

Regional Energy Transitions in England: The Governing Role of Combined Authorities in the Decarbonisation of Heating

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Abstract

In order to meet its carbon targets, the UK must address the decarbonisation of the currently fossil-fuel dependent system of heating. Buildings and heat strategy at the national level has been insufficient in combatting this issue, and it is increasingly suggested that more local and regional approaches will be needed to accelerate the transition to low carbon heating. There is scope for further understanding of the merits of regional governance in this regard. This thesis therefore uses a multiple case study to explore the governing role that combined authorities, a form of regional government, play in low carbon heat strategy in England. It does so by investigating the strategies pursued, and the barriers and enablers faced by combined authorities and their constituent local authorities in relation to the decarbonisation of heating. It uses data collected from climate and energy strategies published by combined authorities and their constituent local authorities, and from interviews conducted with authority officers. This thesis employs thematic analysis based on a conceptual framework drawn primarily from literature on Regional Energy Transitions. The research finds that the strategies pursued by combined authorities and their constituent local authorities share many similarities, but that combined authorities tend to take a broader strategic view while the local authorities implement projects. The results suggest that while the decarbonisation of heating is an emerging issue at the regional level, there are multiple opportunities for combined authorities to influence in this area, both directly and as an enabler and facilitator of action. Many of these opportunities are already being acted upon and can be built upon going forward. These opportunities include carrying out energy planning for the region, steering funding towards the decarbonisation of heating, sharing good practice at a regional level, and lobbying government for policy changes. Areas for future research include comparing access to funding between local authorities who are members of combined authorities and those who are not, to understand if combined authority membership adds an advantage; investigating public engagement on this issue from combined authorities and local authorities; and investigating the role of other local and regional bodies such as Local Enterprise Partnerships and Energy Hubs.

Keywords: Decarbonisation of Heating, Regional Energy Transitions, Combined Authorities

Executive Summary

The UK government has identified the decarbonisation of heat as the country's "most difficult policy and technology challenge" to meet its carbon targets (BEIS, 2017, p. 75). Non-industrial heating makes up approximately 23% of UK emissions (BEIS, 2018), and 90% of homes use fossil fuels for heating, with the current system locked in to use of natural gas (BEIS, 2020c; Broad et al., 2020; Chaudry et al., 2015). Multiple relevant policies exist at the national level but it is suggested that in general, buildings and heating policy is lagging behind what is necessary (CCC, 2020a). Within this context it is increasingly suggested that more local and regional approaches are needed, since different solutions will be suitable based on the characteristics of different areas (Broad et al., 2020; MacLean et al., 2016).

Historically, the privatised, liberalised, and predominantly centralised provision of energy in the UK, along with the favouring of a centralised form of government, has limited the influence which local or regional forms of government have had on the energy system (Bale et al., 2012; Fudge et al., 2016; Hawkey et al., 2018; Tingey & Webb, 2020). Moreover, previous research has found limitations in financing, access to expertise, and ability to mobilise capacity among local authorities in relation to action within energy systems (Fudge et al., 2016; Hawkey et al., 2018; Tingey & Webb, 2020; Webb, 2015). However, the role of sub-national levels of governance in the decarbonisation of energy is increasingly being recognised by the UK government, local and regional authorities themselves, and other important stakeholders (CCC, 2020b). Alongside this, there has been growing interest in regional governance of energy systems and the idea of Regional Energy Transitions (RETs) (Hoppe & Miedema, 2020). It has been proposed that regional authorities have the potential to influence energy systems, such as through energy planning, and facilitating the sharing of knowledge and resources (CBI Heat Policy Commission, 2020; Hoppe & Miedema, 2020; Tingey & Webb, 2020).

There is scope for further understanding of the merits of regional governance in energy system change, including in regard to how it might play a role in regional and local efforts to address the challenge of decarbonising heating. In the UK context, combined authorities (CAs) present a compelling focus for research which furthers this understanding. CAs are governance bodies set up by neighbouring local authorities in order to collaborate on strategy and the provision of services, and to have the ability to agree devolution deals with the UK government to procure additional powers and budgets (Paun et al., 2020). These relatively new forms of government do not necessarily have a clear role in energy governance, yet many have set climate targets and have published climate or energy strategies.

Research Questions and Methodology

Therefore, this thesis aims to further the understanding of the role CAs play in low carbon heat strategy in England, and in particular to understand their role in relation to their constituent local authorities. In doing so it aims to understand if there is evidence of a shifting regime which provides a window of opportunity for regional government to influence energy transitions in the UK. To achieve this aim, it answers the following three questions:

RQ1: What strategies addressing the decarbonisation of heating are pursued by combined authorities and their constituent local authorities?

RQ2: What barriers and enablers exist to combined authorities and their constituent local authorities addressing the decarbonisation of heating?

RQ3: What is the governing role of combined authorities in relation to the role of their constituent local authorities in planning and implementing strategies for the decarbonisation of heating?

The intended audience of this study is policymakers and stakeholders working with and within CAs in England who are seeking to address low carbon heat strategy and scale up action in this area. It also aims to be of interest to researchers working within the field of low carbon heating, energy transitions, and RETs. The findings may also be of interest to those involved in regional governance of energy transitions in similar contexts.

To answer the outlined research questions, this thesis takes a multiple case study approach, focusing on three CAs, Greater Manchester Combined Authority (GMCA), West Yorkshire Combined Authority (WYCA), and Sheffield City Region Combined Authority (SCRCA). Multiple cases were selected to generate a better understanding of how the governing mechanisms of CAs can influence the decarbonisation of heating (Bryman, 2012). Data was also collected from five constituent local authorities: Manchester City Council and Oldham council, members of GMCA; Leeds City Council and Wakefield Council, members of WYCA; and Rotherham Council, a member of SCRCA.

To answer RQ1, a documentary review was carried out on relevant energy and climate strategy documents collected from each of the authorities. This generated an understanding of which low carbon heating solutions are outlined by each of the authorities, which approaches and programmes are pursued by the authorities, and what role is laid out for the authorities in the strategy documents. To answer RQ2 and RQ3, a literature review was first conducted to create a conceptual framework through which to understand and interpret the barriers and enablers facing CAs and local authorities, and to understand the potential governing role of CAs in relation to the decarbonisation of heating. This framework guided the thematic analysis of data collected through semi-structured online interviews with a total of ten authority officers from the case CAs and constituent local authorities.

Main Findings

The findings of this study show that the strategies related to the decarbonisation of heating have many similarities, both across CAs, and also between CAs and their constituent local authorities. These similarities are apparent in terms of both the solutions and approaches pursued. All of the strategies mention a mixture of low carbon heating solutions, with the majority discussing energy efficiency and retrofitting, building standards, electrification of heating or heat pumps, heat networks, and the use of hydrogen. The majority of strategies also discuss the following approaches: working with businesses to support their decision-making but also to develop low carbon heating solutions in the region or local area; using building standards and planning policies to improve thermal performance of buildings and encourage low carbon heating solutions; engaging with businesses and with the general public to promote solutions and support action; investing in low carbon heating solutions; and working with both social and private-sector landlords to promote low carbon heating solutions. The strategies indicate that local authorities are more likely to focus on addressing the decarbonisation of heating in their own operations and implement specific projects, while the CA strategies take a broader strategic overview and are more likely to discuss wider energy planning.

The results also suggest that CAs are facing many of the same barriers as and find similar enablers to those found by their constituent local authorities. There seems to be an increasing willingness to act on the decarbonisation of heating, but CA and local authority action was found to be restricted by a number of issues. The main identified barriers include a lack of funding and/ or capacity and expertise, and the fact that much of the change required for the

decarbonisation of heating relies on the actions of others and on behaviour change, a problem compounded by low public awareness on this issue. Public engagement was found to broadly be viewed as an enabler, as was leading with local knowledge, such as in the execution of spatial heat mapping. One of the other major barriers found to be affecting both CAs and local authorities alike is the lack of clarity and stability from central government policy, which is leading to uncertainty as to which low carbon heating solutions to pursue, and to difficulties when trying to implement programmes and projects. The findings suggest that both CAs and their constituent local authorities are calling for a clearer pathway to be outlined for the different low carbon heating solutions.

The findings of this study illustrate that CAs can play an enabling and facilitating role in the decarbonisation of heating. This was shown to be particularly relevant in relation to enabling access to funding, with significant funding channelled through CAs and working at the regional level giving more clout to access funds. Moreover, working at the CA level was found to enable access to certain programmes, and to increase capacity to lobby central government for policy changes. The results indicate that working with and at the level of the CA may be more beneficial for smaller authorities, which could be important for ensuring that such authorities do not get left behind in relation to reaching net zero. CAs were also found to be acting more directly through the creation of climate and energy strategies which aim to steer actions within the region, taking on the leadership and coordination role needed for a RET. While there remains some lack of alignment between strategies within the regions, evidence from this study suggests that CA action is combatting this.

Overall, the results suggest that it is early days in terms of CA action on the decarbonisation of heating, although there are a number of opportunities for them to steer and enable action on this issue. Landscape pressures, such as the climate emergency agenda and the push at international and national levels for a low carbon transition, have opened a window of opportunity for CAs to act on the decarbonisation of heating, increasing their mandate to act on the issue, particularly in the last 12-18 months.

Conclusions and Recommendations

This research has revealed that the decarbonisation of heating is an emerging issue at the regional level, and that there is evidence for CAs playing a role in RETs as efforts to address this issue develop. The strategies pursued by CAs and their constituent local authorities are similar, and many of the barriers and enablers found in relation to this challenge were similar for both CAs and the local authorities. Still, the results suggest that CAs can play a steering, enabling, and facilitating role in relation to action on the decarbonisation of heating, both at the regional and local level. Given that it seems to be early days in terms of CA action in this area, there remains some uncertainty as to the extent to which regional approaches taken by CAs will be able to significantly influence action in this area. Nevertheless, there are multiple opportunities for CAs to influence action on the decarbonisation of heating, many of which are already being acted upon and can be built upon going forward.

The following opportunities were identified, and are recommended to be built upon:

- Embedding regional strategies for decarbonisation of heating at the local level.
- Taking a strategic view to carry out energy planning across the region.
- Dedicating funding allocated through devolution deals towards decarbonisation.
- Bidding for funding on behalf of the region and providing tools to help local authorities create bids.
- Supporting pilots and experimenting.

- Sharing good practice in relation to low carbon heating projects throughout the region.
- Providing scale and clout to access programmes and lobby government.
- Working with existing networks to promote solutions, e.g., through Local Enterprise Partnerships, or in collaboration with other CAs.
- Setting up shared schemes to build capacity and avoid duplication of effort.

Additionally, it is recommended that policymakers at the national level strengthen relevant policies, such as around building standards and planning policy, to enable the regional and local levels to work on this issue. Moreover, it is recommended that they work on producing a policy framework in consultation with regional and local government, which can provide the level of stability required to move action forward on the decarbonisation of heating.

Further research could be conducted into the details of the barriers, enablers and opportunities identified in this study. For example, further research could compare access to funding between local authorities who are members of CAs and those who are not, to understand if CA membership adds an advantage in this regard. In addition, it could seek a greater understanding of the ways in which CAs and their constituent authorities are engaging with the public, and the effectiveness of their efforts. This could be of great value given the vital role of behaviour change in transforming heating.

Additional research could also build on the understanding of regional and local bodies by investigating the role of other organisations such as Local Enterprise Partnerships and Energy Hubs. Finally, when the UK government's Buildings and Heat Strategy is released later in 2021, its contents could be assessed in light of the results of this study, to understand whether this central government strategy will improve regional or local capacity to act on the decarbonisation of heating.

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Abbreviations

BEIS – Department for Business, Energy and Industrial Strategy

CA – Combined Authority

CCC – Climate Change Committee

GMCA – Greater Manchester Combined Authority

LCC – Leeds City Council

LEP – Local Enterprise Partnership

MCC – Manchester City Council

OC – Oldham Council

RC – Rotherham Council

RETs – Regional Energy Transitions

SCRCA – Sheffield City Region Combined Authority

WC – Wakefield Council

WYCA – West Yorkshire Combined Authority

1 Introduction

To restrict global warming to 1.5C and therefore mitigate the worst effects of Climate Change, the Intergovernmental Panel on Climate Change (IPCC) has suggested that global anthropogenic emissions should reach net zero by approximately 2050 (IPCC, 2018). Staying within these boundaries requires rapid decarbonisation globally, across all systems (IPCC, 2018). In this context, to date, 120 countries and the European Union (EU) have created plans to achieve net zero CO₂ emissions by 2050, identified it as a national goal, or initiated consultations for climate neutrality which correspond to the Paris Agreement (COP25, 2019).

Among these countries is the United Kingdom (UK), which passed legislation committing the country to reach net zero emissions by 2050 in response to recommendations from the Climate Change Committee (CCC) (BEIS, 2019c). Achieving this ambitious goal would require widespread transformation across the UK economy, including in the area of non-industrial heating (BEIS, 2017). Non-industrial heating accounts for approximately 23% of UK emissions (BEIS, 2018), with the main source of emissions in the residential and public sectors arising from the use of natural gas for heating (BEIS, 2020a). The country's National Energy and Climate Plan (NECP) acknowledged that to achieve an 80% reduction in net emissions compared to 1990 levels by 2050, emissions from buildings would need to be near zero (BEIS, 2019b). Now that the ambition of the overall emissions target has been increased to net zero, this aspiration is even more pressing and relevant.

While decarbonisation presents significant challenges across sectors, the UK government has identified the decarbonisation of heat as the country's "most difficult policy and technology challenge" to meet its carbon targets (BEIS, 2017, p. 75). To reach the net zero target, the country will need to transition to low carbon alternatives such as heat pumps, heat networks, and hydrogen, complemented by improvements in energy efficiency. While multiple technically feasible solutions for decarbonising heat exist and are continuously being developed, the transition to low carbon heating represents part of a national energy transition with significant complexity and interdependencies on other areas of transformation.

Moreover, while multiple policies relevant to decarbonising heat exist at the national level, government strategy has repeatedly emphasised that the exact technological changes that will help deliver on decarbonisation targets cannot be predicted, reflecting the uncertainty in the path forward. Meanwhile, the CCC argues that national buildings and heating policy is lagging behind what is necessary (CCC, 2020a). Within this context of ambiguity when it comes to centralised decision-making, it is increasingly suggested that more local and regional approaches are needed, since different solutions will be more suitable based on the characteristics of different areas (Broad et al., 2020; MacLean et al., 2016).

1.1 Problem Definition

Historically, local authorities in the UK have had little influence or involvement with the predominantly centralised provision of energy in the UK (Bale et al., 2012; Fudge et al., 2016). The highly liberalised and privatised context of the UK, with prioritisation of market solutions, has hindered the ability of sub-national levels of government to have a significant influence on energy and heat strategy (Hawkey et al., 2018; Tingey & Webb, 2020; Webb, 2015). Furthermore, the mode of governance in the UK has historically favoured centralised power, with limited devolution to sub-national levels (Bale et al., 2012; Tingey & Webb, 2020). Previous research has also found limits in the extent to which local authorities can enact change within energy systems, with weaknesses identified in financing, expertise, and ability to mobilise capacity (Fudge et al., 2016; Hawkey et al., 2018; Tingey & Webb, 2020; Webb, 2015). However, the role of sub-national levels of government is now increasingly being

recognised by central government, local and regional authorities themselves, and other important stakeholders (CCC, 2020b). Moreover, the growth in recent years of decentralised energy systems, buoyed by the growth of renewable energy technologies, has supported the notion that sub-national government can play a greater role in energy system transformation (Devine-Wright & Wiersma, 2013; Fudge et al., 2016; Newey, 2021; Tingey & Webb, 2020; Webb, 2015).

Alongside this, there has been increasing interest in recent years in the idea of Regional Energy Transitions (RETs), which focus on change at a coherent regional level, covering several districts or municipalities (Engelenburg & Maas, 2018; Hoppe & Miedema, 2020). While this idea is gaining traction, relatively little literature exists on regional governance of energy transitions, especially on regions as the arena in which inter-municipal issues are addressed (Hoppe & Miedema, 2020). It has been proposed that regional authorities have the potential to facilitate regional energy planning (Tingey & Webb, 2020). Their basis in coordination and collaboration between local authorities has been suggested as important in energy governance, since energy projects often have cross-municipal implications and require inter-municipal decision-making (Hoppe & Miedema, 2020). Moreover, they may present an opportunity for the scaling up of innovation at the local level through facilitating the sharing of knowledge and resources between larger, leading local authorities with greater capacity to act, and those who are smaller and are considered followers (CBI Heat Policy Commission, 2020; Hoppe & Miedema, 2020).

These merits of regional governance in energy system change are only beginning to be explored, and there is scope for greater understanding of its potential role in low carbon energy transitions, including in low carbon heating. In the UK context specifically, there has been limited research on the role that devolved regional powers can play within this arena. Tingey and Webb (2020, p. 10) posit that “ongoing devolution processes across the UK provide a ‘natural experiment’ to understand more about the trajectories of local energy activity”.

In 2009, UK legislation enabled the creation of combined authorities (CAs) within England, with 10 such authorities having been established since then (Sandford, 2017). They are governance bodies set up by neighbouring local authorities in order to collaborate on strategy and the provision of services, and to have the ability to agree devolution deals with the UK government which bestow additional powers and budgets (Paun et al., 2020). These relatively new forms of government do not necessarily have a clear role in energy governance, yet many of them have already made strong climate commitments and released energy strategies. They therefore present a compelling focus for further research into understanding the role and potential of such regional forms of government in energy transitions, and local energy and heat planning in particular.

1.2 Aim and Research Questions

This thesis aims to further the understanding of the governing role CAs play in low carbon heat strategy and energy transitions in England, and in particular to understand their role in relation to their constituent local authorities. It seeks to understand how the decarbonisation of heating is addressed in the energy strategies set out by CAs and by their constituent local authorities. Furthermore, it aims to establish what barriers and enablers CAs face regarding the decarbonisation of heating, and how these compare to those faced by their constituent local authorities. This is with the further aim of shedding light on opportunities for CAs to act on the decarbonisation of heating and to play a part in overcoming the barriers at a local level.

To achieve this aim, this thesis answers the following research questions:

RQ1: What strategies addressing the decarbonisation of heating are pursued by combined authorities and their constituent local authorities?

RQ2: What barriers and enablers exist to combined authorities and their constituent local authorities addressing the decarbonisation of heating?

RQ3: What is the governing role of combined authorities in relation to the role of their constituent local authorities in planning and implementing strategies for the decarbonisation of heating?

In answering these questions this study aims to understand how CAs can play a role in the decarbonisation of heating both directly as an enabler which facilitates action at the local level, as well as where there may be hinderances in or as a result of regional action. Thus, this thesis aims to illuminate if the actions of CAs provide evidence of a shifting regime around energy in the UK, and to discuss whether the decarbonisation of heating may provide a ‘window of opportunity’ for regional government to exert greater influence over energy transitions in the UK (Fudge et al., 2016). This is with the greater goal of contributing to research on RETs and the role of devolved, regional, and local authorities in the transition to a low carbon energy system.

1.3 Scope and Delimitations

This thesis focuses on case studies of three CAs. The CAs were selected from those which have published a relevant energy strategy within the last five years due to the interest of this thesis in the current strategies pursued by CAs. Energy strategies were identified as a basis upon which to understand the approaches of CAs to addressing the challenge of the decarbonisation of heating. Of the four that were contacted, three agreed to participate in the study. It is recognised that the choice to select CAs based on those which had recently published relevant strategies has the potential to skew the collected data towards those CAs which may be more engaged in this area. However, this was deemed appropriate for this study because it seeks to understand the potential that this type of organisation has to engage in this area, thus studying those that may be more engaged is of value.

The geographical focus of this thesis is on England (since CAs do not exist within the other constituent countries of the UK), and more specifically on the geographical regions of the selected case CAs. However, implications at the UK level or for regional governance of energy transitions in similar economies may be drawn from the results.

This study investigates the decarbonisation of heating rather than other aspects of energy transitions, although it is acknowledged that the decarbonisation of heating interacts with the decarbonisation of other parts of the energy system. The study includes solutions for reduction in heat demand, such as efficiency retrofitting and behaviour change, as well as low carbon heating solutions, such as heat pumps, hydrogen, and district heating, among others.

For the purpose of this research, data has been gathered pertaining to the CAs and to five of their constituent local authorities. For each CA, two local authorities were selected, one representing the most populous, or what may be considered to be the primary city in the region, and the other representing a less populous area. This was to enable an understanding of whether the relationship to the CA may differ based on the size of the local authority. No response was obtained from one authority in the former category, leading to five local authorities being included in the study. Further information about the selected cases is outlined in section 5.1. Since it is focused on the work of CAs and local authorities specifically, this thesis collected interview data from authority officers, rather than other stakeholders who are involved in low carbon heating at national and sub-national scales.

1.4 Ethical Considerations

This research is not supported or funded by an external organisation. The only parties outside of the academic process with the potential to influence this research are those selected as interview participants, in so far as the data collection depends on the opinions and information they share. A multiple case study approach with participants from a selection of CAs and local authorities was employed to reduce undue influence from one interested party.

Informed consent and understanding of the right to withdraw were established with participants ahead of each interview. Participants received an overview of the research, which was also made available to any other parties who requested it (see Appendix A). Participants included in the study are anonymous, with names and positions replaced with a participant number (see Appendix B) or referred to as simply a representative of their organisation in documents throughout the process. There is recognised potential for participants to be speculatively identified regardless of the omission of their name and position due the relatively narrow geographical and institutional scope. This is addressed by ensuring permission is granted to refer to the participant as an anonymous representative of their organisation. Participants were contacted for verification of information and selected quotes prior to the submission of the thesis for final publication. Negative outcomes of the results of the research are not anticipated for specific individual participants.

All collected data is stored on a personal laptop and OneDrive, both of which are password protected and to which only the researcher has access. Any recordings or transcriptions of interviews were labelled with participant numbers, with a code as to which participant corresponds to which number stored elsewhere in a separate document. Sensitive information was not collected in the process of this research. Nevertheless, the outlined measures protect all collected data. Any interview data from a participant will be provided to that participant if requested by them. Otherwise, no data will be shared with any other party outside of the academic process. The final thesis will be provided to participants upon request.

The research design for this thesis has been reviewed against the criteria for research requiring an ethics board review at Lund University and has been found to not require a statement from the ethics committee.

1.5 Audience

This study is aimed at policymakers, decision makers and other stakeholders working within and with CAs in England who are seeking to address low carbon heat strategy and scale up action in this area. Moreover, it aims to be of interest to researchers working within the field of low carbon heating, energy transitions, low carbon transitions, local and regional energy governance and planning, and RETs. The findings can be of use to these stakeholders in generating an understanding of how the governing role of CAs may be directed towards action on the decarbonisation of heating. The findings may also be of interest to other stakeholders within a similar context who are involved in regional governance of energy transitions.

1.6 Disposition

Chapter 1 introduces the topic of addressing low carbon heating strategy at sub-national scales and gives an overview of the aims of this research.

Chapter 2 presents background information on the decarbonisation of heating in the UK and on combined authorities.

Chapter 3 presents a literature review which outlines the state of the art in this field, as well as outlining a conceptual framework based on relevant theories and research.

Chapter 4 describes the research design and methodology for this thesis.

Chapter 5 presents the findings of the research, and analysis of those findings.

Chapter 6 presents a discussion of the findings, linking back to existing research in this area.

Chapter 7 outlines the conclusions of the study and presents recommendations on how the governing role of CAs can be applied to addressing the decarbonisation of heating, as well as providing recommendations for future research.

2 The UK Context: Decarbonising Heating and Devolution

The following chapter will provide information on the current state of heating in the UK and options for decarbonisation; a brief discussion of national policy; an outline of energy decarbonisation in relation to regional and local authorities; and an overview of devolution in the UK and CAs.

2.1 UK Heating and the Options for Decarbonisation

The UK government has acknowledged that reaching the net zero emissions target by 2050 means moving away from natural gas and transforming the heating sector (BEIS, 2017, 2020c; Broad et al., 2020; Lowes & Woodman, 2020). At present, buildings are the second largest source of emissions in the UK, and 90% of homes use fossil fuels for heating (BEIS, 2020c). Key low carbon heating alternatives that have been repeatedly identified, both by the UK government and CCC, and by academics, are heat pumps, hydrogen gas, heat networks, and biomass, all complemented by energy efficiency (BEIS, 2017, 2020c; CCC, 2020a). Potential pathways are often dominated either by heat pumps or by hydrogen, mostly with an acknowledgement of the need for energy efficiency measures to reduce demand, as well as moving to lower carbon sources of energy generation (Broad et al., 2020; Hawker et al., 2019; HM Government, 2020; MacLean et al., 2016; Seward et al., 2020). However, while heat pumps and hydrogen often dominate, they are not presented as solutions in isolation. Indeed, Hawker et al. (2019) suggest that heat pumps versus hydrogen may be a false dichotomy and reflect along with MacLean et al. (2016) that a varying, regional, localised approach which acknowledges priority areas is needed in reality.

The current system depends on natural gas, and particularly in the residential sector is ‘locked-in’ with significant social and technical barriers to change (Broad et al., 2020; Chaudry et al., 2015). As noted by Broad et al. (2020, p.2) natural gas is popular because it is “well known, relatively cheap, responsive, reliable, quiet, and requires little space”. Moreover, there are uncertainties in understanding which solutions will be best in phasing out natural gas and decarbonising heating systems in the UK (Lowes & Woodman, 2020). This includes ambiguities around heat and energy demand, cost and performance of technologies and their system-wide impacts, spatial sensitivity of these costs, diversity of housing stock, fuel and carbon prices, and public perceptions (Broad et al., 2020; Chaudry et al., 2015).

2.1.1 Overview of Low Carbon Heating Solutions in the UK

Energy Efficiency and Retrofitting

Improving the efficiency of the UK’s buildings, which are among the worst performing in terms of energy efficiency in Europe, is of great importance to addressing the decarbonisation of heating challenge, especially because the majority of today’s buildings will still be in use by 2050 (MacLean et al., 2016). At present, 66% of UK homes are at Energy Performance Certificate (EPC) band D or worse (BEIS, 2020c). Measures need to be put in place to ensure that new buildings are built to high efficiency standards, as well as applying retrofitting to improve the energy performance of existing buildings.

