policies and business models in general.

Also, it is important to consider incumbents’ approaches and strategies towards adapting their business models to comply with transition policy mixes. The notion of BM is intermingled with business strategy and its associated theoretical traditions which might cause conceptual and empirical confusion in using the concepts. To clarify the similarities and differences between business models and business strategies, Casadesus-Masanell and Ricart (2010) interpret business models as a reflection of firms’ realized strategy (Zott et al., 2011). They define business models as “the logic of the firm, the way it operates and how it creates value for its stakeholders” and business strategy as “the choice of business model through which the firm will compete in the Marketplace”. Mellahi et al. (2016) group two mechanisms related to the external nonmarket environment: buffering and bridging. Buffering strategy refers to firms’ efforts to protect their internal operations from an interfering external environment. This strategy includes defensive and proactive activities such as lobbying and campaign contributions to gain influence on control over such external environments. In contrast, bridging refers to firms’ adaptation of organisational activities to conform to external expectations. Transition policies can be considered as an external force in the environment and firms’ strategies towards transition policies can be buffering and bridging to either adapt their business models or resist the change. A comprehensive literature review can help answer the first set of questions:
RQ1: How can transition policies affect incumbents’ business models towards sustainability transitions?

- How do scholars approach the research on transition policies?
  ✓ What are the research patterns within the literature on transition policies?
  ✓ What are the potential knowledge gaps in the literature on transition policies?

- To what extent the literature on transition policy considers incumbents’ business models?

- What are the influencing factors that determine incumbents’ strategies on business model adaptation to comply with transition policies?

The emphasis on the importance of zoom-in mechanisms in which the micro-level dynamics between transition policy mixes and incumbents’ business models are explored, is the topic of the next set of questions. Although these two strands of literature have been studied in isolation, their co-evolution and inter-plays within a socio-technical regime towards sustainability are yet to be explored. So far, incumbents’ business models have been studied through a broad perspective within socio-technical transitions and are mainly considered a source of resistance (see e.g. Bidmon and Knab, 2018). There is a need for research to juxtapose the main business model elements with the socio-technical regime to investigate the required considerations in a policy mix to accelerate sustainability transitions not only by technological innovations but also by incentivising firms to undertake transformational business model adaptations. The proposed questions for this research agenda are:

RQ2: How can a transition policy mix be designed to support firms’ business model adaptation and innovations necessary to bring about transitions towards sustainability?

- What features can a transition policy mix include to facilitate the business model adaptations towards sustainability?

- What are the sources of inertia for incumbents’ business model adaptations, why do they exist and how can they be addressed by transition policy mixes?

The last set of questions responds to the lack of a forward-looking approach to sustainability transitions. The urgency of sustainability issues had led to many regional, national, or
international transitions happening in different industries. However, as mentioned before, most transition studies have focused on historical or recent, successful transitions. This is while there is a need to analyse the failed transitions to explore the nature of the failure and reconsider and redesign policies in current or future transition programmes. A future-oriented study with a focus on policy learning can fill this knowledge gap and enrich transition literature.

**RQ3: To what extent do transition failures lead to learnings and new understandings of ways to accelerate sustainability transitions?**

- What is the nature of transition policy failures?
- How and to what extent do transition policies learn from previous transition failures?
- How can the learnings help to improve future transition policies and new understandings of ways to accelerate sustainability transitions?

These questions, while not exhaustive, are intended to direct part of the exponentially increasing number of academic studies to focus on more holistic and less techno-centric approaches to transitions. This thesis responds to the above-mentioned questions from conceptual and empirical dimensions in a collection of three journal-format papers (Chapters 4 to 6). The conceptual dimension (Chapter 4) responds to the first two sets of questions by implementing a literature review on transition policies literature and developing a conceptual framework to depict the influence of transition policy mixes on firms’ strategies towards business model adaptation. While Chapter 4 investigates the literature and conceptual side of transition policies and business models, Chapters 5 to 7 analyse these two concepts in an empirical context. Chapter 5 introduces the case study of the research – Zero-Carbon Homes in the UK (ZCH) in 2006. It provides a brief overview of the housing industry in the UK, the history of UK housing policy, and introduces the ZCH-related policy instruments. Chapter 6, with a backwards-looking approach, explores the ZCH policy mix as an example of a failed transition policy mix that did not reach its initial goal and was dismantled before 2016. In this chapter, the reasons behind the transition failure are explored with a zoomed-in approach to investigate the micro-level dynamics between transition policies and incumbents’ business models. Gaining insights from Chapter 6, Chapter 7 adopts a forward-looking approach to analyse the policy learning from the previous failures in a recently announced transition policy called Zero-Carbon Ready (ZCR).
2.7. Summary

In this chapter, the overarching framing of the thesis was presented by focusing on the relevant literature. To do so, a sketch of the relevant literature situating the research was provided including sustainability transitions and their relevant frameworks, governance of transitions, and business models. This helped to synthesise the theories, critically analyse their links, and situate the research questions. Table 2.2 shows the research aim, questions, objectives, methods and data sources.
### Table 2.2. Research aim, questions, objectives, methods, and data sources.

**Research Aim:** To gain a deeper understanding of the influence of transition policy mixes on incumbents’ business model adaptation

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Dimensions</th>
<th>Research Questions</th>
<th>Research Objectives</th>
<th>Research Methods</th>
<th>Data Sources</th>
</tr>
</thead>
</table>
| 4       | Conceptual | RQ1: How can transition policies affect incumbents’ business models towards sustainability transitions? | - Providing an overview of the research on transition policies  
- Identifying the influential factors on business model adaptation  
- Developing a conceptual framework | Qualitative: *Text-mining and Bibliometrics*  
Qualitative: *Semi-Systematic and Integrative Literature Review* | Articles (journal, review, conference) and books from Scopus for the period between 1982 to 2021 |
| 6       | Empirical  | RQ2: How can a transition policy mix be designed to support firms’ business model adaptation and innovations necessary to bring about transitions towards sustainability? | - Identifying the sources of failure in a sustainability transitions programme  
- Identifying the sources of inertia for incumbents’ business model adaptation  
- Exploring the micro-level dynamics between transition policy mixes and incumbents’ business models | Qualitative: *Case Study (ZCH)* | Semi-structured interviews (with policymakers, housebuilders, and academics), archival data (policy documents, newspapers, trade journals, and academic papers) |
| 7       | Empirical  | RQ3: To what extent do transition failures lead to policy learnings and new understandings of ways to accelerate sustainability transitions? | - Identify the nature of transition failure for ZCH in 2006  
- Compare and contrast the ZCH and ZCR  
- Identify the nature of learnings from ZCH  
- Provide suggestions to improve the future transition policy mixes | Qualitative: *Case Study (ZCH and ZCR)* | Semi-structured interviews (with policymakers, housebuilders, and academics), archival data (policy documents, newspapers, trade journals, and academic papers), expert panels, observation |
Chapter 3. Understanding the effects of transition policy mixes on business model adaptations: Literature review and conceptual framework

*This paper has received a revise and resubmit from The International Journal of Management Review*
3.1. Introduction

Over the last two decades, a policy turn has emerged in the scholarly inquiry of sustainability transitions. This concerns an increasing tendency for scholars to debate how governments might formulate and execute public policies to enable and accelerate sustainability transitions (Smith et al., 2005, Kemp and Rotmans, 2009). Advancing new approaches to steer sustainability transitions by governments and other actors have become a significant focus of discussion among social scientists (Loorbach, 2010, Voß et al., 2009). Others, including political scientists, have extended the transitions literature into the realms of policymaking and politics (Meadowcroft, 2011, Rosenbloom et al., 2016), and political coalitions (Hess, 2014, Markard et al., 2016b). Furthermore, this policy turn has also been accompanied by the increasing use of a multitude of concepts, ideas and terminologies from other research areas such as environmental and innovation studies – all with the intention of indicating and explicating the roles, perspectives and actions of governments in sustainability transitions. This has led to a rich and diverse strand of literature.

In parallel, the sustainability transitions literature has also paid attention to business models. Business models are broadly defined as the way firms frame strategies and execute them through interdependent activities to generate value propositions for customers (Amit and Zott, 2015, Demil and Lecocq, 2010a). The sustainability transition literature considers incumbents’ business models – existing big players in the market, likely to be involved with unsustainable practices – as a major source of inertia for transitions (Lowes et al., 2017). This is because incumbents with established ways of doing business are seen as being resistant to the business model changes necessary to induce transitions. Yet incumbents generally have greater capacity and incentive when compared to niche firms to drive transitions (Trencher et al., 2021, Köhler et al., 2019). All these perspectives notwithstanding, the nexus between transition policies and business models has remained largely underexplored. In particular, there has been little research on the potential influences of policies on the incumbents’ business model. This shortcoming is notable, given arguments that policy interventions may not have a tangible impact on sustainability transitions unless firms pursue new or modify their existing business models to adopt and commercialise sustainable technological innovations (Wellington et al., 2007, Adams et al., 2016). Indeed, as Wells (2013, p. 238) points out, “an important future research agenda is to uncover the relationships between sustainability […] government policy and regulation, and innovative business models”.
This paper poses the research question: *how can transition policies affect incumbents’ business models towards sustainability transitions?* To address this question, however, it is important to first organise the diverse and dispersed strand of transition literature relating to government policies. Hence, as a first contribution, a semi-systematic review is carried out, revealing the increasing coherence of this literature strand around the notion of ‘policy mixes’. These insights lay the foundation for an integrative literature review, which identifies and characterises three essential building blocks – transition policy mixes, mediating factors, and business model adaptation strategies. These building blocks underpin our second contribution in the form of a conceptual framework that elucidates how transition policy mixes affect incumbents’ business model strategies.

The paper is organised as follows. Section 3.2 outlines the method. In section 3.3, results are presented and the conceptual framework is advanced. Section 3.4 concludes with a summary of the paper’s main contributions, limitations, and suggestions for future research.

### 3.2. Methodology

The ever-increasingly multidisciplinary and dispersed nature of recent research fields such as sustainability asks for an advanced methodological orientation to understand and analyse knowledge accumulation. This paper presents a methodological approach by combining two literature review techniques (Figure 3.2). First, a semi-systematic literature review is implemented on the literature related to governmental policies on sustainability transitions to visualise previous academic research activities and provide insights into the intellectual structure, trends, current status, and emerging research themes. Further, an integrative literature review is employed to critically analyse and synthesize the identified emerging themes and provide a conceptual framework to depict the nexus between transition policies and incumbents’ business models, proposing research avenues for further studies.
Table 3.1 provides a brief description of the semi-systematic literature review and integrative literature review adopted from Snyder (2019). In the subsequent sections, we will discuss this in further detail.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Semi-systematic</th>
<th>Integrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical purpose</td>
<td>Overview of the research area and track development over time</td>
<td>Critique and synthesize</td>
</tr>
<tr>
<td>Research questions</td>
<td>Broad</td>
<td>Narrow or broad</td>
</tr>
<tr>
<td>Search strategy</td>
<td>May or may not be systematic</td>
<td>Usually not systematic</td>
</tr>
<tr>
<td>Sample characteristics</td>
<td>Research articles</td>
<td>Research articles, books, and other published texts</td>
</tr>
<tr>
<td>Analysis and evaluation</td>
<td>Qualitative/quantitative</td>
<td>Qualitative</td>
</tr>
<tr>
<td>Examples of contribution</td>
<td>State of knowledge, Themes in literature, Historical overview, Research agenda</td>
<td>Taxonomy or classification</td>
</tr>
<tr>
<td></td>
<td>Theoretical model</td>
<td>Theoretical model or framework</td>
</tr>
</tbody>
</table>

### 3.2.1. Semi-systematic literature review

A semi-systematic literature review is suitable for topics that different scholars have studied from diverse disciplinary backgrounds (Wong et al., 2013). The objectives of a semi-systematic literature review range from overviewsing a topic, tracking research progress over time, identifying emerging and historical themes, and providing a research agenda (Snyder, 2019).
To achieve such a review’s aim, a combination of bibliometric analysis and content analysis was used. The bibliometric analysis provides a quantitative analysis of large amounts of scientific and technological literature (Zanjirchi et al., 2019). Although bibliometric analysis as an ‘unsupervised technique’ is considered to eliminate or reduce subjective and local biases frequently observed in expert judgments, it is subject to various criticisms. For example, in terms of rigorous validation of the outputs from this technique, practical significance is difficult to verify (Mahanty et al., 2021). To overcome this limitation, a qualitative content analysis was carried out to add more validation to the quantitative results thereby providing a deeper and grounded understanding of the literature. The quantitative and qualitative methods together generate insights into the overall research growth and trajectories of the literature on government policies for sustainability transitions.

3.2.1.1. Database establishment

Data was collected from the Scopus database in December 2021. Scopus was selected as the largest database of peer-reviewed research literature in different scientific fields that includes complete bibliographical data. Compared to the Web-of-Science database which only includes ISI-indexed journals, the Scopus coverage is more extensive (Fahimnia et al., 2015). To locate relevant publications the search string comprised the following: (policy OR policies OR regulation OR governance OR governing OR legislation OR regulatory OR tax OR "transition management") in combination with ("sustainability transition" OR (sustainability AND transition)). The search included peer-reviewed journal articles, reviews, conference proceedings, book chapters, and books to ensure coverage of a broad range of scientific outputs relating to the transition policies even in less-known publications.

Using the “title, abstract, keywords” search in Scopus, the initial data consisted of 4382 documents. The results were stored in CSV format and a random sample of 200 papers was analysed to check their relevance. Since most sustainability transitions studies also provide some policy recommendations or describe policy implications of their study in their abstract, the first corpus of data included papers that were not relevant for the analysis in this paper. Based on the first set of results, the search strategy was further refined. Table 3.2 shows the refined search strategy and the final retrieved publications. The results were then analysed again based on their journals. Certain journals which were unrelated to the topic of interest, for

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4 The Microsoft Excel software was used to randomly pick the 200 papers.
instance, health-related ones that included studies on demographic and youth transitions were also eliminated. After removing duplicates and records with insufficient bibliometric information (no author, abstract, etc), 1232 documents remained.

### Table 3.2. The refined search strategy and resulting papers

<table>
<thead>
<tr>
<th>Search strategy</th>
<th>Search results (no. of papers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TITLE (policy OR policies OR regulation OR governance OR legislation OR regulatory OR tax) AND TITLE-ABS-KEY (&quot;sustainability transition&quot; OR (transition AND sustainability)) AND (LIMIT-TO (LANGUAGE, &quot;English&quot;)) AND (LIMIT-TO (DOCTYPE, &quot;ar&quot;) OR LIMIT-TO (DOCTYPE, &quot;cp&quot;) OR LIMIT-TO (DOCTYPE, &quot;re&quot;) OR LIMIT-TO (DOCTYPE, &quot;ch&quot;) OR LIMIT-TO (DOCTYPE, &quot;bk&quot;))</td>
<td>889</td>
</tr>
<tr>
<td>TITLE-ABS-KEY (&quot;transition polic*&quot; OR &quot;transition management&quot;) AND TITLE-ABS-KEY (sustainability OR environment* OR sustainable OR eco OR green) AND (LIMIT-TO (LANGUAGE, &quot;English&quot;)) AND (LIMIT-TO (DOCTYPE, &quot;ar&quot;) OR LIMIT-TO (DOCTYPE, &quot;cp&quot;) OR LIMIT-TO (DOCTYPE, &quot;re&quot;) OR LIMIT-TO (DOCTYPE, &quot;ch&quot;) OR LIMIT-TO (DOCTYPE, &quot;bk&quot;))</td>
<td>541</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1232</td>
</tr>
</tbody>
</table>

#### 3.2.1.2. Bibliometric mapping and content analysis

Visualising bibliographic data is a popular technique aimed at enhancing our understanding of the relatedness of research and processes of knowledge transfer (Gibson et al., 2018). VOSviewer software tools are used to analyse and present the bibliometric results graphically (Van Eck and Waltman, 2007). In this software, the unit of analysis (whether keyword, journal, or country) is represented as a node, the line between each node represents their connection (such as co-occurrence of keywords, co-authorship, co-citation), and the distance between each node indicates their relatedness (e.g., the closer two journals are located to each other, the stronger their relatedness in terms of co-citation links).

In addition, a content analysis was done on the title, abstract, and keywords of all publications to identify valuable information such as relations, patterns, or thematic contexts from the database. In this phase, the text mining functionality of VOSviewer (version 1.6.18) along with other content analysis techniques (i.e., manual or word frequency) was applied to identify and classify essential keywords and phrases extracted from the body of literature. This qualitative method is a useful supplement to the quantitative bibliometric analysis to enrich the results.
3.2.2. Integrative literature review

An integrative literature review was used to examine the extent to which the literature on government policies on sustainability transitions considers business models. In contrast with the systematic literature review, this technique is useful when the aim is to assess, critique, and synthesise the literature on a research topic to generate new knowledge in the form of a new framework or perspective (Snyder, 2019). An integrative literature review is particularly helpful for new or emerging fields that would benefit from a “holistic conceptualisation and synthesis of the literature to date” (Torraco, 2005, p. 357).

After analysing all 1232 publications through the semi-systematic literature review, the next step was to analyse the papers in which the connections between transition policies and business models were investigated. The phrase “business model” was searched for in the title, abstract, author keywords, and index keywords of the publications within the database. 31 papers were detected in the first phase. Then their abstracts were analysed to remove those studies in which business models were not the main focus, producing a parent corpus of 13 papers (Appendix C).

Although the context of interest is sustainability transitions and transition policies, we judged that there is scope for expanding the scope of the parent corpus (13 papers) so as to generate more comprehensive insights regarding the effects of government policies on business models. Therefore, following Vayda (1983), this paper employs the concept of “progressive contextualisation” in which relationships between different policies and business models are studied within progressively wider contexts such as management, entrepreneurship, and evolutionary economics. 279 documents were collected based on a combination of business model adaptation and policy keywords in the Scopus database.

After analysing their titles and abstracts, 24 articles were selected that discussed the influential factors in business model changes and the accompanying role of policies. These papers and their references were checked for any additional relevant information. 17 articles were added

5 Search strategy: TITLE-ABS-KEY (“business model adaptation” OR “business model transformation” OR “business model change” OR “business model innovation” OR “business model development”, “business model dynamic” OR “business model transition” OR “business model renewal” OR “dynamic business model” OR “business model learning”) AND (policy OR policies OR governance OR government OR regulation OR regulatory OR intervention OR tax OR governing OR legislation) AND (LIMIT-TO (DOCTYPE, “ar”) AND (LIMIT-TO (LANGUAGE, “English”)))
from the references to add more perspective to the review. After removing duplicates, a final corpus of 54 articles was selected for the integrative literature review.

3.3. Results

3.3.1. Research growth and themes

Figure 3.3 illustrates the growth of research publications on transition policy between 1982 and 2020. The transition policy publication output grew from 12 publications in 2000 to well over 1200 publications in 2020. This growth is aligned with the fact that the ‘sustainability transitions’ field itself has gained momentum over the past two decades and reached an output of hundreds of academic papers per year (Markard et al., 2012).

A content analysis of the titles and abstracts of 50 of the top-cited papers was conducted to identify key themes of inquiry underpinning this growth. The results showed that scholarly studies on the role of governments in sustainability transitions started in 2001 with the work of Rotmans et al. (2001) who introduced the notion of “transition management”. Transition Management scrutinises how governments can ‘influence, coordinate and bring together actors and their activities so that they reinforce each other to such an extent that they can compete with dominant actors and practices’ (Loorbach and Rotmans, 2010, p. 239). The transition management literature was then expanded by other scholars, including Kemp and
Loorbach (2006), Kern and Howlett (2009b), Meadowcroft (2009), and Loorbach (2010). Another strand of literature in this field started with studies on “governance of transitions” (Smith et al., 2005, Kemp et al., 2005, Walker and Shove, 2007) and “reflexive governance” (Voss et al., 2006, Hendriks and Grin, 2007, Voß and Bornemann, 2011) which both highlight the role of different actors in governing transitions. The concept of governance of transitions “accommodates the fact that state actors rely upon non-state actors in the formulation and implementation of public policy” (Smith et al., 2005, p. 1498). Reflexive governance is defined as “a mode of steering that encourages actors to scrutinize and reconsider their underlying assumptions, institutional arrangements and practices”.

Governing sustainability transitions has also been studied within the strands of “innovation policies” (Nill and Kemp, 2009, Foxon and Pearson, 2008), “environmental policies” (Smith and Kern, 2009, Ros et al., 2009) and “transition policies” (Kern and Smith, 2008). An innovation policy is “a measure taken by the government to influence innovation processes through changing or control institutions and the behaviour of target groups” (Li, 2013, p. 28). While innovation is also a key part of environmental policies, the focus of innovation policies and environmental policies are slightly different. The focus of innovation policies is on the overall rate of innovation that takes place at regional, local, national, or international levels. In contrast, the focus of environmental policies is on the direction of such innovations to address environmental issues (Popp et al., 2010). Alkemade et al. (2011), by making a distinction between transition and innovation policies, state that these two types of policies mostly pursue different goals which leads to conflicts and misalignments as “transition policy focuses on stimulating the new and phasing out the old whereas innovation policy often focuses on sustaining the old.” Therefore, they are only aligned when they stimulate innovations that aim for both economic growth and sustainable development.

Recent studies on governing sustainability transitions have focused on “policy mixes” as a complex combination of different policy instruments within different policy fields, levels, regions, and rationales to deal with the complexity and multi-faceted nature of sustainability transitions. Kivimaa and Virkamäki (2014) applied a policy mix perspective in sustainability transitions by investigating policy mixes of passenger transport in Finland. Later, policy mixes were expanded through two major studies by Kivimaa and Kern (2016) and Rogge and Reichardt (2016) which have become the leading papers in this field.
3.3.2. Emerging research themes

Co-citation analysis is carried out to understand the social structure of the field. Co-citation provides the basis for topic/theme designation and the intellectual coherence of topic and also reflects the social dimension of the studied field (Small, 1973). This analysis helps in expediting knowledge integration and building research coherence. Figure 3.4 shows the co-citation between major publications in governing sustainability transitions with a minimum citation of 50. Out of 1232 articles, 173 met the threshold of 50 citations and 118 of them were connected through co-citation. The size of the circles indicates the number of citations, and the colour is determined by the year of publication, ranging from purple (before 2008) to yellow (after 2018).

Figure 3.3 indicates that the transition policy research domain is expanding. However, the question that arises is whether it is becoming more diverse or more coherent. According to Figure 3.4, there is a core network of papers influenced by some leading papers such as Rotmans et al. (2001), Smith et al. (2005), and Loorbach (2007). But there is also a small part of the field which is dispersed in terms of co-citations. There are 55 publications with no citations of the core publications shown in the figure. Such publications were randomly checked. These publications covered topics ranging from circular economy (Hartley et al., 2020) and ecological modernisation (Jänicke, 2008) to urban transition management (Scholz et al., 2006) and disaster governance (Tierney, 2012). For each of these topics, there is also a corresponding body of literature that has been on a consistent rise. More information on the bibliometric results of the literature on transition policies is provided in Appendix A and B.

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6 For example, a simple title, abstract, keyword search in Scopus for “circular economy” and “ecological modernisation” results in 13,172 and 1,045 publications respectively (Scopus search dated December 2021)
Transition policies and incumbents’ business models: From resistance and system failure to learning and adaptation

Figure 3.4. Co-citation network of publications with more than 50 citations
A potential reason for this core network of papers and the disorganised stragglers around it could be the ambiguity of concepts related to sustainability in a way that concepts often become like an ‘umbrella construct’ (Hirsch and Levin, 1999) or a ‘contested concept’ (Korhonen et al., 2018). Therefore, there are dispersed understandings, and many different ways of interpreting, conceptualising, and implementing it. This leads to a large degree of “interpretative viability” in sustainability-related research in which potential “users can eclectically select those elements that appeal to them, […] or that they opportunistically select as suitable for their purposes” (Benders and Van Veen, 2001, p. 37). This interpretive viability is also what makes such concepts seductive to a wide range of stakeholders from researchers to policymakers (Abrahamson, 1996).

Based on the above discussions, the question is whether interpretive viability impedes the development of this field. With this in mind, the analysis reviews the 118 documents in the corpus that have a strong co-citation network. The oldest and most cited publications belong to transition management (Rotmans et al., 2001, Meadowcroft, 2009, Loorbach, 2010, Loorbach and Rotmans, 2010) and governance of transitions (Kemp et al., 2005, Smith et al., 2005). The most highly cited publications in the early 2010s investigated the governance of transitions with innovation policies and multi-level perspective point of view (Weber and Rohracher, 2012, Seyfang and Haxeltine, 2012, Geels, 2013) and the role of technological change on policy interventions (Hoppmann et al., 2014).

Although the overall co-citation network is dispersed, especially in early publications, publications on governing sustainability transitions are becoming more coherent in recent years. The reason is that the most recent and highly cited publications mainly study the role of governments in transitions as a policy mix (Reichardt et al., 2016, Kivimaa and Kern, 2016, Edmondson et al., 2018, Turnheim et al., 2018, Edmondson et al., 2020, Rosenbloom et al., 2020). Consistent with and supporting previous research, this emerging research strand argues that tackling a “wicked problem” such as climate change and sustainability crisis requires more than a single policy instrument. Therefore, we argue that although there are still many different concepts and terminologies used to describe the role of governments and policies, the field is becoming more coherent in terms of acknowledging the importance of policy mixes in steering

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7 Hirsch and Levin (1999, p. 200) define umbrella constructs as a “broad concept or idea used loosely to encompass and account for a set of diverse phenomena".
and facilitating sustainability transitions. This acknowledgement is also leading to the dynamic research progress discussed in section 3.3.1.

In addition, there is another emerging strand of research stemming from the research by Boons and Lüdeke-Freund (2013) on the role of firms’ business models in sustainability transitions. Considering the significant role of business models in sustainability transitions, a small strand of research has been built around business models’ interplay with transition policies (Al-Saleh and Mahroum, 2015, Bolton and Hannon, 2016). Although the co-citation network is not very strong, the significance of the research and the citation records shows a strong potential for future studies.

3.3.3. **Nexus between transition policy mixes and business models**

So far, the semi-systematic literature review reveals (sections 3.4.1 and 3.4.2) that policy mixes and the interplay between business models and transition policies have emerged as important emerging themes of scholarly inquiry in sustainability transition studies. This section builds on these results and provides an integrative review of the nexus between transition policy mixes and business models. The integrative literature review focuses on a small section of the overall literature on transition policy reviewed before in which business models are studied. Combining the insights from the parent corpus (13 papers) with 41 papers resulting from progressive contextualisation, this narrowly focused literature review helps to uncover under which conditions policy mixes are more likely to lead to business model adaptation in incumbent firms. A critical review of the final corpus of 54 papers indicates that scholars have examined different facets of transition policies and business models, including factors that influence firms to adapt their business models, or not. These factors are categorised as drivers and barriers to business model adaptation in Table 3.3.

Within this corpus, the first set of papers focuses on the business models of firms, including recommending potential future business model strategies as a response to transition policies or changes in the political environment. Herbes et al. (2017) and Mirzania et al. (2019) considered three possible strategies for firms: closing down, stagnation (such as focusing on existing assets), or growth (such as cooperation and merging with other companies or experimenting with new business models). Specht and Madlener (2019) designed a new business model for energy companies to move from resource-driven businesses to customer-driven ones. Huijben
et al. (2016) also considered two types of strategies for business models in response to niche shielding policies and mainstream regulation. They argue that firms pursue incremental or radical changes in two types of business model strategies: ‘fit-and-conform’ versus ‘stretch and transform’ respectively.

Table 3.3. Barriers and drivers of business model adaptation by firms in response to transition policies

<table>
<thead>
<tr>
<th>Factors</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barriers:</td>
<td>Engelberts et al. (2021), Pollard et al. (2021), Katare et al. (2021), Stornelli et al. (2021), Guan et al. (2021), Leisen et al. (2019), Nußholz et al. (2019), Yang et al. (2019), Osiyevskiy and Devold (2018), Long et al. (2018), Sivertsson and Tell (2015), Mirzania et al. (2019), Herbes et al. (2017), Sovacool et al. (2021), Bucherer et al. (2012), (Bohnsack et al., 2014), (Buchner et al., 2012)</td>
</tr>
<tr>
<td>• Uncertainty/volatility</td>
<td></td>
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<tr>
<td>• Risk of regulatory changes</td>
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<tr>
<td>• Financial/economic/high cost</td>
<td></td>
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<tr>
<td>• Lack of skill/knowledge/competencies</td>
<td></td>
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<tr>
<td>• Ambiguity/lack of standardisation/lack of information/lack of transparency/contradicting policies</td>
<td></td>
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<tr>
<td>• Technological barriers</td>
<td></td>
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<tr>
<td>• Lack of support</td>
<td></td>
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<tr>
<td>• Unreliable policies/policymakers</td>
<td></td>
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<tr>
<td>• Short-term policy/lack of time/short-term regulatory standards with a short implementation period</td>
<td></td>
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<tr>
<td>• Managerial risk aversion/lacking risk-taking leadership/perceived high risk</td>
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<tr>
<td>• Losing competitive advantage</td>
<td></td>
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<tr>
<td>• Perceived success/perceived profitability/managerial cognition</td>
<td></td>
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<tr>
<td>• Potential for growth/growth aspiration</td>
<td></td>
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<tr>
<td>• Resource and capabilities/staff quality</td>
<td></td>
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<tr>
<td>• Regulation/changes in the regulatory environment/simple principle-based regulation across the value chain</td>
<td></td>
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<tr>
<td>• Clear national strategies</td>
<td></td>
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<tr>
<td>• Competition</td>
<td></td>
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<tr>
<td>• The demise of an industry</td>
<td></td>
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<tr>
<td>• Public support/public investment</td>
<td></td>
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<tr>
<td>• Market changes/increased demand/business opportunities/changing customer needs/unserved customer needs/accessible markets</td>
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<tr>
<td>• Technological advancement</td>
<td></td>
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<tr>
<td>• Relationship with external partners (finance and policy)/networking/stakeholder involvement</td>
<td></td>
</tr>
<tr>
<td>• Strategic agility/strategic sensitivity, leadership unity and fluidity of resources</td>
<td></td>
</tr>
</tbody>
</table>

Another set of studies focuses on policies and their impacts on business models. In these studies, the influences of a single policy instrument (Herbes et al., 2017), several policy instruments (Al-Saleh and Mahroum, 2015, Demartini et al., 2020, Kliem et al., 2020), or a general political environment are analysed (Giraldo Nohra et al., 2020, van Rijnsoever and Leendertse, 2020). The third set of papers considers barriers to business model adaptations, e.g., perceived high risk (Herbes et al., 2017, Sovacool et al., 2021), resource scarcity (Nußholz et al., 2019), financial barriers (Sovacool et al., 2021), and market barriers (Nußholz et al., 2019).
More importantly, this review reveals two key perspectives on the nexus between transition policy mixes and business models that are still nascent and require deeper understanding. First, although some of these studies consider multiple policy instruments, they do not adequately characterise these instruments and do not analyse how these instruments cohere and interact holistically to bring about adaptations in business models. For instance, Al-Saleh and Mahroum (2015) analyse the impact of three different types of policy instruments – ‘sticks’, ‘carrots’, and ‘sermons’ – on firms’ business models. However, they investigate the impact of each policy instrument in an isolated manner and conclude that ‘sermons’ perform better in making firms diffuse green technologies even in the absence of supportive fiscal conditions.

