

# Sustainable living places

## - a systems perspective on planning, housing and infrastructure



## Foreword



The most complex and contested issues in society are left to government for decision. Ultimately the most challenging of these issues end up in a government box. This is as it should be in a democratic society, however it means that policymakers generally must exercise judgement in systems characterised by

multiple interactions where the processes of cause and effect are anything but clear. In this situation mapping the system is an essential first step in making a good decision and delivering good government.

The issues that surround sustainability and those that involve the local contexts of place figure among the most complex and urgent that currently face us. The challenge of delivering net zero carbon by 2050 is possibly the largest in human history to date. It is also the most urgent. It is estimated that buildings account for up to 40% of greenhouse gas emissions. When we add to that the transport systems that keep a modern society mobile and the economy thriving it becomes clear that the major part of the challenge rests in places. So too the solution. And yet places are highly complex and

poorly defined. They consist of both the physical and spatial infrastructure of buildings and street systems, but also of people, social and cultural systems, markets and institutions as well as the natural environment of which human settlement is an integral part. If we are to navigate a path through this complex landscape, it is essential that we have a good map within which to take our bearings.

This report sets out to start a process of mapping. Working with a large and diverse group of stakeholders the authors have drawn a very broad boundary around the challenge of delivering sustainable living places. The map is more than just an aid to navigation. It also identifies leverage points - the places where policies can hope to exert the greatest effect.

I welcome the effort that has been put into distilling a dauntingly complex field into a navigable landscape. No doubt there is still much to be done, but this report certainly will help policy makers and decision takers to move in the right direction.

**Professor Alan Penn**  
Chief Scientific Adviser  
Ministry of Housing Communities and Local Government

## Preface



The problem of housing supply in the UK has been an issue for centuries. Repeated governments over several decades, have tried to offer various incentives to make things better, but despite this effort, the rate of housebuilding has tended to remain stubbornly low. Critical shortage of

affordable social housing nationally has had a major societal impact. The art of place-making is a fractured landscape; developing rapidly in a few places while in its infancy in many others. Much new housing is located in places where people ordinarily would not choose to live; situated poorly for public transport access, instead centred around car use, propagating dependency on personal motorised transport, at a time when the UK is legally committed to net zero greenhouse gas emissions by 2050. While many of the individual dwelling places are becoming increasingly low carbon, they are then assimilated into locations where the overall impact is high in carbon. And the problem persists.

As a Fellow of the Royal Academy of Engineering, I have had the pleasure of sitting on the Engineering Policy Centre Committee (EPCC), which oversees the Academy's policy work and I have enjoyed listening and contributing to many lively debates on sustainable housing. As engineers providing independent advice, we wanted to apply our engineering expertise to make life in the UK better. In particular, we had a strong wish to apply the engineering principle of whole-systems thinking into other arenas, where clearly things did not work as well as they could or should. We took the decision to establish a project on Sustainable Living Places following fruitful discussions with the Infrastructure and Projects Authority (IPA). We set up a working group of experts, to explore how this thinking might be applied to housing in the UK, a complex challenge, with social, environmental and governance issues.

The first question we asked ourselves in the working group, was to what extent a system of systems (governed by less rational factors than physics), might be amenable to a systems approach. The second question

was whether the main actors in this system, traditionally unaccustomed to engaging in a conversation with engineers, would welcome input and advice from the Royal Academy of Engineering. Fortunately, the answer to both questions was a resounding yes.

As part of this project, the Academy's policy team engaged widely with a broad group of professionals representing the various actors and disciplines across the housing system, from economists to sociologists and from planners to community leaders. After countless hours of patient interviewing and workshops, the system maps gradually revealed themselves, they were complex, but not unduly so. The veracity of the mapping was often simply confirmed by saddened headshaking from seasoned housing experts, frustrated at the illogical nature of these underpinning challenges across the system, which appeared to be forever immune to correction. The process of collecting these diverse viewpoints, insights and evidence, and validating the input that shaped these maps was immensely time consuming. But it has ultimately allowed us to develop a shared understanding of the system, uniquely bringing together multiple disciplines and views.

The first stage of the work has resulted in maps that offer different and exciting opportunities for change in the system. I have high hopes that the broad and pan professional team behind this work that employed systems thinking can bring fresh thinking and a strong logic to help resolve this most pressing of national problems. More interestingly, it shows that the discipline of whole systems thinking is much more broadly applicable and it can shed new light to traditional problems, where the policy issues are far wider and complex than the engineering ones alone. It also proves that the discipline of engineering in partnership with other professional disciplines can bring a new clarity to policymaking, presenting a high-level and accessible summary of a complex problem involving a panoply of issues.

**Tim Chapman FREng**  
Working Group Chair, Sustainable Living Places Project



## Testimonial



The wellbeing and prosperity of everyone in the UK depends critically on how we rebuild our economy, and transform our infrastructure and public services. Therefore we welcome this report and the work the Academy has put into understanding the housing problem. In the UK, we have been building homes successfully for many years and so both government and industry intrinsically understand the systems that this report has laid out, and yet this is the first time they have been mapped in this way to help provide an understanding of how the many stakeholders in the system will respond and interact.

While there are no 'Silver Bullets' to solve the UK's housing crisis, the IPA supports this report in helping to provide a methodology to understand the causal loops and emergent properties in the complex system of systems that describe the wicked problem of housing.

**Nick Smallwood**  
Chief Executive  
Infrastructure and Projects Authority

## Contents

Foreword	2
Preface	3
Testimonial	4
Executive summary	5
Definition	5
Project objectives	6
Outputs from the study and description of leverage points	6
Systems methods, strengths and challenges	7
Illustration	8
Introduction	10
Context of the this study	12
Overview of method	13
Scoping	13
Mapping the system	14
System dynamics	15
System map	16
Key findings	21
Leverage points	22
Discussion	24
What does the systems approach teach us about achieving SLP?	24
What does the SLP example show us about applying a systems approach and system dynamics principles to complex policy problems?	24
Conclusion	27
About SLP	27
References	28
Abbreviations and acronyms	28
Acknowledgements	29
Appendix	30
Participatory mapping methodology	31
Enablers and inhibitors of SLP	33
Clustering and prioritising enablers and inhibitors	40
SAT analysis	40
System dynamics analysis	44
<b>Part one</b>   Creating clusters of loops	44
<b>Part two</b>   Building a map using the deep structure	44
<b>Part three</b>   Validation of loops	45
<b>Part four</b>   Mapping interdependencies	45
<b>Part five</b>   Journey through the map	46

## Executive summary

Recognising that there are many different systems approaches, this National Engineering Policy Centre (NEPC) report presents a systemic perspective on housing in the UK and the wider planning and infrastructure system in which it is situated. The approach applied is appropriate for tackling complex policy issues that have a social-technical dimension. The system map derived shows where one part of the system influences another part of the system. The findings raise issues specific to planning, housing and infrastructure and discuss the strengths and challenges of applying this systems approach.

The report's findings are aimed primarily at the Infrastructure and Projects Authority (IPA), who partnered to deliver this work. This is intended for an audience that has an interest in testing applications of systems approaches to themes connected to the delivery of places. Other audiences of interest include policymakers in government working on housing or systems connected to housing, professional engineering institutions and infrastructure stakeholders interested in exploring an application of a systems approach.

The current housing crisis indicates an opportunity for change in both the quality of places and the scale of housing delivery. The complexity of the housing problem demands a systemic approach, because solutions targeting one aspect of the system may influence other parts. Approaches that focus on one part of the system in isolation may deliver some objectives yet may also result in unintended consequences. It is important to understand how different parts of the system are interconnected and how they might interact together to achieve the goal of sustainable living places<sup>1</sup>. This is where a systems approach can be valuable in identifying where certain activities could influence the system as a whole.

Little has been done previously to join up these views and develop a systemic understanding that considers the diverse perspectives of the stakeholders involved. Working with different stakeholders requires an approach that can inform exploration of the system and develop a pluralistic perspective. Delivering sustainable housing in the UK at scale therefore requires the many stakeholders involved to contribute to a systemic perspective, as a first step towards delivering sustainable living places.

### Definition

**Sustainable living places refers to happy, healthy, low-carbon, adaptive places where people desire to live.** The 43 partners to the National Engineering Policy Centre (NEPC) convened and prioritised 'sustainable living places' (SLP) as an issue of importance, requiring a systems approach. SLP is defined as follows:

- **'Sustainable'** includes a low-carbon agenda across all infrastructure (water, electricity, transport), goods and services, and the built environment. This acknowledges that there is a legal and political commitment in the UK to be 'net-zero' by 2050.<sup>2</sup>
- **'Living'** is inclusive of different aspects of life (such as domestic, professional, leisure). This must reflect needs at each stage of life, and take into account trends in ageing populations, political economy, productivity, employment and technology.
- **'Places'** expands the focus from simply building homes to cultivating places. This includes the physical, cultural and social identities that define an area and support its ongoing evolution.

<sup>1</sup> Jackson and Keys, 1987, New Directions in Management Science - System of Systems Methodologies

<sup>2</sup> HMT, 2019. HM Treasury's review into funding the transition to a net zero greenhouse gas economy: terms of reference

The system includes stakeholders across housing planning and governance at national and local authority levels, developers, residents, community-based groups and many others. There are several sub-systems that are critical in delivering SLP. This includes but is not limited to transport, health, education, water, energy, social care, and other public, social, and cultural goods. The report incorporates a high-level view of each of these sub-systems into one overarching perspective but does not delve into each in depth. However, it acknowledges that each of these may feature in different ways and draws upon an evidence base that captures this diversity.

The IPA recognised the benefits of a systems perspective and a need for understanding among the various actors in drawing upon the NEPC's expertise. The aim was to generate a systemic view and identify opportunities to improve the delivery of SLP.

### Project objectives

The project objectives were developed by a wide range of experts involved in consultation and guided by a working group comprising 10 experts from the fields of systems thinking, infrastructure and the built environment, in dialogue with the IPA. This was an iterative consultation process that convened monthly to review progress, findings and share feedback. Project objectives included the following:

1. **To derive a system map** drawing upon perspectives and expertise shared by a diverse group of stakeholders.
2. **To capture the process and method of mapping the system** applying the Acumen+ approach and system dynamics. (See appendix: Page 30)
3. **To identify leverage points\*** in the system for creating SLP in the UK.
4. **To identify lessons learned** from applying the approach to this policy challenge.

\*Leverage points draw attention to areas in the system where interventions would strongly influence different aspects of the system. These are starting points for exploring where interventions might have greatest impact and where unintended benefits and consequences could result.

### Outputs from the study and description of leverage points

The study developed a map and captured the process of applying a systems approach informed by perspectives of multiple stakeholders from planning, placemaking, design, infrastructure, housing associations, developers, landowners, community organisations and resident groups.

1. The map presents a view of the current system informed by stakeholders' perspectives. It has five key regions and illustrates leverage points, which could be high-level intervention points such as goals and values, vicious cycles or aspects that are highly connected to different areas within the system.
2. The map of system dynamics achieves several things: it highlights tensions, or paradoxes, within the system such as centralised decision-making about the planning system at a national level versus the mandate to deliver housing and public services at local authority level.
3. The map illustrates multi-level relationships in which the local perspective is a sub-system of the national perspective. The role of central government is to generate coherent national policy and the role of local government is to act on that policy in a manner that reflects and respects the local needs. The map also shows causal relationships between different behaviours in the system and leverage points.

The map helped to identify several potential opportunities for improvement. Drawing upon the leverage points identified, this study identified the following opportunities:

1. **Encouraging the development of a sustainability agenda around the target for net-zero greenhouse gas (GHG) emissions** to catalyse a coherent cross-government plan for housing, infrastructure and placemaking. This agenda would call for better integration between national and local planning policies for delivering places. At a local level, this would mean development frameworks and local plans are aligned with this national sustainability agenda.

2. **Facilitating support for local planning and better masterplanning** that promotes: (1) the creation of mechanisms that enable planning across local authority boundaries; and (2) efforts to level up by addressing regional disparities in productivity and access to social infrastructure.
3. **Providing a flexible funding model to enable holistic business cases for place** that can be administered nationally or locally. Holistic business cases for place would account for factors that enable high-quality developments, meet demands for public services and actively engage residents in delivering places.
4. **Providing technical and financial support to planners in local authorities to address internal barriers to delivery.** This includes resources for increasing the number of staff and providing technical and administrative capacity for existing staff.
5. **Harnessing the power of data sharing to promote access to information about the planning process.** This would include platforms for digital collaboration that can: 1) enable meaningful collaboration and communicate the value of high-quality development to existing communities; and 2) empower those who are unable to access the planning process. As a leverage point, data-sharing could have a positive effect on collaboration and trust but could also have a negative effect.

Each of these findings take place in the context of the UK being considered a highly centralised political economy where there have been some shifts to devolve some powers to the local level. Each of these findings should be considered alongside how inclusive engagement and consultation with local communities on plans can take place.

### Systems methods, strengths and challenges

Overall, this project took a **participatory systems approach**, which drew upon the Acumen+ approach. The Acumen+ approach was developed by The Omidyar Group and adapted by the NEPC for this project. The method draws upon core principles and experience working with systems approaches developed by leaders in systems thinking.<sup>3</sup>

The aim was to generate a systemic view and identify opportunities to improve the delivery of SLP that can inform conversations about 'managing the mess' to inform 'solving the problem'.<sup>4</sup> Developing this view required an **iterative, agile approach to working and engaging different stakeholders at various stages**. This is valuable at an early stage of policy formation. Further work based on these findings would benefit from joining up with other approaches such as longitudinal studies and case studies.

Realising the benefits of a systems approach for SLP raises some challenges that should be taken into consideration and apply to complex policy problems more generally. One challenge for complex policy problems is that there are no quick fixes or silver bullets. Furthermore, it requires iterative engagement to deliver a systemic perspective on the system. Findings in this project are limited in scope to the stakeholders involved in generating this perspective, and the evidence provides a snapshot at a specific point in time. Therefore, the process of involving a diverse group of stakeholders in an iterative way is central to the validation of the approach and its findings.

While a systems approach can support exploration of future impact and cultivate a richer understanding of the problem, it is not a predictive tool. In this case, the approach was largely exploratory and qualitative. However, the approach can inform where an intervention could make an impact on the wider system and help to develop a shared understanding.

