



**A University of Sussex PhD thesis**

Available online via Sussex Research Online:

<http://sro.sussex.ac.uk/>

This thesis is protected by copyright which belongs to the author.

This thesis cannot be reproduced or quoted extensively from without first obtaining permission in writing from the Author

The content must not be changed in any way or sold commercially in any format or medium without the formal permission of the Author

When referring to this work, full bibliographic details including the author, title, awarding institution and date of the thesis must be given

Please visit Sussex Research Online for more information and further details

THE POLITICS OF POLICY-MIX-MAKING  
PROCESSES IN SUSTAINABILITY TRANSITIONS:  
EXPLORING THE FAILURE OF THE ZERO  
CARBON HOMES POLICY MIX IN THE UK

Duncan Edmondson,  
PhD Science and Technology Policy  
Science Policy Research Unit (SPRU), University of Sussex



SPRU  
SCIENCE POLICY  
RESEARCH UNIT

I hereby declare that this thesis has not been, and will not be, submitted in whole or in part to another University for the award of any other degree.

Signature: .....

## Abstract

Understanding the politics and policymaking processes in sustainability transitions remains a crucially important challenge (Köhler et al., 2019). A number of recent contributions in the sustainability transitions literature have started to explore these themes, drawing from various disciplines and approaches. These include theories of the policy process (for a review Kern & Rogge, 2017); power relations and agency (Flor Avelino, 2011) and institutional literatures (Andrews-Speed, 2016; Lockwood, Kuzemko, Mitchell, & Hoggett, 2017). Authors have pointed to insights which are useful for conceptualising certain aspects of the overarching multi-faceted processes of policymaking, but there is less attention to linking these ideas or approaches to processes of socio-technical change in a co-evolutionary manner. Developing such a co-evolutionary perspective can help better explain policy outputs as a result of socio-technical change, and how these outputs then stimulate subsequent socio-technical change. Understanding this dynamic relationship can also help explain policy change or stability over time.

Perhaps more importantly, many of the aforementioned contributions have only focussed on single policy instruments and their revisions over time. However, due to the scale, complexity and urgency of sustainability transitions, scholars and practitioners have increasingly recognised the need to implement combinations of multiple policy instruments, coordinated to meet an overall transition strategy (Rogge, Kern, & Howlett, 2017). Accordingly, the policymaking processes for such ‘policy mixes’ are more complex, and both their design and analysis are more challenging. However, despite several calls for more attention to processes underpinning the development of policy mixes over time, there remains little substantive conceptual development. While it is beyond the scope of a single doctoral thesis to synthesise the aforementioned multitude of insights, ideas and approaches related to policy-mix-making processes, the thesis takes a step forward in this regard. It links policymaking processes, socio-technical change, and political and policymaking institutions, to better conceptualise the development of policy mixes aimed at fostering socio-technical change towards sustainability.

The thesis first develops (paper 1) and applies (paper 2) a co-evolutionary framework to conceptualise interactions of policy-mix-change and socio-technical change over time. The framework is mostly endogenously orientated in its explanation of change, drawing ideas from policy feedback theory. The central focus is how policy design choices alter actor behaviour to induce change in the socio-technical system, and generate incentives for actors to participate in subsequent policymaking. The core idea of policy feedback is that new policy can stimulate change in ways which helps stabilise it (making it increasingly locked-in over time), or which undermine it. The thesis then turns to institutional literature (paper 3) to help explain how the interests of actors are translated into policy outputs by paying attention to the institutional structure in which the policymaking process plays out. While this approach also

contains endogenous elements, it also looks exogenously at the influence of political and policymaking institutional arrangements to analyse their influence on decision-making and policy outputs.

The thesis utilises these analytical approaches to help explain the failed transition of domestic housing in the UK, specifically focussing on the Zero Carbon Homes policy mix between 2006 and 2016. The analysis of a failed attempt of a transition not only generates case-specific insights, but also helps identify more generic implications for policymaking about negative dynamics and makes recommendations to avoid their reoccurrence. Paper 2 generate insights about: i) how a virtuous cycle can be offset, and how this could be avoided; ii) what limitations may prevent a policy mix from producing more positive feedback; and iii) how perceptions of policy mix credibility are formed and how these affect socio-technical change. Paper 3 builds upon these insights, paying attention to institutional factors which may limit positive feedbacks and affect policy mix credibility.

The main contributions of the thesis are that it develops a novel co-evolutionary framework (paper 1), produces novel insights by applying this empirically (paper 2), before zooming-in on the policy subsystem and developing three heuristic forms of institutional arrangements which contributed to the failure of the zero carbon homes policy mix (paper 3). The thesis therefore links policy design literatures with policy-process theory and political science. By linking these more explicitly, it makes a contribution to the literature on the politics of transitions by generating insights about the influence of politics in policy-mix-making processes and the co-evolutionary relationship with socio-technical change. Ultimately, the thesis derives insights which may help practitioners and analysts make more informed policy design choices by ‘thinking-through’ the potential implications of policy-mix-making decisions. Accordingly, this may enable them to make choices which are not only more likely to achieve their respective policy objectives, but may also help to maintain political support over time.

## Acknowledgements

I would like to thank supervisors Florian Kern and Karoline Rogge for the time, effort, and support they have invested in me along with the expertise that both of these inspiring, world-leading scholars have in their respective fields. I would also like to express my sincere gratitude for their patience and understanding over what has been at times a rather challenging four years, with several periods of difficulties occurring in my personal life.

I would also like to thank other scholars who have inspired me on this journey: Andy Sterling, David Hess, Joern Hoppmann, John Grin, Kemp Rotmans, Micheal Grubb, Micheal Howlett, Flor Avelino.

I would also like to thank all the wonderful people that I have had the pleasure to know throughout my time as a doctoral researcher at SPRU. Specifically:

I would like to thank Tim Foxon as head of Doctoral Researchers.

I would like to thank my colleagues in the Centre on Innovation and Energy Demand, from which this project is funded (Grant EP/K011790/1). In particular, I would like to thank the director Benjamin Sovacool, for not only being a source of warmth and inspiration, but also for engaging with me on a personal level and taking an interest in my work. I would like to thank Frank Geels, who helped show me the value of my work. I would also like to thank other members of CIED for engaging conversations: Mari Martisan, Paula Kivimaa and Steve Sorrell.

I would like to thank my fellow PhD students. Without their support and friendship this thesis would not exist, of that I am certain.

I would like to thank Norah and Tahir for being so helpful, without whom I would not have been able to attend the inspiring conferences that helped shape this journey and my personal development.

I would also like to thank the Michael and Adrian for arranging and taking-part in SPRU volleyball, which has made this difficult, final part of the journey a much more pleasant experience in recent months.

I would like to my friends. Tom for putting up with me. Dom for supporting me and challenging me in equal measures. I would also like to thank Tonya, who always fed me when hungry.

Finally, I would like to thank my mum, who has always been a rock for me in hard times, and to whose support I owe an enormous debt of gratitude.

## Preface

Politics is pervasive, affecting all areas of life. The earliest recorded thinkers engaged in the role of political institutions, and their influence on decision-making processes. Now, more than ever it seems, that in an age of ‘fake news’, the role of politics is paramount.

Seemingly, knowledge, which was regarded as “justified true belief” by Plato, is highly subjective. Consequently, the idea that policymaking is based on actual evidence, or technocratic principles, appears somewhat redundant. Politicians can apparently, even eclipse and disregard such justifiable knowledge, making outlandish claims such as Michael Gove’s annunciation that people in the UK “have had enough of experts”.

Consequently, evidence-based policymaking is being replaced by a paradigm of who is the most convincing for largely uninformed masses. This phenomena was captured succinctly in Russell’s ‘The Triumph of Stupidity’(1933), stating “the fundamental cause of the trouble is that in the modern world the stupid are cocksure while the intelligent are full of doubt”.

Even when political support for a given area is high, and when policies and even laws are passed, these can be symbolic in nature, their intention to give re-election minded politicians an opportunity to display support for momentary popular causes. The principle is to tread as lightly as possible on existing power arrangements while giving the appearance of action.

While politics and policymaking are commonly used language, and are at face value something we instinctively know, on closer inspection it is hard to define for the uninitiated, or to hold policymakers accountable for their choices. Consequently, a personal motivation which led to the resultant production of this thesis, was to ‘look behind the curtain’ of relatively hidden processes which seemingly set the course of our collective development. Ultimately, given the current challenges facing us, these processes have significant implications for my own and future generations.

What started as a personal interest motivated by an aspiration to be able to engage with what were seemingly esoteric processes, has developed into a journey of discovery which has both deepened and broadened my personal perception of the world in equal measures, in ways I could not have anticipated.

What I hope is this thesis offers an approachable, yet simultaneously nuanced, understanding of the ways in which politics affects political decision-making. More specifically, it aims to explore ways in which policymaking processes for achieving sustainability transitions can be improved in order to achieve favourable societal outcomes. Accordingly, the core motivation of this thesis is the pursuit of, and contribution to knowledge. A guiding principle in order to achieve that aim is the creation of

clearly defined concepts and mechanisms which are falsifiable, allowing further refinement and advancement.

This approach is captured, somewhat more eloquently than myself, by the late Paul Sabatier, who's own personal pursuit of knowledge, and the lasting contributions that he has made to the study of policymaking, is a remarkable achievement that will undoubtedly continue to inspire generations of scholars, as it did me.

*“Given that we have little choice but to look at the world through a lens consisting of a set of simplifying presuppositions, at least two quite different strategies exist for developing such a lens.*

*On the one hand, the analyst can approach the world in an implicit, ad hoc fashion, using whatever categories and assumptions that have arisen from his or her experience. This is essentially the method of common sense. It may be reasonably accurate for situations important to the analyst's welfare in which she or he has considerable experience. In such situations, the analyst has both the incentive and the experience to eliminate clearly invalid propositions. Beyond that limited scope, the common sense strategy is likely to be beset by internal inconsistencies, ambiguities, erroneous assumptions, and invalid propositions, precisely because the strategy does not contain any explicit methods of error correction. Since its assumptions and propositions remain implicit and largely unknown, they are unlikely to be subjected to serious scrutiny. The analyst simply assumes they are, by and large, correct—insofar as he or she is even cognizant of their content.*

*An alternative strategy is that of science. Its fundamental ontological assumption is that a smaller set of critical relationships underlies the bewildering complexity of phenomena.... The critical characteristics of science are that (1) its methods of data acquisition and analysis should be presented in a sufficiently public manner that they can be replicated by others; (2) its concepts and propositions should be clearly defined and logically consistent and should give rise to empirically falsifiable hypotheses; (3) those propositions should be as general as possible and should explicitly address relevant uncertainties; and (4) both the methods and concepts should be self-consciously subjected to criticism and evaluation by experts in that field... The over-riding strategy can be summarized in the injunction: Be clear enough to be proven wrong.”*

(Sabatier, 2007; 5)



## Table of Contents

<i>Abstract</i> .....	<i>i</i>
<i>Acknowledgements</i> .....	<i>iii</i>
<i>Preface</i> .....	<i>iv</i>
<i>List of figures</i> .....	<i>viii</i>
<i>List of tables</i> .....	<i>viii</i>
<b><i>PART I – INTRODUCTION, THEORY, EMPIRICAL CASE AND RESEARCH DESIGN</i></b> .....	<b><i>1</i></b>
<b>Chapter 1. Introduction</b> .....	<b>2</b>
1.1. Background and motivation.....	2
1.2. Theoretical focus .....	3
1.3. Empirical focus: the UK building sector .....	7
1.4. Research aim, research questions and structure of the thesis.....	9
<b>Chapter 2. Theory and literature review</b> .....	<b>12</b>
2.1. Politics of transitions .....	13
2.2. Policy mixes for sustainability transitions .....	15
2.3. Theories of the policy process and policy feedback .....	16
2.4. Institutional literature and Historical Institutionalism .....	23
<b>Chapter 3. Empirical context: Low/zero carbon housing</b> .....	<b>30</b>
3.1. Context of the UK and the role of domestic buildings in carbon mitigation .....	30
3.2. Zero Carbon Homes policy mix in the UK.....	31
<b>Chapter 4. Research Design, Methods and Data</b> .....	<b>33</b>
4.1. Case study.....	33
4.2. Data sources and collection .....	35
4.3. Data analysis.....	37
<b><i>PART II – JOURNAL ARTICLES (PAPERS 1, 2 AND 3)</i></b> .....	<b><i>39</i></b>
<b>Chapter 5. The Co-Evolution of Policy Mixes and Socio-Technical Systems: Towards a conceptual framework of policy mix feedback in sustainability transitions (Paper 1)</b> .....	<b>40</b>
Abstract.....	40
5.1. Introduction .....	41
5.2. Sustainability Transitions, Politics and Policy Mixes.....	43
5.3. Analysing policy processes: Insights from the Policy Feedback Literature.....	47
5.4. Policy Mix Feedback in Sustainability Transitions: Towards a conceptual framework .....	49
5.5. An Empirical Illustration of Policy Mix Feedbacks in Sustainability Transitions: the UK zero carbon homes policy mix .....	62
5.6. Conclusions .....	69
<b>Chapter 6. Policy mix feedback in socio-technical systems: a co-evolutionary analysis of the Zero Carbon Homes policy mix in the UK (Paper 2)</b> .....	<b>72</b>
Abstract.....	72
6.1. Introduction .....	73
6.2. Policy mix feedback in socio-technical systems: a co-evolutionary framework.....	75
6.3. Methodology.....	79
6.4. Research case.....	82

6.5.	Co-evolutionary analysis of the zero carbon homes policy mix and the house-building socio-technical system in the UK (2006-2016) .....	85
6.6.	Discussion.....	96
6.7.	Conclusions .....	103
<b>Chapter 7. The demise of the UK Zero Carbon Homes policy mix: the role of institutional arrangements .....</b>		<b>105</b>
	Abstract.....	105
7.1.	Introduction .....	106
7.2.	Policy-mix-making, institutions and sustainability transitions .....	108
7.3.	Institutional arrangements of UK house building policymaking .....	112
7.4.	Institutional arrangements contributing to the failure of zero carbon homes.....	122
7.5.	Discussion.....	137
7.6.	Conclusion.....	140
<b><i>PART III - DISCUSSION AND CONCLUSION.....</i></b>		<b>143</b>
<b>Chapter 8. Discussion of findings and contributions .....</b>		<b>144</b>
8.1.	Summary of findings/answers to research questions .....	144
8.2.	Contributions of the thesis .....	149
<b>Chapter 9. Conclusion .....</b>		<b>152</b>
9.1.	Limitations and avenues for further work.....	152
9.2.	Policy implications .....	154
<b><i>References.....</i></b>		<b>157</b>
<b><i>Appendix .....</i></b>		<b>175</b>
<b>Appendix A .....</b>		<b>175</b>
<b>Appendix B .....</b>		<b>176</b>
<b>Appendix C .....</b>		<b>177</b>
<b>Appendix D .....</b>		<b>178</b>
<b>Appendix E .....</b>		<b>179</b>
<b>Appendix F.....</b>		<b>180</b>

## List of figures

Figure 1 - Politics, Policy Processes and Policy Mixes in Sustainability Transitions.....	47
Figure 2 - Dynamic interactions of the policy mix and the rest of the socio-technical system .....	51
Figure 3 - Policy Mix for Zero Carbon Homes.....	64
Figure 4 - Dynamic interactions of the policy mix and the rest of the socio-technical system. ....	77
Figure. 5 -Annual Volume of Completed Domestic New Build (1970-2016).....	83
Figure 6 - Average Price (£) of UK property 2006-2016. ....	83
Figure 7 - Timeline of key developments in the socio-technical system in the period 2006-2016 .....	86
Figure 8 - Percentage change of property value (2006-2016).. ....	92
Figure 9 - Rotation of Government Ministers throughout the progression of ZCH .....	115
Figure 10 - Example of Government Structure in UK.....	117
Figure 11 - Attendance of Housing Ministers to meetings of the Zero Carbon Task Force.....	125
Figure 12 - Letter from the Renewable Energy Association to the Zero Carbon Task Force. ....	129
Figure 13 – Arrangement of key actors in policymaking process of ZCH. ....	130
Figure 14 - Attendees of all meetings of the Zero Carbon Task Force.....	132

## List of tables

Table 1- Theories of the policy process .....	18
Table 2 - Key components of theories of the policy process .....	19
Table 3 - Important institutional factors for sustainability transitions.....	28
Table 4- Interviewees by actor type, group, format, date and duration. ....	36
Table 5 - Archival data by type, source and quantity .....	37
Table 6 - Types of data source and quantity .....	63
Table 7 - Type, Source and Quantity of Archival Data. ....	80
Table 8 - Actor type and group of interview participants. ....	81
Table 9 - Zero Carbon Homes policy mix. ....	84
Table 10 - Summary of main developments within socio-technical system divided by four main phases .....	88
Table 11 - Number of constructed properties according to CSH level. ....	92
Table 12 - Funding mechanisms available for zero carbon homes policy mix compared to housing delivery.....	94
Table 13 - Interactions of exogenous conditions with socio-technical system and policy subsystem	103
Table 14 - Interviewees by actor group, role and affiliation.....	112

PART I – INTRODUCTION, THEORY, EMPIRICAL  
CASE AND RESEARCH DESIGN

# Chapter 1. Introduction

This chapter proceeds by outlining the background and motivation of the thesis, before situating the work in the literature to which it is contributing, and introducing the general context of the empirical focus. The chapter concludes by introducing the research aims and questions, and outlines the structure of the remaining chapters.

## 1.1. Background and motivation

*“χαλεπὰ τὰ καλὰ - Nothing beautiful without struggle.” (Plato, the Republic, 380BC)*

Climate change policy is, inherently, a deeply political matter. At COP 21 in Paris, world leaders reached a landmark agreement, aiming to limit the amount of warming associated with climate change to under 2 °C. Whilst a difficult enough task in its own right, a special report by the UN stated that 2015 levels of temperature change were already causing impacts beyond the current adaptive capacity of many people, and that reducing the limit to 1.5 °C would be needed to avoid the serious residual effects of warming (UN, 2015). Efforts to mitigate these detrimental effects will require both domestic action and international cooperation. In a manner reminiscent of the prisoner’s dilemma, individuals and nations alike need to move beyond acting in self-interest in order to avoid these (disastrous) collective outcomes. Already, we have seen the US withdraw from the Paris agreement, seemingly a historical re-enactment of their previous abandonment of the Kyoto Protocol. Despite which, decentralised initiatives have meant that action is being taken in various states (e.g. California). Moreover, climate change and the actions needed to mitigate it, are currently receiving increasing international public attention and support, including recent global climate strikes, extinction rebellion, flygskam, and a growing youth movement championed by Greta Thunberg.

The challenge of achieving unprecedented levels of climate change mitigation in the next few decades ties into the broader debate on the politics of sustainable development (Meadowcroft, 2007; Scrase & Smith, 2009). At the core of this debate lies the tensions between the radical steps deemed necessary for sustainable development and democratic governance (Stirling, 2011). Taking serious action on climate change will involve the decarbonisation of many sectors deeply embedded in society, including energy generation, agriculture, housing, transport. Each of these areas are dominated by large industries with established relationships with states, making change difficult and often contested. For example, energy industries directly contributed 2.9% to GDP in the UK in 2017, making up 6.3% of industrial employment with 181,000 people directly employed (BEIS, 2018).

Transforming these deeply locked-in societal structures (Unruh, 2000) will require high investment and in new technologies. Therefore, the credibility of political commitments towards achieving these goals is needed in order to reduce the risk of investment. Stability of climate policies is also needed for a re-orientation of the economy to a low carbon trajectory (Rosenbloom, Meadowcroft, & Cashore, 2019). Business leaders, public officials, and environmental advocates have all highlighted policy stability as a crucial precondition for mobilising finances needed to achieve structural transformation (Figueres et al., 2017). Similarity to political commitment, stable climate policy offers a credible signal to redirect individual behaviour and business models toward low-carbon alternatives (Bassi, Carvalho, Doda, & Fankhauser, 2017). However, despite the need to provide stable and credible signals, climate policy continues to undergo significant and unpredictable change, seemingly particularly susceptible to reversal as political administrations change (Aklin & Urpelainen, 2013; Lockwood, 2013). Complete reversal is, however, not the only way in which climate policy instability manifests (Rosenbloom et al., 2019). Defunding critical programs, failing to move to implementation, and not enforcing rules, among other issues, may also erode policy signals and objectives (E. M. Patashnik, 2008).

With these issues in mind, the next section introduces the theoretical underpinnings of the thesis and the ways in which it contributes to these areas.

## 1.2. Theoretical focus

This section introduces the main area of literature that the thesis will contribute to, sustainability transitions. After introducing the general concept, the following subsections will introduce how policy and policy mixes affect transitions, and then politics and policymaking in sustainability transitions.

### 1.2.1. *Sustainability transitions*

The “linkages between elements necessary to fulfil societal functions” (Geels, 2004 p.900), such as energy, transport, housing and food production, are commonly understood as ‘socio-technical systems’ (Geels, 2001, 2002, 2004). Socio-technical systems consist of multi-faceted combinations of actors, networks, institutions, artefacts, infrastructure, markets and practices along with cultural and symbolic views and representations (Geels, 2004). The underlying motivation of research on sustainability transitions is that environmental issues comprise grand societal challenges, brought

about by unsustainable consumption and production patterns within such socio-technical systems (Köhler et al. 2019).

A sustainability transition is a combination of processes leading to a fundamental shift of a socio-technical system, towards a more sustainable way of fulfilling a societal need (Geels and Schot, 2010). Such transition does not occur through incremental improvements and technological fixes, but radical shifts to new types of socio technical systems (Köhler et al. 2019; Grin et al. 2010).

Consequently, sustainability transitions consist of technological, organisational, institutional, political, and socio-cultural changes whereby elements of the existing socio-technical system are occasionally complemented, but more commonly replaced, with novel emergent features (Markard, 2014).

Historical examples of socio-technical transitions would be the shift from sailing ships to steamboats (Geels, 2002), and from horse-driven carriages to automobiles (Geels, 2005).

With over 20,000 journal articles and books published in this field (Köhler et al. 2019), the wide-ranging transitions literature has theoretical roots drawing from institutional theory, evolutionary economics and the sociology of technology (Rip and Kemp 1998; Geels and Schot 2007). Several conceptual approaches and analytical frameworks have been developed in this body of literature (see Markard et al., 2012), including Technological Innovation Systems (TIS) approach (Bergek et al. 2008; Hekkert et al. 2007) and the Multi-Level Perspective (MLP) (Geels, 2002, 2004, 2011; Geels and Schot, 2007). Conceptually there are similarities across these two approaches, and policy makers who have sought to accelerate the process of socio-technical transition have utilised both (Markard et al., 2014). The MLP suggests that the existing socio-technical system, termed the incumbent *regime*, is very resistant to change due to a high degree of structuration, and close relationships of incumbent actors and policy makers. The framework adopts a layered conceptualization whereby the *regime* level, the existing socio technical configuration, is put under pressure by both the *landscape* level<sup>2</sup> and novel technologies developing in *niches*, which may be integrated into the regime, or can disrupt and eventually overthrow it.

The sustainability transitions literature is broader and more interdisciplinary than other approaches including industrial ecology, eco-innovation or environmental economics (Köhler et al. 2019). These approaches tend to focus on single dimensions or particular social groups, have a relatively short-term orientation, fail to acknowledge the systemic dimension, or are overly managerial and technocratic (Köhler et al. 2019). In contrast, sustainability transition perspectives tends to ask ‘big-picture’ questions, and have several characteristics which make them a distinct and challenging topic. They involve multi-dimensionality and co-evolution, occurring over long time frames, and are interested in processes of stability and change (Unruh 2000). Inevitably, this means that they are non-linear processes, which due to their long-time frames, make them inherently uncertain (Geels and Schot

2007). In addition, they are multi-actor processes, which leads to differing values, contention, disagreement and power struggles over which direction they should take (Avelino 2011).

Accordingly, due to the complex and contested nature of sustainability transitions, a key consideration is that public policy has to play a central role in shaping the directionality of the transition through regulation, standards, taxes, innovation policy etc. (Köhler et al. 2019). Related to this central notion is two current research themes in the sustainability transitions literature (see Köhler et al. 2019), which this thesis builds on and brings together: the governance of transitions, and the politics of transitions. The following subsections introduce how policy and policy mixes can be used to govern transition processes, before introducing the role of politics in transitions.

### *1.2.2. Policy (mixes) in sustainability transitions*

Often in the transitions literature policy refers to the content dimension of policymaking, often formalised, and can refer to objectives, programs, regulations, laws and resource allocation (Markard et al., 2014). Policy is an integral part of sustainability transitions, exemplified in the case of the German energy transition with renewable energy innovations receiving public support (e.g. Hoppmann et al., 2013; Jacobsson and Lauber, 2006; van den Bergh, 2013). Scholars have argued that targeted policy interventions can be used to steer or direct transitions, and accelerate the rate of socio-technical change (Kern & Rogge, 2016). Policy is particularly relevant to sustainability transitions where the transition is often an intentional pursuit of policy makers and advocates, requiring significant structural changes, often instigated by policy to reconfigure market section environments, user preferences and cultural cognitions in order to instigate the desired change.

Innovation is a key process in socio-technical transitions, as a number of novel technologies are often needed alongside the cultural and institutional changes (Alkemade et al., 2011). Innovation policy stimulates a range of both complementary and competing technologies to develop outside of normal market selection pressures, and promote social innovations and new business models. Policies can direct resources to particular technologies through research grants, subsidies and tax exemptions. Policy intervention can be directed to purposely promote niche technologies, allowing technologies to be competitive in the current regime in an unchanged selection environment, or by making the selection environment favourable to niche innovation (Smith and Raven, 2012).

A key challenge for policymakers seeking to stimulate sustainability transitions regards moving beyond considering individual policy instruments, towards more comprehensive ‘policy mixes’ (Flanagan, Uyarra, & Laranja, 2011). The policy mix literature seeks to capture the real world



interactions of multiple policy instruments implemented over time to achieve an overall policy strategy. The need for establishing a strategy is needed to help guide sustainability transitions due to their complex nature, non-linearity, and need for establishing a normative directionality. Policy mixes are a key tools that policymakers can use to help establish this, and to help guide the transition process, which is contested by multiple competing actors with their own ideas and interests.

Moreover, taking a policy mix approach acknowledges that there no ‘silver bullets’ which can solve complex challenges of structural change with a single instrument, and also that policymakers are rarely (if ever) presented with a blank slate from which to implement new policy, leading to layering (Howlett & Rayner, 2007) of new policies alongside the pre-existing ones. As such, taking an approach which aims to anticipate the interactions of multiple policies implemented over time can allow for a greater level of coordination in the policymaking process, which (in theory) should lead to more better policy design choices, increasing the possibility of achieving the overall strategy. It also allows the analyst to consider how design choices for one aspect of the policy mix may have unintended outcomes for other instruments, which may be overlooked without taking a comprehensive view of the complexity of real-world policy mixes (Rogge and Reichhardt 2016).

However, while a growing number of contributions within the transitions literature have started to consider policy mixes (for a review Rogge et al., 2017), there has been little attention paid to conceptualising the politics and policy processes which underpin their development over time.

### *1.2.3. Politics and policymaking in transitions*

Decisions around the direction and rate of how transitions unfold are inherently political (Lawhon and Murphy, 2012), and political support for policies aimed to foster transitions needs to be maintained (Lockwood, 2015). Transitions often involve supporting relatively high cost technologies, with high upfront capital costs with long payback periods (Geels et al., 2016). Consequently, firms often prefer stable policy conditions for investment decisions (Kemp and Pontoglio, 2011). Such policy stability is beneficial in creating positive expectations of a path to commercialization for early stage technologies (Foxon et al., 2005). Similarly, policy needs to be designed in a manner that can account for the changing conditions of the socio technical system, incorporating enough flexibility or ‘degrees of freedom’ to allow for change and revision without deterring investor confidence (Howlett and Rayner, 2007, 2013, 2014). Finally, due to the long timeframes involved, the types of policies aimed to foster transitions may change significantly over time to address changing objectives and stages of innovation in the socio-technical system (Turnheim et al., 2015). Over time, political support for the guiding principles and core ideas of sustainability transitions needs to be maintained (Kern and Howlett, 2009;

Kern et al., 2014; Geels et al., 2016), which is influenced by changes in the socio-technical system (Hoppmann, 2014), and the perceived benefits or losses of policy makers, interest groups and mass public of supporting policies aimed to foster sustainability transitions (Pierson, 1993; Oberlander and Weaver, 2015).

As policies play such an integral role in sustainability transitions, policymaking and policy change are a key process in socio-technical transitions. Policy change is understood as the design, implementation, adaptation and discontinuation of public policies (Hoppmann et al., 2014; Markard et al., 2014). Policy change can influence the socio-technical change in various ways, ranging from innovation policies promoting knowledge generation and diffusion to market based tax and regulation policies allowing technology diffusion and up scaling of socio-technical system (Markard et al., 2014). Policy change is also a necessary constituent of transitions, requiring constant realignment of policies consistent with the changes occurring in the socio-technical system. Hoppmann et al., (2014) show how PV policy in Germany underwent a series of reconfigurations to respond to the changing conditions of the socio-technical system, finding that endogenous conditions of the socio-technical system play a more significant role to that of the exogenous political conditions. Hekkert et al., (2007), show how policy change can lead to virtuous or vicious cycles of causation influencing the rate and direction of TIS.

Despite policymaking and politics being a fundamental aspect of sustainability transitions, understanding its influence and better conceptualising its role in processes of socio-technical change remains a key challenge (Köhler et al., 2019). While there have been numerous contributions within the transitions literature in recent years (see section 2.1), there remains a fundamental challenge regarding better linking politics and policy to processes of socio-technical change in a co-evolutionary manner. The most notable example of such is Hoppmann, Huenteler, & Girod, (2014), who follow the co-evolution of the German FiT for solar PV with policy change over time.

Having introduced the main literature to which this thesis makes an overall contribution, the next section introduces the empirical focus: the growing attention to housing within the sustainability transitions literature.

### 1.3. Empirical focus: the UK building sector

As outlined previously this is the area the thesis contributes towards the literature on sustainability transitions. As a whole there has been a disproportionate focus within this literature on energy transitions (mainly electricity), over other sectors (Markard, Raven, & Truffer, 2012). Buildings,

however, have significant potential to contribute to reduction of GHG emissions and contribute to climate mitigation strategies. CO<sub>2</sub>e emissions from buildings are primarily a result of emissions associated with space and water heating, in addition to the emissions associated with electricity consumption for lighting, appliances, and ventilation. The emissions from buildings constitute for example approximately 30% of the UK's CO<sub>2</sub>e emissions (CCC, 2018) and around 53% of its final energy consumption (Palmer et al., 2017). Adjusting for annual temperature changes, emissions from buildings actually increased by 1% in both 2016 and 2017 in the UK (CCC, 2018).

There has been in recent years a growing research agenda around buildings, and more specifically housing within the literature on sustainability transitions. These contributions have focussed on: the role of niche governance for eco-housing (Smith, 2006), multiple niche interactions (Baker & Lester, 2017), interaction dynamics between niche and regime (Berry, Davidson, & Saman, 2013; Smith, 2007), the role of intermediaries (Martiskainen & Kivimaa, 2018), and the retrofit of the existing housing stock (De Laurentis, Eames, & Hunt, 2017). In addition to these insights, there have been several contributions focussing attention to transition dynamics in the UK (Bergman, Whitmarsh, & Köhler, 2007, 2008; Gibbs & O'Neill, 2015), as well as housing innovation in other countries such as Australia (Foong, Mitchell, Wagstaff, Duncan, & McManus, 2017; Moore & Doyon, 2018) as well as cross-country comparisons of zero/near-zero policies (Moore, Horne, & Morrissey, 2014).

In these contributions, while there is attention to governance and policy as a driver of change, the role of politics and policymaking is often underplayed. Perhaps more importantly, is that within this emerging literature, the role of policy mixes is not conceptualised in these accounts of transition dynamics. To date, the most effective implementation of policy mix literature applied to buildings or housing comes from Rosenow et al. (2016). However, application and contribution of this thesis is both different and complimentary to this work for two main reasons. First, is that Rosenow et al. (2016) use a more basic conceptualisation of policy mixes, what Rogge & Reichardt (2016) would call the 'instrument mix'. This is important, as the case analysed in this thesis is an example of a policy mix specifically designed to achieve an overall strategy through several instruments. Importantly, the overarching strategy itself continued to interact and co-evolving with the instrument mix over time. Therefore, excluding the overarching strategy from the analysis, would miss a key component of the case. The second reason this work differs is that it is qualitative research, which develops, tests and refines theory, where the work by (Rosenow et al., 2016) quantitatively assesses instrument interactions.

Finally, the empirical focus in this thesis is on an example of a failed transition which is less common in transitions literature as a whole, and more so for buildings. As will be explained in more detail in chapter 3, the thesis looks at the Zero Carbon Homes policy mix in the UK, which was abandoned prior to achieving its overall objectives. While there has already been several publications on zero

carbon homes, there is a gap in evaluating the policy mix ex post in a prescriptive manner trying to learn from the reasons why it was ultimately unsuccessful, and to make policy recommendations based on these<sup>1</sup>.

Having explained the empirical focus of the thesis, the next section concludes chapter 1 by stating the research questions and outlining the structure of the remainder of the thesis.

#### 1.4. Research aim, research questions and structure of the thesis

This section outlines the overall research aim of this thesis, and the corresponding research questions attributed to the respective articles this thesis is constituted of. The section then concludes the introductory chapter by outlining the structure for the remainder of the thesis.

##### *1.4.1. Research aim and research questions*

The aim of the thesis is to engage with the policymaking processes of policy mixes in socio-technical systems. Given the lack of a conceptual framework in order to analyse these processes in the existing literature the thesis develops and then tests a novel co-evolutionary framework for policy mixes and socio-technical systems. The thesis then pays attention to the institutional setting in which these policy mix making processes occur and develops heuristic forms of institutional arrangement affecting policymaking processes for housing policy in the UK, which is used to help explain the failure of ZCH.

In doing so, the thesis addresses the overarching research question:

*How can conceptualising the role and influence of policy-mix-making processes in sustainability transitions help explain the failure of Zero Carbon Homes?*

To do so, it poses five sub-questions, which are answered across the three articles.

#### **Article 1**

The first paper develops a novel co-evolutionary framework for the dynamic analysis of the co-evolution of policy mixes and socio-technical systems. In doing so, it answers two questions regarding:

- i) *How do policy mixes stimulate changes in socio-technical systems through policy effects?*
- ii) *How can these changes subsequently generate feedback mechanisms influencing the evolution of the policy mix?*

---

<sup>1</sup> Notably, Walker et al. (2015) comment on the denouncement of zero carbon homes, but the authors do not consider in detail the reasons for its failure, nor do they consider it as a policy mix consisting of a strategy and interacting instruments.

## Article 2

Article 2 applies the conceptual framework developed in the first paper to the case of the UK zero carbon homes policy mix. In doing so, it answers the following two research questions:

- i) *How did policy effects and feedback mechanisms influence the coevolution of the zero carbon homes policy mix and the socio-technical system?*
- ii) *How does this help explain why the zero carbon homes target was abandoned?*

## Article 3

Article 3 builds on the empirical findings of the second paper, thereby following an iterative research design to ‘deep-dive’ empirically and develop heuristic forms of institutional arrangements which help explain failure of ZCH. In doing so, it answers the research question:

- i) *How did the institutional arrangements in which policymaking processes occur contribute to the failure of the UK zero carbon homes policy mix?*

### 1.4.2. Thesis structure

The remainder of the thesis is structured as follows:

**PART I** - introduces the thesis, the theoretical and empirical areas it contributes to, and the research aims

Chapter 2 reviews the respective literatures drawn on in the conceptual development of the thesis.

Chapter 3 outlines the empirical case of the UK Zero Carbon Homes policy mix.

Chapter 4 explains the research design, including the methods and data.

**PART II** - contains three journal articles which make up the main contributions of the thesis

Chapter 5 is a conceptual paper (Article 1) synthesising literature on politics of transitions, policy mixes and policy feedback to develop a novel analytical framework for the co-evolution of policy mixes and socio-technical systems.

Chapter 6 is an empirical paper which applies the co-evolutionary framework developed in Article 1 to the case of the Zero Carbon Homes policy mix in the UK. In doing so it tests and refines the analytical framework, as well as generating analytical insights about the case.

Chapter 7 is a second empirical paper which builds on the findings of Article 2. The paper focusses on one aspect in particular, the institutional context in which the policymaking processes of the zero carbon homes policy mix occurred. In doing so, the paper develops three heuristic forms for policymaking processes for UK housing, and uses these to help explain the failure of ZCH.

**PART III** - discusses and concludes thesis, acknowledging limitations and suggesting avenues for further work and the main policy implications of the thesis.

Chapter 8 discusses the contributions the thesis makes to literature, reflects on the methodology and limitations, and makes policy recommendations.

Chapter 9 concludes, reviews how the thesis answers its research questions, and suggests avenues for further work.

## Chapter 2. Theory and literature review

This chapter reviews four areas of literature drawn upon in this thesis, and which contribute to the theoretical development in the papers contained in PART II. As previously outlined in the introductory chapter, the thesis contributes to the literature on sustainability transitions. More specifically, the politics of transitions, and the role of policy and policy mixes in such transitions. In doing so, it addresses a conceptual gap regarding the policymaking processes which underpin the development of sustainability-orientated policy mixes, and the influence of these processes on the rate and direction of transition.

Accordingly, this chapter first reviews: i) the recent developments in the literature on the politics of transitions, ii) the growing literature focussing on policy mixes for sustainability transitions, and iii) theories of the policy process, before explaining why policy feedback theory is considered as a good fit for both the aforementioned strands of literature. Building on the review within this chapter, **paper 1** (Part II - chapter 5) combines insights from these literatures to develop a co-evolutionary analytical framework which conceptualises policy-mix-processes, and their co-evolution with the rest of the socio-technical system.

Finally, iv) the chapter introduces institutionalist literatures, neo-institutionalist approached and Historical Institutionalism (HI). This literature is draw upon in paper 3 while developing an analytical for institutional arrangements affecting policymaking processes in the UK housebuilding sector.

## 2.1. Politics of transitions

*'Behind policy there is always politics'* (Meadowcroft, 2011; 73).

Sustainability transitions are inherently value laden and political, leading to different interpretations and normative struggles over the pace and direction of transitions (Lawhon & Murphy, 2012; Smith & Stirling, 2010), and can become interwoven with conflicts over equity, fairness, and justice (Hess & Brown, 2018). States are dependent on prevailing economic structures and industries, creating vested interests as political and economic actors become entangled, resulting in a high level of influence of incumbent actors on policy decisions (Meadowcroft, 2011). For example, such dependencies and vested interests were found to be highly significant in the failure of the Dutch transitions management experiment (Kern & Howlett, 2009).

Given the intrinsically prevalent nature of politics in sustainability transitions, there have been multiple successive calls from scholars for increased attention (Hendriks & Grin, 2007; Meadowcroft, 2009; Shove & Walker, 2007; Smith & Stirling, 2010; Smith, Stirling, & Berkhout, 2005). In response, there is an emerging body of literature on the politics of transitions (F. Avelino & Rotmans, 2009; Fuenfschilling & Truffer, 2014; F. W. Geels, 2014; Hess, 2014, 2015; Kern, 2011; Smith, Voß, & Grin, 2010; Späth & Rohracher, 2010). Scholars have developed theoretical frameworks for the analysis of power and agency (F. Avelino & Rotmans, 2009; Hess, 2016), reflexive and democratic governance (Voß, Smith, & Grin, 2009); industry and the state dynamics (Fünfschilling & Truffer, 2014, 2016; Turnheim & Geels, 2013) and structuration processes (Grin, 2012). Others have investigated the language used in political discourse (Lawhon and Murphy, 2012), and how alliances form and accumulate around specific transition paths (Grin, 2012; Lawhon and Murphy, 2012; Smith and Raven 2012).

The empirical work on the politics of transitions can be aggregated into three general categories: i) actor relations between incumbents and innovative new entrants; ii) actor strategies of new entrants and transition coalition formation; and iii) how tensions between incumbents and new entrants can become overlaid with political contestation originating from party politics within government.

The first area concerns how incumbent actors can incorporate and transform innovations to make them compatible with the existing socio-technical configuration, or alternatively, resist policy initiatives that appear threatening to their interests. Strategies include: mobilizing resources, shaping political discourse through appropriate framings in the media, innovation of system-compatible technologies, and shaping the structure of institutional power (Geels, 2014). Regime actors may also



attempt to reverse policies already in place that favour emerging innovations (Lauber & Jacobsson, 2016; Hess, 2016a). Another important area is instances where dominant incumbent actors have dominated policymaking processes attempting to stimulate sustainability transitions (e.g. Hendriks, 2008; Kern & Smith, 2008).

The second strand of research draws attentions to the strategies of emergent new entrants and the formation of transition coalitions. Smith and Raven (2012) for instance describe three conditions needed in order to protect them from mainstream selection pressures; shielding, nurturing and empowerment. In order for transition coalitions to gain policy support in favour of emergent innovations, they must successfully place normative pressure on incumbent actors and states, but also be sufficiently developed (both technologically and economically) in order to seize political and economic windows of opportunity (Elzen, Geels, Leeuwis, & Van Mierlo, 2011).

The third strand of research explores how conflicts between incumbents and transition coalitions can become aggravated by conflicts between political parties in governments. In general, when conservative governments have come into power, they have tended to weaken or reverse the pro-environmental initiatives of labor-left-green coalitions (Hess & Brown, 2018). These divisions are especially polarized in the developed majoritarian political systems, but have also had significant effects in other political systems (Lauber & Jacobsson, 2016a; Markard, Suter, & Ingold, 2016). Other contributions foregrounding policy development and retrenchment often go beyond this basic left-right alignment. For example, Markard et al., (2016) show how divisions within conservative coalitions due to heterogeneity of beliefs among incumbent actors can weaken efforts to reverse sustainability policies (Markard et al., 2016). Finally, transition coalitions can sometimes draw on support from countervailing industrial groups, which may form alliances with transition coalitions (Hess, 2016b).

Despite the considerable amount of research and conceptual development, it is still argued that transitions literature “has fallen short in its understanding of power” and that “the conceptualisation of power and politics, and their relations with questions of knowledge and social justice, require further elaboration” (Scoones, Leach, & Newell, 2015, pp. 3–5). In that vein, this thesis argues that linking political influence and power to policymaking outcomes, the rate and direction of socio-technical change, and the interests and participation of key innovative stakeholders in the socio-technical system, in a dynamic and recursive way, remains under-conceptualised. Moreover, linking politics to policy mixes, rather than single policies within the literature on sustainability transitions, is under-explored. Accordingly, having reviewed the key conceptual advances in the three themes of empirical research in the literature on the politics of transitions, the next section turns to the literature on policy mixes in sustainability transitions.

## 2.2. Policy mixes for sustainability transitions

*“Just as there are no technology silver bullets, there are no single policy bullets either.” (Gallagher, Grübler, Kuhl, Nemet, & Wilson, 2012; 151)*

The need for considering policy mixes has been increasingly stressed by scholars in literatures on climate, environment and innovation policy (for a review, see Rogge & Reichardt, 2016). Similarly, scholars and analysts of policy effects on sustainability transitions need to extend the scope of analysis from that of individual policy instruments and their interactions to that of comprehensive policy mixes. Primarily this is necessary due to multiple and interrelated market and system failures that need a range of complementary policy interventions to be overcome (Foxon et al., 2005; Lehmann, 2010; Weber and Rohracher, 2012), along with the need for long term agenda setting strategies and objectives to guide transitions (Foxon and Pearson, 2007, 2008; Quitzow 2015; Weber, Rohracher 2012) complemented with various policies as a means of achieving these strategies (Alkemade et al., 2011). Kern and Howlett, (2009) highlighted that transitions policies are often implemented alongside those which reinforce the existing regime, impeding their transformative potential. Policy mix conceptualisations have contributed in emergent areas of transitions literatures (Kern and Howlett, 2009; Kern et al., 2016, Kivimaa and Kern, 2015; Reichardt et al., 2015a, 2015b), but how the resultant effects of policy mixes on the functioning of the socio-technical system can reshape and restructure the politics and policy processes determining the rate and direction of STs is under conceptualized.

The term policy mix has recently been incorporated by scholars in various scientific disciplines, including policy analysis and design (Howlett, 2014; Howlett and Rayner, 2007, 2013), innovation studies (Nauwelaers et al. 2009), political science and policy process theories (see Sabatier and Weible, 2014) and economic policy and environmental policy (see Flanagan, Uyarra, & Laranja, 2011). Within the policy literature emergent strands have sought to explain several aspects of policy mixes; the design features of individual instruments in the mix (Kemp and Pontoglio, 2011), instrument interactions (del Río González 2006; Nauwelaers et al. 2009) and the elements of the mix (Borrás and Edquist, 2013). Scholars have conceptualized the characteristics of the mix (Rogge & Reichardt, 2016) and how policy mixes can be designed in order to enhance these characteristics (Howlett & Rayner, 2007, 2013), along with the temporal and dynamic nature of the evolution of elements in the mix (Kern and Howlett, 2009), and finally how process dynamics can influence the evolution of policy mixes (Flanagan et al., 2011; Rogge & Reichardt, 2016).

Theoretical contributions from Rogge & Reichardt (2016) have sought to identify common terminologies of these related but slightly divergent conceptual lines and to propose an exploratory

framework of how these aspects can be linked to give a comprehensive, holistic view of policy mixes. This conceptualisation of policy mixes includes *strategies*<sup>2</sup>, the dimensions (e.g. temporal and geographical aspects), the *instrument mix* consisting of the interacting policy instruments implemented towards meeting the overall strategy, and the underlying processes. Rogge and Reichhardt, (2016) see processes as determining the evolution of the mix and influenced by policy outcomes<sup>3</sup> in a recursive dynamic way. Despite this advancement of policy mix thinking, a focus on policy processes and the influence on the coevolution of the mix, and consequently the influence of processes on socio technical change, is still under researched and scholars have called for increased attention to these underlying processes (Kern, Kivimaa, et al 2016; Rosenow, 2015, 2016).

Following the suggestion of (Rogge & Reichardt, 2016), conceptualisations of these processes can be developed by drawing on theories of the policy process (Sabatier and Weible, 2014). This thesis will contribute to this conceptual line, and by ‘zooming in’ on these processes, aims to help explain how politics and process dynamics influence why policy mixes are designed in particular ways, specifically due to the effects of previous policy decisions. This contribution will help develop the conceptual understanding of policy processes within the policy mix literature in line with the advancements from the contemporary process theories. Through contributing to this area we can analyse why certain policy instrument combinations are particularly prevalent and explain how and why any identified synergies, conflicts and gaps may have come about, by looking at what the political dynamics are behind these decisions (Kern, Kivimaa, et al 2015; Rosenow et al, 2015, 2016). Accordingly, this thesis contributes to the research agenda by investigating the coevolution of policy mixes and socio technical change by focusing on how policy processes mediate this dynamic relationship.

The next section turns to policy processes theory, in order to help conceptualise the role of policymaking in this dynamic relationship.

### 2.3. Theories of the policy process and policy feedback

*“Given the staggering complexity of the policy process, the analyst must find some way of simplifying the situation in order to have any chance of understanding it.” (Sabatier, 2007; 4)*

---

<sup>2</sup> Important for sustainability transitions due to the need of guiding visions and on term strategies and for long term socio technical change

<sup>3</sup> Conceptualized in their work as ‘technological change’.

This section introduces theories of the policy process and explains key concepts, and gives an overview of how these theories have started to be applied by transition scholars.

After giving an overview the second sub-section reviews the literature on policy feedback in more detail, which is the approach used in developing the co-evolutionary framework in paper 1 (chapter 5).

### *2.3.1. Overview of theories of the policy process*

Several approaches to study policymaking have been developed within the literature on policy process theories and can offer insight into the conceptualisation of policy processes. Some important insights from these literatures include considering: (1) a wide range of actors influencing policy at many levels of government; (2) a proliferation of rules and norms followed by different levels or types of government; (3) close relationships between policymakers and powerful actors; (4) a tendency for certain beliefs or ‘paradigms’ to dominate discussion; (5) shifting policy conditions and events that can prompt policymakers attention to lurch at short notice (Cairney, 2015; Cairney, Oliver, & Wellstead, 2015).

The theories and frameworks of the policy process seek to analyse and explain policy change (Sabatier and Weible 2014). The prevailing policy theories aim to include certain aspects of this process in their conceptualisations to help enrich the understanding of a complex process<sup>4</sup> (Table 1). Each of these theories describes key components (actors making choices, institutions, networks or subsystems, ideas or beliefs, policy context and events. - Table 2) of an overarching policymaking system and explains their interactions to provide an explanation of the policy process (Cairney and Heikkila, 2014 p.364).

Arguably, some of these theories offer more insight than others into processes of policymaking and change. For example, Sabatier, when referring to Kingdon’s Multiple Streams, remarked that many of the concepts and mechanisms are loosely defined. While making the theory versatile and easily applicable, it means the concepts are not readily falsifiable, and consequently there has been little (if any) theoretical development since its initial conceptualisation. Similarly, Cairney and Jones in a more recent assessment of multiple streams, comment that while it has been widely applied and remains a prominent ‘universal theory’, much of the research represents isolated cases, calling for “new ways to make sure the results are coherent and comparable with each other” (Cairney & Jones, 2016; 53).

---

<sup>4</sup> Consequently, there are aspects which are prominent in some conceptualisations, but underplayed in others.

*“The multiple-streams framework has no explicit hypotheses and is so fluid in its structure and operationalization that falsification is difficult. Given the paucity of tests by other scholars, it is not surprising that Kingdon (1996) has found no need to make revisions.” (Sabatier, 2007; 327)*

Table 1- Theories of the policy process

Theories of the Policy Process	
Multiple Streams Analysis (MSA) (Kingdon, 1984)	Focus on the interaction between two kinds of ideas: the type of policy solution that could draw attention and catch on quickly and the established set of beliefs in a policy community that would slow its progress.
Advocacy Coalition Framework (ACF) (Sabatier and Jenkins-Smith, 1993; Sabatier and Weible, 2007)	According to the ACF, people engage in politics to translate their beliefs into action (Jenkins-Smith, Nohrstedt, and Weible 2014). There are three main types of beliefs: core, policy core, and secondary. Actors with similar beliefs become part of the same advocacy coalition, and coalitions compete with each other.
Institutional Analysis and Development Framework (IAD) (Ostrom, 1990; Scharpf, 1997)	The IAD focuses on the ways in which actors make choices within institutional environments that structure (or at least help explain) their behaviour.
Punctuated Equilibrium Theory (PET) (Jones and Baumgartner, 1993; True et al., 2007)	The PET emphasizes the interaction between two types of ideas: (1) the “monopoly of understandings” underpinning established subsystem relationships, and (2) the new solutions that could “catch fire” following successful venue shopping or prompt endogenous change (when attention shifts and issues are reframed).
Policy Feedback (PF) (Skopkol 1992, Pierson 1993, Mettler and SoRelle 2014)	PF suggests that policy commitments made in the past produce increasing returns and make it costly to choose a different path (Pierson 2000; Cairney 2012b, 76). When a policy becomes established and resources are devoted to programs, it helps structure current activity and provides advantages for some groups more than others (Mettler and SoRelle 2014).
Policy Networks (PN) (Marsh and Rhodes 1992, Marsh 1998)	PN aims to reformulate analysis of policy networks by a new way of understanding the relationship between structure and agency. Policy networks are understood as sets of formal institutional and informal linkages between governmental and other actors structured around shared if endlessly negotiated beliefs and interests in public policy making and implementation

Source: Compiled from Cairney and Heikkila (2014, p.375-380)

Transition scholars have started to integrate insights from prominent policy process theories (Table 1), including Sabatier’s Advocacy Coalition Framework (Markard et al., 2015), Kingdon’s Multiple

Streams (Normann, 2015), and Marsh's Policy Networks Approach (Normann, 2017)<sup>5</sup>. From these contributions, we know that during transition processes windows of opportunity can allow actors to advocate certain technologies and gain favourable policy outputs. Yet, over time, changing conditions can cause these windows to close and policy support to be withdrawn (Normann, 2015). Similarly, beliefs of actors can change over time, which may influence participation in coalitions (Markard et al., 2015) and the formation of policy networks (Normann, 2017).

*Table 2 - Key components of theories of the policy process*

Key components of theories of the policy process	
Actors making choices	The policymaking world may include thousands of people. To simplify, policy theories often categorize and describe key actors. Actors can be individuals or collectives, and collectives can range from private companies to interest groups to governments bodies (Weible 2014).
Institutions	Rules, norms, practices, and relationships that influence individual and collective behaviour. The choices of actors are explained partly by their understanding of and adherence to rules.
Networks or subsystems	These are the relationships between actors responsible for policy decisions and the "pressure participants", such as interest groups with which they consult and negotiate.
Ideas or beliefs	This broad category captures how theories deal with ways of thinking or the knowledge that plays a role in the policy process.
Policy context	Describes the wide array of features of the policymaking environment that can influence policy decisions.
Events	Events can be routine and anticipated, such as elections that produce limited change or introduce new actors with different ideas. Or they can be unanticipated incidents, including social or natural crises or major scientific breakthroughs and technological changes (Weible 2014).

Source: compiled from Cairney and Heikkila (2014, p.364-366)

For this thesis, the insights from Policy Feedback (PF) theory will be the basis for the conceptualization of the policy processes that underpin policy mix evolution in sustainability transitions. As will be further explored in the following subsection, PF is considered to contribute useful insights for the study of policymaking and politics. As a meso-level concept, PF shares similarities with transitions literature. Each draw heavily from concepts of path dependency and lock-in, and each concern how policy can restructure linkages of networks, actor groups, and ideas. PF seeks to explain mechanisms through which public policies reshape social and state actors' interests and capacities over long periods of time in ways that change the prospects for the policies' future maintenance, expansion, or reversal (Skocpol, 1992). PF seeks to explain long term trends in

<sup>5</sup> For a review see (Kern & Rogge, 2017)

policymaking by linking materialist and cognitive ideas to account for actor *preferences*, explaining *why* groups seek policy change when they do (Jacobs & Weaver, 2015).

