Tracking climate change adaptation outcomes: Analysis of adaptation planning in UK urban areas

WILLIAM LEWIS | DIVISION OF RISK MANAGEMENT AND SOCIETAL SAFETY | LTH | LUND UNIVERSITY, SWEDEN

Tracking climate change adaptation outcomes: Analysis of adaptation planning in UK urban areas

William Lewis

Lund 2022

Title: Tracking climate change adaptation outcomes: Analysis of adaptation planning in UK urban areas

Author: William Lewis

Number of pages: 67
Illustrations: 9

Keywords
Adaptation, Climate change, Evaluation, Impact, Indicators, Learning, Monitoring, Objectives, Outcomes, Reporting.

Abstract
As more and more urban areas are planning and responding to climate change there is a need to understand the role that local action is having at the national and international level. The Paris Agreement called for a global goal on adaptation but in practice aggregating progress on adaptation is hard to achieve. Effective monitoring, evaluation, reporting, and learning systems are crucial to inform decision-making and track progress at all levels of government, and adaptation planning documents contain the most up-to-date information on how urban areas are tracking progress. For this reason, the aim of this thesis is to understand the characteristics and use of adaptation metrics across climate adaptation-related planning. A case study is used to analyse what is being done in practice, particularly at the urban scale. To achieve the aim of this thesis 199 urban areas in the UK were analysed, indicators collected for 27 urban areas, and the policies' analysed for a subset of 14 urban areas. The results show that many urban areas are not adequately tracking adaptation progress. However, evidence of best practice can be seen in some 'early adopter' urban areas. Best practice may include localising international agendas such as the Sustainable Development Goals, taking a flexible and transparent approach which enables learning, and considering the broader social agenda. Work needs to be done to build capacity of urban authorities to effectively track adaptation, so that implementation at the local level can be used to inform global goals.

Riskhantering och samhällssäkerhet
Lunds tekniska högskola
Lunds universitet
Box 118
221 00 Lund

http://www.risk.lth.se

Telefon: 046 - 222 73 60

Division of Risk Management and Societal Safety
Faculty of Engineering
Lund University
P.O. Box 118
SE-221 00 Lund
Sweden

http://www.risk.lth.se

Telephone: +46 46 222 73 60

Acknowledgements

I want to start by thanking my supervisor Henrik Tehler for his guidance and answering all of my many questions. I also want to thank my external supervisor Marta Olazabal at the Basque Centre for Climate Change (BC3) for her support, guidance, and comments, throughout the process of writing this thesis. This thesis would not have been possible without her advice and I am really looking forward to continuing working with her at BC3.

Additionally, thank you to all my friends and family for their invaluable love and support and for “making me stressed” about my thesis. I especially want to thank my Lund friends for the many late nights spent in the library. Finally, thank you to the DRMCCA department and all of Batch 6 of the “Master of Disasters” for an inspiring two years in Lund.

Summary

- Cities and urban areas (UAs) are now home to the majority of the world's population (over 4.2 billion people) and by 2050 it is estimated that 68% of the world's population will be urban (Dodman et al., 2022; UN, 2018). For this reason, cities are now hotspots for disaster and risk and are not only central stages for future sustainable development, but also in any work to mitigate and adapt to climate change (Wamsler, 2014).
- As more and more urban areas are planning and responding to climate change there is a need to understand the role that local action is having at the national and international level. The Paris Agreement called for a global goal on adaptation (GGA) but in practice aggregating progress on adaptation is hard to achieve. Effective monitoring, evaluation, reporting and learning (MERL) systems are crucial to inform decision-making and track progress at all levels of government, and adaptation planning documents contain the most up-to-date information on how urban areas are tracking progress.
- The aim of this thesis is to understand the characteristics and use of adaptation metrics across climate adaptation-related planning. A case study is used to analyse what is being done in practice, particularly at the urban scale. To achieve this aim 199 urban areas in the UK were analysed, indicators collected for 27 urban areas and the policies' analysed for a subset of 14 urban areas.
- The aim of the thesis is broken down into two research questions. Research Question 1 (RQ1) looks at "What is the share of UK local adaptation plans that include adaptation metrics, and what are their main characteristics?" and is addressed through an indicator analysis. Research Question 2 (RQ2) is addressed through a policy analysis and asks, "How are adaptation metrics used in UK local adaptation plans to track outcomes?".
- The results show that many urban areas are not adequately tracking adaptation progress. Out of the 163 UAs with climate action plans only 93 UAs referred to MERL. Meanwhile, 27 UAs have developed comprehensive MERL frameworks with associated adaptation indicators, but only 14 UAs are actually measuring adaptation results.
- Evidence of best practice can be seen in some 'early adopter' urban areas. Best practice may include localising international agendas such as the Sustainable Development Goals, taking a flexible and transparent approach which enables learning, and considering the broader social agenda. Further work is needed to build capacity of urban authorities to effectively track adaptation, so that implementation at the local level can be used to inform global goals.

Abbreviations

Aberdeen – Aberdeen City Council
Bolton – Bolton Metropolitan Borough Council
Bracknell – Bracknell Forest Council
Bristol – Bristol City Council
Bury – Bury Metropolitan Borough Council
Cardiff – Cardiff Council
CCA - Climate Change Adaptation
CDP – Carbon Disclosure Project
Charnwood – Charnwood Borough Council
Doncaster – Doncaster Metropolitan Borough Council
Dundee – Dundee City Council
Ealing – London Borough of Ealing
Eastbourne – Eastbourne Borough Council
GGA – Global Goal on Adaptation
Glasgow – Glasgow City Council
GlaSS – Glasgow Sharm El-Sheikh Work Programme
Greater London – Greater London Authority
GST – Global Stocktake
Haringey – London Borough of Haringey
Harrow – London Borough of Harrow
KPI – Key Performance Indicators
Manchester – Manchester City Council
MERL - Monitoring, Evaluation, Reporting and Learning
Merton – London Borough of Merton
Mid Sussex – Mid Sussex District Council
NDCs - Nationally Declared Contributions
Newcastle – Newcastle-upon-Tyne City Council
NIs - National Indicators
Oadby and Wigston – Oadby and Wigston Borough Council
RAG – Red, Amber, Green
Reading – Reading Borough Council
Richmond – London Borough of Richmond upon Thames
SDG – Sustainable Development Goals
Southampton – Southampton City Council
Sutton – London Borough of Sutton
UA - Urban Area
UK - United Kingdom of Great Britain and Northern Ireland
VLR - Voluntary Local Reviews
Wandsworth – London Borough of Wandsworth
Wigan Metropolitan Borough Council - Wigan
Windsor and Maidenhead – Royal Borough of Windsor and Maidenhead

Table of Contents

1. Introduction

1.1 Background and Rationale

Cities and urban areas (UAs) are now home to the majority of the world's population (over 4.2 billion people) and by 2050 it is estimated that 68% of the world's population will be urban (Dodman et al., 2022; UN, 2018). For this reason, cities are now hotspots for disaster and risk. They are not only central stages for future sustainable development, but also in any work to mitigate and adapt to climate change (Wamsler, 2014). Alongside this, risk is becoming increasingly urban, and the processes of urbanisation and rapid population growth are adding to the challenge of adapting to climate change (UNDRR, 2013). Indeed, rapid urbanisation often results in inadequately planned and managed cities, that in turn increase vulnerability and exposure of populations to a range of climatic and non-climatic hazards (Wamsler, 2014; UNDRR, 2013). Vulnerable urban populations already have reduced adaptive capacity and need additional support and interventions (Eriksen et al., 2021). However, cities often lack the capacity and key infrastructure, as well as comprehensive monitoring, evaluation, reporting and learning (MERL) systems to track the effectiveness of these interventions (ibid). This means that in practice adaptation interventions may inadvertently "reinforce, redistribute or create new vulnerability" risking maladaptation (Eriksen et al., 2021, p.1). Recent research has shown that poor urban planning can be a greater contributor to increased risk over that of climate change itself (UNDRR, 2013).

As more and more cities are preparing for climate change impacts by developing adaptation plans, there is a need to understand the role these plans are having (Anguelovski et al., 2016). With now over fifteen years of adaptation projects occurring in combination with urban development remarkably little is known on how these plans and their implementation affect the vulnerability of the urban poor (Anguelovski et al., 2016, Dodman et al., 2022). Additionally, there are unresolved debates over the difference between adaptation and urban development with a significant lack of evidence of what actually constitutes successful adaptation (Wamsler, 2014). This means that although there may be significant climate change adaptation action there is little evidence of adaptation that is successful in reducing climate risk. The COVID-19 pandemic illustrated that policy makers need to design interventions that not only respond to climate change but also achieve wider societal goals (Devine-Wright et al., 2022). As all climate solutions will have a direct impact on people, and as a result science can play a central role. For example, social sciences are key to exposing and unpacking these power inequalities and avoiding unforeseen results such as rebounding of vulnerability, shifting of vulnerability, and negative externalities often termed ‘maladaptation’ (Cologna and Oreskes, 2022; Schipper, 2020). The term ‘maladaptation’ has been used in a variety of contexts to describe undesirable and unforeseen results from approaches to reducing the impact of climate change (Schipper, 2020). To avoid maladaptation there is a clear need to understand what drives vulnerabilities and recognise what adaptation success looks like; effective MERL systems are key to achieving this (Schipper, 2020).

There are a wide range of existing MERL instruments used to track progress on climate change adaptation (Adriázola et al., 2018). However, this diversity impedes the ability for local climate action to be clearly demonstrated at the national and international level (Adriázola et al., 2018). MERL has critical implications for integrating local knowledge and priorities into broader climate discussions and there is a need for metrics to allow local climate action to be reported on at a global level whilst also reflecting the context-specific nature to climate change (de Zoysa, Coger and Krishnan, 2022). Indicator frameworks are one of the most commonly used approaches in urban climate governance (Ford et al. 2015). They provide measurable variables that can be used to track not only the process, but also the result of actions (UNDP, 2019). Additionally, indicators often play a central role in justifying future funding, communicating to stakeholders and policy makers, and reporting on progress on a local, regional, and international level (UNDP, 2019). That being said, there is often a lack of available data and capacity at the local level to design effective MERL systems. Ill-considered, and poorly thought-out MERL systems can lead to the application of imperfect indicators and metrics that not only fail to measure what is expected, but also may lead to the wrong incentives in adaptation planning. Imperfect indicators may prioritise specific outputs over actually achieving outcomes and reducing climate risk (Hallegate and Engle, 2019; Leiter and Pringle, 2018). In the UK, for example, evidence shows that some urban local authorities shifted their focus away from tackling homelessness to relocating rough sleepers to other local authorities. Authorities introduced a ‘reconnection’ policy as it was an easier way to reduce the number of rough sleepers in their authority (the national indicator used to track homelessness) (Johnson and Jones, 2015). This example illustrates the importance of indicators that measure the realisation of outcomes and not just outputs. Without outcome indicators it may look on paper that progress on adaptation is high with a significant number of outputs, but in reality, risk is not being addressed or it is even being exacerbated elsewhere (Leiter et al., 2019).

Since the Paris Climate Change Agreement in 2015 urban areas are increasingly planning for climate change and developing action plans that respond to and future-proof urban settlements (Castan Broto et al., 2020). Global networks of cities such as ICLEI and C40 illustrate the commitment of local actors to engage in climate action (Dodman et al., 2022). That being said, recent research shows that cities are not adequately prepared. A number of cities do not have the appropriate plans in place (Olazabal and Ruiz de Gopegui., 2021). Existing adaptation planning is unlikely to be effective unless improvements are made in financing, context specificity, and crucially, MERL (ibid). Reckien et al. (2018) found, for example, that the use and characteristics of adaptation planning across relevant documents in major cities across the EU-28 was lacking. The study stressed the need for effective adaptation that considers the wider outcomes of adaptation actions (Reckien et al., 2018). Tracking adaptation is needed to ensure that measures are achieving their desired effects and if not; make adjustments (Dodman et al., 2022).

The process of adapting to climate change is highly complex, may be underfunded, and may even increase vulnerability. For this reason, it is essential that adaptation planning has mechanisms in place to ensure continuous, and iterative, cycles of learning (Becker, 2014). An understanding of what constitutes "effective or ineffective adaptation is therefore crucial, yet unlike climate change mitigation, where a reduction in carbon emissions is an easy indicator for success, there is no obvious parallel for adaptation" (Lewis and Olazabal, 2021, p.1). Global discussions as to what constitutes adaptation success have largely been linked to the Paris Agreement. In 2015, the Paris Agreement established the need for a Global Goal on Adaptation (GGA) however, what that looks like in practice is subject to debate (UNFCCC, 2021). Adaptation also receives significantly less funding than mitigation, with the annual $30 billion, far short of what is needed to ensure robust adaptive capacity (GCA, 2021). The Paris Agreement attempted to resolve this by committing countries to $100 billion in adaptation funding, but this money is yet to be delivered (UNFCCC, 2021). Effective MERL systems will be a big part of justifying future funding and ensuring that future funding is achieving results (Leiter, 2017).

Progress to developing the GGA is complicated by the diversity of adaptation practices, difficulties in aggregating nationally and globally, and the need to draw on local and national level experiences (de Zoysa, Coger and Krishnan, 2022). The on-going discussion in the run up to COP27 presents a unique opportunity to make the actions of local governments visible in the international climate arena. Indeed, at COP26, countries established the two-year Glasgow-Sharm el-Sheikh work program (GlaSS) with the aim of enhancing climate change adaptation action through a process driven by individual countries (de Zoysa, Coger and Krishnan, 2022). The first GlaSS workshop in Bonn highlighted the need for more meaningful local integration (UNFCCC, 2021; de Zoysa, Coger and Krishnan, 2022). For example, countries such as

Singapore placed significant emphasis on local integration in their most recent NDC submission (ibid). However, the lack of consistent methods and capacity at the local level to develop aggregable metrics contributes to the fact that many urban areas are overlooked. Further, of the cities that have adopted adaptation metrics the majority only included ‘output’ metrics (e.g., actions implemented) rather than considering ‘outcomes’ (e.g., realised results) (Goonesekera and Olazabal, 2022). Whilst an understanding of outputs is crucial for ongoing management and accountability, it is less helpful when it comes to learning and understanding the broader outcomes of adaptation actions (Leiter, 2017). Adaptation outcomes refer to an actual “reduction in harm, the reduction in the risk of harm, or the realisation of benefits to address climate variability and change” (Donatti et al., 2020, p.416). If urban adaptation is to be deemed successful, evidence of reduction or realisation actually achieved is crucial. To this end, indicators that measure the realisation or ‘outcome’ of climate change adaptation are a crucial first step in developing such evidence for Urban CCA (Olhoff et al., 2018).

1.2 Research Aim and Research Question(s)

The **research aim** of this thesis is *to understand the characteristics and use of adaptation indicators and metrics across climate adaptation-related planning.* For this, a case study is used to analyse what is being done in the adaptation planning practice, particularly at the urban scale. The sample will focus on UK UAs (the justification and details on case study context will be developed further in Chapter 3). The thesis will then attempt to make normative conclusions regarding how outcome data can be better integrated into MERL metrics and the components needed to assess the maturity of MERL frameworks for adaptation-related planning documents.

To address the research aim, two research questions have been formulated contextualised in the UK case study (Figure 1.1). Research Question 1 (RQ1) “What is the share of UK local adaptation plans that include adaptation metrics, and what are their main characteristics?” aims to understand the *characteristics* of indicators and metrics that are currently being used in planning practice. Research Question 2 (RQ2) “How are adaptation metrics used in UK local adaptation plans to track outcomes?” aims to understand the *use* of metrics to track outcomes. These two research questions are addressed through two methods: to respond to RQ1 an analysis of indicators in UK climate planning documents was undertaken, and secondly a more detailed policy analysis of a sample of UK planning documents for RQ2. Planning policies were selected as the primary data source as they represent the most up-to-date information on how urban areas are responding to climate change and tracking progress (Olazabal, Galarraga et al., 2019; Reckien et al., 2018). Indicators were selected as central components of how adaptation plans monitor the progress (UNFCCC, 2021b). The decision to analyse planning documents and indicators will be further motivated in Chapter 3 (UNFCCC, 2021b).

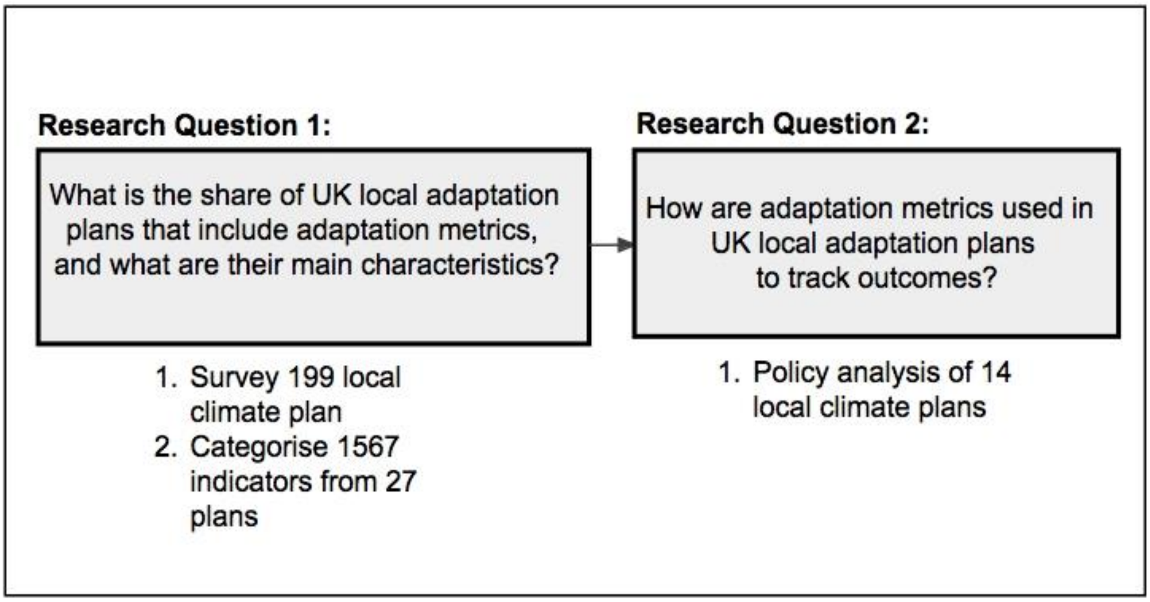

Fig.1.1. Research questions and data sources.

1.3 Structure

This thesis will be structured as follows:

- *Chapter 2: Conceptual framework*

  This section will detail the key concepts used as a conceptual lens for the thesis. The section will also define key terms and discuss the author's ontological and epistemological assumptions.
- *Chapter 3: Methodology*

  This section of the thesis will detail the methodology including the research strategy, sampling approach, indicator, and document analysis method.
- *Chapter 4: Findings and analysis*

  This section will present some broad findings and analysis.
- *Chapter 5: Discussion*

  This section will discuss current approaches to monitoring and evaluation of CCA and build on an index developed as part of this thesis. The section will also detail areas for further research.
- *Chapter 6: Conclusion*

  The thesis will finish with a concluding section and key contributions.

2. Conceptual Framework

This chapter aims to introduce a set of concepts, which will serve as a central lens to understand this master's thesis. These concepts include climate change adaptation, urban climate governance, and monitoring, evaluation, reporting, and learning (MERL). The chapter will also present the epistemological and ontological assumptions of the author.

2.1 Climate Change Adaptation

Climate change adaptation (CCA) refers to "the process of adjustment to actual or expected climate and its effects"; generally, this involves reducing the vulnerability of human systems to moderate or avoid harm (IPCC, 2014, p.35; Field et al., 2014; Mercer, 2010). However, in practice the concept of *adaptation* is used interchangeably. Technical definitions focus on adaptation as a process of adopting technological or engineering fixes to reduce risk (Eriksen et al., 2021). Alternative definitions acknowledge the complex social and political processes that shape how coupled human-environment systems adjust to climate change (Eriksen et al., 2021).

