



Local Government Climate Action Key Performance Indicators **Literature Review**

Local Government Climate Action Key Performance Indicators – Literature Review

May 2021

LGMA Research

ISBN: 978-1-9996982-6-3

This document should be cited as:

Clarke, D. (2021) Local Government Climate Action Key Performance Indicators – Literature Review. Dublin: Local Government Management Agency



Acknowledgements

This research was carried out by Dr. Darren Clarke (Dublin City University) on behalf of the County and City Management Association's Climate Action, Transport and Networks Committee. The author would like to particularly thank the members of the Climate Action KPI Working Group who provided ongoing support and valuable feedback during the research:

Robert Burns, Dun Laoghaire Rathdown County Council

Chris Galvin, South Dublin County Council

Dara McGuigan, Limerick City and County Council

Orla Barrett, Carlow County Council

Joe Ferry, Donegal County Council

Alan Dunney, East & Midlands CARO

Breda Maher, East & Midlands CARO

Dr. Bernie O'Donoghue Hynes, LGMA

Dr. Pat Malone, LGMA

About the author

Darren Clarke is an Assistant Professor in the School of History & Geography at Dublin City University (DCU). He holds a PhD from Maynooth University in climate change adaptation. Prior to joining DCU he worked in the public sector as a Researcher with the Local Government Management Agency. In 2020, he co-led the delivery of the first baseline assessment of the local government sector's climate actions in Ireland. He also acted as the lead Irish researcher for an EU Joint Programming Initiative (JPI) Climate funded project between 2014-2017 examining transformative solutions to climate change across four European countries.

Foreword

The CCMA Climate Action, Transport and Networks (CATN) Committee established a Climate Action Key Performance Indicators Working Group and tasked the members with developing a set of sectoral climate action indicators that would facilitate tracking the delivery of actions under the Climate Action Charter. The working group was comprised of representatives from the CCMA CATN Committee, local authority staff working in the delivery of climate actions as well as staff from the East and Midlands CARO and LGMA Research Unit. While much work on identifying a set of indicators had already been undertaken by CARO staff, the group agreed to commission a literature review to ensure an evidence informed methodology was being used to advance the work, a key objective outlined in the LGMA Corporate Plan.

While local authorities have been delivering on a range of actions that are relevant to, and impact upon, climate action for many years, the recent concentrated policy focus was the catalyst for the sector coming together to develop and articulate a single vision and mission for the sector as expressed in the *Delivering Effective Climate Action 2030* strategy report published by the CCMA earlier in 2021. The mission of local government is to "deliver transformative change and measurable climate action" and KPIs are a key mechanism through which change can be measured.

While the literature review presented in this report will assist in the development of KPIs for local government in Ireland, the report is being published in the belief that it could play a role in supporting various other stakeholders internationally, nationally, regionally and locally, who may be involved in developing their own indicators now, or into the future. An extensive amount of national and international literature was reviewed, and key themes were identified that should be considered when developing climate related indicators.

For instance, the distinction between *process* (or policy) and *outcome indicators* is important as the former enable us to monitor whether the relevant infrastructure is put in place to support climate actions. The literature also reminds us that the development of indicators can be an incremental and sometimes iterative process that needs on-going review and updating to ensure the right outcomes and policy actions are being tracked. It reminds us that some indicators will be time limited while others will be in place for the longer term. Using the information extracted from the indicators to assist in communicating and involving stakeholders is highlighted as is the importance of setting targets and using them to hold those responsible for the actions or outcomes accountable.

As noted in our sectoral strategy, climate action impacts upon all elements of local authority operations, and as such, levels of mainstreaming need to be monitored in both the areas of mitigation and adaptation. Overall, the research findings provide a very useful platform from which local government in Ireland can begin the process of developing sectoral indicators while bearing in mind that simplicity, reliability and ease of implementation are the cornerstones that will inform those we select.

Robert Burns
Chair
CCMA Climate Action Key
Performance Indicator Working Group



CCMA Climate Action, Transport and Networks Committee Members 2021

Paddy Mahon, Longford County Council - **Chair**

Peter Carey, Kildare County Council

Joan Martin, Louth County Council

Danny McLoughlin, South Dublin County Council

John Flanagan, Dublin City Council

Brendan O'Donnell, Donegal County Council

Charlie O'Sullivan, Kerry County Council

Carmel Kirby, Clare County Council

Eamonn Hore, Wexford County Council

Tom Shanahan, Offaly County Council

Ruth McNally, Galway City Council

Breege Kilkenny, Wicklow County Council

Robert Burns, Dun Laoghaire Rathdown County Council

Contents

Acknowledgements	3	3.3.4 Summary	18
About the author	3	3.4 Identification of a list of KPIs that may offer some level of transferability or adaptability in an Irish context	19
Foreword	4	3.4.1 Introduction	19
List of Tables	6	3.4.2 Process or outcome indicators	19
Executive Summary	7	3.4.3 Mitigation and adaptation metrics as primary tools used to measure climate actions	19
1 Project Background	8	3.4.4 Alignment of metrics to Irish local government governance	20
1.1 Introduction	8	3.4.5 Summary	28
1.2 Research Objectives	8	4 Summary Findings	29
2 Methodology	9	5 Conclusion	30
3 Results	10	6 References	31
3.1 Document the extensive work that has taken place to date in the area of climate action, including policy developments nationally and internationally	10		
3.1.1 Introduction	10		
3.1.2 International climate action legislation and policies	10	List of Tables	
3.1.3 Ireland climate action legislation and policies	11	Table 3.1: Summary of key international climate action policies/legislation	11
3.1.4 Summary	13	Table 3.2: Summary of key Irish climate action policies/legislation	11
3.2 Identify national and international best practice regarding the development of climate action KPIs	13	Table 3.3: Summary of key Irish climate action policies/legislation with relevance to local government sector	12
3.2.1 Introduction	13	Table 3.4: Proposed climate action key performance indicators for the local government sector	21
3.2.2 Local government climate action performance management	14		
3.2.3 Summary	17		
3.3 Compare the development of climate action KPIs across jurisdictions	17		
3.3.1 Introduction	17		
3.3.2 Comparison of governance structures across jurisdictions	17		
3.3.3 Development of climate action KPIs	18		

Executive Summary

The Irish local government sector is a key public sector body with respect to the State meeting its climate change ambitions of carbon neutrality by 2050. Its broad operational remit in providing over 1,000 services, many of which require climate-proofing, and its close relationship with communities, means that it is a key public sector body if national and EU climate commitments are to be met. In light of various policy and legislative requirements in recent years, the sector has committed to monitoring, evaluating and reporting annually on the implementation of activities contained in the *Local Authority Climate Action Charter*, a key policy agreed between central government and the sector in 2019.

This research supports the sector through i) documenting the work that has taken place to date in the area of climate action, including policy developments nationally and internationally; ii) developing a comprehensive literature review to identify national and international best practice regarding the development of climate action Key Performance Indicators (KPIs); iii) comparing climate action KPIs across jurisdictions; and iv) exploring opportunities for the development of KPIs for the Irish local government sector aligned to KPIs in other jurisdictions.

An extensive literature review integrating both academic publications and a selection of best practices across municipalities considered at the forefront of climate action globally was undertaken in March/April 2021. Results demonstrated a range of best practices in the development and implementation of climate action performance metrics, including ensuring indicators are clear, broad stakeholder support and engagement exists, climate action KPIs are mainstreamed, benchmarking policies and baseline periods are developed and indicators are simple to measure and report on.

Whilst governance structures within the Irish local government sector are highly centralised in comparison to international standards, the

literature typically identified KPIs as aligning to either mitigation or adaptation metrics. A total of 60 outcome KPIs that may offer some level of transferability or adaptability with respect to local authorities' climate change ambitions were identified. This includes 36 mitigation metrics, 10 adaptation metrics and 14 metrics that are considered both mitigation and adaptation KPIs. These indicators relate to climate change mitigation and adaptation across 14 areas, including but not limited to energy, enterprise, environment, flood risk management, greenhouse gas emissions, housing, public engagement and transport.

This research identified several findings that may be useful with respect to KPIs for the local government sector. First, capturing relevant metrics on *process or policy indicators* is an important first step in ensuring appropriate frameworks or policies are in place to begin with so that the sector can understand what initial supports or practices are necessary. Without such a framework, the *outcome indicators* identified herein may prove challenging to measure. Second, where performance metrics are initially developed, simplicity at the outset is essential. However, being equally ambitious in choosing metrics, and in capturing and improving climate action performance, is also important to ensure commitments and targets detailed in national climate change policy are fulfilled. And finally, whilst these indicators represent the most relevant metrics applicable to the sector, it is important to recognise the evolving nature of climate policy at both EU and national levels. Periodic reviews of indicators to ensure they remain relevant, are aligned with international best practice, and are applicable to current policy and local authority operations would therefore prove beneficial.

The findings identified within this report may support the local government sector to deliver on its national climate action commitments and in demonstrating public sector climate action leadership.

1 Project Background

1.1 Introduction

The *Local Authority Climate Action Charter*, which was developed by the Department of Communications, Climate Action & Environment (DCCAE) in consultation with the local government sector commits local authorities to a number of objectives to address the climate challenge and advocate for climate action and behavioural change among citizens.

The *Local Authority Climate Action Charter* is one of the measures included in the government's *Climate Action Plan* (Department of the Environment, Climate and Communications, 2019a), which names local authorities as Lead Partners in 7 Actions and as Key Stakeholders in a further 22.

Action 3(w) of the *Local Authority Climate Action Charter* requires local authorities to monitor, evaluate and report annually on the implementation of activities under the Charter and as such it is incumbent on the sector to identify a range of Key Performance Indicators (KPI) that will measure and track progress of each local authority, and the sector generally, against the objectives of the Charter.