### 2.3.3. Policy feedback

*“Policies, once enacted, restructure subsequent political processes”* (Skocpol, 1992).

The study of policy feedback was first introduced by Skocpol (1992: 58) suggesting that researchers must make policies the starting points as well as the end points of analysis. PF has roots in historical institutionalism (see section 2.4), and is based around the fundamental idea that policy shapes subsequent politics and policy making. Policy feedback has been very widely debated (Beland 2010: 569), and its precise role for understanding policy change is still only partially understood (Jordan and Matt, 2014).

The theory has an emphasis on policy design, drawing attention to continuous interactions between public policy, the outcomes on society, how these outcomes affect policy actors in a way that influences politics (Weible 2014: p.13). When a policy becomes established and resources are devoted to programs, it helps structure current activity and provides advantages for some groups more than others (Mettler and SoRelle 2014). In Pierson’s (1993) seminal work, he identified a number of ways in which the feedbacks of previous policy can influence the policymaking process by shaping the political conditions. Following Pierson (1993), scholars using the PF seek to explain the influence of policy through two explanatory factors, the ‘resource’ effects (policies as packages of resources that affect interest groups, state capacities and mass publics), and the ‘interpretive’ effects (policies as new sources of information that affect patterns of cognition, understanding and meaning) (Mettler and Soss 2004: 60). However, a criticism common for much of the existing PF literature, and as Pierson observes in a recent assessment, while scholars have made major strides in providing “demonstrations” of the significance of feedback, there has been limited progress in translating such work into a “coherent and cumulative research program” focused on the evaluation of propositions about when we should expect to see what kinds of effects (Patashnik and Zelizer, 2013 p.1075).

The recent contribution of Oberlander and Weaver (2015), is considered here to be a comprehensive conceptualization in this regard, which follows a line of PF scholarship highlighting the need to more comprehensively include the existence of negative feedbacks (Jacobs and Weaver, 2015; Jordan and Matt, 2014; Patashnik and Zelizer, 2009, 2013; Weaver, 2010; Oberlander and Weaver, 2015).

The most politically consequential feedbacks may not necessarily be positive (Jordan and Matt (2014), and evidence for negative and positive feedback processes should be looked for (Weaver 2010: 158). This is of particular relevance for energy transitions which are highly political, and often involving high costs financed from public sources (Schmitz et al 2013). Oberlander and Weaver (2015), categorize feedback mechanisms in three main categories as the *socio political*, the *fiscal* and



the *administrate* effects, along with the conditions that would amplify the occurrence of negative feedback mechanisms (see Table 1).

Socio-political policy feedback effects concern whether public and elite support for a policy regime is reinforced or undermined over time. Socio-political feedbacks include three typologies of effects, which contribute to the level of mass cognition, for example, if the policy is perceived to be successful or disastrous in achieving its objectives, and does it lead predominantly to the mobilization of supporters or opponents (Oberlander and Weaver, 2015 p.43). The socio political feedback relates to state actors, interest groups (niche and regime actors) and mass publics. The cognitions can be influenced by changes of the STS directly influencing actor groups, and by conditions (such as the cost of technology) caused by system innovation in the STS. Fiscal effects relate to if the policy raises budget strains raising concerns among financial ministers or treasury, weakening the autonomy of groups dominating the policy regime (Oberlander and Weaver, 2015 p.43). We suggest that such fiscal effects relate not only to individual policies, but also a policy mix or administrative government department tasked with policy decisions and implementation. Administrative feedback effects influences actors' (in charge of policy implementation) capacities to implement the program in a way which is perceived as successful by constituencies (internal/policymakers and external/social actors).

Various components (Appendix B) of the policy process underlie or inform PFT, which can be observed by identifying its conceptual elements (Cairney and Heikkila, 2014). Actors are present when policies assign different citizen rights to groups, influencing their ability and incentive to mobilise and engage. Networks are implied when government agencies mobilise support, or when groups mobilise, in order to protect policy. Ideas appear in PFT as policies and rules represent institutionalised beliefs or dominant policy framings.

*Lock-in* underlies PFT, and occurs when policy commitments made in the past produce increasing returns, making it costly to choose a different path (Pierson 2000). The conceptualisation of lock-in draws heavily from rational-choice theory, as the constraints of choosing a different route is contrasted against the rational considerations of what the alternate path may offer (Pierson 1993). To help develop the notion of increasing returns, Pierson (2000) identifies two aspects. First is how the cost of switching from one policy alternative to another will, in certain social circumstances, increase markedly over time. Second is the issues of timing and sequence, distinguishing formative moments or conjunctures from the moments that reinforce divergent paths. Temporality is at the heart of the analysis, as it is central to look at not only what happens but also when it happens Pierson, 2000).

Finally, external events need to be considered in the analysis to give context to how policy is developed in light of exogenous conditions. In approaches based on historical institutionalism, "sensitivity to initial conditions" describes a particular sequence of past decisions that sets the broad

context for current policy. “Critical juncture” highlights a major event that may be required to prompt institutional change when policies are locked in (Cairney and Heikkila, 2014).

Of interest here is the effect that policy design and implementation has on actors in the dominant socio-technical system, and how policy can influence actors in a way that motivates them to participate in politics influencing the subsequent policy making. Policies do not automatically generate feedbacks, and require coalitions to take political action for the effect of a given policy to influence the policy process<sup>6</sup> (Pierson 1993, 2000). The focus of the analysis will be that of positive (reinforcing) and negative (undermining) feedback effects that are generated over time due to motivated political actors to support policies leading to policy stability, or the impetus for others to mobilise resistance to a policy program which may result in policy reform. Reinforcing effects are most prominent where policies direct or encourage investment over long timeframes, especially those with high risk (Arrow, 2000). Positive feedbacks are also generated when policies create effects that are visible, traceable to government action (Arnold 1990), and create beneficiaries in the wider public (Campbell, 2012). Social policy benefits delivered through the tax code as tax breaks, tax expenditures, are not recognized by recipients as government benefits and do not generate the same kind of attention to government action as direct spending programs (Mettler, 2001). Self-undermining effects are most prevalent where policies have causal complexity (Jacobs and Weaver 2015), and seek to address multiple objectives, particularly when their success depends on the support of broad publics (Skogstad, 2016). Current acting policy makers often inherit an existing set of policies<sup>7</sup>, and due to the political complexity of terminating existing arrangements, additional policy and revisions are often layered on top of the existing policies (Howlett and Rayner, 2013). In these cases negative feedbacks are expected to arise due to causal complexity, multiple objectives, and unintended outcomes (Jacobs and Weaver, 2015).

## 2.4. Institutional literature and Historical Institutionalism

*“It is almost impossible to remove the effects of political institutions from [policy] success or failure” (Peters 2015, pp. 265)*

This section explores the institutional literatures, then historical intuitionism in more depth. These are used in developing and testing an analytical heuristic in paper 3 (chapter 7). The focus on institutions acknowledges the fact that while policymaking processes and policy design are important, it is also important to consider the institutional setting in which policymaking processes take place.

---

<sup>6</sup> The resource effects and interpretive effects give coalitions the incentives to mobilize

<sup>7</sup> An acting coalition rarely has a blank slate allowing freedom to design a policy mix

The general argument is that different institutional arrangements can affect the ability of policy mixes to produce feedback, and the impact that feedback mechanisms may have on the policy stability of the policy subsystem due to the institutional arrangements which make it up.

#### 2.4.1. Overview institutional literature

*"The beginning of wisdom in approaching institutional theory is to recognize that there is not one but several variants." Scott (1987: 493).*

The examination of political institutions in structuring behaviour; and shaping incentives and normative values, dates back as far as Plato and Aristotle (Steinmo, 2008). Institutional literatures purport that behaviours are the product of ideas, values, and beliefs that originate in the institutional context (Meyer & Rowan, 1977; Meyer, Scott, & Deal, 1983; Zucker, 1983). Institutional theory therefore suggests that organisations must accommodate institutional expectations (D'Aunno, Sutton, & Price, 1991; DiMaggio & Powell, 1991; Scott, 1987), and how organisational behaviours respond to institutional pressures (e.g., pressures from regulatory agencies, such as the state).

Institutionalist literature, at its core, raises the fundamental question 'Do institutions matter?' (Weaver & Rockman, 1993). For the purpose of this thesis, and to understand the role of institutions in more detail, two further questions are of relevance: i) what do we mean by institutions?; and ii) how do institutions affect policymaking? In response to the first question, the most common definition for institutions is: rules (Steinmo, 2008). Some authors focus on formal rules and organizations (Streeck and Thelen 2005), while others address informal rules and norms (Marcussen 2000; Hall 1989). Whether we mean formal institutions or informal rules and norms, they are important for politics because they shape who participates in a given decision and, simultaneously, their strategic behaviour.

The second question regards how institutions affect policymaking. Policy, in of itself, forms a component of institutions, as the formal arrangements that structure the activities of actors. Policy change in and of itself, the purposeful change to formal institutions (and sometimes informal institutions) by state actors, usually involves institutional change (Needham and Louw, 2006) and is overwhelmingly incremental (North, 1990). Policy change can therefore be considered as a form of institutional design (Alexander, 2005) and should be informed by an understanding of how institutions and their constituent actors change and can be changed. Authors including McLeod (1997) and Payne (2013) have suggested that significant institutional change is likely to be the result of a sense of partnership and common enterprise between the state and market-based actors. Therefore, although institutions may be 'sticky' in nature, policy may achieve its intended aims if it

acknowledges the presence of institutional pathways (Needham and Louw, 2006; Smith and Lewis, 2011). Therefore, a key question then to ask which is relevant for effective policy design is whether the policy failure is related to its own design or if the failure is a symptom of being embedded in a more systematic pattern of failure emerging from institutional arrangements (B. G. Peters, 2015).

#### 2.4.2. *Neo-institutionalist literature*

This section will focus primarily on neo-institutionalist literature and briefly summarise and compare the main approaches within this discipline. Neo-institutionalist literatures are primarily concerned with how the interests of actors shape outcomes. While it is not the purpose of this thesis to discuss the relative merits of these different approaches in detail, an important consideration when comparing and choosing which is most suited to the application here involves the model of the individual and how these disciplines base its assumptions of people's interests.

Of the three approaches the main distinction is that of structure vs. agency (B Guy Peters, 2012). Functional approaches focus more on the interaction of individuals with institutions (Thelen, 1999). Functional approaches are Rational Choice institutionalism, drawing on the work of North<sup>8</sup> (1990) and (Williamson, 2000), and assumes that people are rational self-serving individuals, in a manner roughly synonymous to game theory. The main difference between this and the other functional approach, Sociological institutionalism (Scott, 1995), is in its assumption of the individual, which argues that individual choice is socially constructed. The third form of neo-institutionalism is Historical Institutionalism, considered as a structural approach (Thelen, 1999). This approach is agnostic in its model of the individual. Rather than ascribing a particular model of individual behaviour it assumes both rational choice and social constructivism are important. The approach is however, much more heavily orientated towards structure, and its comparatively downplayed attention to linking individuals to institutional change can be considered a weakness of the approach (B Guy Peters, 2012).

While institutions are a core concept in the transitions literature, the conceptualisation used has almost exclusively drawn on the work of Scott (1995). For example, transitions scholars have made use of institutional concepts like rules, culture or legitimacy in order to account for the embeddedness of actors or the persistence of systems (Geels and Verhees, 2011; Geels, 2004, 2010); and Geels and Schot (2007) point out that socio-technical systems are situated at the level of organizational fields.

---

<sup>8</sup> Another institutional approach based up the work of Peter North is new institutional economics (for a review see Perry, 2019), but is considered here less useful for the study of politics and policymaking.

In a recent review, Andrews-Speed (2016) suggests the potential value that drawing on the institutional literatures could contribute to the transitions literature. Of these approaches HI is argued to be the most useful approach for understanding power distribution, which is most suited to deepening our understanding of policymaking processes. This approach will be reviewed in more detail in the next section.

### *2.4.3. Historical institutionalism and transitions*

The literature on historical institutionalism is concerned with how institutions re-enforce each other and reproduce similar outcomes, and the situations under which they may be susceptible to change. This approach has recently been reviewed by authors in regard to their potential use in the context of transitions (Andrews-Speed, 2016; Lockwood, Kuzemko, et al., 2017). (Lockwood, Kuzemko, et al., 2017) propose criteria for helping explain energy transitions in terms of institutions. This sub-section focusses on four of these considerations, which are considered useful for the analysis of a single case study bounded at the national level. A summary of these is displayed in table 3.

#### ***Aggregation of values and interests through political systems***

Primarily the institutional arrangements in a given context will shape which ideas and interests are given more precedence. A key consideration here is the role of partisan veto players, defined as “individual or collective actors whose agreement is necessary for a change in the status quo” (Tsebelis, 2002: 19). The role and influence of such veto players is affected by variations of political institutions, including the electoral system in a given setting. Lockwood *et al.*, (2017) argue that countries with Proportional Representation (PR) electoral systems are more likely to adopt environmental policy measures than those with majoritarian systems, where majoritarian systems incentivise politicians to target the concerns of a relatively small group of swing voters in marginal constituencies, while PR incentivises parties to seek support from a broader spectrum of voters by providing public goods (Lizzeri and Persico, 2001). Second is that PR systems tend to result in centre-left governments which arguably are more proactive in pursuing transitions. Third is that PR systems accommodate smaller political parties, and are more likely to result in coalition government, which gives more influence to groups otherwise marginalised in majoritarian systems. Majoritarian systems instead provide more opportunities for NGOs as vehicles for change (Lockwood et al. 2017).

Another consideration is the role of ‘institutional veto players’, which relate to constitutional agreements. Primarily, this is concerned with if the political system is presidential vs parliamentary, and federalist vs. centralised. Fundamentally the argument is that where political power is

concentrated within a government arrangement, it allows for greater influence of a small number of groups, and without the involvement of institutional veto players, can result in both inaction and inertia or conversely, allow for radical action resulting in either acceleration or reversal in the rate and direction of transition.

### ***Credible commitment and political institutions***

The credibility of political commitment in a given policy mix is related to the political and electoral system in a given context. Following from the arguments regarding the differences in political systems outlined above, these also affect the credibility of the political commitment and in turn the policy mix that results from the policymaking process. PR systems tend to give more credibility due to the number of different actors represented in government, meaning that generally once consensus is reached political commitment to a given policy mix tends to be more stable.

### ***Delegation, regulatory inertia and regulatory activism.***

Regulatory responsibilities may be delegated to a non-government agency. This may be because government lacks the technical expertise to implement and regulate policy, or may be in order to shield it from political contestation, provide more certainty, and reduce risk (Kuzemko, 2016; Lockwood, Kuzemko, et al., 2017). This can lead to situations where the appointed regulator may favour approaches that are in their own interests, or align with the practices or norms currently followed. In such instances, inertia may occur if the regulator intentionally resists some policy initiatives and slows change in the direction of transition. This effect is amplified by the extent to which the regulator has influence/autonomy over regulatory (or even more broadly, policymaking) processes. Conversely, in some situations, the role of the regulator may be underplayed if they do not have statutory powers to instigate policy measures, rendering policymaking and regulatory processes more susceptible to political contestation and providing less stability (Lockwood, Kuzemko, et al., 2017).

### ***Power and capture by incumbents***

Commonly this phenomena is considered as regime resistance in transitions literature, but mechanisms through which such incumbents can affect policymaking processes are often implicit or overlooked. Broadly speaking Lockwood et al. (2017) identifies the role of incumbents in such processes into three considerations: *the power of incumbents*, *the interests of incumbents*, and *the openness of policy and regulatory processes to capture*.

Table 3 - Important institutional factors for sustainability transitions (adapted from Lockwood et al. 2017)

Institutional consideration	Key considerations
<i>Aggregation of values and interests through political systems</i>	<ul style="list-style-type: none"> <li>- Role of veto players</li> <li>- Electoral system – Proportional Representation (PR) vs. majoritarian</li> <li>- PR allows marginalised political powers to have more influence</li> <li>- PR allows public opinion to influence politics more as politics appeals to a wider group of voters.</li> <li>- In political systems concentrating power with few institutionalised veto players, both inaction and radical change are possible.</li> </ul>
<i>Credible commitment and political institutions</i>	<ul style="list-style-type: none"> <li>- Lower credibility in majoritarian systems due to fewer veto players</li> <li>- Tendency for things to be re-politicised in times of crisis.</li> </ul>
<i>Delegation, regulatory inertia and regulatory activism</i>	<ul style="list-style-type: none"> <li>- Delegation of regulatory decision-making.</li> <li>- Used to reduce risk and shield from political interference, in potentially controversial areas.</li> <li>- Strategy of creating new veto players, which can be used to increase credibility.</li> <li>- Delegation could slow the rate of change if these actors have ideas that are inconsistent with transition.</li> </ul>
<i>Power and capture by incumbents</i>	<ul style="list-style-type: none"> <li><i>i) The power of incumbents</i> <ul style="list-style-type: none"> <li>-How much leverage actors have over policymakers.</li> <li>-Related to the level of centralisation/market share of the system.</li> </ul> </li> <li><i>ii) The interests of incumbents</i> <ul style="list-style-type: none"> <li>-Ownership and corporate governance.</li> <li>-Asset specificity</li> </ul> </li> <li><i>iii) The openness of policy and regulatory processes to capture</i> <ul style="list-style-type: none"> <li>-Delegation of policy and regulatory decision making to private sector actors.</li> </ul> </li> </ul>

The power that incumbents have is related to their market share, the degree of centralisation/oligopoly, and other factors such as ability to provide resources that government needs (Lockwood, Kuzemko, et al., 2017). The interests are typically assumed to be in opposition to transition, however this is not homogenous. One consideration is different forms/arrangements of corporate governance across different actors/groups will result in different outcomes, i.e. more cooperatively owned organisations may be more interested in pursuing transition. Also, asset specificity, i.e. how well the proposed transition fits with existing infrastructure of incumbents – will influence the relative support or resistance from these actors. The final consideration is the susceptibility of policy and regulatory processes to capture from such incumbents. Government may lack the technical expertise to design effective policy, which may be exacerbated in institutional arrangements like in the UK, where companies are not obligated to disclose data to government (Lockwood, Kuzemko, et al., 2017), or there are insufficient measurement or enforcement of regulations, making evidenced based decision making more difficult.

Having introduced the theoretical basis of the thesis, and literature on which the thesis draws and builds upon, the next chapter introduces the empirical context the thesis.



## Chapter 3. Empirical context: Low/zero carbon housing

*“Failure is more newsworthy than success, and political analysis is generally more interesting when it includes (at least to some degree) strong aspects of failure.” (McConnell, 2015).*

This chapter introduces the empirical case for the thesis, the UK Zero Carbon homes policy mix. The first section gives an overview of the UK context in terms of the role of buildings and domestic buildings (housing) can play in national efforts to achieve significant carbon abatement, and an overview of the policies introduced in the UK towards achieving this. The second section then introduces the case specifically, and outlines the main reasons that it is considered as particularly useful for the purposes of testing the theoretical propositions of the thesis.

### 3.1.Context of the UK and the role of domestic buildings in carbon mitigation

There is ‘significant potential’ for carbon reductions from improving efficiency in buildings (IEA, 2012), and domestic and non-domestic buildings account for 49% of energy consumption (DECC 2014a), and in 2009 buildings accounted for about 43% of UK’s carbon emissions. In recent years, there have been numerous changes to the policy mix for energy efficiency (and buildings) in the UK during this time period. Kern et al., (2016) conducted research in this area focusing on the characteristics of the policy mix in both the UK and Finland (2000-2013), but did not consider the policy processes behind the evolution of the policy mix. Since 2013, there have been subsequent changes to the policy mix, which in aggregate would indicate reduced ambition and political support for this area of development.

Progress has been slow since the second National Energy Efficiency Action Plan (NEEAP), compared to other EU member state countries in energy efficiency policies. In the period of 2012-2015 the UK was ranked 27 out of 28 countries, where in 2012 it was ranked 13 (Energy Efficiency Watch, 2015). Due to the significant policy changes made in this sector, I consider it to be an *unusual case* (Yin, 2014 p.52), which will serve as a testing ground to build theoretical propositions.

Energy standards in the UK are contained within the national building regulations, under ‘Part L’, and are under the mandate of the Department of Communities and Local Government (DCLG 2008). Updates to these regulations occur every three years and go through a consultation process, which invites participation from industry to provide feedback on draft

regulations and gives the opportunity for revision before their implementation. Once implemented, the enforcement of regulations is delegated. The Construction Industry Council (CIC) is a central government organisation which regulates Private Building Control. Local councils, who prior to the 1984 Building act were solely responsible for enforcement of the regulations, still operate as Local Area Building Control (LABC). The client (e.g. contractor) has the option to choose, but in some regions due to funding cuts and capability shortages, there is not always an option of LABC. The energy component of the building regulations in the UK is measured under the Standard Assessment Procedure (SAP), which calculates the energy performance of the building based on its design specifications.

The domestic construction industry is made up of many private companies, but is dominated by large volume house builders (Building 2008). These relatively powerful actors operate under a business model where they typically buy land for future developments. The size of this land bank has increased over time and the largest builders typically land on which to build for the next 3-5 years (Sceptre 2007). Importantly for updating building regulations, the current arrangements mean that developers can start the construction phase of these planned new developments which locks that site to the standards contained within the building regulations at the time at which construction starts. Accordingly, the business model of these largest developers is to start construction on all of their sites just prior to the implementation of new building regulations, which effectively allows them to avoid building to new regulations and there is typically a lag of around three years before large developments are built to the newly implemented standards. This causes a significant lag in the rate of progress and technological change. Importantly, the SME builders do not typically have land banks and are therefore the segment of the industry that have to build to the new standards first, despite not having the large amounts of capital at their disposal to spend on R&D that the larger builder do.

### 3.2.Zero Carbon Homes policy mix in the UK

In 2006 the UK announced that within 10 years all new domestic housing would be built to ‘zero-carbon standards’. This at the time was a very ambitious proposition, mainly because the UK was largely considered a laggard with regards to energy efficiency. What makes this announcement particularly ambitious is that when first announced, it included the emissions associated with household appliances, which made it the highest standard of anywhere in the world.

This case is also particularly suited to the testing of theoretical conceptual development of the thesis for a number of reasons. Primarily, the original design of the Zero Carbon Homes (ZCH) target was designed as a policy mix. The policymakers intended for the target to be met by three core policy

instruments (DCLG 2006) combined with a number of additional innovation policies, including R&D funding, tax incentives and procurement schemes. Uncommon for transitions, was that the main policy instruments were what Kivimaa & Kern (2016) call ‘control policies, which seek to phase out existing technologies or practices. Secondly, over its development, there were several different political objectives are related to the ZCH policy mix. For example, the UK has an ongoing ‘housing-crisis’, where declining rates of supply and increasing demand has led to highly inflated property prices. Interesting to ZCH is that it was originally intended to achieve both of these political objectives simultaneously, increase volume of supply, while also stimulating a transition in the housebuilding sector.

Another reason that this is a suitable case is that it concerns a wide range of different stakeholders (actors, coalitions, industries) each with their own interests. These include: the incumbent large-scale house builders, large-scale and centralised (renewable) energy companies/utilities, small-scale micro renewables, component manufacturers, NGOs. This allows for a rich analysis of the roles of these different actors in policymaking processes, and their different degrees of influence on decision making.

The final reason that this is deemed an interesting case is that ultimately it is an example of a failed transition. While there has been some progress made in the UK housebuilding sector as a result of the ZCH policy mix, this progress is, arguably, relatively low-hanging fruit which allowed for some incremental improvement of the existing technologies and practices in the building sector. Why I consider it a failed transition is that it did not produce any significant path-breaking or radical change within UK housebuilding. Arguably the most successful aspect of the ZCH policy mix is that the announcement and early commitment from the UK government prompted other countries to adopt their own zero/nearly zero carbon requirements for buildings, which, hopefully, will not suffer the same fate as ZCH.

## Chapter 4. Research Design, Methods and Data

This section details the research design of the thesis along with the methods and data used in the papers of the thesis. The thesis follows a qualitative research design. Accordingly, the rationale behind a case study design is outlined, along with process tracing, allowing for the study of phenomena over time (Yin, 2014). The remainder of the section then outlines the data sources and data collection procedure, before giving an overview of the data analysis. Since the data analysis is different from paper 2 to paper 3 these are considered separately.

### 4.1. Case study

*“[O]ne must consider dynamic processes that can highlight the implications of short time horizons, the scope of unintended consequences, the emergence of path dependence, and the efficacy or limitations of learning and competitive mechanisms. This requires genuinely historical research. By genuinely historical research I mean work that carefully investigates processes unfolding over time.” (Pierson 2000).*

Case study research is relevant when trying to answer ‘how’ and ‘why’ questions, and also while studying an ‘in-depth’ description of a social phenomenon (Yin, 2014, p.4). The case study allows for in depth investigation of a contemporary phenomenon within its real world context, and is especially useful when the ‘boundaries between phenomenon and context may not be clearly evident.’ (Yin, 2014 p.16). When researching politics, many concepts are hard to operationalise in quantitative terms. Opinions can be codified in terms of documents, statements of intent, but these artefacts capture ideas, normative and cognitive aspects which are more suited to an interpretivist research design. Coupling ideas and views to effects requires identifying operational linkages that need to be traced over time, rather than mere frequencies or incidence (Yin, 2014 p.10). Furthermore, for the study of politics and policy feedback, quantitative studies often provide insufficient detail of certain conditions and phenomena, or omit them completely (for a review see Pierson, 2007). While it would be possible to utilize deterministic research design in attempt to understand aspects of the policy process<sup>13</sup>, these studies have usually looked at the effect of a single policy on target populations<sup>14</sup>. Case studies are more suitable for understanding complex causal mechanisms (George and Bennett 2004), and can explain the presumed causal links in real world

interventions that are too complex for survey or experimental methods (Yin, 2014). Case study is also relevant to illustrate certain topics within an evolution, explore a situation where intervention has no single output, and where the investigator has little control over the events (Yin, 2014).

The research consists of a longitudinal single case study, because the complexity of politics requires tracing of the phenomena over time. Single cases aim to produce knowledge generalizable to theoretical propositions but not to populations or universes (Yin, 2014, p.21). Within a single case, empirical observations can be multiplied by formulating and testing hypotheses about the mechanisms that connect causes to effects (Bennett and George 1997). The case study has a single unit of analysis and corresponds to a *holistic design* single case study (Yin, 2014).

The unit of analysis will be the policy mix for low carbon housing, influenced by the effects of the instrument mix on the socio-technical system, and the socio-political, administrative and fiscal feedbacks mechanisms that occur. In order to elucidate the effects of policy feedback mechanism on policy change, I will look for evidence of how feedbacks influence the policy process. Important to the study of policy feedback is that effects do not necessarily or inherently generate feedbacks (Pierson 1993), and require the actions of actors through coalition forming, lobbying, framing and discourse. Many changes will occur within the STS, but in order to reduce the scope of analysis only those relevant to policy feedback mechanisms, or those that had influence through the framings discourse and actions taken by actors will be considered. This is a way to bound the study of such complex causal mechanisms, as the effects that are generated from policy design and implementation influence policy feedbacks, or may require attention to be drawn by a focusing event which directs attention to particular effects in the socio-technical system.

The starting point of the empirical analysis is 2006, ending in 2016. Earlier periods that help explain the history of energy efficiency policy, the progress made, and the socio political and economic factors of the country are also considered as background information. This period has been chosen as it coincides with the implementation Zero Carbon Homes target, following the EU Directive on the energy performance of buildings (EPBD) (Directive 2002/91/EC (EPBD, 2003). This is considered as an exogenous pressure placing pressure on UK policy makers, and the timeframe preceding it allows insight into endogenous conditions of the UK political system. Following the implementation of the EU directive, the UK Housing Act 2004 was implemented, and the analysis of the time preceding this will inform the ‘initial conditions’ of the policy mix for energy efficiency in domestic buildings.

The time period also includes the financial crisis of 2007 which substantially reoriented spending

on policy and acted as a focusing event on the policy subsystem. Throughout this time period, there have been two successive changes in electoral majorities, moving from a Labour majority government, to a Conservative-Liberal Democrat coalition government and finally Conservative majority since May 2015. Again, while these exogenous socio-political changes are not directly attributed to policy feedback at the subsystem level, they help explain the interplay of endogenous policy feedbacks, and why certain feedback effects may be amplified. I consider this to be particularly salient to the analysis, and as suggested by Patashnik and Zelizer (2013, p. 1077), ‘scholars have paid insufficient attention to influence of elections outcomes and partisan forces on the prospects for policy entrenchment’.

#### 4.2.Data sources and collection

The thesis draws on two main sources of evidence. First, archival data for the period 2006-2016. This included newspapers, industry journals, white papers, green papers, consultations, statements, written and oral references in the House of Commons and House of Lords, select committee inquiries, and a Treasury enquiry (table 5). Based on a freedom of information request we also received access for all minutes, agendas and supplementary documents from all meetings of the Zero Carbon Task Force (see **Appendix F**).

Table 4- Interviewees by actor type, group, format, date and duration.

Interview	Actor type	Actor group	Format	Date	Duration (minutes)
1	UK-Green Building Council	NGO	Face to face	31/08/2017	90
2	World Wildlife Fund/Task force/ UK-Green Building Council/Zero Carbon hub	NGO	Telephone	17/08/2017	50
3	NGO/advocacy group	NGO	Telephone	23/09/2017	90
4	Manufacturing – advocacy group	Industry/ Manufacturing/NGO	Face to face	3/10/2017	90
5	Manufacturing – advocacy group	Industry/ Manufacturing/NGO	Telephone	18/09/2017	105
6	Manufacturing/ Zero Carbon Hub	Industry – manufacturing	Telephone	2/10/2017	90
7	House builder/Zero Carbon Hub/ National House Building Council	Industry	Face to face	12/10/2017	90
8	Developer	Industry - developer	Face to face	4/10/2017	90
9	House Builders Federation	Industry - developer	Telephone	1/12/2017	45
10	Chartered Institutions of Building Service Engineers	Expert/ industry	Telephone	17/11/2017	90
11	Consultant/Zero Carbon Hub	Industry/ Expert	Telephone	24/10/2017	90
12	Consultant/Zero Carbon Hub	Industry/ Expert	Face to face	11/09/2017	90
13	Expert/ academic	Expert	Telephone	5/09/2017	90
14	Academic	Expert	Face to face	26/10/2017	60
15	Civil servant/Carbon Trust	Policy maker/ Expert	Face to face	7/09/2017	90
16	Minister/Department of Communities and Local Government	Policy maker	Face to face	17/10/2017	50
17	Office of the Deputy Prime Minister/ Local Area Building Control	Policy maker	Face to face	14/09/2017	90
18	Building Research Establishment/Housing association	Policy maker/ Industry	Face to face	13/10/2017	60

Second, the thesis used 18 semi-structured expert interviews (table 4). Interviewees were selected based on their knowledge of and involvement in relevant processes, while also seeking a balance between different actor groups (policy-makers, NGOs, industry, academic, experts). Interviews were based on a semi-structured questionnaire, were conducted face-to-face and over telephone in the period from August until October 2018, and lasted on average 79 minutes. They were supported by a timeline visualisation compiled from archival data, which allowed for validation of the event timeline with experts, while also looking for additional information.

Table 5 - Archival data by type, source and quantity

Type of archival data	Data Source	Quantity
Policy documents – Government responses to consultations, publications (white papers), speeches, impact assessments	<a href="http://webarchive.nationalarchives.gov.uk/20120919183345/http://www.communities.gov.uk/">http://webarchive.nationalarchives.gov.uk/20120919183345/http://www.communities.gov.uk/</a> <a href="https://www.gov.uk/">https://www.gov.uk/</a>	137
2016 Task Force - meeting minutes, agendas, supporting documents/reports	Freedom of information request to Department of Communities and Local Government (DCLG)	115 (See Appendix A)
Zero carbon hub publications	<a href="http://www.zerocarbonhub.org/recent-publications">http://www.zerocarbonhub.org/recent-publications</a>	148
Industry journals	<a href="https://www.endsreport.com/">https://www.endsreport.com/</a> <a href="https://www.building.co.uk/">https://www.building.co.uk/</a> <a href="https://www.cibsejournal.com/">https://www.cibsejournal.com/</a> <a href="https://www.architectsjournal.co.uk/">https://www.architectsjournal.co.uk/</a>	603 articles - reviewed for relevancy and reduced to 112
Secondary literature	<a href="https://www.scopus.com">https://www.scopus.com</a>	25 academic papers
Inquiries	<a href="https://www.parliament.uk">https://www.parliament.uk</a>	71 written responses in Treasury inquiry 99 written responses in 'Home energy efficiency and demand reduction' inquiry, Energy and Climate Change Committee Documents reviewed using search terms "zero carbon homes" and "allowable solutions".
Debates in the House of Commons and House of Lords over the period of 2006-2016	<a href="https://hansard.parliament.uk/">https://hansard.parliament.uk/</a>	260 spoken references 22 written statements Occurrences resulting from search terms 'Zero Carbon Homes' and 'Code for Sustainable Homes'
Letters (to government ministers)	Various	3
Media	<a href="https://www.theguardian.com/uk">https://www.theguardian.com/uk</a> <a href="https://www.telegraph.co.uk/">https://www.telegraph.co.uk/</a> <a href="https://www.ft.com/?edition=uk">https://www.ft.com/?edition=uk</a> <a href="https://www.independent.co.uk/">https://www.independent.co.uk/</a>	427 occurrences - reviewed for relevance using search terms "zero carbon homes", "eco-towns" and "code for sustainable homes". Reduced to 67.

### 4.3. Data analysis

This section justifies the method of data analysis used in the empirical work contained in papers 2 and 3. Fundamentally, a 'framework analysis' methodology was used for the analysis of collated data (Ritchie & Spencer, 1994). While the methodological approach was consistent throughout the thesis, the frameworks used in papers 2 and 3 were different. As a consequence the coding systems used in these two approaches are different.



Data was first coded by drawing on the collated archival data key events were arranged chronologically. These events were then assigned codes of the conceptual framework and changes in the socio-technical system and the policy mix. For the socio-technical system, quantitative and qualitative information was collected on demonstration projects, annual built rates, research and development activities, activities of key market actors and industry development. For the latter, we included changes in the policy strategy and the instrument mix. For the coding method used here see **Appendix A-D**.

Interviews were transcribed verbatim and then indexed using NVivo11 to deductively code for four phases with nodes derived from our framework. We also coded ‘other’ as sub-nodes of both policy effects and feedback mechanisms, to account for any phenomena not captured by the framework<sup>9</sup>. We ran multiple queries to investigate the relationships between elements of the framework, using matrix-coding queries to look for overlaps. In doing so, we examined whether the interviewees agree with each other and whether there were significant differences in responses, e.g. between interviewees from different actor types. We triangulated our interviews with our archival data to ensure the robustness of our findings. Collectively these sources allowed for a rich analysis of co-evolutionary mechanisms. For an illustration of coding frequency per concept see **Appendix E**.

Additional content analysis involved processing of the primary data of meetings of the task force obtained from the freedom of information request. This analysis involved tracing the participants of meetings of the zero carbon task force, helping identify who had more influence in this aspect of the policy subsystem. Paper 3 also pays more attention to the elected officials responsible for the zero carbon homes policy mix, their involvement and their influence over decision making.

---

<sup>9</sup> However, since the research was designed to look for evidence of the main a priori conceptual components, most data was expected to fit the framework (Ritchie & Spencer, 1994).

## PART II – JOURNAL ARTICLES (PAPERS 1, 2 AND 3)

# Chapter 5. The Co-Evolution of Policy Mixes and Socio-Technical Systems: Towards a conceptual framework of policy mix feedback in sustainability transitions (Paper 1)

Duncan L. Edmondson, Florian Kern, Karoline S. Rogge

Journal: Research Policy

Status: Accepted March 2018

<https://doi.org/10.1016/j.respol.2018.03.010>

## Abstract

Understanding how policymaking processes can influence the rate and direction of socio-technical change towards sustainability is an important, yet underexplored research agenda in the field of sustainability transitions. Some studies have sought to explain how individual policy instruments can influence transitions, and the politics surrounding this process. We argue that such individual policy instruments can cause wider feedback mechanisms that influence not only their own future development, but also other instruments in the same area. Consequently, by extending the scope of analysis to that of a policy mix allows us to account for multiple policy effects on socio-technical change and resultant feedback mechanisms influencing the policy processes that underpin further policy mix change. This paper takes a first step in this regard by combining policy studies and innovation studies literatures to conceptualise the co-evolutionary dynamics of policy mixes and socio-technical systems. We focus on policy processes to help explain how policy mixes influence socio-technical change, and how changes in the socio-technical system also shape the evolution of the policy mix. To do so we draw on insights from the policy feedback literature, and propose a novel conceptual framework. The framework highlights that policy mixes aiming to foster sustainability transitions need to be designed to create incentives for beneficiaries to mobilise further support, while overcoming a number of prevailing challenges which may undermine political support over time. In the paper, we illustrate the framework using the example of the zero carbon homes policy mix in the UK. We conclude with deriving research and policy implications for analysing and designing dynamic policy mixes for sustainability transitions.

### 5.1. Introduction

Understanding the role of policy processes in influencing the rate and direction of sustainability transitions remains a fundamental challenge in the existing literature on socio-technical transitions (Markard et al. 2012). Scholars in this field have sought to facilitate the restructuring of socio-technical systems towards more sustainable ways of fulfilling societal needs (Geels 2002, 2004). Moving towards more sustainable configurations requires significant structural changes in existing systems, often instigated by policy to reconfigure market selection environments, user preferences and cultural perceptions (Geels et al. 2016). Policy action is argued to be required to overcome various market and system failures (Weber and Rohrer 2012).

However, ‘behind policy there is always politics’ (Meadowcroft 2011: 73) and political negotiations can have a major influence on the stability or change of policy, which in turn influences socio-technical developments. It has been argued that policy stability is beneficial in creating positive expectations of a path to commercialization for early stage technologies (Foxon et al. 2005). However, it has also been argued that policy needs to be able to account for changes in the socio-technical system, incorporating enough flexibility to allow for revisions without deterring investor confidence (Hekkert et al. 2007). Due to the long timeframes involved in sustainability transitions, the types of policy instruments aimed to foster transitions may change significantly over time to address changing objectives and different stages of innovation (Turnheim et al. 2015). The ways in which policy mixes evolve over time can have a significant influence on the rate and direction of sustainability transitions (Reichardt et al. 2016). Collectively, these considerations highlight that in the context of sustainability transition processes, it is important not only to study the content of policy instruments (e.g. what level of support is provided for which technology?), but the processes through which instruments are introduced, adapted or kept stable over time.

Another challenge in understanding the influence of policy on sustainability transitions is the need to move beyond a focus on single policy instruments towards wider policy mixes (Rogge et al. 2017). Contributions from various literatures, including innovation studies (Nauwelaers et al. 2009), environmental economics (Lehmann 2010) and policy analysis (Howlett and Rayner 2007), have already sought to explore important aspects of policy mixes; such as the design features of individual instruments in the mix (Kemp and Pontoglio 2011), instrument interactions (del Río González 2006; Nauwelaers et al. 2009), the elements of the mix (Borrás and Edquist 2013), the policy strategy (Quitow 2015a), as well as overall characteristics of mixes (Howlett and Rayner 2013; Reichardt and Rogge 2016) and policy processes (Flanagan et al. 2011). Sustainability transitions are complex, multi-faceted processes, involving long time frames, multiple actors, and often a range of both competing and complementary technologies (Geels 2004). Such complexity means that no single

approach, technology, intervention or policy instrument is capable of achieving transformative change, often resulting in large numbers of policy instruments being implemented over time to address multiple objectives (Loorbach 2010; Kern and Howlett 2009; Kern et al. 2017).

Recently, scholars have called for an integration of these perspectives into the study of sustainability transitions, to produce more meaningful analytical insights and policy recommendations (Rogge and Reichardt 2016). This paper follows suggestions of Flanagan et al. (2011) and Rogge and Reichardt (2016) to take a first step towards better conceptualising the role of policymaking processes in the co-evolution of policy mixes and socio-technical change. Only few studies have started to draw on policy process theories in the context of transitions to better understand processes of policy change (Kern and Rogge 2017). Others have sought to analyse how single policies co-evolve with the socio-technical system (Hoppmann et al. 2014), but only present a relatively simplistic conceptualisation of the policy process. We complement these early attempts by paying greater attention to how policymaking processes influence the co-evolution of policy mixes and socio-technical systems. We do so by drawing on the policy feedback literature from the field of policy sciences (Pierson 1993).

The policy feedback literature draws attention to the continuous interactions between public policy, the outcomes in society, and how these outcomes affect policy actors in ways that influences politics and subsequent policymaking (Weible 2014: 13). We suggest this analytical focus offers important insights to explain the dynamic and recursive nature of how policy mixes and socio-technical systems co-evolve. Our proposed framework aims to explore how policy mixes stimulate changes in socio-technical systems through policy effects, and how these changes can subsequently generate feedback mechanisms influencing the evolution of the policy mix. The paper is predominantly a conceptual contribution developing a novel framework, but uses the zero carbon homes policy mix in the UK as an empirical illustration to help highlight interactions dynamics of the framework. This seems a particularly well suited example as it represents an instance where an ambitious policy target lost political support over time due to a range of policy effects and feedback mechanisms, ultimately leading to its abandonment.

The remainder of the paper is structured as follows. In section 2, we review two emerging strands of research exploring the role of policy in sustainability transitions: section 2.1 reviews work on policy, politics and policy processes within sustainability transitions, while section 2.2 reviews the development of policy mix thinking and its application to sustainability transitions. In section 3, we review concepts from the policy feedback literature and in section 4 utilise these ideas to conceptualise the co-evolution of policy mixes and socio-technical change for sustainability transitions. To illustrate interaction dynamics of the framework, section 5 draws on the zero carbon homes policy mix in the UK. In section 6 we derive conclusions, suggest avenues for further research

and policy mix design considerations for sustainability transitions.

## 5.2. Sustainability Transitions, Politics and Policy Mixes

‘Socio-technical systems’ are commonly understood as the “linkages between elements necessary to fulfil societal functions” (Geels 2004: 900), such as energy, transport, housing and food production and consumption. Such a system consists of multi-faceted combination of actors, networks, institutions, artefacts, infrastructure, markets and practices along with cultural and symbolic views and representations (Geels 2004). A socio-technical transition is a combination of processes leading to a fundamental shift of a socio-technical system (Geels and Schot 2010). Transitions involve technological, organisational, institutional, political, and socio-cultural changes (Markard et al. 2015). Changes to any of these aspects can produce systemic effects, due to their interactions with other components of the socio-technical system (Foxon 2011). However, reconfigurations do not happen autonomously and require the activities of human actors (Geels 2004: 900).

Historical examples of transitions include the shift from sailing ships to steamboats (Geels 2002), and from horse-driven carriages to automobiles (Geels 2005). Studies of such examples highlight that transitions have historically taken long periods of time (25-50 years) to unfold (Geels and Schott 2007). Yet, some more recent transitions have been shown to occur quicker (Sovacool 2016) and there is a live discussion about whether sustainability transitions can occur more quickly if they are consciously governed, while most historical transitions were emergent, market-driven processes (Kern and Rogge 2016). This is indeed the ambitious foundational claim of much thinking in the sustainability transitions literature, that it is possible to influence the speed and direction of socio-technical transitions towards sustainability and that public policy can play a key role in this regard.

One of the main challenges in this field therefore is to improve the understanding of how policies can influence transitions (Markard et al. 2012). In the following sections, we review two areas of development within the literature that have sought to address this challenge: first the role of policy, politics and policy processes in sustainability transitions and second the growing interest in considering policy mixes rather than single instruments.

### 5.2.1. *Policy, politics and policy processes in sustainability transitions*

Policy is widely considered as an integral constituent of transitions towards sustainability (Jacobsson and Lauber 2006) and is argued to help accelerate the pace of transitions (Kern and Rogge 2016). One important policy to change selection environments towards more sustainable configurations, is to internalise the external costs of environmental damage, either through carbon pricing or cap and trade schemes (Baranzini et al. 2017). Early advocates of transition management proposed the use of such ‘control policies’ as part of efforts to promote transitions (Kemp and Rotmans 2004). However,

beyond internalising the market failure of environmental externalities, a number of structural and transformational system failures have been identified which also require policy intervention (Weber and Rohracher 2012; Wieczorek and Hekkert 2012). In this regard, policymakers can implement policies to stimulate transitions, including subsidies, procurement, R&D grants, and upskilling and training incentives (Markard et al. 2015).

More specifically, the Strategic Niche Management (SNM) literature suggests that policymakers need to create protective spaces to shield and nurture sustainable innovations; and to make mainstream market conditions more favourable to emergent technologies (Smith and Raven 2012, Raven et al. 2016). In addition, the Transitions Management literature stresses the importance of ‘transition arenas’ to bring together frontrunners to create new networks and accelerate learning and technological development (Kemp and Rotmans 2004). It has also been stressed that experiments should be complemented with long term agenda setting to help establish a shared vision to guide investment and reduce uncertainty (Rotmans and Loorbach 2010).

Transition scholars suggest that a constant realignment of policy with the changing conditions of the socio-technical system is necessary (Hoppmann et al. 2014), requiring reflexive policymaking and learning over time to account for the unpredictable nature of transitions (Rotmans and Loorbach 2010). Equally, policy change can impact resource availability, investor confidence, or signal changes in political will. Accordingly, not only changes in policy content, but also the process through which policy changes, can have impacts on the socio-technical system (White et al. 2013; Reichardt et al. 2017). Consequently, over time policy changes can lead to virtuous or vicious cycles of causation influencing the momentum of sustainability transitions (Hekkert et al. 2007).

So far, the transitions literature has typically referred to the content of policymaking in terms of objectives, programs, regulations, laws and resource allocations (Markard et al. 2015). Moving beyond the content of policies, “[p]olitics refers to the procedural dimension of policymaking, with a variety of actors negotiating and interacting to produce public policies” (Markard et al. 2014: 4). Policymaking can be understood as the design, implementation, adaptation and discontinuation of public policies (Sabatier and Weible 2014). This can be considered as the process of implementing overarching objectives, and is heavily influenced by the political conditions. States are dependent on prevailing economic structures and industries, which can create vested interests as political and economic actors become entangled, often resulting in a high level of influence of incumbent actors on policy decisions (Meadowcroft 2011; Johnstone et al. 2017).

A number of contributions have already sought to help analyse the politics of transitions (Baker et al. 2014; Meadowcroft 2009; Meadowcroft and Langhelle 2009; Shove and Walker 2007). Studies have for example focused on the way in which ideas are presented (Kern 2011; Scrase and Smith 2009), the

role of coalitions (Hess 2014, 2015; Markard et al. 2015), power relations (Avelino and Rotmans 2009; Avelino 2011; Geels 2014), and policy networks (Normann 2017). To conceptualise how politics influences policymaking processes, transition scholars have started to integrate insights from prominent policy process theories, including Sabatier's Advocacy Coalition Framework (Markard et al. 2015), Kingdon's Multiple Streams (Normann 2015), and Marsh's Policy Networks Approach (Normann 2017). From these contributions, we know that during transition processes windows of opportunity can allow actors to advocate certain technologies and gain favourable policy outputs. Yet, over time, changing conditions can cause these windows to close and policy support to be withdrawn (Normann 2015). Similarly, beliefs of actors can change over time, which may influence participation in coalitions (Markard et al. 2015) and the formation of policy networks (Normann 2017).

Some contributions have also explored linking policy processes to the rate and direction of change in the socio-technical system more directly. Hoppmann et al. (2014) highlight the iterative process of policy realignment for solar PV in Germany, responding to the changing conditions within the socio-technical system. Lauber and Jacobsson (2016) also follow the evolution of the German Feed-in-Tariff (FiT), focussing on the politics surrounding the empowerment of niche actors and how changes in the socio-technical system over time influenced discourses of different actor groups. These papers highlight policy change in response to changes in the socio-technical system, but their conceptualisations of policymaking processes is underdeveloped. Furthermore, these papers only cover a single policy instrument and its revisions over time, rather than a wider policy mix.

Consequently, the interplay of technological change, politics and policy processes remains understudied (Schmidt and Sewerin 2017) and under conceptualised, particularly when considering collections of policies that make up an overarching policy mix. In the following, we therefore review the emerging literature on policy mixes in the field of sustainability transitions.

### *5.2.2. Policy mixes and sustainability transitions*

Recently, there has been increased attention to policy mixes in innovation studies (Flanagan et al. 2011; Guerzoni and Raiteri 2015). Scholars of sustainability transitions also, have argued to extend the scope of analysis beyond individual instruments to that of broader policy mixes (Rogge and Reichardt 2016). Sustainability transitions exhibit several characteristics that make the policy mixes required to foster transitions distinct, and arguably more challenging than in other areas. This is not only due to a number of interrelated market and system failures (Foxon et al. 2005; Weber and Rohracher 2012) but also due to the required speed and unprecedented scale and complexity of the required changes.



Two particular challenges concern destabilization and accumulation. Regarding the former, scholars have argued that policy mixes for sustainability transitions need to actively seek to destabilise the existing configuration to speed up transitions (David 2017; Johnstone and Rogge 2017; Kivimaa and Kern 2016). Regarding the latter, policies to support sustainability transitions are commonly added to the mix alongside existing policies (often supporting the regime) rather than replacing them (Kern and Howlett 2009; Kern et al. 2017). This can limit the transformative potential of policy mixes for sustainability transitions and produce complex combinations of interacting instruments leading to unintended or undesirable effects.

Given these challenges, Rogge and Reichardt (2016) propose a framework for analysing policy mixes for sustainability transitions. They argue that it is important to not only look at interacting instruments but also to consider policy strategies as elements of a policy mix. We follow this conceptualisation, thereby acknowledging the need for long-term strategies for guiding transitions (Foxon and Pearson 2008; Weber and Rohracher 2012), which are considered separately from the instrument mix<sup>10</sup> (Figure 1).

Drawing on insights from the policy design and innovation literatures they also stress that policy mix characteristics, such as the consistency of the instrument mix with stated policy objectives, may help explain the impact of policy mixes (see also Kern and Howlett 2009; Alkemade et al. 2011). In line with Flanagan et al. (2011), they also call for increased attention to the underlying “political problem-solving process among constrained social actors in the search for solutions to societal problems – with the government as primary agent taking conscious, deliberate, authoritative and often interrelated decisions” (Rogge and Reichardt, 2016: 1625).

---

<sup>10</sup> This is an important distinction as much of the policy mix literature uses ‘instrument mix’ and ‘policy mix’ interchangeably.

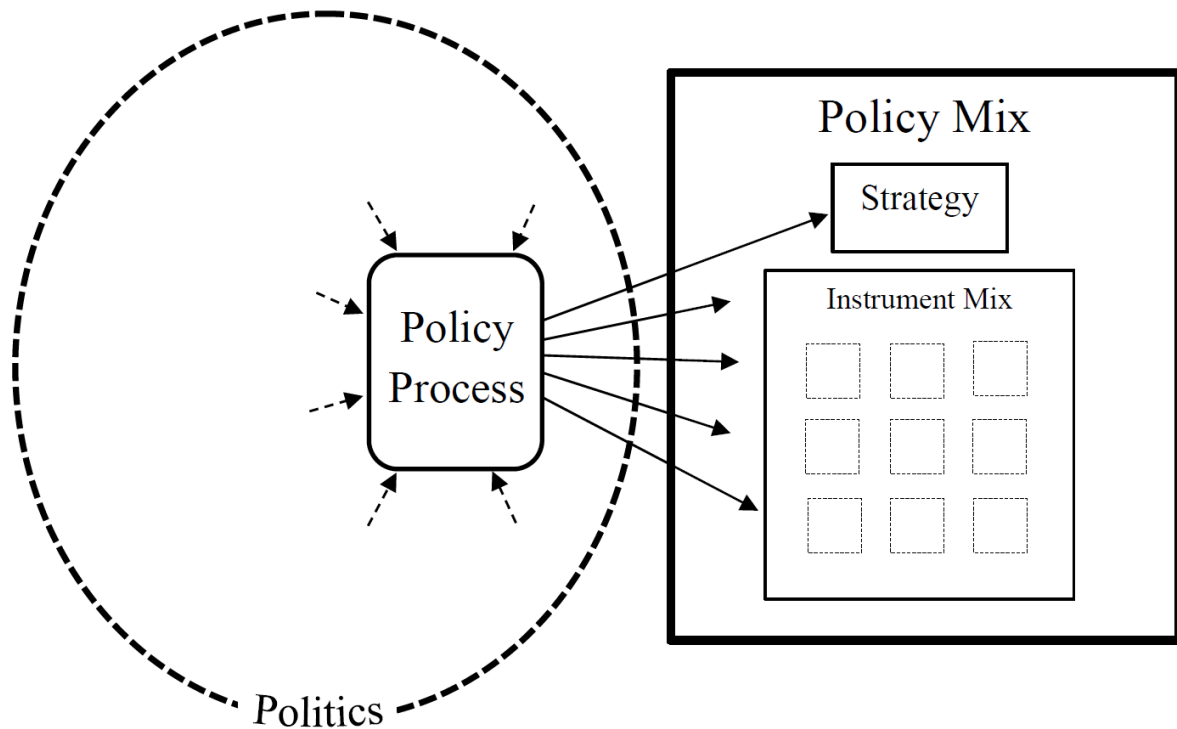


Figure 1 - Politics, Policy Processes and Policy Mixes in Sustainability Transitions

Our contribution focusses on these policy processes, specifically on the effects of policy decisions on socio-technical systems, and the resultant influence of these changes on the further evolution of the policy mix (Section 4). In order to develop a conceptual framework for studying these processes, we draw on the policy feedback literature (Pierson 1993) which we review in the following section.

