C40 CITIES
CLIMATE LEADERSHIP GROUP

ARUP

Climate Action in Megacities 3.0

Networking works, there is no global solution without local action.

December 2015

"The eyes of the world will be on Paris this December, where governments will agree a new, universal climate change agreement. National contributions to this agreement reflect the great potential of cities to rapidly move to low-carbon growth. Implementing the Paris outcomes will require active engagement by cities – and cities are prepared to play a leading role, as clearly shown by C40's new report Climate Action in Megacities 3.0."

Christiana Figueres, *Executive Secretary of the United Nations Framework Convention on Climate Change*

"City governments – learning from each other and through networks like C40 – are already acting on climate. What is good for climate action in cities, is also good for economic growth – investing in public and low emission transport, building efficiency, and waste management in cities could generate as much as US$17 trillion in savings by 2050. This kind of cooperative action can bring about better growth and better climate."

Felipe Calderon, *Chair of the Global Commission on the Economy and Climate and former President of Mexico*

"We're in better shape going into Paris than we were going into Copenhagen largely because of the progress cities have made, and C40 cities have helped lead the way. It's a great example of the power of cooperation - a lesson told in this report that I hope will inspire world leaders at the U.N.'s climate change conference."

Michael R. Bloomberg, *UN Special Envoy for Cities and Climate Change*

"Knowledge is a valuable commodity in the green economy, and knowledge shared is knowledge amplified. The C40 process recognizes this, avoids 'reinventing the wheel' and encourages people to find and highlight technology. It recognizes that this challenge is not about "particulates per ton" but about the well-being of people. The findings of the report indicate that this collaboration is working, with 30% of all climate action in C40 cities taken as a result of city-to-city collaboration, 80% of which is through C40. This gives me great hope that together we can avert the crisis of climate change."

Gro Harlem Brundtland, *former Prime Minister of Norway, former Director-General of the World Health Organisation, former UN Special Envoy for Climate Change (2007-2009), and Deputy Chair of The Elders*

"The C40 now comprises more than 80 cities that are pooling imagination, developing common approaches and sharing best practices to address the challenge of sustainability, our planet's most daunting challenge. If you are feeling pessimistic about climate change, peruse the C40's new Report "Climate Action and Megacities 3.0." It walks the talk when it says "the network works," and it gives hard evidence that through networked local urban actions we can achieve global sustainability "glocality" at its very best."

Benjamin R. Barber, *Senior Research Scholar, The Graduate Center, The City University of New York*

C40 CITIES CLIMATE LEADERSHIP GROUP

The C40 Cities Climate Leadership Group, now in its 10th year, connects more than 80 of the world's greatest cities, representing 600+ million people and one quarter of the global economy. Created and led by cities, C40 is focused on tackling climate change and driving urban action that reduces greenhouse gas emissions and climate risks, while increasing the health, well-being and economic opportunities of urban citizens. www.c40.org

PARTNERSHIP

This report has been delivered through a collaborative partnership between C40 and Arup, the global consultancy firm. Arup has worked with C40 since 2009 to develop strategic research that is central to progressing our understanding of how cities contribute to climate change mitigation and adaptation. This is why in June 2015, Arup announced a major partnership with C40, committing $1 million of professional support over three years to help cities take meaningful action against climate change.

This partnership is founded on Arup's independent and evidence-based approach, alongside C40's longstanding belief in "measurement for management". The partnership supports a strong research agenda, aggregating and analysing city data to help city actors identify opportunities, collaborate and to build roadmaps that will enable them to take meaningful climate action faster and more efficiently.

The C40-Arup partnership is supported by the City Leadership Initiative (CLI) at University College London (UCL). The CLI is a collaboration of UCL, World Bank and UN-Habitat and is geared towards providing improved understanding and advice on the role of city leadership in addressing global challenges.

DONORS

Bloomberg Philanthropies' mission is to ensure better, longer lives for the greatest number of people. The organization focuses on five key areas for creating lasting change: Public Health, Environment, Education, Government Innovation and the Arts. Bloomberg Philanthropies encompasses all of Michael R. Bloomberg's charitable activities, including his foundation and his personal giving. In 2014, Bloomberg Philanthropies distributed 462 million USD.

The Children's Investment Fund Foundation (CIFF) is an independent, philanthropic organisation. Our staff and Trustees combine the best of business and the best of development, bringing a wealth of experience from both sectors to CIFF's work. We aim to demonstrably improve the lives of children in developing countries by achieving large-scale, sustainable impact. We believe that every child deserves to survive, thrive and mature into adulthood in a supportive and safe environment. However, climate change disproportionately affects children living in poverty in developing countries. A key focus for CIFF is climate-smart urbanisation.

Realdania is a modern philanthropic association that works to create quality of life and benefit the common good by improving the built environment: cities, buildings and the built heritage. Realdania grew out of a 150 year old mortgage credit association whose credit activities were sold off in 2000. Over the past 13 years Realdania has engaged in a total project value of approximately EUR 3.7 billion. Realdania's grants accounted for EUR 1.9 billion.

CONTENTS

FOREWORDS

Eduardo Paes

If cities can work together to tackle climate change, nation states can too.

As the international community heads into the crucial COP 21 talks in Paris, this third edition of C40's flagship publication, Climate Action in Megacities (CAM 3.0) presents a definitive assessment of how the world's leading mayors have taken on the urgent challenge of climate change since the unsuccessful Copenhagen climate talks of 2009. By working together, the world's greatest cities are forging a pathway to low carbon and climate resilient development, setting an example for nations to follow.

Based on 2.3 million data points from 66 of C40's current roster of 82 member cities, CAM 3.0's quantitative survey demonstrates that cities are making progress across all sectors, from urban transport to waste management, while improving climate resilience.

Importantly, the report provides compelling evidence for why city governments have demonstrated an ability to get to grips with climate change where others have failed, namely: the ability of mayors to collaborate across geographic, political and economic boundaries. According to our members, 30 percent of the 10,000 climate actions delivered by C40 cities since COP 15 in Copenhagen have been achieved because of collaboration between cities. Four fifths of this collaboration has taken place through C40 itself – a testament to the service offering C40 has built since it was created in 2005.

Success, however, brings new challenges. While CAM 3.0 records a surge in climate action in C40 cities, global carbon emissions continue to rise, increasing the threat of runaway climate change. Significantly, other recent research by C40 shows that a third of the remaining carbon budget (the amount of greenhouse gases that scientists estimate we can 'safely' emit) could be determined by urban policy decisions in the next five years.

The conclusion is clear – cities and mayors are now a central part of the solution to climate change. As CAM 3.0 shows, we have made progress in building a world-class organization that helps our cities work together to meet that global challenge. But we need a lot more support to reach our full potential. Seventy percent of the climate actions recorded in this survey have been funded directly by city authorities. National governments, multi-lateral funding agencies and the private sector need to step up if we are to accelerate action to the level needed. That is why I strongly defend the creation of a global cities climate fund.

The evidence in CAM 3.0 should provide hope to the world and backbone to the climate negotiators assembling in Paris this month to agree on a new, universal climate change accord. If cities can work together to tackle climate change, nation states can too.

Eduardo Paes
Mayor, Rio de Janeiro
Chair, C40

Gregory Hodkinson

Cities have long been the centres of economic, political and social activity, they also have a significant impact on our planet's health. Indeed, whilst cities generate around 80% of GDP, they also consume over two-thirds of global energy and emit more than 70% of greenhouse gases. Against this backdrop it is logical – indeed imperative - that cities take the lead in tackling the global challenge that is climate change.

This is why Arup is delighted to collaborate once again with the C40 Cities Climate Leadership Group to deliver *Climate Action in Megacities 3.0 (CAM 3.0)*. This third instalment of CAM presents new evidence of the burgeoning scale of actions that cities globally are taking to address climate change. The findings highlight both the impressive rate of progress that the C40 network has helped to propagate since it was founded ten years ago, and also the significant opportunities that still exist to help cities do more.

For the first time, CAM 3.0 quantifies the cost of implementing climate action in cities and the carbon savings that can accrue from targeted investments. We have shown that cities are investing to initiate climate actions and when proven to work, cities are seeking opportunities to leverage support from central governments and mobilising the private sector to scale up actions city-wide. As cities are investing in climate action they are making themselves highly investable.

More than ever, cities are focusing on climate adaptation and resilience alongside ongoing efforts to reduce emissions. Over recent years, the world has seen a growing frequency and magnitude of climate related shocks affecting cities. Climate resilience is an increasingly urgent requirement of urban planning, engineering and design. Knowledge transfer across sectors and through global networks can help cities prepare for these changes in global climate.

CAM 3.0 comes at a critical time for international climate change politics, as nations gather to negotiate a global agreement on climate change at the 21st Conference of the Parties to the UN Framework Convention on Climate Change in Paris. This research demonstrates that local action is having global impact. National governments are not alone; cities and their partners are ready to come together in a global commitment on climate change.

Gregory Hodkinson
Chairman
ARUP

9,831

Individual climate actions underway in C40 cities since 2011.

51%

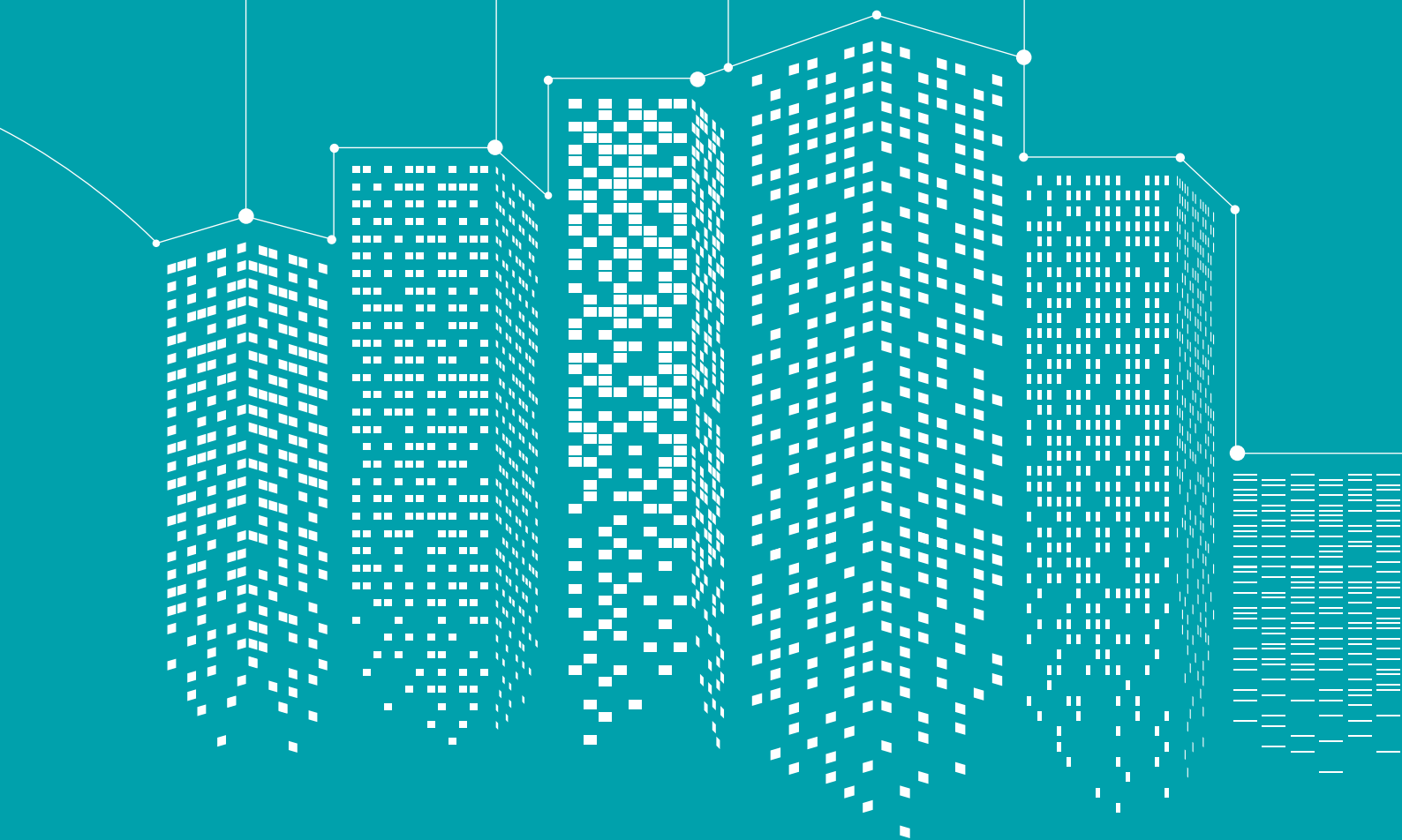
Of actions being delivered by cities in 2015 are at the city wide scale, up from 15% in 2011. This is a 260% increase.

70%

Of C40 cities report that they are already experience the effect of climate change.

30%

Of all climate actions in C40 cities are now being delivered through city-to-city collaboration.



EXECUTIVE SUMMARY

***Climate Action in Megacities 3.0* (CAM 3.0) presents major new insights into the current status, latest trends and future potential for climate action at the city level. Documenting the volume of action being taken by cities, CAM 3.0 marks a new chapter in the C40-Arup research partnership, supported by the City Leadership Initiative at University College London. It provides compelling evidence about cities' commitment to tackling climate change and their critical role in the fight to achieve global emissions reductions.**

66

For this study 66 C40 cities reported on the action they are taking.

Cities Continue To Scale-Up Action

When the first CAM report was published in 2011, 36 cities reported on their actions to mitigate and adapt to the effects of climate change. Today, that number has reached 66. Not only has the number of actions these cities are taking increased, but importantly, the scale at which they are rolling them out has grown as well. Actions being carried out at the city-wide scale have risen to 51% of all action, up from just 15% in 2011. Ever more cities are scaling up actions to the significant and city-wide scales, having completed pilot schemes to confirm which actions are viable, practical, and effective in reducing emissions and adapting to climate change trends.

An increase in significant or city-wide actions across all action areas demonstrates that cities are learning – from their own experiences as well as those of other cities – which actions to implement, how to implement them, and where to allocate human and capital resources to deliver the greatest benefits.

645 $MTCO_2e$

C40 and SEI research estimates that the total potential annual savings by 2020 from city action currently under way in C40 cities is 645 $MtCO_2e$.

Despite the positive progress, much more transformative action is still required globally. Research carried out by C40 and SEI in '*Keeping cities green: Avoiding carbon lock-in due to urban development*' shows that based on current trends of consumption and infrastructure development, within five years we will have "locked-in" sufficient emissions to exceed the globally safe carbon budget.[1]

C40 Is A Successful Model For Global Collaboration On Climate Change

Since its origins in 2005, the C40 Cities Climate Leadership group has focused on tackling climate change and driving urban action that reduces greenhouse gas emissions and climate risks, while increasing the health, wellbeing and economic opportunities of urban citizens. C40 brings the world's megacities together in meaningful exchanges to speed up the global adoption of climate policies and programs that have been demonstrated to work in one or more member cities. C40's 80+ member cities benefit from sharing ideas and solutions through 16 thematic networks spread across six overarching initiative areas: Adaptation & Water; Energy; Finance & Economic Development; Solid Waste Management; Sustainable Communities; and Transportation.

1 Keeping cities green: Avoiding carbon lock-in due to urban development. C40 & SEI, 2015. http://www.sei-international.org/publications?pid=2829

5

5 years left to make the right decisions to avoid locking-in high chances of unsafe climate change.

Thirty percent of all climate actions in C40 cities are now being delivered through city-to-city collaboration. Given that cities are typically very self-reliant this is an exceptionally high figure. Of these actions, 44% (or 13% of all action) involve collaboration via a specific C40 network. Cases involving C40 networks show 38% more city-wide actions are being delivered, compared with smaller-scale schemes being delivered through collaborations not facilitated by C40. Furthermore, given that few countries have more than one C40 city, these collaborations are usually international rather than local.

With 92% of C40 cities now participating in at least one network, and more global cities planning to join C40, the potential for continued growth in climate action looks very positive.

1/3

Of these decisions will be made in cities.

Cities Are Investing In Climate Action, And Securing Investment From Other Actors

Analysis carried out for the first time in CAM 3.0 reveals that cities are investing extensively in climate action, with capital costs ranging from less than $100,000 to over $10 million for a single action. Cities reported cost data for a small portion of the action they are taking, and even these few actions amounted to an investment of over $2.8 billion.

Funding is often an obstacle to transformative climate action, but the data demonstrates that investments are possible even in cities with modest city budgets. The majority of actions being carried out at the city-wide scale currently cost under $500,000. 70% of these actions are being funded using cities' own budgets or savings. For higher-cost actions, cities are using initial grants and subsidies together with funding from other actors to establish pilot schemes, before investing their own funds to scale up actions once the schemes have proven successful.

64%

Cities funded 64% of reported actions with their own budget and savings.

When developing new climate actions, cities are also using alternative financial mechanisms that support and incentivise action, such as bonds, tolls and developer contributions. With the majority of cities, from Barcelona to Bogotá, now holding international credit ratings, cities are showing that they invest, but they are also highly attractive investments. While funding remains a significant challenge for many cities, the potential for cities to mobilise national and international finance in the sectors where it will deliver the greatest impact is higher than ever.

Local Action, Global Impact

Cities have proven themselves enthusiastic, flexible and capable in their approaches to tackling climate change and delivering local action that contributes to national and global climate targets. As part of CAM 3.0, 19 cities reported for the first time on the carbon impact of some of their individual actions. These actions were predominantly in the Private Transport, Buildings, and Energy Supply sectors and are expected to result in cumulative emissions savings of 28 $MtCO_2e$, most of this by 2025, equivalent to the annual emissions of nine coal-fired power stations. This represents only a fraction of all actions underway across the C40 network, indicating a small portion of the much larger impact that cities are making on global emissions reduction.

Certain high-impact actions within these sectors (e.g. time / day restrictions on personal vehicle usage, introducing Bus Rapid Transit, and entering into long-term contracts with renewable energy generators) offer significant opportunities for investment thanks to their readily quantifiable emissions savings and wider benefits from reduced congestion, air quality improvements, and revenue-generating opportunities. Such developments are helping to establish cities' reputation as global changemakers in addressing the climate change challenge.

485,000 people

Ten cities reported that more than 485,000 people were employed in green jobs / industries.

Taking climate action is also fuelling the burgeoning green economy, creating new jobs, developing skills, and bringing economic advantages for city residents across the world. In 2015, ten cities alone reported employing more than 485,000 people in green jobs and industries. An increasing number of cities are now establishing mechanisms, including revolving funds for low carbon projects and procurement levers to influence private sector climate action, which are further helping to promote the growth and development of the green economy.

Mayors are Creating Future Cities through Effective Climate Action

Encouraged by each other and through networks like C40, city governments from around the world are making an ambitious commitment to take meaningful and substantial action on climate change. In 2014, 228 global cities, representing 436 million people, had set greenhouse gas reduction goals and targets amounting to a cumulative reduction of 13 $GtCO_2e$ by 2050.[2] This emphasises how ambitious cities can be in leading emissions reductions. There is, however, scope for even more long-term thinking.

78%

Of actions underway in C40 cities in 2015 are planned for expansion"

In 2015 cities are demonstrating firm ambition and growing confidence through pioneering initiatives like the Compact of Mayors,[3] a global coalition of city leaders addressing climate change by pledging to reduce their greenhouse gas emissions, tracking their progress and preparing for the impacts of climate change. The Compact of Mayors was launched by C40 Board President and former Chair, UN Special Envoy Mike Bloomberg. Eleven cities are already fully compliant with the Compact of Mayors and a total of 42 C40 cities have already signed up to become compliant in the future.

Cities are not just setting targets to reduce emissions, they are making strong commitments to achieving these with practical action plans and by demonstrating evidence of climate action. For instance in 2015, C40 cities reported plans to expand 78% of the actions they are currently taking, up from 30% in 2011. This is a clear indication of their growing understanding of what action is working and the resulting ambition to build on that success.

Cities can and will play a crucial role in ensuring a climate safe future. By piloting climate action and sharing the lessons learned, cities have built the confidence and ambition to implement effective and investable actions. These are now being scaled to deliver transformative change around the world.

2 Working Together: Global Aggregation of City Climate Commitments. C40 & Arup, 2014.
3 http://www.compactofmayors.org

CHAPTER 1

Introduction

1.1 INTRODUCTION

Climate Action in Megacities 3.0 (CAM 3.0) presents the latest research into city climate action, undertaken by C40 and Arup, and supported by the City Leadership Initiative at University College London (UCL).

The research is based on self-reported data from 66 cities in 2015 (see Appendix A1). Following two previous editions in 2011 and 2013, CAM 3.0 tracks the burgeoning scale and volume of city climate action globally.

C40 now maintains a database of 9,831 unique city climate actions spread across 11 city sectors, with nearly 3,000 actions reported in 2015 alone.

Leveraging the breadth and depth of city data held by C40, CAM 3.0 presents key findings about city climate action, providing fundamental evidence for decision-makers and stakeholders involved in negotiations towards a global agreement on climate change. The research demonstrates the crucial role that cities continue to play in addressing climate change, and validates their position as a critical partner to state actors.

The report is structured around findings that support cities' role in reducing global emissions and the risks from associated climate change.

Chapter 2: Transformative Climate Action:
Cities are Scaling Up Solutions.
Analysing climate action trends since 2011, with particular focus on the scale and areas of action.

Chapter 3: A Successful Model for Global Collaboration:
C40 is Working.
Exploring the role of networking and collaboration in cultivating city climate action, incorporating insights from city actions and C40's 16 thematic networks.[4]

Chapter 4: Financing Climate Action:
Cities are Investing.
Focusing on understanding new data collected for 2015 on the costs and funding of city climate action.[5]

4 Climate Action in Megacities 1.0: C40 Cities Baseline and Opportunities, C40 & Arup, 2011.
5 Climate Action in Megacities Volume 2.0, C40 & Arup, 2014.

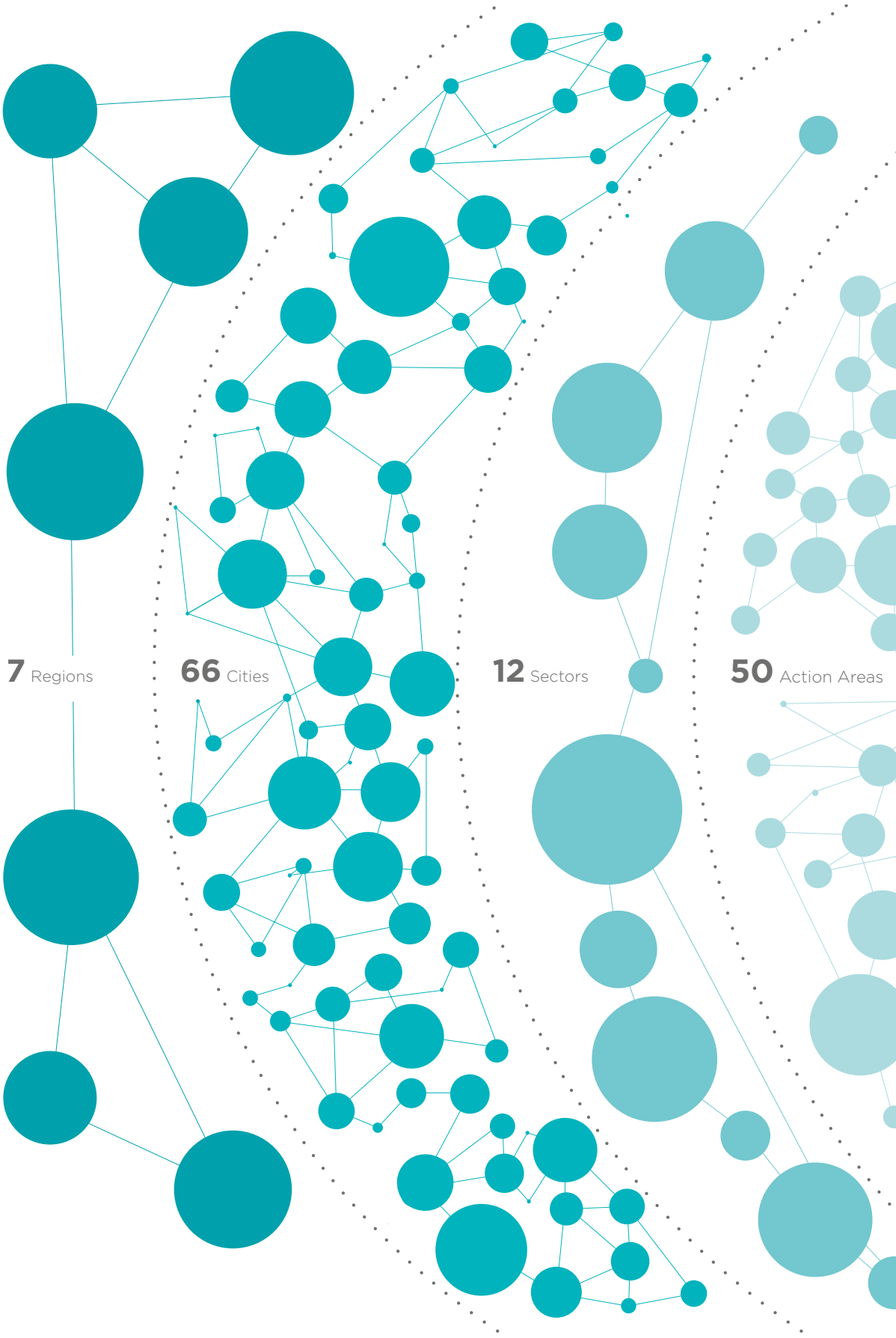
Chapter 5: Cities as Changemakers:
Local Action Delivers Global Impact.
Investigating the direct benefits of city climate action, focusing on greenhouse gas emissions reductions, and building on a number of C40 research streams in addition to the CAM questionnaire.

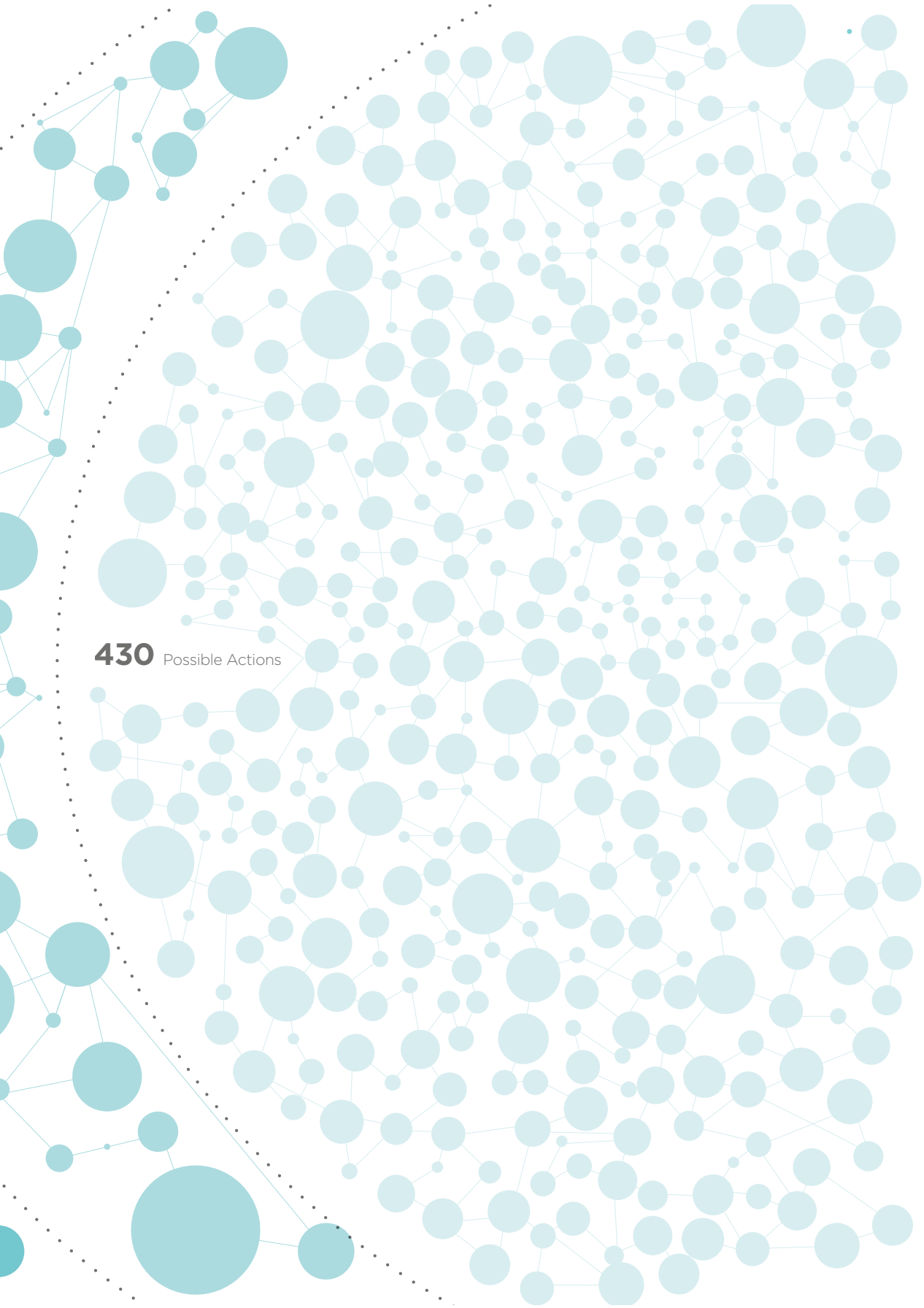
Chapter 6: Cities on the Frontline:
Mayors are Leading Effective City Climate Action for Future Cities.
Highlighting cities' ambitions, goals, and commitment to a zero-carbon future and sustainable global development.

1.2 THE C40 CLIMATE ACTION FRAMEWORK

In researching the climate action taken by the world's megacities, C40 and Arup have developed a detailed framework for the recording and reporting of action. The infographic on the following page demonstrates how data is collected from 66 cities in 7 regions, to cover actions taken in 12 distinct city sectors. Actions in these sectors are broken down across 50 thematic action areas. For a given action that cities are taking, say, "tree planting", cities report on up to 12 data points, covering action scale, the lever used to deliver the action, through to the primary and secondary financial mechanisms used, cumulative emissions savings anticipated, and detailed descriptions. The rich Climate Action dataset now sits at nearly 10,000 unique actions reported since 2011.

1.2 THE C40 CLIMATE ACTION FRAMEWORK




430 Possible Actions

1.3 GLOSSARY OF TERMS

The following terms, developed during the first two editions of CAM, have specific and important meanings within this report.

Climate Action	
Climate Actions	Climate actions are defined as the measures and initiatives cities take to reduce the severity of climate change (mitigation), or their exposure to the effects of climate change (adaptation).
Sectors	Individual sectors of activity in which climate action is being taken by cities. This includes: Adaptation, Buildings, Community-scale Development, Energy Supply, Finance, Food & Agriculture, Mass Transit, Outdoor Lighting, Private Transport, Waste, Water
Overview Data	Descriptive data about the city's characteristics, for example population, GDP, volume and types of waste produced in the city.
Action Area	Thematic groups of actions or tasks where cities pursue climate action within a sector, e.g. 'Water recycling and reclamation' in the Water sector, or 'Energy efficiency / retrofit measures' in the Buildings sector.
Action	Activities leading to climate actions that are underway and planned within the city, including, for example, whether the city is taking action on 'Advanced thermal treatment of biomass'.
Levers	Identifies how an action is taken. When a city is taking action – such as upgrading buses to increase accessibility – they may be doing so with the use of: - Incentive / Disincentive - Policy - Procurement - Programme / Project
Scale	Identifies the extent to which an action is introduced across the city, e.g. are dedicated cycle lanes being implemented across the whole city or piloted in one area initially? The scales are: - Transformative (city-wide) - Significant - Pilot - Under consideration
Networking measures	Investigates how cities are working with each other to deliver actions in their city. Cities have been asked to identify which type of network, if any, they have used. The options are: - Working with cities in a specific C40 network- - Working with other C40 cities - Working with non-C40 cities - None of the above

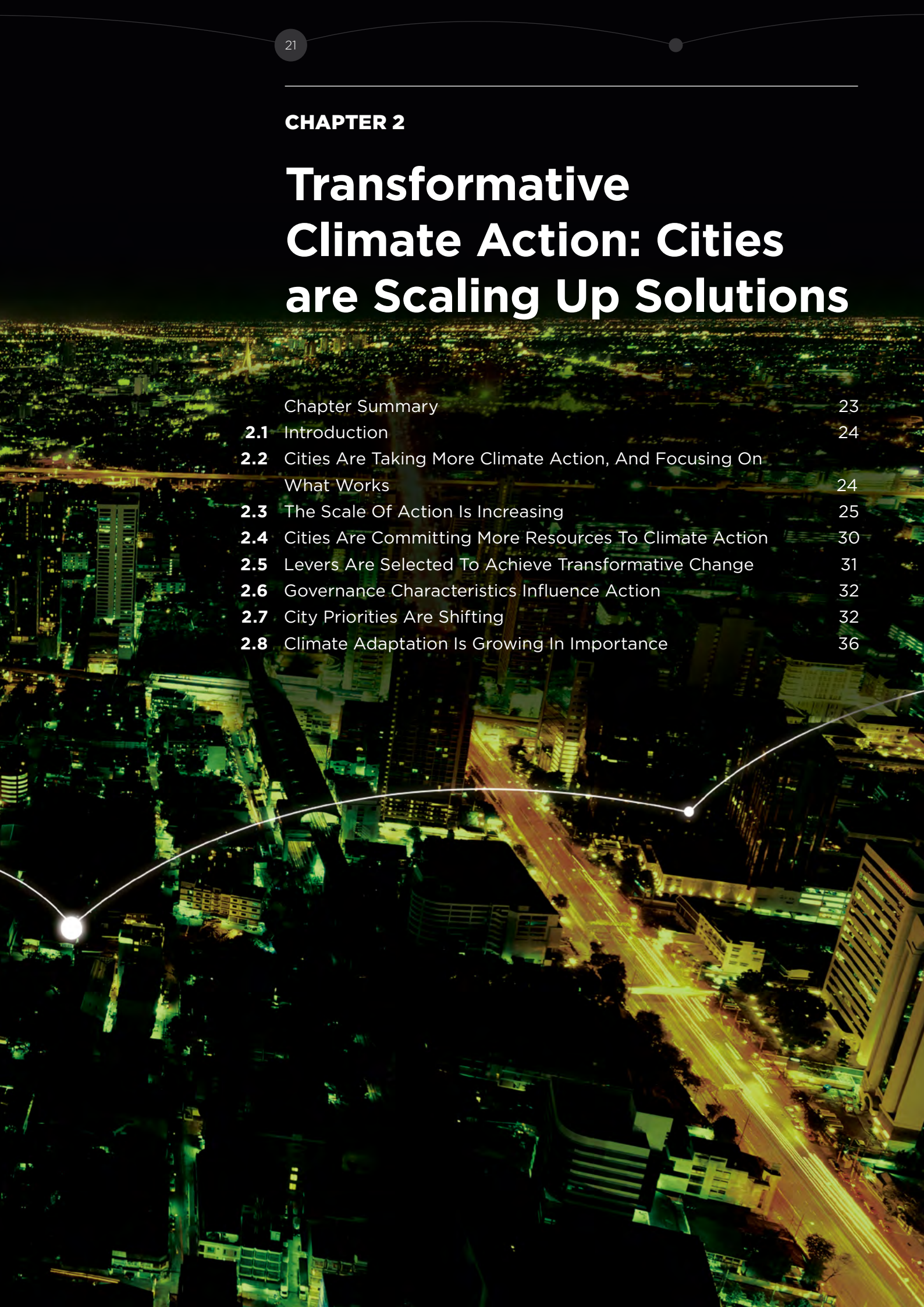
1.3.1 CITY POWERS AND GOVERNANCE

Specific terminology has been developed within the CAM reports to describe the extent and type of power that city mayors have over a range of assets and / or functions within their city, again broken down by sector. These terms and approach were further refined within *Powering Climate Action: Cities as Global Changemakers*, published by C40 and Arup in July 2015.

City Powers and Governance	
Power Dimensions	A categorisation of mayoral powers over a city's climate- related assets and functions according to four power dimensions: - Own or operate - Set or enforce policy / regulation - Control budget - Set vision
City governance typologies	A classification developed by C40 and Arup with UCL, to describe typical models of governance adopted by cities, and to understand a city's capacity to take action. These typologies are specific to city sectors; cities may employ more than one model of governance depending on their levels of power across different city assets / functions. **Commanding cities** typically use regulation and enforcement to deliver action. The role of private and other actors is often small. **Implementing cities** commonly take action through the delivery of projects and programmes, often without the input of private sector and other actors. **Providing cities** are characterised by a high level of control over service delivery, and are able to take action through this influence. **Legislating cities** achieve progress on climate change by setting policy and legislation that requires others to act. **Collaborating cities** commonly act in partnership with other actors to leverage their respective powers. **Facilitating cities** have limited power to take action directly, and instead focus on creating an attractive environment for others to act.

CHAPTER 2

Transformative Climate Action: Cities are Scaling Up Solutions



98%

Nearly all C40 cities recognise the risks of climate change.

