UNIVERSITY OF BIRMINGHAM

THE USE OF EVIDENCE IN LOCAL NET ZERO POLICY: A CASE STUDY OF THE WEST MIDLANDS, UK

by

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Abstract

Net zero policy has largely been developed by national governments. Many countries have set a target date for achieving full decarbonisation of their economies. However, research has increasingly found that net zero policy is most effectively developed and delivered at subnational scales. The cross-cutting nature of net zero as a policy problem relies on contextualised, place-based approaches to achieve good policy outcomes.

In this research I examine the development of local net zero policy through the lens of evidence-based policy. Critical scholarship on evidence use in policymaking suggests that the political, contested nature of policy contexts affects what counts as evidence, the ways in which evidence is used, and the justifications for using evidence. Previous research suggests that policymaking at the local level tends to have less capacity to use evidence than at the national level, and that a multilevel governance perspective is helpful to understanding the different ways in which evidence is used locally.

This study investigates the role of evidence in net zero policymaking processes in the West Midlands, UK. A single embedded case study design is used to examine the West Midlands Combined Authority's Five Year Plan, developed in 2020-2021 to set out high-level actions for achieving the region's net zero emissions target of 2041. The sub-case examines the development of a quantitative carbon model, which was used as a key source of evidence to develop the Five Year Plan. Semi-structured interviews are conducted with local policymakers, politicians, and consultants involved in the development of the policy, in order to gain a deep understanding of the process, alongside documentary analysis of the policy documents.

I find that local policymakers prioritised simplified, quantitative evidence. Limited policymaker capacity led to a reliance on external consultants to produce and utilise quantitative modelling evidence. As such, the policy failed to address uncertainty and ambiguity of net zero in ways that would increase salience, credibility and legitimacy, and prevented the policy from being truly place-based. I discuss how the 'evidence-based' label applied to policies which require multiple disciplinary perspectives can restrict the influence of evidence when analytical policy capacity is not sufficiently embedded within wider policy teams. I conclude that the current use of evidence in local net zero policymaking is not sufficiently contextualised to foster a place-based approach to net zero.

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List of abbreviations

BEIS	Department of Business, Energy and Industrial Strategy
CCC	Climate Change Committee
CoCC	Committee on Climate Change (CCC since 2020)
CSE	Centre for Sustainable Energy
DESNZ	Department of Energy Security and Net Zero
ESC	Energy Systems Catapult
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
LAEP	Local area energy plan
LEP	Local Enterprise Partnership
RCT	Randomised control trial
WMCA	West Midlands Combined Authority
NUSAP	Numeral, Unit, Spread, Pedigree and Assessment
SWM	Sustainability West Midlands
RESP	Regional Energy Strategic Plan

Chapter 1: Introduction

1.1 Introduction

In this opening chapter, I set out the motivations of my research on evidence in local net zero policymaking. I start by describing the global challenge of net zero, drawing connections with climate and energy policy (1.2.1). I then make the case that local approaches to net zero are important, due to the holistic, place-based approach that this scale enables (1.2.2). I then introduce the UK context, demonstrating the growing interest in local net zero policy (1.2.3), before stating some commonly observed barriers to local net zero policy (1.2.4).

Given these barriers, I introduce the theoretical lens of evidence-based policy (1.2.5), arguing that it provides an appropriate framework for understanding local net zero policymaking. Adopting this framework, I then set out the research questions of this study and outline the structure of my thesis (1.3).

1.2 Background to the research

1.2.1 The global challenge of net zero

Mitigation of anthropogenic climate change has been identified as one of the major challenges of the 21st Century (UN, 2024). The landmark Paris Agreement in 2015 set out the ambition of 196 countries to limit the rise in average global temperature to well below 2°C (compared to pre-industrial levels), and as close to 1.5°C as possible (UN, 2015). Following this, the UN's Intergovernmental Panel on Climate Change (IPCC) was tasked with investigating the necessary action for limiting warming to 1.5°C, and explicitly comparing the impacts of 1.5°C and 2°C warming. In its Special Report

Global Warming of 1.5°C, the IPCC found that at the current rate of warming, 1.5°C is likely to be reached between 2030 and 2052 (IPCC, 2018, p. 19), and that the risks to natural and human systems are significantly higher with 2°C warming than 1.5°C (2018, p. 20).

In order to limit warming, cumulative global emissions of CO_2 need to remain below a "total carbon budget" (2018, p. 27). This necessitates that beyond a certain point in time, net emissions must be reduced to zero. Climate modelling analysis showed that limiting warming to 1.5°C required global CO_2 emissions to reach net zero "around 2050" (IPCC, 2018, p. 27). Thus, the problem of climate change mitigation was 'converted' to one of cumulative carbon budgets, and then again to net zero target dates (Asayama et al., 2019). This conversion, catalysed by the IPCC's Special Report (Howarth et al., 2021, p. 3), has been observed in policy responses by governments worldwide, including the UK. The Climate Change Act 2008, which originally set a legally binding target of 80% reduction in UK greenhouse gas emissions by 2050 (compared to a 1990 baseline), was amended in 2019 to reach net zero emissions by 2050 (UK Parliament, 2019).

'Net zero' as a policy problem encompasses aspects of climate and energy policy. Indeed, the breadth of similar terms used to describe net zero points towards the underlying interdisciplinary problem. Although net zero has become more commonplace in recent years, other terms include 'decarbonisation', 'zero-carbon', 'carbon-neutral', and 'carbon-free' (Gudde et al., 2021, p. 5). This restriction from all greenhouse gas emissions typically considered within climate policy to just carbon (dioxide) is motivated by the fact that 70% of global greenhouse gas and 90% of global carbon dioxide emissions are due to the use of fossil fuels (SEI et al., 2019). Thus, the bulk of emissions reductions required to achieve net zero needs to come as a result

of reducing total energy consumption and replacing fossil fuels with renewable and other low carbon generation. This is, however, distinct from energy policy in its entirety, which involves balancing environmental requirements (i.e. net zero) with more technical aspects of energy system management, such as cost and security of energy supply.

Because of the dependence on energy, net zero policy has tended to be structured according to energy demand sectors: typically transport, domestic, and industrial and commercial. As a result, policies developed by central governments tend to take a sectoral approach to net zero policymaking, siloed within specific government departments (Davies, 2020, p. 37).

1.2.2 The importance of local, place-based approaches to net zero

Despite the global framing of the net zero challenge, and the high-level sectoral approach taken by governments developing policy to address it, the need for local, place-based perspectives on net zero has increasingly been acknowledged (Hofbauer et al., 2022, p. 1; McGookin et al., 2021, p. 1; Wesselink and Gouldson, 2014, p. 404). While many of the ‘quick-wins’ of net zero policy are possible to achieve with top-down action, the more challenging residual emissions require a different approach (Buck et al., 2022). For example, in the UK, displacing coal power stations with renewables has driven a 68% reduction in carbon emissions from electricity generation between 2005 and 2019, despite progress stalling in built environment and transport sectors (BEIS, 2024). This has been relatively straightforward to implement, as the cost of renewables has dramatically decreased and there has been no disruption to consumers. However, the remaining cuts to emissions required to reach net zero electricity are seen to be much more expensive and/or to require widespread behaviour change (CCC, 2020).

As such, locally developed policies, which are able take a place's unique context into account, are likely to instil greater cross-sector coordination (Davies, 2020; Wesselink and Gouldson, 2014, p. 404) and build stronger local support for interventions (LGA and WPI Economics, 2021). Locally tailored approaches to net zero have also been found to be more cost effective and provide greater co-benefits than place-agnostic approaches to decarbonisation. In their analysis of six UK city regions, Innovate UK found that place-specific approaches required less than a third of the investment and provided almost twice as much social benefit (Innovate UK, 2022, p. 7).

In addition, place-based approaches lead to more ambitious policies that help to drive national delivery as local areas strive to lead the way (CCC, 2020, p. 393). This will mean that best practice can be shared between local authorities as experience is gained, including with those areas that will find decarbonisation more difficult due to limitations on their ability to influence certain sectors, such as dispersed industry (Rattle et al., 2023). On energy specifically, integrated local energy systems are seen to have a range of wider co-benefits. These include increased resilience, increased capacity for renewable generation, and reduced costs of transmission for the whole system (Busch et al., 2017, p. 171) that local and regional governments are well placed to coordinate and support (Britton et al., 2023, p. 4; Chaudry et al., 2022; Garvey et al., 2023, p. 998; Li and McDowall, 2017, p. 14; UKERC, 2020).

1.2.3 UK context – local approaches to net zero

In the UK context, the Climate Change Committee has highlighted the important role of local authorities in reaching net zero (CoCC, 2012; Marix Evans, 2020). Marix Evans estimates that a third of all UK carbon emissions are dependent on sectors "directly shaped or influenced by local authority practice, policy or partnerships" (2020, p. 16).

Using an ‘onion’ model (Coxcoon, 2019), Marix Evans has referred to several spheres of influence on emissions in local areas, ranging from direct control over authority emissions (2-5%) to softer powers of “place-shaping and leadership” which cover a much broader scope of emissions (2020, p. 5). The UK Government has also acknowledged the important role local authorities can play in reducing emissions (DECC and LGA, 2013).

Over the last 15 years, local energy and climate initiatives that fall under the remit of net zero have grown substantially, falling into three major categories: projects, target setting, and other policies and powers.

1.2.3.1 Projects

Local authorities and Local Net Zero Hubs have been involved in a wide range of energy projects. These have included establishing municipal energy companies, installing renewable generation on council properties, retrofitting energy efficiency measures on council estates, procuring fleets of low emission vehicles and installing heat networks (Midlands Net Zero Hub, 2023; Webb et al., 2017). Projects have also been coordinated by regional bodies. Liverpool City Region Combined Authority has carried out extensive work investigating the feasibility of tidal power from the Mersey estuary (LCRCA, 2022) and the Greater Manchester Combined Authority has set up the Energy Innovation Agency to bring together public, private and academic stakeholders to collaborate on the scaling of new energy technologies (EIA, 2022).

1.2.3.2 Target setting

Many variants on target setting schemes have come and gone. These include UK government schemes to monitor local performance such as National Indicators (Pearce, 2014) and the Carbon Reduction Commitment (BEIS, 2017a), as well as

voluntary schemes such as the Nottingham Declaration on Climate Change (Nottingham CC, 2002), the EU-wide and global Covenants of Mayors for Climate and Energy Covenant of Mayors (Covenant of Mayors, nd; Global Covenant of Mayors, nd). The most recent incarnation of target setting for local places has been widespread 'climate emergency declarations' in response to the IPCC's Special Report (IPCC, 2018), along with target dates by which local authorities intend to achieve net zero carbon emissions (Gudde et al., 2021).

1.2.3.3 Other policies and powers

Local policies have been developed to set a strategic direction for action on net zero. Local Enterprise Partnerships developed local energy strategies following the UK's Industrial Strategy which identified Clean Growth as a 'Grand Challenge' (BEIS, 2017b). Some local authorities have also undertaken strategic energy planning on a more ad hoc basis (Bale et al., 2012). Many recent net zero targets have also been accompanied or followed by local net zero plans or strategies (Garvey et al., 2023).

Councils have also used their powers as statutory planning authorities to set net zero policy. The Merton Rule, introduced by the London Borough of Merton, mandated almost all new developments to produce at least 10% of their own total energy consumption from renewables – eventually entering national planning legislation as part of the Planning and Energy Act 2008 (Crawshaw, 2021). Other councils have encouraged development of onshore wind farms (Hull City Council, nd) to counteract a backdrop of hostile national planning policy (Clark, 2015).

More broadly, UK100 comprehensively reviewed powers that local and combined authorities can use to influence carbon emissions (UK100 and Quantum, 2021) and found that local public investment of £5bn could leverage up to £100bn private

investment in net zero projects (Billington et al., 2020). New devolved powers on energy and net zero have been explored via regional devolution deals (Marsden and Anable, 2021, p. 14), although these are far from uniform (Garvey et al., 2023, p. 990).

1.2.4 Barriers to local net zero

A number of barriers to local net zero approaches have been identified. The UK has a highly centralised governance structure, meaning that local and regional authorities still lack many of the powers they need to strategically implement place-based solutions to net zero (UK100 and Quantum, 2021). A limited role for local or combined authorities in energy system planning has been identified as a particular weakness in the UK (Marix Evans, 2020, p. 24) compared to other countries where municipal authorities are much more involved (Schmid et al., 2020).

Due to the lack of statutory responsibilities to produce net zero targets and strategies, there is no standardisation of policy approaches. This has caused enormous variation between local areas (Climate Emergency UK, 2022), making it difficult to compare similar claims. For example, some plans provide a detailed pathway for significantly reducing emissions and eventually reaching net zero (Manchester CC, 2022), while others rely heavily on carbon offsetting to reach a 2030 net zero date, reducing emissions more widely much later on (Birmingham CC, 2021).

Another side effect of the non-statutory status of net zero work is limited and inconsistent funding (Webb et al., 2017, pp. 13, 36). As austerity budgets significantly shrank direct grants to local authorities from national government throughout the 2010s, statutory functions were prioritised and non-statutory functions were significantly scaled back or halted altogether. Therefore, individual net zero projects and policies have tended to rely on successfully bidding for competitive funding,

making it more difficult for local authorities to work strategically and across siloes (Webb et al., 2017, p. 37). The lack of secure funding has resulted in very small teams of officers, if any, working on net zero within local authorities. As a result, it has proven difficult to grow institutional memory and internal expertise, and small teams constantly rely on external consultants to achieve progress (Webb et al., 2017, p. 36).

Availability of data is also cited as a barrier to local net zero (Li and McDowall, 2017). While national government has guidelines for how to use emissions data in decision-making (BEIS, 2019a), there is no equivalent for local authorities. Data on energy infrastructure can be difficult to obtain; because energy networks are owned by private companies, they will often charge for access to granular data or simply refuse to make it available (CSE, 2020), and the granularity likely does not align with administrative boundaries (ESC, 2020).

1.2.5 Applying the lens of evidence-based policy

Local approaches to net zero and their barriers identified in the previous section highlight the importance of how decisions are made within local governance structures. I argue that this makes the theoretical framework of evidence-based policy a suitable one for understanding how such decisions are made – particularly in policymaking.

Evidence is central to the decision-making process (Cairney, 2017). At the most basic level, the use of evidence in the policy process is justified as a means of improving policy outcomes by improving understanding of policy problems and the likely effectiveness of solutions (McDowall and Britchfield, 2020, p. 14). How it achieves that will depend on the type of evidence, the actors using it, and the policymaking context (Pearce, 2014).

Evidence-based policy offers a conceptual framework for understanding what informs decision-making, how evidence is used, and the underlying rationale for its use. Evidence can come in many forms: for example, datasets which break down all emissions of an economy into high-level sectors, case studies of how other places have reduced emissions, or the predicted costs of clean technology. Particularly common in net zero policymaking is the use of quantitative modelling tools[1] (Fais et al., 2016, p. 154), which is often assumed to improve policy outcomes without further examination (Smith and Stewart, 2015, p. 421).

However, it is worthwhile examining the use of evidence more closely. Using evidence effectively has also been found to be particularly challenging for energy policy, due to the profound systemic changes required for net zero and the wide range of evidence types that are considered to be important, from social science insights on behavioural economics to technical engineering expertise (McDowall and Britchfield, 2020, p. 17). In addition, the global nature of the problem means that even effective evidence-based decision-making in national policies is sensitive to external shocks from around the world (McDowall and Britchfield, 2020, p. 18). This challenge only increases at more local scales; not least because in the UK, capacity to use evidence is mostly situated at national level, (Shaxson et al., 2024, p. 7), with very little locally (McDowall and Britchfield, 2020).

In addition, during the COVID-19 pandemic, policy decisions were often said to be ‘following the science’ (Evans, 2022) when using epidemiological models. This masked the contested value judgements at the heart of such societally impactful decisions (Bacevic, 2022; Pearce, 2020, p. 5). Similarly, concerns have been raised

[1] See for example BEIS, nd; SCATTER, nd.

that net zero target dates adopted in light of the IPCC's Special Report may be nothing more than "exercises in vanity", enabling "politicians to be seen to be doing something when actually they are not" (Haarstad, 2020, p. 65). Given the importance attributed to place-based contributions to decarbonisation, it is worthwhile to investigate more closely the role of evidence in the development of local net zero policy.

1.3 Structure of the thesis

Having argued for the value of an evidence-based policy lens on local net zero, I aim to answer the following research questions in this study:

RQ1: What evidence is used in local net zero policymaking?

RQ2: How is evidence used in local net zero policymaking?

RQ3: Why is evidence used in local net zero policymaking?

The structure of the thesis is as follows. After this Introduction, I turn to a review of the evidence-based policy literature, contrasting the two main schools of thought. While some scholars have held on to the positivist ideas inherited from evidence-based medicine, many have adopted more critical perspectives. I explore the key conceptual points of distinction in a structure matching the three research questions, continuing to build the argument that an evidence perspective is valuable for understanding local net zero policy.

In Chapter 3, I set out the methodological approach taken in this study. I argue that, by adopting the critical approach identified within the literature, an in-depth case study design gives scope to investigate a single policy process in sufficient detail. I justify my choice of case: the development of the West Midlands Combined Authority's Five Year Plan, which sets the strategic priorities for meeting the region's 2041 net zero target. Given the specific interest in quantitative models as evidence within net zero

policy, I add a sub-case to investigate the development of the model that underpinned the Five Year Plan. I set out the methods used to collect data – semi-structured interviews and documentary sources – as well as the process used to undertake thematic analysis.

In Chapters 4 and 5, I present the empirical findings of my research. Chapter 4 presents the holistic case study of the Five Year Plan development process, while Chapter 5 sets out the sub-case of the model development. Chapter 6 then brings the findings of both cases together in a discussion. I draw out three key themes: the prioritisation of quantitative evidence; the significant role played by external consultants, as opposed to embedded policymakers; and the high levels of uncertainty and ambiguity observed. Along these lines, I argue that while all three common justifications for using evidence – increasing salience, legitimacy and credibility (Cash et al., 2002) – can explain each of the three themes, in fact contextual factors of local net zero policy serve to undermine these justifications.

I then argue that the embedded case study structure of this research provides a key contribution to the evidence-based policy and modelling literatures, bridging a gap between them by considering both model and policy development in detail. In illuminating the dynamics of these processes together within the wider multilevel governance context, I argue that this research demonstrates the use of evidence in local net zero policies does not currently enable a sufficiently place-based perspective, and thus can contribute to deficient policies that lead to poor outcomes. Finally, in Chapter 7, I conclude by summarising the main findings of the thesis and discussing implications for current and future local net zero policy.

1.4 Conclusion

In summary, net zero has become a policy priority in the UK nationally and locally. There are significant advantages to local, place-based approaches to net zero, although within the UK context, there are a number of barriers to local policymaking, including a lack of powers, resources and data. I have argued that considering the role of evidence in decision-making provides a conceptual framework that enables greater understanding of local net zero policy. Now, I turn to the academic literature on evidence-based policymaking to construct such a framework for this research.

Chapter 2: Literature Review

2.1 Introduction

In this research, I have set out to understand the ways in which evidence is used to inform local net zero policymaking. This chapter presents a review of the academic literature on evidence-based policy making.

The structure is as follows: I will begin by reviewing the origins of the evidence-based policy field (2.2), tracing the history of political science from the 1950s through to the evidence-based medicine movement in the 1990s, which developed into the contemporary policy and research paradigm with two dominant schools of thought aligned to positivist and critical philosophies.

Before proceeding to examine evidence concepts more closely, I describe theories of policymaking provided by the field of policy studies (2.3). I consider the policy cycle framework as a foundation, then integrate concepts that enable more accurate description of complex policy processes. I then introduce the framework of multilevel governance (2.3.4), which facilitates the differentiated treatment of policymaking in national and subnational governments. Throughout the remainder of the chapter, I identify areas of theory that are either particularly well developed, or in need of more development, both for the application to local policymaking and to the policy problem of net zero.

The next three sections each address key theoretical contributions to evidence-based policy literature. First, I explore what is meant by ‘evidence’ (2.4). I show that there is much debate between the positivist and critical schools. Key differences reflect their views on scientific research (2.4.2); quantitative or qualitative evidence (2.4.3);

evidence of generalised or contextualised findings (2.4.4); and the treatment of knowledge in the form of expertise or local ‘know-how’ (2.4.5). I then consider mathematical modelling as a specific example of evidence along these conceptual dividing lines (2.4.6).

Second, I explore what is meant by the use of evidence in policy (2.5). Here, I separate two distinct aspects: how evidence enters the policy process (2.5.1), and how it is used once it has entered (2.5.2). I then consider how policymaking capacity influences both these aspects of evidence use (2.5.3), distinguishing between analytical, operational and political capacities. Then, mirroring Section (2.4.6), I consider the various uses of mathematical models as evidence for policy (2.5.4).

Third, I consider the justifications given for using evidence in policymaking (2.6). I show that, while it is often taken for granted that the use of evidence is worthwhile, the literature identifies evidence-based approaches as increasing salience, credibility and legitimacy of the policy output (2.6.1). After considering each in turn, I then consider one particularly common reason given for using evidence: addressing uncertainty (2.6.2). In particular, I describe how modelling evidence has been seen as relevant for this aim. In doing so, I show that the stated intentions and reality of evidence-based policy making can differ hugely. Furthermore, I show that interpreting evidence-based policy as an unattainable ideal is helpful (2.6.3), before concluding with a summary of the key influences on the use of evidence in policymaking (2.7).

2.2 The origins of evidence-based policymaking

2.2.1 20th Century policy sciences

The idea of using evidence to inform decisions within the policy process is not new (Wesselink et al., 2014, p. 339). While some authors have drawn connections as far back as Machiavelli (Hammersley, 2013, p. 1), in the interests of brevity, I will begin as many others do in the mid-20th Century (Head, 2010; Nutley and Webb, 2000; Parkhurst, 2017). John Maynard Keynes' work in the 1930s (Keynes, 1978) is regarded as seminal in arguing for ideas and knowledge to inform policy in a rational way (Nutley and Webb, 2000, p. 25), although analysis of this subject only began to accelerate with the birth of 'policy sciences' in the 1950s. Leading figures included American political scientist Harold Lasswell (1951, 1970) and psychologist Donald T Campbell (1969), who identified ways in which research and experimentation (Solesbury, 2001), could play a range of roles to address policy problems. In the 1970s the field of 'knowledge utilisation' emerged (Blume, 1977; Weiss, 1979), exploring the multiple ways in which research influences policy decisions. Overall, the post-war period in the Anglosphere was underpinned by normative expectations of research being used to develop policy (French, 2019, p. 153; Paul and Haddad, 2019, p. 299), identified by some as an 'ideology of scientism' (Dupré, 2001, p. 2; Head, 2010, p. 78; Rosenhead and Thunhurst, 1979).

2.2.2 Evidence-based medicine to evidence-based policy

In 1992, Guyatt et al. introduced the concept of 'evidence-based medicine' to instil a new paradigm within the medical community that "de-emphasise[d] intuition [and] unsystematic clinical experience" (1992, p. 2420). Instead, the best possible outcomes would come from rigorous and systematic research processes to determine the

effectiveness and subsequent choice of clinical interventions (Parkhurst, 2017; Smith, 2013a). A key focus of evidence-based medicine is the quality of evidence, with the use of 'evidence hierarchies' (Dopson et al., 2003) prioritising systematic and randomised methodologies, such as randomised control trials (RCTs). The linear, instrumental model of knowledge utilisation prioritises the supply of evidence as a key variable. More evidence of higher quality leads to better policy (Oliver and Pearce, 2017).

Policymakers observed the success of evidence-based medicine in improving patient outcomes and started to apply it as a template to address policy problems more broadly under the banner of 'evidence-based policy' (Oliver and Pearce, 2017, p. 2; Young, 2011, p. 20). In the UK and US this coincided with 'third way' politicians (Giddens, 1999), who stressed their non-ideological, pragmatic approach in contrast with their opponents. Most notably, the New Labour government elected in 1997, at pains to distinguish itself from its overtly socialist former position, regularly referred to the mantra 'what matters is what works' (HM Government, 1999).

As the interest in 'evidence-based' and 'data-driven' approaches to policy grew (Mullan, 1999, p. 123), so did scholarship, with 'evidence-based policy' seen as "the latest version of the search for usable and relevant knowledge to help address and resolve problems" (Head, 2008, p. 2). The authors of one of the most influential works of the time, *What Works* (Davies et al., 2000), have since reflected on the "tide of optimism around the role of evidence in shaping public policy" (Boaz et al., 2019b, p. 6) at the time of the original publication.

Much of the work in the 1990s and early 2000s – described by Sayer as the "'what works' tradition" (2020, p. 246) – was firmly based in a rationalist, positivist view of

policymaking (Hertin et al., 2009, p. 1186; Smith, 2013b, p. 13). Objective scientific expertise is contrasted with value-led political decision-making. The key variables are the supply of high quality evidence by researchers and the attention paid to evidence by policymakers (Eckard et al., 2017; Nutley and Webb, 2000; Pearce et al., 2014, p. 161; Sanderson, 2002, p. 6). Indeed, much of the early 'what works' literature focused on identifying and categorising enablers of, and barriers to, the greater use of evidence (Contandriopoulos et al., 2010; Innvær et al., 2002; Mitton et al., 2007; Oliver et al., 2014a). A 'what works' perspective is still commonplace today (Davies et al., 2019, p. 372). In the UK, 'What Works Centres' have been created as formal bodies with the explicit goal of identifying 'what works' by producing evidence reviews and guidelines across a range of policy areas (Evaluation Task Force, 2024; What Works Growth, 2022).

2.2.3 Critical turn to evidence-*informed* policy

Since the early optimism of 'what works' perspectives, many more critical perspectives on the use of evidence for policy have emerged (Geyer, 2012, p. 30). Although there are still advocates for the terminology of 'evidence-based policy' (see for example Oliver et al., 2014b, p. 3; Pawson, 2006) it has been criticised for assuming an overly instrumental use of evidence. Alternative suggestions have included 'evidence-inspired' (Duncan, 2005), 'evidence-influenced', 'evidence-aware' (Biesta, 2007, p. 5; Davies et al., 2000, p. 11), and 'intelligent' policymaking (Sanderson, 2009). 'Evidence-informed' policymaking (Boaz et al., 2008) appears to have become the most common choice to represent "a less deterministic, ambitious and hierarchical view of evidence generation and use" (Davies et al., 2019, p. 370; see also Nutley et al., 2007). The 'evidence-informed' perspective represents "an acceptance of the multiple, valid influences on policy" (Smith, 2013b, p. 3) beyond simply research evidence. It draws

on insights from policy studies and political science to capture the inherently value-laden nature of policy (Cairney, 2019, p. 35), but maintains that evidence "can, nonetheless, play an important influencing role" (Boaz et al., 2019b, p. 4).

Two schools of thought have emerged, with three key conceptual differences on evidence in policy. Some have referred to this distinction as a 'paradigm war' between positivist 'evidence-based policy' advocates and more critical and interpretivist 'evidence-informed' accounts (Greenhalgh and Russell, 2009). First, there are various perspectives on what counts as evidence. Evidence-based policy perspectives tend to conflate 'evidence' with 'research'. Drawing from the evidence-based medicine tradition, they exclusively consider the impact of scientifically derived findings. More critical perspectives tend to recognise a broader range of information and knowledge sources as valid (Stevens, 2011). Second, the way in which evidence is used in policymaking tends to be seen as a linear transfer of evidence from researchers to policymakers in the positivist tradition (Sutherland and Burgman, 2015). Researchers and policymakers are conceptualised as homogeneous, distinct 'communities' (Caplan, 1979) and evidence 'speaks for itself' in a rational decision-making process. On the other hand, critical perspectives pay more attention to the co-production of evidence by researchers, policymakers, and a wider ecosystem of policy stakeholders (Maybin, 2016). Critical scholars recognise many indirect and 'irrational' ways in which evidence informs decision-making (Weiss, 1979; Eckard et al., 2017, p. 703). Third, the two perspectives have different underlying motivations for using evidence. Evidence-based policy advocates often simply assume that increasing the use of evidence must necessarily lead to better policy outcomes. Critics tend to question such assumptions, exploring what 'good' use of evidence for policy entails and indeed various meanings of 'better' policy (Parkhurst, 2017).

In the following sections of this Chapter, I explore each of these debates in turn. In the process, I argue that the critical perspective is more appropriate in the analysis of local policymaking in general, and for local net zero policy specifically. Before proceeding, it is first necessary to introduce some key concepts from policy studies and policy analysis (Cairney, 2019, p. 21) which underpin this more critical perspective (Parkhurst, 2017, p. 43).

2.3 Theories of policymaking

2.3.1 Policymaking as a process

To understand how evidence is used for policy, it is first important to recognise policymaking as a process. Few definitions of 'policy' are restricted to an 'outcome' (Cairney, 2019, p. 2) or 'artefact' (Wesselink and Gouldson, 2014, p. 406), instead referring to an 'approach' (French, 2019, p. 151) or 'process' (Howlett et al., 2020, p. 8). This interpretation of policy as a process is "immensely useful in understanding evidence use" (Parkhurst, 2017, p. 43), not least because it helps to move the debate on from a restricted focus on evidence supply which implies that more evidence leads to better policy (McDowall and Britchfield, 2020, p. 17; Oliver et al., 2014b, p. 7).

2.3.2 The policy cycle

The 'policy cycle' is one of the most common approaches to studying public policy (Jann and Wegrich, 2006, p. 1). It conceptualises the process as formed of a series of distinct stages in chronological order. The cycle was first introduced by Harold Lasswell (1956), with subsequent development by Gary Brewer (1974), and popularised in policy textbooks by Charles O. Jones (1970) and James Anderson (1984). Each version of the cycle has had slight variations (Howlett et al., 2020, p. 10),

but typically includes the following stages: agenda setting, policy formulation, decision-making or legitimation, implementation, and monitoring or evaluation (Jann and Wegrich, 2006, p. 1).

Agenda setting refers to the ways in which policy problems come to the attention of policymakers. Here, evidence "can contribute to conceptual reframing and reproblematisation" (Davies et al., 2019, p. 375; van Toorn and Dowse, 2016), where "[f]raming refers to the ways in which actors understand, portray, and categorize issues" (Cairney et al., 2016, p. 2). Formulation describes how policy options are created by policymakers to address the identified problem. In the rationalist view of evidence-based policy, evidence use is greatest during this stage (Nutley and Webb, 2000, p. 25) Decision making (and legitimation) refers to the way in which a government chooses whether to adopt a formulated policy. This is followed by implementation of the policy – how its implications are put into practice. Finally, monitoring and evaluation refer to ways in which implemented policies are measured and their success judged. This measurement is often considered to be a way of collecting and producing evidence which informs the next round of agenda setting once the cycle restarts (Nutley and Webb, 2000, p. 26).

Several arguments for and against the policy cycle are well rehearsed (Cairney et al., 2019; Howlett et al., 2020). Arguments in favour include: the ability for scholars to consider different dynamics within each of the stages (Howlett et al., 2020, p. 12); the applicability to all levels of government from local (Fowler et al., 2001) to supranational (Billings and Hermann, 1998); the capacity to look beyond government departments and examine "the intertwined roles of all actors, ideas, and institutions" (Howlett et al., 2020, p. 12); and the appeal as a normative model for evidence-based policymaking (Everett, 2003, p. 67; Jann and Wegrich, 2006, p. 2).

Critics have pointed out that the model is rarely an accurate description of policymaking in the real world (Cairney et al., 2019, p. 10). Stages of the cycle are often skipped, overlap or occur in reverse order (Jann and Wegrich, 2006, p. 8). In fact, observations that the chronology of the cycle can reverse has led to the concept of 'policy-based evidence' (Cairney, 2019, p. 21; Hughes, 2007; Marmot, 2004, p. 906; Strassheim and Kettunen, 2014, p. 260). Referred to as evidence-based policy's "evil twin" (Pearce et al., 2014, p. 163), policy-based evidence is a critique of the selective use of evidence to justify an existing decision. This reverses the usual order of evidence-based policy, in which decisions should only be taken having considered a range of evidence during formulation. Another criticism has been the poor applicability to subnational levels of government, where the scope to shape policy to local needs in a single cycle is limited (Cairney, 2019, p. 25). Finally, the policy cycle lacks a "notion of causation" (Howlett et al., 2020, p. 13). There is no clear explanation of what drives the cycle from one stage to the next (Sabatier, 1992). In recognising the limits of the model's descriptive capacity, proponents maintain that the policy cycle provides a helpful, if simplified, 'ideal-type' model of the policy process (Jann and Wegrich, 2006, p. 2).

2.3.3 Towards a more complex description of the policy process

In order to provide greater descriptive accuracy of the "kaleidoscopic activity" (Cairney et al., 2019, p. 1) within a real-world policy process, the policy cycle needs to be supplemented with additional theoretical concepts.

One essential concept is the 'bounded rationality' of actors, first introduced by Herbert Simon (1957). Bounded rationality is defined in contrast to the ideal-type of 'comprehensive rationality', in which policymakers are able to fully appraise and

incorporate all relevant information given to them, making an entirely rational decision (Cairney, 2017). Bounded rationality instead recognises that time and resource constraints severely limit the amount of information that busy policymakers can take into account (Everett, 2003, p. 66). Instead, they must combine their limited capacity to be rational with irrational cognitive 'shortcuts'. These may be ideological, political, intuitive, 'common-sense' or best guess. This is in stark contrast to the rationality assumed in the early evidence-based policy literature and requires a broader perspective on decision-making influences to understand the specific influence of evidence (Cairney et al., 2016; Cairney and Oliver, 2017).

A key difference between the use of evidence in medical and policy contexts is the role of values. This has led some to suggest that there is little to be gained in transferring lessons from evidence-based medicine to policymaking (Boaz et al., 2019b). Clinical decisions are often perceived to be specific, technical, and value-free; they feed into "the caricature of the passionless objective (often male) scientist in a white coat" (Kelly et al., 2015, p. 2). While research on evidence-based medicine has progressed since the 1990s to recognise the growing importance of values (Kelly et al., 2015; Oliver and Pearce, 2017), political values in particular are considered to be a more significant factor in policymaking (Capano and Malandrino, 2022, p. 424). This led Pawson to compare the 'six-stone weakling' of evidence to the 'four-hundred pound brute' of politics (2006, p. viii).

However, the idea of "science versus politics" has increasingly been deemed unhelpful (Smith, 2013b, p. 1), presupposing "a 'naïve rationality' … that assumes evidence is somehow outside politics" (Hawkins and Parkhurst, 2016, p. 375). Instead, critical scholars have made the case for analysing evidence itself as contested and value-laden (Dunlop, 2017; Kelly et al., 2015, p. 1; Thomas, 2023, p. 255). Indeed, Cairney

has co-opted the language of positivist evidence-based policy advocates, suggesting that “a pragmatic understanding of ‘what works’ relates as much to the political feasibility of solutions … as it does to technical feasibility” (Cairney, 2019, p. 24).

As such, it is necessary to recognise that there can be many ‘evidence bases’ on a policy problem, each of which may speak to different political priorities (Parkhurst, 2017, p. 22). These may even overlap, with the same evidence being interpreted to have different meanings according to the assumptions and values of actors using that evidence (Oliver and Pearce, 2017, p. 2; Rickinson and McKenzie, 2021, p. 483).

2.3.4 Multilevel governance

The concepts introduced in the previous sections were all first applied in research of policymaking at the national level. An overrepresentation of national policymaking has been found across the field more generally (Weible and Sabatier, 2017) and, in particular, in research on evidence in policy (Cheetham et al., 2022, p. 5; Fitzgerald and Cairney, 2022, p. 4; Wesselink and Gouldson, 2014, p. 408). This is an issue for the study of evidence in local policy, since so many critical scholars have identified context as a central factor (Oliver et al., 2014a, p. 6; Wesselink et al., 2014, p. 342).

The ‘multilevel governance’ framework is one theoretical approach that has been successfully used to analyse policy at levels other than national (Cairney, 2019). Multilevel governance was first introduced by Hooghe and Marks to analyse European governance from local to supranational levels (Hooghe and Marks, 2001). In specifying ‘governance’ and not ‘government’, the framework expands the focus from the “official policy process”, which has often been the exclusive focus in evidence-based policy scholarship (Davies et al., 2000, p. 4). Instead, it acknowledges “the interaction

between many actors across many types of government" across "the blurry boundaries between formal responsibility and informal influence" (Cairney et al., 2019, p. 13).

The multilevel governance framework indicates that different centres of local policymaking may have drastically different policy responses to the same problems. This is due to differing levels of resource constraints, greater or lesser degrees of autonomy, or different political balances (Eckersley et al., 2022, p. 2). Therefore, the study of any particular policymaking venue requires an appreciation of the surrounding 'centres' with which it interacts (Haynes et al., 2020; Wesselink and Gouldson, 2014, p. 419).

Parallels have been drawn with a similar field known as 'polycentric governance' (Ostrom et al., 1961), which captures overlapping 'centres' of authority that can coordinate and/or compete on governance and policy decisions. Polycentric governance is particularly applicable to policy problems that cross physical or institutional boundaries and/or contain interdependencies between multiple sectors – such as net zero (Crowther, 2023; Dent et al., 2019; Garvey et al., 2023; Hofbauer et al., 2022; Marsden and Anable, 2021; Munro and Cairney, 2020, p. 6).

Several authors have proposed merging multilevel and polycentric governance theories due to their close "entanglement" (Russell and Christie, 2021, p. 6). Cairney adds a third perspective of 'complexity theory' under the label of 'multi-centric governance' (Cairney et al., 2019). Throughout this thesis, I, like others (Heinen et al., 2022; Russell and Christie, 2021), have chosen to use 'multilevel governance' as an umbrella term, rather than the more niche 'muti-centric' terminology.