### 5.3. Analysing policy processes: Insights from the Policy Feedback Literature

To address the call for a more explicit consideration of policy processes in the field of sustainability transitions we apply insights from the Policy Feedback literature (Pierson 1993). We have chosen to build on this approach for four reasons.

First, this literature addresses the interdependencies between policies and further policymaking. It investigates how the effects of a policy change alter subsequent rounds of policymaking, which makes it well suited to our focus on the co-evolution of policy mixes and socio-technical change. Secondly, in the transitions literature technological and institutional co-evolution has been used to partly explain ‘carbon lock-in’ (Foxon 2011; Unruh 2000). We suggest that the policy feedback literature with its attention to path dependency (Pierson 2004) can contribute to our understanding of such lock-in processes. Third, policy feedback thinking has epistemological similarities to the transitions literature. Both approaches have conceptual roots derived from the punctuated equilibrium paradigm (Gould and Eldredge 1977). Each propose that revolutionary change happens in cycles, where disruption of a

stable system leads to a period of radical change, which re-stabilises over time to reach a new equilibrium. Finally, within the feedback literature some authors have focused on single policy instruments (Jordan and Matt 2014), while others have already drawn attention to the importance of considering several instruments (Weaver 2010; Oberlander and Weaver 2015). Consequently, the latter strand particularly lends itself to our purpose.

The policy feedback literature has its roots in historical institutionalism and rational choice (Pierson 1993, 2004), and has more recently integrated insights from punctuated equilibrium theory (Jacobs and Weaver 2015; Patashnik and Zelizer 2013). It explores mechanisms through which policies reshape social and state actors' interests and capacities over long periods of time in ways that change the prospects for the policies' future maintenance, expansion, or reversal (Skocpol 1992). The core argument in this literature is that policies are not merely the products of politics, but also influence politics through societal reconfigurations. Policy alters state capacities, it changes incentives for collective action, and encourages social adaptations that may become difficult to reverse (Patashnik and Zelizer 2013).

In Pierson's (1993) seminal work he identified ways in which policy design can incentivise actors to participate in policymaking processes and shape the political conditions. This early literature seeks to explain the influence of policy through two factors: 'resource effects' (policies as packages of resources that affect interest groups, state capacities and mass publics), and 'interpretive effects' (policies as sources of information that affect patterns of cognition, understanding and meaning) (Mettler and Soss 2004: 60). Patashnik and Zelizer (2013) built upon these effects, drawing attention to the institutional supports that may limit the capacity of a policy to create positive feedback. They argue that failure to uproot institutional arrangements, or layering new policy alongside existing arrangements, can generate conflicts among programs and agencies which undermines policy support. Consequently, *layering* is considered much less effective for institutional recalibration than *dismantling* (terminating the existing arrangements) (Patashnik and Zeilzer 2013:1077).

Recent scholarship has highlighted that these effects (resource, interpretive and institutional) are better termed 'feed-forward' effects, as they describe post-enactment policy consequences with no complete feedback loop (Schneider and Ingram 2009: 103; Jordan and Matt 2014: 231). These effects "show the feed but not the back (or they just assume the back)" (Campbell 2012: 347). Therefore, following the suggestions of Jordan and Matt (2014), we move towards a conceptualisation of complete feedback loops making a distinction between the forward and backward dimension of feedback processes. We refer to the effects of policymaking on the socio-technical system as the '*policy effects*' and the resultant influence of the socio-technical system on future policymaking as the '*feedback mechanisms*' (see section 4.1- 4.2).

Policies are not thought to automatically generate feedback mechanisms, but require coalitions of actors to take political action for the effect of a given policy to influence further policy processes (Pierson 1993, 2000). Scholars have conceptualised various feedback mechanisms, including influence on interest groups, altering of administrative capacities of the state (state-building), and changes in political participation (Pierson 1993; Mettler 2002; Béland 2010). In a recent contribution from Oberlander and Weaver (2015), feedback mechanisms are conceptualised into three broad categories: *socio-political*, *fiscal* and *administrative* (see section 4.2 for details). We draw on this contribution as it is the most fully realised conceptualisation of feedback mechanisms to date, while it responds to two criticisms of the existing literature.

First, much feedback literature has narrowly focussed on the occurrence of positive feedback, and has been increasingly criticised for over-determinism (Béland 2010). The underlying assumption of the (positive) feedback literature is that feedbacks will occur, whereby choosing policy alternatives becomes more costly over time, making it increasingly difficult to choose alternatives (Pierson 1993). Therefore, a recent line of scholarship has highlighted the role of negative feedback, and even suggested that negative feedback may have greater influence on policymaking than positive feedback (Patashnik and Zelizer 2009, 2013; Weaver 2010).

Secondly, while scholars have succeeded in providing empirical instances of feedback mechanisms (Pierson 2007), there had been little progress in translating this into a comprehensive research agenda determining when feedback mechanisms are expected to occur (Patashnik and Zelizer 2013: 1075). Scholars had sought to explain *how* these feedbacks occurred, but less attention was paid to *if* they occur or the conditions under which they may or may not. Oberlander and Weaver (2015) describe both positive (self-reinforcing) and negative (self-undermining) feedback mechanisms; along with the conditions that would amplify the occurrence of negative feedback mechanisms. Consequently, we draw on these categories in developing our framework.

#### 5.4. Policy Mix Feedback in Sustainability Transitions: Towards a conceptual framework

In this section, we develop a novel conceptual framework for analysing the co-evolution of policy mixes and socio-technical systems in processes of sustainability transitions (Figure 2). More precisely, as transitions unfold through co-evolutionary dynamics of system components, our framework focusses on the co-evolution of the policy mix, as part of the institutional structure of the system, with the other system components including technologies, user dynamics, and business strategies (Foxon 2011).

The key idea of our co-evolutionary framework is that policy mixes have resource, interpretative and institutional effects on the evolution of the socio-technical system, and that in turn, developments in

the socio-technical system influence the policy mix through a range of feedback mechanisms<sup>11</sup> (Figure 2). These include socio-political, administrative and fiscal feedback mechanisms.

However, rather than influencing the policy mix directly these feedback mechanisms rather influence the ‘policy subsystem’. Such a policy subsystem can be conceptualised as the relationships between actors responsible for policy decisions and ‘pressure participants’ (Jordan et al. 2004), which include interest groups with which decision makers consult (Cairney and Heikkila 2014). Thereby, actors play a central role in the framework as the agents of change in both the policy subsystem and in the socio-technical system.

When considering the influence that actors have on the policy process, the implicit assumption in the transitions literature involves a power struggle between niche actors and dominant incumbents. We infer from existing literature that the political influence of actor coalitions is related to their ability to mobilize resources (Hess 2014; Markard et al. 2015), where resources can be considered “persons, assets, materials or capital, including human, mental, monetary, artefactual and natural resources” (Avelino and Rotmans 2009: 551). Accordingly, policy processes are characterised through resource interdependencies in which bureaucrats seek information and advice from different interest groups, who exchange information for access to and potential influence within government (Cairney and Heikkila 2014).

---

<sup>11</sup> As explained in section 3, we distinguish between the forward and backward dimension of policy feedback. We consider the forward dimension as the policy effects of the mix on socio-technical change. We use ‘feedback mechanisms’ and ‘feedbacks’ interchangeably throughout the remainder of the paper to capture the backward dimension of policy feedback. Feedback loops capture both the forward and backward dimension of policy feedback, which are explained in section 4.4.

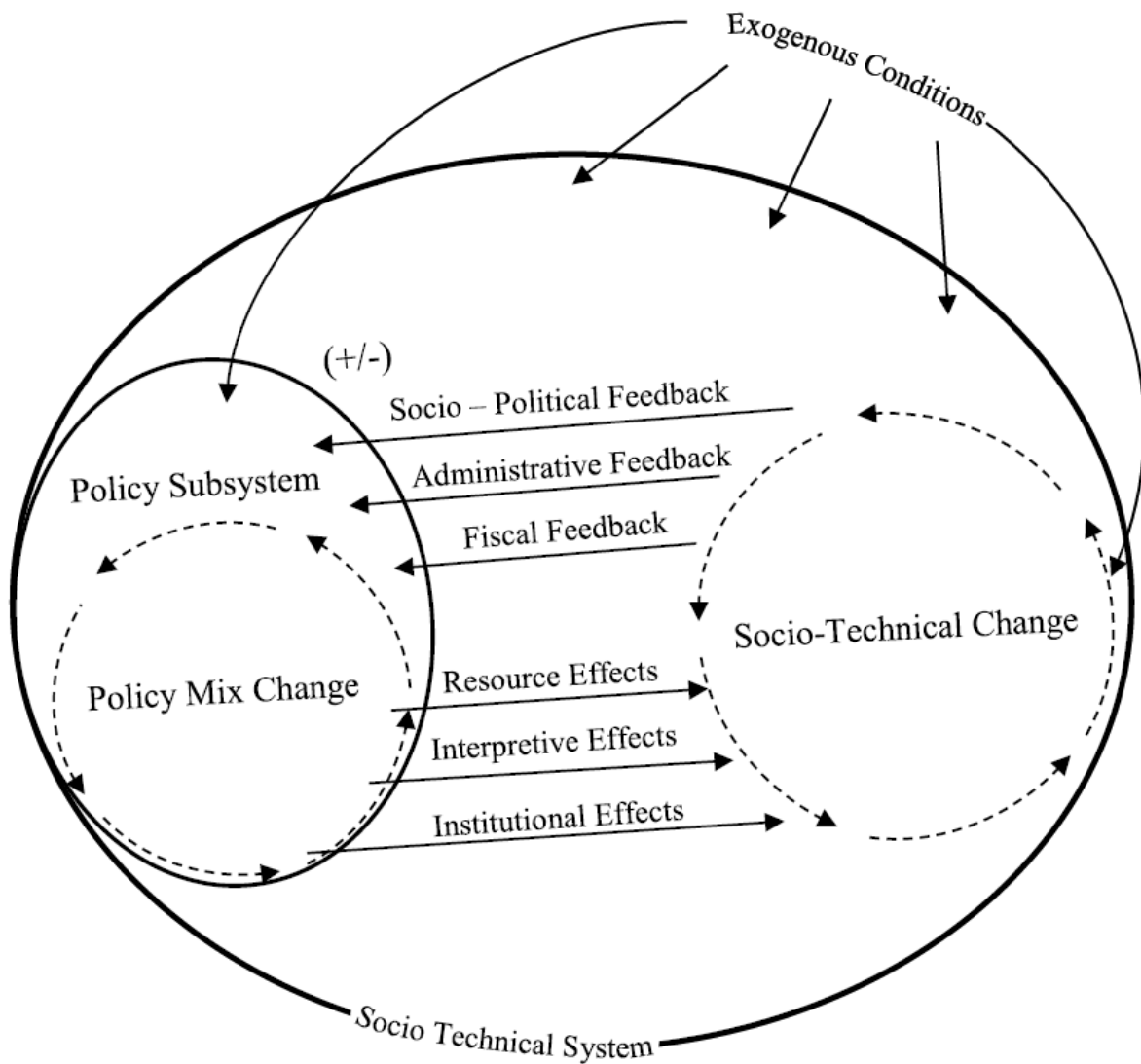


Figure 2 - Dynamic interactions of the policy mix and the rest of the socio-technical system

In the following subsections, we develop the conceptual framework in more detail. While we describe each component in turn, these processes often occur simultaneously, where policies create multiple policy effects, and the forms of feedback that occur often influence each other. Consequently, section 4.4 elaborates potential interactions between the various processes covered by the framework.

#### 5.4.1. *Effects of Policy Mixes on Socio-Technical System*

The policy mix, with its strategies and various instruments, stimulates change in the socio-technical system through resource, interpretative and institutional effects. These policy effects are determined

by choices (intentional or otherwise) regarding design features of individual instruments (such as their level of support), and characteristics of the policy mix (such as its consistency or credibility).

#### 5.4.1.1. Resource Effects

Resource effects are the result of the resources that the policy mix bestows upon target groups (Pierson 1993; Patashnik and Zelizer 2009). These resources can influence the rate and direction of transitions. For example, policy mixes can support knowledge creation of low-carbon technologies through R&D (Hekkert et al. 2007), facilitate their demonstration and procurement (Jacobson and Bergek 2011), or create favourable market conditions for the diffusion of sustainable solutions (Smith and Raven 2012). Providing resources can therefore influence the activities and strategies of actors in ways that stimulate changes of the socio-technical system towards sustainability (Foxon 2011). The magnitude and target actors of resource effects are determined by the design features of individual instruments (e.g. level and duration of support) and interactions with other instruments in the mix (Kemp 1997; del Rio González 2010; Rogge and Reichardt 2016).

Sustainability transitions are complex, multi-faceted processes with multiple actors and often involve supporting both complementary and competing technologies (Geels 2004). Consequently, policy mixes aiming to foster transitions produce multiple resources effects, stimulating hard to predict interactions in the socio-technical system and unintended consequences. This increases as layering of policy mix elements accumulates and as policy instruments act in a changing social, technical and economic context (Jacobs and Weaver 2015). A policy mix may simultaneously support both niche and regime actors, or policy makers may seek to reduce resource flows to unsustainable regime practices which typically affects incumbents (Kivimaa and Kern 2016). Consequently, how resources are allocated will not only influence the rate and direction of socio-technical change, but will also incentivise actors to mobilise and support or oppose the policy mix to protect or secure resources.

#### 5.4.1.2. Interpretive Effects

The policy mix also produces interpretive effects, providing information and changing patterns of cognition, understanding and meaning (Pierson 1993), thereby creating or changing visions and expectations of actors (Jacobson and Bergek, 2011; Smith and Raven 2012). This is important in sustainability transitions as actors' perceptions can influence investment decisions and innovative activities (Hekkert et al. 2007; Jacobson and Bergek 2011), including: engaging in green R&D (Hekkert et al. 2007), the formation of learning networks (Mourik and Raven 2006) and advocacy coalitions to lobby for resources for more sustainable alternatives (Bergek et al. 2008).

If actors perceive apparent 'failings' in the design of either individual policy mix elements (strategies and instruments) or the mix as a whole, it can influence stakeholders' opinions of the capabilities of

the public sector actors charged with design and implementation of the mix, and/or can be seen as indications of limited political will to achieve policy objectives. For example, a policy strategy to promote sustainable innovation may establish expectations about future resource effects beneficial to niche actors, as it provides guidance and a mandate for the design of individual instruments, as well as the composition of the instrument mix. Yet, if actors perceive instruments as providing insufficient resources to achieve policy objectives, this inconsistency may negatively influence the cognitions of actors regarding the strength of the political will behind the stated policy objectives (Reichardt et al. 2016).

In such instances, policy makers may wish to appear to support an area of development for political benefit (such as electoral payoffs), while being reluctant to devote sufficient resources due to split incentives, close networks between incumbents and state actors or budget constraints (Patashnik and Zelizer 2009). Consequently, the credibility of the policy mix, i.e. the extent to which it is considered believable and reliable (Rogge and Reichardt 2016), will influence the perceptions of actors and may have direct effects on their investment decisions (Rogge and Schleich 2018).

#### 5.4.1.3. Institutional Effects

The institutional structure of the socio-technical system includes laws, rules, and regulations. Accordingly, policy mix change can be considered as part of institutional change. However, the mix will also interact with the wider institutional structure it is situated in, which can influence its effects on socio-technical change, and may limit its capacity to achieve policy objectives. Policy mix change may instigate reconfigurations of these wider aspects of the institutional structure through institutional effects. This may include expanding state capacities to design, implement, and evaluate policies, and to enforce compliance, in order to make the policy mix operational (Patashnik and Zelizer 2009). This may for example include the capabilities of local authorities to implement national level policy objectives, which may affect their relative success (ibid). An example of such institutional effects would be establishing an autonomous agency capable of launching policy initiatives (ibid).

Similarly, institutional effects can reconfigure aspects of the institutional structure that may otherwise support the regime. These may include replacing the established unsustainable rules embodied in institutions (e.g. legislations), and changing participation in policy networks to involve outsiders (niche actors) in addition to insiders (incumbents) (Kivimaa and Kern 2016). Policy mixes for sustainability transitions will face the ongoing challenge of maintaining political support if they threaten or impose losses on powerful groups, providing them with motivation for political opposition to protect their interests (Patashnik and Zelizer 2013). Thus, to support a niche as it scales up requires



reforming the institutional structure to protect it, both from processes within the niche that could otherwise de-stabilise it, and against external destabilising processes originating from resistance within the unsustainable regime (Mourik and Raven 2006). For example, bureaucracies and other public bodies may develop operating procedures that favour certain sources of evidence and some participants over others (Béland 2010). Failing to reform these arrangements may allow established relationships with regime actors to influence policy decisions, which may negatively influence the rate and direction of transitions.

After having conceptualised how the policy mix has effects on the socio-technical system, the next subsection will discuss how changes in the socio-technical system, in turn, create feedbacks to the policy subsystem.

#### 5.4.2. *Feedback Mechanisms*

Feedback mechanisms contribute to a reconfiguration of the policy mix over time through socio-political, fiscal and administrative feedbacks. These feedback mechanisms are considered to influence policymaking through different groups of actors active in the policy subsystem. These actors influence the support for the policy mix, which may contribute towards policy mix change. Positive feedbacks can help explain how new policy strategies can become stable and self-reinforcing. Negative feedbacks help explain why opposition against new policy strategies and instruments can result in a loss of political support for policy mix elements. This may result in a reduction or withdrawal of public resources for sustainable alternatives, consequently reducing momentum of transition.

##### 5.4.2.1. Socio-Political Feedback Mechanisms

Socio-political feedbacks concern whether public and stakeholder support for a policy mix, or certain components of it, is reinforced or undermined over time. Such socio-political feedback can involve three dimensions: cognitive, constituency and agenda feedbacks.

*Cognitive feedbacks* contribute to cognitions regarding the effectiveness and/or efficiency of a policy mix or specific components thereof. For example, the mix may be perceived to be successful or disastrous in achieving policy objectives (Oberlander and Weaver 2015). As such, soft institutions including culture and societal views can contribute to this form of feedback. Cognitive feedbacks can involve mass publics, especially if the policy mix is widely perceived as providing benefits or imposing losses relative to the status quo (Jacobs and Weaver 2015). Public opinion can be particularly significant in the context of sustainability transitions if policy mixes impose concentrated

losses on the public. This could occur, for example, through highly visible effects such as wind farms altering landscapes and triggering local opposition (Wolsink 2007). Another example may be the policy mix imposing highly visible financial costs, e.g. through surcharges on electricity bills for supporting renewable energy (Lauber and Jacobsson 2016).

*Constituency feedbacks* relate to whether changes of the policy mix predominantly lead to the mobilization of supporters or opponents of the change (Oberlander and Weaver, 2015 p.43). For example, the financial support provided for renewable energy technologies in Germany through the FiT over time led to an increasingly powerful coalition of green groups, renewables manufacturing firms, local energy cooperatives and installers who benefited from the policy. The political mobilisation of this coalition protected the policy against powerful opponents such as the utilities (Jacobsson and Lauber 2004). In general, sustainability transitions face significant political challenges, as they typically require a reform of sectors long dominated by incumbent firms, typically with close relationships with state actors (Kern and Howlett 2009). Consequently, more radical policy and wider institutional reforms are often politically contested by dominant coalitions, commonly consisting of incumbents who often lobby against major policy changes or try to actively undermine them during implementation (Markard et al. 2015; Stenzel and Frenzel 2008). However, there are instances where such incumbents are not homogenous in their beliefs and actions. Markard et al. (2015) show that in the Swiss energy transition several of the incumbent energy firms were supportive of policy reforms, suggesting that if firms see transitions as opportunities rather than as threats they are more likely to be supportive. Even if incumbents mobilize opposition against reforms, if powerful countervailing coalitions organise the reforms can be protected (Hess 2014; Lauber and Jacobsson 2016).

Agenda feedbacks cover whether satisfaction with, or objection to, the policy mix leads to the consideration of incremental changes to existing policy mix elements or more dramatic reforms (Oberlander and Weaver 2015). Therefore, this form of feedback influences the stability of policy mix elements. How readily replaceable a certain element of the policy mix (such as a specific instrument) is considered, will influence its prospects for maintenance, revision or termination (Jordan and Matt 2014). For example, if there are no obvious alternatives, opposing groups will struggle to make the case for reform or redesign (ibid). In a policy mix, if certain instruments are considered replaceable and ineffective, modification or replacement with a new type of instrument may occur more readily. Similarly, if alternative options for achieving broader objectives (such as mitigating climate change) are seen as more effective or efficient, then radical changes to the mix may occur, including severe reductions in ambition or funding, or even termination of the policy strategy and its supporting

instruments. For example, if demand reduction is advocated as more cost effective for achieving carbon abatement than replacement of existing generation capacity with sustainable alternatives, then instruments supporting sustainable generation technologies may lose political support.

#### 5.4.2.2. Fiscal Feedback Mechanisms

“Fiscal feedbacks capture whether a [policy mix] creates budgetary strains that are likely to raise concerns among powerful actors, notably Treasury or Finance Ministers” (Oberlander and Weaver 2015: 43). In most political systems, the finance ministry is a powerful organisation with the ability to control resource flows. It can exert substantial influence on the policy process, potentially weakening the autonomy of groups otherwise dominating the policy subsystem (ibid).

A rapidly growing demand on the general budget (for example, if the earmarked funding stream becomes insufficient due to unexpected cost trends) and/or an ongoing funding crisis, will likely lead to strong concerns among budget guardians (Oberlander and Weaver 2015: 42). In addition, over time as exogenous conditions (e.g. macro-level socio, economic and political trends) change, the priorities of the finance ministry may shift, and/or the perceived costs of supporting the policy mix may change accordingly. This is a significant risk for sustainability transitions, which are long-term processes. Therefore, if the policy mix can generate tax revenues or produce benefits which align with other ambitions such as economic growth or industrial development, it is more likely to attract or maintain support of the finance ministry who may prioritise these considerations over sustainability.

#### 5.4.2.3. Administrative Feedback Mechanisms

Administrative feedbacks relate to the public bodies in charge of policy design and implementation (Oberlander and Weaver 2015: 42). Administrative feedback can lead to strengthening or weakening of internal morale, sense of mission, external reputation, external political support, and the ability to recruit qualified staff (ibid). Positive feedback can occur when policy objectives are clear and achievable, allowing public bodies to avoid highly visible failures and maintain a reputation for competence (ibid). Negative feedbacks can occur if highly visible failures are blamed on the administrative bodies, which potentially damages reputation, internal morale and external support.

Consequently, administrative feedback may contribute to resultant policy mix changes such as the expansion or reduction of resources and capacities to design and implement policy (Pierson 1993; Béland 2010). For example, thinly staffed public bodies might lack the capabilities to perform the

ambitious task of policy learning, reflexivity and adjusting policies to changing conditions (Borras 2011). This may require the outsourcing of tasks and may reduce the autonomy of the public body. Alternately, a department with high reputation may assimilate a low reputation department, thereby broadening its mandate and taking on new responsibilities. Conversely, a department with low capacities may receive increased support in order to design and implement policies more effectively, if political support for the policy mix objectives is strong.

#### 5.4.3. *Exogenous Conditions*

The interplay between policy effects and feedback mechanisms occurs through changes within the socio-technical system. However, few policy changes occur purely through endogenous feedback mechanisms (Oberlander and Weaver 2015), but instead are often also influenced by exogenous changes beyond the socio-technical system (ibid; Rosenow 2013). In the transitions literature, exogenous conditions (e.g. macro-economic trends, demographic changes, catastrophic events) are conceptualised as the landscape, where landscape developments may be putting pressure on the regime (Geels 2002). We build upon this notion, while also considering learning and innovation outside the boundaries of the socio-technical system as exogenous conditions. Such exogenous conditions can influence the co-evolution of policy mixes and socio-technical change in a number of ways:

First, exogenous conditions can influence the rate and direction of change in the socio-technical system. Economic trends and innovation from outside the system can influence investment and market development, while the entry of new actors from other geographical settings may cause a change in networks or the legitimacy of certain technologies. Exogenous conditions may also influence the incentives of actors to participate in political action. Policy mix elements that originally generated positive feedbacks, may find that under different circumstances such as sudden, unexpected changes in market conditions, start to generate negative feedbacks (Patashnik and Zelizer 2009). For example, in Germany, international competition from the Chinese PV industry weakened domestic support coalitions when German PV manufacturers went bankrupt and domestic PV manufacturing jobs were lost (Lauber and Jacobsson 2016). This undermined the case for supporting the roll-out of (Chinese manufactured) PV modules for actors interested in creating industrial benefits in Germany (ibid; Quitzow 2015b).

Second, exogenous conditions may amplify or constrain the influence that feedback mechanisms have on policy change. Feedback mechanisms are more likely to contribute to policy change when coupled with focusing events that bring attention to policy problems (Jacobs and Weaver 2015; May and

Jochim 2013). For instance, negative feedback mechanisms are rarely a sufficient cause for policy mix change, often requiring other conditions or events to push policy makers to seek alternatives (Oberlander and Weaver 2015). For example, a difficult fiscal climate may bring or increase attention to the relative costs of supporting a policy mix, and strengthen the case for cutting resources. Learning and innovation outside the boundaries of the socio-technical system can also affect feedback mechanisms. For example, learning from policy experiments elsewhere may instigate consideration of modifications to the policy mix (Jacobs and Weaver 2015). In some instances, policy mix elements may remain unchanged simply because there are no obvious or known alternatives towards addressing the problem. Therefore, learning from outside the system boundaries may allow proponents of change to suggest policy or technological alternatives, thereby contributing to agenda feedbacks.

Third, exogenous conditions can also directly influence the policy subsystem, by changing which actors are represented or have influence over the policymaking process. Electoral cycles, changes in government or changes in responsibilities or mandates within government, can change which actors are active in the policy subsystem. This may alter the influence of certain feedback mechanisms on policy change, if proponents/opponents of the policy mix resonate more closely with the ambitions or ideologies of the new or changed government. Interest groups and coalitions may ultimately only be successful in influencing policy change when sympathetic politicians gain power (Oberlander and Weaver 2015). Electoral cycles may also change government's preferences regarding the style of policymaking, with potential repercussions for the policy mix (Patashnik and Zelizer 2009). However, reforms are more resistant to changes in government if there is a strong domestic lobby supporting the policy strategy and corresponding instrument mix. For example, in Germany the Conservative-Social Democrat coalition continued to support the existing instruments in place for supporting renewables after coming to power, even at a time when the subsidies were contested because of contributing to rises in electricity prices, because of the existence of a strong domestic lobby (Lauber and Jacobsson 2016; Geels et al. 2016).

Finally, international governance (UN, EU) may place pressure on national policymakers to implement policy reforms. One example is the pressure of the World Bank for all countries to phase out fossil fuel subsidies by 2025 (Hafeneth 2017). Another example concerns the threat of reputational losses through not living up to international expectations, such as in the case of Germany's pending failure to meet its 2020 target for reducing greenhouse gas emissions by 40% (Podewils 2018).

Considering these factors, the timing of policy implementation relative to exogenous conditions will influence the effects of the policy mix on the socio-technical system and the feedback mechanisms that occur (Pierson 2000; Oberlander and Weaver 2015). Poor timing can imply that conflicting

objectives in other policy areas mean the policy mix is politically contested from the outset, or that changing exogenous conditions may shift priorities and reduce support for policy mix objectives (Patashnik and Zeilizer 2009).

#### 5.4.4. *Dynamic Interactions of Policy Effects and Feedback Mechanisms*

Having explained the conceptual components of the framework individually, we now turn to explaining possible interaction dynamics and feedback loops. In our elaboration of how the processes described above can interact dynamically over time we focus on explaining key interactions, notwithstanding that many more are conceivable.

Policy effects on socio-technical change can lead to positive and negative feedback mechanisms, which may strengthen or weaken support for the policy mix. Positive feedbacks, which maintain or strengthen support, are likely to lead to steady resource flows in favour of transitions which makes successive positive feedbacks more likely (positive feedback loop). Conversely, negative feedbacks may limit the capacity of the policy mix to become stable, and can reduce support and resources for the transition. Over time, reduced resources may result in successive negative feedback occurring (negative feedback loop) leading to the policy mix being revised or terminated. Therefore, the co-evolution of policy mix change and socio-technical change over time can lead to virtuous or vicious cycles<sup>12</sup>.

In the following subsections, we describe some conditions under which both positive (virtuous) and negative (vicious) feedback loops may occur. For the sake of concision, we abbreviate the key processes as: resource [RE], interpretive [IntE] and institutional [InstE]; socio-political [SPF], fiscal [FF] and administrative [AF] feedbacks; and exogenous conditions [ExC].

##### 5.4.4.1. Virtuous cycles of positive feedback loops

Positive feedback mechanisms are most commonly generated when a policy mix provides resources that are visible and traceable to government action [RE] (Arnold 1990), incentivising supporting constituencies to protect these resources [SPF]. Similarly, if public resources are used to create beneficiaries in the wider public [RE] (Campbell 2012), certain instruments may gain political support through formation of electoral coalitions or influencing mass cognitions in favour of support for the policy mix [SPF]. Reinforcing mechanisms may be most prominent where policy mixes encourage investment over long timeframes [RE], creating vested interests in supporting policy maintenance

---

<sup>12</sup> Such cycles can however be interrupted, for example through changing exogenous conditions.

[SPF] (Arrow 2000). This also generates positive expectations, signalling political commitment from government, and indicating stable investment conditions, thereby reducing investor risks [IntE].

Under these conditions, as the new configuration of the socio-technical system matures and niche actors gain market shares, these actors can form increasingly powerful coalitions and networks that challenge the ideas presented by regime actors who may become less influential in lobbying to retain the status quo [SPF]. Secondly, as supply chains are being established and upscaling of production occurs, this can lead to a growing market, improvements in technological performance and cost reductions. This strengthens the arguments put forward in support of the policy mix, which may change perceptions regarding costs of supporting the policy mix [SPF], which may also alleviate the concerns of finance ministers [FF] and improve the reputation of the policy makers responsible for designing the mix [AF]. This may enable expansion of state capacities in favour of the transition [InstE] and the maintenance or expansion of resources [RE]. As a transition matures, the wider diffusion of more sustainable technologies or practices can lead to widespread visible benefits, such as improved air quality, which has the potential to produce increasing levels of public support [SPF], which further sustains the policy mix and reinforces the new direction of travel of the socio-technical system.

#### 5.4.4.2. Vicious cycles of negative feedback loops

If policy instruments are poorly designed, are overly complex, and/or are not well aligned with other instruments in the mix, they are expected to be limited in their transformative potential (Kivimaa and Kern 2016) and their ability to generate positive feedbacks. A policy mix may be poorly designed if it does not provide sufficient resources [RE] or fails to sufficiently support niche technologies through protection and empowerment [RE & IntE & InstE]. Similarly, if resources are widely dispersed and ‘hidden’ from beneficiaries [RE & IntE], this renders the mix ineffective in mobilising support [SPF] (Patashnik and Zeilizer 2009). In such cases, the policy mix will not stimulate sufficient change within the socio-technical system to mobilise supporting constituencies or achieve its objectives [SPF], which can ultimately undermine political support.

Negative feedback mechanisms have been found to be most prevalent where layering of policy mix elements leads to complexity and inconsistency (Jacobs and Weaver 2015), and elements seek to address multiple objectives, particularly when their success depends on the support of the general public (Skogstad 2016). If the mix creates concentrated losses (or the expectation of concentrated losses) for powerful actors [RE], it will provide incentives for them to oppose the mix. However, if the policy mix fails to reform the institutional structures that support the existing regime [RE & InstE], or does not phase out support for unsustainable technologies or practises [RE], it is expected to facilitate regime actors in maintaining their influential position to oppose the mix through negative

feedback [SPF]. Finally, if the amount of support (resources) reduces over time [RE], this can be interpreted as an indication of the direction of travel [IntE], and the level of political will towards meeting sustainability objectives (Rogge and Dötschke 2017). This is most prominent if multiple conflicting changes occur (in rapid succession) leading to uncertainty and perceptions of instability [IntE].

Under such conditions, the pace of transitions may be slow, as the policy mix does not enable green niche actors to grow and gain political influence in order to lobby for resources or to protect the sustainability objectives from opposition [SPF]. In such instances, it is expected that the existing and well-established networks between incumbents and policymakers ensure the stability of the regime through negative feedbacks [SPF]. Such negative feedbacks may lead to a reduction in political will supporting sustainability transitions and may result in reduced resources and revisions or terminations of policy mix elements. This could become even more likely if changes in exogenous conditions such as an economic recession or a shift in political ideologies [ExC] further undermine sustainability objectives.



## 5.5. An Empirical Illustration of Policy Mix Feedbacks in Sustainability Transitions: the UK zero carbon homes policy mix

In this section, we briefly illustrate dynamics of the framework by drawing on the empirical example of the zero carbon homes (ZCH) policy mix in the UK. The ZCH target was announced in 2006 and entailed the ambition that by 2016 all new domestic homes in the UK should be zero carbon. This case provides a relevant illustration showcasing the utility of the proposed framework for several reasons. First, the ZCH target was intentionally designed as a policy mix with several policy instruments to meet the target. Second, the target was conceived to be very ambitious when introduced. Finally, the case provides a rich illustration of an instance where an ambitious policy mix failed to generate self-reinforcing positive feedbacks, leading to its abandonment in 2016.

### 5.5.1. Methodology

The illustration draws on an analysis of policy documents, industry journals, secondary literature, government consultations, select committee publications, inquiries, and debates in the House of Commons and House of Lords over the period 2006-2016 (Table 1). Based on these, we established a chronology of events, mapping the elements of the policy mix and their changes over time (Figure 3). We identified the relevant policy mix following the top down approach outlined by Ossenbrink et al. (this issue), considering the target and the instruments implemented towards achieving it.

Our illustrative case spans the period between September 2006 when the target was first announced, to May 2016 when the target was officially abandoned. For this period, we interpreted the changes in the policy mix through the different conceptual components of the analytical framework proposed in the previous section, which enables us to illustrate some of the interaction dynamics between policy effects and feedbacks in this case. We limit the illustration to the national policy level and focus on the co-evolution of the policy mix with the UK house building socio-technical system.

Type of data source	Quantity
Policy documents – Government response to consultations, publications (white papers), speeches, impact assessments	137
Zero carbon hub publications	148
Industry journals	603 - featuring most prominently ENDS report and Building magazine
Secondary literature	25 academic papers
Inquiries	71 written responses in Treasury inquiry 99 written responses in ‘Home energy efficiency and demand reduction’ inquiry, Energy and Climate Change Committee
Debates in the House of Commons and House of Lords over the period of 2006-2016	260 spoken references 22 written statements Most occurrences resulting from search terms ‘Zero Carbon Homes’ and ‘Code for Sustainable Homes’
Letters (to government ministers)	3
Media	427 - Guardian, Telegraph, Financial Times , Independent

Table 6 - Types of data source and quantity

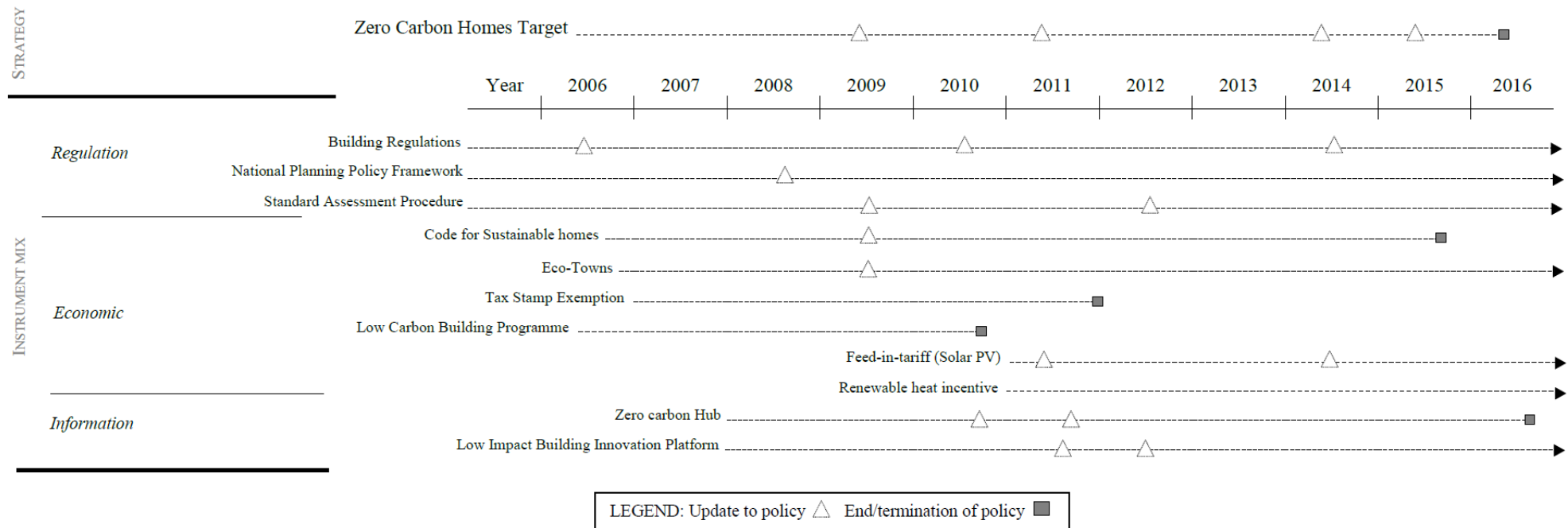


Figure 3 - Policy Mix for Zero Carbon Homes

### 5.5.2. *Overview of illustrative case*

The zero carbon homes target sought to promote a radical paradigm shift in the UK house building socio-technical system by mainstreaming green building methods and techniques (Greenwood 2012). It was adopted for a variety of reasons, including pressure from the EU as well as domestic considerations around meeting carbon targets, and formed a component of the UK Low Carbon Transition Plan (HM Government 2009).

The target was designed to work primarily through two main instruments, a voluntary instrument known as the Code for Sustainable Homes (CSH)<sup>13</sup>, and planned updates to the Building Regulations, which became progressively more stringent leading to zero carbon requirements in 2016. An exemption from stamp duty (economic instrument) was also announced in 2007 for all houses built to zero carbon standards before 2012.

After its announcement, the ZCH target underwent several significant redefinitions, as described in detail by Greenwood (2012, 2015), Heffernan et al. (2015) and Schweber et al. (2015). Also, despite being formalised in 2007, a definition of the technical specifications required to meet the target was not finalised until 2015. In parallel to the ZCH target, the government also aimed to build three million new homes by 2020 in order to tackle a housing crisis. At the time, this second policy target was seen to be complimentary with the ZCH target<sup>14</sup>.

### 5.5.3. *Dynamics of Policy Effects and Feedbacks: Examples from the UK zero carbon homes policy mix*

Throughout the evolution of the ZCH target, a number of policy effects and feedback mechanisms can help explain the revisions and eventual denouncement of the target. For our illustrative purposes, we use empirical examples to highlight some of the dynamics that played a role in these processes. First, we highlight a positive feedback loop occurring after the initial announcement leading to innovation and resource allocation and the expansion of capacities to design and implement policy. Secondly, we describe a series of negative feedback loops which led to the eventual denouncement of the target. In the following, we will use our analytical framework to highlight a number of important interactions

---

<sup>13</sup> The Code for Sustainable Homes (DCLG, 2008) is the most prominent voluntary sustainability label for housing in England (Heffernan et al., 2015). The code was developed by BRE, a private company formally known as the Building Research Establishment (Greenwood 2012), and managed under the direction of the Department of Communities and Local Government (DCLG). The Code is a holistic sustainability rating tool in which homes are rated against indicators in nine categories. Homes can be awarded a star rating between levels 1 and 6, with 6 being the most sustainable (Heffernan et al., 2015).

<sup>14</sup> The combined objectives were intended to deliver 1 million zero carbon homes between 2016-2020.

and use the same abbreviations introduced above for the different processes stipulated in the framework: resource [RE], interpretive [IntE], and institutional [InstE] effects; positive (+) or negative (-) socio-political [SPF], fiscal [FF] and administrative [AF] feedbacks; and exogenous conditions [ExC].

#### 5.5.3.1. Virtuous cycles: An empirical example

The target was first announced in 2006 and was accompanied by a voluntary standard for sustainable homes, planned updates to energy efficiency building regulations, and financial support through a tax exemption and public procurement. This created positive expectations of a potential market for low carbon housing technologies [IntE] and signalled political commitment to improving the efficiency of new buildings, leading to considerable growth of the green housing niche<sup>15</sup>.

In the mainstream building sector, there was little understanding of the methods required to significantly cut emissions among developers (ENDS Report 2006), who were unwilling to move away from traditional methods (Osmani and O'Reilly 2009; Gibbs and O'Neill 2015). However, the expectation of potential resources being channelled into this area seems to have provided a strong enough market signal to stimulate innovative activity among incumbent actors [IntE]. Several of the major housebuilders were founding members of the UK Green Building Council (UK-GBC), a membership organisation which networks actors and provides information about sustainability in the built environment (Seager 2007). Of these housebuilders, Barratt Homes was the first firm to prototype a demonstration of a zero carbon home<sup>16</sup>, and developed the first large scale housing scheme built to zero carbon standards<sup>17</sup>.

When announced, despite signalling political commitment from government, the original definition of the zero carbon homes target was a very general one, raising several questions which became the subject of significant debate across the building industry [IntE] (Greenwood 2012). UK-GBC produced a report (2008) showing that the original 100% on-site energy generation requirement for ZCH was unachievable on 80% of sites in the UK. This suggested the original targets were overambitious, and brought attention to limited capabilities of government to design and implement effective policy [-AF]. However, due to the support from the building sector and political

---

<sup>15</sup> For example, the EcoBuild exhibition has grown from under 1,000 to almost 60,000 visitors and 1,200 exhibitors in 5 years.

<sup>16</sup> The Barratt Green House, which was showcased among other similar projects in the BRE's Innovation Park.

<sup>17</sup> Barratt started development on a site of 186 houses at Hannam Hall in 2008. The efficiency standards of the site were amended in line with the redefinitions of zero carbon throughout its development. Construction finished in December 2015.

commitment from government towards the agenda [+SPF], positive agenda feedbacks resulted in incremental fixes to the strategy.

Acknowledging the concerns, the government commissioned the Callcutt review. Part of the recommendations made to government resulting from the review, was to establish a new platform to work towards an achievable target and implementation plan for the industry [+SPF]. In response, the Zero Carbon Hub was established [RE & InstE], a public private-partnership to act as a steering group towards achieving the target (Schweber et al. 2015). The target was redefined providing clearer guidance for industry on how to meet the target [IntE]. The Hub acted as a coordinator of various actors within the industry and produced research highlighting challenges and skill shortages the industry faced in the run up to 2016.

Overall, we argue these developments to be an example of a beginning virtuous cycle. A strong, long term policy target is established and accompanied by a range of instruments to meet the target. This leads to a positive response from the target group (the mainstream building sector) in terms of investments in pilot projects and knowledge development, and when questions about the definition of the target were raised, a public private partnership was set up to help industry to clarify and meet the target. However, as we will see in the next section these initially positive developments were soon overshadowed by other dynamics.

#### 5.5.3.2. Vicious cycles: An empirical example

In 2010, the Labour government was succeeded by a Conservative-Liberal Democrat coalition, which introduced austerity policies in response to the financial crisis [ExC]. Related to the recession, there was also a shortage of supply of new housing in the UK which pushed up housing prices. This was highly visible in the general public and media [-SPF] and became a key priority for government. A deregulation agenda was pursued by the coalition Government as an attempt to increase the volume of new build in the UK, and the ZCH target was simply seen as another regulation impeding increased supply in this context [-SPF].

As reflected in the 2010 spending review, the perceived relative cost of supporting the zero carbon homes agenda had clearly increased in the treasury [-FF], ultimately leading to a reduction of resources [RE]. The grant funding of the Zero Carbon Hub was reduced in 2010, and subsequently cut altogether in 2011<sup>18</sup> [RE]. In the 2011 budget, the target was redefined for a second time, reducing the overall amount of carbon abatement required. Implementation of the 2013 increase of energy efficiency requirements in the building regulations was delayed by a year and then only reflected a

---

<sup>18</sup> Funding was subsequently awarded from government for specific projects, while majority funding was provided by the National House Building Council (NHBC).

6% increase on the 2010 regulations<sup>19</sup>. Collectively these changes were largely considered by industry to be a weakening of government commitment towards the target [IntE], which seems to have slowed down socio-technical change. In the words of Jo Wheeler<sup>20</sup>: “The watering down of the definition of zero-carbon, coupled with the uncertainty surrounding standards for Part L [building regulations] 2013 and 2016 has inevitably resulted in a decline in innovation” (ENDS Report 2013).

The decline in innovation in the sector due to an uncertain political climate made the achievement of the targets less and less likely in the run up to 2016. The delayed and reduced 2013 building regulation requirements subsequently meant a larger increase in energy efficiency was needed in a shorter period in order to meet the target. Opposing constituencies, consisting of some of the more conservative actors in the mainstream building sector, put forward the argument that the cost of meeting the target would further reduce the volume of new build [-SPF], which seems to have resonated with the ambitions of the treasury to increase the supply of houses. Shortly after the 2015 election, where Conservatives gained an absolute majority [ExC], the target was disbanded. The denouncement came directly from the treasury, who justified the decision by stating that costs of meeting the target were a tax on development <sup>21</sup>.

After the denouncement of the target, the UK-GBC organised over 246 senior leaders from industry actors and interest groups to write an open letter to the Chancellor [+SPF] (UK-GBC 2015). The letter warned that the abandonment of the ZCH target had “undermined industry confidence in Government” and will “curtail investment in British innovation and manufacturing” [IntE]. Importantly, of the 246 signatories on this letter (UK-GBC 2015b), none of the 25 top volume housebuilders over 2007-2010 or the top 20 in 2016 (Building 2016) appeared on this list. It also excluded major housebuilders who had been founding members of the UK-GBC, such as Barrat and Crest Nicolson. We suggest this indicates that the beliefs of these actors had changed over time [IntE] and they withdrew their support for the agenda, fragmenting the supporting coalition [-SPF]. Without the continued support of these politically influential actors, the opposing constituencies were successful in lobbying government to abandon the target [-SPF].

Overall, we argue these developments to be an example of a vicious cycle. A change in government, a change of government priorities, and a reduction of resources together led to a decline in innovative activity in the sector and a delay of key policy changes, as well as a fracturing of the coalition supporting the target, ultimately leaving the policy mix in a vulnerable position.

---

<sup>19</sup> This was less than the lowest scenario (an 8% increase) considered in consultations.

<sup>20</sup> Senior policy advisor at the UK Green Building Council (UK-GBC).

<sup>21</sup> In the inquiry of the treasury, the additional average cost of meeting the target incurred per dwelling was estimated as £3,500. This equates to 1.6% of the average cost of a UK house in 2016, which was £216,750.

## 5.6. Conclusions

Understanding the role of policy processes in influencing the rate and direction of sustainability transitions remains a fundamental challenge in the existing literature. In particular, the processes influencing the development of policy mixes rather than single policy instruments, remain under conceptualised and underexplored. In this paper, we therefore proposed a novel conceptual framework for analysing the co-evolution of policy mixes and socio-technical systems. The core of the framework consists of policy effects influencing socio-technical change, and resulting feedback mechanisms influencing the subsequent development of the policy mix. We consider the framework to be applicable to a wide range of sustainability transitions, such as in energy, mobility or agriculture.

We illustrated the interaction dynamics conceptualised in the framework using the zero carbon homes policy mix in the UK. This example initially displayed characteristics of a virtuous cycle, which became disrupted (partly by exogenous factors), and turned into a vicious cycle, leading to the eventual abandonment of the policy target. The illustration demonstrated that the proposed framework enables new insights on the co-evolution of developments in the policy subsystem and the UK building socio-technical system, helping to explain which processes contributed to this failed attempt of promoting a low carbon transition.

The illustration also helps identify limitations of the proposed framework. Most notable is the current conceptualisation of fiscal feedback adopted from the policy feedback literature. In the illustration, the treasury's priorities shifted towards increasing the volume of new build and considered the sustainability transition to impede upon this ambition, leading to opposition to the target from the treasury. This suggests that finance ministries may oppose a transition if it is seen to be conflicting with other ambitions such as economic growth, irrespective of whether the costs of supporting the mix are borne directly by the finance ministry itself. Similarly, quicker than expected uptake of solar PV in Germany led to concerns about the costs of supporting the technology, resulting in a reduction of resources (Lauber and Jacobsson 2016). The same process played out in the UK less than a year after a FiT was introduced (Smith et al 2014). In these cases the costs of supporting renewable energy was borne by the electricity bill payer, rather than the finance ministry. Therefore, we suggest further work may need to extend the scope of fiscal feedback mechanisms to account for these processes.

Additionally, further conceptual and empirical studies should deepen insights linking policy mix characteristics (such as credibility, comprehensiveness, consistency and coherence) to the kinds of expected policy effects and feedback mechanisms, and how changes of characteristics over time (e.g. its credibility decreasing) influence these dynamics. Finally, more attention should be paid towards the vertical dimensions of policy mix design (Howlett et al 2017), including implementation of national level policies at the local scale. This could help develop the framework further, in particular,



how policy mix elements spanning multiple levels of government can be integrated to reduce conflicts. These considerations may help further conceptualise how policy effects interact with the socio-technical system, and the kinds of resultant feedback expected to occur.

We argue that the proposed framework may help generate important insights for policy makers seeking to support sustainability transitions. It directs attention towards designing policy mixes capable of generating positive feedback, thereby strengthening political support over time. Without generating political support, contestation and potential conflicts with other policy objectives can result in a weakening, dismantling or removal of policy mixes for sustainability transitions (or constituent elements thereof). Consequently, we suggest that maintaining political support through creating incentives for participation from supporting groups and constituencies, is fundamental to maintaining momentum in sustainability transition processes.

It is sometimes argued in the sustainability transitions literature that powerful regime actors need to support the newly emerging socio-technical system for the transition to ‘break through’ (Rotmans and Loorbach 2010). Therefore as seen through the lens of our framework, the argument would be that policy mix design should not only create incentives for emerging niche actors but also for powerful actors to support the transition (Raven et al 2006; Kemp and Rotmans 2007; Markard et al 2015). In doing so, positive feedbacks can be strengthened while simultaneously reducing negative feedback if powerful actors, who would otherwise oppose the transition, have reason to support it.

However, others have argued that policy mixes need to support creative destruction processes by putting incumbents under pressure (Kivimaa and Kern 2016). In this vein and seen through the lens of our framework, positive feedbacks can be strengthened if the policy mix phases out resources for the incumbent regime configuration, or breaks up the institutional structures through targeted instruments. While such reforms will likely face opposition from the regime, they may be necessary as the transition matures to weaken the influence of powerful actors who are unwilling to change and would otherwise seek to undermine it. However, the timing of these interventions is relative to the phase of the transition (Rotmans and Loorbach 2010: 131). If the policy mix attempts to displace the regime before alternative socio-technical configurations have matured and established sufficiently strong coalitions in their favour, the regime may mount significant opposition leading to backlash, which can reverse the direction of travel (ibid).

Building on these ideas, we suggest that the timing (Patashnik and Zelizer 2009) and sequencing (Meckling et al. 2017) of policies should be relative to the phase of the transition. In the formative phase the mix should focus on the promotion of positive feedbacks while aiming to reduce negative feedback until the new socio-technical configuration becomes stable enough to withstand resistance from the regime. Over time, the policy mix can begin phasing out support for the old configuration,

while providing incentives for incumbents who are willing to innovate and adapt to the new sustainable configuration. Beyond the reallocation of resources, this also requires the reconfiguration of supporting institutional structures to break the lock-in of the incumbent regime. Failing to reform institutions will likely dampen the ability of the new socio-technical configuration to become stabilised, and will facilitate continued resistance from the regime. These considerations illustrate how policy mix design for sustainability transitions is fraught with political difficulties, but the proposed framework may help analysts and policymakers to ‘think through’ the political logic of different potential policy effect and feedback mechanism interactions, and can thereby help inform their strategies for policy formulation and implementation.

## Chapter 6. Policy mix feedback in socio-technical systems: a co-evolutionary analysis of the Zero Carbon Homes policy mix in the UK (Paper 2)

Duncan L. Edmondson, Karoline S. Rogge, Florian Kern

Journal: Environmental Innovation and Societal Transitions

Status: Minor revisions – Re-submit November 2019

### Abstract

Understanding how policy and policy-making processes can influence the speed and direction of socio-technical change is an important, yet underexplored research agenda in the field of sustainability transitions. This paper applies a novel analytical framework which conceptualises the co-evolutionary dynamics of policy mixes and socio-technical systems, by complementing the sustainability transitions and policy mix literatures with insights from policy feedback theory. Our paper is an in-depth empirical case study which represents the first application of this analytical framework. It scrutinises the proposed claims about how policy effects and feedback mechanisms influence the co-evolution of policy mixes and socio-technical systems. Empirically, we focus on the zero carbon homes policy mix in the UK which sought to promote radical change in the UK house building system. Our paper makes three contributions. First, it makes an empirical contribution by analysing an example of an ambitious policy strategy in the housing sector while much sustainability transitions research focuses on the energy sector. Our analysis shows how various policy effects and feedback mechanisms led to a loss of political support for the target, eventually leading to its abandonment, and only limited change within the socio-technical system. Second, our paper produces novel insights about the effects of policy mix credibility on socio-technical change, and the underlying feedback mechanisms which influence its formation and loss. Finally, based on our empirical analysis we propose conceptual refinements to the co-evolutionary framework and suggest avenues for future research explaining the dynamics of feedbacks between policy mixes and socio-technical systems.