51%

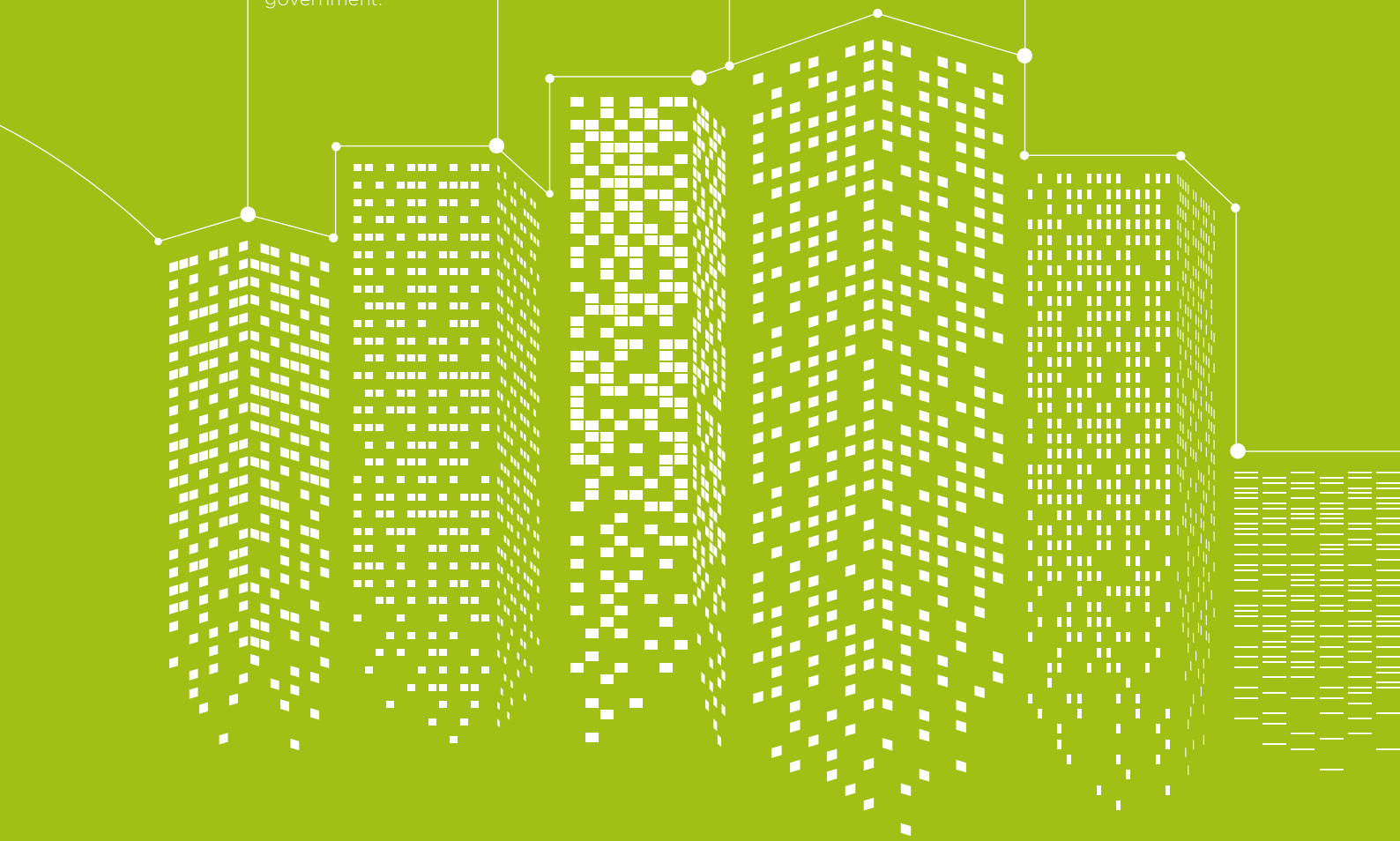
Proportion of climate action at City Scale increased from 15% in 2011 to 51% in 2015.

43

Number of cities that have assigned staff to climate adaptation roles within the city government.

9,831

Since 2011 C40 cities have taken 9,831 actions to reduce emissions and adapt to climate change.



CHAPTER SUMMARY: TRANSFORMATIVE CLIMATE ACTION, CITIES ARE SCALING UP SOLUTIONS

The number of C40 cities reporting climate action has increased year by year, almost doubling from 36 cities in 2011 to 66 cities in 2015. Added to this, cities have increased the scale of the actions they are taking, by expanding from proposed or pilot actions to implement the most effective of these at a city-wide scale. The proportion of climate action in C40 cities taking place at a city-wide scale has increased from 15% in 2011 to a sizeable 51% in 2015.

Going beyond mitigation, adaptation to the effects of climate change has increased in importance to C40 cities. In fact, Adaptation actions have increased from 11% in 2011 to 16% of all actions reported in 2015. With 98% of C40 cities recognising the risks of climate change, 52% of Adaptation actions are now in place at a city-wide scale.

Cities are committing more resources to climate action. Cities' ambition to scale up climate action is reflected in their increasing allocation of staff time and money to build capacity and efficiency in responding to climate challenges. In 2015, 43 cities reported that they have assigned staff to climate adaptation roles within the city government.

2.1 INTRODUCTION

C40 cities are delivering more of their actions at a city-wide scale than ever before. This chapter explores the trends in the scale of city climate action between 2011 and 2015. While much climate action in 2011 was at a "pilot" stage, or still awaiting authorisation, the latest data show a significant shift towards the "city-wide" scale across all sectors.

While overall scale may be increasing, Section 2.6 demonstrates that the focus of city action has shifted since 2011, as cities identify the actions with greatest potential impact, and the means to deliver these. Section 2.7 provides insight into action in the Adaptation sector, which is becoming increasingly more important for cities, and highlights the challenges that cities are facing from a changing climate.

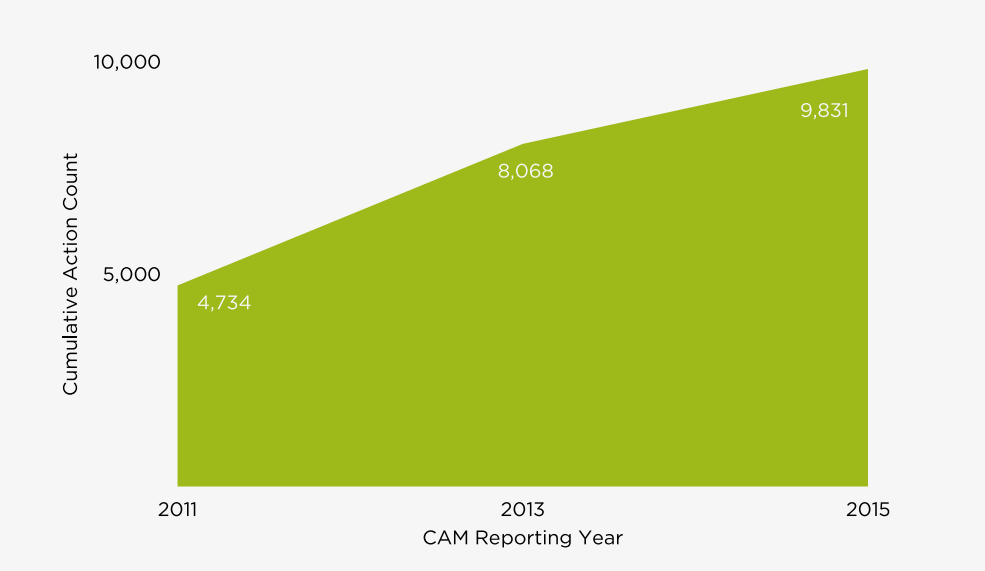
2.2 CITIES ARE TAKING MORE CLIMATE ACTION, AND FOCUSING ON WHAT WORKS

Cities are increasingly seeing the benefits of being part of C40's global network and taking climate action together. As the number of member cities in the C40 network has increased, so has the number of cities responding to the CAM questionnaire. In 2011 36 cities responded; this increased to 55 in 2013, and now includes rich data from 66 cities. The full list of responding cities can be viewed in Appendix A1.

The number of climate actions taken by cities is a useful indicator of their engagement and commitment. It shows a continued interest among cities to improve their response to climate change.[6]

Figure 2.01 demonstrates a year-on-year increase in the cumulative number of reported climate actions,[7] although it also shows that the rate of new action is slowing down. The average number of specific types of action reported per city in 2015 has decreased since 2011. This could suggest that active cities have identified where to focus their efforts to deliver transformative city-wide climate action.

Figure 2.01. Cumulative, latest action count by year.



2.3 THE SCALE OF ACTION IS INCREASING

However, action count is only a partial success metric by itself, as the nature, scale and impact of one action may differ from another. CAM 3.0 also shows that cities are increasing the scale of existing actions, by transitioning from small pilot solutions, to implementing the most effective actions on a city-wide basis. This is positive news for cities, demonstrating that their commitment to tackling climate change is still strong and their actions are more extensive, more focused on what works, and should be more effective in the long-run.

52%

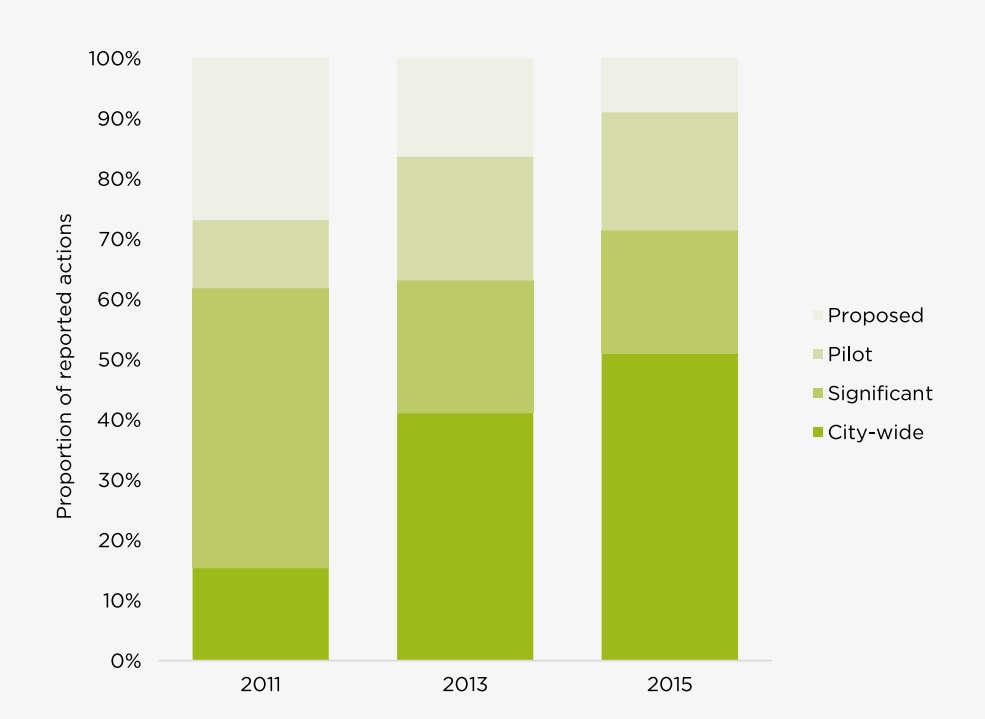
Over half of reported Adaptation actions are now in place in C40 cities at a city-wide scale.

Cities are undertaking a greater proportion of their actions at a city-wide scale than ever before. In 2015, 51% of climate actions in C40 cities are being taken on a city-wide scale, representing a nearly threefold increase from 15% in 2011. Figure 2.02 highlights this transition. Cities have demonstrated success at the pilot level, before scaling up to take city-wide action.

51%

Cities are delivering more of their action at a city-wide scale than ever before: 51% of actions in C40 cities are being taken at a city-wide scale.

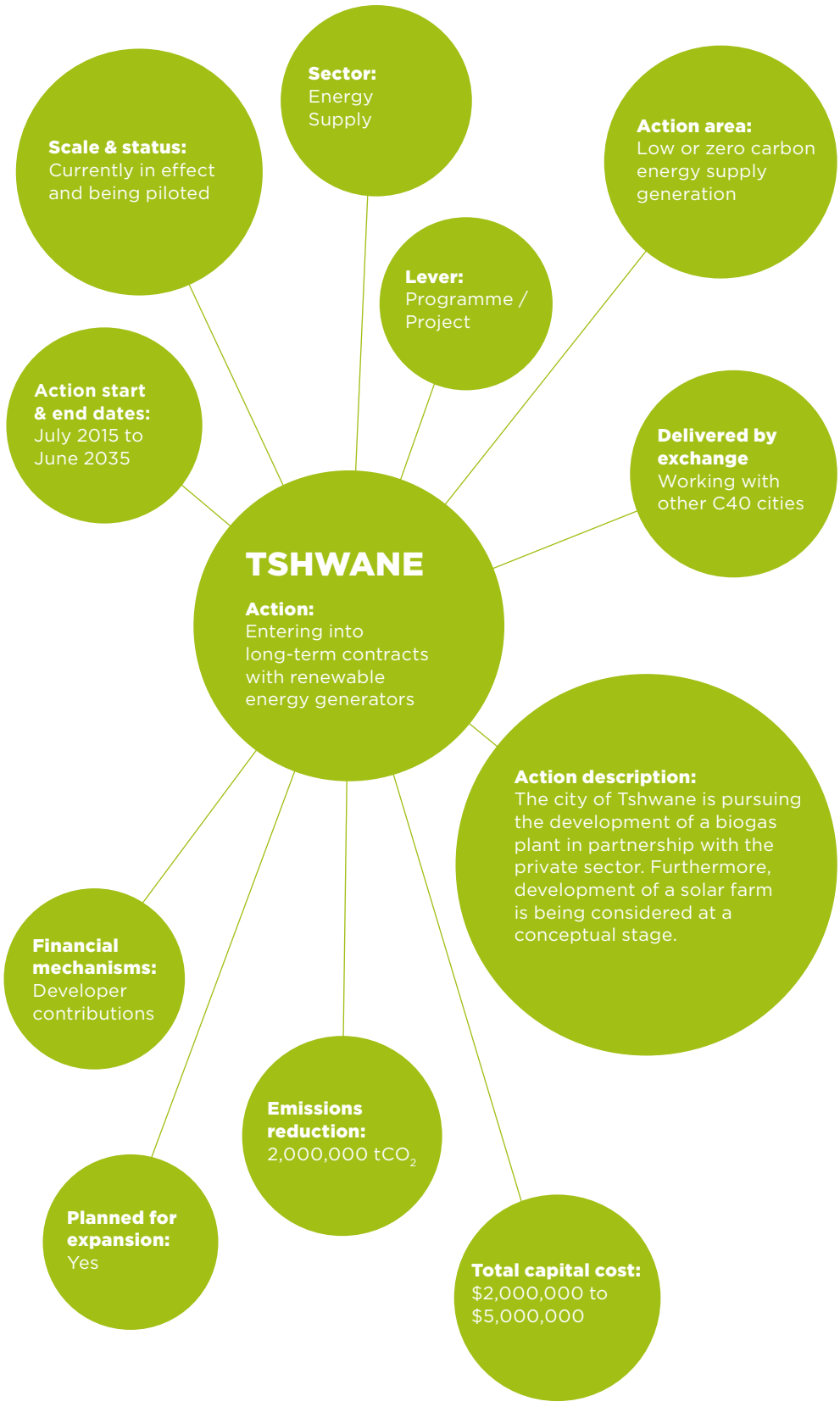
Figure 2.02. Scale of actions being taken per year reported.



6 Section 2.3.1 looks in more detail at the trends in actions within each sector across all years.
7 Cumulative action in this context refers to the latest reported state of actions; where a city has reported on the development of an action over the three reporting years, only the latest data is presented here. Note that actions have been grouped by their action area.

ANATOMY OF AN ACTION 1

The CAM questionnaire allows us to investigate the "Anatomy" of a climate action in considerable detail. This report contains a number of Anatomies of action such as the one below, either dissecting a specific action being taken by one city, or one that is being taken by several, to display trends and commonalities.



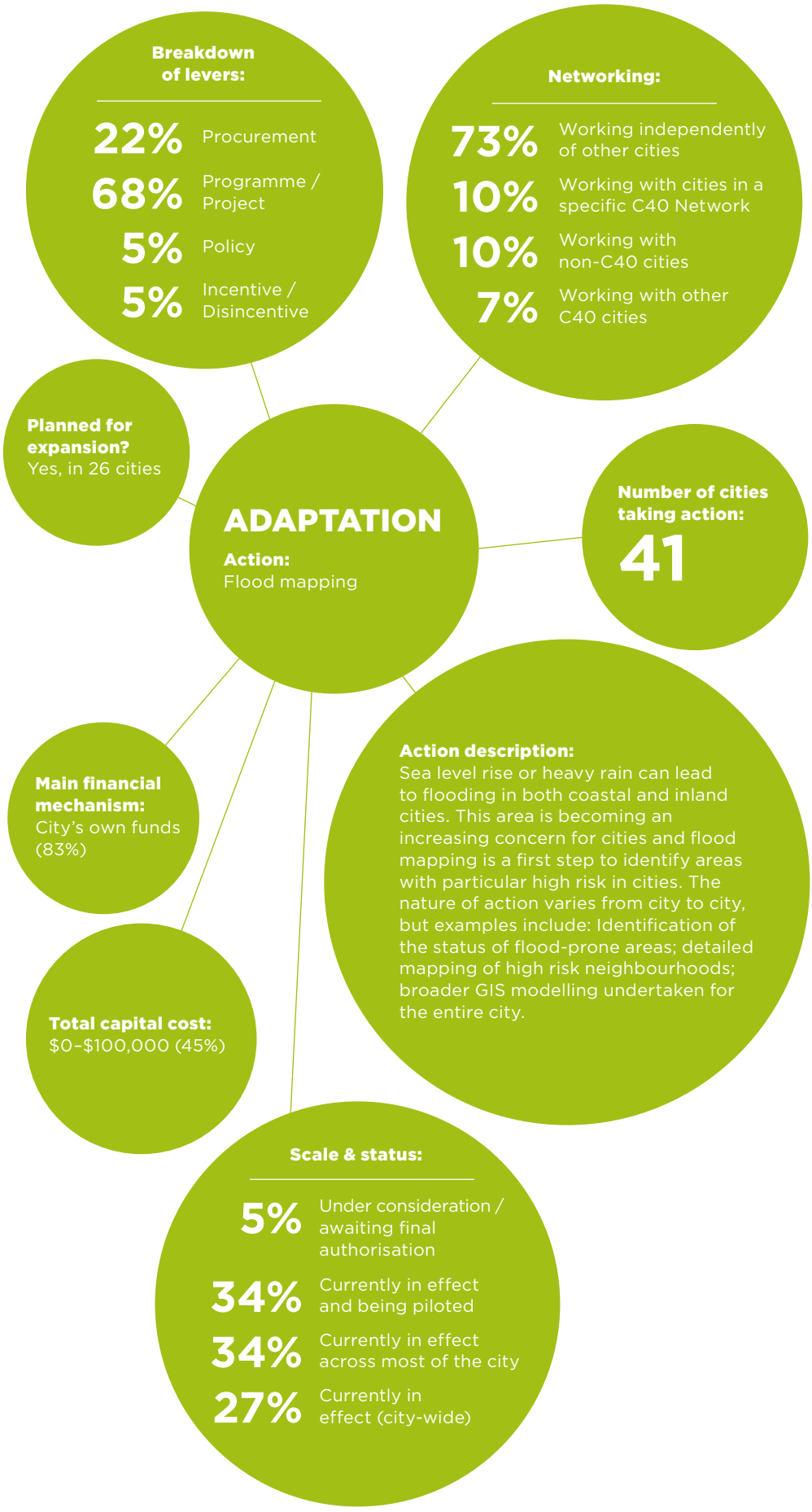
41

The most popular individual action taken by cities is flood mapping, which falls within the Adaptation sector. 41 cities have identified taking this action.

400

Oslo has taken decisive steps towards promoting electro-mobility. Oslo has set a goal to convert its city-owned fleet entirely to electric by 2015. To advance this goal, Oslo has introduced incentives to encourage people to purchase electric vehicles, including: waiving the Value Added Tax, free charging at public charge points, free access to bus lanes, free municipal parking and free access to toll roads. In addition, the city has provided 400 public charging stations, and plans to install 200 additional stations annually until 2015.

ANATOMY OF AN ACTION 2



2.3.1 ALL SECTORS ARE TRANSFORMING

As demonstrated in the graphs below, cities are clearly scaling up their actions across all sectors. A consistent trend is evident across almost every sector, showing a decline in the proportion of pilot and proposed actions with time and a corresponding increase in significant and city-wide actions from CAM 1.0 in 2011 through to CAM 3.0 in 2015.

Figure 2.03 Sector-based graphs depicting change in scale of actions over time.

The increasing proportion of city-wide actions (shown in the darkest shade of green) confirms that cities are focusing on scaling up actions through the years, transforming pilot schemes into city-wide initiatives.

This supports the additional anecdotal evidence provided within CAM 3.0 which suggests that overall, cities are learning from their past experiences, expanding actions in the areas most amenable to progress, and seeking to alter the way they deliver action to overcome barriers. Across all sectors, cities exhibit a growing maturity in their approach to climate action, symbolised by the overall increase in action, particularly city-wide action.

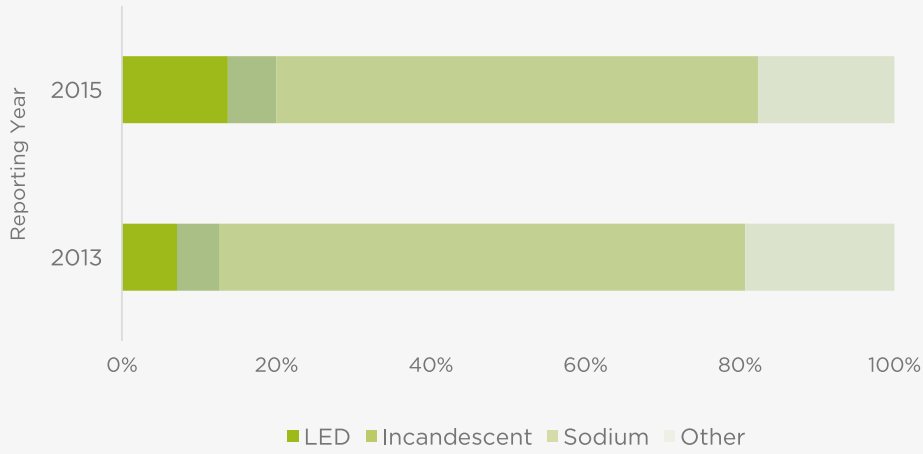
8%

The share of LED lights used amongst C40 cities has more than doubled, increasing by 8 percentage points from 2013 to 2015.

Sector Focus

Within the Outdoor Lighting sector, the share of LED lights used amongst C40 cities has more than doubled, increasing by eight percentage points from 2013 to 2015. In total, 17 C40 cities increased the share of LED lights in their city mix between CAM 2.0 and CAM 3.0. This shows a positive trend in exchanging old technologies with modern, efficient ones. The trend is consistent with the decreasing cost of LED lighting over recent years, which makes the investments more viable.

Figure 2.04. Trends in uptake of efficient lighting.



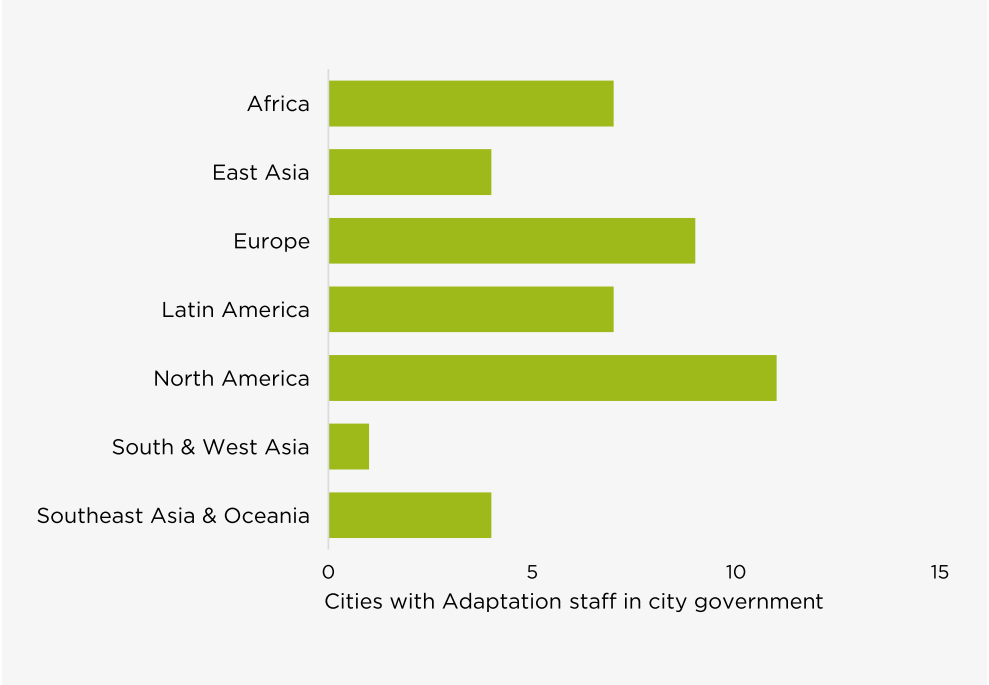
2.4 CITIES ARE COMMITTING MORE RESOURCES TO CLIMATE ACTION

43

cities have assigned staff to climate adaptation roles within the city government.

In order to build capacity and efficiency in responding to climate challenges, more cities are integrating climate change planning into their operations. In 2015, 43 cities have assigned staff to climate adaptation roles within the city government, dedicating resources, time and money to tackling the effects of climate change.

Figure 2.05 Number of cities with climate adaptation staff by region.



10%

Setting strategies to drive sustainability in sectors encourages cities to take action. 38 cities have strategies for urban agriculture and the number of climate actions taken within that sector is 10% higher than In cities that do not have a strategy in place.

In parallel, more cities have allocated specific staff to the IT sector to improve cities' operational efficiency across multiple sectors through the use of smart solutions. This trend is particularly evident in relation to transport management and the use of real-time information, as well as energy management and installation of smart energy meters.

Cities' commitment of resources is also demonstrated by the effective use of strategies to drive the long-term sustainability of specific sectors. For example, in the 38 cities where strategies have been developed for urban agriculture, the number of climate actions taken within that sector is 10% higher than in cities that do not have a strategy in place. Demonstrating commitment through a strategy or plan helps cities push forward climate actions.[8]

45

cities are taking action on municipal recycling points for non-organic waste. This is an increase from 20 cities in 2011.

Similarly, the number of cities with solid waste management plans increased by 15% in 2015, with nine of the new cities being long-term C40 members. This might be linked to the number of cities taking action on municipal recycling points for non-organic waste, which has increased from 20 cities in 2011 to 45 cities in 2015, with seven of these being long-term C40 members.

8 Chapter 7 explores this finding further.

2.5 LEVERS ARE SELECTED TO ACHIEVE TRANSFORMATIVE CHANGE

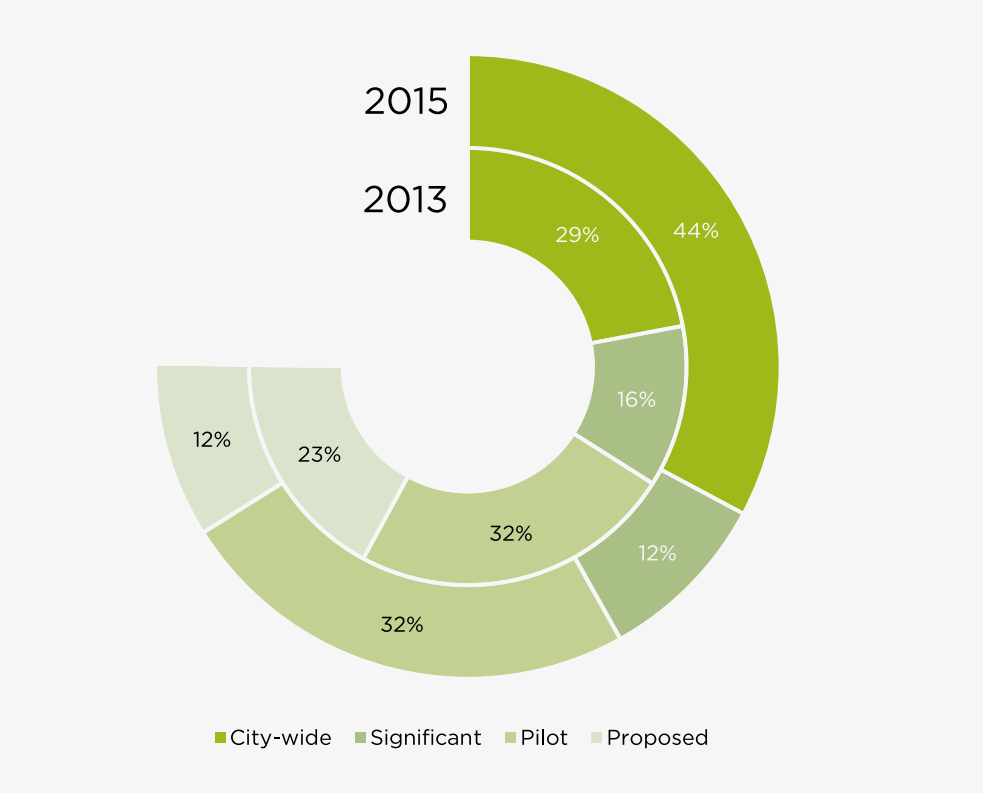
56%

of actions taken by cities in the Energy Supply sector are at a wider scale – described by cities as either significant or city-wide. This is an 11% increase in the two years since 2013.

The ability to progress to city-wide action is often dictated by the level of ownership and control a city has over its assets and functions within a certain sector; this in turn influences the types of levers the city can use to implement action. For example, where cities have a high level of ownership and control of a sector, a greater proportion of action may be delivered through procurement, rather than through other levers such as incentives or regulation. Procurement is a strong lever since it helps to create a market for green solutions, thereby stimulating the private sector to grow their expertise and services. This link between the level of control of an asset and the lever used to promote progress is particularly apparent in the Energy Supply sector, where cities are known to have high levels of control in terms of owning and operating their energy assets.[9] Within this sector, 14% of all actions are delivered through procurement; in other sectors, the procurement lever is employed for only 6% of actions on average.

While the data collected is not conclusive, it is likely that the use of procurement as a lever within the Energy Supply sector has been a driving factor in the shift of action from a pilot stage to a city-wide scale. In 2013, proposed and pilot stage actions made up the majority (55%) of actions occurring within the Energy Supply sector (Figure 2.06). By CAM 3.0 in 2015, 56% of actions were taking place at a wider scale and described by cities as either significant or city-wide.

Figure 2.06 Scale of energy supply action, by year.



9 Powering Climate Action: Cities as Global Changemakers, C40 and Arup with UCL, July 2015.

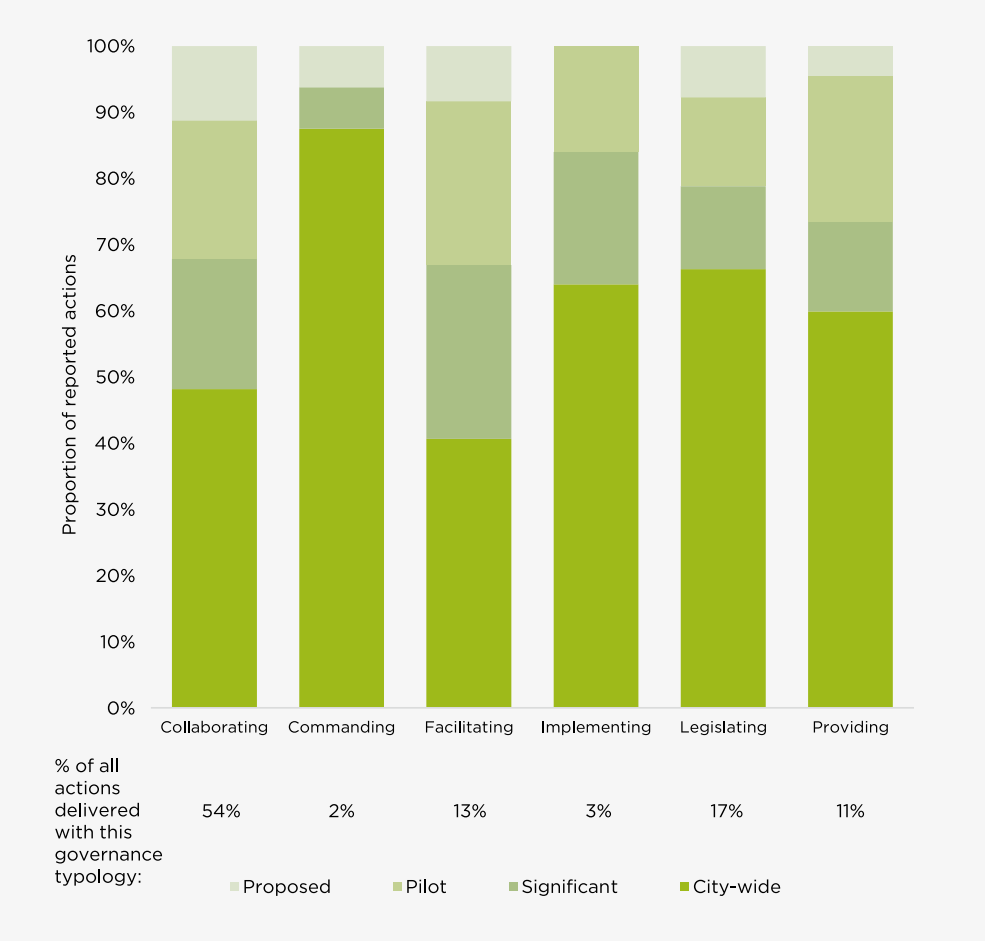
2.6 GOVERNANCE CHARACTERISTICS INFLUENCE ACTION

50%

Actions taken in Collaborating sectors account for more than 50% of all actions. This highlights the importance of sharing experience between cities and sectors.

This section investigates the scale of action reported in 2015 in relation to the governance typologies (by sector) introduced in the report *Powering Climate Action*.

Figure 2.07 Governance characteristics influence action scale.



In 2015, actions being taken in Commanding sectors are proportionally delivered at a greater scale than actions in other governance typologies. That being said, they account for the fewest actions in total, while actions being taken in Collaborating sectors account for more than 50% of all actions. The large share of actions in Collaborating sectors highlights the importance of sharing experience between sectors and cities. These collaborations often lead to piloting new actions (Figure 2.07), which helps to drive innovation in cities. As noted in the earlier sections of this chapter, actions that are piloted are often increased to a city-wide scale at a later date.

2.7 CITY PRIORITIES ARE SHIFTING

While the scale of action may be increasing across the board, this year's data indicates a shift in the areas where cities are delivering action. Likewise, the levers which cities use to deliver action in each sector are changing. This section provides a brief overview of the changes in distribution of action across sectors, and the choice of levers used to deliver action over the years.

13%

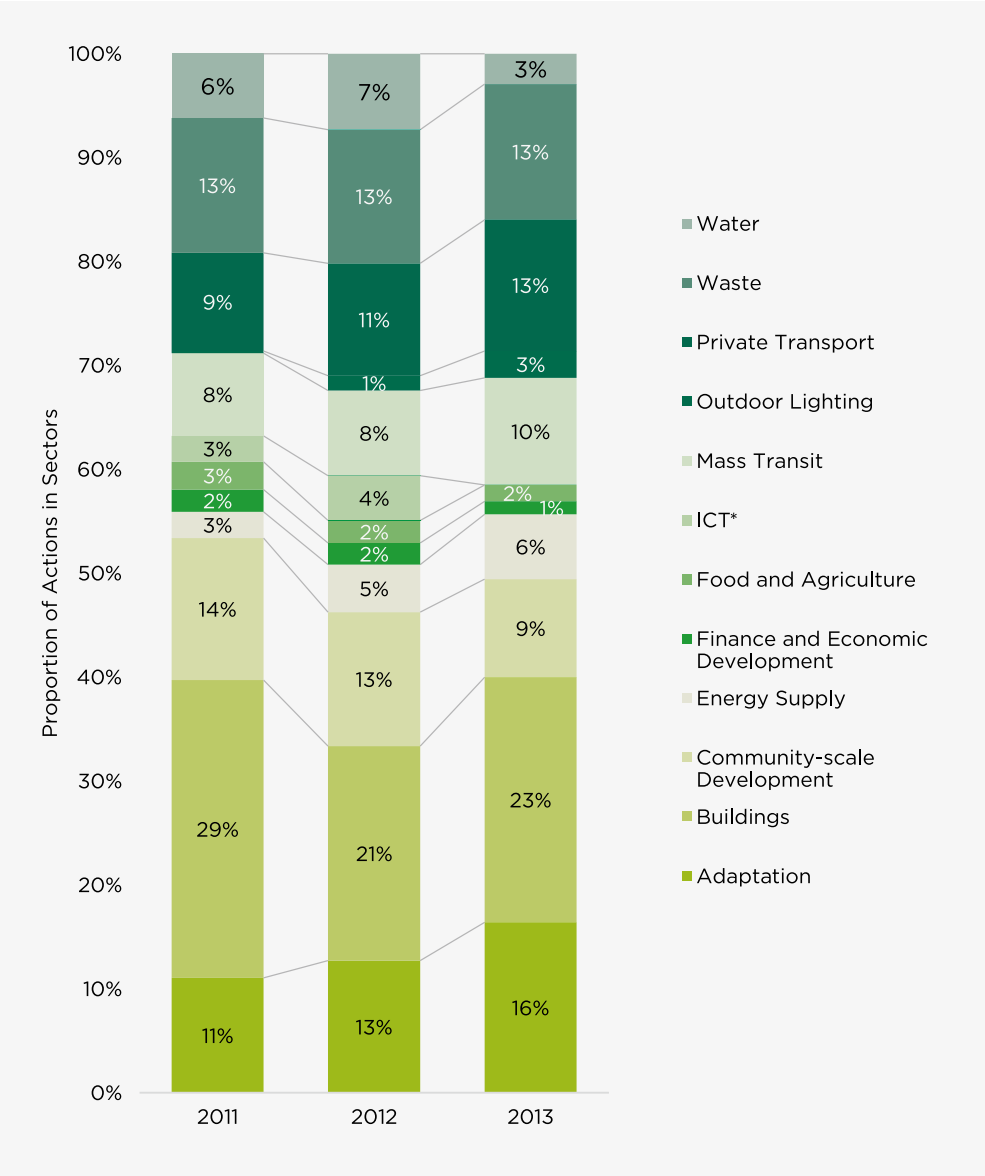
Numerous sectors have seen an increase in their share of actions year-on-year. In the Private Transport sector the share of actions has increased from 9% in 2011 to 13% in 2015.

Figure 2.08 presents a breakdown of action by sector for each year.[10] Certain sectors have seen a persistent increase in their share of actions year-on-year, as well as an increase in the scale of actions. These sectors include Adaptation, Energy Supply, Mass Transit, Outdoor Lighting and Private Transport. In the Private Transport sector, for example, the share of actions has increased year-on-year from 9% in 2011 to 13% in 2015.

