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Assessment of the climate preparedness of 30 urban areas in the UK

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Abstract

Cities are increasingly aware of the need to mitigate greenhouse gas emissions and adapt to changes in weather patterns leading to the production of urban climate change plans. The few existing systematic studies of these plans have focused on either adaptation or mitigation issues, and are typically based on surveys completed by city officials rather than analysis of documented evidence.

To gain insight into the status of adaptation and mitigation action across the UK, climate change documents from 30 urban areas (representing ~28% of the UK's population) were analysed. An Urban Climate Change Preparedness Score, which could be applied to non-UK urban areas, has been devised for comparative analysis. This characterizes progress against (i) Assessment, (ii) Planning, (iii) Action, and (iv) Monitoring, for both adaptation and mitigation. The Preparedness Score allows a quantitative comparison of climate change strategies across the urban areas analysed. This methodology can be transferred to other countries and makes an international comparison of urban areas and their climate change adaptation and mitigation plans possible.

We found that all areas acknowledge climate change being a threat and that adaptation and mitigation planning and action is required. However, two urban areas did not have official adaptation or mitigation plans. Typically, mitigation activities across all cities were more advanced than adaptation plans. Emissions reduction targets ranged from 10%-80% with differing baselines, timeframes and scopes, for defining and meeting these targets. Similar variability was observed across adaptation plans. Several reasons for these differences are considered, but particularly notable, is that a combination of incentives and regulation seem to stimulate more comprehensive strategies and action in many urban areas.

Keywords: Climate preparedness; urban areas; cities; planning; adaptation; mitigation

1. Introduction

1.1. Urban areas and their climate change strategies

Urban areas are pivotal to the implementation of global climate policy, both from mitigation and adaptation perspectives. More than half the world's population now lives in urban areas (OECD, 2010), making them concentrations of vulnerability to climate change impacts (Dawson, 2007; Hallegatte and Corfee-Morlot, 2011; Rosenzweig and Solecki, 2010), whilst also responsible for over 70% of global energy related carbon emissions (International Energy Agency, 2008). Urban areas are increasingly seen as leaders in tackling the drivers and impacts of climate change (Ramaswami and Dhakal, 2011; Rosenzweig and Wilbanks, 2010).

Some urban areas have undertaken risk assessments, set reduction targets and introduced policies, strategies, plans and programmes (henceforth collectively referred to as climate initiatives) to tackle climate change mitigation and adaptation issues in a coherent manner (ARUP, 2011; Carbon Disclosure Project, 2011; Carmin et al., 2012; Hunt and Watkiss, 2011). Although urban responses to climate change can be traced back to the 1990s (Bulkeley, 2010), Hunt and Watkiss (2011) and Carmin et al. (2012) revealed large variations in the climate impacts considered.

A survey of 42 megacities found that 93% of disclosing cities identified their city as being exposed to risks due to climate change and 43% are already dealing with impacts caused by climate change (Carbon Disclosure Project, 2011), whilst a study in the USA revealed that actions cover a wide array of measures in the cities under consideration (Tang et al., 2010). Evaluating progress in adaptation and mitigation is challenging and a degree of subjectivity is inevitable (Bassett and Shandas, 2010; Bulkeley, 2010; Preston et al., 2011; Tang et al., 2010).

This paper provides insights into the state of urban climate change adaptation and mitigation measures and strategies across 30 UK urban areas (representing ~28% of UK population). This provides comparison that is of immediate use to national and international policy makers into how well established adaptation and mitigation processes are in cities, and also helps local authorities identify priorities and opportunities. More generally, the paper also provides useful information for researchers and industry with an interest in urban climate issues.

First, we review relevant climate policies and aspects of the UK planning system before introducing the method for data gathering and analysis. We then introduce the newly developed Urban Climate Change Preparedness Scores. Finally we present the results before discussing their implications and drawing conclusions.

1.2. Policy drivers and emissions reductions targets in UK urban areas

A number of governments signed up to international mitigation commitments such as the Kyoto Protocol. The European Parliament commits its member states to reduce GHG emissions and energy consumption by at least 20% by 2020 from a 1990 baseline (European Parliament, 2009). The UK government has set the pace in terms of legislative framework as The Climate Change Act (2008) commits to a net reduction of the UK carbon account of 80% by the year 2050 (1990 baseline). At a national scale, adaptation is typically behind mitigation strategies, a number of EU countries are publishing national adaptation strategies, although many lack a rigorous implementation and evaluation process (Biesbroek et al., 2010).

Urban areas can join the Covenant of Mayors (2011) which obligates to 11 commitments such as: to exceed a 20% CO₂ reduction target; provide a baseline report emission inventory; adapt city structures; provide a Sustainable Energy Action Plan; and submit progress reports. Within England, the Nottingham Declaration is an initiative tackling climate change and its signatories acknowledge for example, the risks of climate change, work to reduce emissions, monitor progress and publish results (Energy Savings Trust, 2011). The Scottish Climate Change Declaration requires signatories for example to develop adaptation and carbon management plans and report annually on progress (Scottish Government, 2011). The Welsh Local Government Association (2008) provides a Climate Change Declaration but it appears that there is no comparable declaration in Northern Ireland.

1.3. Planning policy in the UK

Central government policies strongly influence the selection of mitigation and adaptation measures within urban areas (Biesbroek et al., 2009; Bulkeley, 2009; Bulkeley and Kern, 2006). The UK comprises four countries (England, Scotland, Wales and Northern Ireland) with devolved planning systems. England and Wales have 25 Planning Policy Statements (PPS) and Guidance, (PPG) and most, if not all,

have relevance to climate change (Bulkeley, 2009). A supplement to ‘Planning Policy Statement 1: Planning and Climate Change’ (PPS1) sets out how planning can support the reduction of emissions and stabilising climate change (DCLG, 2007).

Until recently, ‘Local Development Frameworks’ set out local government spatial strategies, planning policies and criteria by which applications for development are assessed. These strategies address environmental, social and economic considerations. In March 2012 the new ‘National Planning Policy Framework’ was introduced (DCLG, 2012) which still requires a ‘Local Plan’.