1.2 Research Objectives

In light of local authorities' commitments to monitor, evaluate and report annually on the implementation of activities contained in the *Local Authority Climate Action Charter*, the Local Government Management Agency (LGMA), on behalf of the County and City Management Association (CCMA) Climate Action, Transport and Networks (CATN) Committee subsequently sought a structured and evidenced-informed literature review that:

- **Goal 1:** Documents the extensive work that has taken place to date in the area of climate action, including policy developments nationally and internationally;
- **Goal 2:** Identifies national and international best practice regarding the development of climate action KPIs;
- **Goal 3:** Compares the development of climate action KPIs across jurisdictions;
- **Goal 4:** Identifies a list of KPIs that may offer some level of transferability or adaptability in an Irish context.

It is in this context that this research is being undertaken. The remainder of this report is structured as follows: Section 2 outlines the methodology employed to undertake this research. Section 3 presents the results of the research across the four aforementioned goals. In Section 4, the main findings are summarised. Finally, Section 5 provides brief concluding remarks.

2 Methodology

The approach for undertaking this research was based on a thorough review of four databases (Google Scholar, Web of Science, Academic Search Complete and Scopus). Google Scholar is a full text database, whilst the remaining three are bibliographic (i.e. database records are generated as searchable proxies of complete articles). These datasets represent some of the most widely used in academic research.

To standardise search results, retrievals for database searches were limited to keyword searches containing "climate change" AND "performance indicators or performance metrics" AND "local government or city or municipal" (i.e. as exact word phrases) in all databases. As is common practice for topical searches, using the exact word phrase standardised the search in all databases and eliminated researcher bias and search system capabilities as confounding factors (Linder *et al.*, 2015). Database searches returned the following publications relevant to the keyword searches:

- Google Scholar (N=216)
- Web of Science (N=32)
- Academic Search Complete (N=26)
- Scopus (N=12)

The resultant database searches were conducted in March 2021 and were not time-period specific i.e. publications across all years were considered for inclusion. Duplicate publications across all databases were cross-checked and removed. A screening of each publication title, key words and abstract was then used to determine its suitability for further consideration in this study. Other secondary sources were subsequently consulted to support results returned within academic databases, including multiple websites of local governments across international jurisdictions and other relevant websites which provide evidence and examples of climate change performance indicators or metrics across local government. An overview of relevant resources utilised to develop appropriate metrics can be found in Table 3.4.

3 Results

The results presented in Sections 3.1-3.4 align to the four deliverable goals identified in Section 1.2.

3.1 Document the extensive work that has taken place to date in the area of climate action, including policy developments nationally and internationally

3.1.1 Introduction

Climate action can be broadly defined into two distinct categories. First, there is a need to prevent further climate change from occurring, i.e. mitigation. And second, given current and future climate change impacts, societies need to adjust to anticipated and actual changes in the climate i.e. adaptation (Intergovernmental Panel on Climate Change, 2015). Adaptation and mitigation are interconnected however (*ibid*), whereby climate change adaptation can also provide mitigation benefits, and vice versa. It is in this context that the remainder of this section advances the current state of mitigation and adaptation actions and policies that broadly apply at EU, national and sub-national scales and their relevance to Irish public sector bodies including local government.

3.1.2 International climate action legislation and policies

The United Nations Framework Convention on Climate Change (UNFCCC) adoption of the Paris Agreement in 2015 set a historic precedence for countries in limiting rising greenhouse gas emissions to keep global warming well below 2°C of pre-industrial levels, with aims to limit temperature increases to 1.5°C (Intergovernmental Panel on Climate Change, 2018). Since this agreement, global efforts to subsequently meet these commitments have advanced, particularly relating to developing appropriate policies that will ensure such targets are met. Given the policy challenges that exist

to transform societies and entire economies, a global response that is locally relevant is now being advocated for (European Commission, 2020b).

In this context, the European Union (EU) has set out an ambitious policy framework for how it proposes to meet its commitments as part of the Paris Agreement. Specifically, all EU countries have endorsed the objective of achieving climate neutrality by 2050, in accordance with the Paris Agreement (European Council, 2020).

Prior to the signing of the Paris Agreement in 2015, the EU's first package of climate and energy measures was agreed in 2008 and set performance targets for 2020 (European Council, 2020). These included:

1. Reducing greenhouse gas emissions by 20% compared to 1990 emissions (20% reduction relative to 2005 emissions for Ireland)
2. Increasing the share of renewable energy to 20%
3. Achieving a 20% improvement in energy efficiency

Whilst the EU as a bloc is on course to reduce greenhouse gas emissions by more than 24% by year-end 2020 (European Commission, 2020a), some member States, including Ireland, are likely to fail to meet greenhouse gas emissions reductions of 20% as specified in EU legislation (European Council, 2009).

In 2014, the EU's 2030 climate and energy framework agreed more ambitious targets for the period 2021-2030. Under these targets, the EU committed to reducing its greenhouse gas emissions by at least 40% by 2030, compared to 1990. The framework contained policies and goals for member States to adopt monitoring and reporting rules related to greenhouse gas emissions, and required member States to develop national climate and energy plans and long-term strategies (European Council, 2020).

However, in light of commitments to limit global warming to 1.5°C under the Paris Agreement in 2015, a new European Green Deal and a European Climate Law are being advanced which commits the EU to a more ambitious binding target of a reduction of at least 55% in greenhouse gas emissions by 2030 compared to 1990 levels and to climate-neutrality by 2050 (European Commission, 2020c). Table 3.1 provides an overview of relevant international climate legislation and policies.

Table 3.1: Summary of key international climate action policies/legislation

Key policies/ legislation	<ul style="list-style-type: none"> • UNFCCC Paris Agreement • European Green Deal • European Climate Law
--------------------------------------	--

3.1.3 Ireland climate action legislation and policies

One of the most significant developments in recent years at a national level was the initial development of legislation in 2015 for Ireland's first *Climate Action and Low Carbon Development Act 2015*. This legislation subsequently set the basis for more recent legislative and policy developments.

Recognising the need to strengthen the *Climate Action and Low Carbon Development Act 2015* to ensure State commitments towards carbon neutrality by 2050 were met, revisions to the Act were subsequently approved by Government in March 2021. The revised Bill, the *Climate Action and Low Carbon Development (Amendment) Bill 2021*, has been informed by, and strongly aligns with recommendations contained in the *Report of the Citizens' Assembly on How the State Can Make Ireland a Leader in Tackling Climate Change* and the *Oireachtas Joint Committee on Climate Action Report 2019* (Citizen's Assembly, 2018; Houses of the Oireachtas, 2019).

The *Climate Action and Low Carbon Development (Amendment) Bill 2021* now places a greater onus and accountability on all sectors, including public sector bodies, to achieve carbon-neutrality by 2050. If such legislation is passed by the Houses of the Oireachtas as is

expected, it will include carbon budgets with a provision for setting sectoral targets to ensure the State is on a pathway to carbon-neutrality by 2050 (Government of Ireland, 2021).

Specifically, the *Climate Action and Low Carbon Development (Amendment) Bill 2021* commits the State to achieve a reduction in greenhouse gas emissions of 51% relative to 2018 levels by 2030 and to ensure carbon-neutrality by 2050 (Department of the Environment, Climate and Communications, 2021b). Table 3.2 summarises relevant recent Irish climate legislation and policies aligned to this study.

Table 3.2: Summary of key Irish climate action policies/legislation

Key policies/ legislation	<ul style="list-style-type: none"> • Climate Action and Low Carbon Development Act 2015 • Climate Action and Low Carbon Development (Amendment) Bill 2021 • Citizens' Assembly on How the State Can Make Ireland a Leader in Tackling Climate Change • Oireachtas Joint Committee on Climate Action Report 2019 • Climate Action Plan
--------------------------------------	---

3.1.3.1 Public Sector Climate Action and Policies

Climate action is a public service. Public bodies which are engaged and empowered can not only reduce their own emissions, but can also support a societal-wide transition to mitigate and adapt to climate change. Notwithstanding that public sector buildings accounted for only 1.5% of Ireland's greenhouse gas emissions in 2017 (Department of the Environment, Climate and Communications, 2019a), the *Climate Action Plan* published in 2019 places increased onus on public bodies to not only shape and deliver national climate policies but to also demonstrate best practice in taking climate action to lead a wider societal transition (Department of the Environment, Climate and Communications, 2019a). Responsibilities on public sector bodies are likely to increase in the coming decades as

work towards the most ambitious climate action commitments ever attempted by the State begins.

Whilst all public sector bodies are responsible for ensuring climate actions are embedded in day-to-day operational and strategic plans, the local government sector is likely to play a decisive role if national carbon-neutrality climate change commitments are to be achieved by 2050. Specifically, the sector's broad operational remit means that it provides more than 1,000 services (County and City Management Association, 2021), many of which will now require climate-proofing to ensure national and EU climate commitments are met.

Moreover, the *Climate Action Plan* recognised the unique position of local authorities if national climate ambitions are to be achieved given local authorities' close relationships with communities and their ability to mobilise resources efficiently (Department of the Environment, Climate and Communications, 2019a). In response to this, the local authority sector has developed a *Local Authority Climate Action Charter*, in which they commit to 23 separate climate actions over the coming decade. The actions include energy use, public procurement and transportation, in addition to ongoing national and citizen engagement on climate change to facilitate climate actions at local levels (Department of the Environment, Climate and Communications, 2019b).

Alongside efforts to mitigate climate change and achieve carbon-neutrality by 2050, adapting to climate change impacts caused by past and current greenhouse gas emissions will affect all aspects of the economy and society. In this context, the *National Adaptation Framework* developed under the *Climate Action and Low Carbon Development Act 2015*, required seven government departments which have responsibility for priority sectors impacted by climate change to prepare sectoral adaptation plans (Department of the Environment, Climate and Communications, 2021a). Within this, local authorities were recognised as playing a critical

role in managing climate risks and vulnerabilities and identifying adaptation actions to build resilience locally. Under the *National Adaptation Framework* each local authority subsequently developed its own climate adaptation strategy in 2019. Subject to approval of the *Climate Action and Low Carbon Development (Amendment) Bill 2021* by the Houses of the Oireachtas, local authorities are now expected to develop five-year *Climate Action Plans*, to include both mitigation and adaptation measures.