Heat Networks

Heat networks, a system of insulated pipes which take heat from a central source and distribute it to a number of buildings, has been recognised by the UK government as one way in which to decarbonise heating (BEIS, 2017). There are initiatives to support the building and expansion of heat networks in the UK but the portion of non-industrial heat supplied by heat

networks remains low, in 2018 representing just 2% of heat supply and 0.8% of domestic heat supply (Broad et al., 2020; Hawker et al., 2019). Nevertheless, the number of customers connected to a heat network has been rising significantly, more than doubling between 2013 and 2018 (Broad et al., 2020; Hawker et al., 2019). Heat networks are particularly relevant for local authorities because they may be able to use their buildings to anchor the heat load (MacLean et al., 2016). It should be noted that heat networks may not necessarily be sufficient in terms of decarbonisation in the long-term if they rely on natural gas as a heat source (Broad et al., 2020). Heat networks in the UK are currently still 90% reliant on natural gas (BEIS, 2020c).

Electrification and Heat Pumps

Electricity only supplied 13% of UK heat in 2017, primarily through immersion tanks and storage heating (Hawker et al., 2019). Heat pumps, another source of electrified heating, while a proven technology and commercially viable, are used in fewer than 1% of homes in England, (BEIS, 2020c). The UK government has an aim to increase the installation of heat pumps from 30,000pa to 600,000pa by 2028 (BEIS, 2020c). The decarbonisation of heating through electrification relies on the continued decarbonisation of the grid, as well as management of the changing pressures on the grid brought by electrification of both heating and transport.

Hydrogen

Hydrogen is being explored as an option for the decarbonisation of heating as well as the decarbonisation of some transport. However, techniques for hydrogen production and hydrogen based technologies are still emerging and are not well established (BEIS, 2020c). The CCC has not recommended a full hydrogen decarbonisation pathway due to concerns of technical feasibility, insufficient emissions reduction, and import dependency (CCC, 2018; Lowes & Woodman, 2020). Nevertheless, the UK government has set out its intention to increase the generation of hydrogen in the country and develop hydrogen-based heating innovations (HM Government, 2020).

2.2 National Policy

Multiple relevant national policies and measures are currently in place or planned which pertain to low carbon heat strategy (see Appendix C for an overview). However, there is no blanket policy in the UK on how the decarbonisation of heat should be approached, and the government's Clean Growth Strategy (BEIS, 2017) and recent *Ten Point Plan for a Green Industrial Revolution* (HM Government, 2020) emphasise that the exact technological changes that will help deliver on decarbonisation targets cannot be predicted, reflecting the uncertainty in the path forward. It is suggested that the Clean Growth Strategy, while supporting building retrofit and low carbon heating technologies, lacks clear steps for implementation (Broad et al., 2020). A new Buildings and Heat Strategy was anticipated before the end of 2020; however, its release is now set to be ahead of the 26th UN Climate Change Conference of the Parties (COP26), which will take place in November 2021.

While several potential technologies and scenarios have been identified, it has been suggested that progress in decarbonising homes in the UK has not been sufficient in the last decade (CCC, 2020a; Frank et al., 2020; Lowes & Woodman, 2020). Broad et al. (2020) and the CCC (CCC, 2020a) elaborate particularly on the relative failure of the Green Deal and of the Energy Company Obligation to bring about energy efficiency improvements since their implementation in 2013, and Lowes and Woodman (2020) note that the Renewable Heat Incentive has not achieved the expected deployment of low carbon heating technologies. Moreover, it has been argued that a disconnect remains between ambitious goals and policies,

and actions and trends, and that there is an urgent need for this gap to be addressed if decarbonisation targets are to be met (Broad et al., 2020; CCC, 2020; Eyre & Baruah, 2015; Frank et al., 2020; Lowes et al., 2018; Lowes & Woodman, 2020; MacLean et al., 2016).

2.3 Local and Regional Authorities and Energy Decarbonisation

National policies set the conditions under which local or regional authorities are able to create and implement programmes addressing the low carbon energy transition and contribute to national emissions targets (Hoppe & Miedema, 2020). Therefore sub-national action needs support from central government to be able to work effectively towards the transformation of energy and heat systems (Hawkey et al., 2018). Some national UK strategy and policy has encouraged the role of regional and local authorities in its delivery. For example, the Public Sector Decarbonisation Scheme provides grants to public sector bodies such as local governments to decarbonise their operations and estates, with its second phase focusing on heat decarbonisation in particular (BEIS, 2020i). Moreover, £500 million of Green Homes Grant funding will be allocated through the Local Authority Delivery scheme which focuses on low-income and low energy performance homes (BEIS, 2020f).

The national net zero target has implications at sub-national levels, and local and regional authorities within the UK have recognised both a responsibility and opportunity for them to contribute to achieving the net zero target and to act on the issue of climate change more generally. Indeed, as of December 2020, over 300 local authorities had declared a climate emergency, and many of these have also set their own net zero targets which precede the 2050 target (CCC, 2020b). Additionally, some local authorities have made commitments specifically pertaining to low carbon energy, for example, multiple local authorities have pledged to switch to 100% clean energy in their area by 2050 (UK 100, n.d.), and many have developed sustainable energy plans and projects (Tingey & Webb, 2020).

The CCC (2020b) notes that the predominant areas in which urgent action need now be taken to decarbonise the economy in the UK are strongly connected to local action, actors, and infrastructure. Multiple characteristics of local authorities highlight their potential in addressing climate change and as actors in the low carbon energy transition. Figure 1 shows how local authorities can influence emissions, and moreover, influence energy systems.

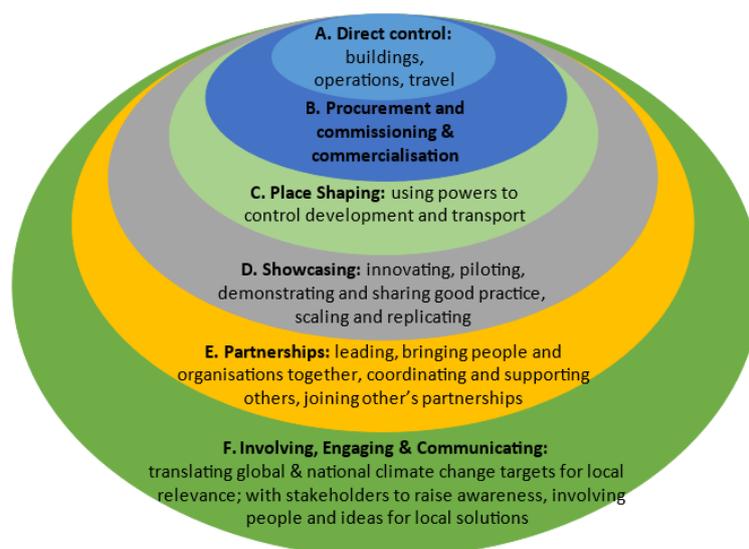


Figure 1. How local authorities control and influence emissions.

Source: adapted from (CCC, 2020b, p. 5)

The decarbonisation of heating has been noted as an area where more regional and local knowledge and decision making will be key to decarbonisation (CBI Heat Policy Commission, 2020; CCC, 2020b; Newey, 2021). Knowledge of local and regional infrastructure, as well as of social, political, and economic conditions, will feed into making appropriate decisions when considering what solutions are most suitable from the diverse mix of technology available (Broad et al., 2020; MacLean et al., 2016). This is especially relevant where there may be interaction with another sector or local industry and when considering the role of heat networks and the structure of different energy grids (CBI Heat Policy Commission, 2020). Furthermore, since heat is generated locally, the transition to low carbon heating requires millions of individual interventions which need to be coordinated; it is proposed that sub-national governments can play a role in this coordination through responsibilities in local planning, local taxation, enforcing building standards, and ensuring that citizens have the appropriate information to make informed decisions about low carbon heating, based on factors associated with their region and their building type (CBI Heat Policy Commission, 2020). Broad et al. (2020) suggest that allowing for a diversity of technologies based on local realities and allowing local actors to identify opportunities could speed up residential heat decarbonisation and support decarbonisation in the face of uncertain technology options. MacLean et al. (2016) add that evidence from other countries shows that the involvement of local authorities is efficient and effective in investing in buildings and heat infrastructure.

2.4 Devolution and Combined Authorities

Devolution is the transfer of certain powers and responsibilities by central government to local or regional government (Civil Service, n.d.). In the UK, perhaps the most recognised form of devolution is in the legislatures and governments in Wales, Scotland and Northern Ireland, each of which have a separate devolution deal with central UK government outlining their powers and areas of responsibility (Civil Service, n.d.). However, more recently there has also been a form of devolution within England with the creation of combined authorities (CAs). These are legal structures set up by neighbouring local authorities, which can take on functions transferred to them by the central UK government, and functions for which the local authorities have agreed to share responsibility (Sandford, 2017). In this way they can be compared to Andersen and Pierre's (2010) 'strategic regions', in so far as they are voluntary agreements of cooperation between local authorities.

CAs do not have legislative powers and still require support, recognition, and approval from central government. Of the ten CAs which have been established since their creation was enabled in 2009, nine are mayoral CAs, led by a metro mayor who is directly elected. Under the current system, the creation of a mayoralty is required for the agreement of any deal which transfers significant powers, meaning mayoral CAs have greater responsibilities and capabilities (Sandford, 2017). One CA which is being studied in this research, West Yorkshire, has recently agreed to move to a mayoral model with the vote taking place in May 2021, and one remains without a devolution deal or metro mayor due to difficulties in negotiations (Paun et al., 2020).

CAs were established with the aim of economic development and growth in 'city-regions' around England (Paun et al., 2020; Sandford, 2017; Tingey & Webb, 2020), with powers pertaining originally to economic development, regeneration, transport, or shared services agreed amongst the constituent authorities. However, devolution processes in the UK have been evolving over the past decade (Tingey & Webb, 2020), and an act in 2016 allowed the Secretary of State in the UK to transfer other statutory functions to the CAs. Table 1 lists the powers which are devolved to one or more of the CAs according to a briefing paper written in March 2020.

Transport	Devolved, consolidated transport budget	Land and housing	Consultation on strategic planning applications
	Bus franchising		Housing grant fund
	Joint working with Highways England and National Rail		Spatial strategy
	Local roads network		Public services
Skills, employment, and health	Joint working with UKTI	Children's services	
	Business support services	Offender management, probation, prison estate	
	Adult Education Budget	Troubled Families / Working Well	
	Work and Health	Police and Crime Commissioner	
Land and housing	Public land commission / joint assets board	Fire service	
	Housing Loan Fund	Finance	Investment fund
	Compulsory purchase orders		Pilot retention of 100% business rates revenue
	Mayoral Development Corporations		Business rates supplement
	Planning call-in powers		Community Infrastructure Levy

Table 1. Powers devolved to one or more combined authority.

Source: adapted from Sandford (2020) with areas identified as of interest for heating highlighted (although others may be indirectly relevant).

The role of CAs in low carbon heat and energy transitions may not be straightforward: they are placed within an already complex system of sub-national government, the powers afforded to each are not consistent, and the agreed deals have not broadly integrated low carbon objectives (National Audit Office, 2017; Tingey & Webb, 2020). Nevertheless, Tingey and Webb (2020, p. 9) suggest that the ongoing devolution processes “create potential for energy policies, regulation and support programmes which differentially ‘unlock’ [local authority] powers to shape meso-scale social innovation” and that CAs specifically could have a role in regional energy planning, directing income and investment into low carbon energy.

In addition to CAs, there are two other regional bodies of note when it comes to low carbon energy transitions. First, there are Local Enterprise Partnerships (LEPs), non-statutory bodies first established in 2010, which take the form of partnerships between local authorities and private businesses (Ward, 2019). There are 38 LEPs in total, covering the whole of England. They work with government to set economic priorities, support businesses, drive job creation and skills, and improve infrastructure (LEP Network, 2021). In many cases, CAs and LEPs have essentially merged, or work very closely on regional and local issues. The nature of the relationship between CAs and LEPs varies, for example with some LEPs remaining entirely separate, some being within the CA but with separate governance arrangements, and others forming an advisory body of the CA (Roberts et al., 2019). Secondly, five Local Energy Hubs (North East, Yorkshire and Humber, North West, Midlands, South East and South West) have been established by the department for Business, Energy and Industrial Strategy (BEIS), with CAs acting as the lead authority for four of the five hubs (apse, 2021). They work with LEPs and local authorities to develop local energy projects and share best practice across regions in England (Greater South East Energy Hub, 2021), although Tingey and Webb (2020) note that they are temporary structures with relatively small budgets.

3 A Conceptual Framework for Combined Authority Action on the Decarbonisation of Heating

This chapter will discuss the rescaling of energy systems and energy governance. It will then draw on literature on Regional Energy Transitions (RETs), and on barriers and enablers for local authority action in energy systems to produce a conceptual framework. This framework provides a foundation on which to build an understanding of the governing role of CAs in relation to the decarbonisation of heating.

3.1 Rescaling of Energy Systems and of Energy Governance

The energy system in the UK has been largely centralised over the past half-century. Local authorities had previously had influence over the system of town gas, but this was greatly diminished after the switch to natural gas from the 1960s (Fudge et al., 2016). In general, the focus on centralised government, centralisation of energy utilities, and market liberalisation has reduced the role of local government in energy systems (Fudge et al., 2016). However, previous research has identified a general trend both in the rescaling of energy systems and governance, and in growth of interest in this area. Now, the questions of centralised versus decentralised energy, of national versus local responsibilities, and of markets versus planning are suggested to be key strategic issues for the energy sector (Newey, 2021).

In recent years, with the increasing prevalence of renewable energy technologies which enable more distributed and localised production of energy, there has been a trend towards the decentralisation of energy (Devine-Wright & Wiersma, 2013). This has been accompanied by more support for the notion that there is a role for sub-national and local scale actors in the transition of the energy system (Fudge et al., 2016; Newey, 2021; Tingey & Webb, 2020; Webb, 2015). This includes local government, who have often been considered to be part of the dominant regime, but also smaller businesses, and ‘grassroots’ approaches like community groups (Fudge et al., 2016). In this context, local governments have been running energy-related projects, and have played a role in the energy system as both regulators and facilitators, as ‘doers’ and ‘enablers’ (Fudge et al., 2016; Hoppe & Miedema, 2020). Nevertheless, while the role of sub-national government has been seen to be growing in the UK, a significant degree of centralisation remains (Fudge et al., 2016).

Multiple studies over the last two decades have focused on local government and other local actors as agents of change within the energy system. As a recent example, Tingey and Webb (2020) researched local energy plans and projects, developing an understanding of the varying roles and responsibilities of local authorities. In another example, Fudge et al. (2016) looked at six case study authorities in the UK, with a Multi-Level Perspective, to understand how they have addressed energy and environmental goals, how they encourage ‘niche’ activity, and the enabling and hindering factors for success in this area. Their study finds that “the UK has witnessed a shifting regulatory regime around energy” in recent years, in part due to local government action, and they argue that with the increasing ‘landscape’ pressures surrounding energy, climate, and the environment, “the low carbon agenda in the UK has provided a ‘window of opportunity’” for local authorities to act in this area (Fudge et al., 2016, p. 2). It suggests that local authority action can encourage carbon reductions at community and household levels by engaging with the technological side of energy transitions and with demand side management (Fudge et al, 2016).

Previous study has posited that there are benefits to decision making at local or regional levels when it comes to the low carbon energy transition. Andersen and Pierre (2010) suggest that in general, there has been regional institutional reform over the past few decades which has been

motivated in part by aims to increase responsiveness to regional and local demands. When it comes to energy more specifically, embedded, bottom-up projects are increasingly seen as an effective way to encourage engagement in more sustainable energy consumption (Fudge & Peters, 2009). Stakeholders in the low carbon heating discourse have expressed the idea that action taken at the sub-national scale is likely to be of great importance for the transition to a low carbon heating system in the UK. A Heat Policy Commission, created by the Confederation of British Industry (CBI) and the University of Birmingham, released a report on the road to low carbon heat which notes that heating solutions will vary regionally according to variables like population and infrastructure, and that this will necessitate local and regional planning, which has been limited (CBI Heat Policy Commission, 2020). Energy Systems Catapult, a not-for-profit organisation aiming to accelerate energy transformation in the UK, also highlight the benefits and importance of understanding the unique characteristics of local areas for the transition to a low carbon energy system through their development of Local Area Energy Planning (Energy Systems Catapult, 2018). This process maps local energy systems to understand potential low carbon scenarios and overcome barriers to low carbon heat. MacLean et al. (2016, p.2) go as far as to say that the current centralised “governance arrangements are not fit for purpose in relation to the new and different challenges of heat decarbonisation” which are defined by local and regional requirements, and that more appropriate arrangements which see a reallocation of responsibility need to be established.

3.2 Regional Energy Transitions

Regional Energy Transitions (RETs) have been receiving more attention from policy makers across Europe over the last decade with experience in this area growing (Hoppe & Miedema, 2020; Mattes et al., 2015; van Engelenburg & Maas, 2018). A region may be defined as a coherent geographical area, with boundaries delineated geographically, culturally, historically or functionally, and include entities such as districts, city-regions, policing regions, or simply regions in which municipalities collaborate (Hoppe & Miedema, 2020; van Engelenburg & Maas, 2018). Research on this topic is in its early stages, and although many studies address local or national governance of energy transitions, less scholarly attention has been paid to the regional level (Hoppe & Miedema, 2020; Mattes et al., 2015; van Engelenburg & Maas, 2018). In particular, there has been limited focus on “regions as the level where inter-municipal issues manifest themselves and are addressed” (Hoppe & Miedema, 2020, p. 2).

Van Engelenburg & Maas (2018) note that research on RETs will have similarities with smart cities and sustainable urban planning since they all deal with understanding the interests of multiple stakeholders, and complex institutions. There has been some study in the area of renewable energy, including homing in on specific energy sources, or focusing on the influence of socio-economic conditions or the participation of local actors and civil society (Lutz et al., 2017). However, decarbonisation of heat does not appear to have been addressed in this context.

3.2.1 Energy Transitions

The transition to a low carbon energy system can be considered as a socio-technical transition which requires changes in the “technology, policy, markets, consumer practices, infrastructure, cultural meaning and scientific knowledge” of the energy system to bring about patterns of low carbon energy production and consumption (Fudge et al., 2016; Geels, 2011, p. 24; Mattes et al., 2015). It is a sustainability transition and is goal-oriented, which differs from many transitions in the past which have been more innovation and market led (Geels, 2011). In these types of transitions the goal is a collective good, and the solutions do not always present immediate or obvious economic or performance benefits over the technologies and systems they are aiming to replace (Geels, 2011). Moreover, the existing systems, such as the energy

system, are often dominated by large and asset rich incumbent firms who have significant power to either lobby against or support new innovations (Geels, 2011). This means that low carbon energy transitions are inherently political, and must be actively steered, with public authorities and policy, especially policy mixes, cited as crucial in bringing about the necessary changes, for example in creating the appropriate economic conditions (Frank et al., 2020; Geels, 2011).

Sustainability transitions face the challenge that many systems are locked into the current unsustainable regime through multiple factors, including sunk costs, power relations, cultural beliefs, the norms of lifestyles and preferences, and political circumstances (Geels, 2011). Within the energy system, this means an ingrained dependency and preference for a fossil-based energy system (Fudge et al., 2016). The idea of a locked-in regime relates to the Multi-Level Perspective (MLP) on socio-technical transitions, which argues that transitions come about as a result of changes in, and interactions between three different levels: the relatively stable regime, which perpetuates the patterns and routines of the current system; the niche level, which is a level of innovation often promoted by regime outsiders; and the landscape level of macro-level trends in economics, culture and politics (Geels & Schot, 2007). Within this view, government institutions, especially at the level of sub-national government, are complex since they can include, support, and act as both regime actors and as innovators (Frank et al., 2020; Fudge et al., 2016). Therefore, understanding what kind of role sub-national government is playing in low carbon energy transitions in reality provides an interesting focus for study.

3.2.2 Key Issues for Regional Energy Transitions

RETs have been connected to the disciplines of regional innovation studies, governance studies, and transition studies (Hoppe & Miedema, 2020). They have been discussed more frequently in transition literature (Lutz et al., 2017), including in relation to the consideration of government as an agent of change, and of its role in developing visions, creating policy, coordinating actions and supporting the development of niche activity (Hoppe & Miedema, 2020). RETs have been linked to a multi-level governance perspective, which addresses the interactions and interdependencies between different levels of government, and to a network governance perspective, an alternative to traditional top-down hierarchical governance involving multiple interdependent actors coordinating on the creation and implementation of policy (Hoppe & Miedema, 2020).

A number of studies which draw on these disciplinary areas have elaborated on key issues involved in regional governance generally, and on RETs specifically. For example, Lutz et al. (2017) draw on existing literature to find driving factors (clustered in four groups: planning and process; exchange and participation; actors and networks; and economic circumstances) for regional implementation of renewable energy which they then apply to case regions in Germany (see Appendix D). Hoppe and Miedema (2020) also created a conceptual framework of elements of RETs. They use this along with a mapping of key projects and events in a case region drawn from interviews, documents, and workshops, to understand how these elements may influence energy transitions in a given region (see Appendix D). Van Engelenburg & Maas (2018) draw on two evaluations of regional energy strategies to elaborate on key issues for RETs. This section will discuss the key issues which are found to recur in the literature relating to RETs, and more specifically which are relevant to the questions posed in this thesis. (See Appendix E for an overview of the key issues).

Structure and Composition of Regional Networks

Hoppe and Miedema (2020) find there are factors related to the structure and composition of a regional network that influence RETs, along with the characteristics of the actors involved.

This ties in with Lutz et al.'s (2017) driver clusters, 'exchange and participation' and 'actors and networks', and van Engelenburg & Maas's (2018) discussion of the involvement of stakeholders. The factors include the size and complexity of regional networks, actor heterogeneity, the presence, skills, and support of key actors, the involvement of regime outsiders and incumbents, and dependencies between different actors. These factors are important because multiple, diverse, and often interdependent stakeholders are involved in or affected by RETs, including local authorities, businesses, consultants, utility providers, energy efficiency supply chains, investors, and developers (Tingey & Webb, 2020; van Engelenburg & Maas, 2018). Lutz et al. (2017) discuss the importance of specific skills of key actors to RETs, and Hoppe and Miedema (2020) emphasise actors' access to and ownership of resources, financial and otherwise.

Cooperation, Coordination, and Actor Characteristics

Cooperation between all stakeholders relevant to the RET, and an understanding of their activities and interdependencies is required for successful and long-lasting change (van Engelenburg & Maas, 2018). For example, the decarbonisation of heating will require coordination with other decarbonisation priorities such as transport and energy supply (CBI Heat Policy Commission, 2020). Moreover, changes in energy infrastructure often have implications across local authority boundaries, requiring cooperation and inter-municipal decision making, which can impact upon the success of projects and on the equity of their outcomes (Hoppe & Miedema, 2020). Hoppe and Miedema (2020) argue that this makes regional approaches both suitable and important for energy transitions. Cooperation between municipalities may be eased where there is a history of collaboration, and incentivised by pre-existing interdependencies, especially when they are faced with similar challenges (Andersen & Pierre, 2010), such as the decarbonisation of heating and other aspects of the low carbon energy transition.

Regional approaches may also highlight or address a general contested issue in regions, where larger cities may have greater capacity to act on their interests than the smaller jurisdictions in the region (Andersen & Pierre, 2010; Hoppe & Miedema, 2020). This idea of disparity in action between different local government authorities is expressed as a concern by the CCC, who had noted a danger that smaller authorities could get left behind in acting on the net zero agenda (CCC, 2020b). This concern is not unfounded, for example, Fudge et al. (2016) found that changes in energy governance at a local level have primarily been driven by a few more progressive authorities, while many others have seen little incentive to take the 'first mover' risk, and Hawkey et al. (2018) found in their investigation of local authority engagement in energy systems that larger authorities do tend to have a higher level of engagement.

Regional approaches are then proposed as a way to coordinate efforts and ensure that smaller areas and authorities are able to participate in energy transitions alongside those who have been leading in this area. Indeed, Boogers et al (2016) found in their study of the effectiveness of regional government in the Netherlands that smaller municipalities benefited most from inter-municipal collaboration, assisting in the implementation of policy and reducing their vulnerability. Additionally, Jacobsen (2015) identified indications of positive effects for smaller municipalities joining networks with larger or stronger members in terms of 'filling in' regarding access to resources. However, tensions in regional governance can also occur due to differences in size and strength between cooperating municipalities. For example, larger authorities must be careful not to be seen to be taking advantage of the strength of their position in such a way that sullies the reputation of the partnership in the eyes of smaller authorities (Andersen & Pierre, 2010), leading to a greater sense among smaller authorities that their power is being 'hollowed out' (Jacobsen, 2015). These concepts tie in with the element of 'leadership and control' identified by Hoppe and Miedema (2020) in their regional energy

transitions framework. Tingey and Webb's (2020) study revealed that more needs to be understood about the governance processes in scaling up low carbon energy across local authorities, including in the actions of leaders and opportunities for followers.

Factors around economic circumstances also represent key issues for RETs, for example, access to funding, funding sources, and influence on the regional economy as highlighted by Hoppe & Miedema (2020) and Lutz et al. (2017). Van Engelenburg & Maas (2018) suggest that regional approaches can have the benefit of joint action leading to a more attractive business case and an alignment in the timing of decision making and action, potentially leading to lower cost solutions for those involved. This aligns with Andersen and Pierre's (2010) concept of 'strategic regions' which are voluntarily created by municipalities to solve collective action problems, and which have the benefits of cost-efficiency and economies of scale. Similarly, in his discussion of the positives and negatives of what he defines as the political governance networks of voluntary regional councils in Norway, Jacobsen (2015) suggests that regional and network governance are seen as a response to solve new and evolving 'wicked' problems which individual actors in the network cannot solve alone, 'filling in' for the shortcomings of existing institutions, and that in particular the greater size of a network can lead to more bargaining power with external actors.

