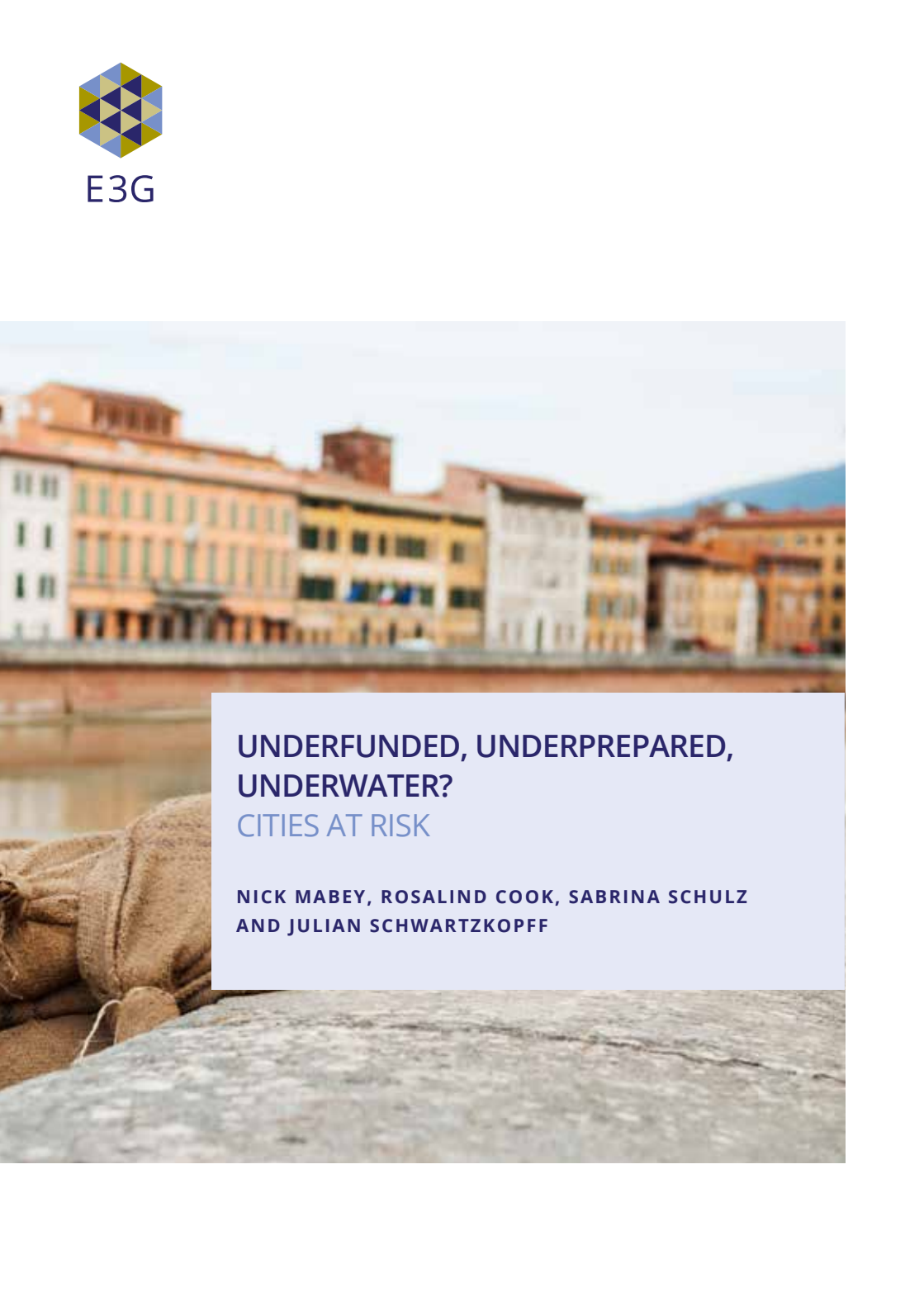




E3G



**UNDERFUNDED, UNDERPREPARED,
UNDERWATER?
CITIES AT RISK**

**NICK MABEY, ROSALIND COOK, SABRINA SCHULZ
AND JULIAN SCHWARTZKOPFF**

ABOUT E3G

E3G is an independent, non-profit European organisation operating in the public interest to accelerate the global transition to sustainable development. E3G builds cross-sectoral coalitions to achieve carefully defined outcomes, chosen for their capacity to leverage change.

E3G works closely with like-minded partners in government, politics, business, civil society, science, the media, public interest foundations and elsewhere. More information is available at www.e3g.org

E3G

47 Great Guildford Street

London SE1 0ES

t: +44 (0)20 7593 2020

e: info@e3g.org

www.e3g.org

© E3G 2014

COPYRIGHT

This work is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 2.0 License.

You are free to:

- Copy, distribute, display, and perform the work.
- Make derivative works.

Under the following conditions:

- You must attribute the work in the manner specified by the author or licensor.
- You may not use this work for commercial purposes.
- If you alter, transform, or build upon this work, you may distribute the resulting work only under a license identical to this one.
- For any reuse or distribution, you must make clear to others the license terms of this work.
- Any of these conditions can be waived if you get permission from the copyright holder.

Your fair use and other rights are in no way affected by the above.



UNDERFUNDED, UNDERPREPARED, UNDERWATER? CITIES AT RISK

**NICK MABEY, ROSALIND COOK, SABRINA
SCHULZ AND JULIAN SCHWARTZKOPFF**

CONTENTS

Acknowledgements	5
Executive summary	6
1. A major challenge to Europe's security and prosperity:	
How climate change impacts cities	13
Introduction	13
Cities face multiple known and unknown climate risks	14
<i>Overview of climate risks</i>	15
<i>Risk of tipping points and radical change to Europe's</i> <i>climate system</i>	16
<i>Risk of cascading systems failures in cities as a consequence</i> <i>of climate change</i>	17
<i>Climate change exacerbates "megatrends"</i>	18
2. How climate risks are being managed in European cities	20
Definitions	20
Cities initiatives on managing climate risk	20
Lack of information, capacity and finance are major barriers	22
3. No one is in charge of managing climate risk in Europe	31
Governments are moving risks onto cities and regions	31
<i>The United Nations Framework Convention on Climate Change</i> <i>(UNFCCC)</i>	31
<i>The European Union</i>	33
<i>National governments</i>	35

Contingency planning for European cities is absent	36
The role of the private sector in managing climate risk at the local level.....	37
Addressing the risk management gap.....	40
Overview of challenges for cities to be climate resilient	41
4. Improving EU climate risk management: A framework for decision making	42
A three-tier “ABC” risk management framework	42
<i>Aim to stay below 2°C</i>	43
<i>Build and budget for 3 to 4°C</i>	45
<i>Contingency planning for 5 to 7°C</i>	46
5. Recommendations	47
Eight recommendations for improving climate risk management in European cities	47
References	54

ACKNOWLEDGEMENTS

This report is the result of the authors’ experience of working on climate risk management and cities. It has been strongly informed by interviews and a workshop convened by E3G during 2014 with city officials, regional representatives and private sector experts from the insurance, construction, energy, transport and water sectors. We would like to thank all the experts that we interviewed. While our thinking was very much influenced by these meetings, the opinions expressed in this paper are E3G’s alone.

We would also like to thank E3G colleagues Tom Burke, Ingrid Holmes and Taylor Dimsdale for very helpful comments and Quentin Genard and Jana Wackermann for invaluable research and project support. We would also like to thank Ada Amon at EnergiaKlub, Robert Brears at RL Expert Group and Michael Leischner from Dortmund City Environment Department for input, support and feedback.

Further details about this paper, downloadable resources and news of related activities are available at www.e3g.org.



This work has received funding from the European Commission through a LIFE grant. The content reflects E3G’s view only. The Commission is not responsible for any use that may be made of the information it contains.

EXECUTIVE SUMMARY

Climate change poses a major challenge to the security and prosperity of European cities

Cities are Europe's social, economic, and cultural centres. However, a growing number of climate risks – including external shocks to resource supplies, extreme weather and food prices – are beyond the control of cities and are threatening their role as growth engines and innovation centres. With 78% of Europeans living in urban areas¹ and nearly 85% of the EU's total GDP being generated in cities,² urban vulnerability to climate change is a major challenge for Europe. While cities are responsible for 75% of the EU's greenhouse gas (GHG) emissions and are leaders in implementing solutions for a low carbon economy, their exposure to climate risks is much less understood and reported on.

Over the past three decades, Europe has seen a 60% increase in extreme weather events including flooding, drought and heat waves. Even if global GHG emissions are rapidly reduced in line with global goals, the trend of increasing extreme weather will accelerate over the coming decades as the impact of current increased concentrations of greenhouse gases feeds through into the climate system. If global GHG concentrations continue to rise, impacts will continue worsening for centuries. The latest estimates based on existing EU, US and Chinese emission pledges suggest an outcome of 2.9-3.1 °C by 2100 if all commitments for emissions cuts are delivered. ³ At the same time, governments agreed to keep global warming below 2 °C to prevent dangerous climate change. The World Economic Forum has now identified the failure of climate change adaptation as one

1 Eurostat, 2012 figures.

2 Eurocities (2013).

3 Hare et al. (2014).

of the greatest risks facing the world.⁴

An aspect of climate impacts that is underestimated, particularly in cities, is cascading system risks. Cities, as interdependent, interconnected networks of people, transport, energy and communication systems are at risk from a failure in one system that causes a set of cascading system failures. Recent experiences of climate impacts – such as the impact of the 2011 Thailand floods on supply chains in the global electronics and automotive industries or the infrastructure failures caused by hurricane Sandy – demonstrate how fragile cities can be to shocks. They suggest that these complex failures are becoming the “new normal” which the EU and cities must navigate.