Second, in the transition policy literature, incumbents’ existing business models are seen as a significant source of inertia for sustainability transitions. Existing business models within a socio-technical regime form cognitive and structural barriers to sustainability transitions by their dominant logic, rules, and structures which lead to path dependencies and fear of cannibalisation (Bohnsack et al., 2014, Bidmon and Knab, 2018). However, there is another view that although incumbents can hamper transitions through their business models, they also have the power to influence transformations by changing, adapting, or innovating their business models. According to Geels (2011, p. 25, emphasis added):

> “Although large incumbent firms will probably not be the initial leaders of sustainability transitions, their involvement might accelerate the breakthrough of environmental innovations if they support these innovations with their complementary assets and resources. This would, however, require a strategic reorientation of incumbents who presently still defend existing systems and regimes.”

What we can conclude then is that although the literature attempts to illustrate policy influences on firms’ business model strategies (including the drivers and barriers of adaptation in Table 3.3), such attempts do not adequately explicate how transition policy mixes influence incumbents to adapt their business models towards sustainability transitions. Also, it should be noted that in this paper, the focus is on the influence of transition policy mixes on business models. As explained in Section 1.3 the influence of incumbents on governmental policies has been studied in many studies before. There is a growing interest in sustainability transitions
studies in the ways incumbent actors react to transition policies by deploying various strategies such as lobbying, donating to political campaigns, or shaping public discourses (Fagan-Watson et al., 2015, Geels and Verhees, 2011, Hess, 2016, Konrad et al., 2012, Lindberg et al., 2018). Some studies consider path dependency in incumbents’ business models as their main source of inertia (Chesbrough and Rosenbloom, 2002, Bohnsack et al., 2014). However, there is a need to uncover what needs to be done through transition policy mixes to mitigate this resistance and use their business models as a driver of change instead. This is the key aspect in the nexus between policies and business models that remains underexplored, and it is this aspect that we will develop in the next section.

3.3.4. Policy mix and business models: building blocks

Drawing upon the literature of the final corpus, this section characterises three essential building blocks and their interactions (Figure 3.5) to elucidate the influence of transition policy mixes on incumbents’ business model adaptation strategies.

![Figure 3.5. Essential building blocks and their interactions](image)

3.3.4.1. Mediating factors

Mediating factors (identified in Table 3.3) are associated with incumbent-specific contexts. They act as mediators through which the effects of policy mixes may be transmitted to incumbents’ business model adaptation strategies. We categorise these factors into two main types – perception and dynamic capability:

**Perception** is related to managerial cognition (Zhao et al., 2018a) and perceived high risk (Herbes et al., 2017, Osiyevskyy and Dewald, 2018) or perceived success and growth (Katare
et al., 2021). Jackson and Dutton (1988) highlight that corporate decision-makers and managers interpret and evaluate events, developments, and trends in their industry based on perceived characteristics of issues as threats or opportunities. They identify specific characteristics to define firms’ perception of threats (negative, may lose and will not gain, personal loss from acting on the issue is likely, others constrain actions, and feeling underqualified) and their perception of opportunity (positive, may gain and will not lose, a resolution is likely, have the means to resolve the issue, have the autonomy to act, have a choice whether to act and feeling qualified). The perceived high risk and the risk aversion of managers are considered one of the main organisational and cognitive barriers which make it challenging to adopt sustainable technologies and practices (Herbes et al., 2017, Sovacool et al., 2021). As Herbes et al. (2017, p. 89) indicate: “members of management perceived it to be their responsibility to shield members from risky activities.” Also, Katare et al. (2021), in a study on small business survival during the COVID-19 shock, highlighted the importance of perceived success, growth potential, and perceived profitability (opportunity) as a driver to change business models. Although some studies have highlighted the superiority of the perception of threat to opportunity in triggering business model innovation (e.g., Saebi et al., 2017), Jackson and Dutton (1988) argue that environmental issues and their associated policies can be linked to both threat and opportunity features such as high priority, urgent, and stressful. Accordingly, this paper considers in what way different features of policy mixes shape firms’ perception of the policy landscape as being a threat or an opportunity and how this perception motivates making business model changes in response.

**Dynamic capability** represents the factors related to acquiring new skills, knowledge, competencies, and resources to deal with transition policies. These resources range from supply chain materials (Nußholz et al., 2019), to know-how (Herbes et al., 2017), and professional staff and experience with new appropriate business models (Mirzania et al., 2019). According to Charitou and Markides (2003), a firm’s response to disruptive forces depends on two factors: motivation and ability. While perception captures motivation, we see a firm’s dynamic capabilities as the ability to respond. Teece (2018, p.1) defines dynamic capability as “firms’ ability to integrate, build and reconfigure internal competencies to address, or in some cases to bring about, changes in the business environment.” Teece (2018) further argues that the speed, degree, and associated cost of aligning the firm’s resources – including its business model(s) – with customer needs depends on the strength of a firm’s dynamic capabilities. We argue that dynamic capabilities are not only necessary to meet customer needs but also essential
for firms to adjust, adapt, or innovate their business models to comply with environmental policies. Zhao et al. (2018a, p. 156) refer to this flexibility in response to environmental changes through dynamic capabilities as “strategic agility” and define it as “a firm’s capability to proactively choose among different BMs [business models], as well as create new BMs”. Zollo and Winter (2002) argue that dynamic capabilities are shaped by the coevolution of three learning mechanisms: experience accumulation, knowledge articulation, and knowledge codification processes. By increasing the ability to transform and implement external knowledge, a firm can increase its dynamic capabilities to respond to external change (Daghfous, 2004).

3.3.4.2. Business model adaptation strategies

Indeed, the main issue is whether managers develop strategies to escape from any changes and stick to business-as-usual (stagnation in studies such as Mirzania et al., 2019, Herbes et al., 2017), adapt to policies with minor changes, or radically change their business models and thrive on disruptive opportunities (growth in studies such as Mirzania et al., 2019, Herbes et al., 2017). The urgency and severity of the sustainability crisis and its related policies make it impossible for firms to stubbornly stick with their old way of doing business and routines. Therefore, adaptation remains the only possible business model strategy.

Business model adaptation implies “any modification of the established business model of an organization, i.e., change in the content, structure, and/or the governance of activities within the business model” (Osiyevskyy and Dewald, 2018, p. 543). It can take place through incremental changes and developments in individual business model elements or radical changes in the business model’s architecture. Incremental changes happen by gradually changing or innovating one or some of the business model elements. By comparison, radical adaptations are revolutionary changes and breakthroughs in the entire business model or its architecture which can create new markets and disrupt existing businesses (Teece, 2010). Subsequent discussions on business model adaptation refer to the exploration-exploitation dichotomy. Osiyevskyy and Dewald (2015, p.58) argue that there are two generic strategies related to business models: “explorative adoption of a disruptive business model, and exploitative strengthening of the existing business model”.

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This paper considers two growth business model change strategies as a response to transition policies: **explorative** and **exploitative**. An exploitative pathway refers to incremental refinements over time or changes in some of the elements of a business model (Osiyevskyy and Dewald, 2015, Knab, 2018) to improve efficiency, competitiveness, and operations while avoiding contingencies and risk, minimising costs, and maximising return on investment (ROI) (Osterwalder et al., 2020, Osiyevskyy and Dewald, 2015, Humble et al., 2017). The perception of firms with an exploitation strategy is that they can comply with the policies to a satisfactory level and survive in the current socio-technical regime through incremental adjustments by only changing some business model elements. Such firms tend to rely on exploitative capabilities that help strengthen the current business model and maintain competitive advantage. Such capabilities mainly focus on short-term financial performance and improving efficiency (Liu et al., 2019).

In comparison, an explorative pathway refers to redesigning existing business models through radical changes in value propositions, value creation and delivery or the overall architecture of a business model (Markides, 1998, Markides, 2006). The critical task is creating new growth and breakthrough innovations by investing and finding opportunities, leveraging contingencies, embracing failure, learning, and rapid adaptation to the changing environment (Osterwalder et al., 2020, Osiyevskyy and Dewald, 2015). Here, the perception of firms is that they will not survive in the socio-technical regime without major modifications to their existing business model. Hence, they need to leverage explorative capabilities to adapt to changes and breakthrough innovations, expand their business, and create new growth (Liu et al., 2019).

### 3.3.4.3. Transition policy mixes

Financial and economic barriers (Engelberts et al., 2021), lack of standardisation, lack of information (Stornelli et al., 2021), lack of policy support (Giraldo Nohra et al., 2020, Long et al., 2018), unreliable and short-term policies (Engelberts et al., 2021, Osiyevskyy and Dewald, 2018), uncertainty (Tian et al., 2019), regulatory changes (Motjolopane and Ruhode, 2021, Ruggiero et al., 2021), technological (Wesseling et al., 2020), and market barriers (Hall et al., 2020), all refer to the policy side of transitions that may be addressed through a comprehensive and well-designed policy mix. Following Rogge and Reichardt (2016), we define and characterise transition policy mixes as a combination of four policy elements – namely policy, policy purpose, policy instruments, and design features and characteristics. These elements are
designed and implemented through what Rogge and Reichardt call policy processes. Note that as we seek to analyse the impact of ‘existing’ policy mixes on business model innovation, in our framework we do not consider how elements of the policy mix come about and why they change, i.e., the policy process.

Policy strategy is associated with barriers such as uncertainty, ambiguity, short-term policies, managerial resistance, and risk aversion (Tian et al., 2019, Mirzania et al., 2019). Studies have highlighted the role of policy strategy in sustainability transitions and technological change (Quitzow, 2015, Rogge and Reichardt, 2016, Weber and Rohracher, 2012). Policy strategy is a combination of policy objectives and the measures (principal plans) designed to achieve them (Rogge and Reichardt, 2016). Policy objectives refer to the long-term targets of policy mixes with quantified ambition levels to address environmental problems and can be broken down into smaller goals (Borrás and Edquist, 2013, Rogge and Reichardt, 2016). Principal plans refer to strategic action plans and roadmaps governments set to achieve such objectives and support long-term visions of policy mixes (Rogge and Reichardt, 2016).

The ‘quality’ aspect of policy strategy (in terms of clarity, coherence, and scope of application) plays a fundamental role in business model adaptation. Mirzania et al. (2019, p. 1287) by studying the influence of the curtailment of renewable support mechanisms in 2015 on the development of the UK’s Community Renewable Energy (CRE) sector, state that “recent policy uncertainty has made it difficult for projects to be run successfully and virtually impossible for any new groups to enter the sector.” Compared to technological change, changes in business models present a greater risk to firms as they may require them to change all or several important elements of their business model such as value propositions, customer segments, and supply chain partners (Saebi et al., 2017). Therefore, managers are more likely to resist and avert such risks (Chesbrough, 2010a) as it could be a time-consuming, expensive, and risky process. Under such conditions, a government strategy that is inconsistent or ambiguous in its applicability and direction will not encourage firms to change their existing ways of doing business.

Moreover, the long-term strategic orientation of policies is a key factor in policy strategies. Leisen et al. (2019), by studying how new sustainable business models work in the energy sector and investigating their risk profile such as regulatory changes, consider short-term regulatory standards with a short implementation period as one of the main risks to business.
model changes towards sustainability. Also, Osievskyy and Dewald (2018, p. 540), state that “high time pressure attenuate[s] the threat-induced explorative business model change intentions”.

A long-term orientation of policy strategies with a clear and coherent scope, guidance and timeframe is positively affected firms’ explorative approach to business model adaptation. First, it crystallises firms’ perception of the inevitability and enduring nature of the policy, convincing them that change is unavoidable and that there is little space to manoeuvre past policies without adapting their business model. Second, the long-term future orientation of policy strategies gives firms a chance to build up dynamic capabilities to respond to external change. They provide firms time to implement changes and form a picture of their future business structures (i.e., value proposition, customer segments, key resources, key partners, etc.) within their long-term vision.

**Policy purpose** deals with the technological (Stornelli et al., 2021) and market factors (Ruggiero et al., 2021) of business model adaptation. Policy intervention is widely considered a fundamental trigger for sustainable technologies. Such technologies’ nascent nature requires substantial R&D to be compatible with existing regimes, and their return on investment is accompanied by a high level of uncertainty and risk (Rennings, 2000, Jaffe et al., 2002). Policies induce the development of sustainable technologies by considering both the supply and the demand side of the regime through technology push and market pull (Peters et al., 2012).

Previous studies highlight the importance of technological advancements in business model adaptation (Tian et al., 2019, Motjolopane and Ruhode, 2021). Technology-push policies tend to address the supply-side failure of knowledge or information-related barriers and seek to support the development of new or existing technologies to ensure their compatibility with the needs of the regime. Although R&D activities do not directly require a change in business models, it could become clear in the development process that ensuing technologies will be incompatible with firms’ existing business models (e.g., see the Xerox case in Chesbrough and Rosenbloom, 2002). For a technology push policy to be successful, policymakers need to also think about its conflicts with firms’ existing business models. The higher the degree of conflict, the more resistance from established players in the market (Charitou and Markides, 2003). Therefore, policymakers might have to consider to what extent the firms receiving
R&D support have the dynamic capabilities that would allow them to change their business model to accommodate novel technologies. They could target firms that have either proven to be more capable of changing their business structure or new ventures that do not have potential conflicts with an existing business model (Bohnsack et al., 2014).

For policy mixes to induce explorative business model adaptation, it is argued that policies creating a market pull are more likely to have an impact because they create customer demand (Schmookler, 1966, Rennings, 2000). Such policies reduce the uncertainty associated with investments in sustainable technologies because they address the risk of failing to get customers. Kliem et al. (2020), by studying the co-evolution of business models and public policies in transitions, claim that in a market-based system, market-based interventions such as introducing a levy on the extraction of natural resources would be the best option. Nußholz et al. (2019) state that the difficulty in increasing market share and sales is one of the common barriers companies have to face in their operations while dealing with transition policies. Sovacool et al. (2021, p. 23) believe that such barriers “cannot really be blamed on the industry, and instead relate to consumers and [consumption] patterns—which are moving generally in the direction of becoming more carbon intensive, rather than less”.

One could argue that so long as there is market demand, firms will have an incentive to change their business model because they lead to guaranteed revenue streams that compensate for potential negative impacts on firms’ competitive advantage (Peters et al., 2012). However, while market pull policies might be perceived as an opportunity to develop new business models, they could also be a threat to existing business models when the niche market cannibalizes demand in the mainstream market. Moreover, if the market pull policy creates a new niche market, once such support is removed, customer demand will disappear making the novel business models obsolete.

Policy mixes that support technology push or market pull do not necessarily lead to explorative business model adaptation as existing business models cannot necessarily accommodate the sustainable technologies that the policy envisages. Firms that lack the dynamic capabilities to reconfigure their business model might use policy support for R&D to develop sustainable technologies but fail to commercialise them when they create conflict within their organizations. For a market pull policy to have such an impact, it should incentivize firms to change their business models used in the mainstream market instead of testing new business
models in niche markets. Policymakers risk supporting the creation of business models that are fully dependent on government support but are not financially viable without such support.

**Instrument types** provide a range of policy instruments to address the regulatory (such as the risk of regulatory changes and lack of standardisation), economic (such as financial and economic barriers, and high costs), and information barriers (such as lack of skills and knowledge, lack of information) of business model adaptation. A successful policy mix needs to act on the most critical decisions firms make within their framework of action. To appropriately support firms to change business models, it is necessary to consider and address the most critical problems at each stage. A successful policy mix contemplates the general picture of the innovation context, identifies the problems firms have to face to deploy sustainable technologies and tries to mitigate them from different angles with a mixture of instruments (Del Río et al., 2010, Kemp, 2011). It is only with a comprehensive policy mix that policymakers can persuade firms to overcome barriers and make a transformational shift towards sustainability. Popularly referred to as sticks, carrots, and sermons (Al-Saleh and Mahroum, 2015), policy instruments are categorised into three groups: regulatory (command-and-control), economic (market-based), and information (soft instruments).

Regulatory instruments are legal and enforceable tools that influence social and market interactions and the behaviour of individuals and firms through binding regulations (Borrás and Edquist, 2013, Quitzow, 2015). The coercive nature of regulatory instruments is an effective push against firms’ resistance to change arising from perceptions or barriers such as managerial resistance and risk aversion (Herbes et al., 2017, Zhao et al., 2018a). Also, by providing strict regulations across value chains, governments can trigger demising unsustainable industries which can become a driver for business model adaptations towards sustainability (Ruggiero et al., 2021).

Financial benefits and profitability are other major factors that can become a barrier if they are not sufficiently achieved. Sovacool et al. (2021, pp. 22-23), in their study of the food and beverage industry, highlight that:

“[…] one certainty is that decarbonisation will entail costs and as such it will require finance. And yet high capital cost and long investment cycles are known to be a serious decarbonisation barrier in the industry, especially given that
equipment investments are often in the range of 20–40 years—creating very few moments when facilities or operations can economically upgrade or change technology.”

Economic instruments are financial and market-based instruments providing fiscal (dis)incentives to influence social and economic activities (Borrás and Edquist, 2013). They alleviate managers’ fear and resistance to change by influencing their perception of the policy as an opportunity to increase profit (potential growth and profitability) or a threat to lose the market (losing competitive advantage). They, too, mitigate market-based barriers and improve dynamic capabilities by providing financial support, facilitating demonstrations (pilot projects) and procurement, as well as creating favourable market conditions (Edmondson et al., 2018) for firms to adjust or innovate their business model at a lower risk and cost.

Information instruments are voluntary and non-coercive policies (metaphorically sermons) that aim to reduce the ‘information costs’ of firms (Jaffe and Stavins, 1994) by providing professional training, cooperative R&D programmes, voluntary agreements, and public-private partnerships (Borrás and Edquist, 2013, Rogge and Reichardt, 2016). Firms can use resources and information provided through information instruments to strengthen their dynamic capabilities, upgrade their business and managerial knowledge, and create economic value by jointly generating ideas and absorbed external information (Paliokaitė, 2019).

**Design features and characteristics** such as stringency, predictability, credibility, and consistency deal with barriers such as managerial risk aversion (Herbes et al., 2017, Zhao et al., 2018a), uncertainty (Sovacool et al., 2021), unreliable policies and policymakers (Engelberts et al., 2021), and contradicting policies (Pollard et al., 2021). Previous studies have highlighted the importance of such features and characteristics in encouraging, mediating, and directing compliance responses and their impact on policy instrument’s effectiveness and efficiency (Del Rio, 2009, Johnstone et al., 2010b, Rogge et al., 2011, Yin and Powers, 2010). For example, stringency defines “the ambition level of an instrument” (Rogge and Reichardt, 2016, p.1624) and shows the level of required effort and expenditure for market actors to comply (Johnstone et al., 2010a). Predictability shows “how certain and foreseeable the policy signal is” (Bergek et al., 2014, p.113) and addresses investor uncertainty (Quitzow, 2015). According to Osiyevskyy and Dewald (2018), low predictability reduces explorative business model change intentions. Credibility is defined as “the extent to which the policy mix is
believable and reliable, both overall and regarding its elements and processes” and consistency defines “how well the elements of the policy mix are aligned with each over, thereby contributing to the achievement of policy objectives” (Rogge and Reichardt, 2016, pp. 1626-1627). Such characteristics address the barriers related to unreliability of the policies or policymakers as well as the contradicting policy instruments that increases the level of risk and ambiguity (Pollard et al., 2021). In a study on a circular economy business model innovation process for the electrical and electronic equipment sector, Pollard et al. (2021) argue that the conflicts between existing legislation and circular activities, make regulations not as a driver, but a barrier to change.

Policy mix design features and characteristics have an important role in encouraging, mediating, and directing innovative compliance responses and their impact on policy instruments’ effectiveness and efficiency (Del Rio, 2009, Rogge et al., 2011). For example, the stringency of policies affects firms’ perception regarding the inevitability of a change and induces compliance with strict policies (Kemp, 2000, Rogge and Reichardt, 2016). A high stringency level usually means a great level of ambition that asks for major changes and efforts to comply with policies and is more likely to bring about explorative changes to business models. In contrast, firms can comply with policies with low stringency by only making small and incremental changes to their business models. Also, as discussed, uncertainty is one of the major barriers hindering business model adaptations (Del Río et al., 2010, Mirzania et al., 2019). Predictability reduces uncertainty and gives firms the needed security to prepare their future business structure, mobilise resources, and improve dynamic capabilities. Credibility and consistency provide insurance and decreases the uncertainty and risks to investing in explorative changes in business models. They also tackle the perception of the unreliability of the policies (Edmondson et al., 2020).

### 3.3.5. Conceptual framework

Based on the above discussions, the building blocks of Figure 3.5 are recast and extended to present a conceptual framework in Figure 3.6, showing the interplay between the building blocks of the transition policy mix, mediating factors and firms’ strategies to adapt their business models. As this framework illustrates, to induce any changes in incumbents’ existing business models, a transition policy mix needs to tackle three types of transition barriers: (i) policy-related barriers through policy strategies, purposes, instruments, and design features and
characteristics; (ii) perception barriers related to managerial cognition and risk aversion; and (iii) dynamic capability barriers related to the required resources, skills, knowledge, partners, and competencies to change. In short, transition policy mixes influence firms’ perception and dynamic capabilities to induce business model adaptation.

**Figure 3.6.** The interplay between policy mix building blocks, the mediating factors, and firms’ strategies for business model adaptation

We argue that the combination of the instruments in a policy mix should be tailored (according to business types and the nature of technologies) to support specific business model adaptation pathways. While all policy mix building blocks are needed to promote both exploitative and explorative pathways, they differ in their focus, levels of support and objectives. The focus, goal, and design features of policy instruments should be targeted to address specific adaptation requirements. To support an exploitative pathway, transition policy mixes must be directed in a way to help firms improve their operations, efficiency, and competitive advantage. Conversely, to accelerate an explorative pathway, policy instruments would have to focus more on destabilising prevailing socio-technical regimes. These instruments provide the ‘window of opportunity’ by facilitating favourable market conditions, delivering necessary knowledge-related support, and addressing adaptation barriers.
Although it has been argued that firms should manage both exploitative and explorative pathways simultaneously (Osterwalder et al., 2020), we posit that it will depend on an industry’s underlying conditions how governments could best stimulate specific pathways to bring about a sustainability transition. The appropriateness of supporting exploitative or explorative business model adaptation depends on whether firms in an industry perceive a policy mix as an opportunity or a threat, to what extent they have the dynamic capabilities to change their existing business model, and which specific barriers they face. In industries where there is much resistance to sustainability transitions, as firms mainly deploy unsustainable technologies, policy mixes should first focus on supporting explorative business model adaptation strategies. Sustainable technologies often stay in the niche due to insufficient evidence for their commercial potential, raising doubt about their chance of survival in mainstream markets. By creating incentives to explore the viability of new business models for sustainable technologies, the government can support the launch of new ventures by start-ups or incumbents that create variety in the market (Hockerts and Wüstenhagen, 2010). Only once there is a sufficient accumulation of their commercial potential as part of mainstream markets, the government can support scaling up such business models and supporting firms in doing so through exploitation activities to improve efficiency and maximise potential (Schaltegger et al., 2016b). In industries where sustainable technologies have already reached maturity and there is less conflict with existing business models, the policy mix should instead be tailored to exploitation more swiftly. Here it is no longer an issue of insufficient market evidence but rather a need for a strong signal to scale up sustainable technologies and accelerate the sustainability transition. Notably, supporting explorative business model innovation in such industries might be counterproductive to a transition as it keeps creating variety, while what is needed is convergence to a new dominant business model for the industry. As the underlying conditions in an industry that support or hinder the uptake of sustainable technologies tend to change over time, policy mixes will have to change accordingly, leading to alternating exploitative and explorative pathways in transitioning to sustainability.

Germany’s Renewable Energy Sources Act (EEG), for example, is a mixture of policies and laws to provide guaranteed payment for operators of renewable power installations (García-Alvarez and Mariz-Pérez, 2012). This framework secured cash inflows for a 20-year period for investors in renewable power generation (BMU, 2000). The long-term strategies and clear principal plans of the EEG meant that ambiguities were reduced, and confidence was boosted. The perceived opportunity along with the assurance of long-term profitability led to a
Destabilisation in the main regime and the creation of many start-ups in the niche level. Such start-ups adopted innovative business models by renting out plots of land to install solar panels to benefit from the ‘early starter bonus’ (explorative business model). This opportunity was perceived as a threat to incumbents. If they did not take action, they would lag behind newcomers that were moving to the mass market and were attracting customers. Consequently, they modified their business models by using renewable energy applications in a centralised format (exploitative business model), leading to a significantly more rapid uptake of renewable technologies in Germany (Oschmann, 2010).

Electric vehicles (EVs) in Norway are another successful example of transition policy mixes that had made this country the leader in the adoption of Electric Vehicles. The Norwegian EV policies can be categorised into two phases. From 1990 to 2009 – the technology was not mature yet – the main focus was on technology niche creation and since 2009 the focus has shifted to creating markets for EVs. In 2009 the new framing of Norwegian EV policies shifted the policy focus from stimulating Norwegian innovation to promoting the import and mass diffusion of EVs (Skjølsvold and Ryghaug, 2020).

In its fifth National Transport Plan 2018 – 2029, the Norwegian Government instituted an ambitious goal of having only zero-emission new cars and light vans by 2025 (Regjeringen, 2016, p.13). The policy mix has significantly influenced EV market growth, leading to substantial success in the development of electric cars in Norway (Lorentzen et al., 2017). The clarity and ambition level of the policy objectives along with a balanced and comprehensive mixture of different regulatory, economic, and information instruments were among the key elements in the success of electric car diffusion in Norway. Also, the policy mixes were designed with appropriate design features and characteristics to provide stability, predictability, stringency, and stricter monitoring and control of efficiency in subordinate agencies (Regjeringen, 2016, Kristensen et al., 2018, IEA, 2018).

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8 Such as the national target of 85gCO₂/km for the average new vehicle sold by 2020
9 Such as measures to reduce the purchase price of EVs, reduces circulation taxes and local incentives, exemptions of battery electric vehicles from 25% value-added tax on purchase
10 Such as R&D grants to support EV fast-charging infrastructure, providing publicly accessible charging outlets across the region, public-private partnerships
11 For example, an infrastructure fund has been established to promote predictable and long term financing of infrastructure projects
The Norwegian EV policy mix has made this country an attractive market for industry leaders such as Tesla, Mitsubishi, Peugeot, Citroën and Nissan. In the early 2010s, the market boomed with the introduction of the Mitsubishi i-MiEV and the Nissan Leaf (Lorentzen et al., 2017). Incumbents entered this market either by direct sales (exploitative business model) or partnerships with start-ups such as ServCo to sell the ‘service of mobility’ with EVs (explorative business model). The latter business model does not have any implications for technological innovation in the EV sector, but it promotes service business models, helps to reduce up-front vehicle costs, spreads risks across the ecosystem, and encourages change in customer behaviour (Weiller and Neely, 2013).

3.4. Conclusion

Research on the design, role, and intervention of government policies in enabling sustainability transitions has flourished in recent years. Yet it is not well understood how policies affect incumbents to adapt their business models towards sustainability. The contributions of the paper are two-fold. The first is methodological. A two-pronged approach comprising a semi-systematic and an integrative literature review was adopted. The former showed that policy mixes have emerged as an important theme of scholarly inquiry in sustainability transition studies, whereas the latter identifies and characterises three essential building blocks – namely, transition policy mixes, mediating factors, and business model adaptation strategies.

These findings underpin our second contribution, which is a conceptual framework. This framework indicates how policy mixes could incentivise drivers and address barriers (Table 3), resulting in the effectuation of two types of business model adaptation strategies by incumbents – exploration and exploitation. We argue that any changes in incumbents’ existing business models depend on: (a) incumbents’ perception of transition policies as opportunities or threats; and (b) incumbents’ dynamic capability in adapting their business models. In other words, transition policy mixes affect incumbents to adapt their business models by influencing their perception and dynamic capability.

This study has two types of limitations that point to directions for future research: research design and empirical contextualisation. Regarding the research design, the method can be strengthened by adding experts’ input along with the bibliometric and content analysis techniques. This can improve the study by bringing human judgement to the interpretation of
qualitative and quantitative results. Also, other scientific databases such as Web of Science can be used along with Scopus to add relevant publications. Empirical contextualisation refers to the exploration of the influence of transition policy mixes on business model adaptations, envisaging several pathways for further research. It would be beneficial to empirically analyse the relationship between policy mixes and firms’ business model adaptation strategies. For example, it would be interesting to analyse this framework in different industries and compare their results to investigate the effect of industry context on the relationship between transition policies and business model adaptation. Second, this paper presented two successful transition programmes (Germany’s PV and Norway’s EV) as examples of the interactions between transition policies and business models. Analysing a failed transition would be helpful to identify the potential challenges ahead of a transition programme and prepare for them. In other words, more research is needed regarding the requirements and challenges of incumbents as they seek to pursue explorative business model adaptations.
Chapter 4. Empirical setting

Figure 4.1. Chapter 4
4.1. Introduction

The next two papers (Chapters 6 and 7) investigate transition policies and incumbents’ business model adaptation in an empirical context, i.e., the UK housing industry and the governmental policies imposed on this sector. In order to understand the context of these two papers, this chapter provides an overview of the empirical setting of the UK housing industry, UK housing policy, and the Zero Carbon Homes policy mix and its main policy instruments. First, the characteristics of the UK housing industry and its two main challenges – housing affordability and housing sustainability – along with the main features of UK major housebuilders (incumbents) and their broader market are described. Next, a brief history of the UK housing policy since the Second World War is presented. Then, since the ZCH policy mix is studied in both empirical papers and includes many different policy instruments, this chapter explains the policy mix and its instruments entirely.

4.2. UK housing industry

The housing industry is one of the central elements in the UK economy and national policy spotlight. It plays an important role in UK GDP growth by generating economic output and Gross Value Added (GVA). According to the Office for National Statistics (ONS)\(^{12}\), in 2019, UK housebuilding generated £47 billion of economic output, with the private sector contributing 85% (Figure 4.2). The numbers fell significantly in 2020 as government restrictions reduced economic activities during the COVID pandemic, however, based on early data in 2021 (Q1) from ONS, it is increasing again (0.9% increase).

\(\text{Figure 4.2. Yearly UK housebuilding economic output in million GBP (data aggregated and synthesised by the author from ONS)}\)

\(^{12}\) Office for National Statistics: [Output in the construction industry](#)
Apart from a direct impact on UK GDP and economic growth, the housing industry has a substantial contribution to creating and supporting employment in the UK (HBF, 2018). According to the latest Business Register and Employment Survey (BRES), more than a quarter million people were employed by 2019 in the construction of domestic buildings¹³ (Table 4.1).

<table>
<thead>
<tr>
<th>SIC 2007</th>
<th>Full-time employees</th>
<th>Part-time employees</th>
<th>Part-time employees</th>
<th>Total employment</th>
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<tr>
<td></td>
<td>Public</td>
<td>Private</td>
<td>All</td>
<td>Public</td>
</tr>
<tr>
<td>41202</td>
<td>8.3</td>
<td>240.1</td>
<td>248.4</td>
<td>1.6</td>
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</tbody>
</table>

Yet, housing provision has been always a controversial and political issue in the UK, facing two major challenges: housing affordability, and housing sustainability (Barker, 2004, Stern et al., 2006). The alignment of the quantitative situation of the housing stock (housing affordability) with qualitative aspects of it (sustainability) has become a major focus in housing and planning policy (Carmona, 2001). In the following sections, these two so-called contradicting challenges are discussed.