Alongside these benefits, tensions may arise regarding resources in the region, for example, over how finance and resource obtained by virtue of the regional organisation is then distributed between the constituent partners (Andersen & Pierre, 2010). Furthermore, Jacobsen (2010) finds that a regional network of greater size can face more challenges as a result of tension and lack of consensus between partners. Moreover, there is also a chance that the creation of regional networks may 'hollow out' the power and legitimacy of existing institutions (Jacobsen, 2015), or at least there may be friction where local authorities and other existing institutions perceive the existence and actions of a regional body as a challenge to their own legitimacy or authority (Andersen & Pierre, 2010). The notion of legitimacy is further raised as an issue in regard to the position of the regional organisation itself, especially in regard to its democratic status and accountability (Andersen & Pierre, 2010). Tingey and Webb (2020) raise this concern in relation to combined authorities, noting that their establishment has not been consistent. However, this is in part addressed in the English system with the establishment of an elected mayoralty as a precondition for more substantial devolution deals. Similarly, it should be noted that in the case of the regional networks described by Jacobsen (2010) where there are concerns of 'hollowing out', these networks differ from Mayoral combined authorities in that they lack elected representatives, hierarchy, and clear systems of accountability.

Leadership and Strategies

Van Engelenburg & Maas (2018) suggest that leadership is needed to coordinate efforts in RETs, which is often expected to come from local authorities but may be initiated elsewhere. The organisation of these efforts is related to the plans of stakeholders in the region, at strategic, tactical, and operational levels: strategic plans delineate long-term ambitions for energy in the region; tactical plans look at a more specific focus such as heat or transport; and operational plans are narrower still, setting out actions for particular projects. Van Engelenburg & Maas (2018) argue that RETs require an alignment of the plans of different stakeholders across the region to find a shared strategic plan. With the varying interests of multiple stakeholders, this is a complex and iterative process, although the existence of a shared vision is noted as vital to achieve the necessary levels of action and cooperation (van Engelenburg & Maas, 2018). Hoppe and Miedema (2020, p. 3) similarly note a need to "align visions, coordinate actions, and... attract more attention", drawing out motivation and goals, goal-setting, planning, and policy, and establishment of a common language as key elements of

RETs. Similarly, Lutz et al. (2017) highlight comprehensive regional planning, energy specific planning, monitoring of goals, and use of milestones as potential drivers for a regional transition to renewable energy. These all echo the idea that “shared visions that mobilise resources and coordinate actors... can accelerate change and facilitate the scaling-up of certain innovations”, with visions and strategy development outlined as a key part of transformative policy (Frank et al., 2020, p. 3).

Complexities and Uncertainties in Energy Transitions

Coordinating action on decarbonisation of heating is important since a transition to a low carbon system will require changes in supply, demand, storage, distribution, and transmission (van Engelenburg & Maas, 2018). Van Engelenburg & Maas (2018) emphasise buildings and transport as key areas in which these changes will need to play out, highlighting the complexities and outlining three main resulting uncertainties. This first is uncertainty as to which solutions to pursue, exacerbated by the interaction between decisions of different stakeholders. The second is uncertainty regarding the data that informs decisions, especially where techno-economic factors are constantly changing, and where at the regional scale, more specific data is required to determine the actual feasibility of specific actions. These two uncertainties relate to Hoppe and Miedema’s (2020) notion of actors’ access to and ownership of resources, including competences and knowledge, and to the idea of knowledge exchange with experts and experienced practitioners noted by Lutz et al. (2017). Moreover, the idea that there needs to be greater certainty around solutions relates to the suggestion that there need to be ‘consistent legal and policy conditions’ (Lutz et al., 2017), since central policy support for particular solutions can increase the certainty with which they are pursued at regional levels.

The importance of consistency in policy conditions is also salient in relation to the third uncertainty proposed by van Engelenburg and Maas (2018), which is that many solutions require taking the risk of large up-front investment, with returns uncertain and usually only seen in the long-term. Consistent policy can help make conditions for these kinds of investments more certain. This third uncertainty leads van Engelenburg and Maas (2018, p. 65) to the conclusion that RETs need a systems approach, and that they represent a complex societal issue which should be tackled by iteratively “analysing, documenting, envisioning, experimenting, evaluating, and adjusting policies and procedures”. Similarly, Hoppe and Miedema (2020) list ‘experimenting’ among the key elements of RETs. Van Engelenburg and Maas (2018) suggest that this approach necessitates cooperation, credibility, trust, and a sense of shared ownership, built through transparency and the sharing of knowledge between stakeholders (van Engelenburg & Maas, 2018).

Legitimacy, Mandate to Act, and Public Engagement

Trust and credibility are also associated with the factors of legitimacy, commitment, and compliance highlighted by Hoppe and Miedema (2020). The legitimacy of regions to act can on the one hand relate to public acceptance of their role, which may be strengthened by greater participation and public involvement, as suggested in the literature discussed by Lutz et al. (2017). However, they found in their study, that the benefits of public participation are not always straightforward, in part because public involvement can be challenging to include from the outset of a project or agenda, and also because participation processes may be time consuming and thus impede implementation of new energy projects (Lutz et al., 2017). Legitimacy may also relate to the formal status of the region and its formal mandate to act (Hoppe & Miedema, 2020), and to support by decision makers both at the regional level itself and at the national level, and resulting consistency in legal and policy conditions (Lutz et al., 2017).

3.3 Barriers and Enablers to Local Authority Action in Energy Transitions

Previous studies have shown that local authorities have been engaging with the low carbon energy transition, both in the UK and elsewhere. Hawkey et al. (2018) found that around one third of the UK's 434 local authorities are actively engaged in energy provision and have capacity for strategic planning, while Tingey and Webb (2020) found that many local authorities in the UK have created energy and carbon plans. Existing studies have found both barriers and enablers to the role of local authorities in low carbon energy transitions. Understanding what issues have been pertinent at the local authority level can aid in understanding what kinds of issues may impact the regional level, and indeed many of the identified barriers and enablers overlap with the key issues that have been highlighted for RETs. This understanding can also be used to help to delineate specific areas in which there may be opportunities for regional governance, where regional action may be able to overcome the local level barriers or aid the local level in overcoming those barriers. Key factors relating to local authority action on energy transitions which have recurred as themes in the literature are outlined below.

3.3.1 Areas of Responsibility and Influence

Previous study has found that some areas of responsibility which local authorities already preside over have enabled them to act in transforming elements of the energy system. Bulkeley and Kern (2006) posit that local authorities have different modes of governing which allow them to intervene in energy systems. First there is self-governing, which includes making changes to their own operations and estates and acting as a role model. Second there is governing by authority, which includes creating or implementing regulations, standards, planning and taxation. Third there is governing by provision, which includes providing low carbon energy or efficiency measures to social housing. And finally, there is governing through enabling, which includes providing advice and funding for energy efficiency or low carbon energy solutions. In their study, Bulkeley and Kern (2006) found self-governing and enabling to be more salient in relation to climate action. In a later study, Bulkeley et al. (2009) added governing by partnership to the list, arguing that sub-national networks and partnerships can help build resources and capacities to address climate change, while also noting that regional government can enable or constrain municipalities. This is echoed in Hoppe and Miedema's (2020) discussion of regional networks and RETs.

Issues which already allow local authorities to influence the energy system include transport, planning, housing policy, and addressing fuel poverty¹ (BEIS, 2020c; Broad et al., 2020; Fudge et al., 2016; MacLean et al., 2016). Tingey and Webb (2020, p. 10) add that local authorities have "competences in management of housing and corporate estate" which support projects such as those regarding combined heat and power, heat networks and energy efficiency, which encourage decentralised infrastructure for energy and heat. Tingey and Webb (2020) found that authorities with greater responsibility across local services had a greater capacity to implement energy initiatives. This mixture of responsibilities could also be beneficial when it comes to decarbonisation of heating given that it will require coordination with decarbonisation of transport and energy supply (CBI Heat Policy Commission, 2020). Moreover, local authorities' proximity to their communities and subsequent ability to engage

¹ Fuel poverty is an issue in the UK where low income households are paying disproportionately for fuel or energy. A household is considered fuel poor if their fuel/energy costs are above average and their disposable income is below the poverty line. (BEIS, 2020d)

with the public has been cited as a factor which gives them potential for influence in energy transitions (Fudge et al., 2016).

It has been suggested that local authorities are more likely to act where policies have social and economic benefits for their communities beyond the less tangible factor of emissions reductions (Morris et al., 2017). For example, fuel poverty and housing standards have been a priority for local authorities (Tingey & Webb, 2020). It should be noted that while motivations to combat fuel poverty may sometimes be aligned with the decarbonisation of heating, for example in the increased provision of energy efficiency measures, they are not always complementary (Morris et al., 2017). For instance, due to the rebound effect of increased energy use or no reductions after efficiency measures are introduced, or because of the continued roll out of gas boilers and gas connections as one of the primary methods to address fuel poverty (Morris et al., 2017).

It is suggested that local authorities may be able to support technological niches (Fudge et al., 2016). This could be through procurement in their own operations or estates or through facilitating pilot projects that add to proof of concept or increase awareness around a particular technology. Indeed, in their study of local authority engagement in energy systems Hawkey et al. (2018) found that much of the activity was labelled as ‘demonstration’. In these cases, local areas can form the arena for experiments for particular pathways or technologies which can encourage innovation or upskilling (Mcguirk et al., 2015; Mulugetta et al., 2010). This is important because one of the challenges in scaling up low carbon heat and energy is the need for sufficiently skilled workers and developed supply chains which enable low carbon solutions to be attractive and affordable (Newey, 2021).

However, local authority power in this area is still limited, often to the areas of responsibility outlined above, with national policy and objectives still holding precedence and relatively few formal duties that explicitly mandate local authorities to act on energy (Fudge et al., 2016; Hawkey et al., 2018; Morris et al., 2017; Tingey & Webb, 2020). It has been suggested that there is not a clear and coherent role for local government in energy policy, and that even national UK energy policy relevant to local authorities is patchy and ambiguous when it comes to the role they are given (Fudge et al., 2016; Tingey & Webb, 2020). This means that local authorities have often had to find innovative ways of working energy initiatives into other services (Tingey & Webb, 2020). Moreover, it is argued that often, local authorities have not had sufficient knowledge and experience of the energy sector to play a substantial or effective role. Nevertheless, this appears to be changing with a movement to give more power to sub-national bodies, such as combined authorities. Tingey and Webb (2020) argue that this is a significant move away from existing systems of centralised governance. Moreover, more local authorities are taking an integrated approach to addressing climate and energy issues within their operations (Tingey & Webb, 2020), which greater enables local authorities to act in this area (Bulkeley and Kern, 2006)

3.3.2 Resources and Funding

A key factor in enabling local authority action in energy transitions is access to resources and funding. Tingey and Webb (2020) found in their study that that local authorities’ engagement in the energy system relates to access to resources and often by extension to scale. With austerity measures in the past decade in the UK, the finances of local government have been diminished and strained, which has restricted ability to act on energy or heating innovation (Morris et al., 2017; Tingey & Webb, 2020). Morris et al. (2017) argue in their study of energy efficiency policy among UK local authorities that while they have been given greater powers to act within the energy system in the past decade, their action continues to be restricted by insufficient transfer of funds, leading to an imbalance between responsibilities and resources.

Of course, access to sufficient funding is related to human resources, and the ability to employ those with the necessary knowledge and capabilities to act on low carbon energy transitions. Hawkey et al. (2018) found that a lack of dedicated budget often led to energy strategy related functions being accommodated within different departments in different councils.

Bulkeley and Kern's (2006) study suggests that even before the advent of the most recent austerity measures, availability and surety of finance for local governments has been a long term barrier to action on climate change in the UK, with external funding proving critical to climate change action schemes. It should also be noted that the funding landscape is now shifting due to the UK's exit from the European Union (Morris et al., 2017). It has been found that while there have been some opportunities created by financial support from central government, access to long term finance has been lacking which has led to one-off projects and little systematic change (Tingey & Webb, 2020). This is especially relevant because energy infrastructure often requires significant investment. Tingey and Webb (2020) argue that greater support for decentralisation could improve certainty around access to finance. MacLean et al (2016) argue that capacity needs to be built among local authorities to enable them to make changes in the energy system, but that it would be beneficial to have shared schemes to achieve this in order to avoid a duplication of effort with every authority expending resource on expertise and support facilities. This highlights an area where regional government or regional networks may be able to play a role in supporting local authorities.

3.3.3 Stability of Policy and Funding Support

Beyond just access to sufficient funding, it has been found that local authorities need stable and consistent policy support from central government in order to be able to play a significant role in energy innovation and the transition to a low carbon system. MacLean et al. (2016) found in their review of literature that local action backed by central government tends to be more successful. At present it appears that the uncertainty of an inconsistent policy landscape has hindered local authorities from acting within low carbon energy transitions, and has tended to lock in a limited and fragmented local authority approach (Fudge et al., 2016; Morris et al., 2017; Tingey & Webb, 2020). Local authorities are left uncertain about their role (Fudge et al., 2016), and a lack of stability in both policy and finance leaves them less able to implement long-term change and engage productively with their communities (Morris et al., 2017; Tingey & Webb, 2020). Tingey and Webb (2020) suggest there may be lessons from Scotland's national policies in which local authorities have been outlined a core role in upgrading building energy performance, and where there has been a mandate for local authorities to draw up whole area heat and energy efficiency strategies, among other policies.

3.3.4 Connecting Stakeholders

The capacity of local authorities to interact with and connect the many stakeholders who are involved, and act as an interface or platform for communication and collaboration has been proposed to enable local authority engagement in energy transitions (Bulkeley & Kern, 2006; Fudge et al., 2016; Morris et al., 2017). This is one of the ways in which local authorities might be considered 'enablers' in the low carbon energy transition (Fudge et al., 2016). In the past, the CCC has referred to "the role of local authorities in providing an effective local interface between technological innovation and diffusion, business practice, institutional change, and broader community and individual behavioural change" (CCC, 2012; Fudge et al., 2016, p. 2). This opportunity for local authorities may arise in part due to the emergence of an 'energy service sector' rather than one that is simply selling energy as a commodity, associated with the greater decentralisation of energy systems (Fudge et al., 2016). This opportunity in playing an interfacing role has often been expressed as theoretical, suggesting further research may be needed to understand if it is a role that local authorities are actually able to take on. Indeed,

the maintenance of partnerships is another area which has been identified as hindered by uncertainty in finance and policy (Morris et al., 2017).

3.3.5 Willingness to Act

Another factor that has been found to be an enabler of local authority action is a willingness to act, among politicians, authority officers, and the public (Fudge et al., 2016; Fudge & Peters, 2009). Fudge et al (2016) found that willingness to act was viewed as a key driver for taking on an energy governance role by those they interviewed from within local authorities. In some cases, the presence of particularly motivated individuals, or ‘champions’ have been identified as critical to how climate change and energy issues are viewed within local authorities and to the success of relevant projects (Bulkeley & Kern, 2006).

3.3.6 Knowledge of the Local Area

The benefits of local knowledge and connection to local communities has also been emphasised as a strength for local government when it comes to acting on low carbon ambitions (CCC, 2020b; Fudge et al., 2016; Tingey & Webb, 2020; Webb, 2015). This ties in with the acknowledgement that the factors impacting energy systems can vary greatly from place to place, and therefore that leading from a local level with local knowledge is important for finding appropriate strategies for decarbonisation of the energy system (CBI Heat Policy Commission, 2020; Fudge et al., 2016). MacLean et al. (2016) note that due to their knowledge of local factors, local authorities are well placed to carry out heat mapping and zoning, which is important for the roll out of heat technologies, particularly district heating, and to communicate planned changes to those who will be affected within their communities.

3.3.7 Public Awareness and Trust

Because communities will be affected by the changes in infrastructure required to reduce emissions, there needs to be greater public awareness and trust to enable the transition to a low carbon energy system. Bulkeley & Kern (2006) suggest public engagement and support are important for local authorities’ capacity to implement climate action measures, because of the requirement for behaviour change and need for legitimacy. Fudge et al. (2016) also consider this to be important, with one of the focus points of their study considering community engagement and how local governments engage the public to drive sustainable energy change.

In the first instance there needs to be a greater awareness of the need for a transition to a low carbon energy and heating system, of low carbon heating technologies, and of the part that small, individual actions can play (Fudge et al., 2016; Newey, 2021). It seems there is currently little awareness among households of the challenge of decarbonising heating (CBI Heat Policy Commission, 2020), indeed research undertaken by BEIS (2020c) suggests most people in the UK have not heard of low carbon heating technologies and nearly 1/3 of those surveyed using gas believed they were using ‘environmentally-friendly heating’. Additionally, there needs to be acceptance among end users of technologies, and among citizens who will be affected by changes in infrastructure (Morris et al., 2017). This is particularly pertinent in the area of heating where changes will be much more noticeable than in the decarbonisation of electricity (Newey, 2021), and where decarbonisation will require millions of private households and businesses to make changes in their lives, such as switching to low carbon heating or installing retrofits (CBI Heat Policy Commission, 2020).

It is suggested that local authorities are in a position to communicate with communities to raise this awareness, build trust and encourage action, although they do not necessarily always take on this role (Fudge & Peters, 2009; Morris et al., 2017). This can be challenging given the

many priorities and issues on which households fix their attention, and some authorities have found it difficult to generate participation beyond those who are already interested in environmental issues (CBI Heat Policy Commission, 2020). Moreover, while in some cases there may be existing levels of trust between local authorities and their communities which aid in this area (Morris et al., 2017), Fudge et al. (2016) found that in the UK, in some cases, there may be low levels of confidence due to local authorities’ association with the traditional governmental regime and a subsequent lack of political trust. It has been proposed that local authorities can have more success when engaging on factors beyond just the figures around energy and carbon reduction, homing in on the needs expressed by citizens and communities (Morris et al., 2017).

3.4 Emerging Concepts

Previous studies have elucidated on the idea of RETs, and others have explored the role of local authorities in energy transitions. However, it appears that there has not been research which has focused specifically on the shift to low carbon heating within regional energy transitions, nor which has taken CAs in England as the specific focus of study. Cowell and Webb’s (2021) very recent study on heat decarbonisation and local energy planning in the UK did use Greater Manchester Combined Authority as one of the actors to be interviewed for their study, but its status as a CA was not a focus point. Therefore, it is pertinent to explore how CAs, as an emerging form of regional governance, might be able to address aspects of the challenge of decarbonisation of heating in a way that traditional forms of government have not, or how they might be able to add to existing efforts.

Table 2 delineates the main themes found in RETs and in local authority action in the energy system and illustrates the links between these. From this, a summarising framework which connects and consolidates the key themes is drawn up in Figure 2. Looking at the relevant energy and climate change strategies of the CAs and their constituent authorities will give an initial understanding of the role that CAs are taking in this area in comparison to the role of local authorities. Using the factors identified in the framework will then allow for the understanding of where CAs are facing both enablers and barriers to acting in this area, and how this compares with those faced by their constituent authorities, to cast further light on the current and potential role of CAs in influencing the transition to low carbon heating. Finally, this analysis can help to illustrate whether there is evidence that low carbon heating presents a window of opportunity for regional influence over energy systems in the England, thus forming part of emerging RETs.

The fact that there are so many overlaps between the key issues for RETs and the main barriers and enablers for local authority action in energy transitions identified in the literature is significant. These overlaps already give some indication that the issues faced at the regional level are likely to echo those found at the local level, but it also delineates specific areas in which the regional level might have opportunities to overcome the barriers or present enablers at the local level.

Table 2. Links between key issues for Regional Energy Transitions and local authority action in energy transitions

<u>Key issues for Regional Energy Transitions</u>	<u>Key issues for local authority energy action</u>
The structure and composition of regional networks influencing energy transitions. - Size - Complexity	Existence of established responsibilities, influence, partners, and relationships with stakeholders. Ability to interact with and connect multiple diverse

<ul style="list-style-type: none"> - Actor heterogeneity - Involvement of regime outsiders and incumbents. 	<p>stakeholders and enable networks</p>
<p>The characteristics of the actors relevant to a regional energy transition.</p> <ul style="list-style-type: none"> - Size, access to resources and capacity (and effects of where this differs) - Motivations and goals - Willingness to engage in energy systems 	<p>Resources and capacities which allow intervention in the energy system.</p> <ul style="list-style-type: none"> - Local knowledge - The willingness to act of politicians and local authority officers - Presence of ‘champions’
<p>The relationship between different relevant stakeholders in the region.</p> <ul style="list-style-type: none"> - Ability to cooperate - Dependencies - History of collaboration - Lack of consensus and tensions - Influence of relationships on the alignment of strategies 	<p>Ability to</p> <ul style="list-style-type: none"> - build partnerships with other municipalities to develop resources and capacity. - provide an interface for relationships and communication between different stakeholders. <p>Effect of relationship with the public.</p> <ul style="list-style-type: none"> - Presence of existing trust or low levels of confidence
<p>Leadership and control within the region</p> <ul style="list-style-type: none"> - How this influences the creation and alignment of strategies - Who is viewed as a leader - How leaders influence followers at a regional scale. 	<p>Control over and responsibility for particular services which enable action in the energy system</p> <ul style="list-style-type: none"> - Dependence on national government policy and objectives <p>Ability to use their leadership position to build public awareness and trust.</p>
<p>Economic circumstances, and access to and ownership of resources.</p> <ul style="list-style-type: none"> - Sources of funding - Influence of actions on the regional economy - Many solutions require large upfront investment and there may be business case, economies of scale and bargaining power benefits of regional action. - Tensions may arise from how resource is distributed regionally. 	<p>Access to funding</p> <ul style="list-style-type: none"> - Restrictions on local authority action due to insufficient funding and resources including knowledge and capabilities. - Funding from external sources has been critical. - There is a suggestion that pooling efforts could help overcome some of the barriers in resources and capabilities.
<p>The presence and alignment of strategies and plans since shared visions are seen as important for the necessary levels of action.</p> <ul style="list-style-type: none"> - Relates to leadership and coordination and the establishment of a common language. 	<p>Self-governing, governing by provision and governing by authority can all be incorporated into local authorities’ strategies for energy transitions and climate action.</p> <ul style="list-style-type: none"> - Local authority responsibilities and influence over several services and areas, and their position in connecting stakeholders could aid in alignment of strategies and plans.
<p>Energy transitions are complex issues which require a systems approach.</p> <ul style="list-style-type: none"> - Need for detailed and regional scale data - Need for access to competences and knowledge - Need for an iterative approach including envisioning, experimenting, and evaluating. 	<p>Local authorities can support technological niches through experimenting/facilitating pilot projects and demonstrations.</p> <p>Leading with local knowledge is important for finding appropriate strategies for decarbonisation of the energy system, e.g., through heat mapping and zoning.</p>
<p>Consistency in policy and funding support.</p> <ul style="list-style-type: none"> - Relates to access to resources and the ability 	<p>Need for stability in policy and funding support.</p> <ul style="list-style-type: none"> - Central government backing linked to success

to create plans - Support from decision makers at a national level.	- Lack of certainty and inconsistency have led to fragmented approaches and little systematic or long-term change.
Public engagement including public acceptance of the role of regional actors. - Public acceptance is vital due to the need for behaviour change - Public engagement can also be difficult and time consuming.	Potential advantage that proximity to communities can bring in building public awareness and trust - Ability to encourage action and behaviour change
Legitimacy and mandate to act. - Democratic status and accountability - Trust and relationships between actors - Effect of regional actions on legitimacy and authority at local level.	Areas of responsibility and influence which give a mandate to act within the energy system. - Limitations on power and responsibilities - Reliance on national policy and objectives.

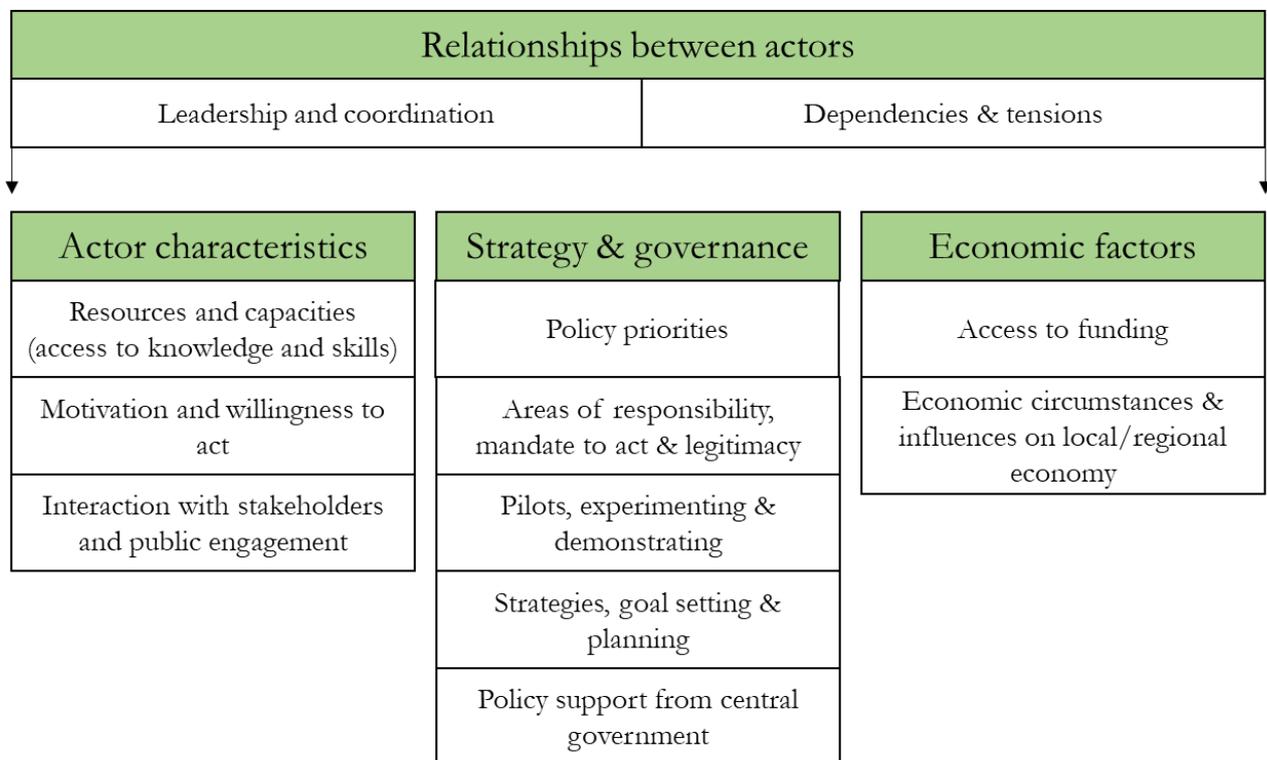


Figure 2. Key themes for understanding CA and local authority action on the decarbonisation of heating and energy transitions.