Climate change driven risks are interacting with and amplifying the effects of other “megatrends” on cities, such as demographic changes. Europe is among the oldest regions in the world with 17% of Europeans aged 65 and over. In 2030, this will be approximately 30%, resulting in a substantial elderly population that is especially vulnerable to extreme heat. During the 2003 heat wave, for example, the mortality rate for this age group increased by 36% in Barcelona, 44% in London and 105% in Paris. ⁵

Cities cannot manage the risks alone

Cities, regions and city networks are doing the best they can to manage climate risks in the face of limited resources, competing priorities and budgetary cuts. There are many innovative initiatives that are supporting cities to enhance their resilience. However, for the most part current action doesn't match the scale of the risks. At least three-quarters of European cities do not have an adaptation strategy in place. An assessment of the adaptation strategies in 30 UK cities found that their quality varied considerably and that citizens were effectively subject to a “postcode lottery of preparedness” with some leaders and many laggards.⁶ Lack of high quality information and

4 World Economic Forum (2015).

5 D'Ippoliti et al. (2010).

6 Heidrich et al. (2013).

sufficient capacity is putting an insurmountable burden on cities and local authorities. In a recent survey of European cities, 77% reported that they had severe capacity gaps, which made it “extremely unlikely” for them to improve their resilience by themselves.⁷

Lack of information, capacity and finance are major barriers for local authorities in improving resilience. Many cities and regions do not have reliable local level data on the range of climate impacts or sufficient resources to undertake the assessment. They often have to rely on past data for future adaptation planning. This approach leads some local authorities to systematically underestimate their city's risk level. Cost estimation models and tools for adaptation measures are also fairly limited in scope. In many cases it is impossible to make rational and informed decisions about the scale of the risks and how to manage them.

Climate risks are being passed to cities

A number of Member States have national adaptation policy frameworks, although quality varies significantly. Very few national governments have adopted dedicated adaptation legislation. While national adaptation strategies cover most of Europe, they are not specific enough for city-level planning. It's clear that national governments are not taking on a strong responsibility to manage climate impacts.

The EU has tried to lead and support action on climate resilience. The European Commission provides some support for cities through the EU adaptation strategy, project funding and advice, but there are significant gaps, including coordinating EU scenario planning and market reforms such as insurance tools. The Commission has been prevented from taking a more stringent approach by Member States that see this as a national competence.

All levels of government have to work together to make Europe climate resilient. Cities need their national governments to pursue ambitious

⁷ EC (2013a).

positions in international negotiations to secure an agreement to limit dangerous climate change. National governments also have to pursue ambitious mitigation plans to limit the need for adaptation. Cities need guidance and financial support from the EU and national governments to address gaps in capacity and funding.

Working together better would require addressing the problem that there are currently few obligations on public or private actors to assess and disclose climate risks. Some leading private sector actors have realised that it is in their business interest to take climate impacts into account in their corporate strategy. However, the overall picture across Europe is that most businesses are not thinking about climate risks. Often, it is not in their short-term interest to fully disclose their potential exposure to climate impacts. This is starting to change, however. In October 2014, for example, the Bank of England wrote to around 30 insurance companies to ask them if they had examined how climate change could impact on their investment portfolios and when extreme weather events could threaten the viability of their business models. Cities will be challenged to work proactively with the private sector, in particular with real estate and insurance companies as well as local utilities to develop meaningful climate risk management systems.

Eight recommendations to improve climate risk management

This combination of structural failures, lack of funding and misaligned incentives prevents cities from adequately managing climate risk. Good risk management requires us to account rigorously for the full range of possible outcomes and to understand the deficiencies of our institutional systems in dealing with them. Critically, it requires objective and independent monitoring of the effectiveness of the risk management policies in practice, and updating and revising them as situations change.

Solutions must go beyond better risk assessments, increased funding or improved cooperation. While these are all essential preconditions for

improving the resilience of urban Europe, structural reforms are needed to move risk management functions to the appropriate level, and improve cities' involvement in risk-management processes.

Recommendations:

- 1. A Climate Risk Management Framework:** Europe needs a comprehensive risk management framework that supports cities and governments to make decisions under uncertainty. The 'ABC' framework proposed here suggests that cities should aim to stay below 2 °C, while building and budgeting for 3-4 °C and putting in place contingency plans for 5-7 °C scenarios.
- 2. High quality risk assessments and new tools:** Cities and regions need high quality local level climate risk assessments. These assessments should consider the full range of climate risks under different climate scenarios – including a 2, 4 or 6 degree global average rise in temperature. They should be comprehensive and consider direct and indirect impacts as well as the implications of cascading system failures. Without reliable analyses and projections, cities do not know what risks they face or what they actually need to manage. Alongside better data, cities will need new tools to use it, including tools for stress-testing decision support tools under different climate scenarios, vulnerability assessments, public participation and developing resilience strategies.
- 3. Capacity to build resilience:** Cities and regions should be given greater direct capacity and budgetary support to undertake local level climate risk assessments and implement resilience planning. They currently do not have the capacity or the financial means to build and budget for a 3-4 °C warmer world. Local authorities will need direct financial support from national governments and the EU to do climate risk assessments in collaboration with local partners. They also need capacity support to ensure that best practice approaches are employed, shared and that they are joined up to regional and cross-border resilience planning. A City Adaptation Innovation Fund at the EU level could be introduced

to finance capacity building programmes for cities and regions and to reward innovative adaptation and resilience measures.

- 4. Responsibility and governance:** Cities and regions need to be part of a comprehensive climate risk management process that brings together the EU, national, and local levels. National governments, together with local authorities, should be clear about who is responsible for managing what kind of risk. The division of responsibility will be different in every country, but the central question is the same: Who is responsible? The answer may result in structural reforms and changes in risk governance with increased devolved powers or mechanisms to ensure greater participation of local authorities in decision making processes. In addition there should be a review of national climate risk management plans for all Member States to assess if any areas can be better supported by EU bodies, including better cross-border resilience planning and coordination. At the EU level, assessments of external risks from climate change to EU markets and imports are required to account for possible second/third order effects for European cities.
- 5. Managing liabilities:** Explicit policies are required on where responsibility and liability for climate damage falls at each level of government. In particular, there is a need to establish under what conditions the public sector would cover climate damages, and when the responsibility would remain with the private sector. To do this, Europe needs to develop stronger duties to disclose climate risks. This could include companies disclosing the physical and economic risks of climate change to their shareholders; EU government departments assessing the full range of risks to their areas of responsibility due to climate change; and cities and regions having a regularly updated climate risk registry listing the full range of potential impacts and second/third order impacts.
- 6. Independent oversight and advice:** Europe has witnessed a number of recent economic shocks and extreme weather events that have far reaching implications for Europe's security and prosperity. While there

are EU-funded assessments of projected climate impacts in a limited range of sectors, no one is in charge of monitoring systemic climate risks to the EU. The global nature of climate risks requires a collective response. In order to improve the robustness and evidence base of decision making at all levels, the EU should set up an independent European Climate Security Observatory. The new institution would be responsible for: 1) Independent evaluation of the collective resilience to climate risks in the EU; 2) Horizon-scanning for potential risks to delivery of EU and Member State climate objectives; 3) Modelling and assessment to test the robustness of Europe's climate and energy policy and decarbonisation pathway against a full range of external shocks and extreme scenarios, and; 4) recommendations to both the European Council and European Commission on actions to manage risk and increase resilience.

7. **Political leadership:** Cities need to speak out, show greater political leadership and have a stronger say in international, EU and national level debates on how to manage climate change. This includes being involved in decisions on the ambition and pace of mitigation action as the only way to reduce the risks of climate change in the long term. Speaking out on climate risk requires political strength, bravery and leadership. Mayors will need to be bold and build alliances with progressive businesses, citizens and stakeholders who want to build resilient and protected cities.
8. **Empowering citizens:** Cities need to reach out to citizens to raise awareness about climate risk and to empower them to respond adequately to a range of climate change scenarios. At the same time citizens need to be aware of the “social contract” on climate change – what their responsibilities and liabilities are and what they can expect from city and national authorities. This will require city leadership to communicate honestly about what climate risk means for people and how they can become resilient. Citizens need to be given better access to information on local climate risks.

1. A MAJOR CHALLENGE TO EUROPE'S SECURITY AND PROSPERITY: HOW CLIMATE CHANGE IMPACTS CITIES

Introduction

Cities are Europe's social, economic, and cultural centres. Yet a growing number of climate risks are challenging their role as growth engines and innovation hubs. With 78% of Europeans living in urban areas⁸ and nearly 85% of the EU's total GDP being generated in cities,⁹ urban vulnerability to climate change is a major challenge for Europe. Climate risks such as an increasing number of extreme weather events, including flooding, storms and heat waves, are already affecting cities directly. Estimates suggest that climate-related damages in the EU might rise to more than €190bn per year in the last three decades of this century.¹⁰ Climate risks also include second order effects on Europe, resulting from the impacts of climate change elsewhere in the world. This includes impacts in emerging economies, with consequences for global supply chains, international trade and economic stability.