<sup>3</sup> Forrester, Jay W. 1994. "System Dynamics, Systems Thinking, and Soft OR." *System Dynamics Review* 10 (2-3): 245-56. <https://doi.org/10.1002/sdr.4260100211>

Sterman, John. 2000. "Causal Loop Diagrams." In *Business Dynamics: Systems Thinking and Modelling For the Complex World*, 137-90. TBS (2000)

<sup>4</sup> Peter Checkland & John Poulter. 2010. *Soft Systems Methodology*. DOI: 10.1007/978-1-84882-809-4\_5. *Systems Approaches to Managing Change: A Practical Guide*







# Introduction

Rising demand for housing in the UK has not been met over recent decades. Many factors have led to this, including but not limited to: property speculation, insufficient build out rates and a lack of infrastructure support to new settlements.<sup>5</sup> Meeting demand and creating SLP requires consideration of a diversity of systems involved in delivering cities, towns and communities: planning, networked utilities (water, electricity, gas), public services (transport and mobility, education, health) and other systems.<sup>6</sup> **SLP refer to happy, low-carbon, adaptive places where people desire to live.**

- **'Sustainable'** includes a low-carbon agenda across all infrastructure (water, electricity, transport), goods and services, and the built environment. Holistically, this means considering cities and communities from an ecological, social and governance perspectives, this includes taking the Sustainable Development Goals into account. There are tensions that must be acknowledged and managed. The inclusion of 'sustainability' recognises that there is a political and legal commitment for the UK to be net zero by 2050.
- **'Living'** is inclusive of different aspects of life (such as domestic, professional, leisure). This must reflect needs at each stage of life, and take into account trends in ageing populations, political economy, productivity, employment and technology.
- **'Places'** expands the focus from simply building homes to cultivating places. Placemaking is an evolving process that is non-linear. There are examples of what

makes a 'good place' that have taken time to develop. This will be subjective, yet includes the physical, cultural and social identities that define an area and support its ongoing evolution.<sup>7</sup> This interpretation acknowledges that in a digital society people exist in many networks - many of which are place-based. The home in this sense can represent a network hub for one of several different networks.<sup>8</sup>

Applying this understanding of SLPs is consistent with the UK Industrial Strategy's Grand Challenges<sup>9</sup> because it would account for areas such as:

- carbon emissions from the built environment, which are a barrier to clean growth and meeting net-zero targets (sustainable)
- an ageing population, which raises questions about the availability and suitability of homes<sup>10</sup> as well as the aspirations of young people (living)<sup>11</sup>
- the future of mobility, which has implications for how homes are linked to places of work and leisure, decarbonising modes of transport and the utilisation of automated modes of transport (places). This acknowledges that homes can be a workplace for carers and that the shift to working from home in a digital economy has implications for homes, transport, energy and ICT systems.<sup>12</sup>

Large development programmes such as the Oxford-Cambridge Arc need to address the quality of placemaking at scale.<sup>13</sup> Central government projects that the UK needs 300,000 new properties a year to meet current demand, with one million homes projected for the Oxford-Cambridge Arc corridor alone.<sup>14</sup> The UK has reached these build-out rates twice historically, with peaks in the 1920s and 1960s.

5 Letwin, Oliver, 2018. Independent Review of Build Out Rates

6 Davies, M., and T. Oreszczyn. 2012. "The Unintended Consequences of Decarbonising the Built Environment: A UK Case Study." *Energy and Buildings* 46: 80-85. <https://doi.org/10.1016/j.enbuild.2011.10.043>

7 Rutland, Casey. London Build Sustainability Summit

8 Baillie, L., Benyon, D. Place and Technology in the Home. *Comput Supported Coop Work* 17, 227-256 (2008). <https://doi.org/10.1007/s10606-007-9063-2>

9 UCL-MOIS. 2019. "A Mission-Oriented UK Industrial Strategy," no. May: 106

[www.ucl.ac.uk/bartlett/public-purpose/sites/public-purpose/files/190515\\_iipp\\_report\\_mois\\_final\\_artwork\\_digital\\_export.pdf](http://www.ucl.ac.uk/bartlett/public-purpose/sites/public-purpose/files/190515_iipp_report_mois_final_artwork_digital_export.pdf)

10 UK 2070 Commission. 2019. "Towards a Framework for Action FAIRER AND STRONGER REBALANCING THE UK ECONOMY UK 2070-An Inquiry into Regional Inequalities Towards a Framework for Action." THE FIRST REPORT OF THE UK2070 COMMISSION Purpose of the Commission Towards a Framework for Action. 2019; (May)

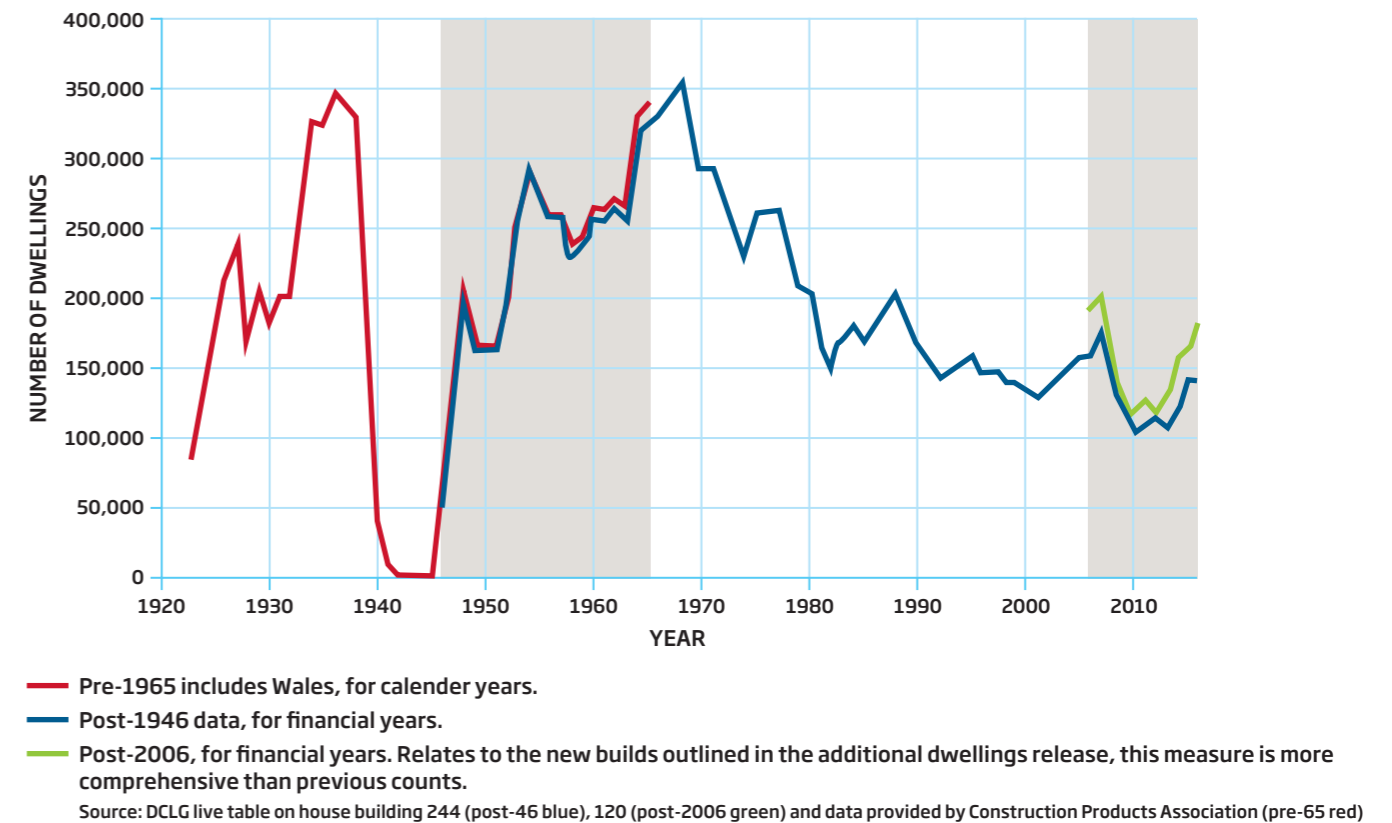
11 Mckee K, Adriana D, Soaita M. The "frustrated" housing aspirations of generation rent. 2018; (August)

12 Baillie, L., Benyon, D. Place and Technology in the Home. *Comput Supported Coop Work* 17, 227-256 (2008). <https://doi.org/10.1007/s10606-007-9063-2>

13 NIC. Partnering for Prosperity: A new deal for the Cambridge-Milton Keynes-Oxford Arc. 2017;1-91. Available from: [www.nic.org.uk/wp-content/uploads/Partnering-for-Prosperity.pdf](http://www.nic.org.uk/wp-content/uploads/Partnering-for-Prosperity.pdf)

14 NIC. Partnering for Prosperity: A new deal for the Cambridge-Milton Keynes-Oxford Arc. 2017;1-91. Available from: [www.nic.org.uk/wp-content/uploads/Partnering-for-Prosperity.pdf](http://www.nic.org.uk/wp-content/uploads/Partnering-for-Prosperity.pdf)

Figure 1 | House building since the 1920s



Delivering SLP that are fit for the future requires a holistic, systems approach that can help tackle many complex and interconnected challenges. A systems approach allows policymakers to explore how elements of the system are interconnected, how they are affecting change together rather than viewing specific components in isolation.<sup>15</sup> To achieve this, systems approaches provide methods and techniques which bring together different perspectives necessary to generate a shared understanding and identify aspects of the system that can be leveraged to achieve the desired outcome.<sup>16</sup> The Acumen+ approach applied in this project was developed by The Omidyar Group and adapted for use by

NEPC for this project. The approach applies core principles and high-level views developed by leaders in systems thinking.<sup>17</sup> The objective here is to illuminate the problem in context and facilitate a conversation about the nature of the solution.

Describing the whole system of placemaking can enable a shared understanding of its behaviours and how they relate to one another in the planning and delivery of SLP. This understanding can be used to better inform the delivery of new homes and places at scale, in a way that is adaptive and facilitates net-zero living.<sup>18</sup>

15 Acumen. 2018. Systems Practice

16 Meadows, Donella. 2011. *Thinking in Systems - a Primer. Environmental Politics*. Vol. 20. Earthscan. <https://doi.org/10.1080/09644016.2011.589585>

17 Jackson and Keys, 1987, *New Directions in Management Science - System of Systems Methodologies*. Forrester, Jay W. 1994. "System Dynamics, Systems Thinking, and Soft OR." *System Dynamics Review* 10 (2-3): 245-56. <https://doi.org/10.1002/sdr.4260100211>

18 UK 2070 Commission. 2019. "Towards a Framework for Action FAIRER AND STRONGER REBALANCING THE UK ECONOMY UK 2070-An Inquiry into Regional Inequalities Towards a Framework for Action." THE FIRST REPORT OF THE UK2070 COMMISSION Purpose of the Commission Towards a Framework for Action. 2019; (May)

## Context of this study



This project was delivered in partnership with the IPA, recognising the need for a systemic perspective on the current system of housing and infrastructure delivery in the UK, and the value of exploring, testing and capturing the process of working with a diverse group of stakeholders. Relevant stakeholders include those from planning, placemaking, design, infrastructure, housing associations, developers, landowners, community organisations and resident groups.

As the government's centre for expertise on delivery of infrastructure and major projects, the IPA was interested in exploring the application of systems approaches to housing, where they are a critical delivery partner. This objective acknowledges that there are power dynamics within planning that cannot be overlooked. The IPA was supportive of a systemic perspective which was to take into account a wide range of stakeholder perspectives in order to inform more holistic planning and delivery of SLP.

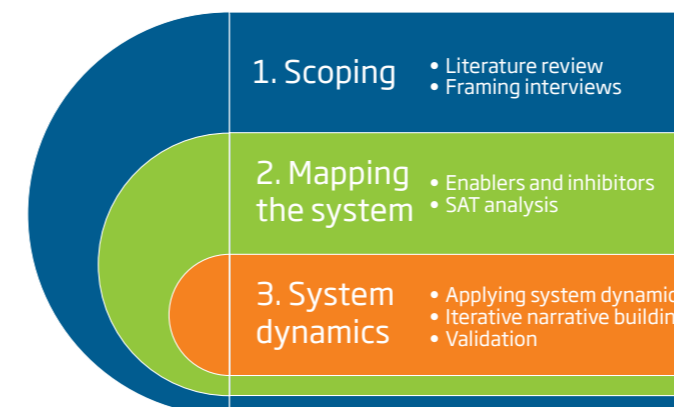
## Overview of method

The study's main stages included scoping, mapping the system and system dynamics. Scoping provided the foundational literature.

Mapping the system included efforts to: convene stakeholders to map their perspectives on the system of housing planning and delivery in the UK, and develop these inputs into an interactive systems map validated with stakeholders. System dynamics included efforts to: examine the interdependencies within and across housing and infrastructure subsystems that impinge on the planning of sustainable living places. This helps to identify leverage points in this system for creating SLP in the UK.

Figure 2 illustrates the main stages of the study. The three stages outlined are described in the sections that follow.

Figure 2 | Systems method



### 1. Scoping

The first stage of the study included a series of scoping interviews across a wide range of stakeholders. Five core themes emerged from these interviews with a systems approach as an opportunity to generate a shared perspective as a cross-cutting theme throughout. The system of housing and infrastructure delivery includes 'hard' infrastructure (water, transport, electricity) and 'soft' infrastructure or services (health, education, social and ecosystem services). Stakeholders highlighted the need to consider attributes such as connectivity, affordability and inclusivity that make places desirable for work and leisure.

The following themes illustrated stakeholders' areas of interest and provided valuable information for the mapping that followed. An illustration of the elements of SLPs that fed into the themes is included in the appendix: page 30. The six themes include:

- Placemaking that is fit for the future** refers to strengthening the connection between people and places through a vision they co-create and co-develop. Placemaking is more than just promoting better urban design. It is responsive to the physical, cultural and social identities that define a place and supports its ongoing evolution in line with these existing identities.<sup>19</sup> This requires a supportive environment that ensures communities have the tools they need and the capacity to deploy them. To embed placemaking at the heart of the system, policymakers must listen to how people want to live in a place and factor in high-quality development to respond to these needs. This requires attention to factors that enable adaptive, resilient, desirable and inclusive places at every stage of development.
- Motivations and incentives of users** who directly engage with the planning system (such as local authorities, housebuilders, landowners, developers and residents). Stakeholders who interact directly with the planning system will have their own specific drivers and motivations, which can act at odds, or in competition, with others in the system. Stakeholders identified different understandings of the system, which risk benefiting some users at the expense of achieving the multiple priorities of SLP. Understanding both relevant stakeholders and users' roles, motivations and levels of comprehension is critical to addressing this gap.

- c. **Ensuring financing, funding and phasing of adequate infrastructure** (economic, environmental and social) to support a growing, successful place requires long term investment to support delivery at the scale and pace of growth required.<sup>20</sup> Mechanisms such as the Ministry of Housing, Communities and Local Government's Housing Infrastructure Fund are responding to the need to deliver infrastructure ahead of housing as an opportunity to introduce financing vehicles and other forms of long-term investment
- d. **Delivering a housing product that society wants and needs** accounts for the ways in which efforts today contribute to a sustainable future. This requires an understanding of how well the system accounts for current needs and pathways towards an increasingly smart, connected and net-zero world. Trends such as an ageing population, increased automation and pandemics will have an impact on domestic life and work practices. These trends should be considered in delivering a desirable built environment.
- e. **High-level national governance strategy to join up delivery where appropriate** requires governance mechanisms that enable joining up between national and local government and equip local authorities to deliver within a national housebuilding programme at scale. This suggests a need for alignment between centralised planning and realities of a market-based economic model and the role of consumer consumption patterns in the current housing system.