4 Research Design and Methods

This chapter outlines the methodology utilised for conducting this study. Section 4.1 gives an overview of the research design and section 4.2 elaborates on methods for data collection and analysis.

4.1 Multiple-Case Study

This research takes a multiple-case study approach. Yin (2014) suggests that case study research investigates a contemporary phenomenon in context, and is particularly suitable when there are not clear boundaries between the phenomenon and its context. Case studies are carried out within the boundaries of one or more social systems (cases), such as organisations, individuals or communities (Swanborn, 2010). In this research the phenomenon of regional governance of the decarbonisation of heating is explored through the cases of combined authorities and their constituent local authorities in the context of the UK and specifically of England. The way in which low carbon heat strategy may be addressed by these organisations is inevitably influenced by their context meaning phenomenon and context are intertwined, and thus make a case study approach appropriate. Moreover, given that low carbon energy transitions can be regarded as socio-technical transitions which are influenced by economic factors, cultural norms and social practices, as well as being inherently political, it is apt that these phenomena should be studied in context (Fudge et al., 2016; Geels, 2011; Geels & Schot, 2007).

A case study approach was further deemed appropriate for this research since case-studies have been identified as suitable means by which to contribute to knowledge on organisations and their processes, as well as social and political phenomena (Yin, 2014). Moreover, case studies are a mode of investigating the interactions between, perceptions of, and decisions made by people or organisations (Swanborn, 2010). The use of cases as the focus of study is a mode of selecting sources of data which would enable the procurement of in-depth insights into a phenomenon within a limited time frame (Blaikie & Priest, 2019; Yin, 2014).

Multiple cases were chosen since this is often considered to make findings more robust and improve theory building (Bryman, 2012; Yin, 2014). This is useful because the results from case studies cannot be generalised to other cases or beyond the context of research; in other words, they have limited external validity (Bryman, 2012). Nevertheless, multiple-case studies help to create a better understanding of the mechanisms behind a phenomenon and the circumstances in which a theory will hold (Bryman, 2012). It is suggested that case studies can be used to expand and build on theories rather than discuss probabilities (Yin, 2014). This study therefore hopes to build on existing theories surrounding regional action in energy transitions with findings generated from multiple CAs.

Some scholars have expressed concerns about the rigour of case study research and how it might stand up to social research questions of reliability, replication, and validity (Bryman, 2012; Yin, 2014). Due to their context specific nature, case studies may present issues for reliability and replication: whether another researcher would be able to repeat the study and find the same conclusions (Bryman, 2012; Yin, 2014). However, this can be combatted through the use of systematic procedures and transparency in communication of the research process and methods. Nowell et al. (2017) suggest that allowing others to understand the research process increases the dependability of the study. To address this issue in this research, all methods are outlined, and the research process is illuminated through the inclusion of materials such as the interview guide, coding framework, and conceptual framework. Moreover, all materials are archived in a case study database for transparency (Yin, 2014).

4.1.1 Case Selection

Yin (2014) suggests that multiple cases should be chosen either on the basis of *literal replication*, which predicts similar results between cases, or *theoretical replication* which predicts contrasting results for anticipatable reasons. This study falls closer to the former, but somewhere between those logics. Similar results are expected between CAs, while the cases selected nonetheless present an opportunity to gain a broad set of insights. This is based on the understanding that institutional and contextual factors could lead to some variety in the findings from the different CAs studied. However, when considering any differences which may be found between cases, it is important to note they may not necessarily be as a result of distinguishing characteristics of those cases (Bryman, 2012). The CAs selected for this study were chosen as exemplifying cases of the broader category of CAs, providing an apposite context for research into key processes (Bryman, 2012).

The three CAs selected for this research are Greater Manchester Combined Authority (GMCA), West Yorkshire Combined Authority (WYCA), and Sheffield City Region Combined Authority (SCRCA). For each of these CAs, two constituent local authorities were selected for data collection. Therefore, the units of analysis for this multiple-case study are the selected CAs, with the boundaries defined as the geographical and organisational boundaries of each CA. The administration of each CA and of each of the selected local authorities form three sub-units for each of the CA units. The selected local authorities were Manchester City Council and Oldham Metropolitan Borough Council (constituent members of GMCA); Leeds City Council and Wakefield Metropolitan District Council (constituent members of WYCA); and Sheffield City Council and Rotherham Metropolitan Borough Council (constituent members of SCRCA).

The CAs were selected based on whether they had published a relevant energy strategy within the last five years. Comparable documents, such as energy plans or strategies were identified as bases upon which to understand approaches to heat strategy within each CA. As noted in Section 1.3, selecting CAs which had published relevant strategies in recent years may lead to data being collected on the CAs who are most engaged in this area. If this is the case, the data collected is nevertheless useful, since it can reveal insights into the potential that this type of organisation has to engage in this area. Moreover, comparable energy and heat strategy documents would allow for meaningful discussion, comparison and understanding of the approaches of different CAs and their constituent local authorities.

The selection process began by identifying relevant strategy documents and information produced by the CAs. Instances of relevant documents which were comparable between different CAs were then noted. Of the four CAs that were established to have suitable strategies, three agreed to participate in the study. The two constituent local authorities were then selected for each CA. For each CA this included the authority representing the most populous city in the region, which are those representing what might be considered the primary city of the city-region: Manchester, Leeds, and Sheffield. One authority representing a less populous borough or district was then selected for each CA: Oldham, Wakefield, and Rotherham. Further information on each of the selected CAs and local authorities and be found in section 5.1.

4.2 Data Collection and Analysis

This thesis uses a qualitative approach. For the purpose of this research a mixture of both documentary data and interviews were used, as is common in the employment of case studies (Swanborn, 2010). Table 3 presents an overview of the data collection and analysis employed in this research.

Table 3. Overview of data collection and analysis.

Method of data collection	Data source	Method of data organisation and analysis	Related to RQ
Literature review	Academic and grey literature accessed via Google Scholar, Science Direct, LUBcat, organisation’s web pages, suggested readings	Synthesis matrix	RQ2, RQ3
Documentary review	Grey literature accessed via web searches, organisation’s web pages, government web pages	Synthesis matrix Thematic analysis	RQ1, RQ2, RQ3
Interviews	Relevant officers working within the CAs and local authorities	Thematic analysis	RQ1, RQ2, RQ3

Although the interviews were used more for RQ2 and RQ3, and the documentary review was used more for RQ1, the relevance of the data sources to multiple RQs meant there was some triangulation in terms of data sources. This can help improve construct validity, since findings can be reiterated across multiple data sources (Yin, 2014).

4.2.1 Literature Review

A literature review was conducted in order to generate a conceptual framework through which to understand RETs and the role of local and regional government in those transitions. Furthermore, the literature review provided an understanding of the barriers and enablers found to be facing local authority action within energy systems and in the decarbonisation of heating which would help to answer RQ2 in particular.

The literature review was conducted using Google Scholar, Science Direct and Lund University Library (LUB) Search, as well as using and building from recommendations from professors and peers. For this study, the empirical sources reviewed were generally restricted to those written after 2006 in order to remain up to date with the evolving socio-political context of heat decarbonisation and local and regional approaches. This restriction did not apply to literature specifically focused on theory. There was also primarily a focus on UK-based studies in order to determine gaps in the literature within the context of interest. Additionally, the UK government and CCC websites, among a few other non-academic sources were consulted to gain a greater understanding of the current outlook on decarbonising heating, and of the role of local and devolved authorities.

Search terms were initially used to identify relevant literature (see Appendix F). Citations in identified literature were then used to discern further relevant studies in a snowballing approach (Wohlin, 2014). Sources were narrowed down after reading the abstract, keywords, introduction, and conclusion of the studies. This allowed for an understanding of subject, context, theory, methods, and results of each study. A synthesis matrix was created using a spreadsheet and used to draw out key themes from the sources. The matrix was built in an iterative process where themes were built up and added to as literature was reviewed.

4.2.2 Documentary Review

Online research was used to identify relevant strategy documentation published by each of the CAs and local authorities (see Appendix F for initial search terms used). The majority of documents were found on the CA and local authority websites, and the primary identified documentation for review was identified as energy or climate change strategies created by the CAs and local authorities. The identified documents were used primarily to answer RQ1, but also to inform answers to RQ2 and RQ3. A preliminary review of the documents provided information on which to build interview plans to gather more in-depth information. A synthesis matrix was created to draw out themes, which were iteratively developed as the documents were reviewed.

First it was established whether the case CAs and local authorities had declared a climate emergency, and whether they had set net zero targets. Then information was garnered on aims set out in the strategies including which solutions are highlighted; what type of programmes are described; and the role of the CAs and local authorities as outlined in the strategies.

4.2.3 Interviews

Semi-structured interviews were conducted with authority officers in order to provide data to answer RQ2 and RQ3, and also to further inform RQ1. The study aimed to conduct interviews with one relevant representative officer from each CA and each of the constituent local authorities, allowing for comparison and the ability to reflect on aspects specific to each CA. Publicly available information on council websites and on LinkedIn were used to identify and establish contact information of officers working with climate change, energy, and heating functions within the authorities. This follows the approach of Fudge et al. (2016) who interviewed authority officers active in energy-related and environmental decision making to identify perspectives from across the local authorities being studied.

Responses were received from eight participants in the first instance. A further two participants were recommended by other interviewees to provide additional information in the cases of Leeds City Council and Rotherham Council. This led to interviews being conducted with ten participants overall (see Appendix B for participant numbers). Although it would have been preferable for achieving a balance between the different case CAs, and despite follow-up emails, no response was obtained from a representative of Sheffield City Council, which was then no longer included in the study. Interviews were conducted online over MS Teams, with the opportunity to conduct in person interviews restricted by the situation surrounding the COVID-19 pandemic. The duration of interviews was between 20-60 minutes, with the majority lasting approximately 45 minutes. All interviews were recorded and subsequently transcribed using transcription software followed by some manual editing.

Questions were tested with academic peers prior to conducting the interviews and interview questions aimed to be non-leading, although probing was used to invite participants to elaborate on certain answers (see Appendix G for interview guide). The interview guide was built based on information gained through the literature review and preliminary documentary review, which enabled more in-depth information on relevant issues to be gathered. It was developed iteratively and adjusted for each CA and local authority.

To analyse the data, thematic analysis was used with the help of NVivo 12 software. This allowed for the systematic creation of coding categories and of a coding framework (see Appendix H). Initial codes were generated based on the conceptual framework drawn from the literature review (see section 3.4) which allowed for detailed analysis of the particular areas of interest for this study (Nowell et al., 2017). These were then added to during the coding

process with some more specific codes. A final step saw the reorganisation and consolidation of codes where there may have been overlaps or codes that became obsolete. Additionally, once the themes were established, diagramming was used to establish relationships between different themes (Nowell et al., 2017).

Thematic analysis is used for identifying, organising, and reporting themes found within collected data (Nowell et al., 2017). The advantages of this method of analysis are that it is flexible and provides an in depth and detailed account suitable for understanding perspectives of different participants (Nowell et al., 2017). Moreover, it is an accessible form of analysis appropriate for master's level research (Nowell et al., 2017). In addition, the use of a conceptual framework and the identification of themes is useful in multiple-case studies as it provides a basis for the facilitation of cross-case analysis (Nowell et al., 2017). It should be noted that there are also limitations to this method, for example, the flexibility afforded by the method can also lead to inconsistency in developing themes (Nowell et al., 2017). This is combatted in this research through the use of the conceptual framework as a means of guiding the coding process (Nowell et al., 2017).

5 Findings and Analysis

This chapter presents the findings of the research. An introduction to the cases is presented in section 5.1, section 5.2 presents the findings from the collected strategy documents, and section 5.3 uses the conceptual framework outlined in section 3.4 to present the barriers and enablers for action on the decarbonisation of heating and the governing role of combined authorities.

5.1 Introduction to the Case Authorities



Figure 3. The Combined Authorities of Greater Manchester, West Yorkshire, and Sheffield City Region (South Yorkshire).

Source: Adapted from Office for National Statistics (2017). Key: 20 = Bolton; 21 = Bury; 22 = Rochdale; 29 = Trafford; 30 = Salford; 31 = Manchester; 32 = Tameside; 33 = Stockport.

Name of Authority	Approx. Population	Constituent Local Authorities	Approx. Population of Selected local authorities
Greater Manchester Combined Authority	>2.8 million	Manchester, Oldham, Bolton, Bury, Rochdale, Salford, Stockport, Tameside, Trafford, Wigan	Manchester: 577 000 Oldham: 234 000
West Yorkshire Combined Authority	>2.5 million	Leeds, Wakefield, Bradford, Calderdale, Kirklees	Leeds: 793 000 Wakefield: 348 000
Sheffield City Region Combined Authority	>1.4 million	Sheffield, Rotherham, Barnsley, Doncaster	Rotherham: 265 000 [Sheffield: 575 000 – included for comparison]

Table 4: Selected combined authorities

Source: (Centre For Cities, n.d.-b, n.d.-a; Leeds Observatory, 2019; Manchester City Council, 2020a; Oldham Council, 2019; Rotherham Data Hub, 2018; Sheffield City Council, 2016; Wakefield Council, 2021; WYCA, n.d.)

5.1.1 GMCA, Manchester City Council, and Oldham Council

Greater Manchester is a region in the northwest of England. It is home to one of the largest metropolitan areas in the UK (The Editors of Encyclopedia Britannica, 2013a). It comprises ten metropolitan boroughs, outlined in Table 5. These ten councils formed the first statutory combined authority in 2010, Greater Manchester Combined Authority (Communities and Local Government, 2010). The CA had an interim Mayor from 2015-2017, and has had an elected Mayor since 2017 (BBC, 2015). Greater Manchester represents one of the largest regional economies in the UK outside of London. Manchester is the central city of the Greater Manchester region and home to the largest population of the boroughs, while Oldham is one of the three smallest boroughs in Greater Manchester in terms of population. In the case of Greater Manchester, the Local Enterprise partnership (LEP) is a major partner to the CA, which contributes to its decision making, and whose senior staff are part of the leadership team at the CA (Greater Manchester Combined Authority, n.d.).

5.1.2 WYCA, Leeds City Council, and Wakefield Council

West Yorkshire is a region in the north of England which contains five metropolitan boroughs, outlined in Table 5 (The Editors of Encyclopedia Britannica, n.d.). The combined authority was formed in consultation with the West Yorkshire Integrated Transport Authority, and the councils comprised in the West Yorkshire transport area, with the transfer of functions pertaining to transport, economic development and regeneration in the region (The West Yorkshire Combined Authority Order 2014, 2014). The region elected a Mayor in 2021. The councils in West Yorkshire are also a part of the Leeds City Region, which encompasses a further five boroughs: Craven, Harrogate, York, Selby, and Barnsley (Leeds City Region Partnership, n.d.). It is notable here that Barnsley falls within both the Sheffield City Region Combined Authority and the Leeds City Region. In West Yorkshire, the CA works in tandem with the Leeds City Region Local Enterprise Partnership and oversees a number of functions across the wider city region (Leeds City Region Enterprise Partnership, n.d.-a). The chair of the LEP is a non-constituent member of the of the CA. Leeds is the largest city in the region, and indeed the largest in Yorkshire as a whole and is “a major commercial and cultural centre” (The Editors of Encyclopedia Britannica, n.d.). Wakefield district is the second smallest borough in the region by population (Wakefield Council, 2021).

5.1.3 SCRCA and Rotherham Council

The mayoral CA of Sheffield City Region is comprised of the four councils which make up the region of South Yorkshire in north-central England, outlined in Table 5 (The Editors of Encyclopedia Britannica, 2013b). These four constituent councils, with the addition of the five non-constituent councils (Bassetlaw, Bolsover, Chesterfield, North East Derbyshire, Derbyshire Dales) make up the Sheffield City Region. The economy of the city region is slightly smaller than that of Greater Manchester or Leeds City Region (Leeds City Region Enterprise Partnership, n.d.-b). The combined authority was established in 2014, becoming responsible for decision making on transport and economic development at the South Yorkshire or Sheffield City Region level (Sheffield City Region Combined Authority, 2018). The first mayor was elected in 2018. The CA works with the Local Enterprise Partnership and the South Yorkshire Passenger Travel Executive to make up the Sheffield City Region. These bodies work on functions across South Yorkshire, but also in the wider city region. The CA has the role of shaping policy and leading on decision making, while the LEP outlines the visions and aims for the economy of the region (Sheffield City Region, 2020b). Sheffield is the largest city in the South Yorkshire region, while Rotherham is the second smallest borough by population (Rotherham Data Hub, 2018; Sheffield City Council, 2016).

5.2 Strategies

This chapter presents the findings for RQ1. It presents findings on which low carbon heating solutions are highlighted, which approaches and programmes are pursued, and what role is outlined for the CAs and local authorities in each of the energy strategies.

5.2.1 Greater Manchester Combined Authority

Table 5. GMCA Targets and Strategies.

Declaration of Climate Emergency	2019
Net zero targets	2038 for the city region
Strategies	<p>5 Year-Environment Plan for Greater Manchester 2019-2024</p> <ul style="list-style-type: none"> - Outlines decarbonisation of heating related issues as priorities within two of its six focus areas: energy supply; and homes, workplaces and public buildings <p>Whole System Smart Energy Plan</p> <ul style="list-style-type: none"> - Subsequent to the Spatial Energy Plan - Part of the Smart Systems and Heat Programme (in collaboration with Energy Systems Catapult² and the Energy Technologies Institute³) - Identifies the decarbonisation of heat as one of four priority areas

Source: Greater Manchester Combined Authority (2019b, 2019a) and Owen (2019)

Which solutions are highlighted?

The 5-Year Environment Plan identifies three main priorities in the area of home, workplaces and buildings: reducing heating demand in commercial and public buildings, in new buildings, and in existing homes, with a focus on a shift to whole house retrofit in the latter (Greater Manchester Combined Authority, 2019). The 5-Year Plan also recognises the need to phase out gas boilers and move to low carbon heating, with an aim to add at least a further 10TWh of low carbon heating to the region by 2024. While primarily referring to the use of heat networks and other low carbon heating such as heat pumps, it notes that the potential role of hydrogen should continue to be considered in line with the situation at the national scale and describes an aim to develop a hydrogen strategy for the region.

What types of programmes are described?

There is a scheme to launch a Greater Manchester retrofit partnership/accelerator to develop the sector and necessary skills in the workforce and to improve capacity and access to finance, as well as a planned drive to raise efficiency standards in the private rented sector including a Greater Manchester Good Landlord standard (Greater Manchester Combined Authority, 2019). The Combined Authority is investigating encouraging energy efficiency through council tax and business rates, and GMCA and its constituent authorities are consulting on requiring zero carbon standards for new builds by 2028 (Greater Manchester Combined Authority, 2019). Moreover, GMCA and its constituent local authorities are collaborating on a Local Energy Market which aims to increase energy efficiency and support low carbon technology and infrastructure, and are rolling out Local Area Energy Planning in the region to identify appropriate heating solutions for different areas (Energy Systems Catapult, 2021). This will involve a public engagement and consultation process. They are also consulting on proposals

² Energy Systems Catapult is a not-for-profit set up to accelerate the transformation of the UK energy system

³ Energy Technologies Institute is a public-private partnership between energy and engineering companies and the UK government

to identify areas of opportunity for heat networks and to require viability assessments for connecting new developments to heat networks. In regard to both reducing heat demand and transitioning to low carbon heating, the 5-Year Plan sets out advice for actions to be taken by residents, constituent authorities, businesses and organisations and other key partners.

What role is outlined for the CA?

GMCA calls for central government to work with them to “establish an Energy Transition Region... in Greater Manchester to test innovative approaches, policy and finance mechanisms to accelerate local renewable energy generation, storage and efficiency at scale”, and for a decision on the future of the decarbonisation of heating leading to a stable and long term policy landscape for low carbon heat (Greater Manchester Combined Authority, 2019, p. 30). Meanwhile it outlines the role of GMCA and its constituent authorities in “convening, engaging and educating”, working to provide a supportive policy framework, and leading by example in their own operations, for example, in installing low carbon solutions where viable when they replace their heating systems (Greater Manchester Combined Authority, 2019, p. 85).

“The role of the GMCA and the ten local authorities is in galvanising and empowering local, regional and national actors, providing the strategic direction required as GM moves towards a local decentralised smart energy system, which will be critical to success.” (Owen, 2019)

With its plan to be an Energy Transition Region, the CA is pushing for strong regional action on transitioning to a low carbon energy system, while it identifies the move to low carbon and decentralised energy systems as an opportunity for innovative governance (Owen, 2019)

5.2.2 Manchester City Council

Table 6. Manchester City Council Targets and Strategies.

Declaration of Climate Emergency	2019
Net zero targets	50% reduction by 2025 for the council 2038 for the city (matching GM target)
Strategies	<p>Climate Change Action Plan 2020-2025 (CCAP)</p> <ul style="list-style-type: none"> - Focuses on how the council can reduce its direct emissions by at least 50% by 2025 - Aims to influence the city to do the same <p>Climate Change Strategy 2017-2050 and Implementation plan 2017-2022</p> <ul style="list-style-type: none"> - Plan for the city - Drawn up prior to 2019 so not inclusive of 2038 target - Aims for the city to become zero carbon by 2050 and discusses the potential need for a more ambitious target - Notes that the strategy can be update before the next implementation plan - 5 objective areas: sustainable economy and jobs; healthy communities; resilience to climate change; zero carbon; and culture change

Source: Manchester City Council (2020b) and Manchester Climate Change Agency (2017a, 2017b).

Which solutions are highlighted?

The strategies express an intention to support the retrofitting of existing buildings and to work with central government, GMCA, housing providers and other local partners to address this problem (Manchester City Council, 2020b; Manchester Climate Change Agency, 2017a, 2017b). In terms of heating technologies, the Climate Change Strategy mentions multiple different solutions. It suggests that current natural gas systems will be replaced by biogas or

hydrogen, or by the use of electric heating systems that run on renewables, such as heat pumps (Manchester Climate Change Agency, 2017a). Heat pumps are also mentioned specifically, alongside efficiency retrofit, in relation to decarbonising the council's operational estate (Manchester City Council, 2020b). Further to this, the strategy and the action plan mention the Civic Quarter district heating network which began development in 2017 (Manchester City Council, 2020b; Manchester Climate Change Agency, 2017a). This heat network will initially use public buildings as the anchor for its heat load with the possibility of expansion in future (Manchester City Council, 2020b). The strategy also makes a brief mention of the opportunity to use green and blue infrastructure to reduce the need for mechanical heating and cooling.

What types of programmes are described?

The Climate Change Strategy sets an aim to develop more stringent building standards for new buildings, which according to the Climate Change Action Plan will be used going forward in new council buildings, extensions and refurbishments (Manchester City Council, 2020c; Manchester Climate Change Agency, 2017a). This will be in cooperation with built environment professionals to ensure that zero carbon buildings are commercially viable. Similarly, the action plan voices the need to work with experts to ensure best practice in building design (Manchester City Council, 2020c). In addition, it sets out aims to survey the stock condition of the Private Rented Sector and work with partners to ensure social housing is on the path to zero carbon (Manchester City Council, 2020c).

The CCAP also describes a Carbon Reduction Programme which will invest in combined heat and power, and energy conservation measures in council buildings among other energy saving measures and technologies (Manchester City Council, 2020b). Since the start of the implementation of the Climate Change Action Plan, the council has undertaken a pilot project of a hydrogen-based heating and hot water technology with UK company HydroZero (Manchester City Council, 2021). Additionally, carbon saving measures are being incorporated into capital projects delivered by the council. It is suggested that further funding is needed to establish a dedicated team for carbon reduction which can deliver programmes such as a zero-carbon whole building retrofit pilot, investments in energy efficiency measures, a boiler replacement programme and commissioning a consultancy to inform on the pathway to zero-carbon heat (Manchester City Council, 2020b). Related to this is the development of a Local Energy Plan via the Greater Manchester Local Energy Market Project which will enable the identification of areas suitable for low carbon heating solutions (Manchester City Council, 2020c).

What role is outlined for the Local Authority and CA?

The Climate Change Strategy expresses the intention for ensuring there is a framework of policies “to encourage, empower and incentivise organisations and individuals” to act (Manchester Climate Change Agency, 2017a). This includes engaging the public on climate change, supporting investment in innovation and business, and the Council taking advantage of its planning powers and infrastructure investment to ensure development in the city is in line with climate targets (Manchester Climate Change Agency, 2017a). The Climate Change Action Plan reiterates this intention, noting the council's ongoing work in raising awareness and supporting behaviour change among residents, partners and within the council, including carbon literacy training for the latter two groups (Manchester City Council, 2020b). The Climate Change Strategy notes that different sources of funding will be required including from the private sector, individuals and communities and from the public sector (Manchester Climate Change Agency, 2017a). An update on the Climate Change Action Plan notes a Greater Manchester-wide bid to the Public Sector Decarbonisation Scheme which will allow for further carbon savings within the council estate (Manchester City Council, 2021).