Climate change adaptation strategies refer to the coordinated efforts to respond to the diverse and unprecedented impacts of climate change. However, even with the influx in adaptation planning, many impacts are now unavoidable, with the physical and socioeconomic impacts highly differentiated between countries, regions, and even local communities (Adger et al., 2005; Mercer, 2010). Any plan or response is therefore characterised by long-term actions aimed at preventing short-term risks and any decision taken by authorities could have consequences of up to 50-100 years (Hallegate, 2009). The fact that local authorities are unable to see the impact of their actions on the climate system, or indeed attribute changes in risk to specific policies, presents a unique challenge to planning authorities (Villanueva, 2011). In sum, responses to climate are highly context-dependent and despite a global commitment to action there is no 'one-size-fits all' solution (European Union, 2020, p.9).

2.2 Urban Climate Governance

Urban climate governance refers to "the ways in which public, private, and civil society actors and institutions articulate climate goals, exercise influence and authority, and manage urban climate planning and implementation processes" (Anguelovski and Carmen, 2011, p.169). With a leading role in climate action and hotspots for climate risk, UAs are crucial for understanding urban climate governance and progress on adaptation (Wamsler, 2014). Urban climate governance therefore has many influences both from local stakeholders but also from national and international agendas (Adriazola et al., 2018). Urban climate governance is central to reproducing power and shaping the complex social and political processes that may enforce and redistribute risk, including the vulnerability of populations to specific risks. If done well, urban climate governance has the potential to go beyond addressing the impacts of climate change and deliver reparative justice for communities compounded with structural inequalities (Castan Broto et al., 2021). However, more frequently the outputs of climate governance do not have the intended impact and can actually exacerbate the vulnerability of urban populations (Anguelovski et al., 2016, Eriksen et al., 2021). The tracking of adaptation is needed to understand these changing vulnerabilities, to ensure resources are being used efficiently, and make adjustments if needed (Olazabal, Ruiz de Gopegui, et al., 2019).

Further to this, the governance of climate change in countries globally is characterised by a number of different levels of government working together, or sometimes against each other, to achieve the goals laid out in the Paris Agreement (Adriázola et al., 2018). Certainly, the different levels of government are mutually dependent on one and other for implementing the Paris Agreement, yet legal, institutional, and financial instruments and frameworks from the national and regional level are often a hindrance to local climate action (Adriazola et al., 2018). For this reason, particularly in the run-up to the second iteration of the National Determined Contributions (NDCs) and the first Global Stocktake (GST) starting in 2023 it is crucial that UAs have the necessary MERL processes to report and share their contributions (UNFCCC, 2021). Adaptation progress therefore needs to be aggregable so that it can be reported at the national level but at the same time specific to the local scale to allow for learning. Aggregable data for adaptation progress at the local government level, is crucial so that UAs can not only report but also lobby national governments for further progress. Indeed, despite the Paris Agreement being negotiated nationally, it is cities that are often doing the implementation on the ground and therefore cities that are key to the reporting progress for the GST in 2023 (UNFCCC, 2021). A recent study found that over two-thirds of the NDCs now contain ‘strong’ or ‘moderate’ urban content (Tollin et al., 2022; p.5). However, there is often a lack of alignment between urban climate responses and climate challenges. The paper outlines strengthening multi-level climate governance and improving consultation with sub-national level stakeholders as key areas for improvement (Tollin et al., 2019). Appropriate metrics and reporting structures are central to achieving this (Tollin et al., 2019).

In the UK, urban climate governance is experiencing a period of intense experimentation thanks to an influx of climate emergency declarations motivated by the UK government committing UK local authorities to reaching net zero carbon emissions by 2050 (PCAN, 2021). However, climate emergency declarations have tended to focus almost exclusively on mitigation measures and measures to reach net zero, with less than 12% of declarations considering adaptation (PCAN, 2021). The UK Green Alliance reported in 2020 that there were a number of factors limiting urban climate governance in the UK including a lack of capacity and expertise, limited, and stretched funding, and the impact of national policy limiting local action. Prior to 2011, the UK's National Performance Framework was a key driver of MERL practices for CCA notably through a set of National Indicators (NIs), which were formulated using self-assessments made by local authority areas on mitigation and adaptation progress (PCAN, 2021). However, in 2011, the NIs were removed, including NI188, the indicator focusing on adaptation progress due a lack of funding and questions over its accuracy (PCAN, 2021). The removal of these indicators severely undermines MERL practices across the UK as there is no longer any requirement for local authorities to report on adaptation progress (PCAN, 2021). This reflects the power that national governments have in motivating or hindering climate action. Indeed, since then Heidrich et al., (2013, p.26) found little to no "evidence of climate change adaptation monitoring and/or that annual reviews of climate change adaptation activities are conducted". Heirdrich et al. (2013) notes that N118 drove the reporting of adaptation in 97% of English authorities and as there is no appropriate alternative many councils continue to use the indicator (Heidrich et al., 2013).

2.3 Monitoring, Evaluation, Reporting, and Learning

Monitoring aims to track changes in climate change impacts and adaptation efforts over time, and across various scales typically using a range of indicators or criteria (EEA, 2020a). Meanwhile, *evaluation* attempts to assess the mainstreaming efforts, based on monitoring (EEA, 2020a). Monitoring typically occurs on an on-going basis whereas evaluation is often an external effort that occurs at predefined intervals (EEA, 2020a). *Reporting* refers to the process of communicating progress to key stakeholders usually through written documentation, reporting CCA is often driven by international networks or agendas such as the Agenda 2030 (SDGs) or the New Urban Agenda (EEA, 2020b; Pringle, 2016). Reporting is driven by relevance, effectiveness, efficiency, impact, and sustainability (C40 Cities, 2019). Finally, *learning* refers to the process of understanding why change has occurred and reflecting on how to make improvements going forwards (Valters, 2015). However, learning requires an understanding of why change has occurred (Christiansen et al., 2018) and for a truly mature approach to learning there is a need to understand how to learn (Valters, 2015).

There are a huge number of diverse ways in which MERL systems can be designed and adopted (Leiter et al., 2019). Most existing efforts have focused on measuring inputs and outcomes, and as stated by Olhoff et al., (2018) there is an evidence gap in terms of measurable adaptation outcomes and adaptation indicators that systematically give an indication of adaptation impacts. In order to understand or track adaptation progress on a global scale, future efforts need to find a balance in metrics that cater for ‘comparability and aggregation’ but also the detail and contextualisation at a local level (Olhoff et al., 2018). MERL processes are central to the learning process and guiding future adaptation efforts, however, the metrics that are useful for reporting are not usually what is useful for learning (Hallegatte and Engle, 2019). MERL can not only act as justification for future funding but is also a key means of avoiding maladaptation and ensuring that existing funds are spent appropriately (Barnett and O’Neill, 2010; EEA, 2020b). Unlike MERL for development projects, CCA occurs at various temporal and spatial scales (Williams et al., 2017). For this reason, the development of methodologies remains highly complex due to the extensive challenges associated with temporality, scale, and uncertainty (Dilling et al., 2019). Common components to MERL systems are listed in Appendix A.

2.4 Adaptation Indicators and Metrics

Indicators and metrics are a useful tool for providing clarity and accountability about the goals and progress of adaptation (Arnott et al., 2016). As previously noted, tracking performance is crucial to not only communicate with stakeholders but also assess needs, design theories of change, guide implementation, assess outcomes and impact, and evaluate cost efficiency (Arnott et al., 2016). In recent years there have been a number of attempts to quantify or measure the global progress on adaptation and as central figures in the climate agenda, cities play a crucial role (Chen et al., 2016). Proposals have been drawn from a wide range of disciplines and theories including evaluation theory (Arnott et al., 2016), ecosystem-based adaptation (Donatti et al., 2016) or focused more broadly on resilience assessment (Jones et al., 2021). However, the challenges with measuring adaptation progress are widely noted, with even a lack of agreement on the definition of the terms ‘indicator’ or ‘metric’ (Christiansen et al., 2018). Christiansen et al., (2018) state that indicator and metric usually refer to the level of detail with 'indicator' a measure of progress and ‘metric' more detailed with a specific unit of measurement e.g., hectares, m2. In this thesis, indicator is used as a broad overarching term to reflect the focus on both qualitative and quantitative measures (Stevens, 1946). In this thesis the terms ‘indicators’and ‘metrics’ have been used interchangeably reflecting their use in wider academic literature noting that there is no all-encompassing term for indicators and metrics (Arnott et al., 2016; Christiansen et al., 2018). However, the analysis section of the thesis the thesis aims to investigate the importance of identifying appropriate measurement approaches and to understand what "level of detail", referring to their degree of quantifiability, is collected in practice (Arnott et al., 2016; Christiansen et al., 2018). For this reason, the analysis section will adopt a 3-level classification developed by Goonesekera and Olazabal (2022, p.3). The classification includes three levels of quantifiability: Objective, Indicator, and Metric.

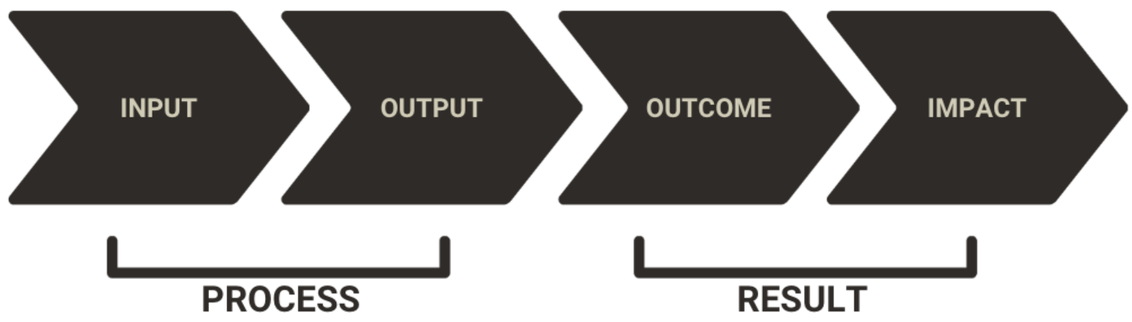

Fig.2.1. Indicator types and change process (Adapted from Leiter al., 2019)

Adaptation indicators tend to focus on either planned adaptation to climate change or the realisation of adaptation, sometimes referred to as the results (Sniffer, 2018). The thesis will build on methods commonly used in international development and will categorise the adaptation metrics according to the stage of change: (1) input, (2) output, and (3) outcome and (4) impact of the adaptation measure (Leiter et al., 2019). Process indicators (input or output) refer to potential for adaptation and usually track whether an action is completed, useful for project administration or budgeting. Meanwhile, outcome or impact indicators refer to the realisation or result of adaptation (Leiter et al., 2019). Day to day the terms outcome and impact are used as synonyms and in this thesis the terms both refer to a type of result-based indicators. In general, an 'outcome' refers to the likely or achieved short-term and medium-term effects of the project (2-5 and 5-20 years), which may take the form of adjustments to human, physical or financial systems within the boundaries of the project (Leiter et al., 2019). Whereas 'impact' refers to the longer-term effects relating to the project that may contribute towards climate resilience but are often not directly attributable to a specific project or action. These are changes of long-term risk typically more than 20 years and particularly hard for indicator systems to quantify and measure (Leiter et al., 2019). Indicators that focus on the potential for adaptation are typically easier to measure and often the most common form of indicator (Goonesekera and Olazabal, 2022). By contrast, impact or outcome indicators that look at the long-term effects of intervention are much more complicated to measure, and yet critical to know if a policy is achieving the desired results (World Bank, 2010). There is an evidence gap in the development of indicators that focus on the resulting change, particularly those capable of capturing the long-term nature of change (UNFCCC, 2016). Figure 2.1 shows the stage of change that the different indicator categories relate to and how they relate to the desired stage of action (C40 Cities, 2019). Future efforts should represent all stages of change while negotiating a balance between comparability, aggregation, and relevance for the local level (UNFCCC, 2016).

2.5 Ontological and Epistemological Assumptions

The concepts discussed in this section present the framing and understanding that will be used as a theoretical lens for the data collection and analysis. This analysis and the understanding of the concepts is applied under a set of ontological and epistemological assumptions which, alongside the key concepts, are useful for understanding and interpreting subsequent findings. Ontological assumptions refer to how we think the world is and epistemological assumptions refer to how we think we can know about it (Blaikie, 2009). From the author's perspective, there is a physical reality outside of the human mind. However, the way we interpret and understand the world is highly subjective. Researchers must adopt a "cautious and critical attitude" towards their topics of research (Blaikie, 2009, p.93). This perspective can be characterised as one of cautious realism. As a result, the thesis will adopt a rigorous and robust approach to data collection and critically apply the concepts in a specific context, in this case UK UAs. The justification for the focus on UK UAs will be discussed in the Chapter 3.2.2 and in total the plans for over 200 UAs have been considered. By considering all UAs in the UK the thesis can aim to make concrete conclusions about the state of adaptation-tracking in the UK. The epistemological perspective can be seen as critical realism (Blaikie, 2009; Crotty, 1998).

3. Methodology

This section will give more specific details of how the UAs were selected, the indicator sampling procedure, and the policy analysis; it will also detail how the different components of MERL were identified.

3.1 Research Strategy

The overall project aim was to understand how UAs in the UK plan to track the outcomes of climate adaptation strategies. This aim was evaluated using an inductive approach using the methodological approaches of an indicator analysis and subsequent policy analysis (Creswell, 2013) as shown in Figure 3.1.

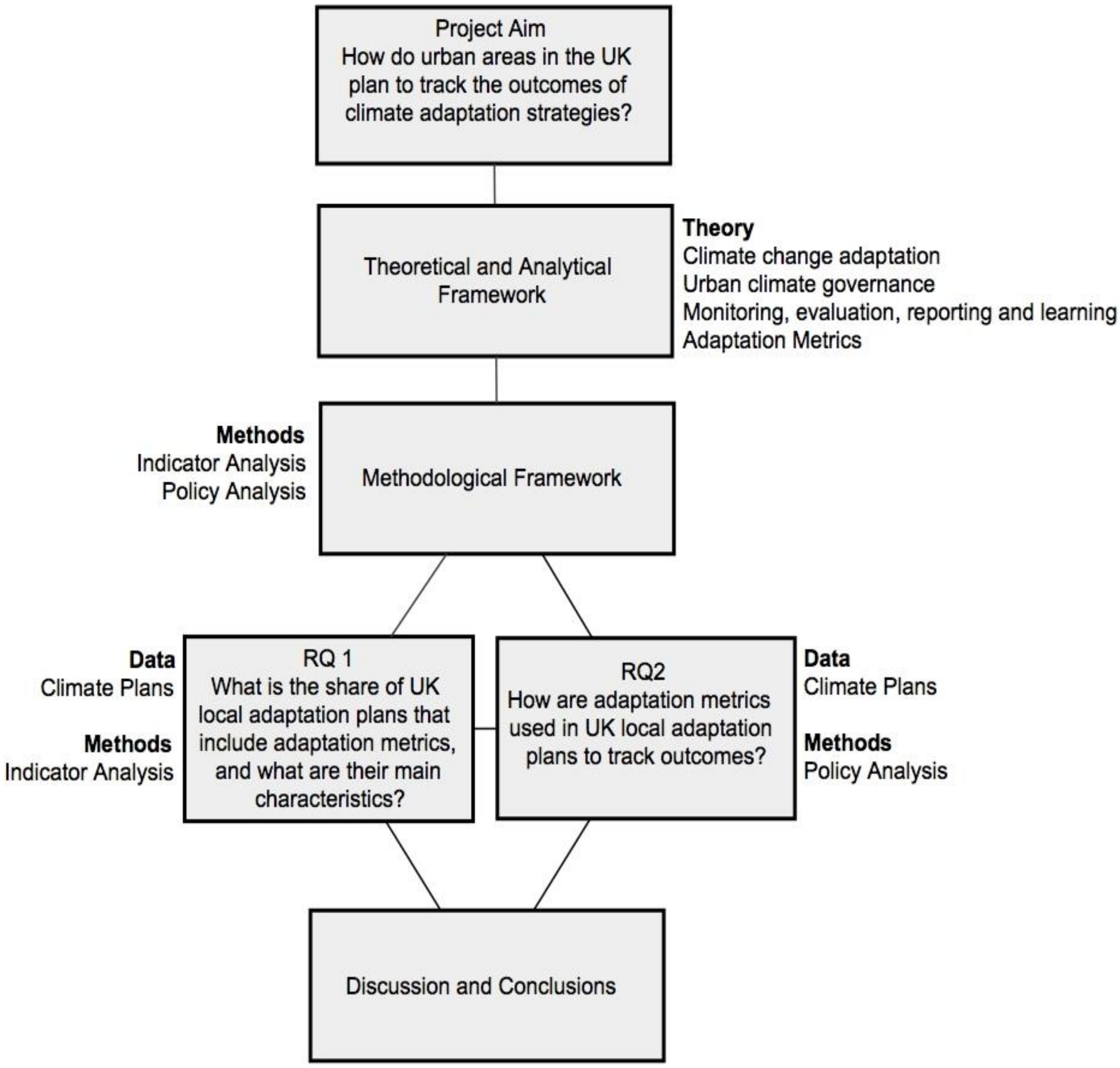

Fig.3.1. Process flow showing the research strategy

This approach was based on the assumption that the development of climate adaptation plans is central to climate policy drawing on the fact that previous studies have assessed adaptation plans as a proxy for adaptation progress (Berrang-Ford et al. 2019; Lesnikowski et al. 2017; Reckien et al. 2018). However, policy development alone does not actually lead to vulnerability or risk reduction (Olazabal, Galarraga et al. 2019). Comprehensive tools, methods, and approaches are needed to track progress. Indicator frameworks have emerged as the primary way in which urban areas are tracking the progress of their adaptation plans (Ford et al. 2015). Therefore, a sample of all local climate plans for UK urban areas was considered in the first instance. Then a selection criterion was applied to select a smaller subset of these for further analysis. For the plans that met the criteria for further analysis, indicators were collected, and a database of the indicators was produced. The findings and analysis were developed for the two research questions shown above and fed into a critical discussion on the way UAs track the realisation of adaptation. The discussion will inform conclusions on ways forward and how to better improve the way outcomes are integrated into urban adaptation plans.

3.2 Data Collection Process

3.2.1 Urban Area Selection

In 2018, Reckien et al. assessed the state of urban adaptation within the EU. In total, the adaptation policies of 885 UAs across the EU-28[1] were identified and analysed. This thesis further developed this research, focusing on indicators and metrics for CCA. Due to language constraints, the sample focused on UK UAs. The original analysis by Reckien et al., (2018) selected UAs using the NUTS3 Eurostat sample and included a sample of 885 core UAs in the EU-28, with 163 of the UAs in the UK. As of 2021, the Eurostat sample is no longer being produced to include the UK as there is no data sharing agreement following Brexit (Eurostat, 2021). This study therefore selected a sample from all UAs in the UK. To develop this sample a comparative definition of UAs across all four nations (England, Scotland, Wales, and Northern Ireland) was needed.

UAs can be characterised by a range of features including population density, land coverage and vegetation, architecture, organisation or structures in space, relationship between buildings and topographic aspects, and infrastructure. It has been noted that defining UAs for the purposes of global comparisons is problematic as definitions differ significantly from one country to

[1] At the time of the study (Reckien et al., 2018) the UK was part of the European Union.

another (Wamsler, 2014). The UN Statistical Commission (2020) proposes that the focus should be on the degree of urbanisation producing three types of settlement:

- **Cities**, which have a population of at least 50,000 inhabitants in contiguous dense grid cells (>1,500 inhabitants per km2)
- **Towns and semi-dense areas**, which have a population of at least 5,000 inhabitants in contiguous grid cells with a density of at least 300 inhabitants per km2
- **Rural areas**, which consist mostly of low-density grid cells

In this regard, UAs are referred to as cities plus towns and semi-dense areas (UN Statistical Commission, 2020). Figure 3.1 shows the range of different local administrative authorities in the UK (ONS, 2019).