## 6.1. Introduction

Understanding the role of policy, policymaking and politics in shaping sustainability transitions is a fundamental challenge. Policy is widely considered as an integral aspect of transitions (Drews & van den Bergh, 2016; Markard, Suter, et al., 2016), and arguably can be used to accelerate the rate of change (Kern & Rogge, 2016). Neo-classically derived policy recommendations typically involve internalising environmental externalities to address the corresponding market failure in the under-provision of environmental protection, but transition scholars have identified a number of structural and transformational system failures which also require policy intervention (Weber & Rohracher, 2012; Wieczorek & Hekkert, 2012). Policy suggestions, amongst others, include creating protective spaces for novel sustainability innovations (Raven, Kern, Verhees, & Smith, 2016; Smith & Raven, 2012), creating new networks to accelerate learning and technological development (Geels et al. 2016), and establishing shared long term visions and expectations (Kemp et al., 2007; Rotmans & Loorbach, 2010).

Beyond the type of policy instruments (e.g. regulation, market-based instruments) and their specific design, the process of policymaking itself has been argued to be of relevance as well (Markard et al. 2012, Rogge and Reichardt 2016). Policymaking refers to the process through which policies are designed, implemented, adapted and discontinued (Sabatier & Weible, 2014). Transition scholars argue that policymaking needs to be iterative and reflexive, in order to adapt to the changing conditions of the socio-technical system as a transition unfolds (Voß and Kemp 2015). To better understand policymaking processes, transition scholars have started to draw on prominent policy process theories (for a review see Kern & Rogge 2017). Other studies link policymaking to socio-technical change more directly, where the two elements co-evolve over time (Hoppmann et al., 2014; Lauber & Jacobsson, 2016b). Despite some conceptual advances on the interactions of technological change, politics and policy processes (Edmondson et al. 2018; Meckling et al. 2017), these dynamics remain empirically understudied in the transitions literature (T. S. Schmidt & Sewerin, 2017).

Sustainability transitions are, by nature, inherently political (Meadowcroft 2009, 2011), and often contested by powerful actors who typically have vested interests in maintaining the status quo (Kern & Howlett 2009; Avelino & Rotmans 2009). Most states have close relationships with powerful incumbents, which contributes to lock-in of existing socio-technical configurations (e.g. see Unruh 2000 on carbon lock-in). For instance, some policy instruments which could radically change the socio-technical system, such as implementing a stringent carbon tax which would impose significant losses on powerful actors, are generally considered politically unfeasible (Drews & van den Bergh, 2016).

To compound these challenges, the speed at which sustainability transitions need to occur, and the scale and complexity of the required changes are unprecedented. Consequently, single ‘silver bullet’ policy instruments cannot address the interrelated multiple market and system failures (Foxon et al., 2005; Weber & Rohracher, 2012), and many governments try to tackle these complex challenges with a variety of policy initiatives (e.g. see Kern et al. 2017 on energy efficiency). Several publications have contributed to this growing research strand focussing on policy mixes for sustainability transitions, such as transitions to sustainable energy systems (for a review see Rogge et al. 2017).

Of these contributions, Rogge & Reichardt (2016) propose a framework for analysing policy mixes for sustainability transitions which extends the scope of analysis from individual policies (and their interactions) to that of an overarching policy mix which captures policy strategies and instrument mixes, as well as policymaking and implementation processes associated with policy mix elements (Rogge & Reichardt, 2016). They also argue that the impact of policy mixes on socio-technical change may be better understood through considering policy mix characteristics such as consistency, coherence, comprehensiveness and credibility (Costantini et al 2017, Rogge and Schleich 2018). Empirical evidence on policy mix *credibility* (which captures the extent to which the policy mix is considered believable and reliable), suggests a link with other policy mix characteristics, such as the overall consistency of the policy mix (Rogge & Dütschke, 2018). If shortcomings in a policy mix are unaddressed by policymakers this may indicate a lack of political commitment or inadequate capabilities of government to design an effective policy mix.

We follow the call of Flanagan et al. (2011) to pay increased attention to the policy processes, as well as to their coherence, i.e. to the synergistic and systematic nature of the policy processes which underpin the evolution of the policy mix (Rogge & Reichardt (2016). Several recent contributions in the transitions literature have explored the role of politics and policy processes, but importantly, have only focussed on single policy instruments. Moreover, there are few co-evolutionary analyses of policy change and socio-technical change. Hoppmann et al. (2014) is a notable example, but their conceptualisation of the policymaking processes is underdeveloped, and follows a single policy instrument and technology. This paper addresses these shortcomings in the literature by drawing on the conceptual framework proposed by Edmondson et al (2018), which builds on insights from policy feedback theory (Pierson 1993, 2000; Beland 2010; Campbell 2012) in order to understand the co-evolution of policy mixes and socio-technical change. Policy feedback theory has been argued as a promising approach for such co-evolutionary analysis (Kern & Rogge, 2017; Roberts et al., 2018), because of its focus on the effects of policy design and implementation on subsequent rounds of policy making.

Empirically, we chose the UK zero carbon homes policy mix, an ambitious strategy intending to phase-out unsustainable practices and technologies while mainstreaming sustainability in the domestic

built environment. We follow the mix's co-evolution with the low carbon house-building sector in the UK from 2006 (when the target was announced) until 2016 (when the target was disbanded). The mix initially stimulated change and showed signs of positive feedbacks, but over time started to produce negative feedbacks, resulting in its abandonment. Accordingly, it is an interesting case since the policy feedback literature would predict that initial positive feedback leads to a self-reinforcing dynamic.

Thereby, we make three contributions to the literature. First, we provide the first empirical application of a novel conceptual framework on policy mix feedbacks in sustainability transitions. Second, we generate novel insights about the role of policy mix credibility in stimulating socio-technical change, and subsequently, maintaining political support. Third, we propose refinements to the conceptual framework for studying policy mix feedbacks in sustainability transitions. The analysis seeks to answer two research questions: i) *how policy effects and feedback mechanisms influenced the co-evolution of the zero carbon homes policy mix and the socio-technical system*, and ii) *why the zero carbon homes target got abandoned*. In doing so, we derive policy recommendations for governing transition processes.

The remainder of the paper is structured as follows: Section 2 introduces the analytical framework, section 3 outlines the methodology, and section 4 introduces the research case. We present the findings of our case study in section 5 and discuss these in section 6. Section 7 offers conclusions and avenues for future research.

## 6.2. Policy mix feedback in socio-technical systems: a co-evolutionary framework

In this section we give an overview of the conceptual framework proposed by Edmondson et al. (2018) (see figure 1). At its core the framework captures the co-evolution of policy mix change and socio-technical change. It proposes that policy mix change influences the rate and direction of socio-technical change through *policy effects*, while socio-technical change can affect subsequent policymaking through *feedback mechanisms*. That is, this co-evolutionary framework elaborates how policy *outputs*, i.e. elements of the policy mix, can influence policy *outcomes*, i.e. socio-technical change, namely through the effects the mix has on the socio-technical system. It also explains how policy *inputs* can affect policy-making processes through the influence feedback mechanisms and exogenous conditions have on the policy subsystem, thereby explaining changes in the policy mix. Importantly, the framework emphasises the role of actors as the agents of change: actors are influenced by policy effects, and seek to influence policymaking through feedback mechanisms.

The *socio-technical system* is a main component of the framework and captures the “linkages between elements necessary to fulfil societal functions” (Geels 2004: 900), consisting of multi-faceted combination of actors, networks, policies, institutions, artefacts, infrastructure, markets and practices along with cultural and symbolic views and representations (Frank W. Geels, 2004). The existing configuration in the socio-technical system consists of social groups (supply chain, users, research, production, public authorities and societal groups), physical artefacts (technology, infrastructure) and institutions (formal and informal) (F. Geels, 2005). The existing policy mix is therefore part of the socio-technical system. Supporting sustainability innovations can help foster the emergence of novel socio-technical configurations. As these emerging configurations scale up, they may change the structural components of the dominant configuration. Such socio-technical change [STC] can occur through several possible transition pathways involving adaption and replacement of structural components (Frank W. Geels et al., 2016; Frank W. Geels & Schot, 2007).

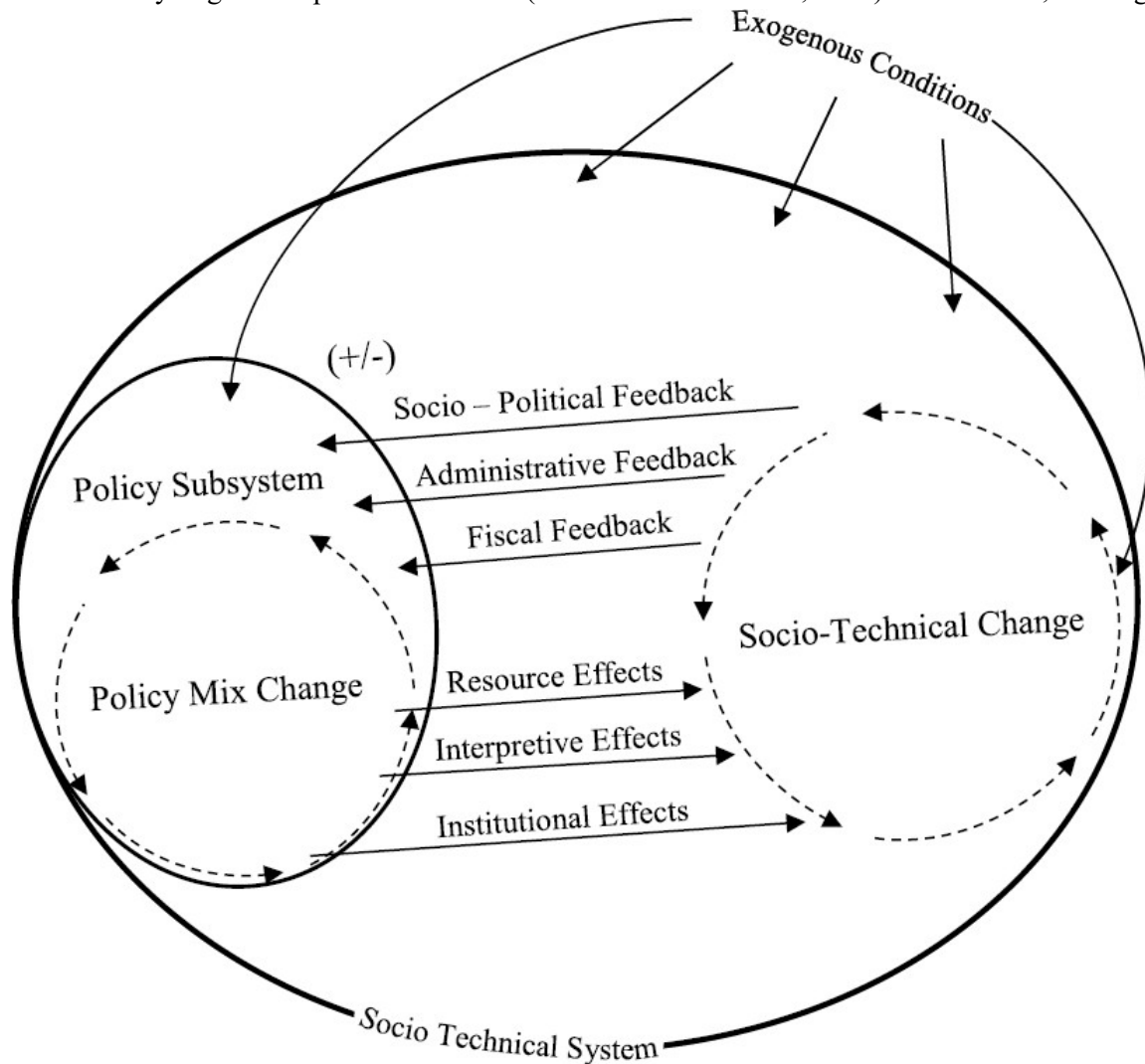
Another key component is the *policy subsystem* which captures the groups of actors involved in the policymaking process (government departments, elected ministers, consultants, experts and ‘pressure participants’ such as lobbyists). Policy subsystem change [PSC] relates to substituting actors involved in the policy process or their respective roles, and/or the views and opinions of the actors involved. We expand on Edmondson et al. (2018), by considering the *policy mix* as the codified outcomes of negotiations of actors who are active in the policy subsystem. The mix’s elements are therefore the output of the process of policy mix change [PMC] (Fig.1). The mix’s elements consist of an overall strategy addressing a policy problem (an objective and principle plans towards achieving it) and the policy instruments implemented towards achieving the policy objective. Importantly, we consider the process through which elements are (attempted to be) added/removed/revised (not simply the final outcome in terms of changes to the policy mix elements) as policy mix change [PMC]. Accordingly, proposed changes may have effects on the socio-technical system even if they are not adopted.

The framework captures the influence of the policy mix on the socio-technical system through *policy effects* which influence actor behaviour, thereby leading to a reconfiguration of the socio-technical system. Policy effects change as the policy mix does, but even when the policy mix is stable (no change) it will continue to have effects. There are three policy effects: *resource*, *interpretive* and *institutional* effects<sup>22</sup>. *Resource effects* [RE] describe the allocation of resources that affect interest groups, state capacities and mass publics (Mettler & Soss 2004: 60). The influence of resource effects on socio-technical change depends on several variables, including the amount and duration of resources provided (Patashnik & Zelizer 2009, 2013), and how dispersed, visible and traceable to government action the resources are (Campbell, 2012). *Interpretive effects* [IntE] describe the

---

<sup>22</sup> While considered separately for analytical purposes, a single policy change commonly produces multiple effects simultaneously.

information a policy mix provides, affecting patterns of cognition, understanding and meaning (Mettler & Soss 2004: 60). Information can be provided through both the codified outputs of policymaking (e.g. instruments), but also through the processes by which the policy mix changes (including implementation). *Institutional effects [InstE]* describe the interaction of the mix with the wider institutional structure of the socio-technical system (E. M. Patashnik & Zelizer, 2013). Failure to reform existing constraining institutional arrangements may limit the mix's transformative capacity and its ability to generate positive feedback (E. Patashnik & Zelizer, 2009). For instance, existing



rules and arrangements may structure how policy instruments are implemented, enforced or evaluated. Institutional effects thus include, for example, reforming such rules, creating new agencies or expanding formal networks which may be necessary to successfully implement the mix<sup>23</sup>.

Figure 4 - Dynamic interactions of the policy mix and the rest of the socio-technical system. Source: Edmondson et al. (2018).

<sup>23</sup> These may require further revision as the policy mix and socio-technical system change over time.



The framework differentiates between three main types of feedbacks: *socio-political*, *fiscal* and *administrative* feedback mechanisms (Oberlander & Weaver, 2015). *Socio-political feedback* [SPF] comprises of three dimensions: cognitive, constituency and agenda. Cognitive feedback relates to how well the mix (or its elements) are perceived to be performing by actors in the policy subsystem. Constituency feedback relates primarily to whether the mix mobilises supporters or opponents. Agenda feedback is whether policy alternatives are considered by actors in the policy subsystem. *Fiscal feedback* [FF] relates to whether the costs of supporting the policy mix over time raise concern to powerful actors, notably the finance ministry. Finally, *administrative feedback* [AF] relates to the public bodies in charge of policy design and implementation, and can lead to strengthening or weakening of internal morale, sense of mission, external reputation, external political support, and the ability to recruit qualified staff (Oberlander and Weaver, 2015).

The framework also captures how a socio-technical system is also affected by *exogenous conditions* [ExC], including social, political and economic trends, along with innovation and policy learning from outside the system. Exogenous conditions can affect the system in four main ways. First is the direct effects on socio-technical change, such as economic trends affecting market conditions. Second, they can amplify or constrain the influence of feedback mechanisms on policy change. For example, feedback mechanisms are more likely to contribute to policy change when coupled with focusing events that bring attention to policy problems (Jacobs & Weaver, 2015; May & Jochim, 2013). Third, exogenous conditions can affect the policy subsystem directly. For instance, a general election will replace ministers from the previous government. This may affect the influence that feedback mechanisms have on the policy process, if supporters/opponents resonate more closely with the ambitions or ideology of the new government. Finally, international agreements such as the COP21 Paris Agreement or EU 2030 targets can place pressure on national policymakers to implement policy reforms. The timing of policy change in relation to changing conditions exogenous to the system can significantly affect the impact of a policy mix, and its prospects of maintaining political support over time (Oberlander & Weaver, 2015; E. Patashnik & Zelizer, 2009; Pierson, 2000). For example, changes in political and economic conditions may render the mix more susceptible to negative feedback, while adverse conditions at the time of implementation may generate opposition from the outset.

The framework's conceptual elements interact dynamically over time, and can result in the occurrence of *feedback loops*. Positive feedbacks, which maintain or strengthens support, are likely to lead to steady resource flows in favour of transitions which makes successive positive feedbacks more likely (virtuous cycle). Conversely, negative feedbacks may limit the capacity of the policy mix to become stable, and can reduce support and resources for the transition. Over time, reduced resources may

result in successive negative feedback occurring (vicious cycles) leading to the policy mix being revised or terminated.

### 6.3. Methodology

For answering our research questions on *how policy effects and feedback mechanisms influenced the co-evolution of the zero carbon homes policy mix and the socio-technical system, and the reasons for its eventual denouncement*, we chose a qualitative research design, conducting a case study which allows for tracing of the phenomena over time (Yin, 2014). Process tracing has been used by case study researchers “either to uncover evidence of causal mechanisms at work or to explain outcomes” (George and Bennet 2005:9). Process tracing therefore allows for the development and testing of theory focussing attention on processes, and the causal mechanisms linking causes to effects (Beach, 2017; George & Bennett, 2005; Tansey, 2007). This is well suited to our focus on co-evolutionary dynamics of the zero carbon homes policy mix and the UK house building socio-technical system.

We drew on two main sources of evidence. First, we collected archival data for the period 2006-2016 (**Table 1**). This included newspapers, industry journals, white papers, green papers, consultations, statements, written and oral references in the House of Commons and House of Lords, select committee inquiries, and a Treasury enquiry. Based on a freedom of information request we also received access for all minutes, agendas and supplementary documents from all meetings of the Zero Carbon Task Force (TF1-115 **Appendix A**). Based on these data, important events were arranged chronologically (see supplementary material), including changes in the socio-technical system and the policy mix. For the former, we looked for quantitative and qualitative information on demonstration projects, annual built rates, research and development activities, activities of key market actors and industry development. For the latter, we included changes in the policy strategy and the instrument mix. For the resulting timeline of events (see supplementary material) we also created a simplified visualisation (see fig 4 in section 3).

Type of archival data	Data Source	Quantity
Policy documents – Government responses to consultations, publications (white papers), speeches, impact assessments	<a href="http://webarchive.nationalarchives.gov.uk/20120919183345/http://www.communities.gov.uk/">http://webarchive.nationalarchives.gov.uk/20120919183345/http://www.communities.gov.uk/</a> <a href="https://www.gov.uk/">https://www.gov.uk/</a>	137
2016 Task Force - meeting minutes, agendas, supporting documents/reports	Freedom of information request to Department of Communities and Local Government (DCLG)	115 (See Appendix A)
Zero carbon hub publications	<a href="http://www.zerocarbonhub.org/recent-publications">http://www.zerocarbonhub.org/recent-publications</a>	148
Industry journals	<a href="https://www.endsreport.com/">https://www.endsreport.com/</a> <a href="https://www.building.co.uk/">https://www.building.co.uk/</a> <a href="https://www.cibsejournal.com/">https://www.cibsejournal.com/</a> <a href="https://www.architectsjournal.co.uk/">https://www.architectsjournal.co.uk/</a>	603 articles - reviewed for relevancy and reduced to 112
Secondary literature	<a href="https://www.scopus.com">https://www.scopus.com</a>	25 academic papers
Inquiries	<a href="https://www.parliament.uk">https://www.parliament.uk</a>	71 written responses in Treasury inquiry 99 written responses in 'Home energy efficiency and demand reduction' inquiry, Energy and Climate Change Committee Documents reviewed using search terms “zero carbon homes” and “allowable solutions”.
Debates in the House of Commons and House of Lords over the period of 2006-2016	<a href="https://hansard.parliament.uk/">https://hansard.parliament.uk/</a>	260 spoken references 22 written statements Occurrences resulting from search terms ‘Zero Carbon Homes’ and ‘Code for Sustainable Homes’
Letters (to government ministers)	Various	3
Media	<a href="https://www.theguardian.com/uk">https://www.theguardian.com/uk</a> <a href="https://www.telegraph.co.uk/">https://www.telegraph.co.uk/</a> <a href="https://www.ft.com/?edition=uk">https://www.ft.com/?edition=uk</a> <a href="https://www.independent.co.uk/">https://www.independent.co.uk/</a>	427 occurrences - reviewed for relevance using search terms “zero carbon homes”, “eco-towns” and “code for sustainable homes”. Reduced to 67.

Table 7 - Type, Source and Quantity of Archival Data.

We then conducted interviews with 18 experts (see table 2) who were selected based on their knowledge of and involvement in relevant processes, while also seeking a balance between different actor groups (policy-makers, NGOs, industry, academic, experts). Interviews were based on a semi-structured questionnaire, were conducted face-to-face and over telephone in the period from August until October 2018, and lasted on average 79 minutes. They were supported by the timeline visualisation which enabled us to validate this event timeline with experts, and look for additional information.

Interviewee	Actor type	Actor group	Format	Date	Duration (minutes)
1	UK-Green Building Council	NGO	Face to face	31/08/2017	90
2	World Wildlife Fund/Task force/ UK-Green Building Council/Zero Carbon hub	NGO	Telephone	17/08/2017	50
3	NGO/advocacy group	NGO	Telephone	23/09/2017	90
4	Manufacturing – advocacy group	Industry/ Manufacturing /NGO	Face to face	3/10/2017	90
5	Manufacturing – advocacy group	Industry/ Manufacturing /NGO	Telephone	18/09/2017	105
6	Manufacturing/ Zero Carbon Hub	Industry – manufacturing	Telephone	2/10/2017	90
7	House builder/Zero Carbon Hub/ National House Building Council	Industry	Face to face	12/10/2017	90
8	Developer	Industry - developer	Face to face	4/10/2017	90
9	House Builders Federation	Industry - developer	Telephone	1/12/2017	45
10	Chartered Institutions of Building Service Engineers	Expert/ industry	Telephone	17/11/2017	90
11	Consultant/Zero Carbon Hub	Industry/ Expert	Telephone	24/10/2017	90
12	Consultant/Zero Carbon Hub	Industry/ Expert	Face to face	11/09/2017	90
13	Expert/ academic	Expert	Telephone	5/09/2017	90
14	Academic	Expert	Face to face	26/10/2017	60
15	Civil servant/Carbon Trust	Policy maker/ Expert	Face to face	7/09/2017	90
16	Minister/Department of Communities and Local Government	Policy maker	Face to face	17/10/2017	50
17	Office of the Deputy Prime Minister/ Local Area Building Control	Policy maker	Face to face	14/09/2017	90
18	Building Research Establishment/Housing association	Policy maker/ Industry	Face to face	13/10/2017	60

Table 8 - Actor type and group of interview participants.

We followed a ‘framework analysis’ methodology for analysis of collated data (Ritchie & Spencer, 1994). Interviews were transcribed verbatim and then indexed using NVivo11 to deductively code for four phases with nodes derived from our framework. We also coded ‘other’ as sub-nodes of both policy effects and feedback mechanisms, to account for any phenomena not captured by the framework<sup>24</sup>. We ran multiple queries to investigate the relationships between elements of the framework, using matrix-coding queries to look for overlaps. In doing so, we examined whether the

<sup>24</sup> However, since the research was designed to look for evidence of the main a priori conceptual components, most data was expected to fit the framework (Ritchie & Spencer, 1994).

interviewees agree with each other and whether there were significant differences in responses, e.g. between interviewees from different actor types. We triangulated our interviews with our archival data to ensure the robustness of our findings. Collectively these sources allowed for a rich analysis of co-evolutionary mechanisms.

#### 6.4. Research case

For the first application of the co-evolutionary framework on policy mixes for sustainability transitions we chose the UK zero carbon homes strategy which was intentionally designed as a policy mix, including a number of interacting instruments. This is a highly illuminating case because it offers an example of a failed transition attempt based on an ambitious policy target which included the phase-out of dominant technologies and practices. As such, the application of the framework can help us understand why transitions may lose support and to derive recommendations for more successful policy mixes. In the following, we provide an introduction to the UK housebuilding socio-technical system and the zero carbon homes policy mix as a background to the case study.

##### 6.4.1. *UK House-building socio technical system*

Demand for new housing in the UK is around 280,000 new homes a year (roughly 1% of total housing stock), due to net migration and a trend towards smaller properties (Kay 2017). Current build rates do not match this demand, as in 2016 only 190,310 new houses were built (ONS 2017a). Low supply has created a ‘housing crisis’, with housing prices increasing 74.4% since 2006, despite the recession (fig.3). Build rates have declined since 1970 by 46.7%, largely due to a drop in the provision of social housing through local authorities in the UK by 99% (DCLG 2017). Consequently, the housebuilding industry is dominated by private developers, whose market share has increased from 48.0% in 1970 to 81.1% in 2016 (fig. 2). To address the highly politicised issue of housing supply, at the time of launching the zero carbon homes policy mix, government also announced an ambition to build 3 million homes by 2020, of which 1 million would be zero carbon.

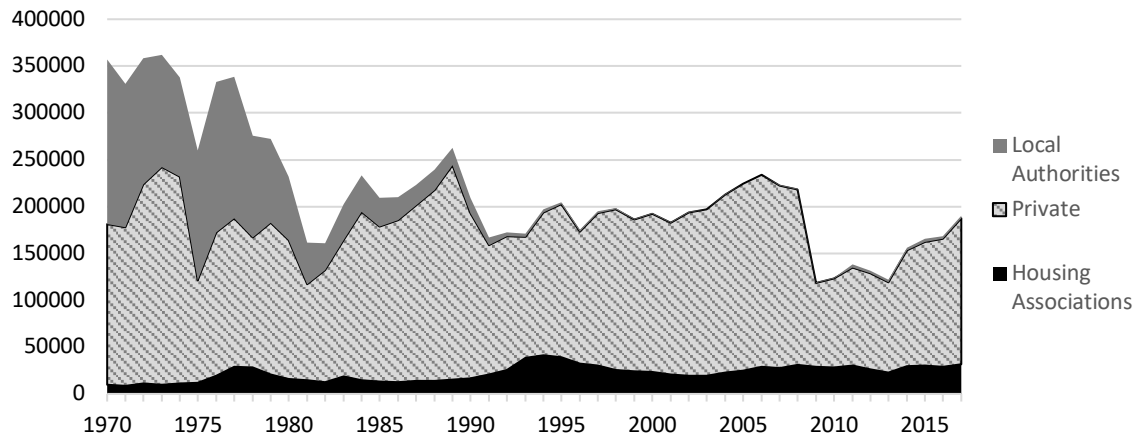


Figure. 5 -Annual Volume of Completed Domestic New Build (1970-2016). Data Source: DCLG (2017)

The private sector housebuilding industry accounts for around 20% of the whole construction sector in the UK (Statista 2018). Market actors comprise of a relatively small number of high volume house-builders, and a larger number of low volume builders. The Home Builders Federation (HBF) is a trade association representing large private sector house-builders and its members deliver around 80% of new homes, while the Federation of Master Builders (FMB) is a trade body representing SMEs. In 2007, the top 25 house-builders accounted for around 49.5% of completed projects, while the top 5 accounted for 32.6% (Building 2008).

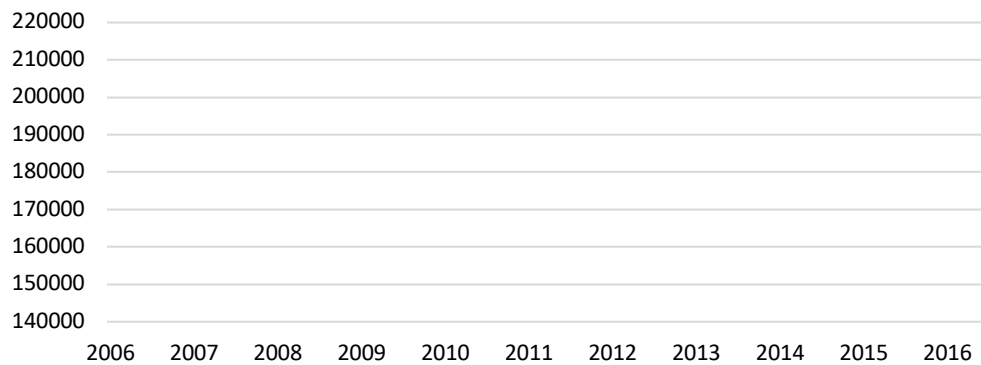


Figure 6 - Average Price (£) of UK property 2006-2016. Data source: ONS (2017b)

#### 6.4.2. Zero Carbon Homes policy mix

The zero carbon homes target was designed as a net-zero approach to housing, aiming for all new housing post 2016 to contribute zero emissions for their operation. This overall strategy would be achieved through a combination of energy efficiency improvements to reduce energy use for heating, cooking and appliances, and complemented by small-scale renewables to offset any remaining emissions. The target was ambitious, accounting for unregulated energy emissions<sup>25</sup>, which exceeded

<sup>25</sup> Post occupancy emissions associated with appliances.

European and international standards. After the target's announcement in 2006, a number of different policy instruments were implemented towards achieving the overall strategy, comprising of regulations and funding schemes. We used a top down perspective to identify instruments (Ossenbrink, Finnsson, Bening, & Hoffmann, 2018), and categorised them according to classifications proposed by Borrás and Edquist (Table 3). *“Generally speaking, there are three large categories of instruments used in public policy: (1) regulatory instruments, (2) economic and financial instruments, and (3) soft instruments”* (Borrás and Edquist 2013:11). The main implementation of the target was through the national building regulations, which were pre-existing prior to the implementation of the mix but were updated.

Table 9 - Zero Carbon Homes policy mix.

Policy mix element	Name	Element Function	Started	Redefined/modified	Terminated
<b>Strategy</b>	Zero Carbon Homes target	Target	2006	<ul style="list-style-type: none"> <li>- 2007 (treasury)</li> <li>- 2008 (consultation)</li> <li>- 2010 (standard for 2010 building regulations decided)</li> <li>- 2011 (removal of unregulated energy use)</li> <li>- 2013 (marginal increase in the 2013 building regulations)</li> <li>- 2014 (small sites exemption and removal of requirements for micro-renewables)</li> </ul>	<ul style="list-style-type: none"> <li>- 2015 (denounced)</li> <li>- 2016 (officially disbanded)</li> </ul>
<b>Instrument Mix</b>	Building regulations - Part L (energy)	Regulatory	1985	<ul style="list-style-type: none"> <li>-2006 (aligned with target)<sup>26</sup></li> <li>-2010 (implemented as planned)</li> <li>-2013 (postponed to 2014 and only marginal increase)</li> <li>- 2016 (Part L was not implemented)</li> </ul>	N/A
	Zero carbon task force	Soft instrument	2006	2010 (terms changed and housing minister stopped attending meetings)	2014 (final meeting)
	Code for sustainable homes	Soft instrument	2007	<ul style="list-style-type: none"> <li>- 2010 (modified to align with the new definition of the target)</li> <li>- 2014 (plans to terminate)</li> </ul>	N/A Still active
	Tax stamp duty exemption	Economic and Financial (market pull)	2007	N/A	2011(ended - as planned)
	Eco-Towns	Economic and Financial (supply push)	2007	<ul style="list-style-type: none"> <li>2009 (commitment to 4 towns)</li> <li>2010 (only 1 town would be built to original standards)</li> </ul>	2011 ( no further sites awarded)
	Carbon challenge	Economic and Financial (supply push)	2007	<ul style="list-style-type: none"> <li>2008 (additional sites added)</li> <li>2010 (funding reductions)</li> </ul>	2012 (no additional sites awarded)
	AIMC4	Economic and Financial (R&D)	2008	N/A	2011(ended - as planned)
	Zero carbon hub	Fiscal (grant funding)	2008	2010 (funding withdrawn apart for specific projects)	2016

<sup>26</sup> While the building regulations did not start in 2006, they were updated at the start of our analysis and became aligned with the overall strategy. For the purposes of this analysis, they can be considered as part of the policy mix at that point.

## 6.5. Co-evolutionary analysis of the zero carbon homes policy mix and the house-building socio-technical system in the UK (2006-2016)

The following subsections present our co-evolutionary analysis, structured into four phases between 2006-2016 (for an overview, see fig 4 and table 4). Each phase starts with a period of significant changes to the policy mix, and is analysed according to a) the policy effects produced and their influence on socio-technical change, and b) the feedback generated and its influence on the policy mix change. We also pay attention to interactions of the socio-technical system and policy mix with exogenous conditions.<sup>27</sup>

### 6.5.1. Phase 1: Initiation of the zero carbon homes policy mix (2006-2008)

The zero carbon homes target announced in 2006 was implemented through increments to the national building regulations occurring in 2010, 2013 and 2016 [PMC]. A voluntary regulation for holistic building sustainability was also introduced in 2007, the Code for Sustainable Homes (CSH). CSH was a rating system with levels ranging from 0-6, where the energy requirements of the highest level (6) were aligned with the zero carbon target (interviews 15,18). CSH was intended to provide clarity and indicate the trajectory of future building regulations, allowing market actors to experiment with new designs based on these standards (DCLG 2006b).

Resources in this phase were limited [RE], but several announcements were made of potential funding opportunities [PMC->IntE]. Most notably was the announcement of five ‘eco-towns’, large scale developments of 5,000-20,000 houses to be built to zero-carbon standards on publically commissioned land (ENDS 2007). Eco-towns were intended to accelerate housing delivery and serve as large-scale demonstration projects for zero carbon housing. Shortly after the ambition was increased to 10 eco-towns [PMC->IntE] (potentially 200,000 new homes). The sites proposed were previously undeveloped (green-field), and would be fast-tracked through the planning system. As the availability of land has significant impact on costs, and planning permission on ‘green-field’ sites is typically difficult to attain, this was an attractive offer to developers.

---

<sup>27</sup> We use abbreviations to refer to the conceptual components of the framework: Policy mix change [PMC], Resource effect [RE], Interpretive effect [IntE], Institutional effect [InstE], Socio-technical change [STC], Socio-political feedback [SPF], Fiscal feedback [FF], Administrative feedback [AF], Exogenous conditions [ExC], Policy subsystem change [PSC].



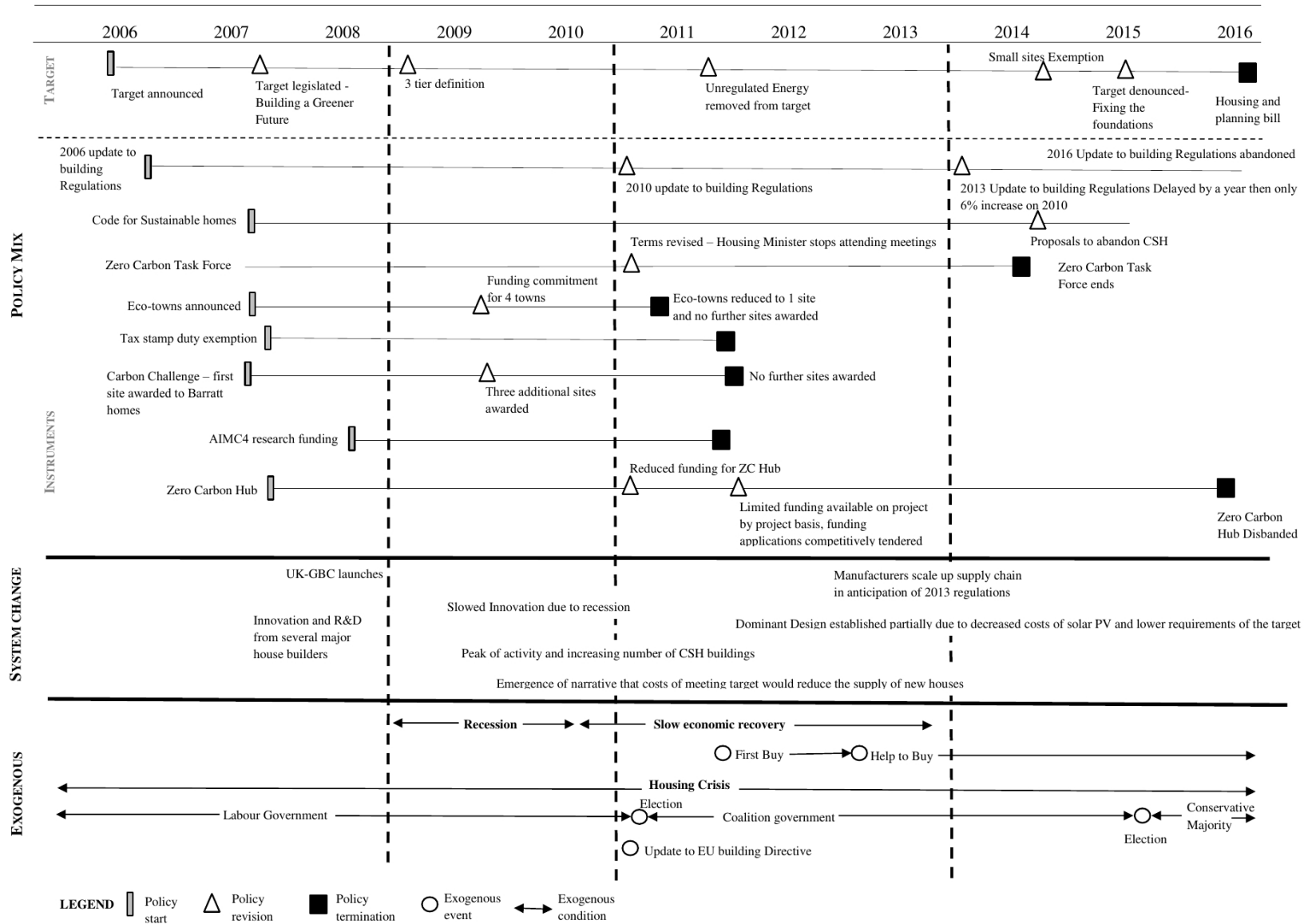


Figure 7 - Timeline of key developments in the socio-technical system in the period 2006-2016

Phase	Policy mix change	Policy effects	Exogenous conditions	Socio-technical system change	Policy subsystem change	Feedback Mechanisms
1. 2006-2008	<ul style="list-style-type: none"> <li>• Introduction of target</li> <li>• Launch of Code of Sustainable Homes</li> <li>• Eco-towns</li> <li>• Carbon challenge (Eco-villages) announced and Hanham Hall site awarded</li> <li>• Exemption from Stamp Duty Land Tax (SDLT), which included a different definition of target</li> <li>• Foundation of the task force</li> <li>• Callcutt review on housing delivery commissioned</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Resource effects</b> <ul style="list-style-type: none"> <li>- limited in this phase</li> <li>- Carbon Challenge</li> <li>- SDLT exemption for new zero-carbon homes</li> </ul> </li> <li>• <b>Interpretive effects</b> <ul style="list-style-type: none"> <li>- expectation of future resources</li> <li>- strong indication of political commitment</li> <li>- lack of clarity (target and eco-towns)</li> <li>- concerns over cost</li> </ul> </li> <li>• <b>Institutional effects</b> <ul style="list-style-type: none"> <li>- establishment of new platforms for policymaking(Task Force)</li> <li>- Regulatory enforcement unreformed</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• High political attention to climate change</li> <li>• All party consensus on Climate Change Act 2008</li> </ul>	<ul style="list-style-type: none"> <li>• Initial support from some major house-builders</li> <li>• Foundation of UKGBC</li> <li>• KingSpan Light house, and Barratt Green House built on the BRE innovation park</li> <li>• Growth in property market</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Labour Government</b></li> <li>• Yvette Cooper (HM DCLG<sup>28</sup> 2006-2007)</li> <li>• Ruth Kelly, John Denham(SS DCLG<sup>29</sup> 2007-2008)</li> <li>• Gordon Brown (Chancellor – Treasury 2006-2007; 2007 – Prime Minister)</li> <li>- Support from treasury</li> <li>• <b>Task force</b> <ul style="list-style-type: none"> <li>- Micro renewables industry not represented in task force</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Support from several major house-builders and HBF chairman Stewart Baseley [+SPF]</li> <li>• Incremental changes to policy mix suggested [+SPF]</li> <li>• Suggestion to establish delivery body though Callcutt review [-AF, +SPF]</li> <li>• Support from manufacturing sector and micro renewables industry (REA) [+SPF]</li> <li>- REA less influential as excluded from task force [-SPF]</li> <li>• Public opposition to eco-towns [-SPF]</li> </ul>
2. 2008-2010	<ul style="list-style-type: none"> <li>• Establishment of Zero Carbon Hub</li> <li>• HCA established</li> <li>• Target redefined through consultation</li> <li>• Reduced ambition of eco-towns</li> <li>• AIMC4</li> <li>• Carbon Challenge – 3 additional sites</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Resource effects</b> <ul style="list-style-type: none"> <li>- increased in this phase</li> <li>- ZC hub</li> <li>- AMIC4</li> <li>- Carbon Challenge</li> </ul> </li> <li>• <b>Interpretive effects</b> <ul style="list-style-type: none"> <li>- strong indication of political commitment despite recession</li> <li>- increased concerns over costs amplified by recession</li> </ul> </li> <li>• <b>Institutional effects</b> <ul style="list-style-type: none"> <li>- establishment of new platforms for policymaking(changes through HCA, ZC Hub)</li> <li>- Regulatory enforcement unreformed</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Recession</li> </ul>	<ul style="list-style-type: none"> <li>• Increased uptake of the code drives innovation in new materials leading to widespread adoption (e.g. certified timber).</li> <li>• Work starts on Hanham hall in 2009, but is delayed (due to recession).</li> <li>• Hanham hall design originally uses a CHP system and district heating</li> <li>• Hub operating as autonomous research institution</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Labour Government</b> <ul style="list-style-type: none"> <li>- John Denham (SS DCLG)</li> <li>- Caroline Flint (HM DCLG 2008-2009)</li> <li>- Margret Beckett (HM DCLG 2009)</li> <li>- John Healy (HM DCLG 2009-2010)</li> </ul> </li> <li>• <b>Task Force</b></li> <li>• <b>ZC Hub</b> <ul style="list-style-type: none"> <li>- research role on delivering target through 5 works streams</li> <li>- influential in redefining the target</li> <li>- hub's recommendations for FEES incorporated into 2010 building regulations</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Increasing opposition from builders due to the recession [-SPF]</li> <li>• Redefinition of target after feasibility questioned [+SPF]</li> <li>• Political opposition to eco-towns from Conservative Party [-SPF]</li> </ul>
3. 2010-2013	<ul style="list-style-type: none"> <li>• 2010 building regulations (contested)</li> <li>• Eco-towns abandoned</li> <li>• Cuts/removal of hub funding</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Resource effects</b> <ul style="list-style-type: none"> <li>- significant cuts to resources through scale back of eco-towns, removal of grant funding for the Hub, scale back of carbon challenge</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Election leads to new government</li> <li>• Political ideology</li> </ul>	<ul style="list-style-type: none"> <li>• Barratt start construction on the main site at Hanham Hall 2011</li> <li>• AIMC4 finished 2011</li> <li>• PV becomes the principle way of achieving 'carbon compliance'</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Coalition Government: Conservative Party (CP)</b> <ul style="list-style-type: none"> <li>- Treasury dominates subsystem (Chancellor George Osborne)</li> <li>- Eric Pickles (SS DCLG)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• House-builders start pushing back harder which seems to resonate with new (CP) government [-SPF]</li> </ul>

<sup>28</sup> HM DCLG - Housing minister, Department of Communities and Local Government

<sup>29</sup> SS DCLG - Secretary of state, Department of Communities and Local Government

	<ul style="list-style-type: none"> <li>•HCA budget cut by 60%</li> <li>•Target reduced (un-regulated energy removed)</li> <li>•2013 building regulations delayed</li> </ul>	<ul style="list-style-type: none"> <li>- small amount of research funding tendered to ZC Hub</li> <li>•<b>Interpretive effects</b> <ul style="list-style-type: none"> <li>- signals a reprioritisation of government towards volume of supply</li> <li>- delays to 2013 building regulations means target less feasible</li> </ul> </li> <li>•<b>Institutional effects</b> <ul style="list-style-type: none"> <li>- task force changes terms under new government</li> <li>- ZC Hub loses autonomy with funding cut</li> <li>- Regulatory enforcement unreformed</li> <li>- ZC Hub's recommendations to change regulations to 'as-built' performance ignored by DCLG</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>shift, austerity and deregulation</li> <li>•Rapidly declining costs of solar PV</li> <li>• Less political attention to climate change</li> <li>• Political resistance to 'green crap'</li> </ul>	<ul style="list-style-type: none"> <li>• Limited evidence of 2010 building regulations in new builds</li> <li>• Manufacturers up-scale production lines anticipating the increase in building regulations</li> </ul>	<ul style="list-style-type: none"> <li>- Grant Shapps (HM DCLG 2010-2012)</li> <li>- Mark Prisk (HM DCLG 2012-2013)</li> <li>- Kris Hopkins (HM DCLG 2013)</li> <li>- Bandon Lewis (HM)</li> <li><b><u>Liberal-democrats (LD) ministers</u></b> <ul style="list-style-type: none"> <li>- Andrew Stunnell (2010 - 2012)</li> <li>- Don Foster (2012- 2013)</li> <li>- Stephen Williams (2013)</li> </ul> </li> <li>• <b>Task Force</b> <ul style="list-style-type: none"> <li>- no engagement from housing minister (CP)</li> <li>- engagement from LD ministers but low political influence</li> </ul> </li> <li>• <b>ZC Hub</b> <ul style="list-style-type: none"> <li>- research role hampered through reduced resources</li> <li>- recommendations for 2013 regulations ignored by government</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>•Barratt construct test units, projected costs generates opposition from stakeholders [-SPF]</li> <li>• Treasury reduced autonomy of DCLG and enforced austerity reducing resources in response to recession [-FF]</li> <li>•Lib Dem ministers supportive of target but not as powerful [+SPF]</li> <li>•Poor reputation of DCLG due to changes made during this phase [-AF]</li> </ul>
4. 2014-2016	<ul style="list-style-type: none"> <li>•Delay to 2013 building regulations</li> <li>•Consultation on removal of CSH</li> <li>•Small sites exemption</li> <li>•Denouncement of target</li> <li>•Amendment from the Lords to reinstate target defeated by a margin of four votes</li> <li>•Target officially abandoned - Housing and Planning Bill</li> </ul>	<ul style="list-style-type: none"> <li>•<b>Resource effects</b> <ul style="list-style-type: none"> <li>- no additional funding allocated</li> <li>- small amount of research funding for allowable solutions mechanism, but project cancelled after 1 month</li> </ul> </li> <li>•<b>Interpretive effects</b> <ul style="list-style-type: none"> <li>- zero carbon homes agenda seen as increasingly under threat</li> </ul> </li> <li>•<b>Institutional effects</b> <ul style="list-style-type: none"> <li>- task force disbanded</li> <li>- ZC Hub closes</li> <li>- Regulatory enforcement unreformed</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>•2015 Election</li> <li>•Change to conservative majority government</li> </ul>	<ul style="list-style-type: none"> <li>• System stabilises through resistance to change</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Coalition (2014 - 2015)</b> <ul style="list-style-type: none"> <li>-Treasury dominates subsystem (Chancellor George Osborne)</li> <li>- Eric Pickles (SS DCLG 2014-2015)</li> <li>- Stephen Williams (LD) (2014-2015)</li> </ul> </li> <li>• <b>Conservative Party (2015-2016)</b> <ul style="list-style-type: none"> <li>- Greg Clark (SS DCLG 2015-2016)</li> <li>- Bandon Lewis (HM DCLG 2014-2016 )</li> </ul> </li> <li>•<b>Task Force</b> <ul style="list-style-type: none"> <li>- disbanded (Jan 2014)</li> </ul> </li> <li>• <b>ZC Hub</b> <ul style="list-style-type: none"> <li>- low influence</li> <li>- disbanded 2016</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Weakened supporting coalition and no supporting house-builders [-SPF]</li> <li>•Opposition from parts of the industry and some politicians to small sites exemption [+SPF]</li> <li>•Denouncement appealed by UKGBC but weak supportive coalition weak [-SPF]</li> <li>- denouncement opposed by the Lords [+SPF]</li> </ul>

Table 10 - Summary of main developments within socio-technical system divided by four main phases

Smaller-scale funding was also available through the ‘carbon-challenge’ for medium scale ‘eco-villages’ (100-750 homes), also built to zero carbon standards [PMC->RE] (Morby 2010). These villages would allow for experimentation with new designs and technologies, and were intended to assist the delivery of the larger-scale towns [RE->STC]. The first site - Hanham Hall - was awarded to Barratt Homes in 2007 (Jansen 2007). Finally, there was a tax exemption for new homes built to the zero carbon standards before 2011 (Gov 2016). The tax exemption was meant to benefit consumers, reducing the overall costs of buying a new home.

These policy changes were introduced within the existing institutional arrangements, rather than reforming them [PMC->InstE]. Most notably was the legal requirements regarding how compliance with building regulations are evaluated and enforced. The only requirement to satisfy building regulations in the UK is to submit a design specification for the standards of the new build [PMC->IntE&InstE] (interview 17). Consequently, there is no legal requirement to evaluate the real performance of buildings after construction [InstE]. Thus, many sites are value-engineered during construction, and materials are replaced with cheaper, less-effective components [PMC->Inst&IntE->STC] (interviews 1,15,18). Another issue relates to skills shortages of site operatives lower down the supply chain, to effectively install components and technologies. Accordingly, there is a commonly acknowledged ‘performance gap’ between as-designed specification and the final building [STC] (interview 1,2,4,6,7,9,18). A notable change of institutional effects was the establishment of the Zero Carbon Task Force, a political steering group for the target [PMC->InstE]. The purpose of the group was to act as a platform in the policy process in which different stakeholders could discuss with the housing minister about future actions to be taken in achieving the target [PSC] (interview 2). The task force was convened by the housing minister and included representation from housebuilders and manufacturers, yet the micro-renewables industry seems to have been excluded, despite requesting representation<sup>30</sup> (TF11). Consequently, the opinions of this industry were excluded from the formal policymaking procedure [-SPF].

The most notable effect was the expectations of future resources [IntE], considered a commercially attractive opportunity to potential beneficiaries (interviews 1,2,6). Combined with perceptions of strong political commitment [IntE], this led to the establishment of UK-GBC<sup>31</sup> [STC], and helped elicit support from some major house builders [+SPF]. However, the eco-towns policy also generated negative feedback from the general public who protested against the proposals, and led to political opposition from the Conservative Party (CP) [-SPF]. Another issue involved different definitions for the target announced by DCLG and Treasury (finance ministry) with the introduction of the tax

---

<sup>30</sup> The Renewable Energy Agency (REA) is the trade body representing the micro renewables sector. REA wrote a letter to the task force voicing support for the target and requesting representation. However, reviewing the attendees at subsequent meetings, REA were not represented.

<sup>31</sup> UK Green Buildings Council.

exemption. This meant that actors weren't sure how to proceed, leading to inertia in the initial phase, with the exception of some experimentation with prototypes on the BRE innovation park (interviews 1,2,7,10,14). The lack of clarity regarding the target **[IntE]** motivated UK-GBC to produce a report assessing the feasibility of the current target **[STC]**, and proposing a new definition which was presented to the task force **[+SPF]** (TF15). This led to suggestions from house builders to introduce the option of off-site carbon mitigation (TF17-20). It also led to the recommendation made in the Callcutt review on Housing Delivery, that government should form a new delivery body, acknowledging a capability deficit to effectively implement the target **[-AF]** (interviews 2,6).

### 6.5.2. *Phase 2: Resource expansion, redefinition and recession: the emergence of an opposing coalition (2008-2010)*

Acknowledging the identified issues from the previous phase **[+SPF&-AF]**, government worked towards re-defining the target **[PSC->PMC]** (Gibbs & O'Neill, 2015), and launched the Zero Carbon Hub (ZCHub) **[PMC->InstE]**. The redefined target comprised of three aspects: a Fabric Energy Emission Standard (FEES), carbon compliance and allowable solutions (Heffernan et al. 2015; Schweber et al. 2015). FEES set the expected level of efficiency of the building fabric, while carbon compliance captured the amount of abatement on-site through the use of renewable energy. The allowable solutions component was originally planned as an abatement fund for local carbon mitigation, without requiring it to be 100% on-site (DCLG 2009c) (interviews 1,4,18). The ZCHub received grant funding from government **[PMC]**, enabling it to serve as an autonomous research group working towards redefining the target and identifying and overcoming potential barriers **[RE&InstE]**. In addition, there was additional funding allocated in this phase through the carbon challenge, AIMC4, and commitment to funding four of the proposed eco-towns **[PMC->RE]**. This helped maintain perceptions of political commitment throughout the phase **[IntE]** (interview 1,2,6,10). Another significant institutional effect in this phase resulted from the Planning and Energy Act 2008 **[PMC]** which introduced mandatory use of the 'Merton Rule' by local councils, effectively allowing local councils to require higher levels of sustainability in their planning permission applications **[IntE]**, and was implemented in many boroughs of London **[STC]** (interviews 1,7,11,12,16). Combined with the Introduction of 'Home Information Packs' **[PMC]** which required all new homes to have a sustainability rating **[IntE]**, there was increased applications of the code of sustainable homes (mainly level 3 and some level 4) **[STC]** (table 5). This was a strong stimulus for innovation **[STC]**, helping promote the uptake of new products into mainstream use, including the adoption of Forest Stewardship Council certified timber **[STC]** (interview 11,12,18). We consider these socio-technical changes as the emergence of a potential virtuous cycle.