## 2. Mapping the system

Using the expertise and insights of more than 50 experts drawn from over 25 organisations from across a range of stakeholder groups, the SLP team conducted two participatory system-mapping workshops and a qualitative system dynamic mapping exercise, which took place between July and September 2019.

The team drew upon stakeholders that represent housing policy, planning, infrastructure, design, placemaking, resident and citizen assembly groups, and local authorities. Organisations were selected to provide a balance across these different categories. Individuals within organisations who provided expertise in this topic area were invited for workshops. Biases toward individual sectors was a concern. To mitigate against biases toward individual sectors, the team recruited stakeholders from a diversity of sectors and communities of practice. The team drew upon stakeholders that represent housing policy, planning, infrastructure, design, placemaking, resident and citizen assembly groups, and local authorities. Organisations were selected to provide a balance across these different categories. Individuals from these organisations were invited to attend workshops.

During the workshops, the team guided stakeholders through a series of group exercises to identify:

- enablers and inhibitors of SLP
- attributes, perceptions and relationships between stakeholders relating to a core theme identified by each table. This is a SAT analysis.

The process and findings are presented in greater detail in the appendix beginning with an overview on page 30: enablers and inhibitors, page 33, and SAT analysis, page 40.

Figure 3 provides a list of participating organisations.

Figure 3 | Stakeholders who contributed to the mapping

National Infrastructure Commission
Cabinet Office
Department for Transport
Bartlett School of Planning and Architecture
Institution of Civil Engineers
Institution of Mechanical Engineers
Ministry of Housing, Communities and Local Government
Homes England
WSP
UK Collaboratorium for Research on Infrastructure in Cities (UKCRIC)
Royal Institution of Chartered Surveyors
Royal Town Planning Institute
The Academy of Urbanism
BRE
University of Bristol
Institution of Engineering and Technology
Berkeley Group
m-labs
Centre for Ageing Better
Fusion21
L& Q Group
Laing O'Rourke
Gascoyne Estates

## 3. System dynamics

After the workshops, the SLP team analysed outputs by mapping the connections between the themes identified. This exercise drew on additional input from workshop participants. This group clustered common themes raised during the workshops. A full overview and description of the methodology and steps taken is included in the Appendix (beginning page 30).

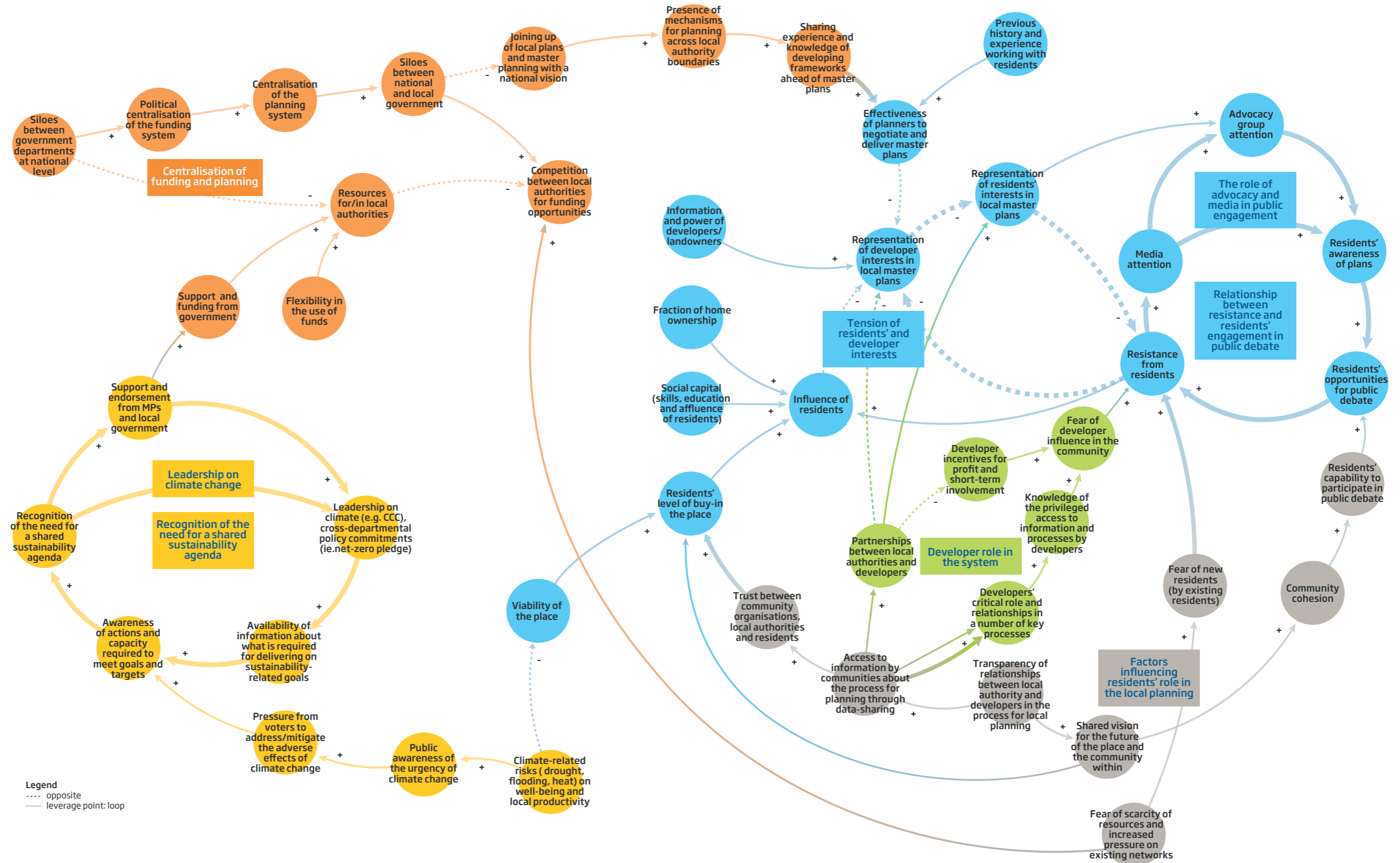
A map of the interconnections and dynamics of the system revealed by this process is included below and is visualised using Kumu, an interactive platform for mapping system dynamics. The team used this tool, as it allows for flexibility and functionality in the map's design, platform sharing with externals and user-friendly data input.

After the workshops and during the system dynamics mapping process, the team shared the results with the working group and asked external experts to provide input, comments and reflection. Initial feedback was collected and incorporated, and the team shared revised versions of the map with stakeholders and asked them to double check that it reflected their input.

The system dynamics map (interconnections and dynamics of the system) reflects the stakeholder perceptions of the system captured during the workshops. The map depicts the **shared perception of the current system and potential leverage points** (loops and highly connected elements) for its improvement. Leverage points draw attention to areas in the system where interventions would strongly influence different aspects of the system. These are starting points for exploring where interventions might have greatest impact, and also where unintended benefits and consequences could result.



Figure 4 | System map of Sustainable Living Places





# The system map

The distinct areas or 'regions' in the map that emerged through the mapping exercise have been assigned different colours. The map is illustrated in Figure 4.

<p><b>Orange</b> Centralisation of planning and funding</p>	<p><b>Green</b> Factors influencing resistance from residents</p>
<p><b>Blue</b> Residents and developers' interests in local planning</p>	<p><b>Yellow</b> Sustainability agenda</p>
<p><b>Grey</b> Factors influencing trust and public participation in local planning</p>	

Table 1 | Journey through the map

Bold connections illustrate potential leverage points (loops or connections between regions of the map that are highly connected to several elements). Table one describes the regions and provides further detail on how each element in the map should be interpreted. See appendix **Part five** | *Journey through the map* for a further narrative and a more detailed description (page 46).

**Centralisation of planning and funding (orange):** This includes issues relating to siloes between government departments and between central and local government. It shows that competition occurs between local authorities for resources allocated by central government. Often, these resources are ringfenced by different government departments.

High-level theme in the map <small>*themes in bold = leverage points</small>	Interpretation
<b>Political centralisation of the funding system</b>	<ul style="list-style-type: none"> <li>Refers to the centralisation of the planning system and centralisation of the tax system.</li> </ul>
<b>Siloes exist between different government departments</b>	<ul style="list-style-type: none"> <li>Refers to ringfencing of funding and delayed payment to local authorities.</li> <li>Local authorities are constrained by type of funding opportunity and by competition.</li> </ul>
<b>Over-competition for resources</b>	<ul style="list-style-type: none"> <li>Refers to competition by local authorities for limited funding opportunities.</li> <li>Over-competition inhibits collaboration and is made worse by a lack of joining up planning.</li> </ul>
<b>Presence of mechanisms for planning across local authorities</b>	<ul style="list-style-type: none"> <li>Within the current system, there is no means of setting a vision for infrastructure and housing planning at a higher level than the individual local authorities.</li> <li>This is despite a shared recognition of the need for coordinated planning at local and national level. As a result, local authorities do not deliver local plans in a coordinated way, and they are not incentivised to work together or pool knowledge and resources to support holistic development.</li> </ul>
<b>Leverage the experience and expertise of developing local plans</b>	<ul style="list-style-type: none"> <li>There is a need to leverage and share the experience and expertise of developing local plans from different local authorities to ensure better coordination and capability across local authority boundaries.</li> </ul>

**Residents and developers' interests in local planning (blue):** This includes issues related to the capacity of local authorities, influence of residents and the representation of developer interests in local planning.

High-level theme in the map <small>*themes in bold = leverage points</small>	Interpretation
<b>Effectiveness of planners to negotiate and deliver local plans</b>	<ul style="list-style-type: none"> <li>Local authorities need to produce local plans with a holistic vision for place that accounts for sustainability, different stages of life and place as a space for work and leisure.</li> <li>Quality is limited by factors related to the capacity, capability and effectiveness of local planners.</li> </ul>
<b>Influence of residents</b>	<ul style="list-style-type: none"> <li>The influence of residents is an enabler of sustainable living places attenuated by different factors: residents' level of buy-in to the place, fraction of homeownership and social capital (skills, education and affluence of residents).</li> </ul>
<b>Representation of developer interests in local planning</b>	<ul style="list-style-type: none"> <li>This is illustrated through a balancing loop whereby the level of resistance from residents balances the level of representation of developers' interests.</li> <li>Level of residents' resistance is influenced by 'The role of advocacy and media in public engagement' and knowledge of the critical role developers play in several processes.</li> </ul>

**Factors influencing trust and public participation in local planning (grey):** Resistance from residents impacts their participation in local planning and is influenced by a variety of factors. Residents' level of influence will vary depending on their social capital (skills, education, networks), level of buy-in, and commitment to, and viability of, the place. Viability refers to how productive and attractive a place is to residents and businesses.

The presence of new residents or a perceived threat from planned developments may influence existing residents' resistance. This is because new residents can be perceived to create pressure on existing services (for example schools, hospitals and public networks, such as roads). Residents may also resist development projects because they are wary about the level of influence developers might have in the community. Some of the reasons underlying this mistrust are illustrated in grey.

High-level theme in the map <small>*themes in bold = leverage points</small>	Interpretation
<b>Trust between communities and a local authority</b>	<ul style="list-style-type: none"> <li>Trust can influence residents' level of buy-in to the place.</li> <li>It can also contribute to the conditions that enable development of a shared vision for the future of the place and the community.</li> </ul>
<b>The shared vision for the future of place and the community</b>	<ul style="list-style-type: none"> <li>This is a prerequisite for community cohesion and positively reinforces residents' capability in participating in public debate.</li> <li>The factors that lead to a shared vision feed into the loop relating to residents' opportunities for public debate.</li> </ul>
<b>Shared vision for the future of the place and the community within</b>	<ul style="list-style-type: none"> <li>This is dependent on factors underlying the influence of residents (highlighted in blue and including the viability of the place, buy-in to the place, fraction of homeownership and social capital).</li> </ul>
<b>Public awareness of the urgency of climate change</b>	<ul style="list-style-type: none"> <li>This is influenced by growing evidence and effects of climate-related risks on wellbeing and local productivity.</li> <li>This has led to increased pressure from voters to address and mitigate the adverse effects of climate change.</li> </ul>



**Factors influencing resistance from residents (green):** Conditions that enable or inhibit resistance from residents include the effectiveness of local authorities to design master plans and residents' opportunities for engaging in public debate around local planning. Participation in planning decisions is influenced by a range of factors (in pink) such as the transparency of relationships involved in the planning process; a lack of transparency can have implications for residents' participation in local planning and their buy-in.

#### High-level theme in the map

#### Interpretation

\*themes in bold = leverage points

#### Resistance from residents

- Resistance from residents' can be strongly influenced by the fear of new residents and the perceived scarcity of resources which could arise due to increased pressure on existing public services (health, education, traffic) and infrastructure (road and rail).

#### The fear of developer influence in the community

- This fear is influenced by **knowledge of developer incentives for profit** and influence they have in **partnerships with local authorities**.
- This fear is also influenced by the visibility of **developers' role and relationships in several processes**.

#### Access to information about the process for planning

- There are some mechanisms in place such as the Community Infrastructure Levy (meant to ensure there is contribution to public goods and services).
- Enforcement of this legal provision varies dramatically. Information about this, as well as factors such as the fear of developer influence in the community, is connected to resistance from residents.

**Sustainability agenda (yellow):** Stakeholders perceived a recognition across government of the need for a shared sustainability agenda that has support from government departments, MPs, local government and the public. This agenda can drive leadership for climate action, for example through the Committee for Climate Change and the implementation of its recommendations. Stakeholders expressed a desire to meet policy commitments for net zero by 2050 and suggested that such a step requires alignment and strong leadership. Participants identified this shared priority as a critical opportunity to deliver systemic change towards establishing SLP.

#### High-level theme in the map

#### Interpretation

\*themes in bold = leverage points

#### Recognising the need for a shared agenda

- This shared agenda around sustainability and climate change emerges from a 2050 commitment to net zero.
- Pressure from voters to mitigate or address adverse effects of climate change can influence the loop.

#### Support and endorsement of this agenda from MPs at a national level to local government

- Effective leadership on climate change and cross-departmental policy commitments (for example Committee on Climate Change) have led to actions to improve the availability of information about what is required to deliver sustainability goals.

#### Climate related risks and viability of place

- Productivity levels and attractiveness of the place influence the viability of place the place. These factors influence reasons why residents commit to a place.
- Social capital of residents (skills for participation in civic life, education and affluence) and resistance from residents contribute to the level of influence that residents have in local planning.

## Key findings

The map presents a view of the current system informed by stakeholders' perspectives. It has five key regions and illustrates leverage points, which could be high-level intervention points such as goals and values, vicious cycles or aspects that are highly connected to different areas within the system.