Other sectors show a different trend. In the Water sector, an increase in the scale of actions over time (pilot to city-wide) is concurrent with a decrease in the total number of actions being taken over the same period. This trend is also present in the Food and Agriculture, Finance and Economic Development, and Community-scale Development sectors.

The exception to these two main trends is found in the Waste sector, which has maintained a constant 13% share of actions across successive reporting periods.

Figure 2.08 Change in distribution of actions across sectors between years.



*Note, ICT sector actions are embedded within other sectors in 2015

10 Note that the focus is on the change in a sector's prominence between years, not the relative significance in a given year.

Figure 2.09: Percentage change in scale of action and levers used by sector between 2013 and 2015 reporting years.

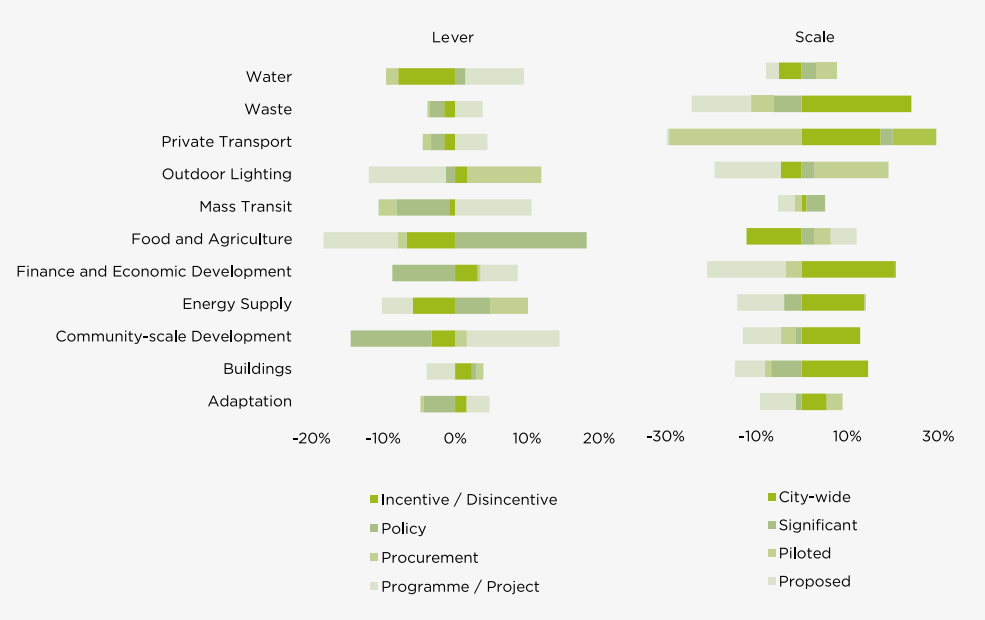


Figure 2.09 shows the proportional change in the type of levers cities reported using for climate action in 2013 compared to those they reported in 2015, and the accompanying scale change. The data demonstrates an overall increase in the use of the programme / project lever in 2015 and decrease in incentive/disincentive.

More significant than the overall change in levers, however, is the shift within specific sectors. For example, in the Community-scale Development sector, there has been a significant swing from the use of policy and incentive / disincentive towards programme / project. This may reflect city governments playing a less controlling part in the development of actions in this sector, instead working with other actors to drive them. City governments may have put in place policies and incentives to grow this sector in 2013, but in 2015 these initiatives are being run by other groups in the city through programmes and projects.

A similar pattern can be seen in the Finance and Economic Development sector, where cities have moved from the predominant use of policy / legislation to programme / project and incentive/disincentive. This may reflect the growth of city leadership in the sector as governments opt to guide and prompt other actors rather than impose regulations to deliver action. As a sector over which cities typically exert a reasonably high level of direct control, this shift may represent an effort by cities to deliver action through collaboration with others rather than by legislation.

The trends highlighted here may reflect a number of factors, including:

- Through experience, cities are gaining a better understanding of which mechanisms drive the most effective actions in their local context.
- Cities are beginning to understand where their most obstructive challenges lie and are seeking alternatives to overcome them.
- Cities are responding to emerging climate hazards.
- The growing availability and scale of funding sources for cities.
- Macro-economic trends prompting cities to invest in sectors offering the greatest overall economic benefits.
- Changes in political circumstances (i.e. the electoral cycle) causing actions to be driven, delayed, or significantly altered.

26%

Cape Town has completed retrofitting of approximately 26% of its large municipal buildings to make them more energy efficient.

1,058 tCO_2e

Cape Town's energy efficiency in buildings programme has resulted in a carbon emission reduction of 1,508 tCO_2e per annum.

City Focus: Cape Town's Commitment To Energy Efficiency In Buildings

Cape Town, the lead city for C40's Municipal Building Efficiency Network, has completed retrofitting of approximately 26% of its large municipal buildings and has installed smart electricity meters (AMRs) in more than half of its largest administrative buildings. The AMR's will allow the monitoring of electricity usage continuously by each department. This is combined with fundamental Energy Management training, incorporating technical and practical training of City staff on how to extract, read and interpret the smart meter data. The city also runs a behaviour change programme to enable building managers and users to effectively manage electricity consumption within their buildings. The programme has resulted in energy savings of approximately 1,068 MWh and carbon emission reduction of 1,058 tCO_2e per annum.

For buildings within the city's ownership an Electricity Savings Campaign was launched, targeting residential and commercial consumers. This aims at reducing electricity consumption through a range of behavioural and technological changes. The campaign has evolved from no-cost / low-cost advice into invest-to-save options, promoting use of solar water heaters, and heat pumps. This has since lead to an accreditation programme for the technology providers to increase trust in the products. For the commercial sector a knowledge sharing forum was set up in partnership with the public utility provider and the South African Property Owners Association (SAPOA).

2.8 CLIMATE ADAPTATION IS GROWING IN IMPORTANCE

16%

16% of actions reported in 2015 were in the Adaptation sector, up from 11% in 2011.

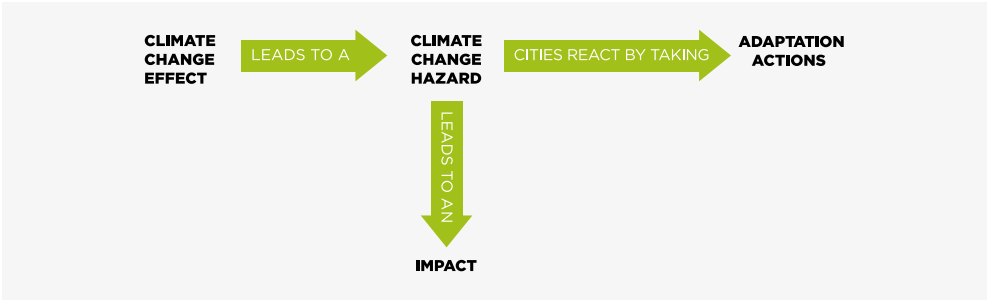
Cities are highly vulnerable to the effects of climate change, from sea level rise to severe heat waves, which can disrupt city services and pose serious hazards to their inhabitants' health and wellbeing as well as vital infrastructure. Of the 66 cities surveyed in 2015, 59 reported information about the climate hazards they face. In 2013, 98% of cities reported that the anticipated effects of climate change present a significant risk to the city; the 2015 data bears out this finding, but for even more cities.

98%

98% of cities reported that the anticipated effects of climate change present a significant risk to the city.

Cities are taking actions such as heat mapping, thermal imaging, and delivering green roofs and walls to anticipate and reduce some of the risks of climate impacts. In fact, climate adaptation is an area of increasing significance to C40 cities, as shown in Figure 2.08. The count of adaptation actions has steadily increased as a proportion of all actions reported by cities since 2011. While 11% of all actions reported in 2011 were in the Adaptation sector, this proportion increased to 13% in 2013 and 16% in 2015. The analysis suggests the emergence of a new phase of climate action, in which cities increasingly recognise the need to adapt even while mitigation actions continue to grow in scale.

Figure 2.10. Trends in climate change effects and hazards.



Understanding the link between climate change effects, hazards, impacts and climate adaptation action is important to identify commonalities between cities and enable the transfer of knowledge and ideas between cities through exchange mechanisms like C40 networks that specifically focus on climate adaptation.

75%

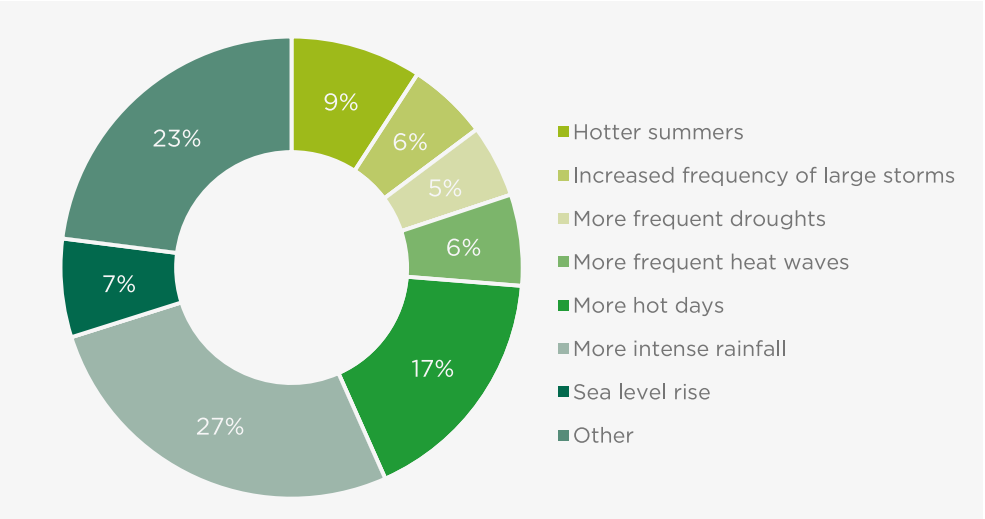
The seven most common climate change effects account for 75% of all reported effects.

C40 and Arup have worked to develop a common framework, or approach, to guide city adaptation planning and to establish standards for reporting on key aspects of that process including climate change hazards, impact and adaptive capacity and adaptation planning and implementation. The Climate Risk and Adaptation Framework and Taxonomy (CRAFT) will allow city policymakers and practitioners to enhance their climate adaptation efforts by understanding city experiences of climate hazards and risks and identifying actions cities are taking to respond to those risks. In future years, adaptation data will be more complete as a result and allow far deeper analysis and understanding of the city adaptation challenge and response.

2.8.1 CLIMATE ADAPTATION IS GROWING IN IMPORTANCE

Cities face similar climate change effects globally. 26% of cities reported experiencing more intense rainfall, while 17% are experiencing more hot days, and 9% are experiencing hotter summers. The seven most common climate change effects account for 75% of all reported effects (28 in total), as shown in Figure 2.10.

Figure 2.11. Most common effects of climate change faced by C40 cities.



41

41 cities across all seven global regions have reported taking a total of 105 types of climate adaptation actions to address the hazards associated with more intense rainfall.

More intense rainfall is the most common climate change effect faced by cities in all regions, and particularly in Latin America. 41 cities in all seven global regions have reported taking a total of 105 types of climate adaptation actions to address the hazards associated with more intense rainfall.

City Focus: Land Use Controls To Reduce Climate Risk In Bogotá

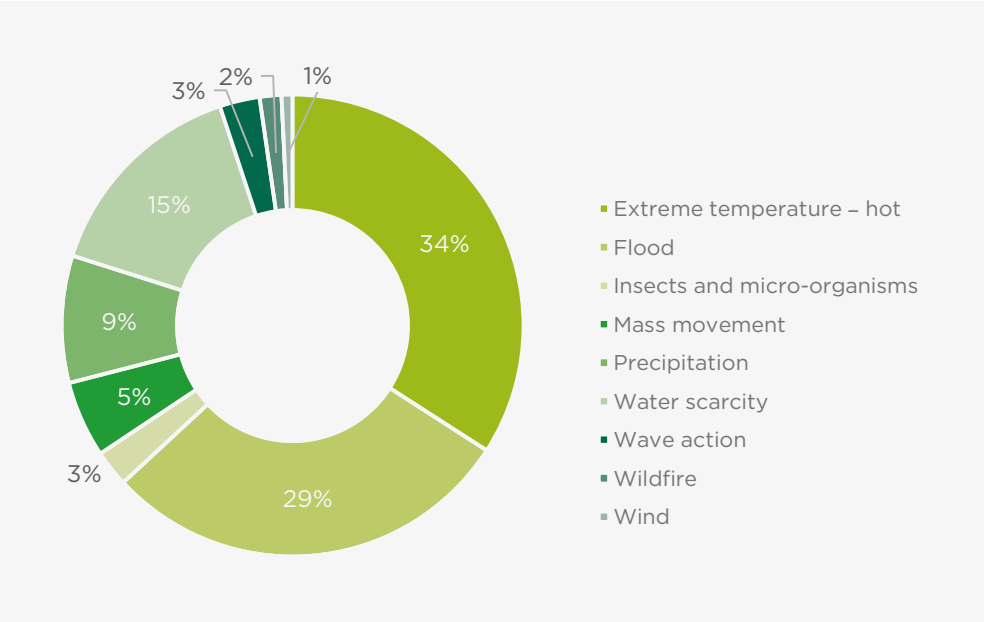
In order to adapt to hazards such as landslides or subsidence caused by intense rainfall, Bogotá has implemented a programme for planting trees and creating green spaces. The programme identifies high risk zones and imposes land use restrictions to mitigate risks and economic loss. Similarly, Caracas and Curitiba are restricting development in at-risk areas to adapt to flooding hazards.

63%

Extreme temperature and flooding are the most common hazards experienced by cities. They account for 63% of all climate change hazards reported globally.

Climate change effects can influence different hazards in different cities. For this report, 57 cities identified the climate hazards they currently face, as in Figure 2.11.

Figure 2.12. Most common climate hazards currently experienced in C40 cities.



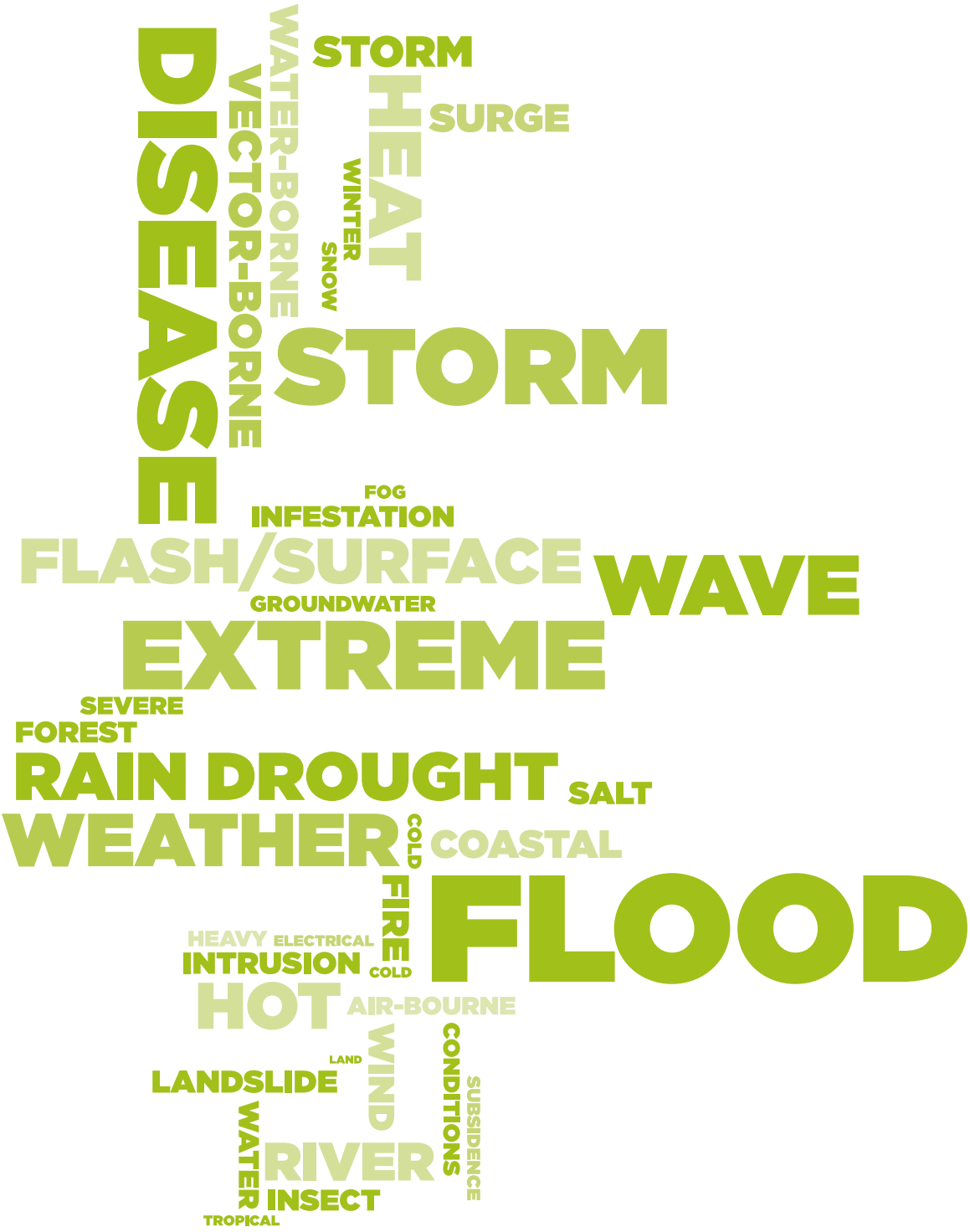
On average, cities face seven different main types of climate hazards. Extreme temperature and flooding are the most common hazards currently experienced by cities, accounting for 63% of all climate change hazards reported globally. North American cities experience more extreme temperature hazards (40%) than any other region, while European cities reported the highest proportion of flooding hazards (30%). 62% of all mass (land) movement hazards were reported by Latin American cities. 63% of all water scarcity hazards were reported by either North American or European cities. These trends reflect major climate-related events experienced by specific cities in these regions over recent years.

Identification of hazards appears to drive action. Cities that reported experiencing more hazards are also taking more adaptation actions than others. Nine of the ten cities that reported the most hazards are also in the top ten cities in terms of the count of adaptation actions they are taking.

Figure 2.12 illustrates the significance of reported future climate hazards that cities expect to face. Floods are the single most common expected hazard, but disease and extreme weather phenomena are likewise very prominent. In general, this graphic highlights the perceived future threat of high-impact events that are often not predictable far in advance. Coupled with Figure 2.13, it also indicates that cities are taking the lead and preparing now to deal with climate change hazards that are more severe or frequent than they have previously experienced.

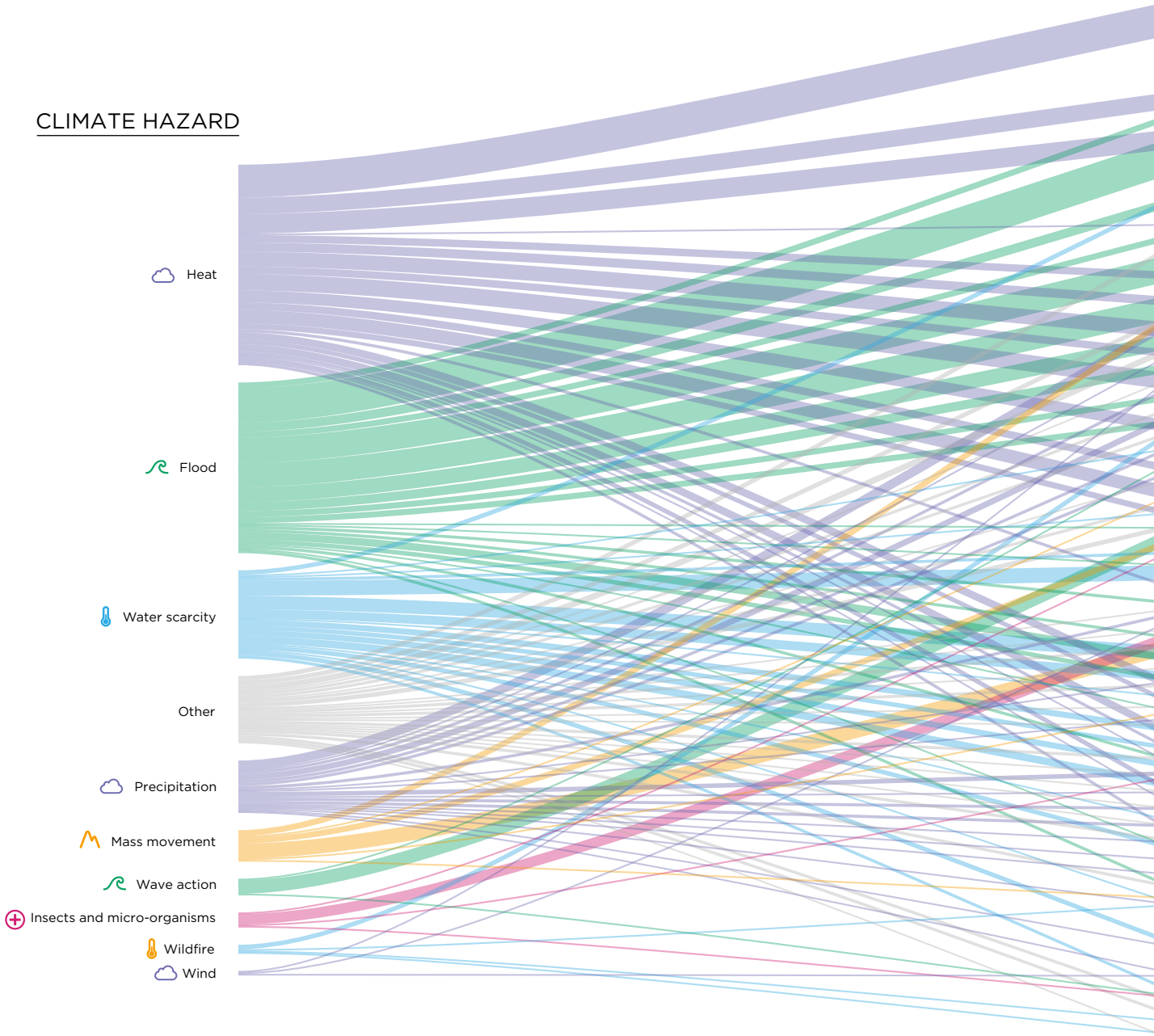
Figure 2.13. Word cloud for the climate hazards cities report they expect to face in the future.

The size of each word indicates the number of times it was mentioned by cities as a future hazard.



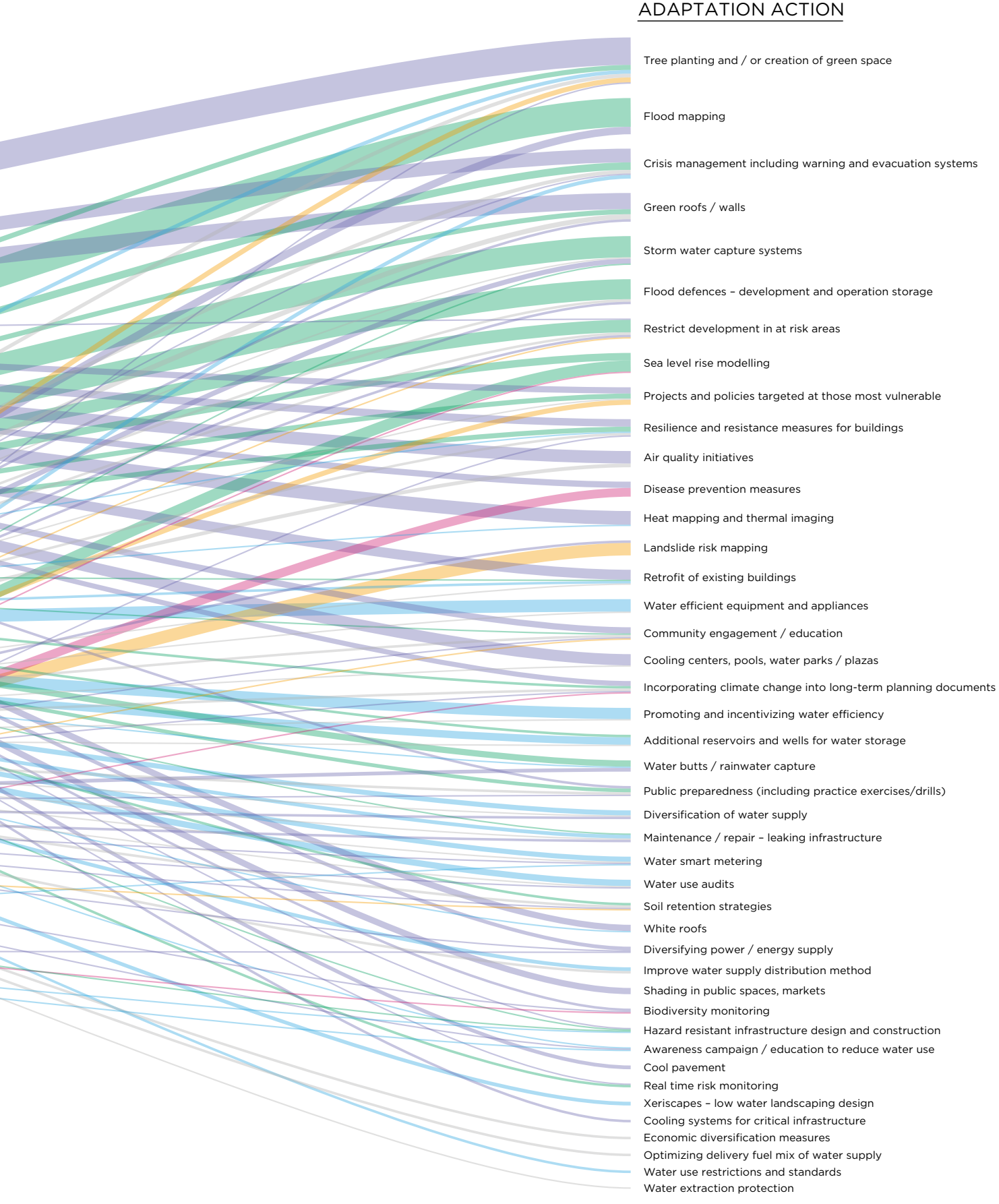
ADAPTATION SANKEY DIAGRAM

The aim of the adaptation sankey diagram is to link climate change effects to hazards and hazards to adaptation actions, showing how different climate change effects can exacerbate the same hazard globally. It shows there is no single correct way to adapt to a given hazard, as different cities respond to the same hazard through different adaptation actions. It also shows that actions may reduce the impacts of multiple hazards, and leaves room for the possibility of greater shared learning and collaboration between cities, making them aware of the various options they have to act.



Classification of city-specific hazards

Meteorological | Geophysical | Climatological | Biological | Hydrological


ADAPTATION ACTION
Tree planting and / or creation of green space
Flood mapping
Crisis management including warning and evacuation systems
Green roofs / walls
Storm water capture systems
Flood defences – development and operation storage
Restrict development in at risk areas
Sea level rise modelling
Projects and policies targeted at those most vulnerable
Resilience and resistance measures for buildings
Air quality initiatives
Disease prevention measures
Heat mapping and thermal imaging
Landslide risk mapping
Retrofit of existing buildings
Water efficient equipment and appliances
Community engagement / education
Cooling centers, pools, water parks / plazas
Incorporating climate change into long-term planning documents
Promoting and incentivizing water efficiency
Additional reservoirs and wells for water storage
Water butts / rainwater capture
Public preparedness (including practice exercises/drills)
Diversification of water supply
Maintenance / repair – leaking infrastructure
Water smart metering
Water use audits
Soil retention strategies
White roofs
Diversifying power / energy supply
Improve water supply distribution method
Shading in public spaces, markets
Biodiversity monitoring
Hazard resistant infrastructure design and construction
Awareness campaign / education to reduce water use
Cool pavement
Real time risk monitoring
Xeriscapes – low water landscaping design
Cooling systems for critical infrastructure
Economic diversification measures
Optimizing delivery fuel mix of water supply
Water use restrictions and standards
Water extraction protection

2.8.2 DELIVERING ADAPTATION ACTIONS

60%

60% of all adaptation actions are being taken by North American and European cities.

Although 60% of all adaptation actions are being taken by North American and European cities,[11] the significance of climate adaptation action has been increasing over the past five years across all seven regions. Figure 2.13 illustrates the regional perspective. Regionally, Africa is reporting the greatest increase in the proportion of adaptation actions being taken. In 2011, 15% of all actions delivered by African cities were around adaptation. This figure increased to 16% in 2013, and to 18% in 2015.

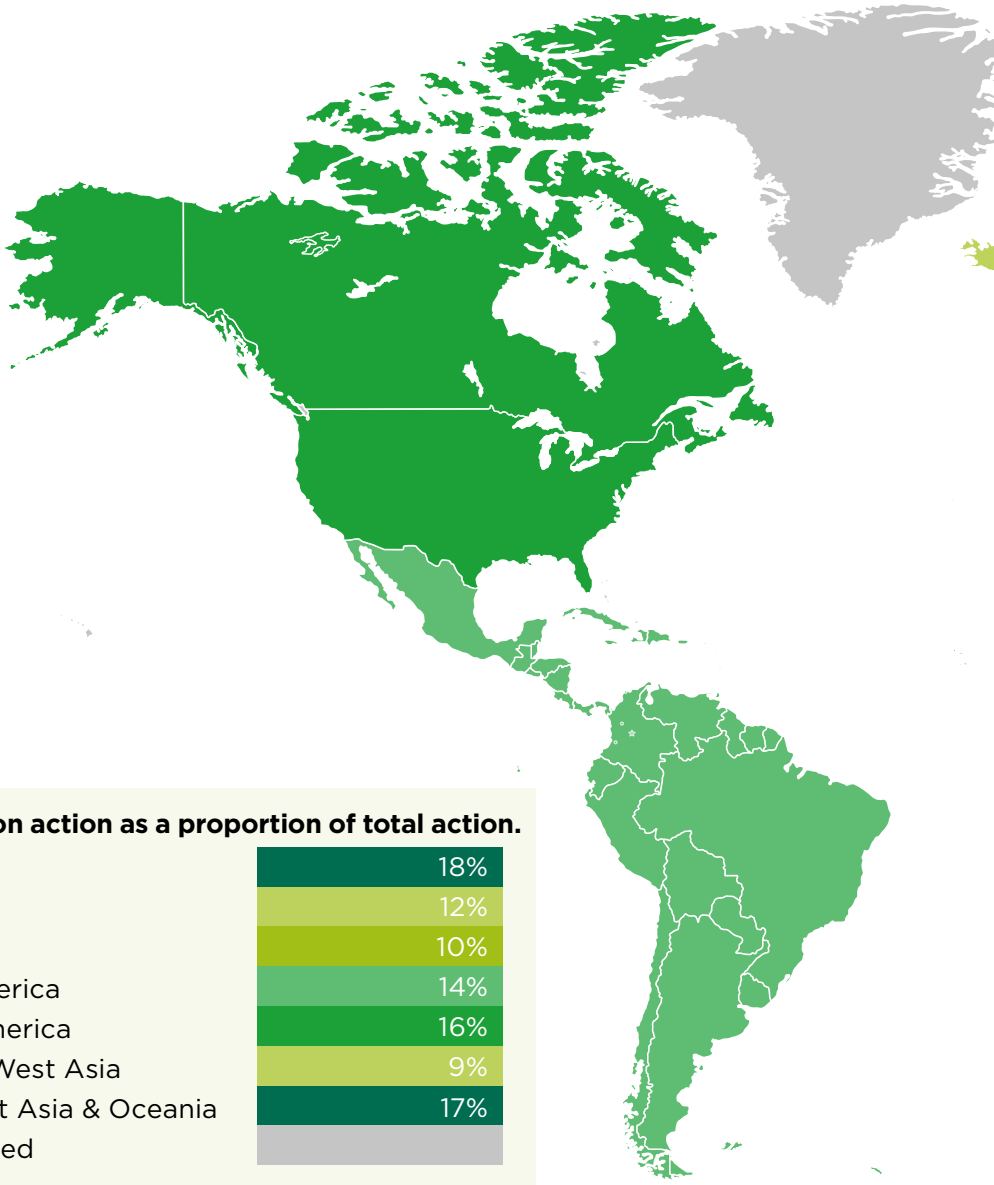
18%

Africa is reporting the greatest increase in the proportion of adaptation actions being taken. In 2011, 15% of all actions delivered by African cities were around adaptation. By 2015 this figure has increased to 18%.

65%

Of all the adaptation actions in North America, 65% are now city-wide.

Figure 2.14. World map with C40 regions coloured according to the significance of adaptation action out of each region's total action count.

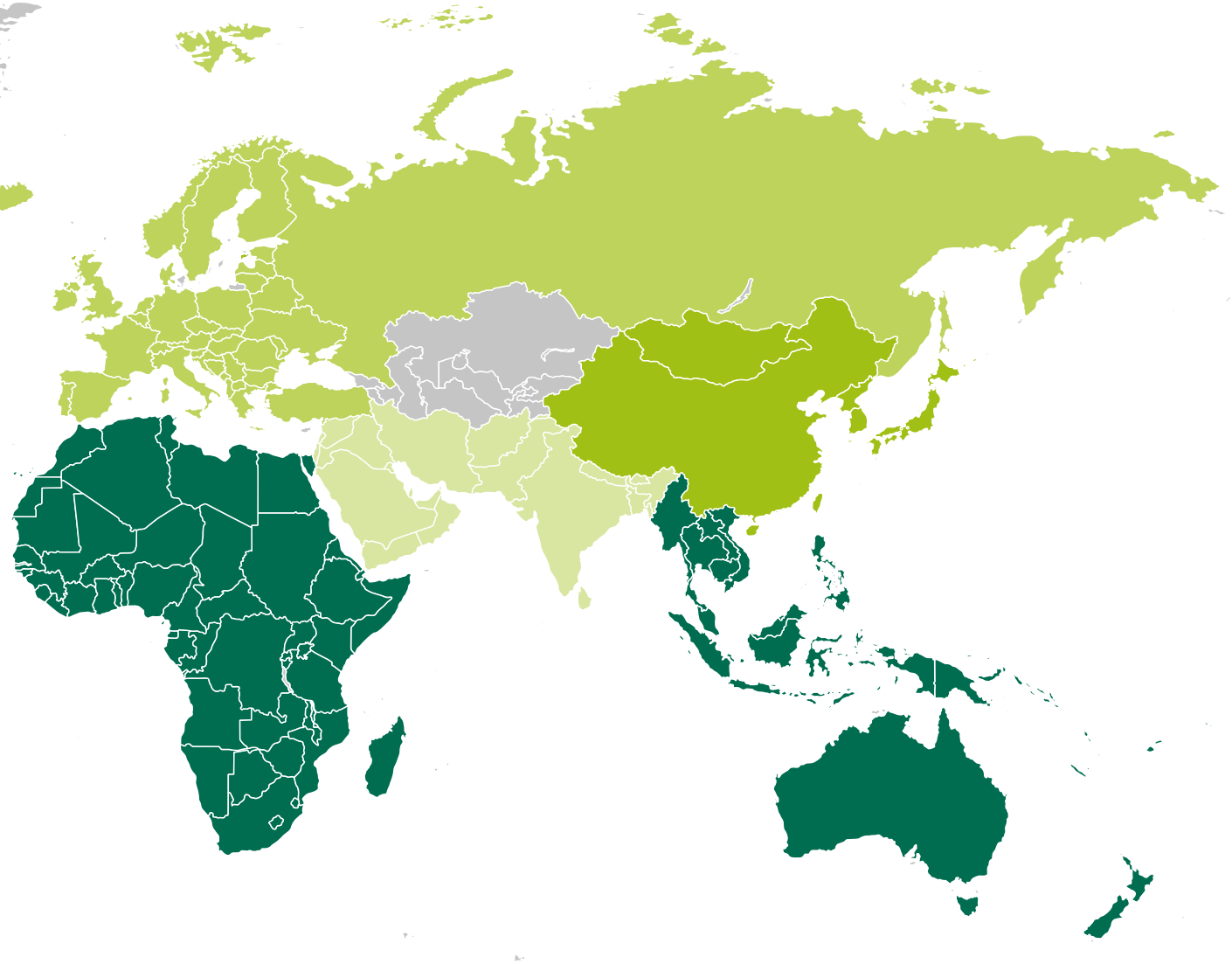


11 It is noted that these are the regions with the highest numbers of reporting cities

In 2015, cities reported taking a total of 438 adaptation actions. There were 43 distinct adaptation actions reported, the five most common being:

- Storm water capture systems
- Green roofs / walls
- Crisis management (including warning and evacuation systems)
- Flood mapping
- Tree planting and / or creation of green spaces.

Cities have consistently scaled up their actions on climate adaptation (see Figure 2.02). In North America 65% of all adaptation actions are now city-wide. Cities like Houston and Toronto have been undertaking long-term, multi-million dollar projects to rebuild the storm water infrastructure across their cities to adapt to flooding hazards.



CHAPTER 3

C40 is Working: A Successful Model for Global Collaboration

$10 million

Almost half of all actions involving collaboration in C40 networks cost over $10 million each.

95%

95% of actions delivered involving collaboration with other cities are planned for expansion.

30%

30% of climate action delivered in 2015 involved collaboration with other cities.

CHAPTER SUMMARY: C40 IS WORKING A SUCCESSFUL MODEL FOR GLOBAL COLLABORATION

16

C40 runs 16 thematic networks within six overarching initiatives to help facilitate dialogue among city officials.

92%

Today, 92% of the C40 cities participate in at least one of the thematic networks.

C40 brings the world's megacities together in meaningful exchanges to speed up the global adoption of climate policies and programmes that have been demonstrated to work in one or more member cities.

C40 currently runs 16 thematic networks within six overarching initiatives to facilitate dialogue among city officials. Participation in these networks allows city officials to share ideas, solutions and lessons, and to tailor their own city actions to local circumstances. C40 cities are actively participating in these networks; today 92% of C40 cities participate in at least one network, with some cities active in as many as 11. The Climate Change Risk Assessment network is the largest thematic network within C40, with 41 of the 82 member cities participating. This further underscores the finding that climate risk and adaptation are important areas for C40 cities.

In 2015, 30% of climate actions were delivered as a result of collaboration with other cities. Two thirds of this collaboration takes place with other C40 cities.