1.4. Climate change adaptation and rating of urban responses

Monitoring and evaluating adaptation and mitigation measures is important and needs to be supported by policies and strategies (Adaptation Sub-Committee, 2010; Rosenzweig and Solecki, 2010). Until recently, in England, National Indicator 188 (DEFRA, 2010) measured how authorities and their communities, on a scale of 0 (lowest) to 4 (highest), were planning to adapt their service delivery, local infrastructure, businesses and the natural environment to climate change. The top-down requirements of reporting raised the profile of climate issues and 97% of English authorities include at least one climate change indicator as a priority (Cooper and Pearce, 2011). However, NI188 was perceived to be problematic in terms of appropriateness, accuracy and timeliness and was set to be abolished (Mortimer, 2010). With no alternative, some authorities still use this framework for their internal reporting.

2. Methodology

2.1. Selection of urban areas and data analysis

To ensure this analysis captured urban areas of a range of population sizes and locations, the 30 cities (Figure 4) previously identified by the European Urban Audit database were used. The Urban Audit methodology aims to provide a balanced and representative sample of cities from European countries by applying the following selection criteria (Eurostat, 2010):

1. At least 20% of the national population should be covered;
2. National capitals and, where possible, regional capitals are included;

3. Some large (more than 250,000 population) and medium-sized urban areas (minimum 50,000 and maximum 250,000 population) are included; and
4. Urban areas should be geographically dispersed within countries.

Published climate initiatives and documentation were collected and analysed for each urban area listed by the Urban Audit database in the following sequence:

1. Download, request by email or telephone and compile climate change documentations from urban areas (Table S1). The data gathering process was finalised on the census date of 31st October 2011.
2. Filter documents to identify only official documents that address climate change mitigation and adaptation and that are authorised by the local authority.
3. Perform detailed analysis of these documents in terms of their scope and their climate change mitigation and adaptation targets and measures.
4. Develop and apply Preparedness Scores for these urban areas.

2.2. Climate change preparedness scores for urban areas

Evaluation procedures were derived to evaluate both the breadth of measures and the detail of analysis from the evidence provided by the authorities. Drawing from analysis of published frameworks and processes (ICLEI, 2008; Johnstone and Moczarski, 2011; Klein et al., 2001; Preston et al., 2011; UKCIP, 2009), we characterised the following four key stages of adaptation and mitigation (i) Assessment, (ii) Planning, (iii) Action, and (iv) Monitoring. Tables S2 and S3 provide the detailed methodological approach. In summary, each stage is scored from 0 to 3 based on the following criteria for adaptation:

- *Assessment of current and future climate risks*- Local Climate Impacts Profile (UKCIP, 2009), climate change risk analysis and accounting of adaptation;
- *Adaptation planning*- Adaptation strategy breadth and depth, existing standardised management systems (e.g. BS EN ISO 14001, 2004) and NI 188 (DEFRA, 2010);
- *Adaptation action*- Quality of adaptation action plans and implemented projects;
- *Adaptation monitoring and review*- Covenant of Mayor signatory, level of senior management commitment and formalised procedures (e.g. annual reviews).

Each stage of mitigation preparedness was assessed using the following criteria:

- *Assessment of GHG and/or carbon emissions*- Status of carbon management programmes and other GHG accounting methods;
- *Mitigation planning*- Mitigation strategies, plans and existing management systems to manage the process;
- *Mitigation action*- Quality of mitigation action plans and implemented projects;
- *Mitigation monitoring and review*- Covenant of Mayor signatory, level of senior management commitment and formalised procedures (e.g. annual reviews).

3. Results

3.1. Demographics and signatories of national and international agreements

The 30 urban areas investigated represent a population of around 17.3 million; with two in Wales (Wrexham and Cardiff), three in Scotland (Aberdeen, Edinburgh and Glasgow), two in Northern Ireland (Belfast and Derry) and 23 in England – including the UK capital (London) and the 8 largest economies outside London (Birmingham, Bristol, Leeds, Liverpool, Manchester, Newcastle, Nottingham and Sheffield). By far the largest urban area is London, with a population of 7.6 million and the smallest is Stevenage with 81,000 inhabitants in 2010 (Office for National Statistics, 2011). In this sample, 43% (13) of the urban areas have signed the Covenant of Mayors’ agreement. Additionally, from the 23 English areas, 22 signed the Nottingham Declaration; the Scottish Declaration is signed by all Scottish areas, whereas the Welsh Declaration appears not to have been signed by Cardiff and Wrexham.

3.2. Climate initiatives analysed

Twenty-eight of the thirty urban areas have published climate initiatives outlining how they will tackle climate change adaptation and mitigation. Derry (Northern Ireland) and Wrexham (Wales) are at the start of this process and had not published an official decision or document tackling climate change. Urban areas are often part of larger Metropolitan, District and County Councils, for example documentations from Stoke on Trent and Gravesham frequently make reference to regional strategies (South Staffordshire Council (2008) and Kent County Council (2011) respectively) rather than provide details and targets.

Only documents that had been approved, or were in the process of approval (draft), by local authority officials at the census date were accepted (Table S1). The majority of urban areas (25 of 30) developed one strategy addressing both mitigation and adaptation in one document. Some authorities (Leicester, London and Nottingham) provide one strategy document for adaptation and one for mitigation. These strategies covered activities across the authorities geography (scope AA) i.e. including activities of households, industry and businesses. However, some authorities, including Coventry and Edinburgh, provided additional strategies that covered activities directly controlled by the authority only (scope AO). Another set of authorities, e.g. Stevenage, Wirral provided a strategy document and a separate action plan. Overlaps between these documents often existed, but as they all had official status they were included in our analysis, thus for the 30 cities we analysed 52 documents (Figure 2).

3.3. Mitigation measures

Of the 52 documents, 49 address mitigation specifically and all urban areas plan energy saving and efficiency improvements e.g. buildings, housing, resources and street lighting, which perhaps reflects the other perceived benefits of economic and energy security (Bulkeley and Kern, 2006; Hunt and Watkiss, 2011). Figure 1 shows the range of proposed mitigation measures from general ones such as energy efficiency and savings, to measures that named specific technologies for transport, heating from renewables and renewable energies e.g. wind, biomass, energy from waste and tidal power. Where possible urban areas build on existing infrastructure, for example, Coventry City Council (2008), and Sheffield First (2007) plan to build upon existing waste to energy plant operations. However, London is proposing new decentralised infrastructures, such as district heating (Mayor of London, 2011a). Despite PPS1 stating that authorities should consider decentralised electricity and heat networks (DCLG, 2007), only 15 urban areas propose these.