In advance of this, in 2020 the local government sector published the first known baseline assessment of climate actions of a public sector body in Ireland. This provided a broad overview of climate actions, including both mitigation and adaptation, occurring across the local government sector between 2011-2018 (Clarke and O'Donoghue-Hynes, 2020). However, as an initial assessment of baseline sectoral climate actions, its ability to capture relevant and reliable climate action performance indicators that could be measured over time was somewhat limited. Table 3.3 provides an overview of relevant recent climate legislation and policies applicable to the local government sector.

Table 3.3: Summary of key Irish climate action policies/legislation with relevance to local government sector

Key policies/ legislation	<ul style="list-style-type: none">• Climate Action and Low Carbon Development Act 2015• Climate Action and Low Carbon Development (Amendment) Bill 2021• Climate Action Plan• Local Authority Climate Action Charter• National Adaptation Framework
------------------------------	--

3.1.4 Summary

The requirements for public sector bodies to lead by example in the *Climate Action Plan*, and a commitment by local authorities to monitor, evaluate and report annually on the implementation of activities contained in the *Local Authority Climate Action Charter*, means that there is a need to measure, demonstrate and improve climate action performance to support national climate ambitions to 2050. It is in this context that this research is being advanced. Specifically, the aim of this literature review is to identify appropriate climate action performance indicators that could support the local government sector such that it can monitor, evaluate and report annually on its climate action activities. This also aligns to proposals contained within the *Climate Action and Low Carbon Development (Amendment) Bill 2021*.

3.2 Identify national and international best practice regarding the development of climate action KPIs

3.2.1 Introduction

Identifying good practice in measuring performance is an important aspect of any performance management system. However, defining good or best practice for climate actions in particular remains challenging because, although many cities or municipalities claim to be climate leaders with examples of successful actions (Castán Broto and Bulkeley, 2013), local contextual differences among cities or municipalities prevent classification of consistent themes across jurisdictions (Boehnke et al., 2019). Additionally, those climate actions implemented may be chosen based on relative ease and timeframe of implementation rather than their ability to produce effective results (Corfee-Morlot et al., 2009). Moreover, a challenge for policymakers to redirect their focus towards implementing specific programmes as opposed to creating municipal-level strategic plans means that there is often no direct link between drafting a *Climate Action Plan* and actual improvements in climate action performance (Castán Broto and Bulkeley, 2013). This is a challenge which local authorities are also likely to face given their different sizes and their diverse environmental, economic, and social characteristics.

To demonstrate good practice in climate action performance, monitoring must be regularly completed to highlight the effects of the implementation of projects and action plans. However, regular project-or-municipal-level data is rarely available, even from major cities considered frontrunners of climate action (Boehnke et al., 2019). Equally, due to complexity and inconsistent definitions often used in climate action metrics, variations in collecting, measuring and reporting can differ greatly both between and within municipalities. Different stakeholders might have different understandings of the meaning of metrics, and attach different relevance to them or the themes indicators belong to (Boehnke et al., 2019). This

may also be related to municipalities often being involved in the management of different sets of issues at local levels, including many that are not even under their direct responsibility. Moreover, given the relatively recent attention paid to climate action there are problems with data availability or measurement without interruption (Boehnke et al., 2019). It is in this context that Section 3.2.2 identifies areas of best practice in developing climate action performance metrics/indicators for the local government sector.

3.2.2 Local government climate action performance management

3.2.2.1 Goal Clarity

The inclusion of a performance component to climate change planning necessitates setting of targets and the development of indicators to ensure clarity of goals. Performance management principles highlight the importance of goal clarity as crucial in informing decisions, monitoring progress and identifying opportunities for quality and efficiency improvements (Ammons and Roenigk, 2015; Jones, 2019; Park and Krause, 2021).

If climate change mitigation and adaptation are to be effective at local government levels, setting clear goals is crucial i.e. actions being measured should be clear and unambiguous to ensure results can be effectively interpreted and compared across jurisdictions and over time (Dupuis and Biesbroek, 2013; Jones, 2019).

There is considerable evidence to suggest that for climate change performance metrics to be effective, and to provide accountability, there is a need to ensure indicators developed are of good quality such that they serve a strategic purpose (Moynihan, 2009; Park and Krause, 2021). For climate change mitigation this is especially important given that local government is required to demonstrate connections between climate change policies and reduced greenhouse gas emissions (Kennedy, Demoullin and Mohareb, 2012). However, where local government climate action indicators are concerned, conceptual challenges in defining what and how to measure actions often tends to lead to vague indicators or avoidance of measurement

elements entirely (Dupuis and Biesbroek, 2013). Evidence subsequently suggests that to ensure effectiveness, indicators should be (1) easily measurable or quantifiable, (2) reliable, (3) valid and (4) relevant to organisational climate change targets (Park and Krause, 2021).

Municipalities that are involved in existing international climate action measurement activities (e.g. ICLEI Local Governments for Sustainability; C40 Cities Climate Leadership Group) may be more likely to keep up-to-date with emerging developments related to developing and implementing measurable climate metrics (Jones, 2019). This is an important point given that measuring climate actions is likely to remain a necessity for the local government sector in the medium-long term. Notably, only one Irish local authority (Cork City Council) is a member of the ICLEI network and no Irish local authorities are members of the C40 Cities programme at present (C40 Cities, 2021; ICLEI, 2021).

3.2.2.2 Mainstreaming

Organisational support systems, including qualified employees and robust and integrated IT infrastructure, play an essential role in ensuring functional sustainability performance systems (Niemann and Hoppe, 2018; Park and Krause, 2021). Where genuine commitment to mainstreaming metrics into management processes is achieved, it can effectively be used to support policy implementation, accountability, transparency and public trust (Rauken, Mydske and Winsvold, 2015; Jones, 2019). Indeed, leading global municipalities measuring climate performance have developed integrated management systems, ensuring mainstreaming and policy co-ordination across functional areas (City of Copenhagen, 2012; City of Stockholm, 2014). Conversely, lack of integration of climate actions across all municipal operations has consistently been identified as a barrier to effective climate action in Dutch cities (den Exter, Lenhart and Kern, 2015).

Notwithstanding differences in local government governance structures, which determines the extent of control municipalities have over developing climate actions and subsequent

KPIs, the need to mainstream climate goals across all municipal operations and assign clear lines of responsibility is widely recognised for climate change metrics (Zeemering, 2018; Jones, 2019; Evans, 2020; Park and Krause, 2021). Specifically, research highlights the importance of connections to climate objectives across all guiding policy documents within a municipality (Bouckaert and Halligan, 2007; Jones, 2019). Regularly reflecting on performance metrics can ensure climate change is embedded as a core strategic policy within the local government sector (Zeemering, 2018), and can also provide important opportunities to ensure such local government climate metrics are aligned with rapidly evolving national and international climate policies and legislation. Evidence suggests that to ensure effectiveness, climate performance information should be used where necessary to upgrade systems and to adjust policy responses (Bouckaert and Halligan, 2007; Park and Krause, 2021).

Performance information also has a key role in motivating employees and in providing opportunities to learn and to improve their performance through examining different ways of undertaking their role. In the context of mainstreaming climate actions however, evidence suggests the need to carefully balance gathering excessive amounts of data with employee perceptions that the process is unnecessarily burdensome or that it significantly increases workloads (Park and Krause, 2021). This is especially important in an Irish local government context given that over 29,000 individuals are employed in the sector (National Oversight and Audit Commission, 2020), and the requirement to ensure buy-in of all employees across all functional areas if mainstreaming is to be effective.

Finally, ensuring that reporting of climate-related performance data at local authority levels are actively promoted as standalone publications and results are not aggregated within annual reports can demonstrate institutional support, thereby increasing accountability, transparency and public trust and support for climate measures (Niemann and Hoppe, 2018; Jones, 2019).

3.2.2.3 Stakeholder Support and Engagement

Research has highlighted concerns over 'reporting fatigue,' leading to discontinuation or radical altering of sustainability reporting practices, or difficulties maintaining public interest over time (Niemann and Hoppe, 2018). Moreover, whilst climate change indicators are typically developed to provide policy directions, their overuse and complexity can make them unattractive for practical use by public officials and policymakers (Boehnke et al., 2019).

Communication to target audiences is also a crucial component in developing climate action metrics. This includes internal stakeholders in local government (e.g. experts, policy officers, practitioners, elected officials) and external stakeholders (e.g. general public, industry partners, other governmental departments). For indicators to be effective in raising public awareness about climate change and to inspire behavioural changes, collective action and value shifts, or to create new debates, utilising discussion forums involving a wide range of stakeholders is essential (Zeemering, 2018; Boehnke et al., 2019). Research shows that effective practices in local climate action are more likely to succeed where municipalities act as facilitators, enabling other actors within municipal boundaries to implement climate actions. This includes public engagement, citizen-led co-operatives, municipal actor engagement, industry partnerships and project creation (Boehnke et al., 2019; Evans, 2020).

Moreover, the importance of citizens being kept informed of local authorities' climate performance and how these are making a difference should not be underestimated (Park and Krause, 2021), especially given the need for local authorities in Ireland to support community capacity building and promote citizen engagement with respect to climate actions and policies. Partnering with citizens, NGOs and businesses in the design, monitoring and updating of climate action performance indicators to ensure buy-in, accountability and trust from the outset is therefore crucial (Palermo and Hernandez, 2020).

3.2.2.4 Benchmarking and Baseline Periods

Benchmarking is a common feature that is utilised in performance management, and compares an organisation's performance to that of a similar organisation. Research shows that jurisdictions with benchmarking policies typically deliver significant decreases in greenhouse gas emissions. For example, buildings in San Francisco subject to specific benchmarking and energy audit requirements reduced emissions by 17% (C40 Cities, 2015).