A higher proportion of actions than average is under consideration or being piloted where cities deliver actions by working with C40 cities directly, or through specific C40 networks. Through these actions, cities are learning from the successes of others and choosing to trial best practices within their own jurisdiction.

Networking also appears to support cities in diversifying the sources of funding for climate actions; cities use less traditional funding sources (such as central city budgets versus tax increment financing) to deliver projects when they work with other cities in a C40 network.

DIRECT C40 CITY LINKS THROUGH INVOLVEMENT IN A C40 NETWORK

The image shows how all C40 cities are integrated through involvement in one or more of the 16 thematic C40 Networks. Each city is connected via a line to any other city that they collaborate with through a C40 Network. This demonstrates the volume and global reach of collaboration between C40 cities.

3.1 INTRODUCTION

The C40 Cities Climate Leadership Group, now in its 10th year, connects more than 80 of the world's greatest cities, representing over 600 million people and one quarter of the global economy. Created and led by cities, C40 is focused on tackling climate change and driving urban action that reduces greenhouse gas emissions and climate risks, while increasing the health, wellbeing and economic opportunities of urban citizens.

C40 cities are committed to working together to address climate change. Currently there are 16 thematic networks and six overarching initiative areas within the C40 to facilitate dialogue around specific sectors. Participation in these networks allows the sharing of challenges, ideas, and solutions, and to tailor their own city actions to local circumstances.

For example, the Climate Change Risk Assessment Network helps to build climate resilient cities by promoting understanding and prioritisation of climate change risks. The Green Growth Network aims to accelerate investment and job creation in the green economy by encouraging the growth of green enterprise districts or clusters and quantifying the wider economic benefits of climate action. The full list of all 16 C40 networks is shown in Table 3.01.

C40 networks help cities replicate, improve and accelerate climate action. These city-only working groups provide for honest knowledge exchange between city peers and links to expert partners. Through networks, cities find opportunities to collaborate on initiatives of mutual interest and benefit. C40 networks also amplify individual city solutions by providing a global platform for showcasing city successes. The data-driven approach used by C40 to identify and launch topic-specific networks ensures that the networks respond to city priorities in areas with the greatest potential for climate impact.

In 2015, for the first time, cities were asked about the information exchange mechanism, if any, that they have used to deliver climate actions. The data reported by the cities has enabled quantification of the impacts of networking over the past three years. An overall upward trend in C40 engagement and the publication of inspiring case studies where collaboration has made a real difference illustrates the growing extent of knowledge sharing between cities, and the potential effectiveness of peer-to-peer networking.

Figure 3.01. Breakdown of actions by the information exchange mechanism through which they were delivered

C40 Networks	
Climate Change Risk Assessment	Building climate resilient cities through best practice understanding and prioritisation of climate change risks
Connecting Delta Cities	Supporting delta cities active in the field of climate change-related spatial development, water management, and adaptation
Cool Cities	Mitigating the urban heat island effect in cities through integration of cool roofs and pavements

C40 Networks	
District Energy	Accelerating the uptake of district heating and cooling systems to improve efficiencies and reduce carbon emissions
Municipal Building Efficiency	Supporting city efforts to improve the energy efficiency of buildings they own and manage
Private Building Efficiency	Supporting city efforts to improve the energy efficiency of existing commercial and residential buildings
Green Growth	Accelerating investment and job creation in the sustainability sector; encouraging the growth of green enterprise districts or clusters; and quantifying the economic benefit of climate action
Sustainable Infrastructure Finance	Financing solutions for sustainable urban infrastructure, including innovative financing approaches for energy, buildings, transportation, waste, water, and other city infrastructure priorities
Creditworthiness	Supporting cities to acquire strong credit ratings
Sustainable Solid Waste Systems	Reducing greenhouse gas emissions across the municipal solid waste sector through improved comprehensive planning and targeted implementation strategies
Waste to Resources	Moving cities from waste management towards resource management by focusing on upper waste hierarchy actions like avoidance, reduction, reutilisation and recovery
Climate Positive Development	Equipping and empowering C40 cities to accelerate the implementation of globally accepted best practice sustainable urban planning strategies for district-scale new build and regeneration projects by providing cities an urban laboratory of cutting edge large-scale development projects that achieve net-negative emissions
Sustainable Urban Development	Enabling cities to work together on policies and programmatic approaches to support environmentally sustainable, district scale, new build developments and regeneration projects
Transit Oriented Development	Supporting cities to become more compact and connected by minimizing vehicle kilometres travelled and increasing citizens' access to public transportation and economic activity
Bus Rapid Transit	Supporting cities around the world in introducing, improving and transforming Bus Rapid Transit (BRT) systems
Low Emission Vehicles	Focused on areas of municipal action critical for facilitating the uptake of low-emission vehicles in cities

30%

In 2015, cities reported that 30% of all actions delivered involved collaboration with other cities. This indicates the value of sharing in the climate field.

3.2 COLLABORATION IS DRIVING CITY ACTIONS

In 2015, cities reported that a substantial 30% of all actions they have delivered involve collaboration with other cities. Between 2013 and 2015, 450 new actions out of 1550 with relevant data were delivered through city-to-city collaboration. Given the wide spectrum of responding cities – spanning 33 countries, 20 time zones and 17 languages – the extent of this collaboration illustrates the potential of C40 and other city networks to facilitate effective connections, despite geographic and other potential barriers.

A Third Of Climate Action Is Delivered Through Collaboration.
Perspective From Mark Watts, C40 Executive Director

The fact that nearly one third of all climate actions reported by C40 members involved collaboration with other cities is one of the strongest findings of CAM 3.0. It is impossible to imagine that the number would have been a fraction of this 10 years ago when C40 started. Indeed, in most other areas of city government work it is probable that this is still the case. Asking for advice and support, particularly across time zones, language and cultural barriers, and geographies is not easy. But the finding that 30% of actions in CAM 3.0 involved cross-city collaboration in their delivery indicates the value of sharing in the climate field – and that C40 has found successful ways of supporting its members in collaborating efficiently.

Cities reported collaborating in three ways:

- Working with cities in a specific C40 network,
- Working with other C40 cities (but not through a specific network), or
- Working with non-C40 cities.

As shown in Figure 3.01, for cities delivering actions through some form of collaboration, two out of three actions (66%) involved collaboration with other C40 cities (through C40, or indirectly).

40%

C40's 16 thematic networks are facilitating 40% of all collaborative actions.

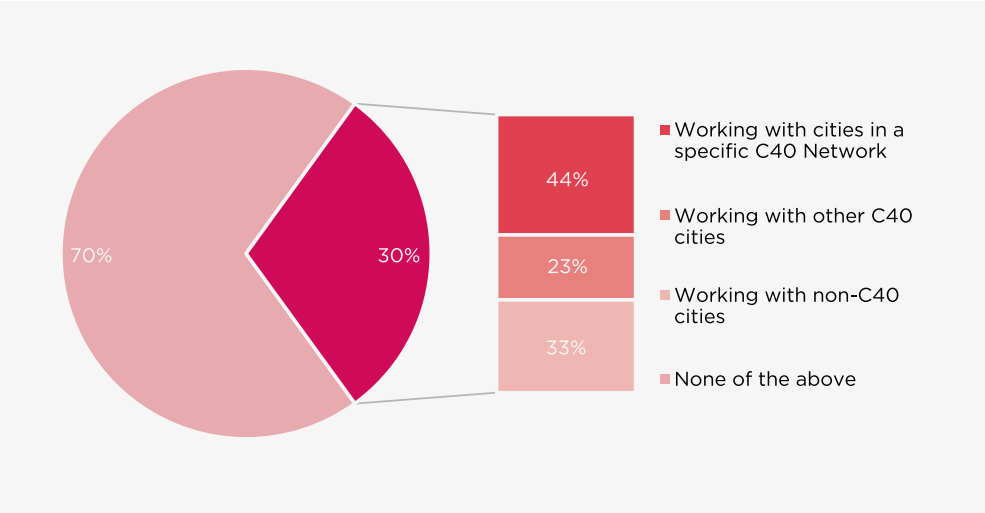
C40's 16 thematic networks are facilitating 40% of all collaborative actions. Furthermore, 13% of all the actions being taken by some of the world's largest cities are being enabled by an NGO comprised of just 70 staff.

13%

Furthermore, 13% of all actions being taken by some of the world's largest cities are being enabled by an NGO comprised of just 70 staff.

Moreover, 42% of responding cities indicated that they have delivered at least one action across 11 sectors through collaboration with other cities.

Figure 3.01. Breakdown of actions by the information exchange mechanism through which they were delivered.



City Focus: Milan's Waste Programme

Milan's actions in the Waste sector exemplify the concept of C40 networks transcending national boundaries. As a result of participation in C40's Waste to Resources Network, Milan connected with cities like Tokyo and San Francisco, learning about strategies to implement mandatory food waste and organics collection programmes for commercial establishments. This knowledge sharing is helping Milan to move beyond the successful city-wide food waste collection programme that they had already implemented.

Milan's collaborative efforts enabled it to accelerate its ambitious disposal reduction goals, beyond European Union regulations. The city also collaborated with Seoul to learn how to develop and implement pay-as-you-throw fee mechanisms for residential and commercial waste.

3.3 TRENDS IN CITY NETWORKING WITHIN C40

92%

92% of C40 cities are participating in at least one network.

The proportion of C40 cities now participating in at least one network stands at 92%, with some cities active in as many as 11. The Climate Change Risk Assessment Network has consistently been the largest thematic network within C40, with 41 of the 82[12] member cities currently participating. Membership of the networks illuminates issues that cities are finding increasingly important; as identified in Chapter 2, climate risk and adaptation are becoming a large focus for cities.

12 Reflects C40 membership at the time of surveying.

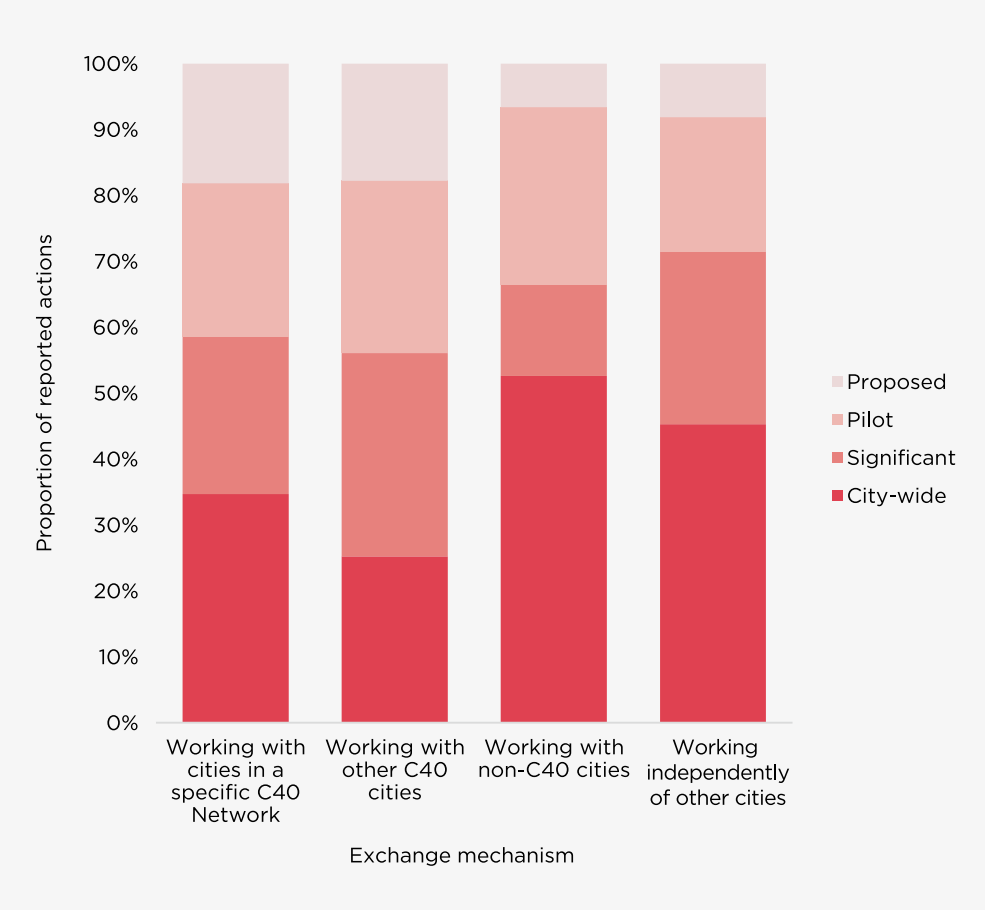
3.4 GLOBAL OUTLOOK ON NETWORKING

There are links between the extent of networking between cities and the scale of action delivered. Where cities deliver actions by working with C40 cities directly, or through specific C40 networks, a higher proportion of actions are under consideration or being piloted, as highlighted by Figure 3.02. These cities are learning from the successes of others and choosing to trial best practices in their own jurisdiction. This trend illustrates the role of networking and partnering through C40 to bring about change in cities, helping them experiment with new solutions, while also giving them the ability to reach beyond their local boundaries and context.

As Figure 3.02 shows, C40 is not the sole vehicle for delivering action through collaboration; C40 cities working with others outside of the C40 are also achieving high rates of transformative and significant actions.

It is also evident that when cities deliver actions by working with other, non-C40 cities, they are still doing so to deliver more transformative action than they would be able to achieve alone. C40 cities are sharing best practices beyond the C40 network and, by collaborating with non-C40 cities, are increasing their exposure to other expertise and experience. In doing so, it is expected that initiatives within the C40 network are also being disseminated more widely to other cities in a two-way exchange.

Figure 3.02. Breakdown of action scales for exchange mechanisms.



95%

Cities report that they are planning to expand 95% of all actions they identify as having delivered through working with other cities.

Furthermore, cities that have networked with other cities have demonstrated a greater ambition for future expansion of their climate actions. Cities report that they are planning to expand 95% of all actions they identify as having delivered through working with other cities. Long-standing networking and partnering efforts through C40 networks have the potential to assist cities as they scale up their actions from pilot projects or programmes to city-wide initiatives.

City Focus: Changwon's Cool Roofs Initiative

As a result of participating in C40's Cool Cities Network and learning from other cities who have implemented cool roof programmes (whether by mandate or incentives), Changwon has developed a pilot programme to subsidise cool roofs (heat-reflective surfaces) and applied techniques used by Tokyo to improve their heat reduction measurement methodologies. This has enabled Changwon to accelerate and better target opportunities for cooling the city to reduce the urban heat island effect and vulnerability to extreme heat waves. As a co-benefit, the need for air conditioning systems will be reduced, leading to greenhouse gas emissions reductions.

3.5 SECTORAL OUTLOOK ON NETWORKING

40%

In the Waste sector, 40% of all actions are delivered through networking. This is higher than any other sector.

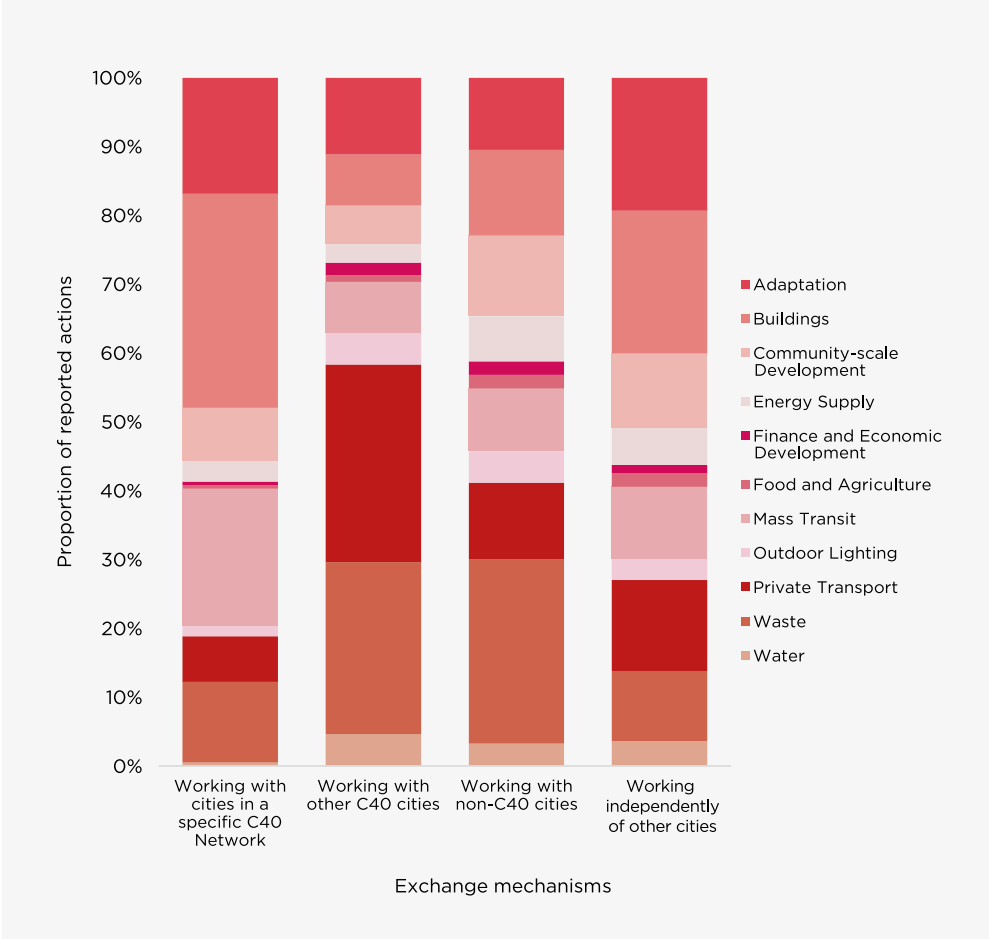
In the Waste sector, 40% of all actions are delivered through networking, which is higher than any other sector. Mass Transit also has a relatively high number of actions delivered via collaboration (35%). Among the most common actions cities have taken through collaboration are the roll-out of more residential non-organic waste solutions using municipal recycling centres, bus rapid transit (BRT) projects, and low-carbon waste collection vehicles.

The sectoral split for actions delivered via networking varies depending on the type of networking identified. The Adaptation, Buildings, and Mass Transit sectors are a common focus for collaboration of any type, while most collaboration in the Private Transport sector happens when cities work with other C40 cities. Alternatively, when working with non-C40 cities, the Waste sector is most prominent. When cities work with other cities in a specific C40 network, they mostly focus on Buildings sector actions. The networks on Municipal Building Efficiency and Private Building Efficiency together have seen participation of nearly half of all C40 member cities.

This may indicate that cities find the Buildings sector most challenging to address, or that they have a common interest in the significant opportunities for cost-effective abatement through energy efficiency.[13] Given that 45% of emissions in C40 cities arise in the Buildings sector (as reported in *Climate Action in Megacities 1.0*), it is encouraging that cities are making this a priority area for collaboration.

13 IEA, 2014. World Energy Outlook 2014. International Energy Agency, Paris.

Figure 3.03. Sectoral trends around exchange mechanisms.



City Focus: London's Business Energy Challenge

Approximately 75% of London's carbon dioxide emissions come from buildings, and workplaces account for 42% of that total. To address this critical sector, London looked to the experience of other C40 cities. Working with the C40 Private Building Efficiency Network, London decided to develop a mayoral recognition programme that challenges the commercial sector to take action and improve its energy efficiency, saving on operational costs and reducing its carbon footprint. Through the network, London learned how similar programmes in New York, Chicago, Houston and Toronto developed data collection platforms, identified key metrics, accounted for changes in building portfolios, and identified staffing needs for similar mayoral recognition programmes. The results of these detailed discussions and information exchange directly influenced the design of London's Business Energy Challenge, which was launched in November 2014. In its first year over 50 of London's leading businesses submitted data for 1,000 buildings. The 27 award winners reduced their carbon emissions from energy use by over 80,000 tonnes across their London locations in 2013/14 compared with 2010/11, and reduced their energy demand enough to power over 10,700 UK households for a year. London now leads one of the Private Building Efficiency Network's key working groups focused on engaging multinational corporations in building energy efficiency.

97%

Of the 270 projects delivered through networking, 97% are planned to expand in the future.

Based on the responses from cities to the networking questionnaire, the distribution of levers is effectively independent of the exchange mechanism used to deliver actions. The data indicates that 61% of all actions use the project and programme lever, a ratio that is essentially the same for all exchange mechanisms. Of the 270 projects and programmes delivered through networking, 35% are now at a city-wide scale and 97% are planned to expand in the future.

3.6 REGIONAL OUTLOOK ON NETWORKING

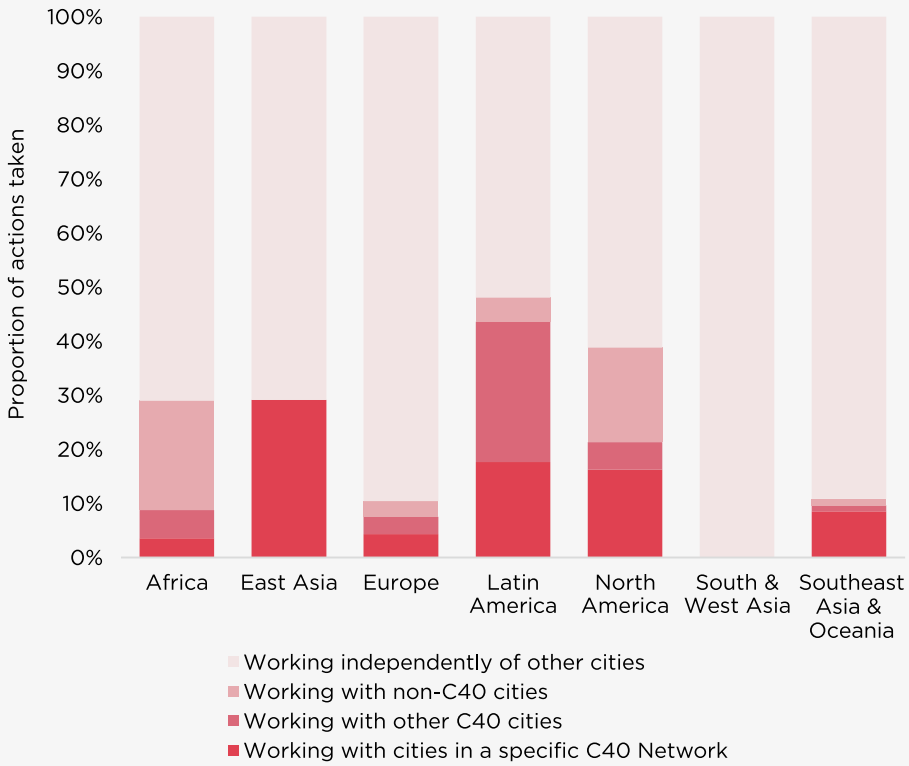
Looking at the regional trends (Figure 3.04), networking in general is most prevalent in the ten Latin American cities participating in the survey, especially in terms of working with other C40 cities. Of the actions in four East Asian cities, 30% are delivered by working with cities in a specific C40 network.

North American and African cities lead the way in working with non-C40 cities. Half of all actions delivered through networking have been implemented by North American cities. This is most likely the result of several other strong city network organisations, such as ICLEI Local Governments for Sustainability and Urban Sustainability Directors' Network (USDN).

70%

Houston is the city with the highest count of actions delivered through networking and collaboration, which represent 70% of the city's total actions.

Figure 3.04. Regional trends around exchange mechanisms



City Focus: Houston as a Leading Networker

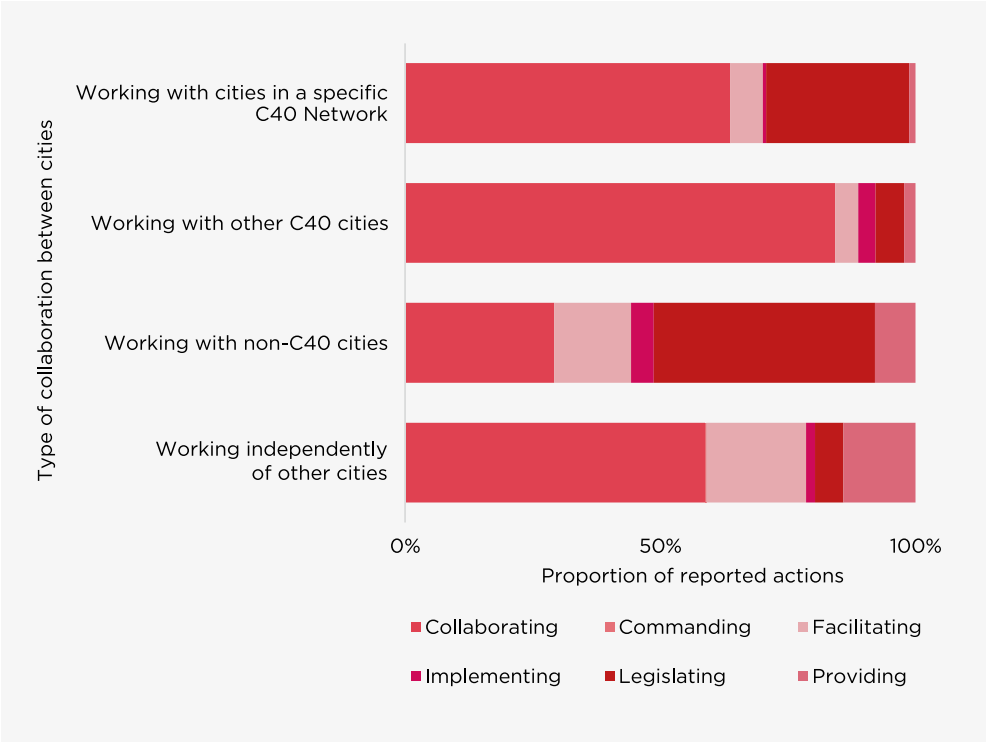
Houston is the city with the highest count of actions delivered through networking and collaboration, which represent 70% of the city's total actions. The city-wide actions delivered via collaboration in Houston include energy performance contracting for a total of six million square feet of municipal facilities, which is expected to achieve guaranteed energy use reductions of 30% and save over 22 million kWh of electricity every year, with paybacks of less than ten years on average.

Houston has also been partnering with organisations like Arup, Bloomberg Philanthropies, USDN and C40, as well as New York City, Washington D.C., San Francisco, Milan, Rio de Janeiro and other cities, to research integrated waste processing technologies.

3.7 GOVERNANCE MODELS ENABLE NETWORKING

The C40 and Arup report *Powering Climate Action* examined six urban governance typologies adopted by cities, and demonstrated how governance – rather than just power – affects a city's capacity to take action. The data in CAM 3.0, as shown in Figure 3.05, illustrates that cities with a Collaborating governance typology continue to lead the way in networking with other cities overall.

Figure 3.05. Breakdown of exchange mechanism by power typology.



70%

Of all action delivered by Collaborating cities networking with other C40 cities, 70% have been delivered in the Mass Transit, Private Transport, and Waste sectors combined.

Collaborating cities commonly act in partnership with other actors to leverage their respective powers. The top five cities that delivered the most action by networking with C40 cities all had collaborative governance typologies across multiple sectors. Of all the action delivered by Collaborating cities networking with other C40 cities, 70% have been delivered in the Mass Transit, Private Transport, and Waste sectors combined. In contrast, Legislating cities tend to take more action when working with non-C40 cities.

Of all actions reported by cities in 2015, 55% have been taken through a Collaborating governance typology. The evidence demonstrates the effectiveness of cities reaching out to peers to collaborate in delivering action. C40 networks give cities the platform to do so. Cities that take a collaborative approach to governance delivered twice as many actions in the 2013-2015 period as those that implemented action through a less partnership-based mode of governance.

55%

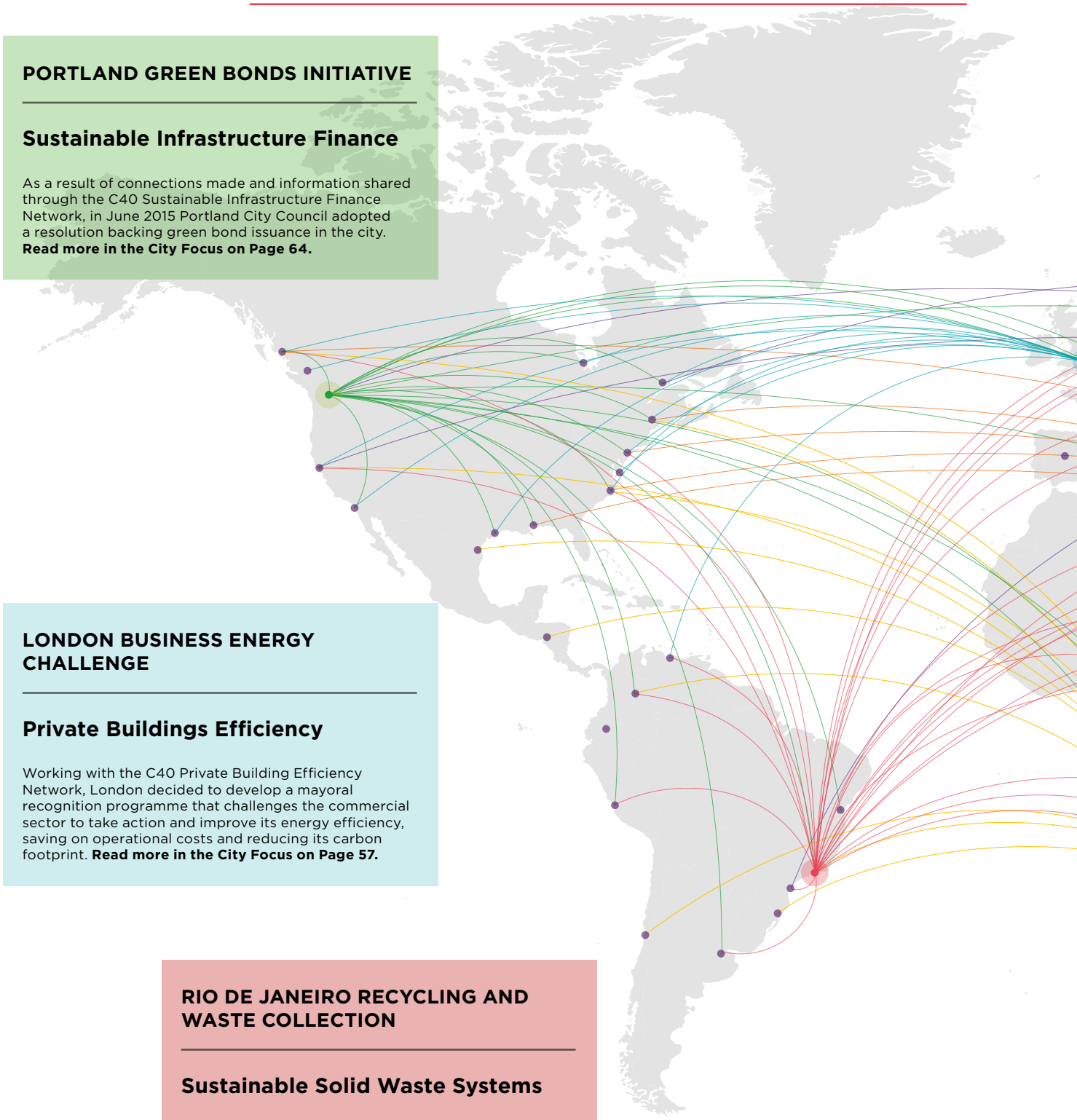
Of all actions reported by cities in 2015, 55% have been taken through a Collaborating governance typology.

THE NETWORK WORKS: EXAMPLES OF CITIES DELIVERING ACTION THROUGH COLLABORATION IN C40'S THEMATIC NETWORKS

PORTLAND GREEN BONDS INITIATIVE

Sustainable Infrastructure Finance

As a result of connections made and information shared through the C40 Sustainable Infrastructure Finance Network, in June 2015 Portland City Council adopted a resolution backing green bond issuance in the city. **Read more in the City Focus on Page 64.**



LONDON BUSINESS ENERGY CHALLENGE

Private Buildings Efficiency

Working with the C40 Private Building Efficiency Network, London decided to develop a mayoral recognition programme that challenges the commercial sector to take action and improve its energy efficiency, saving on operational costs and reducing its carbon footprint. **Read more in the City Focus on Page 57.**

RIO DE JANEIRO RECYCLING AND WASTE COLLECTION

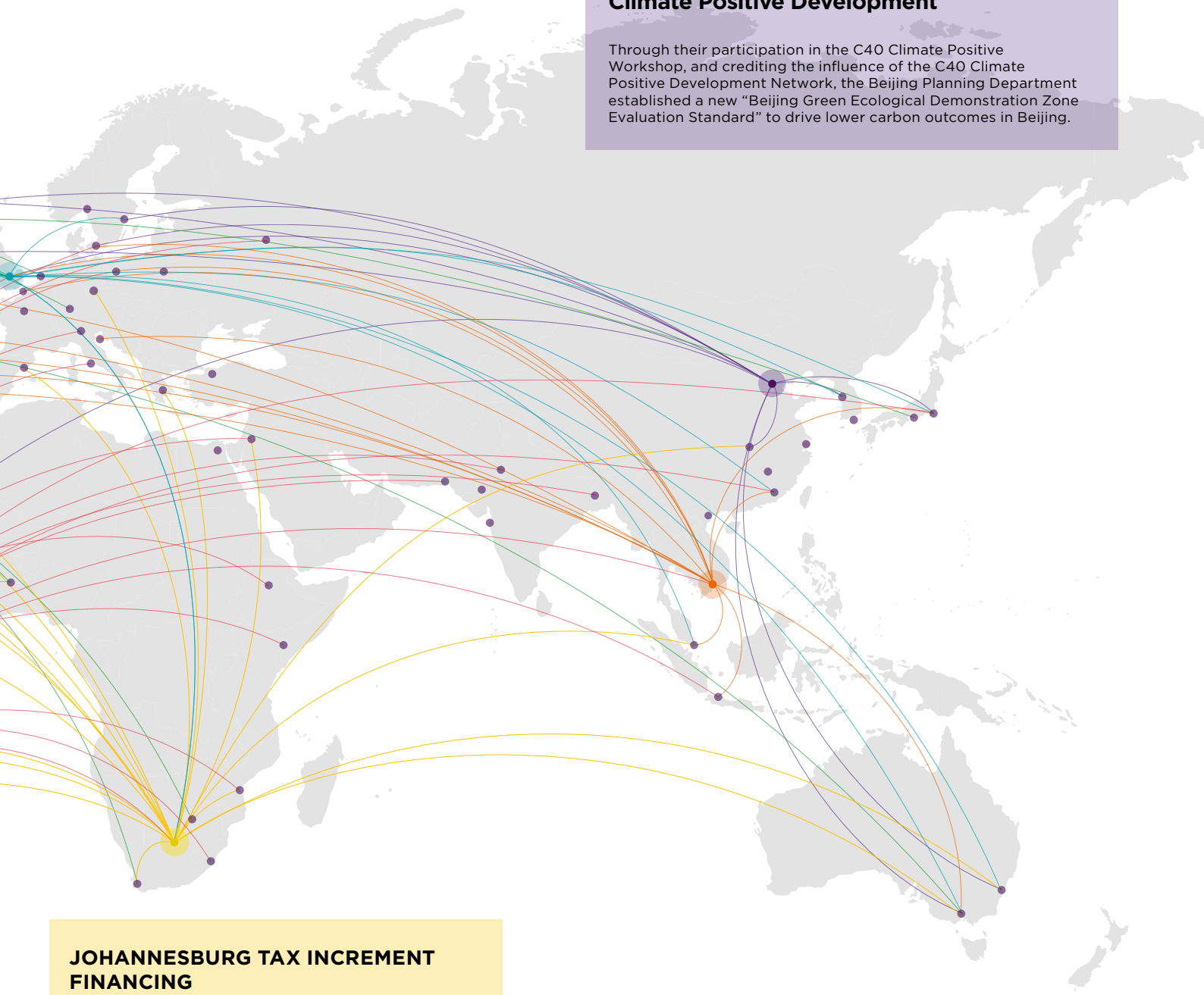
Sustainable Solid Waste Systems

After learning about other cities' recycling rates in C40's waste networks at Sao Paulo in 2012, Rio de Janeiro committed to significantly increase its recycling rate, and has been participating in the C40 Waste Networks ever since. Through the C40 Sustainable Solid Waste Systems Network, Rio learned about Johannesburg and Jakarta's management of waste cooperatives. Rio incorporated aspects of these socialised approaches to enable cooperative workers to operate in their building sorting centres, thus reducing street and landfill scavenging and better enabling the city of Rio to increase its recycling rate.

BEIJING GREEN ECOLOGICAL DEMONSTRATION ZONE EVALUATION STANDARD

Climate Positive Development

Through their participation in the C40 Climate Positive Workshop, and crediting the influence of the C40 Climate Positive Development Network, the Beijing Planning Department established a new "Beijing Green Ecological Demonstration Zone Evaluation Standard" to drive lower carbon outcomes in Beijing.