In UK urban areas there is little agriculture so it should not be surprising that only 14% urban areas included agriculture as a mitigation issue. Transport is a priority for 93% of urban areas through a wide range of activities from providing green travel for staff (Edinburgh City Council, 2007), introducing flexible working hours and low carbon vehicles (Birmingham City Council, 2010) to developing new infrastructure

such as the Bristol Rapid Transit Project (Bristol City Council, 2010). Provision of supporting infrastructure for electric transport or new electric vehicles was proposed by 46% of areas. Waste management, although recognised by 96% of the areas as a component of mitigation, is mainly restricted to activities such as raising awareness and recycling (Glasgow City Council, 2010; Newcastle Partnership, 2010).

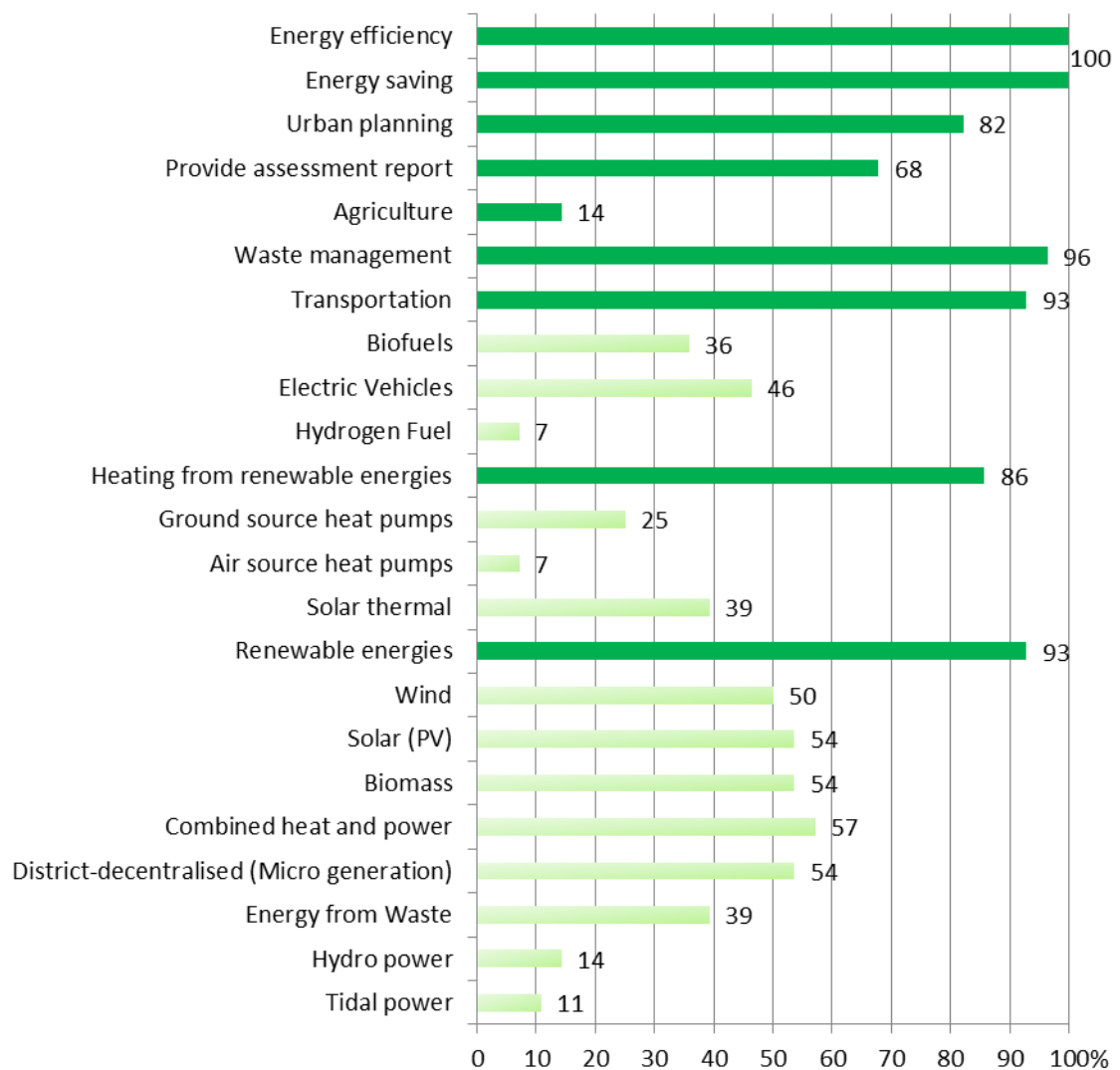


Figure 1: Percentage of 28 urban areas considering climate change mitigation measures (lighter shaded bars show sub-categories of the upper darkly shaded bar – for example, three main sub-categories were identified for heating from renewable energies)

3.4. Emissions reduction targets

The majority (48/52) of documents do refer to emissions reduction targets, although the timescales are unclear in some instances, e.g. for Lincoln City Council (2005). To be meaningful reduction targets require a baseline and a target year but only 8

documents use the 1990 baseline from the Kyoto protocol and UK Climate Change Act (2008). Figure 2 summarises the targets, where possible expressed in terms of CO₂ or carbon reduction that provide a baseline year and target year (green bar); target year but no baseline (shaded green bar) and where no targets are set (yellow bar). Edinburgh is probably the most ambitious with the aspiration to achieve a zero carbon neutral economy by 2050, but it does not provide a baseline (thus being illustrated using a shaded green bar).