Care must be taken in comparing performance across local authority functional areas however given competing policy priorities of different local authorities more generally (National Oversight and Audit Commission, 2020). Whilst there may be differences or factors beyond the organisation's control that may skew comparisons between organisations it can still help municipalities and elected officials understand issues and the degree to which they are being addressed. Consequently, benchmarking of climate change performance metrics across local authorities offers a useful means of comparison, especially given that all local authorities are likely to be required to meet similar climate change performance targets in the future (Evans, 2020). Benchmarking with similar local authorities can therefore identify successes and challenges and the management or service delivery methods used (Sezginalp, 2016). More importantly it offers a means for sectoral best practices to be identified and embedded at an individual local authority level and to be extended at a sectoral level.

The way in which a target is defined is also an important consideration. For instance, the temporal scope of any target, i.e. whether it is a long-term or short-term goal and whether it requires annual reductions or reductions in a single future target year, ultimately determine how municipalities will work to achieve it (Damsø, Kjær and Christensen, 2017).

C40, a network of global megacities, has published a number of good practice guidelines for climate actions. However, implementation of these guides may require far greater capacities, political support, and budgets than are available to smaller municipalities (Boehnke et al., 2019).

Similarly, the Covenant of Mayors (CoM) has developed several "Benchmark[s] of Excellence". Despite this however, these are not a codification of good practice as they provide no guide to implementation or budgets required. Moreover, monitoring whether climate actions have actually been undertaken is difficult as they contain a statement that an action has been undertaken without significant further explanation (Boehnke et al., 2019).

Baselines are also required as a starting point for measuring performance, against which future performance is assessed. Historical performance is typically used as the starting baseline. Where no historical data exists, performance estimates can be determined. However, determining baselines should be a reflective process, and should not be arbitrarily set. Specifically, evidence suggests that a baseline period should be set to align with the intended outcome so it can provide insight on whether performance was successful or not (Sezginalp, 2016). This is especially important where climate action performance metrics are concerned given the evolving nature of climate change (City of Vancouver, 2020), and national and international climate change targets.

3.2.2.5 Simplicity

Evidence highlights the need for simplicity where performance measures are concerned. If too many metrics are developed that demand significant human and financial resources, it is likely to result in ineffective performance management (Sezginalp, 2016).

Equally, measures should be clear and concise and allow for universal measurability across organisations. Clear definitions of measures and data will ensure that staff, managers, elected officials and citizens are able to understand and use the information appropriately. Moreover, evidence suggests that performance measurement information should be developed to serve multiple audiences (Sezginalp, 2016), and should be devoid of technical jargon where possible.

3.2.3 Summary

All performance management systems require development of robust metrics - climate change metrics are no exception. Specifically, Section 3.2.2 highlighted that where climate change performance management is concerned the need for clear climate metrics, mainstreaming climate performance indicators across all aspects of an organisation, ensuring that metrics are used to encourage broad stakeholder engagement, developing appropriate benchmarks and baseline periods, and ensuring any metrics developed are simple, reliable and relatively easy to capture are crucial.

3.3 Compare the development of climate action KPIs across jurisdictions

3.3.1 Introduction

The development of climate action KPIs across international jurisdictions is not a uniform process. Governance structures and competing political, environmental, economic and social priorities often differ significantly, not just at a national level but also at sub-national levels e.g. regions/municipalities. Specifically, where KPIs are developed to measure progress across these priorities, they are often context-specific to the jurisdiction in which they were developed.

Equally, whilst EU legislation requires EU member States to achieve reductions in greenhouse gas emissions, member States often have autonomy over how they will achieve such targets aligned to their own unique governance structures and competing political, environmental, economic and social priorities. This section subsequently highlights the relevance of governance structures to the development of climate action KPIs based on international literature and then identifies the primary ways climate actions are categorised by leading global municipalities in developing climate action KPIs.

3.3.2 Comparison of governance structures across jurisdictions

Local authority governance structures differ significantly internationally. Governance in Ireland is characterised by a high degree of centralisation by international standards (Kitchin *et al.*, 2012; Callanan and Tatham, 2014). For instance, in addition to the functions that local authorities in Ireland have responsibility for (building and planning regulations; business rates; social housing; parking; waste collection; environmental health; economic development; sports centres, parks and playing fields), the UK local government sector has additional responsibility for education and certain public health and social services (Evans, 2020). Each of these areas is likely to be directly or indirectly impacted by climate change. Similarly, Danish

municipalities have extended powers related to pre-school childcare, eldercare and special needs care, certain healthcare, unemployment and illness, retirement benefits and utilities in addition to the key services provided by their Irish counterparts (Ministry for Economic Affairs and the Interior, 2014).

A review of the literature related to climate action KPIs for this study consequently found that municipalities in other jurisdictions typically had greater control of and responsibility for the development of climate mitigation and adaptation targets than is available for the Irish local government sector. It is therefore important to note that evidence of international practices in developing climate action KPIs might not align with Irish local government governance structures. Findings in this report are therefore considered relevant in the context of Irish local authority governance structures and those functions and responsibilities which apply to the sector.

3.3.3 Development of climate action KPIs

Broadly speaking, both the academic literature and global municipality best practices with respect to climate KPIs align to either **mitigation** or **adaptation** metrics. In the context of mitigation actions, an important recurring theme with respect to those municipalities considered at the forefront of global climate action is the framing of their *Climate Action Plans* around a single guiding KPI i.e. *reducing greenhouse gas emissions by a certain percentage by a certain future date* e.g. 0% carbon emissions by 2050 (City of Copenhagen, 2012; City of Amsterdam, 2020; City of Vancouver, 2020; City of Sydney, 2021). It is on the basis of this single climate action KPI that these municipalities subsequently develop *Climate Action Plans* with measurable indicators across all operational areas to assess annual performance against this mitigation target. This process ultimately demands that a full greenhouse gas emissions baseline inventory of each municipal operational area is undertaken. Steps can then be taken to mainstream climate action into decision-making process and annual performance towards the

single guiding KPI can be tracked.

Whilst this approach offers a useful means of classifying actions for the purpose of mitigation metrics, given the nature of both mitigation and adaptation, a metric can often be considered as both mitigation and adaptation e.g. increased tree canopy cover can absorb CO₂ from the atmosphere (mitigation) and can also provide shade during heatwaves or absorb excess rainfall during flood events (adaptation). For this reason, a clear distinction between metrics measuring mitigation or adaptation is not always evident.

3.3.4 Summary

Municipalities in other jurisdictions typically have greater control over the development of climate mitigation and adaptation planning and targets than is available to the Irish local government sector. Regardless of governance structures however, KPIs across jurisdictions typically align to either mitigation or adaptation metrics. Given the pervasive need to mitigate climate change, an important recurring theme with respect to climate action KPIs developed by those municipalities considered at the forefront of global climate action is the framing of their *Climate Action Plans* around a reduction in greenhouse gas emissions within a certain timeframe. However, climate change impacts all aspects of local government operations in Ireland across both mitigation and adaptation planning, including building and planning regulations, social housing, transportation, waste, environmental health, economic development and recreational facilities. Delivering on ambitions to measure and improve climate performance therefore requires that mitigation and adaptation metrics are mainstreamed into decision-making across all organisational functional areas.

3.4 Identification of a list of KPIs that may offer some level of transferability or adaptability in an Irish context

3.4.1 Introduction

The use of performance metrics to measure climate actions is a relatively recent concept within the climate change literature. Whilst many studies have focused on developing broader sustainability indicators related to social, environmental and economic performance indicators (see for example Li, Gu and Liu, 2018; Chao et al., 2020), few have explicitly examined performance indicators solely related to climate change. Unsurprisingly, even fewer studies exist which examine or compare metrics for climate actions across public sector bodies or at smaller scales such as local government. Consequently, this section draws on both academic literature and on practical *Climate Action Plans* and other online resources focused on climate change across municipalities globally. Both of these resources have been used to support identification of climate action KPIs that may be suitable in an Irish context.

3.4.2 Process or outcome indicators

With regard to performance, it is important to distinguish between *process or policy indicators* and *outcome indicators*. *Process or policy indicators* relate to tangible policy measures and supporting infrastructure that contribute to the delivery of climate actions. For instance, this includes indicators that examine whether governments have developed or implemented certain favoured policies, plans, budgets, projects or programme. *Process or policy indicators* typically use binary scales, e.g. assessing whether a certain formal policy is present or absent.

Conversely, *outcome indicators* are typically developed to quantify performance of a particular outcome (e.g. quantifying air quality improvements/greenhouse gas emissions reductions), and to enable governments to

subsequently make investment decisions accordingly (Niemann, Hoppe and Coenen, 2017). Research has highlighted the need for both robust *process or policy indicators* and *outcome indicators* where environmental indicators are concerned, with *process or policy indicators* providing the supporting framework to ensure measurement of *outcome indicators* can be realised (Boehnke et al., 2019).

Clarke and O'Donoghue-Hynes (2020) utilised both *process or policy indicators* (e.g. using binary Yes/No responses), and *outcome indicators* (e.g. using quantitative metrics) in their initial assessment of local government climate actions in Ireland. However, KPIs in their study were heavily weighted towards *process or policy indicators* given that it represented an initial sectoral baseline assessment of climate actions. Following extensive baseline research by Clarke and O'Donoghue-Hynes (2020) on *process or policy indicators*, the present review of KPIs has focused solely on identifying *outcome indicators*. It should be noted however that initially identifying and measuring *process or policy indicators* is an essential aspect of developing and assessing the performance of any *outcome indicator*. For this purpose, it is assumed that all *outcome indicators* identified in Section 3.4.4 are first based on the sector ensuring that appropriate processes or policies are in place across all local authorities i.e. that a *process or policy indicator* is first identified to determine if all local authorities can actually measure proposed *outcome indicators*.

3.4.3 Mitigation and adaptation metrics as primary tools used to measure climate actions

In line with climate actions being considered either mitigation or adaptation, KPIs have been classified within these two parameters. As noted in Section 3.3.3 certain KPIs can be considered as both mitigation and adaptation and in such instances fulfil a dual metric. Where a KPI is both a mitigation or an adaptation action it is explicitly categorised as such (Table 3.4).