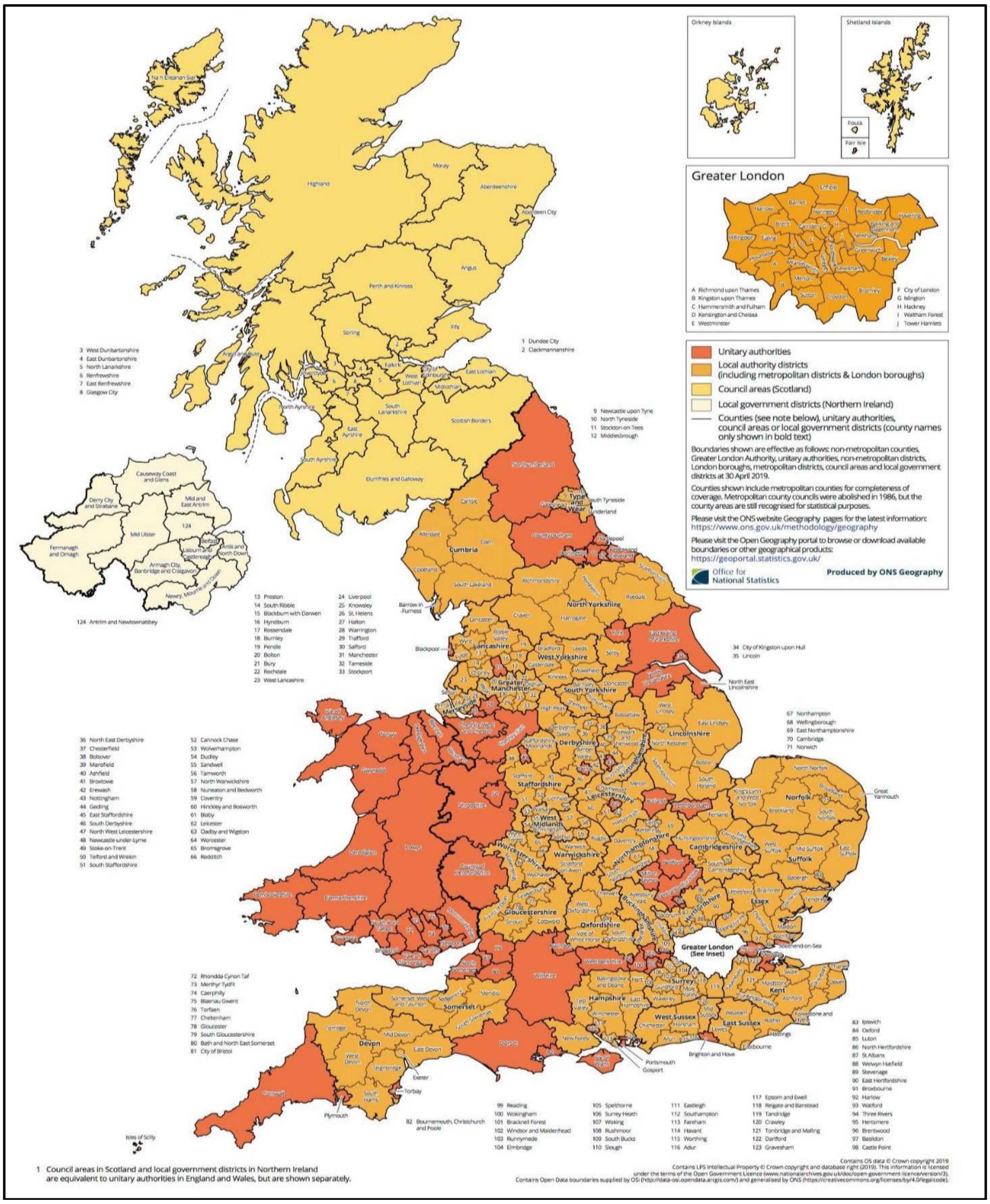

Fig.3.2. Map showing all local authorities in the UK, [colours refer to type of authority] (ONS, 2022).

3.2.2 Case Study Context

The type and authority of each UA differs according to the UK nation. This thesis focused in particular on urban local councils as these are the authorities primarily responsible for climate change action (ONS, 2019). Also included in the study are combined authorities which often have overarching powers for a number of different borough or city councils; this is the case in Greater London (ibid). Combined authorities are also considered because as noted by Holgate (2007), it is important not to consider one level of governance in isolation. The inclusion of Greater London also marks a notable challenge to identifying UAs in the UK as one city can make up multiple local authorities (Heidrich et al., 2013). For the purposes of the study 'District' councils were excluded as they cover a much wider geographic range, with predominantly rural areas (Parsons, 2021). 'Parish' and 'Community' and 'Town' councils were also not included because they are not typically involved with climate change adaptation planning (ibid). In addition to climate responsibility, councils in England, Scotland and Wales are responsible for social care, transport, housing, and education alongside community services including libraries and waste collection (Welsh Government, 2022; Local Government Boundary Commission for Scotland, 2021; ONS, 2019). In Northern Ireland, the powers of local councils are much more restricted, but they still have responsibility for climate matters, alongside neighbourhood services such as waste collection and street cleaning (NI Direct, 2022). Unlike the rest of the UK, councils in Northern Ireland are not responsible for education, libraries, or social care (ibid).

For UAs in the UK there is no comparative measure of how rural/urban an area is (ONS, 2022; SGUR, 2016; NISRA, 2022). For example, the ONS Rural Classification (RUC) in England and Wales uses an 11-point scale, whilst Scotland's Scottish Government Urban Rural Classification (SGUR) uses a 3-point scale focusing on remoteness. Meanwhile, Northern Ireland's NISRA Delineation of Settlements (SDL) uses 8-bands for settlement size and a 3-point urban/rural scale. The definition of population size is also different for each of the four nations, with England/Wales defining rural as less than 10,000 people, Northern Ireland less than 5,000 and Scotland less than 3,000 (Parsons, 2021). For this study sample a composite describing various small areas on a rural/urban scale that is comparable across the UK was adopted. The composite was produced by Parsons (2021) as part of Climate Emergency UK's research into climate emergency declarations at the end of 2018. The composite considers key factors relating to degree of urbanisation including the national distribution of urban and rural areas, population density and area-based distribution.

In 2019, the UK government committed UK local authorities to reaching net zero carbon emissions by 2050. Since then, 270 urban and rural local authorities have published climate action plans with measures introduced not only on how to achieve climate neutrality by 2050 but also how to cope with the impacts of climate change (Climate Emergency UK, 2021). In total, in 2021, out of 409 local authorities across the UK, 84 still did not have climate action plans, while 139 had not committed to reaching net zero emissions by a specific date (ibid). The recent influx in climate planning in the UK has catalysed discussions on how best to measure progress and ensure the accountability of climate change action planning (Creasy et al., 2021).

Howarth et al., (2021) found that local declarations have led to the creation of innovative climate and sustainability strategies (or 'climate action plans') as well as the development of networks as a way of expanding local government capacity. Declarations of climate emergency offer an opportunity to reflect on and expand the capacity of local climate change planning, and many declarations of urgency led to the publication of climate action plans (Climate Emergency UK, 2021). Howarth et al. (2021) and Creasy et al. (2021) discuss the legitimacy of these climate plans by questioning whether they are mere rhetoric or evidence of increased commitment by local government authorities. In January 2022, a report by Climate Emergency UK found that 1 in 5 councils had not published a climate action plan despite declaring a climate emergency. Many councils lack appropriately assigned budgets, resourcing, and staff, and despite the ambitious climate action plans there is very little actual action (ibid). It was noted that without MERL systems to hold local authorities to account the plans become “symbolic acts rather than platforms upon which further action is delivered” (Howarth et al., 2021, p.27).

3.2.3 Document Selection

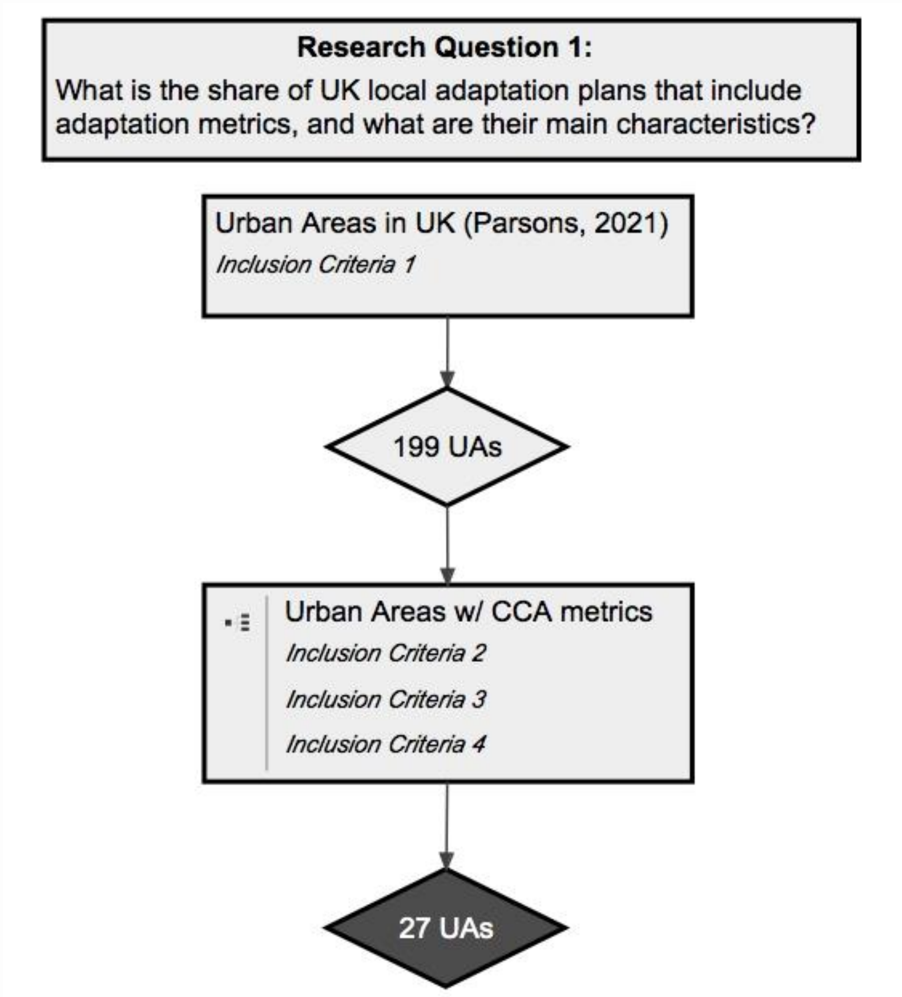

Fig.3.3. Inclusion criteria for RQ1 – What is the share of UK local adaptation plans that include adaptation metrics, and what are their main characteristics?

Inclusion Criteria:

1. *Council is classed as urban (Parsons, 2021)*
2. *Council has published a climate action plan on 20 September 2021*
3. *Plan details information on monitoring and evaluation*
4. *Plan includes CCA metrics*

In total there are 199 local authority areas (Figure 3.3.) that can be defined as urban according to the composite developed by Parsons (2021). Policy documents for all 199 of these local authorities were sourced using Climate Emergency UK's database. The cut-off date for inclusion of policy documents includes Climate Action Plans that were publicly available on council websites on or before 20 September 2021. Where possible, the relevance of climate plans was then verified through contacted stakeholders to check that the plans were still applicable at the time of writing the thesis (Creswell, 2013). Text content research for 'KPI', ‘indicator’, ‘monitor’, ‘measure’, ‘success’, ‘metric’ combined with an initial read-through was used to identify which UAs included indicators and metrics. If the plan did include indicators the UA was deemed relevant and purposefully selected for further analysis. Policy documents which had details on MERL were then further considered to see if indicators or metrics were included. In total 27 UAs had developed indicators or metrics to track progress in urban adaptation (Table.3.1.)

Table.3.1. Table showing UAs that have included adaptation metrics (n=27, details include name of council, name of plan, year published.

Council	Name of Plan	Date Published
Aberdeen City Council	*"Aberdeen Adapts Climate Adaptation Framework"*	2019
Bolton Metropolitan Borough Council	*"Bolton Climate Change Strategy"*	2021
Bracknell Forest Council	*"Climate Change Strategy: Bracknell Forest Council 2020-2024"*	2020
Bristol City Council	*"Bristol One City Plan"*	2019
Bury Metropolitan Borough Council	*"Bury Council Climate Action Plan 2021"*	2021
Cardiff Council	*"One Planet Cardiff"*	2021
Charnwood Borough Council	*"Charnwood Action Plan 2018-2030"*	2018
Doncaster Metropolitan Borough Council	*"ENVIRONMENT AND SUSTAINABILITY STRATEGY 2020-2030"*	2020
Dundee City Council	*"Dundee Climate Action Plan"*	2021
Eastbourne Borough Council	*"Eastbourne Carbon Neutral 2030"*	2021
Glasgow City Council	*"Glasgow’s Climate Plan Our Response to the Climate and Ecological Emergency"*	2020
Greater London Authority	*"London Environment Strategy"*	2019
London Borough of Ealing	*"Ealing Climate and ecological emergency strategy 2021-2025"*	2021
London Borough of Haringey	*"Haringey Climate Change Action Plan"*	2021
London Borough of Harrow	*"London Borough of Harrow Climate Change Strategy Incorporating the Air Quality and Climate Change Action Plan"*	2021
London Borough of Merton	*"MERTON CLIMATE STRATEGY & ACTION PLAN"*	2019
London Borough of Richmond upon Thames	*"LONDON BOROUGH OF RICHMOND UPON THAMES Climate Emergency Strategy 2019-2024"*	2019
London Borough of Sutton	*"Sutton Local Plan 2016-2031"*	2018
London Borough of Wandsworth	*"Wandsworth Environment and Sustainability Strategy 2019 -2030"*	2019
Manchester City Council	*"Manchester Climate Change Strategy 2017-50"*	2017
Mid Sussex District Council	*"Mid Sussex District Council Sustainability Strategy 2018 - 2023"*	2018
Newcastle-upon-Tyne City Council	*"Net Zero Newcastle - 2030 Action Plan"*	2020
Oadby and Wigston Borough Council	*"Oadby and Wigston Borough Council Environment Strategy and Action Plan"*	2019
Reading Borough Council	*"Reading Climate Emergency Strategy 2020-28"*	2020
Royal Borough of Windsor and Maidenhead	*"Royal Borough of Windsor & Maidenhead Environment and Climate Strategy 2020-2025"*	2020
Southampton City Council	*"Southampton City Council Green City Plan 2030"*	2020
Wigan Metropolitan Borough Council	*"Our Adaptation & Resilience Action Plan 2021-2026"*	2021

3.3 Indicator Analysis

Indicators were collected from 27 UAs in order to answer "RQ1 – What is the share of UK local adaptation plans that include adaptation metrics, and what are their main characteristics?". In addition to basic information such as 'name of indicator' and 'urban area' the indicators were also classified according to a set of main characteristics. The indicator classification was adapted from the classification developed by Goonesekera and Olazabal (n.d.) using wider literature and evidenced in the conceptual framework (Table.3.2).

Table.3.2. Table presenting method and references for indicator characteristics (Adapted from Goonesekera and Olazabal, 2022)

Characteristic	Method	Reference(s)
Domain	*(mitigation, adaptation, both, general)*	*Göpfert et al., 2020; Landauer et al. 2019; Sharifi, 2020; Ürge-Vorsatz et al., 2018*
Level of Detail	*(objective, indicator, metric)*	*Leiter et al., 2019; Christiansen et al., 2018; Hale et al., 2021*
Scope	*(general, specific)*	*Olazabal et al., 2019; Klostermann et al., 2018*
Type	*(input, output, outcome, impact)*	*Leiter et al., 2019; Hale et al., 2021*

The first characteristic 'domain' was developed from definitions of 'mitigation', efforts to reduce emissions and 'adaptation' efforts to addressing climate impacts (Castán Broto et al. 2020). 'Both' was included due to widely noted overlap between the two concepts (Göpfert et al., 2020; Landauer et al., 2018; Sharifi, 2020; Ürge-Vorsatz et al., 2018) and this refers to indicators such as the number of trees planted which can contribute to climate mitigation and adaptation. The 'general' class was used to account for indicators not relevant to climate change mitigation or adaptation (e.g. levels of poverty).

The second characteristic 'level of detail' was developed from definitions of 'objective', 'indicator' and 'metric' presented by Leiter et al., (2019), Christiansen et al., (2018) and Hale et al., (2021). In practice these terms are used interchangeably (Christiansen et al., (2018) however here they are used to refer to the level of detail being assessed. 'Objective', relates to the overarching result of an action and is the least detailed (Leiter et al., 2019), 'indicator' a measure of progress (e.g., number or level and can be quantitative or qualitative with a count) (Christiansen et al., 2018), and 'metric' refers to measure with a specific unit of measurement (e.g., hectares, m2) (Christiansen et al., 2018).

Table.3.3. Definition and Example for 'Objective', 'Indicator', and 'Metric' (Adapted from Goonesekera and Olazabal, 2022).

Level of Detail	**Definition and Example**
Objective	An 'objective' points toward a goal and a tendency, but it is still ambiguous in identifying elements to assess (e.g. "increasing green infrastructure").
Indicator	An 'indicator' refers to a particular element being assessed but does still not provide identifiable means of measurement (e.g. level of thermal comfort).
Metric	A 'metric', however, provides specific, unambiguous, and quantifiable aspects that need to be measured, counted, or evaluated (e.g. "number of air conditioning units").

The third characteristic refers to the scope of the indicator developed from definitions presented by Olazabal, Galarraga, et al., 2019 and Klostermann et al. (2018). ‘General’ refers to adaptation indicators that are not linked to any specific objectives and broad overarching indicators for the plan, ‘specific’ refers to adaptation indicators that are linked to a specific objective. For example, many UAs linked their indicators to overarching targets such as SDG11 Sustainable Cities and Communities or SDG13 Climate Action or more localised targets such as improving access to green space.

The final characteristic refers to the type of indicator based primarily on definitions by Leiter et al. (2019) but also informed by Hale et al. (2021). ‘Input’ and ‘Output’ indicators refer to the process of adaptation, ‘input’ refers to the financial, material, or human resources committed as part of the action, ‘output’ refers to products, capital, goods, and services delivered as a direct result of the action (Leiter et al., 2019). ‘Outcome’ and ‘Impact’ indicators refer to realisation or result of adaptation, ‘outcome’ indicators refer to the likely or achieved short-term or medium-term effects of the action (2-5 and 5-20 years), whereas ‘impact’ refer to longer-term effects (typically more than 20 years) that may contribute to climate resilience (Leiter et al., 2019).

All of these definitions are based on standard terminology used in development cooperation (Leiter et al., 2019). The plans that included indicators that focus on the realisation of adaptation (‘outcome’ or ‘impact’ indicators) were selected for further evaluation as part of the policy analysis.