Overall, the key feature of multilevel governance is (formally and informally) dispersed responsibility across multiple organisations and actors, with limited control by any

particular ‘centre’ (Cairney et al., 2019, p. 12). As Cairney et al. describe (2019, p. 52), there are both descriptive and prescriptive justifications for multilevel governance, not least that top-down control by a single ‘centre’ as described by the ‘Westminster model’ (Bache and Flinders, 2004) are neither practical nor desirable from a participatory perspective.

Two multilevel governance concepts are particularly helpful in understanding the role of evidence in local policymaking: fragmentation and incoherence. Fragmentation is a concept borrowed from the related but distinct network governance literature (Nochta, 2017, p. 4). It can refer to the separation of policymaking venues vertically (between central and local government) and horizontally (between policymaking and delivery bodies, or between specialised, siloed sectors) (Klijn and Koppenjan, 2012). Fragmentation can lead to evidence providers struggling to identify the appropriate stakeholders to engage with in a multilevel governance structure (Nochta, 2017, p. 14) – especially in highly centralised UK contexts[2] (Oliver, 2021; Pearce and Cooper, 2011, p. 215; Roelich and Giesekam, 2019, p. 176; Russell and Christie, 2021; Strachan et al., 2009).

Incoherence refers to the lack of alignment between policies at national and local levels (Marsden and Anable, 2021, p. 2). Specifically, there is a trade-off between approaches across multilevel structures that prioritise uniformity by attempting to impose top-down standardisation, and those that recognise and encourage the legitimate autonomy and flexibility of local policymaking (Cairney and Oliver, 2017, p. 6). This is clearly an issue for net zero, since “[w]hatever annual percentage [emissions] reduction is set by the national trajectory must be met by the sum of the

[2] For an account of more decentralised structures, see McDowall and Britchfield’s (2020) comparison of the UK with four other countries.

actions across all local areas" – although the consequence that one local area failing to meet targets necessitates another overperforming is "rarely stated" (Marsden and Anable, 2021, p. 8). Scholars disagree over the best approach to using evidence to address incoherence. Some have argued that the use of evidence to monitor progress towards divergent local targets needs to be standardised and aligned nationally (Garvey et al., 2023, p. 999; Gudde et al., 2021, p. 10). Others have suggested that reliance on national-level evidence to drive local policy may undermine claims of being evidence-based at all (Cash et al., 2002, p. 8; Pearce et al., 2014, p. 188).

In summary, a range of policy theories are valuable in deepening understanding of the role evidence plays in local policymaking. These begin with the structured stages of the policy cycle, developing into more complex descriptions of policymaking within a multilevel governance framework, featuring political actors making decisions with bounded rationality. This underlying framework is illustrated in Figure 1 below. Having set out the necessary overarching concepts to analyse the policymaking process, I can now return to the three axes of debate within the literature on the use of evidence in policy: what counts as evidence, how it is used, and why it is used.

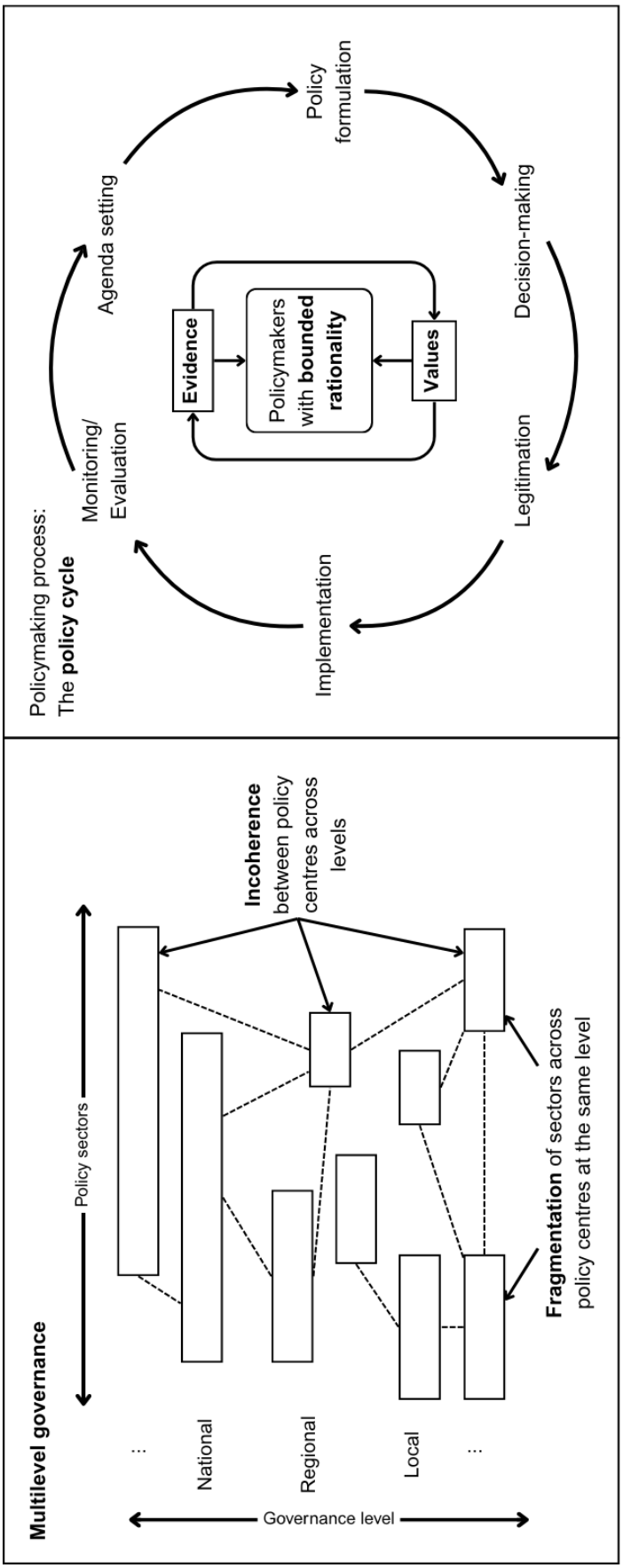

Figure 1 Diagram of the multilevel governance structure and policy cycle.

2.4 What counts as evidence?

2.4.1 Contested definitions of evidence for policy

Despite the large growth of interest in evidence-based policymaking since the 1990s (Boaz et al., 2019a; Davies et al., 2000), in general very little attention is given to clarifying what is meant by 'evidence' in policymaking (Blum and Pattyn, 2022; Oliver et al., 2014a; Pearce et al., 2014, p. 199). As a result, what counts as 'evidence' for policy is "elastic" (Hansen and Rieper, 2010, p. 102) and often disputed (Cairney, 2019, p. 23; Davies et al., 2019, p. 373; Newman et al., 2017, pp. 158–159), with definitions ranging from scientific research to simple observations (Davies et al., 2000, p. 2). One approach suggested by Pearce et al. (2014, p. 161) draws on Lindblom and Cohen's (1979) articulation of social research as "policy-useful information". However, this raises further questions about what determines the usefulness of information, and how the meanings of evidence, knowledge and information interact (Head, 2008, p. 4).

Returning to first principles, the Chambers Dictionary definition of 'evidence' without the context of policymaking indicates possible routes forward. As a noun, evidence is "information, etc that gives grounds for belief; that which points to, reveals or suggests something" or "written or spoken testimony used in a court of law". As a verb, 'to evidence' is "to be evidence of something; [or] to prove" (Chambers, n.d.). In the words of Fletcher, evidence is "simultaneously entity and process" (Fletcher, 2022, p. 291). Therefore, I argue evidence can be viewed as information with an embedded logic or rationale for its claim to truth.

The 'truth' component of evidence is well-recognised (Boaz et al., 2019b, p. 1), with many scholars referring to 'facts', 'information', 'data' or 'knowledge' as essential "building blocks" of evidence (Fraser and Davies, 2019, p. 203; see also Blum and

Pattyn, 2022; Weiss, 1991). The embedded logic or rationale, on the other hand, has tended to be overlooked in descriptions of evidence beyond philosophy (Fletcher, 2022; Thomas, 2023; Neal, 2024; Gettier, 1963). However, it is this justification of truth, or the "process through which facts and data are put" (Fletcher, 2022, p. 302), that appears to distinguish evidence as a worthwhile contribution to policy. Any claim that a decision is evidence-based must be founded on the "ability to provide a sound account" (Thomas, 2023, p. 245). Disagreements remain over what determines 'soundness' (Cartwright et al., 2010), from verifiability (Davies et al., 2000), to process reliability (Goldman, 1979; Sayer, 2020), to support of prior beliefs (Lehrer and Cohen, 1983).

This distinction between the truth and embedded rationale of evidence has similarities with Carol Weiss's framework (Weiss, 1991) for understanding the meaning of policy research as either data, ideas or arguments, which has since been used to categorise 'evidence' more broadly (Pearce, 2014). Evidence as 'data' or 'ideas' appears to correspond with the factual component, while evidence as 'arguments' is analogous with the underlying logical justification. However, Weiss's framework refers more to the ways in which evidence is used, rather than the nature of evidence itself (Pearce et al., 2014, p. 188). In fact, 'evidence as arguments' is understood as evidence which has had an advocacy position added to it (Weiss, 1991, p. 314). It refers, therefore, to the decisions which should be made in light of the evidence, rather than the internal argument that defines the evidence. I will return to Weiss's framework in the section on evidence use.

With this broad understanding of evidence as information with an underlying justification, I now elaborate on several key dimensions of evidence that continue to divide scholars into positivist and critical camps. I examine production of evidence by

scientific research or other methods; quantitative or qualitative evidence; generalised or contextualised evidence; and the status of knowledge as evidence.

2.4.2 Research vs. non-research evidence

One of the most fundamental dividing lines in the evidence-based policy literature is whether evidence is exclusively restricted to outputs of scientific research (Blum and Pattyn, 2022; Head, 2010). Advocates of evidence-based policy, rooted in the evidence-based medicine tradition, tend to restrict their definition of evidence along these lines (Davies et al., 2000; Fraser and Davies, 2019; Nutley et al., 2007). More critical scholars recognise the validity of a broader range of evidence sources (MacKillop and Downe, 2022).

Much of the emphasis on scientific research in the evidence-based policy literature is due to the transfer of ‘evidence hierarchies’ from clinical settings (Head, 2010, p. 82; Nutley et al., 2019, p. 234). These hierarchies were originally developed to assess evidence quality on the basis of methodological rigour (Fletcher, 2022, p. 292; Hadorn et al., 1996). Anecdotal case studies are placed at the bottom of evidence hierarchies, with levels of experimentation and randomisation increasing with higher placement. These often culminate with the ‘gold standard’ of RCTs, systematic reviews and meta-analyses (Parkhurst, 2016, p. 375).

Many scholars have made the case for such hierarchies to be applied to evidence in policymaking (Chalmers and Altman, 1995; Haynes et al., 2012). Indeed, randomised control trials are considered to be “fashionable” (Fleming and Rhodes, 2018, p. 5) evidence for policymaking, offering the greatest promise for establishing effectiveness (Haynes et al., 2012, p. 4) based on causal relationships between policy choices and outcomes (Fraser and Davies, 2019, p. 208). The reliance on scientific methods for

determining evidence quality also allows evidence producers to convey “a reassuring sense of objectivity” (Smith, 2013c, p. 71) – a theme to which I will return in the discussion of justifications for evidence use.

In contrast to the proponents of this ‘what matters is what works’ approach, the use of evidence hierarchies for policy has been subjected to much criticism. The focus on methodology for determining the quality ranking of evidence has been seen as overly restrictive, and ineffective at providing relevant answers to policymakers. Many argue that randomised and experimental methods are not the “magic bullet” suggested by RCT advocates (Hammersley, 2005, p. 91), since many policy areas have no practical way of implementing such research methods (Howlett et al., 2020, p. 186; Head, 2010, p. 83).

Advocates of research evidence have responded by replacing simplistic hierarchies with more complex appraisal frameworks such as evidence checklists, matrices, and evidence ‘principles’ (Nutley et al., 2019, p. 238; Cartwright et al., 2010, p. 9). Nutley et al. (2013) identify 15 examples of ranking systems that are applied to a wide range of policy areas. However, research study design still plays a major role (Parkhurst, 2017, p. 45; Sayer, 2020, p. 244), limiting the possibility of non-scientific evidence scoring highly. This has led to availability bias towards scientific evidence, since “evidence is whatever appears on the list” (Montuschi, 2009, p. 429).

In contrast, critical perspectives have highlighted the fact that policymakers do not necessarily assess the value of evidence based on scientific quality (Cairney, 2017). According to Nutley et al. (2019, p. 246), “their tacit hierarchies of evidence may look very different” (see also Lin, 2003). Consequently, policymakers are likely to recognise “multiple forms of knowledge” (Fleming and Rhodes, 2018, p. 3) as valid evidence.

These include both ‘grey’ literature from think tanks, NGOs or consultancies (Fraser and Davies, 2019, pp. 203–204) and “public opinion and feedback from consultation” (Cairney, 2022, p. 12).

2.4.3 Quantitative vs. qualitative evidence

Within traditional evidence hierarchies, quantitative research methods rank more highly than qualitative. As such, the “prevailing order” (Lennon, 2014) of evidence-based policy has considered technical, quantitative data to be superior to qualitative insights (Davies et al., 2000, p. 292; Hill O’Connor et al., 2023; Sanderson, 2002, p. 6; Wesselink et al., 2014, p. 340). Unlike the mixed preferences for research-based evidence, this bias towards quantitative data is very clearly observed among policymakers (Weiss, 1991, p. 310), including local policymakers (Bynner and Terje, 2021, p. 82). Stone argues that “since at least the nineteenth century, numbers [have been] the premier language for defining and documenting problems” in public policy (Stone, 2015, p. 165), which is explained in part by the “cultural association of numbers with objectivity” (2015, p. 167).

This bias towards quantification is clear to see in net zero policy (Asayama et al., 2019; Pearce, 2014, p. 200). Cooper found that “energy policy has been dominated by a technical/physical approach”, in which policy objectives are “implicitly set out in physical science units”, such as installed capacity of renewables or mass of greenhouse gases (Cooper, 2017, p. 80). He goes on to explain that “[t]o answer questions framed in these terms, answers with these terms are needed, or they can have no traction” (2017, p. 80), creating a demand for quantitative evidence.

A common issue of quantification is oversimplification (Smith and Joyce, 2012, p. 73). Often, quantitative evidence on a policy problem is reduced down to a single number,

potentially concealing underlying uncertainties (Smith and Stewart, 2015, p. 428). Indeed, because of the impression of objectivity given by such evidence (Stone, 2015, p. 167), “a number takes centre-stage with a crisp narrative, [meaning] other possible explanations and estimates can disappear from view” (Saltelli et al., 2020, p. 485). Thus, the use of quantitative evidence can crowd out qualitative evidence.

Scholars also make the case for qualitative evidence for its contribution to understanding “values, attitudes and perceptions” at play (Head, 2010, p. 82; see also Nilsson et al., 2008, p. 350), in particular with the use of case studies (Donmoyer, 2012, p. 670; Head, 2016, p. 477; Harrison, 2000, p. 224). However, UK local policymakers still demonstrate “an ever-growing demand for quantitative indicators” (Pearce et al., 2014, p. 164), despite being aware of the many drawbacks of exclusive focus on quantitative evidence.

2.4.4 Generalised vs. contextualised evidence

The "now-classic distinction" (Cairney and Smith, 2021, p. 4) between the 'what works' approach and 'what works, for whom, in what context' endures as a debate within scholarship on evidence-based policy (Sheldrick et al., 2021). The prioritisation of such an “intuitively appealing” objective as finding ‘what works’ – identifying and verifying solutions to policy problems – led to a strong push towards evidence of generalisable effects (Parkhurst, 2017, p. 34). This aligns closely with the debates in the previous two sections; more systematic and quantitative evidence has been seen as most relevant to answering the ‘what works’ question (Sorrell, 2007; Warren, 2020).

Critics have made the case that unlike medical interventions, which tend to have biological or physiological mechanisms that apply widely, the same is rarely true of policy problems. Policy problems have “socially embedded mechanisms” (Parkhurst,

2017, p. 37) that depend on the specific policy context (Davies et al., 2019; Ylöstalo, 2020; MacKillop and Downe, 2022). In such cases, evidence that answers “what works for whom under what circumstances, and why?” questions (Sanderson, 2002, p. 19), often using qualitative or mixed methods approaches (Pawson and Tilley, 1997; Monaghan and Boaz, 2018; Fraser and Davies, 2019, p. 211), tends to be more applicable than systematic and purely quantitative methods (Sorrell, 2007, p. 1869).This is particularly relevant to the study of local policy, since there is a greater degree of specificity in the policy context (Oliver et al., 2014b, p. 6).

The need for ‘local’ evidence has been consistently identified in analysis of evidence use in local policy processes (Gleeson et al., 2023, p. 13; Hofbauer et al., 2022, p. 7; Parkhurst, 2017, p. 134). In an analysis of evidence use for urban policy, Harrison contrasts generalised policy problems ‘*in* cities’ with more place-based problems ‘*of* cities’, concluding that contextualised evidence is required for the latter (Harrison, 2000, p. 209). In particular, he considers that although quantitative spatial indicators can be seen as valuable evidence, they rely on availability of data at an appropriate scale (2000, p. 215). This combination of local-but-quantitative evidence is widely recognised as important to policymakers (Pearce, 2014; Durrant et al., 2023; Cheetham et al., 2022). Despite the promise, availability is consistently found to be “patchy” (Fitzgerald and Cairney, 2022, p. 8) or non-existent, creating a barrier to local evidence use (Li and McDowall, 2017; Singhal et al., 2022, p. 3).

A common question on local evidence raised in the literature – particularly in studies that employ a multilevel governance framework – is what determines the most appropriate ‘local’ context. While there is certainly inconsistency (McGookin et al., 2021), there are two common approaches. First, most local statistics produced by central governments tend to be aligned to administrative boundaries, such as the

areas covered by local authorities (Pearce and Cooper, 2011). The primary advantage of this approach is the alignment with the policy capacities of local government (Garvey et al., 2022, p. 5; Marsden and Anable, 2021, p. 12). However, for net zero, concerns are often raised that many socio-technical system components, such as energy infrastructure and transport networks, involve significant transboundary flows that are “artificially truncated” by administrative boundaries (Li and McDowall, 2017, p. 13). Alternatively, data can be aligned to features of the energy system, such as areas supplied by individual substations (Day et al., 2024, pp. 1–2). By establishing a connection to physical attributes of the energy infrastructure, this contextualisation could provide a more “meaningful relationship to energy systems” (Day et al., 2024, p. 2).

Where spatial contextualisation is not possible due to a lack of sufficiently granular data, national sectoral data at least provides some breakdown of industries (Rattle et al., 2023). However, research on the ‘modifiable areal unit problem’ demonstrates that such use of national-level data is likely to disguise subnational spatial variations (Li et al., 2016; Garvey et al., 2022, p. 5). Interdisciplinary evidence is seen as one way to make up for the shortfall in spatial contextualisation, by considering multiple sectoral impacts simultaneously – as they are found in locally situated policy problems (Munro and Cairney, 2020; Cash et al., 2002, p. 8; Coutts and Brotchie, 2017).

2.4.5 Knowledge as evidence

The final debate within evidence-based policy discussions is on the distinction between evidence and knowledge of various forms. As with other definitions of evidence described at the beginning of this section, there is substantial ambiguity in much of the literature (Fraser and Davies, 2019, p. 203; Boaz et al., 2016, p. 3), with

assumptions about the nature of knowledge tending not to be articulated (Greenhalgh, 2010; Greenhalgh and Wieringa, 2011).

Discussions tend to distinguish between research-based knowledge (Jørgensen, 2023, p. 207) and other, more experiential types of knowledge (Blum and Pattyn, 2022, p. 9; Easton et al., 2022, p. 311; Sanderson, 2011, p. 70, 2009, p. 713). Head articulates three "kinds of knowledge (and corresponding views of 'evidence') … political know-how; rigorous scientific and technical analysis; and practical and professional field experience" (Head, 2008, p. 5). For the purposes of this research, I have chosen to consider 'rigorous scientific and technical analysis' as synonymous with evidence in the form of data or information as discussed above. Similarly, 'political know-how' will be considered under 'policymaking capacity' in Section 2.5.3 as an essential component of navigating the policy process. Here, I focus exclusively on the treatment of knowledge in the form of practical and professional experience, stakeholder opinions or 'expertise'. That is, policy-relevant knowledge that cannot easily be separated from an individual actor or expressed alternatively as a skill or ability to carry out a process function (see Fleming and Rhodes for a similar "strict division between experience, craft and scientific facts." (2018, p. 3)). The 'professional' and 'practical' components of experience described by Head can be elucidated by drawing on concepts of 'expertise' and 'local knowledge' respectively.

2.4.5.1 Expertise

'Expertise' itself is not usually understood as a form of evidence in its own right. Instead, experts are perceived as "knowledge 'shapers' or as knowledge providers" (Aagaard et al., 2024, p. 9) who gain their expertise from "extensive experience" in a particular industry (Hagedorn, 2023, p. 3). However, a consultation exercise that draws out expert testimony is often used "as though it were data" (Sutherland and Burgman,

2015, p. 317) and “can be as valuable to a policy maker as a brand-new study” (Cairney et al., 2016, p. 3). The use of expert testimony in local net zero decisions is an under-researched topic (Hagedorn, 2023, p. 2).

Expertise, conceptualised here are distinct from ‘facts’ that an expert is able to provide, is difficult to capture in documentary form. Maybin found that “civil servants wanted to talk to the person, and not to read the notes” (Maybin, 2016), concluding that reputation and trust in an expert were essential components of their contribution. As I have already described, positivist evidence-based policy advocates have tended to restrict their focus solely to the objective outputs of scientific research. In contrast, critical perspectives are more open to the possibility that evidence in the form of ideas can be transferred by scientists or any other type of expert, and that it is the expert reputation that provides the underlying justification for the claim to be evidence (Smith, 2007, p. 1445). In part because expertise tends to be sought when alternative forms of evidence are insufficient (Aagaard et al., 2024, pp. 11–12) or uncertain, testimony is understood to be most valuable to policymakers when a “single ‘definitive’ interpretation” is presented, generally downplaying uncertainty (Stirling, 2010, p. 1029).

‘Engineering expertise’ (Head, 2008, p. 4; Cooper et al., 2021; McDowall and Britchfield, 2020, p. 22) is a concept that seeks to recognise the value placed on experts for policy problems in technical fields including net zero (Cooper et al., 2021, p. 501). It goes beyond research-focused knowledge and incorporates a more pragmatic, interdisciplinary, “real (physical) world orientation”, resulting in a “more ‘potent’ … form of expertise for policy” (2021, p. 501; see also Mackenzie et al., 2006, p. 223).

Closely tied to engineering expertise is the perspective of ‘whole systems thinking’, as applied to technical policy problems (Munro and Cairney, 2020, p. 1; Bale et al., 2015, p. 157). For net zero, this is considered essential for providing evidence to policymakers that sufficiently recognises the “interconnected and interdependent nature of energy network infrastructure” (Taylor et al., 2022, p. 2). In particular, conveying an understanding of the need to balance local power networks in light of increasingly variable renewable energy generation (2022, p. 2).

2.4.5.2 Local knowledge

Local knowledge is the “mundane, yet expert understanding of and practical reasoning about local conditions derived from lived experience” (Yanow, 2004, S10–S11). Like technical expertise, it has proved difficult to document (Freeman and Sturdy, 2015), but various methods for elucidating local stakeholder (Boaz and Nutley, 2019, p. 256) and citizen opinions (Strassheim and Kettunen, 2014, p. 262) have been developed, built on the assumption that evidence of this kind can improve policy design (Righettini, 2021, p. 1; Cheetham et al., 2022, p. 3).

Evidence that captures local knowledge is seen as especially valuable when complementing statistical evidence of the sort generally advocated for by ‘what works’ proponents (Fitzgerald and Cairney, 2022, p. 14). However, there is little consensus on the best ways of synthesising such diverse evidence types (Hill O’Connor et al., 2023, p. 284). Perspectives differ on the appropriate timing of such engagement. It is often observed that consultation tends to occur after most policy development has been completed (Hill O’Connor et al., 2023, p. 279; Head, 2014, p. 673), although critical scholars have made the case for earlier inclusion of local knowledge so that policy decisions can be ‘co-produced’ (Shaxson et al., 2024, p. 13; McGookin et al., 2024, p. 2).

Having explored these broad conceptual issues on the nature of evidence, I now turn to evidence in the form of models, seeking to understand their position within the theoretical framework of evidence-based policy.

2.4.6 Models as evidence

The type of mathematical model to which I refer is captured in the following definition by Hawker and Bell:

> A specific model comprises a mathematical framework—a set of equations, perhaps only algebraic, but perhaps also differential or stochastic—designed for a particular analytical purpose, and the parameterization of that set of equations representing—to some degree of accuracy—a specific real-world case. (2020, p. 3)

With this definition I exclude qualitative models, such as conceptual models described within soft systems methodology (Checkland and Poulter, 2020). While models can be defined more broadly as ‘representations’ of (usually) real-world systems (Bale et al., 2015, p. 154), here I only consider those that sufficiently simplify a system to permit as a set of equations describing the relationships between variables (Uusitalo et al., 2015, p. 24).

I make this restriction because quantitative modelling is very commonly identified as a valuable type of evidence for policy (Van Daalen et al., 2002; Kolkman et al., 2016; Saltelli et al., 2020, p. 484). In the heyday of the evidence-based policy movement the UK Government published the report *Adding It Up: Improving Analysis and Modelling in Central Government* (Cabinet Office, 2000), which advocated for greater use of modelling in policymaking. Models have since become a staple type of evidence in government (Kolkman et al., 2016, p. 490), not least for net zero policy. Environmental,

engineering and economic modelling traditions have been brought together to provide quantitative assessments of possible routes to decarbonisation, describing the potential costs and impacts (Hofbauer et al., 2022; Jebaraj and Iniyan, 2006; Li and McDowall, 2017, p. 2; McDowall and Britchfield, 2020; McGookin et al., 2024).

A modelling technique that is “highly influential, even fashionable” for policy evidence is the development of scenarios (Smith and Stewart, 2015, p. 425), defined as “plausible descriptions of how the future may develop, based on a coherent and internally consistent set of assumptions” (Guivarch et al., 2017, p. 201). Again, I restrict the definition to quantitative scenarios constructed from quantitative models, although qualitative ‘narrative’ scenarios – sometimes distinguished as ‘futures’ – have also been used as a decision-making tool since the 1960s (Kwakkel and Haasnoot, 2019, p. 3; Houet et al., 2016, p. 1).

More recently, the COVID-19 pandemic shone a light on the use of models for policy as projected case numbers and reproduction rates became common features of press conferences (Saltelli et al., 2020, p. 483; Pearce, 2020). Models have at different times been conceptualised as ‘policy tools’ (Nilsson et al., 2008; Smith and Stewart, 2015, pp. 426–427) and ‘boundary objects’ (Star and Griesemer, 1989; Li and McDowall, 2017, p. 14; Taylor et al., 2014), both of which can be considered to function as evidence. Ultimately, model evidence provides a way for non-technical policymakers to gain understanding of technical systems (Wilson et al., 2017, p. 2).

I now consider how modelling used in net zero policy fits in with the conceptual framework set out earlier in this section.

2.4.6.1 Research vs. non-research

Although much modelling is carried out by scientific researchers, the majority of this work does not reach policymakers, with only a limited number of core models featuring across multiple policy applications in the UK (most notably, MARKAL) (Hall and Buckley, 2016, p. 610; Taylor et al., 2014). Analysis using these models for policy is often run by civil servants, with a blurring of boundaries between evidence 'producers' and 'users' leading to less systematic approaches (McDowall et al., 2014, p. 71). Such analytical capacity does not generally exist in local government (Britton et al., 2023, p. 14; Hofbauer et al., 2022, p. 1) (see Section 2.5.3).

2.4.6.2 Quantitative vs. qualitative

As I have only considered quantitative models, most of the value of this evidence derives from "[p]roviding clear, quantifiable answers to policy questions" (Smith and Stewart, 2015, p. 429) – described as "gold dust for policy makers" (Smith and Stewart, 2015, p. 425; see also McDowall et al., 2014, pp. 65, 66; Fais et al., 2016, p. 154). Critics have raised concerns about "[o]verreliance on model-generated crisp numbers" (Saltelli and Funtowicz, 2014, p. 81) which convey a false certainty (Pilkey-Jarvis and Pilkey, 2008, p. 470; Dent et al., 2019, p. 8), instead suggesting that quantitative modelling is best used for creating "insights, not numbers" (McDowall et al., 2014, p. 65).

2.4.6.3 Generalised vs. contextualised

Typically, energy models are classified as 'top-down' or 'bottom-up' (Hourcade et al., 2006). Top-down models use macroeconomic perspectives to aggregate sectors over broad boundaries, while bottom-up models have a more granular focus on individual technologies (Li and McDowall, 2017, p. 2). Top-down models are generally quicker

and cheaper to run due to the simplification that comes with aggregating technologies, but lose out on local contextualisation (Britton et al., 2023, p. 5).

For subnational applications the choice of spatial boundaries and granularity are often key concerns (Dent et al., 2019, p. 7; Wilson et al., 2017, p. 9), although lack of sufficiently granular data is often a barrier for local modelling (Britton et al., 2023). Instead, modellers resort to using 'average-types' (Wilson et al., 2017, p. 9; Bale et al., 2015, p. 154; Cooper, 2017, p. 84), or less granular data that has been artificially disaggregated with techniques such as population-based proportioning "which fails to account for regional deviations" (McGookin et al., 2021, p. 2; Pearce, 2014, p. 196).

2.4.6.4 Expertise and local knowledge

Modelling that takes into account multiple disciplinary perspectives (McGookin et al., 2024, p. 5). is seen as valuable for capturing engineering expertise (Britton et al., 2023, p. 14). However, current models used for identifying decarbonisation pathways tend to be "spatio-temporally generic" (Cooper, 2017, p. 84), meaning that energy systems impacts of peak demands are ignored (Hawker and Bell, 2020, p. 9; Chaudry et al., 2022, p. 14).

Local knowledge is usually not captured within a model itself, although participatory modelling methods are increasingly seen as a route to incorporating the opinions of stakeholders (Bale, 2018; Enserink et al., 2013, p. 10; McGookin et al., 2024).

2.5 How does evidence influence the policy process?

Having examined the concepts of the evidence-based policy literature that elucidate what counts as evidence, I now turn to the conceptual frameworks that aid understanding of the ways in which such evidence can influence policy.

Scholars have previously identified a lack of understanding of the many ways in which evidence informs policy processes (Nutley and Webb, 2000, p. 29). Indeed, the language used by different schools of thought comes with connotations which imply certain mechanisms; evidence ‘use’, or ‘basing’ decisions on evidence suggest more instrumental application, whereas ‘informing’ or ‘influencing’ convey a “softer, even nebulous” process (Boaz and Nutley, 2019, p. 252).

Section 2.3.2 on the policy cycle indicated the different stages at which evidence may be used throughout a policy process (Nutley et al., 2007). However, it is widely recognised that the stages only partially explain the ways in which evidence can be used; the same evidence can be used in multiple ways at different times that do not neatly fit within the cycle stages (Boaz and Nutley, 2019, p. 253; Cairney, 2019, p. 28, 2017, p. 2; Klein, 2003, p. 429). Indeed, some scholars have suggested “in a complex policy-making system, it makes little sense to pinpoint discrete examples” of evidence use (Cairney et al., 2016, p. 3), and such isolation may be methodologically challenging (Jørgensen, 2023, pp. 206–207). In light of this, I focus in this section on conceptual frameworks that address two key issues: the ways in which evidence enters the policy process (Best and Holmes, 2010), and the ways in which evidence is utilised once it has entered the process (Shaxson et al., 2024, p. 3).

2.5.1 How does evidence enter the policy process?

Three archetypes of evidence routes into the policy process are commonly used (Boaz and Nutley, 2019), drawing on Best and Holmes’s “three generations of thinking” in the field of ‘knowledge-to-action thinking’. These are linear, relationship (or relational), and systems models (Best and Holmes, 2010, p. 146).

The linear model is the most common identified by early positivist evidence-based policy scholarship. It is still regularly assumed by authors in natural sciences journals that make recommendations for policymakers (for example Singhal et al., 2022). Evidence is conceptualised as a ‘product’ (Best and Holmes, 2010, p. 147; Durrant et al., 2023, p. 2) which needs to be ‘transferred’ from evidence producers (usually restricted to scientific researchers) to policymakers (Boaz and Nutley, 2019, p. 258). The ‘two communities’ of researchers and policymakers (Caplan, 1979) are perceived as entirely independent, drawing on the notion of a ‘science-policy gap’ (Smith, 2013b, p. 4)). Advice for evidence producers tends to focus on increasing the supply of evidence provided to policymakers as the primary means of increasing evidence use (see Cvitanovic et al., 2015).

Limitations of the linear model are well-reported in critical scholarship (Young et al., 2002; Boaz et al., 2008; MacKillop et al., 2020; Smith, 2013b, p. 20). They tend to focus on the overly-simplistic one-way flow of evidence. In contrast, the relational model seeks to address some of the linear model’s shortcomings. Evidence is ‘exchanged’ rather than ‘transferred’ (Boaz and Nutley, 2019, p. 259), and though it is still between two distinct communities of evidence producers and users, it recognises a two-way dialogue. This dialogue enables policymakers to articulate their evidence needs and shape evidence to be relevant to local contexts (Best and Holmes, 2010, p. 147). Instead of simply increasing the supply of evidence, greater evidence use is seen to occur when the gap between the two communities is ‘bridged’ through the use of boundary objects that have sufficient interpretive flexibility to meet the needs of policymakers while maintaining scientific standards of rigour (Cash et al., 2006, p. 468)). ‘Knowledge brokers’ occupy the space between research and policy, acting as

intermediaries (Weiss, 1991, p. 312) to improve communication and trust between the groups (Smith, 2013b, p. 20; Wehrens et al., 2011).

Although non-research sources of evidence are recognised within the relational model (Best and Holmes, 2010, p. 147), the enduring appeal of the 'two communities' framing appears to have been instrumental in maintaining the privileged position of scientific evidence over other sources (Smith, 2013b, p. 20).

In the systems model, the science-policy 'gap' is no longer recognised as a useful concept (Newman and Head, 2015, pp. 385–386), with evidence from a wide range of sources instead being 'mobilised' (Boaz and Nutley, 2019, p. 260) or 'diffused' (Best and Holmes, 2010, p. 148) in non-linear, iterative ways. This occurs within an "evidence ecosystem" (Boaz and Nutley, 2019, p. 251) that encapsulates all policy and evidence stakeholders. Evidence producers and users engage in a two-way negotiated process of 'learning' and co-production (Oliver et al., 2014b, p. 5; Cheetham et al., 2022, p. 12) to foster shared understandings of evidence situated within a complex, political policy process. Although the systems model addresses a number of descriptive concerns expressed by critics of 'two communities' models, it has proven challenging to operationalise as a prescriptive model for policymakers to implement (Boaz and Nutley, 2019, p. 261). Parkhurst's similar articulation of 'good governance of evidence' may have more promise in this regard, since it is explicitly constructed from a 'critical but pragmatic' perspective (Hawkins and Parkhurst, 2016; Parkhurst, 2017).

2.5.2 Knowledge utilisation – models of using evidence

Once evidence has 'entered' the policy process, models of 'knowledge utilisation' (Weiss, 1979) have been used to explain the diversity of functions evidence can have.

Carol Weiss's typology for the utilisation of social science research (1979) is one of the most widely used (Capano and Malandrino, 2022; Parkhurst, 2017; Smith, 2007). Weiss distinguishes between direct and indirect uses across six 'models' of utilisation. These six include two direct and four indirect models.

The two direct models – 'knowledge-driven' and 'problem-solving' – are the most straightforward, instrumental and rational. In the knowledge-driven model, pre-existing research directly influences policymaker decisions. As Weiss puts it, "the sheer fact that knowledge exists presses it toward … use" (1979, p. 427). Weiss remarks that this model is rare in social sciences, but can be observed in natural sciences, particularly when new medical treatments are developed.

The problem-solving model is similar, in that research has a direct influences on decisions, but the research only occurs at the request of policymakers. These direct models align well with the linear and relational models of feeding evidence into policy respectively. They also resonate with the view of 'evidence as data' as set out in a separate typology developed by Weiss that distinguishes between evidence interpretations (Pearce, 2014; Weiss, 1991). Despite the fact that few policy decisions can be made using direct models (Weiss, 1998), the normative view of "technocratic … [o]fficials [who] are zealous to do a competent job" (Weiss, 1991, p. 316) has led to a bias in how much policymakers report direct use of evidence themselves, tending to overemphasise their own rationality compared to their colleagues (Hertin et al., 2009, p. 1198).

The four indirect models are much more prevalent, and fit more naturally with the description of the systems models for inputting evidence to the policy process. The interactive model refers to the consideration of research as "only one part of a

complicated process that also uses experience, political insight, pressure, social technologies, and judgment" (Weiss, 1979, p. 429). It is characterised by a good deal of "back-and-forthness" (p. 428). This resonates with the interpretation of 'evidence as ideas' (Weiss, 1991, p. 311), where the "emphasis is on the gist of the story" (p. 313) and "[s]pecifics of research methodology are lost" (p.311) due to their irrelevance. A good example of quantitative evidence being used for this interactive purpose is David MacKay's seminal book *Sustainable Energy: Without the Hot Air* (MacKay, 2009). MacKay explains that "the calculations … [in the book] are deliberately imprecise[;] … rounded numbers allow quick calculations … accurate enough to inform interesting conversations" (2009, p. 29).