3.4.4 Alignment of metrics to Irish local government governance

Local government governance structures in Ireland are distinctly different to those elsewhere as noted in Section 3.3.2. Consequently, whilst other municipalities may have developed and measured additional or different KPIs, Table 3.4 identifies those indicators that may offer some level of transferability or adaptability in an Irish context based on the governance structures and the key areas which Irish local authorities have responsibility for with respect to climate change. In certain instances, KPIs have been modified from the originally identified metric to align more closely to the Irish local government sector. It is important to note that whilst each KPI has been assigned to only one sub-category or theme in Table 3.4, given the nature of local authority operations each KPI could align to multiple subcategories. The 14 subcategories identified include:

1. Climate justice
2. Energy
3. Enterprise
4. Environment
5. Finance
6. Flood risk management
7. Greenhouse gas emissions
8. Housing
9. Planning
10. Pollution/Waste
11. Public engagement
12. Transportation
13. Water resources
14. Other

A review of the literature subsequently identified 60 climate action KPIs: 36 KPIs related to mitigation, 10 adaptation KPIs and 14 combined mitigation/adaptation KPIs that may offer some level of transferability or adaptability in an Irish context (Table 3.4).

Table 3.4 also provides details of the proposed unit of measurement for each KPI. All indicators relate to annual data unless otherwise stated. Proposed measurements have been classified depending on the metric i.e. %, numeric value, kilometres, metric tonnes, litres/per annum. Indicators have been further categorised based on the estimated timeline for implementation of an indicator (short-term; <1 year, medium-term; 1-3 years and long-term; 3+ years). Finally, details of academic and municipal information sources from which these indicators were derived are also detailed.

Table 3.4: Potential climate action key performance indicators for the local government sector

KPI number	Climate Action Type	Sub Category	KPI	KPI Unit	Timeframe ¹	Academic Information Sources	Municipal Information Sources
1	Adaptation	Environment	Percentage change in fertiliser use by council annually	%	M		(Dorset Council, 2020)
2	Adaptation	Environment	Proportion of bodies of water that meet environmental quality standards for ecological status	%	M		(City of Stockholm, 2016)
3	Adaptation	Environment	Proportion of beaches with water quality in each of the following categories 'excellent', 'good', 'sufficient'	%	S	(Clarke and O'Donoghue-Hynes, 2020)	(City of Stockholm, 2016)
4	Adaptation	Environment	Proportion of citizens with access to public green space/park within x kilometres	%	M		(City of Stockholm, 2016)
5	Adaptation	Flood risk management	Percentage of storms where at least one property is flooded	%	M		(C40 Cities, 2019)
6	Adaptation	Flood risk management	Percentage of properties in local authority which are within each of the following areas: 1 in 10 year, 1 in 50 year, 1 in 100 year, 1 in 200 year flood risk zone	%	M		(C40 Cities, 2019)
7	Adaptation	Flood risk management	Financial investment in flood protection measures in local authority annually	%	M		(C40 Cities, 2019)
8	Adaptation	Flood risk management	Volume of water retention capacity created through sustainable urban drainage systems (SUDS) in m ³	Numeric value	L		(C40 Cities, 2019)
9	Adaptation	Water resources	Number of public drinking fountains installed by local authority annually	Numeric value	L	(Csete and Buzasi, 2016)	(C40 Cities, 2019)
10	Adaptation	Public engagement	Number of local authority climate trainings/community events delivered promoting capacity building to adapt to increased climate risks across all major risks (floods, storms, heatwaves, droughts and wildfires)	Numeric value	M		(C40 Cities, 2019)

¹ Short term (S) <1 year; Medium term (M) 1-3 years; Long term (L) 3+ years

KPI number	Climate Action Type	Sub Category	KPI	KPI Unit	Timeframe ¹	Academic Information Sources	Municipal Information Sources
11	Mitigation	Pollution/Waste	Bulky household items recycled at local authority civic amenity sites/bring centres (tonnes)	Metric tonnes	M		(City of Stockholm, 2016)
12	Mitigation	Pollution/Waste	Hazardous waste recycled at local authority civic amenity sites/bring centres (tonnes)	Metric tonnes	M		(City of Stockholm, 2016)
13	Mitigation	Pollution/Waste	Percentage reduction in solid municipal waste in local authority municipal buildings annually	%	M	(Zhou, 2013; Azizalrahman and Hasyimi, 2018; Li, Gu and Liu, 2018; Boyle <i>et al.</i> , 2019; Alrashed, 2020)	(City of Copenhagen, 2012; City of Stockholm, 2016; Evans, 2020; City of Sydney, 2021)
14	Mitigation	Pollution/Waste	Percentage of municipal waste recycled from local authority municipal buildings annually	%	M	(Zhou, 2013; Azizalrahman and Hasyimi, 2018; Li, Gu and Liu, 2018; Boyle <i>et al.</i> , 2019; Alrashed, 2020; Friends of the Earth, 2021)	(City of Copenhagen, 2012; Evans, 2020)
15	Mitigation	Pollution/Waste	Percentage recovery of construction and demolition (C&D) waste generated from local authority operations	%	S		(City of Sydney, 2021)
16	Mitigation	Pollution/Waste	Percentage recovery of waste from municipal parks/streets/public spaces	%	M		(City of Sydney, 2021)
17	Mitigation	Pollution/Waste	Electrical waste recycled at local authority civic amenity sites/bring centres (tonnes)	Metric tonnes	M		(City of Stockholm, 2016)
18	Mitigation	Pollution/Waste	Green waste (trees, shrubs, branches) recycled at local authority civic amenity sites/bring centres (tonnes)	Metric tonnes	M		(City of Stockholm, 2016)

KPI number	Climate Action Type	Sub Category	KPI	KPI Unit	Timeframe ¹	Academic Information Sources	Municipal Information Sources
19	Mitigation	Energy	Proportion of local authority energy self-sufficiency based on renewable energies use	%	L	(Allman, Fleming and Wallace, 2004; Zhou, 2013; Azizalrahman and Hasyimi, 2018; Kilkiş, 2018; Li, Gu and Liu, 2018; Boehnke et al., 2019; Al Dakheel et al., 2020; Alrashed, 2020; Chao et al., 2020; Friends of the Earth, 2021)	(City of Copenhagen, 2012; City of Stockholm, 2016; Ajuntament de Barcelona, 2020; City of Amsterdam, 2020; Dorset Council, 2020; City of Sydney, 2021)
20	Mitigation	Energy	Cumulative percentage energy savings achieved by year-end relative to baseline year	%	S	(Azizalrahman and Hasyimi, 2018; Department of the Environment, Climate and Communications, 2019a; Al Dakheel et al., 2020; Chao et al., 2020; Clarke and O'Donoghue-Hynes, 2020; Friends of the Earth, 2021)	(City of Copenhagen, 2012; City of Stockholm, 2016)
21	Mitigation	Energy	Proportion of local authority municipal buildings with a Building Energy Rating (BER) 'B' rating	%	S	(Department of the Environment, Climate and Communications, 2019a; Chao et al., 2020)	(City of Copenhagen, 2012; City of Amsterdam, 2020)
22	Mitigation	Energy	Proportion of public lighting using LED lighting	%	S	(Csete and Buzasi, 2016; Kilkiş, 2018; Boehnke et al., 2019; Alrashed, 2020; Friends of the Earth, 2021)	(City of Copenhagen, 2012)
23	Mitigation	Energy	Percentage in energy cost (€) savings annually (from baseline year)	%	S	(Alrashed, 2020)	(City of Copenhagen, 2012)
24	Mitigation	Energy	Percentage of local authority municipal buildings with temperature control systems installed	%	S	(Alrashed, 2020)	
25	Mitigation	Housing	Proportion of local authority social housing stock with a Building Energy Rating (BER) 'B2' rating	%	S	(Department of the Environment, Climate and Communications, 2019a; Chao et al., 2020)	(Ajuntament de Barcelona, 2020; City of Amsterdam, 2020; City of Vancouver, 2020)

KPI number	Climate Action Type	Sub Category	KPI	KPI Unit	Timeframe ¹	Academic Information Sources	Municipal Information Sources
26	Mitigation	Housing	Proportion of local authority housing stock with a BER rating across each BER category: A,B,C,D,E,F	%	L	(Department of the Environment, Climate and Communications, 2019a; Clarke and O'Donoghue-Hynes, 2020; Friends of the Earth, 2021)	
27	Mitigation	Environment	Number of days/ Percentage change in number of days annually air quality levels exceeded EU air quality regulations for each of the following: Ozone, Nitrogen dioxide, Sulphur dioxide, PM ^{2.5} particles and PM ¹⁰ particles for monitoring stations in local authority	Numeric value	M	(Institute for Urban Strategies, 2018)	(City of Stockholm, 2016; City of Vancouver, 2020)
28	Mitigation	Environment	Estimated CO ² removal from/ addition to atmosphere through net trees planted/ removed	Metric tonnes	M		(C40 Cities, 2019)
29	Mitigation	Greenhouse gas emissions	Annual greenhouse gas emissions in carbon dioxide (CO ²) equivalent, including Scope 1, 2 and 3 emissions	Metric tonnes	M	(Pearce and Cooper, 2011; Zhou, 2013; Damsø, Kjær and Christensen, 2017; Azizalrahman and Hasyimi, 2018; Kilkiş, 2018; Li, Gu and Liu, 2018; Boehnke et al., 2019; Department of the Environment, Climate and Communications, 2019a; Alrashed, 2020; Chao et al., 2020)	(City of Stockholm, 2016; Ajuntament de Barcelona, 2020; City of Amsterdam, 2020; City of Vancouver, 2020; City of Sydney, 2021)
30	Mitigation	Greenhouse gas emissions	Cumulative percentage greenhouse gas emission reductions achieved relative to baseline year	%	M	(Pearce and Cooper, 2011; Helmus and Van den Hoed, 2016; Kilkiş, 2018; Boyle et al., 2019; Alrashed, 2020)	(City of Stockholm, 2016; City of Amsterdam, 2020; City of Vancouver, 2020; City of Sydney, 2021)