3.4 Policy Analysis

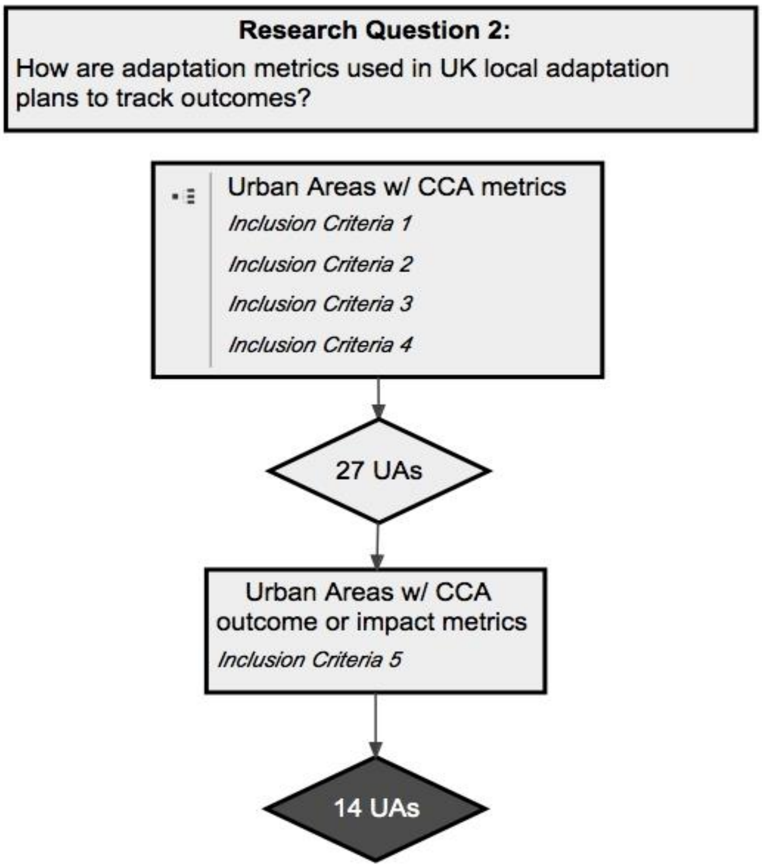

Fig.3.4. Inclusion criteria for RQ2 – How are adaptation metrics used in UK local adaptation plans to track outcomes?

Inclusion Criteria:

1. *Council is classed as urban (Parsons, 2021)*
2. *Council has published a climate action plan on 20 September 2021*
3. *Plan details information on monitoring and evaluation*
4. *Plan includes CCA indicators*
5. *Plan includes CCA indicators classed as 'outcome' or 'impact'*

The final stage of analysis involved a more detailed policy analysis for the policy documents which included 'outcome' or 'impact' indicators. The policy analysis aimed to answer the research question "How are adaptation metrics used in UK local adaptation plans to track outcomes?". A total 14 of the 27 UAs in RQ1 included 'outcome' or 'impact' indicators; these UAs are detailed in Table.3.3.

Table.3.4. UK urban areas included in the policy analysis.

Council
Aberdeen City Council
Bolton Metropolitan Borough Council
Bristol City Council
Bury Metropolitan Borough Council
Cardiff Council
Doncaster Metropolitan Borough Council
Dundee City Council
Eastbourne Borough Council
Glasgow City Council
Greater London Authority
London Borough of Merton
Manchester City Council
Southampton City Council
Wigan Metropolitan Borough Council

Policy analyses are commonly used to give voice and meaning around an assessment topic (Bowen, 2009). In this case the policy analysis will be used to give voice and meaning to the motivations for the inclusion of 'outcome' or 'impact' indicators. To achieve this, the documents were coded using NVivo to identify conceptual categories and create themes. In addition to the main climate plan identified in Table 3.1. additional plans of relevance for adaptation planning were also sourced for each UA (Appendix D). The data was coded following a three-step process (open, axial, and selective coding) first developed by Strauss (1990). The first pass condensed the dataset into preliminary codes, these codes were then analysed and linked, and then a final pass was made of the dataset to select cases to illustrate the key themes (Djamba and Neuman, 2002). These themes could then form the basis for analysis and discussion and compared and contrasted with literature within the field. Open coding is particularly useful for breaking the data down into categories and subcategories (Blaikie, 2009; Creswell, 2013). A secondary stage of the policy analysis included the identification of the main components of MERL systems. A coding process was employed using NVivo where anything that could be referred to as a component of a MERL system was identified and assigned a code. Components were defined based on the deductive coding process used by Goonesekera and Olazabal (2022) and the common MERL components referenced in wider literature (see Appendix A for a summary). Any component that was referenced in two or more of the local authorities was included in the list of eleven components in Table.3.4. To ensure consistency, binary questions with 'yes' or 'no' answers were formulated to assess the presence of each of the eleven components. This was completed because in some instance's components were mentioned only in passing. Table.3.4 details the eleven components, the binary question, and wider literature to support the inclusion of the component. The findings from both stages of the policy analysis were then used to critically discuss the maturity of adaptation planning in UK urban areas and identify ways forward in the discussion.

Table.3.5. Table showing selection criteria for Fig.4.3, criteria developed in Appendix B.

Target	*(y/n) Do the adaptation metrics have a target associated with them?*	*Quesne et al., 2019; Doran 1981; Glahn et al. 2007; Klostermann et al., 2018*
Baseline	(y/n) *Is baseline data being collected, where possible?*	*Quesne et al., 2019; Olazabal & Ruiz De Gopegui, 2021; Hale et al., 2021*
Timeframe	(y/n) *Is there a timeframe established when information will be collected or reported on?*	*Quesne et al., 2019; Doran 1981; Glahn et al. 2007; Klostermann et al., 2018*
Responsible Party	(y/n) *Is there a person responsible for MERL?*	*Olazabal et al., 2019; Quesne et al., 2019; Klosterman et al., 2018*
Budget	(y/n) *Is there an assigned budget?*	*Olazabal et al., 2019; Swart et al. 2009; Klostermann et al., 2018; Soanes et al., 2021*
Linked Objectives	(y/n) *Are the metrics linked to an objective or aim?*	*Olazabal et al., 2019; Van de Sandt et al., 2013; Horrocks and Hunt, 2009*
Method	(y/n) *Are details provided on the method? Or unit of measurement?*	*Olazabal et al., 2019; Quesne et al., 2019; Doran, 1981; Glahn et al. 2007, Klostermann et al., 2018*
Alignment	*(y/n) Are indicators aligned to a wider framework?*	*Leiter et al., 2019*
Reporting	(y/n) *Are the findings reported externally?*	*Olazabal et al., 2019b, Soanes et al., 2021*
Locally Led	(y/n) *Are local stakeholders and voices included in MERL?*	*Soanes et al., 2020*
Learning	(y/n) *Is there evidence of learning?*	*Soanes et al., 2021, Coger et al., 2021, Klostermann et al., 2018*

3.5 Limitations

The study has set a number of parameters which whilst not necessarily limitations are important for understanding the context and breadth of the research findings. The date for adaptation-planning related documents was set to 20 September 2021 and whilst it is acknowledged that some councils have published or updated plans since this date, the study does not have the capacity to continually check for new plans after this date. Additionally, the study focused on UAs, as argued above, excluding UAs with significant rural populations and entirely rural areas. This may overlook novel approaches to considering adaptation outcomes outside of UAs.

The study also focuses on adaptation indicators excluding mitigation indicators and approaches to monitoring, evaluation, reporting and learning that do not rely on indicator systems. Policy documents were only analysed in detail if they included outcome or impact indicators as noted by Hallegatte and Engle (2019) process indicators are equally important for ensuring the inclusion of voices and ensuring representation. This may exclude novel approaches to MERL. Finally, the identification of a normative list of components common to the MERL systems analysed in the study is non-exhaustive and will undoubtedly overlook novel or irregular components to MERL systems. The summary aims to present what is common and shed light on how collectively the UAs are tracking adaptation outcomes.

4. Findings and Analysis

This section will present the findings of the study. The section will start with a summary of the general findings, it will then go into detail about the findings from the analysis of indicators and develop this information with the results from the policy analysis. Finally, the section will summarise the key components to MERL systems that include adaptation metrics focusing on the realisation of adaptation.

4.1 General Findings

According to the study's classification of 'UAs' there are 199 urban local authority areas (see Appendix C for full list of UAs) in the UK. On 20 September 2021, 37 of the local authority areas had no plan published whilst 162 (79%) of these UAs had produced a climate action plan. However, 70 local authorities provided no details on monitoring and evaluation of the plan, with a total of 93 local authorities referring to monitoring and evaluation. In 63 local authorities they had not developed indicators to track adaptation. Although in some instances authorities can be seen to be measuring progress using RAG (Red, Amber, Green) charts or annual reports. In many other instances this monitoring and evaluation focused exclusively on progress towards climate neutrality or mitigation measures, despite the plan itself referencing CCA. Linking back to RQ1 the share of UK urban areas that include adaptation metrics in their local adaptation plans was found to be 27 UAs (14%). The 27 UAs met the selection criteria (as detailed in Chapter 3) for further evaluation (Table.4.1.).

Table.4.1. Table showing UAs that have included adaptation indicators (n=27, details include name of council, name of plan, year published, total number of indicators, number of adaptation indicators, percentage of total indicators that focused on adaptation, type of plan (A=adaptation, M=mitigation, B=both adaptation and mitigation, G=general).

Council	Name of Plan	Year Published	Indicators (#)	Adaptation Metrics (#)	Adaptation Metrics (%)	Type of Plan
Aberdeen City Council	*"Aberdeen Adapts Climate Adaptation Framework"*	2019	22	18	82%	A
Bolton Metropolitan Borough Council	*"Bolton Climate Change Strategy"*	2021	33	18	55%	B
Bracknell Forest Council	*"Climate Change Strategy: Bracknell Forest Council 2020-2024"*	2020	34	3	9%	B
Bristol City Council	*"Bristol One City Plan"*	2019	157	20	13%	G
Bury Metropolitan Borough Council	*"Bury Council Climate Action Plan 2021"*	2021	28	4	14%	B
Cardiff Council	*"One Planet Cardiff"*	2021	6	1	17%	G
Charnwood Borough Council	*"Charnwood Action Plan 2018-2030"*	2018	66	19	29%	B
Doncaster Metropolitan Borough Council	*"Environment and Sustainability Strategy 2020-2030"*	2020	23	7	30%	B
Dundee City Council	*"Dundee Climate Action Plan"*	2021	72	30	42%	B
Eastbourne Borough Council	*"Eastbourne Carbon Neutral 2030"*	2021	21	7	33%	M
Glasgow City Council	*"Glasgow's Climate Plan Our Response to The Climate and Ecological Emergency"*	2020	119	48	40%	B
Greater London Authority	*"London Environment Strategy"*	2019	9	9	100%	A
London Borough of Ealing	*"Ealing Climate and Ecological Emergency Strategy 2021-2025"*	2021	123	23	19%	B
London Borough of Haringey	*"Haringey Climate Change Action Plan"*	2021	44	3	7%	B
London Borough of Harrow	*"London Borough of Harrow Climate Change Strategy"*	2021	38	7	18%	B
London Borough of Merton	*"Merton Climate Strategy & Action Plan"*	2019	32	1	3%	B
London Borough of Richmond Upon Thames	*"London Borough of Richmond Upon Thames Climate Emergency Strategy 2019-2024"*	2019	55	31	56%	B
London Borough of Sutton	*"Sutton Local Plan 2016-2031"*	2018	17	10	59%	B
London Borough of Wandsworth	*"Wandsworth Environment and Sustainability Strategy 2019 -2030"*	2019	171	41	24%	B
Manchester City Council	*"Manchester Climate Change Strategy 2017-50"*	2017	22	6	27%	B
Mid Sussex District Council	*"Mid Sussex District Council Sustainability Strategy 2018 - 2023"*	2018	14	2	14%	B
Newcastle-Upon-Tyne City Council	*"Net Zero Newcastle - 2030 Action Plan"*	2020	93	16	17%	M
Oadby And Wigston Borough Council	*"Oadby And Wigston Borough Council Environment Strategy and Action Plan"*	2019	30	7	23%	B
Reading Borough Council	*"Reading Climate Emergency Strategy 2020-28"*	2020	231	118	51%	B
Royal Borough of Windsor And Maidenhead	*"Royal Borough of Windsor & Maidenhead Environment and Climate Strategy 2020-2025"*	2020	54	14	26%	B
Southampton City Council	*"Southampton City Council Green City Plan 2030"*	2020	26	8	31%	B
Wigan Metropolitan Borough Council	*"Our Adaptation & Resilience Action Plan 2021-2026"*	2021	27	27	100%	A

4.2 Indicator Analysis

For the UAs that met the criteria for further evaluation (i.e., included 'adaptation' or 'both' metrics) indicators were collected. The indicators were analysed to answer the second part of RQ1 – what are the main characteristics of adaptation metrics in UK urban areas. In total, 1567 different indicators were collected from planning documents in the 27 UAs (Table.4.1.). However, only 32% of the 1567 were categorised as relevant to adaptation efforts e.g., 'adaptation' or 'both'. The remaining indicators were either 'mitigation', or 'general' (not related to climate adaptation or mitigation). In 163 out of the 1567 of the proposed indicators were categorised as 'general'. This was particularly the case in cities where the adopted indicator systems were universal for all plans across the UA, or where the climate emergency declaration was part of a wider planning document. Examples of this include Bristol and Cardiff where 71% and 83% of indicators respectively were 'general'. The focus of 'general' indicators tended to be on economic, social or health outcomes (e.g., proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions [Bristol]). 58% of the indicators focused exclusively on 'mitigation' (e.g., average % of carbon emissions saved on site in non-residential schemes permitted per year [Haringey]). Climate change adaptation indicators often focused on flood risk or green space (e.g., infrastructure impacted by flood events [Dundee]) whilst 'both' had implications for 'adaptation' and 'mitigation' (e.g., Climate Change Youth Summit held [Newcastle]). Plans that focused specifically on 'adaptation' had the majority if not all 'adaptation' indicators (Wigan, Greater London, and Aberdeen). As a result, the number of adaptation indicators varied greatly depending on the city with Cardiff only including one adaptation-related indicator (e.g., Cardiff grows in a resilient way [Cardiff]) and Glasgow including 48. Nevertheless, Bolton, Richmond, Sutton and Reading also had high numbers of 'adaptation' indicators compared to 'mitigation', despite having a plan focusing on 'both'. Most other councils had significantly lower shares of 'adaptation' indicators compared to 'mitigation'.

A total of 518 indicators from the 27 UAs were characterised as 'both' and 'adaptation'. In all cases with exception of Cardiff and London these indicators were associated with specific objectives. In Cardiff, the indicators were associated with general overarching goals and were not associated with any of the actions mentioned in the plan. There was also no detail on how these indicators would be measured qualitatively or quantitatively. Meanwhile, in London indicators were developed independently of any climate plan to monitor climate impacts (e.g., London Underground average monthly temperatures [Greater London]).

Figure 4.1. details the level of detail included in the indicators, while Figure 4.2. details the type of indicator. For all the indicators the level of detail was categorised as: ‘objective’ which included the least detail and was usually a specific action to be completed within a certain timeframe (e.g. sponsorship programme created [London]), ‘indicator’ which established trends (e.g. number of community food growing sites [Aberdeen]), and ‘metric’ which included the most detail and was usually quantifiable in some way (e.g. area of river/coastal habitat enhanced/ managed for biodiversity and flood management (m^2) [Dundee]). As shown in Figure 4.1 the level of detail varied greatly between the different UAs. For example, Southampton, Oadby and Wigston, Newcastle, Wandsworth, Ealing, and Cardiff only include ‘objectives’. Most other UAs include a mix of detail, with exception of the Greater London which included only ‘metrics’ (e.g., Mortality risk from high temperatures in London [Greater London]). There was a high incidence of ‘metrics’ or ‘indicators’ in 13 UAs.

Figure. 4.2. details another main characteristic to adaptation indicators: the type. Indicators were either ‘input’ (e.g., % of investments in Green Infrastructure projects [Glasgow]), ‘output’ (e.g., 2 school hedges/year [Reading]), ‘outcome’ (e.g., Tree canopy cover in Bristol [Bristol]), or ‘impact’ (e.g. Frequency and type of weather events impacting highways and infrastructure [Wigan]). The overwhelming majority of indicators were ‘output’ (84%) (in red) with ‘outcome’ (7%) or ‘impact’ (7%) indicators (in green) both representing much smaller percentages. There were the least ‘input’ indicators (in orange) with only 2% of indicators categorised as this type. 11 UAs had only ‘output’ metrics whilst 2 UAs had only ‘impact’ [Merton and London]. 14 UAs included indicators focusing on the realisation of adaptation categorised as either ‘outcome’ or ‘impact’ indicators.

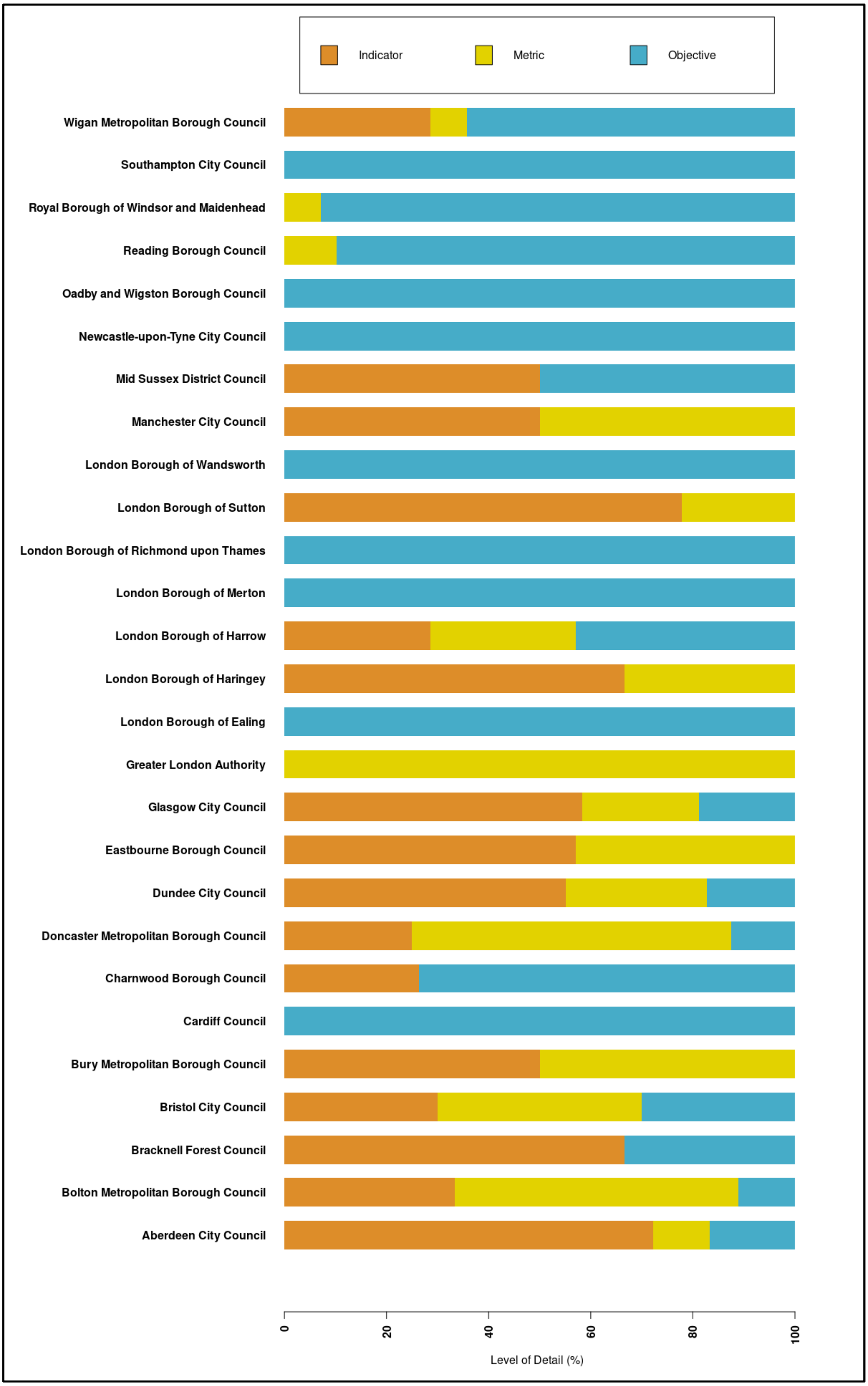

Fig.4.1. Level of detail for adaptation metrics in UAs in the UK (x=level of detail (%), y=local council area (name from plan), n=27)