The political model applies to contexts where "decision-makers are not likely to be receptive to new evidence… [f]or reasons of interest, ideology, or intellect" (Weiss, 1979, p. 429). Here, research is used as "ammunition for the side that finds its conclusions congenial and supportive" (p. 429). Weiss still considers this to be a perfectly legitimate use of evidence, since no manipulation of empirical findings has occurred (see also Hertin et al., 2009, p. 1188). Crucially, quantitative evidence can be used indirectly just as it can directly. Weiss gives an example that the same economic data "have turned up … [in support of] both sides of an issue" (Weiss, 1991, p. 310).

The tactical model sidelines the content of evidence. Instead, "the sheer fact that research is being done" becomes the key influence on decision makers (Weiss, 1979, p. 429). Even if evidence is not regarded as useful for problem-solving, it can still mark a priority, as occurred in English local authorities using National Indicators of carbon emissions to recognise the importance of climate change (Pearce, 2014, p. 195). The tactical model can also be used to "delay or deflect unwanted courses of action" (Cairney, 2019, p. 29), by simply pointing to ongoing evidence production. The tactical

model has been referred to as the ‘symbolic’ use of evidence, (Boswell, 2009), ‘evidence as arguments’ (Weiss, 1991, p. 314), or ‘evidence-informed advocacy’ (Smith and Stewart, 2015, p. 432). This suggests that evidence has been combined with an advocacy position to influence policymaker decisions.

Finally, Weiss suggests that the enlightenment model is the most common way for evidence to enter the policy process (Weiss, 1979, p. 429). In this model, the underlying “concepts and theoretical perspectives … [of evidence] permeate the policy-making process” (p. 429). Once again, this aligns with the interpretation of ‘evidence as ideas’ (Weiss, 1991, p. 316). An example is given by Wesselink and Gouldson, who showed that ‘mini-Stern reviews’, carried out for UK councils to calculate the potential value of low carbon investment (Wesselink and Gouldson, 2014), did not tend to be used instrumentally as a basis for investment plans. Instead, they “helped to make the general case for investment in low carbon” (Wesselink and Gouldson, 2014, p. 417). While the importance of the enlightenment model is recognised in problem framing (Weiss, 1991, p. 313), and can potentially have significant “longer-term influence” (Sanderson, 2003, p. 333). However, the slow process of percolation “can be extremely difficult to trace” (Weiss, 1999, p. 472), even for the individuals using the evidence themselves (Weiss and Bucuvalas, 1980, p. 33). The difficulty of observing enlightenment use of evidence may be the reason for a general dearth in research on local evidence use (Durrant et al., 2023, p. 3); Durrant et al. (2023, p. 19) suggest that the “inherently messier” nature of knowledge mobilisation at the local level may be making it “trickier to capture”.

2.5.3 Policymaking capacity

A key variable that can determine both how evidence enters the policy process and how evidence is used is policymaker capacity (Capano and Malandrino, 2022, p. 424; Howlett et al., 2020, p. 186). This is defined as “the ability to marshal the necessary resources to make intelligent collective choices” (Painter and Pierre, 2005, p. 2), including government and non-government stakeholders across a governance structure (Howlett et al., 2020, p. 14). Once again, there is a diverse range of conceptualisations of capacity across policy studies (Wu et al., 2015, p. 165). Capacity is often treated as an end rather than a means of policymaking, neglecting to consider exactly what capacity is for (Newman et al., 2017, p. 160). Moore’s (1995) framework of policy capacity as comprising ‘analytical’, ‘political’ and ‘operational’ competences remains a popular choice for scholars (Wu et al., 2015, p. 166; Howlett et al., 2020, p. 14) although many others exist, most notably Fleming and Rhodes’s description of ‘craft’ (Fleming and Rhodes, 2018).

Wu et al. (2015, p. 169) define analytical capacity as “the ability to access and apply technical and scientific knowledge and analytical techniques”. This conveys an underlying philosophy observed in the early evidence-based policy literature by prioritising ‘technical and scientific knowledge’. An alternative definition more appropriate for a critical perspective might instead refer more generically to accessing and applying ‘evidence’ and analytical techniques. Analytical capacity clearly affects the extent to which evidence can be obtained and utilised – “governments require a high level of policy analytical capacity in order to effectively … pursue evidence-based policy-making” (Howlett et al., 2020, p. 186).

Political capacity refers to “the know-how, analysis and judgement of political actors” (Head, 2008, p. 5). In accepting the critical framing of evidence-informed policymaking, policy is assumed to be a political process. Therefore, political capacity is necessary for the successful use of evidence. This may include: understanding how best to articulate evidence as an argument, or using evidence with political or tactical models, in order to expedite decision-making (Weiss, 1991, pp. 314–315); using evidence to frame policy problems in agenda setting (Head, 2008, p. 5); or being aware of the “‘relevant organisations’ and ‘big players’ in any particular policy area” (Maybin, 2016).

Operational capacity refers to the ability of policymakers to successfully manage and implement their policies (Wu et al., 2015, p. 169). Although this appears at first to be of less relevance to the use of evidence than the other capacities, there are two main impacts. First, operational capacity tends to contribute to “[i]nstitutional memory … [comprised of] a combination of tacit and explicit information and knowledge” (Fleming and Rhodes, 2018, p. 8). Second, a lack of operational capacity can make monitoring and evaluation challenging – reducing the amount of evidence available for future policy development (Cheetham et al., 2022, p. 7; Wilson et al., 2017, p. 10).

How these three capacities overlap in individuals and in institutions is also an important consideration. While some policy functions may be carried out in silos by actors with one specific capacity (Head, 2016, p. 475), several overlapping capacities are required for ‘good’ use of evidence (Gleeson et al., 2023, p. 13). The literature suggests there is significant benefit to having individuals with a good degree of all three policy capacities, although such overlaps tend to be rare (Head, 2010, p. 85; Waring et al., 2021). Such people are referred to as ‘evidence champions’, ‘boundary spanners’ or ‘knowledge brokers’ (Cheetham et al., 2022, p. 8; Cairney and Smith, 2021, p. 5).

Capacity of all three kinds is often found to be a limiting factor at the local level, particularly for net zero policy (Webb et al., 2017; Britton et al., 2023, p. 12; Gudde et al., 2021, p. 10). In the UK, this has been attributed to overcentralisation and the lack of distributed capacity across the multilevel governance structure. If a particular capacity is high at the national level, it is likely to be low at the local level, as is the case for operational and analytical capacity for energy policy (Busch et al., 2017, p. 170; McDowall and Britchfield, 2020)

One way in which governments have sought to address this issue is by commissioning commercial consultancies to provide additional capacity for using evidence (Weiss, 1986). This usually focuses on analytical capacity (Saunders and Walter, 2005; Head, 2016, p. 478). However, concerns have been raised about the separation of analytical from political and operational capacities (Cheetham et al., 2022, p. 11; Mazzucato and Collington, 2023; Pearce, 2014, p. 196). The concept of ‘embeddedness’ has been used to show how minimum levels of all three policy capacities within any policymaking body increases the potential for evidence to be used with a more holistic understanding (Norton et al., 2021; McDowall and Britchfield, 2020, p. 22; Shaxson et al., 2024, p. 9; Howlett et al., 2020, p. 186).

2.5.4 The uses of models as evidence

Mirroring Section 2.4.6, I now apply the conceptual frameworks of evidence use specifically to quantitative models. These models contribute to policy evidence in a number of ways (Kolkman et al., 2016, p. 491; Van Daalen et al., 2002; Wilson et al., 2017, p. 5). Examples can be found for five of Weiss’s six utilisation models, as shown in the table below.

Utilisation model	Example
Problem-solving	“In the case of modelling … policy makers are attracted by the ability of this kind of evidence tool to provide very specific answers to policy questions” (Smith and Stewart, 2015, p. 429)
Interactive	“much of the analysts’ work was “stress-testing” policy makers’ evidence and assumptions” (McDowall and Britchfield, 2020, p. 62)
Political	“Use 2 [of long-range energy forecasts] : As Aids in Selling Ideas or Achieving Political Ends” (Craig et al., 2002)
Tactical	“conducting analysis as a way of avoiding taking action” (McDowall et al., 2014, p. 16)
Enlightenment	“models … can define the terms in which questions are posed and answers given.” (Taylor et al., 2014, p. 34); “Mathematical models are a great way to explore questions” (Saltelli et al., 2020, p. 485)

Table 1: Examples of models used as evidence in five of Weiss’s (1979) six utilisation models.

I have found no references to quantitative models being used in a so-called ‘knowledge-driven’ model. This is likely due to quantitative model development requiring prior articulation of policymakers needs (Wilson et al., 2017, p. 2).

The model development process is relevant to the ways in which model outputs are eventually used (Kolkman et al., 2016, p. 492; McIntosh et al., 2011). Where there is sufficient embedded analytical capacity, there is much greater scope for interactive and enlightenment models (McDowall and Britchfield, 2020, p. 62; Shaxson et al., 2024, p. 11; Wilson et al., 2017, p. 2). This is especially true of participatory methods to co-produce models (McGookin et al., 2024, p. 9).

By involving wider stakeholders in model development, political capacity becomes equally important as analytical capacity for steering the process in a constructive direction (Neely et al., 2021, p. 169; Bale, 2018, p. 3). In such approaches where non-technical stakeholders are involved, visualisation techniques including graphs, charts, or maps that use GIS data, are often seen to be an effective way to enhance interactive and enlightenment functions of quantitative models (Dent et al., 2019, p. 8; Smith and Joyce, 2012, p. 68; Trutnevyte et al., 2016a, p. 375; Wilson et al., 2017, p. 9).

When embedded analytical capacity is insufficient, modelling evidence enters the policy process in more linear or relational ways. Models are accepted based on the reputation of the developer (Kolkman et al., 2016, p. 499), and for problem-solving, political or tactical uses, simpler models are generally preferred (Vonk and Geertman, 2008).

Within the context of national UK energy policy, McDowall et al. (2014) found that 'two communities' perspective of obtaining evidence did not apply. Modelling evidence entered the policy process within a broad evidence ecosystem, "blurring … the distinction between those 'producing' and those 'consuming' the model outputs and scenarios" (McDowall et al., 2014, p. 71). This was seen to be enabled by embedding modellers with analytical capacity in government policy teams (McDowall et al., 2014, p. 71; McDowall and Britchfield, 2020, p. 21). As a result of the combined and interacting capacities within these teams, the way in which policymakers used modelling evidence became more interactive. Conversations became more "sophisticated" and more "intelligent questions" could be asked of modellers (McDowall et al., 2014, pp. 72–73). However, even national-level bodies, such as the Climate Change Committee, are known to draw on consultancy for additional capacity (McDowall and Britchfield, 2020, p. 66). There is also a clear need for analytical

capacity drawing on a wider set of disciplinary perspectives (Dent et al., 2020, p. 11). In contrast, analytical capacity at the regional and local levels is much more limited (Britton et al., 2023, p. 14; Hofbauer et al., 2022).

Regarding the use of model scenarios, Börjeson et al.'s (2006) widely used typology of 'predictive', 'explorative' and 'normative' scenarios indicates the range of use cases for outputs of different quantitative modelling techniques. Scenarios are 'predictive' where they are forecasting [w]hat will happen?" under certain assumptions (2006, p. 725); 'explorative' where they scrutinise a wide range of possibilities of "[w]hat can happen?" (p. 725); or 'normative' where they indicate "How can a specific target be reached?" (p. 725). Normative scenarios, for example, are tailored use in a direct, problem-solving way. Explorative scenarios are better suited to enlightenment use. Although scenarios are seen to be "highly appealing" (Smith and Stewart, 2015, p. 425), there is a risk that a lack of understanding of modelling processes leads to "inappropriate" interpretations of scenario types (Bale et al., 2015, p. 157). For instance, explorative scenarios may be interpreted as predictive or normative.

2.6 Why is evidence used in the policy process?

Having explored literature on what counts as evidence and how it is used in policymaking, I now turn to the final fundamental question. Why is evidence used for policy?

A common criticism of evidence-based policy is that it is so often considered "self-explanatory" (Marston and Watts, 2003, p. 144) or "so uncontroversial as to be almost impossible to oppose" (Pearce et al., 2014, p. 161). As Hammersley neatly summarises, "[w]ho would want policy or practice *not* to be based on evidence?" (Hammersley, 2005, p. 86). However, these arguments tend to conflate ends and

means (Parkhurst, 2017, p. 35). Evidence-based policy research often begins with the assumption that increased use of evidence leads to better policy outcomes (Davies et al., 2019, p. 370), but provides no justification (Innvær, 2009; Oliver et al., 2014b; Vonk and Geertman, 2008). Several scholars have pointed out the irony that there is in fact little evidence to support these claims of evidence-based policy's success (Fitzgerald and Cairney, 2022, p. 18; French, 2019, p. 153; Davies et al., 2000, p. 352; Smith and Stewart, 2015, p. 416).

Increasingly, critical scholars have questioned what it means for evidence to be used well (Tseng, 2022; Gleeson et al., 2023; Rickinson et al., 2021), or indeed 'misused' (Parkhurst, 2017, p. 20). They acknowledge that such issues are "decidedly normative" (Parkhurst, 2017, p. 43; see also Marceta, 2021). While several sets of criteria for good evidence use have been proposed (Fraser and Davies, 2019, p. 199; Parkhurst, 2017; Hawker and Bell, 2020, p. 3; Nutley et al., 2013), here I focus on the commonly used framework by Cash et al. of 'salience', 'credibility', and 'legitimacy' (2002, 2003). As Parkhurst explains, credibility and salience combine to "broadly capture the EBP [Evidence Based Policy] movement's normative principles of fidelity to science and usefulness in order to achieve social goals" (Parkhurst, 2017, p. 125). Legitimacy, on the other hand, captures why using evidence "is recognised to be the right *way* to make a decision" (McDowall et al., 2014, pp. 16–17 emphasis added).

2.6.1 Salience, credibility and legitimacy

2.6.1.1 Salience

Salience of evidence refers to "relevance … to the needs of decision makers" (Cash et al., 2003, p. 8086). As Cash et al. (2002, p. 4) articulate, "[i]nformation that is timely and informs decision makers about problems that are on their agendas have high

salience". For net zero, quantitative evidence has high salience for two reasons. First, the "fundamental limits" of the physical laws that govern global warming are perceived to be best understood using numbers (MacKay, 2009, p. 30). Second, quantification aids comparison of proposed solutions. Since decision-making is the choice of one option over another, it is salient for policymakers "to know how the one "huge" [impact] compares with another … [with] numbers, not adjectives" (2009, p. 16).

On the other hand, only certain "evidence constructions" are appropriate for addressing policymakers' concerns (Parkhurst, 2017, p. 130). Quantitative models are seen as most salient to policymakers when they 'tell a story' (McDowall et al., 2014, pp. 66–67) that "give[s] them meaning" (Stone, 2015, p. 157). As a result, the presentation of model outputs as a set of scenarios is seen as a particularly salient construction, since each scenario conveys its own narrative (McDowall et al., 2014, p. 15).

Salience is also closely linked to contextual scale. The key question is 'what works *here*', rather than generically 'what works' (Cartwright, 2011, p. 1401; Parkhurst, 2017, p. 131). As such, evidence that is produced at the local scale is generally more salient for local policy than national-scale evidence. This is especially the case where local places have characteristics that differ from national averages (Hofbauer et al., 2022, p. 7).

2.6.1.2 Credibility

Evidence credibility refers to its "scientific adequacy" (Cash et al., 2003, p. 8086), or the extent to which it is "authoritative, believable, and trusted information" (Cash et al., 2002, p. 2). Within a traditional view of evidence-based policy, referring exclusively to scientific evidence, methodological hierarchies or alternative grading frameworks

discussed in Section 2.4.2 are a key determinant of credibility (Nutley et al., 2019). However, even when restricting evidence to scientific research (Warren, 2020, p. 92), the emphasis placed on interdisciplinary perspectives within evidence for many policy areas makes it challenging to rely exclusively on such hierarchies.

Regardless, some of the biases of hierarchies remain. Modelling evidence is generally considered to be credible because of its basis in quantification, which conveys an internal consistency (McDowall et al., 2014, p. 67; Smith and Stewart, 2015, p. 427). However, many critical scholars point out that simply using a mathematical framework does not guarantee that models reflect the “dynamics of the real world” (McDowall et al., 2014, p. 15). Indeed, the use of “fudge factors” (Pilkey-Jarvis and Pilkey, 2008, p. 474) to skew models towards a desired output calls into question the blanket assumption that quantitative evidence is credible.

Instead, “credibility is often assessed ‘by proxy’” (Cash et al., 2002, pp. 4–5), often relying heavily on the reputation of individuals or organisations seen to embody expertise (Easton et al., 2022, p. 311). Reputational credibility accumulates in ‘cycles of credit’ (Bartley, 1988). As Smith explains, “scientists are not distinguishable from their ideas, so it is the credibility of a scientist’s ideas which improves their credibility as a scientist” (2007, p. 1445). As such, improved reputation leads to a higher likelihood to be funded to do further research to generate ideas, and the cycle repeats (2007, p. 1445). This often leads to evidence automatically being labelled credible if it comes from trusted organisations “with a history of getting the “right” answer” (Cash et al., 2002, pp. 4–5). This faith in institutions such as the Climate Change Committee (Wesselink and Gouldson, 2014, p. 415) or universities (Nutley et al., 2019, p. 231) can lead to broad claims of policy being ‘guided by the science’ based on engagement with only a small group of trusted experts (Cairney and Wellstead, 2021).

Despite the significant emphasis placed on credibility in early evidence-based policy scholarship, it is now acknowledged that credibility is no more important than salience or legitimacy (Cash et al., 2002, p. 2). Indeed, salience may be more important (Smith and Stewart, 2015, p. 426), evidenced by the fact that executive summaries used by policymakers tend to gloss over the underlying details of evidence (Weiss, 1991, p. 310).

2.6.1.3 Legitimacy

Whereas salience and credibility are often associated with evidence itself, legitimacy has been linked more closely to evidence usage (Parkhurst, 2017, p. 125). Legitimacy is defined as "how 'fair' an information producing process is and whether it considers appropriate values, concerns, and perspectives of different actors" (Cash et al., 2002, p. 2).

Some scholars have argued that the use of quantitative evidence can increase legitimacy, due to the "aura of impartiality" it conveys (Schlaufer, 2016, p. 550; see also Stone, 2015, p. 167; Smith and Stewart, 2015, p. 433). However, it is generally the transparency of the process used to produce the evidence that determines its use as legitimate. In particular, the nature and extent of stakeholder consultation are significant influences on legitimacy (Head, 2016, p. 472).

For modelling evidence, engagement with stakeholders "both before and during the analytical process" (Dent et al., 2020, p. 11) is seen as the ideal way to ensure an appropriate balance of perspectives (Kolkman et al., 2016, p. 499). In practice, this can be a challenge when analytical work has to be specified at an early stage (McGookin et al., 2024, p. 9). This is common when using consultancy services, scopes or invitations to tender need to be produced before work can begin.

Similarly, the transparency of modelling methods and the extent to which stakeholders can trace the impact of their own inputs can determine legitimacy (Hofbauer et al., 2022, p. 7; Pearce, 2014, pp. 196–197). Closed source and commercially confidential models known as ‘black boxes’ can undermine trust in the evidence (Saltelli and Funtowicz, 2014, p. 80; McDowall and Britchfield, 2020, pp. 66–67; Smith and Stewart, 2015, p. 431; Strassheim and Kettunen, 2014, p. 260; Hall and Buckley, 2016, p. 625). However, as with credibility, institutional reputation for objectivity and neutrality often act as shorthand for legitimacy (Schlaufer, 2016, p. 550; Mossman, 2009). Somewhat counterintuitively, then, it can be the lack of method transparency that enhances expert status. Some argue that if it were possible to be transparent, then there would be no need for experts (Smith and Stewart, 2015, p. 431). Thus, the “mistique [sic]” of black box modelling can also increase perceived legitimacy (2015, p. 430).

Cash et al. (2002) identify a wide range of mechanisms by which salience, credibility and legitimacy are interlinked and interact. In identifying how the perception of each varies with different audiences (p. 4), they suggest that a trade-off between salience, credibility and legitimacy is usually necessary for good use of evidence (p. 7). As a way to explore these concepts, I will now consider how evidence use is justified through the lens of uncertainty.

2.6.2 Evidence used to address uncertainty

A particularly common justification for using evidence in policymaking is the reduction or examination of uncertainty (Cairney et al., 2016; Ylöstalo, 2020, p. 265; Boswell, 2022a, p. 45). This is an understandable cause, since policymaking environments are often characterised as having high levels of uncertainty (Howlett et al., 2020, p. 179; Mossman, 2009; Head, 2016, p. 477; Walker et al., 2013b, p. 398; Davies et al., 2000,

p. 360). Uncertainty is not simply a lack or absence of knowledge. New information can decrease uncertainty, or may increase uncertainty by revealing previously ‘unknown unknowns’ (Walker et al., 2003, p. 4). A more common definition of uncertainty is “inadequacy of knowledge” (Walker et al., 2013b, p. 395). Typologies of uncertainty have distinguished between two forms of uncertainty. ‘Epistemic’ uncertainty is that which can be reduced by increasing knowledge, whereas ‘aleatory’ uncertainty captures inherent variability (Walker et al., 2003, p. 9). Similarly, Knight (1921) first distinguished between ‘risk’ which is quantifiable and ‘uncertainty’ which is not. These are now more commonly referred to as ‘stochastic’ or ‘probabilistic’ uncertainty and ‘incalculable’ uncertainty respectively (Walker et al., 2013b, pp. 395–396).

Other approaches (Walker et al., 2003, 2013b) have sought to categorise levels of uncertainty, creating a scale between “complete certainty and total ignorance” (Walker et al., 2013b, p. 396). The higher levels on these scales refer to situations in which “various parties to a decision do not know or cannot agree on how the system works, how likely various possible future states of the world are, and how important the various outcomes of interest are” (Kwakkel and Haasnoot, 2019, p. 2). These are labelled ‘deep uncertainty’ (Lempert et al., 2003). Many policy problems, including net zero, are characterised by deep uncertainty (Guivarch et al., 2017, p. 202; Stanton and Roelich, 2021; Roelich and Giesekam, 2019; Few et al., 2023; cf. ‘wicked problems’ Rittel and Webber, 1973).

Under these definitions, increasing the supply of evidence can reduce epistemic uncertainty, for example by filling in gaps in data coverage (Pearce and Cooper, 2011, pp. 211–212). However, more evidence cannot reduce the intrinsic aleatory uncertainties. Instead, evidence can be used to improve understanding and

awareness of these uncertainties (Walker et al., 2003, p. 2). This is a common reason cited for using modelling evidence, since there is a wide range of analytical techniques that can be applied to quantitative models for analysing uncertainty (Pye et al., 2018, p. 333; Refsgaard et al., 2007, p. 1543; Fais et al., 2016, p. 155; Azzini et al., 2020; Saltelli et al., 2004; Marchau et al., 2019; Zachary, 2016). In practice, the vast majority of these techniques see little to no application beyond academia (Fais et al., 2016, p. 154).

One commonly found modelling technique for capturing aleatory uncertainty in net zero policy is the production of multiple scenarios (Walker et al., 2003, p. 3; Guivarch et al., 2017; Dent et al., 2019). The presentation of a range of scenarios is intended to convey an appreciation of multiple possible futures based on information about the present (Pye et al., 2017). Superficially, it appears that using such scenarios as evidence increases legitimacy and credibility of policy choices. Quantitative evidence conveys a sense of fairness and impartiality (Stone, 2015, p. 167), in addition to addressing uncertainty that is often linked to credibility (Cash et al., 2002, p. 5). However, beneath the surface, the use of modelling evidence to address uncertainty can have adverse impacts on legitimacy, credibility, and especially salience.

Legitimacy concerns tend to focus on the set of scenarios modellers choose to present (Trutnevyte et al., 2016b, p. 327). Scholars acknowledge the importance of diverse perspectives in scenario curation, in order to truly reflect the breadth of aleatory uncertainty (2016b, p. 336). However, in practice this is “steered by modeller choices and rarely discussed outside the modelling team” (McGookin et al., 2024, p. 9). The influence of other evidence and expertise is far from clear (Florin, 1999, p. 1280).

Credibility concerns often centre around the low number of scenarios presented in policy applications (Hawker and Bell, 2020, p. 6; Fais et al., 2016, p. 154; Dent et al., 2020, p. 13). This inhibits the ability to use scenarios as a "systematic means to examine their implications" (Walker et al., 2013a, p. 957). This breeds "spurious precision" arising from "ritualistic use of quantification" (Saltelli et al., 2020, p. 485), which often conveys "too great a perception of accuracy" (McDowall et al., 2014, p. 85; see also Hertin et al., 2009, p. 1195).

Regarding salience, scholars have increasingly argued for the use of models to support decision-making under uncertainty, particularly where it is not defined in optimisation terms (McDowall et al., 2014, p. 76). Such circumstances may instead require a policy to be 'robust' in order to perform well under a wide range of possible futures (Hallegatte et al., 2012; Busch et al., 2017, p. 179; Bale et al., 2015, p. 156; Walker et al., 2013a, p. 955), or 'adaptive', to meet changing contexts as uncertainties resolve (Pye et al., 2017, p. 4; Walker et al., 2013a; Dent et al., 2020, p. 7; Kwakkel and Haasnoot, 2019, p. 4; Maier et al., 2016). In practice, however, policymakers tend to be less interested in understanding the implications of uncertainty compared to reducing wherever possible (McDowall and Britchfield, 2020, p. 24). This leads to a preference for small numbers of scenarios focused on a central 'most likely' scenario (McDowall et al., 2014, p. 74) where the objective is optimisation or efficiency of outcome (Walker et al., 2013a, p. 968; Marceta, 2021, p. 531).

In summary, despite claims that using evidence is a "useful means of dealing with the problem of uncertainty", in practice this is often no more than "a kind of shifting fix" (Boswell, 2022a, p. 45). Particular uncertainties may be reduced, but many others are ignored. In the words of one of McDowall et al.'s (2014, p. 74) interviewees: "[u]ncertainty is presented, but not confronted".

2.6.3 The enduring ideal of evidence-based policymaking

Returning to the motivating question for this section, the justifications given for evidence-based policy can appear to be at odds with what is observed in practice. The interactions of salience, credibility and legitimacy in addressing uncertainty make clear the normative connotations of the 'evidence-based' label. This label is extremely valuable to policymakers, since there is no obligation to remain true to the underpinning rationalist principles (Boswell, 2022b). With this in mind, it appears most constructive to view 'evidence-based policymaking' as a rhetorical device (Davies et al., 2000, p. 9; Boaz et al., 2016, p. 7; Wesselink et al., 2014, p. 343).

Drawing on Pollitt and Hupe's articulation of 'magical concepts' in public administration (2011), Boswell explains how justification of evidence-based policy lies in the 'sacred story' (2022a, p. 49) that it offers a practical way to navigate a complex policymaking environment in three ways. First, the use of evidence "can function as an organising principle" (Marceta, 2021, p. 529) regardless of how achievable the overall ideal is. This enables problems to be seen as tractable and amenable to incremental progress (Boswell, 2022b, p. 6). Second, pragmatic policy choices can be made using policymakers' "preferred 'magic bullet' solutions" (Boswell, 2022b, p. 6) without comprehensive foresight of their impacts. In this way, "good evidence for policy … does not equate to evidence of absolute certainty" (Parkhurst, 2017, pp. 136–137): it simply has to be 'good enough' (Durose et al., 2017). And third, the ideological neutrality conveyed by 'evidence' (Marceta, 2021, p. 529) enables a consensus-based view of decision-making (Boswell, 2022a, p. 36), de-politicising contentious decisions even when all actors maintain divergent value-based perceptions of that evidence (Parkhurst, 2017; Boswell, 2022a, p. 44).

2.7 Conclusion – key factors influencing the use of evidence in policymaking

To conclude, I have found that evidence in policymaking is conceptualised in a variety of ways, and increasingly since the 1990s, driven by the increased use of evidence in medicine. I have argued that local policymaking is best understood as a multi-level process, in which actors have bounded rationality, and draw on a wide range of influences beyond evidence when making decisions in a political environment.

I have shown that interpretations of what counts as evidence for policy fall into two broad camps. Positivists transfer the concepts of evidence-based medicine to policy with little alteration, whereas critics argue the context of policymaking necessitates changes. Positivists tend to conceptualise evidence as research-based, primarily quantitative, and oriented towards generalised findings. Critics conceptualise evidence as originating from a broader range of information sources beyond science, qualitative as well as quantitative, suitably contextualised to application. Critics also include expert and citizen testimony within their definition.

I have also reviewed the different ways in which evidence use has been articulated. First, considering how evidence enters the policy process, I found that three models – linear, relational, and systems – describe an increasing integration of evidence production and use. This integration blurs the lines between evidence providers and policy users. Second, I reviewed how evidence is used within the policy process according to theories of knowledge utilisation. Direct, instrumental uses are less common in practice than indirect, enlightening processes. I have argued that policymaking capacity, along three dimensions of political, operational and analytical capacity, is a key determinant of evidence use. Capacity affects how evidence enters

policy, how it is utilised, and which types of evidence are more likely to be used under each conceptualisation of evidence use.

Finally, I have identified a range of justifications made for the use of evidence in policy decisions. Evidence is said to increase salience, credibility and legitimacy of policy decisions. However, having demonstrated that such intentions often fall short when attempting to address uncertainty, I have shown that the rhetorical value of the 'evidence-based' label serves more as a tool for 'magical thinking'. This magical thinking enables practical steps to be taken within the complex environment of policymaking. Figure 2 below illustrates the conceptual framework for evidence.

Throughout, I have placed particular emphasis on the use of models as evidence for policymaking, identifying many similar themes to other types of evidence. I have also highlighted the unique role that model scenarios play in bridging the quantitative/qualitative divide. The value of singling out modelling evidence will inform my research methodology, to which I now turn.

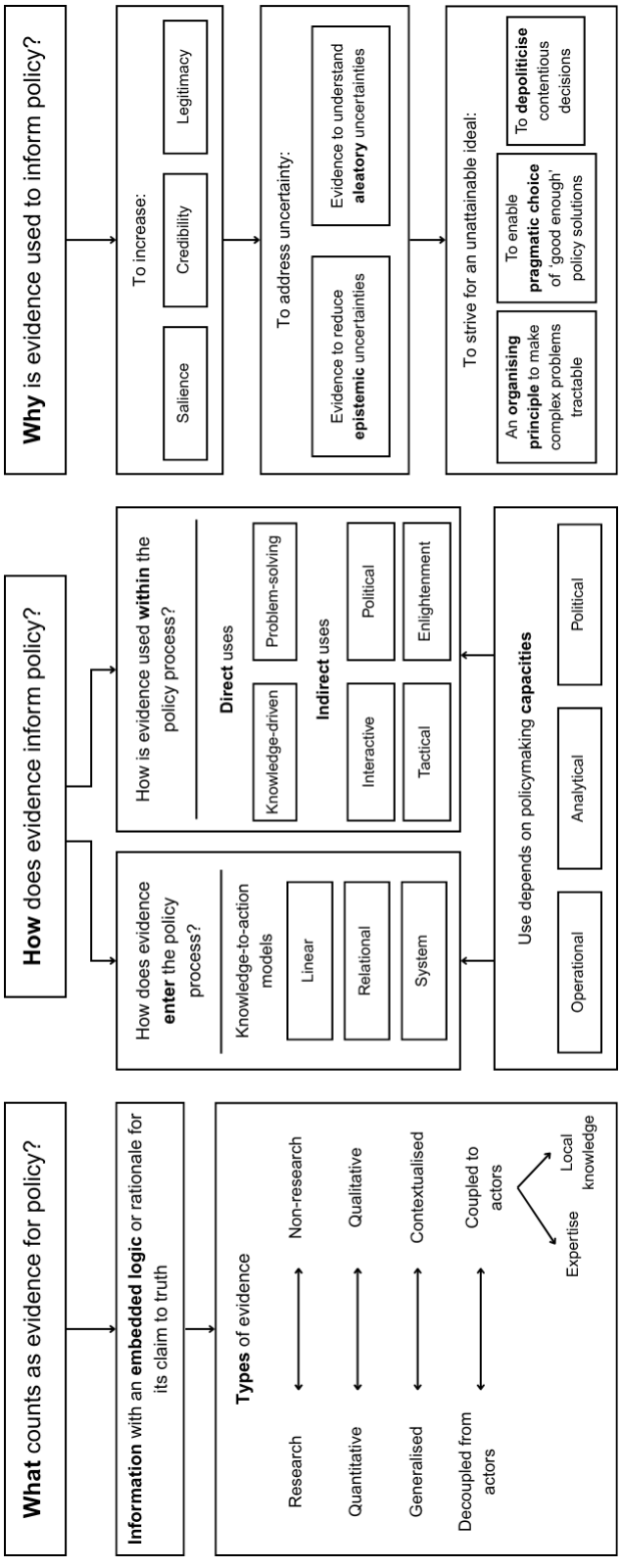

Figure 2 Diagram of the conceptual framework of evidence.

Chapter 3: Methodology

3.1 Introduction

This chapter sets out the methodological approach taken in this project[3]. I begin by briefly establishing my own philosophical position of critical realism (3.2), in line with most of the critical scholarship on evidence-informed policy. Building on this foundation, I then justify the three research questions of this study (3.3), first stated in the Introduction. Next, I argue that a case study research design is appropriate (3.4), justifying the use of a single-embedded case structure and the case selection. Section 3.5 sets out background information on the case study. I describe the West Midlands region and its governance structures (3.5.1), and in particular how regional devolution has created a new layer of governance between national and local governments (3.5.2). I then describe how energy and net zero policy have been developed within the West Midlands over the past 15 years (3.6), detailing the varying roles of local and regional governance bodies.

Then, I describe the research methods that are employed (3.7), briefly discussing alternatives that were considered and summarising the reflexive, thematic approach taken to analysing my data. Following this, I briefly discuss the validity and limitations of the approach taken (3.9).

[3] Methodology is often confused or used interchangeably with 'research methods' (Grix, 2004, p. 32): the processes by which data are collected. However, it is important to disentangle these concepts, since methodology requires a broader discussion of "the *choice* of research strategy taken" over alternative options (2004, p. 32 emphasis in original).

3.2 Research philosophy

To begin, I establish my philosophical approach to this study. Although some scholars see exploration of ontological and epistemological assumptions as “the wheel … [being] endlessly re-invented” (Clough and Nutbrown, 2002, p. 30), others argue that they must be addressed in advance of methodology to avoid confusion and acknowledge the ‘directional dependence’ of the essential foundations of research (Grix, 2004, pp. 66–67; Hay, 2002, p. 64).

It is beyond the scope of this research project to explore deeply the nuanced differences of philosophical positions. It suffices to say that this research is carried out within a post-positivist, or critical realist (Bhaskar, 2011) framework. Although there is a considerable range of meanings for the terms ‘critical realist’ and ‘post-positivist’ – many consider one a subcategory of the other, while others view them as mutually exclusive (Campbell, 1984; Ryan, 2019) – I use the term as it is often applied in studies of evidence-based policy. In this context, critical realism represents a middle ground between the early positivist accounts built on philosophical assumptions transferred from the natural sciences via evidence-based medicine, and constructivist accounts at the other end of the objectivist-subjectivist spectrum (Capano and Malandrino, 2022; Freeman, 2007). As such, I adopt what Parkhurst refers to as a ‘critical yet pragmatic approach’ (Parkhurst, 2016, p. 376). That is, a stratified realist ontology and a relativist epistemology (Saunders et al., 2019, p. 143), viewing social reality as existing independently from observation, but acknowledging the role of interpretation in distinguishing between ‘The Real’, ‘The Actual’ and ‘The Empirical’ (Bhaskar, 2013). Adopting such an approach is recognised as an important foundation for deepening understanding of the “messy realities of the public policy process” (Howlett et al., 2020,

p. 34), and has been encouraged by the peer-reviewed journal *Evidence and Policy* (Pearce et al., 2014).

3.3 Research questions

In light of this critical realist stance, I now review my research questions. To repeat, these are:

RQ1: What evidence is used in local net zero policymaking?

RQ2: How is evidence used in local net zero policymaking?

RQ3: Why is evidence used in local net zero policymaking?

These questions are structured along the lines of the three main debates within the evidence-based policy literature discussed in the previous chapter. The same structure of questions has been used previously to investigate the uses of a single piece of evidence – a so-called 'mini-Stern review' – in local climate policy (Wesselink and Gouldson, 2014, p. 411). Here, I go further by broadening the questions to cover all types of evidence, in order to understand the breadth of what policymakers mean by evidence. In particular, RQ1 seeks to improve understanding of the meaning of 'evidence' (2.4), using concepts from critical frameworks by Blum and Pattyn (2022) and MacKillop and Downe (2022) applied to the context of local net zero policy. RQ2 and RQ3 seek to address a key concern raised in the literature (Oliver et al., 2014b, p. 7; Boaz and Nutley, 2019, p. 268) that research on evidence needs to move beyond (mostly positivist) identification of barriers and facilitators of evidence towards improving understanding of the policy process and how evidence exerts influence within it.

3.4 Research design

3.4.1 Embedded case study

In order to answer the three research questions of this study, a single embedded case study design was chosen. Yin (2017) states that case studies are an effective research design for answering ‘how’ and ‘why’ research questions about contemporary events over which the researcher has little or no control. Thus, a recent example of a local net zero policy process is ideal, given the framing of RQ2 and RQ3. Although a case study is not generalisable to the same extent as randomised, experimental designs, it is still possible to apply the findings of a case study in other settings provided that the researcher does so cautiously and critically (Flyvbjerg, 2006).

Within multilevel contexts, in-depth case studies have also been identified as an effective approach to “teasing out” (Cairney et al., 2019, p. 35) the complexity of governance system dynamics. Indeed, Pearce conducted a case study of the use of evidence in East Midlands local authorities’ climate policies (Pearce, 2013), clearly demonstrating the potential for a case study design to provide in-depth findings and contextualised understanding of local net zero policy.