4.2.1. Housing affordability

The chronic housing shortage has been one of the major challenges confronting UK policymakers (Halligan, 2021). UK’s population has risen by more than 30% from 50 million in 1951 to 66.7 million in 2019 (Figure 4.3.a). However, the main driver of population growth since the 1960s has been migration to the UK (ONS, 2021). This, along with other demographic changes, rising income, immigration and even easy access to mortgages have led to a significant increase in housing demand in the UK (House of Lords, 2016). According to the projections released by ONS in 2020, the number of households in England is predicted to increase to around 150,000 households per year (Figure 4.3.b), growing from 23.2 million in 2018 to 26.9 million in 2043 (Wilson and Barton, 2021).

¹³ BRES 2019: SIC Code 41202 Construction of domestic buildings. Figures do not account for employment in the broader supply chain, including suppliers of goods and services to house builders.
According to the Barker Review in 2004 and the Lyons Review in 2014, at least 250,000 homes are required per year to address the housing shortage only in England (Lyons, 2014, Barker, 2004). Considering new household formations and huge existing backlogs, this figure rises up to 300,000-345,000 new homes per year (HCLG, 2020, Wilson and Barton, 2021). Despite such demand, the supply of new homes in the UK has been slow. Since the 1970s, house building has averaged 16,000 new homes each year in England (DCLG, 2017b) – much lower than the net additional homes target.

In 2015, the Government announced a target to deliver 1 million houses by 2020, and later in 2017 set out another ambition to deliver half a million by 2022 in addition to the previous target (Wilson and Barton, 2021). However, even this additional supply would need to increase by around another 17% to meet the entire housing shortage of 300,000 per year. This severe shortage of supply against the ever-rising house demand had led to a nine-fold increase in the average UK housing price (HM Land Registry, 2020). Figure 4.4 illustrates the net additional housing supply and the average housing prices in England.

The ratio of the average house prices has been more than twice the ratio of average earnings, causing today’s housing affordability crisis (DCLG, 2017b, Halligan, 2021). Figure 4.5 shows the affordability ratio across England by comparing house prices and earnings. As Figure 4.5 illustrates, in some parts of the country, particularly London and South East England, the ratio of house prices is up to more than 14 times higher than the earnings (DCLG, 2017b).
Sky-high property prices have led to a decline in homeownership, particularly among young families, leading to wealth inequality and social division (Halligan, 2021). For example, the number of 16-24 year-olds owning a house has had a 26% decrease compared to the 1990s (Halligan, 2021). As highlighted in the UK Housing Review Briefing Paper in 2017 although supplying 300,000 homes a year is important, the issue of affordability, in both the private and social housing sectors, should not be neglected (Wilcox et al., 2017).

Figure 4.4. (a) Net additional dwellings in England in thousand units compared to the government target (adopted from MHCLG data); (b) Average house price in England in thousand pounds (adopted from ONS data)

Figure 4.5. Affordability ratio by local authority in England (DCLG, 2017b)
4.2.2. Housing sustainability

This sector is among the largest emitting sectors in the UK. Although the energy efficiency of houses has been improving, the reduction in emissions has been very slow. Based on the UK greenhouse gas emissions national statistics, there was only a 14% reduction in carbon emissions in the residential sector from 1990 to 2019 (BEIS, 2021a). Between 2019 and 2020, there was a 1.8% increase in residential carbon dioxide emissions, making this sector the third largest emitter in the UK after transport and energy supply, accounting for almost 21% of all carbon dioxide emissions in the UK (BEIS, 2021b). Figure 4.6 illustrates the greenhouse emissions from the residential sector compared to other major emitters. The use of natural gas for heating and cooking in the case of the residential sector is considered the main source of emissions, which is apart from the generation of electricity consumed within homes. Emissions resulting from heating account for 79% of building emissions in the UK (BEIS, 2021a)\(^\text{14}\).

![Figure 4.6. UK annual territorial greenhouse gas emissions by million tonnes (MtCO2e), including a breakdown by source sector for carbon dioxide emissions, 1990-2020 (source: BEIS, 2021e)](image)

According to the UK Government, the significant role of the residential sector in carbon emissions creates an opportunity and obligation for the housing industry to “take up a position of leadership, going beyond the execution of the work to act as advocates in preparing the broader public sector, business and public opinion for what lies ahead, and setting an example in its own practices” (HM Government, 2010b, p. 14). However, while buildings can offer a

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\(^{14}\) There are about 30 million buildings in the UK (BEIS, 2021a)
large share of cost-effective opportunities for carbon reduction, achieving zero/low carbon buildings asks for massive efforts in enhancing carbon reduction programmes and transition policies\(^{15}\). The challenge of transforming the housing industry towards sustainability roots in the nature of the industry in all its breadth and depth, given the extensive range of activities, involved stakeholders, workload, and scale of business (HM Government, 2010b).

4.3. The history of housing policy

Housing policy is a particularly complicated policymaking area for its multi-faceted nature ranging from planning and credit availability to climate change and design (Halligan, 2021). The UK’s housing policy not only comes from this complexity, but also faces two major issues: housing shortage and affordability, and housing sustainability. The key housing policies in the past few decades reflect these issues to be the key concern of voters and politicians (Hilber and Schöni, 2016). From the Liberal’s ‘Homes Fit for Heroes’ to the conservative’s ‘property-owning democracy’, the promise to resolve the chronic UK housing crisis has been the catchphrase of both the UK’s major parties since the First World War (Swenarton, 2018, Howell, 1984). Given the complex historical narrative that surrounds the UK’s housing policy, it is helpful to start with an overview of housing policy history in the UK to contextualise the focus of this research – i.e., zero-carbon homes – and understand the possible rationales behind the decisions made during 2006-2016.

During the Second World War, almost half a million homes were bombed. This worsened the pre-war housing shortage (Turner and Partington, 2015). New housing plans and policies were enacted to address the housing shortage and the overcrowding of British homes. The 1946 New Towns Act imposed by the Labour Government was a key element of the post-war recovery plan to create new towns. The Act gave the state the legislative role to grant planning permission – mandatory for almost all buildings – for the development of privately owned land (De Smith, 1948). This legislation provided a new and comprehensive system of land taxation enriched by two mechanisms of ‘existing use’ and ‘development charge’. According to this, housebuilders could buy agricultural land based on its relatively low existing value, but for lands with planning permissions, a development charge became due equivalent to the increase in the value of the land (Halligan, 2021). This mechanism prevented land speculation and

\(^{15}\) The United Nations Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report
trading land, as well as supported local authorities with building the required infrastructure and public amenities, both resulting in relatively affordable and decent standard homes.

In the 1950s and early years of the 1960s, the successive conservative governments prioritised the quantity of housing just after the national defence and promised to build 300,000 houses a year while undertaking large-scale slum clearance and creating ‘property-owning democracy’ (Bogdanor and Skidelsky, 1970). In 1959, under the pressure of powerful landowners, the government scrapped the ‘existing use’ for acquiring land to build social housing and obliged local authorities to purchase land at its ‘residential value’ and in 1961, it passed the Land Compensation Act. The Land Compensation Act allowed landowners to “receive full value for all sites including any prospective planning gain” which immediately lead to soaring land prices (Halligan, 2021, p.14).

From 1965, the bye-laws for construction were replaced with a set of prescriptive national Building Regulations as the first national building standard. The regulation covered a range of common technical requirements such as some specific aspects of building design, and construction as well as the required notification procedures for starting, carrying on, and completing building work (Norris, 2007). In 1966, the British Board of Agrément was established to issue certificates for construction products and installers. In 1967, the third and last wave of New Towns was started and continued till 1970, leading to additional growth and construction of new towns such as Milton Keynes, Warrington, and Telford (DCLG, 2017a).

During the 1960s and 70s, the main focus of the UK government was the general quantitative shortage of housing to tackle the crisis as quickly as possible. The number of house completions peaked in 1968 at 352,540. The 1969 Housing Act shifted emphasis from slum clearance to the improvement of existing stock and restoration of older homes (DCLG, 2017a). Although during these two decades, slum clearance and the 1969 Housing Act were implemented as policy responses to solve the sub-standard housing problem, in 1975 nearly a million homes were considered slums, 1.8 million homes were uninhabitable for living, and at least half a million families were sharing homes. The cumulative result of the housing policies in these two decades was the high-density tower blocks, and “vertical slums replacing horizontal ones” (Turner and Partington, 2015, p.19).
The 1980s and 1990s are acclaimed as the time of economic boom and bust, starting with the 1980 Right to Buy as the “sale of the century”, and ending widened inequality gap and negative equity. The improvement in people’s income in the 1980s was accompanied by entrepreneurship and innovations, increased affluence, and also house ownership (DCLG, 2017a). Although the 1965 Building Regulation went through frequent alterations and revisions in the 1970s, in 1984, the Building Act announced the radically new performance-based Building Regulation as a result of the huge expansion in technical information (HM Government, 1984). During these two decades, the quality of houses began to increase as a result of new standards, good urban design principles, and the establishment of the Commission for Architecture in the Built Environment (CABE). The 1990s were the time for two major events regarding climate change and the environment. First, the Earth Summit in Rio de Janeiro in 1992, where the aim was to make an agenda for international actions and development policies on environmental and development issues in the 21st century. As a response to this summit, the Government established The Energy Saving Trust in 1992 to promote sustainable and efficient use of energy and reduce emissions in homes (existing) and transport (EST, 2021). Second, The Kyoto Protocol in 1997 in which the UK Government committed to adopting policies and measures to mitigate greenhouse emissions and report periodically (UNFCCC, 1988).

The beginning of the 21st century can be considered as the time of ‘sustainability awakening’ in the UK housing policy. The UK government took initiatives to meet the challenges of climate change and energy security. Starting with the 2000 edition of Planning Policy Guidance 3 (PPG3), the government pushed for higher-density developments in possible brownfields or urban sites. The year 2000 was also the beginning of the Warm Front Scheme in which the government pushed for improving energy-efficient heating and insulation measures for households (Ipsos MORI and UCL, 2014). In parallel with the EU Directive 2002/91/EC on the energy performance of buildings, the Energy Efficiency Commitment was established in 2002 to promote the achievement of greater domestic energy efficiency by electricity and gas suppliers. In 2003, the Energy White Paper emphasised the importance of energy efficiency in buildings and asked for the use of possible renewables such as photovoltaics to move towards ‘zero space heating’ (DTI, 2003). The 2004 Energy Act provided the development, regulation, and encouragement of using renewable energy resources. Also, the Housing Act in 2004 asked for a Home Information Pack (HIP) for properties in England and Wales to be able to be on open market for sale. HIP was later used in the Zero-Carbon Homes policy mix in 2006.
Along with the Zero-Carbon Homes policy mix which operated between 2006 and 2016, a set of other policies were enforced. The Microgeneration Strategy was launched by the Government in 2006 to make microgeneration a realistic alternative or supplementary source for energy generation for small businesses, communities, and households (DTI, 2006). In 2008, the Climate Change Act introduced targets for the UK to reduce emissions – 80% reduction by 2050. The Act was the first globally to set a legally binding emission reduction target that not only provides a target but also a system of carbon budgeting; and it established the Committee on Climate Change to facilitate meeting the target (Lorenzoni and Benson, 2014). This was followed by the Low Carbon Transition Plan published in 2009 by the Government to set a comprehensive low carbon transition plan to 2020 – 18% on 2008 levels by 2020 and over a one-third reduction on 1990 levels – through transforming the power sector, homes and communities, workplaces and jobs, transport, and farming (HM Government, 2009). The Green Deal, proposed in 2010, helped landlords and tenants to benefit from energy-saving improvements in their homes through the finance they got for an amount based on what they save on energy bills (DECC, 2010). In 2013, the Government responded to the house affordability issue with a new economic scheme ‘Help to Buy’ to stimulate housing demand through four instruments: equity loans, mortgage guarantees, shared ownership, and a “new buy” scheme that allows buyers to purchase a newly-built home with a deposit of only 5% of the purchase price (Hilber and Schöni, 2016). However, this policy has been criticised for increasing the demand while the supply was not enough, leading to increased house prices (Halligan, 2021). Figure 4.7 depicts the major housing policies along with the number of houses completed in each year from 1947 to 2016 across four different themes, i.e., post-war recovery, tower blocks and vertical slums, improved quality and standards, and embracing sustainability.
Figure 4.7. A chronological account of major UK housing policies and their underpinning themes
4.4. **UK housebuilding incumbents**

The unique characteristics of the UK housing industry have made it very different from other manufacturing industries. The effect of inelasticity of land supply on housebuilders’ competitive behaviour makes the business different from other businesses Roy and Cochrane (1999). In order to completely understand the UK housebuilding context, it is instructive to explain the main characteristics of the few powerful housebuilding incumbents – called volume housebuilders\(^\text{16}\) – which dominate the UK housing market and have an oligopoly and speculative business nature (House of Lords, 2016). Halligan (2021) described four distinct characteristics of the UK’s private housebuilding sector, that are problematic and in need of reform, namely the slow build-out, market domination, land banking and lobbying.

One of the important features of the UK housing industry is the delay between obtaining planning permission and building houses. This was previously because of the UK’s planning system and its strict planning laws and complex regulations. But since the introduction of the National Planning Policy Framework in 2012, the number of granted planning permission has increased significantly which makes the planning system much less of a barrier compared to the past (DCLG, 2012). While the planning permissions granted have increased significantly, the number of houses being built has risen far more slowly. This reflects the extent to which large housebuilders have the financial and legal power to obtain land planning permissions (Walker, 2017), sit on such lands, and then “drip-feeding” new homes to the UK housing market to keep the prices high, and have greater overall profitability (Halligan, 2021, p. 84).

As described before, the UK housing market is dominated by a few volume housebuilders. Compared to almost 50 years ago when small housebuilders had a significant contribution to the regional economies by building new homes, the UK housing market is now dominated by almost 7-8 volume housebuilders. Between 2008 and 2015, the market share by volume developers doubled to almost 60 per cent and the share of the SMEs decreased sharply (McGuinness et al., 2018). This not only did not drive efficiency to the housebuilding industry but also led to fewer units being built each year and eventually a market failure (Griffith, 2011).

Land banking is the practice of buying land, applying for planning permission for future sale development, and selling it at much higher prices. The UK incumbent housebuilders are recognised for their unique business model in which land banking and land speculation are

\(^{16}\) Housebuilders that build more than 2000 homes a year.
their core business activity which includes identifying, acquiring, preparing, developing, and selling land (Callcutt, 2007). Land banking has been discussed in many studies either as a rational response by housebuilders to future market uncertainty (Letwin, 2018) or as a cynical act to constrain housing supply and speculate on rising land values (Halligan, 2021). Halligan (2021) believes that currently as the incumbent housebuilders have dominated the market, the land banking business model is a deliberate act by incumbents to restrict the competition in the market and increase the profit.

One of the most common reactions among incumbent firms against any unwanted change is lobbying (Fagan-Watson et al., 2015). UK incumbent housebuilders have influenced policymakers through their political power – such as corporate donations and corporate lobbying – in many cases to keep the status quo and prevent any major changes in the market. According to Halligan (2021), the property sector has accounted for a big portion of the corporate donations received by successive UK governments.

### 4.5. Zero-Carbon Homes

Following Kate Barker’s report on housing affordability (2004) and the Stern Review on the economics of climate change (2006), the UK government suggested that Zero-Carbon Homes can be an opportunity to meet the increasing housing demand and tackle climate change simultaneously. In 2006, the government designed a set of housing and environmental policies (policy mix) with an ambitious target for moving to zero-carbon housing by 2016. Department of Communities and Local Government (DCLG) published the consultation “Building A Greener Future: Towards Zero-carbon Development” to set the Government’s plans and timetable for moving towards zero-carbon development and contribute to the United Kingdom's target to reduce carbon emissions by 60% by 2050 (HM Treasury, 2007a). In this document, the Government set out a package of policy instruments and measures to support this ambition (DCLG, 2006a).

Despite genuine motivations for transitioning towards zero-carbon homes by 2016, the policy mix was scrapped before reaching its target year. This unique policy mix has been the subject of many policy debates and academic research. Recent studies have particularly highlighted the policy process, explaining the evolution and implementation of Zero-Carbon Homes from

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17 The department responsible for building regulations
2006 to 2016 (Schweber et al., 2015, for example, see Greenwood et al., 2017, Edmondson et al., 2020). Although there is consensus among policymakers and academics around UK’s long-term under-supply and inefficient housing, there is less agreement about the ways to achieve wholesale changes in the housing industry (Wilson and Barton, 2021). Regarding the pervasive issue of conservatism among UK housebuilders (Ball, 1999, Barlow, 1999), it is important to analyse the circumstances which cause housebuilders to change their approach or logic of ‘doing business’. As Ahn and Pearce (2007) argue, to avoid the greenwashing of zero-carbon homes, the ZCH policy mix requires changes in the structure and processes of housebuilders’ business models.

4.5.1. Zero-carbon homes policy instruments

The ZCH was an ‘intentionally-built’ transition policy mix introduced in 2006 by the UK government. Intentional policy mix is in contrast with the policy mixes being built by layering. Layering refers to the process in which new policy elements, tools, and objectives are added to the older ones, creating a palimpsest-like mixture of policy instruments, leading to possible inconsistency in the policy mix (Howlett and Del Rio, 2015, Li and Taeihagh, 2020). The ZCH policy mix consisted of regulatory (Building Regulation), economic (tax stamp duty exemption, eco-towns, carbon challenge, and funding for AIMC4 and zero-carbon hub), and information instruments (zero-carbon taskforce, the Code for sustainable homes, AIMC4, and zero-carbon hub). These instruments are explained in more detail in the following sections.

4.5.1.1. Code for Sustainable Homes

The Code for Sustainable Homes can be considered the heart and soul of the policy mix as other policy instruments (e.g., Building Regulation and Eco-towns) depended on the Code to a large extent. Initially designed as a non-mandatory soft instrument, the Code was launched in December 2006 its publication as a ‘Code for Sustainable Homes: A step-change in sustainable home building practice” (DCLG, 2006c, p.21). The Code became operational in 2007 as a method to assess energy efficiency and carbon dioxide emissions and eight other sustainability categories in a two-stage process, i.e., the design stage and the post-construction stage. Credits were awarded using a star ranking system (from one to six) based on the improvements over Building Regulations requirements – ‘1’ star representing a 10% improvement over Part L of the Building Regulations 2006 and ‘6’ stars equating to a zero-carbon home.
The Code replaced EcoHomes for new homes in England from 1st April 2007. It was a voluntary scheme that gave developers the option to decide for themselves whether to build to its standards or not. Developers could determine the most cost-effective mix of features to achieve any code, based on a limited number of mandatory requirements (DCLG, 2009c). Although initiated as a voluntary measure, the Code was to become mandatory as a part of Building Regulations over time. Therefore, the objectives of the code were encouraging home builders to create sustainable dwellings, informing home buyers about the green credentials of their new property, and signalling the direction of change towards zero-carbon homes that would be mandated through the Building Regulations over time (DCLG, 2010b). It was also used as a condition for funding for the Homes and Communities Agency National Affordable Housing Programme. In other words, the Code itself covered all three types of policy instruments that form the bedrock of a solid policy mix – soft, regulatory, and economic.

4.5.1.2. Building Regulations – Part L

In the UK’s zero-carbon home policy mix, Building Regulation was the only regulatory instrument involved in the programme. It was constituted of a series of general guidance about compliance with the building regulation through specific aspects of design and construction such as fire safety, ventilation, electrical safety, etc. The Government updated the regulation in 2006 to make it aligned with the zero-carbon homes policy mix through some amendments in part L – conservation of fuel and power (DCLG, 2006b). The amendments in 2006 and 2007 (DCLG, 2006b, p. 10, DCLG, 2007b, p.2) in part L indicated that:

“Reasonable provision shall be made for the conservation of fuel and power in buildings by:

(a) limiting heat gains and losses
    (i) through thermal elements and other parts of the building fabric; and
    (ii) from pipes, ducts and vessels used for space heating, space cooling and hot water services;

(b) providing fixed building services which
    (i) are energy efficient;
    (ii) have effective controls; and
    (iii) are commissioned by testing and adjusting as necessary to ensure they use no more fuel and power than is reasonable in the circumstances;
(c) providing to the owner sufficient information about the building, the fixed building services and their maintenance requirements so that the building can be operated in such a manner as to use no more fuel and power than is reasonable in the circumstances.”

Building Regulation was aligned with other policy instruments outside the zero-carbon homes policy mix in different fields and governmental levels such as The Green Deal (improving the energy performance of existing buildings), EU Emission Trading Scheme (in case of the need to install renewable energy technologies), and the recast EU Energy Performance of Buildings Directive (2010/31/EU). To comply with the requirements of the Energy Performance of Buildings Directive (EPBD), some changes were made in Part L such as “an obligation to consider the technical, environmental and economic feasibility of high-efficiency alternative systems before starting construction, and a requirement to ensure that in existing buildings, a replacement or renovated thermal element meets minimum energy performance requirements” (DCLG, 2013a, p.8). Also, Part L had an important role in the implementation of EPFD’s requirement for all new buildings to be ‘nearly zero’ energy from 2020.

The Government’s initial plan for the alignment of the Code for Sustainable Homes and Building Regulation Part L, was to progressively improve the energy performance of new homes by tightening the Building Regulation Part L in three steps: 25 per cent improvement in 2010 (compared to 2006 Part L Building Regulations), 44 per cent improvement in 2013, and moving to zero carbon by 2016 (DCLG, 2007a). House builders could meet the requirements through either Fabric Energy Efficiency Standards (FEES), improving the service (e.g. adding a heat recovery device), or adding LZC energy sources such as PV or solar hot water (HM Government, 2013). In cases when meeting the target was not technically feasible or cost-effective through these three options, the remainder of the zero-carbon target could be compensated through supporting off-site carbon abatement measures called ‘allowable solutions’ (DCLG, 2013b). Although the primary focus of the compliance was on energy-efficient fabric and services rather than building integrated renewable technologies, the Government adopted a performance-based approach to provide the required flexibility in choosing the way of compliance in order to stimulate innovation in the construction process (DCLG, 2013a).
The Government claimed that Building Regulation should be used to meet the zero-carbon targets only when (a) it is cost-effective, (b) the market would not change of its own accord, and (c) when other policy instruments are not able to drive this change without it (DCLG, 2013a). The market failures that the Government was initially targeting to tackle with Building Regulation included the lack of information among building buyers/customers about the energy costs and energy efficiency, their lack of capability to act towards it, lock-in nature of buildings for energy consumption after being built, split incentives and low financial benefit, lack of capital, and fear of hassle for house builders (DCLG, 2013a). The initial amendment proposal received significant acceptance from the industry, local authorities, NGOs, etc. There was almost complete consensus – 99 per cent of the respondents to the consultation document – that “alignment of the Code with Part L would promote consistency and avoid confusion” (DCLG, 2010a, p.16).

4.5.1.3. Tax stamp duty exemption

Stamp duty land tax is a transaction tax on the purchase of land and property which is administered and collected by Her Majesty’s Revenue and Customs (HMRC). The rate of the tax depends on the price of the property (HM Treasury, 2007a). A stamp duty land tax exemption was announced in the Pre-Budget Report (PBR) 2006. The exemption was a five-year time limit (starting from 2007) available at the first point of sale of residential transactions. The relief provided exemption from tax liability on dwellings that were zero-carbon (HM Treasury, 2007a). The objective was to help kick-start the market for zero-carbon homes, support renewable technologies, and raise public awareness of the benefits of such homes. It was a financial incentive to get the market to move in the direction of building homes which incorporate specific energy efficiency standards in the fabric of the building and the incorporation of microgeneration technologies at the design stage (HM Treasury, 2007a, HM Treasury, 2007b).

The tax exemption was targeted at individuals. However, the businesses involved in the building and selling of ZCHs would also be affected. The tax exemption was only available for newly built zero-carbon homes at the first point of sale as its key objective was to promote building ZC homes by stimulating customer demand. The government believed that considering the second or subsequent point of sales would not result in any environmental benefits either for the homebuyer or society and would not be a good use of public money.
Developers or solicitors who usually complete and submit the stamp duty land tax return to HMRC on behalf of home buyers would have to pay a small administrative cost to obtain a certificate verifying that a home is built to a zero-carbon standard. In the budget report 2007 – regulatory impact assessment – the government stated that (HM Treasury, 2007a, p. 93):

“It is likely that a significant proportion of the tax incidence will fall upon developers - this means developers will be able to sell these homes at a higher price than they would have otherwise were it not for the tax relief. It would, therefore, reduce potential cost barriers in building these homes.”

4.5.1.4. Eco-towns and carbon challenge

The UK eco-towns policy instrument was announced as a part of the “zero-carbon homes” policy mix in 2007. Its objective was to address the housing shortage in the UK by building large-scale developments of 5,000–20,000 affordable and sustainable houses. The carbon challenge was also announced with smaller-scale funding for medium-scale ‘eco-villages’ (100–750 homes) to act as a testbed for the new code for sustainable homes and help to meet the government target of building zero-carbon new homes by 2016 (DCLG, 2007c).

These policy instruments were introduced “to offer an opportunity to design a whole town to achieve zero carbon development and to use this experience to help guide other developments across the country” (DCLG, 2008, p. 7). The Government expected this idea to be so enthusiastically accepted by society, developers, and local authorities that the construction of 5 eco-towns was thought possible by 2016 and that ten could be built by 2020. They anticipated that society would welcome this idea because it provides green and affordable homes in truly mixed communities with strong economic underpinnings to support jobs and sustainable growth. It was also believed that developers and house builders will swarm in with innovative proposals that had the highest design and environmental standards. The government determine the essential requirements of the eco-towns as (DCLG, 2007c, pp. 12-13):

“(i) Eco-towns must be new settlements, separate and distinct from existing towns but well linked to them. They need to be additional to existing plans, with a minimum target of 5,000–10,000 homes;
(ii) The development as a whole should reach zero carbon standards, and each town should be an exemplar in at least one area of environmental sustainability;
(iii) Eco-town proposals should provide for a good range of facilities within the town – a secondary school, a medium scale retail centre, good quality business space, and leisure facilities;
(iv) Affordable housing should make up between 30 and 50 per cent of the total through a wide range and distribution of tenures in mixed communities, with a particular emphasis on larger family homes;
(v) A management body which will help develop the town, provide support for people moving to the new community, for businesses and to co-ordinate delivery of services and manage facilities.”

4.5.1.5. AIMC4 project
Advanced Innovative Materials, products and processes to meet the government’s Code for Sustainable Homes, Level 4 (AIMC4) was a unique consortium set up in 2009 to meet level 4 energy requirements of the Code for Sustainable Homes through developing and applying innovative materials, products and processes. The consortium comprised three house developers (Stewart Milne Group, Crest Nicholson plc, and Barratt Developments plc), one supplier (H+H UK Ltd), and one research institute (The Building Research Establishment: BRE). The objective was to pioneer the volume production of low-carbon homes and set examples of achieving level 4 cost-effectively only through the innovative fabric and building service solutions (Cartwright and Gaze, 2010a, p.2). The initial target was to build a minimum of 12 homes that not only were energy efficient but also easy to run, reliable and affordable. The result was 17 AIMC4 homes which demonstrated a high level of energy efficiency (code level 4), supply chain effectiveness and reduced construction costs through technological or non-technological innovations (DCLG, 2011).

The total project cost including the planning, designing and building stages was £6.4 million of which half was supported by the Government’s Technology Strategy Board and the rest was invested by the consortium members. Apart from sharing the costs, the risk was also distributed among all the members within the consortium as a joint venture, making it more viable and safe for the members to involve in the project. The project was developed and implemented in three key stages, covering the main steps in the house building process: the pre-construction
stage involving supply chain and design development, the construction stage involving the building delivery, and the evaluation stage involving both as-built and post-occupancy performance evaluation (Tilford and Gaze, 2010, Corfe and Gaze, 2010, Cartwright and Gaze, 2010b). Figure 4.8 shows the AIMC4 project timeline.

Figure 4.8. Timeline of key project milestones and outputs in AIMC4 (Source: Cartwright and Gaze, 2010a)

4.5.1.6. Zero-carbon task force

The Government established the zero-carbon task force as a controlling panel in 2006 jointly chaired by the Minister of Housing and Planning and the Executive Chairman of the Home Builders Federation. The Taskforce also included “members from local government, the energy supply industry, the construction industry and non-governmental organisations” (DCLG, 2007a, p.6). The objective was to identify implementation barriers and find solutions to address them by acting as a platform in which different stakeholders and housing ministers could discuss future steps towards achieving the target (Edmondson et al., 2020). The UK business Council for Sustainable Energy – as a member of the task force – also set up a group to bring UK’s major energy companies to discuss the opportunities of zero-carbon homes either directly or in partnership with housebuilders (DCLG, 2007a).

4.5.1.7. Zero-carbon Hub

The zero-carbon hub was established in 2007 as a response to the recommendations by the Callcutt Review of House-building Delivery (Callcutt, 2007). Its objective was to take day-to-day operational responsibility for achieving ZCH targets and work with the government, councils, and industry to overcome barriers on the journey to zero carbon, raise build standards, and reduce ambiguities and risks associated with ZCH policy implementation (ZCHub, 2021).
The Hub activities included: developing the technical definition of a zero-carbon home; commissioning and carrying out research; providing advice on managing the unintended consequences of building more energy-efficient homes; providing guidance and information through publications; hosting events to create forums for discussion; updating the wider industry on changes to government policy; creating exemplar profiles to highlight innovative solutions which could be incorporated in whole-house energy solutions (ZCHub, 2021).

4.6. Summary

This chapter provided an initiation of the empirical context in which the research case studies are analysed. A brief overview of the UK housing industry context and the policies around it were presented. First, it explains two issues that the UK housing industry faces: sustainability and affordability. Then, it provides a brief history of the UK housing policies introduced since WW2 to tackle these two issues. This section argued that the UK governments often think the sustainability and affordability of houses are two issues in opposite directions that cannot be solved together. As a result, when the focus was on the quality of the houses, the number of houses being built dropped significantly.

Since the main actors of this research case studies are the UK volume housebuilders (incumbents), this chapter also explains their main characteristics and their unique business models which are built around land banking, restricting competitions, and lobbying against any major changes in the housing policies.

In the end, since the ZCH is the basis for both empirical papers, its different policy instruments were explained to provide a basic understanding of the policy mix. These policy instruments and their different characteristics will be analysed in the next two chapters as the case study.
Chapter 5. Transition policy mixes and incumbents’ business model adaptation: A co-evolutionary analysis of UK Zero-Carbon Homes

Figure 5.1. Chapter 5
5.1. Introduction
From Kyoto Protocol to Paris Agreement, there is a consensus among all nations that government interventions are needed for a transformative and long-term change towards sustainability. Socio-technical transitions to sustainability are proposed by academics in the last two decades to investigate the process of this transformation, its required conditions, and the barriers to achieving it (Kemp, 1994). Transition policies refer to government interventions to induce sustainability transitions and often coalesce with other classes of policies such as environmental or innovation policies (Borrás and Edquist, 2013, Del Río et al., 2010, Alkemade et al., 2011). Transition policies are usually justified as a way to correct environmental externalities and market failures (Mrinal, 1990, Griliches, 1998, Popp et al., 2010). Transition policies have been studied through evolutionary theories in the context of innovation systems (IS), the multi-level perspective (MLP), strategic niche management (SNM), and transition management (TM).