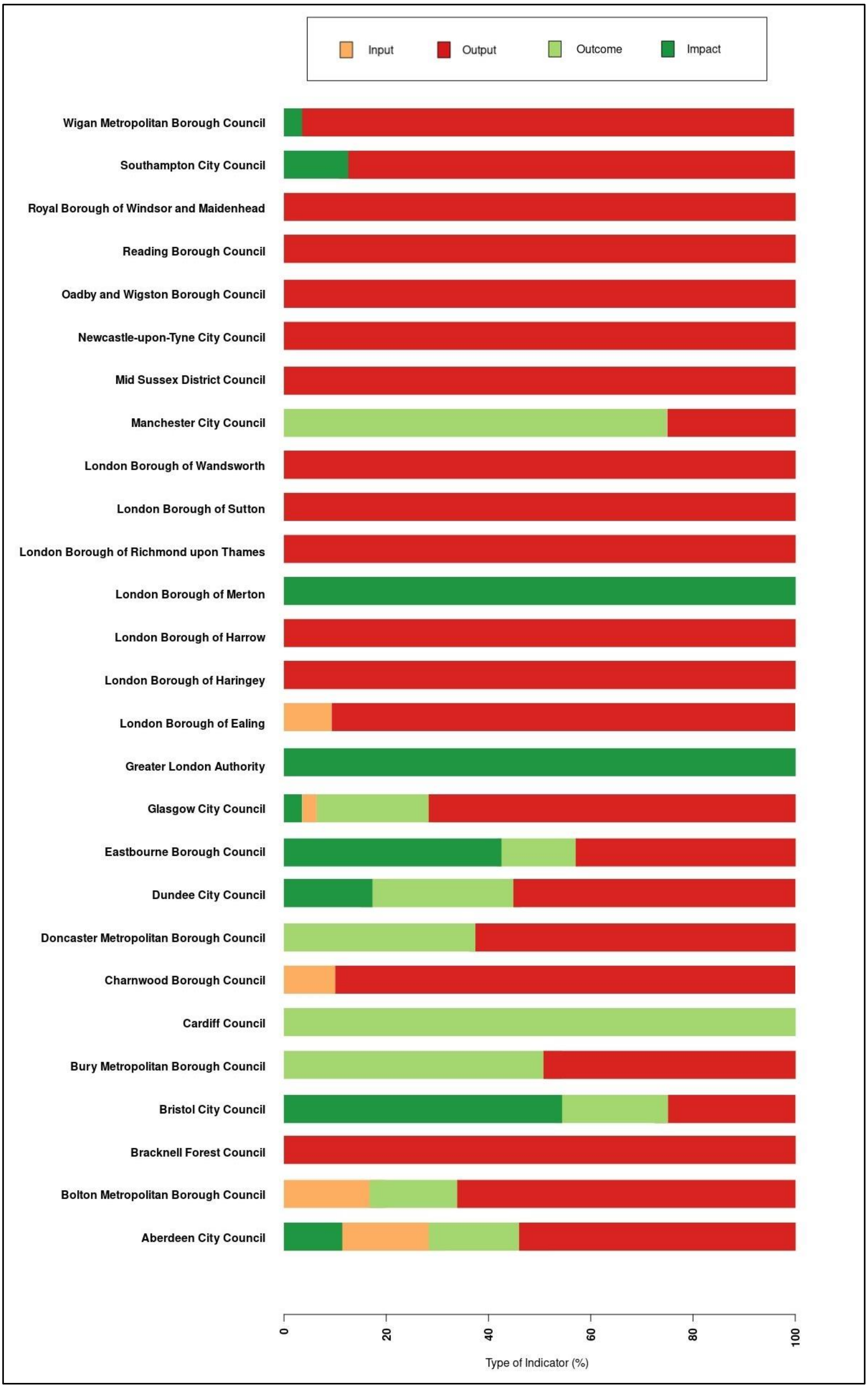

Fig.4.2. Type of adaptation metrics in UAs in the UK (x=type of indicator (%), y=local council area (name from plan), n=27)

The 14 UAs that included 'outcome' or 'impact' indicators met the criteria to be further analysed in the policy analysis as detailed in the methodology. Table 4.2 details the UAs selected to be included in the policy analysis.

Table.4.2. Urban areas included in the policy analysis as well as number of impact or outcome adaptation indicators (red and yellow=less result indicators, green=more result indicators).

Council	Impact	Outcome
Aberdeen City Council	3	3
Bolton Metropolitan Borough C	0	3
Bristol City Council	11	4
Bury Metropolitan Borough Cou	0	1
Cardiff Council	0	1
Doncaster Metropolitan Boroug	0	3
Dundee City Council	5	8
Eastbourne Borough Council	3	1
Glasgow City Council	2	10
Greater London Authority	9	0
London Borough of Merton	1	0
Manchester City Council	0	3
Southampton City Council	1	0
Wigan Metropolitan Borough C	1	0

As shown in Table 4.2 Bristol and Greater London included the greatest number of 'impact' indicators, whilst Bolton, Bury, Cardiff, Doncaster, and Manchester did not include any. Dundee and Glasgow included the highest number of 'outcome' indicators, whilst Greater London, Merton, Southampton, and Wigan did not include any.

4.2 Policy Analysis

The policy analysis aims to answer RQ2 and consider how adaptation metrics are used in UK local adaptation plans to track outcomes. For this reason, the analysis will only focus on the UAs that include adaptation indicators that look at the realisation of adaptation i.e., 'impact' or 'outcome' indicators (Table 4.2). The policy analysis aims to understand the motivations for the inclusion of this type of indicator and look at the main components of MERL systems in these plans. The findings can then be used to critically discuss the maturity of adaptation planning in UK urban areas and identify ways forward in the discussion.

Differing motivations and purposes for MERL

One of the main themes that emerged during the policy analysis was the differing motivations and purposes for MERL practices. For example, in Bristol there is a focus on the wider implications of planning decisions:

> *Where and how this kind of capital is invested affects social, economic, and environmental outcomes far beyond Bristol.* [Bristol 4]

This idea is continued in the adaptation indicators that Bristol has chosen to adopt which include a high number of impact indicators – looking at wider implications. This idea of monitoring the impact of adaptation strategies across local authority boundaries is also evidenced in Aberdeen City Council's climate action which emphasises the need for the plan to be "a forward thinking, co-ordinated approach" [Aberdeen]. A motivation reflected in the selection of indicators which include a mix of outcome, impact, and output indicators. The same is true for the city of Glasgow which places specific emphasis on the alignment with the Sustainable Development Goals.

> *The actions proposed in this plan are aligned with the Sustainable Development Goals, which have been adopted by the United Nations. They ensure that what we do can reach out beyond the traditional performance monitoring approaches of the public sector and engage other sectors and our communities in a meaningful conversation about progress and what it means for the city and its people. They also give us common points of reference when addressing the various actions required to deal with this emergency situation.* [Glasgow]

By contrast, other cities stress that the monitoring and evaluation of climate change actions is to ensure progress against an action plan, as exemplified by:

> *We will evaluate progress by regularly updating the OPC Action Plan, setting out progress against our targeted Carbon Neutral by 2030 targets*. [Cardiff]

This reflects ideas also seen in Eastbourne and Merton which emphasise the tracking of 'new developments' [Eastbourne] or 'mitigation progress' [Merton]. Indeed, evidence of progress is particularly prevalent in the UAs where there is a focus on output indicators. For example, Manchester states that indicators are "for measuring progress" [Manchester]. This idea is also illustrated by Bury when they state the design of their MERL system has placed "a greater focus upon quantitative facts and using these statistics will help us clearly quantify progress" [Bury].

In addition to quantifying progress, communicating, or measuring success was a key motivation for MERL in Southampton mirroring the motivations of Bolton and Doncaster:

> *Our climate dashboard is the way we will measure and demonstrate the success of the Climate Change Strategy.* [Bolton]

> *Progress needs to be measurable so we can continuously determine and communicate the success.* [Doncaster]

Output indicators are more easily quantifiable which may explain the bias towards output indicators in these three urban areas. In Greater London, the focus of the indicators is on developing an evidence base emphasising impacts rather than physical outputs. The clear aim is to show "how London is prepared for the impacts of climate change" [Greater London], reflecting the ambition of Dundee which is two research questions have been formulated contextualised in the UK case study (Figure 1.1). Research Question 1 (RQ1) "What is the share of UK local adaptation plans that include adaptation metrics, and what are their main characteristics?" aims to understand the *characteristics* of indicators and metrics that are currently being used in planning practice. Research Question 2 (RQ2) "How are adaptation metrics used in UK local adaptation plans to track outcomes?" aims to understand the *use* of metrics to track outcomes. These two research questions are addressed through two methods: to respond to RQ1 an analysis of indicators in UK climate planning documents was undertaken, and secondly a more detailed policy analysis of a sample of UK "to take account of the anticipated changes… review progress regularly and evolve the plan" [Dundee], this is undertaken alongside reporting requirements to the Global Covenant of Mayors. This motivation is reflected in both Greater London and Dundee's selection of indicators which both focus heavily on 'impact' indicators.

The final key motivation that was identified during the policy analysis included purposes that aimed to start a conversation or promote engagement. In Wigan the plan describes the purpose of MERL, alongside governance and internal reporting, as ensuring "continuous engagement of private sector, education, and voluntary organisations with regards to overall progress on work related to climate". This was also the case in Cardiff which stated one of the aims was to engage "with City Wide stakeholders in line with our developing engagement and behaviour change strategy" [Cardiff]. This mirrors Bristol and Glasgow where the monitoring aimed "to raise awareness by engaging with citizens and organisations" and act as a starting point for "a meaningful conversation" [Glasgow].

In addition to differing motivations and purposes for the inclusion of MERL there was also great variation in the detail and number of different components of MERL systems for the policies analysed. As was documented in the conceptual framework, the maturity and the components of MERL systems varies greatly in global cities. The next few paragraphs will discuss a selection of these components, and their inclusion, or lack of inclusion in the planning documents and present a summary of the different components for each planning document. This summary sheds light on the design and structure of MERL systems that focus on the realisation of adaptation.

Targets, Baseline, and Timeframe

The first components that were frequently present in the MERL systems were targets, baselines, and timeframes. In total 5 of the urban areas included targets associated with their adaptation metrics in the planning documents. In the instance of Bolton, a climate dashboard has been developed to 'demonstrate the success of the Climate Change Strategy'. The dashboard also includes baselines against which progress can be measured and states that where there is no baseline established work will be completed to develop them in the future, as is the case for 'colleague awareness of climate change'. 50% of urban areas included baseline data as it gives meaning and justification to indicators and the selection of targets. In Bristol, for example, climate resilience is founded on a preliminary climate resilience assessment produced by Arup that was used to inform the baseline to many of the adaptation indicators. Finally, timeframes associated with the indicators were only present in 3 urban areas (Aberdeen, Glasgow, and Wigan).

Responsible party, budget, objectives, and method

In addition to targets, baselines, and timeframes, the majority of the urban areas studied had spent time developing a theory of change[2] with the indicators linked to objectives with Manchester stating the purpose of KPIs as the following:

> *Key performance indicators (KPIs) for measuring progress against the strategy's objectives and key areas of activity.* [Manchester]

Two exceptions of note are Greater London and Cardiff which did not have associated objectives. In Cardiff, this was because indicators are general, not specific to the plan's action

[2] A theory of change refers to the process of articulating the assumptions about how change will occur, in this case linking objectives to indicators and defining methodologies (Anderson, 2006)

but rather an overarching vision. In Greater London the purpose differs stating that data collection is a work in progress that can:

> *Capture evidence of good and poor performance, identify adaptation priorities and highlight knowledge gaps.* [London]

To support the construction of the system of interest, five authorities have also published a methodology for their indicators where possible. This was the case in Bristol, Bury, Eastbourne, Greater London, Merton. In Greater London, the publication of methodologies aligns with the ambition to capture good and poor performance in a transparent manner. By contrast, in Bristol the method was published as part of a Voluntary Local Review of progress on the Sustainable Development Goals (SDGs) which included statistical assessment and was accompanied by a city-wide consultation. Other key components that were considered included budget by Dundee, Glasgow and Wigan and responsible party by a total of 9 urban areas. Wigan even went as far as to name a specific 'Lead Officer' to help support the delivery of the actions and progress on specific indicators.

Learning, reporting, and engagement

Learning, reporting, and engagement with local stakeholders were also key components to the climate plans' MERL. Learning was shown in Aberdeen's central monitoring aim:

> *Monitoring will allow the learning from actions to be captured, evidenced, and assessed. This information can inform decision making and any wider roll out and mainstreaming of adaptation activity.* [Aberdeen]

The emphasis on capturing, evidencing, and assessing suggests a highly reflective approach to adaptation tracking and underlines a key theme that was seen in many of the policy documents. Learning through the use of outcome indicators ensures that any adaptation activity is having the desired result and processes are needed to ensure that future decision making can be informed. However, a 'triple-loop' approach to learning was also present in a number of policy documents with Dundee and Greater London focusing on MERL to 'evolve the plan', identifying 'knowledge gaps' with Bolton and Manchester documenting iterations of indicators.

> *Some indicators do not exist yet, such as a full measure of colleague awareness of climate change or a measure of social value, but data sets will be available in the future and will help to provide baselines against which progress can be measured.* [Bolton]

The policy analysis also identified reporting and the need to share findings with national and international networks and organisations as a key theme that emerged. This was the case in Bristol City Council as one of the main purposes of the monitoring and evaluation was to report progress on the SDGs.

> *We recognise that our climate emergency actions, as well as the work we are doing on SDGs, should feed into future council strategies.* [Bristol 2]

> *VLR* [Voluntary Local Review] *is an instrument for simultaneously reporting locally to the citizens of Bristol and globally to networks and institutions supporting global collective action to address global challenges.* [Bristol 4]

In these instances, the process of reporting was instrumental in improving the detail to adaptation indicator. By contrast there is also evidence that an emphasis on reporting can limit the development of adaptation indicators. For example, Cardiff's earlier iteration of climate plans included a number of adaptation indicators but since working with CDP these have been removed favouring a focus on the UA's decarbonization policy.

> *CDP has been adopted by the Cardiff Capital Region as a framework to monitor and evaluate the region's performance against its decarbonization strategy.* [Cardiff]

Finally, voice and the engagement of vulnerable groups was also a key theme stressed during MERL. This was the case in Bristol, Aberdeen, and Glasgow where emphasis was placed on engaging and public consultation.

> *The process itself offered an opportunity to raise awareness by engaging with citizens and organisations in Bristol through our consultation to understand what is being done to deliver the Goals locally.* [Bristol 2]

> *70 responses were received to a public consultation on Aberdeen Adapts. The responses indicated support for the Aberdeen Adapts priorities, goals, and action areas. Comments have been incorporated into the final framework and environmental report. A summary of the consultation has been produced.* [Aberdeen]

Summary of components

Figure 4.3 summarises the components identified above for each UA. In total there were eleven components that were common to the plans analysed. The eleven components included a [1] target, [2] baseline, or [3] timeframe. Additional components related to the definition of a [4] responsible party, [5] budget, indicators linked to a specific [6] objective and a [7] method of how to calculate the indicator. Other components also seen included [8] an alignment to wider frameworks or indicator systems, [9] reporting externally. Finally, in some plans provisions were detailed to make the plans the [10] locally led (efforts to give a voice to local stakeholders) and evidence of [11] learning e.g. different iterations of indicators proposed or areas where data was missing documented. These components have all been previously identified as basic components to MERL systems as noted in the methodology which also details the binary criteria (yes/no) to justify the presence of each component in a planning document. Figure 4.3 summarises the selected components from above and presents which components are included in each of the urban areas' adaptation plans. Bristol, Glasgow, and Dundee contained most of the selected components whilst Cardiff and Southampton only had one.

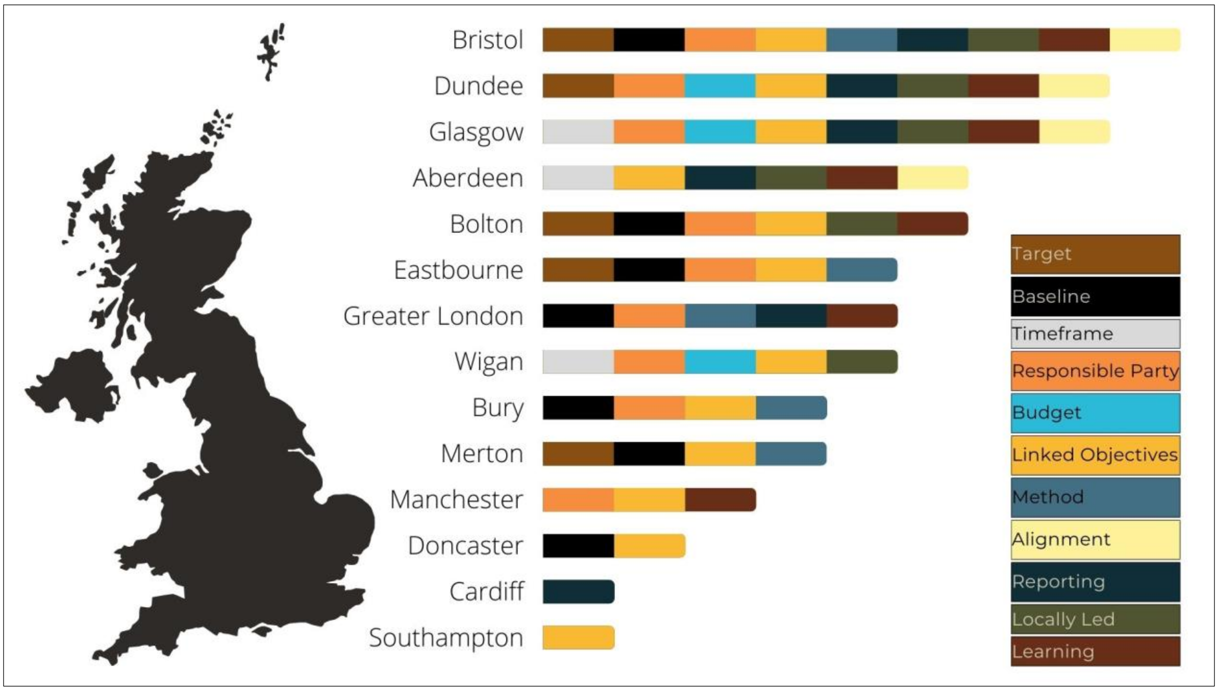

Fig.4.3 Map showing components of MERL for 14 UK urban areas (Councils that include outcome metrics [full council name in table 4.1], n=14; selected components of MERL, n=11 [clockwise: target, baseline, timeframe, responsible party, budget, linked objectives, method, alignment, reporting, locally led, learning], criteria in table 3.5.

5. Discussion

Overall, from the findings, it is clear that in many instances the MERL frameworks of UK UAs are underdeveloped, and there are still significant improvements to be made. This is evident in the fact that of the 163 UAs with climate action plans, only 93 UAs referred to MERL and only a further 27 UAs had developed comprehensive MERL frameworks with associated adaptation indicators. Furthermore, of the basic eleven components on MERL frameworks identified in the conceptual framework, only 3 UAs included more than 8. Indeed, the recent IPCC AR6 report stated that MERL frameworks for adaptation are "far from…fully developed and operationalized both in theory and in practice" (Dodman et al., 2022, p.908). This is in spite of other urban sectors, including but not limited to the health, water, business, industry, or carbon mitigation itself being highly developed with years of experience tracking not only outputs but also outcomes in their urban planning approaches.