These challenges do not only impact on the largest cities that have the capacity and political attention enabling them to act. More importantly, small and medium-sized cities with less than half a million inhabitants – frequently organised in networks of mutually dependent infrastructures and supply chains – are struggling to implement resilience solutions to climate risks with limited capacity and budgets.

8 Eurostat, 2012 figures.

9 Eurocities (2013).

10 Joint Research Centre (2014).

Cities are responsible for 75% of the EU's greenhouse gas (GHG) emissions¹¹ and are leaders in implementing solutions for a low carbon economy. While an increasing number of cities are prioritising sustainable low carbon development, many do not understand the climate risks they are exposed to and lack the necessary adaptation and resilience policies. The issue is important because climate risks impact on the economic competitiveness of a city. This will only increase as the private sector starts to systematically account for climate risks and resilience in investment decisions, including the locations for investment and supply chains. Cities that prioritise resilient and sustainable urban development as a competitive advantage will enhance their attractiveness for investments in the future. Moreover, climate resilient cities are important for protecting local heritage sites and landmarks, as well as providing a high-quality living environment. As labour mobility increases, sustainability and resilience will be essential to attract the highly qualified workers indispensable to many of today's industries.

This report examines how climate change impacts European cities, how the risks are currently being managed and which barriers to effective risk management exist. The report concludes with a proposal for a risk management framework to manage climate risks under uncertainty at the local level, a set of recommendations to operationalise the framework and suggestions on how to raise political support around the issue.

Cities face multiple known and unknown climate risks

European cities are exposed to an already noticeable trend of increasingly frequent and intense heat waves, droughts and flooding, which is driven by climate change.

- > Over the past three decades, Europe has seen a 60% increase in extreme weather events.¹²

11 Eurocities (2013).

12 EASAC (2013).

-
- > These events can occur in quick succession: Copenhagen, for example, suffered a severe 1 in 100 years flood in 2010 followed by an even greater 1 in 1000 years flood the following year.¹³
 - > Yearly damages from natural disasters have increased from €9bn in the 1980s to over €13bn in the 2000s.¹⁴
 - > The heat wave that hit Europe in the summer of 2003 resulted in between 55,000 and 70,000 deaths.¹⁵
 - > In early 2014, flooding and winter storms caused an estimated £14bn in economic damages in the UK alone.¹⁶

Overview of climate risks

The term *climate risk* refers to threats to human and natural systems resulting from climate change impacts and the vulnerability of these systems in the face of these threats. Climate risks manifest themselves in direct physical impacts of severe weather events and other climate impacts, as well as second and third order consequences of climate-related events elsewhere in the world.

There will be further risks to European cities, especially in the long-term. These include rising sea levels that will pose an existential threat to coastal regions, more frequent heat waves impacting on power and transport infrastructure as well as public health, changing precipitation patterns leading to higher rainfall in Northern Europe and drought, and an increased risk of forest fires in Southern Europe. Increasing weather volatility will lead to more frequent cloudbursts and extremely cold winters, even in areas that become drier and warmer on average. These

13 Haghghatafshar et al. (2014).

14 EEA (2012a), figures are adjusted for inflation.

15 Jendritzky (2007), Robine et al. (2008).

16 Confino (2014, quoting O. van Heel from Aldersgate Group).

impacts will already be felt in a 2 °C world, and they will only intensify if global warming exceeds that threshold. Scientists have made it clear that, “beyond two degrees of warming we are leaving the world as we know it.”¹⁷

Cities are especially exposed to the impacts of extreme weather events. They are particularly vulnerable to heat waves because densely built environments heat up faster than the surrounding countryside, creating an urban heat island effect. The concentration of population in cities exacerbates water scarcity due to increased demand. Sealed surfaces diminish the soil's natural drainage capacity thereby increasing the severity and duration of floods. The high concentration of wealth and high-value infrastructure in cities amplifies flood-related damages. According to the European Commission, at least 1,000 km² of land – more than the size of the city of Berlin – are converted for new infrastructure in Europe every year.¹⁸ Thus, as Europe becomes increasingly urbanised, building new urban infrastructure without planning for climate risks will exacerbate the vulnerability of Europe's economy and society to the impacts of climate change. This will make European cities less attractive to investors that depend on reliable infrastructure to maintain their supply chains and run their operations.

Climate risks can be amplified by mal-adaptation and insufficient coordination of adaptation measures. In the area of water and flood management, for example, if flood defences prevent flooding in upstream cities, cities downstream will have to deal with higher river levels. Likewise, cities in water-stressed areas often compete for scarce water resources. The river-water irrigation systems of an upstream city might deprive a downstream city of water for consumption and agriculture.

Risk of tipping points and radical change to Europe's climate system

Certain tipping points could change the global climate system irrevocably. For instance, the melting of Arctic sea ice could shift the jet stream southward which might lead to colder European winters and leave Southern Europe even

17 Pidcock (2014), quoting Anders Levermann from the Potsdam Institute for Climate Impact Research.

18 EC (2012).

drier. The disappearance of alpine glaciers would change seasonal run-off patterns and freshwater supplies with major implications for irrigation and hydropower plants. The melting of ice sheets in Greenland and Antarctica would irreversibly raise sea levels by several meters. Although this process would take centuries, coastal regions in Europe would feel the impacts before the end of this century. This process would also impact on ocean salinity and temperatures, which could lead to a breakdown of the Gulf Stream, thereby lowering surface temperatures by several degrees and reducing precipitation in Northern Europe.¹⁹

To date, climate science cannot predict when these tipping points will be reached. However, we know that they are likely to happen sooner in a 4 to 7 °C world than in a 2 °C world. The collapse of the West Antarctic ice sheet has already begun.²⁰ It is estimated that this process will increase sea levels by 20cm by 2100, which is not fully reflected yet in the latest Assessment Report of the International Panel on Climate Change (IPCC) which predicts a sea level rise of 44 to 74cm by 2100 for different emissions scenarios.²¹ Passing further tipping points would radically alter Europe's climate systems. So far, there are no mechanisms in place whereby the risk of the potential impacts could be managed in an effective way.

Risk of cascading systems failures in cities as a consequence of climate impacts

Cities form highly interdependent and interconnected systems. Electricity grids, communications infrastructure, transportation networks, water supply, sewage systems and health care, for example, are all parts of the city system, and they form links to the wider regional and global economy. A failure in one system can lead to cascading effects through a city's entire organism. In cities, disruptions to electricity grids are a major concern because of the direct impact onto other systems such as traffic control systems, emergency services, communications and financial services. Recent experiences of climate impacts – such as the impact of the 2011

19 Levermann et al. (2012), Joint Research Centre (2014).

20 Joughin et al. (2014), Rignot et al. (2014), Favier et al. (2014).

21 Joint Research Centre (2014).

Thailand floods on supply chains in the global electronics and automotive industries or the infrastructure failures caused by hurricane Sandy – demonstrate how fragile a city is to shocks. They suggest that these complex failures are becoming the “new normal” which the EU and cities must navigate.

Case study: Muenster, Germany

In November 2005, the region around the German city of Muenster was hit by sudden snowfall of 50cm, which caused a severe blackout. Power lines and communication wires collapsed under the strain, cutting off electricity, landline, cell phone and data networks for a quarter of a million people for several days. Further consequences included a complete breakdown of public transport and severe damages to buildings. The “snow chaos” resulted in overall damages of app. €130m.²²

Local crisis management capabilities were severely overstretched. Post-incident investigations revealed that emergency communications systems were deficient and available assets such as emergency generators unavailable because of a lack of coordination systems. The German Federal Office for Materials Research later identified a lack of maintenance of decades-old power pylons by the utility company RWE as the main cause of the blackout.²³

This case study highlights the vulnerabilities of city systems. A failure in one system can create complex cascading failures throughout the city.

Climate change exacerbates “megatrends”

The examples above demonstrate that severe weather events in ever more crowded cities require complex crisis management systems.²⁴

²² Zukunftsforum Öffentliche Sicherheit (2008).

²³ Ibid.

²⁴ Koehring (2014).

Moreover, climate change driven risks are interacting with and amplifying the effects of other “megatrends” on cities, such as resource pressures and demographic and technological changes. This has major implications for Europe’s future security and prosperity.

Demographic trends play a particularly important role. Europe is already among the oldest regions in the world. Currently, about 17% of Europeans are 65 years or older; in 2030, this will be approximately 30%. An elderly population is especially vulnerable to extreme heat. During the 2003 heat wave, for example, the mortality rate for this age group increased by 36% in Barcelona, 44% in London and 105% in Paris.²⁵



Cities are also heavily reliant on food imports as much of the hinterland is urbanised and not available for agricultural use. Thus, an urban population can be directly affected by resource scarcity following drought and other climate impacts in other parts of the world. The urban poor are the most vulnerable to the effects of rising food prices.

Thus, the combined effects of climate impacts and other important trends make cities increasingly vulnerable and require the introduction of complex risk management systems.

²⁵ D’Ippoliti et al. (2010).