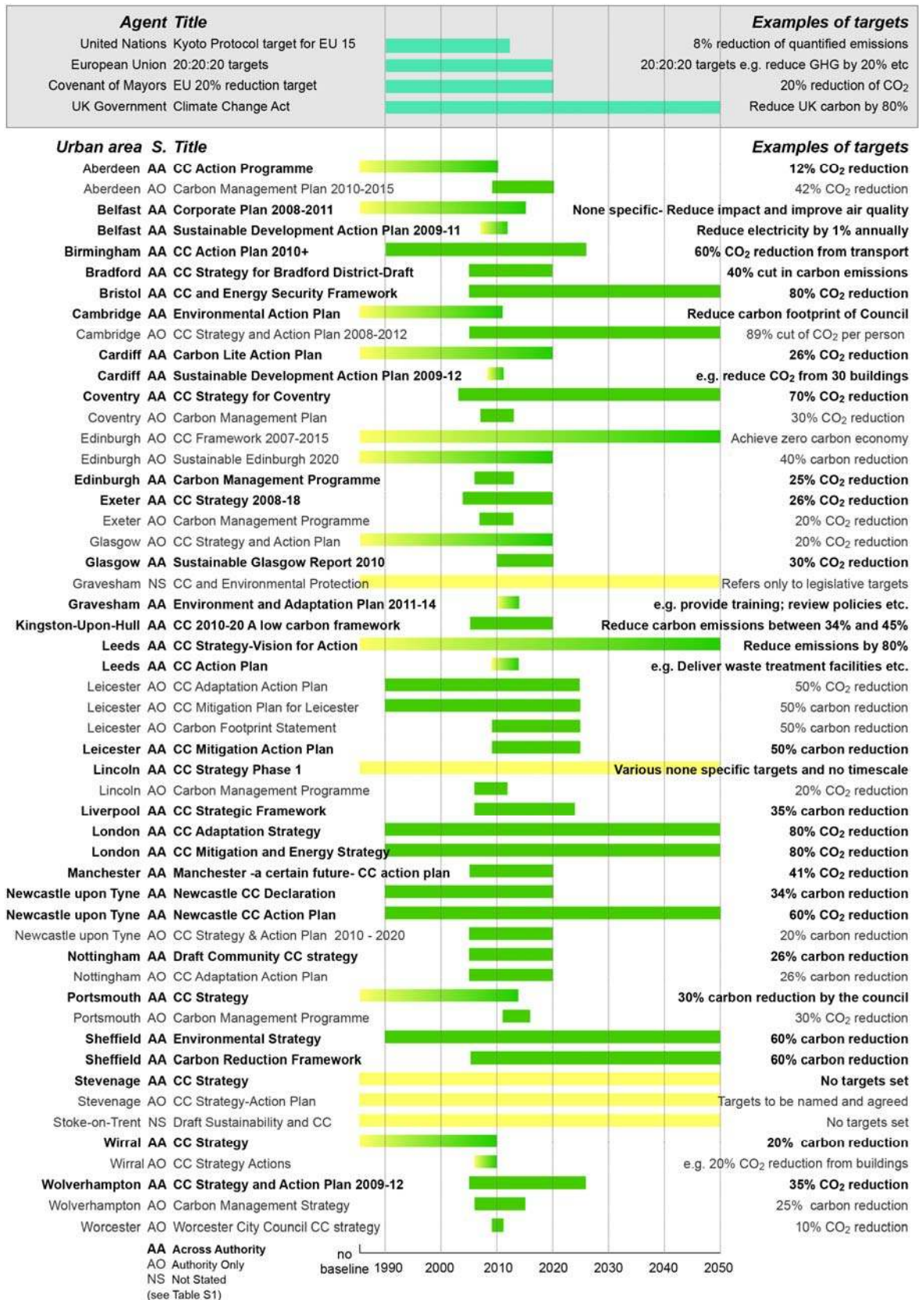


Figure 2: Examples of international, national targets; Emission reduction targets by the 30 cities and the 52 documents analysed; Scopes- Across Authority (AA) includes household, industry and business, Authority Only (AO) under control of the Authority or Not stated (NS); Yellow-no target, green shaded- no baseline but target year, green-baseline and target year.

3.5. Adaptation measures

From the 52 documents analysed, 36 covered adaptation. Floods and droughts (or rather measures to reduce water demand, such as hosepipe bans) are regular occurrences in the UK (Blenkinsop and Fowler, 2007; Pitt, 2007) and 79% of urban areas highlight flood protection and water management as priorities (Figure 3). Urban areas considering ‘urban planning and development’ identify cross-sectorial benefits and overlaps of adaptation measures, such as urban green space and shaded areas to ameliorate urban heat e.g. Lincoln City Council (2005) and increase levels of physical activity and hence health e.g. Nottingham City Council (2011).

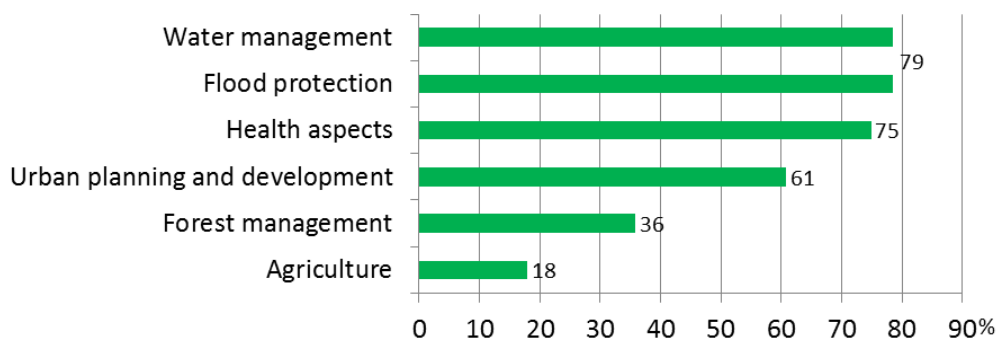


Figure 3: Percentage of 28 urban areas considering climate change adaptation measures

3.6. Urban Climate Change Preparedness Scores

As a next step, the Preparedness Scores of the 30 urban areas in terms of their progress against assessing, planning, implementing and monitoring of both adaptation and mitigation are assessed and visualised in Figure 4. Overall, the highest scoring urban areas are Leicester and London, both of which provide separate plans for adaptation and mitigation (Leicester City Council, 2010a, b; Mayor of London, 2011a, b), assimilate these with the core strategy (e.g. Leicester City Council, 2010c), and provide regular reports and carbon footprints (e.g. Leicester City Council, 2011). Some areas provide various other plans such as the ‘Climate Change Risk Assessment and Management Plan’ (Cambridge City Council, 2009) or ‘Adapting to Climate Change Creating Natural Resistance’ (London Climate Change Partnership, 2009).