As the transition started to gain momentum, however, the UK moved into recession [**ExC**] and the construction sector was one of the worst affected sectors. House prices dropped by 15.9% by the end of 2008 (fig. 5) (Osborne 2009) and the pre-tax profits of the ten largest house-builders dropped from around £2.5 billion in 2006 to over -£3 billion by 2008 (Mathiason 2014)<sup>32</sup>, leading to 25% job losses in the sector (Peacock 2010) [**ExC**->**STC**]. Typically, during periods of ‘bust’ in the construction industry, job losses commonly impact innovative actors worse, leading to reduced capabilities (interviews 1,2,6,7,10). The adverse market conditions and drop in profits also meant that there was less resources available for innovation. The recession also impacted specific instruments, most notably eco-towns. Under tighter economic conditions [**ExC**] the overall budget was reduced [**PMC**->**RE**] (Hope 2008). More importantly, the lack of regulation of the financial sector was blamed for the economic crisis [**ExC**], which increased attention to the role of regulations [**PSC**]. Consequently, the proposals to fast-track the planning system were revoked [**PMC**] (Arnold 2009). Following this change, DCLG produced a report estimating only marginal profits for developers of eco-towns [**RE**], which undermined the expectations created throughout the first phase [**IntE**]. By 2009, Labour committed to funding 4 eco-towns [**PMC**->**RE**], but the proposals were now less attractive [**IntE**], and under tight economic conditions [**ExC**], house builders became more vocally opposed to the target [**-SPF**]. HBF claimed it was unachievable (Goodchild & Walshaw, 2011), and led to the narrative that the target may impact on the delivery of new homes [**STC**->**-SPF**] (Ends 2008). However, resource allocation through the carbon challenge [**RE**] helped maintain support of some house builders, notably Barratt Homes [**+SPF**]. In spite of growing opposition [**-SPF**], commitment to the target remained strong under Labour [**PSC**], and the support of some powerful actors [**+SPF**] meant no changes to the target were made [**PMC**].

---

<sup>32</sup> These actors subsequently evened balance sheets by 2010, and had recovered to 2006 levels by 2014 (Mathiason 2014).

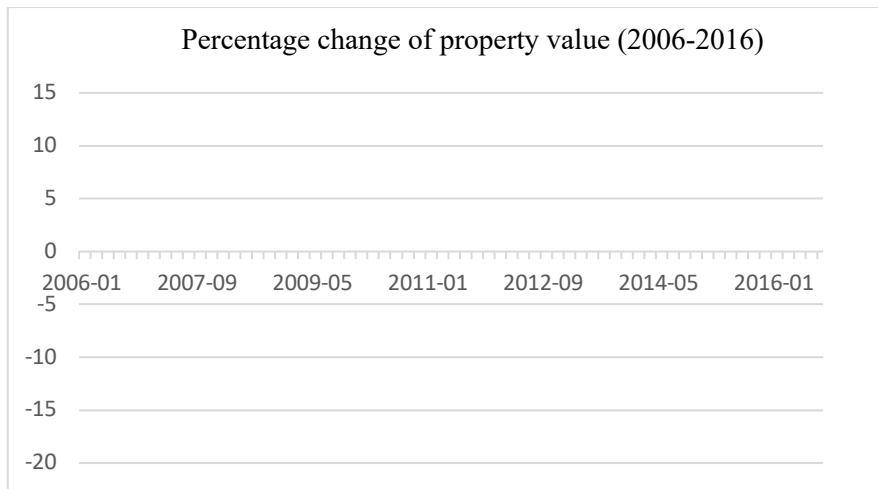


Figure 8 - Percentage change of property value (2006-2016). Source: HM Land Registry.

The UK came out of the recession by the end of this phase, however recovery was the slowest in recorded history [ExC] (Owen 2015). Despite adverse market conditions [STC], throughout this phase progress was made through the CSH [IntE->STC] and the activities of the zero carbon hub, who conducted research on how to operationalise the target [RE->STC]. Participation in the hub from various parts of industry may have also helped safeguard the target's credibility [PMC->IntE] (interview 1), and led to a peak of activity from 2009-2011. Notably, the number of CSH level 3 homes increased significantly [STC] (table 5).

Number of constructed properties to levels 0-6 of CSH (post-construction)							
Code level	0	1	2	3	4	5	6
2008-2009	0	0	1	58	4	2	0
2009-2010	49	34	75	4326	290	37	7
2010-2011	114	54	113	18208	1579	62	24
2011-2012	234	106	335	32384	6299	136	111
2012-2013	369	152	28	36150	9642	268	91
2013-2014	465	120	248	31823	12459	55	14
2014-2015	506	40	113	18749	7561	64	15
<b>TOTAL</b>	<b>1737</b>	<b>506</b>	<b>913</b>	<b>141698</b>	<b>37834</b>	<b>624</b>	<b>262</b>

Table 11 - Number of constructed properties according to CSH level (Source: DCLG).

### 6.5.3. Phase 3: Election, austerity, increasing opposition and a weakening supporting coalition (2010-2013)

In the third phase several detrimental changes to the policy mix occurred [PMC], including significant reductions of resources available (current or anticipated) [RE&IntE]. These changes can partially be attributed to a significant change in the policy subsystem [PSC]. The 2010 election [ExC] led to a new coalition government between the Conservative Party (CP with 306 seats) and the Liberal Democrats (LD with 57 seats) [PSC]. In general, the conservative party are less supportive of climate change mitigation (Carter & Clements, 2015), and place greater emphasis on economic growth [ExC->PSC]. Therefore, the appointment of CP ministers as the most senior positions within DCLG, and the finance ministry was an important change [PSC].

In response to the recession, the government implemented austerity measures, and consequently the costs of supporting the policy mix became considered as an unnecessary expense. This resulted in various funding schemes being cut [PSC->PMC->RE] (interviews 1,10,11), including: ending the grant funding for the ZCHub [PMC->RE] effectively removing its research autonomy [PMC->InstE]; requiring that only one of the four planned eco-towns would be built to the original (sustainability) standards [PMC->RE&IntE]; and reducing funding available through the carbon challenge [PMC->RE]. These reductions of resources significantly weakened the incentive for developers to support the target [PMC->RE&IntE&InstE->STC->SPF] (interviews 1,15).

Combined with the cuts, no additional instruments were added to the mix to address any identified problem areas, support innovation or stimulate demand [PMC], which helped re-stabilise the existing socio-technical system [STC].

These changes are the policy subsystem, which under austerity measures was dominated by Treasury throughout this phase [PSC&-FF->PMC->RE]. With the ongoing housing crisis in the UK, treasury prioritised delivery of new houses over how efficient these were (interviews 1,2,3, 8,10,15,16,18).

This is reflected in the amount of resources dedicated to housing delivery and stimulating the market through ‘First Buy’ and ‘Help to Buy’ policies. By 2013, the new government had committed £15.8 billion to assisting first time buyers get onto the property market (table 6). Importantly, no sustainability requirements were included in these policies, which clearly reflected the government’s reprioritisation. This reprioritisation also meant that anything considered to impact on the volume of supply became opposed by treasury. Consequently, the opposing coalition had more influence, using the narrative that the costs of meeting the target would reduce the rate of housing delivery [SPF&PSC->PMC].

Treasury’s dominance also affected other aspects of the policy mix. Following the target’s previous redefinition to include allowable solutions (abatement fund), this component was appropriated by Treasury, labelling it as a tax and under their mandate [PSC->PMC] (interviews 10,16).

Consequently, throughout this phase, little progress was made towards defining component, as Treasury refused to sign-off on proposals [PSC->PMC] (interview 16).



<i>Policy instrument</i>	<i>Resources available</i>	<i>Beneficiaries</i>	<i>Start date</i>	<i>Revision</i>	<i>End/ termination</i>
Eco-towns	Potential 5 towns of 5,000-20,000 houses	House builders	2007	2007 - Ambition increased to 10 towns. 2009 - Ambition reduced to probable 2. 2010 - £60 million committed to supporting 4 sites. 2010 - Announcement that only one town would be required to be built to the original standards.	2014
Carbon challenge	Funding for medium scale demonstration projects	House Builders	2007	2010 – HCA funding cuts (60%)	2011 (no additional sites awarded)
Tax stamp duty exemption	Exemption from tax stamp duty on	General public	2007	N/A	2011 (31 houses were eligible)
AIMC4	£3.4 million funding awarded (one off)	House builders	2009	N/A	2011
Zero Carbon Hub	£500,000 a year	House builders, Manufacturers	2008	2010 - Funding cut (20%) 2011 - Funding ended (some resources available for specific projects)	2016
<b><i>Other funding for driving housing market (no sustainability requirements)</i></b>					
First Buy	£250 million	General public	2011	N/A	2013
Help to Buy	£15.5 billion	General public	2013	N/A	2016

Table 12 - Funding mechanisms available for zero carbon homes policy mix compared to housing delivery

The target was then subsequently weakened prior to the development of the first zero carbon demonstration [PMC]. This change made it significantly easier to achieve the target, for example it reduced the estimated costs of solar PV needed to develop this demonstration project alone by £2million [PMC->IntE->STC] (ZC Hub 2011). Along with this change, there was also diminishing political commitment to the task force throughout this phase [PMC->IntE] (interviews 1,2,7). In its first meeting under the new government, the CP housing minister proposed changing the terms of the task force (TF 62&65). After which, the CP housing minister stopped attending meetings, and LD junior minister responsible for the building regulations would attend instead [PMC->Inst] (TF6-115).

Whilst LD ministers were supportive and engaged with the target, ultimately CP ministers needed to approve decisions, meaning that overall political commitment wavered [PSC].

Collectively, these policy mix changes signalled by the end of this phase that government was not committed to the target [PMC->IntE] (interviews 1,10,11,15,18). As several house builders began to detect this, they increased opposition by intensifying lobbying efforts [PMC->IntE->STC->SPF] (interviews 1,7). This simultaneously weakened the supportive coalition [-SPF], as those actors who hoped to gain a competitive advantage had less certainty (increasing risk) as the policy mix lost credibility [PMC->IntE->STC->-SPF]. Most notably, this culminated when the 2013 building regulations were delayed by 6 months, and when published only included a marginal increase of 6%, which was lower than any of the values considered throughout the consultation phase [PMC->IntE->STC]. Moreover, the recommendations of the ZCHub to amend regulations to apply to as-built performance, were excluded. The delay, and the outcome of the consultations produced a strong interpretive effect that the government were not committed to the target. It also meant that the amount of abatement needed in the final stage was increased, while the amount of time left before 2016 was reduced [PMC->IntE].

Some individuals within companies remained supportive because they thought it was the right thing to do, but this was in spite of the policy mix and socio-technical configuration, not because of them [SPF] (interviews 1,10). For example, the CEO of Barratt remained supportive as one of the major proponents of the agenda (interviews 1,2), but there was increasing pressure from stakeholders to resist the target (interview 15). By the end of 2013 the supportive coalition was significantly weakened, and resulted in all house builders withdrawing from the supporting coalition [PMC->IntE->STC->SPF], or as expressed by one interviewee: “after 2013 those voices [on the supportive side] started to go quiet” (interview 1).

#### 6.5.4. Phase 4: Dismantling of the zero carbon homes policy mix (2013-2016)

The final phase involved several policy mix changes dismantling the zero carbon homes policy mix, which culminated in the eventual denouncement of the target.

By the end of the previous phase, the Zero Carbon Task Force<sup>33</sup> met less frequently, without the housing minister, and had diminishing influence in the policymaking process. In January 2014, the task force had its final meeting (TF115) [PMC], which removed the formal policy network thereby

---

<sup>33</sup> The Zero Carbon Task Force was the steering group established under the Labour Government in 2007 to help implement the target.

changing the policy process [**InstE**]. By this phase the manufacturing sector was still broadly supportive of the target, but felt increasingly ‘shut-out’ of DCLG<sup>34</sup> (interviews 4,5).

After the abolishment of the task force a number of further changes to instruments and the target itself occurred [**PMC**]. The first of which was proposals to remove the code for sustainable homes (Mark 2014). Next, the Infrastructure Bill published by government June 2014 further revised the target, removing the need for on-site renewables by allowing the abatement fund to offset emissions. With this announcement, a small sites exemption was also announced. This was largely considered as a loop-hole [**IntE**], which would allow developers to avoid compliance with building regulations by phasing sites in rounds of 10 units [**STC**] (Parliament 2014, interviews10,16).

The 2015 general election was won by a conservative majority, changing the policy subsystem [**ExC->PSC**]. While LD ministers had been less influential throughout the previous government, their political support was considered to have kept the target alive, despite being significantly weakened by this point (interviews 1,2,14). In their absence after the election there was no remaining support from within government [**PSC**]. Shortly after the election, the target was denounced [**PMC**]. The announcement came from the treasury, who had already opposed the target throughout the coalition government. Their announcement was made without consulting other departments, highlighting the dominance of the finance ministry by this stage. In a final attempt to maintain the target, UK-GBC sent an open letter to the chancellor asking for the government to reconsider its decision [**PMC->IntE->STC->SPF**]. However, there were no house builders included in the 246 signatories (UK-GBC 2015), and because the announcement was direct from treasury, UK-GBC did not expect the letter to have any impact (interview 1). The government’s decision was also opposed by the House of Lords [**PMC->IntE->STC->SPF**]. The Lords put forward an amendment to reinstate the target but were defeated by a margin of four votes and the target was officially abandoned in 2016.

## 6.6. Discussion

Our analytical framework proposes that in order to be successful, policy mixes need to induce changes in the socio-technical system leading to the creation of self-reinforcing (positive) feedback mechanisms. This is particularly the case for sustainability transitions, which are commonly contested by powerful incumbents (Kern & Howlett, 2009), requiring positive feedback mechanisms to overcome potential negative ones. In the following, we discuss three main insights from our empirical case of relevance for understanding and governing the co-evolutionary dynamics of policy mixes and socio-technical change. First, we reflect on how a potential virtuous cycle can be offset and turn into a

---

<sup>34</sup> The Department of Communities and Local Government is the department responsible for setting the building regulations and the target was under their mandate.

vicious cycle; second, we consider key design limitations which prevented the policy mix from producing more positive feedback; third, we highlight the role of credibility in the co-evolution process. Based on these findings we propose changes to the conceptual framework.

#### *6.6.1. How was a potential virtuous cycle offset and turned into to a vicious cycle?*

We found that a potential virtuous cycle started to emerge in the early phases due to support from some major house-builders, along with the manufacturing and micro renewables sectors. Resource allocation for demonstration projects, combined with the interpretive effects of strong political commitment, expectation of future resource allocation, and potential competitive advantage, attracted support from some large incumbent house-builders. In essence, we find a similar phenomenon to Markard et al. (2016) where incumbents are not homogenous in their beliefs and if such actors view transitions as an opportunity, they are more likely to be supportive.

However, the potential for a virtuous cycle to emerge was partly offset due to adverse effects of the recession on the housebuilding socio-technical system. The market conditions led to large scale job losses and a decline in investment and innovation, and the first medium-scale demonstration project was delayed. The anticipated costs of meeting the target, while in difficult financial conditions, started to generate negative feedback from house-builders. However, resource allocation, perceptions of strong political support, and the sustained expectation of future resources, retained the support of some house-builders, meaning the rising opposition to the target was offset.

A vicious cycle started when resources supporting the mix were removed after the 2010 general election. Innovation declined and very few demonstration projects were built, making the prospects of meeting the target progressively harder. There was little incentive for the previously supportive house-builders to continue to engage in innovation, and there were no resources available to help create positive feedback. Moreover, these changes signalled weakening political commitment, making investments higher risk and undermining perceptions of potential competitive advantage, giving no incentive for further investment.

In the policy feedback literature, it is often argued that once a policy starts to generate positive feedback it can become locked-in and stable, making it harder to change to alternative policy options (Pierson 1993, 2000). However our case indicates that changing exogenous conditions (notably economic) can trigger a response in government (austerity), reducing the resources made available, which can turn previously positive feedback into negative (Oberlander & Weaver, 2015). This highlights how the timing of policy mix implementation, relative to the endogenous and exogenous conditions of the socio-technical system, can drastically affect the prospects of a mix to generate positive feedback (E. Patashnik & Zelizer, 2009).

While some conditions are unexpected and unpredictable, how the government responds to these conditions (more broadly and with regards to the policy mix) can dramatically influence the relative success of policy mixes supporting sustainability transitions. Our case shows that sustained political commitment and continued allocation of resources throughout a recession can help maintain positive feedback, but undermining either of these aspects will likely cause negative backlash (Kemp et al., 2007). Our main recommendations towards withstanding adverse exogenous conditions is to maintain political support in order to: protect the policy mix, incentivise investment and support through sustained long-term resource allocation, and/or improving investor confidence through strong political leadership and commitment to the policy mix's objectives by producing clear and believable resource effects.

#### *6.6.2. What limitations prevented the mix from producing more positive feedback?*

To help understand the impact of the policy mix and its ability to produce positive feedbacks we consider the effects that the policy mix produced and how these influenced the socio-technical system. The resource effects were primarily grant funding for large-scale demonstration projects, and were mostly distributed to the major house-builders who otherwise had little incentive to support the target (Table 6). We suggest that such 'one-off' allocations of resources do not require recipients to protect them as they cannot be withdrawn, in contrast to social policies such as the provision of healthcare providing long term benefits. This implies that resource allocation should have foreseen subsequent rounds of funding to maintain support from beneficiaries. Even though resources which are episodic or of short duration are generally less effective at creating positive feedback than continuous resources (Campbell, 2012), it is still more effective than one-off allocations as seen in this case when subsequent rounds of funding for the eco-towns and the carbon challenge were cancelled. Over time, as beneficiaries make sunk investments (for example in RD&D) their support for the policy is likely to become stronger as they seek to protect their investments. However, in our case the recession happened early on in the process, before any demonstration projects had started, and before there had been significant investment from any of the early beneficiaries. That meant that when the resources available were later cut, the mix had not stimulated strong positive feedback and the incentive to support the target was undermined, making it susceptible to negative feedback.

The way the policymaking process was organised was also a key factor in the case. Our findings highlight how the institutional setting (who was allowed to participate) also affects the potential for the mix to create positive feedback. The sector which stood to benefit most from the target's implementation was the micro-renewables industry. The original requirement for all carbon abatement to be achieved on-site, placed emphasis on micro-renewables. However, the Renewable Energy Association (a trade body representing the micro-renewables industry), was not involved in the Task

Force, despite requesting representation. Their exclusion from the policymaking process meant that their support for the policy mix had little influence. Consequently, it is unsurprising that closer to 2016 the role of micro renewables was first reduced, and then removed from the target in 2014, permitting carbon mitigation to be achieved through the use of an abatement fund, something that the housebuilding industry had lobbied for. This highlights the importance of building the right coalitions to drive policy (Hess 2014, 2015). Similarly, in the later phases the manufacturing sector (the other main beneficiary) felt that they were excluded, and DCLG ceased correspondence. This points to the importance of including a variety of actors (including new entrants) at the negotiation table and points to the limits of an incumbent actors orientated policy approach as taken in the UK (Geels et al. 2017). Moreover, the increments to building fabric efficiency (increased market for components) were implemented through the 2010 and 2013 (very marginal) updates to the building regulations. This reduced the incentive for the energy efficiency component-manufacturers (insulation, windows etc.) to support the target, as the target's final implementation would not have had much (or any) impact on their market.

Another key limitation was the lack of engagement with the general public, the other main beneficiary through potential cost savings on energy bills. However, these are long-term benefits which have low visibility, and due to the relatively low price of energy in the UK, are not particularly significant. More importantly, these potential future benefits never materialised as the target was abandoned. Consequently, it is difficult for the general public to mobilise to protect something that they have not received yet, and for the most part are unaware of. In addition, there is low market demand for zero carbon housing, and energy efficiency of housing is not reflected in property values in the UK (Osmani & O'Reilly, 2009). This raises opposition from house-builders who (claim that they) cannot recover the costs of building to higher regulations. One way of potentially generating support from the public as beneficiaries would be through the provision of social housing. If combined with promoting energy efficiency, then people may mobilise to protect the provision of social housing, rather than for higher sustainability standards. However, provision of social housing seems to be opposed by conservative party ideology, meaning this may only be possible after a change in government.

### 6.6.3. *How are perceptions of policy mix credibility formed and how do these influence socio-technical change?*

In the early stages, the policy mix had some credibility due to strong political commitment, and provision of resources, but a lack of clarity about what was needed to meet the target and an initial period of redefinition of the target caused some inertia. The first reformulation of the target helped improve credibility, and led to a peak of activity in the sector. However, later, when resources were withdrawn and political support diminished, these perceptions of credibility were undermined. We

also consider the previously mentioned limitations (limited and one-off allocation of resources, exclusion of some actors in the policymaking process, and lack of engagement with the general public) to have negatively affected the credibility of the mix over time.

A significant issue with the implementation of the policy mix was how building regulations in the UK are measured and enforced. There are no requirements to evaluate buildings post-construction, and the regulations are based on an ‘as-designed’ specification. The difference between the as-designed and as-built performance of buildings can vary significantly, for various reasons, including components being ‘value-engineered’ during the build-phase, replacing components with cheaper ones which may not perform as well. More importantly, even in instances where the performance of buildings has been found to not meet the required regulations, there has never been a prosecution, fine or any other form of legal consequence for non-compliance with energy efficiency regulations. We argue the lack of a robust enforcement mechanism meant that the regulations carried no consequence, which undermined the credibility of the policy mix as a whole and effectively allowed developers to opt-out of making their product more efficient (Pan & Garmston, 2012).

We also found that feedback mechanisms can influence the credibility of the mix in four ways. First, through the respective strength of the supportive/opposing coalitions (SPF-constituency feedback). If incumbents are supportive of the mix, it makes the prospects of achieving its goal more credible, which may influence other actors to also support the agenda. Conversely, as we saw in our case, as powerful actors stopped supporting the policy mix this undermined credibility, and resulted in a further weakening of the supporting coalition. Second, we suggest that cognitive feedback (SPF) is directly related to credibility of the mix. If specific instruments or the mix as a whole are considered to be ineffective or poorly performing, and these are unaddressed by policy makers, the mix may be considered less credible. Another contributor to the mix’s reduced credibility was policy subsystem change and fiscal feedback. Following the election the treasury dominated the subsystem, who then considered the cost of supporting the policy mix as an unnecessary expense. Treasury cut all resources and reduced autonomy of other actors. As it became apparent to actors that the treasury opposed the target, this undermined the credibility of the mix as a whole. Finally, we consider administrative feedback to influence the credibility of the mix. If widespread perceptions are that the government lacks the capabilities to properly design and implement the mix, it may reduce credibility of the mix and dis-incentivise investment and support.

These considerations suggest credibility is closely related to the occurrence of virtuous or vicious cycles. From our case, progress was initially made when the mix was considered credible, but for various reasons the mix became considered less credible, which only intensified after the vicious cycle started. Based on this we argue that policy makers are well advised to enhance the credibility of the policy mix by providing sufficient and sustained resources, resolving any limitations or

constraining institutions, and through synergistic and systematic policymaking and implementation processes to help improve investor confidence.

#### 6.6.4. *Refinement of the framework*

Based on our empirical analysis, we propose a number of refinements to the framework proposed by Edmondson et al (2018):

First, the framework draws attention to the role and influence of the finance ministry, commonly underplayed or not treated as an important actor with its own interests in most of the transitions literature. The attention to fiscal feedbacks throughout the analysis helped explain the resource cuts that occurred in 2010, and the reluctance to devote any further resources to the mix. However, our application suggests that the current definition of fiscal feedback is too narrow to capture the observed phenomena in full. Currently, it only captures how the costs of supporting a policy mix may raise concerns among powerful actors, notably the finance ministry (following Oberlander & Weaver 2015). In our case, however, opposition to the target from the treasury was not due to direct budget strains, but due to the potential costs on the overall national economy (which the finance ministry was concerned about) and potential backlash, which may affect the government's re-election prospects (Jacobs & Weaver, 2015). Similar phenomena have been observed in the case of both the UK (Smith, Kern, Raven, & Verhees, 2014) and German feed in tariffs for solar PV (Lauber & Jacobsson 2016), where costs of supporting the technology were borne by the bill payer and not the finance ministry. Consequently, we suggest extending the definition of fiscal feedback to consider both the direct costs on government budget, and societal economic costs (current or anticipated) of supporting the mix (which can also raise concerns among powerful actors).<sup>35</sup>

Second, the application of the framework also highlighted a potential expansion of the definition of administrative feedback's influence on policymaking. The finance ministry came to dominate the policy subsystem towards the later phases. This meant that the autonomy of the department previously responsible for policy design and implementation (DCLG) was reduced. Moreover, the changes to the mix in these later stages came direct from the finance ministry, without consulting other departments. However, the current definition of administrative feedback does not capture how the reputation of the government as a whole, and its capabilities, changed. It only narrowly considers the particular government department responsible for implementation (DCLG). Therefore, since the role of this department in the policy process was diminished, it does not capture the phenomenon adequately. Consequently, opinions of actors regarding the capabilities and reputation of the respective government departments (administrative feedback), based on the policy changes occurring later in the timeline, are outside the scope of analysis (because the opinions were traced back to finance ministry,

---

<sup>35</sup> Even if the reduced energy use would offset the initial capital cost in the long term.



not DCLG). We therefore suggest extending the definition of administrative feedback to include all government departments who have a role in the policy mix' evolution. Therefore, in situations where the policy subsystem is dominated by the finance ministry, administrative feedback would relate primarily to the finance ministry (who are making the decisions about changes to the policy mix).

Third, from our empirical application we can also reflect on the proposed interactions of exogenous conditions and the socio-technical system, and its co-evolution with the policy mix over time. Much of the feedback literature commonly only considers exogenous shocks, major events that shift policy makers' attention. Jordan & Matt (2014), expand on these ideas to some extent with their consideration of exogenous conditions and give some examples, but do not propose specific typologies of interaction dynamics. We build on ideas from the transitions literature and our empirical findings to conceptualise mechanisms of interaction. More precisely, we derive direct and indirect interactions occurring within the policy subsystem and the socio-technical system, for each of which we provide examples from the case to illustrate these dynamics (Table 7).

System Level	Direct interaction	Indirect interaction
<b>Policy subsystem</b>	<p>Changes of individuals, and ideologies of actors in the policy subsystem. May be caused by a change in government. Can make certain feedback stronger if it resonates with the ideas of policy makers in the policy subsystem.</p> <p><i>Example: In our case, several changes occurred through the rotation of ministers in certain roles. Also, notably, there was a complete replacement of leading policymaking actors after the general election in 2010, and a partial reshuffle in 2015 (removal of Liberal Democrats). This change of policy actors led to decreased political support as the Conservative government were less interested in taking actions for climate change.</i></p>	<p>Influence from international agreements which place pressure on policymaking actors in the policy subsystem.</p> <p><i>Example: In our case, the EU Buildings Directive helped generate momentum to implement national policies. Later the NZB 2020 target was actually seen to be a constraining factor as the national policy did not match the requirements.</i></p>
<b>Socio-technical system</b>	<p>Changes which influence the endogenous conditions of the socio-technical system may contribute to producing (or changing any existing) feedback. Such conditions may include economic trends changing market conditions, new market actors from outside the system, and innovation from outside the system which can introduce policy options.</p> <p><i>Example: In our case, we observed that a change in the economic conditions of the country led to the generation of negative socio-political feedback, which had previously been mostly positive (or at least neutral). Later, the change of government changed the finance ministry's perceptions of the relative costs of supporting the mix and led to negative fiscal feedback.</i></p>	<p>The influence of exogenous conditions may not result in the formation of new feedback mechanisms, but may affect the endogenous conditions of the socio-technical system in ways that amplifies or constrains existing feedback mechanisms occurring.</p> <p><i>Example: In our case the recession negatively affected market conditions, which gave greater influence of the opposing coalition, and after the change in government (and policy subsystem) the opponents of the policy mix were more influential.</i></p>

Table 13 - Interactions of exogenous conditions with socio-technical system and policy subsystem

## 6.7. Conclusions

In the context of sustainability transitions, several authors have argued that due to the complexity, scale, and urgency of sustainability transitions, analyses should move towards studying multiple policy instruments and their interactions (Rogge et al., 2017). In particular, we follow the call for increased attention to the underlying policymaking processes (Flanagan et al., 2011; Rogge & Reichardt, 2016), offering the first empirical study to combine a consideration of policy processes in an integrated deductive co-evolutionary analysis of policy mix change and socio-technical change. This goes beyond the existing literature by analysing specific mechanisms of how co-evolutionary dynamics play out in practice.

Our paper makes three contributions to the sustainability transitions literature:

First, empirically our study follows a unique case with a very ambitious target being introduced to radically transform the house-building socio-technical system in the UK. Initially, we observed some increasing momentum, but then a vicious cycle set in, slowing progress and raising opponents to the target. Over time the target lost the support of powerful actors in the advocacy coalition. Eventually, the target, vulnerable due to its weakened supportive coalition, was denounced, instigating significant backlash in the transition to a low carbon housing system in the UK. Such cases of failed transitions can help analysts identify important negative dynamics and make policy recommendations of how these could be potentially avoided.

Second, the paper generates novel insights about the role of policy mix credibility, both regarding the factors which influence it and its impact on the socio-technical system. This contributes to the emerging discussion about the role of credibility in policy mixes for sustainability transitions (Rogge & Dutschke, 2018). Credibility was considered as a strong influence in the case, but it was beyond the scope of this paper to explore the role of all policy mix characteristics and their interactions with mechanisms in the framework. We suggest that systematically integrating policy mix characteristics into the framework could be a useful avenue for further work. In particular, the mechanisms of the framework could be used to help explain how certain policy mix characteristics influence socio-technical change, and factors to consider when analysing them.

Finally, conceptually the paper makes a contribution through applying a theoretically derived co-evolutionary framework to an empirical case, and proposing three conceptual refinements on this basis. The first refinement is to extend the definition of fiscal feedback beyond simply budget strains arising from supporting the policy mix, to also consider the societal economic costs (current or anticipated) on the national economy. As a second refinement we widen the definition of

administrative feedback to relate to all government departments responsible for policy making, and the impact this has on the overall perceptions of government capabilities. As a third refinement we more explicitly define interaction mechanisms of exogenous conditions on the socio-technical system. More precisely, we propose that exogenous conditions have direct and indirect influences on the policy subsystem and the socio-technical system.

We would also like to highlight three possible avenues for further work. In our case study we found that implementation of the mix at both the local and national level was of significance. The local level was important though implementation of the CSH in its planning requirements, and the role of local authorities as building control officers. Currently, the framework under-conceptualises vertical interactions between levels of policy mixes (Howlett, Vince, & Del Río, 2017). We suggest that such vertical interactions could be explored in further work. In addition, the analysis also brought attention to the role of coalitions throughout the co-evolution of the policy mix and the housebuilding socio-technical system. In the policy feedback literature such coalitions are captured by interest groups, but a more nuanced view of the role of coalitions could complement the framework. Accordingly, further co-evolutionary work could integrate ideas from the Advocacy Coalition Framework. Finally, it was beyond the scope of this paper to unpack the policymaking process in terms of the difference between design and implementation, which could also be a potential avenue for further work.

We hope the empirical and conceptual contributions made in this paper can assist in the analysis of policymaking processes for sustainability transition policy mixes, by drawing attention to how design choices can influence the socio-technical system, which then generates feedback mechanisms affecting subsequently policymaking.

## Chapter 7. The demise of the UK Zero Carbon Homes policy mix: the role of institutional arrangements

Duncan L. Edmondson

Journal: Energy Research and Social Science

Status: Planned submission October 2019

### Abstract

In 2006, the UK launched an ambitious strategy to radically transform the housebuilding sector. The intention was that by 2016, all new homes would be built to ‘zero-carbon’ standards. Previous work on the Zero Carbon Homes policy mix has pointed to several factors that were considered as constraints towards achieving the target, beyond the design of the specific elements of the policy mix. These issues, including procedural aspects of the policymaking process such as a lack of evidence base used in decision making, are in this paper considered as institutional barriers. The paper draws on institutional literatures and empirical data to develop three heuristic frames for analysing housing policymaking processes in the UK, and then applies these to the specific example of the zero carbon homes policy mix. In doing so, the paper generates insights which help better understand why zero carbon homes had limited impact towards stimulating a transition in the UK house-building sector, and posits reasons which help explain its eventual denouncement. These insights are then linked to wider considerations of policy-mix-making processes including credibility, the susceptibility of policy processes to capture from incumbents, and the ability of policy mixes to generate policy feedback. The findings of the paper also have implications for successive attempts to stimulate transition in the UK housebuilding sector, and highlight that without institutional reform, such attempts will be susceptible to the same constraining factors which ultimately undermined the zero carbon homes policy mix.

## 7.1. Introduction

Improving the efficiency of energy use in buildings has significant potential to contribute to global greenhouse gas (GHG) emission reduction strategies (IEA, 2012). However, currently, there is a lack of progress in reducing emissions across the UK's building stock (CCC, 2016), and housing currently contributes 20% of the UK's CO<sub>2</sub>e emissions (CCC 2018). New buildings make a small, but important contribution to these efforts, which is set to increase over time as more efficient new homes are built. An ambitious policy mix to radically change the house-building sector was introduced in the UK in 2006. The overall aim was that by 2016, all domestic new buildings would be net-zero carbon. This meant that the energy use of the building would be substantially reduced through the use of more sustainable components and new designs, while any remaining emissions would be offset by using on-site renewable generation for electricity and heating (Greenwood, 2012, 2015; Heffernan et al., 2015). Interestingly, the strategy introduced in the UK exceeded any international performance standards at the time by accounting for the emissions associated with household appliances. This was particularly ambitious as the UK was largely considered a laggard in this area when contrasted with the relatively high standards achieved in other Northern European countries (Schweber, Lees, & Torriti, 2015). However, after successive changes reducing the standards needed to achieve the target, and limited success in stimulating a transition, the government finally denounced the Zero Carbon Homes policy mix in 2015.

When considering the potential causes of success or failure, it is “almost impossible to remove the effects of political institutions” (Peters, 2015: 265). In that regard, previous work on the Zero Carbon Homes (ZCH) policy mix has pointed to institutional factors related to the processes of policymaking, rather than simply the design of specific policy instruments, as potential barriers. Greenwood (2012) identifies several conditions considered to have limited the impact of ZCH, including: a lack of evidence base for decision making, decisions being made at a ministerial level; a lack of expertise in the civil service; and lack of incentive to report issues to a minister. Pan and Garmston (2012) also highlight low levels of compliance with building regulations in the UK among house-builders as a potential barrier, and Love et al., (2017) question the validity of the testing and measuring procedures used in order to check/validate compliance. This paper builds on these empirical findings, taking a detailed view of the influence of institutional arrangements on the failure of ZCH.

Processes of structural transformation of embedded societal needs (in this case housing) are the focus of the literature on sustainability transitions (Köhler et al., 2019). Sustainability transitions are “[l]ong-term, multi-dimensional, and fundamental transformation processes through which established socio-technical systems shift to more sustainable modes of production and consumption” (Markard, Raven, & Truffer, 2012). Socio-technical systems are commonly understood as “linkages between

elements necessary to fulfil societal functions” (Geels 2004), including transport, energy generation/use and food provision. A central concept of the transitions literature is that existing socio-technical configurations can be destabilised by: *i*) the emergence of novel, radical, innovations; combined with *ii*) social, political, environmental and/or economic conditions, which place pressure on the old configuration to change, and influence selection preferences/criteria in favour of the novel innovations. A new socio-technical system develops around emerging technologies and practices, and a transition can happen through various pathways (Geels and Schot 2007), including complete displacement of the existing configuration, or through adapting and integrating the emergent configuration while retaining extant structural elements.

Another core idea is that incumbent actors who benefit from the status quo will typically resist change and seek to stabilise the existing configuration (Geels, 2014). Policy action can be used to accelerate and influence the direction of transitions (Kern & Rogge, 2016; Rosenow, Kern, & Rogge, 2017), but is often politically contested, leading to a growing research agenda within sustainability transitions studies towards better understanding the processes of sustainability orientated policymaking (Markard, Suter, et al., 2016; Normann, 2015, 2017). Edmondson, Kern, & Rogge, (2018) conceptualise policy processes while also incorporating the notion of ‘policy mixes’ (Rogge, Kern, & Howlett, 2017), as combinations of policy instruments implemented towards achieving an overall strategy. They develop a co-evolutionary framework to analyse policy-mix-making processes in relation to its dynamic interplay with the rate and direction of sustainability transitions, drawing on insights from policy feedback (Pierson, 1993). However, despite these advances, the role of institutions and their influence over policymaking processes among these contributions remains under-conceptualised (Andrews-Speed, 2016; Lockwood, Kuzemko, Mitchell, & Hoggett, 2017).

Transitions scholars have used institutional concepts like rules, culture or legitimacy in order to account for the embeddedness of actors or the persistence of systems (Geels and Verhees, 2011; Geels, 2004, 2010). This conceptualisation of institutions draws predominantly from the work of Scott (1995), considering institutions as organisational fields (Andrews-Speed, 2016). However, the rich and diverse neo-institutionalist literatures can contribute useful insights to our understanding of policymaking processes in sustainability transitions (Andrews-Speed, 2016; Lockwood et al., 2017). For the conceptualisation of institutions, this paper builds upon Andrews-Speed (2016) and Lockwood et al. (2017), who outline potential contributions that institutional perspectives can provide for understanding policymaking processes. Regarding the conceptualisation of policy-mix-making processes in sustainability transitions, this paper builds upon the Edmondson et al., (2018) socio-technical policy-mix co-evolution (SPC) framework. Combining these literatures, this paper zooms-in on the policy subsystem to consider how policy-mix-making processes are influenced by a given institutional setting in which they take place.

Broadly speaking, the paper combines theory with empirical data about UK policymaking processes to develop three heuristic forms: i) political institutions affecting decision-making through their influence on the policy subsystem, ii) policymaking institutional arrangements within the policy subsystem, and iii) the institutional supports which interact with a policy mix affect its design, implementation and its impact on socio-technical change. The conceptualisation of these heuristics is an attempt to address the research question: *how did institutional arrangements affecting UK housing policymaking contribute to the failure of the zero carbon homes policy mix?*

The remainder of the paper is structured as follows. Section 2 briefly considers how policymaking institutions have typically been defined in the literature on sustainability transitions, before section 3 develops a heuristic to analyse the institutional setting in UK housing policymaking processes. Section 4 applies the heuristic to the case of the ZCH policy mix. Section 5 discusses the main insights in terms of their implications for credibility, capture from incumbents and links to policy feedback; before section 6 finally draws conclusions and makes recommendations for further work.

## 7.2. Policy-mix-making, institutions and sustainability transitions

This section outlines the recent research stream on policy-mix-making processes in the sustainability transitions literature, and insights institutional literature can contribute towards a better conceptualisation.

### 7.2.1. Policy-mix-processes in sustainability transitions

Scholars have argued that the pace of sustainability transitions can be accelerated and directed through targeted policies (Kern & Rogge, 2016), and there has been increasing attention to understanding the processes through which sustainably oriented policies are designed and implemented (Hoppmann et al., 2014). Transition scholars have drawn on various prominent theories of the policy process (Sabatier & Weible, 2014) to help better conceptualise these dynamics (for a review, see Kern & Rogge, 2017). These approaches have typically focussed on single policy instruments and their changes over time. However, increasingly, scholars in the field of sustainability transitions have stressed the need to consider overarching policy mixes (Rogge et al., 2017), consisting of multiple policy instruments implemented towards achieving an overall strategy (Rogge & Reichardt, 2016). Primarily, this is due to the scale, complexity, and urgency of sustainability

transitions, and an acknowledgment that no single policy or ‘silver bullet’ is capable of achieving such systemic transformational change.

Policy mix design implies coordination is needed to meet an overall strategy, necessitating the consideration of interactions, trade-offs and synergies of instruments (Flanagan et al., 2011).

Policymakers are rarely given a blank slate from which to implement new policies, and are typically ‘layered’ alongside numerous pre-existing ones (Howlett & Rayner, 2007, 2013). Previously implemented policies may have produced path-dependant societal and political reconfigurations, making them increasingly difficult to change over time (lock-in) (Pierson, 1993, 2000, 2004). Additionally, the beneficiaries of existing policies may be resistant to change and will seek to influence policymaking outcomes (resultant change or stability of the policy mix as the outcome of policymaking processes occurring within the policy subsystem)<sup>36</sup> in order to protect their interests<sup>37</sup> (Kern & Howlett, 2009; Kern & Smith, 2008). Moreover, as more policies are implemented in a given domain, there is a higher occurrence of unintended consequences as these instruments interact in a changing social and political context (Jordan & Matt, 2014). Consequently, the underlying policy-mix-making processes are more complex than single instrument analyses, and scholars have called for increased attention to processes of policy mix change (Flanagan et al., 2011; Rogge & Reichardt, 2016).

Edmondson, Kern, & Rogge, (2018) focus on policy-mix-making processes, drawing insights from the policy feedback literature (Campbell, 2012; Pierson, 1993). They develop an analytical framework for the co-evolution of policy mixes and socio-technical systems, making two main postulations for conceptualising co-evolutionary interaction dynamics. Firstly, the process of policy-mix-change produces *policy effects*, which influence the rate and direction of socio-technical change by their influence on actor behaviour. Secondly, (often policy-induced) changes within the socio-technical system produce *feedback mechanisms*, affecting the ‘*policy subsystem*’ (the network of actors active in policymaking processes). In doing so, feedback mechanisms influence subsequent rounds of policymaking through actors’ behaviour within the subsystem. Therefore, in line with Flanagan et al., (2011), at the core of these processes is the role and agency of actors, who: *i*) shape policy outcomes by their involvement in processes within the policy subsystem; and *ii*) reconfigure the structural elements of the socio-technical system<sup>38</sup>. However, regarding the first of these considerations, despite being a fundamental presupposition of the co-evolutionary framework, the interactions of actors in processes within the policy subsystem are not explicitly conceptualised.

---

<sup>36</sup> The use of the term ‘policymaking outcome’ is not to be conflated with what Schmidt & Sewerin (2018) call a ‘policy output’, which is better conceptualised as the impact of policymaking outcomes on the reconfiguration of the socio-technical system.

<sup>37</sup> Transition scholars commonly consider this as part of ‘regime resistance’.

<sup>38</sup> No configurations are static and require adaptation over time. Actors who support/benefit from the status quo will seek to prevent more radical reconfiguration and direct change in ways that supports their own interests.



Howlett and Ramesh (2003) define the policy subsystem as “a space where relevant actors discuss policy uses and persuade and bargain in pursuit of their interests”. Feedback mechanisms can help explain the *interests* of policymaking actors, *why* certain groups have incentives to seek change when they do (Jacobs & Weaver, 2015). Regarding *how* these processes unfold, interactions “occur in the context of various institutional arrangements surrounding the policy process, which affect how the actors pursue their interests and ideas and the extent to which their efforts succeed” (Howlett and Ramesh, 2003, pp. 53–54). Edmondson et al., (2018) acknowledge the importance of institutional arrangements, in particular, that institutional reform may be needed for policy mixes to achieve objectives and produce positive feedback mechanisms (Patashnik & Zelizer, 2009). However, the role of institutional arrangements in policymaking processes remains under conceptualised. Given this conceptual gap, the next section turns to institutionalist literatures, drawing insights from Historical Institutionalism (HI) to further develop *how* these processes unfold within the policy subsystem.

### 7.2.2. *Institutions and sustainability transitions*

The main claim of institutionalist approaches is that institutions matter (Weaver & Rockman, 1993). Policy is almost inherently embedded within an institutional framework, making it hard to understand policy without the institutions that produce and reformulate it (Peters, 2012). Neo-institutionalism consists of various approaches which seek to help understand this fundamental claim (March & Olsen, 1984). Functional approaches are concerned with linking individuals to institutions (Thelen, 1999), including sociological institutionalism (Scott, 1995), and rational-choice institutionalism (North, 1992). The key difference between these approaches is their consideration of the individual, where rational choice builds upon game theory and the work of North, and sociological institutionalism argues that decisions are socially constructed (Steinmo, 2008). Historical institutionalism (HI) is considered a structural approach (Peters, 2012), and is primarily focused on explaining dynamics of stability and change within politics and policymaking. Actors are still important, but HI is relatively agnostic when it comes to its model of the individual, which (put simply), is that the choices each individual makes incorporates elements of *both* rational choice and social constructivism, and importantly, these decisions are circumstantial (Immergut, 2006). A fourth, more recent branch is discursive institutionalism (Schmidt, 2008), which is interested in the ways actors frame ideas to shape policy outcomes through discourse, but is less explicit about the institutional setting (structural) in which these processes play out.

There has, to date, been relatively few applications of institutional approaches within the transitions literature. The use of institutions within this literature is primarily concerned with the concept of organisational fields, drawing predominantly on the work of Scott (1995). The first explicit use of

neo-institutionalism (Kern, 2012), combined discursive institutionalism (Schmidt, 2008) with Hajer's (1995) discourse coalitions approach. Recently, however, there has been interest in drawing insights from institutionalist approaches to help better conceptualise politics and policymaking in transitions. Andrews-Speed (2016) reviews neo-institutional approaches with regards to their potential usefulness for transition scholars. Of these approaches, HI is identified as being the approach which best conceptualises power dynamics within policymaking processes. Lockwood, Kuzemko, Mitchell, & Hoggett, (2017) also review the potential insights that HI can offer in more depth, arguing persuasively for the usefulness of HI as complimentary to transitions literatures, and proposing a research agenda working towards better conceptualisation and empirical evaluation of these insights.

Building on the arguments of Lockwood et al. (2017), HI is also considered a particularly promising approach to help further conceptualise politics and policymaking processes in this paper for several reasons. Firstly, it better links public policy to public administration, which are intimately linked yet increasingly divergent disciplines (Peters 2012). Second, HI was developed from ideas regarding 'bringing the state back in' (Evans, Rueschemeyer, & Skocpol, 1988) following the aggressive liberalisation agenda pursued in the 1980s. This resonates with the ideas advocated by many transition scholars, who emphasise the role of the state as a coordinator and the need for strong political leadership to guide transition processes (Johnstone & Newell, 2017). Thirdly, this paper bases its conceptualisation of policy-mix-making processes on Edmondson et al. (2018), who draw heavily from the literature on policy feedback. Policy feedback literature was developed from HI, pioneered by Skocpol (1992) and Pierson (1993), and pays attention to ways in which policy, once enacted, can reconfigure politics. The policy feedback literature has produced multiple insights about the role of feedback on policy change or stability, but as argued by Jacobs & Weaver, (2015) there are limits to policy feedback, and other factors (including institutions) also influence politics and policymaking processes. As observed by Patashnik & Zelizer (2013) "we know what feedback can do—but not as much about when feedback will or won't happen" (Patashnik & Zelizer, 2013: 1075). I argue that feedback and institutional arrangements can be linked more explicitly, and that understanding the role of institutions can help understand how feedback mechanisms are generated (or not), and the influence of these feedbacks on policy outcomes.

### 7.3. Institutional arrangements of UK house building policymaking

This section of the paper develops three heuristic forms of institutional arrangements which help understand the foundations on which new energy efficiency housing policy part of in the UK.

To develop these forms, several forms of data were drawn upon including primary data and secondary. The primary data forms are 18 expert interviews and 118 documents obtained through a freedom of information request made to DCLG for all meeting agendas, minutes, and supplementary material from the Zero Carbon Task Force. Secondary data consisted of archival data, policy documents, media articles, grey literature and debates in the House of Commons and House of Lords.

Interviews were conducted between August and October 2017 (table 1). The participants were selected based on their involvement in, or knowledge of the policymaking process of ZCH. 10 of the interviews were with actors directly involved in the policymaking processes. This means that they were involved in the formal networks of discussion/debate established (Task Force), or were delegates (Hub, BRE). Six of the actors were indirectly involved in policymaking processes, named ‘pressure participants’, meaning that they may have informally contributed to policymaking processes through lobbying (etc.) or through consultation. Finally, 2 interviews were conducted with experts to help validate and corroborate findings.

*Table 14 - Interviewees by actor group, role and affiliation*

Interview	Actor group	Role	Organisation/Affiliation
[1]	Policymaker	Minister	DCLG / Task force
[2]	Policymaker	Civil Servant	Office of the Deputy Prime Minister (ODPM) / Local Area Building Control (LABC) / Zero Carbon Hub
[3]	Policymaker	Civil servant	Carbon Trust / Zero Carbon Hub
[4]	Policymaker	Chairman	Zero Carbon hub / Task Force
[5]	Policymaker	Director	Zero Carbon Hub / Task Force
[6]	Policymaker	Managing Director	Zero Carbon Hub / Task Force
[7]	Policymaker	Technical Manager	Zero Carbon Hub
[8]	Policymaker	Technical Manager	Zero Carbon Hub
[9]	Policymaker	Consultant /Expert	Chartered Institutions of Building Service Engineers (CIBSE) / Zero Carbon Hub
[10]	Policymaker	Technical Manager	Building Research Establishment (BRE)
[11]	Pressure Participant	Industry (Developer)	House Builders Federation (HBF)
[12]	Pressure Participant	Industry (Developer)	House Builders Federation (HBF)
[13]	Pressure Participant	Industry (Manufacturing)	Construction Products Association (CPA)
[14]	Pressure Participant	Industry (Manufacturing)	Association for the Conservation of Energy (ACE)
[15]	Pressure Participant	NGO/Advocacy	UK-Green Building Council
[16]	Pressure Participant	NGO/ Advocacy	E3G
[17]	Expert		
[18]	Expert		

These data sources were used throughout the rest of the paper in both developing the heuristic to evaluate UK housing institutional arrangements affecting the policymaking process, and then when applying these to help explain the failure of ZCH (section 7.4).

### 7.3.1. *Political institutional arrangements*

While *political institutions* originate from outside of the policy subsystem, their influence over the internal processes is profound, and can drastically affect the organisational structure, along with which ideas and interests which are more or less successful in influencing policymaking outcomes (e.g. policy-mix-change). Primarily the political institutions in a given context will shape which ideas and interests are given more precedence. A key consideration here is the role of veto players (Lockwood, Kuzemko, et al., 2017), which are defined as the individual or collective actors whose agreement is a necessary condition for change (Tsebelis, 1995, 2002). For the most part political institutions are relatively stable, but that is not to say that stable political institutions leads to policy stability. To the contrary, some political institutional arrangements significantly change policymaking outcomes and vice-versa (Tsebelis, 1995). Accordingly, institutional change can occur, including changing in the number of veto players (Tsebelis, 2002), but is typically incremental (North, 1990).

There are two forms of veto players, *partisan* and *institutional*.

The role and influence of *partisan veto players* is related to the electoral system in a given setting, and relates to the number of different political parties who can influence (or more importantly block) decision making, therefore making policymaking more consensus driven. Lockwood et al. (2017) argue that Proportional Representation (PR) systems accommodate smaller political parties, and are more likely to result in coalition government. This creates more partisan veto players and gives more influence to groups otherwise marginalised in majoritarian systems, and leads to more stable policy (Lockwood, Kuzemko, et al., 2017). As a *Majoritarian* system the UK is normally considered to have two main parties: Labour and the Conservatives. Consequentially, there are typically no partisan veto players, leading to combative politics (Lockwood et al. 2017).

The number and role of *institutional veto players*, relate to constitutional agreements (Tsebelis, 2002). Primarily, this is concerned with if the political system is presidential vs. parliamentary, and federalist vs. centralised (Lockwood, Kuzemko, et al., 2017).

Policymaking in the UK is *centralised*, set at a national level by government. Implementation is sometimes the responsibility of local authorities, but they generally lack autonomy to design policy independently and are not involved in passing legislation. The UK Government operates under a *parliamentary* system. Government debate occurs in the House of Commons, where all elected

members of parliament (MPs) are represented. UK Government also has a second chamber, the House of Lords. All bills and pieces of legislation must pass through the House of Lords, as well as the House of Commons. However, the Lords are not actually an institutional veto player, as their approval is not needed to pass new legislation (unlike the senate in the US). However, although it is MPs that have the final say, it is in the House of Lords where the Commons' amendments to bills are subjected to scrutiny and debate. Moreover, it would be incorrect to assume that second chambers without veto power do not affect legislation. Tsebelis and Money (1997) have demonstrated that such chambers can influence outcomes, and sometimes can even abort legislation. One example is by suspending legislation just before an election which leads to the termination of bills (Tsebelis, 2002).

The parliamentary arrangement assigns key areas of government policy to various 'Secretaries of State', who make up an overall government 'Cabinet'. The Cabinet are not voted for/elected publicly, instead being appointed by the Prime Minister. This directly affects authoritative decision making within a government department which significantly effects policymaking outcomes. Each government department is (typically)<sup>39</sup> assigned a Secretary of State, who oversees the department and is the key veto player on policy decisions made at the level of the subsystem (fig 10). This is important since if policy change is secondary legislation, decisions can be made within the department (at least officially). Each department is also assigned a number of Ministers of State for specific responsibilities (for example, housing), and a number of junior ministers whose responsibilities are typically split across various different issues. The cabinet system in the UK undergoes fairly frequent re-shuffles (sometimes in response to crises or poor performance in local elections), in which, ministers (especially at the lower levels) are switched to other departments [1]. This procedure of re-shuffling is not often well aligned with ministers' training, background or experience, which can lead to appointments of ministers who have little knowledge (and sometimes interest) of the area in which they are making decisions [1]. The rotation of Ministers throughout the progression of ZCH is represented in fig 9.