2. HOW CLIMATE RISKS ARE BEING MANAGED IN EUROPEAN CITIES

Definitions

The term **infrastructure** in this report uses the OECD definition, referring to various systems of public works including roads, utility lines and public buildings.²⁶

Resilience is defined using the IPCC definition – the ability of urban centres (and their populations, enterprises and governments) and the systems on which they depend to anticipate, reduce, accommodate or recover from the effects of a hazardous event in a timely and efficient manner.²⁷

City initiatives on managing climate risk

Cities have to take the position of first responders when severe weather events hit their population and infrastructure. This is reflected in the existing emergency management systems in cities. At the same time, cities are becoming increasingly aware of the climate impacts they face, and what this means for their crisis response systems and long-term risk management plans. They understand that *resilience* has to be their answer to climate risk.

²⁶ OECD (2014).

²⁷ IPCC (2014).

Resilience goes beyond adaptation. Whilst adaptation allows cities to simply deal with new climatic conditions, resilience implies an ability to return to previous conditions without any long-term damage. Resilience is therefore the more challenging task but it is a necessary precondition for lasting prosperity and security. This report makes a distinction between the terms, although, in reality, they tend to be used interchangeably.

Many cities across the EU have already developed adaptation strategies or are in the process of drawing them up. C40 cities such as Copenhagen, Rotterdam, London and Barcelona are clearly leaders in climate resilience. They have comprehensive cross-sectoral plans, often associated with major infrastructure projects. Copenhagen and Rotterdam, for example, are restructuring their water management systems so that boulevards, parks and plazas become strategic urban zones that can be flooded in the event of heavy rainfall. It's not just large cities, though, that are implementing climate resilience plans. Many other EU cities have adaptation strategies, often focused on the climate risk they are already facing. Some examples include the "*Plan Pluie*" to combat urban flooding following heavy rainfall in Brussels, water management plans to deal with aggravating water scarcity in Zaragoza (Spain), and coastal defence plans to address sea level rise in Tallinn and Pärnu (Estonia).

At the same time, thousands of cities are active in networks such as C40, ICLEI, Eurocities, the Resilient Cities Campaign by the *United Nations International Strategy for Disaster Reduction* (UNISDR), the Covenant of Mayors, and Mayors Adapt where they are sharing experiences and developing creative and innovative policy responses. These initiatives cover a range of different activities including public awareness campaigns, technological support tools, best practice exchanges, and coordination around cross-border planning and infrastructure projects. City networks have clearly pushed climate resilience up the political agenda, especially at the local level, by amplifying voices and providing an important source of operational support to each other.

However, despite these innovative, ground-breaking initiatives by cities

and city networks, the overall picture across Europe is that there are still significant deficiencies in climate risk management. A recent study on the climate change response of 200 urban areas across 11 EU countries has found that 72% of these cities had no adaptation strategy whatsoever.²⁸ The countries with the highest proportion of cities with an adaptation plan were the UK (80%), Finland (50%) and Germany (33%). Urban adaptation strategies were generally less advanced than mitigation strategies.²⁹ The study excludes all of Eastern Europe, where capacity gaps are most severe. The picture for the entire EU therefore is difficult to access. A recent study on UK cities – often leaders on climate resilience – also suggests that there is significant disparity. The assessment, of the adaptation strategies in 30 UK cities, found that their quality varied considerably and that citizens were effectively subject to a “postcode lottery of preparedness” with some leaders and many laggards.³⁰

Thus, there are major gaps in Europe’s urban adaptation and resilience planning. One of the causes is a lack of reliable and comparable data across Europe that would enable governments and cities to plan for specific scenarios corresponding to specific degrees of global warming and related climate impacts.

Lack of information, capacity and finance are major barriers

In interviews, city officials and experts stress the lack of knowledge about the full range of climate impacts their cities are likely to face. There is also a lack of awareness among businesses, citizens and other stakeholders about climate risk. In water management, for instance, climate-related water scarcity is going to be much more severe in southern than in northern Europe. However, it is still a danger in the North, and it is often not fully planned for because the level of risk is not well understood. Many local authorities have stressed

28 Reckien et al. (2014). The countries included were Austria, Belgium, Estonia, Finland, Germany, Ireland, Italy, Netherlands, Spain and the UK. The sample is drawn from the Urban Audit database and is thus balanced and regionally representative for each individual country.

29 Ibid.

30 Heidrich et al. (2013).

the difficulty of not having high quality local level data to be able to accurately assess the risks they face. There is also a significant lack of understanding of the second order impacts of climate change on supply chains, distribution networks and the economy as a whole. These are very difficult and costly to assess but crucial to account for because these second order impacts pose a significant risk to cities and their economies and will occur much sooner than some direct impacts such as coastal erosion.

Due to the lack of reliable analyses and projections, cities and regions are relying on past data for their future adaptation planning. This approach leads some local authorities to systematically underestimate their city’s risk level, which can cause a need for expensive post-hoc retrofitting. As the case study on the Hungarian Danube region shows, this is putting an unmanageable burden on cities’ budgetary resources.

Case study: Resilience planning for urban areas along the river Danube in Hungary

The city of Vac, just outside Budapest, faces severe flooding challenges almost every 4 years. These floods do not only cause direct damages to buildings and infrastructure. In the past, they have also caused sewer overflow, thereby endangering public health, and blocked shipping routes, with knock-on impacts on economic activity.

The flooding is not only a result of increasingly severe impacts of climate change but also due to cities that are located upstream from Vac, including in Slovakia, Austria, and Germany, building flood defences which in turn aggravate flooding in Vac. Long term coordination across national borders on flood management is challenging for local decision-makers because they are often focused on emergency response.

Vac has put together a plan to build a mobile dam to protect the city. They are hoping to receive the necessary funding from the Hungarian

government through a bid for EU funds. The dam only plans for the “last worst” flood, however. Already, city officials had to adapt their flood scenarios from 700cm to 900cm following a flood that turned out to be even more severe than the previous one. Vac’s 2002 flood reached 730cm requiring 80,000 sandbags for protecting the city. In 2013, the level rose to 804cm in 2013 requiring 400,000 sandbags.

The cost of the emergency response and repair of the damage are often borne by the city and by property owners. Insurance against flooding is not possible for the citizens of Vac. Cities do get good support from the central government for damage costs but there is usually a shortfall which has to be met by drawing on the city’s reserve budget, leaving less for city services. As the flooding increases in frequency and intensity, this is proving to be a real challenge for city resources.

Without the right information on the range of possible climate impacts and risks it is extremely difficult to assess the costs of resilience measures and the budget local authorities require. Cost estimates for adaptation measures in Europe are still fairly limited in scope. Existing studies on the costs of adaptation focus on different sectors and time periods and use different measures and methods. There are also significant research gaps from sector-specific bottom-up studies. The sector-specific studies are more helpful, however, than the Integrated Assessment Models (IAMs) approach, which is based on a host of uncertain and controversial assumptions, making the results highly arbitrary. This is also reflected in the often enormous range of cost estimates that these models produce. The Stern Review, for example, estimates that Europe will need to invest between €5 and 70bn in adaptation per year.³¹ Other notable IAM studies have produced similarly large ranges.³² At best, these models can give an indication of the relative distribution of adaptation costs across sectors,

31 Stern (2007), figures have been converted to 2013 Euros.

32 See e.g. OECD (2010), Tyndall Centre for Climate Change Research (2009) or UNFCCC (2007).



regions and time. However, some commentators have concluded that IAMs are “close to useless as tools for policy analysis”.³³ They are certainly unable to help local authorities assess the budget they need to plan for climate risks. In addition to the cost assessments, current guidance offered to cities on how to budget for climate impacts is often limited to generic advice on choosing “low cost”, “win-win” and “no regrets” options.

Carrying out city- and region-specific cost assessments requires substantial capacity and financial resources. The majority of cities still lack the means to approach adaptation in a systematic manner. In a recent survey of European cities, 77% reported that they had severe capacity gaps, which made it “extremely unlikely” for them to improve their resilience by themselves.³⁴ In addition, most EU governments have either frozen or decreased the central budget allocation to local authorities in the past five years.³⁵ At the same time, there has been an increased demand for social welfare and services. As a result, local authorities had to scale back infrastructure investment and increasingly went into debt.³⁶ Many cities and regions have therefore had to focus on short-term priorities of maintaining critical services rather than investing in climate resilience.

33 See Pindyck (2013).

34 EC (2013a).

35 The only exceptions were Germany, Slovakia, Lithuania, Sweden, Poland and Finland.

36 CEMR & DEXIA (2012).

Despite this general trend, there are substantial differences in city finances across EU member states. In Denmark, for example, 67% of public sector revenue goes to municipal budgets. The situation is similar in Sweden (48%) and Finland (41%). Cities in these countries are in a much better position to engage in resilience planning than their counterparts elsewhere in Europe. Local authorities in the UK or the Netherlands, for comparison, receive 32% and 35% of public sector revenue, respectively. In Eastern Europe, municipal budgets receive around 20-35% of public sector revenue. In Germany, only 17% of public sector revenue goes to local authorities. The case study on the city of Dortmund below demonstrates the challenge this poses for German cities.

Case Study: Dortmund

Dortmund is a representative example of how German cities are trying to manage resilience planning and low-carbon development in parallel under severely constrained resources. Dortmund is exemplary in the way it is taking on the *Strukturwandel*, managing the transition from a heavy-industry based economy to a modern diversified and sustainable economy. The city is rebranding itself to become more attractive for investors in future industries, such as ICT, nanotechnology, logistics, biomedicine, and robotics.