In order to provide full answers to the research questions, I decided that an entire policy process – that is, all stages of a policy cycle – would need to be captured by a case study. This would overcome a commonly identified weakness of evidence-based policy research that restricts the perspective to a single moment in time when formal decision-making takes place (Oliver et al., 2014b; Cairney et al., 2016, p. 2). It also enables comparison between cycle stages, rather that solely a deep-dive on agenda setting or policy formulation. However, noting the criticisms of the policy cycle articulated in the previous chapter, emphasis is placed in the research on holistically

capturing the policy process, not on creating problematic boundaries between the stages (Jann and Wegrich, 2006, p. 2).

Yin also notes that “subunits can often add significant opportunities for extensive analysis, enhancing the insights into the single-case” (2017), without losing the holistic view. As such, given the central role of quantitative models identified in Chapter 2, the development of such a model is analysed as its own sub-case.

3.4.2 Research ethics

Ethical approval for the research was granted by the University of Birmingham’s Science, Technology, Engineering and Mathematics Ethical Review Committee and adhered to throughout the research (application ERN_21-0663).

3.4.3 Case selection

I decided that a combined authority policy process would make a suitable case study. Combined authorities are a relatively novel form of English regional governance intended to foster greater partnership and collaboration among a collection of neighbouring local authorities (Ayres et al., 2018). As such, combined authority case studies provide a good perspective on the impact of multilevel governance structures, in addition to the typical local-national relations, due to more formalised intra-regional interactions. Specifically, the mid-level positioning of combined authorities within multilevel governance structures is recognised as important for net zero due to the potential for region-wide coordination (Garvey et al., 2023) and they have been increasingly used as case studies in recent years (Crowther, 2023; Copeland et al., 2022).

In 2020/2021, when this research was being designed, there were ten combined authorities in England. The West Midlands, Greater Manchester, Liverpool City

Region, Sheffield City Region and West Yorkshire Combined Authorities were made up entirely of single-tier metropolitan borough councils. North of Tyne, North East, Cambridgeshire and Peterborough, Tees Valley and West of England were combinations of metropolitan boroughs, unitary and two-tier authorities. Since then, two new combined authorities have been established (York and North Yorkshire, East Midlands) and North of Tyne Combined Authority has merged into North East Combined Authority. Combined authorities are seen as the UK Government's preferred route for English devolution (Henderson et al., 2024).

Several combined authorities were developing or had recently developed net zero policies when this study was being designed. Greater Manchester had produced a 5-Year Environment Plan (GMCA, 2019), Liverpool City Region created a Pathway to Net Zero (LCRCA, 2022), and Sheffield City Region Mayoral Combined Authority (now South Yorkshire Combined Authority) produced an Energy Strategy (SYMCA, 2022). However, the West Midlands Combined Authority's (WMCA's) Five Year Plan (WSP, 2021a) was selected as the holistic case, due to good availability of governance documents online and improved chances of finding research participants via the WMCA's connections with the University of Birmingham. Although this may appear to be a "convenience" case study selection (Koivu and Hinze, 2017), the University of Birmingham had no direct connection to the development work on the Five Year Plan, but instead enabled access to the wider regional governance network. In fact, as I describe below, sourcing participants proved to be a challenging aspect of data collection, despite the institutional connections.

The WMCA area has the largest population (ONS, 2024) and highest annual carbon emissions (BEIS, 2022) of all combined authorities. Since 2022, the WMCA is one of only two combined authorities, along with Greater Manchester, negotiating 'deeper'

devolution deals with the UK government (WMCA, 2022a). The West Midlands also had a separate Regional Energy Strategy (Energy Capital, 2018a). This was developed by the regional energy partnership, Energy Capital, supported via the WMCA's second devolution deal (HM Treasury and WMCA, 2017) – unique among combined authorities. As such, it can be considered an 'unusual' case (Yin, 2017), although the UK government's preference for more uniform devolution (Henderson et al., 2024) suggests that such characteristics may become less 'unusual' over time.

3.5 Background to the West Midlands

The West Midlands metropolitan region is comprised of the conurbation surrounding Birmingham, England's second largest city. including the smaller cities of Coventry and Wolverhampton as well as other smaller towns across the Black Country and Solihull.

The West Midlands is regarded as one of the birthplaces of the Industrial Revolution in the 18th and 19th Centuries (Jackson, 1956). In part due to the plentiful coal and mineral resources across the Black Country and the vast associated mining industry (Jenkins, 1927), the region has historically had substantial metalworking and manufacturing sectors, with automotive manufacturing growing significantly in the 20th Century (Spencer, 1987). The regional economy suffered with deindustrialisation throughout the 1960s and 1970s, and the demise of coal mining in the 1980s (Spencer, 1987), although the growth of service sectors since the 1990s have led to significant regeneration in the main city centres (Martin, 1995).

3.5.1 Governance in the West Midlands

The West Midlands, as defined by the West Midlands metropolitan county boundary, has a population of approximately 2.95 million (ONS, 2024). The West Midlands

metropolitan county lies within one of England's nine statistical regions, also referred to as the West Midlands region, which has a population of six million[4]. Having previously been spread across parts of Warwickshire, Worcestershire and Staffordshire, the West Midlands County Council was established in 1974 under Local Government Act 1972, creating a new county and seven metropolitan boroughs: Birmingham, Coventry, Wolverhampton, Walsall, Sandwell, Dudley, and Solihull. The County Council was abolished in 1986 under the Local Government Act 1985, effectively leaving the seven boroughs operating as independent unitary authorities.

Local Enterprise Partnerships (LEPs) were established in 2010 to replace the business support functions of the abolished Regional Development Agencies. LEPs sought to address the needs of local businesses, acting as the preferred channel for government grants to boost skills and growth in SMEs, including grants for low carbon projects (Shearer, 2021). Three LEPs covered the West Midlands metropolitan county: Greater Birmingham and Solihull, Black Country, and Coventry and Warwickshire. The boundaries of two LEP areas extended beyond the metropolitan country. In fact, LEP boundaries were not perfectly aligned to local authority boundaries across England, with several areas covered by two overlapping LEPs (Shearer, 2021). Each LEP had its own governing Board, comprised of local business leaders, and support officers either employed directly by the LEP or seconded from other organisations. In 2023, the Government announced that LEPs would no longer receive funding from April 2024, with responsibility for LEP functions instead transferring to Combined Authorities, or local authorities in areas without devolution deals (Davison and Hollinrake, 2023).

[4] To avoid confusion, I will refer to the statistical region as the 'wider West Midlands'.

All administrative boundaries are shown in Figure 3.

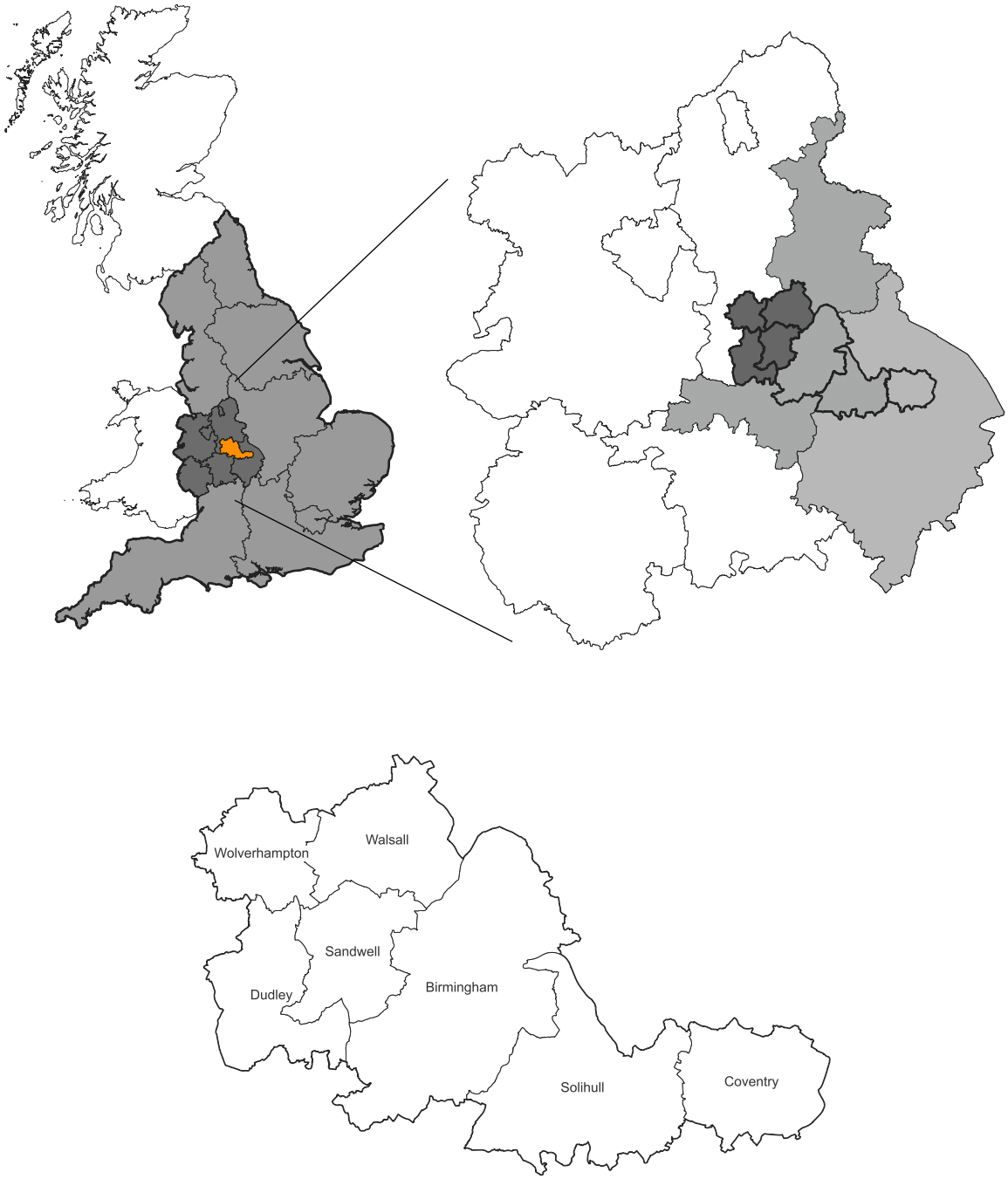

Figure 3 *Maps showing the administrative boundaries of the West Midlands Combined Authority. Top-left: Great Britain, with England (bold border) broken into its statistical regions (light grey) including the West Midlands region in dark grey, containing the West Midlands metropolitan region (orange). Top-right: The West Midlands statistical region, containing the seven West Midlands metropolitan borough councils (bold borders) and the Local Enterprise Partnerships to which they belonged (dark grey - Black Country; hatched – Greater Birmingham and Solihull; light grey – Coventry and Warwickshire). Bottom: The seven West Midlands metropolitan boroughs (author's own using spatial data under Open Government Licence).*

3.5.2 Devolution

Throughout the 2010s, the UK's Conservative-Liberal Democrat coalition government was pursuing routes to devolution for English towns and cities. Initially, bespoke 'City Deals' gained traction from 2012 as a means of devolving funding and decision-making powers to LEP areas, including all three West Midlands areas (Black Country LEP, 2014; Coventry & Warwickshire LEP, 2013; Greater Birmingham & Solihull LEP, 2012). However, no further City Deals were agreed beyond August 2014 (Ward, 2024), as combined authorities emerged as the government's framework of choice for devolution due to the preference for oversight by directly elected mayors. Combined Authorities were intended to foster greater partnership and collaboration among a collection of neighbouring councils (Ayres et al., 2018). Following the success of the first combined authority established in Greater Manchester in 2011 (Department for Communities and Local Government, 2011), a devolution deal was agreed between the UK Government and the seven West Midlands metropolitan borough councils to establish the West Midlands Combined Authority in 2016 (HM Treasury and WMCA, 2015). The agreement covered, among other powers, statutory transport planning responsibilities, control of the 19+ skills budget, and funding for economic development (2015).

The WMCA has a unique tiered membership structure; the seven metropolitan borough councils are 'constituent members' with full voting rights; other neighbouring district, county and unitary councils have reduced voting rights; and the West Midlands Fire and Rescue Authority and West Midlands Police and Crime Commissioner are observer organisations with their own separate regional powers. The Combined Authority governance model is centred around a WMCA Board, comprised of the leaders of member councils, and chaired by a directly elected 'metro mayor'. The WMCA Board "has responsibility for setting the annual budget of the WMCA … as well

as agreeing all major strategic and corporate plans and objectives" (WMCA, nd). Although at time of writing the Mayor does not have any statutory powers as an individual, the role is intended to provide local accountability, act as a single point of contact for discussions with government, and exercise soft power as a regional convener and 'champion of place' (Allen, 2024). The first West Midlands mayoral election was held in May 2017, concurrent with inaugural elections for five other combined authority mayoralties (2024). Andy Street (Conservative) was elected, and subsequently re-elected in 2021, but lost to Richard Parker (Labour and Co-operative) in 2024. The region had been expected to be a Labour stronghold due to Birmingham's young, metropolitan demographic (Parveen, 2017). In fact, all three elections have been extremely close, with the 2024 margin of victory just 0.25% of all votes cast (WMCA, 2024a).

3.6 Energy and net zero in the West Midlands

I identified in Chapter 1 that local authority-led work on energy and net zero in the UK has tended to be largely project-driven (Webb et al., 2017). The West Midlands is no exception; projects have included the development of Energy from Waste plants (Starkey, 2016), urban centre heat networks (Association for Decentralised Energy, n.d.; EQUANS, 2021), an energy innovation hub (Tyseley Energy Park) (Tyseley Energy Park, n.d.), public sector decarbonisation works (BEIS, 2021a), and retrofit schemes for social and council housing (VINCI Facilities UK, 2019). Other proposed schemes, such as Birmingham City Council's plan to launch an energy company, were consulted on but never came to fruition (Birmingham City Council, 2016).

As well as decarbonisation projects, several energy and climate policies began to be developed by West Midlands councils in the 2010s. Coventry's 2012-2020 Climate

Change Strategy set out targets for reducing carbon emissions by 27.5% (Coventry City Council and Coventry Partnership, 2012) – a target met six years early, although Coventry's latest draft strategy acknowledges that much of this reduction was simply due to transfer of attribution for several council-owned buildings to external organisations (Coventry City Council, 2024). Much of the regional activity has been centred on Birmingham as the largest city, drawing in wider stakeholders where possible. In 2010 Sustainability West Midlands, a membership organisation covering the wider West Midlands, produced a Strategic Issues and Options paper to support the development of a Birmingham Energy Strategy (SWM, 2010), however "[t]he final strategy was never published due to other council priorities and the lack of a corporate champion" (SWM, 2014a).

A Green Commission was launched in 2012, comprised of commissioners representing public, private and third sectors and local universities to advise Birmingham City Council on environment and sustainability matters (Franchina et al., 2017, p. 12; SWM, 2014b). The Green Commission published a Vision to "make Birmingham a leading green city" consisting of three pillars, one of which was 'Sustainable Energy and Carbon Dioxide (CO_2) Emissions Reduction' (Birmingham Green Commission, 2013a, pp. 17–18). This Vision led to the publication of a Carbon Roadmap in 2013, establishing a target of 60% carbon dioxide reduction by 2027 (2013b). Five Roundtables were established to oversee the implementation of the Roadmap, including one for the 'Energy and Resources' theme (Birmingham City Council, 2014).

Local Enterprise Partnerships have also played a role in local energy and net zero projects and policy. The Black Country LEP was the most active of the three West Midlands LEPs in energy projects, emphasising the challenge of decarbonising

dispersed manufacturing businesses in the Innovate UK funded project *Repowering the Black Country* (Black Country LEP, 2020). Since the closure of LEPs, the Black Country Industrial Cluster has continued this work as a consortium to "bring inward investment to the region, share best practice with … [its] members, advocate at a local and national level, and provide businesses with access to specialist energy engineering knowledge and consultancies" (Black Country Industrial Cluster, 2023).

While councils have been keen to demonstrate ambition through their projects and policies, capacity has been a significant barrier to delivery. Sustainability West Midlands found that, with the exception of two council-led energy projects in Birmingham, "initiatives … appeared to be the result of wilful individuals, rather than part of any corporate support from the council or strategic partnership working" (SWM, 2014b). Austerity cuts to grant funding from central government amounted to £736m in Birmingham across the 2010s, reducing spending power of the Council by 36.3% (Riley, 2023). One major consequence of this was a 48% reduction in staffing across the decade (2023). In particular, Birmingham City Council's Sustainability Team was "dismantled" in 2017, with most staff made redundant, and the Green Commission and its roundtables ceased meeting in 2016 (Nochta, 2018, p. 184).

In order to support the capacity of LEPs and local authorities across England, BEIS created Five Local Energy Hubs in 2018 (Staffordshire Business & Environment Network, nd). The Midlands Energy Hub, based in Nottingham City Council, covers the WMCA area. One projects officer is assigned to each LEP area to facilitate the delivery of local energy strategies and projects, in order to improve communication between public and private sectors, demonstrate feasibility of attracting investment for energy projects. In 2022, the Local Energy Hubs were renamed Local Net Zero Hubs

to reflect their broadening remit to all decarbonisation projects (Midlands Net Zero Hub, 2022).

3.6.1 Energy and regional devolution

The Energy Capital Partnership "grew out of" the Green Commission in 2016 as regional stakeholders looked for a new body to focus on regional energy and infrastructure challenges (01.AC.EC). Specifically, the University of Birmingham, Aston University, the Energy Technologies Institute (now Energy Systems Catapult), electricity and gas network operators, LEPs, and other member organisations of the Commission's 'Energy and Resources' Roundtable decided to "take over… that legacy body … [and] reformulate it so it covered all three LEPs and was focused on the [energy] devolution ask" (04.EC.LEP). Unlike the Green Commission, member organisations of Energy Capital were expected to contribute funding to a combined pot to pay for consultancy fees and publicity (04.EC.LEP). The first major work done on behalf of the Energy Capital Partnership was the West Midlands Regional Energy Commission, which elaborated on the proposal of Energy Innovation Zones as a mechanism for devolution.

The first West Midlands devolution deal did not explicitly refer to energy – although the ensuing regional Strategic Economic Plan included a target for 40% reduction in carbon emissions from 2010 to 2030 (WMCA, 2016, p. 14). The second deal signed in 2017, however, significantly expanded the WMCA's remit (HM Treasury and WMCA, 2017). There were no formal energy powers devolved in this deal, but the agreement stated the government's support of the West Midlands Regional Energy Commission, included £120,000 funding for a "local energy strategy", and "funding of up to £1.12m to support delivery of energy and low carbon projects across the Midlands" via Local

Enterprise Partnerships (2017, pp. 12–13). Although energy strategy funding was allocated to all LEPs in England as part of the government's Clean Growth Strategy (BEIS, 2017b), the three West Midlands LEPs were uniquely asked to create a joint strategy for the region (04.EC.LEP). The Regional Energy Commission launched its final report, *Powering West Midlands Growth: A Regional Approach to Clean Energy Innovation* (Energy Capital, 2018b) in March 2018 (CW Growth Hub, 2018), and by June 2018, the Energy Capital Partnership had established a formal governance structure, with its own Board to steer the Partnership's work reporting to the WMCA's Strategic Economic Plan Board for greater democratic oversight (Energy Capital, 2018c). Indeed, the Regional Energy Strategy (Energy Capital, 2018a) was presented to and endorsed by the WMCA Board in January 2019 (WMCA, 2019a) as a show of political support for furthering energy devolution (04.EC.LEP).

Distinct from Energy Capital, an Environment Board comprised of local councillors was established within the Combined Authority in September 2018 – meeting quarterly and reporting its business publicly (WMCA, 2018a). It was not designated a 'decision-making body', in that it did not have any authority to approve spending decisions, but it could discuss and note relevant business, with any decisions passed on to the WMCA Board for approval. At the inaugural Environment Board meeting, an emissions strategy was discussed – at this point in time, focused more on pollutants that impact air quality, such as NOx and particulates, than greenhouse gases (WMCA, 2018b). By February 2019, the WMCA's Environment team had been recruited, and the Environment Board set a range of emissions targets to be reported on annually (WMCA, 2019b, p. 10), including a reiteration of the Strategic Economic Plan's targets of 40% reduction in carbon emissions (WMCA, 2016, p. 14). The papers set out the

intention to receive WMCA Board approval of the Low Emissions Strategy by July 2019 (WMCA, 2019b, p. 15).

Since I concluded my data collection for this study, energy devolution has progressed in the West Midlands. In March 2023, a ‘trailblazer devolution deal’ was signed (HM Government and WMCA, 2023) that detailed plans for the region to receive funding as a ‘single settlement’—a budget allocated in Treasury Comprehensive Spending Reviews, in effect treating the WMCA in the same way it would a central government department. This mechanism is intended to remove the burden of competitive bidding and allowing greater flexibility in how the money is spent within the region, and from 2025 will incorporate current schemes including funding for social housing retrofit, public sector buildings decarbonisation and industrial decarbonisation (WMCA, 2023).

In summary, energy and net zero policy in the West Midlands exhibited many of the characteristics of other regions in the UK before 2016, with a variety of projects and policies implemented despite challenges of limited municipal capacity (Webb et al., 2017). Since 2016, devolution via the WMCA has provided a new framework, leading to greater emphasis on region-wide collaboration between local authorities and others – although functions remain spread across a number of separate institutions. Figures 4-7 illustrate this multilevel governance structure at various times throughout the period of interest for this research.

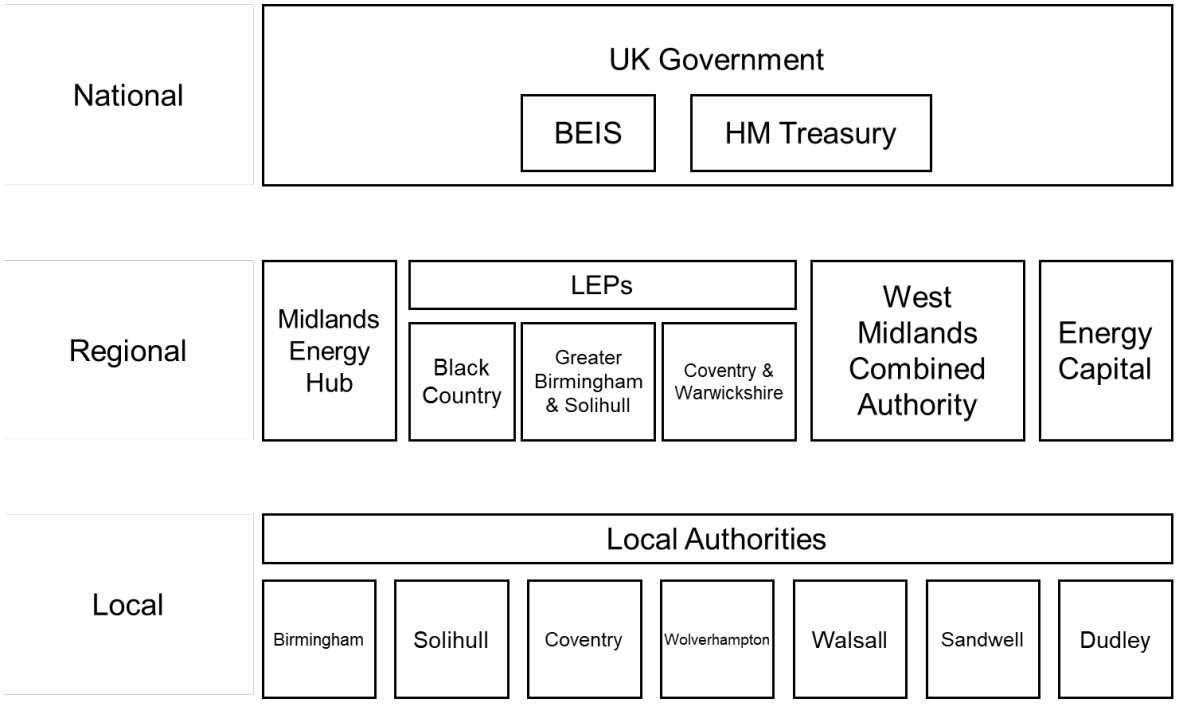

Figure 4 Components of the multilevel governance structure for the West Midlands with responsibilities for energy or net zero.

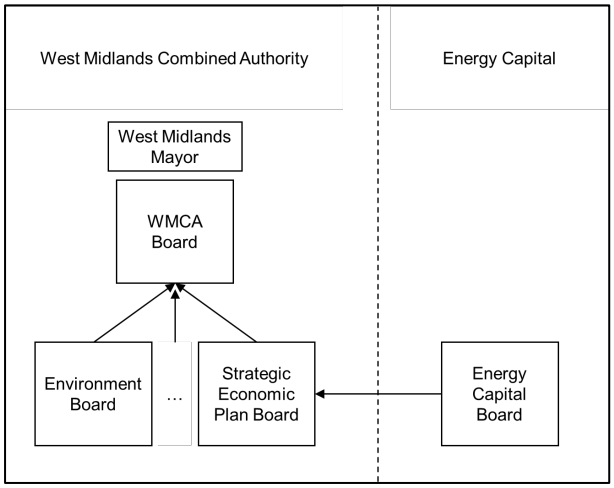

Figure 5 Regional reporting structure for energy and environment before October 2020.

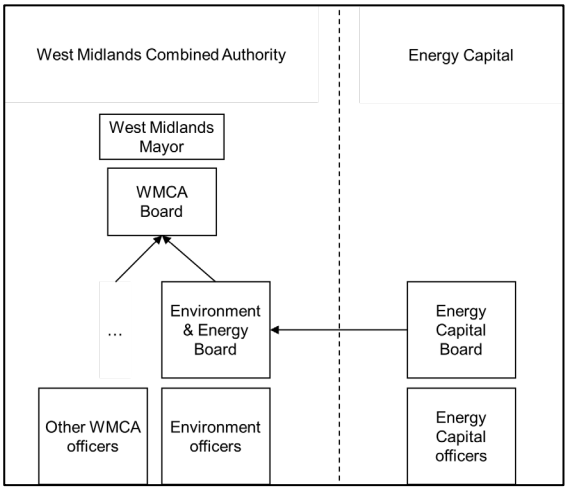

Figure 6 Regional reporting structure for energy and environment October 2020-March 2021

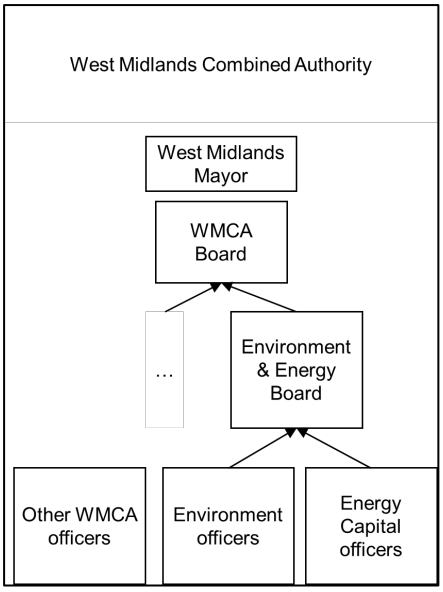

Figure 7 Regional reporting structure for energy and environment March 2021-May 2024.

3.7 Methods

Two methods of data collection were used: semi-structured interviews and analysis of policy documents. These methods are very commonly found in evidence-based policy research, and often in combination with one another (Boaz and Nutley, 2019, p. 268).

3.7.1 Semi-structured interviews

Semi-structured interviews are used to give flexibility to the conversation, allowing the researcher to shape the discussion to suit the individual interviewee while ensuring relevant questions are still asked. Unlike questionnaires, they allow the researcher to respond to interviewees' answers, enabling a greater understanding of their thought processes and interpretations. Interviews also enable greater insight into policymakers' 'mundane' work that they may not believe to be of interest to the research. In fact, accounts of such 'mundane' work can further understanding of processes or structures that are most difficult for an outsider to discover (Shaxson et al., 2024, p. 3).

3.7.1.1 Interview questions

An interview guide was developed to provide a general overview of the topics I intended to cover in interviews, as well as prompts for questions in case interviewees needed further encouragement to elaborate. This was shared with interviewees in advance, along with general background information and a consent form (see Appendix 1).

Questions in the interview guide followed a four-part structure. First, interviewees were asked about their role within the governance structure and Five Year Plan policy process. This ensured that a sufficiently detailed picture of the process and institutional context was developed over the course of all interviews – previously identified as an essential aspect of understanding evidence in policy (Stanton and Roelich, 2021, p. 8).

Second, the interviewee was asked about evidence: how it entered the policy process, what they considered to be relevant information, where it came from, and how it was presented. Questions on evidence were phrased in open-ended terms to determine what the interviewees themselves perceived to be valid evidence. Prompts could be used as a memory aid or to get interviewees to consider a wider range of evidence in their answers, particularly to illuminate why they did not initially consider certain evidence types to be relevant.

Third, interviewees were asked about how uncertainties were considered in the policy process. Further prompts mostly referred to sources of modelling evidence and the ways in which assumptions were made. As a result, only some interviewees were able to answer these questions.

Finally, interviewees were asked for their general reflections on the use of evidence in the Five Year Plan, including any specific enablers or barriers, and any contrasts they identified with other policy processes. Interviewees were also asked to recommend any additional stakeholders as potential participants who had not be identified through searches of local government websites.

Hill and O'Connor (2023) identify a potential bias in studies of evidence in which interviewees are asked directly about the types of evidence they use. These studies tend to result in answers which only reference quantitative evidence (2023, p. 276). To reduce the risk of this visibility bias, a question prompt was included in the guide encouraging participants to consider any qualitative evidence they may have used.

In a similar way, several authors have described the difficulty of capturing indirect evidence use. Interviewees often do not see indirect evidence use as relevant, either because the process happens over such a long time period or simply because they do not remember (Boaz and Nutley, 2019, p. 271; Weiss, 1999, p. 472; Hertin et al., 2009, p. 1187). I adopted an 'inclusive' perspective (MacKillop and Downe, 2022, p. 7), accepting whatever participants considered to be evidence as such to ensure that as many evidence sources were captured as possible.

3.7.1.2 Choice of participants

Interviews were conducted between August 2021 and December 2022. An initial pilot interview was conducted to test the interview guide, in which I spoke with a member of University of Birmingham staff involved in West Midlands energy policymaking. Following this, purposive sampling of participants was carried out

using information found in policy documents associated with the Five Year Plan (see Section 3.7.2). The following interviewees were sought, from within the case study area:

- WMCA: Environment officers, Environment & Energy Board members
- WSP: consultants that worked on the Five Year Plan
- Energy Capital: officers, Board members
- Local authorities: officers and councillors working on energy, sustainability or planning
- Local Energy Hub: officers responsible for WMCA Local Enterprise Partnership (LEP) areas
- LEPs: low carbon officers

Invitations were sent by email, with all interviews held online lasting between 30 and 60 minutes. After initial identification, snowball sampling was carried out using suggestions from interviewees. A wide range of interviewees drawn from across the multilevel governance structure was necessary to give the fullest possible picture of the policymaking context, and thus potential influences on the use of evidence (Cairney et al., 2019, p. 32). Eventually, data saturation (Clark et al., 2021) was reached when additional interviews no longer added further insights. The final total (n=26) represented a good spread of stakeholders from different organisations and in different roles.

Organisation/industry	Number of interviewees
Academia	1
Energy Capital officers	4
Local Energy Hub officers	4
LEP officers	4
Local authority officers	4
WMCA officers (excluding Energy Capital)	3
WSP consultants	2
Councillors	3
Infrastructure operators	2
BEIS	1
Consultant (other)	1

Table 2: Tally of interview participants' roles by organisation

Board members (Councillors/Energy Capital Board/LEP Boards)	Officers	Both	Other
5	15	1	5

Table 3: Tally of interview participants' role by job type

3.7.1.3 Transcription

To analyse interview data alongside documentary sources, interview recordings were automatically transcribed by the video call software preferred by participants (Zoom or Teams). The auto-generated text provided a starting point, but due to poor accuracy, auto-generated transcripts were manually corrected by replaying the recording several times while reading along. This was a time-consuming process, and required a lot more pausing and re-listening than first anticipated, due to poor audio quality or interviewee enunciation. Transcripts and recordings were

pseudonymised before analysis. Quotations from interview transcripts are presented throughout the results chapters with alphanumeric labels. Numbers indicate the order in which the 26 interviews were conducted; the remainder of the labels indicate the role of the interviewee according to the following scheme:

Label	**Definition**
AC	Academic
EC	Energy Capital officer/board member
CA	WMCA officer
CLLR	Local authority councillor
LA	Local authority officer
NZH	Net Zero Hub officer
WSP	WSP consultant
LEP	Local Enterprise Partnership officer/board member
BEIS	BEIS civil servant
ESC	Energy Systems Catapult consultant

Table 4: Labels used for interview quotes in results chapters

3.7.2 Policy documents

I iteratively identified policy documents that illuminated various aspects of the Five Year Plan's development using desk-based research of the WMCA website and from interviewee suggestions. The Five Year Plan itself, including a range of appendices, was considered alongside committee meeting papers and minutes. In one instance, where detailed minutes were not available, a video recording was used. Even though scholars such as Katherine Smith have argued for the conceptual focus on ideas over evidence (Smith, 2013b, p. 5), documents are

recognised as an essential source of data in policy research (Freeman and Maybin, 2011, p. 156). They are artefacts that “embody the political processes by which they are produced” (2011, pp. 164–165). Although policy documents – particularly committee papers – provide “imperfect insight” (Russell and Christie, 2021, p. 18), they “establish the ‘rules of the game’” in complex governance structures and, with validation from interview data, they enable the construction of a “detailed timeline” of policy development (Cairney et al., 2019, pp. 35–36). Details of all documents analysed can be found in Appendix 2.

3.7.3 Other methods considered

I initially attempted a sensitivity audit (Saltelli et al., 2008). in addition to the methods described above. This would have employed quantitative and qualitative techniques of uncertainty analysis following a NUSAP (Numeral, Unit, Spread, Pedigree and Assessment) approach, as has previously been used to study energy models used in UK policy (Pye et al., 2018). However, it quickly became apparent that insufficient information about the model could be made public by the consultancy WSP, due to commercial restrictions on its intellectual property. As such, it was not possible to accurately re-construct the quantitative model with sufficient confidence to apply quantitative techniques of uncertainty analysis within NUSAP or alternative methods. Instead, qualitative insights on model uncertainty are presented in Chapter 5, drawing on data from interviews and policy documents.

To validate the findings of my interviews and documentary analysis, I initially planned to run stakeholder workshops. These workshops would have given an opportunity to test my findings, discussing them in group settings to understand how well they resonated with different stakeholder groups. In the end, this proved

to be impractical due to the limited time stakeholders could offer and several key participants changing jobs since the Five Year Plan's development.

3.8 Reflexive thematic analysis

I used reflexive thematic analysis, following the six phases outlined by Braun and Clarke (2022). Interview transcripts and documentary data were imported to NVivo software for analysis. First, 'familiarisation with the data' was done through re-listening to interview recordings and re-reading transcripts. Sections of text that were pertinent to the research questions were highlighted, and a codebook of potential codes to apply later on was drafted.

Second, after reviewing all data, code suggestions were reviewed to construct an initial coding scheme (see Table 5). This scheme was used to code transcripts, followed by documents. As is to be expected with qualitative analysis (Saldana, 2012), the coding scheme developed iteratively as further insights were drawn from the data (see Table 6). Both semantic and latent codes were used (Braun and Clarke, 2022) to recognise the importance of interpretation within participants' answers and in documents.

Third, initial themes were constructed "based around the data, the research questions, and the researcher's knowledge and insights" (Braun and Clarke, 2022). This, as in the second stage, involved a process of 'zigzagging' (Emmel, 2013) as used by Rattle et al. (2023, p. 4) "to move between theory and data". At this stage, it was decided that some codes initially identified, such as 'uncertainty', were best re-interpreted as themes.

Fourth, in order to develop and review the themes, I ran a workshop with my supervisors to present interim findings and discuss future directions for analysis.

As a result, less emphasis was placed on applying the detailed typologies of uncertainty found in the modelling literature (for example Pye et al., 2018), and more emphasis placed on Cash et al.'s (2002) framework of evidence use justifications for a higher-level perspective to better answer the research questions.

Fifth, themes were further refined as the overall narrative of the findings clarified. This overlapped significantly with the sixth stage of writing up, in which many iterations were tested to present the data coherently. In writing up, I sought to strike a balance between including sufficient data in the form of illustrative quotes embedded in 'thick description' (Geertz, 2008), and ensuring the findings flowed naturally into a cohesive argument.

Evidence			
Data	Modelling	Stakeholder consultation	Case study
Uncertainty			
Assumptions	Conflicting policies	Scenarios	Lack of data
Barriers			
Fragmentation	Politics	Governance structure	Other

Table 5: Initial coding scheme.

Evidence					
Data	Modelling	Stakeholder consultation	Case study	Policy reports	
Uncertainty					
Assumptions	Conflicting policies	Scenarios	Lack of data	Future technology	Path dependency
Barriers					
Fragmentation	Politics	Governance structure	Other		
Evidence usage					
Building trust	Prioritisation	Evidence not used	Ideas	Evidence-based label	

Table 6: Final coding scheme.

3.9 Validity and limitations

I now discuss several limitations of the methodology and the steps taken to reduce the impact on the validity of findings. First, the structure of the case study was changed after several interviews had taken place. Originally, the design had been intended to examine more closely the differences between local and regional net zero policy processes, comparing the WMCA's Five Year Plan with policies developed in Coventry and Sandwell Councils. However, council officers' response rates were low, compounded by staff turnover, meaning that relevant individuals no longer worked for the council and could not be contacted. After several months, the decision was taken to replace the Coventry sub-case with Solihull. However, responses were still inadequate.