Aberdeen, for example, scores a 3 for adaptation analysis, and although their adaptation plan (Aberdeen City Council, 2002) is a decade old, the Council

completed a Local Climate Impact Profile in 2008. Across other categories, Aberdeen scores 2 as the council provides Carbon Programmes (Aberdeen City Council and Carbon Trust, 2010), have signed the Scotland's Climate Change Declaration and the Covenant of Mayors initiative, thus providing annual progress reviews. However, it is unclear if they have a standardised process or state of the art monitoring and reviewing. Derry, on the other hand, has only recently embarked upon tackling climate change and therefore scores between 0 and 1 in the different categories. Although Wrexham scores low as well the council considers mitigation to be a performance criteria (Wrexham County Borough Council, 2011), but planning, implementation and review processes are not established yet.

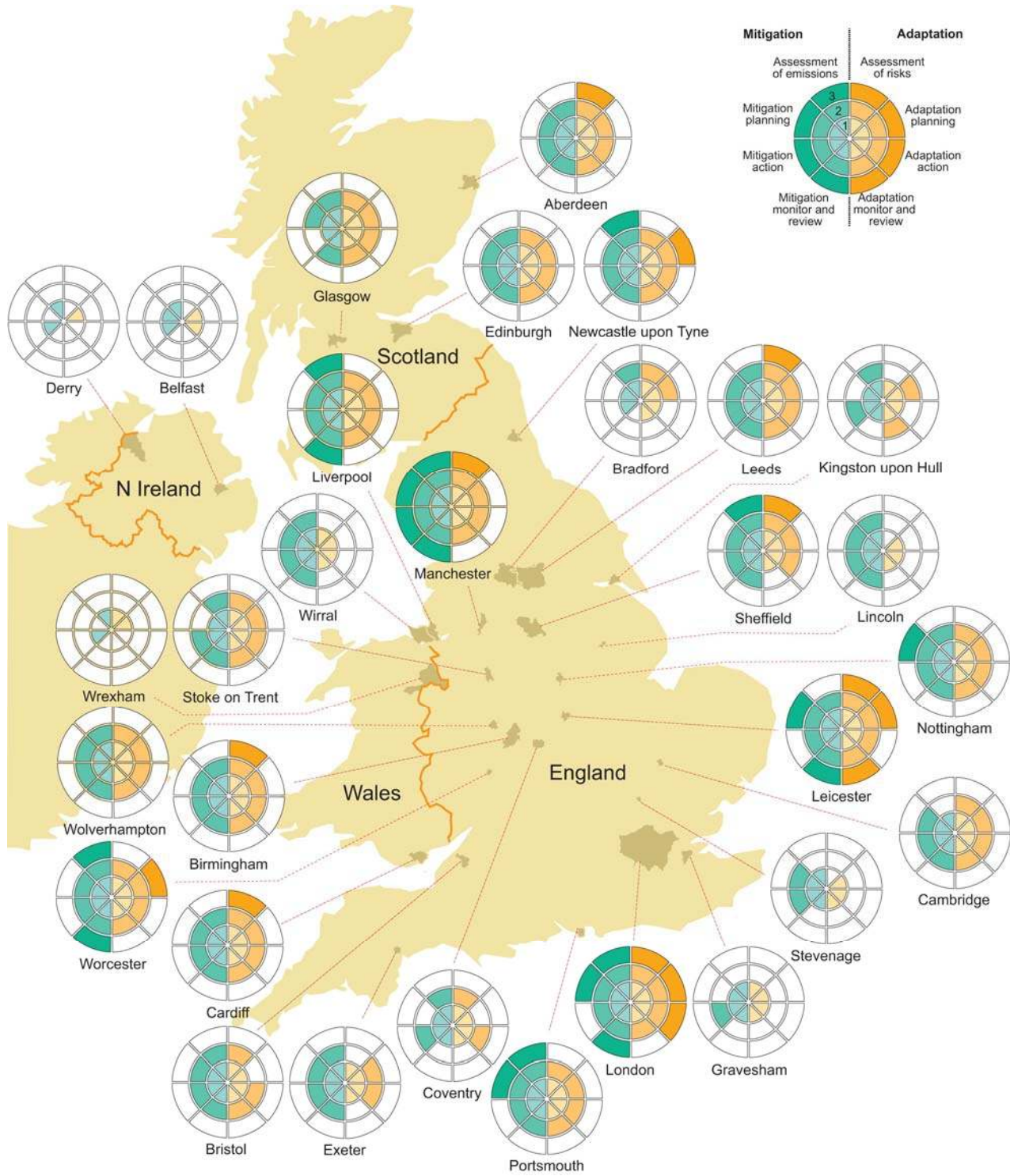


Figure 4: Urban areas and their Climate Change Preparedness Scores (3 being most advanced)

4. Discussion

The strengths of our Urban Climate Change Preparedness Score are that it is more informative than a single number as it captures both, quality and progress, recognising adaptation and mitigation processes. The assessment is rapid to undertake and easy to visualise, and could therefore be undertaken at regular intervals to determine progress and provide a national overview to central government. The potential weakness of any such scoring system is that may overly standardise strategies and their contents thereby reducing the potential for local innovation. Despite following the criteria outlined in Tables S2 and S3 a degree of subjectivity is inevitable.

From the 30 urban areas, 52 official climate adaptation and mitigation documents were obtained, highlighting the plethora of climate initiatives. Although the existence of multiple documents and targets is potentially confusing, the majority are internally consistent and were developed for different purposes. For example, Sustainable Edinburgh 2020 outlines plans to reduce carbon emissions by 40% across Edinburgh (Scope 2) by 2020, whilst the Edinburgh Carbon Management Plan describes how the local authority will contribute to this goal (Scope 1) through a 25% reduction in CO₂ emissions over a five year period using a baseline of 2005/06. However, in several instances discrepancies are evident. For example in Cardiff, despite both emerging from the same department, the 'Carbon Lite Action Plan' (Cardiff Council, 2010) and the 'Sustainable Development Action Plan 2009-12' (Cardiff Council, 2009) cover activities controlled by the council, businesses and households (Scope 2) but the Carbon Lite Action Plan refers to district and decentralised energy generation, energy from waste, combined heat and power, tidal power and solar energy, whereas the Sustainable Development Action Plan does not refer to any of those mitigation measures but refers to biomass and wind energy, which in turn is not mentioned by the Carbon Lite Action Plan.