The map of system dynamics achieves several things:

- It highlights tensions, or paradoxes, within the system such as centralised decision-making about the planning system at a national level versus the mandate to deliver housing and public services at local authority level.
- It illustrates multi-level relationships in which the local perspective is a sub-system of the national perspective. The role of central government is to generate coherent national policy and the role of local government is to act on that policy in a manner that reflects and respects the local needs.
- It shows causal relationships between different behaviours in the system.



## Leverage points

**Leverage points** draw attention to areas in the system where interventions would strongly influence different aspects of the system. These are starting points for exploring where interventions might have greatest impact, but also where unintended benefits and consequences could result.

This section describes the potential leverage points in the map more fully from the perspective of delivering SLP and with attention to opportunities for improving and influencing the system. A 'Journey through the map,' that describes this in greater detail, is included in part five of the appendix. [See page 46.](#)

- a. **Encouraging the development of a sustainability agenda around the target for net-zero greenhouse gas (GHG) emissions** to catalyse a coherent cross-government plan for housing, infrastructure and placemaking. This draws upon the recognition across government of the need for a shared sustainability agenda that has support from government departments, MPs, local government, and the public. As there are a range of different stakeholders, interests and motivations across the system, the net zero target emerges as a promising, shared agenda which could provide a basis for aligning interests.

This agenda can drive strong leadership on climate action, for example through the Committee for Climate Change and the implementation of its recommendations. Stakeholders expressed a desire to meet policy commitments for net zero by 2050 and saw such a step as requiring alignment and leadership. Participants identified this agenda as a critical opportunity to use this shared priority as a vehicle for delivering systemic change towards establishing SLP. At a local level, this would mean development frameworks and local plans are aligned with this national sustainability agenda. This would be a catalyst for coordinating funding across central government.

- b. **Facilitating support for local planning and better master planning** that promotes:

1. the creation of mechanisms that enable planning across local authority boundaries; and
2. efforts to level up by addressing regional disparities in productivity and access to social infrastructure.

- c. **Providing a flexible funding model to enable holistic business cases for place that can be administered nationally or locally.** Holistic business cases for place would account for factors that enable high-quality developments, meet demands for public services and engage residents actively in delivering places.

This would include greater flexibility over the way value is assessed and delivered which can help design more holistic business cases around place. Local authorities need the flexibility to develop schemes that are bespoke to their local conditions. Local authorities are mandated to provide more housing but can experience resistance from current residents. Fear can arise due a perceived shortage of public services (healthcare, education and transport) and goods (leisure, groceries, shops) as a result of population increase and there are further concerns around disruption as a result of long-term construction. This would require models that incentivise longer-term involvement and include more holistic engagement from stakeholders at critical stages in the development process.

This draws upon the leverage points that would reduce fear for residents around the introduction of new residents and encourage investment in local infrastructure. This would help address shortage of public services that could result from increased demand by growing communities through new development.

- d. **Providing technical advice and financial support to planners in local authorities to address internal barriers to good master planning and delivery.** This includes resources for increasing the number of, and providing technical capacity for, existing staff. This would improve local capacity and capability for developing high-quality local master plans and encourage meaningful participation by residents. The tension here is between the pressure local authorities face to provide more housing and a lack of capacity and capability to deliver and execute master planning. This would include providing support to local authorities to address gaps in technical and financial resources.

Meaningful participation from residents and a coherent set of policies and mechanisms for planning enforcement can improve local planning outcomes. Capacity of local planners is another barrier to a successful local plan. Capacity refers to both the technical and administrative capacity in local authorities to deliver. Improving these factors can potentially provide greater opportunities for identifying external support at a local level and create an environment for greater resident participation.

- e. **Harnessing the power of data sharing to promote access to information about the planning process.** This would include platforms for improved digital collaboration to enable better communication of the value of high-quality development to existing communities and empower those currently unable to access the planning process. The desired outcome would be to build trust between communities, local authorities and residents.

This will influence residents' opportunities for, and openness to, meaningful debate and participation in local planning. Access to information about the planning process can increase understanding of critical processes and the role of developers. This can strengthen understanding of the partnerships between local authorities and developers, including knowledge of, and trust in, mechanisms that enable cooperation. There is risk here that if access to information is misused or abused, it could have unintended consequences.

# Discussion

## What does the systems approach teach us about achieving SLP?

This project applied the Acumen+ systems approach, which is based on techniques for qualitative, participatory mapping of systems, to the housing and infrastructure system. The process has brought into focus interactions between the current system for planning and funding at national level, the context for local planning, the role of residents and developers, and the potential role that a shared sustainability agenda might play in driving change across all levels of government.

Specifically, and as outlined above, the study identified several points of leverage that serve as starting points for improving the system to deliver SLP.

- Encouraging the development of a sustainability agenda around net-zero.
- Facilitating support for local planning and better master planning.
- Providing a flexible funding model to enable holistic business cases for place.
- Providing technical and financial support to planners in local authorities to address internal barriers to good master planning and delivery.
- Harnessing the power of data sharing.

The recognition of a shared agenda for sustainability emerged from participants as a potential opportunity to encourage more joined-up and integrated ways of working between central government and local authorities. A direct impact for local authorities harnessing this shared agenda would be mechanisms for enabling planning across local authorities.

The shared agenda can inform participation from different stakeholders early in the planning process. There is an opportunity to join up the process for how local authorities generate local plans through a national agenda given the national priority for planning reform.

This agenda could: Provide mechanisms for enabling planning across local authorities to help address disparities across regions; address the capacity and capability of local planners; and provide opportunities for residents to contribute. The evidence for the potential influence in the current system is its strong connectivity to different aspects across the system.

Understanding how the actions are connected to the system's wider function at the national and local level is another benefit of this approach.

## What does the SLP example show us about applying a systems approach and systems dynamics principles to complex policy problems?

There are many ways (techniques, models, tools) of applying systems approaches. The choice of approach should start with a consideration of the needs or purpose being addressed and the nature of the problem (what is known, what is not, the diversity of perspectives and so on). This project adopted a participatory approach to mapping the system for SLP. However, lessons from this work may have broader application to other complex policy problems. This section presents some strengths and challenges that emerged in relation to the approach adopted for this project.

The project demonstrates some of the **strengths of a qualitative, participatory systems approach**. These are detailed below.

- A guided process for identifying enablers and inhibitors:** A core strength of the approach is the guided process for thinking through the system's enablers and inhibitors with stakeholders. Stakeholders who would not usually interact shared how they perceive and interact with the system (as integral elements of the system) through this process. This diversity in the group provides a deep and well-rounded analysis of enablers and how factors such as attitudes, relationships and institutions relate to them.
- Develop a understanding of the system:** The strength of a participatory systems approach such as the Acumen+ approach is the engagement and interaction with stakeholders across the system that takes place during the process. This interaction generates a common language for working across the different sectors, disciplines, and industries.

A quote from a planning and surveying stakeholder: *"The importance of engaging with a diversity of professionals cannot be stressed sufficiently. We all come with our professional prejudices, which benefit from being challenged through encountering other perspectives on the same problem."*

Stakeholders play a critical role in contributing to a shared understanding of a complex system in which they play a part. This shared perspective can help to inform an approach to the design and evaluation of solutions and potentially contribute to building stakeholder buy-in.

- Complements sector-specific expertise:** The creation of a system-level view complements and contextualises input from subject experts tackling this issue from a sectoral perspective. For example, stakeholders involved in planning who interact with those from transport infrastructure can contribute to collaborative cross-sectoral work. This can be a useful starting point for creating shared visions and ensuring better coordination of infrastructure delivery.
- Enables identification of potential leverage points:** Each of the likely points of leverage in this study come from identifying loops in the map and connections between regions in the map. These emerged from a synthesis of perspectives from stakeholders who engage with the system for housing and infrastructure at different stages of the process. The systems approach reveals understanding of where an action can influence different parts of the system. The systems approach opens opportunities for continued engagement with stakeholders as the findings emerge, which are then refined through iterative review and validation. As leverage points are identified, this potentially means a clearer understanding of the areas where intervening in the system is likely to have strong influence.
- Illustrates complex and engrained behaviours:** A systems approach illustrates system complexity and where certain behaviours may be endemic. For example, the ways in which residents resist new development are influenced by their own experience of participating in the system and, potentially, a preconception that these plans will not address their needs. The plans may be inadequate, fail to address the developers' participation in the system and/or maximise sustainability within the plan. Improving access to information about the process for participation in local planning through data-sharing can influence the level of trust between community organisations, residents and local authorities, and help develop a better understanding of these embedded behaviours. An approach that maximises sustainability might meet less resistance.

- Inform a discussion about unintended consequences:** A systems approach can inform a discussion around how potential interventions the system can cause unintended consequences. The identification of leverage points shows where changes will influence other parts of the system. For example, improving access to information on the planning process can influence how residents navigate it. There may be unintended consequences if information is misused or misinterpreted or if there are disparities between those residents who have access to information and those who do not. The process of identifying leverage points can inform creative thinking and a wider discussion about potential unintended consequences.

Systems approaches do not provide a 'silver bullet': They do not provide a quick answer to fix the problem, or a simple solution. Rather, they provide a process for **generating a systemic understanding with stakeholders and identify areas in the system where an intervention could potentially have leverage**. However, it should be acknowledged that it is the nature of complex problems that they are not amenable to simple solutions, they may require legitimate power to enact systemic change. Systems approaches therefore provide a means of probing, learning and honing in on potential solutions in a way that gives due attention to the relevant perspectives. It is also important to note that perspectives would need to be appropriately weighted.

Nevertheless, several challenges in deploying a **participatory systems approach** emerge from this project:

- The participatory process is fairly resource intensive:** A successful systems approach to inform policy development requires continued and iterative engagement with stakeholders. Managing these expectations and planning with stakeholders is important for maintaining long-term stamina, interest and participation. This includes the process of scoping, developing an understanding of the system, identifying leverage points, and understanding unintended benefits and consequences. This is an important consideration where quick policy solutions and pressure to deliver solutions are required. Engagement and planning at early stages can enable faster delivery.



b. **A systems approach is not a predictive tool:** The findings presented in this paper can be used to inform a common articulation of the system but cannot be used for forecasting or predicting impact. Following on from development of the system map, further work can identify the strength of the linkages and their relative importance to inform prioritisation. At this stage, this would be useful for testing the potential leverage points through scenario analyses as opposed to generating predictions.

c. **The range of stakeholders involved at a given point in time limits the scope:** The perspectives reflect a view of the system from a select (albeit diverse) group of stakeholders and provide a snapshot at a given point in time from a specific context. The map's output reflects diversity of stakeholders **at that point in time**. During the validation process, some stakeholders raised the focus on the planning system and the role of residents as having greater detail than the financing system and the role of developers. The focus on the planning and governance aspects skewed the map to focus on early stage of new developments (pre-planning approval) rather than the focus on financing and delivering through the infrastructure financing and construction phases. There was also evidence in these early discussions that the description of developers as being homogenous defies the inherent diversity in the types of developers, their scale, business models and the levels of influence they may or may not have. These lessons learned and limitations are documented for further exploration in future work.

As the political, economic, technological and demographic characteristics of the population shift, it will be critical to understand the effect these factors have on the overall system. One way to account for these contextual shifts might be to include an ongoing longitudinal case study or a scenario-based trial. Informed by a systems approach, a longitudinal study with a clear hypothesis and where stakeholders could provide updated information at various points in time could address the limitation of focusing on one point in time.

d. **The focus is on causal relationships, rather than other dynamics of the system:** The mapping exercise focuses on causal relationships where there may be illustrations that reflect the relationships more astutely. In this report, care has been taken to

develop and include a narrative that describes how these relationships operate and could be developed further through qualitative methods to discuss the context around each relationship, as well as include nonlinearities and delays. There are other types of relationships that could be explored.

e. **The process of change required is not obvious:** This descriptive approach to the system provides the big picture context from which the policy challenge emerges. However, it may not always provide the interim steps for how change could be implemented. There are other diagnostic methodologies that can provide a process for change. This is where an innovation process for problem-solving for example, theory of change, that frames the problem in the context of systems thinking would be particularly complementary. There are several options and the choice should reflect the ultimate objective.

f. **In creating a big picture view using this approach, detailed representations of sub-systems may not emerge:** While the Acumen+ approach applied in this project provides a big picture view of the system of systems, this case did not delve deeply into the systemic issues facing specific sub-sectors (such as transport, electricity, water). While there were representatives from across these different sectors and other stakeholder groups (such as ageing, placemaking, design), the detail of the dynamics of these sub-systems is less visible. This is partly a reflection of the main themes arising from workshop participants and partly a reflection of aspects in the system that were prioritised for discussion and/or where there was consensus. Exploring these subsystems in more detail and/or with a policy question specific to that sector would help to explore these subsystems more fully.

## Conclusion

Many poor outcomes and unintended consequences may occur in a system especially where stakeholders struggle to understand the different perspectives and interests which influence it. Applying a systems approach to a complex policy challenge offers insights on how those perspectives interact to shape the development of a place. This process helped to identify potential leverage points which have wide-reaching influence in the system and improve the prospect of aligning those interests towards creating a sustainable, happy and adaptive place. In this project, we have set out those leverage points at a high level and documented the process of involving a diverse group of stakeholders as a step towards enabling greater impact.

## About SLP

The SLP project was delivered in partnership with the IPA. The project was led by the Engineering Policy Team at the Royal Academy of Engineering, a partner in the National Engineering Policy Centre (NEPC).