KPI number	Climate Action Type	Sub Category	KPI	KPI Unit	Timeframe ¹	Academic Information Sources	Municipal Information Sources
31	Mitigation	Greenhouse gas emissions	Annual reduction in greenhouse gas emissions across social housing	%	L		(City of Copenhagen, 2012; City of Amsterdam, 2020; City of Vancouver, 2020)
32	Mitigation	Planning	Number of local authority installed charging facilities for electric vehicles	Numeric value	S	(Helmus and Van den Hoed, 2016; Alrashed, 2020)	(City of Amsterdam, 2020; Evans, 2020)
33	Mitigation	Planning	Percentage of population within x kilometres of local authority installed EV charging facilities	%	M	(Friends of the Earth, 2021)	(City of Vancouver, 2020)
34	Mitigation	Planning	Percentage of parking permits issued without fossil fuel surcharge ²	%	S	(Friends of the Earth, 2021)	(City of Vancouver, 2020; Dorset Council, 2020)
35	Mitigation	Transportation	Kilometres of permanent segregated cycling network	Kilometres	S	(Chao et al., 2020; Clarke and O'Donoghue-Hynes, 2020)	(City of Vancouver, 2020; Dorset Council, 2020)
36	Mitigation	Transportation	Kilometres of permanent integrated cycling network	Kilometres	S	(Chao et al., 2020; Clarke and O'Donoghue-Hynes, 2020)	(City of Vancouver, 2020; Dorset Council, 2020)
37	Mitigation	Transportation	Number of dedicated bicycle parking facilities	Numeric value	M	(Csete and Buzasi, 2016)	(Dorset Council, 2020)
38	Mitigation	Transportation	Percentage of traffic lights that offer bicycle priority ²	%	L	(Csete and Buzasi, 2016)	
39	Mitigation	Transportation	Percentage change in greenhouse gas emissions of local authority vehicle fleet	%	L	(Friends of the Earth, 2021)	(City of Copenhagen, 2012; Dorset Council, 2020; City of Sydney, 2021)

² This indicator is most applicable to urban local authorities

KPI number	Climate Action Type	Sub Category	KPI	KPI Unit	Timeframe ¹	Academic Information Sources	Municipal Information Sources
40	Mitigation	Transportation	Percentage of local authority vehicle fleet which are zero emissions	%	S	(Department of the Environment, Climate and Communications, 2019a; Alrashed, 2020; Clarke and O'Donoghue-Hynes, 2020; Friends of the Earth, 2021)	(City of Copenhagen, 2012; Dorset Council, 2020)
41	Mitigation	Transportation	Percentage of local authority vehicle fleet which are hybrid	%	S	(Department of the Environment, Climate and Communications, 2019a; Alrashed, 2020; Clarke and O'Donoghue-Hynes, 2020)	(City of Copenhagen, 2012; C40 Cities, 2019; Dorset Council, 2020)
42	Mitigation	Public engagement	Percentage of local authority citizens who support switch to renewable energies (questionnaire)	%	L		(City of Amsterdam, 2020)
43	Mitigation	Public engagement	Total number of energy consultations undertaken by energy advisors in local authorities	Numeric value	M	(Friends of the Earth, 2021)	(City of Amsterdam, 2020; Dorset Council, 2020)
44	Mitigation	Public engagement	Number of local authority climate trainings/ community events delivered promoting mitigation actions related to carbon emission reductions	Numeric value	M	(Friends of the Earth, 2021)	(C40 Cities, 2019; City of Vancouver, 2020; Dorset Council, 2020; Evans, 2020)
45	Mitigation	Internal practices	Percentage of staff who work from home at least x days annually	%	L		(Dorset Council, 2020)
46	Mitigation	Internal practices	Percentage of 1) elected officials 2) local authority staff to avail of climate action training	%	S		

KPI number	Climate Action Type	Sub Category	KPI	KPI Unit	Timeframe ¹	Academic Information Sources	Municipal Information Sources
47	Mitigation/ Adaptation	Water resources	Percentage reduction in local authority annual water consumption	%	S	(Zhou, 2013; Gordon <i>et al.</i> , 2018; Kilkiş, 2018; Alrashed, 2020)	(Ajuntament de Barcelona, 2020)
48	Mitigation/ Adaptation	Water resources	Rainwater harvested in local authority owned buildings for re-use annually	Litres per annum	M	(Csete and Buzasi, 2016; van de Ven <i>et al.</i> , 2016)	(C40 Cities, 2019; City of Sydney, 2021)
49	Mitigation/ Adaptation	Climate justice	Percentage of low-income households (social housing recipients) whereby more than 10% of household income is spent on energy	%	L		(Ajuntament de Barcelona, 2020; City of Amsterdam, 2020)
50	Mitigation/ Adaptation	Environment	Net addition/ removal to tree cover i.e. no. of trees planted minus no. of trees removed	Numeric value	M	(Csete and Buzasi, 2016; van de Ven <i>et al.</i> , 2016; Institute for Urban Strategies, 2018; Department of the Environment, Climate and Communications, 2019a; Chao <i>et al.</i> , 2020; Clarke and O'Donoghue-Hynes, 2020; Friends of the Earth, 2021)	(C40 Cities, 2019; Dorset Council, 2020; Evans, 2020; City of Sydney, 2021)
51	Mitigation/ Adaptation	Environment	Percentage of local authority buildings with green roofs	%	S	(van de Ven <i>et al.</i> , 2016; Institute for Urban Strategies, 2018)	
52	Mitigation/ Adaptation	Environment	Tree species percentage breakdown for new trees planted for each of the following: plant family (<40%), genus (<30%) and species (<10%)	%	L	(Institute for Urban Strategies, 2018)	(C40 Cities, 2019; Dorset Council, 2020; City of Sydney, 2021)
53	Mitigation/ Adaptation	Finance	Dedicated annual climate change budget (€) per capita	Numeric value	L	(Helmus and Van den Hoed, 2016; Boehnke <i>et al.</i> , 2019)	
54	Mitigation/ Adaptation	Finance	Dedicated annual climate change budget (€) as a proportion of total municipal budget (€)	%	L	(Boehnke <i>et al.</i> , 2019)	

KPI number	Climate Action Type	Sub Category	KPI	KPI Unit	Timeframe ¹	Academic Information Sources	Municipal Information Sources
55	Mitigation/ Adaptation	Finance	Climate-related grant funding received (€) annually	Numeric value	L		(Dorset Council, 2020)
56	Mitigation/ Adaptation	Planning	Proportion of new housing construction placed within x meters/ kilometres of public transport	%	L		(City of Stockholm, 2016)
57	Mitigation/ Adaptation	Public engagement	Financial aid (€) provided by local authorities to community groups/ organisations annually for climate change projects	Numeric value	M		(Ajuntament de Barcelona, 2020)
58	Mitigation/ Adaptation	Public engagement	Number of citizen science climate change projects initiated by local authority in year	Numeric value	L		(C40 Cities, 2019)
59	Mitigation/ Adaptation	Enterprise	Number of green sector businesses supported through Local Enterprise Office initiatives in given year	Numeric value	M		(Dorset Council, 2020)
60	Mitigation/ Adaptation	Internal practices	Number of customer transactions/local authority services completed online, thereby reducing potential need for customer travel	Numeric value	L		(Evans, 2020)

3.4.5 Summary

Drawing on both academic literature and a select number of municipalities of best practice globally, this section primarily focused on *outcome indicators* and identified 60 KPIs related to both mitigation and adaptation that may offer some level of transferability or adaptability for the Irish local government sector. *Outcome indicators* related to climate change mitigation and adaptation were identified across 14 themes, including but not limited to energy, enterprise, environment, flood risk management, greenhouse gas emissions, housing, public engagement and transport. However, many

would need to be reviewed in more detail to determine whether they are completely transferable or operable to the Irish local government sector.

The broad remit of the themes identified, further supports the need to mainstream climate actions and KPIs both locally and at a sectoral level. Where *outcome indicators* are concerned, the need to ensure appropriate *process or policy indicators* are first identified and measured, is essential.

4 Summary Findings

Renewed attention in recent years on climate change action at an EU level under the European Green Deal and nationally under the *Climate Action Plan, Local Authority Climate Action Charter and Climate Action and Low Carbon Development (Amendment) Bill 2021* has resulted in increased climate change responsibilities being placed on all Irish public sector bodies, including the local government sector. Specifically, the latter proposed legislation includes a requirement for local authorities to develop distinct *Climate Action Plans* to include both mitigation and adaptation measures. Demonstrating measurable mitigation and adaptation performance is therefore likely to increase for all public sector bodies under such legislation, including for local government. This research has sought to support the local government sector in identifying KPIs that may be applicable to measure its own climate action performance over time.

Specifically, Section 3.1 provided context of the extensive work that has taken place to date at global, EU, national and sectoral scales to provide context for the development of climate action performance metrics. Section 3.2 then identified national and international best practices regarding the development of climate action KPIs. Results here highlighted the need to set clear goals, mainstream climate actions into all aspects of local authority decision-making, promote broad stakeholder support and engagement, utilise benchmarks and identify appropriate baseline periods, and to keep metrics simple for successful development and implementation of climate action indicators. A comparison of the development of climate action KPIs was subsequently undertaken in Section 3.3, which highlighted distinct differences in governance structures of the Irish local government sector relative to international counterparts. Moreover, the approach taken

by leading international municipalities in developing climate action KPIs was strongly centred on two primary climate actions i.e. mitigation and adaptation. Finally, in Section 3.4 a distinct list of KPIs were identified for the sector following a detailed review of academic and practice-based literature globally. Across adaptation and mitigation actions, 60 KPIs were identified that may be relevant in an Irish context.