At the same time, it was emerging that the evidence mentioned in interviews relating specifically to the WSP carbon model was different from that which fed into the Five Year Plan's development more broadly. In light of the difficulties faced in exploring local authority policies further, and based on the fruitful data collection emerging on the WMCA's Five Year Plan, the decision was taken to restructure the

cases. Thus, the sub-case became a more in-depth investigation of the Five Year Plan's underlying carbon model development.

The change of case study structure, having already conducted several interviews, may appear to be a drawback. However, the interview guide remained the same for both case structures, since it was these question prompts that led to the insights of the modelling process as a worthwhile distinction. In this way, the change of structure was not a drawback, but a demonstration of flexibility as one of the strengths of semi-structured interviews.

A second limitation was the relatively low number of interviewees (n=26), particularly those who had had roles most closely connected to the development of the Five Year Plan (n=7). This reflected the small number of individuals with direct experience of the Five Year Plan's development. In fact, limited policy capacity turned out to be one of the key themes that emerged from analysis. Compounded by the common limitation that senior policymakers are averse to critically discussing their own policy work (Mackenzie et al., 2006, p. 217), I must acknowledge the risk of bias towards the perspectives of a small number of individuals. Whilst more interviewees would have been desirable for the purpose of increasing validity, I was confident that I had achieved data saturation, and that interviews with local authority officers those on the periphery of the Five Year Plan still provided essential insights regarding the nuances of the governance structure (Cairney et al., 2019). As far as possible, I have attempted to draw from as broad a range of interviewees as possible in illustrating the emergent themes of research data as a whole, mitigating the risk of thematic analysis being skewed by "vivid example[s] that dramatise[ ] the point" (Fleming and Rhodes, 2018, p. 10).

A third limitation was the way in which questions were asked about uncertainty. Due to my early reading on uncertainty focusing on methods for scrutinising models, questions were framed in such a way that non-technical stakeholders struggled to engage. Having since explored the literature on uncertainty in policymaking more deeply, I would re-phrase interview questions to approach the concept more indirectly and avoid confusion were I to carry out the interviews again. However, the nature of semi-structured interviews allowed for questions to be re-phrased or revisited, and often the most significant findings on uncertainty arose from the more open-ended discussions towards the end of interviews.

Finally, it is also worth noting that I began work as a part-time employee of the WMCA within Energy Capital in August 2023. This has not posed a potential conflict of interest, as all data collection had been completed more than six months before this employment commenced. WMCA officers have not asked for oversight of this research at any stage. Throughout the writing up stage, I have maintained a critical academic perspective by subjecting my work to the scrutiny of others, including monthly meetings with supervisors and regular presentations to department seminars.

3.10 Conclusion

This chapter has set out the methodological approach of my research. I have stated my critical realist philosophical position and justified my use of a single embedded case study design. I have introduced my case study, demonstrating the extent of the West Midlands' multilevel governance structure. I have justified my choice of semi-structured interviews and policy documents as data sources and reflexive

thematic analysis as my research methods, and discussed the reliability and validity of my approach.

The next two chapters will set out the findings of the case study, beginning in the next chapter with findings on the use of evidence in the Five Year Plan's policy process.

Chapter 4: Case study 1 – evidence in the development of the Five Year Plan

4.1 Introduction

In this chapter, I present my findings on the use of evidence in the development of the West Midlands Combined Authority's net zero policy, the Five Year Plan. These findings are drawn from my research interviews with regional policy stakeholders, and analysis of relevant policy documents, including the Five Year Plan itself. As described in Chapter Three, my findings are structured according to the single embedded case study design employed.

To begin, I analyse the timeline of the WMCA's Five Year Plan development following a policy cycle framework (4.2). First, agenda setting (4.2.1) covers the period of time from the adoption of a regional net zero target in July 2019 to the WMCA Board paper proposing a Five Year Plan in June 2020. Next, I describe policy formulation (4.2.2), which was carried out with the support of external consultants. 'Decision making' (4.2.3) includes the formal approval of the plan by the WMCA Board in March 2021, before finally the early stages of implementation and monitoring from the summer of 2021 (4.2.4).

Following this timeline, in Section 4.3 I present an overview of the various types of evidence that were observed during the policy's development. These evidence types draw on categories discussed in Chapter 2. I then turn to the differentiated use of this evidence during different stages of the policy cycle (4.4).

Following this, I focus on two factors that influenced the use of evidence throughout the process: a lack of policymaking capacity (4.5.1), and the separation between environment and energy policymakers during the Five Year Plan's development (4.5.2). I conclude by providing a brief summary of the key findings (4.6).

4.2 The policy process of the Five Year Plan

4.2.1 Agenda setting

4.2.1.1 IPCC Special Report on 1.5C to climate emergency declarations – the window of opportunity

By June 2019, the environmental policy priorities of the WMCA had significantly shifted from air quality to climate change. One interviewee described how the shift was very sudden:

> it's hard to believe, but climate change was not a big priority [in 2018], … I was told to put my resources into initially doing an air quality strategy [the Emissions Reduction Strategy]… The evidence base was done, all the politics was done, and then at the last minute, it was pulled because this [climate change] was now more of a priority (25.CA).

This was due to the response to the IPCC's Special Report on 1.5°C in October 2018 (IPCC, 2018), which highlighted the stark differences between the impacts of 1.5°C and 2°C global warming. The report also provided analysis of a global carbon budget that would be likely to limit warming to 1.5°C and associated target dates for emissions reduction. It stated that, compared to a 1990 baseline, carbon emissions would have to be reduced by 50% by 2030, and by 100% – in other words, net zero – by 2050.

After the report was published, local and combined authorities across the UK began to 'declare' climate emergencies, and align with the report's key recommendations of rapidly reducing carbon emissions to net zero by the middle of the century. The first was Bristol City Council in November 2018, which went further by targeting net zero emissions by 2030 (Bristol CC, nd). In fact, by 2020, the majority of UK councils had set a 2030 net zero target (Holden et al., 2020). At the national level, the Committee on Climate Change (now Climate Change Committee), the UK's climate advisory body, recommended in May 2019 that a national target of net zero emissions by 2050 should be adopted (CoCC, 2019). A month later, the Climate Change Act 2008 was amended to enshrine the target in law (UK Parliament, 2019).

4.2.1.2 Adoption of carbon budget and net zero target

Within the WMCA, a report was commissioned from the Tyndall Centre – a partnership of universities that provides consultancy on climate change – to investigate what a reasonable carbon budget and net zero target date would be for the West Midlands (Kuriakose et al., 2019). This report was initially considered at the June 2019 WMCA Board meeting, where the intention was "to signal a re-fresh of the WMCA Environmental portfolio… [and] [s]pecifically … [t]o be clear on the escalating scale of the issue posed by climate change" (WMCA, 2019c, p. 208). The Board declared a climate emergency, and agreed to consult on a regional net zero target on the basis of the Tyndall Centre report (WMCA, 2019d, p. 5). To reinforce the refresh, the Mayor also appointed each of the seven constituent local authority leaders as Portfolio Leads across the WMCA's work, including one for "Environment, Energy & HS2" that would chair the Environment Board (WMCA, 2019c, p. 18).

At the July 2019 WMCA Board, the targets set out in the Tyndall Centre report were formally adopted (WMCA, 2019e, p. 4). Namely, the targets were to achieve net zero carbon emissions by 2041, and "interim targets based on a 2018 baseline of 36% reduction by 2022, and 69% reduction by 2027" (WMCA, 2019f, p. 36). Officers were also asked to produce a Carbon Reduction Action Plan by the Autumn.

4.2.1.3 #WM2041 green paper

The October 2019 Environment Board received an update on the development of a "climate green paper… meant as a starting point, containing proposals and propositions, rather than pre-determined activities and outcomes." (WMCA, 2019g). This green paper eventually became *#WM2041: Actions to meet the climate crisis with inclusivity, prosperity and fairness* (WMCA, 2020a), which was presented to and endorsed by the WMCA Board in January 2020 (WMCA, 2020b). The green paper set out statistics on historical emissions in the region, provided five guiding principles for the region's net zero transition, showcased several case studies of good practice that would require scaling up, including the advocacy work of Core Cities UK (2020a, p. 17) and research into bioenergy at Aston University (p. 42), and summarised short-, medium- and long-term actions that would be required to achieve net zero.

The report was launched publicly on 23rd January 2020, beginning a six-week engagement process "seeking comments from councils, businesses, organisations and communities on our proposed actions" (WMCA, 2020c, p. 7). In February 2020, officers provided the Environment Board with an interim update on the consultation process, emphasising the breadth of engagement achieved and the

importance of that breadth for robust future policy development (WMCA, 2020d, p. 2).

4.2.1.4 WM2041: a programme for implementing an environmental recovery

In June 2020, the WMCA Board discussed the full findings of the #WM2041 consultation (WMCA, 2020e). By this time, the first UK national lockdown of the COVID-19 pandemic was in place. As a result, the #WM2041 programme was reframed "to be within the context of COVID-19 and the transition to a 'healthier, greener' West Midlands" (WMCA, 2020f, p. 1) within the report *WM2041: a programme for implementing an environmental recovery* (WMCA, 2020f). This report reflected on the feedback received in the consultation, and set out "a commitment to building [four] five yearly delivery plans" (2020f, p. 16) for the first time, with the first one required by 2021 to align with the 2041 target date. The proposal was endorsed by the Board (WMCA, 2020g, p. 7). Interim decision-making on the development of the first Five Year Plan was handed to the Environment Board (WMCA, 2020e, p. 5).

4.2.2 Policy formulation

4.2.2.1 Outsourcing of Five Year Plan development

At the subsequent June 2020 Environment Board, the scope for work on the Five Year Plan was shared, including six priority areas:

a) A technical and spatial evidence base of existing activity.
b) Priority actions and investment opportunities.
c) Finance and resource delivery overview.
d) Carbon budget accounting.
e) Stakeholders and governance.

f) Communications Plan. (WMCA, 2020h, p. 67)

The board papers state that the project “will require externally commissioned consultancy support to produce the outputs listed” (2020h, p. 68). An initial budget for the work of £80,000 was allocated, subject to confirmation as plans were finalised (2020h, p. 68). The Board approved the proposed work programme (WMCA, 2020i), and also agreed to change the board’s name to Environment & Energy to recognise the “synergies” between WM2041 and Energy Capital’s work (WMCA, 2020h, p. 74). Energy Capital would henceforth bring future board papers to the Environment and Energy Board instead of the Strategic Economic Delivery (formerly Plan) Board.

By October 2020, following a tendering process, the consultancy WSP had been appointed as consultants to develop the Five Year Plan (WMCA, 2020j, p. 12). WSP consultants presented to the Environment & Energy Board on the approach they were taking to the policy’s development, and set out a timeline of plan development, culminating in a December 2020 approval by the Environment & Energy Board (WMCA, 2020j, p. 13), which the Board noted (WMCA, 2020k).

The WSP consultants initially conducted a stakeholder mapping to determine who the relevant individuals and organisations were to engage in the process. Having identified 110 organisations, the consultants were able to follow up with 87, by presenting at pre-existing regular meetings, conducting one-to-one interviews, and using online surveys (WSP, 2021b). One WSP consultant admitted that they “wouldn't normally do as much stakeholder engagement as [they] did” for the Five Year Plan – this was “mainly driven by” the Environment team (15.WSP). The

purpose of consultation at this stage was to “listen” and gather “initial information” (WSP, 2021b, p. 3).

4.2.2.2 WSP development of scenarios from the energy and carbon model

A large aspect of WSP’s work was a “[c]arbon budget impact analysis” (WMCA, 2020j, p. 10) – later referred to in the Five Year Plan as the “energy and carbon model” (WSP, 2021a, p. 34). This was undertaken in five stages:

1. Tyndall Centre carbon budget re-calculation. The carbon budget adopted by the WMCA Board in July 2019 had been for the West Midlands region as defined by the 3-LEP area. However, the Five Year Plan was only intended as a plan for the smaller area covering just the seven metropolitan boroughs. Thus, WSP calculated a scaled-down carbon budget for the WMCA, reducing from 126 $MtCO_2$ (Kuriakose et al., 2019, p. 8) to 74.1 $MtCO_2$ for 2020-2100, and 34 $MtCO_2$ for the first Five Year Plan’s duration of 2021–2026 (WSP, 2021a, p. 27).
2. Greenhouse gas (GHG) baseline. WSP projected a pathway of annual GHG emissions that assumed no local action would be taken to reduce emissions.
3. A ‘Business as Usual’ scenario. This accounted for “all the actions which are likely to be undertaken or have already been confirmed in the region or nationally” (WSP, 2021a, p. 36), such as the 2030 sales ban of new internal combustion engine vehicles.
4. Modelled impact of goals. The consultants provided a framework of interventions they could model, across Domestic, Commercial, Industrial,

Transport, Strategic Land Use, Indirect and System Management[5]. More detail on this modelling process will be given in the second findings chapter.

5. Scenarios. Having estimated carbon savings for all 15 interventions at Low, Medium, High and Very High ambition levels, three representative scenarios were constructed to summarise the results.

In creating the scenarios, the consultants fed back to the WMCA officers that there was no “realistic way … to get on line with this trajectory that the Tyndall Centre ha[d] sent” in 2019 (10.WSP). They created a ‘Maximum’ scenario that met all existing Tyndall Centre targets, but did not recommend that the WMCA adopt this pathway, since it was “likely to be at the limit or beyond what it is technically possible” (WSP, 2021a, p. 101) and “could create unintended consequences for a just transition” (p. 12). The ‘Moderate’ scenario set out a trajectory “beyond the current efforts” (p. 91) identified in the Business as Usual pathway, but missed the 2041 net zero target as well as all interim Tyndall Centre targets. Finally, the ‘Accelerated’ scenario demonstrated “the necessary ambition to cause a very significant reduction in the region’s carbon emissions, while still being technically feasible” (2021a, p. 94). This met the 2041 net zero target, but missed all interim targets, taking a less steep trajectory than the Tyndall Centre’s recommendation and therefore requiring a larger regional carbon budget. All pathways are shown in Figure 8.

[5] Indirect and System Management sections were dropped from the modelling before quantification began.

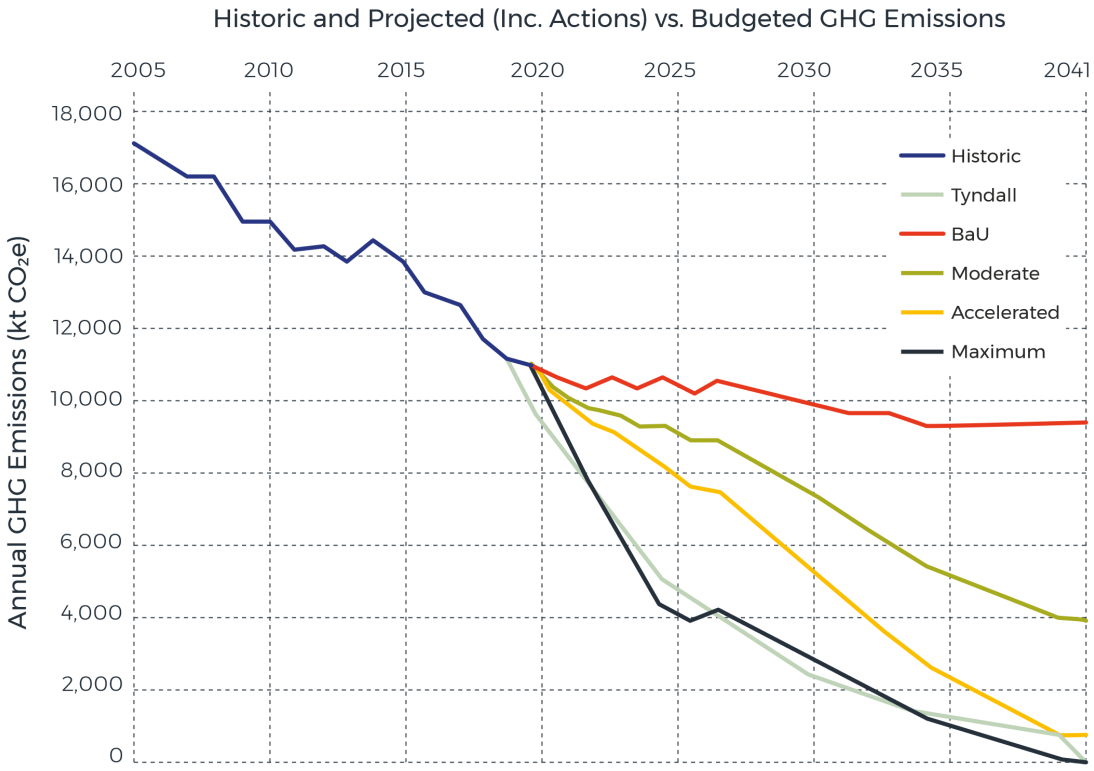

Figure 8 All greenhouse gas reduction pathways analysed in the Five Year Plan (WSP, 2021a, p. 91) (copyright permission obtained from WMCA)

4.2.3 Decision making and legitimation

4.2.3.1 Ongoing consultation

More limited consultation was conducted towards the end of the policy process with only “selected groups” to “present and test” the draft (WSP, 2021b, p. 3). In December 2020, the Environment & Energy Board received another verbal update from WSP, with an updated timeline for approval to allow time to take feedback into account following further engagement with the Energy Capital and the WMCA’s Strategic Transport Boards (WMCA, 2020l, p. 28). The progress was noted by the Board, although one board member raised concern about “how difficult it would be to implement many of the changes envisaged” and the need for interventions proposed in the plan to be “realistic” (WMCA, 2020m, p. 3).

4.2.3.2 Formal endorsement of the plan

In February 2021, WSP presented a draft Five Year Plan to the Environment & Energy Board (WMCA, 2021a). By this time, the 'Accelerated' scenario was the "reference scenario for the plan" (WMCA, 2021a, p. 41) and had been used as the basis for subsequent modelling of jobs and skills requirements and investment priorities in the form of a marginal abatement cost curve (p. 13). In an interview, one officer emphasised the importance of the wider engagement 'behind-the-scenes' leading to this meeting:

> [B]y the point it reached the [Environment & Energy and WMCA] Boards …, there had been a lot of input and work with elected Members and with officials to make sure that people were on the journey with us, and understood what we were doing (09.CA).

The Environment & Energy Board were recommended to "adopt the Accelerated scenario in the first Five Year Plan" (WMCA, 2021a, p. 12). The board accepted the recommendation, and agreed for the final draft of the plan to be presented to WMCA Board for final sign-off in March (WMCA, 2021b). In the same month, the WMCA Board approved the 2021/22 Budget (WMCA, 2021c, p. 2) which, for the first time, included £200,000 funding allocated for Energy Capital to receive ongoing funding and formally become part of the WMCA (WMCA, 2021d, p. 61).

In March 2021, the Environment & Energy Board reviewed the final draft of the Five Year Plan, and discussed the board papers that would accompany it at the WMCA Board meeting. In particular, they considered three levels of funding to request from the WMCA Investment Fund in order to deliver the plan (WMCA, 2021e, p. 19). On 19th March – the final opportunity before the pre-election period began – the

WMCA Board approved the Five Year Plan, “adopted” the ‘Accelerated’ scenario as a target pathway, and allocated £5.1m of the Investment Fund – the highest amount considered by the Environment & Energy Board (WMCA, 2021f, p. 4).

4.2.4 Implementation and monitoring

Following the adoption of the plan, the Environment & Energy Board continued to receive updates on the plan’s implementation. A brief update on the ongoing “enabling activity” was given in July 2021 (WMCA, 2021g, p. 3), and a more substantial report (WMCA, 2021h) was seen in September 2021 (WMCA, 2021i). This showed that: ten new officers were being recruited – five each for the Environment and Energy Capital teams (WMCA, 2021h, p. 3); a “Centre for Climate Data … to bring together information to inform decisions on net zero and produce independent models and predictions” was being scoped (p. 4), and; the WMCA were using the Carbon Disclosure Project as a mechanism for monitoring progress towards net zero (p. 13).

Subsequently, a quarterly Greener Together forum was established in 2022 to give citizens the chance to feedback their views on the net zero work to the WMCA officers (WMCA, 2022b). In addition, a deliberative Citizens Panel was recruited in 2023 to give a representative sample of West Midlands residents the chance to engage with key decisions in more depth, in order to demonstrate better informed views of residents than a typical consultation exercise (WMCA, n.d.).

The WMCA produced a State of the Region report in 2024 – the first since the completion of the Five Year Plan – which presented publicly available government statistics and some WMCA analysis relating to climate change. The Five Year Plan

is mentioned (WMCA, 2024b, p. 23), but no connection is made between the statistics presented and progress against the Five Year Plan targets.

The proposal for a Centre for Climate Data was superseded by an Environment and Net Zero Data Dashboard (WMCA, n.d.), which summarises similar government statistics to the State of the Region report, as well as some more specific to energy, such as the distribution of domestic Energy Performance Certificates.

The Environment Team commissioned a progress report by WSP in 2022, with one of the same consultants involved in the development of the original policy also involved in the review . This report was never made public, but demonstrated mixed progress against the goals, and identified issues with sourcing reliable data to monitor several goals (WSP, 2022).

Wolverhampton Council produced an audit report on the implementation of the Five Year Plan, which was published in October 2022 (City of Wolverhampton Council, 2022). The report found that updates on delivery to the Environment and Energy Board “required improvement” (p. 5), and that programme updates needed clearer links back to the Five Year Plan’s goals.

The WMCA participated in the public disclosure system run by international environmental impact charity, Carbon Disclosure Project (CDP). Disclosure involves inputting government statistics on local carbon emissions, along with a range of other quantitative and qualitative data on the WMCA’s delivery programmes. In 2021, the authority was on CDP’s ‘B list’, and by 2022 made it on to the ‘A list’, making the WMCA one of the top 12% of cities and regions participating (WMCA, 2022c).

4.3 Evidence used in the policy process

I observed a diverse range of evidence that featured throughout the Five Year Plan's development. I will begin by briefly describing some of the different evidence types.

4.3.1 Modelling

The carbon model developed by WSP was the central piece of evidence that shaped the Five Year Plan: "the calculation that underpins it" (26.CA). The model was described as "a high level analysis of what sort of measures, actions, plans they [the WMCA] would need to take to decarbonise" (15.WSP). Specifically, the 'Accelerated' scenario became the "reference scenario" for the plan (WSP, 2021a, p. 91), meaning that the scenario acted as the starting assumption for economic modelling (p. 106), job impacts modelling (p. 125) and delivery plans (p. 138) within the policy. The next chapter will provide more detail on the development of the carbon model specifically.

Although the carbon model was the central evidence source, results of other modelling exercises were also factored into the policy. Based on the outputs of the carbon model, WSP consultants conducted an economic analysis of the recommended goals, producing a marginal abatement cost curve to present a "financial overview of the cost and payback of each of the recommended goals" (WSP, 2021a, p. 19). Similarly, the skills modelling presented within the Five Year Plan was used to "forecast the future number of jobs created" under the carbon model's 'Accelerated' scenario (2021a, p. 125).

4.3.2 Quantitative data

As well as original modelling analysis carried out for the purpose of producing the Five Year Plan, a range of existing quantitative data sources were used throughout the process. Specifically, Government statistics on annual energy consumption and carbon dioxide emissions by local authority area were presented in graphs and charts in the final policy document's 'Energy and Emissions Overview' section (WSP, 2021a, pp. 22–27). The same datasets were also used in monitoring the plan's implementation (2021a, p. 23; interviewee 10.WSP).

Quantitative data on the outputs of local and regional delivery programmes were also recommended as a source of evidence for monitoring; for instance, reporting on the number of homes that have had retrofit measures installed through the Social Housing Decarbonisation Fund (10.WSP).

4.3.3 Stakeholder consultation and expert feedback

Following the stakeholder mapping exercise at the start of their work on the Five Year Plan, the WSP consultants engaged with a large number of organisations in a variety of different ways to elucidate their perspectives and "ensure the plan considered their views and addressed key concerns" (WSP, 2021a, p. 19). While stakeholder feedback was often referred to in generic terms as 'evidence gathering', the consultants spoke about different types of input stakeholders were able to provide; "sometimes the source is a stakeholder, or sometimes they reference a report in addition to that" (15.WSP). Along similar lines, participants in stakeholder engagement workshops had mixed preferences for what they wanted to discuss; "some of them were interested in numbers, some of them were interested in qualitative [aspects]" (10.WSP).

4.3.4 Grey literature

A number of previous policy documents were considered to be evidence in the decision-making surrounding the Five Year Plan. “[D]rawing on former [grey literature] reports as an evidence base” was seen as good practice for developing this type of policy in order “to provide the assurance that the statements, opinions, recommendations of the report were well-grounded” (01.AC.EC). These included references to the Tyndall Centre’s report (Kuriakose et al., 2019) analysing the West Midlands’ carbon budget and net zero target (WSP, 2021a, p. 27), the Regional Energy Strategy (Energy Capital, 2018a, p. 17; interviewee 26.CA), and many more featured in WSP’s Document Review (WSP, 2021c) – one of the Five Year Plan’s appendices.

4.3.5 Case studies

Cases of other regions creating similar policies were seen as evidence of how to go about the same process in the West Midlands. As one officer described:

> I looked a lot to other places that were further ahead than us [the West Midlands]. So I looked to Greater Manchester, I looked at some of the work that was being done in Bristol by [the consultancy] Anthesis to see the way they were structuring [their plan]. (26.CA)

Case studies of local delivery projects also featured heavily in the final published document, including a map (see Figure 9) showing a wide range of projects across

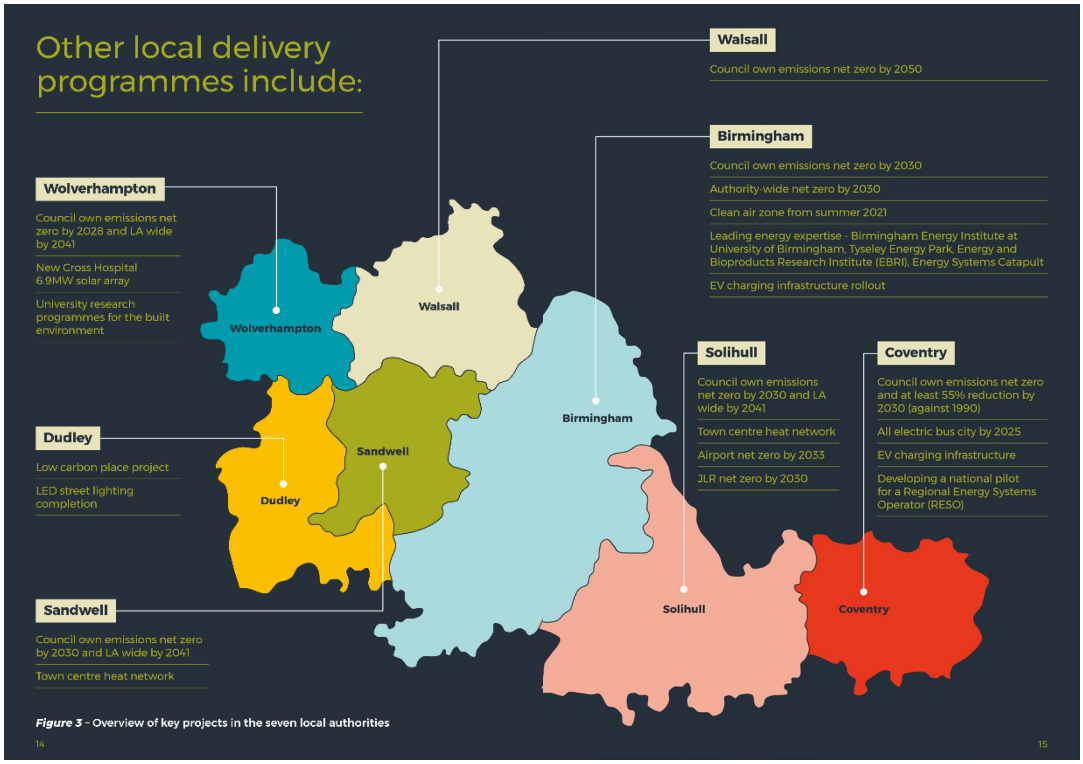

Figure 9 A map showing case studies of local net zero delivery projects and programmes (WSP, 2021a, pp. 14–15) (copyright WMCA, permission obtained)

the region, ranging from university research facilities to LED street lighting procurement and municipal heat network proposals.

In summary, the evidence inputs to the development of the Five Year Plan were very diverse, and by no means restricted to research sources. In the following sections, I will present findings on several themes that emerged on the use of this evidence.

4.4 Evidence uses throughout the policy cycle

I observed evidence used in various ways, and various justifications given for evidence use, during the different stages of the policy cycle.

4.4.1 Agenda setting – evidence used for problem framing

During the agenda setting stage, some types of evidence were better suited to problem framing, although the roles of different actors influenced which evidence

was seen as most influential. With WMCA officers, the IPCC's Special Report on 1.5°C (IPCC, 2018) captured attention and framed the policy problem as requiring places to set carbon budget targets in line with national and international obligations. However, it was the quantitative framing of this policy problem in a regional context by the Tyndall Centre that was seen as particularly influential for policymakers: "the carbon budget is important – that's what tethers us to our international commitments, and our national commitments" (26.CA). One WMCA officer described how local authority officers seemed to benefit from a workshop the WMCA ran to "test" the report. This made the carbon budget "a bit more tangible", and allowed them to "feel comfortable enough, having been involved" to advocate for the recommended targets themselves (25.CA) – hinting at a more 'interactive' model of evidence use to bolster legitimacy.

For local politicians as well, the Tyndall Centre's report was seen as an important piece of evidence for determining their net zero target date; their justifications tended to focus more on the reputational expertise and independence of the research-based Tyndall Centre – thus employing a more tactical model of evidence use when explaining that the "2041 date is based on science" (16.CLLR.EC). Indeed, officers recognised the value that councillors saw in "a process that someone else has done – [it] can be challenged, can be changed, but it is the best evidence available at the time" (25.CA).

The use of evidence was also direct in some cases during agenda setting, in the sense that the climate emergency declaration and carbon targets were adopted wholesale by the WMCA Board with little scrutiny – a decision that one officer said "took us all by surprise" (26.CA).

I also found that case studies of other places adopting similar targets made for a compelling source of evidence to politicians used in a 'direct' model (see Section 2.5.2 on Weiss's models of evidence use). The Environment Board Chair "reported that the WMCA should … be looking at best practice within combined authorities across the country" (WMCA, 2018a, p. 2) as a source of ideas for West Midlands policy. Case studies of other places adopting similar targets and strategies were also influential via an 'enlightenment' model in framing the policy problem in such a way that appeared to be achievable – since examples of other places provided a template for the West Midlands – while also creating a sense of urgency by bringing focus to competition between places. Comparison was seen as a call to action and "a chance [for the WMCA] to make its own statement of intent underpinned by credible delivery" (WMCA, 2019c, p. 210).

One officer argued that the emphasis placed on 'credible delivery' by politicians provided the primary justification for an evidence-based approach. They saw the alternative to be to succumb to "political pressure" where the likely justification for a target would have been to choose "one year better than someone else's" – particularly referring to the 2038 target Greater Manchester had adopted shortly before the WMCA's decision (25.CA).

As well as the agenda setting stage making use of specific types of evidence, the framing activity that went on at this time determined what types of evidence would be possible to use later on in the process. Within the Five Year Plan itself, contemporary policies were used to frame the need for the policy as they "provide[d] important context" (WSP, 2021a, p. 7). These included references to the *Ten Point Plan for a Green Industrial Revolution* (HM Government, 2020), which would "mobilise £12 billion of government investment" (p.7). Officers

reported the investment framing as essential for demonstrating salience to politicians, who “were asking… ‘where's the biggest bang for our buck?’ in very crude terms – ‘if we're going to invest, what's going to make the most difference?’” (09.CA).

The Five Year Plan also highlighted the latest (2018) snapshots of regional emissions and energy consumption data broken down by end-use sector (domestic, transport, and industrial and commercial) and by fuel type (electricity, gas, transport and residual fuels), as well as a trajectory of annual emissions broken down by fuel (WSP, 2021a, pp. 22, 25). These splits were then used to justify which interventions would be considered in the model; for example, highlighting the decarbonisation of the electricity grid that was already underway that meant “a shift away from gas use will be a priority for buildings, while shifting away from petroleum is also needed in the transport sector” (2021a, p. 23). This was reflected in one consultant’s summary of the net zero transition as the need to “electrify everything” (10.WSP).

4.4.2 Formulation and decision-making – the need for quantification

Quantification was seen as essential throughout the detailed development of the policy document. One officer explained how this prioritisation came first and foremost from politicians that requested a plan following the target setting to enhance credibility: “there are lots of numbers, because that's what we were asked for [by the WMCA Board]” (09.CA). Indeed, the consultants ensured that the executive summary of the final policy document had quantitative values “very clearly laid out” (15.WSP). An officer went on to speak about the carbon model’s role in ensuring salience of the policy, as a tool for understanding how to most

efficiently achieve their desired policy outcome. They said the topics it would cover were known from the start, since “built environment, energy, and transport” sectors are “the same in any climate plan … But what we now know is where it makes sense to focus most effort [in the West Midlands], because we now understand… where is there going to be most impact” (09.CA).

Similarly, another reason given for quantification by the consultants was the ability to quickly estimate the relative impacts of different interventions, ensuring policy salience. On energy efficiency, the consultants argued that although their target of retrofitting every home in the West Midlands by a particular date was “unrealistic” because there would always be exceptions, it was a worthwhile exercise because “you can mark it very easily [with numbers]” to assess whether it is then worth further investigation of the implementation challenges (10.WSP). A WMCA officer thought that quantification was necessary for policy salience because simply “say[ing], ‘we need to retrofit’ … gets us nowhere … the evidence and the numbers have made a really big difference because people can see now the scale of the challenge” (09.CA).

Quantification was also used for rapid credibility checks of the policy. One WMCA officer described how quantification was helpful to assess the “balance between ambition and deliverability … given the point that we're starting from” (26.CA). In particular, they gave an example of how Birmingham City Council’s 2030 target did not stand up to such scrutiny using a quick calculation:

> Birmingham … knew damn well [net zero by 2030] was undeliverable… You're going to have to have retrofitted every house in Birmingham [more

than 400,000], and you're currently doing less than 1000 properties a year. It's not going to [succeed] …, this is just basic maths (26.CA).

Another common reason for needing quantification was as a first step towards obtaining funding for delivery projects. Consultants recognised the value to the WMCA officers of being able to say to funders "'we need a billion pounds, because that's what our consultant said we need'" (10.WSP). Here, WSP's economic modelling was most highly regarded; taking the 'Accelerated' scenario as its assumption, "the major capital investment elements were quantified" to "allow for the understanding of the broad costs and value for money" (WSP, 2021a, p. 106). Salience was particularly high for not only generating 'a number', but specifically a financial cost. The consultants also understood that the overall development of the report would be used to develop a broader work programme, with the modelling starting the process of "creating … mini business cases" for the WMCA (10.WSP). Indeed, officers did find that having the policy approved "unlocked the resourcing that we needed to deliver on the climate change agenda … in a really practical way" (09.CA) – with the approved policy then itself becoming the evidence for decisions to increase resources.

The potential drawbacks of quantification were recognised by several officers – particularly around the perceived credibility of a specific target date. One argued that too much attention was placed on the date which distracted from other priorities for policymakers: "actually, it's [just] a target, it's a line in the sand, it's a statement of ambition to do something and do it quickly. I think we can get too bogged down in the date, rather than [focusing on] what we need to just get on and do" (09.CA). Similarly, another officer felt that it was important to move past the pass-fail framing of a specific target date to place more emphasis on effecting

change in broader terms: “if we get into a position where we're … missing that carbon budget by 10%, we're already immeasurably in a better position than we are now” (26.CA).

Other interviewees took issue with the modelling methods used more than quantification itself as a risk to salience. The framing of the policy problem within the Five Year Plan as having a solution in the form of technologically targeted investment was heavily criticised by one interviewee for being too reductive and not taking into account the wider place-based context of technologies: “telling West Midlands politicians that, say, solar panels are cheaper than fuel cells, is not only useless, it's really dangerous and irresponsible and professionally wrong, it's just not a useful kind of use of data” (04.EC.LEP). Instead, this interviewee argued that “access to the really detailed data that exists about the state of the [energy] networks and the infrastructure and demands and everything in [a particular place]” (04.EC.LEP) was essential to ensure that technologies were not being applied poorly.

Although much of the modelling within the policy refers to quantitative results as definitive and certain, the skills modelling was an exception. Like the carbon model, this evidence was described in the plan in ways that emphasised its rigour; the plan states that this analysis was “based on research” (WSP, 2021a, p. 125) and that its methodology was derived from the HCA’s Additionality Guide (Homes and Communities Agency, 2014) – government guidance on assessing impact that is consistent with HM Treasury’s main evaluation guidance, the Green Book (HM Treasury, 2020). The purpose was still “to identify and quantify” the jobs required to implement the carbon model’s goals (WSP, 2021a, p. 125), and the emphasis was still on increasing understanding of “the scale and range of new jobs” (p. 116).

However, unlike the carbon model, there was a greater acknowledgement that "supporting evidence [was] limited" (2021a, p. 125), and that while WSP's results were "broadly similar to jobs impacts analysis undertaken by Ecuity" for the Local Government Association (Ecuity, 2020), there were discrepancies between the two analyses (2021a, p. 127).

By the time the Five Year Plan reached the stage of receiving formal approval by the Environment & Energy and WMCA Boards, specific choices of evidence framing were clear. The scenario outputs of WSP's carbon model were not presented as a set of three futures from which the WMCA Board would have to choose one, so much as the policy rested on a single 'reference scenario' which the Boards were asked to adopt. In the words of one WMCA officer: "we went for the 'Accelerated' scenario because, quite frankly, that's the only option to keep on track for 2041" (09.CA).