## References

- Acumen. 2018. Systems Practice.
- Baillie, L., Benyon, D. Place and Technology in the Home. *Comput Supported Coop Work* 17, 227–256 (2008). <https://doi.org/10.1007/s10606-007-9063-2>
- Peter Checkland & John Poulter. 2010. Soft Systems Methodology. DOI: 10.1007/978-1-84882-809-4\_5. Systems Approaches to Managing Change: A Practical Guide
- Davies, M., and T. Oreszczyn. 2012. "The Unintended Consequences of Decarbonising the Built Environment: A UK Case Study." *Energy and Buildings* 46: 80–85. <https://doi.org/10.1016/j.enbuild.2011.10.043>
- Forrester, Jay W. 1994. "System Dynamics, Systems Thinking, and Soft OR." *System Dynamics Review* 10 (2–3): 245–56. <https://doi.org/10.1002/sdr.4260100211>
- HMT, 2019. *HM Treasury's review into funding the transition to a net zero greenhouse gas economy: terms of reference*
- Jackson and Keys, 1987, *New Directions in Management Science - System of Systems Methodologies*
- Kumu. n.d. "Systems Practice Workbook," 94. <https://docs.kumu.io/content/Workbook-012617.pdf>
- Leeming J. Building the future. *Nature*. 2018;557(7706):S31–3
- Letwin, Oliver, 2018. Independent Review of Build Out Rates
- Mckee K, Adriana D, Soaita M. The "frustrated" housing aspirations of generation rent. 2018;(August)
- Meadows, Donella. 2011. *Thinking in Systems - a Primer. Environmental Politics*. Vol. 20. Earthscan. <https://doi.org/10.1080/09644016.2011.589585>
- NIC. Partnering for Prosperity: A new deal for the Cambridge-Milton Keynes-Oxford Arc. 2017;1–91. Available from: [www.nic.org.uk/wp-content/uploads/Partnering-for-Prosperty.pdf](http://www.nic.org.uk/wp-content/uploads/Partnering-for-Prosperty.pdf)
- Sterman, John. 2000. "Causal Loop Diagrams." In *Business Dynamics: Systems Thinking and Modelling For the Complex World*, 137–90. TBS (2000)
- UCL-MOIS. 2019. "A Mission-Oriented UK Industrial Strategy," no. May: 106. [www.ucl.ac.uk/bartlett/public-purpose/sites/public-purpose/files/190515\\_iipp\\_report\\_mois\\_final\\_artwork\\_digital\\_export.pdf](http://www.ucl.ac.uk/bartlett/public-purpose/sites/public-purpose/files/190515_iipp_report_mois_final_artwork_digital_export.pdf)
- UK 2070 Commission. 2019. "Towards a Framework for Action *Fairer and stronger rebalancing the UK economy UK 2070 - An Inquiry into Regional Inequalities Towards a Framework for Action.*" *The first report of the UK 2070 Commission* Purpose of the Commission Towards a Framework for Action. 2019; (May)

## Abbreviations and acronyms

### National Engineering Policy Centre

NEPC

### Infrastructure and Projects Authority

IPA

### Sustainable Living Places

SLP

### Sustainable Development Goals

SDGs

### Information, Communication and Technology

ICT

### Oxford Cambridge Corridor

Ox-Cam

### Structures, Attitudes and Transactions Analysis

SAT analysis

### Greenhouse gas

GHG emissions

## Acknowledgements

### The project was overseen by a working group:

#### Tim Chapman FREng

Arup (Chair)

#### Dr Steve Denton FREng

WSP

#### Victoria Hills MRTPI FICE

Royal Town Planning Institute

#### Professor Gordon Masterton OBE DL FREng FRSE

University of Edinburgh

#### Francis Mills

Institution of Mechanical Engineers

#### Steve Yianni FREng

Independent Consultant

#### Dr Nici Zimmermann

University College London

The Bartlett UCL Institute for Environmental Design and Engineering

### With authorship and strategic project management from the following staff:

#### Dr Corina Shika Kwami

Policy Advisor, Royal Academy of Engineering (Project Lead)

#### Dr Philippa Westbury

Senior Policy Advisor, Royal Academy of Engineering

#### Dr Andrew Chilvers

Senior Policy Advisor, Royal Academy of Engineering

### Special thanks to the organisations who contributed at various stages to this project:

National Infrastructure Commission

Cabinet Office

Department for Transport

Bartlett School of Planning and Architecture

Institution of Civil Engineers

Institution of Mechanical Engineers

Ministry of Housing, Communities and Local Government

Homes England

WSP

UK Collaboratorium for Research on Infrastructure in Cities (UKCRIC)

Royal Institution of Chartered Surveyors

Royal Town Planning Institute

The Academy of Urbanism

BRE

University of Bristol

Institution of Engineering and Technology

Berkeley Group

m-labs

Centre for Ageing Better

Fusion21

L&amp;Q Group

Laing O'Rourke

Gascoyne Estates

### External reviewers:

#### Professor Alan Penn

Chief Scientific Adviser

Ministry of Housing Communities and Local Government

#### Professor Brian Collins CB FREng

UKCRIC Deputy Convenor (UCL)

#### Dr Elanor Warwick

Head of Strategic Policy and Research

Clarion Housing Group

#### Dr Jean Venables CBE FREng FICE

Director, Venables Consultancy

#### Professor John Beckford, Ph.D., MMS., F.Cyb.S., FRSA, FIET

Beckford Consulting

#### Kathryn Tombling

Architect Director, BDP

#### Stephen Wells

Executive Director

Planning &amp; Advisory Business Unit, WSP

#### Professor Nick Tyler FREng

Chadwick Professor of Civil Engineering at UCL and PEARL (Person-Environment-Activity Research Laboratory)

### Opportunities to share work at various stages of development enabled by:

UK Collaboratorium for Research on Infrastructure in Cities, LSE Cities, Imperial College Centre for Systems Engineering and Innovation, Fusion21, New Civil Engineer magazine, The Edge, Infrastructure Projects Authority and the Ministry for Housing, Communities and Local Government.

### Cover illustration:

Becky James and Natalia Talkowska

Natalka Design Studio



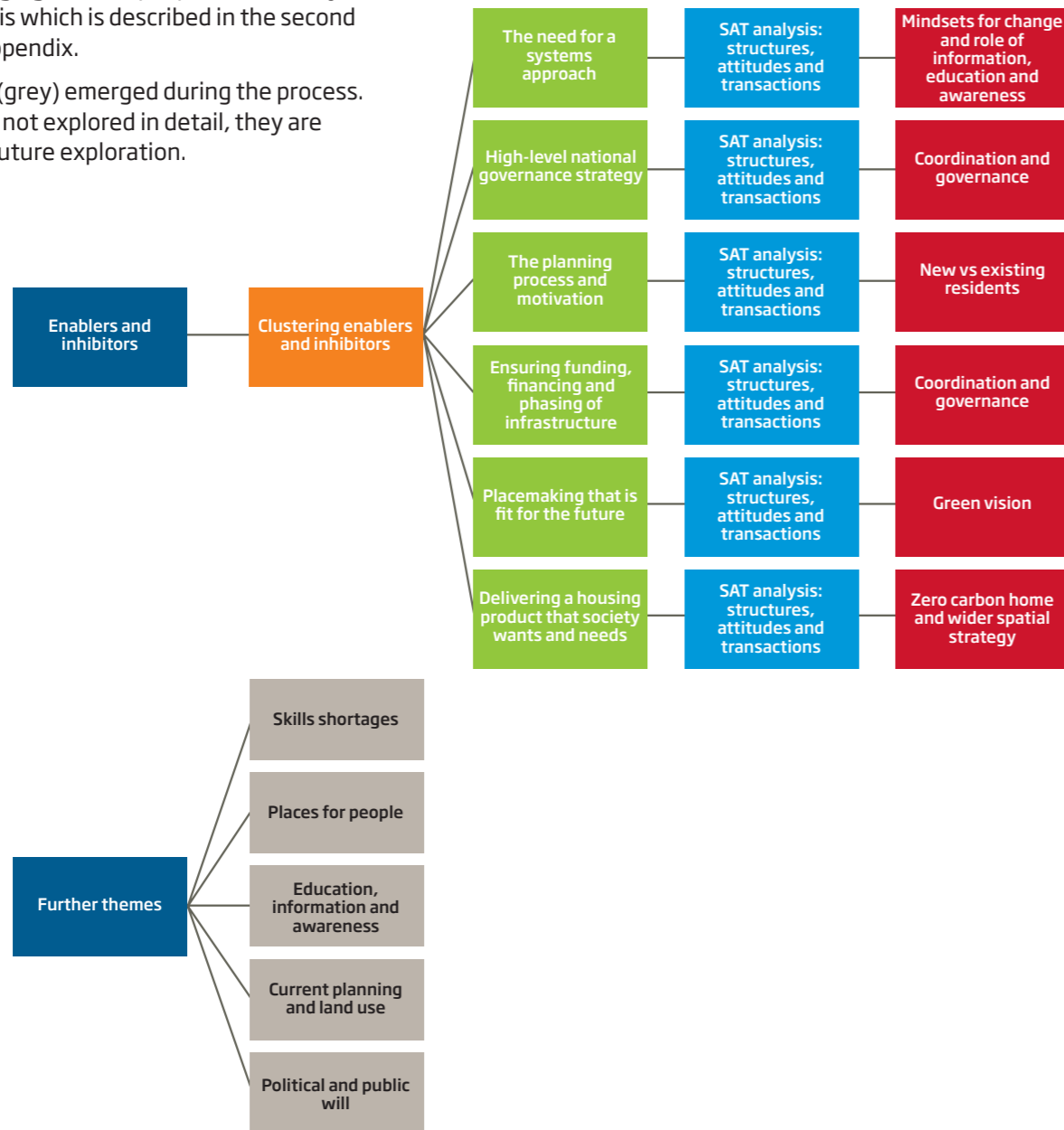
# Appendix

The appendix describes each stage of the method, which was outlined in the section 'Overview of Method'. This includes the **participatory system mapping stage of the project and the system dynamics analysis**.

## Participatory mapping

This diagram shows the steps involved in the participatory mapping process, which is described in the first section of the appendix. The steps are: Identifying enablers and inhibitors (dark blue), clustering enablers and inhibitors (orange to green) in preparation for an analysis of structures, attitudes and transactions (blue). The emerging themes (red) fed into the system dynamics analysis which is described in the second section of the appendix.

Further themes (grey) emerged during the process. While they were not explored in detail, they are highlighted for future exploration.



## 1. Participatory mapping methodology

The team used the Acumen+ systems mapping approach for social impact purposes (Acumen 2018) for the participatory mapping component of the work. Jay Forrester's principles on system dynamics informed the system dynamics analysis (Forrester 1994). To select these approaches among the different system mapping and tools available, the SLP team consulted stakeholders working with systems approaches for complex policy problems. The team acknowledges that there are many different approaches. The Acumen+ approach is useful for complex policy problems because it provides a **curated process for working with stakeholders to identify behaviours within and across the system**.

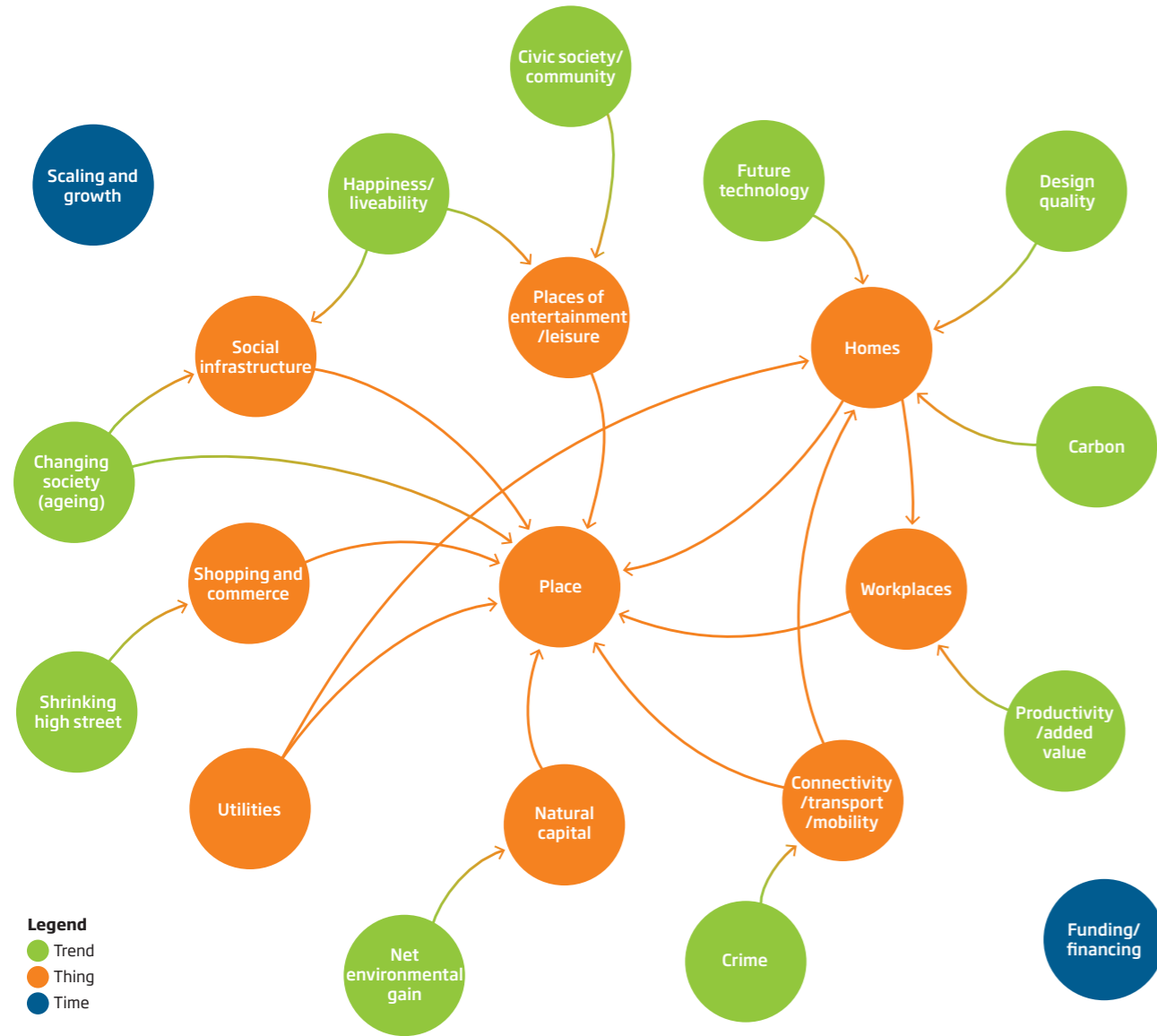
Figure 5 (on page 32) presents a map showing the system elements of SLP. The arrows, representing connections between elements, were suggested by stakeholders during the initial information gathering phase. The connections show possible links between themes and the importance of putting "place" at the centre. They were drawn for **purely illustrative purposes to show where connections might exist between elements and are by no means discrete, exclusive or exhaustive**.<sup>21</sup> At the scoping stage, the intention was to gather a breadth of themes rather than to rank them. The elements fed into themes, which are described on page 13.

An approach that would facilitate engagement with a range of stakeholders, both within and beyond engineering, was investigated. The SLP team reached out to a diverse group of stakeholders for the participatory mapping workshop. These stakeholders include representatives from:

- Professional engineering institutions (PEIs), including the Energy Institute, the Institution of Engineering and Technology, the Institution of Civil Engineers and the Institution of Mechanical Engineers.
- Government bodies, such as Homes England.
- Private sector partners, such as BRE Group.
- Academic institutions, including University College London and the University of Bristol.
- Thinktanks, such as the Centre for Ageing Better.
- Independent consultants and advisors.

<sup>21</sup> The elements and connections were not weighted at this early scoping stage

Figure 5 | System elements of SLP that informed the initial framework



### Enablers and inhibitors of SLP

During the workshops, participants reflected individually on enablers and inhibitors of SLP and shared them in group discussion.

- **An inhibitor** is a significant force in the environment that undermines or prevents the health and effectiveness of the system as defined by the overall purpose.
- **An enabler** is a significant force in the environment that supports, encourages or increases the health and effectiveness of the system as by the overall purpose.

A full list of enablers and inhibitors collected over the two workshops can be found in **tables 1 to 6 below**.