Dortmund, like all cities in the Ruhr region, is however highly vulnerable to heavy rainfall and flooding because of previous coal mining activities: subsidence damage is commonplace – large areas have subsided by up to 30 metres- and the groundwater needs to be pumped into the river Rhine to avoid flooding.

More than 120 pumping stations are in use in the Ruhr area. This has a major impact on infrastructure for transport and communication. Increasing amounts of public money have to be spent on the combined challenges of the long-term effects of coal mining and the increased frequency of storms and heavy rainfall.

To be able to attract clean industries, the city will have to design and implement effective systems to manage the increasing risk of severe weather events, including storms and flooding. Power outages and the flooding of roads and train lines have the potential to severely impact on the ICT and logistics sectors. IKEA's main European logistics centre, for instance, is located in Dortmund. The city is developing an adaptation strategy and the state of North Rhine-Westfalia has a climate protection act. However, managing the range of climate impacts in the Ruhr region will require many levels of governance to work together and it is unclear which authorities are responsible for monitoring and preventing risks on supply chains and cascading risks.

At the same time, the city is facing numerous challenges regarding the conversion of former industrial areas, including coal mines and steel works and associated social challenges. Managing these requires funds for integrated adaptation and climate risk planning that goes beyond the climate-proofing of infrastructure.

Currently, there are no dedicated funds or financial mechanisms at the EU or international level that provide direct access to cities to finance mitigation and adaptation or resilience activities. However, some initiatives are currently building networks around climate finance in cities. For example, at the UN Climate Summit in September 2014, the Cities Climate Finance Leadership Alliance was launched. It aims at supporting cities in low and middle income countries to overcome structural and institutional barriers when trying to attract investment in low carbon and climate resilient infrastructure.³⁷ Moreover, the C40 initiative launched the Sustainable Infrastructure Finance Network which facilitates the exchange of information and advises on approaches to finance.³⁸ Climate finance has a central role to play in the transition to low carbon, resilient cities and all cities, including in Europe, must be able to gain access to it.

³⁷ Cities Climate Finance Leadership Alliance (2014).

³⁸ C40 Cities (2014).

As this chapter has shown, the lack of information, capacity and finance is putting an insurmountable burden on cities and local authorities. Cities, regions and city networks are doing the best they can to manage climate risks in the face of limited resources, competing priorities and budgetary cuts. However, without reliable data and sufficient resources, it is impossible to make rational and informed decisions about the scale of the risk and how to manage it. In the face of insufficient information, cities might ultimately have to adapt to a worst case scenario, which has massive financial and capacity implications. National governments as well as the EU will have to support cities to deal with this challenge.

City powers and budgets: Comparing three selected countries

United Kingdom

The UK governance structure is highly centralised and cities are subject to performance measurement and control by the central government. The role of local authorities is to provide public services and there is little flexibility for implementing local initiatives or to exercise influence at the national level.

Reforms in 2001 and 2011, respectively, under the label of “new localism” have granted local authorities more powers and a general competence as is common in continental Europe. However, local budgets have also been slashed by over a third since the 2011 reform. As a result, the new competences have not been widely used as cities are struggling to make ends meet. There is now a clear mismatch between competences and available public funds. Moreover, many of the responsibilities for effective climate risk management remain with the central government. This includes flood management, disaster response, public safety and infrastructure planning.

Dynamic forms of cooperation amongst municipalities have developed in recent years, partly out of the necessity to cut costs.

Many cities have entered into agreements where they jointly run policing, fire fighting services, public transport or waste disposal. However, such structured cooperation has not spilled over into joint climate risk management.

Germany

German cities have traditionally enjoyed strong local autonomy and a broad scope for action. Successive reforms have led to greater decentralisation by giving local authorities additional responsibilities in providing government services. As a result, German cities control many of the competences needed for effective climate risk management, such as urban planning, public safety, road and public transport infrastructure, flood control and management, water supply and public utilities.

Local government finances have increasingly come under pressure, however. Tax reforms, slow growth in the early 2000s and the economic and financial crisis have limited tax income, which is the most important source of revenues for municipalities. Thus, local revenues decreased at a time when expenditures, especially on social measures, kept increasing, putting significant pressure on local budgets. Federal authorities had to step in to cover rising social costs after the economic crisis, which eased the pressure on city budgets somewhat without addressing the underlying problems.

The financial situation has led to a focus on crisis management rather than long-term planning, which makes climate risk management much more difficult. Many cities had to take out loans, privatise public services and cut back administrative staff to deal with the budget crisis. Intra-municipal cooperation is another cost-saving strategy – but it is largely limited to public service delivery, not strategic planning. This situation prevents cities from exercising their traditionally strong autonomy and hampers their ability to manage climate risks effectively.

The Netherlands

Like their counterparts across Europe, municipalities in the Netherlands are facing increasing budgetary pressures. Many local authorities have been cutting staff and operating budgets, and privatising public services. Decentralisation reforms have given municipalities new competences in the areas of social services and health in recent years, although funding for these activities was cut at the same time. However, the cooperative management style prevalent in the Netherlands means that Dutch cities seem better positioned to deal with climate risks than their financial situation would suggest.

The Netherlands has a long tradition of cooperation between government bodies and across levels of government. Similar to German cities, Dutch municipalities have many important competences for resilience planning, such as civil engineering and infrastructure development, maintenance of roads, housing and urban planning. Local authorities can also autonomously develop their own policies as long as they do not conflict with national legislation. In practice, many competences are shared with the national government.

The law facilitates cooperation between municipalities and with other government bodies, such as water management authorities. Such cooperation is widespread and covers a broad range of areas including social service provision, waste processing, joint administration, ICT governance, public procurement and public safety matters. Dutch municipalities are used to dealing with environmental risks, especially because of recurrent challenges around flooding, and cooperate to address common problems. A good example is the work of the Association of Dutch River Municipalities.

Cities also encourage citizen and stakeholder participation. Instruments such as public hearings, non-binding referenda and stakeholder involvement in planning processes are widely used at the local level.

3. NO ONE IS IN CHARGE OF MANAGING CLIMATE RISK IN EUROPE

Governments are moving risks onto cities and regions

All levels of government have to work together to make Europe climate resilient. Cities need their national governments to pursue ambitious negotiating positions in international negotiations to secure an agreement to limit dangerous climate change. National governments also have to pursue ambitious mitigation plans to limit the need for adaptation. Cities need guidance and financial support from the EU and national governments to address gaps in capacity and funding.

At the same time, cities are sources of information on adaptation needs and best practice when it comes to resilience planning at the local level. Moreover, cities control many of the resources that are necessary for effective adaptation, such as spatial planning, control over city budgets and ownership of or involvement in public utilities. About two-thirds of public sector infrastructure investment comes out of municipal budgets, so local authorities have a crucial role in building a climate-resilient Europe.³⁹ But instead of ensuring reliable coordination of policies across all levels of governance, the current policy framework encourages incompatible and competing approaches and leaves cities to deal with the consequences.

The United Nations Framework Convention on Climate Change (UNFCCC)

Climate change is currently not well managed at the international level. The World Economic Forum recently identified the failure of climate

³⁹ CEMR (2013).



UNFCCC NEGOTIATIONS

change adaptation as one of the greatest risks facing the world.⁴⁰ The agreed goal of the international community is to limit global temperature rise to below 2 °C compared to pre-industrial levels. However, this goal is less clear than it seems given that climate science is based on probabilities and trajectories consistent with a 50%, 66% and 85% chance of staying below 2 °C have all been considered.⁴¹ According to the UNFCCC Secretariat, even the most successful outcome being considered for the Paris negotiations will not put the world on a secure 2 °C pathway.⁴² The latest estimates based on existing EU, US and Chinese emission pledges suggest an outcome of 2.9-3.1 °C by 2100 if all commitments for emissions cuts are delivered and trajectories continued.⁴³ Whatever the outcome, however, cities will have to deal with the consequences. Therefore, cities rely on national governments to push the EU to take on a bolder and more confident attitude in the climate negotiations.

40 World Economic Forum (2015).

41 IPCC (2014).

42 Reuters (2014).

43 Hare et al. (2014).

Climate risk management in US defence policy

The U.S. Department of Defense (DoD) is undergoing an extensive process of mainstreaming climate change considerations across all departmental operations. In 2014, the Department released its Climate Change Adaptation Roadmap which detailed these efforts, including integrating climate change into war games and defence planning scenarios.

A key component of the DoD strategy involves conducting risk assessments of the vulnerability of more than 7,000 military bases, installations, and other facilities. One of the earliest pilot projects involved developing sea level rise and coastal storm scenarios for Hampton Roads, Virginia which houses the largest concentration of US military sites in the world. Similar assessments are being carried out for U.S. military bases worldwide to determine where investments in resilience must be made and which installations may need to be abandoned. There is currently no comparable effort to mainstream climate resilience into EU defence policy and provide detailed climate risk scenarios.

The European Union

Coordination of climate risk management at the EU level is weak. In 2013, the European Commission published an EU adaptation strategy that focuses on developing better knowledge and understanding of climate impacts, climate-proofing of specific sectoral policies and the promotion of action by Member States and cities through non-legislative means. During the development of the strategy the Commission considered proposing comprehensive adaptation legislation but received significant opposition from Member States. The Commission is no longer planning to introduce legislation in the future, saying it will assess Member State progress in 2017 to decide whether or not there is a need.⁴⁴ Member States have

44 EC (2013b).

limited the scope of the Commission's role on climate risk management despite the clear added value of having a coordinated approach to cross border impacts. At the same time, EU national governments are not taking on the responsibility to adequately manage climate risks themselves.