4.4.3 Implementation – the policy becomes evidence

Once the Five Year Plan had been adopted by the WMCA Board, the plan itself became seen as a source of evidence in justifying spending decisions; indeed, the money allocated to the net zero work from the WMCA's Investment Programme was justified by referring to the "independent evidence base" produced by WSP for the development of the Five Year Plan (WMCA, 2021j, p. 3). References to the policy would usually be cursory – mostly including the 2041 target date – but it was seen to be "useful for [the WMCA] to help build our [delivery] plans" in part because it was credibly built on "a lot of modelling" (WMCA 2021, 00:58-00:59). As well as being able to nod to the 'evidence-based' status of the Five Year Plan, programmes would often draw on specific targets set out within the 'Accelerated' scenario; for

example, the target to retrofit 1.2 million homes by 2041 being used to justify specific retrofit delivery schemes (WMCA, 2021k), even though the proposed schemes came nowhere near meeting the required annual targets.

However, the quantitative targets had lost their original foundation in data by the time programme updates were given to the Environment & Energy Board from Autumn 2021; since early year targets were not met as delivery programmes and demonstrators were established from a standing start, the quantitative reasoning became misaligned with the WSP modelling of interventions (WMCA, 2022d). In fact, the goals were never well aligned to specific delivery by the WMCA, since distinctions between WMCA-, local authority- or private sector-led schemes was not made.

As well as referring to the policy's targets, during implementation officers saw it as important to evidence their own activity in ways that resonated with activists that may have seen the policymaking process as a distraction from essential climate action: "when you're being effectively criticised by lots of different outside environmental groups with very different agendas, it's very useful … to be showing some tangible things, like [a] car-free day" (25.CA). Likewise, on tree planting, earlier ambitions for delivery were 'translated' to reflect the quantitative targets that emerged from the carbon modelling: "WSP have done a pretty precise calculation on where will we need to plant more trees… [one WMCA officer] very ably translated that into the Virtual Forest Platform, so that we could … have that policy being delivered" (26.CA).

4.4.4 Monitoring

In the plan itself, descriptions of monitoring evidence were limited, but what was referenced was almost exclusively quantitative. The policy document sets out recommendations for future monitoring, including annual reports to the Environment & Energy Board, “[e]xternal/independent auditing”, “[t]echnological assessments and reviews of emerging best practices” twice during the lifetime of the plan, and “[d]ata collection, validation and interpretation” every quarter “to inform project planning, specification and resources” (WSP, 2021a, p. 153). In practice, officers had to weigh up the practicalities and politics of monitoring early work following the plan. One officer pointed out that a minimum period of time would be necessary for policy delivery to show impact because they had “only just finished recruiting the resourcing that we need, and putting some of the structure in place that's going to be important for delivery” (09.CA). They feared that publicly monitoring progress too early could risk losing the political support of councillors, since it would not show “masses of progress” on carbon reduction despite having completed “loads of work” (09.CA).

The most common source of monitoring evidence participants referred to was the dataset of annual carbon emissions by local authority published by BEIS. This had the immediate advantage of consistency with the model’s baseline, which used this dataset’s historical record to extrapolate future emissions. The consultants also spoke highly about the credibility of the data: “those BEIS numbers are actually pretty good. They're… [derived from] proper metered [energy use] data, which is pretty impressive and pretty accurate” (10.WSP). This basis in real-world data collection, as opposed to more indirect estimates, meant that the data was considered very trustworthy. One Environment & Energy Board member spoke

about the importance of monitoring coming from reputable sources, also citing the government's energy department as a good example: "I think we definitely need measurement, and we need tracking [of policies]. I don't know much about how it's done, to be perfectly honest, it's beyond my knowledge, but I would have thought BEIS are probably as good as anyone to do it" (16.CLLR.EC).

Despite the value of BEIS's data from a credibility perspective, the main drawback of the BEIS dataset was a two-year lag between collection and publication. Many participants identified this as a frustration, and especially so during a pandemic; the distortion of carbon emissions caused by lockdowns would still skew the data for several years to come. They also recognised that with a clear five-year timeline for the work, a two-year delay on their main source of monitoring data would leave them with limited opportunity to make adjustments if the emissions reductions were not sufficient (09.CA) – limiting the data's salience. However, the consultants explained that the WMCA was "going to have to accept that, because … trying to do it with other data sets I think would be really, really difficult… [and] would probably be disproportionate and suffer from inaccuracies" (10.WSP).

To counter the lack of early access to high-level emissions data, the WSP consultants recommended bottom-up monitoring of specific projects aligned to the modelled interventions. These would include local authority retrofit delivery programmes, as well as the use of planning databases for targets such as domestic renewable energy. However, reviewing the interventions a year after the plan was approved, several interventions, such as commercial heat pump installations, had no feasible monitoring methodology and no prospect of central government establishing new datasets (WSP, 2022). Furthermore, participants also spoke about the difficulty of using data collected by local authorities to inform decisions.

Reasons given included the “patchy” coverage of data, meaning a comprehensive view of a local authority area was difficult to achieve, and a lack of “common format”, with data inconsistently stored in “everything from excel spreadsheets to databases” (01.AC.EC).

4.5 Factors influencing evidence use throughout the process

Having set out the differentiated uses of evidence at different stages of the policy cycle, I now present two themes that emerged on the use of evidence throughout the policy process: the impact of limited policy capacity, and of the siloed structure of net zero policy capacity.

4.5.1 Lack of local and regional policy capacity

Limitations on the use of evidence were often linked to a lack of policy capacity. In the West Midlands, policy capacity was fragmented across a range of organisations. For example, Local Energy Hubs (later Local Net Zero Hubs) set up by BEIS were required to be based within a local authority, not a combined authority (25.CA). As a result, the Hub responsible for the West Midlands was hosted by Nottingham City Council in the East Midlands. This was described by one officer as a “bizarre” way of providing additional capacity “to cover the whole Midlands, despite there being a reasonable amount of people doing stuff for energy in the West Midlands” (25.CA).

Capacity constraints that limited evidence use were sometimes alleviated by the WMCA commissioning a single piece of evidence regionally to be filtered down to local authorities further down the governance structure. For instance, the Tyndall Centre report was written to cover the wider West Midlands region since “[local authorities] haven't got the budget to do this [research, and] they were very thankful

someone else was doing it" (25.CA). Indeed, Solihull Council used the report as evidence in a 'direct' model for its own local net zero strategy by adopting the 2041 target as the policy's starting point (Solihull Borough Council, 2021).

Since capacity was limited, and officers with knowledge of climate change even more so, little time could be allocated to the development of policies, restricting the amount of evidence that could be processed. One officer described how the *#WM2041* document had to be written in just four days: "it was a remarkably quick thing to write – mostly because I was told to write it quickly" (26.CA).

However, for the Five Year Plan's development, most policymakers and councillors prioritised and valued quantitative modelling evidence highly. Therefore, due to the limited number of officers responsible for developing the policy, and the lack of technical skills within the policy team, external consultancy was required to meet the need for modelling evidence. In the words of one WMCA policy officer: "I am no modeller… that's why we bring in the expertise, because we don't have it in-house to be able to do that kind of modelling" (09.CA). The same reliance also existed at local authority level, with one officer expressing both the desire to benefit from consultancy expertise and the lack of alternative due to capacity constraints: "we use consultants for the technical knowledge… we'd probably always try and use a consultancy if we could do … if we had a massive team then maybe that would be different, but we don't" (18.LA).

Although the need for consultants was primarily borne out of necessity, others highlighted the reputational benefit of using consultant expertise in its own right. Energy Capital officers developing devolution policy in parallel with the Five Year Plan found that inclusion of consultancy was recognised as a positive attribute by

central government: “although we’d done the [Energy Policy] Commission, we got the [Regional Energy] Strategy [approved], [there] wasn't enough detail, [so] government said they would give us more money, but to do more study, to engage more consultants” (04.EC.LEP).

The consultants leant heavily on their professional reputation to build trust in their evidence, asserting “we're experts” on technical aspects of net zero (10.WSP). However, this separation of evidence use from internal policy officers did raise concerns that trust would be difficult to build and maintain. One academic believed that modelling evidence in particular needed “a heck of a lot of work to convince people… that what you're doing is trustable”, and that the process risked being perceived as “a black box… stuff goes into our model, and the model does its stuff, and some numbers drop out the other end of it” (01.AC.EC).

As part of this convincing work, stakeholder consultation was seen as an essential source of evidence. Consultation was extensive throughout the policy’s development, with the intention of getting “feedback on what they [WSP consultants] were doing [while developing the plan and] what they [stakeholders] thought would work” (10.WSP). The emphasis on this approach to gathering information was seen as a direct result of the combined authority’s foundation in collaborative work across the constituent local authorities. In fact, the consultants acknowledged that they “wouldn't normally do as much stakeholder engagement as we did in WMCA” (15.WSP). The consultants were expected to mobilise their modelling evidence to facilitate meaningful consultation, tailoring their approach for different audiences. This was to enable officers with more technical expertise to scrutinise the model details, while less technical officers could still have a general appreciation for the structure of the model: “The people that were interested in the

modelling, … in Transport for West Midlands, and … Energy Capital, WSP had conversations with them around that, and had probably more basic conversations with some of us [in the Environment team]" (09.CA).

However, the substantive influence of stakeholder consultation was difficult to identify. The ways in which previous policy reports were practically used was generally described in vague terms such as "build[ing] in" (22.EC), with little detail offered. One interviewee expressed doubt in the meaningful influence of the workshops they attended: "I'm not sure that it's a process which is hugely consultative [in practice]" (01.AC.EC). Indeed, even in the more technical consultations, concerns were raised that the main structure of WSP's model had already been determined by October 2020: "many [consultancy] organisations have ways of formulating [net zero] plans which is essentially a recipe… [where] they have established a methodology and then they apply that within a [particular] context [every time] and my sense is that's what happened on this particular occasion with WSP" (01.AC.EC). However, Environment officers recognised the 'tactical' role of consultation evidence. They described how consultation had a broader purpose than gathering insights and information, and that engaging widely led to additional political support for the policy as a whole. They described how they "took a lot of time talking people through what we were doing and involving people at every stage, and that is just so important… we worked really hard… to make sure that people were supportive, comfortable and happy with what we were doing" (09.CA).

4.5.2 Separation of energy and environment

Another significant influence on evidence use in the eyes of research participants was the separation of energy and environment policy functions within the WMCA. This was described as “a slightly dysfunctional way of organising things” due to the ”historical complexity” of Energy Capital establishing itself independently from the WMCA (01.AC.EC) – also described more emphatically by one WMCA officer as “just bonkers … [that] they were separated” (25.CA).

Because the Environment team was already embedded within the WMCA when the carbon budget and net zero target were adopted, they had formal ownership of and responsibility for the Five Year Plan’s development. As such, the specification of the consultancy tender was shaped to meet the needs of the Environment officers, who “spent a long time building the invitation to tender … to make sure we had something that was … going to deliver us what *we* [the Environment Team] needed” (09.CA) (emphasis added). This need to specify the work in detail from the outset was a consequence of outsourcing capacity to consultants: “you have to really pre-empt everything that you think you're going to want in that plan, because … once you've appointed that consultant, anything additional has implications for the budget” (09.CA).

In contrast with the early development work by Environment officers, Energy Capital officers’ expertise influenced the Five Year Plan as evidence in the form of stakeholder consultation, in much the same way as other external stakeholders. Energy Capital officers at the time described how the weren’t “heavily involved” (22.EC), and an Energy Capital Board member could recall involvement only as far as “one interim presentation and a final presentation” from WSP (01.AC.EC).

The economic framing of Energy Capital's work was believed to have inhibited the influence of its evidence on the Five Year Plan. Because the Regional Energy Strategy developed by the Energy Capital Partnership "was to do with business", with a strong emphasis on industrial energy costs, Energy Capital reported into the WMCA's Strategic Economic Plan Board, "sitting under Economic Development" (25.CA). As a result "[The Regional] Energy Strategy … didn't really factor decarbonisation in at all", and with the net zero framing of the Five Year Plan, "the energy team were caught on the hop" (25.CA). This meant that, although the Energy Strategy was regarded among WMCA policymakers as "lay[ing] out very well" the "challenges of electrification" (26.CA), energy officers did not have suitably framed evidence to feed into the Five Year Plan. One WMCA officer believed that Energy Capital officers were in some ways defensive about 'business framing' of their Strategy, and that the risk with the Five Year Plan would be a perception that "now energy is an environment thing, rather than a business thing" – although the WMCA officer argued that that was "certainly not the intention" (25.CA). Rather, they believed that it was in the interests of Energy Capital to engage with the Environment team's framing, because the "carbon target … will have implications for the Energy Strategy, because there will be more expectations of how are [Energy Capital] going to deliver [decarbonisation]" (25.CA).

The clearest illustration of the lack of influence of Energy Capital's evidence was the structure of the carbon model that underpinned the Five Year Plan. The model used an accounting method in which annual energy consumption was the "fundamental data set" (10.WSP). As such, this accounting approach viewed units of energy as transferrable between time of generation and consumption; all generated renewable energy was assumed to be consumed within the sectors set

out in the plan. Thus, the real-time nature of energy was not considered: “we did talk to the DNO [electricity distribution network operator], but… we didn’t model peak demand in the system” (10.WSP). Energy officers wanted greater consideration of system-level changes that would be required to enable all of the electrification interventions dependent on a reinforced grid, but made the criticism that the modelling “doesn't allow us the depth to understand actually what the system change underneath [the targets] looks like” (22.EC). Another participant described how “a more fundamental understanding of the technologies” targeted within the Five Year Plan was needed, and that the approach used for the carbon model “with the right caveats, might help you start your search in roughly the right areas – but it might be completely wrong [from an energy system perspective]” (04.EC.LEP).

Even one of the WSP consultants with a pivotal role in developing the Five Year Plan expressed frustration at the lack of energy system perspectives in all contemporary net zero strategies, describing it as a “bit of a bee in my bonnet … [that] they completely discount the real time nature of energy” (10.WSP). The same consultant went on to say that they believed energy system insights were unlikely to be perceived as salient to such a policy’s primary audiences: “I love … modelling energy systems. But most people aren't going… [to] even read it or understand it” (10.WSP). Although the consultants included a section in the final report on ‘system management’, referring to the need to utilise smart technology and flexible energy demand to reduce overall costs that would be “crucial as an enabler“, they admit such concerns do “not directly affect the [carbon] modelling results” (WSP, 2021a, p. 90). In the words of one consultant: “if you wanted to summarize the net zero transition in a sentence, I would say you electrify everything, and then balance the

[energy] system … ‘electrify everything’ is pretty much in that report [the Five Year Plan] … The balancing isn't really” (10.WSP)

4.6 Conclusion

To summarise, I have presented my findings on the use of evidence in the development of the West Midlands Combined Authority’s Five Year Plan, a regional net zero policy that detailed how a net zero target of 2041 could be achieved. I have shown how the wave of local climate emergency declarations and net zero target setting created a window of opportunity for the WMCA to follow suit, and how subsequent internal policy documents made the case for a series of four Five Year Plans that would break down the 20-year period preceding the 2041 deadline. I have shown that the WMCA’s Environment team were responsible for the Five Year Plan’s development, but external consultants were contracted to play a significant role, including carrying out quantitative analysis that broke down the net zero target into 15 high-level goals. These goals were summarised as three scenarios, and the decision makers on the WMCA Board ‘adopted’ one of these scenarios as their pathway to achieving net zero. Following the policy’s adoption, resources for environment and energy activity within the WMCA were increased, as attention turned to implementation of the programmes and projects set out in the policy. Discussions about monitoring progress towards the policy’s goals also took place, although concerns were raised that updates to decision makers were not clearly compared with the targets set out in the Five Year Plan.

I identified a wide range of evidence types that were seen to influence the development of the policy, ranging from the quantitative carbon modelling done by WSP specifically for this policy, to qualitative sources including stakeholder

consultation and case studies. Following a policy cycle framework, I also found that different stages of the development process prioritised greater use of specific types of evidence, and that the way in which evidence was used varied according to the justification for using evidence to inform policy in the first place. During agenda setting, qualitative and quantitative evidence types were both considered useful for framing the policy problem, as evidence use was characterised as enhancing the salience of net zero and credibility of the process by which targets were set. During policy formulation, quantitative modelling evidence became dominant as politicians and officers saw the ability to compare quantified impacts and costs of specific interventions as most salient. Following endorsement of the policy, the Five Year Plan itself became seen as evidence for implementation of regional projects and programmes, while the underlying evidence base used to produce the plan was largely ignored. For monitoring, what limited options were available for quantitative data, which was generally preferred, had issues of salience due to a two-year lag in publication.

Two key influences on the use of evidence cut across the stages of the policy cycle. First, the limited and fragmented policymaker capacity within the region resulted in a reliance on external consultants. This was due to the strong preference for the use of quantitative modelling evidence. Stakeholder consultation was also valued, but since the carbon model structure was determined by consultants early on in the policy's development, consultation responses were used more tactically than in direct, interactive or enlightenment models (Weiss, 1979). I also found that the separation of energy and environment policymakers, due to historical complexity of energy and climate governance, led to evidence on energy systems impacts and

the real-time nature of energy being overlooked within a framing set by Environment officers from the outset.

In the next chapter, I consider the subcase more closely to present findings on the use of evidence specifically in the development of WSP's carbon model.

Chapter 5: Case study 2 – evidence in the development of the Five Year Plan's carbon model

5.1 Introduction

In this chapter, I set out my findings on the development of WSP's energy and carbon model. This model was used as the primary source of evidence during the production of the WMCA's Five Year Plan. I draw on findings from stakeholder interviews and analysis of policy documents.

Following this introduction, I provide an overview of the model's development process undertaken by WSP (5.2), including two specific examples of the goals that were quantified to describe the model structure (5.2.3.1-5.2.3.2). I then present results under two main themes. First, the influence of the consultants' expertise (5.3), which separated local policymakers from the appraisal of evidence quality (5.3.1) and had implications for the use of locally contextualised data as evidence (5.3.2). Second, uncertainty and ambiguity within the model was partially addressed (5.4) through the consideration of the model's assumptions and evidence used to populate the model's parameters (5.4.1), and through the use of multiple modelled scenarios (5.4.2). I conclude with a brief summary of the key findings (5.5).

5.2 Development of the carbon model

5.2.1 Re-scaling of the Tyndall Centre carbon budget

The consultants began by determining the carbon budget for the West Midlands metropolitan region, since the Tyndall Centre budget adopted by the WMCA Board covered the 3-LEP region expanding beyond the boundaries of the seven constituent local authorities. The Five Year Plan describes this process as 'using a similar methodology' to that of the Tyndall Centre (WSP, 2021a, p. 27), however no further detail of this methodology is provided anywhere in the policy document or Technical Appendices. The result of this re-calculation was a carbon budget of 74.1 $MtCO_2$ between 2020 and 2100, with 34 $MtCO_2$ within the Five Year Plan's defined period of 2021-2026 (WSP, 2021a, p. 27).

5.2.2 Baseline and 'Business as Usual'

Next, the consultants turned to the quantification of a 'baseline', projecting annual carbon dioxide emissions out to 2041. This began with the latest available BEIS data for energy consumption within the WMCA (2018 data), described as "the fundamental data set" for the entire model (10.WSP). Then, this number "was projected forward using other [government] data sources" (WSP, 2021a, p. 36), primarily: the energy and emissions projections (BEIS, 2019b), which sets out annual changes in energy demand by sector; supplementary guidance for the Treasury's Green Book (BEIS, 2019a), which provides a forecast for the falling carbon intensity of grid electricity; and static emissions conversion factors (BEIS, 2020), for fuels that have constant carbon intensity over time. Using these values, annual energy usage could be extrapolated, then converted to carbon emissions equivalent ($ktCO_2e$).

The consultants then incorporated this baseline within a ‘Business as Usual’ pathway, which accounted for “all the actions which are likely to be undertaken or have already been confirmed in the region or nationally” (WSP, 2021a, p. 36). As well as national pledges, such as the 2030 ban on internal combustion engine cars, the ‘Business as Usual’ pathway took into account emission reduction pledges already made by large organisations in the region, defined as those that produced at least 0.1% of the region’s total emissions (WSP, 2021d, p. 5). Evidence for this pathway was largely obtained verbally via stakeholder consultation, but in several cases was followed up with documentary evidence such as annual company reports which contained quantitative emissions data that was “added … into the model” (15.WSP).

5.2.3 Interventions and goals

After producing the ‘Business as Usual’ pathway, the consultants turned to the quantification of 15 high-level interventions that would reduce carbon dioxide emissions, including “Domestic heating retrofit”, “Industrial renewables” and “Improving freight fleets” (WSP, 2021a, p. 40). For each action, the consultants set targets for four levels of ambition; Low, Medium, High and Very High. High ambition was generally considered to be the maximum that could realistically be achieved, with Very High “representing an ambition beyond what is currently considered realistic” (2021a, p. 36). Each level of ambition corresponded to a series of annual emissions reductions from 2022 to 2041. To illustrate the process, I will now provide examples of how the first two goals were quantified within the model.

5.2.3.1 Example 1 – domestic energy efficiency

The first intervention modelled was retrofit of domestic properties with energy efficiency measures. For this, total annual national gas consumption in domestic buildings was first sourced from government statistics. The value for 2018, the latest year available at the time, was used.

An assumption was made that “domestic energy consumption patterns in the WMCA broadly mirror the country as a whole” (WSP, 2021a, p. 24). Therefore, an estimate for the annual gas consumption of a West Midlands home was found by dividing the national domestic gas consumption by the total number of UK dwellings. The average proportion of gas used for space heating (76%) was taken from BEIS’s “ECUK [Energy Consumption in the UK] datasets” (WSP, 2021a, p. 24) and multiplied by average domestic gas use to find the annual gas consumption of an average West Midlands home used for space heating.

Next, the potential energy savings of retrofit interventions were estimated. This used estimates of percentage reductions in space heating demand associated with a range of measures, including loft insulation, cavity wall insulation and double glazing on an average domestic building. These were also multiplied by applicability factors – the percentage of homes that do not yet have such measures installed. Thus, if a large proportion of homes already have a measure, the potential for further savings was reduced.

These resultant percentage energy savings for each retrofit measure were then multiplied together to get an average percentage net energy demand reduction. This was multiplied by the average domestic space heating gas demand to find the

average demand after retrofit measures, with the difference giving the estimated reduction in fuel demand associated with a single home being retrofitted.

Finally, the number of properties targeted for retrofitting each year was set out for each level of ambition. The cumulative total of retrofitted domestic properties in each year of the projection was multiplied by the average fuel saving to give the total West Midlands gas saving each year, then finally each annual gas reduction multiplied by the natural gas carbon factor to give the reduction in carbon emissions associated with the goal.

All targets for Goal 1 were presented as a total number of homes retrofitted by a certain date, with the assumption that rollout was linear – in other words, the same number of installations are assumed each year until the target is met. The Low ambition for Goal 1 was for all homes in the West Midlands excluding owner-occupier tenure by 2041; Medium was for all homes including owner-occupiers by 2041; High was all homes by 2031; and Very High was all homes by 2026.

5.2.3.2 Example 2 – domestic heat pumps

This goal follows a similar process to Goal 1. It was assumed that retrofit measures have already been installed before a home is eligible for a heat pump installation. Therefore, the annual domestic gas demand for space heating post-retrofit was taken from the calculation in Goal 1. Now, the heat demand met by gas was assumed to be substituted for a heat pump. A coefficient of performance of 2.65 was assumed, meaning approximately 38% of pre-heat pump gas demand was added to electricity consumption, and (space heating) gas consumption was reduced to zero.

As with Goal 1, reduction in gas demand and associated emissions reductions were calculated using the emissions conversion factor. In addition for Goal 2, the increase in electricity consumption needed to be accounted for by multiplying by the projected grid electricity carbon intensity for each year – offsetting a portion of the savings from gas.

Goal 2 also presents ambition levels as total heat pumps by a target date, although not all pathways assume linear rollout. The Low ambition targets 331,000 homes by 2041, following a trajectory "broadly in line with the [UK Government's] Ten Point Plan" (WSP, 2021a, p. 45); Medium targets 550,000 homes by 2041, following the more ambitious trajectory within the Climate Change Committee's Sixth Carbon Budget; High targets a linear deployment until all homes have heat pumps by 2041; and Very High targets linear deployment to all homes by 2026.

5.2.4 Scenarios – framing of the modelling results

Having calculated the carbon savings of all 15 interventions, each at four levels of ambition, there were in theory more than a billion possible combinations of targets[6]. The WSP consultants decided to summarise the results with three representative scenarios, labelled 'Moderate', 'Accelerated' and 'Maximum'. Initially, the consultants had intended to have three scenarios representing "all high, all medium or all low" ambition across the 15 interventions, but after discussions with WMCA officers adjusted a small number of ambition levels to better reflect the officers'

[6] Due to certain dependencies between goals, not all combinations would have been considered valid. For example, choosing the Low ambition for Goal 1 would have invalidated the High and Very High targets for Goal 2, which assumed more homes were retrofitted than had heat pumps.

confidence in their ability to meet the targets – notably, reducing the Ambition on industrial fuel switching in the ‘Accelerated’ scenario (15.WSP).

5.3 The influence of consultant expertise

Consultant expertise was pivotal in shaping the perception that the carbon modelling was a rigorously produced, credible piece of evidence. As there was no capacity within the WMCA officer team to carry out technical modelling, they were “pretty dependent on [WSP]: as in, they were happy that [the consultants] were the experts in this stuff, and therefore we could do the analysis” (10.WSP). Credibility of the consultants arose from a “long track record of doing this kind of modelling, [where] … other [organisations] have employed your modelling and delivered success on the back of it” (01.AC.EC).

One consequence of the use of consultants with such a ‘track record’ of producing similar modelling results was that WSP had developed “a standard way of doing” carbon accounting (01.AC.EC). While this was a positive for reputational purposes, an academic pointed out the inherent risk that reusing a standardised process “stops people thinking in a creative way” (01.AC.EC). They went further, using a mechanical analogy to describe how “consultants at the beginning of establishing a process [for developing plans] do quite a good job… [but] [t]hereafter “just turn the handle” of the same modelling ‘machinery’, with “the value and accuracy of these things diminishes the more that they are deployed” (01.AC.EC).

This raised potential issues of model transparency and therefore legitimacy of the modelling as evidence. The consultants themselves referred to their modelling process as a “sausage machine” that incorporated the necessary data without any need for technical input by local policymakers, meaning that WMCA officers “won't

have seen much of the [input] data" for themselves (10.WSP). This limited the ability of WMCA officers to meaningfully engage with and scrutinise the model design in early discussions, although a lack of modelling skills also inhibited informed conversations at this stage. As one officer explained: "we know that there are assumptions made [within the model], but… I didn't have a particularly detailed, in-depth, techy conversation with [the WSP consultants about the modelling] because I'd soon come unravelled" (09.CA).

Consultants' intellectual property restricted how open the modelling evidence could be. As a result of the consultants' "bits of intelligence in the model" (15.WSP), the model was considered to be proprietary and the model itself was not made public – despite all input data sources being publicly accessible. This was seen as a common barrier to effectively building on previous modelling work: "you get a consultant come in to do a study, they'll give you a number, … it gets battered about [during consultations], and then if something changes… you don't have that data in-house [to update the model]". (22.EC). Despite the frustration expressed by the energy officer, they understood the commercial incentives that prevented WSP from making the carbon model open source: "I used to be a consultant myself, I wouldn't want to give away my model" (22.EC). One civil servant from BEIS argued that, in general, such static models run by consultants were "significantly better than nothing", but that dynamic models that could automatically update as new datasets were published would remove a significant burden from local policymakers "so that you can update these reports without having to go … right the way back to the model every time", and in doing so relieve some capacity constraints that created the need for external support in the first place (23.BEIS).

5.3.1 The outsourcing of quality of evidence appraisal

Despite much being made of the consultants' reputations as modellers to boost the apparent credibility and salience of the carbon model, speaking to them revealed judgements they were regularly having to make on whether to incorporate imperfect data. One spoke about their years of experience working on similar models shaping their own intuition for identifying "reasonably good data sets that we trust for various reasons … we've been doing this [modelling] for so long, I know where the evidence bases are, and I know the evidence bases that are realistic" (10.WSP).

Reputational expertise of the organisation providing the evidence was a key factor considered by the consultants appraising its quality. For instance, they referred to projections for grid carbon intensity provided by the 'Interdepartmental Analyst Group'. The consultant "[didn't] know who they are… but… that's [the] industry standard" (10.WSP). Frequently, by relying on evidence sources with good reputations that they knew about from their years of experience, consultants turned to national government and other UK-wide organisations to source several statistics. For instance, the domestic retrofit measures analysed in Goal 1 (such as cavity wall insulation and double glazing) each had an energy saving potential and an applicability percentage found from sources including government housing statistics, public polling and independent bodies such as the Energy Savings Trust (WSP, 2021e, p. 2).

To make these national-scale statistics salient to the West Midlands, scaling factors were found to approximate values for the West Midlands. These scaling factors used other statistics that were available at local granularity, such as population,

number of dwellings, GVA or commercial floorspace. Thus, a national-scale statistic could scaled by the West Midlands population as a proportion of the UK population, for example. Using this technique, one consultant described how they "can go from that big[-picture data] down, I can make it a bit more granular" (10.WSP).

The drawback to this was that statistics were often only available at national scale, so additional assumptions that the West Midlands was a good match for the UK or England as a whole had to be built in to the model – as set out above in Example 1 of the target for domestic retrofit. One consultant acknowledged that this method did have drawbacks: "obviously it's not quite right, it's using a lot of estimates and benchmarks" (10.WSP).

In contrast with the approach taken within the carbon model, one WMCA officer acknowledged the issue that disaggregation of top-down models in general "becomes more and more meaningless the lower you push it" to more local scales. In this case, they were justifying why it was not worth "tying ourselves up in knots" trying to disaggregate the Tyndall Centre budget further to local or neighbourhood levels due to the reduced salience (26.CA). A civil servant from BEIS shared a similar concern that this approach to 'cutting' national datasets into subnational areas was dubious and affected the credibility of evidence: "at the moment, a lot of those data sets [useful for net zero strategies] are national. They are then cut, and we all know what happens to data when you give it to a scientist to cut … what's the expression, 'statistics, lies, damn lies, and statistics',… you can make a data set say what you like when you start cutting it" (23.BEIS).

The use of national-scale statistics was most striking when modelling commercial and industrial fuel use for Goals 4, 5 and 7, since “no area-specific data [was] available” for the West Midlands (WSP, 2021a, p. 24). The consultants acknowledge in the plan that “[t]his approach is not ideal”, but justify their approach by arguing that the West Midlands is “reasonably representative of the wider country” (2021a, p. 21). However, a closer look at data on the distribution of commercial and industrial businesses in the region suggests that the West Midlands has a greater than average manufacturing base, and its relatively high number of smaller businesses likely alters the distribution of fuels used across the sector (see Figures 10 and 11 below). This discrepancy in the modelling due to the use of national-scale statistics reduces the credibility and salience of the evidence.

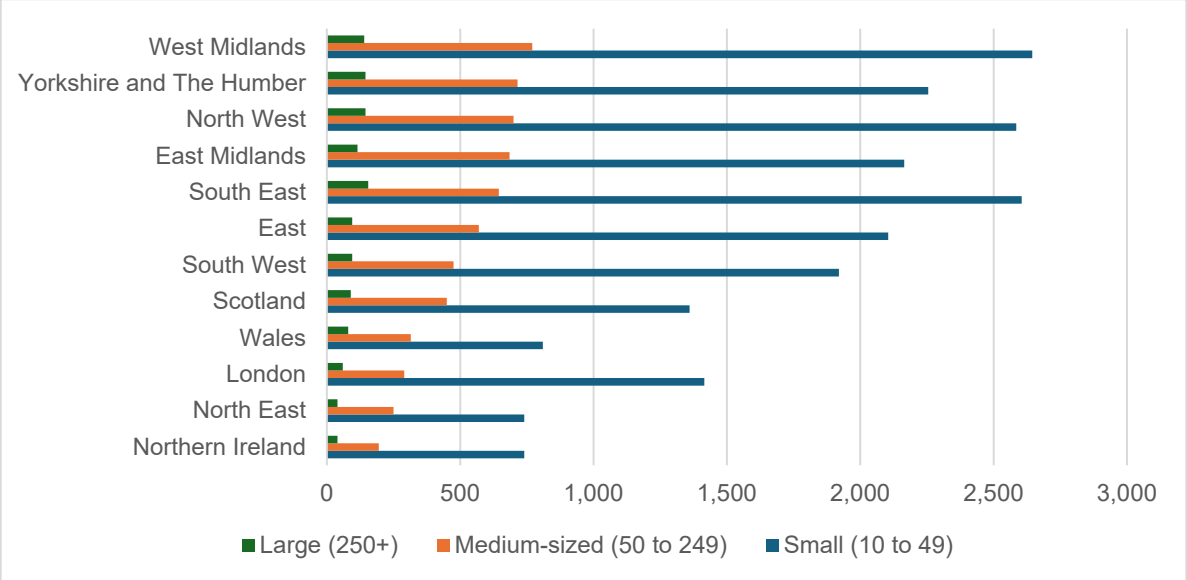

Figure 10 Number of small, medium and large industrial businesses by UK statistical region. The West Midlands has the greatest number of small and medium businesses of any region. (West Midlands Industrial Energy Taskforce 2023a, p.3)

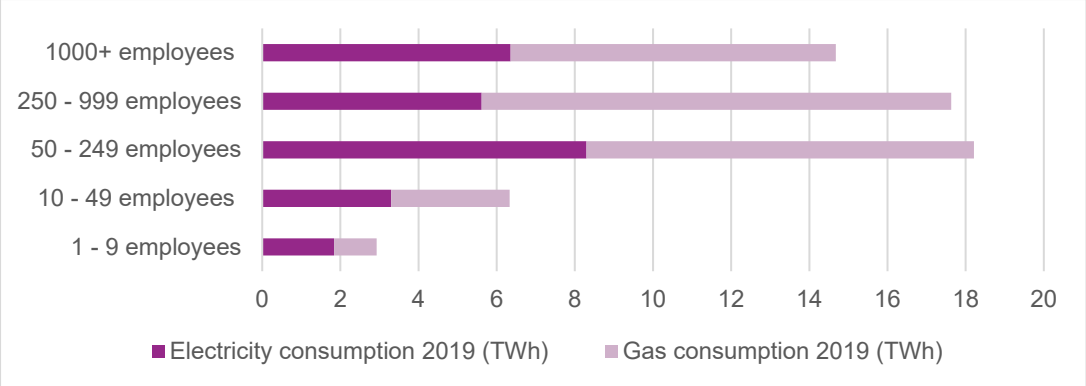

Figure 11 Electricity and gas consumption by factories by business size, 2019, from Non-domestic National Energy Efficiency Data Framework (ND-NEED) (DESNZ, 2021). Medium-sized factories account for disproportionately high energy consumption.

A civil servant from BEIS also expressed similar doubts in the credibility of SCATTER, a modelling tool developed by BEIS and regularly used to produce local net zero strategies by other consultancies (for example, net zero plans for Solihull and Birmingham Councils (Solihull Borough Council, 2021; Anthesis, 2020)). They found that using SCATTER modelling:

> bizarrely, Greater Manchester and Leeds, … both need to be net zero by 2038" to be compliant with the Paris Agreement … [P]art of me thinks that that's rubbish – it's just that the data we fed in is so generic, that's the only answer that would come out if you have a city of a certain size, because you've averaged everything to a point where when you add up all the averages, it's going to be an average answer (23.BEIS).

5.3.2 Granular data sources were generally overlooked or unavailable

In contrast, stakeholders other than the consultants saw greater value in data that was locally contextualised, or pertained specifically to the local area. For instance, the Document Review Appendix references a *Black Country Utilities Infrastructure Capacity Study* (WSP, 2021c, p. 4). This study identified "four strategic centres" within the Black Country, as well as constraints on the electricity grid that could

cause problems for future developments (2021c, p. 4). However, such issues are not taken into account in any of the modelled goals; potential risks to the delivery of the goals are identified (see WSP, 2021a, p. 90), but not quantified. An academic said that as a result of the model structure “aggregating” all measures at a regional scale, without considering local variability, “you begin to lose some of the granularity which is important in the decision-making process” (01.AC.EC), thus reducing local salience of the evidence.

There were occasional examples of the model taking more locally specific evidence into account. Some data sources used were specifically produced at a local level using ‘bottom-up’ modelling techniques – aggregating analysis done on a building-by-building basis across the region. For example, when estimating the potential for solar panels on domestic buildings, the consultants used a GIS study done on all buildings in Birmingham (CSE, 2017) as a starting point. This study analysed generation potential based on solar irradiance, roof area and pitch for individual buildings, as well as land suitable for ground-mounted solar panels. However, rather than extend this geospatial modelling approach to all buildings in the West Midlands, the total potential energy generation was extrapolated by scaling by number of dwellings in the West Midlands relative to those in Birmingham. This aggregation would likely have been fairly accurate for buildings alone, but the inclusion of ground-mounted solar would likely have skewed the final value, since the number of potential sites would likely have been higher in less densely populated areas of the region such as Solihull. To improve credibility, the final targets were “validated by comparing against regional Western Power Grid [the Distribution Network Operator] projections” (WSP, 2021e, p. 3). However, this study used an entirely different definition of the West Midlands boundary only found in

electricity network planning (see Figure 12), which excluded all of Coventry and a large section of Solihull, and extended far into the more rural areas of Warwickshire, Staffordshire and the Marches – casting doubt on the validity of the comparison. Due to the lack of public access to the Birmingham solar study, it was not possible for me to scrutinise the discrepancy in more detail.