The policy and indicator analysis found that there was a strong bias towards mitigation indicators in UK climate planning. This suggests that adaptation tracking lacks maturity and further illustrates that UAs are much more comfortable, tracking climate mitigation versus adaptation. This is particularly prevalent in the UA of Cardiff where the city's partnership with the CDP (Carbon Disclosure Project) has driven the on-going reporting of carbon reduction measures. Adaptation is only mentioned in passing when saying that Cardiff City Council aims to demonstrate "our progress and activities around climate change mitigation and adaptation" using CDP's framework. This highlights the wealth of international partners and networks available to promote and build capacity for tracking mitigation, networks that are often lacking for adaptation tracking. Similarly, in Belfast which did not meet the inclusion criteria for the policy analysis, the plan states that "the capacity of a city to respond to economic shocks is a strong indicator of its resilience" (Belfast City Council, 2020). This is reminiscent of the fact that the city has chosen to adopt metrics it is comfortable in — ones involving monetary value.

Additionally, there is significant evidence of output-based indicators associated with specific projects with 220 of the 518 indicators categorised as output (e.g., 2 school hedges/year [Reading]). This was also the case in UA of Eastbourne, Merton, and Wigan which emphasise the tracking where indicators were largely specific outputs or actions that needed to be completed within a set time frame (e.g., Review the existing maintenance regimes of highway drainage gullies and assets, identifying priority areas. [Wigan]). This approach does however have potential, as shown by Donatti et al. (2020), so long as the focus is on delivering projects that have the desired outcome or impact. Nevertheless, either a focus on overarching resilience or on specific project outputs begs the question as to whether approaches are being conducted at the appropriate scale, and level to inform adaptation decision-making, augment learning, and ensure that adaptation is having the desired result.

Given that many cities are now entering into the second or third iterations of climate planning there is great potential for the creation of sets of adaptation metrics that allow a certain degree of comparability and standardisation, thus complementing context-specific metrics (Leiter et al., 2019). In Doncaster and Bury, for example, the focus is placed on creating measurable metrics that can be used to determine and communicate the success. However, in practice, the wide range of approaches to measuring MERL limits their usefulness for informing across multi-level climate governance structures (Adriázola et al., 2018). This highlights the key issue to tracking adaptation: balancing specificity at the local level with global progress on adaptation. Many consider resilience the conceptual bridge between adaptation and urban planning, with Sharifi (2016) detailing a number of examples where resilience assessments have been developed with associated indicators. However, the usefulness and applicability in informing the realities of decision making is unproven. As a consequence, local adaptation managers may be underusing available MERL resources or indeed demand greater knowledge, capacity, and resources to develop MERL systems. In any case, the findings show the choice of metrics depends largely on the purpose and requires careful consideration of what one intends to measure or achieve (Leiter et al., 2019).

5.1 Focus on Purpose

The purpose of MERL in the UA climate action plans was a controlling factor in shaping the type and detail of indicators collected. From the analysis, five main purposes of MERL emerge: decision-making and learning, financing and accountability, targets, and reporting, and finally, understanding vulnerability and risk.

Informing decision making and learning were frequently cited as being key motivators for MERL development. For example, Aberdeen City Council stresses that "learning from actions… can inform decision making and any wider roll out and mainstreaming of adaptation activity" echoing Manchester's emphasis on using "the lessons learned as the basis of further work" and enabling "climate-positive decision-making". How this purpose translates into indicators differs greatly between the two UAs. For example, Aberdeen has a number of different indicator types, whereas Manchester focuses on the realms or themes of resilience, cultural change, and green space and has a smaller number of specific outcome or output indicators. Aberdeen's mix of process, outcome, and output indicators reflects Klostermann et al. (2018) recommendation to include a mix of the three types: process-based to monitor policy, institutional and governance processes needed to build capacities, output to ensure implementation and mainstreaming activities, and outcome to measure effectiveness and adaptive capacity. Pringle et al., (2016) agree with this, stating that five criteria are needed: effectiveness and efficiency; communication; accountability; double loop learning, and climate justice. While learning and accountability are not necessarily in opposition, "official policies that profess the importance of learning are often contradicted by bureaucratic protocols and accounting systems which demand proof of results against pre-set targets" (Guijt, 2010, p.277). For truly reflective learning new approaches need to be developed. Coger et al., (2021) argues that we need to reshape monitoring and evaluation for locally led adaptation. In order to do this, we need to create locally appropriate and context-specific indicator frameworks. A good starting point for this is adaptive capacity which could include indicators that relate to knowledge and skills. For example, Glasgow includes an indicator "Number of people supported to retrain and transfer skills to access green job opportunities".

Overall, assessing the outcomes of climate change adaptation policies and projects is plagued with difficulties. In many instances the type of indicators differs according to the original purpose laid out for the MERL framework and the maturity of the climate planning document. Leiter et al., (2019) lays out several key considerations when designing any approach to MERL. These considerations included considering the main intention or general purpose and then adapting and choosing the indicators accordingly (ibid). Research by Bours et al., (2014) proposes using a theory of change approach to ensure the measurement of climate change adaptation outcomes. They discuss how the approach can be applied to climate change adaptation programme design, monitoring, and evaluation. Crucially, the approach can help to establish an overall long-term goal; and then map clear steps (intermediate outcomes) alongside "clearly-articulated indicators, thresholds, and assumptions" (Bours et al., 2014, p.10). It is important to remember that adaptation indicators alone cannot show why an adaptation plan does or doesn't work, this can only be explored in retrospect with evaluations based on monitoring results (Klostermann et al., 2018).

5.2 The Social Agenda

The UA of Cardiff has chosen not to develop a detailed set of metrics for its climate plan, instead the plan has invested in a strong understanding of the wider resilience of the city. This mirrors the approach of Manchester which has gone further to consider the city's residents through vulnerability mapping and a social impact analysis, guided by Climate Ready Clyde's approach. Indeed, in Manchester, as was done in Glasgow, social impact assessments have been used to ensure that social justice is put first and foremost at the centre of the climate plan. The combination of social impact assessments and vulnerability mapping gives Manchester a solid foundation of data to support their plan. Another UA that has put significant emphasis on social vulnerability and voice is the city of Aberdeen. For example, during the development of the 'Aberdeen Adapts' framework, the UA brought together 41 different local stakeholders to understand local priorities. This consultation approach has then been continued in the MERL with 5 stakeholder groups, and crucially, the city voice survey used to understand progress on adaptation actions already underway. A total of 70 responses were recorded in this qualitative assessment tool which in a city of 229,060 people (NRS Scotland, 2022) does not represent a significant portion of the population but does reflect the ambition of Aberdeen City Council to allow typically marginalised groups to voice their opinions or concerns. Groups such as the elderly, children or the disabled are often overlooked in climate governance and it is therefore important to give them the opportunity to voice their perspectives (Dahiya and Das, 2020). This ambition is further emphasised through workshops delivering Climate Ready Lesson Plans with 4 inner-city schools. A combination of process and outcome indicators then monitor the on-going project and final result, allowing great potential for learning and advice to be developed from this inclusionary approach. Similarly, the UA of Bristol recognises that a key challenge to monitoring and implementing its climate action plan is the engagement of a wider demographic of young people, from all schools and colleges across the city, particularly recognising the urgent need to listen to the voices of the lowest income households. The city found that the process of monitoring against the SDGs offered an opportunity to raise awareness by engaging with citizens and organisations in Bristol through consultation to understand what is being done to deliver the Goals locally.

By linking climate change adaptation to wider objectives such as sustainable development, urban adaptation monitoring and evaluation can then help inform national and international processes that inform the GST (Long and Rice, 2019). Considering the wider social agenda is also crucial to ensure the full picture is considered and maladaptive interventions are avoided (Schipper, 2020). Nevertheless, a certain degree of caution is needed as smaller cities and urban areas may find that the global SDG indicators may not be appropriate for realities at the local level (Simon et al., 2016). Indeed, the assessment and consideration of top-down adaptations needs to occur alongside bottom-up approaches to include vulnerable communities. Glasgow for example collaborates with the overarching authority of 'Climate Ready Clyde' to develop three stretching targets. The city has worked with a number of different partners to conduct a social impact analysis and map intersecting vulnerabilities across the city, crucially the process involved community representatives and different community groups to get their feedback

(Lewis and Olazabal, 2019). In Glasgow, “social impact assessments have been used to ensure that social justice is put first and foremost at the centre of the climate plan” (Lewis and Olazabal, 2021, p.3). The combination of social impact assessments, a comprehensive theory of change, and vulnerability maps gives Glasgow a solid foundation of data to support their plan (ibid).

By contrast, Spielman et al., (2020) caution against the use of overarching measures of social vulnerability, as in practice vulnerability is highly context specific. They argue that social vulnerability should be used in combination with other criteria, to ensure that vulnerable populations are appropriately catered for in risk reduction planning (ibid). The UA of Greater London has employed a combined approach of vulnerability and climate impact when monitoring its climate ambitions. Although this approach allows the city authorities to have a comprehensive understanding of the climate situation, research has shown that risk-based metrics can lead to an overemphasis on technical or engineering fixes that perform well on quantitative scales (Dodman et al., 2022). The London Combined Authority acknowledges this, referencing difficulties relating to attribution and in measuring avoided impacts and the long-term and uncertain nature of climate change. To combat this the UA adopts a pragmatic approach stating that the project will not initially draw conclusions from the collected data but only use it as a means to gather data and begin to build the foundations for future trends and analysis of climate change adaptation progress. In the meantime, qualitative reporting will be used to coordinate and ensure on-going action. This reflects common consensus that recommends a mix of outcome, output indicators and process indicators to reflect the diverse and complex processes that shape urban climate change adaptation (Leiter et al., 2019).

5.3 Learn how to Learn

There is an argument to be made that given the intricacies of monitoring climate change adaptation UAs need to adopt a mature approach like that of Greater London and learn how to learn (Lewis and Olazabal, 2021). Cities need to be realistic about the type and quality of data they can initially gather and where they are unable to collect data right now, acknowledge that and leave it in the plan. Klostermann et al., (2018) and Leiter et al., (2019) both acknowledge that learning and iterative approaches are needed due to the degree of complexity, the level of subjectivity, and the limited level of available experience. These sentiments are reflected by Dundee when it says it wants to evolve the plan in a transparent and open way reflecting calls for MERL to be “incremental and additive” (Solecki and Rosensweig, 2020, p.2). Research has shown that alongside transparency it makes sense to integrate climate change adaptation assessment goals and needs into existing frameworks for the purposes of efficiency. The combined approaches seen in the cities of Aberdeen and Bristol arguably offer an opportunity to create a "shared understanding of the problem" that can then be used to inform evaluation and responses (McDermott and Surminski, 2018, p.2). These efforts to coordinate frameworks for the assessment of sustainability are useful for focusing on the local level whilst also reporting at a global level. MERL instruments can form "a systemic shift towards tracking of adaptation that is locally led, context-aware, and itself adaptive" (Coger et al., 2021). Indeed, underpinned by proper tracking, locally led adaptation is crucial for linking funders, intermediary organisations at a national and international level (Coger et al., 2021). Coger et al., (2021) develops this idea with a number of principles that provide a roadmap for locally led adaptation.

One of the key challenges in collecting outcome data is the need to work with many different groups and departments. The proposed solution for this in many cities has been a platform to centralise data collection. However, in Bristol's experience, the process of completing a Voluntary Local Review (VLR) in partnership with the University of Bristol, was a tangible framework and mutual goal to motivate the collection of MERL data. Through a mapping exercise conducted in consultation with other cities also engaging in VLRs[3], the city of Bristol identified locally relevant targets and subsequently 108 indicators that were locally relevant but also linked to the SDGs. Through harmonising the SDG framework with existing indicators that were directly relevant to locally defined objectives, the ambition is to institutionalise monitoring of the SDGs going forward. Guidance from UCLG (2014) identifies data access, institutional capacities, and mechanisms for data collection as key barriers to current MERL practices and the localisation of the SDGs. They call for a global commitment to support the localisation of global frameworks because as stressed in the Synthesis Report of the UN Secretary General (2014, p.22) "many of the investments to achieve the sustainable development goals will take place at the subnational level and be led by local authorities". Meanwhile, UN-Habitat highlights that data gathering and participation are key and as seen in Bristol and Glasgow the process of establishing measurable goals at the city level encourages the engagement of residents (UN-Habitat, 2016). Mirroring Albert and Pandey's (2022) perspective that localisation helps to improve quality of life, urban governance, and efficiency. In the case of Bristol, as the indicator framework was developed by the University of Bristol in partnership with Bristol City Council it will be interesting to see how well the approach is linked to council approaches in practice and creates a learning and reporting culture.

[3] VLRs have been conducted in Baltimore, Manheim, Malmö, Hanover, Los Angeles, New York, San Jose, Mexico City, Bogota, and Nairobi.

The significant time component to collecting and sourcing data is frequently acknowledged as being challenging to MERL approaches. For example, where data is unavailable or there is no methodology for a certain indicator, the city of Bolton leaves the indicator in the plan as an action to develop this type of information. This is a highly transparent approach that keeps the department accountable and also able to easily include the data in the plan when it becomes available. The approach acknowledges the inherent complexities to outcome data collection accepting that the long-time horizons to adaptation require specific dedicated resources. For any city to become a learning organisation, time and effort is needed to create the necessary infrastructure and culture (Coger et al., 2021). Wigan's approach to name a specific 'Lead Officer' for each MERL section will arguably go a long way to help institutionalise MERL and help support the delivery of the actions and progress on specific targets.

This final section of the discussion will summarise best practices from local authorities included in this study to improve the detail and accuracy of their MERL efforts. The following recommendations are in no way meant to be prescriptive of how to achieve successful MERL in local authorities. The recommendations cover three main themes evidenced throughout the thesis: social impact, transparency, and learning.

Table.5.1. Specific recommendations for UK urban areas.

#	Recommendation	Example
1	**Consider a Voluntary Local Review (VLR)**	*Bristol* - Voluntary Local Review (VLR) is a mapping exercise conducted in consultation with local stakeholders to measure progress towards the SDGs. The process can help to develop locally relevant targets and subsequently indicators.
2.	**Practice data transparency in reporting processes**	*Bolton* - Where there is no data or methodology for an indicator, it is important to still include the lack of an indicator in the plan as an action to develop this type of information in the future.
3.	**Employ a 'Lead Officer' for MERL**	*Wigan* – The approach to name a specific 'Lead Officer' for each MERL section can help to institutionalise MERL and help support the delivery of the actions and progress on specific targets.
4.	**Ensure local voices are included in MERL**	*Aberdeen* – Aberdeen brought together 41 different local stakeholders to understand local priorities. This consultation approach has then been continued in the MERL with 5 stakeholder groups, and crucially, the city voice survey used to understand progress on adaptation actions already underway. A total of 70 responses were recorded in this qualitative assessment tool.

5.	**Develop a mix of outcome and impact indicators**	*London* - The UA of Greater London has employed a combined approach of vulnerability and climate impact when monitoring its climate ambitions.
6.	**Conduct social impact analysis**	*Manchester* - Social impact assessments have been used to ensure that social justice is put first and foremost at the centre of the climate plan. The combination of social impact assessments and vulnerability mapping gives Manchester a solid foundation of data to support their plan
7.	**Develop research projects to increase the availability of data**	*Greater London* - Greater London, investing in learning, and developing specific research projects to fill data gaps is central to developing a solid picture of adaptation progress in any urban area. A focus on completeness and utility of data is needed so that urban areas can make informed decisions. Global networks of cities such as ICLEI and C40 illustrate the commitment of local actors to engage in climate action.

6. Conclusion

Contributions

In 2022, discussions at the Bonn Climate Change Conference called for meaningful integration of local level adaptation into the international climate arena. Monitoring, Evaluation, Reporting, and Learning systems are key to this integration. Overall, by tracking the actual results of local adaptation policies, not just outputs, local knowledge and the priorities of sub-national actors can be used to inform national and international climate discussions. Through a case study analysis of MERL adaptation planning practice in all UK UAs this research provides a timely input to these discussions, and in particular, the first iteration of the Global Stocktake in 2023 and the definition of the Global Goal on Adaptation. Linking back to RQ1 out of the 199 urban areas in the UK only 27 (14%) were found to include adaptation metrics in their local adaptation plans. The 27 UAs met the selection criteria for further evaluation as part of RQ2 that found a range of adaptation indicators and metrics across climate adaptation planning but there is still a significant lack of consistency, maturity, and capacity for MERL in UK urban planning. What is clear is that for MERL instruments to be successful, there is a need for iterative approaches that not only cater for the challenges of learning and multi-level governance but also incorporate the social agenda. Examples of best practice include the need to focus on purpose, include the broader social agenda, and take a transparent, flexible approach to learning.

Targeted recommendations

The research makes seven targeted recommendations to UK UAs based on the analysis of UK adaptation planning policy. These recommendations include the suggestion for cities to work with international agendas and guidance for the localisation of the Sustainable Development Goals for example, the 2030 Agenda through Voluntary Local Reviews (VLRs). As evidenced by Bristol and Glasgow, by conducting a VLR, urban areas are much more likely to design rigorous and mature MERL instruments that consider the realisation of adaptation outcomes and the wider societal benefits. There is also potential alignment with the New Urban Agenda and country-level discussions regarding National Determined Contributions. The recommendations also stress the need for transparency, not only in the sense of engaging with other UAs and city-networks but also in what data is available and what data is still missing. By acknowledging missing or lack of data, progress can be made, and policy decisions will not be made in a vacuum. Further, taking a broader approach to MERL that considers social vulnerability is shown to provide a solid baseline to enable future MERL best practice. Finally, as illustrated by Greater London, investing in learning, and developing specific research projects to fill data gaps is central to developing a solid picture of adaptation progress in any urban area. A focus on completeness and utility of data is needed so that urban areas can make informed decisions. Indeed, the measurability and aggregability of data should not be the initial defining feature to any MERL system.

Looking forward

Cities are finding new and original ways to learn and understand the wider impacts to their climate adaptation plans. Future research needs to look at alternative approaches to evaluate adaptation and develop a shared definition of successful adaptation. Only then can globally goals and metrics be established that are of relevance at the local level. In the meantime, refocusing MERL conversations on the concept of learning could be tangible of developing meaningful data at the local level that can be used to avoid maladaptation. A future study could partner with an UA to develop an in-depth case study and experiment with different ways of tracking adaptation.

The experiences of UK UAs illustrate that there are a great number of ways to track the implementation of climate change adaptation. Many cities are still overly reliant on process indicators that lack insight into the scope of adaptation actually realised. However, there is evidence of novel approaches that reflect on the purpose of MERL and strive to learn how to learn and incorporate the social agenda. As described above, for cities to truly become a learning organisation, an open and transparent approach to data, and the lack of data is needed. Additionally, building on existing frameworks and approaches such as the SDGs is useful in not only motivating MERL, but also bringing together different aspects of sustainability that are often treated in silos. However, what is clear is that through the practices of transparency and learning UAs can begin to identify approaches that not only cater for the highly context-specific nature to adaptation but also produce data that can help understand adaptation progress across governance levels.

References

Adger, N., Arnell, N. W., & Tompkins, E. L. (2005). Successful adaptation to climate change across scales. Global Environmental Change, 15(2), 77–86. https://doi.org/10.1016/j.gloenvcha.2004.12.005

Adger, W. N., & Hodbod, J. (2014). Ecological and social resilience. In the Handbook of sustainable development. Edward Elgar Publishing.