*"It's not a particularly sophisticated attempt to match people to their skills and aptitudes or their preferences, particularly not at the lower levels. People just want to be in the ministerial team and if the Prime Minister says 'It's Agriculture' you say 'Yes please', you don't say 'No I only want Education'."*  
[1]

---

<sup>39</sup> Not all departments have a Secretary of State, for example HM Treasury (financial ministry) is headed by the Chancellor of the Exchequer

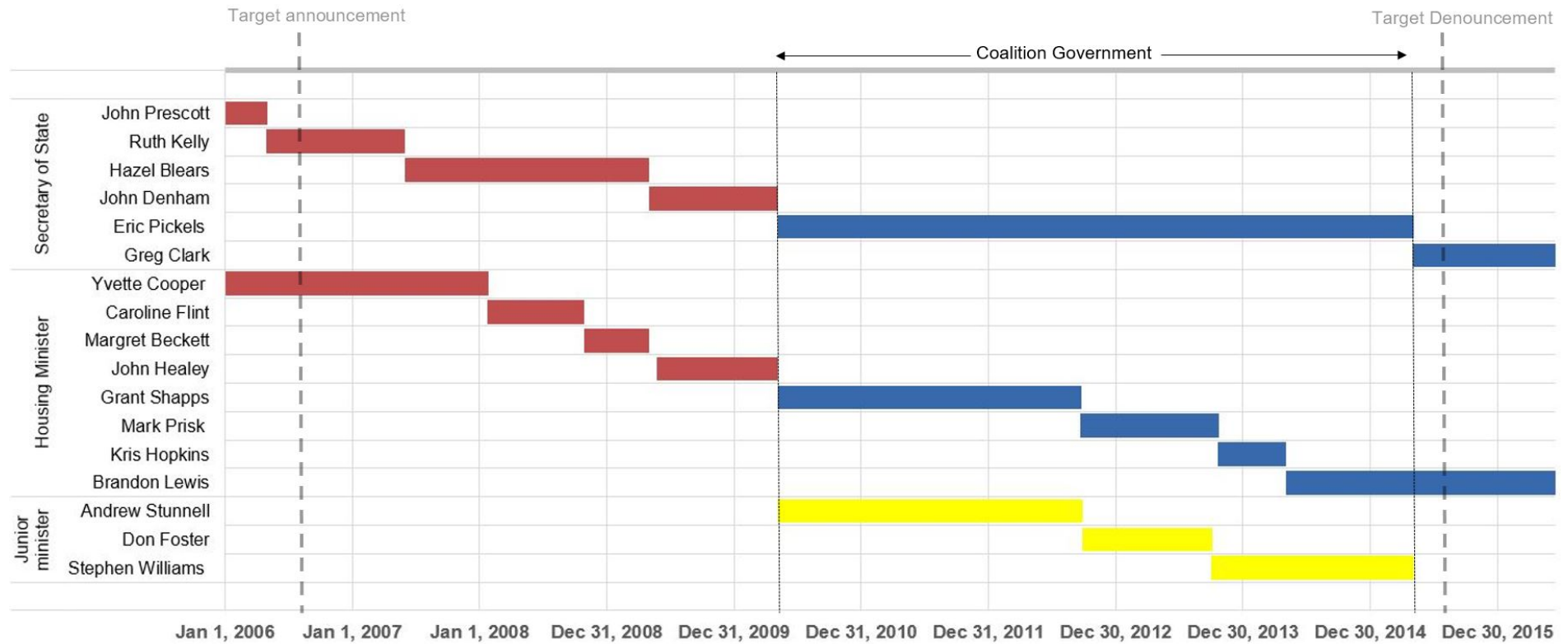


Figure 9 - Rotation of Government Ministers throughout the progression of ZCH

Historically, the Cabinet would make collective, consensus-driven decisions on important new policies. However, since the 1980s, the role of the Cabinet in UK government decision-making has seemingly retracted, leading to less-formalised arrangements among a smaller number of political actors/key veto players (Hennessy, 2005). For example, the ‘new-labour’ government operated under an informal ‘sofa-cabinet’ (Hennessy, 2005). Officially, the Cabinet still operated, but was considered as a ‘rubber-stamping’ process for decisions which had already been made elsewhere (Heffernan, 2011). This style of government more closely resembles a *Presidential* system, but without other institutional veto players involved as with the US (house and senate).

This arrangement somewhat undermines the official structure and procedure of decision-making, and significantly concentrates power to a select few veto players. Moreover, informal decision-making with low visibility, also makes it hard to account what evidence is being used in decision-making. The ‘sofa-cabinet’ came under scrutiny, with regards to the evidence of ‘Weapons of Mass Destruction’ used to justify the UK’s involvement in the Iraq war (Butler Review, 2004). This resulted in some reform back towards the Cabinet Style of Government, re-establishing a number of Cabinet Committees (Hennessy, 2007). However, as will be explored in the next section, the political institutional arrangement during the Coalition Government (2010-2015) are significant for the ZCH policy mix, and its implications will be discussed further in the next section of the paper.

Related to the number and type of veto players, is the presence or absence of credible commitment regarding policymaking processes. Broadly speaking, the fewer the number of veto players in a political system, the greater the power of those veto players to effect policy change. In Majoritarian systems with low/no partisan veto players, and a fairly low, concentrated number of institutional veto players, there is little credibility for long term decision making. The expectation is that in the occurrence of a change in government, the combative nature of majoritarian politics means that the newly elected government is likely to change the existing policies. PR systems tend to give more credibility due to the number of different actors represented in government, meaning that generally once consensus is reached political commitment to a given policy mix tends to be more stable (Lockwood, Kuzemko, et al., 2017).

Overall, the combination of political institutional arrangements in the UK means that power is concentrated, and allows for greater influence of a small number of key veto players (Lockwood, Kuzemko, et al., 2017). Without the involvement of other institutional veto players, or consensus-driven decision-making, radical action and inaction/inertia are both possible depending on if the status quo aligns with the interests of this small, concentrated number of powerful veto players. However, veto players are not the only consideration important for policy change. Hacker (2004), links the concept of veto players to policy change, while also considering what he calls the ‘barriers to internal

policy conversion', the most prevalent aspects of this concept being the discretion of policymakers to enact reforms (how visible the area is) and the strength of the supporting coalitions. With more veto players, policymakers change the policy mix through 'drift' (changing the objectives of policy) or 'conversion' (altering or changing policy mix instruments) in situations of high and low barriers (respectively). Hacker (2004) also proposes that in situations with few veto players but strong supporting coalitions for the status quo, policy reforms are layered on top of the existing ones, but without strong coalitions reform or termination is possible. Linking this concept to the idea of policy feedback would therefore suggest that low numbers of veto players actually makes producing strong positive feedback and constituencies of support if even more important than for arrangements with more veto players.

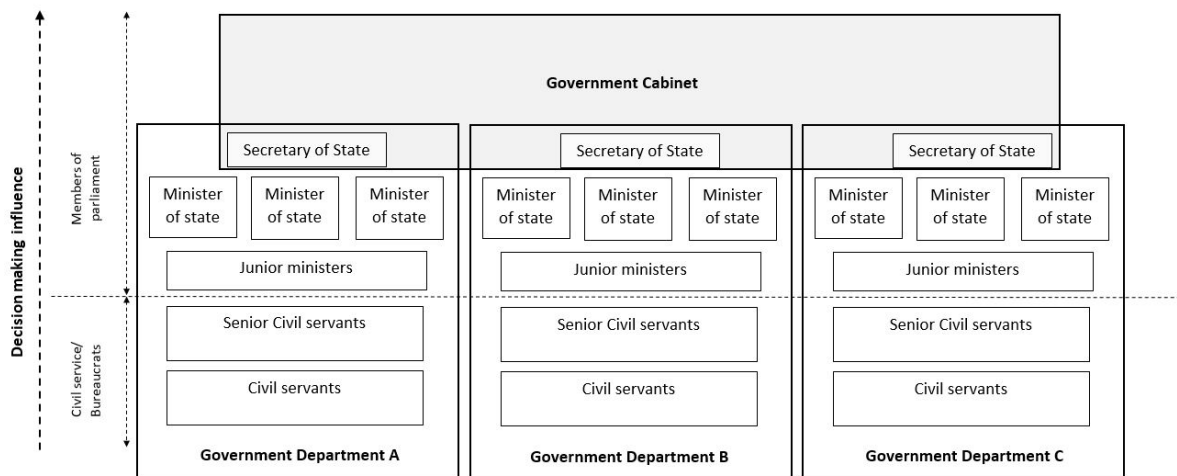


Figure 10 - Example of Government Structure in UK.

### 7.3.2. Policymaking institutional arrangements

*Policymaking institutions* significantly alter dynamics occurring within the policy subsystem, and relate to the organisation of government departments responsible for designing and implementing policy (Lockwood, Mitchell, Hoggetta, & Kuzemkob, 2017).

While political veto players in the subsystem greatly influence the decision-making aspect of policymaking, they generally have less influence over design. More importantly, are the capabilities of governmental departments to effectively design and implement policy (Patashnik & Zelizer, 2009).



This includes technical capabilities, and government's ability to access information, which is important for assessing costs, making strategic choices and long-term agenda setting (Kuzemko, 2016). If government lacks the technical expertise to design and implement policy, it may establish public-private networks to help design and steer policymaking, or it may choose to delegate policymaking responsibilities to non-governmental actors/organisations. In the case of delegation, this may also occur in order to shield it from political contestation, provide more certainty, and reduce risk (Lockwood, Kuzemko, et al., 2017). Delegation has been argued to be a potential tactic to shield policymaking from unstable political conditions caused by Majoritarian systems, by effectively creating new institutional veto players (Lockwood, Kuzemko, et al., 2017).

In the UK, Policy-design is the responsibility of the Civil Service (bureaucracy) working within a government department, where senior civil servants oversee a large number of junior civil servants. There is a culture of high-turnover of staff within the civil service (particularly junior level), which is much higher than other countries (Sasse & Norris, 2019a). The Ministry of Housing, Communities and Local Government (formerly DCLG) lost almost a quarter of its staff in 2018 (Sasse & Norris, 2019b). This is not a recent phenomenon. In 1968, Lord Fulton criticised excessive turnover in a report on the composition of the civil service:

*"It cannot make for the efficient despatch of public business when key men rarely stay in one job longer than two or three years before being moved to some other post, often in a very different area of government activity".<sup>40</sup>*

The highest proportion of turnover occurs in London (Whitehall). With a total of 80,000 roles, employees are constantly looking for a promotion, and transfer to other departments is common practice. According to civil servants "you are always on the lookout for a move" and "I'd been in the department six months so it was time to start looking for something else" (cited in Sasse & Norris, 2019: 11). This workforce model is expensive and inefficient. High turnover adds significant direct costs: recruitment is expensive and time-consuming; and departments invest significant resources in training staff, who then move on quickly. The indirect costs of high turnover are more significant. While some turnover is optimal<sup>41</sup>, excessively high turnover is associated with lower productivity, as staff have insufficient knowledge and expertise about how to do their jobs (Sasse & Norris 2019).

This reduced government capacity has led to a tendency to delegate to non-government actors (for an account of government delegation in the UK energy sector see Kuzemko, 2016), which becomes self-reinforcing as capabilities reduce further and as policy areas become less 'visible'. Most technical

---

<sup>40</sup> Lord Fulton, The Civil Service Vol. 1 Report of the Committee 1966-68, HM Stationery Office, 1968, [www.civilservant.org.uk/library/1968\\_fulton\\_report.html](http://www.civilservant.org.uk/library/1968_fulton_report.html)

<sup>41</sup> Low turnover has been associated with existing staff lacking new ideas or incentives to perform well (Sasse & Norris, 2019b).

energy expertise in the public sector was lost to private companies (Rutledge, 2010), making Government dependent on them for technical capacity, through secondments (Kuzemko, 2016). A similar situation can be observed with regards to buildings. Historically, the Building Research Establishment (BRE) was the UK government owned national laboratory for research in the built environment. However, in 1997, the conservative government privatised BRE. Since privatisation, BRE operates as a charitable organisation funded through commissioned research, its commercial products (such as building standards), and digital tools used in the construction sector [10]. This is what Kuzemko (2016) calls *Marketised* delegation, involving the privatisation of policymaking and/or regulatory processes to independent market based actors. Typically motivated by neo-liberal ideologies, this form of deregulation tends to lead to embedded corporate power in decision making.

Another form of marketised delegation important for buildings/housing in the UK is, the delegated implementation of UK Building regulations. After the introduction of the Building Act in 1984, a body called the Construction Industry Council (CIC) was formed to allow the privatisation of Building Control. This central government organisation regulates Private Building Control and approves inspectors to carry out this role, as well as local councils who had been previously responsible. The first company to gain CIC approval was the National House Building Council (NHBC) in the 1990s. There are now more than 150 companies nationwide who offer Building Control services for residential or commercial properties. Housing developers now have a choice regarding if they choose local council inspectors<sup>42</sup>, or private sector actors. However, due to funding cuts and the option of private building control, capabilities within local authorities have decreased [2,7,8]. Moreover, an important consideration for energy is that (as discussed further in the following subsection) the method of compliance for the energy component is via the Standards Assessment Procedure (SAP) a certification designed by BRE. Consequently, the SAP rating of the building has to be approved by SAP assessor, trained and registered SAP under BRE. An important implication is that local building control officers are not SAP assessors [2], which means that the option for a non-market based actor is not an option for assessment of energy.

*“Building control officers are not SAP assessors, they are separate. Some building control officers will become SAP assessors just out of interest, and some of them moonlight and do SAP assessments for others, but it is separate, and given all the other things that building control officers have to look out for, I guess many are happy that that’s taken out of their... and they say ‘yes, we had this SAP assessment, we looked at it, it seemed to meet all the requirements, and so we don’t need to check that anymore’.”*

Kuzemko (2016) also identifies two further forms of delegation, technocratic and non-deliberative. *Technocratic* delegation is often argued to be appropriate by government when it is simply not

---

<sup>42</sup> Collectively represented by Local Area Building Control.

qualified enough to make effective decisions on policymaking, but as argued by Kuzemko (2016) becomes self-fulfilling and self-reinforcing over time as capabilities are lost within government and certain policy areas become less visible. Finally, *non-deliberate* delegation is the outcome of unequal access to information and resources which leads to the exclusion of some groups while favouring others in decision making processes. All of these forms of delegation are closely related to the idea of capture of policymaking processes by incumbency (Johnstone, Stirling, & Sovacool, 2017), and in line with (Lockwood, Kuzemko, et al., 2017) this paper questions whether certain types of institutional arrangements allow for higher degree of capture. The next section of the paper will look at the policymaking institutional arrangements specifically affecting ZCH, and if these allowed for capture.

### 7.3.3. *Institutional supports*

Policy, in and of itself, is a type of formal institution embedded in wider institutional environment. Policy mixes will interact with a number of other pre-existing institutions, including laws and informal rules (North 1994). This affects how the instruments which make up a policy mix are designed, implemented and enforced. These are the *institutional supports* which interact with the mix, which in general may include: existing laws or the legal system within which policy has to be designed; the interactions with other policy mixes in different domains (Peters, 2015); or what (Williamson, 2000) refers to as being ‘institutions governing transactions’. Failure to pay attention to, or reform, this wider institutional environment may mean that policy mixes are unable to achieve their objectives, or generate positive feedback (Patashnik & Zelizer, 2009).

New policy is often layered on an existing institutional structure, as policymakers rarely start from a blank slate to implement new policy (Howlett, 2014), and some institutions have high internal barriers to change (Hacker, 2004). In the UK, national building regulations were first introduced in 1985, following the Building Act in 1984. This Act allowed subsequent changes to be made as secondary legislation by the relevant government department. Building regulations were first amended to include energy in 1990, introducing ‘Part L - conservation of fuel and power’. This was largely driven by the miner’s strikes in the early 1980s and the 1979 oil crisis, which had caused (macro-political) concerns in government over the scarcity of fuel [2]. In the early 2000s, increased attention to climate change mitigation led to the passing of the Sustainable and Secure Building Act (2004), which introduced sustainability and energy efficiency into the national building regulations for the first time [1,6]. This laid the foundations for how the zero carbon homes target was designed, which was to be implemented through updates to the energy efficiency standards contained in the national building regulations.

By being incorporated into the national regulations, updates to energy efficiency requirements were subject to the pre-existing procedural rules. The process of updating the building regulations in the UK is through consultation, in which draft proposals are released, allowing industry to respond before final publication [1]. The frequency at which these regulations are updated is roughly every three years [1]. Consequently, the zero carbon homes target was designed to be achieved through increments to the building regulations in 2006, 2010, 2013 and finally 2016.

*“The idea of the three years was first introduced maybe 15 years ago ... the industry didn’t want changes every year. It was then agreed that, you’d accumulate any changes you wanted to make and do them, then there’d be 3 years before the next set. But the process of reviewing the regulations and bringing stuff forward isn’t a sudden thing, the deal is that you publish what you intend to do a year before. You, the ministry, the government, publishes what it intends to do and then 6 months later it takes a look at the representations and says we’ve taken a look and this is what we are going to do in a further 6 months.”[1]*

Institutional supports can also exist outside the policy domain and may originate from deeply rooted principles such as common law, and taxation (Patashnik & Zelizer, 2013). Given the difficulties in replacing or terminating these kind of existing institutions arrangements, new policy is typically layered alongside them. Therefore, policymakers should design policy while considering potential interactions with these forms of institutional supports, including the influence of these kind of institutions on actor behaviour (Williamson 2000), and failure to do so may lead to suboptimal outputs.

A key institutional support of this form interacting with building regulations, is the existing planning laws, which have two major implications for housebuilding in the UK. Planning restrictions have a significant impact on house and land prices, and the availability of housing development sites is a highly political issue [6]. Government intervention in the process can create very large distortions in the price of land. Land speculation occurs frequently and can cause major distortions to the price of land, therefore peaks and troughs of land prices have historically been greater than those of house prices [6]. Consequently, the business model of all the major house builders is to hold a land bank on which to build [6]. The relative size of the land bank of the top 5 builders increased from just over 3 years of supply in the 1990s, to 4.4 years by 2006 (Sceptre 2007).

Secondly, the existing planning laws in the UK allow developers to register a site by laying foundations [1,6]. Doing so, locks the requirements for houses built on the site to the regulatory standards at the time of registration [1,6,15]. This strategy is supported by the business model to bank land reserves. As a consequence, there is typically a 2-3 year lag between new regulation coming in and new developments building to those standards [1,6]. Importantly, SMEs do not have land bank

reserves and therefore bear the brunt of the new regulations before the major developers, despite their typically small profit margins.

*“If you’ve got you’re planning permission and Building Regulation approval before the [new] regulations come in then you only have to comply with what was in force when you started.” [1]*

However, not all institutional supports are so deeply embedded, and may be linked to rules and operating procedures about how policy is enforced. An example of this form of institutional support is the capabilities to effectively evaluate policy performance and compliance, and the ability to enforce these. Regulatory policy may be dependent on the measurement tools available for checking compliance. Low technical capabilities, may mean the design of these tools are outsourced, but without government capabilities to make changes, the design of regulatory policy is constrained to the parameters (what is measured) of the compliance procedure. With regards to ZCH, the Standard Assessment Procedure (SAP) was created by the BRE in 1992 as digital tool to assist the design of more efficient buildings. It has since been adopted by government as the method of assessing compliance with the energy component of building regulations in the UK.

#### 7.4. Institutional arrangements contributing to the failure of zero carbon homes

In this section of the paper, the three heuristic frames are applied to policymaking processes leading up to the failure of the zero carbon homes to help understand their role in its eventual denouncement.

The findings in this section were derived from the evaluation of both

##### *7.4.1. Political institutional arrangements*

The key consideration when evaluating political institutions is the role of veto players and their influence on policymaking. In that regard, the most significant impact of political institutions on ZCH is the period of Government under the Coalition government (2010-2015) formed between the Conservative Party (CP) and the Liberal Democrats (LD). Coalitions are rare in UK government, and its formation created a new partisan veto player, which in theory should move toward consensus based decision-making. However, the number of institutional veto players was low under this government. Core decision-making operated under ‘the Quad’, a group at the top of the government consisting of four representatives: the Prime Minister David Cameron (CP), Deputy Prime Minister Nick Clegg (LD), Chancellor of the Exchequer George Osborne (CP), and Chief Secretary to the

Treasury Danny Alexander (LD). This meant that half of this group of key veto players were financial/treasury representatives (Forsyth 2012)<sup>43</sup>.

The key objective of the new formed government was reducing the deficit, as stated in the coalition agreement: “[T]he most urgent task facing this coalition is to tackle our record debts, because without sound finances, none of our ambitions will be deliverable.” (Cabinet Office, 2010). The core ideologies accompanying this ambition was to reduce government spending (austerity) and to de-regulate industries to assist economic recovery. Due to its high involvement within the Quad, Treasury took an active role in all areas of government [2,6]. As well as an aggressive deregulation agenda dubbed ‘cutting the red tape’, Treasury also placed restrictions of government departments introducing new regulation:

*“What they introduced was a one-in, two-out policy. So that if you wanted to introduce new regulations, you had to take two out. Then that changed to one-in, three-out, which is the current policy. I think it’s one of the most stupid bits of government policy ever introduced. If there’s a good case for a new regulation, you should be able to introduce it without having to search the statute book for regulations which are three times the value of the cost you’re incurring on industry.” [2]*

Austerity measures were implanted through funding cuts enacted through the new CP ministers assigned to DCLG, Secretary of State Erik Pickles (CP), and Housing Minister Grant Shapps (CP). The most notable change was to cut the funding to the zero carbon hub, which will be explored in more depth in the following subsection. The other significant change for policymaking processes was to the terms of the Zero Carbon Task Force, a group established under Labour and chaired by the Housing Minister in order to consult with industry representatives and to help steer policymaking towards achieving ZCH. The change of terms was announced by the new Housing Minister at the first meeting under the new government (TF 62), after which he stopped attending (fig 11). Without representation from the Minister, the purpose of the Task Force was undermined and it was disbanded January 2014 [5,6].

Beyond these changes to the policymaking processes, the new secretary of state had little interest in sustainability, or even the building regulations [1]. Throughout the coalition Pickles remained in this senior role, and was widely regarded as an obstacle to achieving the ZCH strategy [1,2,9,15].

---

<sup>43</sup> Forsyth, (2012). Politics: Britain’s new gang of four. <https://www.spectator.co.uk/2012/02/politics-britains-new-gang-of-four/>

*“Secretary of State, Eric Pickles ... suppressed any attempts to do anything innovative or technically challenging, and clearly had absolutely no interest in what we were trying to do. I’m not sure he had any idea what it was about...I think that in terms of removing carbon emissions from the UK buildings stock, Eric Pickles was the biggest disaster to ever hold office. I don’t think the man had the foggiest idea, I’m not even sure if he understood the implications of climate change.”[9]*

Responsibilities for the building regulations were delegated to LD junior minister Andrew Stunnell, who as a trained architect was interested in building sustainability and had technical capabilities that many other government ministers did not [5,6,9,15].

*“When I was appointed, the first day I went in and met Eric and he said ‘We need a discussion about areas of responsibility’ and I said, ‘Do you know who’s going to be doing Building Regulations?’ and he said ‘What are they?’” [1]*

However, as a junior minister his responsibilities were split among several areas, *“maybe that was a day a week of what I was doing” [1]*, which combined with relatively low influence in decision making (despite a keen interest in achieving ZCH), meant his impact on policymaking was limited [2].

Meeting No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Date	31/0 1/07	15/0 5/07	13/0 6/07	24/1 0/07	18/1 2/07	11/0 3/08	05/0 6/08	21/1 0/08	27/0 1/09	29/0 4/09	11/0 6/09	21/1 0/09	27/0 1/10	02/1 1/10	16/0 3/11	06/0 6/11	13/0 9/11	15/1 1/11	14/0 2/12	29/0 5/12	25/0 6/13	05/0 9/13	14/0 1/14
<b>Housing minister (DCLG)</b>																							
Yvette Cooper																							
Caroline Flint																							
Margret Beckett																							
John Healey																							
Grant Shapps																							
<b>Parliamentary Under-Secretary of State (DCLG)</b>																							
Andrew Stunnell																							
Don Foster																							
Stephen Williams																							

■ Labour Party   
 ■ Conservative Party   
 ■ Liberal Democrats

Figure 11 - Attendance of Housing Ministers to meetings of the Zero Carbon Task Force



*“DECC was greener than DCLG most of the time because it had a Secretary of State wanting to deliver, whereas in my case I had one who was prepared to indulge me but for whom it was completely irrelevant.” [1]*

It soon became clear that while engagement with the LD ministers was good, getting the Secretary of State or Treasury to sign-off on decisions was difficult [6,15].

*“You had internal struggles within DCLG itself... DECC was rather uninfluential... the treasury was somewhat anti-red tape... you [were] sort of picking and choosing allies within government, and it was clear from then that it was going to be more of a struggle.” [15].*

The other, and perhaps most important change to policymaking processes that occurred was the increased influence of Treasury over decisions normally made within the department [1,2,6]. The construction sector was seen as a major contributor to economic recovery. In particular, housing supply/delivery was a main priority, in attempt to alleviate the ongoing housing crisis [1,2]. The housing industry was able to lobby treasury to revoke the target using the argument that increased costs associated with higher energy requirements of buildings would further reduce the rate of supply.

*“[HBF] has regular meetings with the treasury, because delivery of houses is very high on the government agenda ... Housing is very important, HBF is seen as (as indeed they are) the representatives of the major home builders. Since 2010, the HBF has become more powerful. Because of the change in government...Between 2010 and 2015, if the HBF had said to George Osborne that ‘we don’t want DCLG doing this’, they wouldn’t have done it.” [2]*

The changes occurring within the coalition government reflects the principles of policy ‘drift’ and ‘conversion’, as argued by Hacker (2004). Environmental policy became a source of contention between the coalition members, with Cameron famously announcing to “cut all the green crap” (Carter & Clements, 2015). Clearly, the CP wanted to terminate the target, but due to the LD partisan veto player, for whom ZCH was a totemic policy, they had to employ other forms of retrenchment (E. M. Patashnik, 2008). In addition to the *conversion* of policymaking institutions (Task Force and Hub), CP also used *drift* through the re-definition of the requirements of the target. This was enabled by concentration of veto powers to treasury under grounds of deficit reduction.

*“So what happened is that the God within the coalition was treasury, so every decision that we [were] making in the Zero Carbon Hub, DCLG and DECC had to be fed into treasury for approval so that’s why [announcements] started coming through there”. [6]*

By 2014, government proposed an exemption from the ZCH standard for ‘small sites’. This was contested in the House of Lords, who highlighted that government’s the term ‘small sites’ was

undefined and could act as a loophole, where phased development of larger sites could avoid regulation (Parliament 2014)<sup>44</sup>. Irrespectively, in March 2015 the government published its response to the consultation, confirming that sites of 10 units or less would be exempt.

Based on the extent of retrenchment occurring within the coalition, it is unsurprising that just one month after the 2015 general election, and CP gained a 12 seat majority, the target was denounced. HM treasury released “Fixing the foundations: creating a more prosperous nation”, which included plans to abandon the ZCH target and the energy efficiency standards in the 2016 building regulations. This came direct from Treasury, without having consulted with any other department [2,3,6,15]. This highlights how the decision-making processes become concentrated to a key veto player (treasury), and without the partisan veto player they could terminate the policy. The more radical reforms made in the later stages, including government’s proposals introduce a small sites exception, and then to remove the target in the Housing and Planning Bill 2015, were opposed in the House of Lords. However, without veto powers, government were able to defeated these amendment

#### *7.4.2. Policymaking institutional arrangements*

As already explained while developing the heuristic in the previous section, the UK has low government capacities, and outsources the design and enforcement of building regulations. This section will explain how these aspects acted as significant barriers to achieving ZCH. In addition, it will consider the formation of two additional groups the ‘Zero Carbon Task Force’ and the ‘Zero Carbon Hub’, specifically intended to assist in the delivery of ZCH and how the changes made to these groups contributed to the eventual failure of ZCH. The interaction of different organisations involved in the policymaking processes of ZCH is represented in fig 13.

##### *7.4.2.1. Enforcement/compliance of regulation*

The marketised delegation of both: i) designing and updating the tools for compliance (SAP), and ii) the enforcement of building regulations has, together, had significant implications for the prospects of achieving serious transformative change in the building sector in the UK. Privatisation of building control has led to a situation where the inspected party is also the client. Consequently, inspectors who have a reputation for being strict do not get repeat work [10]. As it is a competitive market, there

---

<sup>44</sup> Infrastructure Bill [Lords]. 08 December 2014. Volume 589. [https://hansard.parliament.uk/Commons/2014-12-08/debates/14120810000001/InfrastructureBill\(Lords\)#contribution-14120836000033](https://hansard.parliament.uk/Commons/2014-12-08/debates/14120810000001/InfrastructureBill(Lords)#contribution-14120836000033)

is now a situation where inspectors need to look for ‘creative solutions’, ways of interpreting regulations to make them easier to attain for the client [10]. As a consequence, even if buildings have a specific SAP or CSH rating, the evaluation method has commonly been manipulated to achieve compliance while doing as little as possible [10].

*“Running a team of Code Assessors, you start to see... if you’re a developer and you come to me and appoint me to be your Code Assessor... if I’m the most strict Code Assessor who’s really committed to sustainability and really committed to doing it right, I won’t get any more work from you. Whether it’s the Code or Building Regulations, an inspector who’s being paid by the person he’s inspecting, if he wants more work, needs to find ways to interpret the requirement to make it easier for the developer. I’m not saying everyone just turns a blind eye, but it makes it a hell of a lot easier for the contractor or the developer to do what they want if they’ve got someone who’s creatively thinking ‘oh, if you look at it from that angle then it actually could comply’. It takes the spirit of the requirement and it dilutes it... you end up with lots of different parties involved, [and] no-one with overall responsibility [and] no-one really checking the checkers even though they are being paid by the client... We need to have a really robust independent inspection regime otherwise contractors who are driven purely by profit will do the least they can do to get past the requirement... it’s a race to the bottom.”[10]*

#### 7.4.2.2.Task force

The previous section has already discussed how toward the eventual abandonment of ZCH, the role of the task force was downplayed as decision making became more concentrated to fewer and fewer veto players, and how after the change in government the lack of involvement of the housing minister practically made the group obsolete. What is of interest here is prior to the coalition government, when the group was more influential, and its influence in the policymaking process.

Evaluating the participants at these meetings, reveals the participation of different stakeholders in proportion to the number of representatives for each respective organisation. The number of representatives by organisation for all the meetings of the task force are represented visually in fig 14. From this, we can see that there is relatively small representation of the renewables industry. Importantly, despite the target having a significant portion of on-site abatement (micro-renewables), representation from the micro-renewables industry is very low. Moreover, the Renewable Energy Association, the trade body representing this sector, wrote a letter to the task force requesting

representation at the meetings (fig 12). However, reviewing the participants at later meetings (fig xx), despite this request, they remained excluded.

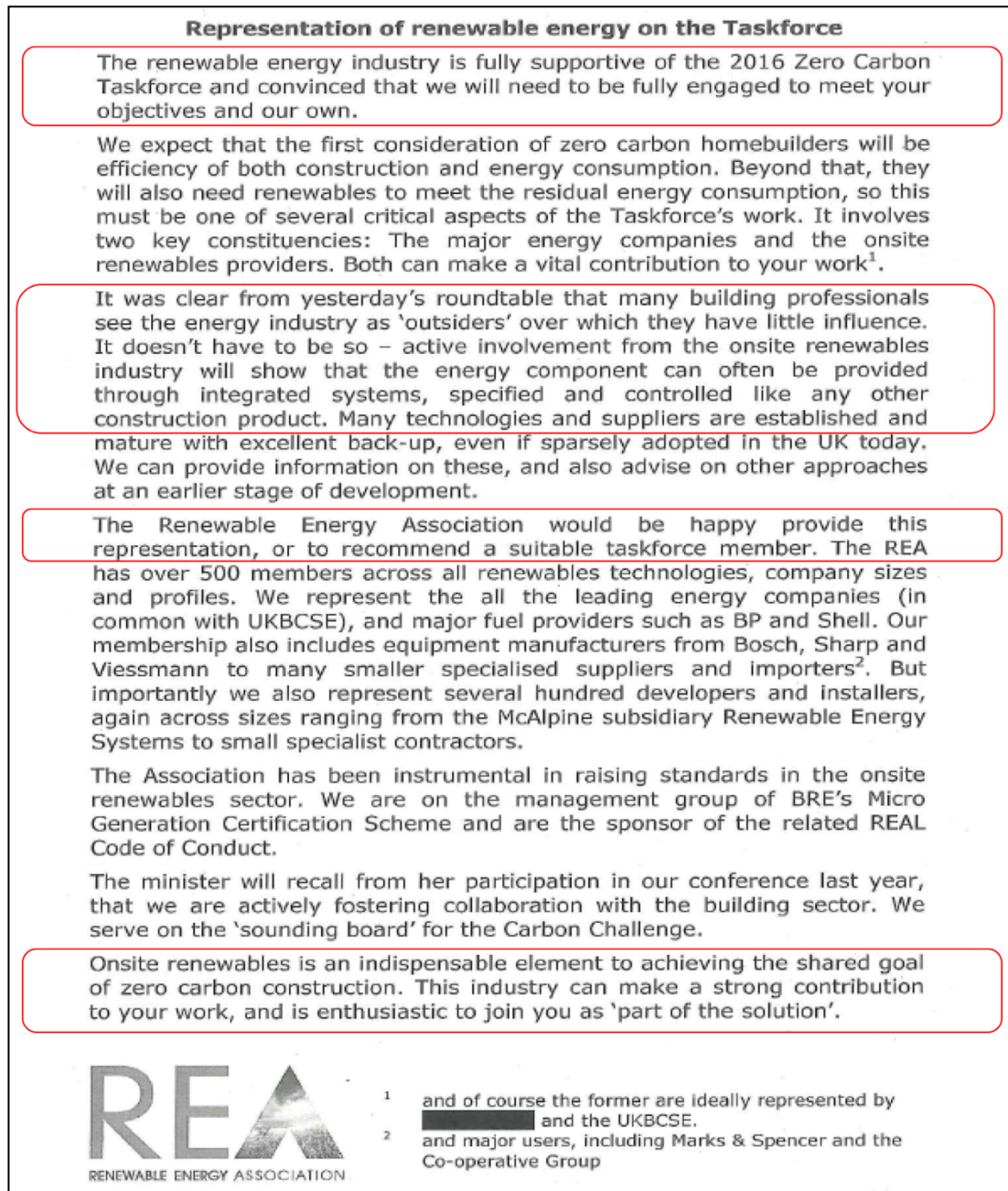


Figure 12 - Letter from the Renewable Energy Association to the Zero Carbon Task Force. (Emphasis added)

One group that was well represented at these meetings was the UK Business Council for Sustainable Energy (UKBCSE). Importantly, this (now dissolved) trade body represented large-scale renewable energy (such as offshore wind) and natural gas, and its members were made up of the major energy utilities in the UK. Given the high involvement of this sector, and practically no representation from the micro-renewables industry. Somewhat unsurprisingly, at the early meetings of the task force, members lobbied for the incorporation of 'off-site solutions' (TF 21). This was later included in a redefined version of the target, called 'allowable solutions', and was originally framed as an option



By labelling the allowable solutions component as a tax they were able to effectively remove autonomy from DCLG to make changes to the 2013 update to the regulations, which were ultimately delayed and then significantly watered-down.

*“When I left office, which was September 2012, we had [the draft 2013 regulations] ready to go for [consultation] October and it didn’t happen” [1]*

Moreover, at the same time as introducing the small sites exemption, the target was redefined again, making allowable solutions method of achieving carbon abatement for electricity generation, excluding the use of micro-renewables altogether. Interestingly, the use of allowable solutions was actually given as a reason for the denouncement of the target, claiming it did not incentivise innovation in a select committee enquiry into the treasury’s actions in 2016.

	31/01 /07	15/05 /07	13/06 /07	24/10 /07	18/12 /07	11/03 /08	05/06 /08	21/10 /08	27/01 /09	29/04/ 09	11/06 /09	21/10 /09	27/01 /10	02/11 /10	16/03 /11	06/06 /11	13/09 /11	15/11 /11	14/02 /12	29/05 /12	25/06 /13	05/09 /13	14/01 /14
DCLG																							
HBF																							
ZC Hub																							
CPA																							
NHBC																							
UK-GBC																							
DECC																							
EST																							
LGA																							
TCPA																							
UK-BCSE																							
HCA																							
WWF																							
DTI																							
CR																							
CT																							
EEPH																							
MGICG																							
RAB																							
Defra																							

Number of representatives:  5  4  3  2  1  0

1. DCLG Department of communities and Local Government
2. HBF House Builders Federation
3. ZC Hub Zero Carbon Hub
4. CPA Construction Products Association
5. NHBC National House Builders Council
6. UK-GBC UK Green Building Council
7. DECC Department of Energy and Climate Change
8. EST Energy Saving Trust
9. LGA Local Government Association
10. TCPA Town and Country Planning Association

11. UK-BCSE UK Business Council for Sustainable Energy
12. HCA Homes and Communities Agency
13. WWF World Wildlife Fund
14. DTI Department of Trade and Industry
15. CR Callcutt Review
16. CT Carbon trust
17. EEPH Energy Efficiency Partnership for Homes
18. MGICG Microgeneration industry contact group
19. RAB Renewables advisory board
20. Defra (Department of Environment, Food and Rural Affairs)

Figure 14 - Attendees of all meetings of the Zero Carbon Task Force

#### 7.4.2.3. Zero Carbon Hub

Another important aspect of the policymaking process was the role of the Zero Carbon Hub, as a means of assisting with the delivery of the target. When first launched it was public-private partnership, co-funded by government and industry. Various aspects of the industry were represented, and it was generally considered as a positive step forward towards achieving the target [2,3,4,5,6,7,8, 15]. Given the low capabilities of government, this can be considered as a form of expansion of state capacities. The Hub reported directly to the task force, but did have the autonomy to spend its funding (total £1.6 million) on research projects [7,8]. The Hub ran a series of working groups inviting participation from across industry and had representatives from DCLG and DECC. While *“the input from government wasn’t brilliant because it didn’t actually have the technical expertise to get involved in all the consultations.”* [15], engagement with government was good [7]. Through participation in the working groups *“they were able to hear to the discussions about pros and cons”* [8] and in addition, Hub members would present reports directly to DCLG officials [7,8]. However, the two most senior positions within the Hub were appointed to actors from the housebuilding industry and NHBC, the major/main insurance provider in the housing sector, which indicates a degree of capture from incumbency in another aspect of the policymaking process.

The withdrawal of funding for the ZC Hub, was announced by the Housing Minister in 2010 [6]. This action sent a signal of intent (or rather lack of) for the delivery of ZCH [3].

*“Okay, so government... you no longer have a vehicle to help you deliver this policy? All that’s going to happen is we’re going to treat you as undesirable [because], you’re not going to be working with us. So they lost the whole vehicle to potentially take this forward.”* [6].

Funding for the continued operation of the Hub was picked up by NHBC, but that did not cover the costs of research projects.

*“NHBC were major funders of the organization but not much of that money ever went into a project. That was just the running costs of the Hub, mostly my salary. About half a million pounds a year they put in typically.”* [6]

Some funding was later made available from government, but these were commissioned for specific areas, such as overheating and the performance gap [6,7,8]. This marked a change in the operating procedures of the Hub, which no longer had the autonomy to launch its own research programs [8].



### 7.4.3. Institutional arrangements

In section 7.3.3., the institutional supports in the UK housebuilding sector were introduced, primarily i) the interaction of the planning laws with the implementation of the building regulations, and ii) the procedure for updating regulations (consultations). This section will explain how these institutional supports acted as barriers towards achieving more radical change in the building industry.

#### 7.4.3.1. Planning laws

Combined with the intervals at which the building regulations were planned to be updated, the 2-3 year lag it takes for new development to be built to new standards meant that by the time of consulting for the next round of updates, there was no evidence of the previous regulations working or of the costs incurred by building to them [1,2]. While this had always been the situation, it became more significant as the level of lobbying against the target increased from the house builders, in part due to recession. The overall lack of evidence made it easier for influential house-builders to exaggerate the costs of meeting the target, even though they had not actually started to build to these regulations, making their arguments about costs unsubstantiated.

*“Of course, it’s true there was practically no evidence of any cost or anything else from 2010 being available when you’re deciding what happens in 2013.” [1]*

This issue was highlighted by industry actors to DCLG, acknowledging it to be a barrier to both quicker progress and more importantly, evidence-based policymaking [1,4,5,6]. However, efforts to reform this constraining institutional support was unsuccessful, due to its highly embedded nature within UK common law [1].

*“There were people, including in the Green industry, saying we should make it so that if you had got permission already was irrelevant, and when the [new] regulation came in you should [have to comply with it], but that would be a completely new legal principle in UK law... So people were asking for something which was fundamentally undeliverable, certainly not something for [DCLG]. You’d need the Department of Justice, I expect the Human Rights Act would come into it, it would be a nightmare. I don’t think that point got through to people, the way it works.” [1]*

#### 7.4.3.2. SAP / design of building regulations

The other main institutional support which was, and remains to be, a significant barrier towards transition in the building sector, is the use of SAP as the main compliance method, and the implications its use has for the design of the energy component (Part L1A) of building regulations. The most significant of which, is that Part L1A is based off the ‘as-designed’ performance of buildings, not the ‘as-built’ performance. What this means is that in order to meet Part L1A requirements, it is only a necessary attain a SAP rating based on the architect’s *design* for the building [2,6,7,8,]. It essentially means that there is no testing or enforcement of regulations based on how the actual building is constructed. This has led to a tendency for buildings to be value-engineered in the build phase, with the replacement of parts with cheaper, lower-quality ones, meaning the final building quality does not meet its design specification [4,5,6,11]. To compound this matter, there are no practical testing procedures in place<sup>45</sup> to assess the final performance of buildings [2]. Perhaps most detrimental, is that there is in fact no legal obligations to do so [2]. The responsibility of building control ends with the construction of the building, meaning that even in cases of non-compliance with the regulations, they have no powers to intervene [2]. Consequently, to date, there has never been any prosecutions or legal repercussions for issues of known non-compliance with energy regulations [2].

*“Building control’s job ends when the building is complete. And you may not discover that your building is using twice the amount of energy than is expected until it has been running for some time. So legally, building control has no responsibility, and indeed no powers to intervene after that. And it may be a defect of the system, that there’s no-one responsible.”*

The Zero Carbon Hub made recommendations to reform the building regulations in the consultation phase of the 2013 update to the building regulations [7]. This was supported by a project they had conducted on the ‘performance gap’ of buildings, relating to the difference of what the design specifications were, and the actual performance. These proposals were strongly opposed by the house-builders, and were subsequently excluded when the 2013 update was published [8].

*“In the Performance Gap group that we were running, there were lots of conversations about the need for end of line tests, but obviously the developers were extremely pushing back on that, so we never explicitly really made the recommendations because they would not buy into that part of it.” [8]*

---

<sup>45</sup> The co-heating test is the most accurate way of measuring energy performance in buildings but even in cases where this has been used it has been found that results was been tampered with by builder by, for instance putting masking tape around window frames to feign better air tightness (Love et al., 2017).

#### 7.4.4. Overall assessment

While each of the forms of institutional arrangement revealed issues which acted as constraining factors in the delivery of ZCH, the procedural rules related to the enforcement of energy performance of buildings in the UK is perhaps the biggest issue of all other institutional factors identified in this paper. This contributes to an overall lack of credibility for Part L1A, and raises serious questions regarding the actual impact that the ZCH target would have had on the housebuilding sector, even if it had been implemented in full in 2016. This calls for serious reform of the way in which regulations are designed, implemented and enforced.

I will end this assessment with a several statements from interview participants which corroborate this point.

*“I certainly think that the Building Control side of things is failing at the moment, in terms of [energy efficiency]. They are more interested in if it going to fall down, is there a fire risk that sort of thing. The energy side is really, really low on their agenda. Non-compliance with Part L type issues, are much less likely to be pointed out and are much less likely to be amended on site. And there’s no end of line test seeing ‘how have you done’. There’s no mechanism for the builder to be caught out in that respect.” [8]*

*“Nothing’s going to change until they change the system and make the housebuilder accountable for performance. You can’t rely on what that product manufacturers said about their product as it operated in the book under standard conditions, etc., etc., and assume by putting all those components together in a muddy field it’s going to perform as you expected it to. Only if you shift accountability to performance to the people who are handing over those homes would you change that system.” [5]*

*It’s hardly surprising that people either deliberately or un-deliberately don’t adhere to the regulations to the letter of the law, because they know they are not going to be policed. They know they are not going to lose their job, they know they are not going to be taken to court over certainly the energy regulations and therefore they are just not interpreted very well or implemented very well as a result of all of those things.’ [17]*

*“No prosecutions, so the enforcement has been, I would think, a disappointment in that respect. I think it reflects how important building control officers view the various elements of building regulations. They know it’s far more serious, in terms of hitting headlines, if a housing development starts shifting because of subsidence or because the foundations have not been deep enough. There is a concern there that in the working day of the building control*

*officer which he or she is under a lot of pressure anyway, it takes quite a courageous one to actually say stop work if you've not got your SAP rating. They can probably find agreement with the site manager if the foundations aren't right but the SAP ratings? 'You've got to be joking'. [3]*

*"There was always a point in this debate which was about, it's all very well you know, ramping up the level of [regulations] but actually if no-one's delivering on them and nobody's checking, you know... who are we kidding?" [5].*

## 7.5. Discussion

The claim of institutional literatures is that institutions matter. This paper demonstrated institutional arrangements affecting the policymaking processes of ZCH, ultimately contributing to its failure. This section discussed the wider implications of these findings with regards to three aspects. First, by discussing the influence of institutional arrangement on policy mix credibility. Second, it considers how certain institutional arrangements may lead to a higher susceptibility of capture of policymaking processes from incumbents. Finally, the discussion considers how institutional arrangements may link to policy feedback.

### *7.5.1. How did Institutional arrangements affect policy mix credibility?*

Policy mix literature normally considers credibility as the extent to which the mix is believable and reliable (Rogge & Reichardt, 2016), however, in this part of the discussion I argue that credibility is not only related to the mix itself, but the institutional arrangements that produce it and interact with it.

The link between macro-political institutions and credibility is already established (see Lockwood *et al.*, 2017). To summarise this argument, less stability at the political level makes long-term credible commitments more difficult to achieve. This means that systems with fewer numbers of veto players have more difficulty in creating credible commitment, as there is an expectation that a change in government may change/overturn these. Therefore, certain constitutional arrangements make credibility harder, but one strategy to overcome this involves delegating decision-making to a non-political actor/organisation (Kuzemko, 2016), which is a strategy of creating more veto players (Lockwood, Kuzemko, et al., 2017).

In the case, decision-making was never delegated, just the design of the policy mix, in terms of (re)defining the target and the design of the CSH. This meant the role of veto players was always

prevalent and consequently, the credibility of the ZCH policy mix was always questionable. This was reinforced, as right from the time of the announcement of ZCH there was tensions between the Labour Party, accompanied by a general loss of public support for the party. However, support from the other political parties helped maintain credibility for the target, along with the establishment of the climate change act and the CCC. However, it soon became apparent after the 2010 election that the new government were not committed to the target, as demonstrated by a number of changes to the policy mix and the policy subsystem shortly after the 2010 general election.

This raises another consideration, in that the actions and placement of veto players within the subsystem will have implications for policy mix credibility. It became apparent that the (CP) Secretary of State and Housing Minister assigned to DCLG had little interest in achieving the target, which was interpreted this as a negative signal regarding credibility. A related consideration is the capabilities of government, the extent to which roles are delegated, and access to information to make informed strategic decisions. All of these aspects are related to the idea of capture of policymaking processes from incumbent actors, which will be elaborated in the following subsection. For now, it will suffice to say that higher levels of capture from incumbents will negatively affect perceptions of credibility of the policy mix.

The final consideration from the case linked to credibility, is that of the compliance and enforcement procedures in the UK for energy efficiency. As explained in the case study above, the institutional supports means that there is no requirement to test the performance of the building for energy efficiency, and even in cases of know non-compliance there has been no legal repercussions. This undermines the credibility of the national building regulations with regards to energy efficiency, as a whole which is arguably a serious barrier to achieving a transition in the UK housing sector.

#### *7.5.2. How did the institutional arrangements facilitate capture from incumbents?*

Transitions can be considered as period of instability within a socio-technical system. Capture from incumbents is important in policymaking processes because it relates to the stability of the policy subsystem, and its ability to maintain the status quo. Transitional policy mixes intend to change the status quo, effectively destabilising the policy subsystem. Therefore, in circumstances of high degrees of capture from incumbent actors, there is a greater ability to resist change by re-stabilising the policy subsystem. In this sub-section, drawing on insights from the case, I suggest ways in which the institutional arrangements of the policy making process allow for greater degrees of capture from incumbents. To do so, the discussion draws on and adapts strategies which incumbents use in order to maintain the status quo developed by Johnstone et al. (2017) and links these to institutional arrangements.

The analysis found that all three forms of institutional arrangements led to a greater degree of capture. The most straightforward and direct strategy capture is the ability of incumbents to dominate processes within the policy subsystem by placement of actors in key strategic positions. This link is already captured by Lockwood et al. (2017), and put simply, is that low capabilities within government leads to delegation, making it easier for incumbent actors to influence policy design and decision making. We can see evidence of this within the case through the high involvement of housebuilders in the Task Force, compared to the relatively low involvement of the renewables industry. Another example is the placement of incumbent actors in the most senior roles within the Zero Carbon Hub, which was amplified when funding was taken up by NHBC.

The case also highlights two additional forms of capture. These are linked to the direct influence incumbent actors have in policymaking processes (above), but can be considered as indirect methods of capture, which importantly, may allow incumbent actors to override formal policymaking procedures altogether by appealing to the interests of key veto players through informal lobbying.

One strategy that incumbents can use to re-stabilise the status quo is to link the policy discourse to a salient political issue (Johnstone et al., 2017). In this case, housebuilders were able to link increasing regulation to reduced rates of housing delivery, which conflicted with the macro-political objective of economic recovery (volume of supply and the housing crisis). This argument was very influential with the financial ministry, who had significant influence over the policymaking process at the time due to the macro-political institutions (primarily a small number of concentrated veto players), and was able to significantly intervene in policymaking processes, leading to the eventual abandonment of the ZCH policy mix.

In this case we can see that this was also combined with another strategy of incumbency, to mask the costs of achieving the aims of the sustainability transition (Johnstone et al., 2017). This was enabled by the lack of evidence regarding the costs of achieving the target, due to several institutional arrangements. The first is that the low state capacities means that government does not have the technical capabilities to assess the costs, leading to delegation to the private sector, in and of itself allowing a higher degree of capture. It also is to do with the fact that industry do not have to disclose sensitive information in the UK about costs, third that the design of the updates does not allow enough time for evidence to be collected, there is no effective measurement techniques in order to collect this data, and (even if there were) no requirements to collect the data. This asymmetry of information allowed incumbent actors to mask the true costs of building to these standards, exaggerate them, and ultimately link these to the national macro-political issue of the housing crisis and the apparent negative effects that the new regulations would have on housing delivery.

### 7.5.3. *How do institutional arrangements link to policy feedback mechanisms?*

Building on the ideas in the previous subsections, the final part of the discussion considers the role of institutional supports in the ability of policy mixes to generate feedback, and impact that policy feedback may have on the subsystem and policymaking processes. I suggest four considerations which relate to policy feedback.

The first is that lower credibility creates interpretive effects to actors in the socio-technical system, which makes it less likely that they will make sunk investments and will ultimately make it harder to create a strong constituency of support, and produce positive feedback mechanisms.

The second is that the institutional supports outlined above make it hard to produce evidence about how well the policy is performing or not, making it difficult to produce positive feedback, and making it easier for opponents of the policy mix (incumbents) to create negative feedback.

The third is that capture from incumbents affects the influence of feedback mechanisms on the subsystem. Feedback can be considered as a stabilising or de-stabilising force on the policy subsystem, and therefore the ability of the subsystem to withstand destabilisation will affect the influence that feedback mechanisms can have. Therefore for positive feedback to be effective, requires undercutting the institutional basis of support for the status quo (E. Patashnik & Zelizer, 2009). Otherwise it will continue to resist change will likely kill any ability of the new policy direction to de-stabilise and the replace the existing policy monopoly, and reform the policy subsystem in a way which is reinforcing of the transition.

The final consideration from the case is that policy feedback can be used to alter macro-political objectives, and can have major consequences for the decisions made in the policy subsystem. This appears to have more influence in situations with fewer veto players, and if the issues resonate with their interests. Admittedly, this can be both good and bad, and in the case, we see that incumbents were able to use negative feedback to appeal to the interests of key veto players and re-stabilise the system, which had detrimental effects for ZCH. But equally, this suggests that it may be possible for feedback to increase the salience of certain issues on the macro-political agenda, which may result in actions which reinforce transitions and overcome resistance from the status quo. For example, mass civil protests regarding climate change mitigation may force decision makers to take such action.

## 7.6. Conclusion

The role of politics and policymaking processes remains a (fundamental) challenge in the literature on sustainability transitions (Köhler et al., 2019). In particular, the role of policy-mix-making processes

and the institutional arrangements in which these occur, is under-conceptualised and underexplored. This paper follows recent contributions from Andrews-Speed (2016) and Lockwood et al. (2017), by drawing on Historical Institutionalism to help develop a heuristic which links institutions to policymaking processes occurring within the '*policy subsystem*' - a network of actors who interact to shape policy outputs based on their interests.

The development of the heuristic makes three main claims. The first is that policy mixes are affected by existing institutional arrangements (and changes) occurring at the macro-political level. These exist outside of the subsystem but have significant influence over the processes occurring within it, especially when decision making is the role of political actors within the subsystem (for example Ministers). Second, is that policymaking institutional arrangements within the policy subsystem (such as government capacities and delegation) have significant influence over policy-mix-making outputs. Finally, the framework draws attention to the wider institutional supports in which the policy mix is enacted, and the interactions of these arrangements with the processes of design and implementation of policy mixes. The heuristic argues that often policy mixes are designed to fit with these existing arrangements or are layered on top of them, which may limit the ability of the mix to achieve its objectives or produce positive feedback.