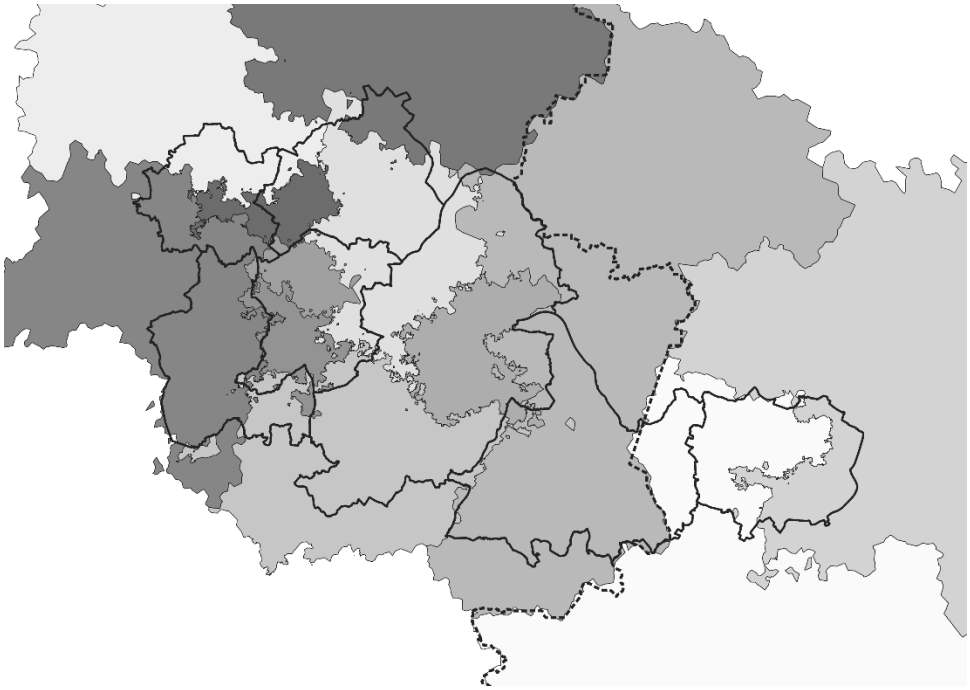

Figure 12 The boundaries used by the Distribution Network Operator do not align with administrative boundaries: WMCA local authority boundaries (in bold), boundary between East Midlands and West Midlands ESAs (electricity supply areas) (dotted line), and GSP (grid supply point) areas in shades of grey. Each GSP is served by a transformer which connects a region of the distribution network to the transmission grid.

Similarly, with GIS analysis carried out by WSP specifically for the Five Year Plan, several of the assumptions made were given little justification. When estimating potential for wind turbines, the assumed density of turbines in MW per hectare was drawn from a regional study (for the wider West Midlands region including several rural counties) that was ten years old, despite significant technological advancement in the intervening years (Enevoldsen and Jacobson, 2021), casting doubt on its credibility. Validation was sought by comparing with the real-world energy densities of wind farms. However, the farms used were all more than ten

years old and were located in parts of the UK with significantly different wind conditions to the West Midlands (Met Office, 2015). Recent studies suggest that the 9ha per MW requirement assumed for farms larger than 20ha could be almost half the current technological potential (Enevoldsen and Jacobson, 2021).

Although the consultants' modelling approach was in general not amenable to incorporating locally-specific data, the fundamental lack of public access to such datasets, where they exist at all, was also a clear factor. One participant pointed out the difficulty of obtaining real time energy system data because private "monopolies who control [that] data … [are not currently] required to share that data" (04.EC.LEP). A BEIS civil servant observed that "local data sets on energy and net zero are particularly poor", and that this was not a problem unique to the West Midlands but "one of the big problems that we face" nationally (23.BEIS). They went on to say it was a bigger problem than commercial licensing: "there are fundamental issues with [local] data … I was stunned at how little data some DNOs have on some areas of their energy network. I kind of thought they'd know how much capacity they had in a[ny particular] bit of wire – no!" (23.BEIS).

This barrier was recognised by the consultants: one described having "to use real, crunchy data sets and iffy data sets" to populate the model with its required quantitative parameters (10.WSP). However, the prioritisation of quantitative evidence within the carbon model meant that data availability was a higher priority than data quality, so on balance it was still seen as a valid approach in order to start from somewhere – what one consultant coined the "realpolitik of modelling" (10.WSP).

5.4 Uncertainty and ambiguity

Despite the strong bias observed towards quantitative data, no quantitative uncertainty analysis was performed on any of the scenarios produced by the carbon model. Consultants described their modelling process as “pretty rough and ready… [without] using massively robust statistical techniques” (10.WSP), and believed that their treatment of uncertainty was appropriate for the type of “high level“ analysis they were doing: “we were covering the whole of society, the economy, in a single project. So I guess there was an understanding that, obviously, it's approximate” (15.WSP).

However, comparison of goals with the other available major subnational scenario analysis, DFES, casts doubt on the claim of ‘approximate but good enough’ analysis. For example, the largest contribution to emissions reduction from the 15 goals came from the target for domestic heat pumps, accounting for a reduction of approximately 500 $ktCO_2$ by 2026 under the ‘Accelerated’ scenario. In the 2020 DFES, even the most ambitious scenario, ‘Leading the Way’, projects a significantly slower rollout. In particular, the mid-2020s annual totals are half the value of WSP’s estimates – despite the DFES methodology in 2020 including all domestic and non-domestic heat pumps (see Figure 13). Although it has not been possible to reverse engineer WSP’s carbon model with perfect accuracy, the relationship between annual emissions savings and total number of heat pumps installed is near linear, with non-linearity due to the decrease in grid carbon intensity over time. Therefore, by assuming much greater levels of heat pump adoption, and in particular at a higher rate in early years, both annual and cumulative reductions are much greater than they would be under DFES assumptions.

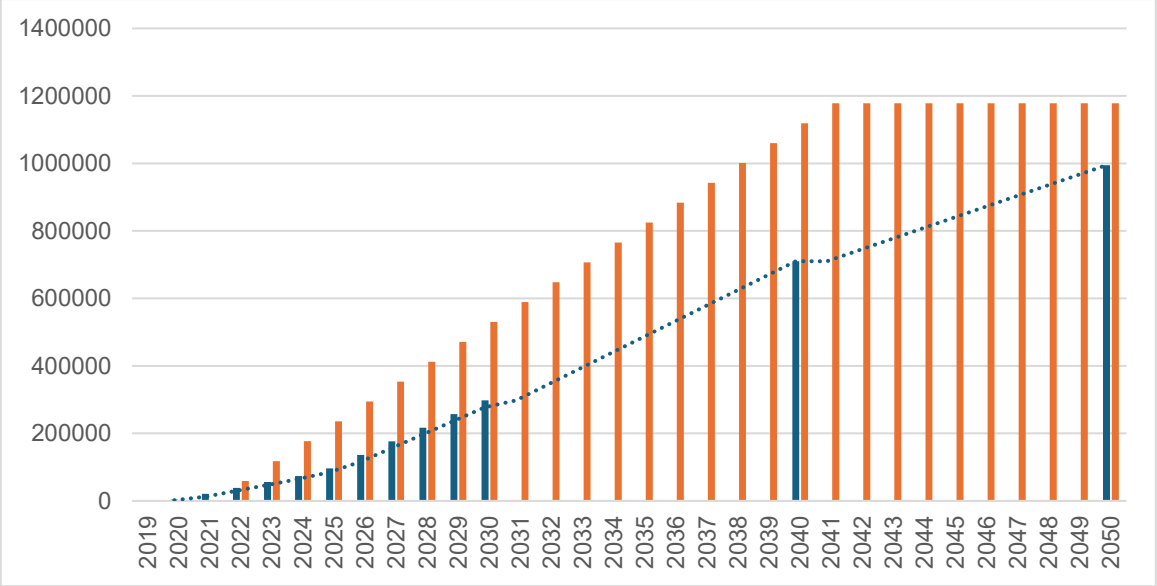

Figure 13 Comparison of heat pump rollout scenarios in the Five Year Plan (orange) and 2020 DFES (blue)

In fact, the plethora of methods used for emissions accounting enabled the consultants to perpetuate ambiguity, and therefore argue that further analysis – particularly comparative – would be redundant. One of the consultants pointed to the relative 'youth' of emissions accounting as a policy tool as a reason for incompatibility of different studies: "there is a certain level of inconsistency" of carbon accounting "in general" (15.WSP). Since both the scope of emissions to be accounted and the baseline against which to compare future emissions are "up to the choice of the client… they're not directly comparable" between different consultancies (15.WSP).

For some policymakers, the model did not go far enough in addressing uncertainty about the route to net zero. In particular, because the model was "just a spreadsheet that's static" (10.WSP), it did not allow for more "adaptive" explorations of potential futures beyond the consultants' contract with the WMCA (22.EC). One consultant acknowledged that very soon after the publication of the Five Year Plan, "the projects and actions that we've assumed [in the plan likely]…

start to diverge from" reality (15.WSP), significantly limiting the salience of the model beyond formal approval and meaning that the entire model would have to be re-created for a second plan five years later.

One energy officer also believed that the lack of further analysis of the three scenarios undermined the salience of the model as the central evidence underpinning the plan. In particular, they believed that further scrutiny of the "intangible, conceptual things that need to shift underneath [the 'Accelerated' scenario] to achieve [its] goals" was necessary beyond simply acting as a "means of holding ourselves to account" (22.EC).

5.4.1 Modelling assumptions and parameters

The consultants described a number of ways in which they made the assumptions within their model to maintain credibility and robustness. A common technique used was to choose 'conservative' parameters within the model. Consultants described this as a "careful" approach to making assumptions (10.WSP). This included choosing values of static parameters that were known to be underestimates, such as the solar capacity factor in the West Midlands equivalent to 850 kWh/kWp annually (p. 3) when several other sources assume this to be at least 900 kWh/kWp (Solargis, nd; European Commission, nd). Elsewhere, they "refrained from relying too much on new technologies" (15.WSP) without evidence that such technologies would emerge. For example, one consultant explained that their retrofit goals assumed that LED lighting efficiency "just … stays at 100 [lumens per watt]", even

though “if you go to industry, they'll tell you it's going to be doing 300 lumens per watt by 2030” (10.WSP)[7].

Similarly, the consultants tried to ensure credible modelling assumptions by including in-use factors for reduced efficiency of real world implementation of technologies:

> when someone puts in loft insulation, … they leave gaps [which reduce its performance.] [Likewise,] if you buy a boiler, it will say it’s 90.1% efficient. In use, … it's nearer 75[%], because you turn the boiler on and off rapidly, so you get losses (10.WSP).

Thus, the inclusion of in-use factors ensured that the potential of technologies to achieve emissions reductions was not overestimated.

In other cases, not even ‘conservative’ quantification was attempted due to the inherent deep uncertainty of systemic changes over a number of years. For example, on the potential role of hydrogen in “industrial decarbonisation… WSP didn't even cost that, because there are too many unknowns” (09.CA). However, this was only observed in the economic modelling; due to the priority placed on quantifying the carbon impacts of the 15 goals, the carbon model was entirely quantitative. Here, the five-year timeline of the plan was seen as a mitigation, as the next plan in 2026 would be able to assess technologies when some uncertainties may have been resolved. As one officer described: “we were quite clear in saying that the reason it was [framed over] five years is we don't know what's going to happen with a lot of things … like carbon capture and storage – is

[7] This interviewee gave the value of 100 as an illustrative example for comparison, not to give the exact value they took into account.

that something that's really going to take off?" (09.CA). Thus, if new technologies did 'take off' in the intervening years, new goals could be added or assumptions about their influence on existing goals could be taken into account.

Another way in which consultants sought to ensure credibility of assumptions was by drawing on social scientific concepts. One consultant spoke about how theories of the diffusion of innovation were considered in their plan, referring to 'S curves' of new technology adoption (15.WSP). However, implementation was mixed. As illustrated in the examples above, although rollout of domestic heat pumps in Goal 2 was assumed to follow an 'S curve' for the Low and Medium ambition levels, the High ambition – which was incorporated in the 'Accelerated' scenario, and is the single largest contribution to emissions reduction – instead follows a linear trajectory.

Other social phenomena, such as behaviour change, were treated in a similarly patchy way. The transport goals were the only ones that did account for behaviour change, since consultants could "specifically… [adopt modal shift] targets from the Movement for Growth strategy" published by Transport for West Midlands in 2016 (WSP, 2021e, p. 8). Elsewhere, the "widely recognised… 'rebound' effect" (WSP, 2021e, p. 2) – which explains the increase in domestic energy demand observed following retrofit – was excluded from the analysis of efficiency goals with no explanation, despite the consultants acknowledging that this would "reduc[e] the amount of energy savings eventually achieved" (2021e, p. 2).

For some goals, quantitative data was not used directly as a model parameter, but instead performed the anecdotal function that qualitative case studies played elsewhere in the policy process. For example, the consultants made assumptions

about the practicality of different levels of ambition for goals that relied on widespread electrification, such as domestic heat pumps in Goal 2. They described how high ambition, that may have been challenged by the DNO responsible for providing the supporting energy infrastructure, could be justified as credible with data:

> [Octopus Research] shared with me a dataset of 1000 homes in London that have been retrofitted with heat pumps … The peak demand, ADMD [After Diversity Maximum Demand], as they call it, [was] 1.8kW… If you asked a DNO what they would assume that was, you'd be talking crazy numbers – 4, 5, 8[kW] … so I think it's going to be a lot easier than [the DNO] think[s] (10.WSP).

However, similar insights based on qualitative evidence struggled to have a substantive influence on the model assumptions. In particular, stakeholders with specific areas of expertise, such as the Wildlife Trust, were consulted in workshops and provided qualitative insights into the challenges of implementation. These were, however, glossed over in the model's assumptions; whereas the consultants modelled the entire natural capital intervention as tree planting a uniformly spread native tree mix, "the Wildlife Trust said the problem with that is … you don't pick up on … the really important stuff – the smaller projects. It's not all about trees – it's about hedges, and things like that (10.WSP). Here, the high-level nature of the model meant that, despite the expert opinion that it was salient to consider, such granular analysis was "just too small and bitty to get into [the model]" (10.WSP).

I also identified several pieces of quantitative evidence within the model that invoked reputational credibility without further justification. Several parameters

were said to have been “obtained from Government data“ (WSP, 2021e, pp. 2, 8), or simply stated with no justification at all, such as the values given for heat pump coefficients of performance (p. 2), or the usable life span of a car (p. 9). Elsewhere, multiple national datasets were used that provided different values for the same characteristic. When estimating the potential of domestic retrofit, the number of homes in the West Midlands was determined from the Office for National Statistics’ ‘(ONS, 2019)alternative estimates of subnational dwelling stock by tenure’ (2021e, p. 2). These estimates were used so that different dwelling tenures could be targeted in levels of ambition, so that private housing that was less easily influenced by the WMCA was only included in higher ambition targets. Elsewhere, for the domestic solar PV intervention, the more commonly used council tax stock of properties dataset from the Valuation Office Agency was used (2021e, p. 3). While the totals are within less than 1% of each other (1,165,420 and 1,178,260 respectively), the breakdown by tenure contains considerable uncertainty; the count of private rental dwellings in Dudley for instance is “considered unreliable for practical purposes” according to the dataset’s own ‘statistical robustness’ rubric (ONS, 2019).

5.4.2 Scenarios – tension between salience and credibility

The primary way in which the consultants sought to address high levels of uncertainty and ambiguity was by presenting the modelling outputs in the form of scenarios. The fact that multiple pathways were produced was seen to communicate a range of possible outcomes, and that the ‘Accelerated’ scenario in particular, and the modelling in general, “was pretty clear as to what it was assuming and calculating” (15.WSP). Indeed, one consultant believed that the

inclusion of more than one pathway would encourage an interpretation of the scenarios as exploratory, “rather than trying to predict the future” (15.WSP).

However, the inclusion of only three scenarios that led politicians to ‘adopt’ a single scenario – indicating a more ‘predictive’ interpretation. One consultant described the inherent challenge in communicating such modelling results: “It's always a tension… you want to simplify it [the modelling] for the end user, but you also want to give them confidence that you’ve gone through a robust methodology” (10.WSP). They described how, in their experience, three scenarios provided an appropriate balance: “it was always our intention to run three scenarios…[because] it gives you a higher bound, the lower bound, and somewhere in between” (10.WSP). The consultants acknowledged the risk to evidence legitimacy. Because such a framing encouraged ‘choosing’ a scenario, and there were clear reasons given not to choose the most or least extreme, scrutiny may have been more limited than if a larger number of scenarios had been presented. In particular, one consultant wondered whether politicians may have been unaware of the scale of the ambition they were agreeing to by adopting the plan: “when you talk to [local authorities that have committed to net zero], clearly, the ambition doesn't match their plans, by far. So it is possible that some of that is taking place here” (15.WSP).

In fact, consultants described political pressures that influenced the way in which the scenarios were portrayed in the policy document. From the consultants’ perspective, they were presented with a challenge when “it became clear that that [Tyndall Centre carbon budget] was really not achievable” following early modelling results (15.WSP) due to the unrealistic level of ambition that would be required. They were aware of the political imperative to produce a solution-focused plan that did not immediately dismiss earlier targets as unrealistic: “there is a risk of

politicians can say, ‘we just paid you a load of money to tell us how to do it [reach net zero], not how *not* to do it!’” (10.WSP). On the other hand, officers were concerned that “they would be criticised for lacking ambition” (10.WSP) by activist groups that had been arguing from the outset for an earlier net zero target date (25.CA), and at the very least the 2041 net zero target needed to be kept due to its symbolic commitment in the name of the *#WM2041* work programme.

To resolve these issues, the consultants used the ‘Maximum’ scenario to frame the ‘Accelerated’ scenario “just to illustrate the scale of what was needed [to meet the original Tyndall Centre budget] … as a way to justify why we couldn't commit to that” (15.WSP). They also invoked their expert reputation and external position to depoliticise the adoption of the ‘Accelerated’ scenario: “we were trying to say, how can you be very ambitious, but not completely ridiculous, and … in [our] professional opinion… we think [the Maximum scenario] will be very challenging, [so] we recommend the [‘Accelerated’] scenario” (10.WSP). As a result of this reframing, the ‘recommended’ scenario no longer met either the original requirements specified for the Five Year Plan or the interim targets adopted by the WMCA Board at the same time as the 2041 deadline. Thus, the framing of the policy problem as remaining within a carbon budget had now been abandoned.

The approach to creating scenarios adopted by the WSP consultants was contrasted with other regional scenarios tools. In the Distribution Future Energy Scenarios (DFES) produced by Western Power Distribution (now National Grid Electricity Distribution), four exploratory scenarios are produced – Falling Short, Consumer Transformation, System Transformation and Leading the Way. Crucially, three of these four scenarios are compliant with the national net zero target of 2050 and are all described as credible pathways. Furthermore, as part of the

development of the DFES, scenarios undergo a process of ‘reconciliation’ with the national-scale Future Energy Scenarios to ensure consistency across the country and credible comparison between regions.

In the West Midlands, the DFES were scaled down further to a city-scale during the RESO (Regional Energy Systems Operator) research project led by the WMCA energy officers. They identified this as a more beneficial scenario modelling exercise because, unlike the single valid output of WSP’s modelling, “we don't have one answer, we have a range of different things that we could do” (22.EC). In particular, they referred to the ability to identify “least regret or no regret options” for investment – thus, improving robustness – by looking for similarities across different scenarios: “whether this fails or that fails [according to different scenarios] … actually there's something that we can do that mitigates all of those things, so that's a sensible investment for us to make now” (22.EC).

5.5 Conclusion

In summary, I have presented my findings on the use of evidence in the development of WSP’s carbon model. I have shown that the expert reputation of the consultants gave them significant control over the modelling process, raising concerns about legitimacy of evidence use. Furthermore, with control of the process, the consultants were responsible for choosing appropriate evidence to build the model. In general, evidence quality was appraised based on the reputation of the evidence producer, leading consultants to favour national-scale evidence sources over local evidence. As a result, very little granular evidence salient to the West Midlands was used – although a limited available supply of such evidence was also a factor. In addition, the consultants viewed the ambiguity of

emissions modelling in general as justification for addressing uncertainty within the carbon model in very limited ways. I found that they believed making ‘cautious’ modelling assumptions and presenting the model outputs as multiple scenarios was sufficient to maintain credibility of the model as evidence. However, wider stakeholders found this to be insufficient, given the framing of the ‘Accelerated’ scenario as the only realistic pathway to net zero, and the commercial restrictions on the underlying data of the model that limited scrutiny which undermined the credibility, salience and legitimacy of the model as evidence. Having presented my empirical findings, the next chapter will discuss the implications of these results in the context of the wider literature.

Chapter 6: Discussion

6.1 Introduction

In this chapter, I bring the findings of my empirical research into dialogue with the evidence-based policy literature. In doing so, I aim to draw out the significance and originality of my findings, situating them within the wider field.

To do this, I begin by reviewing a summary of my findings (6.2), identifying clear links to previous scholarship following the structure of my three research questions. After this summary, I turn to three cross-cutting themes that tie together the findings of the main and sub-case studies. First, I will discuss the finding that quantitative evidence was more prevalent and influential than qualitative evidence (6.3.1). I will examine the implications of this bias on evidence use in local settings. Second, I will discuss the way in which the perceived expertise of external consultants shaped the use of evidence, as well as the extent to which the lack of embedded analytical capacity prevented deeper consideration of evidence on energy system impacts (6.3.2). Third, I will discuss how ambiguity and uncertainty were perpetuated by evidence, rather than reduced (6.3.3). In doing so, I will demonstrate how the complexity and ambiguity of net zero within local contexts was responsible. Linking these three themes, I argue that the lack of capacity in subnational governance bodies inhibits their ability to leverage an advantageous position within a multilevel governance structure to develop place-based policy (6.4).

I then reflect on the key contributions of this research to the evidence-based policy literature (6.5). Finally, I consider next steps for further development of this research (6.6).

6.2 Summary of key findings

6.2.1 Policymakers recognise many types of ‘evidence’

I found that interpretations of ‘evidence’ were broad among policymakers who developed the Five Year Plan. I found that quantitative evidence sources, such as WSP’s carbon model and government statistics on annual energy consumption by local authority area, were seen as valid. Likewise, qualitative evidence provided by stakeholder consultation workshops, policy reports and other ‘grey’ literature, and case studies of successful projects in other local settings were also perceived as evidence. This concurs with the findings of critical evidence-informed policy scholars that evidence beyond scientific research outputs is considered valid by policymakers (Cheetham et al., 2022; Smith, 2013b, p. 3; Parkhurst, 2017).

Indeed, there were no examples of bona fide scientific research that were found to directly inform the policy process, as the ‘what works’ school would suggest is required. The evidence which most closely resembled scientific research was the IPCC’s Special Report on 1.5°C, which was authored by scientists and underwent review processes akin to academic peer review (IPCC, 2018, p. viii). However, this was not the most influential form of evidence that conveyed the importance of net zero. Instead, West Midlands politicians’ attention was captured by subsequent case studies of other local authorities’ targets, national policy agendas prioritising net zero, and the re-contextualisation of the carbon budget to a regional level by the Tyndall Centre.

Despite the lack of ‘scientific’ evidence, the preferences for quantitative and generalised evidence types deriving from traditional evidence hierarchies were very commonly found. Most significantly, the quantitative modelling evidence produced by WSP ‘underpinned’ the entire policy. The carbon model and the economic modelling, which produced the marginal abatement cost curve, both produced generalised quantitative outputs. Although they were minimally contextualised to provide information specific to the West Midlands, the models overwhelmingly considered mostly generic actions that could be implemented anywhere. They used average-types with imperfect disaggregation techniques rather than locally contextualised or granular data, with a small number or exceptions. Those few exceptions included the use of geospatial analysis to determine suitable land area to build renewables within the WMCA border, and a previous study carried out on an individual building granularity to assess the potential for rooftop solar generation in Birmingham.

Also concurring with the critical perspective was the value placed on local knowledge as evidence. This was demonstrated during the agenda setting and formulation stages, which both emphasised the findings of large stakeholder engagement exercises. Similarly, the establishment of a Citizens’ Panel following the adoption of the policy sought to ensure ongoing activity was informed by the perspectives of local people. However, looking at the development of the model specifically, I found that a much more limited set of evidence sources – in particular of local evidence – was used. This was due to the selection of suitable evidence being made exclusively by consultants, since no WMCA policymakers had the requisite technical skills to develop the model.

6.2.2 Multiple uses of evidence throughout policy development

I observed many of Weiss's (1979) models of evidence utilisation throughout the policy process. Policymakers and consultants emphasised the broad consultation processes that were ongoing throughout the development of the Five Year Plan. They conveyed an image of co-produced evidence within an ecosystem model (Best and Holmes, 2010). I also found clear differences in utilisation models in the policy cycle stages. During agenda setting, an 'enlightenment' model was observed in the use of national policy reports, such as the Prime Minister's 10 Point Plan, and case studies of other local and regional authorities setting targets. These all brought net zero to the attention of policymakers and conveyed a consensus framing of the problem. Namely, that the important components were a deadline year by which emissions should reach net zero, alongside economic opportunities and costs of sectoral interventions, such as 'domestic buildings', 'heat pumps' or 'electric vehicles'.

During policy formulation, the carbon model developed by WSP served as a way of marking these sectoral categories as important (see Pearce, 2014), while also enabling comparison between them in a more interactive utilisation model. On the other hand, I found 'problem-solving' and 'political' utilisations of the carbon model by WMCA officers and politicians who lacked technical expertise.

Government statistics on energy consumption and carbon emissions were used to support the argument that the fundamental aspect of achieving net zero was to 'electrify everything'. Within the carbon modelling, some quantitative evidence was used as 'data' (Weiss, 1991), such as the number of homes in the West Midlands used to construct emissions savings estimates. Others quantitative evidence,

including the Octopus research on grid impacts of heat pumps, instead conveyed an evidence interpretation as ‘ideas’. Finally, quantitative estimates for costs of the recommended interventions were interpreted as evidence ‘arguments’, intended to make the case for more local resources. Emissions and energy consumption statistics were also used for the monitoring of the policy, demonstrating that the same evidence could have multiple uses and meanings throughout the policy cycle, in accordance with previous critical studies (Oliver and Pearce, 2017, p. 2; Rickinson and McKenzie, 2021, p. 483).

By capturing all stages of a policy cycle within this research, I have been able to track the changing uses of evidence throughout the policy process. I have shown how the same evidence can be used multiple times throughout a policy’s development. Furthermore, I have shown that the same evidence tends to be utilised in different ways at different stages. In summary, I have confirmed Cheetham et al.’s (2022, p. 3) finding that evidence use in UK local government is “nuanced, dynamic, political and contested”.

6.2.3 Different evidence serves different purposes

Regarding the justifications for using evidence, I found arguments grounded in salience, credibility and legitimacy (Cash et al., 2002). Different evidence types were used to support each of these justifications. Modelling served to increase credibility by supporting applications for further resources to deliver net zero locally. It also increased salience, by providing quantitative comparisons of different targets, giving policymakers a better understanding of the investment priorities for achieving net zero. The use of government data increased credibility, since it was seen as a reliable and trustworthy source of information, however as monitoring

evidence, its salience was reduced by the two-year publication delay. Stakeholder consultation evidence was seen to increase legitimacy by demonstrating the breadth of opinion that had been taken into account throughout the policy process.

However, a closer look at the process of developing the model painted a very different picture. Uncertainty was treated very lightly, with widespread simplifications and assumptions made with little or no justification. Just three model scenarios were presented in the final policy, despite the model's capacity to produce many more. Only one was presented as achievable and meeting the needs of policymakers. Contextual, place-based factors were poorly reflected due to the lack of granular analysis and average-type techniques used to disaggregate national-scale data.

6.3 Overarching themes of the case study analysis

In this section, I identify three key themes that emerge from the overall research. I consider both holistic and sub- cases together and identify the significance of these themes in the context of the evidence-based policy literature. These themes are the primacy of quantitative modelling evidence, the primacy of external consultants, and the pervasive ambiguity and uncertainty of local net zero policy.

6.3.1 The primacy of quantitative modelling evidence

I found that quantitative evidence (especially modelling) was far more influential in the local net zero policy process than qualitative evidence. I argue that this bias was driven by policymakers' perceptions of how quantitative evidence increased salience, credibility and legitimacy. However, viewed through a place-based lens, I claim that overreliance on quantitative evidence in fact reduced salience, credibility and legitimacy.

As many others have found (for example Asayama et al., 2019; Pearce, 2014), the environmental and economic framings of net zero led policymakers to perceive quantitative evidence as more credible than qualitative. In the West Midlands, these were the two dominant policy framings. Carbon accounting was seen to address concerns of the Environment team. Energy Capital, reporting to the Strategic Economic Plan Board before the Environment Board expanded its remit, focusing on a framing of investment opportunities and costs. Numbers were seen to give the Five Year Plan a rigorous foundation. Politicians referred to their net zero target as 'science-based', invoking the reputational credibility of the experts responsible for its calculation. Indeed, credibility was rooted in precise quantitative evidence. As one interviewee (25.CA) suggested, the specificity of the 2041 target, as opposed to a 'rounded' 2040 target, increased credibility. The extra significant figure conveyed a sense that the target had been 'calculated' rather than 'plucked out of thin air'.

Similarly, a quantitative framing enabled a significant simplification of the policy problem. By limiting the framing of sustainability, first to general emissions reductions, then to a carbon budget, and finally to a net zero target date (see Asayama et al., 2019). Evidence became most salient to West Midlands politicians and officers when it demonstrated clearly how a proposal contributed to achieving the net zero target, and how it compared to other proposals. For such comparisons, as MacKay identified, 'numbers not adjectives' provide more salient evidence (2009). Simplified evidence was also seen to be more salient in a policymaking environment with limited embedded analytical capacity. Simple, approximate numbers were used to weigh the comparative value of different policy choices. These numbers were ideally suited to a more linear model of evidence, in which

external consultants fed into the policy process. This was because they had limited time to spend on this specific project and had to work within the pre-defined scope, limiting any additional analysis requirements.

Finally, and to a lesser extent than credibility or salience, quantitative evidence was seen to increase legitimacy. The perception of quantitative evidence was as an objective, value-free analysis of the potential solutions that the WMCA could implement to achieve net zero. As discussed above, the acknowledgement of scientific underpinnings of the policy was utilised by politicians and officers seeking to demonstrate the consensus-based approach taken where the evidence 'spoke for itself'.

However, despite a commonly observed belief that quantitative evidence served to improve the policymaking process, my findings cast doubt on whether in practice quantitative evidence served to increase credibility, salience and legitimacy in the context of local net zero. By placing such great emphasis on the importance of quantitative analysis in a combined authority with very little analytical capacity, consultants had to be contracted to carry out any significant quantitative analysis. The analytical process undertaken by the consultants, though, was one which did not serve to maximise the influence of local stakeholders, or locally contextualised evidence. Instead, the 'sausage machine' process described by interviewees was one in which the consultants 'turned the handle' on a modelling process which prioritised transferability to other contexts. This created future opportunities for the consultants to generate revenue resulting from a single investment in model development. This was clear from the initial presentation WSP gave to the Environment & Energy Board, which contained an outline of what became the carbon model. Even at that early stage the schematic resembled the final structure

very closely, with only difficult-to-quantify goals such as ‘system management’ excluded from the analysis.

When consultation did occur, it was not able to have a significant influence on the policy process, as decisions on the structure of the model design had already been made by the consultants before significant stakeholder engagement began. The lack of transparency of the model, due to the model’s commercial confidentiality as intellectual property of WSP, also obscured the model’s construction. Thus, the emphasis placed on modelling evidence served to reduce the local legitimacy of the Five Year Plan’s evidence base.

Another consequence of the transferability of the consultants’ modelling design was to generally overlook locally bespoke data sets. Instead, they favoured national government statistics that could easily be used to apply the model to any UK locality without needing to find a new data source. Although some local data was used, government energy consumption statistics served as the foundation of the model. This engendered a top-down model (Hourcade et al., 2006) which made it systematically challenging to integrate local data sets. Thus, local knowledge from within the West Midlands struggled to influence the model framework, which undermined local salience of the policy’s central evidence source. For local politicians, whose potential to implement change lay in place-based interventions, the siloed, sectoral structure of the model was not relevant (UK100 and Quantum, 2021; Coxcoon, 2019).

Even with a sectoral approach – found to be very common in energy modelling more generally (Bale et al., 2015) – the consultants developed a model based on annual energy consumption. They declined to analyse peak demand loads on the

energy infrastructure, or the spatial distribution of energy generation and demand. Instead, to minimise their costs in developing the policy, the consultants drew on the most readily available government statistics (annual energy consumption by local authority) and the simplest static carbon accounting modelling technique. In doing so, they neglected to analyse the true energy system impacts of the proposed interventions. Since the true energy system impacts were determined by peak loads, this significantly limited credibility in the eyes of energy stakeholders. Furthermore, the presentation of model results as a very small set of scenarios, in which only the impact of one scenario was considered beyond the accounting exercise, significantly limited the credibility of the way in which uncertainties were addressed by the plan.

The consequences of using simplified quantitative evidence included the dissociation of the policy from its underlying evidence base. The simple 2041 target signalled the ‘evidence-based’ approach taken in developing the Five Year Plan, and was referred to as such. However, the supporting evidence base soon lost credibility; delivery in practice fell well short of the targets included in the Five Year Plan’s analysis. This undermined the derivation of the 2041 target date, which was based on remaining within a cumulative carbon budget. The budget required early annual reductions to be the largest, allowing for more years at a lower emissions rate.

The modelling literature suggests that there is always a trade-off between two factors; model complexity, which can enhance its credibility, and model simplicity, which enhances salience to policymakers (Saltelli et al., 2020, p. 484). Two aspects of local net zero make this trade-off more difficult to evaluate: the complexity of the energy system, and the lack of sufficiently granular data.

The challenge of capturing the spatial heterogeneity of impacts and the real-time nature of energy are recognised as difficult to model tractably (Hawker and Bell, 2020). Attempting to more accurately model dynamics of the energy system tends to produce unwieldy models with results that have unclear implications for policy (Bale et al., 2015). This illustrates the trade-off, since it is always likely that consultants would choose simple models over more credible, complex models, in order to ensure their analysis was salient.

What is more, a dearth of granular data was also a clear limiting factor in the West Midlands. Very little granular data was available for consultants to even consider using as evidence, since much of the energy system data was kept confidential by the private infrastructure operators. The available data was not salient to their modelling approach, since it was rarely in formats that aligned with the WMCA's boundaries. However, future plans to make more granular data available, such as from smart meters, may not improve decision-making. It could incentivise use of extremely large datasets for policy decisions where such data is not salient (Dent et al., 2019, p. 9). Furthermore, the use of such data may introduce new problems, such as the risk of breaches to privacy and anonymity created by overlaying multiple datasets (Bale et al., 2015, p. 155). Thus, simply increasing the supply of granular data generically is not sufficient. A more strategic approach is necessary.

Visualisation techniques, including the use of GIS data, have also been suggested (Smith and Joyce, 2012, p. 58) as a way of presenting quantitative analysis that does not require decision maker expertise or familiarity with quantitative skills. The visualisation of quantitative evidence could also increase the likelihood of policymakers accepting whole-systems insights. This could include qualitative modelling techniques such as causal loop mapping (Wang et al., 2022). However,

in this case, geospatial visualisation was rarely used. The (rough) identification of projects across the region only provided borough granularity.

Despite the general finding that simplified, quantitative evidence was valuable to many stakeholders, it is important to note that this was not universal. Some interviewees recognised the local salience of case study evidence, which suggested pragmatic next steps for implementation. One interviewee expressed the need to treat WSP's modelling as 'order of magnitude estimates', akin to MacKay's (2009) plea for the use of approximate quantification. Another suggested that the targets were simply a statement of ambition, designed to enable further policy development.

6.3.2 The primacy of external consultants

In my case study, I found that the use of consultants was seen as more important than the actual evidence that they produced. The lack of embedded analytical capacity within the WMCA prevented officers from being able to tailor the consultants' scope to provide evidence that was locally salient. As such, perceptions of expertise leading to credible, legitimate and salient evidence-based policymaking were misplaced.

The lack of policy capacity in UK subnational government is widely acknowledged – particularly the lack of analytical capacity (Britton et al., 2023; McDowall and Britchfield, 2020). In the West Midlands, this was clearly illustrated by the fact that the *#WM2041* green paper was written hastily by a single officer in a single week. The widely held preference for quantitative evidence highlighted in the previous section has led local and governance bodies to increasingly outsource analytical capacity to produce evidence, especially for net zero (Webb et al., 2017). However,

the contrast between a desire to use quantitative evidence, and the lack of internal capacity to produce or interpret it, meant that officers did not have a way of appraising such evidence on any technical basis. Instead, they had to use expert reputation as a proxy for 'good evidence producer'.

'Good' in this context related to credibility, salience and legitimacy. Outsourced expertise stood for legitimacy and credibility in much the same way as quantitative evidence did in general (as discussed above). Arguments for increasing resources to deliver the plan were stronger because the consultants said so. The expertise of consultants was positioned by policymakers as more central than the evidence they produced (Smith, 2013c).

Consultant expertise was also seen to increase salience in two main ways. First, the consultants were seen to provide more than the analytical capacity the WMCA lacked. To a limited extent, they provided some policy entrepreneur functions, connecting the policy problem with solutions in ways that would be politically acceptable (see Stone, 2015, p. 165). To justify costs, this was identified as a necessary aspect of consultancy; WSP had to provide a 'solution-focused', workable policy that would be salient to policymakers. Second, such a policy recommendation was seen as most salient because it gave a single, definitive answer to the policy problem, a common advantage attributed to expert advice in the literature (Stirling, 2010, p. 1029). These results suggest that in a limited capacity setting, policymakers considered evidence to be salient if it could be utilised either directly, or indirectly in tactical or political models. Concerns of credibility and legitimacy were satisfied on the basis that the evidence process involved experts that provided analytical capacity.