While distinctive, these theories all highlight technological change and its evolutionary attributes, for example, variety, multi-dimensionality, and learning processes as the driving forces of socio-technical transitions (Safarzyńska et al., 2012, Geels, 2002). However, the techno-centric nature of such theories has been criticised for underemphasising the importance of non-technological innovations (particularly, business models) in transitions (Foxon, 2011, Lawhon and Murphy, 2012). As Fagerberg (2018) argues, technological innovations must be complemented by non-technological ones to drive structural changes and transitions towards sustainability. Therefore, all kinds of innovations, i.e. the product, process and organisational innovations, are suggested as being possible responses to achieve sustainability transitions (Schumpeter, 1934).

Moreover, transition policies and theories are subject to other limitations and critiques. First, traditional theories and empirical studies offer broad and zoomed-out perspectives of transitions, engaging with transition phenomena in their overall scope. These theories tend to overlook the micro-foundations where multiple actors (e.g., firms and policymakers) interact to produce change. Second, the literature on transition policy, particularly the empirical

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18 Market prices do not sufficiently reflect the environmental side effects of economic activities.
19 Firms are not able to reach a certain desirable outcome in resource use because the social benefits of the environmental innovations outweigh their private benefits because such innovations are considered as a public good (Mrinal, 1990, Griliches, 1998).
research, is more often limited to a single policy instrument rather than a more comprehensive policy mix (Köhler et al., 2019). Studying and evaluating the interplay of different policy goals, instruments, and processes in a policy mix format is crucial in the analysis of how policies facilitate, hinder, or accelerate transitions (Reichardt et al., 2016). Third, the literature is criticised for mainly looking at transitions from a bottom-up approach where changes are usually driven by newcomer firms at the niche level and move to regimes through windows of opportunity (Trencher et al., 2021). This literature seems to disregard both technological and non-technological innovations of incumbents at regime levels as well as niches. This is while niche and grassroots innovations have rarely been powerful enough to bring transformative changes because of their fragmented nature (Scrase and Smith, 2009). Besides, because of their deeper financial, human, and intellectual capital, incumbents are argued to have the potential to drive radical transitions (Trencher et al., 2021, Köhler et al., 2019).

A growing scholarly interest is observed in sustainability transitions regarding the reactions of incumbent actors to transition policies (Al-Saleh and Mahroum, 2015, Geels and Verhees, 2011, Hess, 2016, Konrad et al., 2012). Recent studies identify incumbents’ existing business models as their main reason/source of inertia that “hamper transitions by reinforcing the current system’s stability” (Bidmon and Knab, 2018, p. 903). However, with a few exceptions, the relationship between transition policy mixes and incumbents’ business models has not been well addressed in previous studies (Al-Saleh and Mahroum, 2015). As such, there is a need to uncover why incumbents resist radical changes in socio-technical regimes, how their business models can be a source of inertia or transformational changes, and how policy mixed may be designed not only to address incumbents’ resistance, but use their business models as a source of transformational change.

This paper addresses the question: How might a transition policy mix be designed to support firms’ business model adaptation and innovations necessary to bring about transitions towards sustainability? It analyses how interactions between governments and incumbents affect socio-technical transitions towards sustainability. To do so, instead of a successful transition programme, this paper investigates a failed one to analyse the reasons for transition failure. The Zero Carbon Homes (ZCH) policy mix is selected as the case study based on three main reasons. First, ZCH was an ‘intentionally-built’ transition policy mix. Second, it had an ambitious policy target of supporting decarbonisation. Third, it is considered a failed transition to sustainability. Analysing a failed transition is helpful to identify the potential challenges
ahead of transition programmes and prepare for them. In other words, by finding the lacking features that led to the failure of the transition policy mix, the paper highlighted the crucial features in a successful transition policy mix from policy and business model perspectives.

This paper contributes to transitions literature by providing a zoomed-in representation of the micro-level dynamics between two important elements of socio-technical regimes, i.e., policies and industry incumbents. The importance of this research is underpinned by the assumption that policy recommendations for sustainability transitions will be inadequate unless the context of a particular sector or society is taken into account (Bergman and Eyre, 2011, Foxon, 2011). Moreover, unlike the previous studies on successful transition programmes that mainly provide recommendations on the nature of policy outcomes, this paper analyses the transition from a failure point of view. By studying the ZCH programme, the paper attempts to specify and juxtapose the underlying reasons behind its failure in a systemic way. The findings can help build insights into designing and implementing transition policy mixes to avoid such failures in the current and future transition policies. The importance of this research is underpinned by the assumption that policy recommendations for sustainability transitions will be inadequate unless the context of a particular sector or society is taken into account (Bergman and Eyre, 2011, Foxon, 2011).

5.2. Literature review and theoretical background

5.2.1. Transition policies and policy mixes

Researchers have enriched the study of environmental and transition policies by looking at the effects of different policy instruments on transitions. They have assigned different categories for policy instruments from technology-specific versus general instruments (Bergek et al., 2014) to economic versus regulation and information (Rogge and Reichardt, 2016), and command-and-control versus market-based, and voluntary policies (Bohnsack et al., 2015, Kemp and Pontoglio, 2011). Despite the different categorisations, these instruments have two mutually reinforcing roles to bring about transitions effectively: first, supporting and creating niche innovations and, second, destabilizing existing socio-technical regimes to create opportunities for innovation growth (Kivimaa and Kern, 2016).

Whilst the importance of public policy in transitions is well established, a large body of literature examines the impacts of policies as separate instruments rather than a policy mix.
Transitions towards sustainability require deep structural changes and ask for a combination of policy instruments, acting simultaneously or sequentially over time (Trencher and van der Heijden, 2019, Rogge and Reichardt, 2016). Studying the interactions between different policy goals, instruments, and processes as a ‘policy mix’ – inspired by innovation system literature – has become an important strand to determine how policy might accelerate or hinder transitions (Flanagan et al., 2011a, Kivimaa et al., 2021, Rogge and Reichardt, 2016). Flanagan et al. (2011b) highlight the importance of studying policy mixes in sustainability transitions by indicating that the emergence of the policy mixes can be considered as a window of opportunity to deal with a messy and complex, multi-level, multi-actor reality. Policy mixes are complex arrangements of multiple policy instruments in different domains which interact over a certain objective and develop and evolve incrementally over time (Rogge and Reichardt, 2016, Kern and Howlett, 2009a).

According to the framework proposed by Rogge and Reichardt (2016, p.1622), a policy mix is “a combination of the three building blocks elements, processes, and characteristics, which can be specified using different dimensions”. Policy mix elements include policy strategies (policy objectives and principal plans), and instrument mix (policy instruments, their goals, type, and design features). These elements have different characteristics and are designed and implemented (policy process) through different dimensions.

This paper’s theoretical framework is based on the policy mix building blocks proposed by Rogge and Reichardt (2016), but it also incorporates insights from the main transition theories such as MLP, IS, and TM. However, rather than focusing on technological innovations, the paper uses these theories to provide an analysis of the co-evolution of transition policies – in a policy mix framework – with firms’ business models. Although many types of co-evolutionary processes such as technological, environment-economy, and supply-demand co-evolutions have been analysed in previous studies, the co-evolution of policy mixes and business models is yet to be investigated.

### 5.2.2. Business model adaptation and innovation

Business models are the ways firms deliver value to their customers, entice customers to pay for value, and convert the payments to profit (Amit and Zott, 2001, Teece, 2010). The recent strand of business model literature has moved from a static view on business models which
Transition policies and incumbents’ business models: From resistance and system failure to learning and adaptation


This dynamic business model literature can be categorised into two main strands of literature. The first – known as business model innovation – explores the creation of new innovative business models as commercialisation tools to disrupt the market (Chesbrough and Rosenbloom, 2002, Shin and Park, 2009, Aspara et al., 2010). The second – business model evolution, change, transformation, or adaptation – studies change in existing business models as a response to external triggers (Cavalcante et al., 2011, Frishammar and Parida, 2019, Denoo et al., 2021, Corbo et al., 2018, Biloslavo et al., 2020). In this paper, our unit of analysis is the business model adaptation of incumbents in a socio-technical regime and we focus on the way they adapt or transform their business model in response to transition policies. Saebi et al. (2017, p.569) define business model adaptation as “the process by which management actively aligns the firm’s business model to a changing environment, for example, changes in the preferences of customers, supplier bargaining power, technological changes, competition, etc.”. However, a possible outcome of business model adaptation might be considered business model innovation when the change turns out to be more radical (Snihur et al., 2021, Saebi et al., 2017).

Business model adaptation is a challenge for firms – especially for incumbents – as it requires changing all or several essential elements of their business such as the value proposition, value delivery, and value capture (Aspara et al., 2013). Furthermore, barriers such as managerial resistance (Chesbrough, 2010b) and ambiguity and uncertainty of external factors (Pinkse and Groot, 2015, Kennedy and Bocken, 2020, Osiyevskyy and Dewald, 2015) make business model adaptation a time-consuming, expensive and risky process. Although this challenging task has been the subject of many studies in recent years (Frishammar and Parida, 2019, Biloslavo et al., 2020, Carlborg et al., 2021), how government intervention either incentivises or hinders incumbents to adapt their business models to become more sustainable is yet to be investigated. This is of great importance as incumbents play a key role in socio-technical regimes and have the resources to drive or hamper radical transitions (Trencher et al., 2021, Köhler et al., 2019).
5.3. Research design and methodology

5.3.1. The zero-carbon homes policy mix

Following Kate Barker’s report on housing affordability (2004) and the Stern Review on the economics of climate change (2006), the UK government suggested that zero-carbon homes can be an opportunity to meet the increasing housing demand and tackle climate change. In 2006, the government designed a set of housing and environmental policies (policy mix) with an ambitious target of moving to zero-carbon housing by 2016. Department of Communities and Local Government (DCLG)\(^2\) published the consultation “Building A Greener Future: Towards Zero-carbon Development” to set the Government’s plans and timetable for moving towards zero-carbon development and contribute to the United Kingdom’s target to reduce carbon emissions by 60% by 2050 (HM Treasury, 2007a). In this document, the Government set out a package of policy instruments and measures to support this ambition (DCLG, 2006a). The mix consisted of regulatory (Building Regulation), economic (tax stamp duty exemption, eco-towns, carbon challenge, and fundings for AIMC4\(^2\) and zero-carbon hub), and information instruments (zero-carbon taskforce, the Code for sustainable homes, AIMC4, and zero-carbon hub).

Despite genuine motivation for transitioning towards zero-carbon homes by 2016, the policy mix was scrapped before reaching its target year. This unique policy mix has been the subject of many policy debates and academic studies (Edmondson et al., 2020, Goodchild and Walshaw, 2011, Greenwood, 2015, Heffernan et al., 2015, O’Neill and Gibbs, 2020, Osmani and Gordon, 2012). Recent studies have particularly highlighted the policy process, explaining the evolution and implementation of Zero-Carbon Homes from 2006 to 2016 (Schweber et al., 2015, for example, see Greenwood et al., 2017, Edmondson et al., 2020). Although there is consensus among policymakers and academics around UK’s long-term under-supply and inefficient housing, there is less agreement about the ways to achieve wholesale changes in the housing industry (Wilson and Barton, 2021). Regarding the pervasive issue of conservatism among UK housebuilders (Ball, 1999, Barlow, 1999), it is important to analyse the circumstances which cause housebuilders to change their approach or logic of ‘doing business’.

\(^2\) The department responsible for building regulations

\(^2\) Advanced Innovative Materials, products and process to meet the government's Code for Sustainable Homes, Level 4
As Ahn and Pearce (2007) argue, to avoid the greenwashing of zero-carbon homes, the ZCH policy mix requires changes in the structure and processes of housebuilders’ business models.

This paper complements previous research by investigating the ZCH transition from both macro-(policy) and micro-(firm) level perspectives. The ZCH is studied in an embedded single case study (two units of analysis) with an interpretive approach that enables the explanation, description and exploration of phenomena in the ‘real world’ that can then provide lessons for other cases (Yin, 2003). This paper attempts to articulate and elaborate on the underlying reasons for the ZCH failure by looking at the impact of incumbents’ attempts to protect or adapt their business model in response to the government’s policy mix.

5.3.2. Data collection

This research involves multiple sources of evidence for data triangulation (Eisenhardt, 1989). We employ the following sources of data: (a) archival data including policy documents, newspapers, trade journal articles, academic papers, house builders’ reports, business models, and websites, and (b) semi-structured interviews with housing policy experts, housebuilders, and academics.

We used three types of archival data sources to gain insight into the policy mix. First, we used policy documents the UK government published between 2006 and 2016 including white papers, green papers, planning policy statements, reports, consultations, and assessments. These documents are mainly collected from the UK Government Web Archive, Ministry of Housing, Communities and Local Government22 (MHCLG) policy papers and consultations, and the UK Parliament publications. Second, newspapers (Financial Times, The Guardian, and The Times) and trade journals (Building, Planning (U.K.) and Building Design) were accessed through Factiva's global news database to gain additional information about each policy instrument. Third, academic papers available on the Scopus database related to each policy instrument and ZCH, in general, were analysed. Table 5.1 lists a summary of the archival data about the policy mix. In addition, we collected archival data about housebuilders’ business models and strategies. We retrieved publicly available data sources including annual reports, socio-economic footprints, sustainability frameworks, corporate responsibility reports, and business models by accessing the websites of volume housebuilders.

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22 Known as the Department for Communities and Local Government (DCLG) by 2018
Table 5.1. Archival data sources

<table>
<thead>
<tr>
<th>Policy Instrument</th>
<th>Source</th>
<th>Quantity</th>
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<tbody>
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<td>• Code for sustainable homes</td>
<td>Government sources</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Newspapers and trade journals</td>
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</tr>
<tr>
<td></td>
<td>Academic papers</td>
<td>23</td>
</tr>
<tr>
<td>• Eco-towns and Carbon challenge</td>
<td>Government sources</td>
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<td></td>
<td>Academic papers</td>
<td>9</td>
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<tr>
<td>• Building Regulations</td>
<td>Government sources</td>
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<td>• AIMC4</td>
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<td>Newspapers and trade journals</td>
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<td>Academic papers</td>
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<tr>
<td>• Zero-carbon hub</td>
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<td>• Tax stamp duty exemption</td>
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<td>Newspapers and trade journals</td>
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<td>• ZCH in general (including reports</td>
<td>Government sources</td>
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<td>and planning policy statements)</td>
<td>Newspapers and trade journals</td>
<td>24</td>
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<td></td>
<td>Academic papers</td>
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Following Gioia et al. (2013), we used semi-structured interviews to obtain both retrospective and real-time accounts of people experiencing and engaging with the ZCH programme. We conducted the interviews through video conferencing with three groups of experts – policymakers, housebuilders, and academics. We selected interviewees based on their expertise and experience in UK housing policies and the housing and construction sector. We asked them the same set of core questions, although variations and follow-up questions were posed to confirm correct understanding. We consistently organised and subjected the data to the same analysis procedure. These steps enabled us to meet case study parameters of reliability and external validity (Eisenhardt, 1989). We conducted the interviews between April and October 2021 by which time they had provided a sufficiently wide range of perspectives to facilitate the interpretation of the policy mix problems.

For the first group of interviews, i.e., policy experts, the focus was on the issues with the ZCH policy mix and its influences on the housing industry during 2006-2016. The interviewees were selected based on their knowledge, experience, or involvement in ZCH from different governmental departments or private policy sectors such as The Ministry of Housing, Communities and Local Government (HCLG), The Department for Business, Energy, and
Industrial Strategy (BEIS), National House Building Council (NHBC), Building Research Establishment (BRE), and Zero Carbon Hub.

The second group of interviewees were volume housebuilders. Since the focus of the paper is on incumbents’ business models, only large housebuilders were selected. The list of volume housebuilders in the UK was drawn using the FAME database, a source of company information in the UK and Ireland. The search strategy was limited to the UK SIC (2007) code 41202 for the construction of domestic buildings. The top 10 housebuilders were selected based on their annual turnover. Individuals within the selected firms were contacted by email, phone, their website, or LinkedIn. This was accompanied by interviews with members of the Home Builders Federation (HBF) which is the representative body of the home building industry in England and Wales and accounts for 80% of all new homes built in these regions. Interviews were conducted with people most familiar with zero-carbon houses, sustainable housing, or housing policies such as technology and innovation directors, innovation managers, sustainability directors, policy managers, and government affairs directors. The questions were mainly on the effects of ZCH on their business models as well as the enablers and inhibitors for adapting to transition policies.

The third group of interviewees were academics with a background in the UK housing policy or housing industry. They were contacted based on their publications in this area available on Scopus and were mainly asked about the overall ZCH policy mix and connecting it to transition and organisational theories. Table 5.2 provides an overview of the conducted interviews.
Table 5.2. Interview details

<table>
<thead>
<tr>
<th>Expertise group</th>
<th>Interviewees</th>
<th>Interviewee code</th>
<th>Duration (Minutes)</th>
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<tr>
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<td>P1</td>
<td>60</td>
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<tr>
<td>Policy</td>
<td>Ministry of Housing, Communities and Local Government</td>
<td>P2</td>
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<td>Building Research Establishment, Policy council,</td>
<td>P3</td>
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<tr>
<td>Policy</td>
<td>Building Research Establishment, National House Building Council</td>
<td>P4</td>
<td>60</td>
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<tr>
<td>Policy</td>
<td>Building Research Establishment, Future Homes Hub</td>
<td>P5</td>
<td>60</td>
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<tr>
<td>Policy</td>
<td>Building Research Establishment, Zero-Carbon Hub</td>
<td>P6</td>
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<td>Building Research Establishment</td>
<td>P7</td>
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<td>Volume housebuilder</td>
<td>I1</td>
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<td>Volume housebuilder</td>
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<td>Volume housebuilder</td>
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<td>Volume housebuilder</td>
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<td>A2</td>
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<td>Science, technology, and innovation policy</td>
<td>A3</td>
<td>60</td>
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<tr>
<td>Academia</td>
<td>Environmental geography and governance</td>
<td>A4</td>
<td>75</td>
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5.3.3. Data analysis

The qualitative data organizing software Nvivo12 was used for archiving, coding, and revising the data. The archival data and interview transcriptions were coded and conceptualised following the methodology proposed by Gioia et al. (2013). First, the raw data including policy documents, interview transcripts, and news articles were manually analysed through ‘open coding’ with a little attempt to clarify categories. The documents related to policy instruments were coded separately at first to scrutinise their content and then the whole policy mix was analysed to investigate the interactions between each instrument. In this step, almost 70 concepts were identified and extracted from the data. These concepts were then reduced into a more manageable number of codes (16 first-order themes) through axial coding – merging codes based on their similarities and differences (Strauss and Corbin, 1998). Second, going back and forth between relevant literature and theoretical perspectives as well as the data, the themes were categorised into eight constructs, which shed light on why the policy mix failed and thereby, helped establish the internal validity of the case study (Eisenhardt, 1989). The final step was to build a data structure based on the first and second steps and group them into two aggregated theoretical dimensions with a selective approach. These three steps enable a “cyclical and evolving data loop” in which we constantly compared the data and applied data
reduction and consolidation techniques (Williams and Moser, 2019, p.47). Figure 5.2 shows the coding structure and its three main steps. As shown, the first four constructs are related to the shortcomings related to the design and implementation of ZCH policy mixes and the last four are related to the barriers to business model adaptation from an incumbent point of view.

**Figure 5.2. Coding scheme**

### 5.4. Findings

#### 5.4.1. Policy shortcomings

The ZCH policy mix, while being considered a unique and ambitious policy towards sustainability, has been the subject of significant criticism. In this section, the four macro-level constructs of ZCH policy shortcomings and their associated factors are discussed.
5.4.1.1. Clarity

**Ambiguous definition and characterisation of ZCH as a policy target.** The first issue that was often raised in the early days of the ZCH programme was the lack of clarity about the definition of the target and ways of achieving it in practice. According to housebuilders’ response to policy consultations (DCLG, 2007a, p.14):

“...the way in which zero carbon is defined will have a major impact on the costs and deliverability of zero carbon homes within the timetable specified [10 years]”.

The Government tried to address this by launching the Zero Carbon Hub which served as an autonomous research group to redefine the target and identify and address potential barriers. However, it was a time-consuming task which led to lots of uncertainties at the early stages of the programme.

**Lack of concrete justifications for policy intervention types.** Housebuilders and other stakeholders within the housing industry wanted more evidence to be convinced that the proposed solutions would be sustainable. In particular, there were great concerns over the significance of retrofitting the existing housing stock compared to new homes in terms of environmental gains (DCLG, 2008, p.10):

“Existing housing stock, which contributes 27 per cent of the UK’s total carbon emissions, has the potential to help achieve the Government’s overall target to reduce carbon emissions by 60 per cent by 2050. The Government needs to maintain an appropriate balance between new build and regeneration”.

The same ambiguity happened in the Eco-towns programme. The stakeholders needed more clarity over the Government’s expectations and promise such as locating facilities within a 10-minute walking distance, the target for up to 50 per cent affordable homes, the job creation potential of the sites, and the stated zero-carbon credentials (DCLG, 2007c). The ambiguous Eco-town proposal and the unclear guidance to achieve it made it be perceived as “a mere statement of intent” rather than a well-thought, reality-based policy instrument.

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23 Financial Times (2008): [An eco-town on greenfield site is unsustainable](http://www.ft.com)
24 Financial Times (2009): [You don’t have to change your lives](http://www.ft.com) – In the words of Bill Oliver, the chief executive of developer St Modwen, “too much thought has been given to the idea of an ‘eco-town’ and not enough to the reality of the concept”.
Comprehensiveness

Inadequate policy action to destabilise the dominant regime. For incumbents to change their business models in a supplier-driven market such as the UK housing industry, it will not only be sufficient to provide support for sustainable technologies but to also ban or remove support for unsustainable ones, thereby destabilizing the regime. “A strong, central role for government in setting national, mandatory standards and supporting their delivery”, Greenwood et al. (2017, p.490) argue, is required to mainstream sustainability in the UK housebuilding industry.

Building Regulations, while positioned as an important instrument in the ZCH policy mix, did not sufficiently destabilise the regime incumbents for the transition. The inconsistent planning and implementation of tightening the emission standards in 2013 is an example of softening the only regulatory instrument involved in the programme. Although the Zero Carbon Hub recommended a tightening of emission standards by almost 50% in 2013, the Government carried out a consultation process to consider other options. Eventually, in 2013, after a 6-month delay, the Government announced the final decision to only go for a 6% reduction – which was even lower than the values suggested in the consultation process. The justification was that “the regulatory costs of this was considered to potentially pose challenges to home builders in the current economic climate” (HM Government, 2013, p.9).

Because of the political clout and oligopoly position of incumbents (discussed in section 4.2), a solitary, inconsistent regulatory instrument was not enough to destabilise the dominant UK housing regime. To illustrate, Interviewee P1 stated:

“The regulations could push firms to become more sustainable to a certain degree. [...] Were these interventions of such a scale that they can fundamentally change the system? No. We have got the major housing developers sitting on billions of pounds worth of land. And the scale of our interventions is tiny compared to that.”

This problem was also highlighted by the Callcutt Review (2007) stating that unless the legislation is credible, sustained, clear and enforced, it may act as a barrier to transitions (Callcutt, 2007).
5.4.1.3. Coherence

Lack of inter-policy coordination among involved government departments. The multifaceted construction industry involves many different, yet interrelated policy sectors and departments such as MHCLG, the Department for Business, Energy, and Industrial Strategy (BEIS), the Department for Environment, Food and Rural Affairs (DEFRA), the Department of Business, Enterprise, and Regulatory Reform (DBERR), and HM Treasury. While the importance of coordination between policy sectors in a policy has been stressed in many studies (see for example Rogge and Reichardt, 2016), the ZCH policy mix was criticised for the confusing and rather conflicting role of these sectors in the achievement of the 2016 target. In a parliament committee debate over the draft stamp duty land tax regulations in 2007, one of the committee members stated (House of Commons, 2007):

“Under the Economic Secretary’s predecessor, relations between the Treasury and DCLG were completely harmonious, providing a model of constructive marriage between departments. I am sure that the relationship is still close, but will she [Economic Secretary to the Treasury] confirm whether it will be HMRC, DCLG, DEFRA or DBERR that takes ownership of any future revisions to the regulations, since all four presently have a piece of the pie, or whether developers will continue to be condemned to death by acronyms?”

This was also highlighted by Interviewee P4:

“What we had was a set of departments with competing objectives. I don’t think we coordinated them effectively.”

Weak coordination across national and sub-national levels. The insufficient coordination across different governance levels was the other coherence problem within the ZCH policy mix. Under Planning Policy Statement 1 on planning and climate change, local authorities were given the autonomy to have their own sustainability-based planning objectives and targets such as minimum levels of CSH, or on-site renewable percentage of electricity generation. However, this created inconsistency between local and national objectives and a lack of stringency in reducing emissions (Greenwood, 2012).
On the other hand, in the Eco-towns case, the Government was criticised for not having an effective engagement with local authorities and “bypassing local democracy and planning processes”\textsuperscript{25}. The Eco-town policy instrument faced massive opposition\textsuperscript{26} and many local authorities were among the protesters\textsuperscript{27}. Eco-towns policy instrument was criticised for overlooking the important role of local authorities (DCLG, 2008, p.34) and their required capability to handle it (DCLG, 2008, p.31):

“Local authorities need to be involved in this process from the earliest stages, and this must include an analysis of alternative approaches to accommodating development”.

“Eco-towns are coming forward at a time when local authorities are going through significant transitions, and this is likely to impact their ability to deal with the eco-town initiative”

5.4.1.4. Credibility

\textbf{Frequent churn in housing ministers}. The very frequent changes in housing ministers\textsuperscript{28} in the UK were considered a massive issue in the housing industry. According to Interviewee P5:

“Housing ministers in MHCLG literally change once or sometimes twice every year. These are the people who are shaping the policies. If you have responsibilities split across at least three departments, and you have the problem of civil servants keep getting rotated, it will impact your efficiency. It will impact anybody that has to manage anything technical in the government”.

\textbf{Inconsistency in the implementation of the ZCH policy mix}. One of the main factors that hindered housebuilders to adapt their business models with the ZCH policies was the stop-start approach of the government. Zero-carbon homes suffered severely from the short-term

\textsuperscript{25} Financial Times (2008): Councils attack eco-towns policy – “By pursuing an eco-town policy that enables the bypassing of decision-making by democratically elected councils, the government risks being both judge and jury”.

\textsuperscript{26} The Guardian (2008): \textit{Wildlife trusts warn of 'eco-towns' dangers} – The Wildlife Trust said that by trying to build low-carbon eco-towns, the Government failed in other important ecological considerations and “made a mockery of the term eco-town”.

\textsuperscript{27} The Times (2008): \textit{Eco town plan in disarray as sites fail to meet targets} – Only one-fourth of the proposals had local council backing and the Local Government Association was threatening legal action against it.

\textsuperscript{28} Since 2006, the UK has had 14 housing ministers.
horizons of policymakers, known as the ‘electoral cycles’. One government initiates the policy and struggles in its progress, and the next government, instead of fixing the problem, starts “watering down”\(^\text{29}\) the whole policy, and ultimately dismantles it (P3, P4). This massive policy switch raised questions about the policy’s credibility and reduced industry confidence.

In the Eco-towns case, the Government initially announced building five eco-towns and enthusiastically increased it to ten in 2007. However, almost one year later, Margaret Beckett, the then housing minister, described the plan of building 10 eco-towns as “more of a hope than a firm target”\(^\text{30}\) and in 2010, the Government scaled eco-towns back to 4 sites (DCLG, 2009b). Also, with the change in Government, the £60 million promised funding for the eco-towns was halved\(^\text{31}\). These massive political and policy shifts in the programme led to uncertainty and watered down both the Government and housebuilders’ efforts towards the implementation of eco-towns. Consequently, housebuilders found it not sufficiently reliable to invest in devising detailed plans for a proposal that might not get accepted, and in a programme that might get dismantled completely in the future. According to Interviewee I1:

“\text{It [watering down the target] did both disappoint and reduce the industries’ confidence in government in setting policies and sticking with it because they just dropped it without trying to make it work].}”

**Policy loopholes and potential circumvention by incumbents.** The other problem which led to the low credibility of the policy mix was the existence of different loopholes within it. For example, the measures to evaluate the performance of new homes only covered the design stage. This led to a gap between the design and as-built performance for new homes (DCLG, 2013a) which enabled housebuilders to use it as a loophole to use cheaper and less sustainable options after getting the certificate for their design (P4 and P6). Although the aim was to ‘lock in’ the efficiently designed houses to reduce energy consumption and future retrofitting costs, the lack of an appropriate assessment after the construction led to less sustainable houses in the end being added to the required retrofitting stock. In the words of Interviewee A1:

\(\text{\ldots}\)

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\(^{30}\) Financial Times (2008): Only one eco-town site classed as suitable

\(^{31}\) The Telegraph (2010): Question-mark over labour's eco-towns as Grant Shapps cuts funding by 50 per cent
“There is no point laying down the regulation if you have got no means of seeing whether people are complying with it. Unfortunately, even tragedies such as Grenfell Tower can be tracked back to non-compliance and insufficient inspection”.

Also, in 2014, the Government updated the off-site carbon abatement measures, i.e., allowable solutions. Housebuilders could comply with the Building Regulation requirements through four routes: on-site or connected measures, off-site carbon abatement actions themselves, off-site carbon abatement through a third party, and making a payment into a fund which would be invested in carbon abatement projects. In addition, the Government announced an exemption for small sites to “ensure that small housebuilders do not face unreasonable extra costs” (DCLG, 2014, p.5). This paved the way for housebuilders to circumvent the regulation by either paying for the allowable solutions or limiting their construction units to meet the small-scale exemptions. In any case, they found it much easier compared to the carbon compliance standards.

5.4.2. Business model adaptation barriers

Although there is a growing consensus that the housing industry requires major reforms, the nature of such reforms has mainly been on technological specifications and design standards while the challenges of such transformation in practice have been relatively neglected (Greenwood et al., 2017). Unless other dimensions of transitioning the housing industry are not addressed in a broad sense such as economic and social barriers, decarbonising UK housing will continue to stall (Hoffman and Henn, 2008). To accurately analyse and diagnose the policy mix problems from a broad perspective, in this section the firm-level barriers are discussed. Given the complexity of the housing industry and the difficulty of the changes in business models, it is instructive to break down the transition challenges that are associated with the incumbents’ business models. Considering the zero-carbon homes as a new value proposition to incumbents’ business models, we categorise the business model adaptation barriers into four categories: feasibility, desirability, viability, and externality.