JOHANNESBURG TAX INCREMENT FINANCING

Sustainable Urban Development

Informed by discussions with the city of Washington, D.C. through C40's Sustainable Urban Development Network, Johannesburg is exploring new strategies, such as the use of TIF notes. **Read more in the City Focus on Page 84.**

HO CHI MINH CITY ADAPTATION STRATEGY

Connecting Delta Cities

Inspired by discussions with other cities in C40's Connecting Delta Cities Network, Ho Chi Minh City established an institutional body on climate change to better understand how they should administer their climate resilience work. **Read more in the City Focus on Page 79.**

ANATOMY OF AN ACTION 3

3.8 FINANCING CLIMATE ACTIONS THROUGH NETWORKING

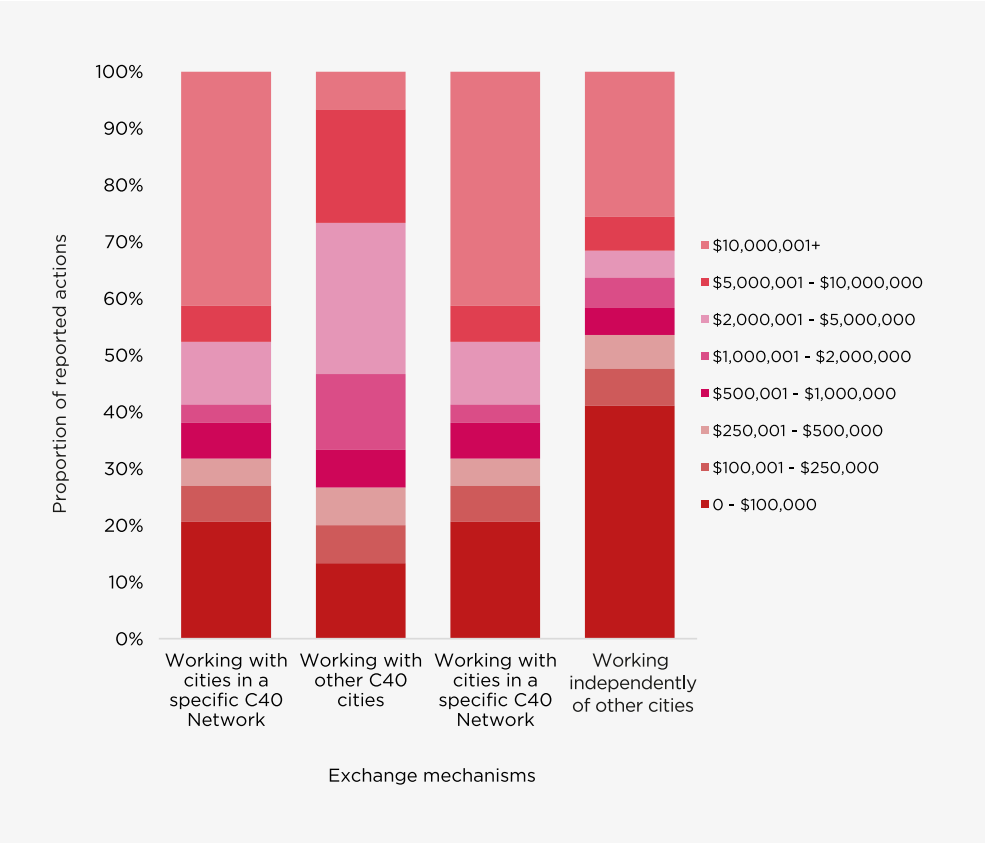
$1 MILLION

Cities in C40 networks have generally undertaken a higher proportion of actions that cost more than $1 million than other cities.

C40 networks create collective power to access resources, including technical and financial support. The result is that cities' actions to mitigate greenhouse gas emissions and climate risks are bolder, and implemented faster, than if they were to go it alone.

Cities in specific C40 networks, and that work with other C40 cities, have generally undertaken a higher proportion of actions that cost more than $1 million than other cities, potentially due to their ability to access innovative financing mechanisms. Where cities work with other cities in specific networks, nearly half of all actions reported cost above $10 million (Figure 3.06).[14]

Figure 3.06. Cost breakdown of actions by different exchange mechanisms.



Cities rely less on traditional funding sources (e.g. central city budget) to deliver projects when they work with other cities in a C40 network. They tend to draw from a broader spectrum of financing options (e.g. city climate funds, green bonds, and tax increment financing (TIF). Networking through C40 has the potential to introduce new ideas, opportunities and partnerships to city officials looking for ways to finance climate actions. As such, almost half of all actions delivered though networking are funded by grants and subsidies.

14 It is noted that cities with the most financial resources may have more time available to spend on networking activities.

City Focus: Portland's Green Bonds

As a result of connections made and information shared through the C40 Sustainable Infrastructure Finance Network, in June 2015 Portland City Council adopted a resolution backing green bond issuance in the city. Green bonds can support cities with financing the infrastructure needed to reduce carbon emissions and become more resilient to the effects of climate change. The resolution passed with unanimous support from City Commissioners, and the City will now begin to develop a "top-shelf" framework defining project eligibility, expenditure tracking, requirements for reporting project outcomes, and other programme considerations.

Portland expects to issue their first green bonds in 2016 to finance LED retrofits and other sustainability projects. Portland's progress on green bonds could support the wider development of the green bond market in cities, with a number of C40 cities actively interested in progressing their own green bond programmes. Johannesburg set the precedent for this action, as the first C40 city to issue a green bond in 2014.

3.9 IDENTIFYING COMMON GROUND AMONG CITIES: NETWORKING THROUGH TYPOLOGY ANALYSIS

C40's networks strive to, wherever possible, connect cities facing specific climate action challenges with cities that are leaders in that field. C40 networks also aim to bring together cities with similar characteristics, with the understanding that they might work together to bridge common barriers. Certain characteristics (such as a city's climate) may be obvious, but others can remain obscured, possibly representing missed opportunities to drive action.

C40's data-driven approach to climate action has resulted in a wealth of information on cities' characteristics and activities, from simple population and GDP statistics, to detail on the preferred sectors for climate action and types of funding mechanisms used. With the launch of CAM 3.0, C40 and Arup built on their city expertise, using statistical analysis to delve into the full CAM dataset and develop a series of "City Characteristics Typology Clusters" (CCTCs).

3.10 CITY CHARACTERISTICS TYPOLOGY CLUSTERS

A highlight of the methodology for the typologies analysis, carried out by Arup's data partner Mastodon C, is provided in Appendix A3. This section briefly presents four examples of CCTCs identified, along with examples of some of the insights available from these linkages.

CCTCs present a number of interesting perspectives. As is evident, there is no single-region cluster; cities have more in common with each other than may be apparent at first glance. The clusters present themselves as a prospectus for a range of city stakeholders, from policymakers who can seek out knowledge and experience from cities facing similar challenges, through to investors seeking to place their funds where they might have the greatest benefits for all parties concerned.

1) Addis Ababa, Hanoi, Johannesburg, Karachi, Nairobi

Cities in this cluster favour policy as a means of delivering climate action, and do so by Collaborating less frequently than average. Instead, they take action in sectors with Providing or Legislating typologies.[15] This cluster has the second highest proportion of pilot actions, with all current actions in the sub-$100,000 cost range.

> 80% of the actions delivered by cities in this typology are in climate adaptation. These actions include tree planting and the creation of green space, flood mapping, and heat mapping. These all cost under $100,000 and are the result of policy implemented by the cities.

2) Amman, Ho Chi Minh City, Jaipur, Salvador

These cities demonstrate fewer actions in the Buildings and Private Transport sectors than average, but exhibit a strong focus on Waste sector action. These cities are large investors, with more actions in the $10+ million cost range, and less in the sub-$100,000 band. As with the previous cluster, these cities act through Collaborating far less than average. This cluster holds more actions planned for expansion per city than any other cluster. Additionally, these cities have more actions (proportionally) at pilot scale than in all other clusters; these cities hold the potential for a boom in climate action. However, they are far less reliant on their own funds than average, instead utilising grants to fund their action.

> 13 of the climate actions in these four cities cost in excess of $10 million, with these funded via loans

15 Note that C40 governance typologies are currently only available for those cities reported on in CAM 2.0.

3) Athens, Curitiba, Lima, London, Milan, Oslo, Rome, Rotterdam, Venice, Warsaw

The 10 cities in this cluster tend to deliver actions in the $2-5 million cost range, with a slight preference to do so by using their own funds. They exhibit the Collaborating governance typology more than average, preferring this over the Legislating typology. Curitiba and Lima stand out as Latin American cities acting among a group of European peers.their own funds than average, instead utilising grants to fund their action.

One of the cities in this cluster is looking to commence a $10 million-plus municipal energy efficiency programme, with the funding means and source still to be identified.

4) Lagos, Mexico City, Rio de Janeiro, São Paulo

While the cities in this cluster favour actions costing $5 million and above, they also report a greater than average number of actions awaiting identification of a funding source. This cluster delivers actions by Collaborating more than average. As a result, perhaps, in absolute terms this cluster contains the second most actions delivered via networking.[16]

Rio de Janeiro is highly committed to expanding and improving bus infrastructure, services and operations, implementing six out of the eight possible actions in this action area. These actions focus on improving the city's Bus Rapid Transit (BRT) system, which has substantial potential to reduce emissions in the Transport sector by facilitating a shift from more emissions-intensive modes of transport and improving fuel efficiency.

For the actions that have the total cost information, received investment is in excess of $10 million. Rio de Janeiro has directed its own funds and savings towards implementing four BRT systems and creating exclusive lanes for buses and efficient management of bus traffic. However, they still need to determine a funding source to improve the bus shelters.

C40's networks have played a role in improving bus infrastructure, services and operations in Rio de Janeiro. In fact, the delivery of half of these actions have been assisted by working with other cities in a specific C40 network.

16 The only greater number of actions delivered through networking comes in a 20-city cluster not presented here.

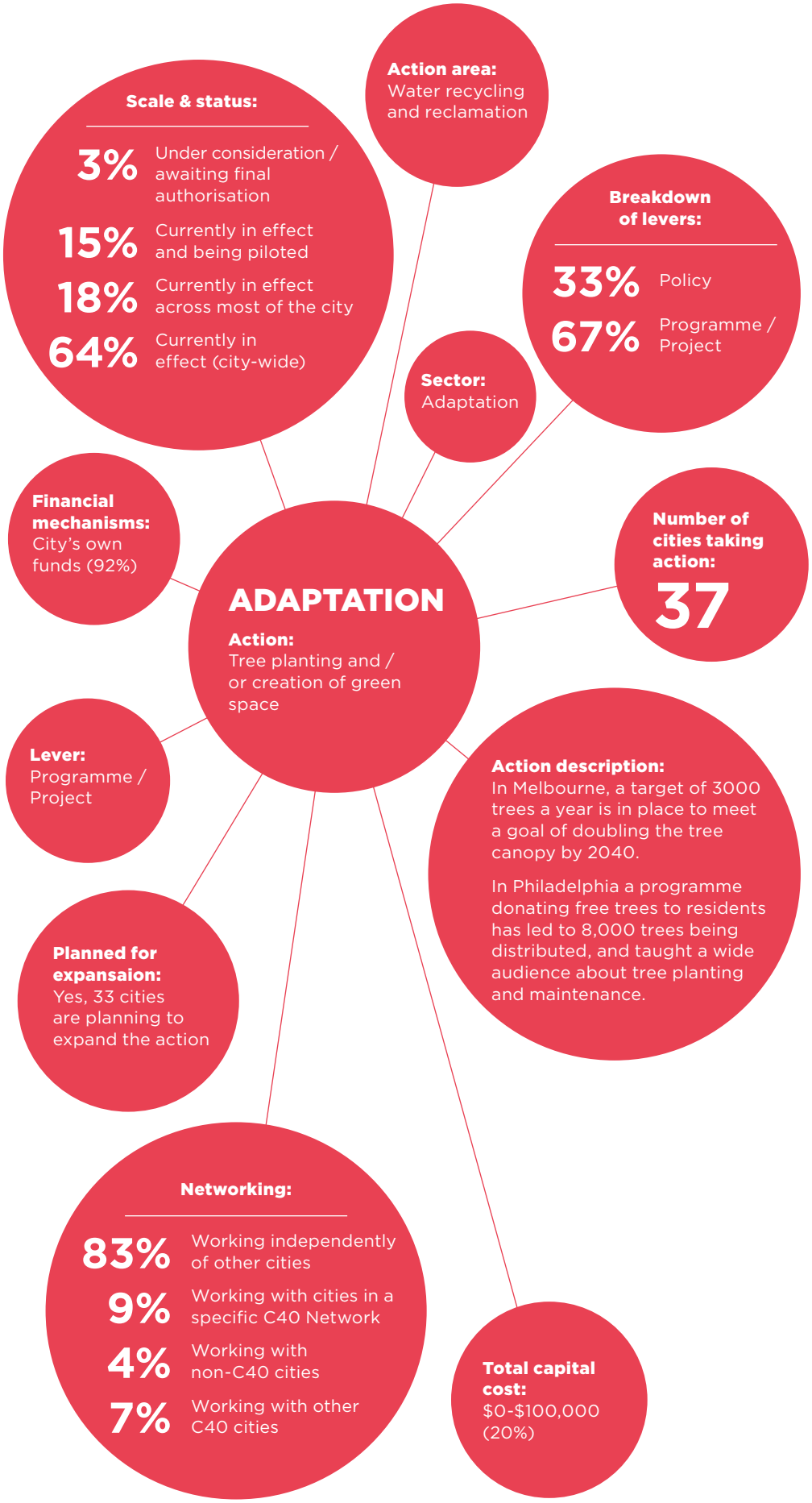
37

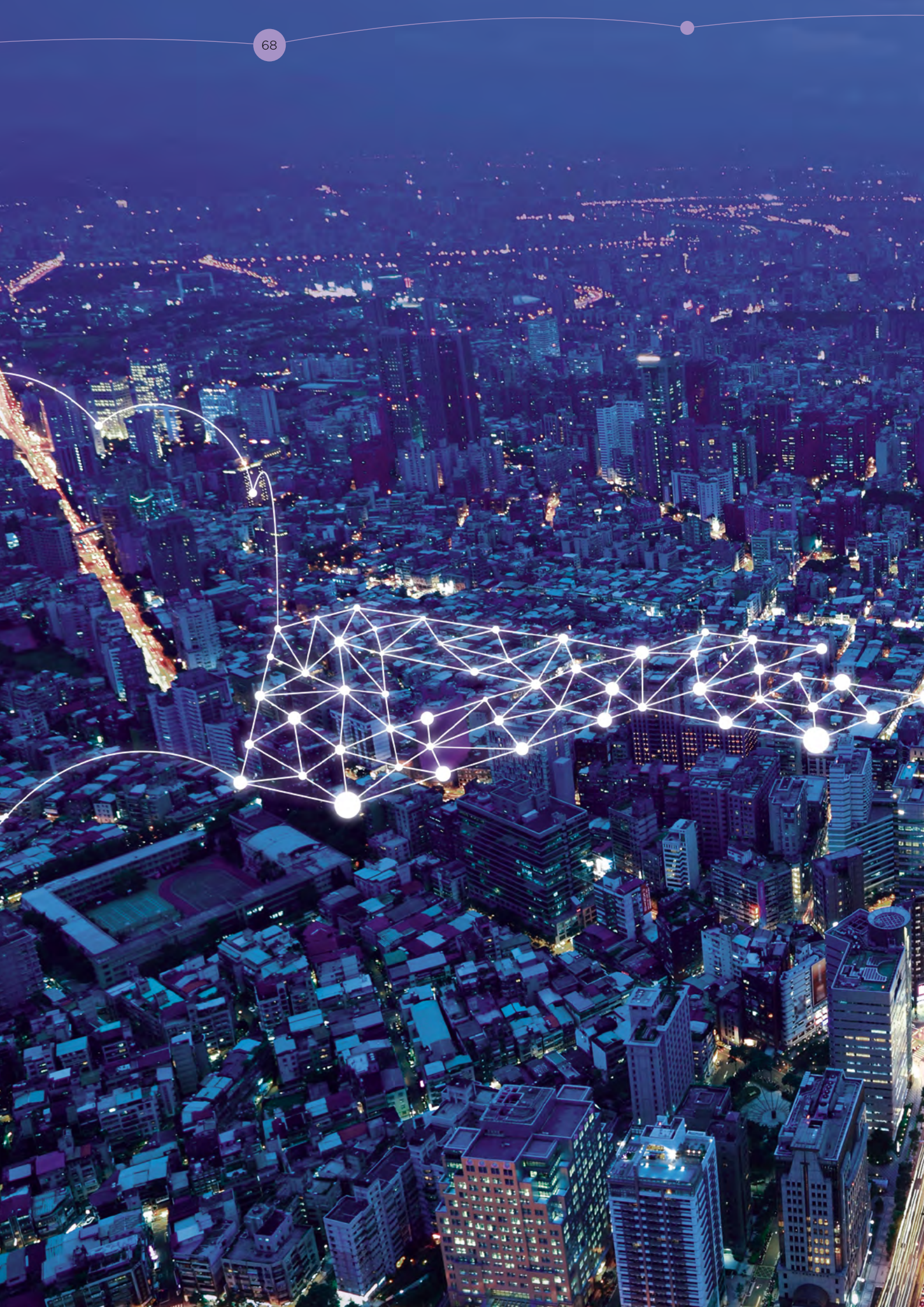
37 C40 cities are taking tree planting and / or creation of green space action.

3,000 TREES A YEAR

The target in Melbourne is to plant 3,000 trees a year to meet a goal of doubling the tree canopy by 2040.

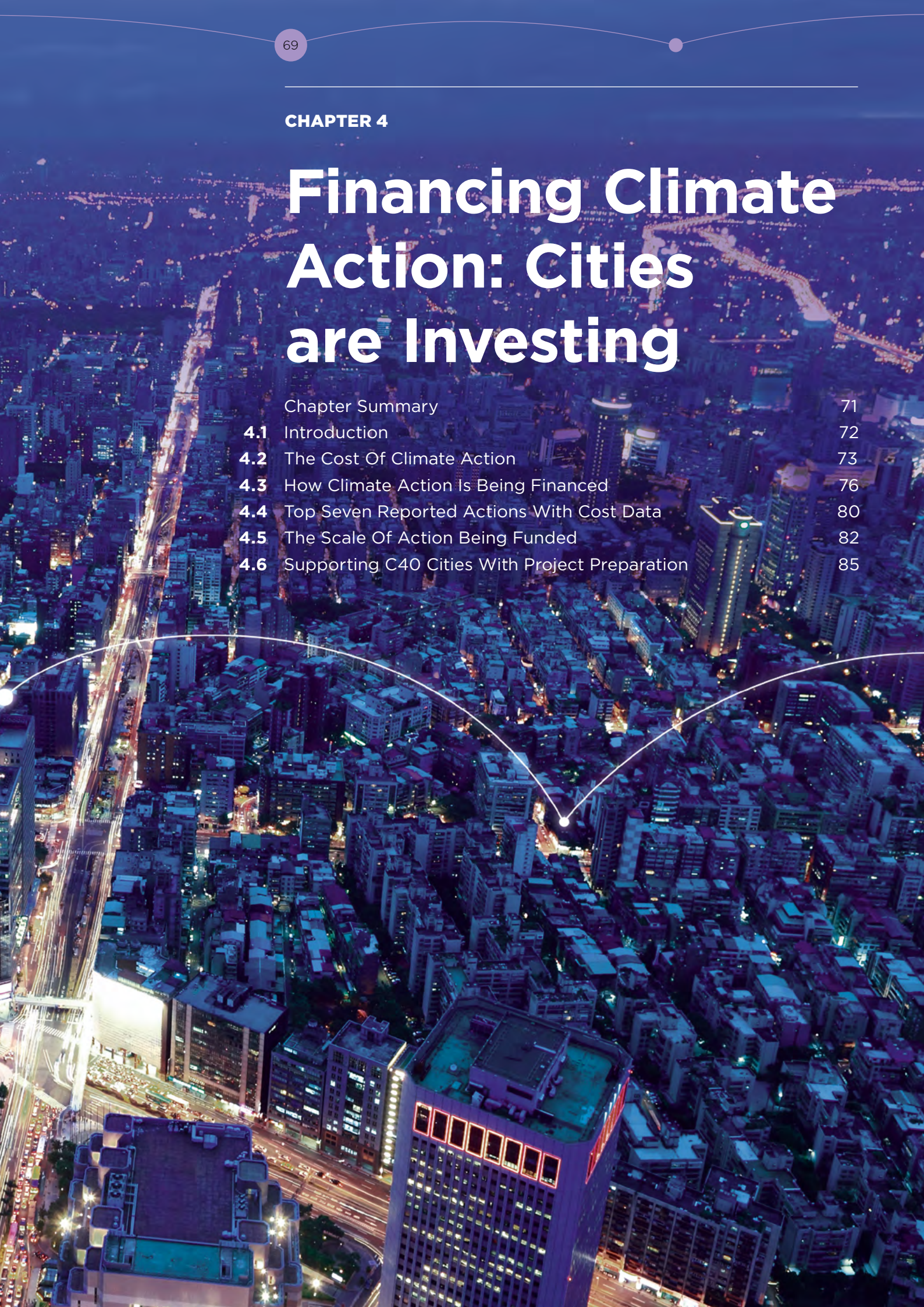
ANATOMY OF AN ACTION 4





CHAPTER 4

Financing Climate Action: Cities are Investing



64%

Cities funded 64% of reported actions with their own budget and savings.

$2.8 billion

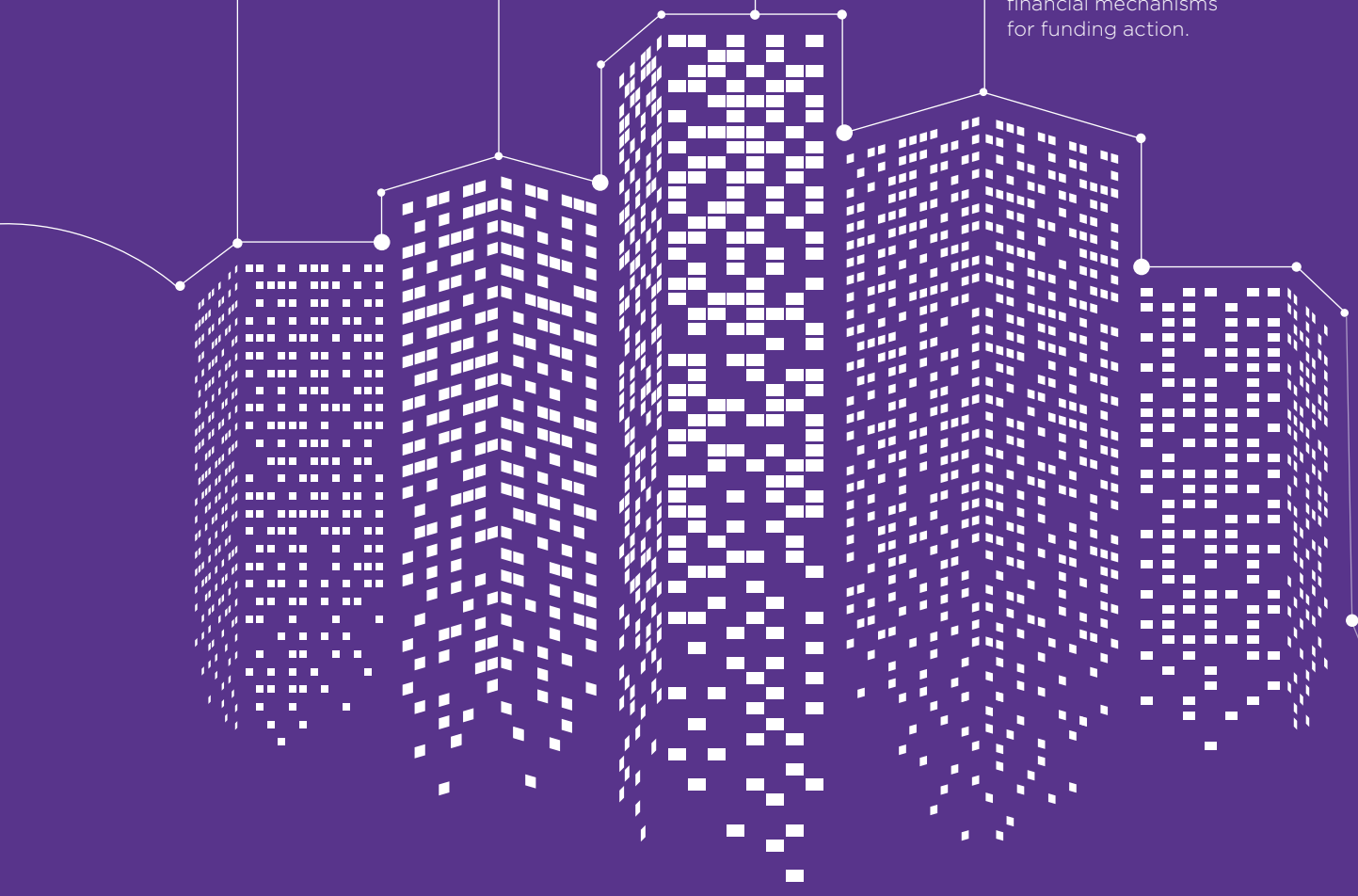
450 out of the total 9831 action being taken by C40 cities alone accounts for more than a reported $2.8 billion of investment.

25%

In 2015, the data shows that 25% of actions received investment of more than $10 million.

35

35 C40 cities, from Barcelona to Bogotá, have an international credit rating, providing access to a range of financial mechanisms for funding action.



CHAPTER SUMMARY: FINANCING CLIMATE ACTION, CITIES ARE INVESTING

$10 MILLION

In 2015, 25% of actions received investment of more than $10 million.

70%

For actions taken at a city-wide scale, cities funded 70% of actions with their own budget and savings.

$500,000

Cities can achieve a lot through innovation, ingenuity, and collaboration. The majority of city-wide actions cost under $500,000 per action.

For the first time, C40 and Arup have been able to analyse data on the cost, funding and financing mechanisms of thousands of climate actions, investigating the relationship between the capital cost, scale of action, and the levers used for implementation.

The findings highlight that cities are prepared to direct large sums of money towards actions that directly lead to emissions reductions and which help their cities adapt to the effects of climate change. In 2015, the data shows that 25% of actions received investment of more than $10 million. It is estimated that the investments behind just 450 city climate actions, a small proportion of the total actions reported, totaled $2.8 billion.

Furthermore, C40 cities are willing to step up and use their own funds to take climate action. Cities funded 64% of reported actions with their own budget and savings. This proportion increases to 70% for those actions taken at a city-wide scale.

When developing new climate actions, cities are also using alternative financial mechanisms that support and incentivise action, such as bonds, tolls and developer contributions. They are also using their relationships with other actors to pilot actions and demonstrate their effectiveness before scaling them up.

35 C40 cities, from Barcelona to Bogotá, have an international credit rating, providing access to a range of financial mechanisms for funding action. Cities invest, but they also attract investment. Coupled with C40's action dataset, the potential to mobilise international funding to the areas where it will deliver the greatest impact is higher than ever.

But large-scale investments are not all that is needed, and cities are finding ways to leverage smaller sums of money to take city-wide action. In fact, the majority of city-wide actions cost under $500,000, a demonstration of what can be achieved with innovation, ingenuity, and collaboration with other partners.

4.1 INTRODUCTION

$16.6 TRILLION

New analysis suggests that low carbon actions in cities represent a $16.6 trillion global economic opportunity.

Many cities, particularly in developing countries, need support from national or international institutions to transition to low-carbon development models. National policy is critical in determining the powers and financial resources available to city authorities. At all levels, policies and financial circumstances need to shift quickly and significantly to help cities, states and regions to address climate change. New analysis undertaken in 2015 suggests that low carbon actions in cities represent a $16.6 trillion global economic opportunity.[17]

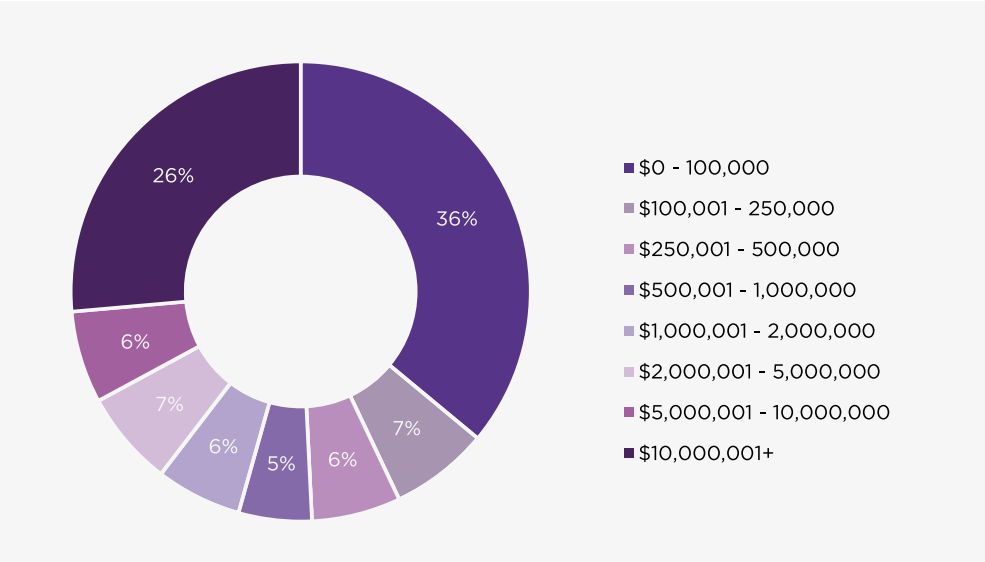
This chapter investigates the cost of climate action and looks at how climate action is being funded within cities. It looks at the most commonly reported actions with finance data and investigates the relationship between the capital cost, scale and levers being used to deliver climate actions. It also focuses particular attention on adaptation finance and the relationship between city governance typologies and climate finance mechanisms. While not all actions within CAM reported information on capital costs or financing, there is still sufficient information to paint a very informative picture about how cities are mobilising funds to take proactive climate action.

17 The New Climate Economy: Seizing the Global Opportunity Partnerships for Better Growth and a Better Climate, New Climate Economy, 2015.

4.2 THE COST OF CLIMATE ACTION

Climate action can range in size from relatively small, targeted initiatives to large-scale, city-wide programmes. What is obvious from this year's responses to CAM 3.0, is that cities are investing in a range of actions with a variety of capital budgets.

Figure 4.01. Percentage of actions by total capital cost.



36%

36% of actions have capital costs of below $100,000.

25%

Cities are prepared to direct large sums of money into action. 25% of actions have received capital investment of more than $10 million.

$2.8 BILLION

The combined value of the 450 action out of 9,831 for which cost data was reported, is estimated at $2.8 billion.

As illustrated in Figure 4.01, the majority (54%) of climate actions with reported expenditure information cost less than $1 million. While a large proportion (36%) of the actions have capital costs of below $100,000, one in four have received capital investment of more than $10 million. This shows that cities are prepared, where necessary, to direct large sums of money into actions that directly lead to emissions reduction and risk minimisation within their jurisdictions.

While cities only reported cost ranges of their actions (exact costs were not disclosed), the combined value of the 450 actions with cost data is conservatively estimated at $2.8 billion. If this cost profile is applied to all 9,831 actions in the database, the total investment is as high as $60 billion.

Considering the capital cost of actions against the scale of the action is also useful in understanding how much money is being used to support climate initiatives. Figure 4.02 shows that for climate actions which are still under consideration

40%

There is a wide range of cost effective climate actions that can be delivered at the city-wide scale. Approximately 40% of all actions have low capital investment requirements, of less than $100,000.

$100,000

Over 30% of actions in Adaptation, Building and Community-scale Development sectors cost less than $100,000.

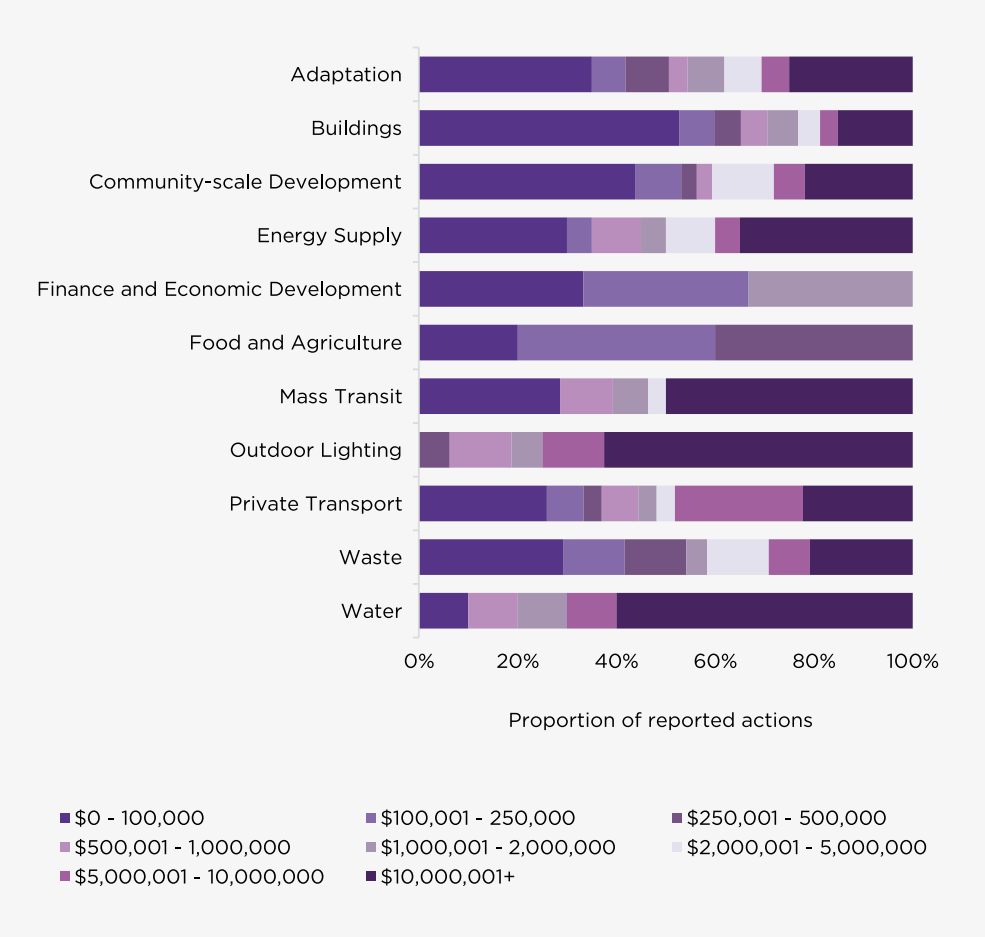
or awaiting final authorisation, the majority have low capital costs of less than $100,000. In contrast, those actions which are currently in effect at a significant scale across most of the city have a more equal spread of capital costs. For actions with reported cost information at that scale, almost 40% cost more than $10 million.

The most interesting figures in Figure 4.02 can be seen within the actions that are currently in effect (city-wide). This scale category has the most widely distributed range of capital cost values for the actions with reported cost information. Roughly 40% of the actions have low capital investment requirements (of less than $100,000), and just over 20% have high capital cost of over $1 million. This shows that there is a wide range of cost effective climate actions that can be delivered at a transformative, city-wide scale within cities. City-wide initiatives do not have to break the bank, and Figure 4.02 illustrates that city authorities can deliver action across the entirety of their jurisdiction on a variety of budgets.

The nature and scale of climate action vary across different sectors. This is reflected in Figure 4.03, which depicts the capital cost of different actions across each CAM sector. The figure shows that certain sectors have a higher proportion of actions with large capital costs. The Mass Transit, Outdoor Lighting and Water sectors are good examples of this, where the majority of actions with reported cost information reported capital investment requirements of over $10 million. By contrast, over 30% of actions in each of the Adaptation, Buildings and Community-scale Development sectors cost less than $100,000.

Figure 4.02. Actions by scale, broken down by capital cost.

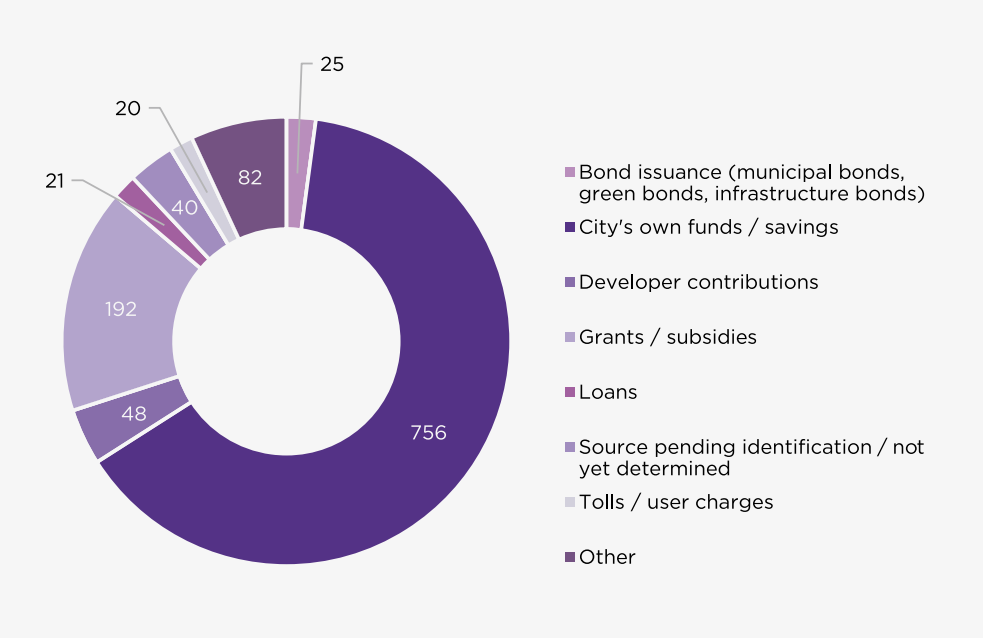
Figure 4.03. Breakdown of capital cost of action per sector.



4.3 HOW CLIMATE ACTION IS BEING FINANCED

Cities in the C40 network are committed to financing climate action. As demonstrated in Figure 4.04, cities have funded a significant proportion (approximately 64%) of actions with their own budgets or savings.

Figure 4.04. Breakdown of actions by financial mechanisms used.