GMCA and the Greater Manchester region are mentioned at points throughout the strategies. It is stated that policy support from both GMCA and national government will be needed to meet the objectives of the strategy and that some initiatives are best delivered with GMCA and the other constituent authorities (Manchester City Council, 2020b; Manchester Climate Change Agency, 2017a). The Climate Change Strategy notes that “the city region can offer economies of scale, access to funding, and the momentum needed to translate... bigger ideas into action”, and that working with the Combined Authority allows them to work with and influence central government (Manchester Climate Change Agency, 2017a, p. 14). It calls for devolved powers to be built on to enable cities to address climate change and clarifies the intention of the strategy to work towards these powers. Moreover, it discusses where Manchester City Council may influence GMCA climate change strategy, for example through setting of the city’s carbon budget, and an intention to influence the Greater Manchester Spatial Framework. The implementation plan for the strategy notes that Manchester should participate in the programme of energy activities in the Greater Manchester Climate Change Action Strategy Implementation Plan (Manchester Climate Change Agency, 2017b). It also describes working with GMCA to investigate a Greater Manchester domestic retrofit strategy and city-region-wide programmes resulting in zero or very low carbon homes, and to deliver the Civic Quarter heat network (Manchester Climate Change Agency, 2017b).

5.2.3 Oldham Council

Table 7. Oldham Council Targets and Strategies.

Declaration of Climate Emergency	2019
Net zero targets	2025 for the council 2030 for the borough - Previously had referred to the GMCA target of 2038
Strategies	Oldham Green New Deal (GND) - Successor to the Climate Change Strategy 2013-2020 - Three pillars: ‘Green Economy’ – growing the ‘green’ business sector; ‘Low Carbon’; and ‘Northern Roots’ – including infrastructure and tourism - Additional aim of embedding the approach of the GND, including in the following strategies: Our approach to Business Engagement; The Council’s buildings rationalisation programme and Medium Term Property Strategy; Regeneration programmes, in particular Oldham Town Centre, Housing Strategy and Strategic Planning - Drawn up through engagement with a range of stakeholders from within the Council and with strategic partners and expert external organisations, with the intention to engage the public and businesses as the strategy is pursued

Source: Oldham Council (2019a, 2020) and Hunt (2019).

Which solutions are highlighted?

The GND mentions improvements in efficiency, particularly in relation to fuel poverty, but also in continuing to employ them to reduce emissions from council buildings, and in supporting businesses to improve the efficiency of their buildings (Oldham Council, 2020). Additionally, improving buildings standards and developing low carbon heat networks are discussed. The council is planning to develop a 4MW district heating network for the town centre which will use ground source heat from disused coal mines, which they note could be joined up with a pre-existing network in the area (Hunt, 2020b). The strategy discusses the intention to enable the transition to electrical heating systems, but it does not mention heat pumps specifically (Oldham Council, 2020).

What types of programmes are described?

The GND pledges to develop an ‘Oldham Code’ for buildings to reduce emissions from new build homes and ensure developments which are built in the borough are held to high environmental standards (Oldham Council, 2020). It proposes that the council will invest in and support large-scale low carbon energy infrastructure including low carbon heat networks (Oldham Council, 2020). The Council also notes that they are exploring low carbon heating technologies at council owned sites (Hunt, 2020b). The strategy mentions the Warm Homes Oldham programme which provides advice on heating and insulation, energy use and energy providers to households having trouble paying their energy bills; and engaging with residents on the topic of energy. Additionally, it suggests that an energy efficiency awareness course could be made available to beneficiaries of the Warm Homes Oldham scheme. Regarding the heat network, funding was secured from the Heat Network Development Unit at BEIS for feasibility studies, which they have sought out from the Coal Authority and from Ramboll consultants (Hunt, 2020b). However, full funding for the project is yet to be identified and depends on a “robust and viable business case”, with the council currently bidding for Towns Fund grant money from the Ministry of Housing, Communities and Local Government (Hunt, 2020b).

One of the primary aims of the GND is ‘sustainable economic development’ and to find and take advantage of the economic opportunities presented by the ‘green’ economic sector. As such, part of the council’s plan for decarbonisation in the borough is through supporting businesses and the growth of the ‘Green Technology and Services’ sector within the borough. Another is the proposal of the creation of a Local Energy Market which would develop low carbon housing, enable the transition to electrical heating systems, enable zero-carbon regeneration of the town centre and address fuel poverty by generating funds for efficiency retrofit measures. In response to the COVID-19 pandemic, it was decided that the GND was to be aligned with Oldham’s COVID19 economic recovery plan (Hunt, 2020b).

What role is outlined for the Local Authority and CA?

The strategy states that the sought outcomes cannot be achieved by the council alone, but outlines a role for the Council both in the decarbonisation of its own operation and estates, for example mentioning procurement as key, but also using its leadership position in enabling change across the borough (Hunt, 2020a). This is summarised by the following quote:

“The Oldham Green New Deal Strategy and delivery programme aim to engage everyone in Oldham. Led by the Council, the strategy and programme include initiatives to engage residents, businesses and strategic partners in the public, private and community sectors... In respect of the 2030 target for carbon neutrality for the borough in particular, the Council’s main role will be as an enabler for all sections of the community to act, and in fact the success of the Oldham Green New Deal approach as a co-operative initiative will dictate the strength of the final outcome in terms of economic and social benefit for the borough, and achievement of our environmental targets.” (Hunt, 2020a, p. 8)

The GND notes that council investment in capital-intensive low carbon energy projects can contribute to broader scale change to the heating system in the borough overall, and that they may attract private investment.

The strategy discusses the Greater Manchester region and the Combined Authority on several occasions. Two target outcomes are expressed in relation to the region: retain the lowest carbon footprint in Greater Manchester; and have the most community owned renewable generation in the region. Additionally, in their proposals for the decarbonisation of the borough they refer to maximising benefits from Greater Manchester as well as the national level. They also cite that their programme to decarbonise the Council’s estate is scoped

through engagement with GMCA Decarbonisation of the Public Estate programme “which offers additional capacity and expertise” (Hunt, 2020a, p. 11). Finally, they include an appendix to the strategy which discusses it in relation to GM level strategies. It notes that it is aligned with the plans of the city region, but also that its climate change initiatives have often been more ambitious than the GM level plans and that it has been able to contribute to the GM 5-year environment plan and lead on region-wide projects.

One such project which is relevant to low carbon heating is RED WoLF (Rethink Electricity Distribution Without Load Following), an Interreg NW Europe funded project which is developing a low carbon electrical heating system for homes (Hunt, 2020a). Oldham Council is a partner of the project and is running a pilot for the system, but is also responsible for promoting the system across Greater Manchester and has cited an opportunity for local businesses to benefit from supplying and installing the systems across the region (Hunt, 2020b). It is also noted that this project and the ‘Oldham Code’ building standard have the potential to influence the GM Spatial Framework aim for all new developments to be zero carbon by 2028. Another example is where Oldham’s housing team led on a bid to the Green Homes Grant Local Authority Delivery Scheme, gaining \$4.7 million for provision of insulation and low carbon heating for low-income households across the Greater Manchester region.

5.2.4 West Yorkshire Combined Authority

Table 8. WYCA Targets and Strategies.

Declaration of Climate Emergency	2019
Net zero targets	2038 for the region
Strategies	<p>Leeds City Region Energy Strategy and Delivery Plan</p> <ul style="list-style-type: none"> - Published prior to declaration of climate emergency in 2018 - To be replaced by West Yorkshire Tackling the Climate Emergency Strategy and Delivery Plan, complemented by the Zero Emissions Strategic Infrastructure Investment Framework which is also being developed - Five priority areas: resource efficiency business and industry; new energy generation; energy efficiency and empowering consumers; smart grid systems integration; and efficiency and integrated transport - Built on a qualitative assessment of the range of energy technology options in the city region, a spatial assessment which identifies suitable locations for different technologies, and a baseline assessment of energy in the region forecasted to 2036

Source: Leeds City Region Enterprise Partnership (n.d.-c) and West Yorkshire Combined Authority (2018)

Which solutions are highlighted?

The Energy Strategy and Delivery Plan discusses two potential energy transition pathways which have been developed for the region and can be used in future planning, one that is high hydrogen and one that is high electricity, with improved energy efficiency, heat networks, and the decarbonisation of electricity common to both scenarios (West Yorkshire Combined Authority, 2018). All of the solutions in the pathways are being explored to various degrees. The region is involved in pursuing the development of the use of hydrogen, in part through the Energy Accelerator but also in partnership with the cross-Local Enterprise Partnership North East, Yorkshire and Humber Energy Hub (West Yorkshire Combined Authority, 2018). It is proposed that a hydrogen project currently centred on Leeds can act as a pilot which could have a wider influence on the rest of the City Region. Further to this, the Energy

Strategy and Delivery Plan sets an aim to drive investment in low carbon energy projects such as heat pumps and mine water recovery, as well as in heat networks (West Yorkshire Combined Authority, 2018). Moreover, the plan looks to improve energy efficiency in the region, suggest that WYCA can act on engaging with residents, and working with partners in the region to roll out energy efficiency programmes. Additionally, there is an aim to promote improved standards for new builds (West Yorkshire Combined Authority, 2018)

What types of programmes are described?

An Energy Accelerator has been established by WYCA to provide technical support and advice to businesses and the public sector for energy projects such as those related to energy efficiency and heat networks (West Yorkshire Combined Authority, n.d., 2018). There is also the Resource Efficiency Programme and subsequent REBiz programme which work with SMEs, providing advice and support on resource efficiency including energy efficiency and low carbon technologies (West Yorkshire Combined Authority, n.d., 2018). The Better Homes Yorkshire programme, supported by WYCA and local authorities helps residents to install energy efficiency and heating improvements in their homes. This has been complemented by the CA’s Warm Homes programme and Tackling Fuel Poverty Programme (West Yorkshire Combined Authority, 2018). In addition, the Leeds City Region District Heat Programme, pursued in partnership between the Local Enterprise Partnership (which forms part of the governance of the CA) and local authorities, is supporting district heat network opportunities across the region (West Yorkshire Combined Authority, 2018).

What role is outlined for the CA?

The Energy Strategy and Delivery Plan suggests the role of the CA is: “to provide vision and leadership; to monitor progress and give visibility to success; to be accountable for progress against objectives; to ensure adequate resourcing is available; to provide an effective link to national bodies” (West Yorkshire Combined Authority, 2018, p. 53). The plan also suggests that the city region can play a role in piloting and demonstrating new and innovative technologies. It acknowledges throughout that WYCA and the Local Enterprise Partnership will need to work with multiple stakeholders in order to achieve the targeted changes in the energy system. The plan mentions a recommendation for drawing up Local Energy Devolution Deals with central government to accelerate a decentralised energy system, suggesting support for greater powers to be given for action on energy at a regional and local scale (West Yorkshire Combined Authority, 2018). The incoming mayoral system and new devolution deal for WYCA brings significant investment sums under control of WYCA with more freedom to spend on local priorities, including infrastructure, and housing and regeneration, as well as greater opportunities to influence and collaborate with government (West Yorkshire Combined Authority, 2020).

5.2.5 Leeds City Council

Table 9. Leeds City Council Targets and Strategies.

Declaration of Climate Emergency	2019
Net zero targets	2030 for the city
Strategies	<p>Best Council Plan</p> <ul style="list-style-type: none"> - Includes sections on sustainable infrastructure and housing which are relevant to the decarbonisation of heating <p>Climate Change Emergency Report</p> <ul style="list-style-type: none"> - Outlines how the council plans to act on reducing emissions - Informed by work with the University of Leeds, a consultation and a citizen’s

	<p>jury</p> <ul style="list-style-type: none"> - Identifies housing, and emissions from buildings as key challenges for net zero - Acknowledges the difficulties of pursuing low carbon heating technologies - Notes that the climate emergency is one of four key priorities considered when allocating the capital budget
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Source: Leeds City Council (n.d., 2020) and Cook & Evans (2020)

Which solutions are highlighted?

The Best Council Plan and Climate Emergency report suggest that improving the energy efficiency of buildings and reducing space heating requirements is vital and building energy performance and energy efficiency are frequently mentioned. The council is aiming to provide low carbon heating (district heating and heat pumps) to a portion of council housing, stating an intention to connect 1000 further homes to district heating (Cook & Evans, 2020; Leeds City Council, 2020). The council is in the process of rolling out a district heating network which is connected to a Recycling and Energy Recovery Facility and will replace gas in its city centre buildings (Cook & Evans, 2020). It is acknowledged in the Climate Change Emergency report that a full decarbonisation of heat is likely to be necessary to reach net zero, and as such it is working with academic institutions and several Local Enterprise Partnerships, including that of West Yorkshire, to promote hydrogen as a replacement for natural gas (Cook & Evans, 2020). It also mentions a proposal from Northern Gas Networks to transform the gas network in Leeds to deliver hydrogen.

What types of programmes are described?

The council has invested in council housing over the last 15 years, ensuring that it is at Energy Performance Certificate (EPC) rating C as of 2019, compared to an average rating of D for housing as a whole. Leeds has an Affordable Warmth Strategy which set targets for 2020 and 2030 in improving the energy performance of all housing in Leeds. The Climate Emergency report informs that the 2020 target was not due to be met due to the diminishment of support from central government (Cook & Evans, 2020). However, the council has been able to conduct retrofitting in social housing, secured funding for the installation of air source heat pumps in 100 council properties, and has commissioned the university to carry out analysis of the council housing stock. Moreover, the authority has sought to embed consideration for climate action into local planning (Cook & Evans, 2020).

The authority has secured funding for further retrofit measures, has developed the 'Leeds Standard' which sets requirements exceeding current building regulations for new builds, and is lobbying for increased national funding to cover the high costs of rolling out retrofit measures to existing homes (Leeds City Council, 2020). Moreover, the council has received funding from BEIS in collaboration with two other councils to conduct a feasibility study on whether council tax and business rates can incentivise building owners to implement efficiency improvements. The council suggests that its planning policies support high levels of efficiency but that these need to be supported by national policies, in particular in enforcing high building standards (Cook & Evans, 2020).

What role is outlined for the Local Authority and CA?

In the Climate Emergency report, it discusses that the council has invested and will continue to invest significantly in taking action on climate change, both mitigation and adaptation, but that much more funding is needed: from the council, but also from central government and private individuals and businesses (Cook & Evans, 2020). For example, the council admit that they have less influence in the owner occupied and private rented sector, and that these provide a significant challenge, which the council does not have the power or resources to

address (Cook & Evans, 2020; Leeds City Council, 2020). However, it is noted that the council can demonstrate successful energy efficiency improvements, engage landlords and residents on these issues, support other organisations working in this area, and call for greater national measures to enable change in these homes and increase local influence over which schemes receive funding (Cook & Evans, 2020; Leeds City Council, 2020). In relation to low carbon heating solutions, the Climate Change Emergency report notes that the decarbonisation of heat is a “key policy area outside of the council’s control”, and that decisions on the future of the decarbonisation of heating and of gas need to be made at a national level for these kinds of projects to be taken forward (Cook & Evans, 2020, p. 49).

The Climate Emergency report states the council’s intention to work with WYCA on challenges which require significant investment. However, in the report, the CA is only mentioned twice in relation to subjects concerning the decarbonisation of heating, and in the Best Council Plan it is more frequently mentioned regarding transport strategy.

5.2.6 Wakefield Council

Table 10. Wakefield Council Targets and Strategies.

Declaration of Climate Emergency	2019
Net zero targets	2030 for the council 2038 (at the latest) for the city
Strategies	Climate Change Action Plan <ul style="list-style-type: none"> - Six workstreams: Low Carbon Estate, Low Carbon Fleet, Renewable Energy, Carbon Offsetting, Behaviour Change and Influencing, and Place: District-wide Net Zero - Five of the six are focused on the council’s own operations, and the last is focused on district level work - The sixth workstream is a placeholder for district-level work - a separate but aligned plan for working towards net zero in the district will be drawn up in the near future - Expresses motivations for pursuing net zero: improving health and wellbeing, making a ‘green’ recovery from COVID-19, supporting biodiversity, addressing fuel poverty and air quality, and promoting community cohesion

Source: Wakefield Council (n.d.-a, 2020) and personal communication with 2D (April 1, 2021)

Which solutions are highlighted?

Under the Low Carbon Estate Workstream of the CCAP, the council is looking to improve energy efficiency in council properties through multiple different measures, as well as reduce their reliance on gas. They have completed a review of their buildings and are working with partners to understand which measures, in terms of both energy conservation and alternative heating, would be suitable where. Technologies considered include heat pumps, solar thermal, and alternative fuel (hydrogen) boilers, and there is an aim to look at the feasibility of low carbon heat networks such as one using heat from mine water. Within their Renewable Energy Workstream there is also a proposal for the utilisation of biomethane from existing anaerobic digesters in the gas grid, as opposed to its current use in combustion for electricity.

What types of programmes are described?

The council has been working on improving the efficiency of its buildings (Wakefield Council, 2020). It also has an Affordable Warmth Charter which aims to improve the energy efficiency of homes, such as via their Home Energy Efficiency Improvement Programme; provide

education and advice; and work with partners to address the problem of fuel poverty (Wakefield Council, 2019). The authority is planning to conduct a public consultation on the approaches that should be taken district wide, to conduct programmes which engage the public to encourage more sustainable lifestyles, and to create more sustainable communities through consultation, planning and regeneration. There is also an aim to engage with all businesses and sectors within the district to support decarbonisation. The council recognises that changing attitudes and behaviour, and achieving this wider transformation will be challenging (Wakefield Council, 2020). Wakefield council notes that it has the ability to set priorities for LA-Flex ECO3 funding, part of the Energy Company Obligation, but also that all councils in the Leeds City Region (a wider region in which some programmes are managed by WYCA) have adopted a city region-wide approach to this (Wakefield Council, n.d.).

What role is outlined for the Local Authority and CA?

While the CCAP is largely focused on decarbonisation of the council’s own operations and estates, in the district-wide workstream the plan suggests that the council has significant influence on the direction of the district, for example through local development and planning (Wakefield Council, 2020). It also suggests that its climate emergency commitments give it a mandate to act in this area. The council sees opportunities in its networks and partnerships which allow for engaging the public and collaboration on finding solutions, and in its assets and resources which it can take advantage of to support decarbonisation projects (Wakefield Council, 2020).

The CCAP mentions WYCA on several occasions. First, the council is working with WYCA to develop a combined emissions pathway for the Leeds City Region, which will in turn help the council to establish its own emissions baseline and carbon budget for the district. Second, it is mentioned that the council is working with WYCA Resource Efficiency Fund to support small and medium sized enterprises (SMEs) with decarbonisation. Third, there is an intention set to work with WYCA and other regional partners on creating structural, systemic change to achieve deep decarbonisation “to ensure alignment of goals, promote cross boundary decarbonisation, and avoid duplication of effort” (Wakefield Council, 2020, p. 39). Overall, the CCAP recognises the need to make the most of partnerships, networks and resources across the district and the Leeds City Region, and to ensure that their work is aligned with the new Mayoral system in West Yorkshire (Wakefield Council, 2020).

5.2.7 Sheffield City Region Combined Authority

Table 11. SCRCA Targets and Strategies.

Declaration of Climate Emergency	2019
Net zero targets	2040 for the city region
Strategies	<p>Energy Strategy</p> <ul style="list-style-type: none"> - Four goals: “Drive clean growth and decarbonisation in our local businesses and industry whilst maintaining their competitiveness; promote investment and innovation in low carbon energy generation, distribution and storage technologies; improve the energy efficiency and sustainability of our built environment, and encourage communities to be part of the transition; and accelerate the transition to ultra-low emission vehicles (ULEVs) and transport systems through modal shift and supporting infrastructure” (Sheffield City Region, 2020b, p. 8). - Notes intention for development of a Sheffield City Region Climate Action Plan for their own operations since the public sector should lead by example

	<ul style="list-style-type: none"> - Drawn up in collaboration with academia, businesses, and local communities <p>Renewal Action Plan</p> <ul style="list-style-type: none"> - Which outlines plans for economic recovery from the effects of COVID-19 - Includes investment in low carbon energy
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Source: Sheffield City Region (2020c, 2020d, 2020b, 2020a)

Which solutions are highlighted?

The Energy Strategy looks to improve the energy efficiency of existing and new build homes, setting specific targets for different types of retrofitting (Sheffield City Region, 2020b). Moreover, it aims for no fossil fuel heating in new homes from 2025 and all new homes to be built at close to Passivhaus standard from 2030 (Sheffield City Region, 2020b). It also aims to drive investment in heat decarbonisation including heat networks, hydrogen, and electrification of heat, aiming for “complete low carbon heating penetration (or hydrogen ready) by 2040” (Sheffield City Region, 2020b). The Renewal Action Plan echoes these ambitions suggesting that a substantial retrofit programme and support for low carbon energy projects such as those using heat pumps could be part of the economic recovery in the coming years (Sheffield City Region, 2020c).

The Sheffield City Region is home to multiple energy intensive industries such as steel and glassworks and it is noted that there are opportunities to use the waste heat from these industries (Sheffield City Region, 2020b). The strategy also draws on the industrial past of the region in that it recognises that there is little heat storage in South Yorkshire but discusses the opportunity to use disused mines as sites to store thermal energy (Sheffield City Region, 2020b). The strategy notes the opportunity in taking advantage of current infrastructure and natural resources in the region, remarking on South Yorkshire’s historical strength in developing heat networks, as well as expertise in the region in hydrogen, in particular its generation via electrolysis (Sheffield City Region, 2020b).

What types of programmes are described?

Several housing schemes in South Yorkshire are piloting new high efficiency housing innovations including some supported by the Sheffield City Region (Sheffield City Region, 2020b). The possibilities for using former mines for heating is being explored by the CA and it is drawing up a Mine Energy White Paper with partners in the region (Sheffield City Region, 2020a). Moreover, it identifies several research and innovation organisations in the region which can aid in working towards a low carbon energy transition. The South Yorkshire Hydrogen Network has been established in partnership with Arup to identify opportunities for hydrogen in the region (Sheffield City Region, 2020a). The city region has a set of policy targets which it has developed based on pathways and analysis conducted by consultancies and the CCC, although their deliverability has not yet been fully established. In relation to the decarbonisation of heating this includes installing heat pumps in 570,000 homes and 80-90% of commercial buildings, and other renewable heating including hydrogen and biogas in 101,000 homes and 10-20% of commercial buildings by 2040.

What role is outlined for the CA?

It is suggested that the City Region should support businesses to help them decarbonise; establish the region as an innovation incubator; work with central government to develop skills in the low carbon energy sector; work with industry and incumbents on the decarbonisation of heating; enable communities to develop community energy schemes; and work with partners to assess dwellings and roll out widespread energy efficiency improvements (Sheffield City Region, 2020b). With regard to the latter, the Energy Strategy

suggests that devolution funds can be used to help priority households with the installation of efficiency measures (Sheffield City Region, 2020b).

It is suggested that the region needs to build its interventions on strategies employed at the national scale, with the trend in energy decentralisation noted (Sheffield City Region, 2020b). Furthermore the energy strategy states that its implementation relies on collaboration between “the Sheffield City Region (SCR) Mayoral Combined Authority (MCA), Local Enterprise Partnership (LEP), local authorities, central Government, private organisations, charitable/community bodies, and individual residents of South Yorkshire” (Sheffield City Region, 2020b, p. 57). The Renewal Action Plan similarly expresses the intention to work with central government and local partners on infrastructure investments (Sheffield City Region, 2020c).

5.2.8 Rotherham Council

Table 12. Rotherham Council Targets and Strategies.

Declaration of Climate Emergency	2019
Net zero targets	2030 for the council 2040 for the borough
Strategies	Climate Emergency Progress Report/Action Plan <ul style="list-style-type: none"> - Summary of progress for 2020/21, and actions for 2021/22 - Actions for reduction in council emissions and a strategy for the council’s role in reducing emissions across the borough - 7 themes: Overarching Activity; Energy; Transport; Housing; Waste; Built and Natural Environment; Influence and Engagement Responding to the Climate Emergency Policy Statement <ul style="list-style-type: none"> - Discusses action to take towards decarbonisation

Source: Rotherham Council (2019, 2020, 2021)

Which solutions are highlighted?

Rotherham Council has been taking steps to improve the energy efficiency of its own energy use and has been conducting assessments of its buildings to understand where it can implement measure for efficiency and decarbonisation (Rotherham Council, 2020, 2021). Moreover, the council recognises the importance of energy efficient housing and suggests action should be taken to implement efficiency upgrades to existing housing (Rotherham Council, 2020, 2021). In its declaration of a climate emergency, the council notes the proposed development of a district heat network supplied by a biomass power plant as one of five significant opportunities to reduce the council’s carbon emissions in the near future (Rotherham Council, 2019), and support for this private sector led heat network is reiterated in the 2020 policy statement and in the Progress Report/Action Plan (Rotherham Council, 2020, 2021).

What types of programmes are described?

The council has existing work relevant to the decarbonisation of heating advising and supporting residents with energy efficiency improvements for their homes, with a particular aim to help low-income households and tackle fuel poverty (Rotherham Council, n.d.). The council has been working on decarbonising heating in their own operational buildings and aims to continue to implement efficiency measures based on site surveys. The 2021 progress report states that the council has acquired Green Homes Grant Local Authority Delivery Funding and that it will be using this to carry out retrofitting on 217 homes by September

2021 in order to create an ‘Eco Village’. The council also proposes building social housing to a high energy performance standard and suggests that the council could set requirements for developers to adhere to high efficiency standards (Rotherham Council, 2020).

What role is outlined for the Local Authority and CA?

In terms of how it describes its own role in tackling climate change, the council makes it clear that local authorities have a duty to act in this area in its declaration of a climate emergency (Rotherham Council, 2019). Although the 2020 policy statement proposes that initial action taken will focus on the council’s direct emissions (Rotherham Council, 2020), the declaration of a climate emergency suggests that the council should “play a leadership role in promoting community, public and business partnerships in reducing carbon emissions” and that it can encourage its partners to reduce their emissions (Rotherham Council, 2019). This idea of leadership is repeated in the 2020 policy statement, further suggesting the council can lead by example. Nevertheless, the statement repeats the need to lobby national government for the resources needed to enact change, and suggests that the right national policy frameworks will be required to help the council to reduce its emissions (Rotherham Council, 2020). The policy statement and progress report also elaborate on the role of the council in encouraging community participation and engagement with action to tackle climate change (Rotherham Council, 2020, 2021).