5.4.2.1. Feasibility

Relative disregard of supply chain actors. The housebuilding industry involves several partners who have the power to influence the design, process, and outcome either collectively
or individually (Hoffman and Henn, 2008). This elaborates on the importance of mobilisation and management of the collaboration between a wide range of interdisciplinary partners within this industry as its performance depends on the function of their entire network (Gann and Salter, 2000). The ZCH policy mix required housebuilders to adopt new technologies such as solar PV, wind turbines, and heat pumps. This brought about two supply chain challenges for the housebuilders. First, there was little confidence among housebuilders about the maturity and reliability of technologies as it could mean greater risks and increased cost of construction and maintenance activities (P2, P5, P6, I1, I2, I3, A2). Second, housebuilders had to rely on new partnerships with suppliers of such technologies – for example, partnerships with microgeneration technologies to manage on-site low or zero energy supply. This created an element of risk for incumbents. In the beginning, the UK Government assured facilitation of this partnership through the Zero-Carbon Taskforce in which the UK’s major energy companies could assess how to engage with zero-carbon homes in partnership with the housebuilding industry. However, the Taskforce did not adequately represent the Renewable Energy Association (REA) and left a gap between housebuilders and the micro-renewables industry (Edmondson et al., 2020). According to Interviewee P3:

“The process of constructing a house is essentially an assembly process which brings inputs together from a wide variety of suppliers from quite a range of interests and disciplines. This means if you are looking for a breakthrough change, you have to bring all these people together to consider all that matters. You can’t just focus on what the ultimate assemblers are doing without acknowledging the suppliers”.

Public-private partnerships play a crucial role in building effective networks and partnerships and are considered a legitimate mode of governance especially in dealing with problems such as climate change. In the ZCH policy mix, AIMC4 was employed for this task. The AIMC4 project was considered a ground-breaking collaboration that built a high level of communication and trust between all the stakeholders within the supply chain. It demonstrated how bringing developers and suppliers together can “instigate a step change in supply chain innovation by stimulating the collaboration” (Cartwright and Gaze, 2010b, p.5). The project “built internal trust, and [...] draw suppliers into an open relationship with the consortium and between each other, even if they competed in the same field” (Cartwright and Gaze, 2010b, p.2). This integrated design and collaboration between developers and suppliers led to
considerable achievements not only in technical solutions but also in process and market innovations (Tilford and Gaze, 2010). However, according to Interviewee I4, AIMC4 could happen much earlier in the period of the ZCH policy mix. According to Interviewee I4:

“Having AIMC4 in earlier stages of ZCH could reduce many uncertainties and risks we had to deal with at that time. Personally, I believe, that should have happened even before the policy [ZCH] was announced. That could also help policymakers to see how feasible their expectations are”.

Unrealistic timeframe. The ZCH policy mix specified a ten-year plan for the new homes to be completely zero-carbon. During this period, the code for sustainable homes signalled the direction of change towards zero-carbon homes through the Building Regulations. With the early-stage ambiguities over target definitions and certifications, it took time for housebuilders and other involved stakeholders to become familiar with the assessment and certification process, which led to uncertainty, increased costs, and delays in the completion of certification. Therefore, the lack of a more realistic timeframe for zero-carbon homes was a major stumbling block (P4, I1, I2, I3, A2, Osmani and O'Reilly, 2009).

Insufficient knowledge, capability, and skills for adaptation. To comply with the zero-carbon policy mix, housebuilders had to gather the required information and knowledge to build internal capacity and change their way of doing business. However, the complex supply chain of the industry made the diffusion of new knowledge and skills challenging. Consequently, there was a substantial knowledge, skill, and networking gap among supply chain partners which led to the preference for more routinised low-risk solutions rather than more sustainable ones (P4, I6, Schweber et al., 2015, Mokhlesian and Holmén, 2012).

To assist this knowledge gathering, the government initiated the Callcutt Review to “highlight the skills needed in the housebuilding industry to make sure that housing supply targets are met whilst achieving the higher environmental standards” (DCLG, 2007a, p.21). However, this guidance was not enough for housebuilders to build internal capabilities in a limited time (I2, I3, I4, I5, Hashemi and Hadjri, 2013, Heffernan et al., 2015). Although AIMC4 successfully facilitated knowledge sharing among supply chain partners, it provided innovative solutions only to comply with Code level 4 (44% emission reduction). For the higher levels of the Code, housebuilders had to employ renewable energy technologies to meet the dwelling’s thermal
and/or electrical demands. The integration of such technologies into incumbents’ business models required changes in their business structure. Consequently, developers found it beyond their capability to comply with the policies and meet all the requirements and therefore started lobbying for less strict requirements. For example, in the Eco-towns case, one of the first reactions from housebuilders was to put pressure on the Government to drop the requirement for homes in meeting Code Level 6 and perusing only Code Level 4 instead (DCLG, 2008). The low feasibility of the Eco-towns affected its credibility (see section 4.5.1) and led to a perception of ‘Government greenwashing’ and prioritising housing shortage over sustainability. This also encouraged housebuilders to circumvent the policy by reviving previously rejected proposals to get planning permissions (P2, P4, P5, P6).

5.4.2.2. Desirability

Low demand for ZCHs. The UK housing industry suffers from two general issues: sustainability and affordability. The Callcutt Review (2007) stated that in the UK, the preference for price, size, and location outweighed the preference for sustainability and energy efficiency among homebuyers. This low demand for ZCHs made the market less interesting for housebuilders to fully invest in them. The Government took initiatives to boost the demand by incentivising homebuyers through many instruments such as stamp duty exemption, reduced VAT, and landlord energy saving allowance. The Government believed that (DCLG, 2007d, p.41):

“The more that on-going costs and benefits to households can be built into buying decisions, and therefore house prices, the more developers will be incentivised to respond by building to higher efficiency and sustainability standards”.

Several benefits were highlighted to incentivise people to buy ZCHs. The main economic benefit was the financial savings from reduced energy bills resulting from improved energy efficiency and the potentially lower cost of fuel from renewable sources. However, the majority of housebuilders perceived that there was still a lack of demand and appreciation of ZCHs amongst the general public (I1-6, Osmani and O'Reilly, 2009). In the words of Interviewee I5:

32 Financial Times (2008): Housebuilding plans are seen as neither green nor pleasant
“The problem is whether the money comes back fast enough for the people to benefit. The payback time is a very real issue. It's an even more accurate issue in rental properties because the improvements will cost the landlords but the benefits go to the tenants who pay the energy bills”.

Also, the initiatives for Eco-town and Carbon challenge created friction. In a summary of the consultation response document published in 2008, the UK Government stated that at least one-third of the responses were postcards and petitions from campaigners and protest groups against some of the proposals (DCLG, 2008). Besides, housing additionality was one of the key concerns as there was no compelling evidence that the housing market was strong enough to deliver the level of additional housing being advocated (DCLG, 2008). Especially in the time of recession, when developers faced the worst collapse in the housing market in decades, some of the eco-towns were unlikely to deliver the critical mass required to support a stand-alone sustainable community33. According to Interviewee I2:

“Installing expensive green technologies to build zero-carbon homes, such as ground source heat pumps and solar panels was not reasonable for us when there was no or little market value in return”

The stamp duty exemption was not successful, too, in attracting more customers for zero-carbon homes. Although it seemed an attractive bonus for prospective homebuyers, in reality, it was claimed to have little impact on the demand as “the number of houses to benefit could fill one street”34. In a parliament committee debate over stamp duty exemption in 2007, it was stated that (House of Commons, 2007):

“This statutory instrument is quite specific [...] to be eligible for the relief, the homes have to be zero-carbon, so there is no prize for being five-star or four-star. It has to be six-star—zero-carbon. [...] The regulations, well-intentioned though [...] will actually achieve very little. Those of us who are concerned about climate change—the Opposition certainly are—would be disappointed to see this building block not achieve its aims.”

33 Financial Times (2008): Only one eco-town site classed as suitable
34 Financial Times (2006): Exemption from stamp duty seen as token gesture ‘ZERO-CARBON’ HOMES: The number of houses to benefit could fill one street, write Fiona Harvey and Sharlene Goff.
The AIMC4 project, by highlighting the importance of energy cost savings being reflected in mortgage valuations and affordability criteria, acknowledged that (Gaze, 2010b, p.8):

“The lower running costs of AIMC4 and other modern homes have not had significant impact on the market. Until they do, new homes with energy performance better than Regulation will remain the exception and not the norm.”

**Lack of necessary societal behaviour change incentives and education.** A further challenge was related to the education about ZCHs and required behavioural changes in society. The homebuyers needed to be educated about the benefits of ZCHs as by then the energy efficiency gains were less significant for homebuyers than other aspects (Greenwood et al., 2017). The uncertainty and lack of knowledge about green technologies and the perceived costly maintenance made customers reluctant to pursue ZCHs. Also, many firms acknowledged the need for behavioural change among homebuyers as the performance of such houses depended heavily on the way occupants operated their homes (DCLG, 2008, Gaze, 2010a). The AIMC4 project raised this issue:

“The technical changes to home design resulting from government’s regulatory pressure did not take into account the reality of consumers’ views and the way occupiers actually operate their homes.”

### 5.4.2.3. Viability

**Increased construction costs.** The housebuilders saw significant increases in construction costs resulting from limited time, resources, knowledge, and skills. The Government intended to compensate some parts of the costs by increasing demand and creating a market for ZCHs. However, all these economic instruments were designed as benefits for homebuyers and additional construction costs fell initially on housebuilders. Also, the option to pass costs back in terms of reduced prices for land was not achievable in the relatively short-term period of 10 years. Consequently, even with using the Code as a competitive differentiation strategy, the costs of compliance with ZCH standards exceeded the benefits of the potential demand, resulting in an unsatisfactory revenue stream.

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35 Housebuilder & Developer (2014): AIMC4 – Creating a template for tomorrow’s new home construction
In eco-towns, the Government expected that the use of surplus public sector land, economies of scale, and increases in land value to deliver new technology and infrastructure would balance the costs and revenue (DCLG, 2009b). It was believed that the scheme could generate sufficient revenue over the development life-cycle and, therefore, cover the costs without relying on public funds beyond those that were already available (DCLG, 2009a). However, there was a significant difference between the developers’ proposal – both in terms of the infrastructure required and cost – and the Government’s assessment. Building an entire development as a new town rather than expanding an existing one would inevitably raise the average cost of a house (DCLG, 2008). Yet, housebuilders could not pass on these increased costs to the customer as 30-50 per cent of the houses needed to be affordable and the price elasticity was relatively low. From a policy point of view, Interviewee P7, by emphasising the resistance of housebuilders to extra costs, indicated that:

“You can go back decades. Any proposal that would increase the price of construction of a house was resisted. Because it upsets their calculations. And the first reaction you get from them is that it will affect housing supply as they become more expensive.”

On the other hand, Interviewee I6 discusses the problems for the volume housebuilders:

“We should be very careful about demonising developers because at the end of the day, their companies are there to make a profit. Housebuilders have shareholders and their job is to maximise return to shareholders. In a market economy that is what they have to do. So, you [governments] have got two levers: either you make the market so that they can make money out of being green, or you oblige them by regulation. Sadly, there has always been the second one with lots of flaws and has not been implemented wisely”.

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36 Meeting documents- Cabinet. Response to government consultation on draft planning policy statement and sustainability appraisal on Eco-towns; and progress report on Eco-town proposals at Weston Otmoor and NW Bicester, Report by Head of Sustainable Development, 17 February 2009
It is claimed that the ultra-competitive land market and the extremely high land prices have made it “practically impossible to run a business specialising in low-cost homes, producing large volumes at lower margins” (Halligan, 2021, p. 79).

5.4.2.4. Externality

**Blocked window of opportunity for SMEs.** The UK housebuilding market includes a small number of large ‘volume housebuilders’ that are increasingly dominating the industry. The land speculation or land banking37 business model of volume housebuilders as well as their corporate lobbying38 has given them the power to obtain most of the available planning permissions and therefore, boost their stock market valuation, and control the housing supply and its price (Halligan, 2021). According to Interviewee P1:

> I think the UK is almost unique in terms of the extent to which the market for land and the provision of land influences every aspect of housing policy, including zero-carbon homes. Any problem relating to housing in the UK and what you want the provision of housing to be in the future, you inevitably get dragged back into this [land market].

The land speculation prevents SMEs to acquire planning permissions to build elsewhere in the same locality and has made it almost impossible for them to compete with the large incumbents. Consequently, the window of opportunity that should be there to destabilise the regime and keep it dynamic and competitive remains blocked and push SMEs back to the niche level (Gibbs and O’Neill, 2015). According to an inquiry by the house of lords (2016, p.24):

> “Since the 1980s we have been relying on the private sector to provide the homes that are needed. The sector, especially since the financial crisis, has all the characteristics of an oligopoly: there are high barriers to entry and the large housebuilders are responsible for a substantial proportion of output”.

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37 Land banking is the practice of buying land, applying for planning permission for future sale development, and sell it on much higher prices. Although acknowledged by many studies and reports, as well as the majority of our interviewees, there are still some claims that there is no evidence of land banking among volume housebuilders – e.g. Rt Hon Sir Oliver Letwin, *Independent Review of Build Out Rates – draft analysis*, June 2018. In this paper, our analysis is based on the majority opinion.

38 The property sector has accounted for a big portion of the corporate donations received by successive UK governments (Halligan, 2021).
Landscape forces act as barriers towards ZCH business model adaptation. The 2008 economic crisis and the following recession significantly influenced UK housebuilders’ financial performance, stability and output – catalysing the worst housing crisis of a generation (Payne, 2015, KPMG and Shelter, 2015). The resulting economic austerity recession became a motive for the conservative government to initiate a massive policy reform and eventually dismantle the ZCH policy mix (O’Neill and Gibbs, 2020). Although many volume housebuilders were financially affected by such a turn of events, the 2008 recession is mainly viewed as an excuse to justify the major policy reorientation and prioritise economic growth over sustainability. From a volume housebuilder point of view, Interviewee I1 stated:

“The housebuilding industry was not ready for it. Everyone was getting ready for delivering ZCHs. We even participated in projects such as AIMC4. Of course, we were affected by the recession but we were recovering. I think if the Government was really worried about our recovery, it could extend the target year and move it to 2020 for example, instead of killing it off”.

Interviewee P7 also highlighted that:

“It [ZCH policy mix] was scrapped without any consultation. It just bounced back into productisation and preference for quantity over quality. That was damaging. Now we have a pile of unsustainable houses being added to the backlog of required retrofitting. The recession undoubtedly had an economic impact on housebuilders. But I don’t think that was beyond control.”

Being evident from the interviews as well as the archival documents, the destructive landscape force that led to the policy mix dismantling, rather than the recession, was the change of government and its priorities. The elected Conservative-Liberal Democrat coalition government was perceived to have less commitment towards ZCHs in light of the austerity programme and their misperception of the conflict between economic growth and sustainability transitions (O’Neill and Gibbs, 2020). Although the dismantlement of the policy mix was opposed by both housebuilders and other political parties, the policy mix got officially axed in 2016 (Edmondson et al., 2020).
5.5. ZCH as a system failure

By analysing the ZCH policy mix and the socio-technical regime in which it was embedded, this study explores the reasons for its failures. Our investigation revealed that the bottlenecks did not lie in the transition policy alone, but rather included the incumbents’ business model as well. While policy mixes represent one part of the socio-technical regime, incumbents’ business models have the capability to cover the rest of the socio-technical regime elements such as industry, technology, market, and culture. The problem of the UK housing industry and zero-carbon homes was not a market failure that could be fixed with demand-pull policies such as stamp duty exemption. Although market creations prompted incumbents to change their business models to benefit from the potential advantages, because other policy shortcomings and adaptation barriers were not addressed, incumbent housebuilders were not committed to changing their core business models. Along similar lines, Rosenbloom et al. (2020) also argue that transition research should move from perspectives of market failure to system change. As such, when demand-side support was removed, the ZCH policy became unviable. The failure of ZCH was not only a policy failure (McConnell, 2015) alone rather it is what transitions researchers call a ‘system failure’ (Markard et al., 2012, Lee et al., 2022, Turnheim and Sovacool, 2020). It was a system failure involving various stakeholders in the UK housing industry such as the government, incumbent housebuilders, suppliers, green manufacturers, and customers who had the power to influence the direction of transition individually and collectively.

In exploring the policy aspects of the system failure, the findings indicate the lack of clarity, comprehensiveness, coherence, and credibility of the ZCH policy mix. These aspects did not encourage the incumbents to adapt their business models and build more sustainable and energy-efficient houses. The first issue often raised during the early days of the ZCH programme was the lack of clarity regarding the definition of the target and the ways of achieving it in practice. Further, the destabilising side of the ZCH policy mix was weak through a lack of commitment to regulation targets and existing loopholes. Consequently, the obligatory nature of the policy mix was not perceived as strong enough to prevent possible circumventions. The findings also demonstrate a lack of coherence in the context of the complex ZCH programme in which several government departments are involved at different levels with an evident lack of coordination in implementing the policies, subsequently resulting in transition failure. The different priorities and goals among the involved departments caused
confusion and decreased the credibility and reliability of the programme. The stop-start approach resulting from the electoral cycles and the changes in housing ministers reduced the credibility of the ZCH programme and undermined the tacit knowledge gained during previous attempts at implementing ZCH.

Nonetheless, policy shortcomings were not the only reason for ZCH's failure. Even if those shortcomings were addressed, the policy mix might not have succeeded because of its narrow focus on technical specifications and for not considering the challenges of business model adaptation for incumbents. Even if certain measures had been undertaken to rectify the problems and address the concerns (such as Zero Carbon Hub), they were not enough to address the system failure. Moreover, the solutions or interim measures were focused on the technical aspects of the programme.

Not surprisingly, the firm-level barriers were traced back to the main elements of the incumbents’ business model—i.e., value creation, value delivery, and value capture which includes all activities within their business, the adopted technologies, the partners and suppliers of materials and technologies (feasibility), customers and their preferences (desirability), and financial matters (viability). The paper evidenced that when the implementation of a transition policy mix is significantly dependent on incumbents in a specific industry or supplier, ignoring their business model might result in transition failures. The barriers to business model adaptation discussed in this paper show the required considerations related to incumbent business models that were lacking in the ZCH policy mix design and implementation and led to failure consequently.

This paper also considered the external environment of volume housebuilders. It argues that one of the main factors for any firm to change its business model is the changes in its competitive landscape and threats from its competitors (Bucherer et al., 2012, Nair and Paulose, 2014). However, this study showed that the oligopoly nature of the incumbents and their power for land banking has blocked new housebuilders to enter the mass housing market in the UK. For the transition policies to make such incumbents change their business models, it is necessary to pave the way for other players to enter the market and bring about ‘existential crises’ for incumbents in case of non-compliance.
Figure 5.3 provides a summary of the findings and depicts a zoomed-in schematic representation of interdependencies between policies and incumbents at a socio-technical regime level. The figure draws from MLP thereby including the notions of landscape, socio-technical regime, and niche levels, which provides context to the ZCH case study. In the socio-technical regime, the focus is on policy and incumbents’ business models. The identified policy design and implementation barriers (i.e., clarity, comprehensiveness, coherence and credibility) are aligned with the framework by Rogge and Richardt’s (2016) about policy mix building blocks. Incumbents’ business model adaption barriers (i.e., feasibility, desirability, viability) are aligned with Osterwalder’s (2004) business model canvas. Feasibility is about value creation issues, desirability is about value proposition and delivery, and feasibility is about value capture problems. The last barrier to business model adaptation (externality) is related to the external environment, which influences the incumbent’s business model. The externality is represented in the landscape and niche levels of the MLP. In general, a combination of the policy design and implementation issues with the business model adaption barriers resulted in the overall transition failure.

**Figure 5.3.** The failure reasons of zero-carbon homes based on the zoom-in perspective of the policy mixes and incumbents' business models within a multi-level perspective of socio-technical transition
5.6. Conclusion and recommendations

This paper highlighted some of the shortcomings and criticisms about transition policies and theories i.e., (i) being techno-centric, (ii) providing only zoomed-out perspectives, (iii) not analysing the micro-level dynamics between actors within a socio-technical system, (iv) not having enough empirical studies on policy mixes, (v) and not deeply analysing how incumbents can participate in transitions and what the reasons behind their resistance to change. The paper contributes to both transition policy and business model literature by considering the above-mentioned gaps. By using incumbents’ business models as the unit of analysis, this paper moved beyond technology development in sustainability transitions and focused on a broader perspective on firm-level adaptations required for transitions. This helped to consider the micro-level dynamics and interactions between two main actors in a socio-technical regime, i.e., policy and industry incumbents. By analysing incumbents’ business models, this paper pursued a systemic approach to analyse the regime (policy mixes and business model main elements), niche (involvement of SMEs) and landscape levels (recession and change of the government's priorities). Although the role of business models in transitions has been previously studied (see e.g., Bidmon and Knab, 2018), such studies tend to take a broad and macro-level perspective of business models and socio-technical regimes. In comparison, this study brings a firm-level approach to systemic transition theories such as MLP and IS. By juxtaposing the business model's main elements with the regime section of MLP, we investigated ‘what’ the sources of these barriers are, ‘why’ they exist, and ‘how’ transition policy mixes can address them.

The zero-carbon programme enabled us to empirically scrutinise the influence of different policy mix building blocks on incumbents’ business models. Although it was studied before (Edmondson et al., 2020, O'Neill and Gibbs, 2020, Greenwood, 2015, Goodchild and Walshaw, 2011), it was either based on a single policy instrument or technological developments. We believe that the results of this paper can lead to the consideration of important factors, other than technological aspects, in designing transition policy mixes to support the required adaptations in incumbents’ business models towards sustainability and by reducing their resistance to change. For all we know, it takes two to tango, housebuilders and policymakers need to stop working in silos and demonizing one another and rather work together towards collective action.
The conservative and fragmented nature of the UK’s housing industry and its supply chain, exacerbated by consumer preferences, planning regimes, and slow housing provision, suggest a strong need for a ‘system transition’ and transformative innovations within this industry. The literature on transition policy provides recommendations on how some of the reasons for failure outlined in this paper can be addressed. For instance, Rogge and Reichardt (2016) argue that clarity can be improved by well-designed policy strategies. Policy strategy gives direction to actions by providing actors with guidance and communicating the objectives and the means to achieve them (Grant, 2016). This gives the incumbents enough information, time and assurance to pursue major changes in their business models. Further, comprehensiveness can be attained by maintaining a balance between the two mutually reinforcing roles of transition policies: supporting and destabilising (Kivimaa and Kern, 2016). According to Jones (2002, p. 391) a “systematic promotion of mutually reinforcing policy action” is needed across the involved departments to create synergies towards achieving sustainability targets and achieving comprehensiveness.

One potential recommendation to address issues arising from the stop-start approach resulting from the electoral cycles and the changes in housing ministers would be having independent advisors with the necessary power and resources to coordinate all actions and proactively investigate any breach or failure in implementing the policies. Also, having more transparency over corporate donations and lobbying individuals and companies is argued to be effective in avoiding any misconduct and improving policy credibility (Marks and Whiffen, 2021). In essence, a certain level of stability in the regulations and other policy instruments can help in the successful implementation of transition policies.

The paper showed that the traditional way of “innovation behind closed doors” is not a solution for sustainability. In interdisciplinary and multi-stakeholder industries such as housebuilding, collaborative innovations within supply chains can facilitate housebuilders to gather and integrate intra/inter-organisational resources to develop a joint innovation force and speed up the transition (Xing et al., 2021). To accelerate transitions, governments can facilitate communication between firms and their supply chain partners. We suggest that in the ZCH programme, earlier involvement of interest groups could lead to a meaningful engagement of stakeholders, characterising the scope of policy options, and developing evidence-driven solutions that were more likely to resolve the housing problems. Moreover, the market incentives should be designed based on the specific characteristics of the target industry. To
incentivise housebuilders to build more zero-carbon homes and the customers to buy them, the unique characteristics of the housing industry can play a big role: (i) the long payback period for being zero-carbon, (ii) the difference between the people who pay for the costs (housebuilders and homebuyers) and people who benefit from reduced energy bills (tenants and occupiers), and (iii) the dependence of houses energy performance on the behaviour of the occupants.

There are limitations in this research, which may suggest fruitful avenues for future research. First, we only focused on the policy mix timeline, i.e., 2006-2016. Comparing and contrasting new housing policies that were enforced after 2016 with the ZCH policy instruments may be able to provide valuable insights for future policies. Second, we used ZCH as a failed policy mix to investigate the influence of policy mixes on incumbents’ business models. Considering successful policy mixes in other industries (such as Norway’s electric vehicles) can help to generalise the findings. Further empirical research including the consideration of niche-level firms along with incumbents seems necessary to deliver more generalised recommendations for designing and implementing transition policy mixes.
Chapter 6. Learnings from failed sustainability transitions: 
From zero carbon to zero carbon ready

Figure 6.1. Chapter 6
6.1. Introduction

With the acceleration of sustainability and climate change issues, there has been a significant increase in the academic literature on sustainability transitions and transforming existing regional, national, or international socio-technical systems. However, most transition studies have focused on lessons from history (Penna and Geels, 2015, Roberts and Geels, 2019) or successful transitions as a case study to analyse the transition processes and their requirements (Konefal, 2015, Nilsson and Nykvist, 2016, Marchi et al., 2018, Sinsel et al., 2020). This is while failed transitions present valuable learning opportunities for academics, practitioners, and public officials. Although successful transitions can be helpful to trace success conditions, “dissatisfaction serves a stronger stimulus for a search for new ideas than success” (May, 1992, p. 341). Especially in the case of transition policies, sustainability transition failure can act as a trigger to reconsider the existing dominant causal reasoning underpinning the policies and to redesign policies based on learnings from failed cases (May, 1992).

Learning from failed transitions, whilst important, is not yet well developed. We know very little about transition failures and their impact on policymakers and their future endeavours towards sustainability transitions. More importantly, there are extremely limited empirical investigations of lessons from failed transitions as the governments might run from admitting and embracing the failure. This is while the inability to learn from failed transitions might lead to a cycle of failure and dysfunctional socio-technical system transitions. Studies have shown how failure to learn or incomplete learning can bring about macro-level failures where the socio-technical systems and policy communities are unable to reform (Jones et al., 2016, Kay, 2017).

This paper aims to investigate this broken link between transition failures and transition learning by addressing this question: To what extent do transition failures lead to learnings and new understandings of ways to accelerate sustainability transitions? To explore this question, the paper analyses the housing industry in the UK, and one of its famous failed transition programmes in 2006 called Zero-carbon Homes (ZCH). Drawing on evidence more than fifteen years after implementation and comparing it with the most recent transition policies in the UK such as Zero-Carbon Ready (ZCR) and Home Standards announced in 2021, this paper stands back and considers multiple cases of learnings associated with the ZCH failure both in policy and industry sectors. This time-distant comparison between two different
transition programmes within the same industry and the same country provides three desirable attributes for studying learning situations. First, contextual factors such as social, cultural, ideological, and industrial can be controlled to a reasonable level. Second, this fifteen-year period is long enough to go beyond the implementation problems of new policies and analyse the consequences of the failed transitions. Third, this time period allows considering the extent of learnings and their influences on the recent institutional, policy, and organisational reforms.

The contribution of this paper is two-folded: first, it analyses a failed transition programme to shed light on the challenges and barriers of a transition and identify the nature of the failure within a transition programme. Second, learning from a failed transition provides a forward-looking approach to help improve current and future transition policies in accelerating transitions. To do so, the paper uses a qualitative approach by combining three different methods including semi-structured interviews, expert panels, and observation. The chapter continues by providing a literature review on policy failure and policy learning in Section 6.2. Section 6.3 explains the research design and methodology including the selected case study. Section 6.4 provides the results on the nature of ZCH failure, and the policy and organisational learnings in the ZCR programme and Section 6.5 provides some discussion on the findings and concludes with contributions and suggestions for further research.

6.2. Literature review

6.2.1. Policy failure

The analysis of policy failure gained attraction with the emergence of policy evaluation in the 1970s (Dunlop, 2017). Different terminologies have been used by scholars to study the causes or the nature of failed policies such as policy failure (Ingram and Mann, 1980a), governance failure (Vining and Weimer, 1990), policy anomalies (Hall, 1993), policy disaster (Dunleavy, 1995), policy fiasco (Bovens and Hart, 1995), policy catastrophe (Moran, 2001), and policy accident (Cobb and Primo, 2004). Studying policy failure is important as it wastes scarce resources, poses many risks to social well-being, negatively impacts society and future economic performance, and threatens the government’s legitimacy (Schuck, 2014, Gibb, 2015).

Because of the ‘eye of the beholder’ quality of policy failure, there are various definitions based on the unit of analysis, target groups, varying measures and perceptions (Dunlop, 2017).
Although some scholars believe that failure is self-evident and does not need a definition, the definition of policy failure and its methodological difficulties is essential in making sense of the messiness and contestability of failure (McConnell, 2015). To define policy failure, McConnell (2015) uses the definition of public policy (Dye, 2013, p. 12): “whatever governments choose to do or not do”. He argues that “if we know what governments ‘do’, we are well placed to understand ‘failures to do’” (McConnell, 2015, p. 232).

Another common way to reduce different interpretations is to define policy failure by reversing policy success. A policy is successful “if it achieves the goals that proponents set out to achieve and attracts no criticism of any significance and/or support is virtually universal” (McConnell, 2010, p. 351). McConnell (2015, p. 230) by conceiving policy failure as ‘art and craft’, states that “a policy fails, even if it is successful in some minimal respects, if it does not fundamentally achieve the goals that proponents set out to achieve, and opposition is great and/or support is virtually non-existent.” Figure 6.2 shows the differences between policy success and policy failure.

![Figure 6.2. The difference between policy success and policy failure based on 6 criteria (adopted from McConnell, 2010, Howlett, 2012)](image)

Different categorisations have been proposed for policy failure. Drawing on the two dimensions of success – programmatic and political – by Bovens and Hart (1995), McConnell (2010) categorises policy failure into three groups: process, programme, and political. Process failure indicated the inability of the government to negotiate and legitimise the policy and its process through building coalitions and translating the idea into reality. Process failure is about problem definition and consultation, options appraisal and policy design, or political issues.
such as selecting the people who hold power in policy formation processes (McConnell, 2015). Programme failure stems from technical or substantive deficiencies in government interventions such as public information campaigns, subsidies, or regulations that prevent reaching policy goals. Political failure is related to the failure in achieving political outcomes as a result of ‘partisan distortions of the policy’ (McConnell, 2015, Dunlop, 2017). Howlett (2012) proposes six dimensions by which policy failures can be categorised: intentionality, extent, avoidability, visibility, duration, and intensity. He distinguishes intentional policy failures (the failure is let to happen by the policymakers) from accidental ones (unanticipated failures) and states the latter are avoidable. Accidental policy failures can be categorised based on the depth of failure (the extent and duration of failure) and the salience of it (intensity and visibility) (Howlett, 2012, table 2, p. 544).

King and Crewe (2014) categorise recent UK policy blunders into three groups: human error, institutional, and systemic weaknesses. In a similar vein, Dunlop (2017, pp. 7-9) analyses policy failure based on three levels: micro where “the attention is focused mainly on the impact of individuals on policy failure” based on behavioural psychology such as human cognition; meso where the focus is either “on the impact of failure on groups and institutional processes” or “on the collective processes that mediate the likelihood and form of failure”; and macro where the failure is at the system level and the focus is on “the impact of policy failure in societies as a whole”. To construct a systemic analysis of the factors and forces that might combine to create policy failure, a multidisciplinary approach is needed to make use of different strands of literature including economics, law, history, management, and policy analysis (Gibb, 2015).