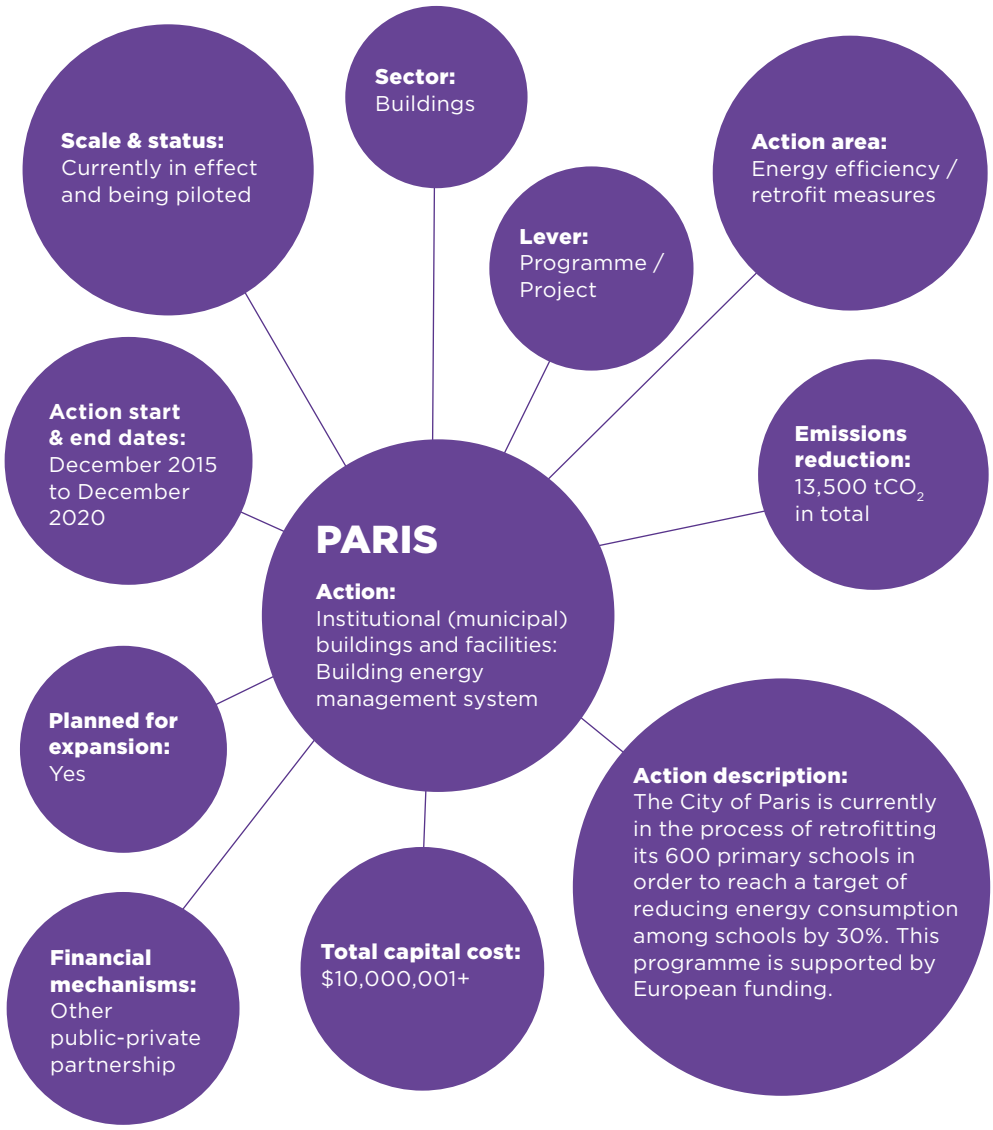
In addition to the use of their own budget, cities are showing initiative and are making use of a variety of mechanisms to fund climate action. These range from the use of green bonds, developer contributions, tolls and user charges, to grants and subsidies, and traditional loans. Grant funds are the second most commonly used mechanism reported in CAM, while the other financial mechanisms listed are currently used less frequently (i.e. to finance less than 10% of the actions for which data was provided). The financing of climate action, often termed as 'Climate Finance' is a field in which there has recently been significant transformation, and it is expected that the mechanisms and sources used to fund climate action in the future may change considerably in the coming years.

Thirty-five C40 cities, from Barcelona to Bogotá, now have an international credit rating, and with the growing popularity of such mechanisms as municipal green bonds and the establishment of city revolving green funds, cities are increasingly seeing more financing options available to support their climate actions. Future CAM reports will seek to investigate these changing trends over time and understand how they are helping C40 cities to achieve their climate action goals.

13,500tCO$_2$

Paris installed building energy management systems across most of the municipal buildings and facilities which has resulted in a 13,500 tCO$_2$ emissions reduction.

ANATOMY OF AN ACTION 5



$130 BILLION

In 2012, weather-related events caused more than $130 billion in losses worldwide.

43

Cities recognise the need to invest in adapting to climate change. Over the past two years, 43 cities have invested their own budget in adapting to the effects of climate change.

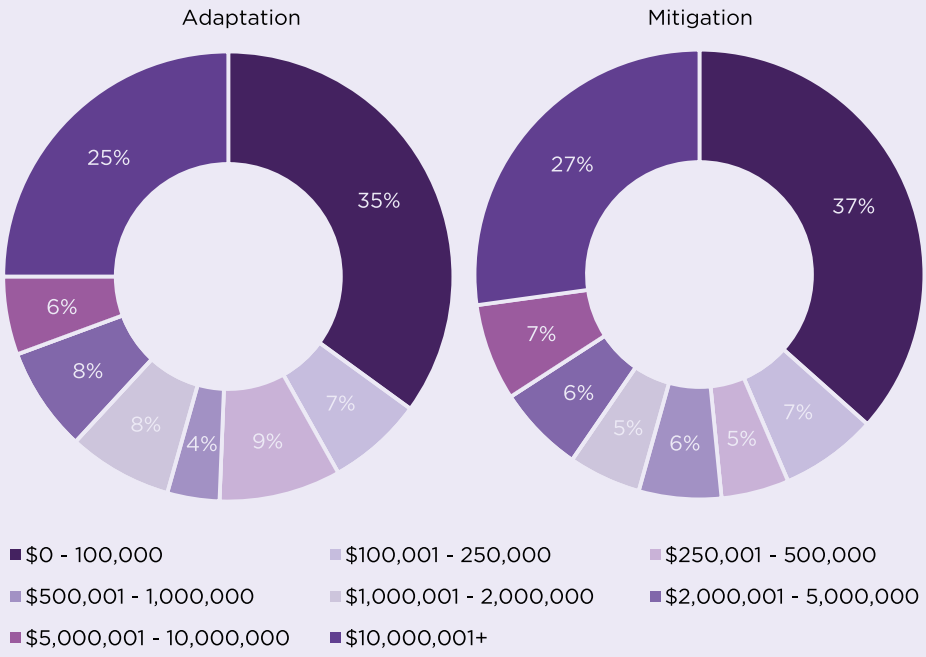
Adaptation Finance

Munich Re reported that in 2012, weather-related events caused more than $130 billion in losses worldwide.[18] It is estimated that Hurricane Sandy alone cost the US government $50 billion.[19] In other words, climate impacts can be severe and costly, but cities are taking action to become more resilient.[20]

Over the past two years, 43 cities have invested their own budget in adapting to the effects of climate change. However, these investments must be scaled up to enable cities to adapt to the growing range, frequency and severity of hazards they face (see Chapter 2).

18 http://www.munichre.com/en/media-relations/publications/press-releases/2011/2011-01-03-press-release/index.html
19 http://www.eqecat.com/catwatch/post-landfall-loss-estimates-superstorm-sandy-released-2012-11-01/
20 http://www.c40.org/blog_posts/a-stronger-more-resilient-new-york

Figure 4.05. Cost comparison of adaptation and mitigation actions.



40%

Of the adaptation actions, 40% are being delivered at a citywide scale, compared to 35% for mitigation.

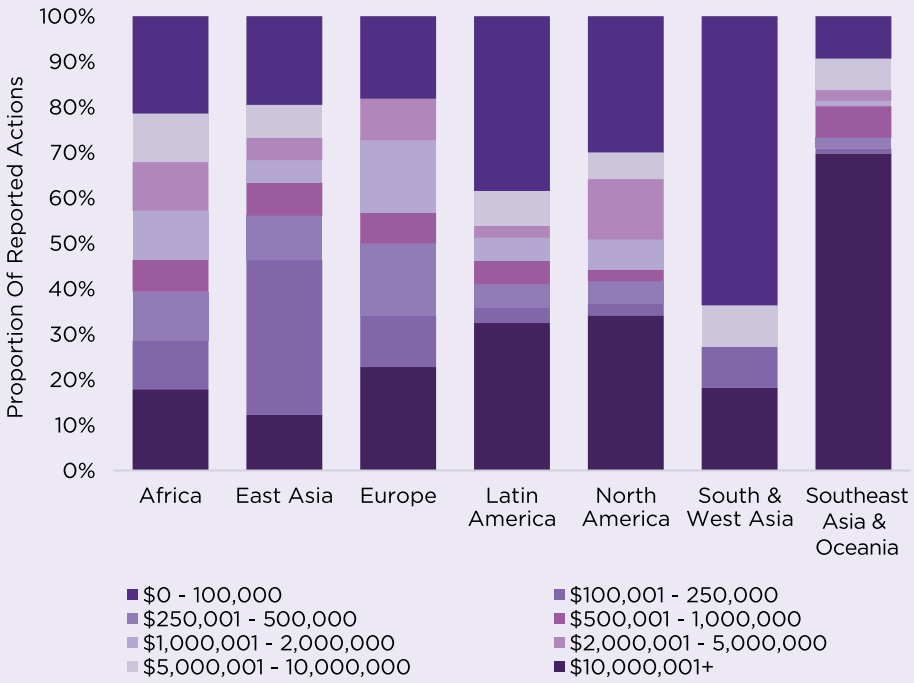
>$10 MILLION

Latin America is taking the most adaptation actions costing more than $10 million. Cities in Latin America have focussed their efforts on delivery city-wide actions to adapt to hazards such as extreme temperatures, flooding, and mass movement.

In line with the overall trends, cities mostly use their municipal budgets to deliver adaptation actions. Adaptation actions have a similar breakdown of average costs as mitigation actions, although they tend to be more complex due to the larger scale at which they are often delivered. Of the adaptation actions, 40% are being delivered at city-wide scale, compared with 35% for mitigation actions.

The Latin American region has the largest share of adaptation actions costing more than $10 million and a higher proportion of actions above $1 million compared with other regions. Although 13% of adaptation actions are being taken in Latin America, the region currently reports 50% of the highest-cost adaptation actions globally. Latin American cities like Bogotá, Mexico City, Quito and Rio de Janeiro have been concentrating their resources on high-cost, city-wide actions to adapt to hazards like extreme temperatures, flooding, and mass movement.

Figure 4.06. Regional trends around adaptation action costs.



City Focus: Ho Chi Minh City's Climate Adaptation Strategy

Inspired by discussions with other cities in C40's Connecting Delta Cities Network, Ho Chi Minh City established an institutional body on climate change to better understand how they should administer their climate resilience work. Through Rotterdam's direct assistance, Ho Chi Minh City secured funding from the Dutch government and technical assistance from Dutch consultants and companies to complete their Climate Adaptation Strategy (CAS).

Ho Chi Minh City shifted from CAS planning to implementation with Rotterdam's assistance. Through direct technical support from Rotterdam, Ho Chi Minh City is now applying adaptation principles in pilot districts and engaging various segments of government to design flood control measures in specific locations.

City Focus: Washington, D.C. Stormwater Regulations

C40 cities are taking action to finance adaptation in a number of ways. Washington, D.C. finalised new stormwater regulations that require large development projects to install green infrastructure practices such as cisterns, rain gardens, green roofs and permeable pavement in order to retain stormwater on-site. The regulation allows development projects to meet a portion of their stormwater retention requirement through Stormwater Retention Credits (SRC). SRC is an open-market trading programme in which property owners who have voluntarily installed green practices can sell credits to others. Voluntary stormwater capture practices are incentivised through the RiverSmart Program, which provides property owners with discounts and rebates to help defray costs of rain barrels or cisterns.

4.4 TOP SEVEN REPORTED ACTIONS WITH COST DATA

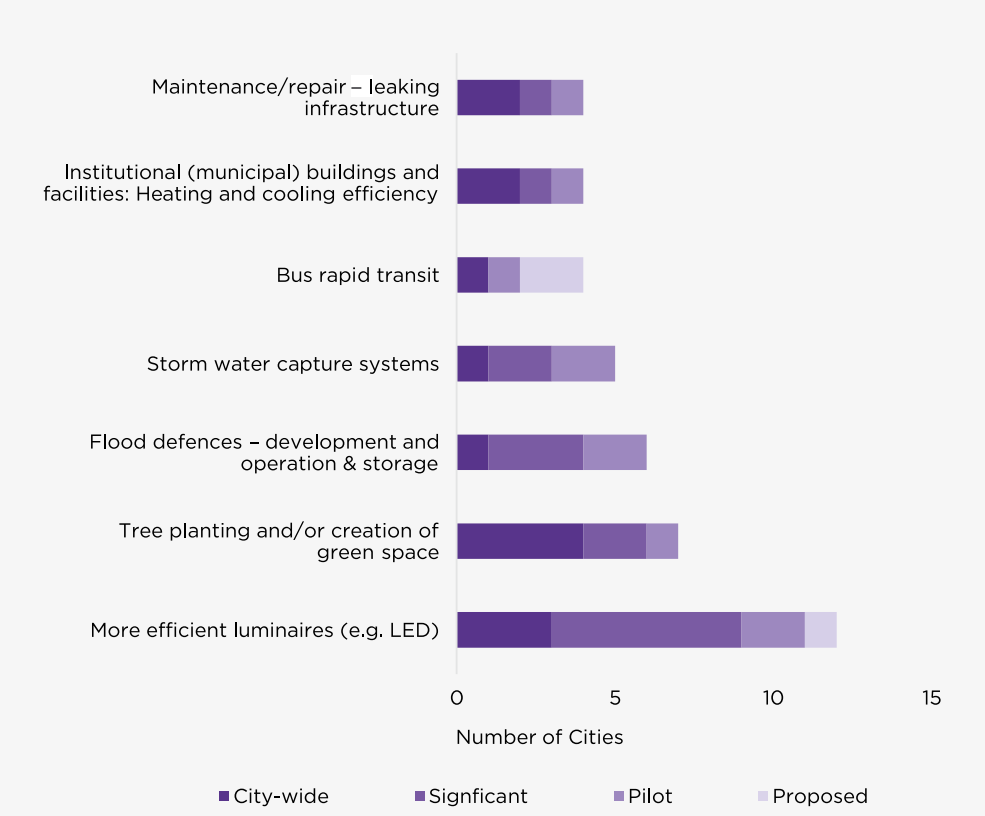
Over 30% of CAM actions with expenditure information have been identified as costing $5 million or more. It is interesting to focus in on these high-cost actions to see which are the most widely reported. As shown in Figure 4.07, there are seven specific actions that four or more cities have implemented costing $5 million or more (at the same time there are many more being taken by less than four cities). These actions range from LED lighting solutions to bus rapid transit and municipal building heating and cooling and occur across multiple sectors. Three of these actions relate to adaptation while the other four represent mitigation, highlighting the comparable levels of investment required for each.

The above is in contrast to actions that have a total capital cost of $100,000 or less, where there is only one common action (flood mapping) that more than four cities have identified. This highlights the wide range of relatively low-cost actions that are possible. If these low-cost actions prove to be effective, this points to a potentially significant, cost-effective opportunity that a majority of C40 cities could harness.

$5 MILLION

Over 30% of CAM actions have been identified as cost more than $5 million.

Figure 4.07. Actions costing $5 million or more being taken by at least four cities.



City Focus: Heating and Cooling Efficiency in New York City's Buildings and Facilities

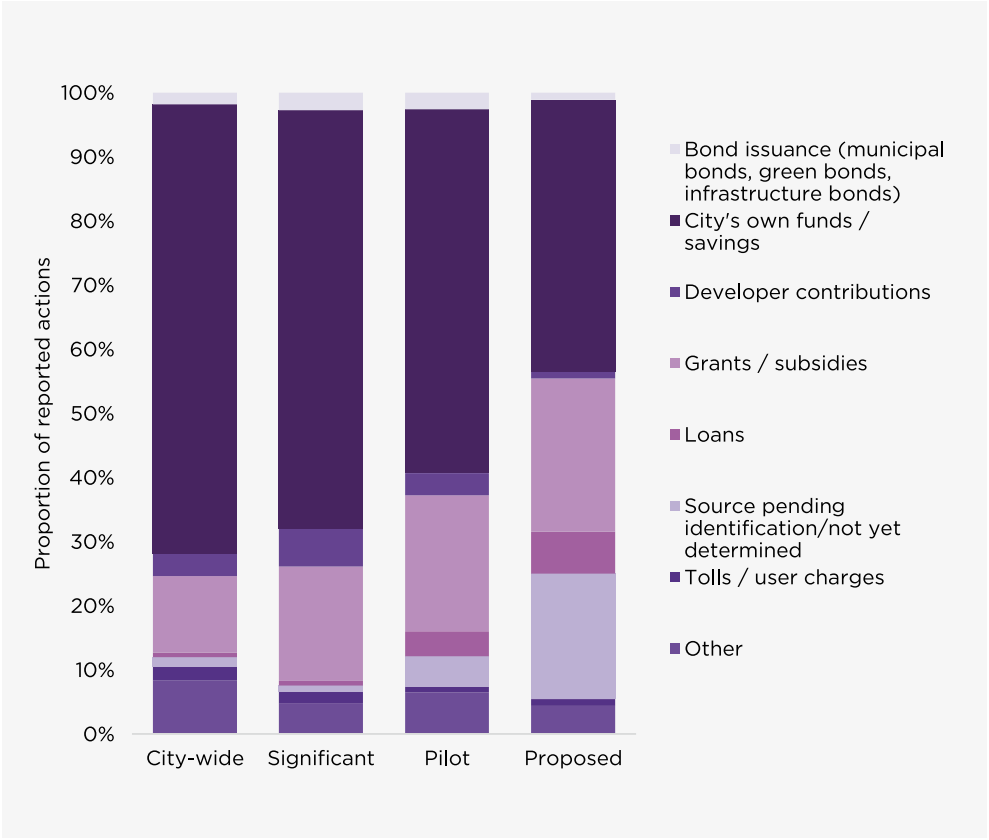
New York City is investing approximately $150 million in the Accelerated Conservation and Efficiency programme which is a competitive funding programme for City Agency identified and implemented energy efficiency projects with high emission savings potential. The funding for the project was raised from New York City's own funds and savings and through bond issuance. It has been allocated to fifteen City Agencies for over 80 projects which together are estimated to reduce the city's emissions by approximately 50,000 $MtCO_2e$.

A small number of projects were completed in 2014, and as more projects are completed in 2015, it is anticipated the programme will become a major driver of emissions reduction in 2016.

4.5 THE SCALE OF ACTION BEING FUNDED

Figure 4.08 suggests that when cities have access to funds or savings, they tend to take actions at a greater scale. It illustrates that for actions occurring at a city-wide scale, approximately 70% were financed using the city's own funds or savings. However, the data also shows that cities use their own funds or savings less frequently when piloting climate action. This suggests that cities are using their relationships with other actors to attract funding for pilot actions and demonstrate their effectiveness, before taking responsibility themselves for funding these actions to reach a more transformative scale. There is a role at this level, then, for financial agents such as venture philanthropists to invest in early stage projects to bridge the gap between concept and city-wide delivery, bringing in funding from cities once they are proven.

Figure 4.08. Proportional breakdown of mechanisms used to finance climate action by scale.



70%

When cities have access to funds or savings, they tend to take actions at a greater scale. 70% of actions occurring at a citywide scale were financed using city's own funds or savings.

Figure 4.08 presents the interesting dynamic of the relationship between financing mechanisms being used and the scale of action taking place.

4.5.1 FINANCING PILOT ACTIONS

There is a number of competing factors that might explain why cities are financing a lower proportion of pilot actions. Financial mechanisms such as loans, grants and subsidies are used more frequently by cities for actions taken at a smaller scale.

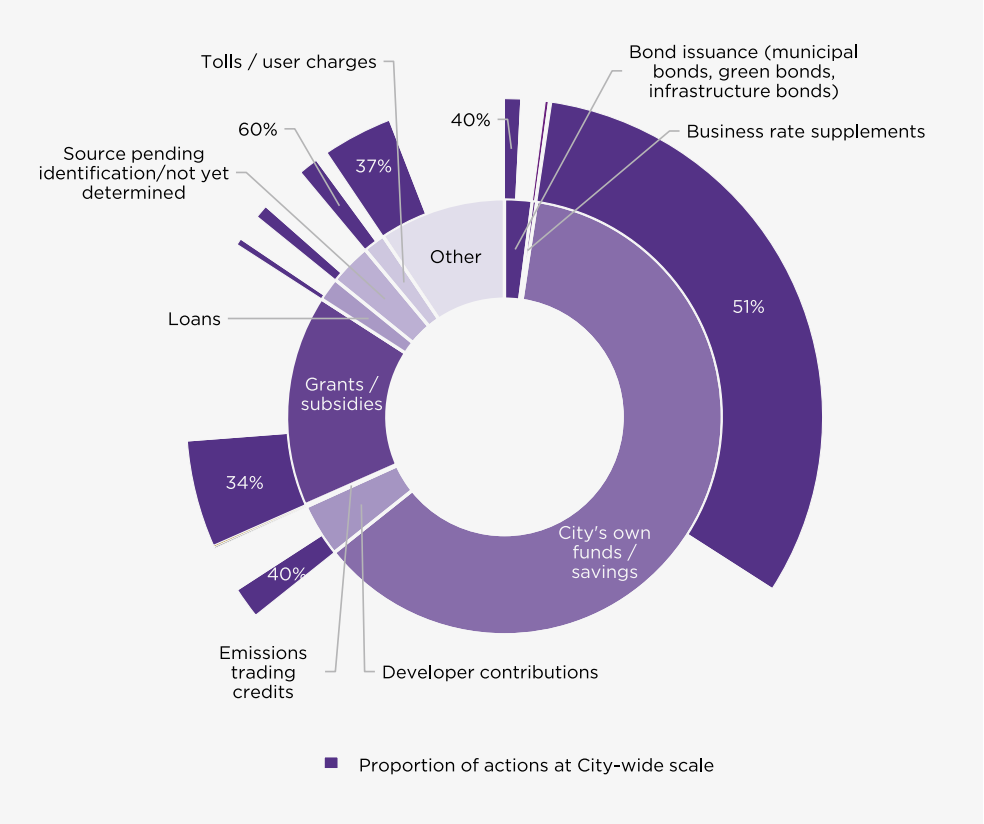
This may suggest that cities are using grants or subsidies in the initial stages of a project's development to determine feasibility or reduce the financial risks to the city. Portland, for example, has used grants and subsidies to support the piloting of community-scale solar systems, exploring a number of different models for publicly-owned facilities.

There may also be times when cities have no choice but to pilot a project – when insufficient funds prevent an action from being scaled, for example. Due to limited funds, Dar Es Salaam piloted the improvement and environmental protection of an existing residential organic waste site in this way. Pilot projects give cities the opportunity to evaluate the appropriateness of schemes before committing to major investments. The process also allows them to gather crucial evidence which will inform later decisions to scale up action.

4.5.2 FINANCING CITY-WIDE ACTIONS

Delving into the financing of city-wide actions in more detail, Figure 4.09 shows the breakdown of financial mechanisms used to finance climate action at a city-wide scale.

Figure 4.09. Breakdown of financial mechanisms with proportion of city-wide scale actions for each.

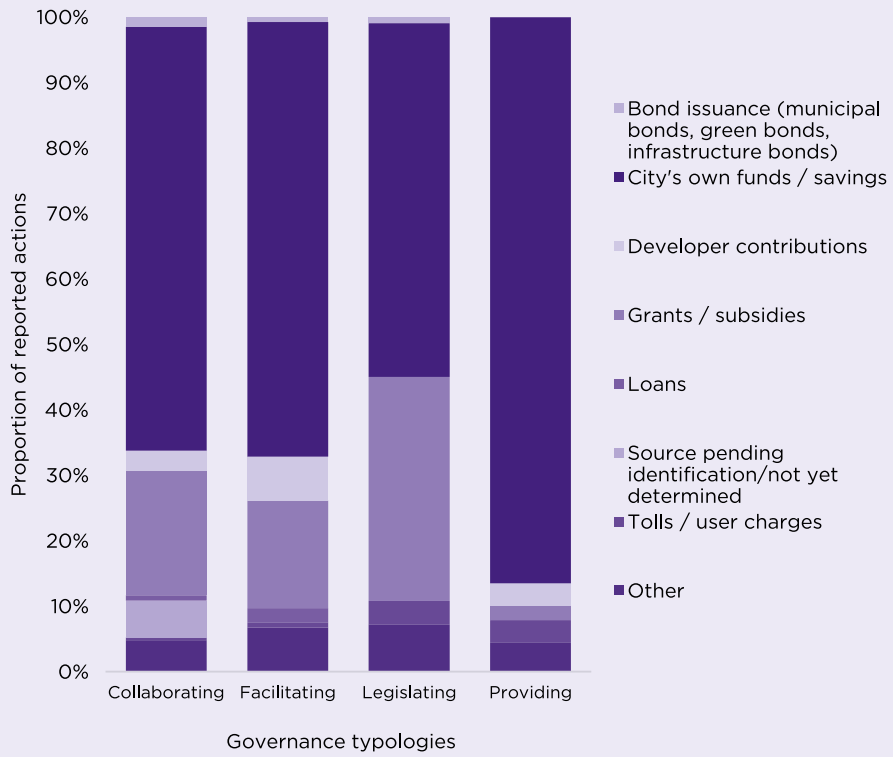


The inner ring in Figure 4.09 represents the proportion of actions delivered via different financial mechanisms, and is identical to Figure 4.04. The outer ring shows which percentage of the actions delivered via that funding mechanism occurred at a city-wide scale. The figure illustrates that the greatest proportion of city-wide actions are delivered when a city uses its own funds and savings.

City Focus: Tax Increment Financing in Johannesburg

Johannesburg is working with local partners and the World Bank to implement new financing structures for neighbourhood improvement efforts, including tax increment financing (TIF). Informed by discussions with the city of Washington, D.C. through C40's Sustainable Urban Development Network, Johannesburg is exploring new strategies, such as the use of TIF notes. In addition, Washington, D.C.'s experience led Johannesburg to rethink the strategy not as a standalone financial mechanism, but as an integrated planning approach to neighbourhood improvement.

Figure 4.10. The relationship between governance typologies and financial mechanisms.



*Note: Governance typologies with insufficient financing data excluded.

The models of governance that cities adopt shape the types of mechanisms they use to fund climate action. For example, when cities govern by Providing, over 80% of actions are funded using the city's own funds or savings. This may be due to the fact that as a majority shareholder in assets (a characteristic of Providing cities), the city would most likely be drawing on its allocated

'Govern by providing' Please refer to glossary of terms

80%

When cities govern by Providing, over 80% of actions are funded using the city's own funds or savings.

budgets. In the 2015 report *Powering Climate Action*, C40 and Arup found that cities with the power to own or operate city assets often have a direct role in the provision of services and resources, and are therefore better positioned to determine the development of an action and the practices used to deliver it.

Cities that adopt the Collaborating governance typology report actions whose source of funding is still to be determined, more so than other typologies.

In both the Collaborating and Legislating governance typologies there is a greater proportion of actions financed by grants and subsidies compared with other types of governance. The Facilitating governance typology has the highest proportion of actions financed by developer contributions.

4.6 SUPPORTING C40 CITIES WITH PROJECT PREPARATION

$172 MILLION

The London Green Fund was established to invest in schemes to cut London's CO_2 emissions. The $172 million invested in the fund hopes to leverage over $1 billion of investment to CO_2 reduction programmes.

Across C40 cities, there are relatively few actions reported in relation to developing specific funds for low carbon projects, although 33 cities have reported having established revolving funds for low carbon, energy efficiency, or green projects since 2013. These funds provide vital support to green and low carbon projects in cities, enabling businesses, communities and non-governmental organisations to take climate action that would otherwise have been un-investable. For example, the London Green Fund was set up to invest in schemes to cut London's CO_2 emissions. The £110 million ($172 million) invested in the fund hopes to leverage over $1 billion of investment in CO_2 reduction and wider 'green' programmes in London.

C40 cities in developing countries, supported by the findings of multiple international research studies, recognise that a major challenge preventing cities from progressing their greenhouse gas reduction projects and delivering on their sustainability aspirations is a lack of city capacity and skills to prepare projects for investment. Being able to demonstrate a sound business case and utilising the most appropriate financing mechanisms is crucial when accessing capital to fund a project. Limited resources and expertise within a city government, as well as unique and sometimes complex business models associated with climate actions, can make this challenging.

$1 BILLION

C40 intends to provide project preparation support to $1bn worth of sustainable infrastructure.

C40 is therefore working to address the major challenge of project preparation for the infrastructure required under C40 cities' climate action plans. C40's ambition is to raise funds to provide technical assistance in the form of project preparation support to cities to take technically viable projects and turn them into investment-worthy opportunities that can attract public and private finance. The scale of the challenge is considerable, however C40 believe supporting cities to prepare investments of $1bn is achievable over the coming years.

The impact of the support will be magnified by encouraging replicable projects, building city capacity and promoting further knowledge sharing among C40 cities.

CHAPTER 5

Cities as Changemakers: Local Climate Action Delivers Global Impact

5 YEARS

We have until 2020 to avoid locking in carbon emissions to exceed an agreed limit of 2 degrees warming.

28 $MtCO_2e$

Actions being taken by only 19 cities in 2015 have expected cumulative emissions savings of 28 Mt CO_2, much of this by 2025.

45 Gt CO_2

By 2030, cities have the potential to avoid locking-in 45 Gt CO_2.

485,000

In 2015, 10 cities alone reported that more than 485,000 people were employed in green jobs / industries.

CHAPTER SUMMARY: LOCAL CLIMATE ACTION DELIVERS GLOBAL IMPACT

645 $MtCO_2e$

C40 and SEI research estimates that the total potential annual savings by 2020 from city action currently under way in C40 cities is 645 $MtCO_2e$.

31%

Of the roughly 200 $GtCO_2e$ remaining carbon budget, 31% will be in cities.

It is clear that transformative city action on climate change is needed more urgently than ever. A recent C40 and Stockholm Environment Institute (SEI) study entitled *"Keeping cities green: Avoiding carbon lock-in due to urban development"* confirms this.[21] It suggests that based on current trends of growth in infrastructure and consumption, by 2020 the entire "safe" global carbon budget will have been locked-in, meaning that emissions will be unavoidable unless assets are retrofitted or replaced. This will likely result in the "locking-in" of at least a 2 degree warming trajectory.

Encouragingly, CAM 3.0 demonstrates that the action being taken by cities at a local scale is significant at the global level. Just a handful of actions being taken by 19 cities in 2015 have expected cumulative emissions savings of 28 $MtCO_2e$, equivalent to the annual emissions of nine coal-fired power stations. These savings are being driven primarily by actions in the Private Transport, Buildings, and Energy Supply sectors. Furthermore, C40 and SEI research estimates that the total potential annual savings by 2020 from city action currently under way in C40 cities is 645 $MtCO_2e$.

Not only are C40 cities having a direct and tangible impact on the reduction of greenhouse gas emissions globally, they are also helping to lead the change towards a green economy and developing human capital with skills in this area. Climate action in C40 cities is creating jobs, providing opportunities for hundreds of thousands of people living in cities across the world. In 2015, ten cities alone reported that more than 485,000 people were employed in green jobs / industries.

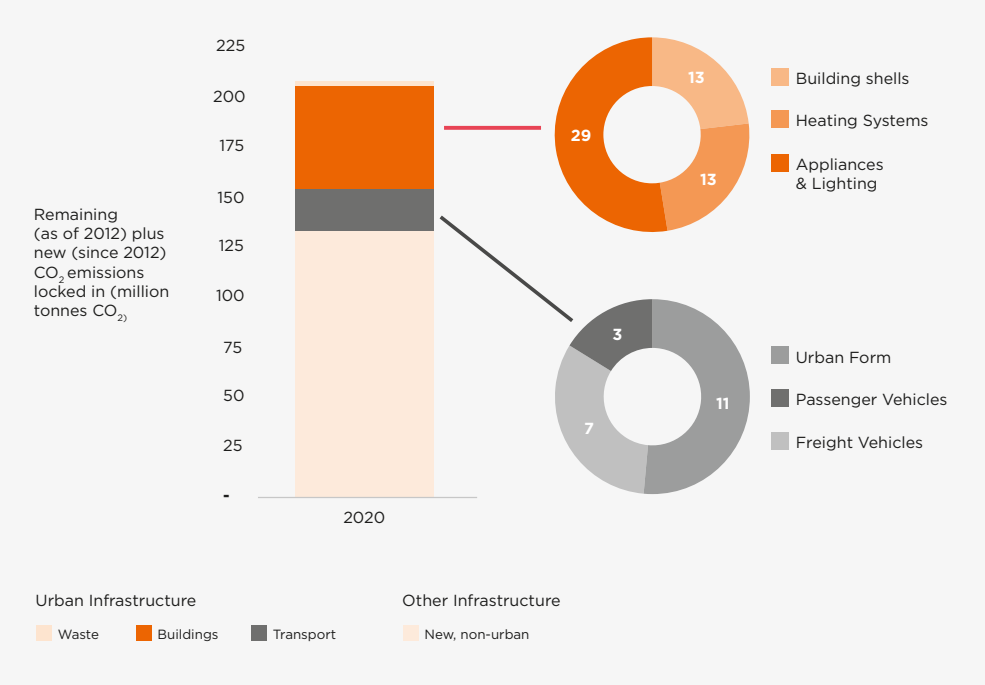
21 *'Keeping cities green: Avoiding carbon lock-in due to urban development'*, C40 and SEI, 2015.

5.1 INTRODUCTION

By taking action locally, cities are collectively delivering carbon reductions and advancing climate adaptation globally, and helping to contribute to national and international targets. The collective impact of this action is helping to establish the reputation of cities as changemakers in the race to tackle climate change.

Through this and previous editions of the CAM research, C40 has demonstrated the expansive and trend-setting nature of city action on climate change. In the previous chapters, this report has highlighted details of the 9,831 actions that cities are taking to tackle climate change up to 2015. Each mitigation action that cities have reported leads to direct or indirect climate impacts. However, the measurement of emissions has historically not been standardised or readily accessible. Using potential emissions reduction as an indicator of impact, this chapter identifies the impact of currently reported climate actions and highlights some of the actions that cities have reported as delivering the greatest emissions reductions.[22] The chapter also investigates the impact that cities are having on the growth of the green economy globally.

Figure 5.01. Proportion of actions planned for future expansion by year reported.[24]



22 *'Keeping cities green: Avoiding carbon lock-in due to urban development'*, C40 and SEI, 2015.

The study suggests that a low-carbon development approach is possible. If global citizens commit to strong and urgent action, enormous emissions levels can be avoided. The opportunity to impact future emissions through new infrastructure development is identified as greatest in the fast-growing cities of the Global South, which can "leapfrog" directly to low carbon solutions. Developed cities, meanwhile, must significantly reduce consumption and mitigate their already locked-in emissions through retrofitting and replacing existing infrastructure, "unlocking" some of the 800 $GtCO_2e$ of emissions already committed.

5.2 EMISSIONS REDUCTION POTENTIAL: CITY CLIMATE ACTION IS ALREADY HAVING A HUGE IMPACT

645 $MtCO_2e$

The action already taken by C40 cities in 2015 will cumulatively have delivered a reduction of 645 $MtCO_2$ by 2020.

Measuring the impact of specific climate actions on reducing GHG emissions is notoriously complex. Naturally the range of locally specific factors makes doing accurate project level estimates very challenging. C40 is in the early stages of a long-term programme of work to assist our cities in doing just that.

A top down approach has been applied in the meantime, based on work undertaken in partnership with SEI in 2014 to estimate the potential for GHG reduction in cities.

C40 have used a modified version of this approach to consider the impact of the action reported here in this document. The following figures must therefore be recognised as estimates developed by C40 staff, rather than measured and directly reported by cities.

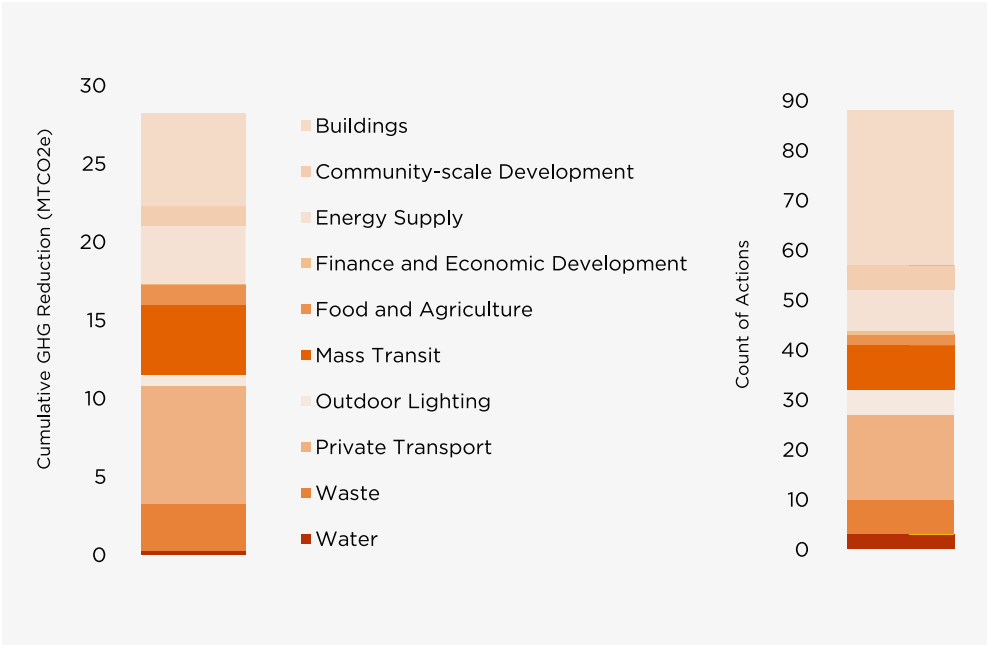
C40 estimates that action already taken by C40 cities in 2015 will cumulatively have delivered emissions reductions of 645 $MtCO_2e$ by 2020, or 193 $MtCO_2e$ per year by 2020.

This represents a projected average saving of 10% relative to emission levels over a 2015 baseline. This is a sign of progress and leadership from C40's membership more than half of which is from the Global South. This also highlights the potential there remains for further emissions reductions, with many cities having targets much higher than 10% by 2020, and certainly by 2030.

5.3 C40 ACTIONS AND GREENHOUSE GAS MITIGATION - CITIES ARE STARTING TO SHOW THE REAL IMPACT OF ACTIONS

Whilst many city climate actions are effective at reducing emissions and changing community behaviour, it is not always easy, practical, or feasible for cities to collect data on the actual emissions savings resulting from the implementation or completion of an action. For this reason, the ability to directly measure impact is limited. Despite this difficulty, in 2015, 19 of the 66 participating cities reported on the direct (cumulative or annual) emissions savings resulting from 127 actions that they are undertaking.

Figure 5.02 & 5.03. Breakdown of cumulative action count by sector.