As noted by Carter (2011) and Adaptation Sub-Committee (2010) a proliferation of policies and strategies can lead to confusion, or authorities paying lip service to the issue of climate change rather than embedding adaptation and mitigation within their ethos. It is our view that the role of the documents within the planning process is not clearly defined and there is no consensus whether adaptation and mitigation should

be addressed separately, together; or within the context of a wider policy on urban sustainability.

Although most urban areas recognised that adaptation and mitigation are related, the larger emphasis tends to be placed upon mitigation with an average score across all urban areas and stages of 1.88 for mitigation compared with 1.73 for adaptation. This is in part because of legislation to meet national targets, these targets are easier to define and measure and many authorities highlight the immediate economic and air quality benefits of reducing energy use (Bassett and Shandas 2010). Conversely, as also observed by Bulkeley (2010), adaptation is perceived, at least in the short term, to require upfront investment and be more complex to weave into longer term strategies.

Even though various strategies set a range of targets these are not necessarily consistent across the same authority (e.g. Coventry or Portsmouth). It should be noted that sometimes these inconsistencies are due to the scope of the documents. Often authorities set more ambitious targets for their own operations, reflecting opportunities within their control, than for the area as a whole, as this requires action from third parties including citizens, utility owners, commerce and industry.

Our analysis shows (Table S1) that most documents are authored by sustainability/environment units, but they do not consider strategies across different sectors and are often not connected to sectoral strategies. For example, a transport strategy is often developed by the transport unit in line with PPS 13, the different authorship and purpose of this strategy has led to at best a missed opportunity in terms of maximising cross-sector benefits, or in some instances conflicting statements about mitigation targets and priorities. New business and delivery models are required that can more readily take advantage of potential co-benefits and ensure improved collaboration across relevant sectors and organisations.

There are many potential reasons as to why cities have different scores and our analysis shows that population or size of the city does not strongly correlate with the preparedness score for these 30 cities. London, Leicester and Manchester demonstrate a high level of adaptation and mitigation implementation and reviewing, as well as having an established process well embedded in their planning process.

Bradford, Stevenage and Gravesham have strategies, but their monitoring process appears less well developed. The three Scottish urban areas score well, which is understandable as they provide annual progress updates as signatories to Scotland's Climate Change Declaration. Three of the four areas in Northern Ireland and Wales score poorly, except for Cardiff which is a signatory of the Covenant of Mayors. Interviews with local officials revealed that this process is now underway, however, regional and national legislation or agreements may improve the design of adaptation policies (perhaps through sharing of experiences), but certainly improve the monitoring and reviewing process.

It is a general observation that urban areas that are required (Scottish CC declaration) or volunteer (Covenant of Mayor) to report on climate change are more advanced and achieve higher scores. Climate change drivers and impacts do not respect administrative boundaries of councils or metropolitan areas, therefore policies to manage adaptation and mitigation will, in many instances, be more successful if implemented over broader areas. If a large proportion of transport emissions are generated by people living outside the urban area then substantial transport mitigation will only be possible at a supra-urban scale. Likewise, activities to manage flood risk must be cognisant of their effect in neighbouring constituencies. However, aligning multiple local authority objectives is challenging, but in many instances infrastructure and services are operated by another set of agents, often with different priorities. In this regard, London, which has a unique governance structure in the UK, has an advantage over many local authorities. The Greater London Authority, comprising 33 local authorities, has strategic powers over sectors such as transport, economic development and emergency planning. This breadth of oversight and a capacity to lever greater resources enables adaptation measures to be implemented at the systems-scale (e.g. tackling the urban heat island, or tidal flood risk across the estuary) and mitigation activities do not require re-aligning the priorities of multiple agents (e.g. Transport for London has responsibility for over- and underground rail, ferries, buses, hire bicycles and congestion charging). Individual measures still require consideration of local issues, whilst other policies are better addressed by central government. A multi-scale approach seems desirable, but to ensure climate objectives are met will also require collaboration with the other agents and organisations responsible for many sectors.

To manage the adaptation and mitigation process the four stages of assessing, planning, action and review are applicable across areas and even sectors. The methodology presented in this paper helps to assess and rate the overall performance and status of adaptation and mitigation planning and implementation across urban areas. It makes a national and international comparison of urban areas and their climate change adaptation and mitigation initiatives consistent, transparent and easy. The general approach could be transferred to other countries. Indeed, many of the systems considered (e.g. ISO 14001, Covenant of Mayors) are already international. However, the information used for scoring (Tables S2 and S3) would need to be augmented to ensure evidence specific to each country was incorporated e.g. considering 'Le Grenelle Environnement' process for French Authorities (Ministère de l'Ecologie, 2012). Our method can be utilized by central government and voluntary organizations such as ICLEI or the Covenant of Mayors to compare urban areas. Also representatives from local government may be interested to benchmark their performance against other urban areas using the Climate Change Preparedness Scores.

5. Conclusions

This paper has reviewed and analyzed climate change policies, strategies, plans and programmes from 30 urban areas in the UK and has proposed a metric to assess their Urban Climate Change Preparedness. This scores the depth of analysis and implementation progress of adaptation and mitigation policies at the urban area level, yet is sufficiently straightforward to enable rapid assessment across areas and even countries. Unlike similar assessments, it is based upon documented evidence rather than survey results from local government officials.

This analysis has shown that UK urban areas of all sizes acknowledge climate change being a threat, although there is larger variation in the detail of analysis, targets and timeframes. Furthermore, targets are seldom in line with international and national magnitudes or timescales. Moreover, there are a considerable spread of mitigation and adaptation measures under consideration, whilst their degree of implementation varied across the UK. We have shown inconsistency between strategies from different urban areas but also between strategies produced by a single authority.