6.2.2. Policy learning

Due to the inherent complexity of socio-technical systems, governments cannot accurately foresee all the consequences of policy interventions (Hoppmann et al., 2014). This uncertainty leads to governments’ dependence on trial-and-error approaches and adjusting actions based on the experience they gained and their relative achievements (Forester, 1984). Such changes in policymakers' beliefs and preferences based on their experiences, analysis, and social interactions are called policy learning (Witting and Moyson, 2015, Dunlop, 2017). The study of policy learning was central to the post-war beginnings of policy analysis (Dunlop, 2017) and
Transition policies and incumbents' business models: From resistance and system failure to learning and adaptation

gained momentum since Deutsch (1966) explored the role of feedback in governmental learning.

The common definition of policy learning is the alterations to present actions based on feedback from past experiences (Bennett and Howlett, 1992). As expressed by Howlett (2012, p. 549), the “blame-adverse nature of policymaking behaviour” of policy practitioners obliges them to consider policy failure a major subject of policy learning. According to Hood (2010), policymakers seek to imitate positive examples of successful policies and avoid negative examples of failed ones. In a similar vein, Stone (2017, p. 61) discusses the “negative lesson drawing” where “policy lessons can help crystallise what ideas and policy paths decision-makers do not wish to follow”. Although previous policies have the potential to learn, May (1992 p. 333) argues that any observation of experience does not guarantee policy learning. Therefore, learning is different from copying or mimicking as it implies improved understanding, which is “reflected by an ability to draw lessons about policy problems, objectives, or interventions”.

Different types of policy learning have been identified based on their intentionality, depth of learning, and measurement. Policy learning can either be intentional to deliberately draw lessons from the previous policies at a specific time (Hall, 1993) or happen evolutionarily and dynamically over time (Weiss, 1977). According to the depth of analysis, policy learning is categorised into single-loop versus double-loop (Argyris and Schön, 1997), hard versus soft (Dolowitz, 2009), and simple versus complex (Levy, 1994, Dunlop and Radaelli, 2013). Common policy learning is the changes in policy tools (or instruments) which are described as the single-loop, hard, and simple versions of policy learning. The latter learnings – double-loop, soft, and complex – are related to deeper learnings associated with alterations of political objectives (Dunlop, 2017).

May (1992) describes policy learning in three different categories. (a) Instrumental learning entails lessons about the viability of policy instruments or implementation design. Kaye-Essien (2020, p. 167) defines instrumental learning as the adjustments in policies “in the light of a new understanding of how a policy tool is designed, implemented, monitored and evaluated”. (b) Social learning entails lessons about the social construction of policy problems. It includes reaffirmation or revision of the policy problem itself, the scope of the policy, or policy goals. (c) Political learning entails the political feasibility of policy proposals. Political learning is
concerned with lessons about “manoeuvring within and manipulation of policy processes in order to advance an idea or problem” (May, 1992, p. 340).

Apart from the depth of learning, studies have used other measures to categorise policy learning. Boon and Bakker (2016, p. 187, table 1) analyse policy learning in the context of transitions and protecting socio-technical niches within five dimensions: width, depth, duration, tools, and legitimisation. Width or scope indicates the type of products or sectors to which the protection applies. Depth indicates the extent of the protection provided. Duration indicated the period during which protection is maintained. Tools indicate the specific aspects of the protective instrument providing the protection. Legitimisation indicates the assumptions underlying width depth, etc. Mah et al. (2021, p. 5) in a study of the policy learning process of energy transitions, use three types of policy learning: (a) technical learning as a weak form of policy learning based on a “technocratic search for more effective forms of policy intervention”; (b) conceptual learning as an intermediate form of policy learning in which the “policy goals are redefined, problem definitions debated and problem-solving strategies adjusted”; and (c) social learning as the most advanced form of policy learning which “emphasises the interplay between actors that improve policies”. In a study of paradigm change within the energy sector and wind power, Szarka (2006) uses three policy learning dimensions: learnings to increase production capacity, learnings to increase institutional capacity, and learning to increase social capacity. (Mah et al., 2021).

This paper draws on the theories of policy failure and policy learning to analyse the ZCR policy. To identify the nature of ZCH failure, the paper uses McConnell’s (2015) proposed policy failure types, i.e. programme, process, and political failures. Then the paper employs the three types of policy learning proposed by (May, 1992) – instrumental learning, social learning, and political learning – to analyse policy learning.

6.3. Research design and methodology

6.3.1. Zero Carbon Ready

The UK passed a net-zero emission target into law, which requires the UK to bring all greenhouse gas emissions to net zero by 2050 (BEIS, 2019). Consequently, the Six Carbon Budget was brought into law to reduce carbon emissions by 78 per cent by 2035 compared to the 1990 level (BEIS, 2021c). In the Six Carbon Budget, the Climate Change Committee
(Committee on Climate Change, 2019) outlined that “it would require a fully decarbonised energy system by 2035” (House of Lords, 2022, p. 5). In 2021 the government published the Net Zero Strategy, confirming that the target of a fully decarbonised power system will move to 2035, subject to the security of supply (HM Government, 2021). The Net Zero Strategy set out policies for decarbonising all sectors within the UK economy including ‘Heat and Buildings’. The Heat and Building Strategy determines how the UK will decarbonise homes as well as commercial, industrial, and public sector buildings (BEIS, 2021d). Considering the significant impact of the housing industry and its required heating and powering (ONS, 2020), the government allocated a minimum energy efficiency standard as part of setting a path to net zero by 2050. In 2019, the Government committed to introducing a Future Home Standard (FHS) for new build homes to be future-proofed with low-carbon heating and world-leading levels of energy efficiency by 2025 (HM Treasury, 2019). The consultation for the Future Homes Standard was launched in October 2019, representing the first step in incentivising and providing a clear vision for such transitions by setting an uplift to the energy performance requirements in the Building Regulations for new homes (MHCLG, 2021a).

The FHS objective is to deliver homes that are zero-carbon ready (ZCR) by 2025 and to ensure that homes will be fit for the future based on environmental and affordability aspects. The ZCR homes will produce 75-80 per cent less carbon emissions compared to the current levels and they are expected to be completely zero-carbon over time by decarbonising the electricity grid without the need for further costly retrofitting work (DLUHC, 2021b). To ensure industry readiness and compliance, in 2021 the Government also implemented an interim standard uplift to the building regulation in which the new homes should produce around 30% fewer carbon emissions (DLUHC, 2021a). The interim uplift will come into force in June 2022 including uplifts to Part L (fuel and power), Part F (ventilation), and Approved Document O (overheating). The full technical specification for the Future Homes Standard will be consulted in 2023 and the necessary legislation will be introduced in 2024, ahead of implementation in 2025 (MHCLG, 2021a). Figure 6.3 shows the scope of the consultations on Future Homes and Buildings Standards.

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39 According to the report by Office for National Statistics, in 2018, heating and powering homes accounted for 22% of all greenhouse gas emissions in the UK
40 Later renamed as Future Homes and Buildings Standard (FHBS)
Although the Future Homes and Building Standard is a regulatory instrument, there are other government policies to help reach the Zero-Carbon Ready and Net Zero Strategy targets. Table 6.1 lists the recent policy announcements and initiatives that (in)directly support FHBS and ZCR.
Table 6.1. A mix of policy strategies and instruments to support Zero-Carbon Ready homes

<table>
<thead>
<tr>
<th>Policy instrument</th>
<th>Policy type</th>
<th>Definition</th>
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<tbody>
<tr>
<td>The Prime Minister’s ten-point plan</td>
<td>Policy strategy</td>
<td>The ten-point plan for a green industrial revolution published in 2020 sets out the approach government will take to build back better, support green jobs, and accelerate the path to net zero. In this plan, the government announced an ambition to grow the heat pump market to 600k installations per annum by 2028 (HM Government, 2020)</td>
</tr>
<tr>
<td>The Energy White Paper</td>
<td>Policy strategy</td>
<td>The Energy White Paper sets out how the UK will clean up its energy system and reach net zero emissions by 2050. It confirmed that the Government will “seek views on the feasibility of ending the connection of new build homes to the natural gas grid” (BEIS, 2020a, p. 110).</td>
</tr>
<tr>
<td>The Clean Growth Strategy</td>
<td>Policy strategy</td>
<td>The Clean Growth Strategy set an ambitious blueprint for Britain’s low-carbon future and committed to “phase out installation of high carbon fossil fuel heating in buildings not connected to the gas grid, starting with the new build, during the 2020s” (BEIS, 2017, p. 13).</td>
</tr>
<tr>
<td>The Green Homes Grant</td>
<td>Economic instrument</td>
<td>The Green Homes Grant was considered “a key part of UK’s green economic recovery following COVID-19, expecting to help build demand for low carbon technology in the short term, while also strengthening supply chains of low carbon materials for the longer term” (MHCLG, 2021a, p. 25).</td>
</tr>
<tr>
<td>Heat pump manufacturing supply chain research project</td>
<td>Information instrument</td>
<td>The heat pump manufacturing supply chain (BEIS, 2020e) investigates the opportunity for additional manufacturing in the UK. “To give businesses in the UK heat network supply chain certainty and the opportunity to make longer-term strategic investment decisions and expand their current UK offerings, there will also be continued Government support through the Heat Networks Delivery Unit, the Heat Networks Investment Project, the Green Heat Network Fund and, from 2022, the Heat Network Market Framework” (MHCLG, 2021a, p. 25).</td>
</tr>
<tr>
<td>Future Homes Task Force and Future Homes Hub</td>
<td>Information instrument</td>
<td>The Future Homes Task Force is set to establish a Delivery Hub (Future Homes Hub) by bringing together representatives from different sectors such as housebuilders, utility providers, suppliers, and the government. Its objective is to assist the built environment sector meet the climate and environmental challenges ahead.</td>
</tr>
<tr>
<td>Green Jobs Taskforce</td>
<td>Information instrument</td>
<td>The green Job Taskforce was launched in 2020 to set a direction for the job market towards a high-skill, low-carbon economy. It aims to “ensure that green jobs are good quality, that they can be accessed by people of all backgrounds and in all parts of the country, and those workers in sectors and industries undergoing change can reapply their skills and expertise towards this new challenge” (Green Job Taskforce, 2020, p. 3).</td>
</tr>
</tbody>
</table>

6.3.2. Case study design

The design of the case study follows Yin’s (2003, p. 46) proposed design type for “multiple-case design” (Zero-Carbon Homes in 2006 and Zero-Carbon Ready in 2019) comprising multiple units of analysis (policy and industry). Case studies have been gaining momentum in sustainability transitions to enrich theoretical and empirical knowledge on sustainability transitions and their ‘real-world’ challenges either as a single case (Geels, 2002, Gibbs and O’Neill, 2015) or as multiple-case designs (Loorbach and Rotmans, 2010, Ehnert et al., 2018). In this paper, the implemented interpretive approach leads to an explanatory (describing the
nature of failure) as well as an exploratory investigation (investigating the lessons learned in the policy and industry) to provide lessons for other cases of sustainability transitions.

6.3.3. Data collection

This research relies on four data sources to enable data triangulation (Eisenhardt, 1989): (a) semi-structured interviews, (b) archival data, (c) expert panel discussion, and (d) observations.

**Semi-structured interviews:** Following the interviews taken in the previous stage of the empirical research (ZCH 2006), another round of interviews was taken with the same experts – policymakers, housebuilders, and academics – to discuss the current policies on FHS and ZCR through video conferencing. The questions were focused on the current policies and their differences from the previous ones (ZCH in 2006). Also, the housebuilders’ progress towards building more sustainable homes and their responses to the current policies were explored. The interviews were conducted between August and December 2021 to provide a wide range of perspectives on the case study. Table 6.2 provides an overview of the conducted interviews.

<table>
<thead>
<tr>
<th>Expertise group</th>
<th>Interviewees</th>
<th>Interviewee code</th>
<th>Duration (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Policy</td>
<td>Department for Business, Energy and Industrial Strategy</td>
<td>P1</td>
<td>45</td>
</tr>
<tr>
<td>• Policy</td>
<td>Ministry of Housing, Communities and Local Government</td>
<td>P2</td>
<td>60</td>
</tr>
<tr>
<td>• Policy</td>
<td>Building Research Establishment, Policy council</td>
<td>P3</td>
<td>30</td>
</tr>
<tr>
<td>• Policy</td>
<td>Building Research Establishment, National House Building Council</td>
<td>P4</td>
<td>50</td>
</tr>
<tr>
<td>• Policy</td>
<td>Building Research Establishment, Future Homes Hub</td>
<td>P5</td>
<td>60</td>
</tr>
<tr>
<td>• Policy</td>
<td>Building Research Establishment, Zero-Carbon Hub</td>
<td>P6</td>
<td>60</td>
</tr>
<tr>
<td>• Policy</td>
<td>Building Research Establishment</td>
<td>P7</td>
<td>75</td>
</tr>
<tr>
<td>• Industry</td>
<td>Volume housebuilder</td>
<td>I1</td>
<td>45</td>
</tr>
<tr>
<td>• Industry</td>
<td>Volume housebuilder</td>
<td>I2</td>
<td>45</td>
</tr>
<tr>
<td>• Industry</td>
<td>Volume housebuilder</td>
<td>I3</td>
<td>45</td>
</tr>
<tr>
<td>• Industry</td>
<td>Volume housebuilder</td>
<td>I4</td>
<td>30</td>
</tr>
<tr>
<td>• Industry</td>
<td>Volume housebuilder</td>
<td>I5</td>
<td>30</td>
</tr>
<tr>
<td>• Industry</td>
<td>The Home Builders Federation</td>
<td>I6</td>
<td>45</td>
</tr>
<tr>
<td>• Academia</td>
<td>Sustainability transitions</td>
<td>A1</td>
<td>60</td>
</tr>
<tr>
<td>• Academia</td>
<td>Innovation management</td>
<td>A2</td>
<td>45</td>
</tr>
<tr>
<td>• Academia</td>
<td>Science, technology, and innovation policy</td>
<td>A3</td>
<td>45</td>
</tr>
<tr>
<td>• Academia</td>
<td>Environmental geography and governance</td>
<td>A4</td>
<td>45</td>
</tr>
</tbody>
</table>
Archival data: Three types of archival data were used: (a) policy documents published by the UK government about the Future Homes Standard, Zero-Carbon Ready homes, and decarbonisation of new residential houses; (b) news published in newspapers (such as Financial Times, The Guardian, and The Times) and trade journals (such as Building, Planning (U.K.) and Building Design) about the policies; (c) publicly available data sources including annual reports, socio-economic footprints, sustainability frameworks, corporate responsibility reports, and business models by accessing the websites of volume housebuilders. Table 6.3 lists a summary of the archival utilized in this paper.

Table 6.3. Archival data sources

<table>
<thead>
<tr>
<th>Type of data</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy documents</td>
<td>73 documents from the UK Government website, The Office of National Statistics (ONS), House of Commons, DLUHC reports, BEIS reports, Treasury reports, Future Homes Hub, Green Jobs Taskforce, and International Energy Agency</td>
</tr>
<tr>
<td>News articles</td>
<td>46 newspaper articles and 21 trade journal articles</td>
</tr>
<tr>
<td>Housebuilders’ data</td>
<td>36 documents from 6 major housebuilders’ annual reports, sustainability reports, and corporate responsibility reports from 2019 to 2021</td>
</tr>
</tbody>
</table>

Expert panel: Panels are often organised to bring legitimate expertise as well as creative, imaginative and visionary perspectives for future actions (Georghiou, 2008). Such insights help develop recommendations on a programme, proposal, or issue that can influence future decision-making. A group of five experts from the policy, industry, and academic environment were gathered in an online panel to share, analyse, and combine their knowledge concerning the ZCH and ZCR policies in the UK housing industry. The panel lasted for 120 minutes covering topics related to the major problems within ZCH and ZCR, the possible learnings from ZCH, the improvements that happened in ZCR, the possible future challenges and opportunities, the changes in housebuilders' response to decarbonisation, and the changes in the context of the housing industry. Table 6.4 summarises the information on the involved experts.
Table 6.4. Expert panel information

<table>
<thead>
<tr>
<th>Expertise group</th>
<th>Interviewees</th>
<th>Expert code</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Policy</td>
<td>Building Research Establishment, Policy council</td>
<td>E1</td>
</tr>
<tr>
<td>• Policy</td>
<td>Department for Business, Energy and Industrial Strategy</td>
<td>E2</td>
</tr>
<tr>
<td>• Industry</td>
<td>Director of sustainability in an incumbent housebuilder</td>
<td>E3</td>
</tr>
<tr>
<td>• Academia</td>
<td>Environmental geography and governance</td>
<td>E4</td>
</tr>
<tr>
<td>• Academia</td>
<td>Science, technology, and innovation policy</td>
<td>E5</td>
</tr>
</tbody>
</table>

Observation: Observations from three conferences (Table 6.5) were also used to provide more insights into the decarbonisation of the UK housing industry. All the conferences and events were online and participants were allowed to ask questions related to the topic. The discussions provided in such events helped to enrich the data collection on different dimensions of energy efficiency, green homes, and decarbonising cities.

Table 6.5. Details of industry conferences

<table>
<thead>
<tr>
<th>Conference/Event</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>• BEIS Energy Policy Briefings</td>
<td>Feb 2022</td>
<td>The Department of Business, Energy and Industrial Strategy (BEIS) together with the Open Innovation Team (OIT) and UK Research and Innovation (UKRI) provided an energy policy briefing for UK academics. The briefing covered topics on the built environment, energy security, and energy storage.</td>
</tr>
<tr>
<td>• Making the Switch to Cleaner, Greener Homes Event Series</td>
<td>Oct 2021- Feb 2022</td>
<td>In this five-part event series, experts, leaders and practitioners from the energy sector and beyond were brought together to explore a host of issues around the decarbonisation of homes.</td>
</tr>
<tr>
<td>• Manchester Festival of Climate Action</td>
<td>Sep 2021</td>
<td>Manchester Festival of Climate Action was a 4-day festival that acted as a forum to share insight and innovations on how to secure global net zero, how to protect communities and natural habitats, How to finance required changes, and how to turn ambition into reality.</td>
</tr>
</tbody>
</table>

6.3.4. Data analysis

The qualitative data organising software Nvivo12 was used for archiving, coding, and revising the data. The Secondary archival data, the transcriptions of interviews, expert panels, and conference events were coded to identify the nature of the ZCH failure and the possible following learnings within the Government and industry in the current ZCR programme. While coding the documents, the literature on policy failure and policy learning was also analysed to relate the findings to the relevant theories in the literature. This strategy enables a cyclical and evolving data loop in which the researcher interacts with the data, compares it with theories,
and applies data reduction and consolidation techniques to reach the best possible explanation of the studied phenomenon.

**6.4. Results**

**6.4.1. The ZCH failure**

Although Zero-Carbon Homes started with ambitious targets and goodwill, because of the problems in the design and implementation of the policy mix as well as some unpredictable landscape forces, it did not reach its initial goal. According to McConnell’s (2015) definition of policy failure, since the ZCH policy mix did not fundamentally achieve its initial goals, it can be considered a policy failure and transition failure. Also, ZCH can be considered a failure based on Howlett’s (2012) failure criteria (Figure 6.2): it did not achieve its original objective; it was claimed to have a negative impact on main stakeholders such as housebuilders and homebuyers; it did not improve the problem of housing sustainability; it increased the prices; and it led to the same old responses from the housebuilders such as lobbying, business-as-usual, or incremental changes in their business models. However, the nature of the failure differs in different stages of the ZCH policy mix design and implementation. This paper identifies the traces of all three types of McConnell’s (2015) proposed policy failure from the archival documents, interviews, expert panel discussion and observations: programme, process, and political failure.

**Programme failure:** This type of failure refers to a poor policy design at the early stages of the ZCH policy mix in terms of technical, efficiency, and effectiveness factors of the policy instruments. The failure in specifying the technical requirements and even the definition of zero-carbon homes in the early stages of the ZCH policy implementation (DCLG, 2007a); the questionable realistic and feasibility of some of the initial expectations (P3, P4, I2, I3, A2, Osman and O'Reilly, 2009); attracting oppositions against some of the policy instruments (DCLG, 2008); as well as the failure in designing the policy instruments and means to match the policy goals (P1, DCLG, 2007c, DCLG, 2008, Greenwood et al., 2017) prevented to meet the policy mix expectations. However, the Government partly addressed this failure by launching the Zero Carbon Hub which served as an autonomous research group to redefine the target and identify and /or address potential barriers. Therefore, the ZCH programme failure at the early

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42 The dismantlement of the transition policy mix and the change of priority from quality to quantity led to the building of lots of low-quality houses which later were in the queue of retrofitting.

43 Detailed information is provided in the previous chapter.
stages, while important, can be regarded as a conflicted failure when “the failures to achieve goals are fairly evenly matched with attainment of goals, with strong criticism and strong defence in roughly equal measures. In essence, conflicted failures are dogged by periodic controversy that is never quite enough to act as a fatal blow to the policy, but insufficient to seriously damage its defenders” (McConnell, 2015, p. 237).

**Process failure:** The problem of process failure can be traced back to the failure proceeding from the ZCH idea to reality. The ZCH policy mix failed in the policy implementation process such as policy formulation, approval of all key actors, legitimation in the policy process, creation of support coalition, and policy evaluation. In the policy formulation, the Government attempted to solve the sustainability problem of the housing industry without a comprehensive investigation to identify the roots of the problem and the probable consequences of the proposed policy instruments. In this policy mix, the main focus was on technological innovations and developments while the main barrier to sustainability transitions (i.e., incumbents’ business models) was neglected. During the policy implementation, many key stakeholders were neglected in the process of implementing the policy mix such as green suppliers and customers (A1, Cartwright and Gaze, 2010b, Tilford and Gaze, 2010, Edmondson et al., 2020). The loopholes in the policy instruments (A1, DCLG, 2014), the start-stop approach in the policy implementation (P3, P4, I1, DCLG, 2009b), and the frequent churn in housing ministers (P5) negatively influenced the legitimacy and credibility of the policy mix. Also, there was a gap in the design and as-built performance evaluation for zero-carbon homes which made it easy for potential policy circumventions. As mentioned in Chapter 5, this lack of appropriate assessment and policy monitoring led to less sustainable houses being added to the required retrofitting stock eventually. Although the policy implementation failed in certain aspects, it did achieve some positive outcomes as well. The economic and information instruments within the ZCH policy mix were partly successful in attracting some of the powerful housebuilders in the UK. Especially the large-scale demonstration projects and public-private partnerships such as AIMC4 led to improvements in transitioning towards sustainability (Gaze, 2010b, Tilford and Gaze, 2010). Therefore, the ZCH policy process can also be regarded as a conflicted failure.

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44 Advanced Innovative Materials, products and process to meet the government’s Code for Sustainable Homes, Level 4 (AIMC4)
**Political failure:** The political failure can be found mainly in the latest stages of ZCH with political debates after the 2008 financial recession and the change of government and its priorities in 2010. The political consequences of the earlier programme and process failure of the Labour Government were used as a discursive tool for the Conservative party in public debates to seek political, partisan, and electoral advantages (Hood, 2002, Sulitzeanu-Kenan and Hood, 2005) in the 2010 elections. Consequently, it led to declines in electoral support and resulted “in the growth and success of rival parties [Conservative in this case] and contestants for office even in non-democratic systems” (Howlett, 2012, p. 547). The change of government in 2010 provided the opportunity for ‘partisanship’ in which the new government that did not ‘own’ the policy took a political route linking the failures to the previous government rather than exploring the potential remedies to solve the problem (Dunlop, 2017). The new Government used the 2008 recession as an excuse to water down and later dismantle the ZCH policy mix and pursue an austerity programme in which the number of houses being built became the priority again (Edmondson et al., 2020). However, this led to even more serious tensions and failure which McConnell (2015, p. 238) calls the “programme success vs. political failure”. Although the Government succeeded in implementing the unpopular austerity measures (programme success), it produced significant damage to its political aspirations (political failure) such as its reputation and its sustainability agenda (P3, I1, I2, I5, A2).

In the early stages of the ZCH a potential “virtuous cycle” was emerging (Edmondson et al., 2020, p. 152). O’Neill and Gibbs (2020, p. 122) refer to the period of 2003-2010 as the “Policy expansion: An emerging green building agenda” during which the concern for climate change increased and many transition policies such as ZCH were introduced. As mentioned before, despite some programme and process failures the Government also achieved some important outcomes in terms of setting initiatives towards sustainability transitions. However, a “vicious cycle” started after the transition policy supports were weakened as a result of the 2010 general election and the austerity measures (Edmondson et al., 2020, p. 152). O’Neill and Gibbs (2020, p. 123) call the period between 2010 to 2015 the “symbolic dismantling” and the “diminution of the zero carbon homes policy” (emphasis added):

Initially, climate change and the environment was a cornerstone of the Conservative Party’s election campaign and in The Coalition: Our Programme for Government, the government promised to ‘implement a full programme of measures to fulfil our joint ambitions for a low carbon and eco-friendly economy’ (HM Government, 2010: 16). However, it soon transpired that ‘the environment’ would cause tension in the elected Conservative-Liberal Democrat coalition government (the Coalition), particularly in light of austerity programmes and the (mis)perception that economic growth cannot be compatible with the environment in the transition to a low carbon economy”.

Such kind of policy failure represents the avoidability and intentionality factors presented by (Howlett, 2012). In this case, the Government was unable to foresee the potential problems arising from the dismantlement of the ZCH policy mix (P1, P3, P6, A1, E1). This made the political failure at the final stages of the ZCH an outright failure in which “failures outweigh success and the policy is a political liability” (McConnell, 2015, p. 237). This also was highlighted in the expert panel discussion as one of the experts (E1) stated:

“There is no doubt that the reason for [ZCH] failure was more related to political issues. If you look over the history of initiatives to produce energy-efficient housing, what has been done is the result of dialogues, consultations, and sometimes conflicts between different interests out of which the political judgements come.”

Expert E2 emphasised the damaging consequences of dismantling the ZCH policy mix as a political failure and indicated that:

“Because of that [ZCH dismantlement], we are probably at least 10 years behind where we could be, in terms of having improved quality homes with low carbon emissions and far more energy and heat efficiency.”

6.4.2. The ZCR policy learning

The previous section indicated the nature of the ZCH failure, its intensity, and the reasons behind it. This section investigates the presence of the same counterforces in the current housing policy, i.e., ZCR. In other words, this section analyses whether the whole environment

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– in which the policies, politics, and industries operate – has changed sufficiently so that there is a much greater prospect of sustainability transitions happening in the UK housing industry.

The first and most important aspect arising from all the data sources is the dramatic change in the context of the UK housing industry in favour of sustainability transitions. Almost three-quarters of local authorities in the UK have declared Climate Emergency, taking action to reduce their carbon emissions in their local area. The change in customer sentiment towards sustainability has taken significantly, putting energy efficiency a much more significant part of home buying decisions (I4). People are more conscious about the quality of the built environment such as insulation, ventilation, air quality, and their impact on their health. According to the Interviewee I6:

   “People are starting to be conscious of the already existing effects of climate change by realising that their current homes are not designed to be resilient to its effects. The next generation of homebuyers is increasingly aware of carbon issues. They ask for greenhouses with good digital connections while willing to compromise on other things. It’s becoming very clear that things have to change.”

Young generations are asking about initiatives to tackle climate change. According to expert E3:

   “The pivot point of climate change awakening and climate strikes started about three years ago with Generation Z protests and the Extinction Rebellion which was then accompanied by a massive policy writing forced by the Government.”

Another important factor in the context is the improvement of green technologies. According to Interviewee I5:

   “I think the supply chain is a lot better developed. One of the things that have changed for example is solar PV. It is so much a mainstream measure now. It is cheaper, the feed-in tariff programme has delivered a functioning market for solar PV and housebuilders are accustomed to working with that measuring.”

47 Local Government Association: Climate Change
Such awakening in the society means that now the policymakers and housebuilders are working in a completely different context with a different attitude to the environment and sustainability that existed in the past. This means another policy failure in this sector can lead to much greater consequences. According to Expert E3:

“There needs to be a huge amount of changes to happen in the 3-5 years otherwise it [ZCR] will start to fail. And failure could be catastrophic for both the Government and us [housebuilders]. The Government could lose credibility completely over its sustainability agenda. And It can be a disaster for companies like us as well as green suppliers.”

By comparing the past policy mix (ZCH) and the current one (ZCR), this section analyses three types of policy learning proposed by (May, 1992): instrumental learning, social learning, and political learning.

**6.4.2.1. Instrumental learning**

As discussed before, instrumental learning is about the policy instrument design, implementation, monitoring, and evaluation (Kaye-Essien, 2020). Here learnings about these factors will be investigated:

**Policy design:** In the ZCH policy, all three policy instruments were available: regulation (Building regulation – Part L), economic (tax stamp duty exemption, eco-towns, and carbon challenge), and information (Code for Sustainable Homes, AIMC4, Zero carbon taskforce, and Zero carbon hub). The current ZCR programme has many differences from the previous one. Compared to the past when the Building Regulation tightening only affected Part L (fuel and power), the current Future Building Standard represents changes in Building Regulation covering wider impacts of Part L such as ventilation and overheating (MHCLG, 2021a). This regulatory change attempts to solve the problems arising from housing insulation. Another problem in the past was that the Building Regulation was not destabilising the socio-technical regime. In other words, the building regulation was not strong enough to push for major changes in the way the major housebuilders did their business. Although analysing the effectiveness of the current Building Regulation requires more time, the presence of other
policies makes the regulations seem more promising than before. The main assuring policy is the UK’s net zero emission by 2050 and the Net Zero Strategy. The 2050 target brings the required necessity and the urge to support the Building Regulations to push for transitioning towards sustainability in the housing industry. According to Interviewee P1:

“*I think the regulation power has changed. Because we have imposed the statutory target of net zero carbon by 2050. And we going to legislate that interim targets of a 68% reduction in carbon emissions by 2030 and a 78% reduction of carbon emissions by 2035. The moment you do that you have to accept that all new homes and buildings that we produce in the UK have to be significantly more energy and heat efficient. And in addition, that means they have to be significantly higher quality because you can’t guarantee that you will achieve those heat and emissions standards unless the built assets that you are producing are much higher quality and manufactured to achieve those higher standards.*”

Although the building regulations have become stronger compared to the past, the other two instruments are not much supported in the ZCR programme. The only economic instrument mentioned in the FHS consultation was the Green Homes Grant (MHCLG, 2021a) which could indirectly influence the ZCR by strengthening supply chains of low-carbon materials. This policy instrument was designed to improve 600,000 properties through energy efficiency measures. However, it was scrapped in March 2021, only 6 months after its launch48, reaching less than 7% of its initial goal49. The Industry and Regulators Committee (IRC, 2022, p. 17) argues in its report on the net zero transformation:

“*We strongly urge the Government to set out how the transition will be funded. In doing so, it should explicitly set out the distributional consequences for any funding proposals.*”

The Heat pump manufacturing supply chain research project is the information instrument provided by the Department for Business, Energy and Industrial Strategy (BEIS). The project analyses the existing supply chain of heat pumps and assesses the risks and opportunities for the growth of this technology in the UK. The expanding global market for heat pumps and the

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48 The Guardian: [UK government scraps green homes grant after six months](https://www.theguardian.com/uk-news/2021/mar/16/uk-government-scraps-green-homes-grant-after-six-months)

49 The Guardian: [Green homes grant scheme helped just 15,000 low-income households buy insulation](https://www.theguardian.com/uk-news/2022/apr/27/green-homes-grant-scheme-helped-just-15000-low-income-households-buy-insulation)
investment opportunities for UK heating manufacturers have the potential to offer a major industrial boost. This leads to lots of industry initiatives. UK heat pump manufacturers such as Mitsubishi50 and Kensa Group51 are scaling up their manufacturing and attracting investments52 and other manufacturers such as Villant53 are entering the market to benefit from its rapid growth. Interviewee A2 highlights that:

“To a certain extent, heat pumps are further behind other green technologies such as solar PV. But the market for heat pumps is developing very rapidly and there is a lot of investment happening from the supply chain. I think suppliers are feeling confident to invest in the UK housing market for heat pumps. And we have seen businesses like Kensa have new ways to work with housebuilders. It is important to see how the Government will use these opportunities to achieve the ZCR goal.”