Focussing on actions for which cumulative emissions savings figures were available, cities reported expected savings of 28 $MtCO_2e$, the equivalent of nine coal-fired power stations. Figure 5.02 breaks down these savings by the sectors they were reported in, while Figure 5.03 indicates the number of actions being reported by sector. This provides an indication of the relative impact of action. As is clear, the sectors responsible for the greatest cumulative savings are Private Transport, Buildings, and Energy Supply.[23]

Across these sectors, 60% of reported cumulative savings come from just five actions, namely:

- Time / day restrictions on personal vehicle usage
- Bus rapid transit
- Entering into long-term contracts with renewable energy generators
- Private residential housing – energy efficient appliance purchases
- Landfill gas management / landfill gas to energy

23 It is noted that this sample size is likely insufficient for any detailed trends to be inferred. This section aims only to highlight the currently available data.

These particular actions are examples of very high-impact measures, with often very readily quantifiable emissions savings and wider benefits such as reduced congestion, air quality improvements, and, in certain cases, direct financial benefits.

City Focus: Mexico City's Leading Approach To Emissions Measurement

Of the 19 cities reporting actual emissions reduction figures in 2015, Mexico City has by far the most comprehensive emissions savings data across its suite of city action areas. For this reason, C40 and Arup have decided to profile Mexico City as a leader in the reporting of emissions savings associated with climate action, and to delve into the emissions saving data in more detail.

Mexico City is able to report annual or cumulative project lifetime emissions savings across almost half of all the actions which it has reported in 2015. Twenty-six of its 60 actions have associated emissions saving figures.

Buildings, Mass Transit and Private Transport are the sectors in which the most projects have taken place in Mexico City. Within the Buildings sector, 10 separate actions and associated annual emissions reduction impacts are listed, and these include actions being delivered as policy, programmes / projects and incentives / disincentives. For many of these projects, the city used its own funds / savings to finance the actions.

Within the Buildings sector, the cumulative emissions savings anticipated for these projects over the total project lifetimes is almost two million metric tonnes of CO_2.

The actions with the highest anticipated annual emissions savings include Mexico City's famous 'No drive day' programme, improved waste management practices and use of high calorific waste as alternative fuels, the retrofit of lighting systems in different districts, and energy efficiency projects in city water and asphalt plants. Each of these activities is anticipated to save over half a million tonnes of CO_2 annually.

26

Mexico City has the most comprehensive emissions savings data. 26 of its 60 actions in 2015 have associated emissions savings figures.

5.4 IMPACTS BEYOND EMISSIONS – CITY CLIMATE ACTION IS ALSO INCREASING PROSPERITY

485,000 PEOPLE

In 2015, ten cities reported more than 485,000 people as being employed in green jobs / industries.

Not only are C40 cities having a direct and tangible impact on the reduction of greenhouse gas emissions globally, they are also helping to lead the change towards a green economy and developing human capital with skillsets in this area.

In 2015, ten cities reported more than 485,000 people as being employed in green jobs / industries. London, New York and Paris reported the greatest number of their citizens working within the green economy. Furthermore, 43 city governments have appointed staff to deal with climate change adaptation, by creating specific adaptation roles within their administrations. These 43 cities have collectively employed

43

43 city governments have appointed staff to deal with climate change adaptation.

around 150 people to work in this area, which further strengthens the development of the modern green economy in those locations.

As reported in Chapters 2 and 4, cities are making real impact on the green economy by using procurement to access services to support climate actions and also driving private investment in low carbon projects. Numerous cities report on the establishment of revolving funds for low carbon or green projects, operating certification schemes to promote local green business, and providing subsidies for green businesses. Each of these small actions is helping to further promote the growth and development of the green economy.

Sector Focus: Energy Supply

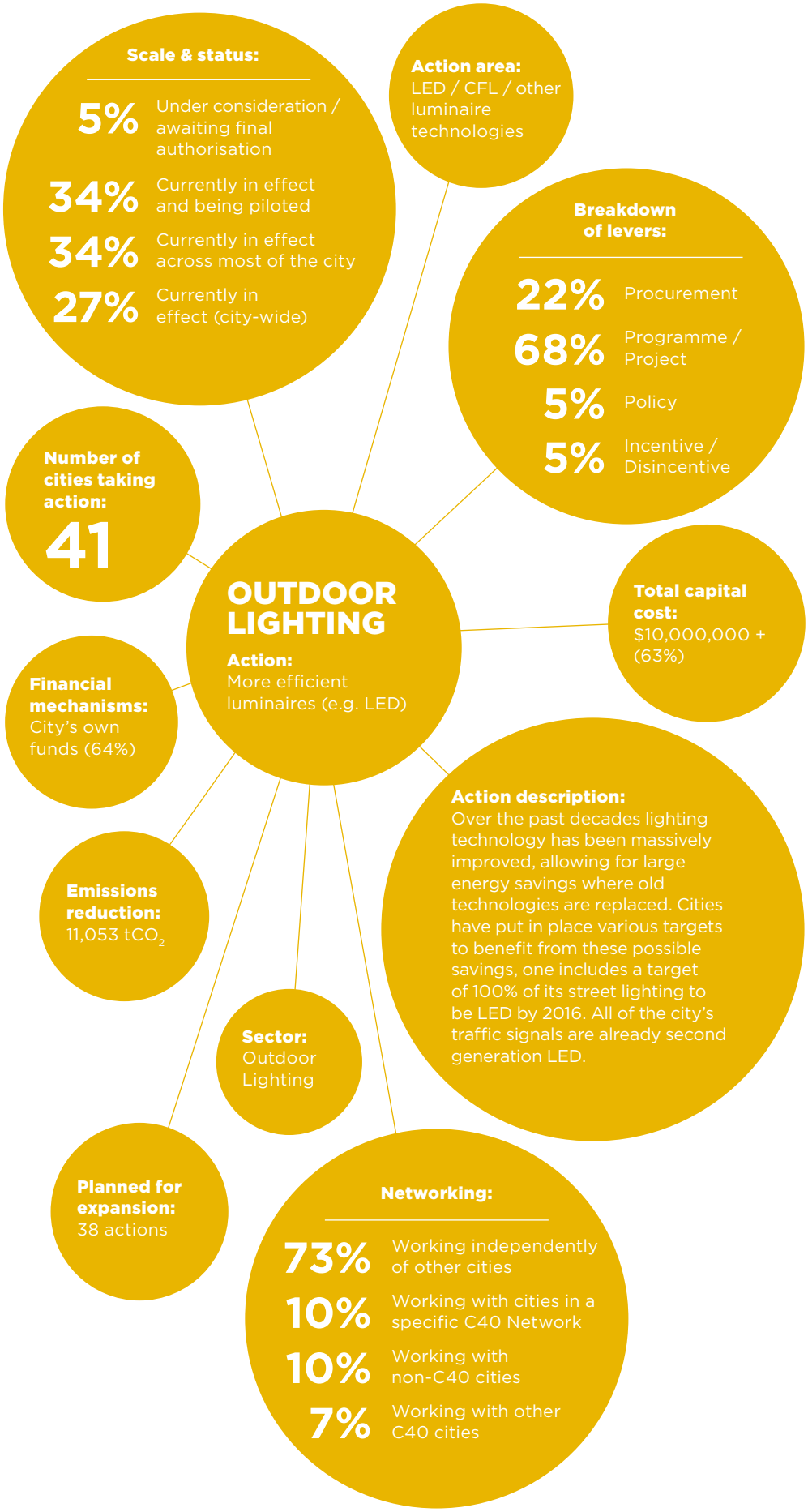
San Francisco has set out a strong commitment to achieving a near zero carbon electricity supply. Today San Francisco Public Utilities Commission supplies all municipal buildings with 100% carbon free electricity and the city is hoping to expand on this, to supply 100% of all residential customers and 80% of all commercial customers zero carbon electricity by 2030. Zero carbon electricity has substantial potential to reduce greenhouse gas emissions, connecting 100% of all residents and 80% of businesses. By 2030, the initiative is expected to reduce emissions by 987,245 $MtCO_2e$ over the lifetime of the action.

Changwon has been selected to trial a new smart grid project in South Korea. It is anticipated the smart grid will be connected to sixty small and medium companies to facilitate increased demand response and energy efficiency and a greater integration of renewable energy resources, thus reducing emissions. The smart grid will require an investment of more than $10 million, some of which will financed through grants and subsidies.

Oslo has rolled out two citywide waste to energy incineration plants with the capacity to burn 410,000 tonnes of waste a year. The two plants are producing district heating equivalent to the needs (or consumption) of 83,200 households (832 GWh), and the electricity use of 26,400 households (132 GWh).

Singapore is exploring ways to increase its use of solar energy. They are actively investing in R&D and test-bedding to improve the efficiency and lower the price of solar technologies for adoption on a larger scale. The industry is also adopting innovative financing models such as solar leasing, whereby an organisation can lease solar panels under long term contracts with the leasing company which is responsible for designing, financing, maintaining and operating the solar photovoltaic (PV) systems. Singapore aims to increase the adoption of solar power in the system from approximately 33 MWp of installed capacity to 350 MWp by 2020. This is the equivalent to 5% of the city's expected 2020 peak electricity demand.

ANATOMY OF AN ACTION 6



100%

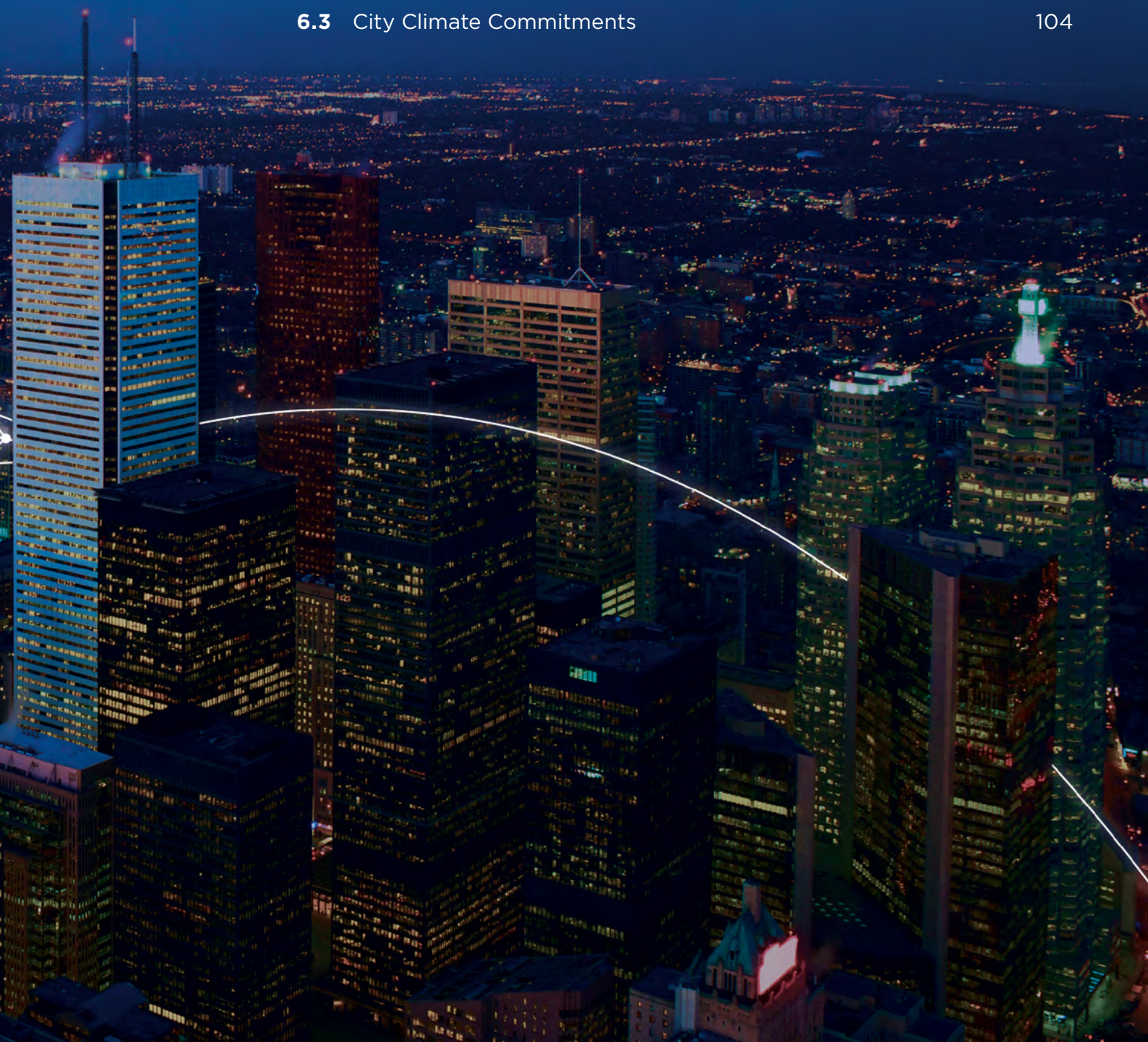
San Francisco Public Utilities Commission supplies all municipal buildings with 100% carbon free electricity. The city is hoping to expand on this.

5%

Singapore aim to increase the adoption of solar power in their system. The planned increase is the equivalent to 5% of the city's 2020 peak electricity demand.

CHAPTER 6

Cities on the Frontline: Mayors are Creating Future Cities through Effective City Climate Action



18/53

Number of mayors that have a statutory duty to reduce GHG emissions.

15 years

Average length of strategic planning or vision document.

37/50

Number of cities have included adaptation within their long-term planning document.

4 years

Average term-length of C40 mayors.

CHAPTER SUMMARY: CITIES ON THE FRONTLINE, MAYORS ARE CREATING FUTURE CITIES THROUGH EFFECTIVE CITY CLIMATE ACTION

228

In 2014, 228 cities had set greenhouse gas reduction goals and targets.

78%

In 2015, cities reported plans to expand 78% of reported actions. This is up from 30% in 2011.

Through their involvement in C40, city governments from around the world are making an ambitious commitment to take meaningful and substantial action on climate change.

In 2014, 228 global cities, representing 436 million people, had set greenhouse gas reduction goals and targets amounting to a cumulative reduction of 13 $GtCO_2e$ by 2050, more than three times the annual emissions of the European Union. This emphasises how ambitious cities can be in leading emissions reductions. There is, however, scope for even more long-term thinking. While a number of ambitious cities target high reductions to 2050, the majority of targets do not stretch beyond 2020. Mayors must continue to show leadership in mitigating the impacts of climate change.

C40 mayors are demonstrating leadership by setting ambitious targets and putting strategies in place for action that go long beyond their term in office. In 2015, cities reported plans to expand 78% of reported actions, up from 30% in 2011. By committing to longer-term climate action and leading on the delivery of these actions, mayors are demonstrating that cities are the place to make viable investments in actions to address climate change. By channelling additional funds to cities, action on climate change could take place faster and more effectively.

Cities are the changemakers – by piloting climate action and sharing the lessons learned, cities have established a portfolio of effective and investible actions that will result in transformative change across the world. By demonstrating that climate action is possible to deliver, is scalable, and is relevant across all regions, cities are leading the charge to achieving the ambitious climate action required on a global scale.

6.1 INTRODUCTION

Cities are on the frontline of climate change – both vulnerable to climate impacts and responsible for the lion's share of global emissions. In response, mayors have taken a leadership role on the world stage. Through their involvement in C40, mayors are making an ambitious commitment to take genuine and substantial action on climate change. In the absence of significant climate actions by many national governments, mayors are stepping up to fill the void, and are forging strong partnerships with the private sector.

While cities have long managed the risks posed by both sudden and chronic climate hazards, they are increasingly facing hazards that they have rarely, if ever, experienced before. With ever-increasing population density, building resilience to the immediate, as well as the longer term, impacts of climate change is an increasingly important agenda for mayors and city governments.

While this report has focused on the breadth of actions which cities have previously, or are currently, taking to tackle climate change, this chapter looks to the future, to understand what upcoming plans and ambitions they have to lead the way on effective climate action.

City Focus: Sustainable Urban Planning in Athens

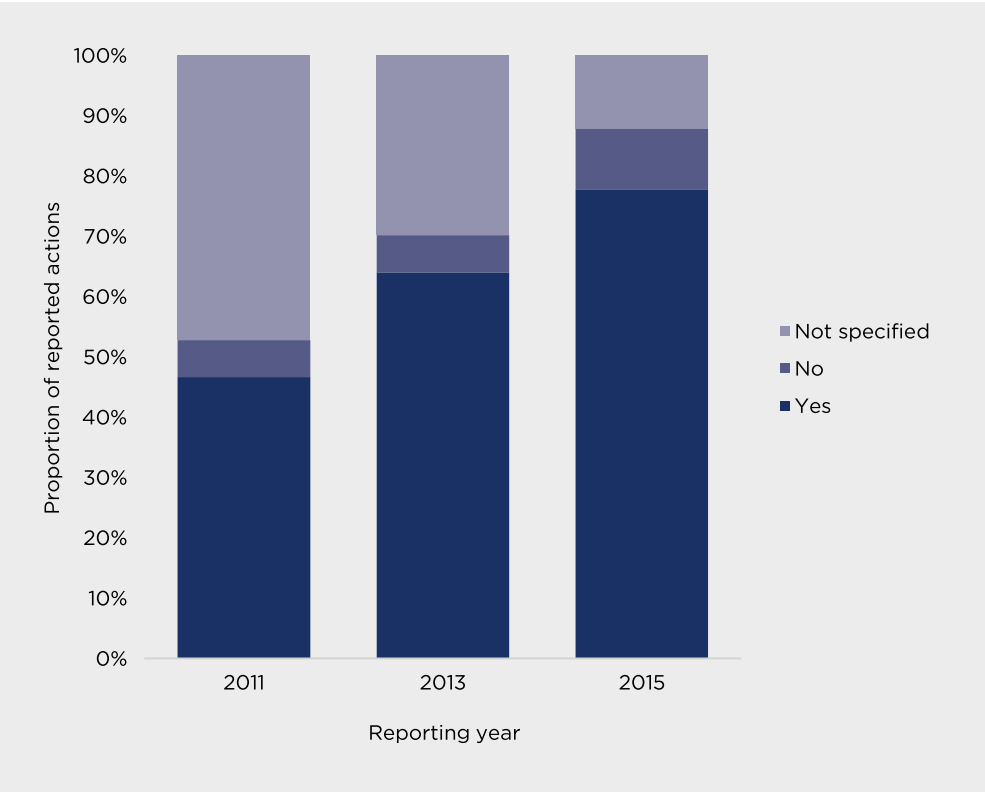
Athens is working with the C40 Sustainable Urban Development Network to develop an internal coordinating body to ensure sustainability goals are integrated across all city departments and to redevelop a central-city neighbourhood integrating sustainability and resiliency elements. Through C40-facilitated discussions between a Melbourne City Councillor and an Athens City Councillor, Athens has initiated the restructuring of its Urban Sustainability group specifically replicating Melbourne's successful portfolio structure. Using data, advice and the experience of Melbourne regarding the co-benefits of integrating sustainability across city departments, Athens was able to secure support from the City Council and the Mayor for these critical changes.

6.2 CITY LEADERSHIP: AMBITION AND INNOVATION

The average term length for C40 mayors is four years, while the average length of their key strategic planning or vision document is 15 years. Over 80% of C40 cities have such a plan in place or are currently developing one, demonstrating a commitment to long-range planning, including on climate change objectives. The longer time horizons of these plans offer an opportunity for cities to work with key stakeholders to make commitments to action that transcend political cycles.

CAM 3.0 has shown that city mayors are demonstrating significant ambition and commitment, by planning to expand their already extensive climate action in the future. In 2015, cities are planning to expand approximately 78% of reported actions. As shown by Figure 6.01, this commitment has increased year on year, with cities increasing the proportion of actions they plan to expand in the future by approximately 30 percentage points since 2011.

Figure 6.01. Proportion of actions planned for future expansion by year reported.



94%

94% of actions have a future expansion plan when they are still under consideration or awaiting final authorisation.

There is a relationship between the scale of actions and whether or not cities hope to expand those actions going forward. For actions reported in 2015, the proportion of future actions that have an expansion plan is higher when actions are in their early stages (i.e. either still under consideration / awaiting final authorisation, or are currently being piloted) than when actions are at a city-wide scale (Figure 6.02). For example, 94% of actions have a future expansion plan when they are still under consideration or awaiting final authorisation, compared with only 85% for city-wide actions. It is important to note that cities are also reporting plans for expansion of city-wide actions, as city administrations may still be able to broaden and develop city-wide initiatives beyond their existing scope.

93%

Of the 398 reported adaptation actions, 93% will be expanded in the future. The Adaptation sector has one of the highest proportions of actions to be expanded in the future. Cities recognise the importance of taking adaptation seriously and including it as a long-term priority.

The Adaptation sector has one of the highest proportions of actions to be expanded in the future, demonstrating that cities are taking adaptation seriously as a long-term priority. Of the 398 reported adaptation actions, 93% will be expanded in the future. Similarly, in the Water, Energy Supply, Private Transport and Community-scale Development sectors, over 90% of actions will be expanded in the future.

In contrast, the Buildings and Waste sectors have the highest proportion of actions that will not be expanded in the future. Of all new Buildings sector actions reported in 2015 (currently more than any other sector), 16% will not be expanded. This may highlight a shift towards investment in different types of city initiatives in the future.

6.2.1 INNOVATION

Cities are demonstrating their position at the forefront of innovation with respect to climate change action. City governments are developing and implementing innovative technologies, and are also looking for new and alternative methods to harness innovation in climate action when working in collaboration with civil society, business, national government and non-governmental institutions.

Cities are developing innovative policy frameworks and supporting the development of critical projects to guarantee the continuation and expansion of climate action not just within the city, but also across regional and national boundaries.

As Table 6.01 suggests, cities are using their leadership to innovate and overcome obstacles which would otherwise prevent climate action from taking place. Cities are exploiting opportunities as they arise and using their skills, knowledge and partnerships to overcome potential barriers to taking climate action.

Based on the 2015 data, the leadership cities are showing can be grouped into five key areas: finance, policy, technology, planning, and the economy.

Table 6.01. Cities demonstrate innovation in their approach to taking leadership on climate action.

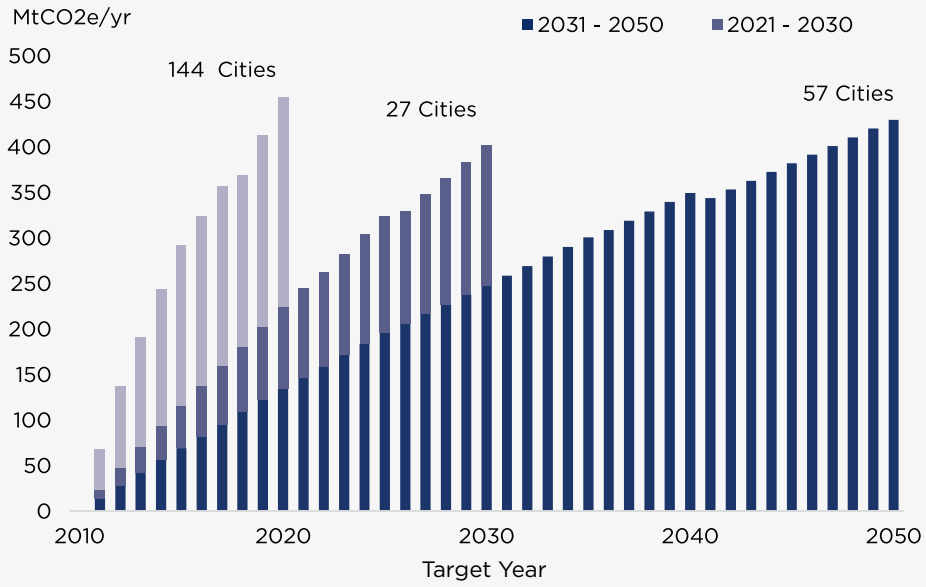
Innovation	Description	Example
Finance	Cities are finding ways to support innovative projects by securing and distributing funds. In particular, cities are using innovative finance mechanisms and applying for grants.	New York City secured $40 million in American Recovery and Reinvestment Act funding to make energy efficiency and renewable energy more accessible to thousands of homes and businesses through innovative financing models. The Toronto Atmospheric Fund (TAF) provides grants to City of Toronto departments, divisions and agencies and non-profit organisations to incubate innovative approaches to reduce emissions and address barriers to the larger-scale adoption of effective climate and air quality solutions. Philadelphia received $25 million to implement pioneering and innovative programmes - in collaboration with civil society, governments, and private sector - for concentrated and broad-based retrofits of neighbourhoods, towns and eventually entire states.

Innovation	Description	Example
Policy	Cities are developing innovative policy and programme frameworks that will support the development of critical pilot projects, and monitoring innovation to update policies to harness opportunities.	Melbourne has monitored innovation in car sharing and used this to update policy where these would produce improvements. Tokyo's cap-and-trade programme is the world's first urban cap-and-trade programme targeting urban facilities. This programme covers approximately 1,400 large facilities that consume energy of 1,500kL crude oil equivalent or more per year.
Technology	Cities are the first to pilot and roll out new technologies in their country or have been involved in the development of new technologies.	HOUZE® Advanced Building Science Inc., along with the City of Houston, piloted the first-of-its-kind zero-energy homes in the United States. Sydney was the first city in Australia to roll-out new energy-efficient light-emitting diode (LED) street and park lights. The City of Sydney is saving nearly $800,000 a year and reducing greenhouse gas emissions in city-owned street lights by 51%.
Planning	Cities are rethinking how space is being used within the city to ensure future development is sustainable and resilient	The Microcentro Plan is repositioning the city of Buenos Aires as a symbol of innovation and modernity in Latin America. The plan involves multiple interrelated initiatives, such as ordering traffic and public space and maintenance of streets. The second stage is in progress and aims to achieve 70% of the area with pedestrian priority, increasing the number of underground containers and restore the facades of 70 buildings with heritage value.
Economy	Cities are building new industries in climate action by driving local firms to build up expertise ahead of the rest of the country.	Portland's policies and programmes helped create an early market for LEED buildings, driving local firms to develop green building expertise well ahead of the rest of the country. The City of Toronto has completed a Green Economic Sector Development Strategy, with a vision to become a globally recognised green industry hub. The city is estimated to have over 1,000 companies whose primary business is in the environment and clean energy sectors, or offer a 'green' element to their main product or service line. These activities are projected to generate over 20,000 jobs and US$2.1 billion of revenue annually for the local economy.

6.3 CITY CLIMATE COMMITMENTS

In 2014, C40 and Arup published *Working Together: Global Aggregation of City Climate Commitments*, a report which uncovers the significant commitment cities have already made to tackling climate change. In 2014, 228 global cities, representing 436 million people, had set greenhouse gas reduction goals and targets amounting to a cumulative reduction of 13 $GtCO_2e$ by 2050. The greatest impact of the commitments from cities should be felt between 2030 and 2050, as per Figure 6.02 below.

Figure 6.02. Annual GHG emissions savings from cities with climate commitments by year of commitment end date.[24]

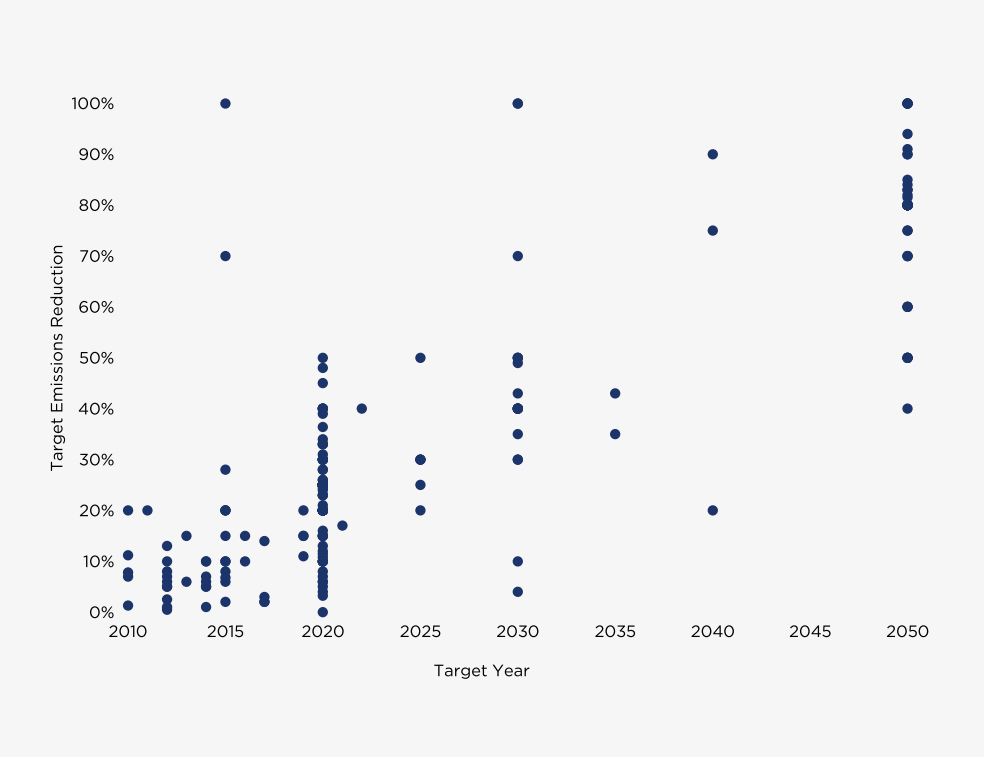


While action count statistics quoted in this report are positive, 98% of actions in the CAM catalogue have expiry dates within the next ten years. With city emissions targets there is a similar story (Figure 6.03); while a number of ambitious cities target high reductions out to 2050, the majority of targets do not stretch beyond 2020.

This fact reinforces the need for continued and long-term action. Many actions already in place will no doubt have lasting benefits for their cities, but there is an urgent need for cities to continue to accelerate action with a longer term trajectory. Cities must extend their ambitions, and, if necessary, be more empowered to do so, as they continue to demonstrate their role as accelerators and innovators of action.

24 Working Together: Global Aggregation of City Climate Commitments, C40 / Arup, 2014.

Figure 6.03. Breakdown of city greenhouse gas emissions reduction targets by end date and percentage reduction versus baseline.[25]



18/53

Within C40's membership, 18 out of 53 responding city mayors have a statutory duty to reduce emissions.

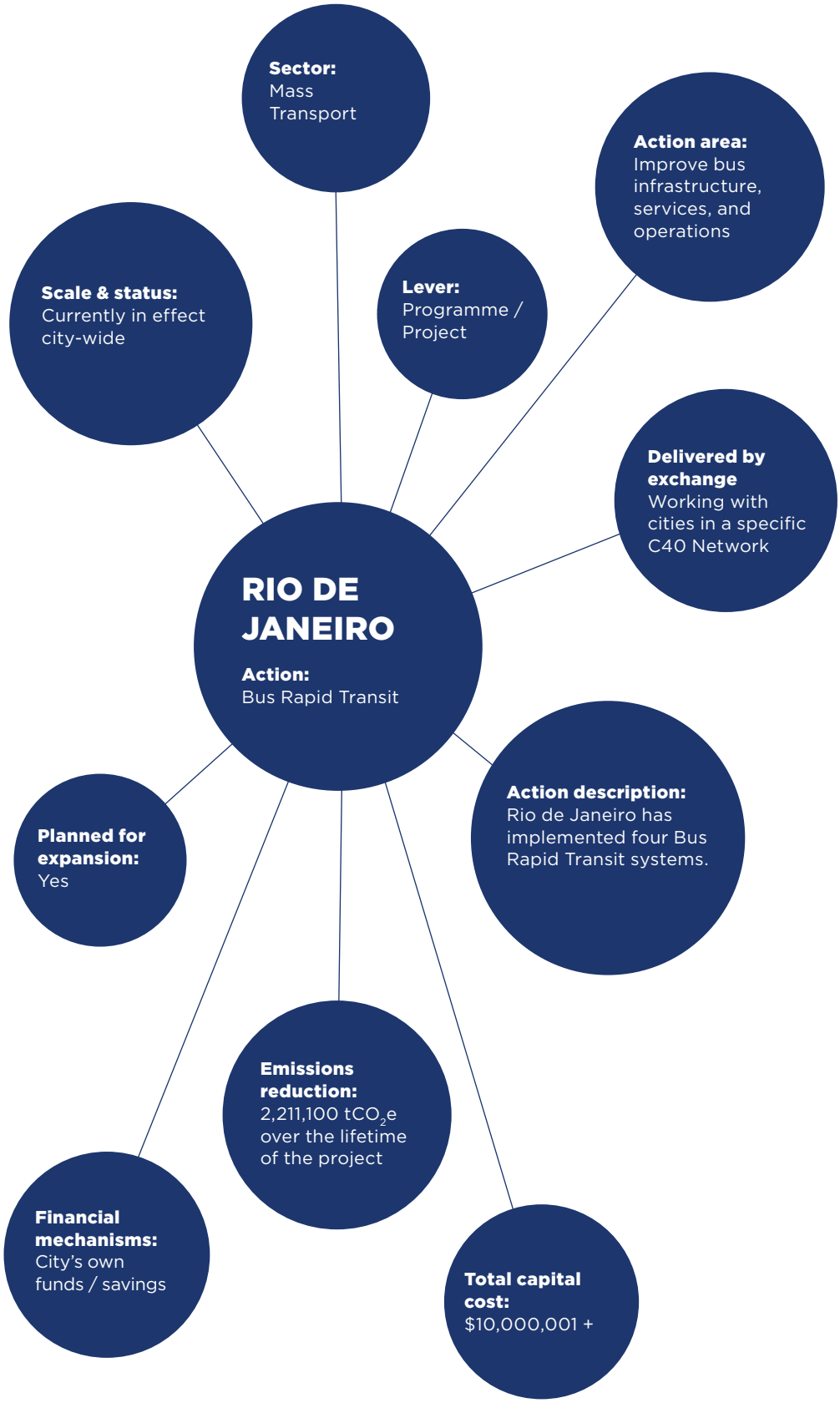
Mayors continue to show further leadership in mitigating the impacts of climate change. The Compact of Mayors[26] is a global coalition of mayors and city officials pledging to reduce local greenhouse gas emissions and enhance resilience to climate change—and track their progress transparently. The Compact is significant as it demonstrates cities' leadership in delivering climate action, encourages investment in cities, and creates a robust data set around city emissions, allowing future action to be targeted where it will be most effective.

The U.S. Mayors Climate Protection Agreement is another example of city leaders wielding their collective power to tackle climate change.

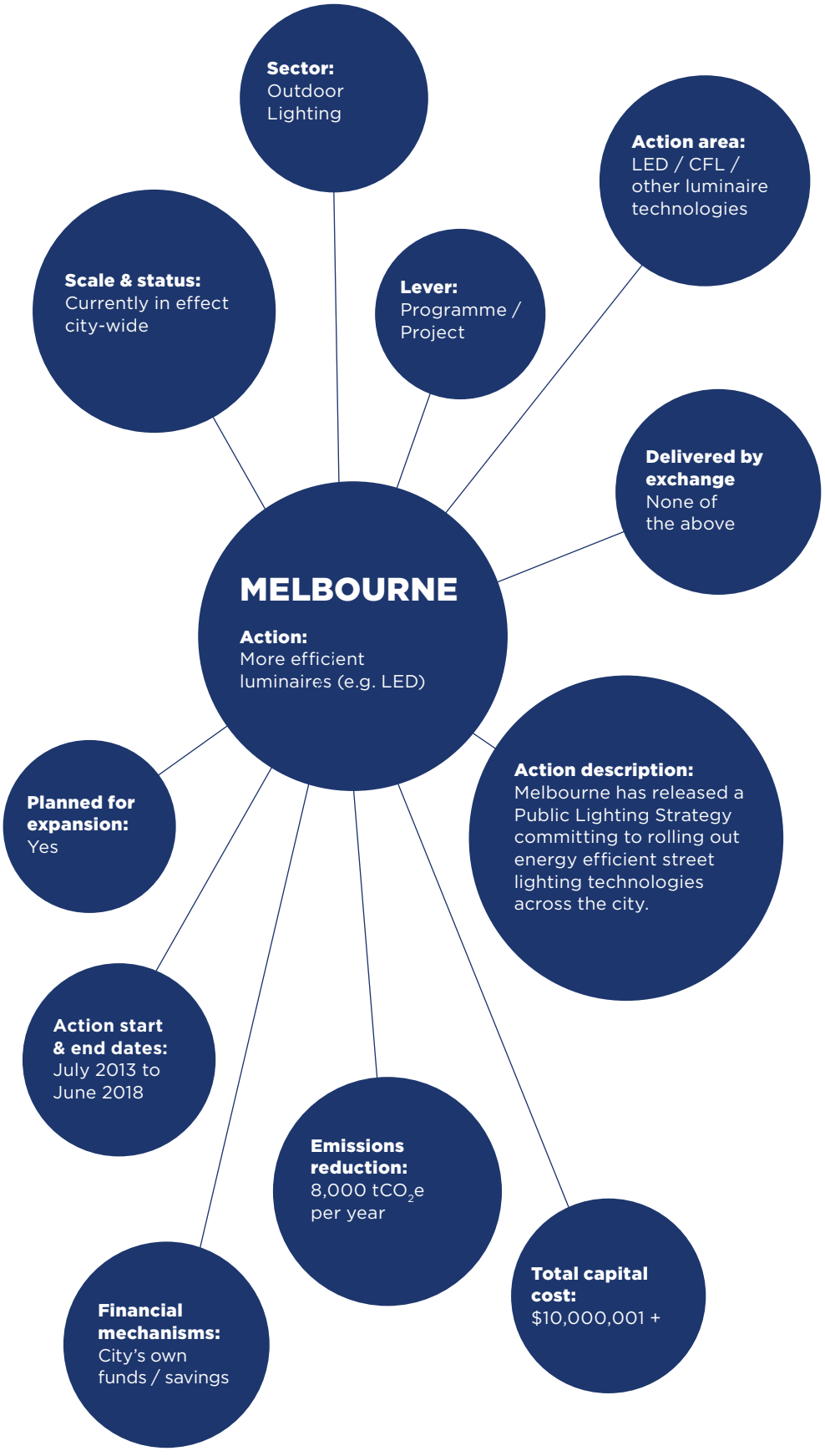
Within C40's membership, 18 out of 53 responding city mayors have a statutory duty to reduce emissions. Furthermore, cities are taking into account adaptation measures in conjunction with mitigation efforts. Out of 55 cities, 36 have undertaken a climate vulnerability assessment and nine more have one in progress. Similarly, 37 out of 50 cities have included adaptation within their long-term planning documents, which indicates that cities recognise the implications and severity of climate change and want to mitigate and be prepared for the impacts.