In addition, as part of the EU Adaptation Strategy, the Commission also published a Green Paper consultation on insurance policies for man-made disasters about whether there should be any changes or harmonisation at EU level.⁴⁵ The Commission recognised the problem that catastrophes are on the rise while the EU is not making maximum use of the capacity and capabilities of the insurance industry to insure against them. This discussion is unlikely to be taken further following the strong response from insurance companies against European level solutions.

Creating coherence across regions and policy areas is necessary to remove barriers to effective adaptation in the EU. The lack of coherence across the EU's central and regional strategies as well as existing national strategies has already reduced the effectiveness of adaptation planning in the Baltic Sea region, for instance.⁴⁶ Similarly, insufficient cross-national and cross-city coordination along the Danube have led to a situation where some cities face intensified flooding due to flood defences being built in other cities upstream. Such policy fragmentation, where it occurs, is especially problematic for cities as it forces them to commit time and resources on deciding which adaptation policy frameworks apply in their municipality.

On the other hand, an area where the EU has made substantial progress is the current EU Multiannual Financial Framework (MFF) 2014-2020 where 20% of the budget is earmarked for spending on climate-related activities. This represents €19bn, triple the amount compared to the previous spending period, which is remarkable given the 3.5% reduction on the 2014-2020 budget overall. This is the first time the European Council and the European Parliament agreed on a specific spending target for climate-

45 EC (2013c).

46 Glaas & Juhola (2013).

related activities.⁴⁷ While it is too early to evaluate the effects of this, it is encouraging to see that EU funding is supporting a number of EU cities to start developing their adaptation strategies.⁴⁸

National governments

Member States are managing climate risks primarily through National Adaptation Strategies. As of 2014, 18 out of 28 EU Member States had adopted such a strategy.⁴⁹ However, many Member States in Central and Eastern Europe and the Baltic States, for example, have no strategies in place. Greece and Italy, two countries that stand to be hit hard by a combination of drought, heat waves and sea level rise, also have no official adaptation strategies. Where there is no national strategy in place, cities are working in a regulatory and policy void, which can aggravate barriers to coordination and even lead to maladaptation at a later stage.⁵⁰

Where National Adaptation Strategies are in place, many cities report that they do not find them particularly useful for the local context. Frequently, these strategies focus on broad issues at the national level without specifically including local and urban challenges. National strategies are also often disconnected from regional and local strategies and do not set out clear responsibilities for resilience planning.⁵¹ While some countries including the UK provide an extensive set of online tools to help cities plan for climate change, there is no national guidance on planning methods or accessing funds for adaptation.

Monitoring and evaluation is another weak point of existing National Adaptation Strategies. As "resilience" is a moving target, effective policy review mechanisms are crucial to ensure that adaptation measures are regularly matched to new evidence. So far, only six EU countries have put

47 EC (2013d).

48 EC (2013a).

49 EEA (2014). Only half of the countries with a NAS have adopted National Adaptation Plans (NAPs) under the UNFCCC.

50 EC (2013a).

51 EC (2013a), Partnership for European Environmental Research (2009).

such mechanisms in place.⁵² Member States currently use a variety of approaches like independent reviews, self-assessments or indicator-based monitoring, which makes comparative assessments and best-practice sharing difficult. The Commission is planning in 2017 to evaluate Member State preparedness using an adaptation policy scoreboard to determine if their action is “sufficient”.⁵³

Only a few Member States have so far adopted specific legislation on adaptation.⁵⁴ The UK’s 2008 Climate Change Act requires a climate change risk assessment every five years⁵⁵ and gives the government special powers, e.g. to require utilities to report on their climate risk preparedness. Germany, in contrast, relies on a sector-by-sector approach. The federal government has mainstreamed adaptation concerns into specific sectoral legislation, such as the 2008 Regional Planning Law, the 2011 Urban Development Planning Law, and the 2009 Water Pollution Law.⁵⁶ This can be compared to the United States, where an Executive Order by President Obama requires all government departments to undertake risk assessments concerning their policy areas and to report directly to the White House.

Contingency planning for European cities is absent

The risk assessments underpinning national and EU plans also have significant blind spots. First of all, there is little information on local climate risks as most impact assessments focus on the national and EU levels. Most cities, however, simply do not have the capacity to develop detailed scaled-down analyses of climate impacts, local vulnerabilities and possible economic consequences under different scenarios. Policy-makers at higher levels of government have so far not managed to remedy this situation. Moreover, existing impact assessments tend to focus heavily on

52 EEA (2014).

53 EC (2013b).

54 EEA (2013).

55 The first UK Climate Risk Assessment was published in 2012 and a second one is being prepared for 2017.

56 EEA (2013).

the direct impacts of climate change on selected sectors.⁵⁷ The possibility of indirect damages through cross-sectoral linkages, cascading systems failures and disruptions of global markets are not yet taken into account.

The existing process for producing impact assessments also fails to take the full range of possible climate futures into account. The EU’s climate impact assessments, for instance, all use 3.3 °C of warming compared to pre-industrial levels as the worst case scenario.⁵⁸ While many Member States use a broader range of scenarios, no government is considering a scenario beyond 5 °C. According to the IPCC’s projections, however, an increase in temperature of up to 7 °C is possible if mitigation measures prove insufficient or unsuccessful. Climate tipping points and their potential economic consequences are not analysed at all in existing impact assessments.⁵⁹

The role of the private sector in managing climate risk at the local level

Governments currently do not usually have someone responsible for managing climate risk at the appropriate level, and most institutions are not looking at climate risk. At the same time, there are no obligations on any public or private actors to assess and disclose climate risks. This has implications for the relationship between cities and the private sector when planning for resilience.

Some leading private sector actors have realised that it is in their business interest to take climate impacts into account in their corporate strategy. These companies are voluntarily integrating climate risk assessments into their planning processes. The UK supermarket chain ASDA, for example, assessed their fresh produce supply chain and found that 95% of it was

57 Partnership for European Environmental Research (2009).

58 See EEA (2012), EC (2013b), JRC (2014). The temperature increase compared to pre-industrial levels was calculated with data from NASA’s Land-Ocean Temperature Index. The earliest recorded 20-year period (1880-1899) was used as a baseline to approximate pre-industrial temperature levels.

59 JRC (2014).

at risk from climate change.⁶⁰ British retailer Marks and Spencer, Unilever, and the Austrian postal service⁶¹ are also among the leaders in integrating climate impacts into their operations.

However, the overall picture across Europe is that most businesses are not thinking about climate risks. Frequently, it is also not in their interest to fully disclose their potential exposure to climate impacts. This is particularly true for the real estate sector because risk disclosure can lead to a decrease in property values.⁶² A recent survey amongst executives of major real estate companies found that only 28% of them are performing climate risk assessments. 60% said they were not planning to prioritise climate risk in the future either.⁶³ This is despite “green value premiums” for resilient and eco-friendly properties and “grey discounts” for outdated real estate already being felt in the market by some real estate executives.⁶⁴

Cities and regions will need to coordinate closely with local businesses and real estate developers in the future when designing adaptation and resilience solutions. Cities may face different interests in their roles of managing land use and protecting citizens against the impacts of climate change. Property values drive urban planning as well as infrastructure development and there could be a costly misallocation of investments if climate risks are not integrated in property development and spatial planning.

Similar arguments apply to companies in the manufacturing and logistics sectors that are increasingly aware of the need to factor climate risks into their business operations. Yet much of this is happening under the radar and does not translate into calls for improved preparedness and resilience of the cities where they are located. This is understandable as the reputational damage for both sides could be significant. However, as climate impacts intensify, the debate is bound to develop momentum.

60 ASDA (2014).
61 CDP (2014).
62 ULI (2014).
63 Bienert (2014).
64 Ibid.

A comparable discussion on risk disclosure also applies to local utilities and grid operators. So far, they are not systematically integrating climate risk assessments into their operations and safety procedures. A survey of major players in the sector found that two thirds of fossil fuel plant operators had not evaluated the climate-vulnerability of their plants. Grid operators and renewable energy companies showed even less awareness of climate risks.⁶⁵ The general approach to resilience is still to react in an ad hoc manner in the case of an incident or emergency.⁶⁶ This is worrying given the central role of electricity to the functioning of a city and its interconnected infrastructures. Spontaneous reactions will not suffice to tackle the impacts of climate change on utilities in the future – and yet again cities are at the centre of both the problem and the solution.

The insurance industry is already engaged in discussions on risk disclosure, factors for insurability of risk and determining liability for mismanaging climate risks. However, a proactive and transparent debate is still lacking, not least due to the sheer magnitude of the challenge for insurers. The most common way of dealing with the situation so far are exclusion clauses and the definition of uninsurable risks such as in the in the Danube region (see case study in Chapter 2). In practice, this shifts the risks to taxpayers. On the other hand, if the insurance industry were to fully account for climate risks in their insurance policies, this could raise prices to a level that would be too high for many clients.