We have identified and discussed a number of mechanisms that could explain some of the differences in the climate preparedness scores. Whilst governance structures and institutional capacity have an influence, areas obliged (whether by regulations, self-imposed, or as a prerequisite for membership of another body) to report on their progress appear more advanced in adapting and mitigating – highlighting the important benefits regulation and incentives can have.

Given the importance of urban areas and spatial planning to manage climate impacts and reduce emissions, it is essential to embed adaptation and mitigation within the urban planning framework and the organisations responsible for delivering local infrastructure and services. This must be supported through local, national and international initiatives to stimulate and, where necessary, enforce appropriate action, monitoring and review.

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Assessment of the climate preparedness of 30 urban areas in the UK

Supplementary Information

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Table S1: Urban Areas and climate change (CC) documents analysed

Urban Area	Population in 2010	Covenant of Mayor	Nottingham, Scotland, Welsh Declaration	Name of climate initiative analysed	Status ¹	Authors	Date	Scope ²
Aberdeen	217,100	Yes	Yes	Climate Change (CC) action programme	F	Environment and CC Working Group	2002	AA
				Carbon management plan 2010-2015	F	Carbon Group and Carbon Trust	2010	AO
Belfast	268,700	No	N/a	Corporate plan 2008-2011	F	Councillors	2008	AA
				Sustainable development action plan 2009-11	F	Sustainable Development Steering Group	2009	AA
Birmingham	1,036,900	Yes	Yes	CC action plan 2010+	F	Department for CC and Sustainability	2010	AA
Bradford	512,600	No	Yes	CC strategy for Bradford district-DRAFT	C	Environment and CC Unit	2011	AA
Bristol	441,300	Yes	Yes	CC and energy security framework	C	Strategic Director – City Development	2010	AA
Cambridge	125,700	No	Yes	CC strategy and action plan 2008-2012	F	Environment and Planning	2008	AA
				Environmental action plan	F	Sustainable City Team	2010	AO
Cardiff	341,100	Yes	No	Carbon lite action plan	F	Sustainable Development Unit	2010	AA
				Sustainable development action plan 2009-12	F	Sustainable Development Unit	2009	AA
Coventry	315,700	No	Yes	CC strategy for Coventry	F	CC, Housing & Sustainability	2008	AA
				Carbon management plan	F	Carbon Team and Carbon Trust	2009	AO
Derry	107,300	No	N/a	No published plan, strategy etc. available	A	n.a.	n.a.	
Edinburgh	486,100	Yes	Yes	CC framework 2007-2015	unclear	Carbon, Climate and Sustainability Team	2007	AO
				Carbon management programme	F	CCS Team and Carbon Trust	2008	AO
				Sustainable Edinburgh 2020	F	CCS Team	2011	AA
Exeter	119,600	No	Yes	CC strategy 2008-18	F	Environmental Coordinator	2008	AA
				Carbon management programme	F	Environ. Coordinator and Carbon Trust	2008	AO
Glasgow	592,800	Yes	Yes	CC strategy and action plan	F	Development and Regeneration Services	2010	AO
				Sustainable Glasgow Report 2010	C	Sustainable Glasgow	2010	AA
Gravesham	99,600	No	No	CC and environmental protection-baseline 2009	unclear	not clear	2009	NS
				Environment and adaptation plan 2011-14	unclear	not clear	2010	AA
Kingston upon Hull	263,900	No	Yes	CC 2010-20 A low carbon framework	F	Environment and CC Advisory Group	2010	AA
Leeds	798,800	No	Yes	CC strategy-vision for action	F	Environment Leeds and CC Partnership	2010	AA

¹ Status is defined as: A- no official plan, strategy etc. exist; B- official decision to develop plans exist; C- preliminary work has commenced; D- draft plan published; E- final plan submitted for approval by Authority; F- Plan approved by Authority and published.

² Scope is defined as: NS- Not Stated; AO- Authority Only- covers only activities controlled by the Authority; AA- Across Authority- covers activities across the Authority i.e. activities controlled by the Authority, as well as activities by households, industry, businesses.

Urban Area	Population in 2010	Covenant of Mayor	Nottingham, Scotland, Welsh Declaration	Name of climate initiative analysed	Status ¹	Authors	Date	Scope ²
				CC action plan	unclear	not clear	2010	AA
Leicester	306,600	Yes	Yes	Carbon footprint statement	unclear	Environment Team	2011	AO
				CC adaptation action plan	E	Environment Team	2010	AA
				CC mitigation action plan	E	Environment Team	2010	AO
				CC mitigation plan for Leicester	E	Environment Team	2010	AA
Lincoln	89,700	No	Yes	CC strategy phase 1	F	Environmental Services	2005	AA
				Carbon management programme	F	Environmental Services and Carbon Trust	2007	AO
Liverpool	445,200	Yes	Yes	CC strategic framework- prospectus of action	F	Regeneration Policy Business Unit	2009	AA
London	7,825,200	Yes	Yes	The Mayor's CC adaptation strategy	F	Mayor of London and GLA	2011	AA
				The Mayor's CC mitigation and energy strategy	F	Mayor of London and GLA	2011	AA
Manchester	498,800	Yes	Yes	Manchester-a certain future-CC action plan	F	City Council (not specified)	2009	AA
Newcastle u. Tyne	292,200	Yes	Yes	Citywide CC strategy & action plan 2010-2020	F	Newcastle Partnership	2010	AA
				Newcastle CC declaration	F	Council (not specified)	2010	AA
				Newcastle CC action plan	F	Council (not specified)	2008	AO
Nottingham	306,700	Yes	Yes	Draft community CC strategy	C	CC Team	2011	AA
				CC adaptation action plan	F	CC Team	2011	AO
Portsmouth	207,100	No	Yes	CC strategy	F	Portsmouth Sustainability Action Group	2009	AA
				Carbon management programme	F	Council and Carbon Trust	2009	AO
Sheffield	555,500	No	Yes	Carbon reduction framework	C	Not specified	2009	AA
				Environmental strategy	F	Sheffield First	2007	AA
Stevenage	81,800	No	Yes	CC strategy	F	Borough Council	2009	AA
				CC strategy-action plan	F	Borough Council	2011	AO
Stoke-on-Trent	240,100	Yes	Yes	DRAFT sustainability and CC	C	City of Stoke	2010	NS
Wirral	308,800	No	Yes	CC strategy	F	Sustainability dep; Wirral CC Group	2007	AA
				CC strategy actions	F	Sustainability dep; Wirral CC Group	2007	AO
Wolverhampton	239,400	No	Yes	CC strategy and action plan 2009-12	F	Council and Wolverhampton Partnership	2009	AA
				Carbon strategy and implementation plan	F	Council and Carbon Trust	2008	AO
Worcester	94,800	No	Yes	Worcester City Council CC strategy	F	Policy and Performance Team and CC WG	2009	AO
Wrexham	133,600	No	No	No published plan, strategy etc. available	A	n.a.	n.a.	
Total	17,352,700	13	25	52 documents analysed in detail				