Although the market for heat pumps looks promising, a lack of instruments to support the upstream and downstream markets can become problematic. Expert E3 states:

“The heat pump market is indeed growing. But it is not everything. It is also about integrating it into the design of homes. It is about installers and retraining gas engineers into air source heat pump engineers. It is about the interface with the customer so that the customer feels comfortable and confident to operate them. It is also about the maintenance afterwards. So there is a bunch of pieces that need to be in place in a very short time frame to be a successful transition to heat pumps.

While there are people that are aware of the challenge, it is not clear how that challenge is being met right at this moment.”

The complex nature of the construction industry and its wide variety of suppliers raises another issue for any sustainable initiative, i.e., lack of knowledge and skills. This problem was very critical in the past (ZCH) leading to lots of resistance to change from housebuilders and suppliers. Consequently, the importance of providing the required skills was also mentioned in a report on Reducing UK Emissions (Committee on Climate Change, 2020). The Government

50 Heating and Ventilation: Mitsubishi's Ecodan heat pump to be made in Scotland
51 One of the UK’s largest players in the ground source heat pump technology sector.
52 Legal & General Capital (LGC) took a 36% stake in The Kensa Group to scale up its investments in addressing decarbonisation.
53 Vaillant: Villant Expands UK Manufacturing Facility to Produce its aroTHERM plus Heat Pumps
responded to this advice by “collaborating between departments and across administrations to ensure skills match the needs of Net Zero” (BEIS, 2021d, p. 47). The independent Green Jobs Taskforce has been launched by the Government to deliver 2 million net zero jobs by 2030 (BEIS, 2021d). Regarding the installation of heat pumps the Government is working with the industry to “ensure that appropriate high-quality training is available, both for new entrants to the sector and existing heating installers who do not have heat pump experience” (BEIS, 2021d, p. 52). Moreover, the Government has launched a £6.9 million Skills Training Competition (BEIS, 2020b) in which tradespeople get trained professionally to deliver the Government’s current and future home decarbonisation schemes.

Although the Government acknowledges the importance of skills, the skill shortage is still one of the issues which threaten the growth ambitions in the sector (especially in the heat network industry) leading to delays in developments, lower quality projects, higher costs, and greater reliance on subcontractors (BEIS, 2020c). According to BEIS, there are five skill challenges within the heating industry: limited recruitment pool, the difficulty in finding the right blend of skills in one individual, the short supply of people for skilled senior roles, the difficulty in finding solely focused individuals on heat networks, and the difficulty in maximising suitable graduate recruitment pool. The literature review on heat network skills by BEIS (2020d) also indicated that the experienced workers are retiring and moving out of the industry and are not being replaced in a sufficient ratio. The housing industry is also concerned that the skill shortage can be problematic in progressing towards ZCR homes. According to Interviewee I2:

“The heat pump technology is mature enough. They are being used in Europe for years. The UK is quite unusual for having a gas grid. So, the installation practice for heat pumps is not mature here. Trade people are very conservative and they don’t like change. Because if you have been installing gas boilers for the last 10-20 years, you know how to do it. You know if you do it properly, you are not going to get any complaints. Whereas in heat pumps if you get that wrong, then it is not going to be a pleasant experience. And because heat pumps provide low-intensity heat, if you have some problems with your insulation, then they are never going to overcome it, no matter how you install it. The house will be cold and people will be very unhappy.”
**Policy implementation:** Three implementation problems were indicated in ZCH, i.e., the frequent churn in housing ministers, the inconsistent approach in the implementation of policy instruments, and the lack of coordination among different governmental departments in implementing the policy instruments.

The rapid change of UK housing ministers was criticised by the interviewees as a negative influence on the ZCH progress between 2006 to 2016. They claimed that the frequent churn and the lack of continuity were among the factors that prevented the government from tackling the housing problems, and prioritising policy delivery. Being evident from the data, this problem still exists. This problem can have several impacts on ZCR progress. First, according to Cleary and Reeves (2009, p. 5) if ministers are moved so frequently, “they [will] have little incentive to grapple with difficult policy problems.” As the housing policies, especially the ones related to sustainability, require long-term planning, investment, and consistency, the frequent churn of ministers can lead to short-term initiatives “which may earn them a good headline but are unlikely to deliver substantial and lasting benefits.”

Second, the constant minister reshuffling means the tacit knowledge of housing ministers gets lost due to the low knowledge transfer among different ministers. According to Interviewee P5:

> “Changing too frequently has reduced the tacit knowledge and expertise. I think currently there is a very limited institutional memory of what happened in 2016 in BEIS or MHCLG. Possibly there is still a lot for policymakers to learn. Valuable knowledge is lost when experienced members exit the intra- and inter-ministerial departments without having their knowledge documented.”

Expert E1 by confirming this issue, argues that this frequent churn cannot lead to corporate memory loss as it depends more on the civil servants:

> “We do have the habit of changing housing ministers quite frequently. But the corporate memory rests with the civil servants. If you look at the technical people who deal with matters like building regulations, it does have a lot more continuity.”

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54 The Negotiator: [No wonder nothing’s ever joined up! Housing minister role has highest ministerial churn](#)
When the politics impose, the main ministers can have different views quite legitimately, but the background and understanding will rest elsewhere."

Although the role of civil servants in keeping the corporate memory should not be neglected, the new ministers need time to build up their knowledge and expertise with the help of civil servants. The third problem arises when this required time resets every time the housing ministers are changed (P2, P7). Moreover, as stated by Cleary and Reeves (2009, p. 5) this ministerial churn and the dependence on the civil servants might bring about “an imbalance of power between elected ministers and unelected civil servants”.

The second implementation problem in ZCH was the start-stop approach of the Government in implementing the policies. As discussed before, the dismantlement of the ZCH policy mix caused many negative consequences for policymakers and housebuilders. Putting aside the sustainability agenda and then getting back to it again after almost five years created a lot of uncertainty and mistrust that have not been addressed completely by the government. This hot-and-cold approach to the policy agenda still exists to some extent. The Green Homes Grant is a clear example of this. According to Interviewee A4:

“The housing policies in the last five years have been made on the hoof. The Government meddled with them and changed them in response to external criticism or a quick awareness that the policy isn't going to work as it intended. Take the Green Homes Grant for example. That was introduced as a sort of covid recovery measure only last year to be axed within the same calendar year. Such incidents suggest that we're going to continue to see U-turns and policy experiments that weren't intended to be experiments but which turned out to be experimental because of the failings that they demonstrate.”

This inconsistency in housing policy implementations along with the lack of transparency and insufficient use of evidence and analysis (I1-I4, P2) creates a credibility problem for any governmental initiatives in the housing industry. However, the recent policies supporting the ZCR programme (such as the net-zero 2050 and the Heat and Building Strategy) provide some hope for the current sustainability agenda to have some stability and continue towards the 2050 target. According to Interviewee I1:
“The big disappointment is that I’ve been in the space for like more than 30 years and there hasn’t been a consistent policy position on the housing industry. Policies have been chopped and changed and cut and it’s almost possible to plan. The Code for Sustainable Homes almost gave us that consistency but not completely. I think the Future Home Standard is probably in a solid policy position now. Albeit, the first of many quality positions that would be needed to reach the net-zero target.”

The last problem mentioned in ZCH implementation was the lack of coordination among different governmental departments. The ZCH policy mix was criticised for the confusing and rather conflicting role of the involved governmental sectors such as MHCLG, BEIS, and Treasury in the achievement of the 2016 target. According to the data, this issue has improved compared to the past but is not fixed completely. The Industry and Regulators Committee (IRC) report on the net zero transformation argues that the “coordination within government, across departmental boundaries, is always a challenge but it is better than it was” (IRC, 2022). Expert E2 states:

“The change in the whole political and social background is being manifested in striking commitments not least by the Government. I think while it’s clear that departments have still different views about things, they are now signed up for the overall net-zero policy and are having to face the consequences of their policies and initiatives. That is quite different to the past.”

However, there are still a lot of conflicts and debates around policy coordination. The IRC (2022, p. 19) report states:

“The changes needed to ensure the transition to net zero by 2050 are transformational, not gradual and incremental. There is insufficient coordination within Government on net zero, as well as evidence of insufficient bandwidth in BEIS to tackle the full range of issues associated with the transition.”

Interviewee P5 by highlighting the power of the Treasury in housing policies, states that:
“The big announcements are always made by Treasury. The person who made the announcement [ZCH] was Gordon brown when he was the Chancellor of the Exchequer. The person who said we are not going to do it, was George Osborne when he was the Chancellor of the Exchequer. The person who said we are going to get rid of the gas boiler was Philip Hammond when he was the Chancellor of the Exchequer. So all of these big announcements are made with the Treasury.”

In 2021, the Treasury published the “Net Zero Review Final Report” to address the uncertainty on technologies, costs, and the changes to the economy over the next thirty years as the UK decarbonises (HM treasury, 2021). However, the report was criticised by some Members of Parliament (MPs) for not having a clear plan for funding the transition to net zero. This can become problematic again as recently the Treasury rejected MPs’ request to come up with a “clear funding plan” for the cost of meeting the 2050 target. According to the chairwoman of the public accounts committee 55:

“Government's unwillingness to engage with the nitty-gritty of reaching net zero [...] makes us fear [...] this target will go the way of all the other broken promises.”

Reaching the ZCR and later the 2050 targets asks for a stable, coordinated, and consistent approach across different governmental departments at all levels. Some of the policymakers called for a new governmental body to drive the transition to the net-zero target and convey the overarching objectives into deliverable plans, while some believe that any new body becomes “just another entity to co-ordinate” (IRC, 2022, p. 20). By warning about the insufficient coordination and strategic direction related to reaching the target, IRC (2022, p. 21) warns that any coordination function should not create “new and unnecessary levels of bureaucracy”. Following the example of the Vaccine Taskforce during the Covid pandemic, the IRC has proposed creating an expert taskforce “responsible for economy-wide strategic planning, cross-departmental coordination, implementation of some agreed policies and operational delivery monitoring in relation to the net zero transition by all departments and agencies. (IRC, 2022, p. 21)”

55 The Times (2022): Treasury spurns call for net-zero cost plan
Policy monitoring and evaluation: The Fabric Energy Efficiency Standard created in ZCH has been retained as a performance metric in Building Regulation – Part L. The Government has slightly revised the package of performance metrics to ensure a low-carbon heating system and a fabric-first approach in all new homes. A total of four performance metrics including primary energy target, emission target, fabric energy efficiency target, and minimum standard for fabric and fixed building services. The Government also improved the problem of the gap between the design and as-built performance. During the ZCH programme, this problem was claimed to result in some policy circumventions. The Government has put forward some measures to assess as-built compliance “by improving the accuracy of as-built energy calculations and providing clearer information about the as-built specifications of new buildings to both building control bodies and homeowners” (DLUHC, 2021b, p. 5).

In general, there are some traces of instrumental learning across the policy design, implementation, monitoring, and evaluation. However, it seems that there is still a lot to be done regarding the required stable, coordinated, and consistent action across all government departments at all levels. Failing to reach this, the government can lose its hard-won credibility over the net zero agenda.

6.4.2.2. Social learning

In this section the learnings and improvements in the social construction of the policy problem, the scope of the policy, and the policy goals are analysed. The main difference between the ZCH in 2006 and the current policies on ZCR is that the policy is not aiming for a complete net zero. As described before, the ZCR homes are expected to produce almost 75 per cent fewer carbon emissions by 2025. From the beginning of the Future Homes Standard consultations in 2019, this emission reduction target was criticised for being not enough. The consultation received 3310 individual responses from a range of organisations, trade bodies, industry professionals, academics, etc. The first question in the consultation was about the stringency of the target: “Do you agree with our expectation that a home built to the Future Homes Standard should produce 75-80% less CO2 emissions than one built to current requirements?” (MHCLG, 2021a, p. 12). Table 6.6 summarises the responses to this question.

As illustrated, 80 per cent of the respondents believed that the target is not enough and asked for a more stringent policy. Especially with the target of decarbonising the electricity grid,
some experts argue that reaching the 75% emission reduction is much easier (P6). However, given the time remaining to reach the target (less than three years), the target might be ambitious enough.

Table 6.6. Summary of responses to the first question on FHS consultation in 2019

<table>
<thead>
<tr>
<th>Question 1</th>
<th>No. of all responses</th>
<th>% of all responses</th>
<th>% of responses to Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Yes</td>
<td>522</td>
<td>16%</td>
<td>18%</td>
</tr>
<tr>
<td>b) No – 75-80% is too high a reduction in CO2</td>
<td>65</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>c) No – 75-80% is too low a reduction in CO2</td>
<td>2,388</td>
<td>72%</td>
<td>80%</td>
</tr>
<tr>
<td>Did not respond</td>
<td>335</td>
<td>10%</td>
<td>-</td>
</tr>
</tbody>
</table>

In the Future Homes Standard consultation, the industry including the housebuilders and supply chain manufacturers claimed that developing the necessary supply chain, skills, and construction practices to meet the ZCR target will need time (MHCLG, 2021a). Expert E4 indicates:

“The timing is ambitious even if someone says the policy is not as ambitious as we might want to see. 2025 is three years away and that’s a lot to do in principle.”

Moreover, there are debates about the feasibility of the Prime Minister’s ten-point plan for the acceleration of heat pumps. Expert E3 highlights this from a housebuilder perspective:

“Heat pumps are seen to be the only game in town for the 2025 regulations. It seems very difficult to meet the Future Homes standard and ZCR goals in any other way. But there is a massive scaling up required from about 30,000 a year at the moment to Boris Jonson’s target which is 600,000 by 2028. I don’t think it is possible at this rate.”

Such feasibility problems and the fuzziness of the ways to achieve the ZCR target can be a warning of a repeating problem as ZCH in 2006. In the past, the ambiguous policy objectives, definitions, and guidelines around ZCH were claimed to be one of its failure reasons. In the Future Homes Standard consultation, respondents have called for more detail on how the ZCR programme will be enacted and enforced and how building standards will evolve to

“There are still major questions to be answered [...] including what level of insulation will be needed to efficiently operate heat pumps, whether hydrogen for heating will be available as a source of heat for all homes, and what this means for the continuing use of the gas network, and how to deliver these major changes in people’s homes.”

Expert E4 also confirms this ambiguity:

“In the Heat and Building Strategy, there are a lot of aspirations rather less of an actual well worked out a plan for achieving what needs to be done.”

Interview I3 highlights the importance of a clear, ambitious, and plausible target in tackling the climate crisis by comparing it with the Covid crisis:

“Necessity is the mother of invention. If you set the challenge and you are reasonably confident that people can hit it, you will be amazed by the innovations that people come up with. So I think the main thing going forward is that what we need is that goal. You see, we had the Covid crisis. Lo and behold, the world started to develop about 7 vaccines against covid in the space of 3 months. So within a year, there is 7 of them. That is because we had to do it. It is amazing what can happen when you start setting people a target of what they can achieve. I am not asking about a target as ambitious as solving a health crisis, I am talking about a target that is much easier than that [housing sustainability].”

The Government has planned a full technical consultation on the Future Homes Standard for spring 2023 to consider the appropriate transitional arrangements. However, the concern is that the time left to reach the goal would not be enough to offer certainty to all stakeholders to pursue transformational changes. Although the Government has aimed for a less stringent target for decarbonising new residential buildings, it seems that the ambiguity and the time pressure have the potential to impact the feasibility of the ZCR programme.
6.4.2.3. Political learning

The ZCH policy mix has shown how political conflicts can lead to major policy failures. Given the involvement of multiple policy departments and organisations in the housing policy, the political conflicts are usually about what the priority is, who is in charge and who is responsible for solving the housing problem (P3).

The 2008 economic crisis during the ZCH policy mix became a major political force in the housing economic and socio-technical landscape. As described in the previous chapter, this crisis shifted the Government's priority from sustainability transitions to economic growth (O'Neill and Gibbs, 2020). Since the consultations on Future Homes standards, three major forces happened with the potential to influence the progress and priority of the sustainable agenda: Brexit, the Covid-19 pandemic, and the Russia-Ukraine war. Although they are all considered landscape forces, their nature and impact on the ZCR programme are different. According to the experts and interviewees, the UK's withdrawal from the European Union (EU) in January 2020 did not have a massive impact on the zero-carbon standards. However, it worsened the skill shortage in the construction industry. Overseas workers constitute 7% of total UK construction labour and 28% of London’s.56 The migration of skilled labour has had a direct impact on UK housing. Expert E3 states:

“From a housebuilding perspective, Brexit has had a significant impact on importation overseas but we are much less affected compared to most other sectors because the building products are manufactured within the UK. However, regarding the labour supply, the impact has been significant. Before Brexit, I think three-quarters of the carpenters in London were from the EU. This is an ongoing saga that lurches from bad to worse in terms of labour supply. We do have a significant labour problem.”

Expert E1 highlights a possible impact of Brexit on the standardisation of energy-efficient equipment such as heat pumps:

“I don’t know how that is working out but one of the effects of Brexit is at least the possibility that our standards differ from those in Europe. And that will affect the manufacturers and suppliers who work internationally. If UK standards become

56 ONS (2018): Migrant labour force within the UK's construction industry: August 2018
different from European standards, the arising questions will be [a] whether they will supply to the UK; [b] whether there are extra costs associated with it; or [c] whether in the end the UK comes in the line and maintain its alignment with European standards.”

The Covid-19 pandemic, on the other hand, had a positive influence on the recognition of climate change and also a boom in the housing industry. One of the UK’s biggest housebuilders declared an almost doubling of profit during the pandemic in 2021. Interview I4 states:

“COVID has been completely different from the 2008 financial crisis. After the financial crisis, it was back to the sense of “business-as-usual” as much as possible. But Covid, if anything, accelerated the sustainability agenda. People took the opportunity to rethink. And then, there was a race for space and a different type of lifestyle. People moving out of cities, valuing gardens, and valuing health and well-being. Now the priorities have changed in favour of better quality and better-performing housing.”

Although the pandemic had a positive influence on climate change awareness, experts believe that this can change if the pandemic results in an economic crisis. Expert E5 highlights:

“The pandemic itself is not a big deal unless it results in an economic crash. The thing that affects these policies most, is when there is a complete economic crash and a collapse in house prices. Then everybody gets worried about housebuilders.”

The most recent landscape force impacting the housing and energy industry has been the Russia-Ukraine war. The war in 2022 has had a major influence on energy prices in European countries and the UK. Although the dependence on Russian oil and gas is not significant in the UK, the global price surge in the international gas market and the drop in global supply will inevitably impact UK energy prices. This volatility in the energy market has led to a significant increase in gas and electricity bills that could “plunge many people into fuel poverty” and could become a political crisis for the Government. However, this situation can increase heat

58 ONS: [Only 5-6% of UK’s gas import is from Russia](https://www.ons.gov.uk/economy/energyandpowerstatistics/articles/ukimportofnaturalgasbysource/2021)
59 The Guardian: [Ukraine war ‘will mean high food and energy prices for three years’](https://www.theguardian.com/business/2022/apr/21/uk-ukraine-war-high-food-energy-prices-three-years)
60 BBC: Ukraine crisis: [Warning UK energy bills could top £3,000 a year](https://www.bbc.com/news/business/61131179)
Transition policies and incumbents’ business models: From resistance and system failure to learning and adaptation

pumps, renewable energies, and energy efficiency as solutions to reduce energy demand, provide energy security, and limit bill increases for homes. From a housebuilder perspective, expert E3 indicates:

“There are some challenges to the global supply chain network. There are things that we never knew that they came from Russia or had Russian money behind them and now they [suppliers] are disaggregating that. Of course, the energy price resulting from the war could have beneficial effects in terms of preferentially biasing sustainable technologies and sustainable ways of thinking.”

However, energy security can also become a force majeure to use unsustainable energy resources as well. Expert E4 highlights the flip side of this crisis:

“It can go in an opposite direction. We have seen in the last couple of years a push towards fracking in the UK as a mechanism of providing energy security and things like West Cumbria Mining for example. Even though we have held COP26, that coal mine is being discussed but also justified as a more climate-friendly alternative to importing coal from overseas.”

These three landscape forces have had the power to change the direction and priority of the sustainability agenda in both positive and negative ways. The Government’s ability to use such sources in favour of ZCR and the net-zero target in the near future shows the extent to which the Government have learnt from the consequences of the 2008 crisis on ZCH. The government mustn’t let political issues influence the policy paradigm related to ZCR and the sustainability agenda as a whole. Expert E1 highlights some of the recent political issues regarding the net-zero target:

“The political will is important in the progress of the ZCR target. During such crises, opponent views might arise on the sustainability agenda. To take an example, Mr Nigel Farage seems to have hitched his wagon to opposing net zero

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61 Sky News: Cost of living: Why are energy bills so high - and will going green help send them down?
62 Policy paradigms are collective sets of beliefs commonly shared by dominant policymakers who effectively influence policy decisions thanks to their resources and position Wittting, A. & Moysone, S. 2015. Learning in post-recession framing contests: Changing UK road policy.
63 The Guardian: Nigel Farage’s hard-right faction won Brexit. Now net zero is in its sights
on the ground that it’s unaffordable and just not the right thing to do at the moment. Now it may or may not become a significant countermove. But it illustrates that politics does not happen in a vacuum. What happens is a result of different pressures from different directions.”

Apart from landscape forces that can affect the Government’s priority on the sustainability agenda, political issues also arise when talking about who is in charge of solving the housing problem. Previously, the policy and political conflicts between involved governmental departments in ZCH and ZCR and their coordination problems were discussed. Apart from the government, the industry is also responsible for the development and implementation of ZCR homes. One of the main political issues related to the housing industry is the power struggle with the few housebuilders (incumbents) in this country that dominate the market and have an oligopoly business nature (House of Lords, 2016). The high political barriers against SME housebuilders including the difficulty in getting planning permissions and compliance with complex regulations make it almost impossible for them to enter the UK market and compete with incumbents. This problem was mentioned as one of the ZCH failure reasons which led to a lack of competition and incentive within incumbents in improving the quality of houses and transition towards sustainability. Evidently, the political will to mitigate this oligopoly in the housing industry does not exist yet. According to Interviewee P1:

“In terms of the production of individual homes, there are plenty of firms that can do this. Now, the issue is less the capability and the design. There are a lot of firms that can produce homes that are energy and heat efficient and some can even produce net zero-carbon homes. That isn’t too much of a challenge to do. It's been done so well, for over a decade and it's been done in a large number of countries. So there's no challenge of capability. The big challenge is around capacity and that's a challenge that's been created by the stakeholders that the large housing developers have on land availability and supply. Because that imposes an economic constraint on the scale to winch some of the smaller firms, which have got the better designs and are more sophisticated manufacturers of homes can reach and the change for us is really been to change the approach of the large housing developers because the only alternative to that would be a very large scale public sector intervention in the land market in the UK, which is politically very difficult to do
and would be extremely expensive to do as well. It would be a very radical policy choice for a government to adopt. We will never be willing to take on the powerful political lobby of incumbent housebuilders and we will suffer the consequences of that.”

Not only this problem has not been solved, but also it has got worsened compared to the ZCH era. The complexities around the ZCR requirements in the housing industry make it even harder for SME housebuilders to compete with the incumbents. Interviewee I7 states:

*I never worked for an SME housebuilder but if I was, my head would be spinning now with the concepts of not only ZCR homes but zero-carbon embodied homes with requirements on biodiversity, reduction in water consumption, over-heating, indoor air quality, and so on. We have got a massive team in the xxx company, and we are working full hours with the internal team to keep up with such challenges.*

Although Future Homes Hub is established to do all the heavy technical work and support the housebuilders, the difficulty in securing land and obtaining permission to develop are still the main challenges for small housebuilders to compete with incumbents. Incumbent land possession skills along with their huge financial resources and expertise show their crucial role in transitioning the housing industry that cannot easily be replicated.

6.4.3. The ZCR organisational learning

The common business model for incumbent housebuilders in the UK has been fundamentally focusing on land acquisition and speculation as key business drivers (Payne, 2015). It has been claimed that the main priority of housebuilders has always been the acquisition of the best possible land rather than design or process innovation (Adams and Watkins, 2008, Adams and Tiesdell, 2012). This business model benefits from house price inflation as well as economies of scale resulting from standardisation in housing products and materials (Gibb, 1999). However, it also can be negatively influenced by uncertainties related to sales values, costs, or “unanticipated systematic risk in the structure of housing provision (such as house price deflation or skills and materials shortages)” (Payne, 2015, p. 10). Consequently, any substantial changes in the house production process (such as decarbonisation) have not been welcomed by the incumbents. The ZCH policy mix, while being dismantled, resulted in many
organisational learnings in the housebuilding industry towards sustainability and decarbonisation. The housebuilders are now aware that decarbonising their houses has become a ‘must’. Expert E2 states that:

“The most likely scenario over the next 10 years is that the UK housing market will not fundamentally change. It will continue to be dominated by a relatively small group of large firms. But the business model of those firms will change quite significantly. I can't see how major housebuilders can continue to operate in the way they have operated for the last 40 years.”

The unavoidable change in the housing industry has pushed housebuilders to benefit from the upcoming changes in Building Regulations by becoming the first adopters. Interviewee I5 highlights the advantages of this change towards sustainability:

“There is a massive opportunity, particularly for new-built houses. The government is looking to phase out gas boilers in second-hand houses by 2035 and people are thinking ahead if they want to have a new-built or a second-hand home. The second-hand homes will come with significant bills for increasing levels of insulation, upgrading the fabric, and retrofitting heat pumps. This is going to push people towards new-built houses. It is also a competitive advantage for large builders because of all the complex requirements not just on the carbon agenda, but on biodiversity, water, place-making, and design. There are so radical changes all at once that SME housebuilders are going to get dizzy with the amount of change that occurs. So, I am seeing this beneficial for large-scale housebuilders.”

Therefore, incumbent housebuilders have changed their attitude towards sustainability compared to the ZCH era. Interviewee P2 explains this change with the statement: ‘that which cannot be resisted should be embraced’. Moreover, the finance sector is much more engaged in the housing industry and net-zero conversations compared to the past. The recent investments of financial companies and banks such as Goldman Sachs64 and Legal & General Capital13 in the UK housing industry have also encouraged housebuilders to improve their performance. This can also encourage other banks and financial sectors to move into investing

64 Financial Times (2022): Goldman-backed housebuilder to build Europe’s largest home factory in the UK
in the housing industry which has the potential to change the dynamics of the market and shift patterns of investment and activities towards sustainability in this sector (P1).

Such incentives have led to many initiatives from the incumbent housebuilders to build ZCR homes. One of the biggest organisational learnings from the ZCH policy mix is learnings from the collaboration in the AIMC4 project. The successful collaboration between different housebuilders, suppliers, government parties, and research institutes during the AIMC4 project resulted in many innovations – particularly non-technological. After the dismantlement of the ZCH policy mix, the housebuilders in AIMC4 continued this network. In 2019, those housebuilders started a three-year research project with some technology manufacturers, material suppliers, construction companies, housing trusts, and innovation centres. The new collaboration project is called Advanced Industrialised Methods for the Construction of Homes (AIMCH). The AIMCH project aimed to tackle the housing sectors challenges such as skill shortage, ageing workforce, poor productivity, and low affordability (Barratts Developments, 2019). Interviewee I4 indicates:

“We learned a lot from AIMC4 between 2009 to 2012. Although the number of houses that we built in that project was limited, the communication between all stakeholders in that project and the fundamental research behind it helped us to understand the zero-carbon concept, its feasibility, and customers’ requirements. That has affected how we build homes now. AIMCH is our attempt to keep this collaborative innovation as the next iteration of AIMC4.”

Such organisational learnings by UK incumbent housebuilders have led to many changes in housebuilders' business models that have the potential to radically change their main business models over time. Two business models that are emerging in the housing industry are build-to-rent construction and off-site construction. Build-to-rent business model refers to the construction of houses designed for rent rather than sale and it usually offers longer tenancy agreements65. These emerging business models help the housebuilders professionally manage the house themselves and economically benefit from the energy savings of zero-carbon homes.

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65 UK Government: Guidance on build to rent.
Off-site construction refers to the completion of construction components at a different location which is usually industrialised. The built components then are transferred to and assembled at the site where the building will be located permanently. Off-site construction makes it easier for housebuilders to comply with different standards such as fabric and air tightness. Recently many of the big housebuilders are beginning to invest in the off-site production of homes (P7). Interviewee A3 states:

“If you industrialize the production of homes, you produce building elements in factories to a much higher specification and in a controlled environment where you are confident that you can minimize the errors and defects. You simply can’t produce buildings consistently to the quality that’s required if you use traditional on-site construction techniques. So that has galvanized a change in approach which is much more coherent and joined up across all of the involved manufacturers. This trend will continue. We have gone beyond the level of experimentation now. We have seen very significant financial commitments being made by big firms in this. In 5 to 10 years, housebuilders will all be producing the majority of their development using off-site. And their current construction techniques and on-site elements of their business will dwindle dramatically.”

Although ZCH did not achieve its ultimate policy goals, the 10-year period offered a great stage for housebuilders to learn new skills and get familiarised with the decarbonisation of new homes. At the end of the discussion in the expert panel, expert E3 indicated that:

“I think people were probably a little harsh on ZCH policy. Although it did not achieve its overall aim, it transformed the fabric of new-build homes. It also set up the zero-carbon hub and the concept of collaboration between different actors in projects such as AIMC4. Moreover, it showed us how costs can come down. Back in 2006, people were talking about 20-40 thousand pounds extra cost on zero-carbon homes, but it came down to a couple of thousand pounds in the end. So it did actually do a tremendous amount of good. We would not be in the place we are now without it.”

66 Willmott Dixon: Factory assembly of key project elements means faster deliver and better quality
6.5. Discussion and conclusions

This paper analysed the concepts of policy failure and policy learning in the sustainability transition context. By investigating the nature of policy failure in a failed transition policy mix (ZCH), the paper attempted to track down the learned lessons in a current transition policy (ZCR) in the UK. Various data sources including interviews with major stakeholders, archival data, expert panels, and observations were used to triangulate the information on both previous and current transition programmes. To learn from the previous transition policy mix, this paper was drawn on the specific types of failures involved in ZCH related to the programme, process, and political sources. The lessons learned are also analysed in both policy (policy learning) and industry worlds (organisational learning). The aim was to see whether the government and housebuilders have structured the learnings from the ZCH experience and developed mindful approaches for the new transition policies such as ZCR.