The paper then tests the analytical heuristic to help explain the apparent failure of the Zero Carbon Homes policy mix in the UK. This makes it not only the first application of the analytical heuristic, but also the first empirical application of Historical Institutionalism within the transitions literature. The analysis generates novel insights about how institutional arrangements may render policy-mix-making processes more susceptible to capture from incumbency. The analysis found that all three forms of institutional arrangements led to a greater degree of capture. The first issues is that The existing institutional supports of the policy mix meant that it was not possible to produce evidence of the effects of the policy mix on the rate and direction of socio-technical change, in particular the technology costs of achieving the increasing efficiency standards contained in the building regulations. This asymmetry of information allowed incumbent actors to 'mask' the true costs of building to these standards, exaggerate them, and ultimately link these to a national macro-political issue of the housing crisis and the apparent negative effects that the new regulations would have on housing delivery. This made the argument a persuasive one for the financial ministry, who due to the macro-political institutions (low number of concentrated veto players) was able to significantly intervene and (wind-down) the policy mix.

A related point to capture is the ability of the policy mix to produce positive feedback mechanisms. The aforementioned lack of evidence of whether the policy was working, or the costs of achieving the increasing standards in the building regulations meant that feedback based on facts was absent. Instead, there was significant negative feedback coming from the incumbent actors who opposed the



policy mix due to the incurred costs on them. This increases with the degree of capture of these actors over the policymaking process outlined above, where the increased amount of influence that incumbent actors have make it increasingly difficult to generate positive feedback, at least in the absence of attention and support from mass publics, who have the potential to bring issues onto the macro-political agenda and subsequently, affect processes occurring within the subsystem.

The paper also generates novel insights about the links between institutional arrangements and policy mix credibility. While links between credible commitment and institutions have already been established (see Lockwood et al. 2017 and Kuzemko et al. 2016), the analysis suggests that existing institutional supports are highly influential in creating credibility. In the case a combination of institutional supports including the frequency of the updates to regulations, existing planning laws postponing implementation of the new regulations, a lack of a robust measurement and enforcement of regulations contributed to a situation in which there was very little evidence of energy performance of the building stock, and even in instances of non-compliance, there had been no prosecutions or legal repercussions. This undermined the credibility of the whole policy mix, as well as contributing to capture and limiting the ability of the mix to produce positive feedback.

A limitation of this paper is that it does not draw on the existing literature on policy implementation. While it was beyond the scope of this paper to integrate insights more explicitly, I suggest that the definition and conceptualisation of *institutional supports* could be further developed/complemented in further work by integrating insights from this literature. Another avenue for further work would be to apply and test the framework in a contrasting institutional setting. The single case study of this paper provided interesting insights for the UK and the ZCH policy mix, but is based on several context-specific institutional arrangements which are not applicable in other geographical settings. Therefore, future comparative work could build on the insights here to help produce a more generalisable conceptualisation of such institutional arrangements. Finally, the links between institutional arrangements and policy feedback could be further developed in further work. The paper suggests in a general sense how institutional arrangements may affect if policy mixes produce feedback, and if so the polarity (positive or negative) of the feedback that is produced. However, while this is an interesting observation, the discussion of feedback is somewhat superficial, and a potential avenue for further work would be to more explicitly link institutional arrangements to specific types of feedback mechanisms (for example drawing on the categories established in Edmondson et al. 2018).

## PART III - DISCUSSION AND CONCLUSION

## Chapter 8. Discussion of findings and contributions

In this chapter of the thesis the main findings are summarised, with respect to answering the research questions established in PART I (section 1.4). The second section of the chapter (8.2.) then states the main contributions of the thesis, both in terms of its conceptual contributions and the empirical contribution it makes.

### 8.1. Summary of findings/answers to research questions

This section discusses how this thesis has answered the overall research question:

*How can conceptualising the role and influence of policy-mix-making processes in sustainability transitions help explain the failure of Zero Carbon Homes?*

To do so, the remainder of the section explores a five more nuanced questions which collectively answer the overarching question.

#### *1. How do policy mixes stimulate changes in socio-technical systems through policy effects?*

The thesis conceptually developed and the tested empirically mechanisms through which policy-mix-change alters the behaviour of actors in the socio-technical system which stimulates its reconfiguration. These mechanisms occur through the creation of policy effects, which have three forms.

The first of the effects (resources) is essentially the amount and duration of resources provided to beneficiaries, or conversely, if resources are withdrawn. There is already considerable literature on the effects of these forms of policies, which bestow resources to certain actor groups. For example, these may be in the form of direct subsidy or tax relief, to shield and nurture emerging innovations, or through policy interventions empowering novel innovations through changing mainstream selection environment to be more favourable to the new innovation (Smith & Raven, 2012). The analysis showed that resources were allocated through funding for research (AimC4) and for subsidised development of ‘eco-villages’. This stimulated innovation, which improved the building fabric efficiency of housing, and resulted the largest house building in the UK (Barratt Homes) building Hanham Hall, a medium sized zero-carbon development.

The second of these effects (interpretive) relates the information that policy mix change produces and how this changes the cognition of actors. This relates to transition concepts such as creating expectations and shared visions (Kemp et al., 2007), and also credibility of political commitment based on observations of the direction of travel and market signals (Rogge & Reichardt, 2016). These were significant in the analysis, and also linked to the first kind of effect (resources) for example allocation of resources shows a strong signal of intent and helps create credible commitment, which was seen through the government's original plans to subsidise the development of large 'eco-towns' which helped solicit support from some of the large house builders. These funds were later cut, along with the funding for the Zero Carbon Hub (a public-private partnership to help deliver the target). These changes signalled a loss of credibility which negatively affected stakeholders in the socio-technical system, leading to a weakening of the supporting coalition for ZCH.

The final form of effect (institutional) is rules which affect how the other policy effects affect actor behaviour and may structure their behaviour. An example of an institutional effect from the analysis is that rules within the planning laws in the UK allow developers to pre-register land before building regulations increase, even though they have no intention to start building on that site for several years. By pre-registering the land they only have to build to the building regulations at the time of registration, which means there is a lag between new regulations coming in and when the first housing developments are actually built to these standards.

## *2. How can these changes subsequently generate feedback mechanisms influencing the evolution of the policy mix?*

Policy effects affect actor behaviour and their interests and can provide incentives to participate in policymaking (for example to protect resource flows). Feedbacks to not affect the policy subsystem directly and require the actions of actors participating in the subsystem to shape the discourse in favour of their interests to achieve favourable outcomes. Feedback mechanism come in three main forms.

The first (socio-political) affects regards perceptions of how well (or not) policy is performing, the formation of constituencies in support or opposition of policy, and whether these groups advocate incremental fixes or more radical reforms. The analysis of ZCH showed how an initial coalition supporting the agenda helped, maintain resource flows, and led to more stable policy conditions consisting of incremental fixes. It also showed that as the supportive coalition weakened, and the opposing coalition dominated the policy subsystem more radical reforms started to occur, leading to retrenchment and eventual denouncement of the policy mix.

The second form (fiscal) concerns the role of the financial ministry and whether the costs (current, perceived or anticipated) raises concerns about the costs of supporting the policy mix. A novel insight from the application of this concept was that with regards to ZCH it was not the actual (current) costs of supporting the policy mix that became opposed by the financial ministry, it was the potential risk that the policy mix could have reduced the rate of housing delivery, and the repercussions this would have had for the overall national economy that became opposed. From this empirical finding an extended definition of what is considered as fiscal feedback, and how it is defined it suggested.

The final form of feedback is administrative, which relates to opinions about the departments tasked with policy design and implementation. These feedbacks affect the behaviours of actors in the subsystem and can contribute to policy mix stability or change. We found that the aggressive austerity measures, retraction of resources and incoherence of policymaking processes contributed to negative administrative feedback in the development of ZCH. However, again based on the findings in the empirics, redefinition of the concept is suggested. This was mainly due to the operation of the policy subsystem and decision making responsibilities. Because the financial ministry took such an active role in policymaking process, far beyond simply controlling resource flows, the administrative feedback was attributed to it, not just the department allegedly responsible for designing and implementing the policy mix (DCLG).

### *3. How did policy effects and feedback mechanisms influence the coevolution of the zero carbon homes policy mix and the socio-technical system?*

The analysis found that a potential virtuous cycle started to emerge in the early phases due to support from some major house-builders, along with the manufacturing and micro renewables sectors. Resource allocation for demonstration projects, combined with the interpretive effects of strong political commitment, expectation of future resource allocation, and potential competitive advantage, attracted support from some large incumbent house-builders. In essence, we find a similar phenomenon to Markard et al. (2016) where incumbents are not homogenous in their beliefs and if such actors view transitions as an opportunity, they are more likely to be supportive.

However, the potential for a virtuous cycle to emerge was partly offset due to adverse effects of the recession on the housebuilding socio-technical system. The market conditions led to large scale job losses and a decline in investment and innovation, and the first medium-scale demonstration project was delayed. The anticipated costs of meeting the target, while in difficult financial conditions, started to generate negative feedback from house-builders. However, resource allocation, perceptions of strong political support, and the sustained expectation of future resources, retained the support of some house-builders, meaning the rising opposition to the target was offset.

A vicious cycle started when resources supporting the mix were removed after the 2010 general election. Innovation declined and very few demonstration projects were built, making the prospects of meeting the target progressively harder. There was little incentive for the previously supportive house-builders to continue to engage in innovation, and there were no resources available to help create positive feedback. Moreover, these changes signalled weakening political commitment, making investments higher risk and undermining perceptions of potential competitive advantage, giving no incentive for further investment.

*4. How does this help explain why the zero carbon homes target got abandoned?*

A key finding was that credibility is closely related to the occurrence of virtuous or vicious cycles. Progress was initially made when the mix was considered credible, but for various reasons the mix became considered less credible, which only intensified after the vicious cycle started leading to the eventual denouncement. Consequently, by better understanding the ways in which feedback mechanisms link to credibility can help explain why in this case, credibility was lost leading to the abandonment of ZCH.

Feedback mechanisms can influence the credibility of the mix in four ways. First, through the respective strength of the supportive/opposing coalitions. If incumbents are supportive of the mix, it makes the prospects of achieving its goal more credible, which may influence other actors to also support the agenda. Conversely, as we saw in this case, as powerful actors stopped supporting the policy mix this undermined credibility, and resulted in a further weakening of the supporting coalition. Second, cognitive feedback is directly related to credibility of the mix. If specific instruments or the mix as a whole are considered to be ineffective or poorly performing, and these are unaddressed by policy makers, the mix may be considered less credible. Another contributor to the mix's reduced credibility was policy subsystem change and fiscal feedback. Following the election the treasury dominated the subsystem, who then considered the cost of supporting the policy mix as an unnecessary expense. Treasury cut all resources and reduced autonomy of other actors. As it became apparent to actors that the treasury opposed the target, this undermined the credibility of the mix as a whole. Finally, we consider administrative feedback to influence the credibility of the mix. If widespread perceptions are that the government lacks the capabilities to properly design and implement the mix, it may reduce credibility of the mix and dis-incentivise investment and support.

*5. How did the institutional arrangements in which policymaking processes occur contribute to the failure of the zero carbon homes policy mix?*

In explaining the failure of ZCH I will focus on the policymaking institutional arrangements affecting the design, and the institutional supports affecting the implementation and enforcement. While political institutions are significant in explaining the failure of ZCH, these are less generalisable focussing on the political conditions at a very specific time (coalition government).

*Policymaking* institutional barriers were observed in regard to the actors involved in policymaking processes and the capabilities. An overall lack of technical capabilities of government has led to a high degree of capture of incumbents in policymaking and regulatory processes, and amplified the asymmetry of information between government officials and the private sector. This general lack of information of decision makers regarding the actual costs of supporting the mix allowed the (already influential) incumbent actors to lobby government by linking the (exaggerated) costs of meeting target to lower rates of housing supply, which linked to a bigger macro-political issue of the ongoing housing crisis in the UK, and high housing inflation. Policymaking institutional arrangements also significantly affected who was allowed to participate and therefore the interests that were represented. The sector which stood to benefit most from the target's implementation was the micro-renewables industry, as the original requirement for all carbon abatement to be achieved on-site, placed emphasis on micro-renewables. However, this industry was not represented in Task Force, despite requesting to be so. Their exclusion from the policymaking process meant that their interests were not considered in the subsequent development of the policy mix. Unsurprisingly, over the development of the mix, it was re-defined and in the later stages, any requirement for on-site carbon abatement for energy generation was removed.

A significant issue barrier related to the *institutional supports* of the policy mix regards how building regulations in the UK are measured and enforced. There are no requirements to evaluate buildings post-construction, and the regulations are based on an 'as-designed' specification. The difference between the as-designed and as-built performance of buildings can vary significantly, for various reasons, including components being 'value-engineered' during the build-phase, replacing components with cheaper ones which may not perform as well. More importantly, even in instances where the performance of buildings has been found to not meet the required regulations, there has never been a prosecution, fine or any other form of legal consequence for non-compliance with energy efficiency regulations. The lack of a robust enforcement mechanism meant that the regulations carried no consequence, which undermined the credibility of the policy mix as a whole and effectively allowed developers to opt-out of making their product more efficient (Pan & Garmston, 2012).

## 8.2. Contributions of the thesis

This section summarises the main conceptual and empirical contributions that the thesis. Conceptually, it primarily contributes to the literature on policy mixes for sustainability transitions, but also contributes to the literature on policy feedback.

### 8.2.1. *Conceptual contributions*

This thesis contributes to several challenges within the transitions literature. Primarily it develops a co-evolutionary framework, linking the policymaking processes which underpin policy mix development, and links this to processes of socio-technical change. It does so by focussing on policy feedback to provide conceptual insights about this co-evolutionary dynamic, which links policy design choices to societal reconfigurations, which then affect subsequent policy making processes through feedback mechanism. The thesis then builds upon this policy-oriented explanation of change and stability, by focussing on the institutional conditions in which policy-mix-making processes occur. It suggest that doing so can help determine if policy design choices are the cause of change or stability, or if the institutional setting in which design choices are made affect a policy mix's ability to generate feedback, or limit or amplify the impact on policymaking of feedback which may be generated.

The thesis also contributes to the literature on public policy, more specifically policy feedback. While not, by any means, the only method of knowledge creation (see for example Latour and Woolgar, 1979) one approach is the establishment of clearly defined and falsifiable propositions, which allows for advancement of theory, as scholars apply and refine these concepts (Sabatier & Weible, 2014). In this regard the thesis makes a contribution by establishing a more nuanced concept of what is meant by 'policy feedback'. It does so by following the suggestion of Campbell (2012), making a distinction between the forward and backward dimensions of feedback. The thesis defines these two dimensions as being, 'policy effects' (forward dimension) and 'feedback mechanisms' (backwards dimension), and defines the mechanisms of their interactions, with societal change and policy change, respectively.

In defining these mechanisms, the thesis also contributes a novel form of policy effect, the institutional effects of policy mix change. Originally derived from existing links between institutions and the formation of policy feedback within literature (E. M. Patashnik & Zelizer, 2013), the concept was developed further through empirical application and conceptual refinement, and drawing insights from institutionalist literatures (Andrews-Speed, 2016; Hacker, 2004; Lockwood, Kuzemko, et al., 2017; Tsebelis, 2002). Indeed, I believe the concept can be developed further by application to more diverse empirical settings and comparative work, as will be further discussed in the limitations and



recommendations for further work. The other main contribution that emerged while developing this concept is that it makes a first step towards linking the interactions of institutional arrangements, and the role of policy feedback in policymaking processes, suggesting further integration with the literature on punctuated equilibrium as an avenue for further research.

### 8.2.2. *Empirical contributions*

The empirical work, by applying the novel co-evolutionary framework generated insights about how virtuous and vicious cycles are created, and the roles of producing and maintaining constituencies of support, and gaining the support of powerful actors in transition processes. In doing so, the thesis makes a contribution to the empirical strand of research concerned with the strategies of incumbent actors, and their ability to absorb novel technologies and maintain the structure of the socio-technical system (F. W. Geels, 2014). In addition, by studying an example of a failed transition, and the contested nature of ZCH across three different Government arrangements, it also makes a contribution to the strand of research within the literature on the politics of transitions concerned with how conflicts between incumbents and transition coalitions can become aggravated by conflicts between political parties in governments. The thesis found that in the UK context, house builders successfully lobbied government purporting that the delivery of ZCH would reduce the volume of housing supply, which conflicted with the conservative's core ideology of economic recovery (due to the contribution of the building sector to the economy and the housing inflation incurred by lower rates of housing supply). However, while ZCH was contested by Conservative party within the coalition they were unable to terminate ZCH, due to the partisan veto player in the coalition (Liberal Democrats). Instead they used a number of alternate forms of retrenchment (E. M. Patashnik, 2008), including the removal of funding and delayed implementation of key policy instruments.

The thesis also contributes to the growing literature on sustainability transitions in the housing sector. A major contribution of the thesis is that it develops a novel heuristic to help analyse intuitional arrangements affecting policymaking processes in the UK housebuilding sector. By applying this heuristic generated insights about the barriers affecting the demise of ZCH and implications more generally that this has for subsequent attempts to stimulate transition. These insights are related to the political and policymaking institutions which structure the responsibilities of the actors in the policy subsystem. The main findings are that the three heuristics combined contributed to high degrees of capture of policymaking processes from incumbents, and overall low credibility of ZCH. While these insights are specific to the UK setting for policymaking affecting housebuilding, recent growing attention to climate change and the environmental performance may soon lead to another attempt to stimulate transition through policy intervention, and consequently, this heuristic and the insights

regarding why ZCH was unsuccessful could help policymakers design a policy mix which is ultimately more successful.

## Chapter 9. Conclusion

This final chapter of the thesis, first reflects on the limitations of the research design and then suggests promising avenues of further work, before making overall policy recommendations for policymaking processes in sustainability transitions, by drawing on the main findings of the thesis.

### 9.1. Limitations and avenues for further work

The research design and methodology used in this thesis, while appropriate, had limitations, which will be reflected upon here, followed by the most promising avenues for further research.

The first limitation involves the use of expert interviews as a primary source of data, and important considerations the analyst should be aware of when drawing on interviewees. The first is the (selective) memory of participants when asking historical-based questions, which is more significant in instances where the participants have changed job or roles (sometimes several times). Another consideration with historical research especially, is when soliciting what views and perceptions of the participants were *at the time* (for instance concepts like credibility and interpretive effects of policymaking outcomes). Almost inevitably, the participant's memory of these aspects will be distorted by events that came afterwards, rather than a truly accurate account of their perceptions when the event actually occurred. However, despite these limitations, interviews were still the most appropriate form of primary data collection for the thesis, mainly due to the relatively 'hidden' and informal nature of political decision-making and policymaking processes, meaning that some information is only obtainable by speaking to actors in key roles related to policymaking. Secondly, the aforementioned issues associated with cognitive bias, can be minimised through triangulation with other data sources. In this theses the amount of archival data was extensive, and was also supported by additional primary data obtained through a freedom of information request, which helps validate the interviews.

Another consideration is the availability and willingness of important actors to participate. One such case-specific limitation in this research was the willingness of (active) civil servants to participate in the research. This relates to the timing of the research, as the period of data collection occurred shortly after the Grenfell Tower disaster, in which a block of flats caught fire and burnt-down, killing 72 people. It was found the fire was caused due to the building not being built to the correct standards of fire safety, and is another, much more visible, example of the failure to properly enforce building regulations in the UK. Consequently, despite significant effort to solicit participation, sensitivities regarding building regulations in general meant that several civil servants responded that it was

‘inappropriate’ for them to participate. However, this limitation was alleviated by speaking to a total of 10 actors directly involved in the policymaking process of ZCH (two of which were former civil servants and a former minister within DCLG), in addition to the triangulation methods mentioned in the previous paragraph.

Another limitation of the research regards the selection of case for the full utility of the framework. While the development and demise of ZCH has proved a rich empirical case, allowing for the testing of the theoretical propositions of the thesis, it highlighted one key area of the framework which was under-utilised. This regards the role of policy feedback occurring through the attention of mass publics and the electoral pressures this can place on policymaker to enact reforms, otherwise risk detrimental electoral outcomes (not being re-elected). With regards to ZCH this mechanism was completely absent, which was due a combination of factors. The first being that as a proportion of the total housing market, new build make up a low proportion. Consequently, the amount of people affected by ZCH (at least in the short term) is relatively low. The second aspect is that the benefits of energy efficiency are much less visible than for types of policy intervention, for example subsidising electric vehicles. A third consideration is that media attention to ZCH was low (Cherry, Hopfe, MacGillivray, & Pidgeon, 2015).

With this in mind, a key avenue for further work would be to test the conceptual framework on a form of policy which has high public attention, and where socio-political policy feedback, (driven by the visible impacts that policymaking has on mass publics) would render insights and dynamics that were not observed here. While there is considerable focus to dynamics of mass publics in the literature on policy feedback, it would be interesting to see how these dynamics play out in the context of sustainability transitions. This could be a particularly interesting insight given the current high profile public attention to climate change.

Another limitation linked to the selection of the case is regarding the fact that ultimately ZCH was a failure, which did not generate sufficient positive feedback to become stable and locked-in, and was subsequently terminated. This has been a very useful case to test the interplay of both positive and negative feedback, making it a good utilisation of the framework, and its explanatory capabilities. However, as this is ultimately a failed case the empirical application helps us explain why an emergent virtuous cycle may lose support, but it does not offer much insight into how support can be maintained. Accordingly a promising avenue for further work would be to apply the co-evolutionary framework to a case of a successful transition.

A final limitation linked to, but not caused by, the case selection is to do with the analytical heuristic developed for institutional arrangements in UK housing policymaking processes. The limitation here is that while a useful contribution for understanding the processes of policymaking within this very specific setting, the findings are not particularly generalisable to other settings. This is primarily

because institutional settings are highly context specific and while there may be similarities to other settings it cannot be assumed the arrangements play out the same way. More importantly, when considering the *interactions* of the heuristic forms in the case, it is improbable that these findings will be generalise at all outside of the empirical context. However, what would be a promising avenue for further work would be to apply the same basic concepts underlying the heuristic to housing policy in other country, which could lead to comparative work and potential theory building.

## 9.2. Policy implications

Policymakers seeking to stimulate transitions need to establish credible commitment, through a well-defined strategy. In the case it was found that when first announced, the strategy was ill-defined, and stakeholders (and indeed government) were not entirely sure of what the target and their objective was. This led to a period of inertia, where government and stakeholders in the policy subsystem worked to establish a target that was credible. Arguably, had the target been more established when announced, the response from industry may have been more receptive to the overall strategy and more progress would have been made in the early phases, before changing conditions (namely the economic recession) made maintaining support more difficult. Another repercussion of this was that it highlighted the lack of technical capabilities of the government allowing for higher degrees of capture from incumbent actors.

Related to this consideration is the key role of policymakers in establishing an even playing field, and inclusion of both insiders and outsiders in policymaking processes. This reinforces policy monopolies where certain sources of information are favoured over others. To help alleviate these affects policymakers should seek to utilise information from various different sources, not just established relationships with key stakeholders. From the case we can see that there was a disproportionate representation of incumbents in influential positions, as opposed to outsiders such as small scale renewable industries. Interestingly, by the eventual denouncement of the target, the re-defined target had completely excluded the use of small scale renewables. This is related to involvement of energy utilities in the policymaking process, who had lobbied for ‘off-site’ solutions which align with a centralised model of energy supply, and supports their interests. Indeed while some progress was actually stimulated by the target with regards to energy efficiency due to improvements in the design of new buildings, it is the energy supply aspect of the overall strategy that was ultimately the most significant failure.

Another key recommendation for policymaker is having access to information in order to make decisions and the technical capabilities to make informed choices. This was found to be a significant

barrier in the case. In order to make such evaluations, a general recommendation for the UK context would be to increase the technical capabilities of the state, either internally by upskilling and reducing turnover in the civil service, or by creating independent public bodies to do so. The tendency to privatise and marketised key policymaking and regulatory processes in the UK housebuilding sector had led to high levels of capture from incumbent actors, which poses a severe barrier to change within this sector.

Policymakers should also make sure policy support (for example resource allocation) is available to a wide range of actors. In this case the beneficiaries of resources were primarily the incumbent firms, and emphasis was on the large-scale builders to drive innovation. There is logic to this. Due to the large market share of volume builders, these are the only actors capable of achieving transition at scale. However, since they already have market-share, these actor's incentives to innovate are only driven by regulation and any resources offered by government. After the recession and resources were withdrawn, the lack of credible enforcement of regulations provided them little incentive to do so.

Policymakers also need to establish effective and credible means of assessing compliance with regulations and have the means to enforce it. In the case the lack of a robust measurement and compliance regime, had the immediate effect of lowering credibility and dis-incentivising incumbents to innovate. Even had the zero carbon target remained in place and been enacted through the 2016 building regulations, the general consensus is that buildings are not being built to current regulations, and without the means to effectively enforce these, industry has adopted a *laissez faire* attitude towards compliance. This is also related to access to information and the ability to make evidence based decisions, as without information reporting back how well new buildings were performing with regards to the new standards it was not possible to base subsequent decision making on this.

Another recommendation is to realise the specific types of policy mixes needed for specific contexts. Each challenge will have elements which are specific to it in relation to other areas of policy. While there are general policy mix designs which can be helpful, paying attention to the particular context, and the needs of the transition is needed. Following a more bottom-up style approach to policymaking would be needed. Similarly, a bottom up approach could be applied to the institutional context, particularly the institutional support which interact with the policy mix. In doing so policymakers should aim to make sure institutional supports are consistent with the logic and objectives of the policy mix, and do not conflict or act as a barrier to change.

An overall final recommendation is for policy makers to establish and maintain credibility in order to reduce risk, increase investment and drive sustainability transitions. Many of the aforementioned recommendations relate to particular issues that not only acted as a barrier to change in their own right within the case, but contributed to an overall lack of credibility of the policy mix. While not an easy

task policy makers should endeavour to create the right conditions for emergent transitions, and are well advised to enhance the credibility of the policy mix by providing sufficient and sustained resources, resolving any limitations or constraining institutions, and through synergistic and systematic policymaking and implementation processes to help improve investor confidence.

## References

- Aklin, M., & Urpelainen, J. (2013). Political competition, path dependence, and the strategy of sustainable energy transitions. *American Journal of Political Science*, 57(3), 643–658. <https://doi.org/10.1111/ajps.12002>
- Alkemade, F., Hekkert, M. P., Negro, S. O. (2011). Transition policy and innovation policy: Friends or foes? *Environmental Innovation and Societal Transitions*, 1(1), 125–129.
- Andrews-Speed, P. (2016). Applying institutional theory to the low-carbon energy transition. *Energy Research and Social Science*, 13, 216–225. <https://doi.org/10.1016/j.erss.2015.12.011>
- Arnold, A.D. (1990). *The Logic of Congressional Action*. New Haven, CT: Yale Univ. Press<sup>[1]</sup><sub>SEP</sub>
- Arrow, K.J. (2000). ‘Increasing Returns: Historiographic Issues and Path Dependence’, *The European Journal of the History of Economic Thought*, 7, 1, 171–80.<sup>[1]</sup><sub>SEP</sub>
- Avelino, F. (2011). *Power in Transition. Empowering Discourses on Sustainability Transitions*. Erasmus University, Rotterdam.
- Avelino, F., & Rotmans, J. (2009). Power in Transition: An Interdisciplinary Framework to Study Power in Relation to Structural Change. *European Journal of Social Theory*, 12(4), 543–569. <https://doi.org/10.1177/1368431009349830>
- Baker, E., & Lester, L. (2017). Multiple housing problems: A view through the housing niche lens. *Cities*, 62, 146–151. <https://doi.org/10.1016/j.cities.2016.10.001>
- Baker, L., Newell, P., Phillips, J. (2014). The Political Economy of Energy Transitions: The Case of South Africa. *New Political Economy*, 19(6), 791–818. <https://doi.org/10.1080/13563467.2013.849674>
- Baranzini, A., van den Bergh, J. C. J. M., Carattini, S., Howarth, R. B., Padilla, E. and Roca, J. (2017), Carbon pricing in climate policy: seven reasons, complementary instruments, and political economy considerations. *WIREs Clim Change*, 8: n/a, e462. doi:10.1002/wcc.462
- Bassi, S., Carvalho, M., Doda, B., & Fankhauser, S. (2017). Credible, effective and publicly acceptable policies to decarbonise the European Union (Final report). London. Retrieved from <http://www.lse.ac.uk/GranthamInstitute/publication/credible-effective-publicly-acceptable-policies-decarbonise-european-union-final-report/>
- Beach, D. (2017). *Process-Tracing Methods in Social Science* (Vol. 1). <https://doi.org/10.1093/acrefore/9780190228637.013.176>
- BEIS. Department of Business Energy and Industrial Strategy. (2018). *UK Energy in Brief*. UK Gov. Retrieved from [www.nationalarchives.gov.uk/doc/open-government-](http://www.nationalarchives.gov.uk/doc/open-government-licence/)
- Beland, D. (2010). Reconsidering Policy Feedback: How Policies Affect Politics. *Administration & Society*, 42(5), 568–590. <https://doi.org/10.1177/0095399710377444>
- Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: a scheme of analysis. *Research Policy* 37, 407–429.<sup>[1]</sup><sub>SEP</sub>
- Bergman, N., Whitmarsh, L., & Köhler, J. (2007). Assessing transitions to sustainable housing and communities in the UK. *International Conference on Whole Life Urban Sustainability and Its Assessment*, 1–31.
- Bergman, N., Whitmarsh, L., & Köhler, J. (2008). Transition to sustainable development in the UK housing sector : from case study to model implementation. *Environmental Sciences*, (August), 39. <https://doi.org/http://dx.doi.org/>



- Berry, S., Davidson, K., & Saman, W. (2013). The impact of niche green developments in transforming the building sector: The case study of lochiel park. *Energy Policy*, 62, 646–655. <https://doi.org/10.1016/j.enpol.2013.07.067>
- Borras 2011: policy learning and organizational capacities in innovation policies. *Science and Public Policy* 38, 725-734
- Borrás, S., Edquist, C. (2013). The choice of innovation policy instruments. *Technological Forecasting and Social Change* 80, 1513–1522.
- Building. (2016). Top 20 housebuilders 2016. Building. <http://www.building.co.uk/top-20-housebuilders-2016/5082787.article>
- Building. 2018. Top 150 contractors and housebuilders 2008. <https://www.building.co.uk/focus/top-150-contractors-and-housebuilders-2008/3118735.article>
- Building. 2018. Top 150 contractors and housebuilders 2018. Building Digital Edition: 27 July 2018. <https://www.building.co.uk/digital-editions/building-digital-edition-27-july-2018/5094845.article>
- Butler Review. (2004). Review of Intelligence on Weapons of Mass Destruction. House of Commons Committee Report..
- Cabinet Office. Coalition: Our Programme for Government, Cabinet Office (2010). Retrieved from [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/78977/coalition\\_programme\\_for\\_government.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/78977/coalition_programme_for_government.pdf)
- Cairney, P. (2015). The Science of Policymaking Preface. Palgrave Pivot. <https://doi.org/10.1017/CBO9781107415324.004>
- Cairney, P. Heikkila, T. (2014). Comparing Theoretical Approaches. Chapter 10. Theories of the Policy Process. Edited by Paul A. Sabatier, Christopher M. Weible. Third Edition. July 29, 2014. Westview Press, Boulder. ISBN: 9780813349268.
- Cairney, P., & Jones, M. D. (2016). Kingdon's Multiple Streams Approach: What Is the Empirical Impact of this Universal Theory? *Policy Studies Journal*, 44(1), 37–58. <https://doi.org/10.1111/psj.12111>
- Cairney, P., Oliver, K., & Wellstead, A. (2015). Public Administration Review. Evidence in Public Administration Series, 1. <https://doi.org/10.1017/CBO9781107415324.004>
- Campbell, A. L. (2012). Policy Makes Mass Politics. *Annual Review of Political Science*, 15(1), 333–351. <https://doi.org/10.1146/annurev-polisci-012610-135202>
- Carter, N., & Clements, B. (2015). From “greenest government ever” to “get rid of all the green crap”: David Cameron, the Conservatives and the environment. *British Politics*, 10(2), 204–225. <https://doi.org/10.1057/bp.2015.16>
- CCC. (2016). Meeting Carbon Budgets - 2016 Progress Report to Parliament. Nations and households in economic growth.
- Cherry, C., Hopfe, C., MacGillivray, B., & Pidgeon, N. (2015). Media discourses of low carbon housing: The marginalisation of social and behavioural dimensions within the British broadsheet press. *Public Understanding of Science*, 24(3), 302–310. <https://doi.org/10.1177/0963662513512442>
- Costantini, V., Crespi, F., & Palma, A. (2017). Characterizing the policy mix and its impact on eco-innovation: A patent analysis of energy-efficient technologies. *Research Policy*, 46(4), 799–819. <https://doi.org/10.1016/j.respol.2017.02.004>

- David, M. (2017). Moving beyond the heuristic of creative destruction: Targeting exnovation with policy mixes for energy transitions. *Energy Research and Social Science*, 33(January), 138–146. <https://doi.org/10.1016/j.erss.2017.09.023>
- DCLG (Department for Communities and Local Government). 2006b. Code for Sustainable Homes: a step change in sustainable home building practice.
- DCLG (Department for Communities and Local Government). 2008b. Definition of Zero Carbon Homes, Impact Assessment. London.
- DCLG (Department for Communities and Local Government). 2009a. Planning Policy Statement: eco-towns. A supplement to planning policy 1. [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/7773/pps-ecotowns.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7773/pps-ecotowns.pdf)
- DCLG (Department for Communities and Local Government). 2009b. Definition of Zero Carbon Homes, Impact Assessment (London: DCLG).
- DCLG (Department for Communities and Local Government). 2009c. Sustainable New Homes - The Road to Zero Carbon (London: DCLG). [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/8557/1415525.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/8557/1415525.pdf)
- DCLG, (Department for Communities and Local Government), 2006. Building A Greener Future: Towards Zero Carbon Development. , (December), pp.1–44. <http://www.communities.gov.uk/archived/publications/planningandbuilding/buildinggreener>.
- DCLG. (2008). Definition of zero carbon homes and non-domestic buildings - consultation London: H.M. Government.
- DCLG. 2011. Cost of Building to the Code for Sustainable Homes. Updated Cost Review.
- De Laurentis, C., Eames, M, and Hunt M. 2017. Retrofitting the Built Environment ‘to Save’ Energy: Arbed, the Emergence of a Distinctive Sustainability Transition Pathway in Wales. *Environment and Planning C: Politics and Space* 35(7):1156–75. <https://doi.org/10.1177/0263774X16648332>
- De Wilde, Pieter. 2014. The Gap between Predicted and Measured Energy Performance of Buildings: A Framework for Investigation. *Automation in Construction* 41:40–49.
- del Río González, P. (2006). The interaction between emissions trading and renewable electricity support schemes: an overview of the literature. *Mitigation and Adaptation Strategies for Global Change* 12, 1363–1390.
- del Río González, P., (2010). Analysing the interactions between renewable energy promotion and energy efficiency support schemes: the impact of different instruments and design elements. *Energy Policy* 38, 4978–4989.
- Drewe, S., & van den Bergh, J. C. J. M. (2016). What explains public support for climate policies? A review of empirical and experimental studies. *Climate Policy*, 16(7), 855–876. <https://doi.org/10.1080/14693062.2015.1058240>
- Edmondson, D. L., Kern, F., & Rogge, K. S. (2018). The co-evolution of policy mixes and socio-technical systems: Towards a conceptual framework of policy mix feedback in sustainability transitions. *Research Policy*, (March 2018), 1–14. <https://doi.org/https://doi.org/10.1016/j.respol.2018.03.010>
- Elzen, B., Geels, F. W., Leeuwis, C., & Van Mierlo, B. (2011). Normative contestation in transitions “in the making”: Animal welfare concerns and system innovation in pig husbandry. *Research Policy*, 40(2), 263–275. <https://doi.org/10.1016/j.respol.2010.09.018>

- ENDS (the ENDS Report). 2007. Plans for zero carbon homes set out.  
<http://www.endsreport.com/article/17669/plans-for-zero-carbon-homes-set-out>. (accessed 14/04/2017)
- ENDS (the ENDS Report). 2008. Slow progress on green homes.  
<https://www.endsreport.com/article/19571/slow-progress-on-green-homes>. (accessed 14/04/2017)
- ENDS (the ENDS Report). 2009a. House builders question zero carbon target.  
<https://www.endsreport.com/article/21443/housebuilders-question-zero-carbon-target>. (accessed 20/04/2017)
- ENDS (the ENDS Report). 2009b. Zero carbon homes defined.  
<https://www.endsreport.com/article/20153/zero-carbon-homes-defined>. (accessed 13/04/2017)
- ENDS (the ENDS Report). 2011. MPs attack government drift on green taxes.  
<https://www.endsreport.com/article/29552/mps-attack-government-drift-on-green-taxes>. (accessed 24/04/2017)
- ENDS report. (2006). On the road to zero- carbon developments. Analysis. The ends report.  
<http://www.endsreport.com/article/16427/on-the-road-to-zero-carbon-developments>
- ENDS report. (2013). Home energy efficiency still in the doldrums. The ends report.  
<http://www.endsreport.com/article/38131/home-energy-efficiency-still-in-the-doldrums>
- Evans, P. B., Rueschemeyer, D., & Skocpol, T. (1988). Bringing the State Back In. Cambridge: Cambridge University Press. Hc & pb (GBP 9.95). 390 pp. *Journal of Peace Research*, 25(2), 201. <https://doi.org/10.1177/002234338802500211>
- Figueres, C., Schellnhuber, H. J., Whiteman, G., Rockström, J., Hobley, A., & Rahmstorf, S. (2017). Three years to safeguard our climate. *Nature*, 546(7660), 593–595.  
<https://doi.org/10.1038/546593a>
- Flanagan, K., Uyarra, E., & Laranja, M. (2011). Reconceptualising the “policy mix” for innovation. *Research Policy*, 40(5), 702–713. <https://doi.org/10.1016/j.respol.2011.02.005>
- Foong, D., Mitchell, P., Wagstaff, N., Duncan, E., & McManus, P. (2017). Transitioning to a more sustainable residential built environment in Sydney? *Geo: Geography and Environment*, 4(1), 1–11. <https://doi.org/10.1002/geo2.33>
- Foxon, T. J. (2011). A coevolutionary framework for analysing a transition to a sustainable low carbon economy. *Ecological Economics*, 70(12), 2258–2267.  
doi:10.1016/j.ecolecon.2011.07.014
- Foxon, T. J., Gross, R., Chase, A., Howes, J., Arnall, A., & Anderson, D. (2005). UK innovation systems for new and renewable energy technologies: Drivers, barriers and systems failures. *Energy Policy*, 33(16), 2123–2137. <https://doi.org/10.1016/j.enpol.2004.04.011>
- Foxon, T.J.; Pearson, P.J.G. (2008). Overcoming barriers to innovation and diffusion of cleaner technologies: some features of a sustainable innovation policy regime. *Journal of Cleaner Production* 16, 148-61.
- Fuenfschilling, L., & Truffer, B. (2014). The structuration of socio-technical regimes - Conceptual foundations from institutional theory. *Research Policy*, 43(4), 772–791.  
<https://doi.org/10.1016/j.respol.2013.10.010>
- Fuerst, F., McAllister, P., Nanda, A., and Wyatt, P. 2013. Final Project Report: An Investigation of the Effect of EPC Ratings on House Prices.

- Gallagher, K. S., Grübler, A., Kuhl, L., Nemet, G., & Wilson, C. (2012). The Energy Technology Innovation System. *Annual Review of Environment and Resources*, 37(1), 137–162. <https://doi.org/10.1146/annurev-environ-060311-133915>
- Geels, F. (2005). Co-evolution of technology and society: The transition in water supply and personal hygiene in the Netherlands (1850-1930) - A case study in multi-level perspective. *Technology in Society*, 27(3), 363–397. <https://doi.org/10.1016/j.techsoc.2005.04.008>
- Geels, F. 2005. Co-Evolution of Technology and Society: The Transition in Water Supply and Personal Hygiene in the Netherlands (1850-1930) - A Case Study in Multi-Level Perspective. *Technology in Society*. 27(3):363–97.
- Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research Policy*, 31(8–9), 1257–1274.
- Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Research Policy*, 33(6–7), 897–920. <https://doi.org/10.1016/j.respol.2004.01.015>
- Geels, F. W. (2005). Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective. *Technological Forecasting and Social Change*, 72(6 SPEC. ISS.), 681–696.
- Geels, F. W. (2014). Regime Resistance against Low-Carbon Transitions: Introducing Politics and Power into the Multi-Level Perspective. *Theory, Culture & Society*, (May 2013), 0263276414531627-. <https://doi.org/10.1177/0263276414531627>
- Geels, F. W. 2011. The Multi-Level Perspective on Sustainability Transitions: Responses to Seven Criticisms. *Environmental Innovation and Societal Transitions* 1(1):24–40.
- Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy*, 36(3), 399–417. <https://doi.org/10.1016/j.respol.2007.01.003>
- Geels, F. W., & Schot, J. (2010) The dynamics of transitions: a socio-technical perspective. In: Grin, John, Rotmans, Jan and Schot, Johan (eds.) *Transitions to sustainable development: new directions in the study of long term transformative change*. Routledge, pp. 11-104. ISBN 9780415876759
- Geels, F. W., Kern F, Fuchs, G, Hinderer, H Kungl, G Josephine Mylan, J Mario Neukirch, M and Wassermann. S 2016. The Enactment of Socio-Technical Transition Pathways: A Reformulated Typology and a Comparative Multi-Level Analysis of the German and UK Low-Carbon Electricity Transitions (1990–2014). *Research Policy* 45(4):896–913.
- Geels, F. W., Kern, F., Fuchs, G., Hinderer, N., Kungl, G., Mylan, J., ... Wassermann, S. (2016). The enactment of socio-technical transition pathways: A reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990–2014). *Research Policy*, 45(4), 896–913. <https://doi.org/10.1016/j.respol.2016.01.015>
- Geels, F. W., Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy*, 36(3), 399–417.
- Geels, F. W.' and Schot. J., 2007. Typology of Sociotechnical Transition Pathways. *Research Policy* 36(3):399–417.
- Geels, Frank W. 2004. From Sectoral Systems of Innovation to Socio-Technical Systems: Insights about Dynamics and Change from Sociology and Institutional Theory. *Research Policy* 33(6–7):897–920.
- George, A. L., & Bennett, A. (2005). *Case Studies and Theory Development in the Social Sciences*. MIT Press.
- Gibbs, D., & O'Neill, K. (2015). Building a green economy? Sustainability transitions in the UK building sector. *Geoforum*, 59, 133–141. <https://doi.org/10.1016/j.geoforum.2014.12.004>

- Goodchild, B., & Walshaw, A. (2011). Towards zero carbon homes in England? from inception to partial implementation. *Housing Studies*, 26(6), 933–949.  
<https://doi.org/10.1080/02673037.2011.593132>
- Gould, S. J., Eldredge, N. (1977). Punctuated equilibria: the tempo and mode of evolution reconsidered. *Paleobiology*, 3(2), 115–151.
- Gov.2016. HMRC internal manual. Stamp Duty Land Tax Manual. HM Revenue & Customs.  
<https://www.gov.uk/hmrc-internal-manuals/stamp-duty-land-tax-manual/sdltm20700>  
(accessed 14/03/2017)
- Greenwood, D. (2012). The challenge of policy coordination for sustainable sociotechnical transitions: The case of the zero-carbon homes agenda in England. *Environment and Planning C: Government and Policy*, 30(1), 162–179. <https://doi.org/10.1068/c1146>
- Greenwood, D. (2015). In search of Green political economy: steering markets, innovation, and the zero carbon homes agenda in England. *Environmental Politics*, 24(3), 423–441.  
<https://doi.org/10.1080/09644016.2015.1008227>
- Greenwood, Dan. 2012. The Challenge of Policy Coordination for Sustainable Sociotechnical Transitions: The Case of the Zero-Carbon Homes Agenda in England. *Environment and Planning C: Government and Policy* 30(1):162–79.
- Guerzoni, M., Raiteri, E. (2015). Demand-side vs. supply-side technology policies: Hidden treatment and new empirical evidence on the policy mix. *Research Policy*, 44(3), 726–747.  
doi:10.1016/j.respol.2014.10.009
- Hacker, J. S. (2004). Privatizing risk without privatizing the welfare state: The hidden politics of social policy retrenchment in the United States. *American Political Science Review*, 98(2), 243–260. <https://doi.org/10.1017/S0003055404001121>
- Hafeneth, T. (2017). Reforming Fossil Fuel Subsidies for a Cleaner Future. The World Bank.  
<http://www.worldbank.org/en/news/feature/2017/11/21/reforming-fossil-fuel-subsidies-for-a-cleaner-future>
- Hatchwell, P. 2013. DCLG scales back ambition for energy efficiency in Building Regulations. ENDS report. <https://www.endsreport.com/article/40235/dclg-scales-back-ambition-for-energy-efficiency-in-building-regulations>. (accessed 12/04/2017)
- HBF. 2010. Member briefing – the 2010 spending review. House Builders Federation.  
[https://www.hbf.co.uk/documents/5412/Member\\_Briefing\\_-THE\\_2010\\_SPENDING\\_REVIEW\\_-20-Oct-2010.pdf](https://www.hbf.co.uk/documents/5412/Member_Briefing_-THE_2010_SPENDING_REVIEW_-20-Oct-2010.pdf). (accessed 24/04/2017)
- Heffernan, E., Pan, W., Liang, X., & de Wilde, P. (2015). Zero carbon homes: Perceptions from the UK construction industry. *Energy Policy*, 79(2015), 23–36.  
<https://doi.org/10.1016/j.enpol.2015.01.005>
- Heffernan, R. (2011). Labour’s New Labour Legacy: Politics after Blair and Brown. *Political Studies Review*, 9(2), 163–177. <https://doi.org/10.1111/j.1478-9302.2011.00230.x>
- Hekkert, M. P., Suurs, R. A. A., Negro, S. O., Kuhlmann, S., Smits, R. E. H. M. (2007). Functions of innovation systems: A new approach for analysing technological change. *Technological Forecasting and Social Change*, 74/4: 413–32.
- Hendriks, C. M., & Grin, J. (2007). Contextualizing Reflexive Governance: the Politics of Dutch Transitions to Sustainability. *Journal of Environmental Policy & Planning*, 9(3–4), 333–350.  
<https://doi.org/10.1080/15239080701622790>
- Hennessy, P. (2005). Rulers and servants of the state: The Blair style of government 1997–2004. *Parliamentary Affairs*, 58(1), 6–16+1. <https://doi.org/10.1093/pa/gsi003>



- Hennessy, P. (2007). From Blair to Brown: The condition of British government. *Political Quarterly*, 78(3), 344–352. <https://doi.org/10.1111/j.1467-923X.2007.00863.x>
- Hess, D. J. (2014). Sustainability transitions: A political coalition perspective. *Research Policy*, 43(2), 278–283. <https://doi.org/10.1016/j.respol.2013.10.008>
- Hess, D. J. (2015). The politics of niche-regime conflicts: Distributed solar energy in the United States. *Environmental Innovation and Societal Transitions*, 1–9. <https://doi.org/10.1016/j.eist.2015.09.002>
- Hess, D. J. (2016). The politics of niche-regime conflicts: Distributed solar energy in the United States. *Environmental Innovation and Societal Transitions*, 19, 42–50. <https://doi.org/10.1016/j.eist.2015.09.002>
- Hess, D. J., & Brown, K. P. (2018). Water and the politics of sustainability transitions: from regime actor conflicts to system governance organizations. *Journal of Environmental Policy and Planning*, 20(2), 128–142. <https://doi.org/10.1080/1523908X.2017.1341304>
- Hinsliff, G. 2008. Flagship eco-town plan falters in tough climate. <https://www.theguardian.com/environment/2008/oct/26/ecotowns-green-building>. (accessed 20/04/2017)
- HM Government (2009). The UK Low Carbon Transition Plan. TSO, Norwich. [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/228752/9780108508394.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228752/9780108508394.pdf)
- Hope, C. 2008. Eco-towns do not offer 'sustainable living'. <https://www.telegraph.co.uk/news/earth/earthnews/3345805/Eco-towns-do-not-offer-sustainable-living.html>. (accessed 15/04/2017)
- Hoppmann, J., Huenteler, J., & Girod, B. (2014). Compulsive policy-making - The evolution of the German feed-in tariff system for solar photovoltaic power. *Research Policy*, 43(8), 1422–1441. <https://doi.org/10.1016/j.respol.2014.01.014>
- Howlett, M. (2014). From the 'old' to the 'new' policy design: design thinking beyond markets and collaborative governance. *Policy Sciences*, 47(3), 187–207. <https://doi.org/10.1007/s11077-014-9199-0>
- Howlett, M., & Rayner, J. (2007). Design Principles for Policy Mixes: Cohesion and Coherence in 'New Governance Arrangements.' *Policy and Society*, 26(4), 1–18. [https://doi.org/10.1016/S1449-4035\(07\)70118-2](https://doi.org/10.1016/S1449-4035(07)70118-2)
- Howlett, M., & Rayner, J. (2013). Patching vs Packaging in Policy Formulation: Complementary Effects, Goodness of Fit, Degrees of Freedom, and Feasibility in Policy Portfolio Design. *Politics and Governance*, 1(December), 170–182.
- Howlett, M., Vince, J., & Del Río, P. (2017). Policy Integration and Multi-Level Governance: Dealing with the Vertical Dimension of Policy Mix Designs. *Politics and Governance*, 5(2), 69. <https://doi.org/10.17645/pag.v5i2.928>
- <https://doi.org/10.1177/0952076715581540>
- <https://doi.org/10.12924/pag2013.01020170>
- Immergut, E. M. (2006). Historical-Institutionalism in Political Science and the Problem of Change. In A. Wimmer & R. Kössler (Eds.), *Understanding Change: Models, Methodologies and Metaphors* (pp. 237–259). London: Palgrave Macmillan UK. [https://doi.org/10.1057/9780230524644\\_17](https://doi.org/10.1057/9780230524644_17)

- Innovate UK. 2014. Future building. The Low Impact Building Innovation Platform.  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/408711/Future\\_Building\\_-\\_the\\_Low\\_Impact\\_Building\\_Innovation\\_Platform.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/408711/Future_Building_-_the_Low_Impact_Building_Innovation_Platform.pdf).  
 (accessed 12/04/2017)
- Jacobs, A. M., & Weaver, R. K. (2015). When Policies Undo Themselves: Self-Undermining Feedback as a Source of Policy Change. *Governance*, 28(4), 441–457.  
<https://doi.org/10.1111/gove.12101>
- Jacobs, A. M., Weaver, R. K. (2015). When Policies Undo Themselves: Self-Undermining Feedback as a Source of Policy Change. *Governance*, 28(4), 441–457.
- Jacobsson, S., Bergek, A. (2011). Innovation system analyses and sustainability transitions: contributions and suggestions for research. *Environ. Innov. Soc. Transit.* 1 (1), 41–57.
- Jacobsson, S., Lauber, V. (2006). The politics and policy of energy system transformation—explaining the German diffusion of renewable energy technology. *Energy Policy*, 34(3), 256–276.
- Johnstone, P., & Newell, P. (2017). Sustainability transitions and the state. *Environmental Innovation and Societal Transitions*, (February), 0–1. <https://doi.org/10.1016/j.eist.2017.10.006>
- Johnstone, P., Stirling, A., & Sovacool, B. (2017). Policy mixes for incumbency: Exploring the destructive recreation of renewable energy, shale gas “fracking,” and nuclear power in the United Kingdom. *Energy Research and Social Science*, 33(August), 147–162.  
<https://doi.org/10.1016/j.erss.2017.09.005>
- Jordan, A., & Matt, E. (2014). Designing policies that intentionally stick: Policy feedback in a changing climate. *Policy Sciences*, 47(3), 227–247. <https://doi.org/10.1007/s11077-014-9201-x>
- Jordan, G., D. Halpin, and W. Maloney. (2004). Defining Interests: Disambiguation and the Need for New Distinctions? *British Journal of Politics and International Relations* 6, no. 2: 195–212.
- Kemp, R. (1997). *Environmental Policy and Technical Change*. Edward Elgar, Cheltenham, Brookfield.
- Kemp, R., Loorbach, D., & Rotmans, J. (2007). Transition management as a model for managing processes of co-evolution towards sustainable development. *International Journal of Sustainable Development & World Ecology*, 14(1), 78–91.  
<https://doi.org/10.1080/13504500709469709>
- Kemp, R., Pontoglio, S. (2011). The innovation effects of environmental policy instruments - A typical case of the blind men and the elephant? *Ecological Economics*, 72, 28–36.
- Kemp, R., Rotmans, J. (2004). Managing the transition to sustainable mobility. Elzen, B., Geels, F.W., Green, K. (Eds.), *System Innovation and the Transition to Sustainability*. In: Elzen, B., Geels, F.W., Green, K. (Eds.), *Theory, Evidence and Policy*. Edward Elgar, Cheltenham, pp. 137–167.
- Kern, F. (2011). Ideas, institutions, and interests: Explaining policy divergence in fostering “system innovations” towards sustainability. *Environment and Planning C: Government and Policy*, 29(6), 1116–1134. <https://doi.org/10.1068/c1142>
- Kern, F. (2012). The discursive politics of governing transitions towards sustainability: the UK Carbon Trust. *International Journal of Sustainable Development*, 15(1/2), 90.  
<https://doi.org/10.1504/IJSD.2012.044036>
- Kern, F., & Howlett, M. (2009). Implementing transition management as policy reforms: a case study of the Dutch energy sector. *Policy Sciences*, 42(4), 391–408. <https://doi.org/10.1007/s11077-009-9099-x>