SwissRe as a large reinsurer with reliable modelling software, for example, is able to insure the full range of potential damages. However, this more realistic risk assessment also results in higher insurance premiums. The reinsurance industry is working with primary insurers as well as with large businesses such as Fortune 200 companies which they insure directly to incentivise precautionary measures, which in turn brings down insurance premiums. Linking resilience measures to a reduction in risk premiums is a promising approach. However, these strategies to manage the impacts

65 EC (2011).
66 The only notable exception are nuclear power plants which are subject to mandatory risk assessments covering a wide range of risks and threats including climate change.

of weather and climate-related damages on the insurance industry itself have not yet translated into a broader political debate on the role of insurance in climate risk management.

The tools of reinsurers to quantify the risks and costs of the climate exposure of insured assets, especially SwissRe's CatNet system model and Munich-Re's NatCatSERVICE, could impact on the value of property in the future. Investors may decide to reconsider the choice of their business location depending on its exposure to climate risks. The debate on details of risk disclosure and monitoring is in the very early stages but is starting to gain traction. In October 2014, for example, the Bank of England wrote to around 30 insurance companies to ask them if they had examined how climate change could impact on their investment portfolio and when extreme weather events could threaten the viability of their business model.

This is a discussion that will only grow in importance and it is only a matter of time before climate vulnerability and resilience will feature in companies' decisions to invest or divest in a certain region. Cities will be challenged to work proactively with the private sector, in particular with real estate and insurance companies as well as local utilities to develop meaningful climate risk management systems.

Addressing the risk management gap

Incoherent adaptation frameworks place the adaptation burden squarely on cities, but without giving them the tools to do anything about it. Evidence also shows that the quality of data and information on climate risks is not sufficient to enable cities to make rational decisions about climate risk management. At the same time, they cannot afford to plan for any worst case scenarios – nor should they. Cities will have to make use of their existing local networks to improve their resilience planning; they will have to continue working horizontally in city networks to socialise experience and best practice in both mitigation action and climate risk management. Most importantly, however, they will have to use their collective voice to put pressure on national governments and

the EU to increase the level of ambition in international climate policy and diplomacy. It is clear that cities are under-represented relative to their economic weight and strategic importance in national and EU level debates on mitigation policy, adaptation and risk management, yet they have the most to lose. This is why they are key partners in the development of climate risk management strategies.

Overview of challenges for cities to be climate resilient



Budget

Financing resilience measures is a challenge. In the past five years, many cities have faced budget cuts, a decrease or freeze in central government budget allocation and increased demand for social/welfare services.



Power

Much of the responsibility for managing climate risks is falling onto cities but the powers and decision making authority on key aspects of resilience (eg. public investments, budget, flood management) are at different levels of governance.



Information

Data on comprehensive local level climate risks and cost assessments is often limited. This can lead to planning based on past damages rather than projections of climate impacts.



Capacity

77% of European cities reported that they had severe capacity gaps, which made it "extremely unlikely" for them to improve their resilience by themselves.⁶⁷



Awareness

There is a lack of awareness among business and citizens about climate risk. There are few obligations on any public or private actors to assess and disclose climate risks.

⁶⁷ EC (2013a).

4. IMPROVING EU CLIMATE RISK MANAGEMENT: A FRAMEWORK FOR DECISION MAKING

A three-tier “ABC” risk management framework

Managing climate risks implies making decisions in the face of great uncertainty. We do not know what the precise impacts of climate change will be or when and where extreme weather events will strike. Neither can we predict the speed of technological development in areas such as renewable energy, energy efficiency, climate resilient infrastructure or the uptake of new technologies, which are crucial for mitigating the worst consequences. The effectiveness of future climate policy is as uncertain as the shape of future economic policies.

Given the potentially disastrous consequences of not acting on climate change, however, uncertainty is no excuse for inaction. We cannot assume that we will manage to contain global warming to a 2 °C maximum. If scientists have underestimated the sensitivity of the earth’s climate system or if international climate policy fails, global warming is bound to surpass 2 °C. Current emissions reduction pledges are putting the world on a path to a 2.9-3.1 °C temperature rise,⁶⁸ and the world is already locked into warming of close to 1.5 °C.⁶⁹ We therefore need to build resilience for possible climate impacts in a 3 to 4 °C world.

Risk management is about reducing both the probability of a bad outcome and the potential severity of its consequences. Good risk management requires us to account rigorously for the full range of possible outcomes

68 Hare et al. (2014).

69 World Bank (2014).

and to understand the deficiencies of our institutional systems in dealing with them. Critically, it requires objective and independent monitoring of the effectiveness of the risk management policies in practice, and updating and revising them as situations change.

Risk management is a practical process that provides a basis for decision-makers to compare different policy choices. It considers the likely human and financial costs and benefits of investing in prevention, adaptation and contingency planning responses. Some risks cannot be reduced cost effectively, just as there are some potential impacts to which we cannot feasibly adapt while retaining current levels of development and security.

The risk management framework we propose here is a guide for decision making at all levels towards minimising climate risks. It provides advice for developing effective adaptation policies and contingency plans which are capable of responding to the full range of possible higher risk scenarios. The ABC framework provides guidance but national governments, cities and regions will need to assess their own goals based on national/local impacts and priorities. As emerged from our research, a central question throughout has to be: who is responsible for managing the risks?

Our climate risk management framework rests on a three-tier ‘ABC’ approach:

Aim to stay below 2 °C

Build and budget for 3 to 4 °C

Contingency planning for 5 to 7 °C

Aim to stay below 2 °C

Responsible climate risk management must do everything possible to keep global warming below 2 °C. This is the goalpost of international



climate diplomacy and the generally accepted threshold below which climate risks are regarded to still be manageable. Cities are crucial players in implementing mitigation measures on the ground, but decisions on climate policy are taken at the national, European and international levels. If governments fail to decide on a global climate agreement that prevents dangerous climate change, the responsibility and liability for managing the impacts will automatically be with cities.

The EU and Member States are therefore responsible for delivering an ambitious international agreement on climate change to protect cities, their populations and economies from the worst impacts. European cities can and must take an active part in the debates and processes increasing the momentum and level of ambition over the coming months.

The EU and national governments also have to provide the framework for mitigation action. The EU's 2030 package for climate and energy policy does not deliver a cost efficient pathway to decarbonise the European economy, nor does it deliver a 2 °C outcome in Paris. National mitigation actions going beyond the level of ambition in the 2030 package will

therefore be important for building trust with other countries in the international negotiations.

Cities are already leaders in low carbon development. Many understand that a green and sustainable approach to urban planning will attract businesses that drive innovations for a low carbon economy. Cities can therefore promote best practice for a low carbon transition. At the same time, however, they need to become more vocal and demand that their national governments deliver in Paris.

Build and budget for 3 to 4 °C

There will be no certainty that the world is on an emissions path compatible with a 2 °C scenario until well beyond 2030. China has only committed to peak its emissions in 2030 and has not committed to a rate of decline. Other developing countries containing most of the world's population such as India have yet to make any commitments on when they will peak. Even with clarity on emissions trajectories, uncertainty over actual climate sensitivity to GHG concentrations and the impact of potential tipping points will remain highly uncertain. Responsible decision makers building long-lived infrastructure and urban plans need to take into account the significant probability of higher climate scenarios and plan for 3-4 °C changes. National governments are in the best position to provide assessments of sensible planning assumptions based on likely global emissions pathways and the best available climate science and to provide a subsequent range of possible temperatures to city decision makers.

It's important that national adaptation planning focuses much more on the needs of cities for reliable local data on climate impacts under different scenarios. This will enable cities to develop local strategies for local needs. Cities are well placed to do this because they control many of the powers needed for effective action at the local level. Local players tend to understand specific vulnerabilities and the feasibility of different adaptation and resilience options better than decision-makers at the national level. This includes challenges around both integrated

infrastructure planning and disaster response mechanisms. It also includes the incentives that are required in a specific local context for actors across different sectors to collaborate.

Cities also have a better understanding of the financial requirements to build and budget for 3 to 4 °C. Support from national governments or at the EU and international levels in terms of targeted funding is necessary. If European cities have to continue to rely on ad hoc adaptation, they will be left exposed to major climate risks.

Cities also know how to best ensure public participation in resilience planning. After all, resilience is not only about the right “hardware”, i.e. infrastructure; it is also about the processes preparing citizens for future climate impacts such as flooding and heat waves and empowering them to take action. Unless people know how to deal with severe weather events and how to work effectively with local authorities and first responders, even the best adaptation policies will fail.

Contingency planning for 5 to 7 °C

It is clear that for scenarios beyond 4 °C we still lack the necessary data on the precise impacts of this level of warming, especially at the local level. As the previous chapter showed, current national adaptation plans do not go beyond a maximum of 4.5 °C. At the same time however, there is a growing body of evidence to suggest that the likelihood of catastrophic impacts may be higher than expected. National governments therefore need to provide targeted funding to help cities that are particularly exposed to specific climate risks to conduct vulnerability assessments. This can then provide a basis for stress testing local infrastructure against different scenarios.

Apart from improved knowledge, contingency planning also relies on functional local disaster response mechanisms and the accessibility of emergency funds. Issues such as contingency liability and loss and damage have to be tackled by cities and national decision-makers in close collaboration.