Previous literature has argued that although policy failure can be a source of valuable lessons for policymakers, it rarely triggers learning processes and often gets repeated (Moran, 2001). Even collective processes of policy evaluation cannot guarantee that lessons will be applied in future. Allen and Gunderson (2011) argue that often the governments are aware of the failure reasons and the resulting lessons, but they take them for granted as the required actions are too difficult from political, economic, or logistic perspectives. Such behaviour was also witnessed in ZCR programme. The results showed that many ZCH mistakes/problems are only partially corrected or even repeated in the ZCR policy by the UK Government. While there are some signals of instrumental, social, and political learnings and reforms, the risk here is that the shallow, partial, or wrong learnings from the ZCH policy mix can result in macro-level failures in the future. More specifically, the main learning and reforms in ZCR policy have been on instrumental and technical parts of the policies. However, as Howlett (2012, p. 550) argues, “an emphasis only upon technical learning may not lessen, but in fact contribute to a continued lack of policy success, that is repeating over and over again the errors of the past, often developing ever more precise and detailed programme and plans with still little chances of overall success.”

Blaming the previous governments for not reaching the initial goals in ZCH did not help in learning from the failure to develop alternative strategies or improved courses of action. The question is although the ZCH did not survive the change of government and was widely
condemned by opposition parties and media, does it constitute a policy failure? The results showed that the housebuilders were quite successful in learning from the ZCH programme. The resulting organisational learning proved that the ZCH policy mix did set the foundations for transitioning to zero-carbon homes in the UK and if it was not dismantled the industry could achieve the net zero goals much sooner than what the Government is aiming for now. The recent changes in housebuilders' business models indicate the key role of incumbents’ organisational learning in strengthening the link between failure and learning in a transition programme. This highlights the importance of perception and interpretation of how a policy failure is conceptualised. As Dunlop (2017, p. 10) argues, “failure and success sit alongside each other underpinned by ongoing learning process”. Therefore, while the previous studies have considered ZCH a failure, this paper revealed that although ZCH was an imperfect attempt at sustainability transition, the policy can be regarded as partially failed while also being partially successful. It is important to consider this inevitable complexity in policy evaluation as a goal-based evaluation can lead to flawed initiatives by governments. As Ingram and Mann (1980b, p. 20) argue “the goals of policy are often not what they seem to be, and it is a mistake to take stated purposes too literally”.

This paper contributes to both transition and policy literature. By analysing a failed transition programme, the nature of the failure was identified to highlight the challenges and barriers with transition programmes. Since it has been more than 10 years since the announcement of the ZCH policy mix, the consequences of the ZCH failure in both policy and industry world were investigated. Also, the time-distant comparison between the previous and current transition policies in the housing industry helped to identify the actual and potential policy and organisational learnings resulting from the previous transition failure. The identified learned or unlearned issues within the ZCR programme can help provide applicable lessons for the policy and industry world to further improve their future actions towards sustainability in the housing industry. Understanding the lessons before and after failure is crucial in creating the will to change from the reflections. Although this paper has focused on the current and near-future policies on decarbonising the housing industry, a more forward-looking approach can provide more long-term insights for the future to help the main stakeholders in this industry build the required skills and capabilities and prepare for any possible challenges. Foresight methods such as scenario planning and road mapping can be implemented for further studies.
Chapter 7. Conclusion

Figure 7.1. Chapter 7
7.1. Introduction

This doctoral research has investigated the notion of transition policy mixes and their influence on incumbents’ business models. This thesis is based on the research problem: How do interactions between governments and incumbents affect socio-technical transitions towards sustainability? So far, the thesis comprises 7 chapters exploring this research problem. In Chapter 1 the context of the research, research problem, research questions, philosophical orientation, research audience, and thesis structure are introduced. In Chapter 2 the main theoretical background on sustainability transitions, governance of transitions, and business models is discussed. Chapter 3 explores the theoretical and practical gaps within the literature and provided three sets of questions:

RQ1) How can transition policies affect incumbents’ business models towards sustainability transitions?
RQ2) How can a transition policy mix be designed to support firms’ business model adaptation and innovations necessary to bring about transitions towards sustainability?
RQ3) To what extent do transition failures lead to learnings and new understandings of ways to accelerate sustainability transitions?

This thesis responds to these questions through three different research papers (Chapters 4, 6, and 7). This chapter summarises the key findings in relation to each question from the research papers and concludes the thesis by discussing the policy implications, contributions, limitations, and suggestions for future research.

7.2. Addressing the research questions

The underlying motivation for this doctoral research was to explore the influence of transition policy mixes and incumbents’ business models and their adaptation towards sustainability transitions. Although incumbents and their business models have a significant role in transitioning a socio-technical regime towards sustainability, they have remained under-researched in the transition policy literature. Transitions literature often considers incumbents and their business models as the main source of inertia. However, incumbents can be also a source of transformational change if they adapt their business model towards sustainability. This is due to their deeper financial, human, and intellectual capital, which has the potential to
drive radical transitions (Trencher et al., 2021, Köhler et al., 2019). This thesis shed light on the influence of transition policy mixes on incumbent business models along conceptual and empirical dimensions resulting in three journal-format papers.

The first research question, “how can transition policies affect incumbents’ business models towards sustainability transitions?” and its sub-questions are addressed in Chapter 4 through a combined literature review technique including a semi-systematic literature review and an integrative literature review. The semi-systematic literature review provides an overview of the literature on transition policies, their research pattern, themes, and potential knowledge gaps. The insights from this phase lay the foundation for an integrative literature review. The integrative literature focuses on the publications on transition policies and business models, which leads to a conceptual framework depicting the influence of transition policy mixes on strategies for business model adaptation towards sustainability. The contribution of this chapter is two-fold. The first contribution is the conceptual framework, which indicates how policy mixes could enhance drivers and address barriers, resulting in the effectuation of two types of business model adaptation strategies by incumbents – exploration and exploitation. The chapter argues that inducing any changes in incumbents’ business models requires transition policy mixes to consider addressing the three different barriers: (a) the policy-related barriers within policy mix building blocks such as policy strategies, purposes, instruments, and design features and characteristics; (b) the perception barriers related to managerial cognition and risk aversion; and (c) the dynamic capability barriers related to the required resources, skills, knowledge, partners, and competencies to change. In other words, transition policy mixes and their specific building blocks affect incumbents to adapt their business models by influencing their perception and dynamic capability. The second contribution is methodological – that is, the adoption of a two-pronged approach comprising a semi-systematic and an integrative literature review to provide insights on a dispersed set of literature and then focus on the knowledge gaps to present a research agenda for future studies or provide a theoretical or conceptual framework of the phenomenon.

The second research question, “how can a transition policy mix be designed to support firms’ business model adaptation and innovations necessary to bring about transitions towards sustainability?”, is answered in Chapter 6. However, to be able to scrutinise the dynamics within this transition programme, Chapter 5 first provides an overview of the UK housing industry and its main challenges, i.e., housing affordability and housing sustainability. This
chapter also presents a brief history of *UK housing policy* since the Second World War. Knowing the history of UK housing policy helps to contextualise the focus of this research and to understand the possible rationales behind the decisions made since 2006. Chapter 5 also provides the basis for addressing RQ3 where ZCR policy is used as the case study along with ZCH. In essence, Chapter 5 provides a detailed explanation of the ZCH policy mix and its instruments due to its importance in both empirical papers.

By analysing a failed transition policy in the past (ZCH), Chapter 6 analysed the reasons for transition failure. The ZCH case study helps to find the required features for a successful transition policy mix in an antithetic way. By finding the missing features that led to the failure of the transition policy mix, the chapter highlighted the cruciality of such features in a successful transition policy mix. To do so, it investigates the ZCH transition to analyse incumbents’ attempts to protect or adapt their business model in response to the government’s policy mix. The chapter contributes both to the transition policy and business model literature by considering some of the gaps identified in Chapter 3. First, instead of a techno-centric study on transition policies and sustainability transitions, this paper moves *beyond technological developments* in the industry and considers housebuilders' business models as the unit of analysis to provide a broader perspective on firm-level adaptations required for transitions. Second, by focusing on this industry and its main actors – house builders, suppliers, and customers as well as the government bodies related to UK housing – the chapter provides a *zoomed-in perspective* to show all the micro-level dynamics between them and the challenges arising from such dynamics within a socio-technical regime. Third, it provides an *empirical analysis of a policy mix* by selecting ZCH as the case study and analysing its building blocks and policy instruments and their influence on incumbents’ business model adaptations. Lastly, it focuses on *incumbents as the sources of inertia as well as sources of change and innovation*. It highlights the reasons the incumbent housebuilders could not adapt their business models to bring about transformational changes in the housing industry towards sustainability. This helps to understand the required considerations for future transition policy mixes to facilitate incumbents’ business model adaptation.

The third research question, “*to what extent do transition failures lead to learnings and new understandings of ways to accelerate sustainability transitions?*”, is answered in Chapter 7. Chapter 7 responds to the question in another case-study research focusing on both ZCH and ZCR. The failed ZCH transition provides valuable learning opportunities to reconsider the
existing dominant causal reasoning underpinning the UK housing policies and to redesign policies based on learnings from ZCH. By investigating the nature of policy failures in the ZCH failed transition in 2006, this chapter identifies lessons that are relevant to the current ZCR transition policy in the UK. The contribution of this paper is two-fold. First, it contributes to the literature on sustainability transitions by bringing a forward-looking approach by learning from a failed transition and focusing on current and future transition policies. Unlike most transition studies that focus on ‘historical data’ to analyse ‘successful examples’ of sustainability transitions, this paper analyses a failed transition and highlights the lessons from it in a transition programme that was recently announced and is going to be in force in the future. Second, it contributes to the literature on transition policies by identifying the learned and unlearned by governments and firms after a failed transition programme. The elapsed time since the announcement of the ZCH policy mix helps to investigate the consequences of the ZCH failure in both policy and industry worlds. This approach helps improve the current and future policies in accelerating transitions. The results of this chapter show that the UK government has partially corrected the ZCH problems in the current ZCR programme. Also, some of the previous problems still exist in ZCR, even though shallow and partial learnings from the transition failure can increase the chance of macro-level failures in the future. However, the results show that incumbent housebuilders were quite successful in learning from the ZCH programme. The resulting organisational learning suggests that the ZCH policy mix did set the foundations for transitioning to zero-carbon homes in the UK and if it were not dismantled, the industry could have achieved the net-zero goals much sooner than what the Government is aiming for now. Therefore, while previous studies have considered ZCH a failure, this chapter suggests that although ZCH was an imperfect attempt at a sustainability transition, the policy can be regarded as partially failed while also being partially successful.

7.3. Critical Reflection

In Chapter 3, I explained the research gaps within the literature on sustainability transitions, transition policies, and business models. This chapter set the rationale behind the three research questions. In the previous section, a summary of answers to the research questions and the resulting contributions were discussed. In general, the message of this research can be summarised in three points.

First, policymakers can accelerate transitions by bringing incumbents into the equation not only as resisting forces, but also as change agents with powerful resources that can provide
transformational change. However, to trigger this transformational change, policymakers should design the transition policies in a way that considers all the important elements of incumbent business models, i.e., their supply chain partners, key activities, capabilities, customers and their preferences, and their financial models. This can help incumbents to build their capabilities in the direction of changing towards sustainability. Neglecting such factors can lead to incumbents’ resistance in different forms such as lobbying, circumvention, and minor changes in their business models.

Second, it is very important for transition policies to show the inevitability of changes towards sustainability. Problems in designing and implementing policies that influence the policies’ reliability and credibility can induce the perception that circumvention of the policies is possible. This will lead to resistance to change or only marginal changes from the incumbents. Although the recent ZCR policies do not provide a very strong perception of the inevitable change, the changes in the landscape – such as increased energy prices and societal awareness – provide enough perception of urgency and inevitability of a societal change towards sustainability. This has led to recent initiatives from incumbent housebuilders to build more sustainable houses.

Third, evaluating and criticising a transition programme cannot be limited to the final objectives of the policy. Due to the complexity and difficulty in achieving sustainable objectives, one cannot merely judge a policy for failing to completely reach its initial objectives. More importantly, completely dismantling a partially failed transition policy mix not only fails to solve the problem, but it creates many unintended consequences for both policymakers and industry actors. It is important to add the evaluation and monitoring phases during the implementation of transition policy mixes so that the reflected learnings can be added to the next rounds. This constant reforming and improving transition policies can help to mitigate the failures and get closer to the initial objectives.

### 7.4. Implications for policymakers

This research provides the basis for analysing sustainability transitions and transition policies beyond technological innovation and adoption. It provides a basis for comprehending how incumbents’ business models can act as a source of inertia or transformational change based on the characteristics and features of transition policy mixes. Two main policy implications are provided. The first is the significance of the incumbents’ business model itself in transition
programmes. This thesis showed that turning a blind eye to incumbents’ business models and merely focusing on technological developments and technical specifications can lead to possible failures in the progress of a transition policy mix towards sustainability. A technological focus can lead to a narrow perspective on sustainability transitions and increase the risk of oversimplifying the other change drivers in sustainability transitions such as institutions and non-technological innovations. However, business models, due to their systemic characteristics, provide a more holistic view of activities being performed in the socio-technical regime by incumbent firms with their main stakeholders such as suppliers and customers. The systemic perspective provided by considering business models helps to scrutinise the entire socio-technical regime and its transition towards sustainability. This approach helps policymakers to understand better the factors that can influence incumbent strategies towards changing and adapting their business models, identify the sources of inertia in incumbent firms, address the barriers with appropriate measures, and use incumbent capabilities and resources to bring about transformational changes towards sustainability.

The second implication is the question of important considerations for designing transition policy mixes – both from policy and incumbent perspectives – in order to avoid possible failures. Although governments might be reluctant in accepting failures due to their blame-avoidance nature, it is important to analyse the reasons behind an important transition policy mix and the reasons behind its failure to reconsider its initiatives towards sustainability. In particular, the empirical context of this research can provide insights for major reforms in the governmental policies in the UK housing industry. This industry has always been a key subject of mainstream political discourses since it plays a significant role in achieving the 2050 net-zero targets by the government. The housing affordability and sustainability problems discussed in Chapter 3 call for a clear, robust and decisive policy mix for transitioning this industry. The focus on the underlying failure reasons can help policymakers to identify the roots of the UK’s chronic housing problems from a systemic perspective and take drastic steps to ensure such problems are solved in the future in collaboration with incumbent housebuilders.

The analysis of possible policy and organisational learnings from ZCH and applying them in the ZCR programme provides future pathways and required reforms for both governments and housebuilders. The recent initiatives on ZCR and Future Homes Standard are a new start that could be built upon through a set of measures designed based on the learnings from the ZCH experience.
7.5. Limitations and future research

This study provides a detailed investigation of the influence of transition policies on incumbents’ business models. However, inevitably there are limitations in this study. Given this PhD thesis had to be completed within a stipulated time frame there are some aspects which could not be fully explored. In drawing attention to such limitations, however, it is possible to pave the way for future research avenues that may be worth exploring.

The first set of limitations relates to the conceptual research paper i.e., Chapter 4. The results are based on using bibliometrics and content analysis, analysis and contextualization undertaken by the author. I recognise that such analysis can be critiqued for researcher bias. Attempts have been made to reduce such bias by using a very clear research design and using a combination of methods that also enable triangulation to some extent. However, as a next step, the bringing of expert judgement to the bibliometrics and to the content analysis would allow for possibly broader interpretive assessment. This could enable further enhancing or providing context to the existing results.

Secondly, a comprehensive dataset has been used for the analysis in this paper based on the articles collected from the Scopus database. However, only English language articles have been covered. There is a limitation of not covering articles in other languages. Also, there is a burgeoning rate of growth of transition policy-related articles. It is infeasible to constantly update the dataset to include the articles that are being published almost on a daily basis. A study in the future to understand how the research landscape is changing temporally compared to the current understanding presented in this thesis will be a fruitful direction of inquiry.

Thirdly, the limitation on empirical contextualisation of the conceptual paper refers to a lack of an empirical analysis of the relationship between policy mixes and firms’ business model adaptation strategies. This is important because establishing direct causal links between transition policies and business model adaptation strategies is difficult because of the many complex variables between the two and the role of different contexts in this relationship. Although this paper only focuses on the literature and conceptually depicts the influence of transition policy mixes on business model strategies, the next two papers compensate for this limitation. It should be noted that this conceptual paper only attempts to depict the influence of transition policies on incumbent business models. Adding the feedback loop to the
Transition policies and incumbents' business models: From resistance and system failure to learning and adaptation

framework can make it more comprehensive since incumbents can also shape their environment and transition policies. Adding incumbents' influence on transition policies can show the two-way evolutionary relationship between these two actors in the socio-technical regime. Such a framework can present new avenues for further research on sustainability transitions and transition policies.

The second set of limitations is related to the empirical papers that study the ZCH and ZCR transition programmes in Chapters 6 and 7. First, these papers only focus on one industry, i.e., UK housebuilding. While this provides interesting results, if such transitions are explored within different industries, then results can be compared and contrasted. A multi-industry study would enable researchers to bring some insights into sustainability transitions in a range of industry contexts. Also, the two empirical papers investigate a failed transition policy mix (ZCH). Considering successful policy mixes in other industries (such as Norway’s electric vehicles) can help to generalise the findings. Further empirical research including the consideration of niche-level firms and SMEs along with incumbents seems necessary to deliver more generalised recommendations for designing and implementing policy mixes to accelerate transitions. Although this paper only focused on new-build residential houses, adding other types of buildings – such as non-residential or social housing – and sustainability projects – such as retrofitting old houses – can help to enrich the findings. Also, bringing examples of transitions in different countries can help to examine the rationales behind different governmental decisions and policies based on their national contexts.

One of the limitations of the empirical papers is the difficulty of getting a sense of how the internal business models of housebuilders really work. Also, it is difficult to identify the specific parts or elements of a transition policy mix in which the incumbents take into account more for complying. Although I tried to uncover the black box of business models and their elements in sustainability transitions, this research is limited in that it relies heavily on the collected data and my own interpretations of archival documents and interviews. Expert panels helped a lot to discuss the hidden challenges in the transition programmes as they brought together representatives of the main actors in the programme. However, there is a need for a more in-depth analysis of incumbents’ business models. This was not possible during my research as the thesis was impacted by COVID-19 lockdowns and limitations. Consequently, there had to be a heavier reliance on archival documents and online interviews. In-depth field
studies can help to uncover hidden insights about housebuilders' business models in the context of the UK housebuilding industry.

The third paper (i.e., Chapter 7) focuses on the current and near-future policies on decarbonising the housing industry to investigate the learnings from the failure of the ZCH policy mix and provide suggestions for further learning. However, there are still many open questions regarding the future situation of the housing industry and sustainability. Especially due to the recent landscape forces such as the pandemic and Ukraine war (discussed in Chapter 7), the future of housing and energy security is blurred. How will the skyrocketing energy prices influence future business models in the housing industry? Will the energy crisis lead to a more sustainable mode of building houses? A more forward-looking approach can provide more long-term insights for the future to help the main stakeholders in this industry build the required skills and capabilities and prepare for any possible challenges. Foresight methods such as scenario planning and road mapping can be implemented for further studies.
Appendices

Appendix 4A

Geographical perspective of literature on transition policy mixes

Bibliometric studies usually consider the number of publications to measure productivity, and the number of citations as an influence (Martínez-López et al., 2018). Figure 0.1 presents the network of the top influential and productive countries in the governing sustainability transitions literature. The size of the circles represents the number of publications. In contrast with most scientific literature where the United States and China are the leading countries in the number of publications because of their population and other institutional factors, the most productive country is the United Kingdom. This is followed by the Netherlands, Germany, the United States, Finland, Sweden, and Canada.

![Network visualisation of the most productive and influential countries](image)

**Figure 0.1.** Network visualisation of the most productive and influential countries

To detect the possible reason behind this, the funding information of publications was analysed. According to Etzkowitz and Kemelgor (1998) funding has a palpable influence on research production and its direction. Funding and financial support for research are particularly important in scaling up emerging scientific fields either by expanding collaborations or by attracting attention to produce research publications (Bordoloi et al., 2021). This is aligned
with funding available in the United Kingdom and other leading countries. Out of 1232 publications in the dataset, around 42% or 526 research outputs acknowledged one or more funders. In the United Kingdom funding bodies such as UK Research and Innovation, Economic and Social Research Council, and Engineering and Physical Sciences Research Council supported the most papers within the corpus. Many publications in Europe were also supported by the European Commission, Horizon 2020, the Seventh Framework Programme, and the European Research Council supported the research on transition policies.

In Figure 0.1 the colour shows the average citation per publication in each country, and the thickness of the lines indicates the strongest co-citation links between countries. The United Kingdom with 12,838 citations, the Netherlands with 12,618 citations, and Germany with 5,196 citations are the top three countries with the most cited articles. Although other forces such as institutional networks, reputational influences, and geographical proximity of researchers also play a role in the number of citations, citation frequency is mainly used to demonstrate research quality, significance, and impact (Cole and Cole, 1974, Durieux and Gevenois, 2010). These highly cited countries have also the strongest co-citation link with each other. According to Reader and Watkins (2006), there is a strong link between the patterns of co-citation and the social interaction of researchers. Researchers with higher social interaction tend to exchange papers and ideas more which may lead to “subsequent development of a scientific community’s networks, facilitating some trajectories and impeding others” (Aldrich, 2012, p. 1247). To verify this a co-authorship network analysis was also carried out which confirmed these three countries have had the most joint publications with each other, leading to strengthening their citation profile with replicated and validated publications.
Appendix 4B

Thematic perspectives of literature on transition policy mixes

Thematic or content analysis is a commonly used technique to identify, analyse, and report key themes within a scientific field (Braun and Clarke, 2012). Although thematic analysis is usually a qualitative technique, it can be facilitated through some quantitative tools such as text mining or statistical analysis (Rezaeian et al., 2017). In the previous sections, different ways of conceptualising the role of governments and policies in transitions were identified through trend analysis, content analysis, and network analysis of publications. In this section, the main themes (contexts) that are considered important subjects of empirical investigation within the field of transition policies are identified.

First, the title, abstract, and keywords of the papers were broken into words and phrases. Then the list of keywords/phrases was manually filtered to select the most relevant keywords and remove generic ones such as sustainability transitions, governance, policy, article, case study, survey, or the name of countries. This is of importance as such broad and general terms can influence the results as they are common words in many different themes. After filtering the main keywords, the VOSviewer software was used to identify, cluster, and visualise the main themes based on the frequency of keywords and their co-occurrence with others. Figure 0.2 presents a co-occurrence network of the most common research themes and their sub-fields.

As indicated, the most common themes within this field can be categorised into five clusters. 

**Energy transitions** (Kern and Smith, 2008, Seyfang and Haxeltine, 2012) in one of the hottest topics in transition policies with a focus on renewable energies such as solar (Hoppmann et al., 2014, Marchi et al., 2018), wind (Reichardt et al., 2016, Normann, 2017), and biofuel (Castanheira and Da Silva, 2010, Levidow and Papaioannou, 2014). **Sustainable transportation** and electric vehicles as promising technologies in transitions towards sustainability are another common themes in this database (Santos et al., 2010, Auvinen et al., 2012, Steinhilber et al., 2013). The next cluster of publications belongs to **urban transitions** with subfiles such as urban resilience (Crowe et al., 2016, Meacham, 2016), water management (Brown and Keath, 2008, Rouillard et al., 2016), sustainable cities (Nevens et al., 2013, Dassen et al., 2013), and smart cities (Rønne, 2018, Mora et al., 2021). **Sustainable food** (Marsden, 2013, Galli et al., 2020), environmental forest policies (McDermott et al., 2010, Zulu, 2010), biodiversity (Gomar, 2014, Otero et al., 2020), and sustainable agriculture (Grin, 2012, Konefal, 2015) represent the fourth
The last thematic cluster represents the words related to *technological innovations/change* (Reichardt et al., 2016, Raven and Walrave, 2020) towards sustainability and its frameworks such as multi-level perspective (Kern, 2012, Ehnert et al., 2018). In this map, the distance between each keyword shows the extent to which they belong to similar themes. As this is a general context in which many empirical studies can benefit from to conceptualise or theorise transitions, this cluster has been located in the centre of the network.

**Figure 0.2.** Co-occurrence network of the almost 500 most frequent words/phrases covering the five themes
Appendix 4C

Table 0.1. A summary of 13 publications on transition policies that analyse business models

<table>
<thead>
<tr>
<th>Reference</th>
<th>Context</th>
<th>Policy</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Saleh and Mahroum (2015)</td>
<td>Built environment – General</td>
<td>Green policy instruments in terms of ‘sticks’, ‘carrots’ and ‘sermons’</td>
<td>Provides a critical review of business models that have emerged in response to three types of policy regimes. The paper finds that most green business models in response to sticks tend to pass costs to others and skirt around the stick of regulation. Those that emerge in response to carrots aimed at capturing a temporary gain and those that emerged in response to sermon-orientated policies show a tendency to diffuse even in the absence of supportive fiscal conditions.</td>
</tr>
<tr>
<td>Bolton and Hannon (2016)</td>
<td>Energy Services Companies (ESCo) – United Kingdom</td>
<td>Low carbon energy policy and heat decarbonisation strategy</td>
<td>Analyses the interfaces between business models, energy infrastructure and institutions. The paper shows how a system-based approach to the analysis of business models as embedded in their socio-technical contexts can offer new insights into the dynamics and governance of sustainability transitions.</td>
</tr>
<tr>
<td>Bontoux and Bengtsson (2016)</td>
<td>General – European Union</td>
<td>Fiscal policies</td>
<td>Constructs four scenarios by fiscal policy mixes (supportive or not supportive) and social values (individualistic or collaborative) to identify which policy mixes would be best adapted to push for a more sustainable future. The results showed that research and innovation, new business models and education were important for all four scenarios.</td>
</tr>
<tr>
<td>Herbes et al. (2017)</td>
<td>Renewable Energy Cooperatives (RECs) – Germany</td>
<td>Feed-in tariff</td>
<td>Identifies new models in Renewable Energy Cooperatives (RECs) in Germany as a result of changes in Germany’s feed-in tariff and characterises the implementation barriers RECs face. The paper argues that the RECs have three strategic options as a response to policy changes: (1) Closing down, (2) Stagnation, (3) Growth through employing professional management, merging with other ERC, or cooperation.</td>
</tr>
<tr>
<td>Nußholz et al. (2019)</td>
<td>Building sector (construction material) – Denmark and Sweden</td>
<td>Multiple policy instruments at the EU and Member State level</td>
<td>Provides an understanding of the relevance of secondary material for decarbonisation of the building sector, as well as the interplay of business model innovation and policy instruments in this transition. The paper argues that public policies that can help companies remove barriers include (1) incorporating the reuse of higher material value in construction and demolition waste targets, and (2) incentivising waste collection and recovery markets to offer recovered material at a higher value.</td>
</tr>
<tr>
<td>Mirzania et al. (2019)</td>
<td>Community Renewable Energy projects – United Kingdom</td>
<td>renewable support policy instruments</td>
<td>Analyses the impacts of policy changes on Community Renewable Energy (CRE) projects in the UK. The paper indicates that the strategic approaches that CRE groups have undertaken or are planning to undertake in response to the recent changes in government policies are: (1) discontinuing their business, (2) stagnation (focusing on managing existing assets, or buying other operational projects running under old tariff), (3) evolve/growth (changing the type of activities, experimenting new business models).</td>
</tr>
<tr>
<td>Specht and Madlener (2019)</td>
<td>Energy supply industry – Germany</td>
<td>Energy regulations such as Renewable Energy Sources Act (EEG)</td>
<td>Analyses the transition process of business models in the energy supply industry and identifies regulatory obstacles. The paper results that many of the legal advances are either inconsistent, incomplete, or immature. The requirements were detected as: (1) a stronger mandate for the regulator to publish more detailed grid data, (2) defining consistent standards, and (3) a steady, intensive, but balanced political discourse that, on the one hand, guarantees customer protection but, on the other hand, avoids stirring up rather irrational fears.</td>
</tr>
<tr>
<td>Giraldo Nohra et al. (2020)</td>
<td>Interreg Europe RETRACE – European Union</td>
<td>General circular economy policies</td>
<td>Explores the impacts of circular economy policy design processes driven by a systemic design on a circular transition in EU regions. The paper shows that regulatory and political barriers are among the main barriers to circular economy implementation. The identified policy gaps are: (1) support collaboration between sectors, (2) knowledge among operators, (3) clear and harmonized policy regulations, (4) tailored policy measures (5) policy in support of business and market development (6) policy focused on SMEs and micro-manufacturing.</td>
</tr>
<tr>
<td>van Rijnsoever and Leendertse (2020)</td>
<td>Food industry – The Netherlands</td>
<td>General</td>
<td>Introduces the transition model canvas (TMC) based on the business model canvas (BMC) from entrepreneurship and the multi-level perspective (MLP) from transition studies, as a tool for systematically</td>
</tr>
</tbody>
</table>
### Transition policies and incumbents’ business models: From resistance and system failure to learning and adaptation

<table>
<thead>
<tr>
<th>Authors</th>
<th>Industry/Region</th>
<th>Key Elements Discussed</th>
<th>Multi-Disciplinary Aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kliem et al. (2020)</td>
<td>Gravel industry – Switzerland</td>
<td>Three policy instruments including different regulations and economic policies</td>
<td>mapping the key elements, and their interactions, with socio-technical transitions. Argues that public policies and business strategies co-evolve towards lock-ins, creating barriers in the mineral construction material industry towards sustainable production and consumption practices. The paper generates three scenarios based on perceptions regarding policy interventions. Resulting of the simulation model, the paper claims that in a market-based system, market-based interventions such as introducing a levy on the extraction of natural resources are the best option.</td>
</tr>
<tr>
<td>Demartini et al. (2020)</td>
<td>Steel, pulp, and cement industry – United Kingdom</td>
<td>Two economic policy instruments: tax and subsidy</td>
<td>Analyses the redesign of companies based on industrial symbiosis (IS) strategies and the impact of specific policies on the transition to industrial symbiosis. The paper shows that not only top-down IS can be promoted by politicians, but also a favourable environment for bottom-up self-organized IS could be created using specific economic and fiscal policies, for example, tax incentives, and economic subsidies for industrial plants which involve an IS or landfill tax.</td>
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<tr>
<td>Sovacool et al. (2021)</td>
<td>Food and beverage industry – United Kingdom</td>
<td>General</td>
<td>Presents a critical and systematic review on the topic of greenhouse gas emissions from the food and beverage industry. The paper examines the benefits of sector decarbonisation as well as barriers across financial and economic, institutional, managerial, behavioural and consumer dimensions. It discusses how financing, business models, and policy can be harnessed to help overcome these barriers and identifies a set of research gaps</td>
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<tr>
<td>Serhan and Yannou-Lebris (2021)</td>
<td>Food science and engineering – France</td>
<td>Governmental Idefi-EcoTrophelia programme</td>
<td>Discusses how sustainable policies and development goals can be translated into educational programmes, tools, BMs, and, ultimately, products and services. The paper demonstrated that the development of sustainable food BMs and products with eco-design and eco-innovation practices is possible, but it requires a systematic and multidisciplinary approach.</td>
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