Sheffield City Region (SCR) is mentioned in the progress document and in the policy statement. In the policy statement it is largely in reference to matters related to transport. However, it is also mentioned that the council should work with SCR on shared climate change goals, and to lobby government to secure funding and establish a favourable policy context for local action towards mitigating climate change (Rotherham Council, 2020). The progress report states that the council is engaged at the regional level, contributing to the Sheffield City Region Energy Strategy, and with the leader of the council chairing the city region’s transport and environment board (Rotherham Council, 2021). There is an intention to continue to engage at the regional level alongside the idea that this will bring benefits for local action (Rotherham Council, 2021).

5.3 Barriers and Enablers for Action on the Decarbonisation of Heating and the Governing Role of Combined Authorities

This chapter presents the findings for RQ2 and RQ3 and draws on the data collected via interview with participants from the CAs and local authorities. It presents results utilising the framework set out in section 3.4. The main findings for the sub-themes are illustrated using a figure showing barriers on the left in red, enablers on the right in green, and factors which act as both barriers and enablers in the middle in yellow. The CA and local authority sources are shown for each primary finding. The findings for each sub-theme are then elaborated on in more detail. The sources of the findings are expressed as the following acronyms: GMCA (Greater Manchester Combined Authority); MCC (Manchester City Council); OC (Oldham Council); WYCA (West Yorkshire Combined Authority); LCC (Leeds City Council); WC (Wakefield Council); SCRCA (Sheffield City Region Combined Authority); RC (Rotherham Council).

5.3.1 Challenges and Complexities of the Decarbonisation of Heating

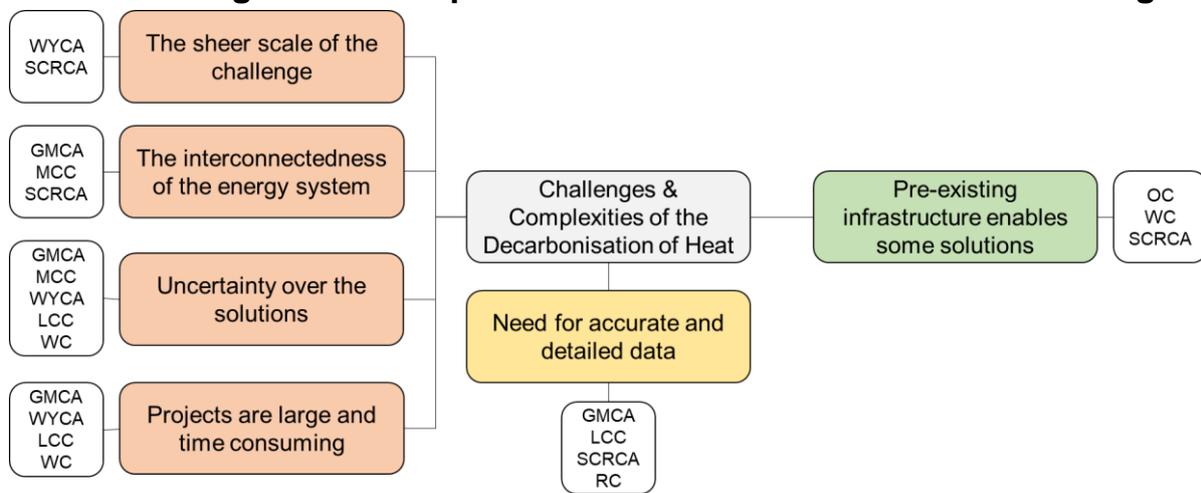


Figure 4. Main findings for Challenges and Complexities of the Decarbonisation of Heating.

The challenges and complexities of the decarbonisation of heating were acknowledged by all of the participants. The scale of the challenge was noted (WYCA, SCRCA), as well as the complexity brought by the interconnectedness of the energy system (GMCA, MCC, SCRCA). Two participants expressed that there is uncertainty over which solutions are the right ones (WC, RC), while another expressed concerns over the uncertainty of technological readiness and cost of solutions (MCC). In relation to this, the participant from WYCA suggested that the necessary skilled workforce and established supply chain are not in place to enable the deployment of some solutions. Multiple participants expressed both that the future of hydrogen in particular is uncertain and that it will not be ready soon enough to decarbonise heat within the timescales of the set net zero targets (GMCA, MCC, WYCA, LCC, WC). Conversely, the participant from SCRCA spoke more affirmatively about hydrogen suggesting that its development could be accelerated.

The long timescales and the cost of implementing solutions for the decarbonisation of heating were expressed as barriers by a number of participants, particularly in relation to heat networks (GMCA, WYCA, LCC, WC). The participant from WYCA suggested that these longer timescales can hamper the viability of projects, giving an example of a planned heat network in the region which is no longer viable due to circumstances changing over the time of exploring its development. Nevertheless, participants from MCC, OC, and LCC suggested

that the creation of heat networks by public authorities is a long-term solution with flexibility in terms of heat source, which enables residents and businesses to access low carbon heating.

The participant from WYCA suggested that the barrier of uncertainty over solutions could be combatted by developing a spatial mapping of decarbonisation across the region which helps to create an understanding of which technologies are suitable in different places, suggesting that the right solution will vary based on the circumstances. This latter idea was also posited by the participant from GMCA. This connects to the idea that there is a need for accurate and detailed data, expressed by a number of participants (GMCA, LCC, SCRCA, RC). Both the participant from GMCA and from RC noted that the data used to build strategies and plans is subject to change based on the level of detail used, adding further complexity. Participants from OC, WC, and SCRCA suggested that pre-existing local infrastructure enables some solutions, for example with the exploration of the use of mine water for heat networks by both OC and WC.

5.3.2 Actor Characteristics

Access to Resources, Capacity, & Expertise

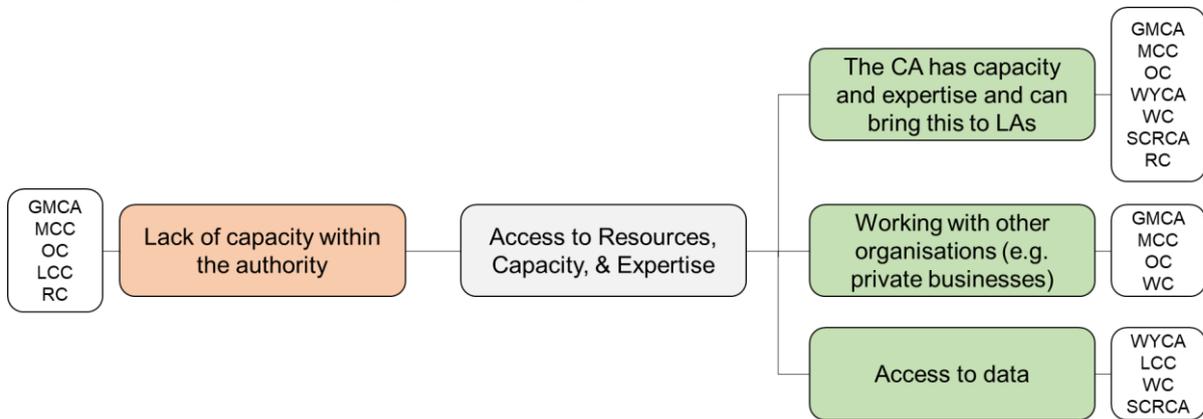


Figure 5. Main findings for Access to Resources, Capacity, & Expertise.

Four participants suggested that there is a lack of the necessary capacity in the authority, including in officer time and in expertise, to deliver effectively on the decarbonisation of heating (GMCA, OC, LCC, RC), while the participants from MCC and RC both stated that the teams working on this within the council are small. The participant from RC described their team as a “a handful of people”, comparing it to a council in another part of the UK (which is not part of a CA) who had about 40 people working on the climate emergency. The participants from RC suggested that COVID-19 has in some ways reduced capacity over the past 18 months but has also increased it through the enabling of online meetings.

Findings from all the authorities except LCC suggested directly that the CA has capacity and expertise to work on this issue and that it can bring this value to the local authorities (GMCA, MCC, OC, WYCA, WC, SCRCA, RC). The participant from WYCA posited that the CA has beneficial contacts and relationships, that it may have more lobbying power and clout compared to local authorities, that becoming a Mayoral CA is increasing its capacity, and that it is able to disseminate learnings from projects from across the region to constituent authorities. The participant from SCRCA also noted the CA’s contacts and networks as an enabler and was joined by one participant from RC in suggesting that the CA, Mayor, and leaders of the local authorities have lobbying power. Meanwhile, the participant from WC

suggested that coordination at the CA level could reduce the resource intensiveness of going out to tender for each of the authorities.

The participant from WYCA stated that because the CA has access to certain budgets and funding, they may, in general, be able to have more staff working on this agenda than the local authorities. This is with the caveat that it depends on the local authority since some are very well resourced and may be further ahead with this agenda. This was a view expressed about LCC in particular by participants from across West Yorkshire.

“We’ve been working with [WYCA] on the climate emergency side. It’s probably fair to say that our team is a bit further ahead than WYCA in terms of developing climate emergency policies and looking at how you implement some of the governance structures around that.” (LCC)

This quote from a participant from LCC suggests that there may be cases where local authorities have dedicated more resources or spent more time working on the climate emergency agenda over the years than other local authorities, or than CAs to which they belong. However, it also suggests that this can benefit CAs as climate action comes into focus on their agenda, since expertise from these authorities can be shared at the CA level.

Working with other organisations such as academic institutions, consultancies, energy distributors or other private businesses was expressed by all participants as something that could increase access to knowledge, expertise, and skills. In the same vein, several participants noted that access to data, and expertise to process that data are enablers, which can sometimes be enhanced by working with external organisations (WYCA, LCC, WC, SCRCA, RC).

Dependencies on External Stakeholders, & Public Engagement



Figure 6. Main findings for Dependencies on External Stakeholders, & Public Engagement.

It was widely explicitly acknowledged that the decarbonisation of heating cannot be combatted by public authorities alone and that the CAs and local authorities would need to work with others on this issue, especially because of the extent to which this transformation will rely on behaviour change among the wider population (GMCA, MCC, WYCA, LCC, WC, SCRCA, RC). This is where it was suggested that the CAs and local authorities can use their existing networks with business to encourage change (SCRCA). The participant from GMCA suggested that social housing presents one of the biggest opportunities for decarbonisation outside of public sector buildings, and thus, that working with social landlords is key. There was also an acknowledgement of the influence of the interests and actions of incumbent players, particularly those working in the gas supply chain (WYCA, LCC).

Public awareness and perceptions of the problem of and solutions to the decarbonisation of heating were called out as a hinderance by participants from all three of the CAs, as well as by the participant from MCC. Beside this, engaging with the public as an enabler of wider action

was highlighted by participants representing seven authorities (GMCA, MCC, OC, WYCA, LCC, WC, RC). The participant from WYCA speculated that the CA may be able to reach more people due to operating over a wider geography, while a participant from LCC understood there to be a certain level of trust in the local authority in the provision of heating which is a benefit for engaging the public regarding their heat network. The participant from GMCA argued that engagement of the public needs to be in relation to their priorities, which are more likely to be financial savings or jobs rather than carbon reductions.

Willingness to Act & Motivations

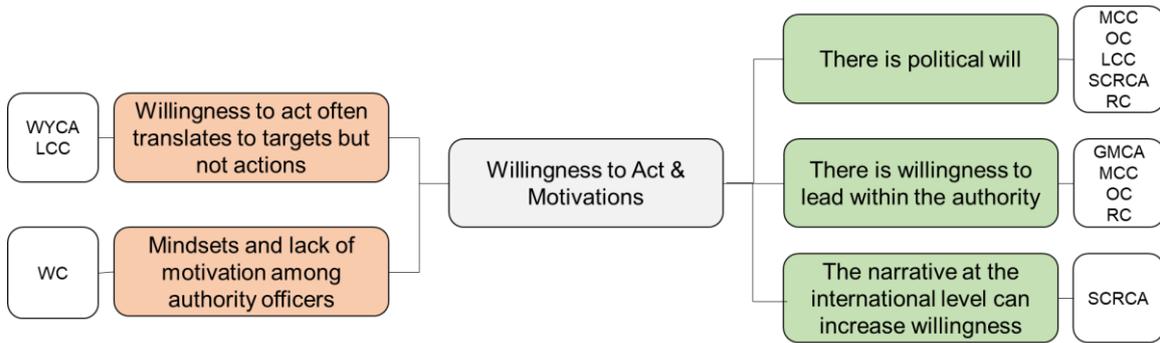


Figure 7. Main findings for Willingness to Act & Motivations.

Five participants stated that there is political will to work in the climate emergency and the decarbonisation of heating (MCC, OC, LCC, SCRCA, RC), while four suggested that there is a willingness to lead within the authority (GMCA, MCC, OC, RC), and two argued that political will is paramount for moving forward with this agenda (OC, LCC). The participant from SCRCA suggested that the increase in focus on the climate emergency at the international level has increased the political will to work on decarbonisation at national and sub-national levels within the UK. Two participants brought up the fact that this political will has translated to ambitious targets but that it has not always led to accompanying plans, policies, and actions to work towards those targets (WYCA, WC). The participant from WC proposed that there was still work to be done regarding the motivations and mindsets of officers within the council when it comes to working on this agenda.

5.3.3 Strategy and Governance

Policy Priorities

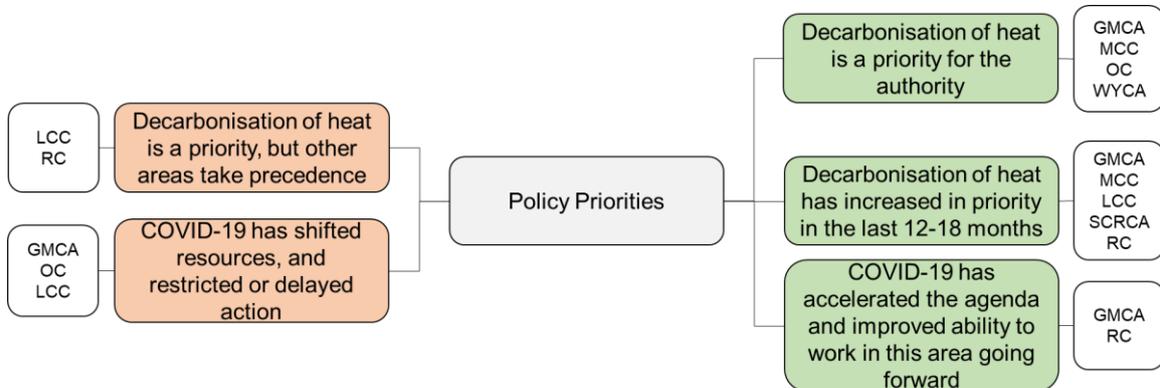


Figure 8. Main findings for Policy Priorities.

The decarbonisation of heating was outlined as a priority for the authority by four participants (GMCA, MCC, OC, WYCA). The participant from WYCA suggested that heat decarbonisation is not always a specific focus but will come about as a result of other programmes. Responses from LCC and RC were that decarbonisation of heating is a priority but that other areas still take precedence, for example development and housing priorities can be a barrier to pushing forward policies on the decarbonisation of heating. The participant from WYCA discussed the impact of prioritising addressing fuel poverty, suggesting that it can lead to short-term thinking regarding the decarbonisation of heating.

Participants from five of the authorities emphasised that the decarbonisation of heating has become more of a priority in the last 12-18 months, alongside the climate emergency agenda, and that it is now very much more on the radar of those working within the authorities (GMCA, MCC, LCC, SCRCA, RC). The participant from WC also found that there is emerging recognition for the issue. A participant from LCC suggested that until recently, WYCA had been focused on transport and more limited in this area, but that its role in aspects outside of transport is expanding and improving. This idea was echoed by the participant from WC who suggested that WYCA have *“a lot of power in terms of transportation networks, but in terms of built environment, very limited”*, while noting that they expect this to change. A participant from RC also found that the decarbonisation of heating is increasing in priority for the CA, and that this in turn is forcing it to be a priority for the local authority, while the participant from SCRCA explained that decarbonisation is now being embedded into all of the work of the CA. While COVID-19 was acknowledged to have shifted resources and restricted or delayed action (GMCA, OC, LCC, RC), the participant from GMCA suggested that it has accelerated the agenda *“under a green growth agenda”*.

Areas of Responsibility & Mandate to Act

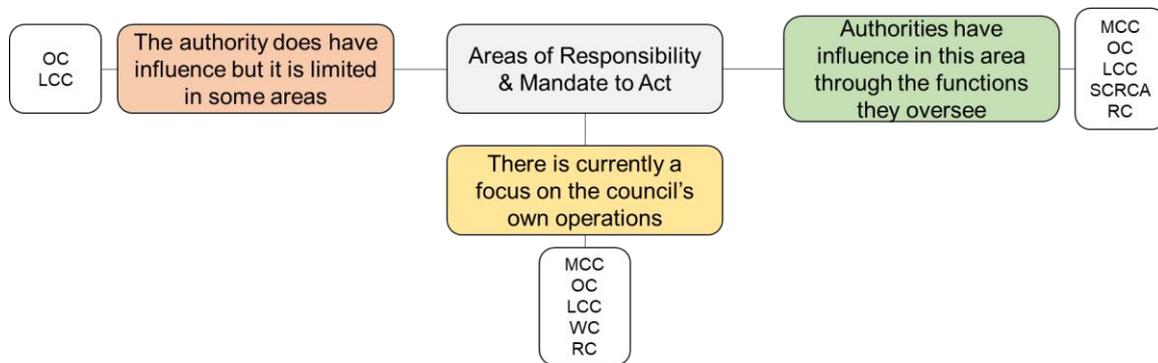


Figure 9. Main findings for Areas of Responsibility & Mandate to Act.

Participants from all of the local authorities stated that there is currently a focus on the council’s own operations when it comes to the decarbonisation of heating (MCC, OC, LCC, WC, RC), although efforts are being made to effect change elsewhere. This may in part be explained by the fact that the CA has less to do in terms of their own buildings and operations because they have a relatively small estate, as expressed by the participant from OC. Focusing on their own operations can be both a barrier and an enabler, since it enables them to act in this area, but also may narrow their focus. Nevertheless, three participants from the local authorities argued that piloting and demonstrating is an important way for the authority to contribute to this area, which can be achieved through work in their own operations (MCC, WC, RC). This can provide evidence and help bring technology to market (MCC), and generally get the ball rolling on a programme of heat decarbonisation (WC).

Participants from four local authorities (MCC, OC, LCC, RC) and from SCRCA posited that authorities have influence through the different functions they oversee, for example, regeneration (LCC) or through purchasing power (MCC, SCRCA). Participants from OC, LCC, and RC suggested that while local authorities do have some influence through planning policy and building standards, that this is only to a limited extent, and that change on this needs to happen at the national level. One participant from LCC explained that it is the local authorities' responsibility to deliver the projects, while the CA supports them, with the other LCC participant suggesting that the CA is more of a funding body.

Strategies, Goal Setting, & Planning



Figure 10. Main findings for Strategies, Goal Setting, & Planning.

Almost all of the participants suggested that strategies enable authorities to influence change in this area (GMCA, MCC, OC, WYCA, LCC, WC, SCRCA), with those from Greater Manchester stating that strategies are currently in place to drive the agenda (GMCA, MCC, OC). Strategies were said to increase the understanding of the challenges faced (WYCA, SCRCA), and to help in the creation of bids for funding (WYCA). All three of the participants from the CAs suggested that they believed CA strategy and planning to be influencing and moving the agenda across the region (GMCA, WYCA, SCRCA). It was argued that the CA can take a strategic viewpoint by looking across multiple local authority areas (WYCA), while the participant from SCRCA stated that the CA works with the local authorities to embed strategic policy. This is in slight contrast to the response from RC, who suggested that the SCR strategy has “not been adopted for individual councils to action”. This may imply that this is a new and ongoing process.

The participants from WYCA and from WC argued that there is a need to translate the net zero targets set by the CA and local authorities into workable strategies, with the participant from WYCA arguing that the strategy specifically for the decarbonisation of heating could be clearer. It was also suggested that work needs to be done in WC to incorporate climate strategies into all functions of the council to ensure that everything is working to the same vision (WC).

Policy Support from Central Government

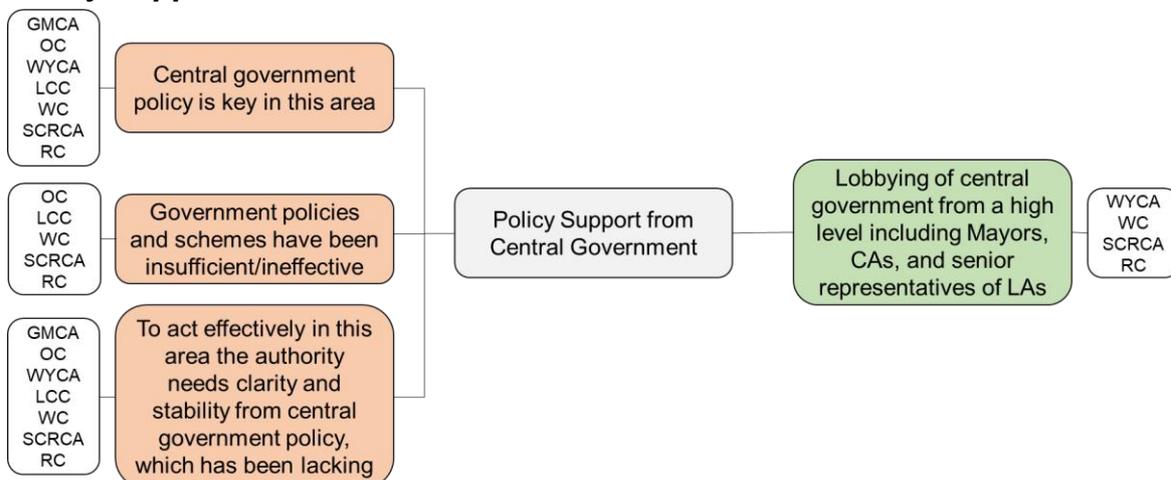


Figure 11. Main findings for Policy Support from Central Government.

It was broadly expressed that central government policy is key to effecting change in this area, thus limiting the capacity of both CAs and local authorities to address the problem (GMCA, OC, WYCA, LCC, WC, SCRCA, RC). Participants from OC and from RC indicated that direction on this issue is taken from central government and that they are dependent on its policies. The participant from GMCA suggested three policy areas in which central government could make a big impact: requiring retrofit assessments for homes when they are being put on the market; a change in regulation which addresses the fact that gas is currently still cheaper than electric; and heat network zoning policy, which is currently in development.

Five participants contended that central government policies and schemes in this area have been insufficient and ineffective (OC, LCC, WC, SCRCA, RC). It was suggested that central government has been good at making broader commitments when it comes to reducing emissions but that these very often do not translate to delivery on the ground in local areas and are not always well thought through (LCC). It was mentioned that the timescales of the Green Homes Grant made delivery challenging (OC, LCC), and that national planning policy and building standards have not been stringent enough (WC, RC). Seven participants argued that for CAs and local authorities to be able to act effectively on the decarbonisation of heating, there needs to be clarity of direction and stability in policy and funding support from central government which has been lacking (GMCA, OC, WYCA, LCC, WC, SCRCA, RC). The participant from GMCA suggested that there needs to be more control at regional and local levels due to the fact that central government policy is working towards a later net zero target, and thus moving more slowly on this issue, and that as much action as possible needs to be taken at the sub-national level, so that when national policy “catches up” it can just “fill the gap”.

5.3.4 Economic Factors

Access to Funding

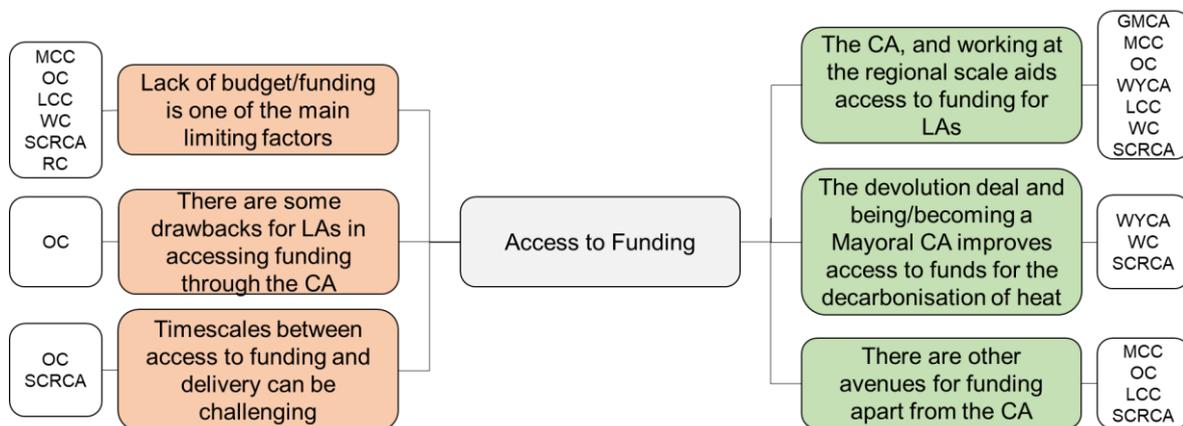


Figure 12. Main findings for Access to Funding.

Budget or funding was said to be one of the major limiting factors to action on the decarbonisation of heating for six of the authorities (MCC, OC, LCC, WC, SCRCA, RC). It was said that the dictated timescales between gaining access to funding and delivery can make it challenging to take advantage of the funding that is available (OC, SCRCA). The participant from SCRCA explained that the effect of COVID-19 on the economy is likely to mean more constraints on funding for the decarbonisation of heating. It was suggested by the participant from WYCA that the CA may have an advantage in that, in general, it has not been as constrained as local authorities in terms of budgets, but also that the decarbonisation of heating is nevertheless competing with other priorities for funding within the CA.