However, the significant fragmentation of net zero policy capacity in the West Midlands casts doubt on the claim of good evidence use. Operational capacity largely sat in local authorities and the regional Net Zero Hub. Analytical capacity was broadly lacking across the structure, despite some found in LEPs. Political capacity was distributed across multiple policymaking centres. In fact, capacity was also siloed by discipline, most notably with Energy Capital officers working separately from the WMCA's internal Environment team until after the Five Year Plan had been adopted.

Since the Environment team was already embedded within the combined authority, it 'owned' the work of developing the Five Year Plan and steering it through the approval process. As such, it was Environment officers that were responsible for developing the scope of the consultancy tender (4.2.2.1). Although Environment officers spoke about spending much time honing the scope, I found no evidence that Energy Capital officers were involved in the drafting process. Indeed, an Energy Capital officer expressed frustration at the eventual outputs of the consultants' modelling, further supporting the possibility that multiple disciplinary perspectives were not sought. Here, I note the accordance with Mazzucato and Kattel's (2020, p. 261) account of national policy capacity, in which they conclude that the extent of outsourcing has ironically damaged governments' capacity to design appropriate consultancy contracts to make up for such capacity gaps.

As a result, all technical expertise was described interchangeably as a proxy for good use of evidence. In fact, expertise on energy systems, or broader 'engineering expertise' (Cooper et al., 2021), did not meaningfully shape the Five Year Plan. I argue that this significantly reduced local salience of the modelling

evidence, since impacts of net zero on the energy system are widely regarded to be best understood and addressed at a subnational level (see Chapter 1).

Outsourcing also reduced local legitimacy. Consultants' exclusive production and use meant that the most influential place in which stakeholder consultation could shape the policy was in the design and structuring of the carbon model. However, because the consultants were not embedded within the WMCA, they were not able to make use of broader stakeholder evidence. This included evidence from other policy teams such as Energy Capital, beyond a 'tactical' utilisation by citing locally produced evidence in a document review. Similarly, the lack of internal analytical capacity meant there was very limited technical scrutiny of the consultants' modelling. As a result, several assumptions were stated in the Five Year Plan appendices with no justification, contributing to a reduction in credibility.

One oft cited solution to limited analytical capacity in a multilevel structure may be to accumulate analytical capacity in a combined, regional body (Webb et al., 2017; Britton et al., 2023). However, the Tyndall Centre carbon budget analysis offers a cautionary tale. The 'testing workshop' described by one interviewee was intended to give local policy officers the chance to draw on region-wide commissioned evidence. The intention was to provide evidence that increased legitimacy, credibility and salience locally, such that local authorities would be able to draw on the Tyndall Centre report in their own net zero policymaking without the need for further outsourcing. In fact, local authorities did seek their own consultancy-led policy processes. Only two of the seven West Midlands councils (Solihull and Wolverhampton) adopting 2041 locally. This suggests that intra-regional incoherence is as much of a challenge for net zero policy as national incoherence (Marsden and Anable, 2021). Furthermore, local authorities with low levels of

internal capacity still appear to derive legitimacy from consultant-led evidence-based policy processes, despite the lack of local influence.

6.3.3 Pervasive ambiguity and uncertainty

I have found that many stakeholders saw evidence as playing a role in reducing ambiguity and uncertainty. However, I argue that a combination of emphasising simplified quantification and the lack of embedded analytical capacity meant that certain steps taken in the name of ‘evidence-based policymaking’ perpetuated ambiguity and uncertainty. This inhibited efforts to increase legitimacy, credibility or salience.

Consultants argued that uncertainty was taken into account within the Five Year Plan in a number of different ways. They explained that a range of scenarios conveyed the possibility of multiple futures, and that conservative estimates in the model prevented overconfidence in emerging technologies. However, due to the ambiguity of the policy problem, the strong preference for simplified, quantitative evidence, and a lack of analytical capacity, the techniques used to address uncertainty were insufficient and may have contributed to increasing ambiguity and uncertainty.

Net zero as a policy problem is fundamentally ambiguous. As previously discussed, the reframing of climate change from limiting temperature rises, to cumulative carbon budgets, to net zero target dates leaves room for manoeuvre with each change. Ambiguity is even greater at subnational scales, as notions of fairness for disaggregating an allocated national carbon budget into regional or local areas are value-laden and highly contested (Garvey et al., 2023). Without addressing

uncertainty, the chance of policy incoherence across scales increases (2023, p. 998; Marsden and Anable, 2021).

Within an environment with limited analytical capacity and a bias towards simple, quantitative measures, quantitative evidence such as the carbon model was seen to reduce uncertainty. For the WMCA, some evidence was better than no evidence. Quantitative evidence was also seen to reduce uncertainty more than qualitative evidence, as a more authoritative indication of knowledge. As a result, the policy process was labelled as ‘evidence-based’ or ‘science-based’, with the perception that the process by which evidence had informed the policy increased credibility, salience and legitimacy.

However, the ‘evidence-based’ label was only valid for a particular framing of the policy problem, and risked perpetuating uncertainty from other perspectives. The carbon model scenarios quantified the relative contributions that 15 interventions would make to reducing carbon emissions. One scenario was chosen as the central piece of evidence, informing the wider aspects of the Five Year Plan. In this sense, the policy was ‘evidence-based’ when framed as an initial exercise in scoping the relative contributions different sectors could make to decarbonisation. However, from an energy systems perspective, the policy does not reduce uncertainty about the impacts of such measures on peak loads or requisite reinforcement costs. The policy’s ‘evidence-based’ label shut down the potential to investigate energy systems impacts further, thus perpetuating uncertainty.

To be clear, this would not be an issue if a single consensus framing were to be adopted. The Five Year Plan does set out its scope and generally includes caveats within the appendices detailing modelling assumptions. But within a political

environment, on a notoriously contested policy problem, the pretence that the policy serves as a single perspective on a multifaceted problem does not withstand scrutiny (see Section 2.3.3). This was emphasised by the wider range of interpretations expressed interviewees – not least among WMCA officers.

In this way, the use of evidence failed to address uncertainty, and thus decreased salience, credibility and legitimacy. Energy officers found that a limited consideration of wider uncertainty reduced future salience of the policy. They expressed frustration that WSP's model was static and commercially confidential, meaning officers could not 'play' with the underlying data. Thus, it was not possible to gain insights on what robust, no-regret, or least-regret next steps would be. By presenting evidence as simplified quantitative targets and preventing scrutiny of the aleatory uncertainties inherent in the problem of net zero, stakeholders were not given the opportunity to engage with the uncertainties built into the modelling. This reduced the legitimacy of the use of evidence. Furthermore, by regularly using average-types to disaggregate national statistics into regional estimates, or by limiting the range of scenarios presented for comparison within the plan, I argue that the model reduced credibility in the eyes of stakeholders with quantitative expertise.

These findings present a challenge for Boswell's argument that the 'ideal' of evidence-based policymaking is a type of 'magical thinking' that enables policymakers to take pragmatic steps in addressing complex problems (2022b). Although there was a strong consensus that the Five Year Plan resulted in positive, pragmatic changes to the WMCA's net zero response, the relentless focus on quantitative evidence, coupled with little embedded analytical capacity, risks policymakers being lulled into a false sense of certainty. This is especially apparent

when closer scrutiny of the assumptions made within the model call into question the validity of quantification at all.

One way in which the literature suggests the policy could have better addressed ambiguity and uncertainty, would have been to make greater use of evidence from a broader range of disciplines (Bale et al., 2015, p. 157; Taylor et al., 2022). This would have brought tensions and disagreements to the fore, indicated where data was not available for reliable quantitative analysis (e.g. where datasets were “crunchy and iffy” (10.WSP)), and highlighted ways in which aleatory uncertainties could be treated to the same extent as epistemic uncertainties. This would have provided greater insights for policymakers interested in adaptive and robust next steps.

The ambiguity of the policy problem itself appears to have been exacerbated by a lack of awareness of the underlying physical processes of climate change. Although Cooper et al. (2021, p. 494) argue that ‘engineering expertise’ ought to be given more prominence due to its high salience, or ‘potency’ for policymaking, this suggestion needs to be treated cautiously. By de-coupling net zero targets from carbon budgets, policymakers demonstrated a fundamental misunderstanding of the physical mechanisms of climate change, suggesting that this policy issue is particularly susceptible to misinterpretation under different policy problem framings.

Consultants only partially considered uncertainty within the Five Year Plan. The conservative assumptions made about technological developments (to be credible from an analytical perspective) were paired with assumptions about the rollout of technology, even where these pathways were not seen to be credible from an

operational perspective. This supports the argument that the lack of embedded analytical policy capacity within a wider policy team limits the validity of the claim that evidence increased credibility, salience and legitimacy of the policy in the eyes of those responsible for delivering it.

Limited operational capacity also had an impact on the use of evidence, most notably during monitoring. Much of the monitoring evidence recommended by WSP consultants was never collected or utilised, and many of the recommended review processes were not implemented after the consultancy contract ended. The justification given by officers for minimal monitoring at an early stage was that the embedded operational capacity at the time of the plan's adoption was insufficient to deliver at the required pace. However, this simply revealed a shortcoming of the policy's design, in that it failed to allow time for growth in operational capacity.

6.4 The limited capability of local policy processes to produce locally contextualised policy

Drawing together the overarching themes, I argue that the use of evidence in local net zero policy does not support a place-based approach to net zero. In many ways, it hinders it. As such, local net zero policies are not currently performing their unique function. This may lead to inadequate policy outcomes, putting local contributions to sufficiently coherent net zero policy at national and international levels at risk.

As identified in Chapters 1 and 2, the literature on local net zero recognises the capacity of local policy to be tailored to specific contexts. Such contextualised policies can improve outcomes, in comparison to generic alternatives. My findings demonstrate that the use of evidence in local policymaking is not well tailored to

local context and that the reliance on external consultants has led to too great a focus on generic, sectoral quantitative modelling of carbon savings. As such, the salience, credibility and legitimacy of evidence use in local net zero policymaking is far lower than the policymakers currently perceive.

Thus, I have shown that while external analytical capacity may appear to improve local policy processes, the fragmentation of technical expertise in this case (notably siloisation of environment and energy perspectives) contributed to a lack of interdisciplinary thinking. By overlooking evidence on energy systems impacts, the consultants failed to consider evidence that was sufficiently granular in dimensions of time and space. This meant that the Five Year Plan did not address spatial distribution of potential issues due to the real-time nature of energy supply and demand. For instance, no consideration was given to which electricity substations would be most in need of reinforcement or upgrade, or which neighbourhoods may face infrastructure barriers to the type of solutions captured in the 15 interventions. This poses a challenge for local policymaking, since interdisciplinary thinking lies at the heart of effective place-based approaches (Munro and Cairney, 2020).

My findings demonstrate that there would be significant value to increasing analytical policy capacity within local and regional governance bodies. This would reduce fragmentation of policy capacities, enabling deeper engagement with evidence (Dent et al., 2020, p. 12; Marsden and Anable, 2021). In turn, it would ensure that these bodies are better able to contribute to credible, legitimate net zero policy that is both salient to the local context and contributes to a broader coherent net zero policy across the entire governance structure.

6.5 Positioning the research within the field of evidence-based policy

I now reflect on the implications of my research in the context of the evidence-based policymaking literature, before considering possible future directions of research in this field stemming from this thesis.

First, the findings have deepened critical understanding of the use of models as evidence by analysing both policy and model development. Previous studies have considered the modelling process in isolation, focusing on analysis of uncertainties to improve credibility, salience and legitimacy (Pye et al., 2018, p. 333; Refsgaard et al., 2007, p. 1543; Saltelli et al., 2020). However, these studies tend to assume policymakers will use such modelling in direct, instrumental ways (Cabinet Office, 2000). Elsewhere, within the field of policy studies, scholars have shown how quantitative evidence may not necessarily used instrumentally (Wesselink and Gouldson, 2014). However, they have not analysed the way in which the development process of quantitative models shapes their suitability or use cases. My case study has demonstrated the value of combining these perspectives. By examining the modelling process more closely, I have been able to scrutinise policymaker perceptions of modelling evidence.

I have found that within local contexts, many of the beliefs about how modelling evidence increases salience, credibility and legitimacy are not well-founded. My examination of the modelling process has revealed the limited extent to which qualitative evidence can influence a net zero policy beyond agenda setting. Although stakeholder consultation continued beyond agenda setting, its influence was restricted to tactical and political uses, since the carbon model's structure was

fixed from an early stage. Furthermore, the model structure was largely decided before the consultants even began work with WMCA officers. This indicates a more fundamental restriction on qualitative evidence due to the externalisation of analytical capacity.

Second, I have been able to provide a richer explanation of evidence use in net zero policymaking by considering 'what counts' as evidence to policymakers alongside the ways in which they use evidence and their underlying justifications for doing so. I have identified the ways in which modelling evidence is treated in a problem-solving model, compared to more indirect models (see Section 2.5.2). I have shown that the underlying logic of using evidence to increase salience, legitimacy or credibility can be more or less valid. In doing this, I have addressed concerns raised in the literature that research on evidence-based policy often fails to engage sufficiently with the conceptualisation of evidence (Blum and Pattyn, 2022). Future research on evidence-based policy would benefit from greater integration of the frameworks I have utilised (see also McDowall, 2024).

Third, I have brought evidence-based policy into dialogue with multilevel governance concepts. The conceptual framework has enabled a detailed account of evidence use within the complex governance structure of this case. Fragmentation and siloisation emerged as key variables which both limited the use of certain types of evidence, and often only permitted symbolic utilisation of evidence. In exploring these implications, I have built on previous findings that local capacity for evidence use is more limited than national capacity (McDowall and Britchfield, 2020). I argue that increasing 'local' capacity for evidence requires a holistic perspective, encompassing the entire policy ecosystem in a way that crosses vertical hierarchies and horizontal siloes.

6.6 Next steps for the research

Having identified the strengths of this research, I now discuss several of the limitations I have identified of this work. From this discussion, I suggest possible improvements and identify potential future areas for follow-up research.

First, as discussed in the Methodology chapter, the single embedded case study design limits generalisability. Although the embedded design has enabled novel insights and the case study is a research design intended to prioritise rich contextualised understanding over generalisability, the single overarching case provides limited scope to transfer the findings of this study to other policy contexts. As a result, further studies of evidence use within different subnational governance settings would be a natural next step. Indeed, a replication in another combined authority may be helpful in validating the findings presented here, particularly since my own research was conducted at a time when a global pandemic was exerting significant influence on policy agendas worldwide. In addition, insights could be gained by choosing cases in other metropolitan boroughs, rural or suburban lower tier councils, county councils (including those with devolution deals), or international equivalents.

Second, a focused view of a single tier within a multilevel structure has clearly left most vertical interactions unexplored. The impact of local-regional, local-national, and regional-national relationships would be a logical avenue to explore. A more thorough analysis of evidence use in net zero policies being developed simultaneously at two different levels of a governance structure – as this research initially set out to do – would provide fascinating insights into the influence of inter-centre relations on the use of evidence.

Third, a more in-depth analysis of uncertainty would be valuable for understanding the extent to which oversimplifications and assumptions made within energy models limit credibility. Using the more advanced uncertainty analysis and auditing techniques from the academic literature may prove more fruitful than the quantitative analysis initially explored during this study. However, access to closed source modelling data would likely still prove to be a significant barrier.

Fourth, a more methodologically pluralistic approach to understanding both the policy process and the model development would have added to the rigour of my study. Using supplementary data collection methods, such as interactive stakeholder workshops, surveys or follow-up interviews with key actors, would be of benefit to future studies. In future analysis, a more comprehensive operationalisation of complex systems theories may provide deeper insights.

Fifth, an ethnographic approach may prove insightful. As an outsider to the policy process investigating the WMCA's Five Year Plan retrospectively, I inevitably faced difficulties due to staff having left jobs since the policy's development, a lack of access to internal meetings and documents, and the imperfect recall of past events by interview participants. An ethnography in which a researcher gained access to policymakers in anticipation of a new policy's development would enable them to record a much more detailed account of the process and the influence of evidence. However, this could limit the detailed understanding of quantitative models, since the overlap of such skills in ethnography are likely to be rare (Oliver et al., 2014a, p. 4).

Finally, extending this research approach to policy fields beyond net zero may provide worthwhile comparison, particularly looking to other policy problems in

which modelling evidence plays a large role. For instance, a similar study on epidemiology, or economic growth, could study model development is studied alongside the policy process in which it is used as evidence. This would be beneficial in understanding the unique challenges of net zero policy, and how they affect the use of evidence.

6.7 Conclusion

In this chapter, I have brought the empirical findings of my research into dialogue with the evidence-based policy literature. In doing so, I have shown that many of my findings align well with critical accounts of evidence-based policy. Evidence for policy is seen to take many forms beyond scientific research, but quantitative evidence remains dominant. Evidence does not tend to be used in a direct, instrumental way, but rather indirectly within a political environment. The justifications for using evidence revolve around salience, credibility and legitimacy. These three characteristics are overwhelmingly presented as ideals towards which real policymakers can take practical steps, making complex policy problems tractable. However, I have argued that the local context of the Five Year Plan undermines many of the justifications made for using evidence to increase salience, credibility and legitimacy.

I have identified the primary contributions of the case to the evidence-based policy literature. It provides detailed accounts of the use of evidence in the policy process, and the development of the model that was most influential. Likewise, I have demonstrated the influence of wider multilevel governance structures on the development of local net zero policy. In doing so, I have shown that current processes for evidence use produce policies that are not sufficiently tailored to the

context of their application. These policy processes do not leverage the specific advantages of a local approach to net zero, which has been commonly identified (Innovate UK, 2022; Hofbauer et al., 2022). They risk inadequate policy outcomes, which fail to contribute to national and international efforts towards net zero.

I now turn in the final chapter to summarise my thesis and consider the implications for current and future policy.

Chapter 7: Conclusions

7.1 Introduction

In this final chapter, I review my research on the use of evidence in local net zero policy (7.2). I answer each of the three research questions first set out Section 1.3 and summarise the main arguments of the thesis. I then set out the key contributions of this research to theory and practice (7.3). To finish, I explore the implications for current and future policy (7.4), considering three contemporary local net zero policy developments.

7.2 Summary of the research

I set out to understand the use of evidence in local net zero policy. Net zero is one of the most pressing contemporary policy problems. It is widely understood to be a multi-faceted challenge requiring diverse multi- and interdisciplinary perspectives to inform policymaking. Local policymaking has been identified as particularly important for addressing net zero, due to the whole-systems nature of the problem. Net zero affects energy infrastructure across all vectors, transport systems, the built and natural environments, and necessitates widespread behaviour change. Local policy enables a place-based approach to addressing these components simultaneously, to an extent that is not feasible at national scales.

In light of this, I sought to understand the use of evidence in local net zero policymaking. Evidence-based policy has been a popular lens for those examining policymakers' decision-making processes. It has been particularly popular in applications to policy areas that have close connections to science, such as medicine and climate change. The literature on evidence use tends to analyse

policymaking at national scales, although subnational contexts have increasingly been recognised as worthwhile cases.

I structured my research questions around three major conceptual components of evidence-based policymaking theory.

First, I examined what counts as evidence. Many researchers continue to employ a restricted focus on scientific research, drawing on early evidence-based policymaking literature. More critical scholarship has recognised that within a value-laden, contestable policymaking environment, what counts as evidence is much broader than the outputs of academic research.

Second, I examined how evidence is used within a policy process. The critical perspective dismisses one-way, linear models of evidence entering the policy process, seeing them as overly simplistic. Instead, evidence producers and evidence users are conceptualised as much more heterogeneous groups spread across an evidence ecosystem. Amongst these diverse groups, evidence iteratively moves back and forth. The ways in which evidence is utilised by policymakers vary widely. These include direct applications leading to immediate decisions, interactive consideration alongside competing influences, and enabling policymakers to consider problems from alternative perspectives without directly affecting decisions.

Third, I examined why evidence is used to inform policy. Cash et al.'s (2002) framework of salience, credibility and legitimacy moves beyond the evidence-based medicine perspective which assumes the use of evidence (restricted to scientific research) necessarily improves policy outcomes. Instead, evidence must

be relevant to policymakers' problems and address their needs, it must be rigorous and reliable, and it must be trustworthy.

I used a combination of semi-structured interviews and documentary analysis to investigate these questions, applying them in a single embedded case study of the West Midlands Combined Authority's Five Year Plan. The Five Year Plan is a net zero strategy developed in 2020/2021, which set out high-level actions required to achieve the region's adopted target of net zero by 2041. The overarching case was the development process of the policy itself, while the sub-case was the development of the carbon model that became the central piece of evidence underpinning the policy.

7.2.1 Reflections on the research questions

On what counted as evidence (RQ1), I found many different evidence sources were used to develop the Five Year Plan. Government statistical data, stakeholder consultation, previous policy reports and other 'grey' literature, and case studies were all used. However, the scenario outputs of the quantitative model developed by WSP consultants were the most influential pieces of evidence.

On how evidence was used (RQ2), I found that many stakeholders from across the multilevel governance structure were involved in extensive engagement throughout the development. These stakeholders contributed to a perception of evidence co-production within a wider ecosystem. I found a range of evidence utilisation models throughout the policy process, with clear differences between policy cycle stages. During agenda setting, enlightenment usage of 'grey' literature shaped the scope of the policy. In policy formulation and decision-making, WSP's carbon model was used both in a problem-solving mode to address the questions

of local politicians, and in a political mode by WMCA officers. During implementation and monitoring, the Five Year Plan itself was used ‘tactically’ to limit scrutiny during an early stage of delivery.

On why evidence was used (RQ3), I found that evidence was perceived to increase salience, credibility and legitimacy of the Five Year Plan. Different evidence types were more commonly used for each justification. Modelling served to increase credibility, making the case for increasing resources to deliver net zero locally, as well as to increase salience by providing quantitative comparison of different targets. This ensured policymakers had a better understanding of which aspects of net zero they ought to prioritise or invest in. The use of government data increased credibility, since it was seen as a reliable and trustworthy source of information. However, as monitoring evidence, its salience was reduced by the two-year publication delay. Stakeholder consultation evidence was seen to increase legitimacy by demonstrating the breadth of opinion that had been taken into account throughout the policy process. However, a closer look at the model development process painted a very different picture. Uncertainty was treated very lightly, with widespread simplifications and assumptions made with little or no justification. Just three model scenarios were presented in the final policy, despite the model’s capacity to produce many more. Of these three, only one was seen as achievable and meeting the needs of policymakers. Contextual, place-based factors were poorly reflected due to the lack of granular analysis and average-type techniques for disaggregating national-scale data.

As such, I have argued that the overemphasis on quantitative evidence, the overreliance on external analytical policy capacity, and high levels of ambiguity and uncertainty, contributed to a local net zero policy that was not sufficiently

contextualised to maximise the benefits that a place-based approach to net zero can offer.

7.3 Key contributions of the research

There are three key contributions made by this study to theory and practice. First, the innovative research design of the embedded case study. By looking concurrently at development processes of both the policy and the model in detail, I have been able to closely scrutinise policymaker perceptions of modelling evidence. By synthesising two previously distinct approaches, the use of an embedded case study research design has provided a novel perspective on the interaction between evidence production and evidence use within a policy process.

Second, this study has improved the theoretical understanding of the use of evidence in local policymaking. Focusing on the specific case of net zero policy, I have drawn on a wide range of concepts that illuminate how policy is developed at a local level. Most significantly, I have identified ways in which current practices for the use of evidence in local government hinder the extent to which local policies can be said to adopt a place-based approach. The research highlights the need for greater awareness of multilevel and place-based effects in the study of evidence use in local policymaking.

Third, this study has identified practical barriers in local government to the development of more place-based net zero policy. I have demonstrated how the lack of policymaker capacity – especially analytical capacity – instils a dependence on external consultants for technical expertise, and limits the extent to which local policymakers can utilise evidence to support place-based policy. Re-establishing

this capacity within local government is necessary to enable evidence use to support a place-based approach to local net zero policy.

7.4 Implications for current and future policy

As I described in Chapter 3, this research has not been designed with an objectivist epistemology. Therefore, it cannot claim to have isolated causal links between specific variables. As a result, it would be disingenuous to make 'recommendations for policymakers' that are a common feature of many scientific conclusion chapters. Instead, I will consider the implications of my research for contemporary UK local net zero policy and identify where a critical evidence-informed policymaking perspective may prove useful.

One of the key findings of this research is that justifications for evidence-based policy processes as more credible, salient and legitimate are often self-contradictory. This problem is compounded in local settings, particularly in the context of net zero policy. As such, the findings suggest that policymakers should be sceptical of 'evidence-based' labels. The political, contested policymaking environment incentivises policymakers to exploit the bounded rationality of actors. It appeals to their preconceptions of 'science' and 'evidence'. While this has no doubt proved to be a useful tactic, and whilst the 'magical thinking' of evidence-based policy has enabled pragmatic steps to be taken in addressing the complex policy problem of net zero, it employs a very limited framing of evidence-based policy, which can have detrimental impacts on policy outcomes. By restricting the frame of what is considered salient and credible evidence to quantitative carbon accounting models, the essential diversity of multidisciplinary perspectives necessary to fully grasp the challenges of net zero are locked out of the policy

process. In doing so, ambiguity and uncertainty go unaddressed and can grow, embedding future policy problems.

As such, local net zero policy processes ought to involve a broader range of disciplinary perspectives at a much earlier stage in policy development. While it is clear that a lack of policy capacities of all three types have been constraints on the inclusion of broader evidence bases, the rise of net zero within policy agendas may result in increased resources (as occurred in the WMCA). This could facilitate a step change in the level of interdisciplinary perspectives shaping the use of evidence in local net zero policy.

I now consider three areas of current local policy in the UK, using this context to reflect on the implications of my research.

7.4.1 Future local net zero strategies

Within this research, I acknowledged concerns that local plans for net zero do not currently match the scale of ambition demonstrated in climate emergency declarations and net zero targets. This has already become a legal issue for the UK government on more than one occasion. The UK's Net Zero Strategy (BEIS, 2021b) was found to be unlawful by two judicial reviews for failing to provide sufficient detail on how emissions reductions would reach the government's targets (Good Law Project, 2024). Although subnational strategies are not currently held to such strict standards as UK policy is under the Climate Change Act, local authorities with the most ambitious net zero targets have already had to renege, (BBC, 2024a, 2024b). They have cited limited capacity, unaffordable costs, and lack of national government support.

In fact, as net zero target dates grow ever closer, attention will increasingly focus on the tensions between different definitions of net zero itself. Indeed, the West Midlands' strategy would fail if it were held to the same standard as the UK's national strategy, since the 'Accelerated' scenario emissions only reached a total reduction of 95.4% (WSP, 2021f). Having identified the range of uncertainties within the scenario's construction, it may be irrelevant to scrutinise the residual emissions. However, within five years, many local authorities will be reaching their deadlines for net zero. This will focus attention on the pass/fail nature of the net zero framing. Attention must turn to how decarbonisation is assessed in less black and white terms. A place achieving a 99.9% emissions reduction should not be considered to have failed. Similarly, a local authority that keeps perfectly to its Tyndall Centre pathway (without a stop year) will still not have reached 'zero' emissions by their target date. Nonetheless, by keeping within a tight carbon budget, they will be contributing to better outcomes than local authorities that neglect their carbon budget in favour of offsets or negative emissions technologies to meet a net zero target.

Having analysed the WMCA's Five Year Plan, it is clear that future local net zero strategies must consider energy system impacts in far greater detail. As such, policymakers from a range of disciplinary perspectives will need to be involved from the very first stages of policy development. They must shape the evidence requirements and ensure the inclusion of evidence which addresses the implications of peak power demand alongside environmental and economic evidence.

7.4.2 Local area energy plans

Interest in local area energy plans (LAEPs) was growing at the time of my research interviews (CSE and ESC, 2020; ESC, 2021). Indeed, several interviewees made comparisons between the WMCA's strategy development and LAEPs being developed elsewhere. LAEPs are intended to provide a granular, place-based perspective on the strategic direction of energy system transformation required for decarbonisation.

The findings of my research suggest that LAEPs will be a positive contribution to local net zero policy, provided they contribute to a greater understanding of place-based energy system impacts. However, the influence of such plans on wider local and national policy remains unclear (Britton et al., 2023, p. 7). The challenges that I have identified for net zero policies will likewise affect LAEPs. The lack of available local data will be a barrier to more granular resolutions, although the Energy Systems Catapult has built a substantial library of LAEP-relevant granular datasets (ESC, n.d.). However, the ability to utilise this data will vary depending on financial resources and analytical capacity within local and regional authorities. Indeed, LAEPs produced to date have relied on consultancies providing external support, suggesting that the same risks to local salience, credibility and legitimacy I have previously identified, may still apply.

Furthermore, the use of consultancies has led to a diversity of approaches to defining a LAEP. There are at least four approaches used across Wales alone (Arup, 2023). Like net zero targets and strategies, a lack of standardisation for LAEP methodologies risks leading to policy incoherence across multilevel governance structures.

LAEPs can address uncertainty in a more holistic way than the WMCA's Five Year Plan. Instead of calculating a small set of scenarios using a static model, LAEPs tend to identify no- or low-regret energy system investment opportunities. They do so by incorporating many more simulations in their analysis. Once again, however, the embedded local capacity to make good use of this modelling will rely on greater levels of analytical capacity, working alongside political and operational capacities.

7.4.3 Regional Energy Strategic Plans

Ofgem announced in 2023 that a new strategic planning function would be recommended in order to better coordinate the net zero transition (Ofgem, 2024). Although the governance bodies responsible for delivering this function are yet to be confirmed, Regional Energy Strategic Plans (RESPs) must be designed to feed into a national Strategic Spatial Energy Plan. This has been broadly welcomed as a change that could improve the local use of evidence on energy system impacts in the net zero transition (Britton et al., 2023, p. 8). RESPs will consider all energy vectors and major energy demands, applying a whole-systems perspective at a regional level. As such, they are expected to take a more interdisciplinary approach than I found in the WMCA's Five Year Plan.

The main concern for RESPs is the risk of perpetuating fragmentation. If RESP Boards are created as an additional layer of governance, they may further strain local policy capacity. Furthermore, as I observed in the West Midlands, the involvement of decision makers and technical experts from multiple disciplines does not guarantee that they have substantive roles in contributing evidence and shaping policy decisions. Engagement early in the process will be essential to

ensure that any modelling evidence produced to support the RESPs embeds multiple disciplinary perspectives from the outset.

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Appendix 1: Participant Information Sheet and Consent Form

Participant Information Sheet

Evidence-informed energy policy in the West Midlands

This study aims to identify how different types of evidence (modelling, scenarios, expert opinions etc.) are informing policymaking processes in the West Midlands. The Combined Authority's WM2041 Five Year Plan and the Local Plans of Solihull and Sandwell Councils will form the basis of the study.

The study is being conducted by Mr Laurie Duncan, a PhD student in the University of Birmingham's Energy Systems and Policy Analysis research group, funded by the School of Chemical Engineering. The first stage of the project will consist of interviews with key actors in the West Midlands involved in developing the policies mentioned above.

You have been identified from analysis of committee minutes and government websites as a valuable person to talk to. We would be very grateful if you would be willing to be interviewed by Laurie for the project.

If you agree to participate, your name and contact details will not be made public in any of the research outputs (PhD thesis, conference presentations, published papers etc.). Any quotes from the interview will be labelled with your organisation and job title. If you would prefer a more anonymous label, we can discuss this before commencing the interview.

A list of questions that may be covered in an interview is included below. The interviews will be held online over Zoom and will last up to 1 hour, scheduled according to your availability. Subject to agreement, the interview will be recorded, and a transcript auto generated. Interview data (recordings, notes, and participant's contact details) will be held securely and confidentially in compliance with the University of Birmingham Code of Practice for Research for 10 years in the University's Research Data Store.

Participation is voluntary, and participants can withdraw their contribution within 14 days of the interview by emailing the researcher; any data would be deleted, and the information provided in the interviews would be eliminated from the research.

Participants can opt-in to receive an executive summary of the project findings and be notified of any published research that comes out of the study via email.

If you would like to participate, please confirm your availability via email at [redacted]

Thank you for participating in the research project. If you have any questions about the project, please contact Laurie or his supervisors, Dr Jonathan Radcliffe ([redacted] and Dr Louise Reardon ([redacted]

Interview Questions

Evidence-informed energy policy in the West Midlands

The following questions are a guide of topics likely to be covered in the interview. They may be modified, followed up in more detail, or asked in a different order.

Local Plan questions

1. **Process**

Describe the process of developing the Local Plan.

What was your role?

Who were the key individuals/organisations involved in the process (internal and external)?

How does it address energy and decarbonisation?

How does it align with planning at different levels of governance (LEP/WMCA/national)?

How did you develop your initial aims and objectives?

Were there particular groups you needed to consult with?

How did the consultation affect the development of the plan?

How is the implementation of the plan being monitored?

2. **Evidence**

Where did you obtain evidence/information from (on energy and decarbonisation) to support plan development? Why/how were they chosen? (e.g. academics, consultants, internal researchers, WMCA, national government, neighbouring LAs, LEP, Local Energy Hub)

What sort of information were you looking for? Large datasets? Opinions of experts/residents/business owners/infrastructure owners? Scenarios? Interactive modelling? Quantitative/qualitative?

In what form was this information presented/summarised for decision makers? Simplified graphics/data with several metrics?

3. **Uncertainties**

How were uncertainties about future energy needs considered when developing the plan (future demand/decarbonisation targets)?

How were modelling assumptions determined (e.g. grid electricity carbon intensity, future cost of renewables)?

How were overlapping policy areas managed (e.g. transport, housing targets, emissions monitoring)?

4. **General reflections**

In general, how effective do you think the process is for incorporating evidence on energy and decarbonisation into Local Plans?

What were the most important factors influencing decisions taken? Compelling evidence/political agenda? Why?

What are the limits/barriers to the process being more effective? Sufficient capacity/capability/carbon literacy?

Is there anything else that might be relevant that hasn't been mentioned?

Is there anyone else that you think it would be useful for me to talk to in this local authority or externally?

Five Year Plan questions

1. **Process**

Describe the process of developing the Five Year Plan.

What was your role?

Who were the key individuals/organisations involved in the process (internal and external)?

How does it align with planning at different levels of governance (LEP/local authority/national)?

How did you develop your initial aims and objectives?

Were there particular groups you needed to consult with?

How did the consultation affect the development of the plan?

How is the implementation of the plan being monitored?

2. **Evidence**

Where did you obtain evidence/information from (on energy and decarbonisation) to support plan development? Why/how were they chosen? (e.g. academics, consultants, internal researchers, national government, constituent/non-constituent LAs, LEP, Local Energy Hub)

What sort of information were you looking for? Large datasets? Opinions of experts/residents/business owners/infrastructure owners? Scenarios? Interactive modelling? Quantitative/qualitative?

In what form was this information presented/summarised for decision makers? Simplified graphics/data with several metrics?

3. **Uncertainties**

How were uncertainties about future energy needs considered when developing the plan (future demand/decarbonisation targets)?

How were modelling assumptions determined (e.g. grid electricity carbon intensity, future cost of renewables)?

How were overlapping policy areas managed (e.g. transport, housing targets, emissions monitoring)?

4. **General reflections**

In general, how effective do you think the process is for incorporating evidence on energy and decarbonisation into the Five Year Plan?

What were the most important factors influencing decisions taken? Compelling evidence/political agenda? Why?

What are the limits/barriers to the process being more effective? Sufficient capacity/capability/carbon literacy?

Is there anything else that might be relevant that hasn't been mentioned?

Is there anyone else that you think it would be useful for me to talk to in the combined authority or externally?

Interview Consent Form

Evidence-informed energy policy in the West Midlands

Please tick the boxes and sign below to consent to participating in the study:

I have read the Participant Information Sheet and have had the opportunity to ask any questions about the research project	☐
I agree to participate in the interview	☐
I consent to an audio recording of the interview being made	☐
I consent to the interview being transcribed with Zoom's auto generated captions	☐
I consent to the researcher using anonymised quotations from the interview	☐
I understand that I can ask to withdraw at any point in the interview, and can withdraw entirely from the study up to 14 days after the interview	☐
I understand that any data generated during the interview will be stored securely for 10 years in the University's Research Data Store	☐

Participant Full Name	
Participant Signature	
Date	

If you would like to be notified about the results of this research project, please tick yes:

Yes, notify me about research outputs ☐

No, do not notify me about research outputs ☐

Appendix 2: Table of documents analysed

Document	Source
Local authority strategies (for reference)	
Net Zero Solihull Green Paper	Solihull Council website
Solihull Net Zero Action Plan	
Sandwell Climate Change Strategy	Sandwell Council website
Five Year Plan documents	
Net Zero 2041 Five Year Plan Independent Technical Report Draft	WMCA website
WM2041 Five Year Plan 2021-26 Technical Report (final version) Appendix A Document Review Appendix B Stakeholder Engagement Appendix C GIS Mapping Appendix D Assumptions Under Business as Usual Appendix E Plan Modelling Goals Appendix F MACC Assumptions Appendix G Jobs and Skills Appendices	
WMCA Carbon Accounting Tool spreadsheet	WSP (with WMCA permission)
Other reports	
Setting Climate Change Commitments for West Midlands Combined Authority Area ('Tyndall Centre Report')	WMCA website
#WM2041 Initial Engagement Report 2020	
WM2041 a Programme for Implementing an Environmental Recovery	
#WM2041: Actions to Meet the Climate Crisis with Inclusivity, Prosperity and Fairness (#WM2041 'green paper')	
The West Midlands Net Zero Pathfinder: Proposals to HM Government to Accelerate the Net Zero Transition and a Green Industrial Revolution	
Board papers and minutes	
WMCA Board 11 January 2019 28 June 2019 26 July 2019 17 January 2020 5 June 2020 12 February 2021 19 March 2021	WMCA website
Environment Board 10 September 2018 8 February 2019 24 October 2019 27 February 2020 25 June 2020	

Environment & Energy Board 15 October 2020 9 December 2020 1 February 2021 10 March 2021 (video recording on YouTube also used) 1 July 2021 9 September 2021	