Adriázola, P., Dellas, E. and Tänzler, D. (2018). *Multi-Level Climate Governance Supporting Local Action*. Climate Policy Meets Urban Development. Bonn: GIZ. https://www.citiesalliance.org/sites/default/files/giz2018-0318en-cpmud-multi-level-climate-governance.pdf.

Albert, S. & Pandey, M. (2022). To build sustainable cities, involve those who live in them**.** https://www.fastcompany.com/90776435/to-build-sustainable-cities-involve-those-who-live-in-them.

Anderson, A. A. (2006). The community builder's approach to Theory of Change.

Anguelovski, I., & Carmin, J. (2011). Something borrowed, everything new: Innovation and institutionalisation in urban climate governance. Current Opinion in Environmental Sustainability, 3(3), 169–175. https://doi.org/10.1016/j.cosust.2010.12.017

Anguelovski, I., Shi, L., Chu, E., Gallagher, D., Goh, K., Lamb, Z., Reeve, K., & Teicher, H. (2016). Equity Impacts of Urban Land Use Planning for Climate Adaptation: Critical Perspectives from the Global North and South. Journal of Planning Education and Research, 36(3), 333–348. https://doi.org/10.1177/0739456X16645166

Arnott, J. C., Moser, S. C., & Goodrich, K. A. (2016). Evaluation that counts: A review of climate change adaptation indicators & metrics using lessons from effective evaluation and science-practice interaction. Environmental Science & Policy, 66(C), 383–392.

Barnett, J., & O'Neill, S. (2010). Maladaptation. Global Environmental Change, 20(2), 211–213. https://doi.org/10.1016/j.gloenvcha.2009.11.004

Becker, P. (2014). Sustainability Science: Managing Risk and Resilience for Sustainable Development. Newnes.

Berrang-Ford, L., Biesbroek, R., Ford, J., Lesnikowski, A., Tanabe, A., & Wang, F. et al. (2019). Tracking global climate change adaptation among governments. *Nature Climate Change*, *9*(6), 440-449. doi: 10.1038/s41558-019-0490-0.

Belfast City Council. (2020). Resilience Assessment. https://www.belfastcity.gov.uk/Documents/Resilience-Assessment. [Accessed 20 September 2021].

Blaikie, N. (2009). Designing Social Research: The Logic of Anticipation (2nd edition). Polity.

Bours, D., McGinn, C., & Pringle, P. (2014). Guidance note 3: Theory of Change approach to climate change adaptation programming. Guidance for M&E of climate change interventions: UKCIP. www.ukcip.org.uk/wp-content/PDFs/MandE-Guidance-Note3.pdf.

Bowen, G. A. (2009). Document Analysis as a Qualitative Research Method. Qualitative Research Journal, 9(2), 27–40. https://doi.org/10.3316/QRJ0902027

C40 Cities. (2019). C40 City Monitoring, Evaluation and Reporting Guidance. https://cdn.locomotive.works/sites/5ab410c8a2f42204838f797e/content_entry5ab410fb74c4833febe6c81a/5f8f40cc25fb7d00ac5dec06/files/City_CAP_MER_Guidance_Final.pdf?1621855171.

Castán Broto, V., & Westman, L. K. (2020). Ten years after Copenhagen: Reimagining climate change governance in urban areas. WIREs Climate Change, 11(4), e643. https://doi.org/10.1002/wcc.643.

Castan Broto, V., Westman, L., & Huang, P. (2021). Reparative innovation for urban climate adaptation. Journal of the British Academy, 9s9, 205–218. https://doi.org/10.5871/jba/009s9.205.

Chen, M., S. Roever and C. Skinner, 2016: Urban livelihoods: Reframing theory and policy. Sage Publications, London, England.

Christiansen, L., & Martinez, G., Naswa, Prakriti, UNEP DTU Partnership. (2018). Adaptation metrics—Perspectives on measuring, aggregating, and comparing adaptation results. UNEP DTU Partnership.

Climate Emergency UK, (2021). *Council Climate Plan Scorecards*. Climate Emergency UK. https://councilclimatescorecards.uk. [Accessed 20 September 2021].

Coger et al., (2021). Locally Led Adaptation: From Principles to Practice. https://www.wri.org/research/locally-led-adaptation-principles-practice

Cologna, V., & Oreskes, N. (2022). Don't gloss over social science! a response to: Glavovic et al. (2021) 'the tragedy of climate change science'. *Climate And Development*, 1-3. doi: 10.1080/17565529.2022.2076647.

Creasy, A., Lane, M., Owen, A., Howarth, C., & van der Horst, D. (2021). Representing 'place': City climate commissions and the institutionalisation of experimental governance in Edinburgh. Politics and Governance, 9(2), 64–75.

Creswell, J. (2013). Steps in Conducting a Scholarly Mixed Methods Study. DBER Speaker Series. https://digitalcommons.unl.edu/dberspeakers/48.

Crotty, M., & Crotty, M. F. (1998). The Foundations of Social Research: Meaning and Perspective in the Research Process. SAGE Publications.

Dahiya, B., & Das, A. (2020). New Urban Agenda in Asia-Pacific: Governance for Sustainable and Inclusive Cities. In B. Dahiya & A. Das (Eds.), New Urban Agenda in Asia-Pacific: Governance for Sustainable and Inclusive Cities (pp. 3–36). Springer. https://doi.org/10.1007/978-981-13-6709-0_1.

de Zoysa, K., Coger, T. and Krishnan, N. (2022). Can the Global Goal on Adaptation Be Locally Led? World Resources Institute. https://www.wri.org/insights/can-global-goal-adaptation-be-locally-led. [Accessed 5 August 2022].

Devine-Wright, P., Whitmarsh, L., Gatersleben, B., O'Neill, S., Hartley, S., & Burningham, K. et al. (2022). Placing people at the heart of climate action. *PLOS Climate*, *1*(5), e0000035. doi: 10.1371/journal.pclm.0000035.

Dilling, L., Prakash, A., Zommers, Z., Ahmad, F., Singh, N., Wit, S., Nalau, J., Daly, M., & Bowman, K. (2019). Is adaptation success a flawed concept? Nature Climate Change, 9, 1. https://doi.org/10.1038/s41558-019-0539-0.

Djamba, Y. K., & Neuman, W. L. (2002). Social Research Methods: Qualitative and Quantitative Approaches. Teaching Sociology, 30(3), 380. https://doi.org/10.2307/3211488.

Dodman, D., B. Hayward, M. Pelling, V. Castan Broto, W. Chow, E. Chu, R. Dawson, L. Khirfan, T. McPhearson, A. Prakash, Y. Zheng, and G. Ziervogel, 2022: Cities, Settlements and Key Infrastructure. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 907–1040, doi:10.1017/9781009325844.008.

Donatti, C. I., Harvey, C. A., Hole, D., Panfil, S. N., & Schurman, H. (2020). Indicators to measure the climate change adaptation outcomes of ecosystem-based adaptation. Climatic Change, 158(3), 413–433. https://doi.org/10.1007/s10584-019-02565-9.

Doran, G. (1981). There's a S.M.A.R.T. way to write management's goals and objectives. https://community.mis.temple.edu/mis0855002fall2015/files/2015/10/S.M.A.R.T-Way-Management-Review.pdf.

EEA - European Environment Agency, (2020a), "Monitoring and evaluation of national adaptation policies throughout the policy cycle". https://www.eea.europa.eu/publications/national-adaptation-policies.

EEA - European Environment Agency, (2020b), "Urban adaptation in Europe: how cities and towns respond to climate change". https://www.eea.europa.eu/publications/urban-adaptation-in-europe.

Eriksen, S., Schipper, E. L. F., Scoville-Simonds, M., Vincent, K., Adam, H. N., Brooks, N., Harding, B., Khatri, D., Lenaerts, L., Liverman, D., Mills-Novoa, M., Mosberg, M., Movik, S., Muok, B., Nightingale, A., Ojha, H., Sygna, L., Taylor, M., Vogel, C., & West, J. J. (2021). Adaptation interventions and their effect on vulnerability in developing countries: Help, hindrance, or irrelevance? World Development, 141, 105383. https://doi.org/10.1016/j.worlddev.2020.105383

European Union. (2020). Adapting to climate change: Challenges and opportunities for the EU local and regional authorities. https://cor.europa.eu/en/engage/studies/Documents/Climate%20Change_adaptation.pdf.

Eurostat. (2021). Eurostat. https://ec.europa.eu/eurostat. [Accessed 20 September 2021].

Field, R.D., D. Kim, A.N. LeGrande, J. Worden, M. Kelley, and G.A. Schmidt, 2014: Evaluating climate model performance in the tropics with retrievals of water isotopic composition from Aura TES. *Geophys. Res. Lett.*, **41**, no. 16, 6030-6036, doi:10.1002/2014GL060572.

Ford, J. D. et al., 2015: Adaptation tracking for a post-2015 climate agreement. Nature Climate Change, 5(11), 967.

GCA - Global Center on Adaptation, (2021), "State and Trends in Adaptation Report 2020". https://www.cas2021.com/documents/reports/2021/01/22/state-and-trends-in-adaptation-report-2020.

Glahn, C., Specht, M., & Koper, R. (2007). Smart Indicators on Learning Interactions. In E. Duval, R. Klamma, & M. Wolpers (Eds.), Creating New Learning Experiences on a Global Scale (pp. 56–70). Springer. https://doi.org/10.1007/978-3-540-75195-3_5.

Goonesekera, S. M., & Olazabal, M. (2022). Climate adaptation indicators and metrics: State of local policy practice. *Ecological Indicators*, *145*, 109657.

Göpfert, C., Wamsler, C., & Lang, W. (2020). Enhancing structures for joint climate change mitigation and adaptation action in city administrations – Empirical insights and practical implications. City and Environment Interactions, 8, 100052. https://doi.org/10.1016/j.cacint.2020.100052.

Guijt, I. (2010). Accountability and Learning. Capacity Development in Practice. https://www.academia.edu/1452140/Accountability_and_Learning.

Hale, T., Chan, S., Hsu, A., Clapper, A., Elliott, C., Faria, P., Kuramochi, T., McDaniel, S., Morgado, M., Roelfsema, M., Santaella, M., Singh, N., Tout, I., Weber, C., Weinfurter, A., & Widerberg, O. (2021). Sub- and non-state climate action: A framework to assess progress, implementation, and impact. Taylor & Francis. https://scholarbank.nus.edu.sg/handle/10635/187279.

Hallegatte, S. (2009). Strategies to adapt to an uncertain climate change. Global Environmental Change, 19(2), 240–247. https://doi.org/10.1016/j.gloenvcha.2008.12.003.

Hallegatte, S., & Engle, N. L. (2019). The search for the perfect indicator: Reflections on monitoring and evaluation of resilience for improved climate risk management. Climate Risk Management, 23, 1–6. https://doi.org/10.1016/j.crm.2018.12.001.

Heidrich, O., Dawson, R., Reckien, D., & Walsh, C. (2013). Assessment of the climate preparedness of 30 urban areas in the UK. Climatic Change, 120. https://doi.org/10.1007/s10584-013-0846-9.

Holgate, C. (2007). Factors and Actors in Climate Change Mitigation: A Tale of Two South African Cities. Local Environment, 12(5), 471–484. https://doi.org/10.1080/13549830701656994.

Horrocks, L., & Hunt, A. (2009). Towards indicators for adaptation: Policy needs, possible approaches and practical solutions. IOP Conference Series. Earth and Environmental Science, 6(36). https://doi.org/10.1088/1755-1307/6/36/362015.

Howarth, C., Lane, M., & Fankhauser, S. (2021). What next for local government climate emergency declarations? The gap between rhetoric and action. *Climatic Change*, *167*(3-4). https://10.1007/s10584-021-03147-4.

IPCC, (2014). "Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change "[Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

Johnsen, S. & Jones, A. (2015) *The reconnection of rough sleepers within the UK: an evaluation*. London: Crisis.

Jones, L., A. Constas, M., Matthews, N., & Verkaart, S. (2021). Advancing resilience measurement. Nature Sustainability, 4(4), 288–289. https://doi.org/10.1038/s41893-020-00642-x.

Klostermann, J., van de Sandt, K., Harley, M., Hildén, M., Leiter, T., van Minnen, J., Pieterse, N., & van Bree, L. (2018). Towards a framework to assess, compare and develop monitoring and evaluation of climate change adaptation in Europe. Mitigation and Adaptation Strategies for Global Change, 23(2), 187–209. https://doi.org/10.1007/s11027-015-9678-4.

Landauer, M., Juhola, S., & Klein, J. (2018). The role of scale in integrating climate change adaptation and mitigation in cities. *Journal Of Environmental Planning And Management*, *62*(5), 741-765. doi: 10.1080/09640568.2018.1430022.

Leiter, T. (2015). Linking Monitoring and Evaluation of Adaptation to Climate Change Across Scales: Avenues and Practical Approaches. New Directions for Evaluation, 2015(147), 117–127. https://doi.org/10.1002/ev.20135.

Leiter, T. (2017). The Adaptation M&E Navigator: a decision support tool for the selection of suitable approaches to monitor and evaluate adaptation to climate change. In *Evaluating climate change action for sustainable development* (pp. 327-341). Springer, Cham.

Leiter, T., & Pringle, P. (2018). Pitfalls and potential of measuring climate change adaptation through adaptation metrics. In: Christiansen, L., & Martinez, G., Naswa, Prakriti, UNEP DTU Partnership. (2018). Adaptation metrics—Perspectives on measuring, aggregating, and comparing adaptation results. UNEP DTU Partnership.

Leiter, T., Olhoff, A., Al Aza, R., Barmby, V., Bours, D., Clemen, V. W. C., Dale, T. W., Davies, C., & Jacobs, H. (2019). Adaptation Metrics. Current Landscape and Evolving Practices. Adaptation Metrics. Current Landscape and Evolving Practices.

Lesnikowski, A., Ford, J., Biesbroek, R., Berrang-Ford, L., Maillet, M., Araos, M., & Austin, S. (2016). What does the Paris Agreement mean for adaptation?. *Climate Policy, 17*(7), 825-831. doi: 10.1080/14693062.2016.1248889.

Lewis, W. & Olazabal, M. (2021). Learning How to Learn: The experiences of 6 global cities in tracking urban adaptation. Basque Centre for Climate Change – BC3 Policy Briefings. https://www.bc3research.org/index.php?option=com_pbriefings&task=showdetails&idpbriefings=60&Itemid=292&lang=en_EN.

Local Government Boundary Commission Scotland. (2021). Boundaries. https://boundaries.scot/. [Accessed 20 September 2021].

Long, J., & Rice, J. L. (2019). From sustainable urbanism to climate urbanism. Urban Studies, 56(5), 992–1008. https://doi.org/10.1177/0042098018770846.

Marek Soanes, A. V. B. (n.d.). Principles for locally led adaptation. Publications Library; IIED. Retrieved May 18, 2022, from https://pubs.iied.org/10211iied.

McDermott, T. K. J., & Surminski, S. (2018). How normative interpretations of climate risk assessment affect local decision-making: An exploratory study at the city scale in Cork, Ireland. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 376(2121), 20170300. https://doi.org/10.1098/rsta.2017.0300.

Mercer, J. (2010). Disaster risk reduction or climate change adaptation: Are we reinventing the wheel? Journal of International Development, 22(2), 247–264. https://doi.org/10.1002/jid.1677.

NI Direct. (2022). NI Direct. https://www.nidirect.gov.uk/.

NISRA. (2019). Mid-Year Population Estimates Northern Ireland. https://www.nisra.gov.uk/publications/2019-mid-year-population-estimates-northern-ireland.

NISRA. (2022). Urban Rural Geography Documents. https://www.nisra.gov.uk/publications/urban-rural-geography-documents-2015.

NRS Scotland. (2022). Population Estimates. https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/population/population-estimates.

Olazabal, M., & Ruiz De Gopegui, M. (2021). Adaptation planning in large cities is unlikely to be effective. Landscape and Urban Planning, 206, 103974. https://doi.org/10.1016/j.landurbplan.2020.103974.

Olazabal, M., Galarraga, I., Ford, J., Sainz De Murieta, E., & Lesnikowski, A. (2019). Are local climate adaptation policies credible? A conceptual and operational assessment framework. International Journal of Urban Sustainable Development, 11(3), 277–296. https://doi.org/10.1080/19463138.2019.1583234.

Olazabal, M., Ruiz de Gopegui, M., Tompkins, E. L., Venner, K., & Smith, R. (2019). A cross-scale worldwide analysis of coastal adaptation planning. Environmental Research Letters, 14(12), 124056. https://doi.org/10.1088/1748-9326/ab5532.

Olhoff, A. (2018). Tracking Adaptation Progress at the Global Level: Key Issues and Priorities. In: Zommers, Z. & Alverson, K. (Ed.). Resilience: The Science of Adaptation (51-61). ScienceDirect.

Olhoff, A. (2018). Tracking Adaptation Progress at the Global Level: Key Issues and Priorities. https://www.sciencedirect.com/science/article/pii/B9780128118917000049.

Olhoff, A., & Schaer, C. (2010). Screening tools and guidelines to support the mainstreaming of climate change adaptation into development assistance-a stocktaking report. Screening Tools and Guidelines to Support the Mainstreaming of Climate Change Adaptation into Development Assistance-a Stocktaking Report.

ONS. (2019). Population Estimates. https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/lowersuperoutputareamidyearpopulationestimates.

ONS. (2022). Rural Urban Classifications. https://www.ons.gov.uk/methodology/geography/geographicalproducts/ruralurbanclassifications

Parsons, A. (2021). UK Rural/Urban measures, https://github.com/mysociety/uk_ruc. [Accessed 20 September 2021].

PCAN. (2021). Trends in Local Climate Action in the UK. https://pcancities.org.uk/trends-local-climate-action-uk.

Pringle, P. (2016). AdaptME toolkit: Adaptation monitoring and evaluation. https://ora.ox.ac.uk/objects/uuid:65770b08-eb6f-432b-9b2c-5c65ea6b44b3.

Quesne, G., Ramaroson, N. & Manesimana, M. (2019). Designing, setting up and implementing a climate change adaptation monitoring and evaluation framework: concrete examples from Madagascar. In: Christiansen, L., & Martinez, G., Naswa, Prakriti, UNEP DTU Partnership. (2018). Adaptation metrics—Perspectives on measuring, aggregating, and comparing adaptation results. UNEP DTU Partnership.

Reckien, D., Salvia, M., Heidrich, O., Church, J. M., Pietrapertosa, F., De Gregorio-Hurtado, S., D'Alonzo, V., Foley, A., Simoes, S. G., Krkoška Lorencová, E., Orru, H., Orru, K., Wejs, A., Flacke, J., Olazabal, M., Geneletti, D., Feliu, E., Vasilie, S., Nador, C., … Dawson, R. (2018). How are cities planning to respond to climate change? Assessment of local climate plans from 885 cities in the EU-28. Journal of Cleaner Production, 191, 207–219. https://doi.org/10.1016/j.jclepro.2018.03.220.

Roberts, J. (2020). The leadership of place and people in the new English combined authorities. Local Government Studies, 46(6), 995–1014. https://doi.org/10.1080/03003930.2020.1719076.

Schipper, E. L. F. (2020). Maladaptation: When Adaptation to Climate Change Goes Very Wrong. One Earth, 3(4), 409–414. https://doi.org/10.1016/j.oneear.2020.09.014.

SGUR. (2016). Scottish Government Urban Rural Classification. https://www.gov.scot/publications/scottish-government-urban-rural-classification-2016/pages/2/. [Accessed 20 September 2021].

Sharifi, A. (2016). A critical review of selected tools for assessing community resilience. Ecological Indicators, 69, 629–647. https://doi.org/10.1016/j.ecolind.2016.05.023.

Sharifi, A., & Khavarian-Garmsir, A. R. (2020). The COVID-19 pandemic: Impacts on cities and major lessons for urban planning, design, and management. Science of The Total Environment, 749, 142391. https://doi.org/10.1016/j.scitotenv.2020.142391.