It was put forward by participants from seven authorities that the CA aids funding access for local authorities, and that working at the regional scale also enables access to funding (GMCA, MCC, OC, WYCA, LCC, WC, SCRCA). It was noted that the CA has capacity to work on bids and clout to win funding, and that significant funding is or will be channelled through the CA, including via the LEP (GMCA, WYCA, WC, SCRCA). In relation to this, it was suggested that devolution deals and being or becoming a Mayoral CA improves access to funding for the decarbonisation of heating (WYCA, WC, SCRCA). WYCA was seen by participants from LCC largely as a funder, and it was mentioned that LCC works with the CA to access funding and to help it be spent and distributed effectively (LCC). The participant from OC mentioned that there could be some drawbacks regarding the CA in terms of accessing funding. First, that the CA takes a portion of the allocated funding to pay for their team’s work on securing a successful bid. Secondly, that local authorities can be in competition with the CA for certain funds. It was noted by several participants that there are other avenues for accessing funding (MCC, OC, LCC, SCRCA), for example Energy Hubs.

Economic Circumstances & Influence on Regional/Local Economy

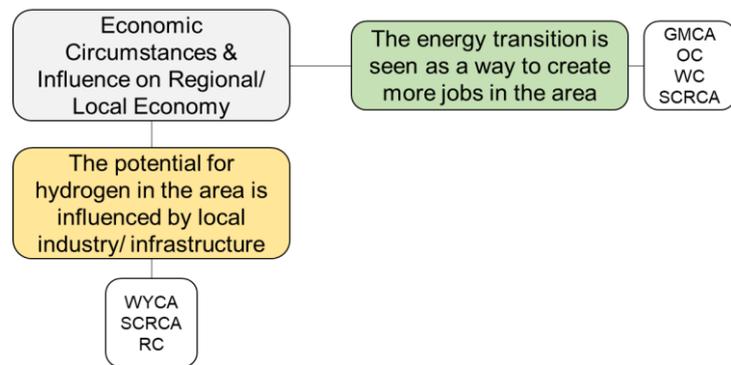


Figure 13. Main findings for Economic Circumstances & Influence on Regional/Local Economy.

Four participants suggested that the low carbon energy transition and the decarbonisation of heating is a way to create more jobs in the local area or region (GMCA, OC, WC, SCRCA), while the participants from GMCA and OC added that it is effective to communicate that. While the perceived prospects for economic development were seen as an enabler in this way, a participant from RC also suggested aims for economic development can hinder policies conducive to the decarbonisation of heating. For example, there are concerns that stipulating higher building standards at a local level will drive development elsewhere (RC).

The influence of industries in the region and the regional economy arose as particularly relevant when it comes to how the future of hydrogen is viewed. For example, the participant from SCRCA explained that the region, and Yorkshire more generally, are in a good position to lead in the development of hydrogen due to the presence of various industries and of infrastructure which can be utilised. This includes ITM power, “international leader in terms of hydrogen electrolysis” and the CA-owned Advanced Manufacturing Park Technology Centre, which is home to a hydrogen refuelling station, both of which are in South Yorkshire (SCRCA). The participant was quick to note that leading on hydrogen would be important for the region not just for climate benefits but for the economic benefits as well. RC was also said to be looking at hydrogen options due to the presence of hydrogen innovation nearby. One participant from the West Yorkshire region on the other hand suggested that the more service-based industry of West Yorkshire may be less suited to that initial hydrogen development due to having fewer relevant industrial clusters.

5.3.5 Leadership, Coordination, Dependencies, & Tensions

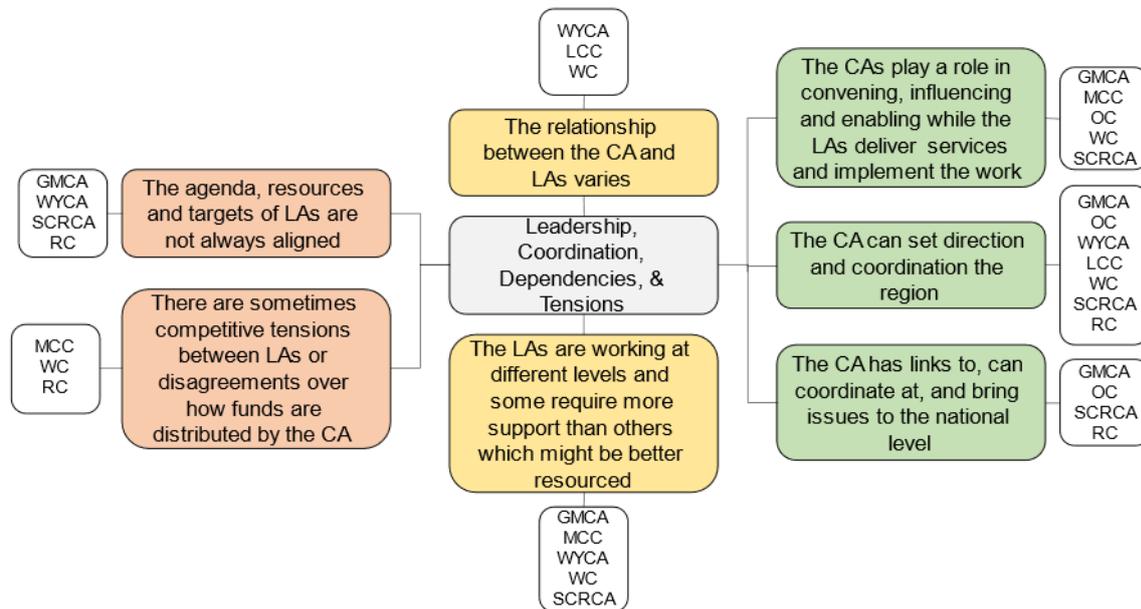


Figure 14. Main findings for Leadership, Coordination, Dependencies, & Tensions.

Several participants described the role of CAs as convening, influencing, and enabling, while local authorities are the ones to deliver services and implement the work (GMCA, MCC, OC, WC, SCRCA). This was particularly prominent in the case of Greater Manchester, where it was suggested that GMCA are often better placed to convene, facilitate, develop strategy, and provide headspace, while the local authorities are the ones delivering the projects and services (GMCA, MCC, OC):

“We’ve got services to deliver... Whereas the CA are people having thoughts and ideas for projects... Their constituent audience is made up of the other local authorities so really their role is there to facilitate.” (MCC)

“It’s the individual local authorities and the public sector organisations that actually do the doing, as it were...the combined authority can’t do anything of itself... but it can really add value to what we’re all doing as individual councils”. (OC)

A similar sentiment was expressed by the representative from WC:

“WYCA is more of a sort of high-level overarching setup that helps to fund some of these things and thinks about the bigger picture strategically, whereas we are actually in control of these districts.” (WC)

Seven participants suggested that the CA is able to set direction and coordinate the region (GMCA, OC, WYCA, LCC, WC, SCRCA, RC). It was noted that GMCA communicate with multiple different levels to ensure that everyone in the region is on the same page (GMCA), and the participant from OC stated that the CA is able to support and lead all public sector services in the region, not just the local authorities. Participants from Greater Manchester also suggested that GMCA is well established and has a history of working with its local authorities which can bring an advantage for coordination in the region (GMCA, MCC).

The results suggested that there can be some barriers to coordination when working at the regional level, for example it was noted that the agenda, resources, and targets of the different

local authorities are not always aligned (GMCA, WYCA, SCRCA, RC). In Greater Manchester and West Yorkshire, the CA net zero target for the region is 2038, matched by all the constituent authorities except Bolton and Oldham in Greater Manchester, and Leeds in West Yorkshire whose targets are all set at 2030. SCRCA's target is 2040, matched by Rotherham and Doncaster, preceded by Sheffield at 2030, and with Barnsley's target falling behind that of the region at 2045. The participant from SCRCA suggested it was natural that "*not everywhere can go at the same speed*" due to differing local circumstances. However, it is notable that this leeway for differing circumstances is not reflected in a regional target which matches the capabilities or ambitions of its constituent councils, since if Barnsley is not at net zero by 2040, it seems unlikely that the region will be. Indeed, a participant from RC suggested that all of the local authorities in the region needed to agree on the same targets. Beyond lack of consensus around targets, coordination may also be hindered due to competitive tensions between local authorities (WC, RC), or due to disagreements over how funds won by the CA are then distributed between the councils (MCC, RC).

Nevertheless, it was found by participants from the West Yorkshire region that there is particular value in the coordinating role of the CA where there are differences between local authorities when it comes to working on this agenda (WYCA, LCC, WC), for example, because the CA is able to enable and facilitate the sharing of knowledge and resources between local authorities (WC). The participant from GMCA similarly stated that it is [part of](#) the job of the team at the CA to understand where resources differ between local authorities at any given time, and to "*plug the gaps*" and "*support where necessary*". Multiple participants suggested that the local authorities in the region are working on decarbonisation at different levels and that some require more support than others which are better resourced (GMCA, MCC, WYCA, WC, SCRCA).

The differing characteristics of the constituent local authorities was also suggested to result in varying relationships between the CA and local authorities. Two participants from the West Yorkshire region identified potential tensions between the CA and the larger constituent local authorities. They also suggested that some of the smaller local authorities are more likely to see value in regional collaboration and in working with the CA.⁴ The participant from MCC expressed that they did not want more oversight than necessary from the CA, perhaps also indicative of tensions between larger authorities and the CA. An apparent difference between the larger authority and the other local authorities was also highlighted by a participant from RC, who suggested that the local authorities within South Yorkshire have discussed the benefits of collaboration and have been making use of their regional CA ties by cooperating and communicating with each other, in particular on housing and on procurement (RC). However, they explained that this was generally between Rotherham, Barnsley, and Doncaster and less with Sheffield, although they thought that Sheffield was now becoming more interested in collaboration (RC).

It was remarked that local authorities can have influence in supporting governance at the regional level (GMCA, LCC), for example GMCA will ask the local authorities if they want to lead a project or programme on behalf of the whole region. Beyond coordination at the regional level, it was discussed by four participants that the CAs can enable action as they have links to, can coordinate at, and bring issues to the national level (GMCA, OC, SCRCA, RC).

⁴ Participants not specified here due to a request for anonymity in relation to this statement.

It should be noted that many of these responses were about the roles played by CAs generally and not always specifically in relation to the decarbonisation of heating. Indeed, participants from two local authorities suggested that in terms of leadership from and collaboration with the CA on heating specifically it is still early days (WC, RC). It should also be said that other platforms for regional collaboration were mentioned as enablers in this area such as Energy Hubs or a regional climate commission (LCC, SCRCA, RC). Finally, it was noted by one of the participants from LCC that they imagined that tensions in the last year between the Mayor of GMCA and central government over COVID-19 restrictions may have affected the role of Mayors going forward. They suggested that there seemed *“to have been a bit of a swing over the last six months to government doing stuff much more directly with local authorities rather than through Mayors”* (LCC).

6 Discussion

This thesis aimed to understand which strategies on the decarbonisation of heating are being pursued by combined authorities and what barriers and enablers exist for their action in this area. In doing so it aimed to further the understanding of what governing role CAs can and do play regarding the decarbonisation of heating. The following chapter will interpret the findings of this study and discuss their significance in light of what has been established in previous literature. It will then elaborate on the limitations of this study.

6.1 Interpretation of the Findings and their Significance

This study has been able to look into a part of the evolving devolution processes in the UK to understand more about regional and local activity in relation to the decarbonisation of heating (Tingey & Webb, 2020). By focusing on the governing role of CAs, it has added to the body of knowledge on the development of sub-national and local authority action within the energy system and in relation to low carbon energy transitions. It has revealed that the decarbonisation of heating is an emerging issue at the regional level, and that there is evidence for CAs playing a role in RETs as efforts to address this issue develop.

6.1.1 Strategies

This study has found that the strategies related to the decarbonisation of heating are largely similar both across CAs, and also between CAs and their constituent local authorities. All of the strategies highlight a mixture of solutions. They all mention energy efficiency and retrofitting, and the majority mention building standards, electrification of heating or heat pumps, heat networks and the use of hydrogen. Information from the strategy documents and interview data suggests that the CA strategies take a broader level role in setting strategy while local authorities are those implementing more specific plans within the region. This can be likened to van Engelenburg and Maas' (2018) discussion of the alignment of strategic, tactical and operational plans within a region. CAs set out strategic plans for the long-term direction of energy and some tactical plans on the specific area of heating. Local authorities may set out their own strategic and tactical plans, but also seem more likely than CAs to be drawing up operational plans for specific projects.

There were also many similarities in the approaches taken by the CAs and the local authorities. The following approaches were discussed within the majority of the strategies: working with businesses to support their decision-making but also to develop low carbon heating solutions in the region or local area; using building standards and planning policies to improve thermal performance of buildings and encourage low carbon heating solutions; engaging with businesses and with the general public to promote solutions and support action; investing in low carbon heating solutions; working with both social and private-sector landlords to promote low carbon heating solutions. The local authority strategies were more likely to focus on addressing the decarbonisation of heating in their own operations, while the CAs were more likely to discuss broader energy planning to understand the suitability and feasibility of solutions across the region.

The strategies appear to reflect communication and coordination in the governance structure of the CAs, in that there seems to be an influential role of regional strategy on local and vice-versa. For example, in the adoption by some local authorities of the same net zero targets as the CA, and explicit recognition of the input of councils into regional strategies, and of regional strategies or pathways influencing the councils' own plans. This suggests that as governance bodies, CAs are able to facilitate, to some extent, the alignment of visions and creation of shared strategy which have been highlighted as important factors in mobilising

resources and coordinating actors in the development of RETs (Frank et al., 2020; Hoppe & Miedema, 2020; Lutz et al., 2017; van Engelenburg & Maas, 2018).

It should be noted that while the CAs and local authorities are beginning to set out their vision for the decarbonisation of heating, it was still suggested by a number of participants that strategies need to be more comprehensively aligned with the net zero targets which have been set, implying that the disconnect between goals and actions which has been argued to be present at the national level is also an issue at the regional and local levels (Broad et al., 2020; CCC, 2020a; Eyre & Baruah, 2015; Frank et al., 2020; Lowes & Woodman, 2020; MacLean et al., 2016).

The strategies present evidence both of the recognition that a combination of solutions is going to be needed to address the decarbonisation of heating, and also that regional or local infrastructural characteristics present opportunities for certain solutions (CBI Heat Policy Commission, 2020), for example in the case of using mine water for heat networks mentioned in the strategies of WYCA, Wakefield Council, and Oldham Council. This supports previous research which has concluded that regional or localised approaches which adopt a variety of solutions is needed (Hawker et al., 2019; MacLean et al., 2016).

6.1.2 Barriers and Enablers for Authority Action on the Decarbonisation of Heating

As was initially indicated by the many overlaps found in previous literature between the key issues for RETs and the main barriers and enablers for local authority action in the energy system, CAs are facing many of the same barriers as and find similar enablers to those found by their constituent local authorities, and local authorities in general.

Funding, Capacity of Authorities, & Dependence on the Actions of Others

The results of this study indicated that there is an increasing willingness to act on the decarbonisation of heating, both within CAs and their constituent local authorities, a factor which has been previously found to be an enabler for local authority action within energy transitions (Bulkeley & Kern, 2006; Fudge et al., 2016; Fudge & Peters, 2009).

Nevertheless, CA and local authority action was found to be restricted on this issue, with a number of significant barriers to action presented. Almost across the board, participants of this study noted a lack of funding and/or capacity and expertise to effectively approach this problem. In addition, the fact that much of the change required for the decarbonisation of heating relies on the actions of other stakeholders and on behaviour change, was also noted as providing a significant barrier to the scale or pace of change which public authorities are able effect. These findings are unsurprising: they are the primary challenges of addressing the decarbonisation of heating in the UK.

These findings echo the results of research into the barriers to local authority action in the energy system (Morris et al., 2017; Tingey & Webb, 2020). Moreover, as found in previous literature on local authority action, public awareness and engagement are viewed as key to effecting change in this area (Bulkeley & Kern, 2006; Fudge et al., 2016). Lutz et al. (2017) found in their study of regional action on renewable energy production that public involvement can be challenging or hamper implementation of projects. However, the need for public engagement would appear to be non-negotiable in addressing the decarbonisation of heating, since unlike decarbonisation of the grid the changes required are much more visible to the public and rely more heavily on decisions made by consumers. Therefore, if CAs and local authorities want the net zero targets they have set for their regions or areas to be

reached, the level of public engagement on this matter needs to be increased sooner rather than later.

This study does not reveal many details about the ways in which CAs or their constituent local authorities are engaging with the public, apart from that it is widely agreed to be an enabler for action in this area. The participant from WYCA speculated that CAs may be able to reach more of the public due to operating over a wider geography, while it has also been suggested that local authorities' proximity to their communities could allow them to influence behaviours (Fudge et al., 2016). Future research could investigate and compare the processes and effectiveness of CA and local authority engagement with the public to get a better understanding of whether their engagement can help to effect change in this area. If it is the case, as suggested by the CCC (2012; Fudge et al., 2016, p. 2), that local authorities are able to provide an interface between “technological innovation and diffusion, business practice, institutional change, and broader community and individual behavioural change”, it seems likely that CAs will also find strength in this regard, especially where they are intertwined with or well connected to the Local Enterprise Partnership(s) in their region, which gives them insight into business and technologies and further connection to the public.

Leading with local knowledge was another enabler highlighted in the results of this study which aligned with findings from the CCC (2020b) and previous studies (Fudge et al., 2016; Tingey & Webb, 2020; Webb, 2015). This was apparent in the participants' references to the need for accurate data, spatial mapping, and the need to get an understanding of which solutions would be most suitable in different areas. MacLean et al. (2016) stated that local authorities are well placed to carry out heat mapping and zoning due to their local knowledge and proximity to communities, and it could be argued that CAs are similarly well placed, and can also facilitate it at the local authority level, as is currently happening in both Greater Manchester and West Yorkshire.

Clarity and Stability in Central Government Policy

Mirroring previous research both into RETs and into local authority action in energy transitions, the other major barriers found to be widely referred to in this study were a lack of clarity when it comes to decarbonisation of heating solutions and a lack of stability in relevant policies from central government (Fudge et al., 2016; Lutz et al., 2017; Morris et al., 2017; Tingey & Webb, 2020). There is an uncertainty in which solutions to pursue at both CA and local authority level (van Engelenburg & Maas, 2018), especially when it comes to the use of hydrogen for heating. Multiple solutions are being pursued, while multiple of the participants were calling for more clarity and policy stability from central government. This is revealing of the extent to which CAs are and feel beholden to national policy on this issue, in the same way that local authorities have been found to be (Fudge et al., 2016; Hawkey et al., 2018; Morris et al., 2017; Tingey & Webb, 2020).

It is interesting that this narrative of asking for more clarity on the direction of low carbon heating from central government co-exists with a recognition of the varying suitability of different solutions shown by CAs, especially since the results of this study also present evidence of this varying suitability (CBI Heat Policy Commission, 2020). For example, it is evident in the discussion of mine water heat networks; or the apparent enthusiasm for hydrogen among SCRCA and Rotherham Council due to the presence of relevant infrastructure in the region, versus the relative uncertainty presented by some of the participants from within the other regions.

It remains to be seen what the outlook of the government's Buildings and Heat strategy will be when it is published later this year. Given the known limitations of both electrification of

heating and of the use of hydrogen, namely the capacity of the grid, and technological readiness and uncertainty of emissions reductions, respectively, it seems unlikely that it will necessarily favour one of these solutions over the other. Moreover, recent policy from central government, such as the Energy White Paper (BEIS, 2020c) and the Ten Point Plan for a Green Industrial Revolution (HM Government, 2020), has expressed support for both electrification and hydrogen going forward, as well as for heat networks.

Still, it seems that both CAs and their constituent local authorities want and need a clearer pathway outlined for each of the solutions on the table, perhaps with an indication of the continued availability of funding, and reassurances for the soundness of investments in technology. It may be that there is a desire to wait for good news on the development of hydrogen for heating due to its potential to reduce the need for behaviour change, for example, if natural gas boilers are simply able to be replaced by hydrogen boilers. However, the indicative trajectories for hydrogen for heating expressed by central government set intentions for a demonstration scale ‘Hydrogen Town’ by 2030 (HM Government, 2020). Therefore, waiting for advances in hydrogen before pushing ahead on the decarbonisation of heating could lead to action being taken too late and to CAs and local authorities missing their ambitious net zero targets, which tend to be ahead of the national target of 2050.

Regardless of what central government will commit to in terms of heating solutions, the results suggest that there are regulations that need to be changed at the national level, in particular around building standards, planning policy and energy pricing in order to enable both CAs and local authorities to act more effectively in this area.

6.1.3 The Governing Role of Combined Authorities

Regional governance has been proposed as a form of governance introduced in response to new and ‘wicked’ problems. It has also been an emerging trend in England over the past decade with the development of CAs. While CAs were created with economic priorities, they form a type of regional governance which may have both the ability and the will to address other problems which are emerging or growing in significance. Decarbonisation of heating represents such a problem: it is complex and has been cited as one of the greatest challenges for the UK in reducing its carbon emissions. Moreover, relevant stakeholders have suggested that a regional approach may be an effective way to address this issue. The results of this study indicate that CAs can also perform a number of the functions by which local authorities are suggested to be able to control and influence emissions (CCC, 2020b), for example in leading, coordinating and supporting others, working through partnerships, sharing good practice, and translating global and national targets for local relevance.

CAs as Enablers

The findings of this study suggest that CAs play an enabling and facilitating role in the decarbonisation of heating. This was highlighted in several participants’ discussion of CAs’ role in high-level strategic thinking and supporting and funding the local authorities who are the ones to actually ‘do the doing’. Moreover, they were said to have less by way of operations and estates, an asset cited by the CCC (2020b) as enabling local authorities to influence emissions. Therefore, the use of self-governing, one of the ways in which local authorities can intervene in energy systems noted by Bulkeley and Kern (Bulkeley & Kern, 2006), can be argued to be less relevant for CAs, with governing by enabling proving more relevant. The use of pilots and experimenting was more directly discussed by the participants from local authorities, perhaps because local authorities’ services and assets better place them to provide the site for pilot projects, while again, CAs are more likely to enable or facilitate them. Nevertheless, there appeared to be scope for experimenting and pilot projects to influence the region as a whole, thus potentially feeding into a RET (Hoppe & Miedema, 2020; van

Engelenburg & Maas, 2018). This was the hope expressed by the participant from OC regarding the RED WoLF electrical heating project. Thus, there is evidence here that CAs, like local authorities, can include, support, and act as both regime actors and innovators (Frank et al., 2020; Fudge et al., 2016).

One of the major areas in which the results suggested that CAs can play an enabling role is in the provision of funding. This may be linked to Bulkeley and Kern's (2006) notion of governing by provision. Significant relevant funding is and can be channelled through CAs, and through LEPs with whom they are interconnected or strongly linked. Moreover, the CA working at the regional level may have more clout to gain access to funds. While this study strongly indicates that CA membership acts as an enabler for the constituent local authorities to access funding, further study could investigate this claim by looking at access to funding for local authorities who are CA members versus local authorities who are not. Advantages in access to funding are important in this area, given that it has been identified as one of the primary barriers to action. With greater stability of funding outlined as vital to local authority action in this area, there may be opportunities for CAs to increase the stability of funding for decarbonisation projects, given that participants from CAs in this study were discussing the benefits of CA control over the spending of significant funds, and a large, dedicated decarbonisation budget mentioned by the participant from SCRCAs.

This study presents evidence for other opportunities for CAs to play a role in overcoming barriers to action on the decarbonisation of heating at the local level, demonstrative of Bulkeley and Kern's (2009) idea that governing by partnership can help build capacity and resources to address climate change. For example, in line with van Engelenburg & Maas' (2018) and Andersen & Pierre's (2010) discussion of the benefits of working with energy transitions at the regional level, working at the CA level has brought a scale which can improve the business case for projects and enable access to certain programmes which would otherwise be inaccessible to local authorities. There is less evidence for cross-authority projects which were highlighted as a reason for approaches at the regional level by Hoppe & Miedema (2020), however, it may be the case that these become more frequent as there begins to be more substantial transformation of the heating system in the UK.

The results of this study suggest that CAs have some capacity to lobby central government for policy changes, a vital role given the dependence of both CAs and local authorities on the direction and support from central government. This reiterates Jacobsen's (2015) notion of larger networks having more bargaining power. Several participants noted the benefits of being able to present a united front when lobbying central government, with the implication that this could reduce the transaction costs of each authority taking on this role. The results suggest that CAs may also be well placed to reduce transaction costs when putting in bids for funding or setting up new heating-related projects. Working through CAs may then be a means through which to set up shared schemes which avoid duplication of effort for building of capacity and expertise, suggested as valuable by MacLean et al (2016). On the other hand, in some areas, transaction costs may be increased by working at the CA level due to the processes and tensions involved in cooperation and collaboration. Jacobsen (2015) also found that larger networks can face challenges due to lack of consensus, and Andersen and Pierre (2010) found that there can be tensions around how funding is distributed within the region. Both of these issues arose in the cases presented here. It is then a question of whether the benefits of collaboration outweigh these costs, something which could be investigated through further study.

There is some indication from the results of this study that CAs, and working at the regional level, may be more beneficial for smaller authorities and that it is viewed as such by smaller

authorities. This could be important due to the concern expressed by the CCC (2020b) that smaller authorities could get left behind on net zero. It should be noted that regional collaboration may be viewed as more beneficial even by smaller authorities who are more ambitious and proactive on this agenda, as appears to be the case with Oldham Council. Evidence from this study indicated that larger authorities may feel less need to take advantage of opportunities presented by the CA and may be less active in collaboration. This reiterates findings that smaller authorities benefit more from inter-municipal collaboration (Boogers et al., 2016), and that there are positive effects for smaller authorities from joining networks with larger or stronger members (Jacobsen, 2015). However, in regard to the latter, while there is evidence for this in this study in terms of sharing learnings and increasing clout, it also seems that just being a part of a larger whole regardless of the relative size of the other members can enable greater action to be taken within energy systems and on the decarbonisation of heating. While Jacobsen (2015) highlighted a concern among smaller authorities that their power might be ‘hollowed out’ by regional networks, this research did not find this concern and in fact showed more evidence of power concerns among larger authorities, although the participants from MCC and LCC nevertheless expressed an overall positive relationship with their respective CAs.