Data availability is a key area of consideration when developing KPIs. Data for many of the indicators identified in this study may not be formally captured by the sector at present, and for many indicators, systems and policies may need to be established so that they can be accurately captured in the long-term. As with any performance indicators, the importance of developing and measuring both *process* and *outcome indicators* to align with climate policy ambitions is therefore crucial. Specifically, capturing relevant metrics on *process or policy indicators* is an important first step in ensuring appropriate frameworks or policies are in place to begin with so that an understanding is gained as to what initial supports or practices are necessary to monitor and evaluate climate action performance. Without such a framework, *outcome indicators* may prove challenging to measure.

The outcome KPIs identified in this study, taken from both the academic literature and a range of international municipal best practices, may assist the Irish local government sector and offer some level of transferability or adaptability with respect to local authorities' climate change ambitions. Notwithstanding this, some KPIs may need to be reviewed in more detail to determine if they are transferable to the Irish local government sector given the international literature from which they were derived.

5 Conclusion

Simple, reliable and relatively easy-to-implement *outcome indicators* are likely to be beneficial as a starting point in supporting the sector to demonstrate its climate action performance. Learnings from implementation of an initial set of indicators could then be used to support the development of future KPIs, thereby supporting an evidence-based approach to future KPI implementation. Indeed, as with development and implementation of all performance metrics, capturing and measuring any KPI is likely to be an iterative process. Each indicator may require time to be accurately defined, adjusted, embedded and measured based on sectoral needs, policies, learnings and best practices in the coming years. This is an important point given that both IT infrastructure and policy priorities can differ significantly across local authorities. For this reason, almost 75% of KPIs are classified as requiring a medium to long-term timeframe for implementation.

A structured and iterative approach may also provide the sector with an opportunity to undertake periodic reviews of indicators to ensure they remain relevant, are aligned with international best practice, and are applicable to the rapidly changing nature of climate policy at both EU and national levels. In the long term however, being equally ambitious in choosing metrics, and in capturing and improving climate action performance, is also important to ensure commitments and targets detailed in national climate change policy are fulfilled.

Finally, whilst the indicators in this study may be relevant in an Irish local government sector context, this research may also provide a useful baseline and practical publication to support local authorities internationally develop their own climate action KPIs given the broad objectives of the research. Some of the KPIs developed may also be relevant and adaptable to other Irish public sector bodies required to monitor and evaluate their own climate action performance.

Performance management systems and performance indicators can serve as an effective means of capturing good or best practices, and in identifying potential areas of improvement for organisations. Performance indicators related to social, environmental and economic sustainability have existed and been used by organisations for some time. Increased attention on climate change in recent years however has coincided with organisations seeking to explore, develop and adopt metrics related to climate action performance to demonstrate their ambitions and progress in this area.

The Irish local government sector has assumed an enhanced role in terms of climate action commitments in recent years arising from various policy and legislative changes. The KPIs identified in this study may assist the Irish local government sector and offer some level of transferability or adaptability for local authorities in measuring their climate change ambitions. Simplicity, reliability and ease of implementation of KPIs may serve as a useful starting point in supporting the sector in its ambitions. As sectoral climate action ambitions progress, more data may become available against which performance can be measured. Given the iterative nature of implementing KPIs into performance management systems, this structured approach may subsequently facilitate meaningful KPIs to be embedded based on sectoral ambitions, policies, learnings and best practices in the coming years.

6 References

Ajuntament de Barcelona (2020) *Monitoring the measures for taking on the climate emergency: Barcelona for Climate*. Available at: <https://www.barcelona.cat/barcelona-pel-clima/en/barcelona-responds/monitoring-measures-taking-climate-emergency> (Accessed: 8 March 2021).

Al Dakheel, J. et al. (2020) 'Smart buildings features and key performance indicators: A review', *Sustainable Cities and Society*, 61, p. 102328. doi: 10.1016/j.scs.2020.102328.

Allman, L., Fleming, P. and Wallace, A. (2004) 'The progress of English and Welsh local authorities in addressing climate change', *Local Environment*, 9(3), pp. 271–283. doi: 10.1080/1354983042000219379.

Alrashed, S. (2020) 'Key performance indicators for Smart Campus and Microgrid', *Sustainable Cities and Society*, 60, p. 102264. doi: 10.1016/j.scs.2020.102264.

Ammons, D. N. and Roenigk, D. J. (2015) 'Performance Management in Local Government: Is Practice Influenced by Doctrine?', *Public Performance & Management Review*, 38(3), pp. 514–541. doi: 10.1080/15309576.2015.1006461.

Azizalrahman, H. and Hasyimi, V. (2018) 'Towards a generic multi-criteria evaluation model for low carbon cities', *Sustainable Cities and Society*, 39, pp. 275–282. doi: 10.1016/j.scs.2018.02.026.

Boehnke, R. F. et al. (2019) 'Good practices in local climate mitigation action by small and medium-sized cities; exploring meaning, implementation and linkage to actual lowering of carbon emissions in thirteen municipalities in The Netherlands', *Journal of Cleaner Production*, 207, pp. 630–644. doi: 10.1016/j.jclepro.2018.09.264.

Bouckaert, G. and Halligan, J. (2007) *Managing Performance: International Comparisons*. Abingdon: Routledge.

Boyle, M. et al. (2019) *Towards a Green Future for Liverpool City Region*. Liverpool: Heseltine Institute for Public Policy, Practice and Place.

C40 Cities (2015) *The Benefits of Benchmarking Building Performance*. Available at: https://www.c40knowledgehub.org/s/article/The-Benefits-of-Benchmarking-Building-Performance?language=en_US (Accessed: 20 March 2021).

C40 Cities (2019) *Measuring Progress in Urban Climate Adaptation: Monitoring - Evaluating - Reporting Framework*. Denmark: Ramboll Fonden. Available at: https://c40-production-images.s3.amazonaws.com/other_uploads/images/2154_20190228_MER_Framework_Final.original.pdf?1553033351 (Accessed: 3 January 2021).

C40 Cities (2021) C40. Available at: <https://www.C40.org/cities> (Accessed: 1 March 2021).

Callanan, M. and Tatham, M. (2014) 'Territorial interest representation in the European Union: actors, objectives and strategies', *Journal of European Public Policy*, 21(2), pp. 188–210. doi: 10.1080/13501763.2013.829579.

Castán Broto, V. and Bulkeley, H. (2013) 'A survey of urban climate change experiments in 100 cities', *Global Environmental Change*, 23(1), pp. 92–102. doi: 10.1016/j.gloenvcha.2012.07.005.

Chao, A. L. et al. (2020) *Indicators Framework for Sustainable Urban Design, Atmosphere*. MDPI AG. doi: 10.3390/atmos1111143.

Citizen's Assembly (2018) *Third Report and Recommendations of the Citizens' Assembly: How the State Can Make Ireland a Leader in Tackling Climate Change*. Citizen's Assembly. Available at: <https://2016-2018.citizensassembly.ie/en/How-the-State-can-make-Ireland-a-leader-in-tackling-climate-change/Final-Report-on-how-the-State-can-make-Ireland-a-leader-in-tackling-climate-change/Final-Report-on-how-the-State-can-make-Ireland-a-leader-in-tackling-climate-change.html> (Accessed: 10 April 2021).

City of Amsterdam (2020) *Roadmap: Amsterdam Climate Neutral 2050*. webpagina. Amsterdam: City of Amsterdam. Available at: <https://www.amsterdam.nl/en/policy/sustainability/policy-climate-neutrality/> (Accessed: 8 March 2021).

City of Copenhagen (2012) *CPH 2020 Climate Plan: A Green, Smart and Carbon Neutral City*. Copenhagen: City of Copenhagen. Available at: https://kk.sites.itera.dk/apps/kk_pub2/index.asp?mode=detalje&id=983 (Accessed: 8 March 2021).

City of Stockholm (2014) *City of Stockholm Annual Report*. Stockholm: City of Stockholm. Available at: <https://international.stockholm.se/globalassets/rapporter/annual-report-2014.pdf> (Accessed: 3 January 2021).

City of Stockholm (2016) *The Stockholm Environment Programme 2016-2019*. Stockholm: Executive Office. Available at: <https://international.stockholm.se/globalassets/rapporter/the-stockholm-environment-programme-2016-2019.pdf> (Accessed: 20 March 2021).

City of Sydney (2021) *Green Environmental Sustainability Progress Report*. Sydney: City of Sydney. Available at: <https://www.cityofsydney.nsw.gov.au/surveys-case-studies-reports/green-reports> (Accessed: 3 August 2021).

City of Vancouver (2020) *Climate Emergency Action Plan*. Vancouver: City of Vancouver. Available at: <https://council.vancouver.ca/20201103/documents/p1.pdf> (Accessed: 3 May 2021).

Clarke, D. and O'Donoghue-Hynes, B. (2020) *A Profile of Local Government Climate Actions in Ireland*. Dublin: Local Government Management Agency. Available at: <https://www.lgma.ie/en/publications/local-authority-sector-reports/a-profile-of-local-government-climate-actions-in-ireland.pdf>.

Corfee-Morlot, J. et al. (2009) *Cities, Climate Change and Multilevel Governance*. OECD. Available at: <https://www.oecd-ilibrary.org/content/paper/220062444715> (Accessed: 6 March 2021).

County and City Management Association (2021) *Delivering Effective Climate Action 2030: Local authority sector strategy for delivering on the Climate Action Charter and Climate Action Plan*. Dublin: Local Government Management Agency.

Csete, M. and Buzasi, A. (2016) 'Climate-Oriented Assessment of Main Street Design and Development in Budapest', *Journal of Environmental Engineering and Landscape Management*, 24(4), pp. 258–268. doi: 10.3846/16486897.2016.1185431.

Damsø, T., Kjær, T. and Christensen, T. B. (2017) 'Implementation of local Climate Action Plans: Copenhagen – Towards a carbon-neutral capital', *Journal of Cleaner Production*, 167, pp. 406–415. doi: 10.1016/j.jclepro.2017.08.156.