Simon, D., 2016: Rethinking sustainable cities: Accessible, green and fair. Policy Press, Bristol and Chicago.

Sniffer. (2018). Monitoring and Evaluation for Climate Change Adaptation. Adaptation Scotland.https://www.adaptationscotland.org.uk/application/files/4215/5799/7134/M__E_Summary__Resources___Final.pdf.

Solecki, W., & Rosenzweig, C. (2020). Indicators and monitoring systems for urban climate resiliency. *Climatic Change*, *163*(4), 1815-1837. doi: 10.1007/s10584-020-02947-4.

Spielman, S. E., J. Tuccillo, D. C. Folch, A. Schweikert, R. Davies, N. Wood and E. Tate, 2020: Evaluating social vulnerability indicators: criteria and their application to the Social Vulnerability Index. Natural Hazards, 100(1), 417– 436.

Strauss, A. L. (1990). Systematic coding in qualitative research. BMS: Bulletin of Sociological Methodology / Bulletin de Méthodologie Sociologique, 27, 52–62.

Swart, R. J., Biesbroek, G. R., Binnerup, S., Carter, T., Cowan, C., Henrichs, T., Loquen, S., Mela, H., Morecroft, M., Reese, M., & Rey, D. (2009). Europe adapts to climate change. Comparing National Adaptation Strategies in Europe (No. 1; p.). PEER. https://library.wur.nl/WebQuery/wurpubs/382425.

Tollin, N., Kehew, R., Caballero, V., Robba, G., & Pizzorni, M. (2022). *Nationally Determined Contributions (NDCs) White Paper*. Nairobi: UN-Habitat. Retrieved from https://unhabitat.org/nationally-determined-contributions-ndcs-white-paper.

UCLG (2014). How to localize targets and indicators of the post-2015 agenda. UCLG. https://www.uclg.org/sites/default/files/localization_targets_indicator_web.pdf.

Uitto, J. I., Puri, J., & van den Berg, R. D. (Eds.). (2017). Evaluating Climate Change Action for Sustainable Development. Springer International Publishing. https://doi.org/10.1007/978-3-319-43702-6.

UKCIP (2004) Costing the impacts of climate change in the UK. Implementation report. Oxford UK. https://www.ukcip.org.uk/wp-content/PDFs/Costings_overview.pdf.

UN Secretary General. (2014). Synthesis report of the Secretary-General on the post-2015 sustainable development agenda. https://www.un.org/ga/search/view_doc.asp?symbol=A/69/700&Lang=E.

UN Statistical Commission. (2020). Cities in the world. https://www.oecd-ilibrary.org/urban-rural-and-regional-development/cities-in-the-world_d0efcbda-en;jsessionid=YCVrJYDO20wvVZP50WjMinoz_N5jpTbVUPKql37J.ip-10-240-5-142.

UK Green Alliance. (2020). The Local Climate Challenge. https://green-alliance.org.uk/wp-content/uploads/2021/11/The_local_climate_challenge.pdf.

UN-Habitat. (2016). Roadmap for localizing the SDGs: Implementation and monitoring at subnational level. https://unhabitat.org/sites/default/files/download-manager-files/Roadmap%20Localising%20SDG%20FINAL.pdf.

UNDP. (2019). Module 8 – Indicators ETF Online. https://www.adaptation-undp.org/sites/default/files/uploaded-images/module_8_indicators_etf_online_0.pdf.

UN. (2018). Revision of World Urbanization Prospects. https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.

UNDRR. (2013). Poorly planned urban development. https://www.preventionweb.net/understanding-disaster-risk/risk-drivers/poorly-planned-urban-development.

UNFCCC. (2016). Inventory of ongoing monitoring and evaluation work of adaptation prepared under the Nairobi work programme on impacts, vulnerability and adaptation to climate change. https://unfccc.int/files/adaptation/groups_committees/adaptation_committee/application/pdf/ac10_5b_m_and_e_.pdf.

UNFCCC. (2021). Approaches to reviewing the overall progress made in achieving the global goal on adaptation. Technical Paper. https://unfccc.int/sites/default/files/resource/ac2021_tp_gga.pdf.

Ürge-Vorsatz, D., Rosenzweig, C., Dawson, R. J., Sanchez Rodriguez, R., Bai, X., Barau, A. S., Seto, K. C., & Dhakal, S. (2018). Locking in positive climate responses in cities. Nature Climate Change, 8(3), 174–177. https://doi.org/10.1038/s41558-018-0100-6.

Valters, C. (2015). Theories of Change: Time for a radical approach to learning in development. ODI: Think Change. https://odi.org/en/publications/theories-of-change-time-for-a-radical-approach-to-learning-in-development/.

Van de Sandt, K.H. van de; Klostermann, J.E.M.; Minnen, J. van; Pieterse, N.; Bree, L. van. (2013). Framework for guiding monitoring and evaluation of climate adaptation policies and projects. Wageningen : Wageningen UR Alterra - p. https://www.wur.nl/en/Publication-details.htm?publicationId=publication-way-343832383636.

Villanueva, P. (2011). Learning to ADAPT: Monitoring and evaluation approaches in climate change adaptation and disaster risk reduction – challenges, gaps, and ways forward. https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/2509.

Wamsler, C. (2014). Cities, Disaster Risk and Adaptation. Routledge.

Welsh Government. (2022). Local Government. https://gov.wales/local-government.

Williams, A., Colvin, J., Ebi, K., Patwardhan,, A. and Lebel, S., (2017), “Strengthening Monitoring and Evaluation of Climate Change Adaptation: A STAP Advisory Document”, May 2017. DOI: 10.13140/RG.2.2.

World Bank. (2010). Cities and climate change : an urgent agenda. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/194831468325262572/cities-and-climate-change-an-urgent-agenda.

Appendices

Appendix A. Common components to MERL systems

Component	Further detail(s)	Reference(s)
Domain	Mitigation - reducing emissions, Adaptation - addressing climate impacts, Both - overlap between two concepts, General - definition needed	*Göpfert et al., 2020; Landauer et al., 2018; Sharifi, 2020; Ürge-Vorsatz et al., 2018*
Level of Detail	Used interchangeable. Here refers to the level of detail being assessed. 'Objective' relates to the overarching result of action - usually binary (yes or no).'Indicator' measure of progress e.g., number or level, can be quantitative or qualitative with a count, 'Metric' refers to measuring with a specific unit of measurement e.g., hectares, m2.	*Leiter et al., 2019; Christiansen et al., 2018; Hale et al., 2021*
Scope	The definition of a context-specific tailored system adapted to existing local institutions. Context-specific Klostermann et al., 2018)	*Olazabal et al., 2019; Klostermann et al., 2018*
Type	Indicators are commonly classified according to the stage in the change process that they refer to, in other words, whether they indicate the potential for adaptation (process or output indicators) or the realisation of adaptation (outcome indicators). These categories (input, output, outcome, impact) follow the standard terminology used in development cooperation	*Leiter et al., 2019; Hale et al., 2021*
Target	Are targets realistic and achievable? target a specific area for improvement	*Quesne et al., 2019; Doran 1981; Glahn et al. 2007; Klostermann et al., 2018*
Baseline	Are baseline data available for each indicator? Prior to adaptation tracking needs a baseline / reference. Indicators only meaningful with baseline.	*Quesne et al., 2019; Olazabal & Ruiz De Gopegui, 2021; Hale et al., 2021*
Timeframe	Do targets specify an achievement date? SMART indicators e.g., specify when the results can be achieved.	*Quesne et al., 2019; Doran 1981; Glahn et al. 2007; Klostermann et al., 2018*
Responsible Party	The definition of a responsible party (public authority, department, group, or organisation), A responsible organisation should be permanent and equipped with appropriate resources, as it will need to gather data on climate adaptation on an ongoing basis (Swart et al. 2009).	*Olazabal et al., 2019; Quesne et al., 2019; Klosterman et al., 2018*
Budget	The definition and assignment of the appropriate budget over time, A responsible organisation should be permanent and equipped with appropriate resources, as it will need to gather data on climate adaptation on an ongoing basis (Swart et al. 2009). The funding commitment.	*Olazabal et al., 2019; Swart et al. 2009; Klostermann et al., 2018; Soanes et al., 2021*
Linked Objectives	The identification of monitoring objectives with linked indicators. What adaptation objectives are realistic and necessary to be monitored, and whatnot. Clarity over the objective of M&E activities is crucial to guide the development of appropriate M&E approaches. policy makers will need to set clear objectives not only for their adaptation policies	*Olazabal et al., 2019; Van de Sandt et al., 2013; Horrocks and Hunt, 2009*
Method	The definition of a method and process to evaluate outcomes of the monitoring process, Measurable	*Olazabal et al., 2019; Quesne et al., 2019; Doran, 1981; Glahn et al. 2007, Klostermann et al., 2018*
Alignment	The established framework under the 2030 Agenda for Sustainable Development could be the starting point for adaptation tracking.	*Leiter et al., 2019*
Reporting	The reporting process (how and who the outputs will be reported to). Reporting on the localisation of adaptation funding and decision making at all levels.	*Olazabal et al., 2019b, Soanes et al., 2021*
Locally Led	Local actors have individual and collective agency over their adaptation priorities and how adaptation takes place. Empowerment and agency. M&E systems can include indicators to track the depth and quality of local agency, empowerment, engagement, and leadership in development processes and decision making, drawing on existing approaches	*Soanes et al., 2020*
Learning	The presence of iterative learning mechanisms. Learning is applied, documented, and shared horizontally at the local level and vertically to national and international levels as appropriate. Understanding, by an intervention's stakeholders, of what works, in what contexts, for whom, and why. Iterative cycles of selection of monitoring objectives, procedures, data collection and evaluation and inputs to adaptation policy and planning processes.	*Soanes et al., 2021, Coger et al., 2021, Klostermann et al., 2018*

Appendix B. Components (y/n)

Council	Target	Baseline	Timeframe	Responsible Party	Budget	Linked Objectives	Method	External Reporting	Voices and Empowerment	Learning	Alignment to Wider Goals
Aberdeen City Council	0	0	1	0	0	1	0	1	1	1	1
Bolton Metropolitan Borough Council	1	1	0	1	0	1	0	0	1	1	0
Bristol City Council	1	1	0	1	0	1	1	1	1	1	1
Bury Metropolitan Borough Council	0	1	0	1	0	1	1	0	0	0	0
Cardiff Council	0	0	0	0	0	0	0	1	0	0	0
Doncaster Metropolitan Borough Council	0	1	0	0	0	1	0	0	0	0	0
Dundee City Council	1	0	0	1	1	1	0	1	1	1	1
Eastbourne Borough Council	1	1	0	1	0	1	1	0	0	0	0
Glasgow City Council	0	0	1	1	1	1	0	1	1	1	1
Greater London Authority	0	1	0	1	0	0	1	1	0	1	0
London Borough of Merton	1	1	0	0	0	1	1	0	0	0	0
Manchester City Council	0	0	0	1	0	1	0	0	0	1	0
Southampton City Council	0	0	0	0	0	1	0	0	0	0	0
Wigan Metropolitan Borough Council	0	0	1	1	1	1	0	0	1	0	0
Total	5	7	3	9	3	12	5	6	6	7	4

Appendix C. Cities included n=199.

Councils	
Manchester City Council	City of York Council
Solihull Metropolitan Borough Council	Northeast Lincolnshire Council
City of Edinburgh Council	Hartlepool Borough Council
Newcastle-upon-Tyne City Council	Sheffield City Council
London Borough of Hammersmith & Fulham	Renfrewshire Council
South Gloucestershire Council	Stoke-on-Trent City Council
London Borough of Southwark	Thurrock Council
Telford & Wrekin Council	Tameside Metropolitan Borough Council
London Borough of Richmond upon Thames	Kirklees Council
London Borough of Lewisham	Woking Borough Council
Nottingham City Council	Reigate & Banstead Borough Council
Glasgow City Council	Cambridge City Council
Reading Borough Council	Surrey Heath Borough Council
London Borough of Brent	Fareham Borough Council

London Borough of Ealing	Exeter City Council
Leicester City Council	South Ribble Borough Council
Medway Council	Canterbury City Council
Leeds City Council	Elmbridge Borough Council
Wokingham Borough Council	Thanet District Council
Cardiff Council	Three Rivers District Council
London Borough of Haringey	Epsom and Ewell Borough Council
Plymouth City Council	Adur District Council
Cheshire East Council (Unitary)	St Albans City and District Council
Slough Borough Council	Worthing Borough Council
Brighton and Hove City Council	Warwick District Council
London Borough of Hounslow	Ipswich Borough Council
Royal Borough of Greenwich	Eastbourne Borough Council
Trafford Metropolitan Borough Council	Basildon Borough Council
Bristol City Council	Oxford City Council
Dundee City Council	Eastleigh Borough Council
Royal Borough of Kensington and Chelsea	Worcester City Council
London Borough of Harrow	Rushmoor Borough Council
London Borough of Islington	Dacorum Council
Sandwell Metropolitan Borough Council	Havant Borough Council
London Borough of Camden	Gosport Borough Council
Blackpool Borough Council	Hastings Borough Council
Darlington Borough Council	Mansfield District Council
London Borough of Croydon	Hertsmere Borough Council
Salford City Council	Watford Borough Council
Sunderland City Council	Stevenage Borough Council
Bury Metropolitan Borough Council	Northeast Derbyshire District Council
Swindon Borough Council	Norwich City Council
London Borough of Wandsworth	Borough of Broxbourne
East Dunbartonshire Council	North Hertfordshire District Council
Westminster City Council	Oadby and Wigston Borough Council
Southend-on-Sea Borough Council	Pendle Borough Council
West Dunbartonshire Council	Broxtowe Borough Council
North Tyneside Metropolitan Borough Council	Welwyn Hatfield Council
London Borough of Bromley	Chesterfield Borough Council
Royal Borough of Kingston upon Thames	Cheltenham Borough Council
Birmingham City Council	Charnwood Borough Council

Wirral Council	Mid Sussex District Council
London Borough of Redbridge	City of Lincoln Council
North Lanarkshire Council	Rossendale Borough Council
London Borough of Merton	Bromsgrove District Council
Wigan Metropolitan Borough Council	Harlow Council
London Borough of Newham	Rochford District Council
Rotherham Metropolitan Borough Council	Tamworth Borough Council
Walsall Metropolitan Borough Council	Erewash Borough Council
Kingston-Upon-Hull City Council	Gloucester City Council
South Tyneside Council	Cannock Chase District Council
Milton Keynes	Nuneaton and Bedworth Borough Council
London Borough of Sutton	Burnley Borough Council
Royal Borough of Windsor and Maidenhead	Ashfield District Council
Bournemouth, Christchurch, and Poole Borough Council	Dartford Borough Council
London Borough of Enfield	Crawley Borough Council
Bolton Metropolitan Borough Council	Spelthorne Borough Council
Barnsley Metropolitan Borough Council	Preston City Council
Stockton-on-Tees Borough Council	Redditch Borough Council
London Borough of Hillingdon	Runnymede Borough Council
Blackburn with Darwen Borough Council	Hyndburn Borough Council
Torbay Council	Arun District Council
Southampton City Council	Castle Point Borough Council
Portsmouth City Council	West Midlands Combined Authority
Doncaster Metropolitan Borough Council	Greater London Authority
London Borough of Lambeth	Greater Manchester Combined Authority
Aberdeen City Council	Liverpool City Region Combined Authority
City of London	West Yorkshire Combined Authority
London Borough of Barking and Dagenham	North of Tyne Combined Authority
London Borough of Tower Hamlets	West of England Combined Authority
Oldham Metropolitan Borough Council	South Yorkshire Mayoral Combined Authority
North Somerset Council	Cambridgeshire and Peterborough Combined Authority
Sefton Metropolitan Borough Council	Northeast Combined Authority
Warrington Borough Council	Tees Valley Combined Authority
Peterborough City Council	Belfast City Council
Stockport Metropolitan Borough Council	Rochdale Metropolitan Borough Council
Calderdale Metropolitan Borough Council	Merthyr Tydfil County Borough Council
Middlesbrough Borough Council	Halton Borough Council

Knowsley Metropolitan Borough Council	London Borough of Hackney
Wolverhampton City Council	London Borough of Havering
Bradford Metropolitan District Council	East Renfrewshire Council
Liverpool City Council	Dudley Metropolitan Borough Council
Bracknell Forest Council	Derby City Council
Inverclyde Council	Coventry City Council
Luton Borough Council	London Borough of Bexley
Swansea City Council	London Borough of Barnet
Blaenau Gwent County Borough Council	Torfaen County Borough Council
Gateshead Metropolitan Borough Council	London Borough of Waltham Forest
Falkirk Council	St Helens Metropolitan Borough Council
Newport City Council	

Appendix D. Full list of plans included in the policy analysis.

All adaptation-related documents were sampled from Climate Emergency UK data on 20 September 2021. Numbering refers to in-text references for additional plans.

Aberdeen City Council

- Aberdeen (1)- Aberdeen Adapts: Building resilience and adapting to the changing climate Aberdeen's Climate Adaptation Framework.
- Aberdeen 2 - Council Climate Change Plan 2021 - 2025 Towards a Net Zero and Climate Resilient Council.

Bolton Metropolitan Borough Council

- Bolton (1)– Bolton Climate Change Strategy: A Joint Framework for Bolton to Act on the Climate Emergency (2021-2030).

Bristol City Council

- Bristol (1)- Bristol One City Plan: A strategy for a carbon neutral, climate resilient Bristol by 2030.
- Bristol 2 – Bristol One City Climate Strategy: Preliminary Climate Resilience Assessment.
- Bristol 3 – Bristol and the SDGs: A Voluntary Local Review of Progress 2019.
- Bristol 4 – Aligning Bristol's One City Plan with the SDGs.

Bury Metropolitan Council

- Bury (1) – Bury Council Climate Action Strategy 2021
- Bury 2 – Bury Council Climate Action Plan 2021

Cardiff Council

- Cardiff (1) – One Planet Cardiff: Our vision for a Carbon Neutral City by 2030
- Cardiff 2 – One Planet Cardiff: Action Plan September 2021

Doncaster Metropolitan Borough Council

- Doncaster (1) – Environment and Sustainability Strategy 2020-2030

- Doncaster 2 – Environment and Sustainability Strategy 2020-2030: Evidence Base 2020

Dundee City Council
- Dundee (1) – Dundee Climate Action Plan

Eastbourne Borough Council
- Eastbourne (1) – Eastbourne Carbon Neutral 2030: ECN2030 Eastbourne Borough Council Climate Emergency Strategy
- Eastbourne 2 – Eastbourne Carbon Neutral 2030: A Plan for Action

Glasgow City Council
- Glasgow (1) – Glasgow's Climate Plan Our Response to the Climate and Ecological Emergency

Greater London Authority
- Greater London (1) – London Environment Strategy
- Greater London 2 – London Environment Strategy: Implementation Plan
- Greater London 3 – Climate Change Adaptation Indicators: https://data.london.gov.uk/climate-change/

London Borough of Merton
- Merton (1) – Merton Climate Strategy & Action Plan
- Merton 2 – Climate Change Delivery Plan – Year 1
- Merton 3 – London Borough of Merton Climate Action Support June 2020

Manchester City Council
- Manchester (1) - Manchester Climate Change Strategy 2017-50
- Manchester 2 – Manchester City Council Climate Change Action Plan 2020-2025
- Manchester 3 – Manchester Climate Change Strategy 2017-50 Implementation Plan 2017-22

Southampton City Council
- Southampton (1) – Southampton City Council Green City Plan 2030

Wigan Metropolitan Council
- Wigan (1) – Our Adaptation and Resilience Action Plan 2021-2026
- Wigan 2 – Outline Climate Change Strategy: Net Zero Vision 2038