Table S2: Method for scoring the preparedness of climate change adaptation activities (refer to Table S1 for status and scope classification)

Score	Assessment	Planning	Action	Monitoring
0	No evidence of assessment or acknowledgment of current and future climate risks found.	No evidence of climate change adaptation planning and/or scored 0 on NI 188.	No evidence of climate change adaptation action plans or project activities.	No evidence of climate change adaptation monitoring and/or that annual reviews of climate change adaptation activities are conducted.
1	Acknowledges climate change risk but not formalised (status A-B). Evidence is gathered from website and discussion with member of staff only (i.e. not published).	Evidence of adaptation planning from website and discussion with member of staff (status A-B), but not drafted or a formalised process yet and/or scored 1 or below on the NI 188.	Publishes disjointed case studies on website or leaflets but does not have an adaptation action plan published (status A-B).	Provides no monitoring or process but based on discussion the authority and/or the department considers reviews informally (status A-B); some senior management commitment is evident (e.g. statement on a website and/or declaration).
2	Provides some adaptation risk assessment (status C-D) at authority level and/or regional level, but did not use a standardised method (or not available) and/or coverage was not across the whole urban area and/or include risks associated with selected sectors (scope AO).	Drafting of climate change adaptation plan and/or provides evidence that planning is conducted (status C-D) at parts of the area or at the regional level but not for the whole urban area and sectors (scope AO) following standardised processes and has standardised management systems in place (e.g. 14001) and/or scored 2 or below on the NI 188.	Provides action plan but not clear if it is published or approved by the authority (status C-D); and/or provides selected case studies but are not clearly linked to the action plan and not for the whole area and sectors (scope AO).	Senior management commitment is evident (e.g. minutes from councillor meetings; signatory of declaration) but no formal commitment or formalised procedure (status C-D) for monitoring and review; does not cover the whole area and sectors (scope AO).
3	Publishes local climate impact profile or similar assessments of risks; conducts detailed risk assessments and is active in regional climate change risk assessments using standardised methodologies covering the whole urban area and various sectors (scope AA); formalised (status E-F) and is state of the art.	Publishes climate change adaptation plan (status E-F) for the whole urban area and sectors (scope AA) and aligned with regional and national planning processes; describes methods and has standardised management systems in place (e.g. 14001); and/or scored 2 or above on the NI 188; formalised and is state of the art.	Provides action plan authorised by the authority (status E-F) covering the whole area and sectors (scope AA); follows up; report outputs of actions and has implemented various projects and provides case studies; formalised and is state of the art.	Has an established process of annual reviews and reporting (e.g. signatory of declaration and/or Covenant of Mayors); senior management commitment is evident and (status E-F) formalised procedures are in place (e.g. ISO 14001 or similar) covers the whole area and sectors (scope AA); formalised and is state of the art.

Table S3: Method for scoring the preparedness of climate change mitigation activities (refer to Table S1 for status and scope classification)

Score	Assessment	Planning	Action	Monitoring
0	No evidence that the authority has assessed its carbon and/or GHG emissions.	No evidence that the authority is providing, or is in the process of providing a mitigation plan.	No evidence of climate change mitigation action plans or projects.	No evidence of climate change mitigation monitoring and/or that annual reviews of climate change mitigation activities are conducted.
1	Provides carbon and/or GHG accounting for some sectors; and/or does not follow standardised process/methodology; and/or does not publish results (status A-B); and/or is out of date.	Evidence of mitigation planning from website and discussion with member of staff, but not drafted or a formalised process yet (status A-B).	Publishes disjointed case studies on website or leaflets but does not have a mitigation action plan published (status A-B).	Provides no monitoring process but based on discussion the authority and/or the department considers reviews informally (status A-B); some senior management commitment is evident (e.g. statement on a website or leaflet).
2	Started to assess carbon and/or GHG accounting for authority only and not cross sectorial (status C-D); uses standard method (e.g. Carbon Management Programme or equivalent) but is not considering whole area and sectors (scope AO).	Drafting of climate change mitigation plan and/or provided evidence that planning is conducted (status C-D) at parts of the area or at the regional level but not for the whole urban area and sectors (scope AO) following standardised processes and has standardised management systems in place (e.g. 14001) to manage the process.	Provides mitigation action plan but is not clear if it is published or approved by the authority (status C-D); and/or provides selected case studies but not clearly linked to the action plan and not for the whole area and sectors (scope AO).	Senior management commitment is evident (e.g. minutes from councillor meetings; signed declaration) but no formal commitment or formalised procedure (status C-D) for monitoring and review is in place and does not cover the whole area and sectors (scope AO).
3	Assessed and reported carbon and/or GHG accounting for whole area and sectors (scope AA); uses standard method (e.g. Carbon Management Programme or equivalent); active at local and regional level, formalised (status E-F) and is state of the art.	Publishes climate change mitigation plan for the whole urban area and sectors (scope AA) and aligned with regional and national planning processes; clearly defined methods and has standardised management systems in place (e.g. 14001) to manage the process; formalised (status E-F) and is state of the art.	Provides mitigation action plan authorised by the authority covering the whole area and sectors (scope AA) and follows up action plan; reports outputs of actions and has implemented various projects and provides case studies; formalised (status E-F) and is state of the art.	Has an established process of annual reviews (e.g. signatory of declaration and/or Covenant of Mayors); senior management commitment is evident and formalised procedures are in place (e.g. ISO 14001 or similar); covers the whole area and sectors (scope AA); formalised (status E-F) and is state of the art.