CA as Doers

CAs may be more of an enabler and facilitator, both in general, and when it comes to action on energy and the decarbonisation of heating. However, they can be argued to be acting more directly in regard to the energy system in their creation of strategies which aim to steer the region. The results of this study suggest that with the creation of these shared regional strategies, CAs may be initiating and placing themselves as key players within RETs, taking on the necessary leadership and coordination role (van Engelenburg & Maas, 2018). Moreover, the creation of strategies at the regional level is a means by which to put in place the planning, goal-setting, milestones, and monitoring noted by Lutz et al. (2017) as drivers for regional implementation of changes to the energy system. While there may still be some lack of alignment between the strategies and plans within the regions, the results of this study suggest that CA action is playing a role in aligning those visions, for example, with many of the constituent local authorities adopting the same net zero target as the CA, and willingness to act at the CA level said to be increasing willingness to act at the local level.

The Decarbonisation of Heating

The results of this study suggest that CAs may be able to play a key role in RETs going forward and present a number of opportunities for them to steer and enable action on the decarbonisation of heating. However, regarding the specific issue of the decarbonisation of heating it appears to be early days, as expressed by participants in the cases of WYCA and SCRCA. GMCA appear to be the furthest ahead in regard to addressing the challenge, with region-wide strategies specifically focusing on heating and the retrofitting of existing buildings in the region. Participants in the case of GMCA suggested that there is a history of collaboration in the region which has benefited them, which reiterates Andersen & Pierre’s (2010) suggestion that this can ease cooperation. Although the other two regions have a history of working together as city regions with joint governance structures, it is true that GMCA became the country’s first CA, described at the time in 2010 as a ‘flagship’ city region and ‘pioneering body’ (Communities and Local Government, 2010). In its creation there was an emphasis on recovery from the economic crisis but also written within their responsibilities was tackling climate change locally, setting a precedent for this kind of action.

The ability of CAs to influence the decarbonisation of heating is limited by national policy, just as it is for local authorities. Furthermore, while CAs have previously had some impact on this area, for example through work on fuel poverty, this issue has only been more recently

emerging on the main agenda of CA work. Therefore, there remains some uncertainty as to the extent to which regional approaches taken by CAs will be able to significantly influence action in this area, especially because it relies so heavily on behaviour change. Because of this factor, more needs to be understood about CA's ability to engage with the public on this issue.

6.1.4 Climate Emergencies and a Shifting Regime

This thesis aimed to understand if the actions of CAs provide evidence of a shifting regime around energy in the UK and to discuss whether the decarbonisation of heating may provide a 'window of opportunity' for regional government to exert greater influence over energy transitions in the UK (Fudge et al., 2016). The decarbonisation of heating itself cannot necessarily be argued to present a window of opportunity for CA action in the energy system. Rather, as found by Fudge et al. (2016), landscape pressures, such as the climate emergency agenda and the push at international and nation levels for a low carbon transition, have opened a window of opportunity for CAs to act on the decarbonisation of heating. These landscape pressures could be argued to be even stronger now, with the climate protests and climate emergency declarations of 2019 bringing further prominence to climate concerns in international, national, and sub-national discourse. It seems likely that the pressures at the international level will continue to influence the national and sub-national levels, including regarding the decarbonisation of heating. For example, a recent publication by the International Energy Agency set out the banning of new fossil fuel boilers by 2025 as one of 400 recommendations for reaching net zero emissions by 2050 (IEA, 2021).

The results of this study suggest that the climate emergency agenda has increased the mandate to act on the decarbonisation of heating for both CAs and local authorities, with the issue moving much further up the priority list in the last 12-18 months. While CAs' mandate does not necessarily explicitly cover decarbonisation of heating, the climate emergency agenda is building climate concerns into all areas and because heating is a pervasive function which affects public authorities, business and the general public, its decarbonisation is necessarily now falling within CAs' remit. Moreover, there is impetus from central government to transition to a low carbon economy in the UK, meaning that decarbonisation is increasingly likely to be embedded into the economic priorities of CAs, and the direction they are setting for the regional economy. In relation to the decarbonisation of heating, this could be significant for the development of supply chains and of a skilled workforce for the scaling up of low carbon heat solutions (Newey, 2021). It should be noted here that the transition to a low carbon economy in the UK is under the banner of a green growth agenda, as demonstrated by the title of the *Ten Point Plan for a Green Industrial Revolution*, and that there is a heavy focus in the UK on the notion of net zero, both of which are narratives which have been argued to hamper ambition for action on emissions reduction or not promote rapid enough decarbonisation (Hickel & Kallis, 2020; McLaren, 2019). Nevertheless, the results of this study still suggest that these guiding narratives are leading to a greater impetus among both CAs and local authorities to act on the decarbonisation of heating, and on emissions reductions more generally.

6.2 Critical Reflections on the Study

The methods employed by this study enabled relevant data to be collected to answer the three research questions. Reviewing the strategies set out by the CAs and local authorities allowed for an understanding of what is being pursued regarding the decarbonisation of heating as well as some initial information on barriers, enablers, and the role played by the different authorities. The interviews then allowed for more detail to be collected on the barriers and enablers, the roles played by the authorities, and the significance of the relationships between the different authorities when it comes to capacity to act on the decarbonisation of heating.

The research questions were deemed appropriate to address the aim of the study, namely, to further the understanding of the role CAs play in low carbon heat strategy and energy transitions in England.

The selection of three case CAs with recent relevant strategies allowed for a level of understanding of the potential role of CAs more generally. Although the results from case studies are argued to have limited external validity, the use of a multiple case study approach allowed for a greater understanding of how the governing mechanisms of CAs as a type of sub-national governmental body may influence action on the decarbonisation of heating, and of the circumstances which may affect this influence (Bryman, 2012). In this way the findings are able to build on theories about local authority and regional action in energy systems established in previous literature (Yin, 2014).

It is judged that including more CA cases would not necessarily have significantly added to the data collected. However, it is deemed that including input from more of the constituent local authorities could have added useful further insight, and strengthened the validity of some of the results, particularly around the relationships between CAs and their constituent local authorities and how they may affect work on the decarbonisation of heating. Moreover, the study could have benefited from the inclusion of senior officers from the CAs and local authorities who may have oversight over more functions of the authority. This could enable a greater understanding of how this issue is viewed beyond those who are directly involved in climate or energy functions, who may be more inclined to talk proactively on this issue.

While the use of interviews was deemed appropriate due to its capacity to generate detailed data, there are a number of limitations to the method of data collection. First, the views expressed by the authority officers are a reflection of their interpretation of situations and events, and it should be acknowledged that their views may not necessarily be representative of the authorities to which they belong (Swanborn, 2010). Nevertheless, the fact that the officers who were interviewed are significant actors within the climate or energy related functions of the councils does enable insight into the workings of the organisation in relation to this issue. Secondly, conducting semi-structured interviews allows for the collection of potentially richer data by enabling participants to elaborate on points that may not have been considered by the researcher, but they can make it more challenging to compare responses between participants. It is also recognised that a significant amount of time elapsed between the first and last interviews. The use of semi-structured interviews allowed the researcher to adapt and use the additional knowledge gained to adapt the interview guide in order to gather more salient data. However, this also may have led to a difference in the quality of responses from the participants as the research progressed. Finally, the data produced through interviews is ultimately a co-creation of the researcher and the participants, and is inevitably also shaped by the researchers own world view (Swanborn, 2010).

7 Conclusions

The aim of this study has been to further the understanding of the role combined authorities (CAs) play in low carbon heat strategy and energy transitions in England. It set out the following research questions:

RQ1: What strategies addressing the decarbonisation of heating are pursued by combined authorities and their constituent local authorities?

RQ2: What barriers and enablers exist to combined authorities and their constituent local authorities addressing the decarbonisation of heating?

RQ3: What is the governing role of combined authorities in relation to the role of their constituent local authorities in planning and implementing strategies for the decarbonisation of heating?

This chapter will present the conclusions of this research and discuss its implications for non-academic audiences and for future academic research.

The results of the study show that the strategies pursued by CAs and their constituent local authorities have many similarities, mentioning a range of solutions to the decarbonisation of heating and outlining similar approaches, such as engaging with businesses and the public, using building standards and planning policies, and investing in low carbon heating solutions. Differences between the strategies suggest a greater focus on the authority's own operations among local authorities, and a broader more strategic view at the CA level, which looks at approaches like spatial energy planning. The findings suggest that the strategies and visions of the CAs and their constituent local authorities mutually feed into one another, aiding in the alignment of visions which could enable the development of a RET.

The barriers and enablers to action on the decarbonisation of heating were also determined to be similar in the cases of CAs and of their constituent local authorities, and similar to the barriers and enablers found to affect local authorities in previous research. It was found that there is an apparent willingness to act on this issue, but that the CAs and local authorities are broadly facing barriers due to a lack of funding and/ or capacity and expertise, and a dependence on the actions of others to address the problem, all of which are linked to the scale of the problem that is faced regarding the decarbonisation of heating. One of the major barriers to action which emerged from this study, and which reflects conclusions found in previous research, is the lack of clarity of direction, efficacy, and stability from central government policy. This was explicitly discussed by the majority of the participants, and further illustrated by uncertainty expressed over which solutions to pursue. The results of the study revealed an interesting potential conflict between the recognition at local levels for the suitability of a variety of solutions based on local or regional circumstances, and a simultaneous call for more direction from central government. It seems likely that multiple solutions will be supported, especially given this acknowledgement of the need for a mixture of solutions. Nevertheless, the results show that more effective and stable policy is needed to enable further CA and local authority action in this area.

The results of the study suggest that CAs' governing role in relation to the decarbonisation of heating is in enabling and facilitating, through the provision of funding, providing additional capacity, improving access to expertise, and lobbying central government. This enabling role is shown to come about not just as an advantage of the work done by the officers of the CA, but also by virtue of collaboration at the regional level, for example where it enables knowledge sharing across the region, access to certain programmes, or increased clout when lobbying

central government for policy changes. The results present evidence that there may be greater benefits for smaller authorities, and thus that CAs may have a role in ensuring that smaller authorities which have been less engaged or have less capacity are not left behind on reaching net zero targets. While there was some discussion of tensions in working at the regional level, these did not appear to be significant barriers to action on the decarbonisation of heating.

CAs are beginning to take a more active role in addressing the issue with the creation of energy and climate strategies which outline a vision for the region and describe goals and actions for the decarbonisation of heating. However, this research suggests that it is generally early days in terms of CA action on the decarbonisation of heating. There are opportunities for CAs to influence action on the issue, many of which are already being acted upon and can be built upon. Still, there remains some uncertainty as to the extent to which regional approaches will be able to influence action, especially since national policy, and behaviour change have been shown to remain as key limiting factors.

This study has reiterated the idea that the decarbonisation of heating is a compelling area for action at a regional level. At the same time, it has found that changing narratives and priorities around climate action at the landscape level have led to the decarbonisation of heating becoming a far greater priority for both CAs and their constituent local authorities over the last 12-18 months. Therefore, while this study suggests that the decarbonisation of heating presents a window of opportunity for regional action in the wider energy system, it shows that more significantly, landscape pressures such as the climate emergency agenda have provided a window of opportunity for regional action on the decarbonisation of heating. Moreover, it has shown that CAs can play an important role in this regional action. Still, the decarbonisation of heating appears to be a relatively new game for CAs, which are relatively young as organisations themselves. Strategies have now been laid out which set intentions in this area, but it remains to be seen how successfully these strategies will be translated into action.

7.1 Recommendations for Practitioners

This study highlights areas of opportunity for CAs to influence action on the decarbonisation of heating and to aid in overcoming barriers to intervention in heating and wider energy systems at the local authority level. While many of these opportunities are already being taken advantage of to some extent by CAs, there is scope for them to be built upon, especially when it comes to the issue of decarbonisation of heating specifically. The identified opportunities are outlined below:

Opportunities for CAs to influence action on the decarbonisation of heating:

- Embed regional strategies for decarbonisation of heating at the local level.
- Take a strategic view to carry out energy planning across the region.
- Dedicate funding allocated through devolution deals towards decarbonisation.
- Bid for funding on behalf of the region and provide tools to help local authorities create bids.
- Support pilots and experimenting.
- Share good practice in relation to low carbon heating projects throughout the region.
- Provide scale and clout to access programmes and lobby government.
- Work with existing networks to promote solutions, e.g., through LEPs, or with other CAs.
- Set up shared schemes to build capacity and avoid duplication of effort.

It is also recommended based on the results of this study that policymakers at the national level strengthen relevant policies, such as around building standards and planning policy, to enable regional and local level work on this issue. Moreover, it is recommended that central government works on producing a policy framework which can provide the level of stability required to move action forward on the decarbonisation of heating, and that they consult with CAs, local authorities, and other regional networks to inform the development of heat strategy going forward, to generate a deeper understanding of how local and regional circumstances will affect the implementation of low carbon heating solutions. Finally, it is recommended that public engagement is increased at all levels of government, to increase awareness of the problem and its solutions.

7.2 Recommendations for future research

This thesis contributed to the understanding of RETs, and of how ongoing processes of devolution in the UK are influencing regional and local activity in the energy system. It increased the understanding of the barriers facing CAs as a form of regional government when it comes to addressing this issue, and where there are opportunities for them to act.

Further research could be conducted into the details of these barriers, enablers, and opportunities. For example, while this study suggested that CAs could help their constituent local authorities access funding, further research could compare access to funding between local authorities who are members of CAs and those who are not, to understand if CA membership adds an advantage in this regard. In addition, it was widely suggested by the results of the study that CAs and local authorities view engaging the public as an enabler when it comes to the decarbonisation of heating. Further study could investigate this supposition and seek a greater understanding of the ways in which CAs and their constituent authorities are engaging with the public and the effectiveness of their efforts. Research could find out what the community perception is of the different organisations, and whether they are reached by their public engagement programmes. This could be of great value given the vital role of behaviour change in transforming heating. Future research could also delve deeper into understanding the benefits and transaction costs associated with collaboration at the regional scale.

Additional research could build on the understanding of regional bodies by investigating other organisations such as LEPs and Energy Hubs and the role they are playing in the transition to low carbon heating. Finally, when the Buildings and Heat Strategy is released in November 2021, its contents could be assessed in light of the results of this study, to understand whether this central government strategy will improve regional or local capacity to act on the decarbonisation of heating.

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Appendix A: Participant Information Sheet

MSc Environmental Management and Policy, IIIIEE, Lund University March 2021

MSc Thesis, Participant Information Sheet

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Working title: Scaling-up low carbon heat at the local and regional levels in England

What is the purpose of the study?

- The aim of this study is to further the understanding of the role of Combined Authorities and their constituent authorities in low carbon heat strategy in England.
- This is with the greater aim of contributing to research on the role of devolved, regional, and local authorities in the transition to a low-carbon energy system.
- The study aims to look at key issues and strategies; barriers and enablers to Combined Authorities and their constituent authorities addressing the transition to low carbon heating; and to identify opportunities.
- The study will be conducted between January and May 2021.

About participation:

- Publicly available documents from selected authorities will be analysed.
- Additionally, interviews will be conducted with relevant actors from the selected authorities between March – April 2021.
- Interviews will take place online via a platform agreed with the participant. All interviews will be audio and video recorded, transcribed, and analysed. Transcription software may be used.
- Interview participants may receive brief follow up questions via email.
- Participation is voluntary. As an interviewee, you do not have to answer all the questions that are asked; you reserve the right to refuse or cease participation in the interview process without stating your reason and may request to keep certain materials confidential.
- Interview participants reserve the right to withdraw participation and associated interview data.
- Participants will be contacted for verification of selected information and quotes prior to the submission of the thesis.
- There are no anticipated risks to individuals taking part in this study.
- It is recognised that there is potential for the results of the research to reflect both positively and negatively on the selected authorities.

About data:

- Participants will remain anonymous and collected data will not be identifiable to a participant. Interview data will be stored and analysed using a participant number which will be recorded in a separate document.

- Data included in the final thesis will not be identifiable to a participant. Participants will only be referred to as an employee of each selected authority.
- All data will be handled in line with Lund University guidelines.
- All research materials, including participant data, will be securely stored with password access only provided to the researcher. No data will be shared with any other party outside the academic process.
- Certain research materials will be securely stored for a limited time after research has concluded for validation of research findings. No personal data will be shared in this process.
- At any stage, research participants have a right to gain access to their own personal data, request its correction or deletion or limitation to processing of data, and they can file a complaint about how their personal data is used.

About results:

- The results of this study will be written up as an MSc thesis and presented in an internal
- thesis defence in June 2021.
- A final version of the thesis will be published online in the university open-access database, Autumn 2021 (available at the following web address:

<https://www.iiee.lu.se/education/masters-programme-environmental-management-andpolicy-emp/msc-theses-iiee>)

Thank you for reading and your consideration of participation in this study.

Appendix B: Participants

Table 13. Participant numbers

Authority	Participant number(s)
GMCA	1A
Manchester City Council	1B
Oldham Council	1C
WYCA	2A
Leeds City Council	2B, 2C
Wakefield Council	2D
SCRCA	3A
Rotherham Council	3B, 3C

Appendix C: Overview of National Policy

Strategies	Description
Energy White Paper	Sets out strategy linked to the decarbonisation of heating, including regarding heat pumps, low carbon hydrogen production, energy efficiency measures, and buildings standards.
<i>Ten Point Plan for a Green Industrial Revolution</i>	Sets out plans to create ‘green’ jobs in energy, transport, and other sectors. Includes strategy on efficiency retrofit, heat pumps, and hydrogen.
Sustainable Warmth	Recent fuel poverty strategy to improve the quality of the poorest quality housing in the UK. Looks at addressing fuel poverty within the context of the net zero emissions target.
Measures	Description
Domestic and Non-Domestic Renewable Heat Incentives (RHI)	Provides funding towards renewable heat technologies. One scheme geared towards domestic properties and the other to non-domestic.
Green Homes Grant	Provides funding to households to improve the energy efficiency of their homes, with particular focus on low-income households. Includes Local Authority Delivery, which sees the grants and implementation channelled through local authorities.
Clean Heat Grant	Proposed successor to the RHI. Targeted at households and small non-domestic buildings. Builds on the Green Homes Grant
Public Sector Decarbonisation Scheme	Provides funding to the public sector to make energy efficiency improvements and to invest in low carbon heating technologies.
Social Housing Decarbonisation Fund	Provides funding to improve the building energy standards of social housing to at least Energy Performance Certificate (EPC) band C.
Energy Company Obligation	Requires larger energy suppliers to provide energy efficiency and heating measures for fuel poor households. Prioritises low income and vulnerable households.
Future Homes Standard	Proposes that from 2025 all new build homes will have low carbon heating and high levels of energy efficiency.
Heat Networks Investment Project (HNIP)	Provides capital funding to heat network projects in England and Wales, investing up to £320 million, using grants and loans.
Heat Networks Delivery Unit (HNDU)	Provides support (grant funding) to local authorities in England and Wales for the early stages of heat network development: heat mapping; energy masterplanning; techno-economic feasibility; detailed project development.
Heat Network Transformation Programme	New programme for improving heat networks. Encompasses the new Green Heat Network Fund and improvements to existing networks, as well as implementing local authority zoning by 2025.
Green Heat Network Fund	Successor to HNIP aimed at delivering additional low carbon heat networks. More focus on waste heat recovery and heat pumps.
Electrification of Heat Demonstration Project	Seeks to illustrate the feasibility of large scale roll out of heat pumps by installing them in 750 representative homes.
Green Gas Support Scheme	Forthcoming scheme which provides support for development of anaerobic digestion and biomethane plants
Hydrogen Neighbourhood and Town trials	Government supported pilot projects trialling hydrogen technologies. Aiming for a Hydrogen Town demonstration project by the end of the decade.
Hy4Heat programme	Supporting the development of decarbonising heat using hydrogen.

Table 14. Current and forthcoming national strategy and policy relevant to the decarbonisation of heating

Source: (BEIS, 2019a, 2020c, 2020f, 2020i, 2020g, 2020h, 2020e, 2020b, 2021d, 2021a, 2021c, 2021b; HM Government, n.d.-a, n.d.-b, 2020; Ministry of Housing, Communities and Local Government, 2021)

Appendix D: Frameworks for Regional Energy Transitions

Table 15. Characteristics of a networked approach to governance of a Regional Energy Transition (RET)

Characteristic	Indicators
Structural characteristics of the regional network	Size
	Degree of complexity
	Polycentric decision-making arenas
	Cohesion
	Presence of clusters, sub-networks and coalitions
	(Weak) ties to other networks
Regional network composition	Actor membership and heterogeneity
	Scope (multi-level, multi-sector)
	Involvement of regime outsiders
	Interaction with incumbents
	Interaction of subsystems
	History of network actor interaction
	Culture of interaction
Actor characteristics	Motivation and goals
	Cognition
	Access to and ownership of resources (e.g., competences, knowledge, capacities, ownership of critical infrastructure)
	Dependencies, such as need of inter-municipal collaboration
	Intra-organizational characteristics (organizational culture, esprit de corps, adaptive management, bureaucracy)
Regional network governance	Agenda (goal-setting, planning and policy) of the regional network as a collective
	Legitimacy, commitment and compliance
	Rules of the game (institutional rules)
	Leadership and control
	Presence of a regional network organization
	Experimenting
	Arena of arenas with forum ('meta governance')
	Formal mandate to act
	Process- and network management
	Establishment of a common language
	Proximity
	Policy instruments and 'mixes'
	Membership of issue networks
External factors	Economic circumstances
	Context-specific characteristics of the region (like presence of natural resources or industry)
	Formal status of the region
	Region's status as embedded in governance structures

	Regional politics and policy priorities
	Presence of energy plants and infrastructures in the region

Source: Hoppe & Miedema (2020)

Table 16. Driving factors of regional implementation processes of renewable energy.

Process and planning	Duration of process
	Comprehensive regional planning
	Energy specific planning
	monitoring of goals
	use of milestones
	Support by decision makers
	Consistent legal and policy conditions
Exchange and participation	use of various information channels
	Participation and public involvement
	Knowledge exchange with experts and experienced practitioners
Actors and Networks	key actors
	networks
	Actor heterogeneity
	specific skills of key actors
	supporting/opposing actors
Economic circumstances	funding sources
	community initiatives
	positive influence on regional economy

Source: Lutz et al. (2017)

Appendix E: Overview of Key Issues for Regional Energy Transitions

Table 17. Key issues for Regional Energy Transitions and how this relates to CAs and the decarbonisation of heating.

Key Issues	Relevance for this thesis
The structure and composition of regional networks influencing energy transitions	This relates to who is influencing the CAs' and local authorities' (LAs) strategies for decarbonisation of heating and the presence of different actors in the regions which encourages or enables particular strategies.
The characteristics of the actors relevant to a regional energy transition (including size, resources, and capacities)	This relates to the size, motivations, resources, capacities and status of the different CAs and local authorities.
The relationship between different relevant stakeholders in the region	This relates to how the relationship between CAs and their constituent LAs, as well as the relationship between LAs can influence energy transitions in the region. It is influenced by the characteristics of the different actors.
Leadership and control within the region	This can be related to whether and how CAs, or one or more of their constituent LAs, play a leadership role when it comes to the decarbonisation of heating.
Economic circumstances, and access to and ownership of resources	This relates to whether CAs and LAs have access to the funding and resources needed to take meaningful action on the decarbonisation of heating, and to the question of CAs influence on LAs access to those resources.
The presence and alignment of strategies and plans	This relates to the discussion of what strategies and measures CAs and their constituent LAs are employing related to emissions reduction and the decarbonisation of heating, and the extent to which this contributes to a regional energy transition.
Energy transitions are complex issues which require a systems approach	This relates to how CAs and LAs are thinking about wider systems in their approach towards the decarbonisation of heating
Consistency in policy and funding support	This relates to the nature of policy and funding, generally from a national level, which is supportive of the decarbonisation of heating, including through local action, and how CAs and their constituent LAs interact with this.
Public engagement	This relates to the CAs and LAs position in relation to their communities and the extent to which they are able to influence the necessary behaviour change required for the decarbonisation of heating.
Legitimacy and mandate to act	This relates to whether the responsibilities of CAs and LAs enables them to act on the decarbonisation of heating and whether this action is accepted by other organisations and by the public.

Appendix F: Search Terms

List of initial search terms for literature review:

- Combined authority energy strategy
- Combined authority heat
- Decarbonisation heat
- Decarbonising heat
- Low carbon heat
- Local energy strategy
- Local energy governance
- Local heat strategy
- Regional energy transitions

List of initial search terms for documentary review

- Energy strategy
- Climate strategy
- Heat strategy
- Climate change

Appendix G: Interview Guide

The following questions form the basis of the interview guide. However, the questions and structure were adjusted for different participants.

- 1) To what extent is the decarbonisation of heating a priority for the authority?
- 2) How much of the action the authority is taking on the decarbonisation of heating is within its own operations and estates versus enacting change within the wider community?
- 3) What enables the authority to act on and influence the decarbonisation of heating?
- 4) What approaches does the authority take to act on the decarbonisation of heating?
- 5) What are the main barriers to authority action in this area?
- 6) How do the local authority and the combined authority collaborate on this issue?
- 7) Are there any areas in which the combined authority and local authority have conflicting interests or are competing in this area?
- 8) How does the capacity of the combined authority to act on this issue compare to the capacity of the local authority?
- 9) Who are the main stakeholders with which the authority is working on this issue?

Appendix H: Coding Framework

Table 18. Coding framework.

Node	Sub-node	Sub-sub-node
Actor characteristics	Key actors' skills and influence	Champions
	Resources and capacities	Access to expertise
		Local knowledge
	Willingness to act	
COVID		
Economic Factors	Access to funding	
	External Funding	
	Influence on local or regional economy	
	Local, regional infrastructure	
	Policy and funding support	
Interaction and relationships with stakeholders	External Stakeholders	Public engagement
	Internal Stakeholders	
Low carbon heating solutions	District Heating	
	Efficiency	
	Heat Pumps	
	Hydrogen	
Relationships between actors	Coordination and tensions	Regional distribution of resources
	Leadership	
Strategy & governance	Areas of responsibility	Enabling
		Own operations and estates
	Encouraging uptake and innovation	
	Legitimacy, mandate to act	
	Pilots, demonstrations and experimenting	
	Policy priorities	
	Strategic benefits of regional action	
	Strategies, goal-setting & planning	
	Support from central government (policy support)	
	Systems thinking	