The enablers and inhibitors are grouped by the **themes that emerged** during the scoping phase (see page 13).

General statements relate to the system whereas specific statements speak to a sub-system or focused aspect of the system.

The descriptions emerged from the participants' post-it notes. Any amendments or interpretations are included in *italics*.

Table 1 | The need for a systems approach

Enablers	Inhibitors
Understanding of digital tools	Disconnect between consumers and systems
Cross-disciplinary skills in working across sectors	Lack of a systems approach to delivering sustainable infrastructure
Communication across disciplines	Siloed thinking
Representations of the systems or group of systems that join up housing, infrastructure and related social, economic and political systems	Problems that are influenced by other systems
Systems leadership as part of effort to improve governance	Fragmentation of the sector
Efforts to create accountability across ministerial departments in delivering a shared vision	Mindsets, attitudes and perceptions that inhibit a systems approach
Mindsets, attitudes and perceptions that enable a systems approach	Lack of focus from policymakers on infrastructure systems beyond transport
Quality of data and evidence	Lack of active listening
	Oversimplified definitions of key terminology



Table 2 | High-level national governance strategy

Enablers	Inhibitors
Mechanisms to improve transparency	Lack of joined-up thinking
Political and public will to change	Dysfunctional governance at various levels
Appropriate communication and consensus at all levels	Small number of actors and different objectives at a general level
Clarity of governance structures	Poor political intervention
Mechanisms to promote transparency	Lack of focus on infrastructure beyond transport
Willingness of stakeholders to support a spatial strategy that clearly defines the roles and responsibilities at national, regional and local levels	Lack of political will sustained over political cycles as a systemic problem
Focused effort at all levels of government to define what a spatial strategy would mean for households and neighbourhoods if implemented with a green mandate in mind	Fragmentation and lack of alignment
Opportunity to use data to connect silos and increase visibility	Lack of collaboration between the stakeholders that deliver policy on the ground and society
Better awareness of the urgency of issues	Lack of future visioning in planning
Widespread enthusiasm for better development	Lack of long-term, sustained political will
Mission oriented approaches	Lack of connection between government budgets regarding housing and health policies
Alignment of values and stewardship of landowners and developers	Uncertainty about how to rank/prioritise decisions
	Political inertia/short-term electoral cycles

Table 3 | The planning process and motivation

Enablers	Inhibitors
Ability to access, manage and control land	Lack of incentives towards more holistic delivery of homes
Transparency and understanding	Lack of incentives towards improving rented properties
High house prices and low building costs	Land ownership and economic rent extraction
Leadership in the context of early engagement with the public on how land is allocated and used	Lack of transparency of land ownership ( <i>need to pay to access register</i> )
Education on the benefits of how national infrastructure can be shared with local communities	Disconnection between how the community infrastructure levy is used and the needs and priorities of the community
Communication of national policy from central government, and engagement across different levels of government	Fear of change related to volume housebuilding culture
Hooking up big picture to local scale	Resistance to change by communities
Space approach to decision-making and prioritising	Lack of trust by council averse to risk
	Insiders vs outsiders (issues around nimbyism and house price inflation)
	Long timescales for large planned plots
	Small land plots that are associated with an inability to consider wider place
	Limited means of producing housing (few large developers and limited scope for housing associations)

Table 4 | Ensuring funding, financing and phasing of adequate infrastructure

Enablers	Inhibitors
Cost-effectiveness and comfort improvements of efficiency retrofits/upgrades	Fear and obsession with the bottom line ( <i>stifles vision</i> )
Increased access to finance through new business models	Funding and value creation ( <i>social and economic</i> )
Potential for new innovations in finance and ownership models	Myths around funding ( <i>for example, sustainability is costly</i> )
Leadership that shows strong business cases with detail on economic and social benefits and priorities at the appropriate scale	Lack of finance because of a big market without guidance on the endgame and how to achieve it to follow through strategically beyond a one-off project
Value creation in the context of a financial system where affordability is a need	Fragmented approach creates difficulty to resource efficiently for delivery
	Community resistance is a potential barrier to adopting solutions
Economic aggregation of local drivers	Short-term financial and political priorities vs long-term outcomes
Balancing finance for hard and soft infrastructure ( <i>built aspects, public spaces, and social infrastructure</i> )	<i>Viscosity of business model change (including planning)</i>
Localisation of employment	Resistance and other barriers to adopting new technology solutions
	Manipulation of viability clause
	Skills shortage

Table 5 | Placemaking that is fit for the future

Enablers	Inhibitors
Efforts that build and/or expand networks of green spaces: green corridors, wildlife, cycle routes, walking, health, pleasure and wellbeing	Lack of big picture thinking and vision
Support for efforts to improve natural capital	Lack of thinking and designing for broader societal outcomes
Recognised need for a spatial vision	Lack of clarity on who places are for/lack of customer focus
A vision that retains local culture and accommodates needs of different demographics, working patterns for the future, continuity over a life course and economic aspects	Fear and obsession with the bottom line was flagged as an inhibitor to delivering sustainable, happy, low-carbon places that are fit for the future
A vision that accounts for the big picture	Piecemeal approach to project development
Conversations on who has the power to make and champion change	Density in rural areas to sustain community facilities
Learning from best practices and lessons learned from organisations that have the critical mass to make change	
A master developer that can incorporate infrastructure and community planning	
Designing places with 'build, live, work' to move away from commuting	
Early engagement for public feedback	



Table 6 | Delivering a housing product that society wants and needs

Enablers	Inhibitors
Development of places that are liveable, smart, connected and low-carbon	Absence of sectoral linkages and pathways for decision-making
Flexible funding for use between generations	Financial austerity and constraints on spending at a local level
Plans that account for resilience, ageing societies, digital growth and changing nature of work	Lack of knowledge and dissemination of plans and strategies to local communities
Leadership to show strong business cases with detail on economic and social benefits	Poorly considered vision
Open data/data sharing can be an enabler	Conservative behaviour of conservatives ( <i>lack of desire to change</i> )
Discussions with organisations with critical mass to make change happen are needed	
New technology and construction methods	
Cost-effectiveness and comfort improvements of efficiency retrofits/upgrades	Accessible homes ( <i>currently not happening outside of London</i> )
Incentivising efficient new buildings through entire construction chain (design/build/commission)	Lack of thinking and designing for broader societal outcomes
Growing awareness of need for more holistic approach to climate/future	Inappropriate designs for people wishing to downsize
	Difficulty in commissioning and operating buildings to their designed energy performance

The enablers and inhibitors exercise highlighted additional themes, beyond those identified during the initial scoping phase (see page 13). The additional themes are listed below.

Figure 6 includes additional elements that emerged from the workshops (shown in yellow).

**Places for people**

**Current planning and land use**

**Skills shortages**

**Education, information and awareness**

**Political and public will**

**Communication**

**Places for people**

Places for people - putting people at the centre of placemaking - was a consistent theme that emerged throughout the discussions and must be taken into consideration for SLP. This theme refers to challenges that arise from failing to consider people, and the relationship between place and broader societal outcomes.

Stakeholders identified inhibitors such as a lack of clarity about who new developments and places are for, a lack of a customer focus in designing places for the end user and nimbyism by existing residents.

**Current planning and land use**

Current planning and land use was a theme that emerged in discussions relating to the role of landowners and developers. This included descriptions of how landowners access, manage and control land and have an influence on how land could be used. Their role in the system is linked to challenges including land availability and suitability (ownership and planning), long timescales for large planned plots (increased risk), and the rate of change of regulation and policy.

**Skills shortages**

Shortages in skills and talent were referred to in relation to the construction and building sector, although there was an acknowledgement that this is a challenge that influences different sectors beyond construction.

**Education, information and awareness.**

This refers to the understanding of what makes a sustainable living place and awareness of what is required to achieve it. This can include school education and public engagement in the planning process.

**Political and public will**

Emerged in relation to the need for better awareness of how the planning system is performing through quality of data and evidence, and information that helps to create connections between communities, aspirations and needs. This includes pathways for direct policy engagement.

**Communication**

With a proliferation of interdisciplinary and cross-sector networks, there are efforts to promote good communication, knowledge sharing, and data and information availability about the planning process and development project delivery to enable joined-up thinking across disciplines and sectors.

Stakeholders also suggested removing connections between themes in Figure 6 at this stage, as the map should focus on the breadth of elements as opposed to connections between them.

Figure 6 | System elements post workshop one



### Clustering and prioritising enablers and inhibitors

Participants clustered related enablers and inhibitors into themes and prioritised themes for more detailed discussion. From the two workshops held, the following six themes were prioritised:

1. Coordination and governance for housing delivery.
2. Role of education in creating holistic places.
3. Different motivations between new and existing residents.
4. Mindsets to change include attitudes that enable or inhibit systems thinking.
5. Zero-carbon home in the wider spatial strategy for the UK, refers to spatial thinking and operating at different scales of governance in which to enact decisions.
6. Setting a green vision, which refers to linking customer need and the economy within a green ecosystem underpinned by economic and consumer understanding. This group was concerned with the communication required for this and how to align decisions with the value attached by people to the places they live.

These six themes form the basis for **SAT analysis**, which investigates structural, attitudinal and transactional aspects to understand their composite parts and how they operate in the system. **The process is described in detail in the box 'SAT analysis'.**

### SAT analysis

Participants analysed the **structural, attitudinal and transactional (SAT)** aspects of the themes identified above to understand their composite parts and how they operate in the system.

- **Structural** aspects of the system refer to the institutions, processes and stakeholders that are involved.
- **Attitudinal** aspects refer to widely held perceptions, values, norms and intergroup relations that affect how large groups of people think and behave.
- **Transactional** aspects refer to the relationships and interactions among individuals and organisations as they deal with important social, political and economic issues.

The SAT analyses for each of the six themes are captured in the following six diagrams.

- The green elements describe the current situation (Structure).
- The red elements illustrate attitudes and perceptions of the system by different stakeholders (Attitude).
- The blue elements illustrate relationships between stakeholders, which together influence the current situation (Relationship).

These images represent a snapshot, or particular point in time, shared during the workshop and are by no means exhaustive.