25 Working Together: Global Aggregation of City Climate Commitments, C40 / Arup, 2014.
26 The Compact of Mayors was launched under the leadership of Michael R. Bloomberg in his role as UN Special Envoy for Cities and Climate Change, in partnership with the world's global city networks—C40 Cities Climate Leadership Group, ICLEI-Local Governments for Sustainability and the United Cities and Local Governments—and with support from UN-Habitat.

ANATOMY OF AN ACTION 7



ANATOMY OF AN ACTION 8



CHAPTER 7

Conclusions

7.1 CONCLUSION

Climate Action in Megacities 3.0 synthesises the latest reported action from C40 cities, together with data and analysis from across C40's wider research portfolio. This is the first time that C40 data has been reviewed in such a comprehensive way, leading to deeper insights about what is working – and how – across the C40 network. The research leads us towards some critical insights and conclusions about climate action in cities, which are fundamental in shaping the future climate change interventions at the city, state, national and international levels, while also establishing the context for private sector collaboration with and investment in cities.

1. Cities Continue To Demonstrate Firm And Growing Leadership On Climate Change.

This leadership is delivering real impact, both directly in the form of greenhouse gas emissions reductions and improved climate adaptation; and indirectly by promoting private sector investment in green solutions and triggering the growth of a green economy. Through their clear and confident commitment to climate action – from policies and legislation through to pilot projects – cities are demonstrating their trajectory for future development, and creating investor confidence for continued innovation.

2. Adaptation Is A Growing Priority For Cities Facing An Array Of Climate Change Effects And Hazards.

While mitigation actions have traditionally been the focus of many cities, there is increasing acceptance that the climate is already changing and the world is locked in to some degree of inevitable continuing change. Recent climate shocks in cities globally have highlighted the impacts that climate hazards can have across sectors and for society, the economy and the environment. Cities are investing in adaptation now in order to avert the costs of unmitigated damage later on. The scale and cost of adaptation actions call for greater financial and technical support to cities from the private sector, international institutions, and higher tiers of government.

3. Cities That Collaborate, Innovate, Invest And Deliver.

There is an invaluable role for city networks and peer-to-peer sharing of knowledge and best practices of climate action. In cities globally, the evidence shows that collaboration leads to increasing numbers and scale of actions, and improved access to finance and technical expertise for more innovative and ambitious interventions. C40's 16 thematic networks in particular are proving their value. There is a continuing and critical role for city networks and other facilitators of city collaboration in promoting climate action.

4. Channelling Additional Funds To Cities Would Enable Faster And More Effective Investment In Climate Action.

To date, cities have demonstrated incredible resourcefulness in identifying financing mechanisms and using these mechanisms in the optimal way to pilot and scale up climate actions. However, broader access to climate finance would enable cities to deliver more rapidly on their ambitions to expand climate action.

Cities are the changemakers – by piloting climate action and sharing lessons learned, cities have established a portfolio of effective and investible actions that will result in transformative change across the world. By demonstrating that climate action is possible to deliver, is scalable, and is relevant across all regions, cities are leading the charge to achieving the ambitious climate action required to put the world on a climate-safe path.

Appendix

Supplementary Information

A1: 2015 REPORTING CITIES

The following cities provided overview and action data in response to the 2015 Climate Action in Megacities survey:

Addis Ababa
Amman
Amsterdam
Athens
Austin
Bangkok
Barcelona
Basel
Berlin
Bogotá
Boston
Buenos Aires
Cape Town
Caracas
Changwon
Chicago
Copenhagen
Curitiba
Dar es Salaam
Dhaka
Durban
Ho Chi Minh City
Hong Kong
Houston
Jaipur
Johannesburg
Karachi
Lagos
Lima
London
Los Angeles
Madrid
Melbourne
Mexico City
Milan
Moscow
Nairobi
New Orleans
New York City
Oslo
Paris
Philadelphia
Portland
Quito
Rio de Janeiro
Rome
Rotterdam
Salvador
San Francisco
Santiago de Chile
São Paulo
Seattle
Seoul
Shenzhen
Singapore
Stockholm
Sydney
Tokyo
Toronto
Tshwane
Vancouver
Venice
Warsaw
Washington, D.C.
Wuhan
Yokohama

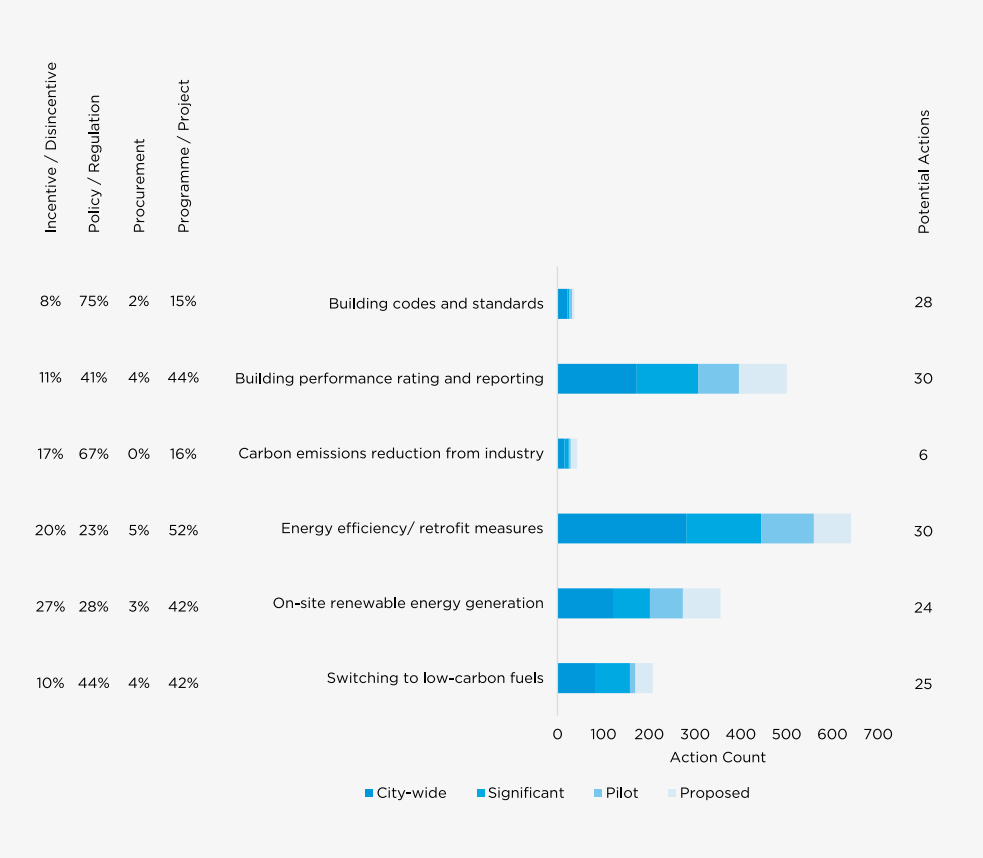
A2: CITY ACTION SNAPSHOTS

The graphs and commentary in this section reflect the most up-to-date information available on C40 cities' cumulative climate action, covering all actions reported by cities since 2011. Cumulative action (as introduced in Chapter 2) in this context refers to the latest reported state of actions; where a city has reported on the development of an action over the three reporting years, only the latest data is presented here. All sectors are represented, with the exception of Adaptation, which is discussed in more detail in the main report.

Note that actions have been grouped by their action area to allow coverage of more than 400 potential individual actions cities could report in a more comprehensive format. The number of possible actions within each action area is indicated to the right hand side of all figures.

A2.1 BUILDINGS

Figure A2.01. Buildings sector action snapshot.



Energy efficiency / retrofit measures are the most common actions being taken by C40 cities in the Buildings sector, with over 600 in effect at the city-wide scale. These actions may reflect evidence from Chapter 3 regarding the power of networking, in that participation levels are up to nearly half of all C40 member cities in C40's Municipal Building Efficiency and Private Building Efficiency Networks, respectively.

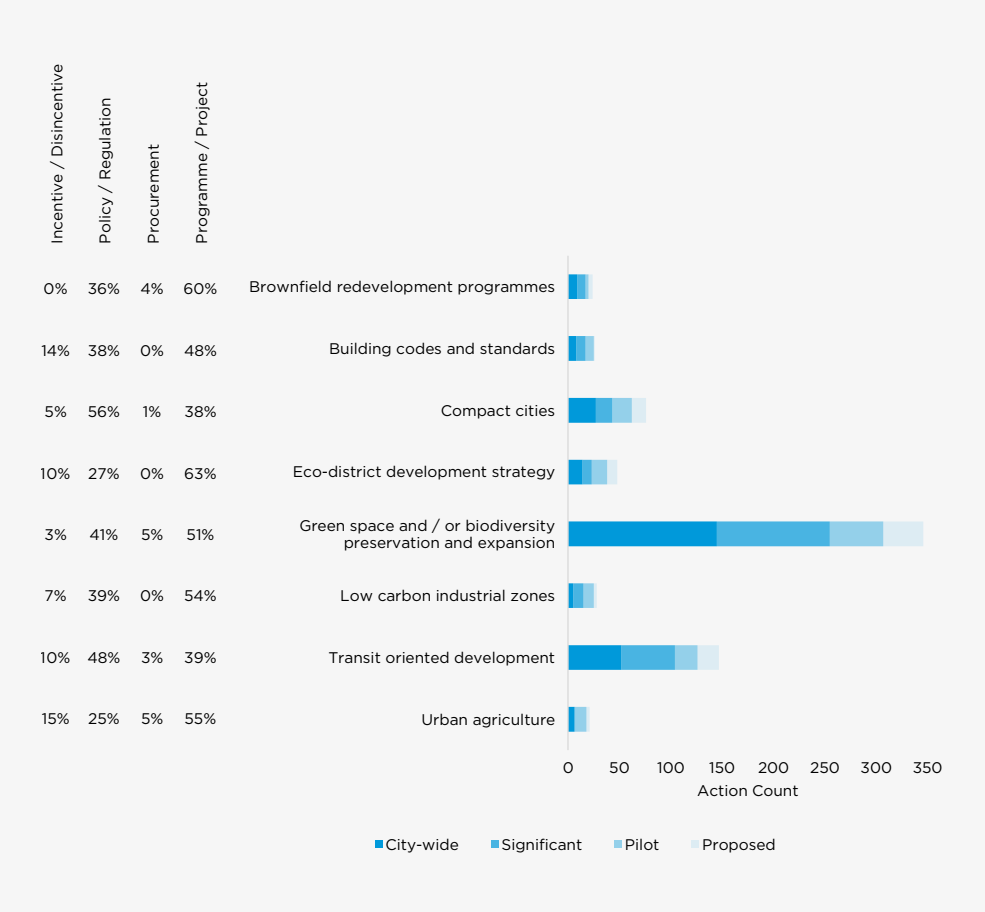
In building performance rating and reporting, the second most common action area, cities are exhibiting leadership by expanding the scale at which actions are taken from the pilot, to the significant, and finally the city-wide level.

Policy / legislation, and programme / project are the levers most commonly utilised to deliver action in these two leading action areas. The dominant use of these two levers confirms that cities are using both their capacity for direct control in these areas (shown by the use of policy / legislation) as well as their ability and willingness to initiate projects and programmes.

Actions associated with switching to low-carbon fuels and on-site renewable energy generation are being delivered through a similar combination of levers. However, where fuel switching is strongly driven by policy levers, incentives and disincentives are more commonly used to deliver renewable energy actions. This may reflect the use of feed-in-tariffs and financial incentives to drive renewables while more traditional policy tools and regulations are relied upon to guide fuel switching.

A2.2 COMMUNITY-SCALE DEVELOPMENT

Figure A2.02 Community-scale Development sector action snapshot.

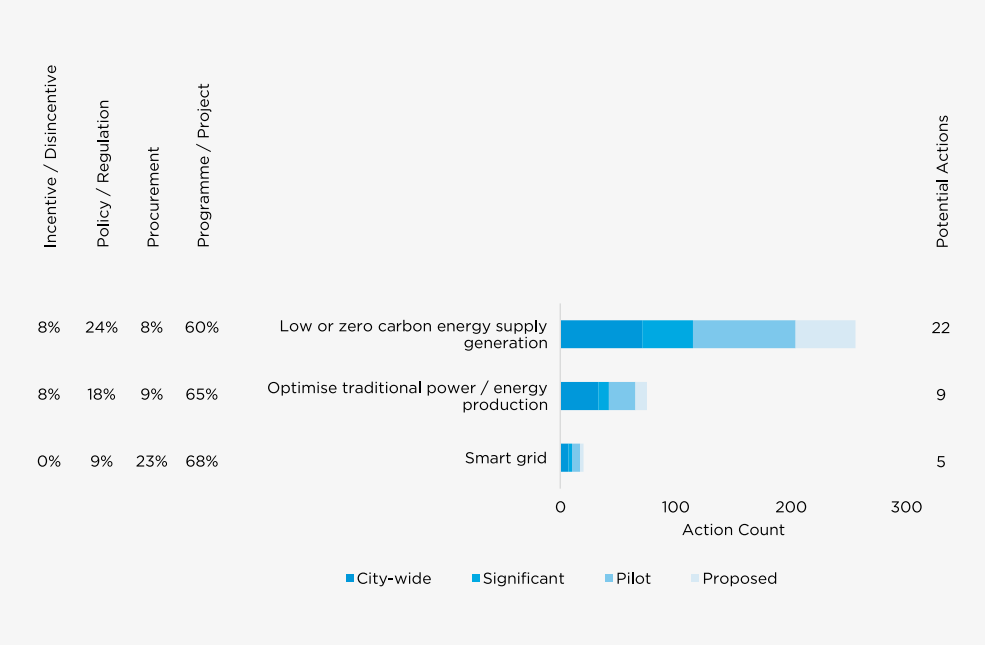


Actions related to green space and / or biodiversity preservation and expansion occur around twice as frequently as any other Community-scale Development action area. This type of initiative may be popular due to its additional capacity to deliver co-benefits including increased recreational space, improved air quality and opportunities for non-motorised transport infrastructure (e.g. cycle lanes and pedestrian plazas).

Reflecting the high level of progress in this action area, almost half of all green space and biodiversity actions are occurring at the city-wide scale, while a further 30% are in place at the significant scale. In the transit oriented development area, with a majority of action at the pilot and significant scale, action is expected to keep growing in the coming years. An increasing interest in transit oriented development among C40 cities may also support the argument that cities are seeking co-benefits from the actions they deliver. C40 established its Transit Oriented Development Network in 2015 in response to this growing city interest and opportunity.

A2.3 ENERGY SUPPLY

Figure A2.03 Buildings sector action snapshot.



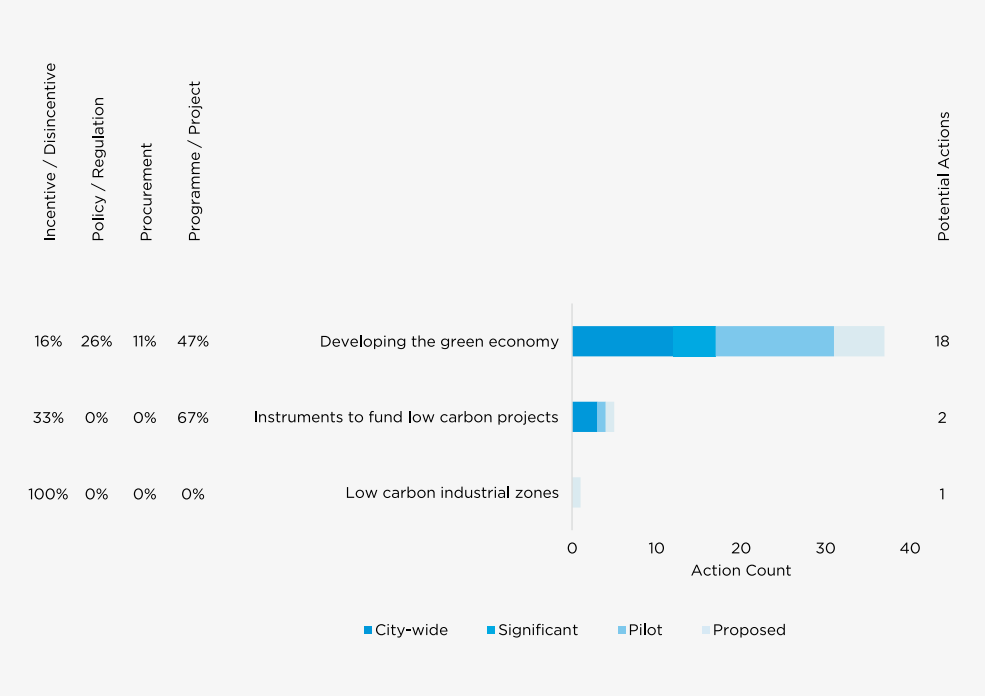
Actions related to low or zero carbon energy supply take place in C40 cities more than three times as frequently as any other Energy Supply action area. However, more than 50% of these actions are either still being piloted or under consideration or awaiting final authorisation, which may suggest that some cities continue to require support from other stakeholders to deliver action, e.g. central government, or the private sector.

Almost a third of actions (28%) are occurring at a city-wide scale. The data suggests that cities are making steady progress in expanding action on low- and zero-carbon energy generation but are continuing to innovate and experiment through pilot projects.

Smart grid is the action area with the fewest actions currently being undertaken. The majority (60%) of actions are being delivered via the programme / project lever. Compared with other sectors and action areas, there is a strong tendency towards the use of procurement in this action area, suggesting that city governments see the necessity of sourcing additional technical expertise from the private sector.

A2.4 FINANCE AND ECONOMIC DEVELOPMENT

Figure A2.04 Finance and Economic Development sector action snapshot.



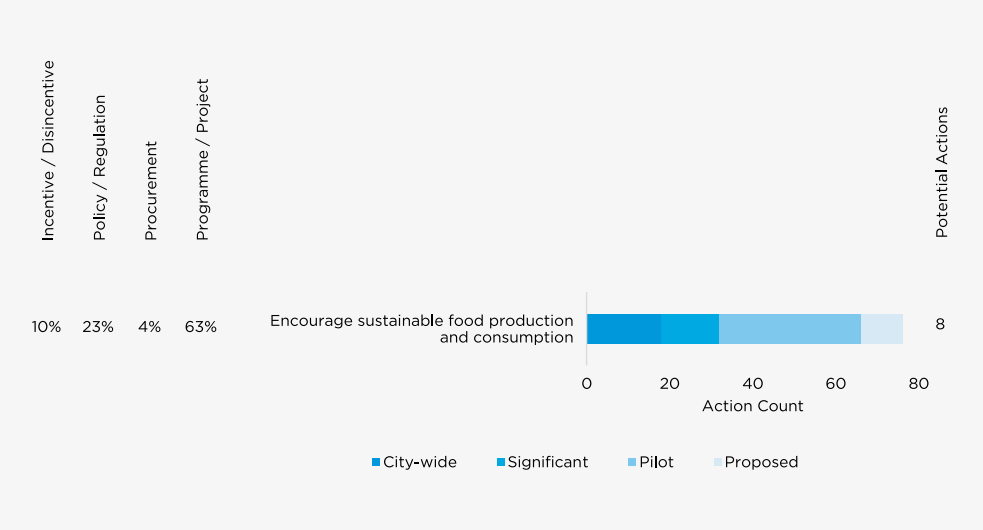
The greatest activity in the Finance and Economic Development sector involves developing the green economy. While more than half of all actions in this area are city-wide or significant in scale, the other half are being piloted or awaiting final authorisation. A range of levers is being used for these pilot and proposed actions, suggesting a degree of experimentation and innovation.

If actions are scaled up by cities in the coming years, there is likely to be significant growth across C40 cities in this action area. As discussed in Chapter 2, this sector has not seen the same action growth rates since 2011. This may be due to shifting priorities in the face of climate challenges, macro-economic trends that force cities to invest in the sectors that offer the greatest economic benefits, political challenges or a reduction in cities' ability to access funding in certain sectors.

The predominance of activity in the green economy action area may align with C40 cities' desire to invest in areas that deliver co-benefits. In this case, these could include expanding employment opportunities, enhancing economic and physical resilience, diversification and up-skilling of the workforce, liveability, and overall improvement to a city's competitiveness, as well as long-term health and social impacts from a lower carbon environment.

A2.5 FOOD AND AGRICULTURE

Figure A2.05 Food and Agriculture sector action snapshot.



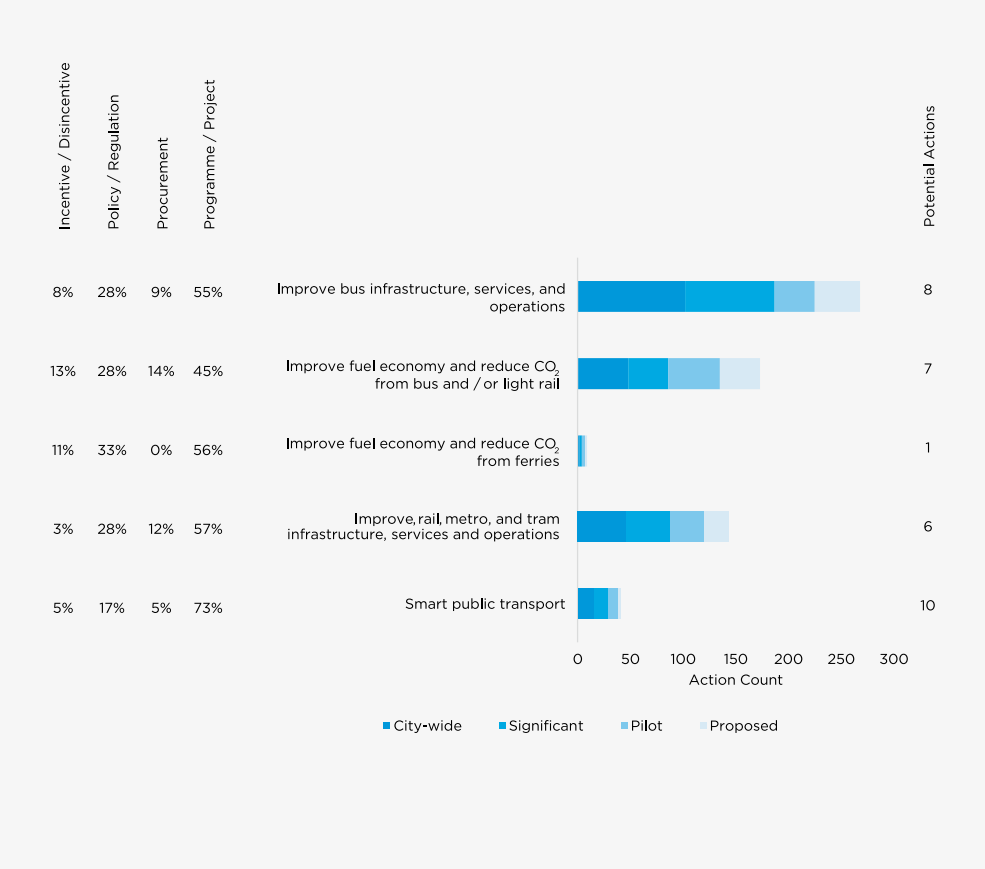
Two-thirds of all actions in this sector are occurring either at the pilot stage or are still under consideration / awaiting final authorisation.

While some cities have shown strong progress in this action area, others are still in the process of piloting and considering how to implement action. This situation is symptomatic of a sector in which city governments are a relatively minor player compared to private sector and civil society actors. With more than half of all actions at the pilot stage, this appears to be an emerging area for climate action with a strong potential for growth of action through experimentation of new projects and approaches to delivering action.

Out of the eighteen distinct actions in the Food and Agriculture sector, actions on community gardens and allotments have been the most popular over the last three reporting years, representing 20% of all actions taken in this sector. Cumulatively, 63 cities have taken action on community garden and allotments so far and 60% of their actions have been either city-wide or at a significant scale.

A2.6 MASS TRANSIT

Figure A2.06 Mass Transit sector action snapshot.



The majority of actions in the Mass Transit sector are associated with the improvement of bus and rail infrastructure, services, and operations. The majority of these actions are taking place at the city-wide or significant scale.

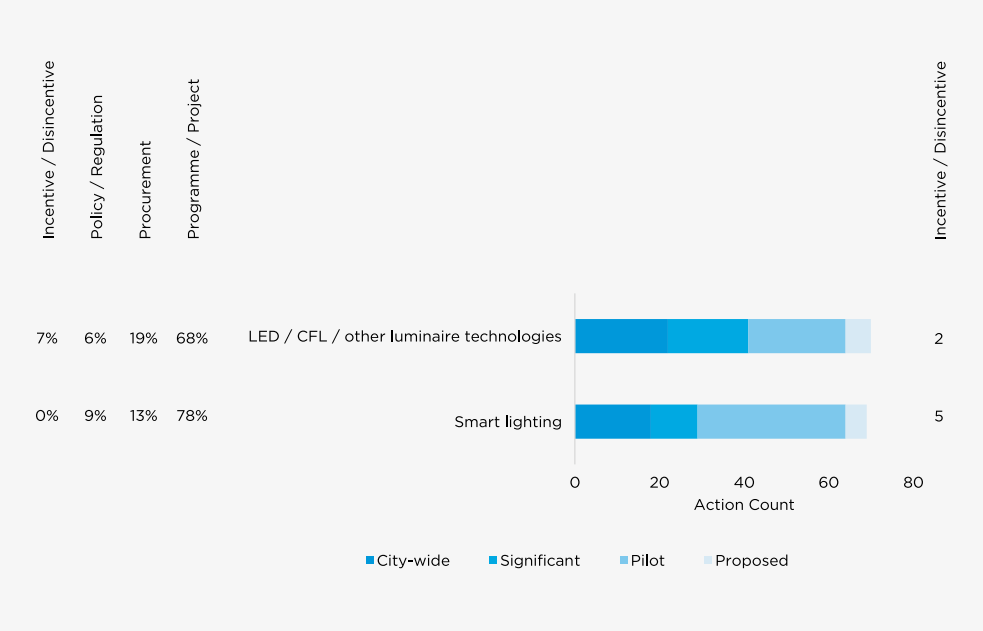
35% of all actions reported in 2015 in the Mass Transit sector are delivered through networking of one sort or another, of which bus rapid transit projects, and cycle hire programmes are the actions most frequently delivered.

Increasing routes, frequency and night services has been the most popular action in this sector this year, representing 8% of all mass transit actions. Moreover, 45% of these actions have been implemented at the city-wide scale in 2015.

C40 cities are focusing on the improvement of bus, tram, metro and rail infrastructure and services to a greater extent than the performance of the vehicles themselves. This may in part be attributed to the fact that cities often own or operate fixed infrastructure assets, putting them in a better position to directly influence the provision of infrastructure, in contrast to vehicle and service provision, which are often the domain of transport operating companies and therefore cities have limited ability to influence.

A2.7 OUTDOOR LIGHTING

Figure A2.07 Outdoor Lighting sector action snapshot.



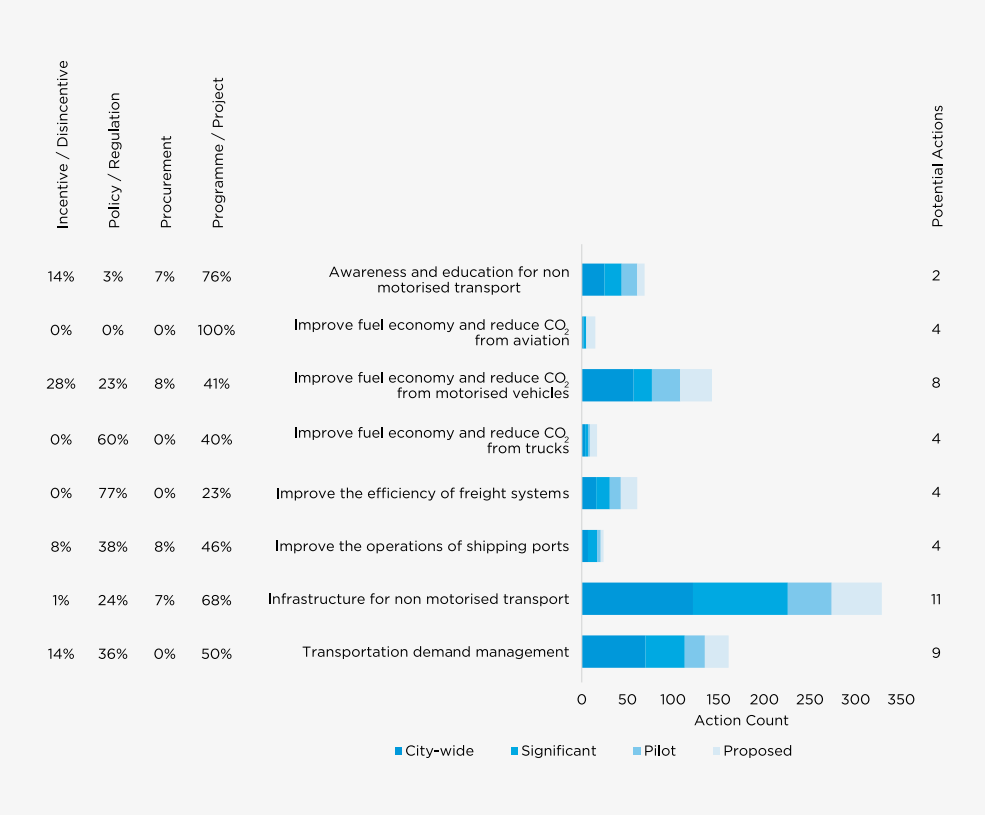
Actions in the Outdoor Lighting sector are split almost exactly across the two action areas, although the scale at which actions are currently being taken is higher with respect to the replacement of lighting with lower carbon technologies such as LEDs and CFLs. As noted in Chapter 2, this sector has reported year-on-year growth in climate action since 2011, as well as significant transformation from pilot stage actions to city-wide delivery.

Programme / project is by far the dominant lever used to deliver action in the Outdoor Lighting sector. However, procurement is increasingly being used to carry our smart lighting actions reflecting the increasing desire by city governments to work with experts from the private sector actors to enhance progress in this sector.

Replacing outdoor luminaires with more efficient ones like LED is the most frequently reported action in this sector, representing 40% of all actions in outdoor lighting. This year alone, 33 cities have taken this action. Cumulatively, 69 cities have reported this move into more efficient luminaires over the last three reporting years.

A2.8 PRIVATE TRANSPORT

Figure A2.08 Private Transport sector action snapshot.



Overall, cities are taking more action on passenger transport than on freight and shipping in the Private Transport sector.

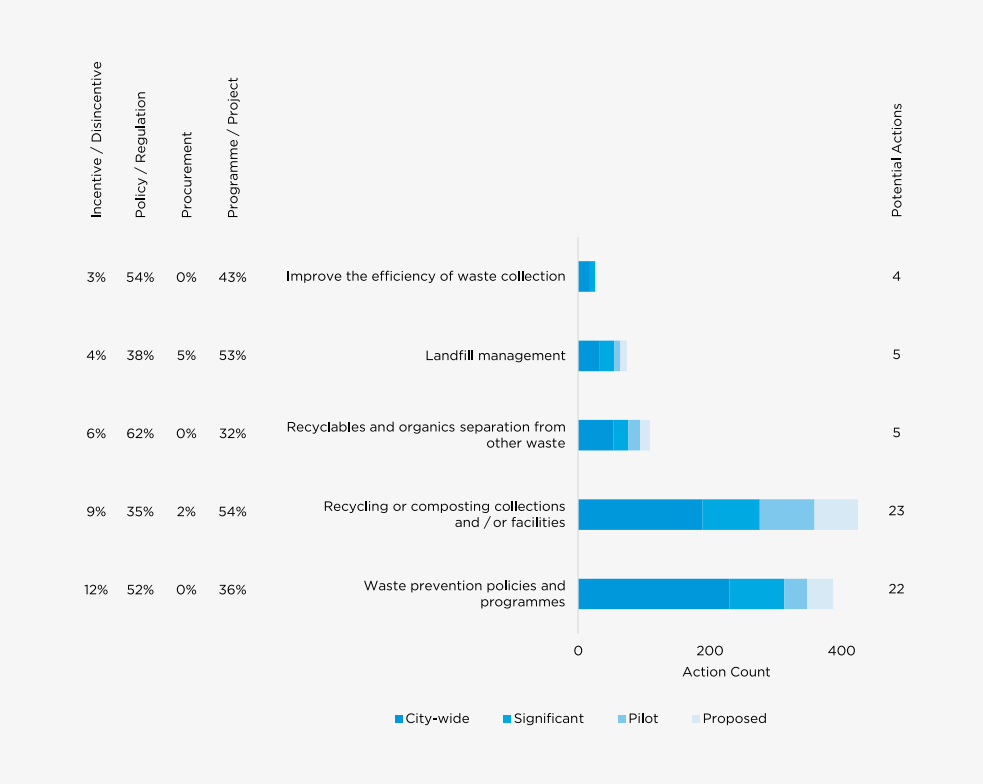
C40 cities are also focusing overwhelmingly on actions related to infrastructure for non-motorised transport. These actions are predominantly associated with cycling schemes and activities such as cycle hire / share programmes. Actions in this area make-up nearly half of all actions in the sector and are all delivered through programme / project levers.

The predominance of passenger-related actions is also found in the Mass Transit sector. Given that these areas offer similar co-benefits, including environmental and socio-economic advantages, focus on them would suggest that C40 cities are seeking to maximise the impacts of investing in transport and focusing on connected action areas such as transport demand management and infrastructure for non-motorised transport to support and consolidate their activities.

Actions relating to cycling have been the most frequently reported in the Private Transport sector. Cycle hire / share programmes, dedicated cycle lane, cycle parking and cycle training actions accounted for 25% of all private transport actions.

A2.9 WASTE

Figure A2.09 Waste sector action snapshot.

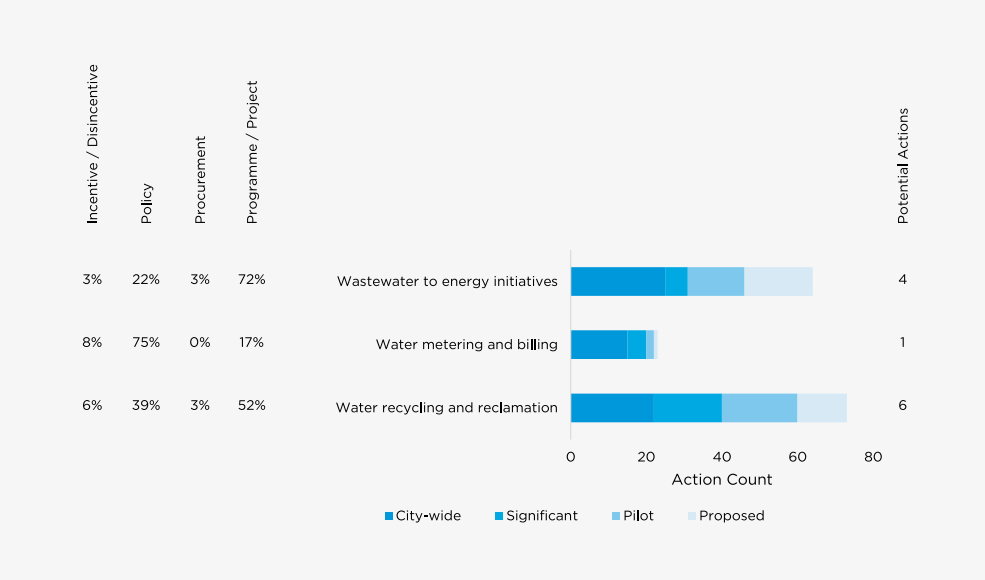


Recycling, composting, and waste prevention are the focus for action by C40 cities in the Waste sector. Across all areas related to recycling and waste prevention, cities are carrying out action predominantly at the city-wide scale. These types of actions are often well established in city planning, with cities generally having a high degree of control over assets, and indeed possessing more power over waste management than any other sector.

In the Waste sector, actions delivered through networking are the highest for any city sector; 40% of all actions in total are delivered this way. In this sector, C40 cities have also shown a preference for working across borders in partnership with non-C40 cities; residential non-organic waste solutions using municipal recycling centres are amongst the most commonly delivered actions utilising this mechanism. For an example, see the “City Focus” on Milan’s waste programme in Chapter 3.2.

A2.10 WATER

Figure A2.10 Water sector action snapshot.



C40 cities are currently paying equal attention to actions related to water recycling and reclamation, and those related to generating energy from wastewater. Both of these action areas offer direct co-benefits, particularly in climate change adaptation and energy supply.

In the Water sector, cities typically have a high level of control over their assets and functions, which has likely enabled them to deliver action across the sector at a city-wide or significant scale, as shown in the graph.

Cities are also using all the forms of collaboration available (see Chapter 3.2) to deliver water-related actions, suggesting that cities are seeking alternative means to direct legislation to achieve their goals in the Water sector. Increasing collaboration with water utility companies and other non-state groups offers cities the opportunity to learn about and trial new water-related schemes and share the financial burden of funding them.

Compared to previous years, cities focused less on Water sector actions in 2015. Water recycling and reclamation has been the most popular action in 2015, representing 20% of Water sector actions, followed by methane recovery for re-use (18%), connection fees for new buildings (15%), and wastewater to energy initiatives (13%).

A3: TYPOLOGIES: TECHNICAL SUMMARY

Working with Mastodon C, Arup's data partner, C40 sought to develop a number of "Typologies" based on the clustering of cities by statistically meaningful characteristics mined from the cumulative CAM dataset. The process was designed to be scalable, flexible, transparent, and replicable, such that a similar method could be streamlined following future rounds of data collection.

The CAM data was passed through a range of transformations and analysis modes. Probabilistic Principal Component Analysis (PPCA) was followed by hierarchical clustering to automatically group cities into clusters based on their "relatedness" along principal component dimensions. These clusters were then reviewed and assessed for their stability. The cities in these clusters, described in the next section, are referred to as having the same City Typology.

The Typologies identified have varying degrees of confidence associated with them, and it is cautioned that this work represents a first proof of concept. Understanding any shortcomings in the data now will allow research questions to be better tailored in the future, enabling the Typologies to be built on and firmed up.

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