- Kern, F., & Rogge, K. S. (2016). The pace of governed energy transitions: Agency, international dynamics and the global Paris agreement accelerating decarbonisation processes? *Energy Research and Social Science*, 22, 13–17. <https://doi.org/10.1016/j.erss.2016.08.016>
- Kern, F., & Rogge, K. S. (2017). Harnessing theories of the policy process for analysing the politics of sustainability transitions: A critical survey. *Environmental Innovation and Societal Transitions*, (October), 0–1. <https://doi.org/10.1016/j.eist.2017.11.001>
- Kern, F., & Smith, A. (2008). Restructuring energy systems for sustainability? Energy transition policy in the Netherlands. *Energy Policy*, 36(11), 4093–4103. <https://doi.org/10.1016/j.enpol.2008.06.018>
- Kern, F., Kivimaa, P., Martiskainen, M. (2017). Policy packaging or policy patching? The development of complex energy efficiency policy mixes. *Energy Research & Social Science*, 23, 11–25.
- Kern, Florian, Paula Kivimaa, and M. Martiskainen. 2016. The Development of Energy Efficiency Policy Mixes : The Case of Buildings in Finland and the UK. 1–36.
- Kivimaa, P., & Kern, F. (2016). Creative destruction or mere niche support? Innovation policy mixes for sustainability transitions. *Research Policy*, 45(1), 205–217. <https://doi.org/10.1016/j.respol.2015.09.008>
- Köhler, J., Geels, F. W., Kern, F., Markard, J., Onsongo, E., Wieczorek, A., ... Wells, P. (2019). An agenda for sustainability transitions research : State of the art and future directions ☆. *Environmental Innovation and Societal Transitions*, (January), 1–32. <https://doi.org/10.1016/j.eist.2019.01.004>
- Kuzemko, C. (2016). Energy Depoliticisation in the UK : Depoliticisation Destroying Political Energy in the UK : <https://doi.org/10.1111/1467-856X.12068>
- Kuzemko, C., Lockwood, M., Mitchell, C., & Hoggett, R. (2016). Governing for sustainable energy system change : Politics , contexts and contingency. *Energy Research & Social Science*, 12, 96–105. <https://doi.org/10.1016/j.erss.2015.12.022>
- Latour, B., & Woolgar, S. (1979). *Laboratory Life. The Construction of Scientific Facts*.
- Lauber, V., & Jacobsson, S. (2016). The politics and economics of constructing, contesting and restricting socio-political space for renewables - The German Renewable Energy Act. *Environmental Innovation and Societal Transitions*, 18(November), 147–163. <https://doi.org/10.1016/j.eist.2015.06.005>
- Lauber, V., Jacobsson, S. (2016). The politics and economics of constructing, contesting and restricting socio-political space for renewables – the case of the German Renewable Energy Act. *Environmental Innovation and Societal Transitions*, 18, 147–163.
- Lawhon, M., & Murphy, J. T. (2012). Socio-technical regimes and sustainability transitions: Insights from political ecology. *Progress in Human Geography*, 36(3), 354–378. <https://doi.org/10.1177/0309132511427960>
- Lehmann, P. (2010). Using a policy mix to combat climate change - An economic evaluation of policies in the German electricity sector, PhD thesis. Universität Halle- Wittenberg.
- Lockwood, M. (2013). The political sustainability of climate policy: The case of the UK Climate Change Act. *Global Environmental Change*, 23(5), 1339–1348. <https://doi.org/10.1016/j.gloenvcha.2013.07.001>
- Lockwood, M., Kuzemko, C., Mitchell, C., & Hoggett, R. (2017). Historical institutionalism and the politics of sustainable energy transitions: A research agenda. *Environment and Planning C: Government and Policy*, 35(2), 312–333. <https://doi.org/10.1177/0263774X16660561>



- Lockwood, M., Mitchell, C., Hoggetta, R., & Kuzemkob, C. (2017). Governance of industry rules and energy system innovation: The case of codes in Great Britain. *Utilities Policy*, (June).
- Lockwood, Matthew, Caroline Kuzemko, Catherine Mitchell, and Richard Hoggett. 2017. Historical Institutionalism and the Politics of Sustainable Energy Transitions: A Research Agenda. *Environment and Planning C: Government and Policy* 35(2):312–33.
- Loorbach, D. (2010). Transition management for sustainable development: A prescriptive, complexity-based governance framework. *Governance*, 23(1), 161–183.
- Love, J., Wingfield, J., Smith, A. Z. P., Biddulph, P., Oreszczyn, T., Lowe, R., & Elwell, C. A. (2017). ‘Hitting the target and missing the point’: Analysis of air permeability data for new UK dwellings and what it reveals about the testing procedure. *Energy and Buildings*, 155, 88–97. <https://doi.org/10.1016/j.enbuild.2017.09.013>
- March, J. G., & Olsen, J. P. (1984). *The New Institutionalism : Organizational Factors in Political Life* Author ( s ): James G . March and Johan P . Olsen Source : *The American Political Science Review* , Vol . 78 , No . 3 ( Sep . , 1984 ) , pp . 734-749 Published by : American Political Scienc. *The American Political Science Review*, 78(3), 734–749.
- Mark, L. 2014. It’s official: government to scrap Code for Sustainable Homes. <https://www.architectsjournal.co.uk/news/its-official-government-to-scrap-code-for-sustainable-homes/8660376.article>. (accessed 11/04/2017)
- Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy*, 41(6), 955–967. <https://doi.org/10.1016/j.respol.2012.02.013>
- Markard, J., Suter, M., & Ingold, K. (2016). Socio-technical transitions and policy change - Advocacy coalitions in Swiss energy policy. *Environmental Innovation and Societal Transitions*, 18, 215–237. <https://doi.org/10.1016/j.eist.2015.05.003>
- Markard, J., Suter, M., Ingold, K. (2014). Energy transition and policy change - Advocacy coalitions in Swiss energy policy. *IST Conference*, (October), 1–31.
- Markard, J., Wirth, S., & Truffer, B. (2016). Institutional dynamics and technology legitimacy – A framework and a case study on biogas technology. *Research Policy*, 45(1), 330–344. <https://doi.org/10.1016/j.respol.2015.10.009>
- Martiskainen, M., & Kivimaa, P. (2018). Creating innovative zero carbon homes in the United Kingdom — Intermediaries and champions in building projects. *Environmental Innovation and Societal Transitions*, 26(August 2017), 15–31. <https://doi.org/10.1016/j.eist.2017.08.002>
- May, P. J., & Jochim, A. E. (2013). Policy Regime Perspectives : Policies , Politics , and Governing, 41(Cmmi), 426–452.
- McCarthy, M. 2008. The Big Question: What are eco-towns, and how green are they in reality? <https://www.independent.co.uk/extras/big-question/the-big-question-what-are-eco-towns-and-how-green-are-they-in-reality-5545719.html>. (accessed 05/06/2017)
- McConnell, A. (2015). What is policy failure? A primer to help navigate the maze. *Public Policy and Administration*, 30(3–4), 221–242. <https://doi.org/10.1177/0952076714565416>
- McLeod, Robert S., Christina J. Hopfe, and Yacine Rezgui. 2012. An Investigation into Recent Proposals for a Revised Definition of Zero Carbon Homes in the UK. *Energy Policy* 46:25–35.
- McWhirter, S. 2010. Coalition deal wavers on zero carbon targets. <https://www.wwf.org.uk/updates/coalition-deal-wavers-zero-carbon-targets>. (accessed 27/03/2017)

- Meadowcroft, J. (2007). Who is in charge here? Governance for sustainable development in a complex world. *Journal of Environmental Policy and Planning*, 9(3–4), 299–314. <https://doi.org/10.1080/15239080701631544>
- Meadowcroft, J. (2009). What about the politics? Sustainable development, transition management, and long term energy transitions. *Policy Sciences*, 42(4), 323–340. <https://doi.org/10.1007/s11077-009-9097-z>
- Meadowcroft, J. (2009). What about the politics? Sustainable development, transition management, and long term energy transitions. *Policy Sciences*, 42(4), 323–340.
- Meadowcroft, J. (2011). Engaging with the politics of sustainability transitions. *Environmental Innovation and Societal Transitions*, 1(1), 70–75. <https://doi.org/10.1016/j.eist.2011.02.003>
- Meadowcroft, J. 2009. What about the Politics? Sustainable Development, Transition Management, and Long Term Energy Transitions. *Policy Sciences* 42(4):323–40.
- Meadowcroft, J., Langhelle, O. (2009). *Caching the Carbon. The Politics and Policy of Carbon Capture and Storage*, Cheltenham and Northampton, Edward Elgar.
- Meckling, J., Sterner, T., & Wagner, G. (2017). Policy sequencing toward decarbonization. *Nature Energy*, 2(12), 918–922. <https://doi.org/10.1038/s41560-017-0025-8>
- Meins, E., Wallbaum H., Hardziewski, R., and Feige, A., 2010. Sustainability and Property Valuation: A Risk-Based Approach. *Building Research and Information* 38(3):280–300.
- Mettler, S. (2002). Bringing the state back in to civic engagement: Policy feedback effects of the G.I. Bill for World War II veterans. *American Political Science Review*, 96(02), 351–365.
- Mettler, S., & Soss, J. (2004). The Consequences of Public Policy for Democratic Citizenship: Bridging Policy Studies and Mass Politics. *Perspectives on Politics*, 2(1), 55–73. <https://doi.org/10.1017/S1537592704000623>
- Moore, T., & Doyon, A. (2018). The uncommon Nightingale: Sustainable housing innovation in Australia. *Sustainability (Switzerland)*, 10(10), 1–18. <https://doi.org/10.3390/su10103469>
- Moore, T., Horne, R., & Morrissey, J. (2014). Zero emission housing: Policy development in Australia and comparisons with the EU, UK, USA and California. *Environmental Innovation and Societal Transitions*, 11, 25–45. <https://doi.org/10.1016/j.eist.2013.12.003>
- Moore, Trivess and Andréanne Doyon. 2018. The Uncommon Nightingale: Sustainable Housing Innovation in Australia. *Sustainability (Switzerland)* 10(10):1–18.
- Moore, Trivess, Ralph Horne, and John Morrissey. 2014. Zero Emission Housing: Policy Development in Australia and Comparisons with the EU, UK, USA and California. *Environmental Innovation and Societal Transitions* 11:25–45.
- Morby, A. 2010. Largest UK zero carbon homes project wins funding. <http://www.constructionenquirer.com/2010/10/15/largest-uk-zero-carbon-homes-project-wins-funding/>. (accessed 12/04/2017).
- Mourik, R., and Raven, R. 2006. A Practioner ' s View on Strategic Niche Management Towards a Future Research Outline. (December):37.
- Mourik, R., Raven, R. (2006). A practioner's view on Strategic Niche Management Towards a future research outline, (December), 37.
- Nauwelaers, C. Boekholk, P., Mostert, B., Cunningham, P., Guy, K., Hofer, R., Rammer, C. (2009). Policy Mixes for R&D in Europe. European Commission – Directorate – General for Research, Maastricht

- Normann, H. E. (2015). The role of politics in sustainable transitions: The rise and decline of offshore wind in Norway. *Environmental Innovation and Societal Transitions*, 15, 180–193. <https://doi.org/10.1016/j.eist.2014.11.002>
- Normann, H. E. (2017). Policy networks in energy transitions: The cases of carbon capture and storage and offshore wind in Norway. *Technological Forecasting and Social Change*. <https://doi.org/10.1016/j.techfore.2017.02.004>
- Oberlander, J., & Weaver, R. K. (2015). Unraveling from Within? The Affordable Care Act and Self-Undermining Policy Feedbacks. *The Forum*, 13(1), 37–62. <https://doi.org/10.1515/for-2015-0010>
- ONS (Office for National Statistics). 2017a. Total number of households by region and country of the UK, 1996 to 2017. <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families/adhocs/005374totalnumberofhouseholdsbysregionandcountryoftheuk1996to2015>
- ONS (Office for National Statistics). 2017b. UK House Price Index Statistical bulletins. Office for national statistics. <https://www.ons.gov.uk/economy/inflationandpriceindices/bulletins/housepriceindex/previousReleases>
- Osbourne, H. 2009. House prices fall by 16% in 2008. <https://www.theguardian.com/money/2009/jan/06/house-prices-fall-in-december>
- Osmani, M., & O'Reilly, A. (2009). Feasibility of zero carbon homes in England by 2016: A house builder's perspective. *Building and Environment*, 44(9), 1917–1924. <https://doi.org/10.1016/j.buildenv.2009.01.005>
- Ossenbrink, J., Finnsson, S., Bening, C. R., & Hoffmann, V. H. (2018). Delineating policy mixes: Contrasting top-down and bottom-up approaches to the case of energy-storage policy in California. *Research Policy*, (April 2017). <https://doi.org/10.1016/j.respol.2018.04.014>
- Ossenbrink, J., Finnsson, S., Bening, C. R., Hoffmann, V. H. (Submitted to *Research Policy*). Delineating policy mixes – contrasting the top down and bottom up approach along the case of energy storage in California.
- Owen, J. 2015. Recovery of UK economy is the slowest since records began, say unions
- Pan, W., & Garmston, H. (2012). Compliance with building energy regulations for new-build dwellings. *Energy*. <https://doi.org/10.1016/j.energy.2012.06.048>
- Pan, Wei and Yan Ning. 2014. A Socio-Technical Framework of Zero-Carbon Building Policies. *Building Research & Information* 43(April):94–110.
- Parliament. 2014. Infrastructure Bill [Lords]. 08 December 2014. Volume 589. [https://hansard.parliament.uk/Commons/2014-12-08/debates/14120810000001/InfrastructureBill\(Lords\)#contribution-14120836000033](https://hansard.parliament.uk/Commons/2014-12-08/debates/14120810000001/InfrastructureBill(Lords)#contribution-14120836000033). (accessed 27/03/2017).
- Patashnik, E. and J. Zelizer. 2009. When Policy Does Not Remake Politics: The Limits of Policy Feedback. Annual Meeting of the American Political Science Association, Toronto, Canada 1–39.
- Patashnik, E. M. (2008). *Reforms at Risk*. Princeton University Press. Retrieved from <http://www.jstor.org/stable/j.ctt7rw81>
- Patashnik, E. M., & Zelizer, J. E. (2013). The Struggle to Remake Politics: Liberal Reform and the Limits of Policy Feedback in the Contemporary American State. *Perspectives on Politics*, 11(04), 1071–1087. <https://doi.org/10.1017/S1537592713002831>

- Patashnik, E., & Zelizer, J. (2009). When policy does not remake politics: The limits of policy feedback. Annual Meeting of the American Political Science Association, Toronto, Canada, 1–39. Retrieved from [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1449996](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1449996)
- Paton, E. 2015. Barratt CEO Mark Clare steps down. <https://www.ft.com/content/7167d310-d456-11e4-8be8-00144feab7de>. (accessed 07/05/2017)
- Peacock, L. 2010. Construction jobs worst hit during recession. <https://www.telegraph.co.uk/finance/jobs/8078937/Construction-jobs-worst-hit-during-recession.html>. (accessed 03/05/2017)
- Perry, K. K. (2019). Institutions , Innovation and Development : A critical review and political economy analysis of late-industrialising countries, (September 2017), 1–45.
- Peters, B. G. (2012). Institutional theory in political science : the new institutionalism / B. Guy Peters. New York: Continuum.
- Peters, B. G. (2015). State failure, governance failure and policy failure: Exploring the linkages. Public Policy and Administration, 0952076715581540-. <https://doi.org/10.1177/0952076715581540>
- Pierson, P. (1993). Policy Feedback and Policy Change. World Politics, 45(4), 595–628.
- Pierson, P. (2000). Increasing Returns, Path Dependence, and the Study of Politics. The American Political Science Review, 94(2), 251–267.
- Pierson, P. (2004). Politics in time : history, institutions, and social analysis / Paul Pierson. Princeton, N.J: Princeton University Press.
- Pierson, P. (2007). The Costs of Marginalization Qualitative Methods in the Study of American Politics. Compar-ative Political Studies 40(2): 146–69.
- Podewils, C. (2018). Records with renewables, but once again no progress on CO2 emissions – 2017 was a year of mixed success for the energy transition. Agora-Energiewende. <https://www.agora-energiewende.de/en/topics/-agothem-/Produkt/produkt/464/Gemischte+Energiewende-Bilanz+2017%3A+Rekorde+bei+Erneuerbaren+Energien%2C+aber+erneut+keinerlei+Fortschritt+beim+Klimaschutz/>
- Quitow, R. (2015a). Assessing policy strategies for the promotion of environmental technologies: a review of India’s National Solar Mission. Res. Policy 44, 233–243.
- Quitow, R. (2015b). Dynamics of a policy-driven market: the co-evolution of technological innovation systems for solar photovoltaics in China and Germany. Environ. Innov. Soc. Trans. 17, 126–148.
- Raven, R., Kern, F., Verhees, B., & Smith, A. (2016). Niche construction and empowerment through socio-political work. A meta-analysis of six low-carbon technology cases. Environmental Innovation and Societal Transitions, 18, 164–180. <https://doi.org/10.1016/j.eist.2015.02.002>
- Reichardt, K., & Rogge, K. (2016). How the policy mix impacts innovation: Findings from company case studies on offshore wind in Germany. Environmental Innovation and Societal Transitions, 18, 62–81. <https://doi.org/10.1016/j.eist.2015.08.001>
- Reichardt, K., Negro, S. O., Rogge, K. S., Hekkert, M. P. (2016). Analyzing interdependencies between policy mixes and technological innovation systems: The case of offshore wind in Germany. Technological Forecasting and Social Change, 106, 11–21.
- Reichardt, K., Rogge, K. (2016).
- Reichardt, K., Rogge, K.S., Negro, S.O., (2017). Unpacking policy processes for addressing systemic problems in technological innovation systems: The case of offshore wind in Germany. Renewable and Sustainable Energy Reviews 80, 1217–1226.

- Ritchie, J., & Spencer, L. (1994). Qualitative data analysis for applied policy research. In A. Bryman & B. Burgess (Eds.), *Analyzing qualitative data* (1st ed., pp. 173–194). London: Routledge.  
<https://doi.org/10.4324/9780203413081-14>
- Roberts, C., Geels, F. W., Lockwood, M., Newell, P., Schmitz, H., Turnheim, B., & Jordan, A. (2018). The politics of accelerating low-carbon transitions: Towards a new research agenda. *Energy Research and Social Science*, 44(February), 304–311.  
<https://doi.org/10.1016/j.erss.2018.06.001>
- Rogge K., Schleich J., (2018). Do Policy Mix Characteristics Matter for Low-Carbon Innovation? A Survey-Based Exploration for Renewable Power Generation Technologies in Germany. Accepted in *Research Policy*.
- Rogge, K. S., & Dütschke, E. (2018). What makes them believe in the low-carbon energy transition ? Exploring corporate perceptions of the credibility of climate policy mixes. *Environmental Science and Policy*, 87(February), 74–84. <https://doi.org/10.1016/j.envsci.2018.05.009>
- Rogge, K. S., & Reichardt, K. (2016). Policy mixes for sustainability transitions : An extended concept and framework for analysis. *Research Policy*, 45(8), 1620–1635.  
<https://doi.org/10.1016/j.respol.2016.04.004>
- Rogge, K. S., Johnstone, P. (2017). Exploring the role of phase-out policies for low-carbon energy transitions: The case of the German Energiewende. *Energy Research & Social Science*, 33(February), 128–137. <https://doi.org/10.1016/j.erss.2017.10.004>
- Rogge, K. S., Kern, F., & Howlett, M. (2017). Conceptual and empirical advances in analysing policy mixes for energy transitions. *Energy Research and Social Science*, 33(October), 1–10.  
<https://doi.org/10.1016/j.erss.2017.09.025>
- Rogge, K.S., Dütschke, E., (2017). Exploring perceptions of the credibility of policy mixes: the case of German manufacturers of renewable power generation technologies. *SPRU Working Paper Series (SWPS)* 23, 1–53.
- Rosenbloom, D., Meadowcroft, J., & Cashore, B. (2019). Stability and climate policy? Harnessing, policy feedback, and transition pathways. *Energy Research and Social Science*, 50(December 2018), 168–178. <https://doi.org/10.1016/j.erss.2018.12.009>
- Rosenow, J. (2013). The politics of the German CO2-Building Rehabilitation Programme. *Energy Efficiency*, 6(2), 219–238.
- Rosenow, J., Fawcett, T., Eyre, N., & Oikonomou, V. (2016). Energy efficiency and the policy mix. *Building Research & Information*, 3218(August), 1–13.  
<https://doi.org/10.1080/09613218.2016.1138803>
- Rosenow, J., Kern, F., & Rogge, K. (2017). The need for comprehensive and well targeted instrument mixes to stimulate energy transitions: The case of energy efficiency policy. *Energy Research and Social Science*, 33. <https://doi.org/10.1016/j.erss.2017.09.013>
- Rotmans, J. and Loorbach, D., (2010). Towards a better understanding of transitions and their governance. A systemic and reflexive approach. *Transitions to sustainable development. New directions in the study of long term transformative change*, p.105-198. Routledge.
- Rotmans, J., & Loorbach, D. (2010). II . 3 Conceptual Framework for Analyzing Transitions. *Transitions to Sustainable Development Long Term Transformative Change*, (i).
- Sabatier, P. (2007). *Theories of the policy process* (2nd ed.). Boulder, Colo.: Westview.
- Sabatier, P.A.; Weible, C.M. (2014). *Theories of the Policy Process*. Third Edition, July 29, 2014, Westview Press, Boulder. ISBN: 978081334926829
- Sasse, T., & Norris, E. (2019a). Moving On: The costs of high staff turnover in the civil service. Institute for Government, 78. Retrieved from



[https://www.instituteforgovernment.org.uk/sites/default/files/publications/IfG\\_staff\\_turnover\\_WEB.pdf](https://www.instituteforgovernment.org.uk/sites/default/files/publications/IfG_staff_turnover_WEB.pdf)

- Sasse, T., & Norris, E. (2019b). Moving On: The costs of high staff turnover in the civil service. Institute for Government, 78.
- Sceptre investment management, 2007. UK Housebuilding.  
[http://www.sceptrefunds.co.uk/articles/UK Housebuilding.pdf](http://www.sceptrefunds.co.uk/articles/UK%20Housebuilding.pdf).
- Sceptre. 2007. Sceptre investment management – UK housebuilding.  
<http://www.sceptrefunds.co.uk/articles/UK%20Housebuilding.pdf>
- Schmidt, T. S., & Sewerin, S. (2017). Technology as a driver of climate and energy politics. *Nature Energy*, 2(6), 17084. <https://doi.org/10.1038/nenergy.2017.84>
- Schmidt, T. S., & Sewerin, S. (2018).
- Schmidt, T. S., & Sewerin, S. (2018). Measuring the temporal dynamics of policy mixes – An empirical analysis of renewable energy policy mixes’ balance and design features in nine countries. *Research Policy*, (April), 1–13. <https://doi.org/10.1016/j.respol.2018.03.012>
- Schmidt, V. A. (2008a). Discursive Institutionalism: The Explanatory Power of Ideas and Discourse. *Annual Review of Political Science*, 11(1), 303–326.  
<https://doi.org/10.1146/annurev.polisci.11.060606.135342>
- Schmidt, V. A. (2008b). From Historical Institutionalism To Discursive Institutionalism: Explaining Change in Comparative Political Economy. *American Political Science Association Meetings*, (February), 25. Retrieved from <http://www.mendeley.com/import/>
- Schneider, A., Ingram, H. (2009). What is next for policy design and social construction theory? *Policy Studies Journal*, 37(1), 103–119.
- Schweber, L., Lees, T., & Torriti, J. (2015). Framing evidence : policy design for the zero-carbon home. *Building Research & Information*, 3218(February), 37–41.  
<https://doi.org/10.1080/09613218.2015.1004658>
- Scott, W. R. (1995). *Institutions and Organizations: Ideas, Interests, and Identities* (Fourth Edi). SAGE Publications. Retrieved from <https://books.google.co.uk/books?id=NbQgAQAAQBAJ>
- Scott. R., 1995. *Institutions and Organizations. Ideas, Interests and Identities*. Paperback: 360 pages  
Publisher: Sage (1995) Language: English ISBN: 978-142242224
- Scrase, I., & Smith, A. (2009). The (non-)politics of managing low carbon socio-technical transitions. *Environmental Politics*, 18(5), 707–726. <https://doi.org/10.1080/09644010903157008>
- Seager, A. (2007). Construction sector rises to challenge of building eco-friendly homes of the future. *The Guardian*. <https://www.theguardian.com/business/2007/feb/28/communities.society>
- Shapps, G. 2010. We’re lifting burden from the backs of builders. Ministerial statement.  
<https://www.gov.uk/government/news/were-lifting-burdens-from-the-backs-of-builders>
- Shove, E., & Walker, G. (2007). CAUTION! Transitions ahead: Politics, practice, and sustainable transition management. *Environment and Planning A*, 39(4), 763–770.  
<https://doi.org/10.1068/a39310>
- Skocpol, T. (1992). *Protecting Soldiers and Mothers: The Political Origins of Social Policy in the United States*. Cambridge, MA: The Belknap Press of Harvard University Press. Retrieved from <http://www.amazon.com/Protecting-Soldiers-Mothers-Political-Origins/dp/067471766X>
- Skogstad, G. (2016). Policy feedback and self-reinforcing and self- undermining processes in EU biofuels policy, 1763(March).

- Smith, A. (2006). Governance lessons from green niches: The case of eco-housing. In J. Murphy (Ed.), *Framing the Present, Shaping the Future: Contemporary Governance of Sustainable Technologies* (pp. 41–62). London: Earthscan, <https://doi.org/10.4324/9781849771511>
- Smith, A. (2007). Translating sustainabilities between green niches and socio-technical regimes. *Technology Analysis and Strategic Management*, 19(4), 427–450. <https://doi.org/10.1080/09537320701403334>
- Smith, A., & Raven, R. (2012). What is protective space? Reconsidering niches in transitions to sustainability. *Research Policy*, 41(6), 1025–1036. <https://doi.org/10.1016/j.respol.2011.12.012>
- Smith, A., & Stirling, A. (2010). The politics of social-ecological resilience and sustainable socio-technical transitions. *Ecology and Society*, 15(1). <https://doi.org/10.5751/ES-04565-170208>
- Smith, A., Kern, F., Raven, R., & Verhees, B. (2014). Spaces for sustainable innovation: Solar photovoltaic electricity in the UK. *Technological Forecasting and Social Change*, 81(1), 115–130. <https://doi.org/10.1016/j.techfore.2013.02.001>
- Smith, A., Stirling, A., & Berkhout, F. (2005). The governance of sustainable socio-technical transitions. *Research Policy*, 34(10), 1491–1510. <https://doi.org/10.1016/j.respol.2005.07.005>
- Smith, A., Voß, J.-P., & Grin, J. (2010). Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. *Research Policy*, 39(4), 435–448. <https://doi.org/10.1016/j.respol.2010.01.023>
- Sovacool, B. K. (2016). How long will it take? Conceptualizing the temporal dynamics of energy transitions. *Energy Research & Social Science*, 13, 202–215. doi:10.1016/j.erss.2015.12.020
- Späth, P., & Rohrer, H. (2010). ‘Energy regions’: The transformative power of regional discourses on socio-technical futures. *Research Policy*, 39(4), 449–458. <https://doi.org/10.1016/j.respol.2010.01.017>
- Statista. 2018. Construction industry structure UK. <https://www.statista.com/statistics/565511/construction-industry-structure-uk/>
- Steinmo, S. (2008). Chapter 7 What is Historical Institutionalism? Sven Steinmo, (January 1989).
- Stenzel, T., Frenzel, A. (2008). Regulating technological change – the strategic reactions of utility companies towards subsidy policies in the German, Spanish and UK electricity markets. *Energy Policy* 36 (7), 2645–2657.
- Stirling, A. (2011). Pluralising progress: From integrative transitions to transformative diversity. *Environmental Innovation and Societal Transitions*, 1(1), 82–88. <https://doi.org/10.1016/j.eist.2011.03.005>
- Tansey, O. (2007). Process A Case Tracing and Elite Interviewing : Sampling for Non-probability Process Tracing : Definition. *PS: Political Science and Politics*, 40(4), 765–772. <https://doi.org/10.1017/Si049096507071211>
- Thelen, K. (1999). HISTORICAL INSTITUTIONALISM IN COMPARATIVE POLITICS, 369–404.
- Thomas, D. 2014. Barratt CEO Mark Clare steps down. <https://www.ft.com/content/7167d310-d456-11e4-8be8-00144feab7de>. (accessed 12/05/2017)
- Tsebelis, G. (1995). Decision Making in Political Systems: Veto Players in Presidentialism, Parliamentarism, Multicameralism and Multipartyism. *British Journal of Political Science*, 25(3), 289–325. Retrieved from <http://www.jstor.org/stable/194257>
- Tsebelis, G. (2002). Veto players: How political institutions work. *Veto Players: How Political Institutions Work*, 1–317.

- Turnheim, B., Berkhout, F., Geels, F., Hof, A., McMeekin, A., Nykvist, B., van Vuuren, D. (2015). Evaluating sustainability transitions pathways: Bridging analytical approaches to address governance challenges. *Global Environmental Change*, 35, 239–253.
- UK-GBC. (2015). Over 200 businesses urge Chancellor to reconsider scrapping zero carbon. UK-GBC News. <http://www.ukgbc.org/news/over-200-businesses-urge-chancellor-reconsider-scrapping-zero-carbon>
- UK-GBC. (2015b). Open letter to George Osborne on zero carbon policy [open letter]. Constructing Excellence. Retrieved from <http://constructingexcellence.org.uk/open-letter-to-george-osborne-on-zero-carbon-policy/>
- UK-GBC. 2015. Open letter to George Osborne on zero carbon policy.
- UN. (2015). Report on the structured expert dialogue on the 2013–2015 review. Fccc (Vol. 08863). <https://doi.org/http://unfccc.int/resource/docs/2015/sb/eng/inf01.pdf>
- Unruh, G. C. (2000). Understanding carbon lock-in. *Energy Policy*, 28(12), 817–830. [https://doi.org/10.1016/S0301-4215\(00\)00070-7](https://doi.org/10.1016/S0301-4215(00)00070-7)
- Unruh, G. C. 2000. Understanding carbon lock-in. *Energy policy*, 28(12), 817-830. [https://doi.org/10.1016/S0301-4215\(00\)00070-7](https://doi.org/10.1016/S0301-4215(00)00070-7)
- Voß, J.-P., Smith, A., & Grin, J. (2009). Designing long-term policy: rethinking transition management. *Policy Sciences*, 42(4), 275–302. Retrieved from <http://www.jstor.org/stable/40586541>
- Voß, J.P. and Kemp, R., 2015. Sustainability and reflexive governance: introduction. Technische Universität Berlin. <http://nbn-resolving.de/urn:nbn:de:kobv:83-opus4-68521>
- Walker, G., Karvonen, A., & Guy, S. (2015). Reflections on a policy denouement: The politics of mainstreaming zero-carbon housing. *Transactions of the Institute of British Geographers*, 2015–2017. <https://doi.org/10.1111/tran.12104>
- Warren, A. 2013. A disaster for energy efficiency inside DCLG. ENDS report. <https://www.endsreport.com/article/42181/a-disaster-for-energy-efficiency-inside-dclg>. (accessed 14/05/2017)
- Weaver, K. (2010). Paths and Forks or Chutes and Ladders?: Negative Feedbacks and Policy Regime Change. *Journal of Public Policy*, 30(2), 137–162.
- Weaver, R. K., & Rockman, B. A. (1993). Do institutions matter?: government capabilities in the United States and abroad. The Brookings Institution. Retrieved from <https://books.google.co.uk/books?id=OF2GAAAAMAAJ>
- Weber, K. M., & Rohracher, H. (2012). Legitimizing research, technology and innovation policies for transformative change: Combining insights from innovation systems and multi-level perspective in a comprehensive “failures” framework. *Research Policy*, 41(6), 1037–1047. <https://doi.org/10.1016/j.respol.2011.10.015>
- Weible, C.M. (2014). Introducing the scope and focus of policy process research and theory. Chapter 1. *Theories of the Policy Process*. Edited by Paul A. Sabatier, Christopher M. Weible. Third Edition. July 29, 2014. Westview Press, Boulder. ISBN: 9780813349268.
- White, W., Lunnan, A., Nybakk, E., Kulisic, B., (2013). The role of governments in renewable energy: The importance of policy consistency. *Biomass and Bioenergy* 57, 97–105.
- Wieczorek, A. J., & Hekkert, M. P. (2012). Systemic instruments for systemic innovation problems: A framework for policy makers and innovation scholars. *Science and Public Policy*, 39(1), 74–87. <https://doi.org/10.1093/scipol/scr008>



- Williamson, O. E. (2000). The new institutional economics: Taking stock, looking ahead. *Journal of Economic Literature*, 38(3), 595–613. <https://doi.org/10.1257/jel.38.3.595>
- Wolsink, M. (2007). Wind power implementation: The nature of public attitudes: Equity and fairness instead of “backyard motives.” *Renewable and Sustainable Energy Reviews*, 11(6), 1188–1207.
- Yin, R. K. (2014). *Case Study Research Design and Methods* (5th ed.). Sage Publications.  
<https://doi.org/DOI: 10.3138/cjpe.30.1.108>

# Appendix

## Appendix A

Time	Event	Mechanism
<b>2006</b>		
September	Yvette Cooper announces ambition to exceed Scandinavian standards for energy efficiency in 10 years	[PMC]->[IntE]
December	Gordon Brown makes statement that in 10 years all new homes will be built o zero carbon standards	[PMC]->[IntE]
	Tax stamp duty exemption also announced	[PMC]->[IntE]
	Code for sustainable homes officially introduced by government	[PMC]->[IntE]
	Yvette Cooper (DCLG) establishes the 2016 Task Force with Stuart Baseley (HBF)	[PMC]->[InstE]
	Having HBF involved in the process helped reduce resistance to target	[InstE] ->[SPF]
	Callcutt review commissioned	[PMC]->[RE]
	Consultation on the delivery of the target through building regulations, code and planning policy.	[PMC]->[IntE]
<b>2007</b>		
January	Task Force first meets	[InstE]
February	UK-GBC launched, including founding member Barratt Homes	[IntE]->[S-TC]
March	Eco-towns announced by Gordon Brown (Chancellor of the Exchequer – Treasury)	[PMC]->[IntE]
April	Code for sustainable homes launched	[PMC]->[RE & IntE]
June	“Building a greener future” policy statement formally introduced the target	
	Gordon Brown announces ambition to build 3 million new homes by 2020; and that 1 million will be zero carbon.	[IntE]
	First code demonstrations at BRE’s OFFSITE event. Kingspan lighthouse first to reach level 6, Stewart Milne build to level 5	[IntE]->[S-TC]
	Gordon Brown succeeds Tony Blair as Prime Minister	[ExC]->[PSC]
July	Gordon Brown increases the ambition for Eco-towns to 10 sites	[PMC]->[IntE]
	Savills estimate costs of meeting target will add £36,000 to construction.	[STC]
October	Budget Introduces tax stamp duty exemption	[PMC]->[RE]
	Tax stamp duty exemption contains a different definition of the zero carbon target than proposed by DCLG	[PMC]->[IntE]
	Callcutt review makes recommendation of establishing a delivery body due to slow starting period	[S-TC]->[SPF & AF]
December	Barratt Homes wins bid for Hanham Hall site through Carbon Challenge run by English Partnerships	[PMC]->[RE]
<b>2008</b>		
April	“Eco-towns: Living a green future” consultation launched by DCLG	[PMC]
	Requirement for all publicly funded housing to achieve a minimum of level 3 of code for sustainable homes	[RE & InstE]-> [S-TC]
May	UKGBC produces report saying that the original definition of zero carbon unachievable on 10-80% of sites	[S-TC]->[SPF]
	Low Impact Building Innovation Platform (LIBIP) launched	[RE & InstE]
	Barratt Homes reveal ‘Green House’, the first zero carbon house build by a major house builder	[S-TC]
	All homes required to have a sustainability certificate through introduction of Home Information Packs, making code for sustainable homes mandatory.	[InstE]
	Housing Minister Yvette Cooper is replaced by Caroline Flint	[ExC]->[PSC]
June	Task Force creates report on definition of zero carbon which is presented to Housing Minister Caroline Flint. Report makes recommendation to adopt heretical structure, Caroline flint says consultation documents will be released in June.	[SPF]->[PMC] ->[IntE]

## Appendix B

Time	Event	Mechanism
<b>2008</b>		
June	Zero Carbon Hub established with matched funding from Government by NHBC	[SPF&AF]->[PMC]->[RE&InstE]
	Recession starts in the UK	[ExC]
	Eco-towns policy generates local NIMBY opposition and protests against 9 of the 15 proposed sites	[PMC]->[IntE]->[SPF]
	Shadow Housing Minister Grant Shapps (CP) voices opposition to the Eco-towns policy	[SPF]
October	Eco-towns ambition questioned, DCLG suggest only one or two sites feasible	[ExC]->[PMC]->[IntE]
November	Climate Change Act (2008) passed	[ExC]->[IntE]
	Housing and Planning Bill receives Royal Assent. The bill allows local councils to set building requirements using the code which exceed the national building regulations.	[P-MC]->[InstE]->[RE]->[S-TC]
	Margret Beckett replaces Caroline Flint as Housing Minister	[ExC]->[PSC]
December	Homes Communities Agency (HCA) launched	[InstE]
	House prices dropped by 15.9%. Pre-tax profits of the largest developers drops from £2.5 billion to -£3 billion, job losses of 25% in construction industry.	[ExC]->[STC]
	Consultation for definition of target released after delay	[PMC]
<b>2009</b>		
January	AIMC4 project launched by LIBIP. £3.4 million funding.	[RE]
March-May	Work starts on Hanham Hall, clearing the site and preparing for construction.	[S-TC]
May	John Healey replaced Margret Beckett as Housing Minister	[ExC]->[PSC]
July	4 of the original Eco-towns proposed get approved	[PMC]->[IntE]
October	Conservative party pledge to reduce regulations at Party Conference. This is well received by the HBF.	[ExC]->[IntE]
November	Planning granted on Hanham Hall site	[InstE]->[STC]
<b>2010</b>		
February	£60 million is dedicated to their delivery by government to supporting the first 4 Eco-towns.	[PMC]->[RE]
March	HCA propose new standards for publicly funded housing at code level 4	[PMC]

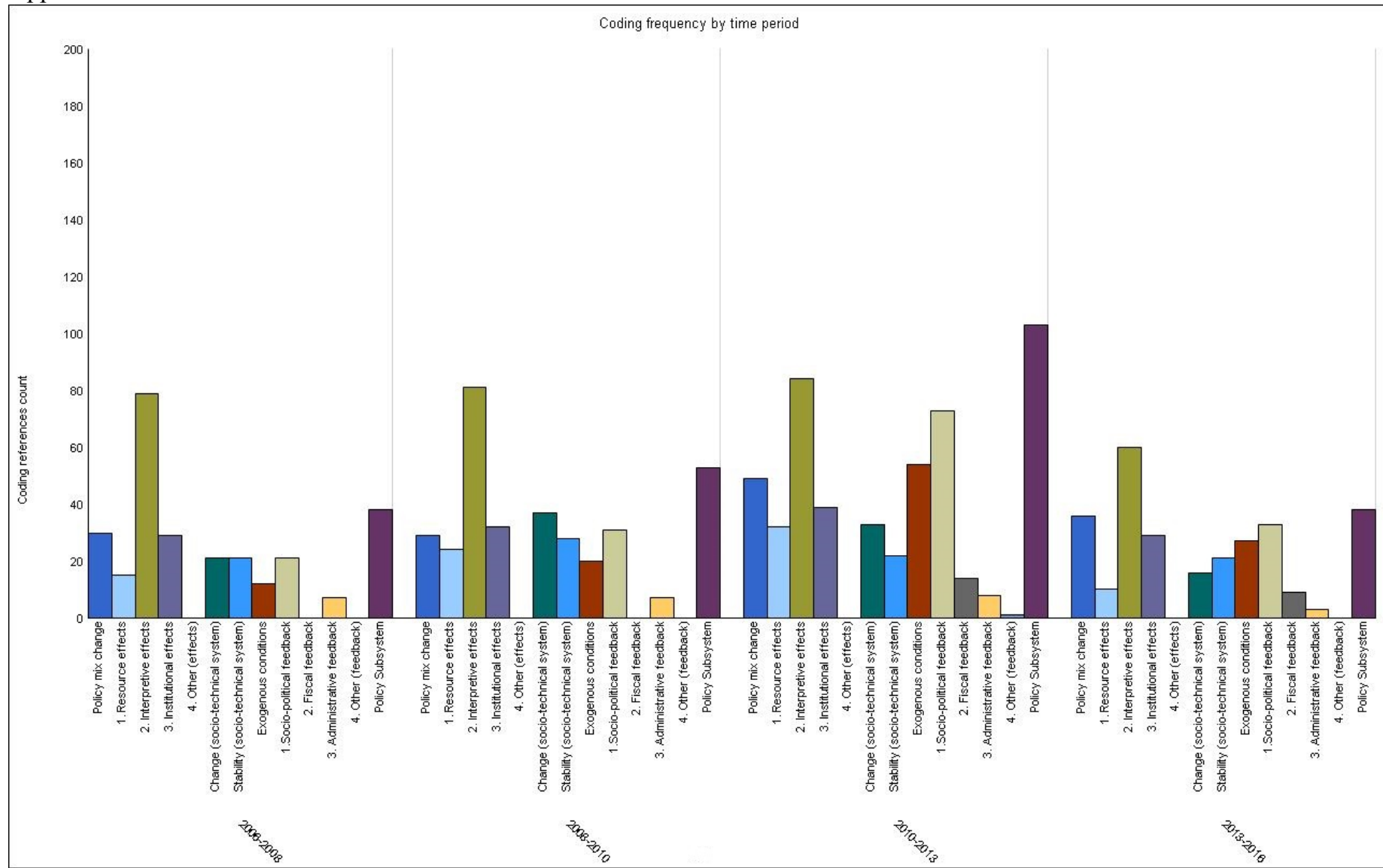
## Appendix C

Time	Event	Mechanism
<b>2010</b>		
May	General election won by coalition of Conservative Party (CP) and the Liberal Democrats (LD). Responsibilities are split between the parties. Eric Pickles (CP) is Secretary of State for DCLG, Grant Shapps (CP) is housing minister and Andrew Stunnell (LD) is minister for building regulations.	[ExC]->[PSC]
	Test units constructed on Hanham Hall site by Barratts through 'Carbon Challenge'	[RE]->[S-TC]
July	Housing Minister (CP) announces Eco-Towns funding to be cut by 50%	[PMC]->[RE]
	Housing Minister (CP) reaffirms commitment to target and confirms that funding allocated for the Zero Carbon Hub under Labour (£600,000) will continue.	[IntE]
	DCLG launch consultation on how to cut red tape.	
October	2010 updates to building regulations implemented as planned based on the Zero Carbon Hub's recommendations.	[InstE]->[PMC]->[RE]
	HCA awards £7.8 million for second site of carbon challenge programme.	[RE]->[STC]
	Autumn spending review re-iterates government's commitment to reducing regulation.	[IntE]
November	Housing Minister drops HCA's proposals for publicly funded buildings to have to meet code level 4	[PMC]->[RE]
	Zero Carbon Hub's funding cut by 20%, and would end completely in March 2011. This changed the model of the Hub as funding from NHBC was secured for running costs. Research money had to be bid for on specific projects.	[PMC]->[RE]->[InstE]->[S-TC]
	Terms of the 2016 Task Force were reviewed, after which the Housing Minister stopped attending meetings.	[InstE]->[PSC]
<b>2011</b>		
January	Treasury introduce "1 in 1" out on regulations	[InstE]
February	Consultation on 2013 building regulations released by DCLG	[PMC]
	Test units completed on Hanham Hall site	[STC]
	Housing minister commissions zero carbon hub to create a workable framework for allowable solutions	[RE]
March	Treasury announce that target would no longer include un-regulated energy use. This lowered the amount of carbon to be abated (150% -> 100%), and would reduce costs.	[PMC]->[RE]
	WWF walk away from 2016 Task Force in protest after announcement.	[IntE]->[S-TC]
April	Announcement that only one of the proposed Eco-Towns will be built to the original (zero carbon) standards.	[PMC]->[RE]
<b>2012</b>		
September	Andrew Stunnell (LD) loses his post as minister for being intransigent. Replaced by Don Foster (LD).	[SPF]->[PSC]
<b>2013</b>		
March	Budget reaffirms government commitment to target	[IntE]
	George Osborne announces the 'help to buy' scheme in order to boost the housing market, and dedicated £3.5 billion pound. No carbon requirements are included.	
May	SAP 2012 update for use with 2013 building regulations released	[PMC]->[RE]
	Response to 2013 building regulations consultations postponed.	[PMC]->[IntE]
June	Government announces plans to amend 2013 regulations to "strike a balance regulatory burden and Government's zero carbon home commitments".	
August	Consultation for Allowable solutions released by DCLG	[PMC]
	Housing Standards review propose abandoning Code for Sustainable Homes. It also proposes removing the powers granted to local councils through the Planning Act 2008. This is strongly supported by the HBF.	[SPF]->[PMC]->[SPF]
October	2013 building regulation delayed, seen a signal of wavering commitment to target.	[PMC]->[IntE]
	Don Foster (LD) replaced by Stephen Williams (LD)	[PSC]
	2013 building regulations released to come into force April 2014. Part L delayed.	[PMC]->[IntE]
November	Part L released. Energy savings 6% higher than 2010 regulations. Lower than the least ambitious scenario considered in consultation. Zero Carbon Hub's recommendations not included.	[PMC]->[RE & IntE]
	Environmental Audit Committee (EAC) warn against abandoning of the Planning Act 2008, and against having a single set of building regulations.	[PMC]->[SPF]

## Appendix D

Time	Event	Mechanism
<b>2014</b>		
January	2016 Task Force stops meeting	[PMC]->[InstE]->[IntE]
March	Government proposes to include requirements in the Code for Sustainable Homes into the building regulations as voluntary measures.	[SPF]->[PMC]->[RE & IntE]
April	2013 building regulations come into force after 6 month delay	
June	Infrastructure Bill published by the Department for Transport proposes definition of target at Level 5, permitting developers to build to Level 4 and use allowable solutions to achieve Level 5. More controversially, it also proposed an exemption for small sites.	[PMC]->[IntE]
September	Paul King, CEO of UK-GBC announces leaving	[IntE]->[S-TC]
November	Consultation on small sites exemption issued	[PMC]
December	Small sites exemption contested in the House of Lords	[PMC]->[IntE]->[SPF]
<b>2015</b>		
March	Government releases response to small sites consultation. Confirms sites of 10 units or less would be exempt from target.	[PMC]->[RE & IntE]
	The same day the CEO of Barratt Homes Mark Clare steps down after leading the company for 9 years.	[PMC]->[RE & IntE]->[S-TC]
May	Conservative party (CP) gain majority after the general election	[ExC] -> [PSC]
July	Treasury denounces 2016 target	[PMC]->[IntE]
	UK-GBC organises a letter to Chancellor to appeal decision, but has no impact	[PMC]->[IntE]->[STC]->[SPF]
October	Government includes its proposals to remove the target in Housing and Planning Bill	[P-MC]->[IntE]
December	Environmental Audit Committee calls for evidence on an inquiry of the Treasury on its actions regarding sustainability	[PMC]->[IntE] ->[SPF & AF]
<b>2016</b>		
March	Zero Carbon Hub disbanded after NHBC withdrew funding	[PMC]->[IntE]->[S-TC]->[PSC]
April	Housing and planning Bill contested in the House of Lords including amendments to reintroduce the target.	[PMC]->[IntE]->[SPF]->[PMC]
May	Amendment defeated by a margin of four votes, officially ending the target	[P-MC] -> [RE]

## Appendix E



## Appendix F

Reference	Date	Title	Reference	Date	Title
TF1	070131	- Minutes	TF59	100127	- Task Force Jan 10 mtg Item 4 - Hub Timeline
TF2	070328	- 2016 Concordat	TF60	100127	- Task Force Jan 10 mtg Item 7 - Hub Progress Report
TF3	070328	- Agenda	TF61	101102	- Agenda
TF4	070515	- Agenda	TF62	101102	- Minutes
TF5	070515	- 2016 Concordat vs4	TF63	101102	- Hub Timeline Report - Taskforce - 2 Nov 2010
TF6	070328	- Zero Carbon definition paper1	TF64	101102	- Hub Progress Report - Taskforce - 2 Nov 2010
TF7	070515	- Minutes	TF65	101102	- 2016 Task Force Draft revised Terms of Reference
TF8	070613	- 2016 Commitment	TF66	110316	- Minutes
TF9	070613	- Agenda	TF67	110316	- Agenda
TF10	070613	- Minutes	TF68	110316	- 2016 Taskforce TOR
TF11	070613	- HBFTaskforce2	TF69	110316	- HBF Hub review
TF12	071024	- Agenda	TF70	110316	- Hub - Progress Report Taskforce - 16 Mar 20101
TF13	070613	- Opinion polling	TF71	110316	- Programme Delivery Report - 16 March 20111
TF14	071218	- Agenda	TF72	110606	- Agenda
TF15	071024	- Minutes	TF73	110606	- Hub - Progress Report Taskforce - 6 June 2011
TF16	071218	- Minutes	TF74	110606	- Hub - Programme Delivery Timeline - 6 June 2011
TF17	080311	- Agenda	TF75	110913	- Annex A
TF18	080311	- Minutes	TF76	110913	- Agenda
TF19	080311	- Part L SAP progress report March 08 Mar	TF77	110606	- Minutes
TF20	080311	- Appendices ZC Homes delivery hub scope long version 7 Mar 08 Paper A3	TF78	110913	- Annex B
TF21	080311	- Taskforce meeting CPA paper SAP Amendments and Additions Paper C	TF79	110913	- Minutes
TF22	080311	- ZC Homes delivery hub scope long version 7	TF80	110913	- Hub - Progress Report Taskforce - 13 September 2011
TF23	080605	- Agenda	TF81	110913	- Programme Delivery Report 6 September 2011
TF24	080311	- Zero Carbon Homes delivery hub summary Final paper A1	TF82	111115	- Agenda
TF25	080605	- Minutes	TF83	110913	- SAP brief for ZC Taskforce
TF26	080605	- P NHBC Presentation Consumer Marketing	TF84	111115	- Minutes
TF27	080605	- Paper B 2016 Taskforce Delivery Hub	TF85	111115	- 2016 Timeline update
TF28	080605	- Paper C UK GBC ZC Definition Presentation.	TF86	111115	- SAP update
TF29	081021	- Agenda	TF87	111115	- Hub Progress Report
TF30	080605	- Paper D - ZC and eco-towns	TF88	111115	- Brief on the SAP Review for taskforce
TF31	081021	- Item 4 ZC Hub progress report	TF89	111115	- Allowable Solution Trials 2012-14
TF32	081021	- Item 5 ZC Homes Programme delivery	TF90	120214	- Part L
TF33	090127	- Agenda	TF91	120214	- Minutes
TF34	081021	- Minutes	TF92	120214	- Agenda
TF35	090127	- Minutes	TF93	120214	- SAP update
TF36	090127	- Paper2-Initial reactions and next steps	TF94	120214	- Hub update
TF37	090127	- ZC Hub - Programme Delivery - 27 Jan 09	TF95	120214	- AS presentation
TF38	090429	- Agenda	TF96	120214	- Zero Carbon Timeline
TF39	090127	- ZC Hub-Progress Report - 27 Jan 09	TF97	120529	- Agenda
TF40	090429	- Minutes	TF98	120529	- Hub Progress Report 29 May 2012
TF41	090429	- Pres-Consultation analysis-item 3B	TF99	120529	- Building Performance Modelling Stewardship Body v3
TF42	090429	- P-LGA note on ZCH and HES-item 7	TF100	120529	- Minutes
TF43	090429	- Pres-Have Your Say-item 3A	TF101	120529	- Programme Delivery Report 29 May 2012
TF44	090611	- Agenda	TF102	120529	- ZCH Report on SAP2012
TF45	090429	- Pres-Work programme-item 4	TF103	130625	- Agenda
TF46	091021	- Agenda	TF104	130625	- Minutes
TF47	090611	- Pres-Hub presentation	TF105	130625	- Hub Progress Report 25 June 2013
TF48	090611	- Minutes	TF106	130905	- Agenda
TF49	091021	- ZC Hub - Energy Efficiency Standard	TF107	130625	- Programme Delivery Report 25 June 2013
TF50	091021	- Minutes	TF108	130905	- Minutes
TF51	091021	- ZC Hub - Energy Efficiency Standard Briefing	TF109	130905	- Hub Progress Report
TF52	091021	- ZC Hub - Progress Report - 21 Oct 09	TF110	130905	- Allowable Solutions pres for Task Force
TF53	091021	- ZCH Zero Carbon programme delivery review Oct 09 Final	TF111	140114	- Agenda
TF54	091021	- Pres-Allowable solutions for 2016 task force	TF112	130905	- Timeline Report
TF55	100127	- Minutes	TF113	140114	- Allowable Solutions consultation response presentation
TF56	100127	- Agenda	TF114	140114	- Minutes
TF57	100127	- Annie Hall's presentation to 2016 Task Group 27Jan10	TF115	140114	- Timeline Report
TF58	100127	- Marian Spain's presentation to 2016 Task Force 27Jan10			