Figure 7 | Coordination and governance

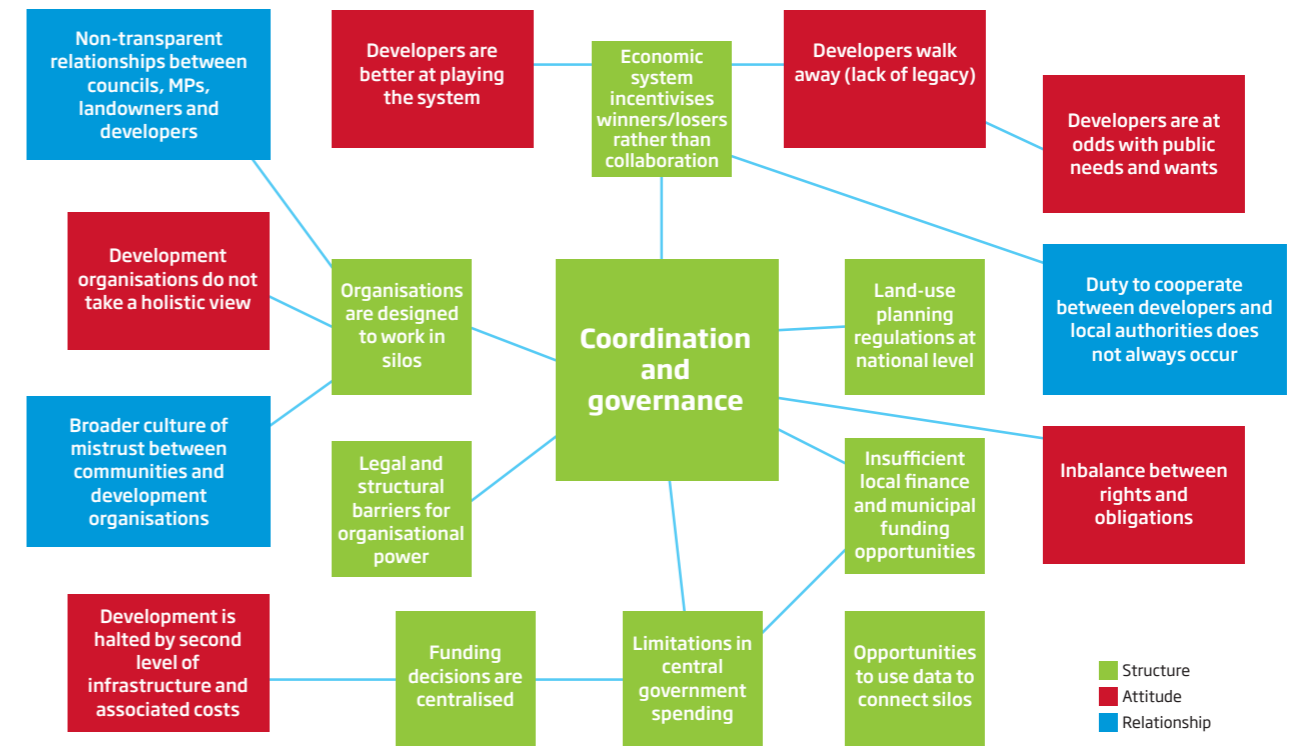


Figure 8 | New and existing residents

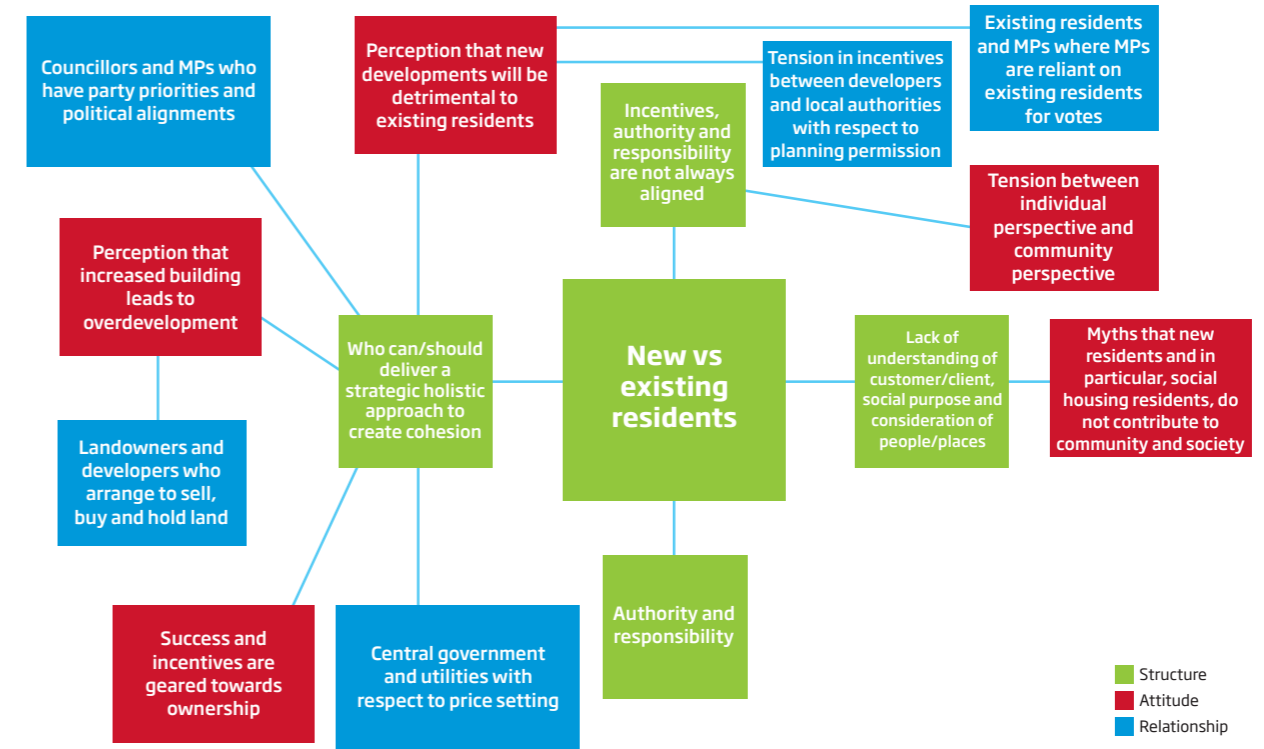




Figure 9 | Zero carbon home and wider spatial strategy

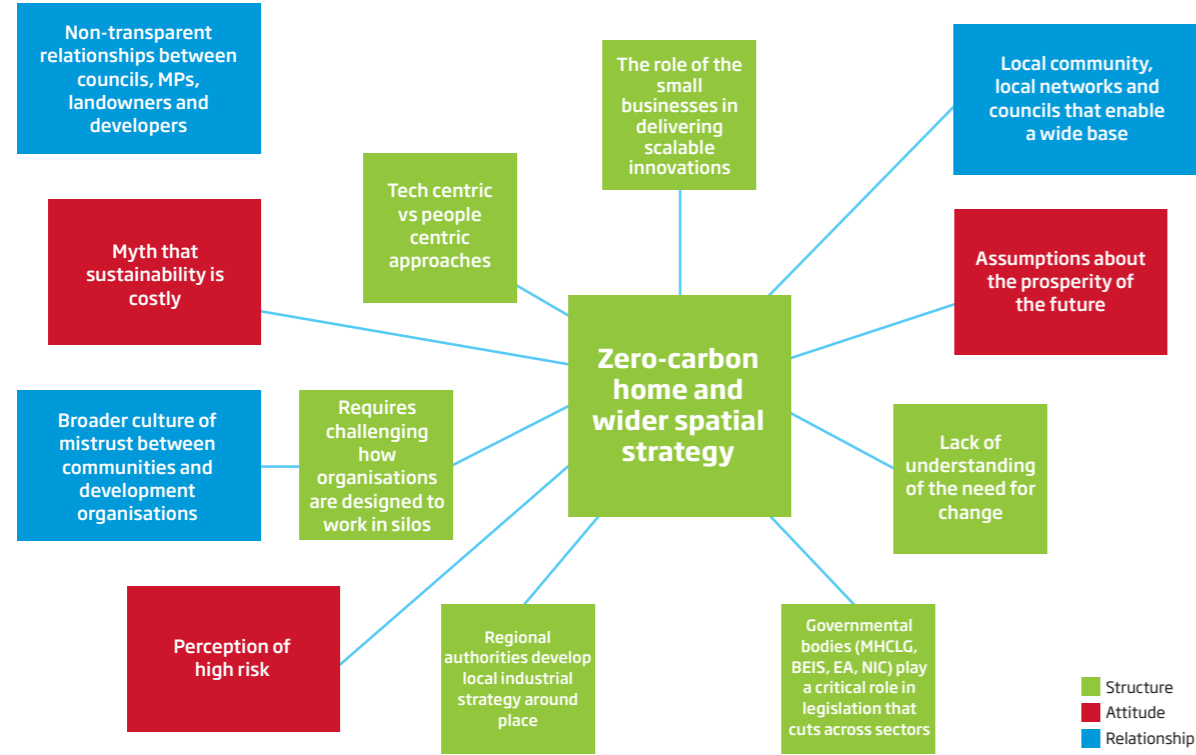


Figure 10 | Green vision

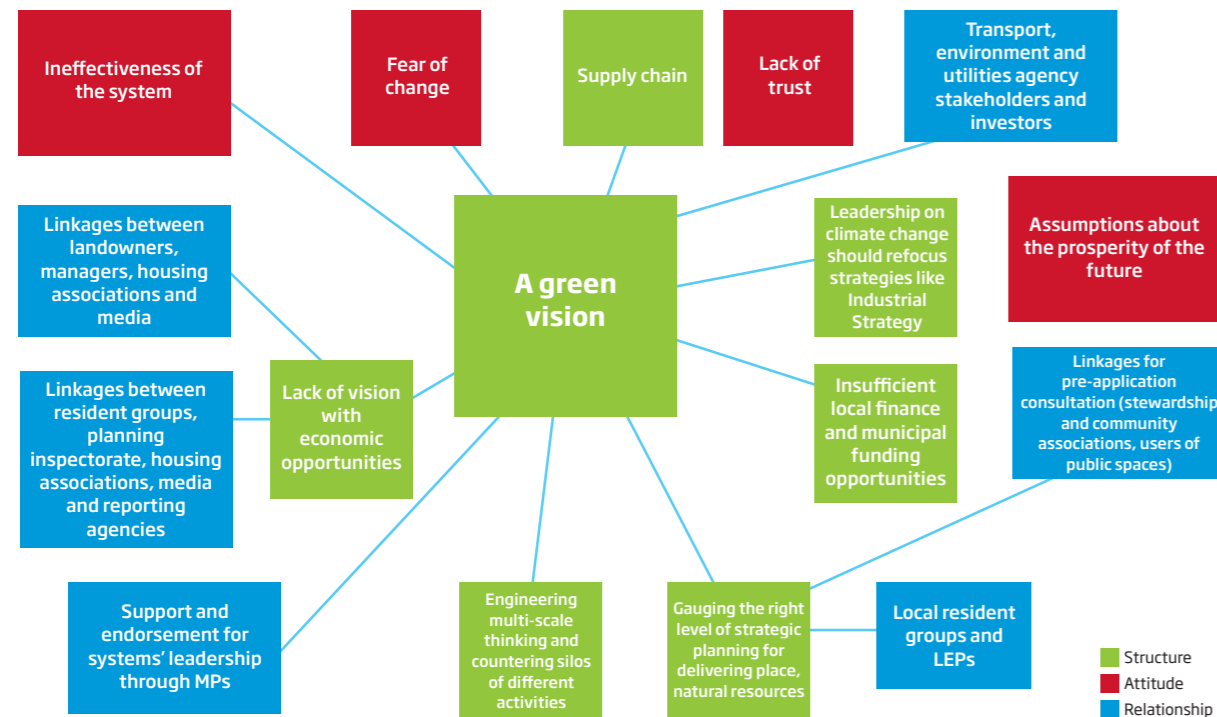


Figure 11 | Role of education, information and awareness

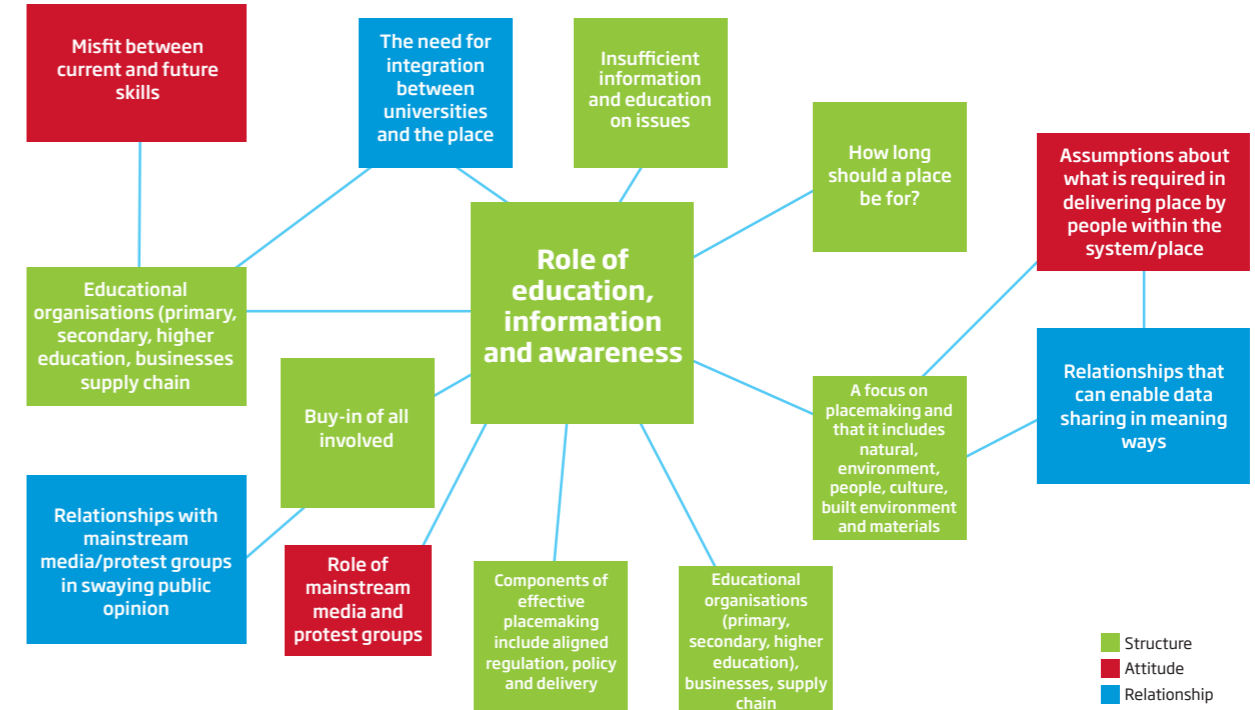
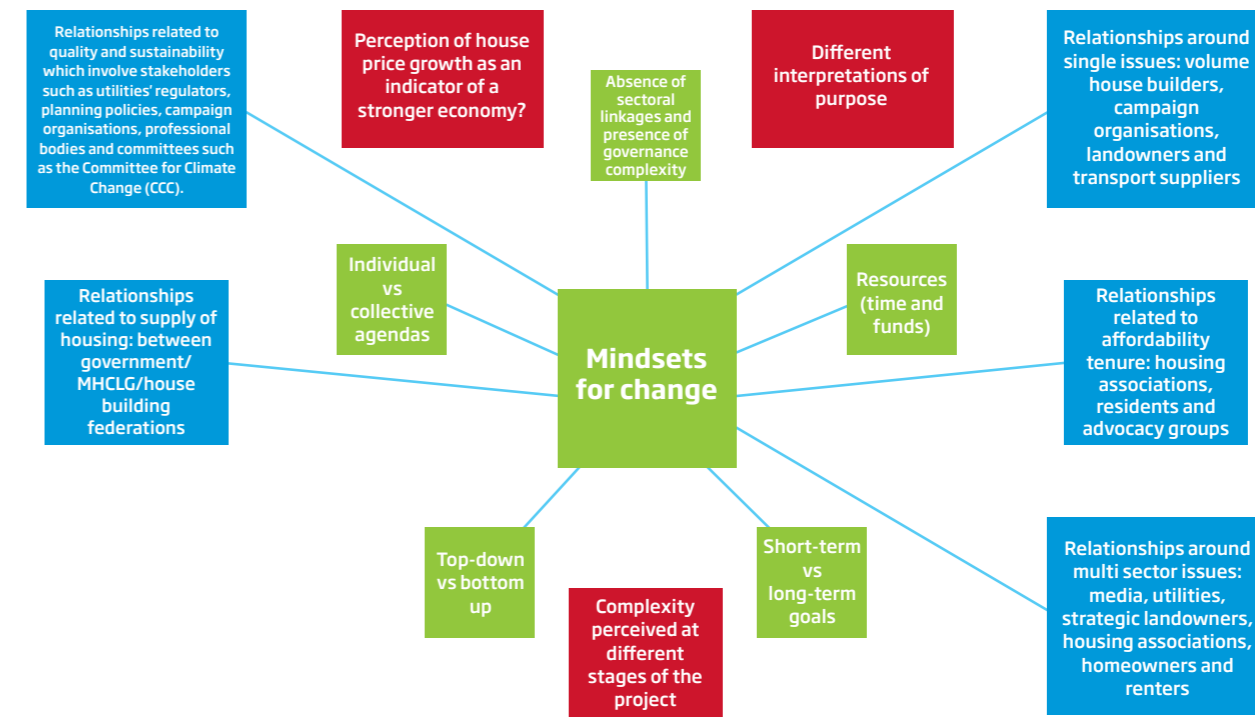
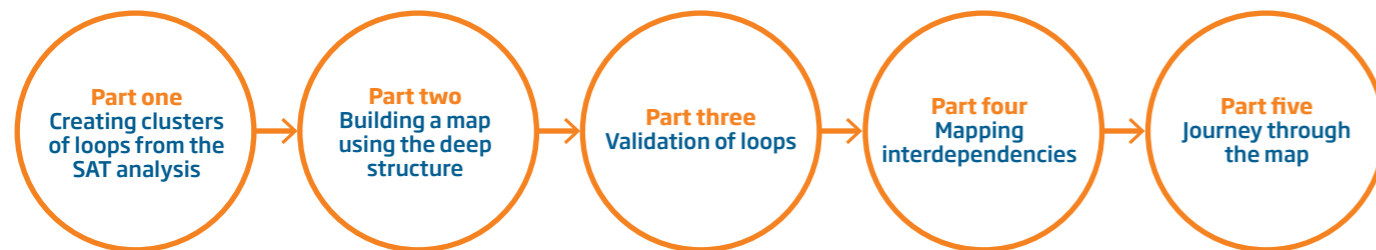


Figure 12 | Mindsets for change



## 2. System dynamics analysis



The SAT analysis is the input for the systems dynamics analysis. **The steps taken in carrying out systems dynamics analysis are included below. The system map which emerged from this analysis is shown on page 16.**

### Part one - Creating clusters of loops

Loops represent the links between different elements in the system. With small groups, ranging between four and six people from across housing and infrastructure, the task was to use the outputs from the SAT analysis to craft loops. Outputs from SAT analysis for the following six themes were used:

- Role of coordination and governance** for housing delivery.
- New vs existing residents** and different motivations
- Zero-carbon** home and wider spatial strategy for the UK, refers to spatial thinking and operating at different scales of governance in which to enact decisions.
- Green vision**, which refers to linking customer need and the economy within a green ecosystem underpinned by economic and consumer understanding. This group was concerned with the communication required for this and how to align decisions with place value held by people.
- Role of information, education and awareness** in creating holistic places.
- Mindsets for change** that enable and inhibit systems thinking.

The SLP team used each theme to collect other inputs from the group using the following guiding questions:

- What is missing in the logic of the story?