Department of the Environment, Climate and Communications (2019a) *Climate Action Plan 2019*. Dublin: Government of Ireland. Available at: <https://www.gov.ie/en/publication/ccb2e0-the-climate-action-plan-2019/> (Accessed: 27 February 2021).

Department of the Environment, Climate and Communications (2019b) *Local Authority Climate Action Charter*. Available at: <https://www.gov.ie/en/publication/d914a-local-authority-climate-action-charter/> (Accessed: 27 February 2021).

Department of the Environment, Climate and Communications (2021a) *Adapting to Climate Breakdown*. Available at: <https://www.gov.ie/en/policy-information/37d691-adapting-to-climate-breakdown/> (Accessed: 27 February 2021).

Department of the Environment, Climate and Communications (2021b) National Policy Position on Climate Action and Low Carbon Development. Available at: <https://www.gov.ie/en/publication/6f393-national-climate-policy-position/> (Accessed: 27 February 2021).

Dorset Council (2020) *Dorset Council Climate Action Plan*. Dorset, UK: Dorset Council. Available at: <https://news.dorsetcouncil.gov.uk/2020/09/28/dorset-council-publishes-climate-and-ecological-emergency-action-plan-ahead-of-cabinet-meeting/#:~:text=Dorset%20Council%20publishes%20Climate%20and%20Ecological%20Emergency%20Action%20Plan%20ahead%20of%20Cabinet%20meeting,-September%2028%2C%202020&text=This%20presented%20eight%20key%20areas,Dorset%20Council%20area%20by%202050>. (Accessed: 20 March 2021).

Dupuis, J. and Biesbroek, R. (2013) 'Comparing apples and oranges: The dependent variable problem in comparing and evaluating climate change adaptation policies', *Global Environmental Change*, 23(6), pp. 1476–1487. doi: 10.1016/j.gloenvcha.2013.07.022.

European Commission (2020a) Progress made in cutting emissions, *Climate Action - European Commission*. Available at: https://ec.europa.eu/clima/policies/strategies/progress_en (Accessed: 27 February 2021).

European Commission (2020b) *REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing the framework for achieving climate neutrality and amending Regulation (EU) 2018/1999 (European Climate Law)*. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020PC0080&from=EN> (Accessed: 27 February 2021).

European Commission (2020c) 'Submission by Croatia and the European Commission on behalf of the European Union and its Member States'. Available at: <https://unfccc.int/sites/default/files/resource/HR-03-06-2020%20EU%20Submission%20on%20Long%20term%20strategy.pdf> (Accessed: 27 February 2021).

European Council (2009) 'Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020', *Official Journal of the European Union*, 140, pp. 136–148.

European Council (2020) *Climate change: what the EU is doing*. Available at: <https://www.consilium.europa.eu/en/policies/climate-change/> (Accessed: 27 February 2021).

Evans, L. (2020) *Local Authorities and the Sixth Carbon Budget*. UK: Climate Change Committee. Available at: <https://www.theccc.org.uk/publication/local-authorities-and-the-sixth-carbon-budget/> (Accessed: 20 March 2021).

den Exter, R., Lenhart, J. and Kern, K. (2015) 'Governing climate change in Dutch cities: anchoring local climate strategies in organisation, policy and practical implementation', *Local Environment*, 20(9), pp. 1062–1080. doi: 10.1080/13549839.2014.892919.

Friends of the Earth (2021) *33 actions local authorities can take on climate change / Policy and insight*. Available at: <https://policy.friendsoftheearth.uk/insight/33-actions-local-authorities-can-take-climate-change> (Accessed: 20 March 2021).

Gordon, B. L. et al. (2018) 'A case-study based framework for assessing the multi-sector performance of green infrastructure', *Journal of environmental management*, 223, pp. 371–384.

Government of Ireland (2021) *Climate Action and Low Carbon Development (Amendment) Bill 2021*. Available at: <https://www.gov.ie/en/publication/984d2-climate-action-and-low-carbon-development-amendment-bill-2020/> (Accessed: 27 February 2021).

- Helmus, J. and Van den Hoed, R. (2016) 'Key performance indicators of charging infrastructure', *World Electric Vehicle Journal*, 8(4), pp. 733–741.
- Houses of the Oireachtas (2019) *Report of the Joint Committee on Climate Action Climate Change: A Cross-Party Consensus for Action*. Dublin: Houses of the Oireachtas. Available at: https://data.oireachtas.ie/ie/oireachtas/committee/dail/32/joint_committee_on_climate_action/reports/2019/2019-03-28_report-climate-change-a-cross-party-consensus-for-action_en.pdf (Accessed: 10 April 2021).
- ICLEI (2021) *ICLEI Members / ICLEI Global*. Available at: <http://old.iclei.org/index.php?id=9&id=9&page=7> (Accessed: 1 March 2021).
- Institute for Urban Strategies (2018) *Global Power City Index*. London: Institute for Urban Strategies. Available at: http://mori-m-foundation.or.jp/pdf/GPCI2018_summary.pdf (Accessed: 3 June 2021).
- Intergovernmental Panel on Climate Change (ed.) (2015) *Climate Change 2014: Synthesis Report*. Geneva, Switzerland: Intergovernmental Panel on Climate Change.
- Intergovernmental Panel on Climate Change (2018) 'Summary for Policymakers – Global Warming of 1.5 °C'. Available at: <https://www.ipcc.ch/sr15/chapter/spm/> (Accessed: 27 February 2021).
- Jones, S. (2019) 'City governments measuring their response to climate change', *Regional Studies*, 53(1), pp. 146–155. doi: 10.1080/00343404.2018.1463517.
- Kennedy, C., Demoulin, S. and Mohareb, E. (2012) 'Cities reducing their greenhouse gas emissions', *Energy Policy*, 49, pp. 774–777. doi: 10.1016/j.enpol.2012.07.030.
- Kilkiş, Ş. (2018) *Benchmarking South East European Cities with the Sustainable Development of Energy, Water and Environment Systems Index*. Journal of Sustainable Development of Energy, Water and Environment Systems. SDEWES Centre. doi: 10.13044/j.sdewes.d5.0179.
- Kitchin, R. et al. (2012) 'Placing Neoliberalism: The Rise and Fall of Ireland's Celtic Tiger', *Environment and Planning A: Economy and Space*, 44(6), pp. 1302–1326. doi: 10.1068/a44349.
- Li, Y., Gu, Y. and Liu, C. (2018) 'Prioritising performance indicators for sustainable construction and development of university campuses using an integrated assessment approach', *Journal of Cleaner Production*, 202, pp. 959–968. doi: 10.1016/j.jclepro.2018.08.217.
- Linder, S. K. et al. (2015) 'Citation searches are more sensitive than keyword searches to identify studies using specific measurement instruments', *Journal of clinical epidemiology*, 68(4), pp. 412–417. doi: 10.1016/j.jclinepi.2014.10.008.
- Ministry for Economic Affairs and the Interior (2014) *Municipalities and Regions - Tasks and Financing*. Copenhagen: Ministry for Economic Affairs and the Interior. Available at: <https://english.im.dk/media/22352/municipalities-and-regions-tasks-and-financing-june-2014.pdf> (Accessed: 20 March 2021).
- Moynihan, D. P. (2009) 'Through A Glass, Darkly', *Public Performance & Management Review*, 32(4), pp. 592–603. doi: 10.2753/PMR1530-9576320409.
- National Oversight and Audit Commission (2020) *Local Authority Performance Indicator Report 2019*. Dublin: NOAC. Available at: <https://noac.ie/wp-content/uploads/2021/01/Final-NOAC-LAPIR-2019-Complete-11-Jan.pdf> (Accessed: 3 May 2021).

Niemann, L. and Hoppe, T. (2018) 'Sustainability reporting by local governments: a magic tool? Lessons on use and usefulness from European pioneers', *Public Management Review*, 20(1), pp. 201–223. doi: 10.1080/14719037.2017.1293149.

Niemann, L., Hoppe, T. and Coenen, F. (2017) 'On the benefits of using process indicators in local sustainability monitoring: Lessons from a Dutch municipal ranking (1999–2014)', *Environmental policy and governance*, 27(1), pp. 28–44.

Palermo, V. and Hernandez, Y. (2020) 'Group discussions on how to implement a participatory process in climate adaptation planning: a case study in Malaysia', *Ecological Economics*, 177, p. 106791. doi: 10.1016/j.ecolecon.2020.106791.

Park, A. Y. and Krause, R. M. (2021) 'Exploring the landscape of sustainability performance management systems in US local governments', *Journal of Environmental Management*, 279, p. 111764.

Pearce, G. and Cooper, S. (2011) 'Sub-national Responses to Climate Change in England: Evidence from Local Area Agreements', *Local Government Studies*, 37(2), pp. 199–217. doi: 10.1080/03003930.2011.554825.

Rauken, T., Mydske, P. K. and Winsvold, M. (2015) 'Mainstreaming climate change adaptation at the local level', *Local Environment*, 20(4), pp. 408–423. doi: 10.1080/13549839.2014.880412.

Sezginalp, K. (2016) *Metro Vancouver: Improving upon performance measures*. University of Victoria. Available at: <http://hdl.handle.net/1828/7365> (Accessed: 11 March 2021).

Van de Ven, F. H. M. et al. (2016) 'Adaptation Planning Support Toolbox: Measurable performance information based tools for co-creation of resilient, ecosystem-based urban plans with urban designers, decision-makers and stakeholders', *Environmental Science & Policy*, 66, pp. 427–436. doi: 10.1016/j.envsci.2016.06.010.

Zeemering, E. S. (2018) 'Sustainability management, strategy and reform in local government', *Public Management Review*, 20(1), pp. 136–153.

Zhou, N. (2013) 'An international review of eco-city theory, indicators, and case studies' Berkeley: Lawrence Berkeley National Laboratory.



Local Government Climate Action Key Performance Indicators – **Literature Review**