- What is the relationship between the elements? For example, is an increase in element A creating an increase in element B?

The group created at least one loop for each theme, with an understanding that each theme can generate two or more loops.

To know when the creation of loops was complete i.e. saturation, the group was asked whether *"no full description of the system is complete without a story of \_\_\_\_?"*

And *"to what extent did new and important stories emerge?"*

### Part two - Building a map using the deep structure

After creating loops, the SLP team went through a mapping process to generate a deep structure, a central locus for arranging the loops. This is called the deep structure because it holds the centre of the map (Acumen 2018). The process included:

- clustering loops** near other loops that address similar issues
- creating a label** that describes the dominant characteristics of that cluster
- arranging clusters** near others that logically fit together.

The SLP team shared these loops and the initial structure with stakeholders asking *"What is the dominant behaviour in the system and how does it work?"* encouraging them to reflect on the clusters and identify the story that ties the different regions together.

Group members shared individual perspectives in relation to the map generated by the wider group of stakeholders. Loops were arranged and re-arranged around the deep structure in thematic regions.

Five regions of the map emerged from this process. These regions represent clusters of loops, elements and relationships:

1. Centralisation of funding and planning.
2. Tension of resident and developer interests.
3. Developer role in the system.
4. Factors influencing residents' role in local planning.
5. Recognition of the need for a shared sustainability agenda.

### Part three - Validation of loops

To validate the map, the SLP team asked stakeholders to reflect to on accuracy of the loops and to what extent it captured the narrative. Through iterative engagement, stakeholders provided input on the dynamics, or interactions that may not have been initially captured within the system. The criteria for the map's structure was that it should be:

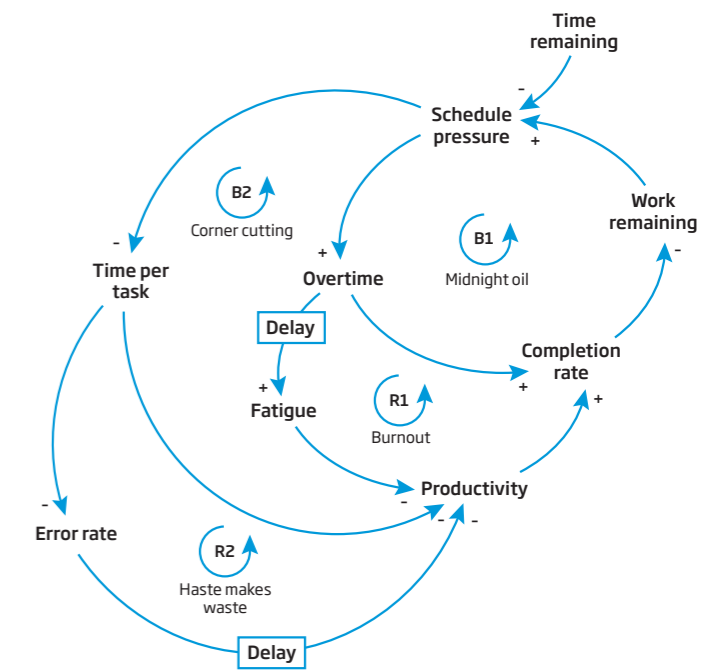
- real (evidenced based on the loops built)
- powerful (capture the essence of the system and how it behaves)
- functional (anchor point for the other loops in the map).

This was an iterative process of refining and redrafting new loops or sub-loops as stakeholders provided more information on interactions, causal linkages and relationships in the system.

The validation of this approach included eight to ten meetings with stakeholders from across the system, sharing results with the SLP team and incorporating feedback from the working group. The SLP team refined the map at each stage with the goal of **generating language that accurately captures the insights** shared during the participatory mapping process. Iterations of the map during these stages is not included here, but available upon request.

Following a validation exercise, loops were shared with stakeholders through a series of small group sessions to review the results.

Figure 13. Causal loop diagram example of the causes of late delivery for design work. Adapted from Business Dynamics (Sterman 2000)



### Part four - Mapping interdependencies

This section's purpose is to consider how the most important, repeating elements and relationships are identified and interdependent (for example, new factors, causal relationships, loops).

Identifying interdependencies highlights areas within the system that may be interrelated; for example, causal linkages. The assumption is that forces that drive the system are tied together in feedback loops. The following example emerges from Sterman's work on causal loop diagrams (see Figure 13). Each of the feedback loops has a series of links that have a positive or negative polarity, which indicate how the elements relate to one another. This translates into a direct correlation (+), or inverse (-) correlation. For example in the cluster related to 'leadership on climate change', 'recognition of the need for a shared agenda to address net zero from across government and local authorities' has led to 'leadership on climate change, through mechanisms such as the Committee on Climate Change (CCC) and cross-departmental policy commitments from government'.



These are linked to one another by a positive relationship – where the former is increasing/ influencing the latter.

With an understanding of how the elements relate to one another, the next step is to identify connections, loops and/or clusters of loops that have a strong influence on different parts of the system. These are **leverage points** which draw attention to areas in the system where interventions would strongly influence different aspects of the system. These are starting points for exploring where interventions might have greatest impact, but also where unintended benefits and consequences could result.

The mapping exercise resulted in several iterations of the map to develop a shared narrative that captures the depth and breadth of the stakeholder perspectives. The team worked with a small group of stakeholders from the built environment to understand and validate how each element influences or is influenced by another element. The following 'Journey through the map' describes the different elements, connections and leverage points for the system.

### Part five - Journey through the map

This section provides a detailed description of the system map shown on page 16.

#### Centralised system for funding and planning (orange)

**1. Political centralisation of the funding system** refers to the **centralisation of the planning system** and centralisation of the tax system.

**2.** There is a disconnect between decision-making at a national level and needs at the local government level, which results in a tension between the planning and funding system that is centralised (national level) and a delivery model that is localised (local authority level).

**3. Siloes exist between different government departments at national level**, which results in ringfencing of funding and delayed payment to local authorities.

- This leads to financing constraints that inhibit alternative investment models, and potentially discentivise investors at a local level.
- A **lack of flexibility in the use of funds** can constrain local authorities in terms of the funding they can apply for and the amount of funding available.
- The result is **competition between local authorities for funding opportunities**.
- Competition precludes a culture of collaboration that is needed to deliver on large-scale developments across multiple local authorities.
- This competition is exacerbated by insufficient **support and funding from central government**, and the absence of mechanisms for planning across local authority boundaries, which makes cooperation between local authorities difficult.

**4.** Siloes between national and local government can be mitigated by **joining up local plans in a national vision**, alongside the **presence of mechanisms for planning across local authority boundaries**.

- The connection between the orange and blue regions of the map (a leverage point in bold) demonstrates this.
- There is currently **no national framework in place** that describes how different local authority areas can plan their housing delivery across local authority boundaries.
- As a result, local authorities do not deliver local plans in a coordinated way.
- They are not incentivised to work together or pool knowledge and resources to support holistic development.
- This is the status quo despite a shared recognition of the need for coordinated planning across local authority boundaries, both at local and national level.

**5.** Where local authorities used mechanisms for planning across local authority boundaries, **there is the opportunity to leverage experience and share knowledge of development frameworks ahead of the local plans** (the development process more broadly). This links the orange region of the map to the blue region of the map.

- This experience and knowledge sharing (good practices and lessons learned) between local authorities, can influence the **effectiveness of planners to negotiate and deliver local plans**.
- As there are examples where this is done well, there is a need to **leverage the experience and expertise of developing local plans** from different local authority areas to ensure better coordination and capability across local authority boundaries.

#### Residents and developers' interests in local planning (blue)

**6.** Local authorities need to produce local plans with a holistic vision, but quality is limited by factors such as the **effectiveness of planners to negotiate and deliver master plans**.

- Capacity, capability and effectiveness will vary considerably from local authority to another.
- Factors such as **history and previous experience working with residents** and human and financial resources, have an influence on overall effectiveness.

**7.** The **influence of residents** is an enabler of SLP, but is attenuated by different factors: **residents' level of buy-in to the place, fraction of homeownership and social capital (skills, education and affluence of residents)**.

- Stakeholders stressed that the large share of residents' participation with the local plan is in the form of resistance to new developments.

**8.** This resistance can act to balance **the representation of developer interests in local planning** as well as influence **media and advocacy attention**.

- This attention can reinforce **residents' awareness of plans** and, as a result, promote **residents' opportunities for public debate**.
- Illustrated by the loops in bold, 'the role of advocacy and media in public engagement' and 'relationships between resistance and residents' engagement in public debate' demonstrate leverage points that influence resistance from residents.

**9.** As a contrast to the level of residents' influence in local plans, the **representation of developers in local plans** often reflects their high level of access to **information and knowledge about the planning** and land development process, as well as the **critical role they play in a number of processes and relationships central to the development process**.

- The balance of power between residents and developers' interests in plans is influenced largely by the level of resistance from residents.
- This is illustrated through a balancing loop in bold.
- This loop offers another example of a leverage point whereby the level of resistance from residents affects the balance between the representation of developer interests vs residents' interests.

#### Developer role in the system (green)

**10.** Knowledge of **developer incentives for profit, their short-term involvement** in places and their **partnerships with local authorities** are factors that affect residents' **fear of developer influence in the community**. The visibility of **developers' roles and relationships in several processes**, including design, planning, financing and delivery, influences this fear.

**11.** There are some mechanisms to ensure communities reap the benefits of new development such as the Community Infrastructure Levy.

- a. This is meant to ensure there is contribution to public goods and services, yet enforcement of this legal provision varies dramatically.
- b. Awareness of this law and its success or failure can either reinforce or reduce negative sentiment toward developers.
- c. **Access to information for communities about the process for planning through shared data** influences how **partnerships between local authorities and developers** perform.
- d. Fear of developer influence in the community is connected to resistance from residents (which forms part of two loops); this factor can act as a leverage point.

#### **Factors influencing residents' role in local planning (grey)**

**12.** The discussion identified the importance of **resistance from residents** that influences their representation in local planning. **Fear of new residents (by existing residents) can increase resistance.** This fear arises from a perception that there will be a **scarcity of resources and increased pressure on existing networks**; in particular, increased pressure on existing public services (health, education, traffic), increased demand on infrastructure (road and rail) and construction works that may be lengthy, loud and noisy

**13.** Residents' current opportunities for debate will vary by local authority.

Factors influencing this include the level of **access to information about the process for planning through data sharing.** In turn, this influences the level of **transparency of the relationships between the local authority and developers in the process for local planning.** These factors together contribute to overall **trust between community organisations, local authorities and residents.**

**14.** Trust can influence **residents' level of buy-in to the place** as well contribute to the conditions that enable development of **a shared vision for the future of the place and the community.**

- a. The **shared vision for the future of place and the community** is a pre-requisite for community cohesion.
- b. Ultimately, trust positively reinforces **residents' capability to participate in public debate.**
- c. The effects of a **shared vision for the future of the place and the community within** and the factors that lead to a shared vision feed into the loop relating to **residents' opportunities for public debate,** acting as a form of a leverage point.

**15.** How residents shape and design **a shared vision for the future of the place and the community within** relies on factors underlying the influence of residents (highlighted in blue): **the viability of the place, buy-in to the place, fraction of homeownership and social capital.**

#### **Shared recognition of the sustainability agenda (yellow)**

**16.** There is broad consensus and **public awareness of the urgency of climate change.**

- a. Growing evidence and effects of **climate-related risks (drought, flooding and extreme weather patterns)** on wellbeing and local productivity has led to increased **pressure from voters to address/mitigate the adverse effects of climate change.**
- b. Harnessing this pressure can draw upon this shared recognition to create a bottom up and top down approach to tackling the climate crisis through the creation of SLP.

**17.** The **recognition of the need for a shared agenda** around sustainability and climate change emerges from a commitment to net zero by 2050.

- a. **Support and endorsement of this agenda from MPs and local government** has led to **leadership on climate change** and **cross-departmental policy commitments (for example, the Committee on Climate Change).**
- b. This priority policy area has promoted actions to improve **the availability of information about what is required to deliver sustainability-related goals.**
- c. A result is that there is increased **awareness of the actions and capacity required to meet these goals.**

**18.** This shared **recognition of the need for a shared agenda** is illustrated in the form of 'reinforcing' loops.

- a. Such loops can act as a form of 'leverage point' and virtuous cycle whereby increasing the magnitude of elements such as **'the recognition of the need for a shared agenda ... local authorities'** can increase the variables illustrated in the loop and the areas of the map that are connected to it.
- b. There are also factors that influence the loop externally: pressure from voters to **address/mitigate the adverse effects of climate change.**
- c. Influencing this enabler can potentially have an impact on the loop as a whole.

**19.** The future of **climate-related risks** will have implications on the **viability of places** of the future. This links the yellow area of the map to the blue area.

- a. Other factors influence the **viability of the place** (productivity levels, attractiveness of the place).
- b. These factors contribute to reasons why **residents have buy-in,** or commitment to, a place. This in turn affects the **influence of residents** alongside factors such as **the fraction of residents who own their homes, social capital of residents (skills for participation in civic life, education and affluence), and resistance from residents.**





**The Royal Academy of Engineering** is harnessing the power of engineering to build a sustainable society and an inclusive economy that works for everyone.

In collaboration with our Fellows and partners, we're growing talent and developing skills for the future, driving innovation and building global partnerships, and influencing policy and engaging the public.

Together we're working to tackle the greatest challenges of our age.

## What we do

### TALENT & DIVERSITY

**We're growing talent** by training, supporting, mentoring and funding the most talented and creative researchers, innovators and leaders from across the engineering profession.

**We're developing skills for the future** by identifying the challenges of an ever-changing world and developing the skills and approaches we need to build a resilient and diverse engineering profession.

### INNOVATION

**We're driving innovation** by investing in some of the country's most creative and exciting engineering ideas and businesses.

**We're building global partnerships** that bring the world's best engineers from industry, entrepreneurship and academia together to collaborate on creative innovations that address the greatest global challenges of our age.

### POLICY & ENGAGEMENT

**We're influencing policy** through the National Engineering Policy Centre - providing independent expert support to policymakers on issues of importance.

**We're engaging the public** by opening their eyes to the wonders of engineering and inspiring young people to become the next generation of engineers.

The **National Engineering Policy Centre** connects policymakers with critical engineering expertise to inform and respond to policy issues of national importance, giving policymakers a route to advice from across the whole profession, and the profession a unified voice on shared challenges.

The Centre is an ambitious partnership, led by the Royal Academy of Engineering, between 43 different UK engineering organisations representing 450,000 engineers.

Our ambition is that the National Engineering Policy Centre will be a trusted partner for policymakers, enabling them to access excellent engineering expertise, for social and economic benefit.

Royal Academy of Engineering  
Prince Philip House  
3 Carlton House Terrace  
London SW1Y 5DG

Tel 020 7766 0600  
[www.raeng.org.uk](http://www.raeng.org.uk)  
@RAEngNews

Registered charity number 293074