5. RECOMMENDATIONS

Eight recommendations for improving climate risk management in European cities

1. The European Union should follow a climate risk management framework

The EU should follow a comprehensive climate risk management framework that guides cities and governments when taking adaptation and resilience decisions under uncertainty. Good risk management requires us to account rigorously for the full range of possible outcomes and to understand the deficiencies of our institutional systems in dealing with them. Critically, it requires objective and independent monitoring of the effectiveness of the risk management policies in practice, and updating and revising them as situations change. Whatever the decided institutional design of such a framework, it should be built around the core idea that cities should aim to stay below 2 °C, while building and budgeting for 3-4° C and putting in place contingency plans for 5-7 °C scenarios. This is the most cost-effective approach to minimising climate risks.

The appropriate role of national or EU authorities is to provide assessments of the likelihood of different scenarios based on best climate science on sensitivity and tipping points and their assessment of likely global emission pathways. The ABC framework provides guidance to do this but national governments, cities and regions will need to assess their own goals based on national/local impacts and priorities.

2. Risk assessment and analysis: Cities need high quality data and new tools

In order to have a comprehensive risk management framework, cities and regions first need high quality local-level climate risk assessments.

These assessments should consider the full range of climate risks under different climate scenarios – including a 2, 4 or 6 degrees Celsius global average rise in temperature. They should be comprehensive and consider direct and indirect impacts as well as the implications of cascading system failures. Such assessments should also include an evaluation of the budget required to make a city resilient.

This is an essential precondition for being able to build and budget for 3-4 °C and plan for higher warming scenarios. Without reliable analyses and projections, cities do not know what risks they face and what climate impacts they need to manage. Lack of information often leads to cities systematically underestimating the risks they have to manage and can result in wasted money or even maladaptation. Alongside better data, cities and governments will need new tools to use it, including tools for decision support and stress testing under different scenarios, vulnerability assessments, public participation and developing resilience strategies. The stress-testing decision support tools could be developed by using a set of future climate change impact scenarios for a range of future political, climate sensitivity and technological uncertainties to 2060, and represent the economic lifetime of long lived infrastructure investments made in 2020. These scenarios would be used to “stress test” current systems in order to identify how well future risks will be managed and critical gaps that need to be addressed.

3. Capacity to build resilience: need for greater direct capacity and budgetary support

Cities and regions should be given greater direct capacity and budgetary support to undertake local-level climate risk assessments and implement resilience planning. They currently do not have the capacity for resilience and contingency planning, or the financial means to build and budget for 3-4 °C. Local authorities will need direct financial support from national governments and the EU to do climate risk assessments in collaboration with local partners. They also need capacity support to ensure that best practice approaches are employed, shared and that they are joined up to regional and cross-border resilience planning.

A City Adaptation Innovation Fund at the EU level could be introduced to finance capacity building programmes for cities and regions and to reward innovative adaptation and resilience measures. This could include a capacity programme that helps local and regional authorities prepare innovative projects that can then receive funding. Such a programme could be provided by the European Commission and the EIB, similar to the capacity assistance given by the ELENA programme that mobilises local investment in energy efficiency or renewable energy projects.

Cities and regions should also appoint City Resilience Managers to lead, support and coordinate action across different local departments. It will be important to have a central, high-level overview of how all climate and other risks are being managed.

4. Responsibility and governance: Who is in charge?

Cities and regions need to be part of a comprehensive climate risk management process that brings together the EU, national, and local levels. The research in this report has found that much of the responsibility for managing climate risk falls to cities and regions. At the same time, they do not usually have the necessary powers in all areas to take decisions about how risks are being managed, e.g. in infrastructure planning. National governments, together with local authorities, should be clear about who is responsible for managing what kind of risk.

The division of responsibility will be different in every country, but the question is the same: Who is responsible? The answer may result in structural reforms and changes in risk governance with increased devolved powers or mechanisms to ensure greater participation of local authorities in decision-making processes. If cities remain principally responsible for managing climate risks, they need greater powers to do it.

A comprehensive climate risk management process in the EU requires a better harmonisation of standards and indicators for risk profiles and resilience measures. Therefore, a review of national climate risk management plans should be mandatory for all Member States. The

results would then be assessed at the EU level to determine if any areas can be better supported by EU bodies, including better cross-border resilience planning and coordination. At the EU level, assessments of external risks from climate change to EU markets and imports are required to account for possible second/third order effects for European cities emanating from these risks.

A review of national and regional infrastructure governance should also be part of this process. The review has to ensure that construction standards and planning procedures of infrastructure investments are consistent with a 2, 3 or 4 °C world. Stress tests should be undertaken to ensure that cascading systems failures can be effectively managed.

Cities also need to have a much greater role in national adaptation policy and resilience debates – it needs to be clearer what risks European cities are exposed to. At Member State level, regular national climate risk assessments need to involve city representatives and be made available to municipalities to help with their planning assumptions.

5. Managing liabilities: Covering damages and duties to disclose risk

Explicit policies are required on which actors need to take on the responsibility and liability for climate damage. In particular, it needs to be established under what conditions the public sector would cover climate damages, and when the responsibility would remain with the private sector. Decisions on liability require sound estimates of the implied adaptation costs and comprehensive assessments of insurance needs and costs as well as listings of uninsured losses. In the US, a new set of law suits are arising where government bodies are being sued for damages for not effectively managing climate impacts such as floods or droughts.⁷⁰ The impacts of climate change are already being felt, which raises serious questions on liability. Governments need to manage this challenge and introduce a proactive framework to deal with questions of liability for climate impacts.

⁷⁰ Washington Post (2014).

As part of this framework, Europe may need to develop stronger duties to disclose climate risks. This could include companies disclosing the physical and economic risks of climate change to their shareholders; and EU government departments assessing the full range of risks to their areas of responsibility due to climate change – similar to US President Obama's Executive Order on climate resilience. Cities and regions could have a regularly updated climate risk registry listing the full range of potential impacts and detailing who is in charge of ensuring resilience proactively, who is responsible for crisis management and who is liable for climate-related damages. This would support good management of climate risks because current uncertainty about competences and responsibilities is preventing greater action.

6. Independent oversight and advice

Europe has witnessed a number of recent economic shocks and extreme weather events that have far reaching implications for Europe's security and prosperity. While there are EU funded assessments of projected climate impacts in a limited range of sectors, no one is in charge of monitoring systemic climate risks to the EU. The global nature of climate risks requires a collective response. Shocks, disruptions, maladaptation and policy failures in individual Member States, cities and regions will have consequences across borders and through the interconnected European market.

In order to improve the robustness and evidence base of decision-making at all levels, the EU should set up an independent European Climate Security Observatory. The new institution would be responsible for:

- > Independent evaluation of the collective resilience to climate risks in the EU, including national and EU level climate risk management strategies, direct and indirect climate impacts as well as the implications of cascading system failures.
- > Horizon-scanning for potential risks to delivery of EU and member state climate objectives, drawing on a full range of scientific, economic, security, foreign policy, and technological expertise.

-
- > Modelling and assessment to test the robustness of Europe's climate and energy policy and decarbonisation pathway against a full range of external shocks and extreme scenarios.
 - > Submission of recommendations to both the European Council and European Commission on EU- and national-level actions to manage risk and increase resilience.

7. Political leadership

Cities need to speak out, show greater political leadership and have a stronger say in international, EU and national-level debates on managing climate change. They have the most to lose if climate change is not addressed effectively.

Cities need a greater role that reflects their economic weight and strategic importance in national and EU level debates on climate resilience and risk management. This includes having a greater say on the level and pace of mitigation action as the only way to reduce the risks of climate change in the long term. Governments, businesses and citizens will not understand the real extent of the challenges of managing climate risks and why it is in their own interest to tackle climate change unless cities become more vocal.

Speaking out on climate risks requires political strength, bravery and leadership. There will likely be vested interests that wish to avoid telling the truth about climate risks, for example in relation to property prices and planning permissions, and this could put local authorities under pressure not to disclose information. Mayors will need to be bold and build alliances with progressive businesses, citizens and stakeholders who want to build resilient and protected cities. Rewarding successful initiatives through city awards can support this.

8. Empowering citizens

Cities need to reach out to citizens to raise awareness about climate risks and to empower them to respond adequately to a range of climate



change scenarios. At the same time citizens need to be aware of the “social contract” on climate change – what their responsibilities and liabilities are and what they can expect from city and national authorities. This will require city leadership to communicate honestly about what climate risk means for people and their lives and how to become resilient. Climate impacts will be felt across all aspects of our lives, from the direct impacts that endanger lives and disrupt lifestyles, to the second-order consequences on our economic system, savings and future progress.

To do this, citizens need to be given better access to information on local climate risks. While the EU grants significant rights on access to environmental information, for example under the Aarhus Convention, these rights to information are not fit for purpose if public authorities have not conducted adequate local climate risk assessments in the first place. Making sure cities and regions are able to perform high quality risk analysis and assessments is crucial. Cities and citizens need to know the real climate risks they face.

REFERENCES

ASDA (2014) *The challenge of a changing climate*. ASDA brochure.

Available at: http://your.asda.com/system/dragonfly/production/2014/06/17/15_38_19_612_4234_Climate_Resilience_Campaign_a5_Brochure_v10.pdf

Bienert, S. (2014) Preliminary survey results presented at "Impact of Extreme Weather Events on Property Values" workshop. Event held on 4 December by Urban Land Institute, London.

C40 Cities (2014) *Sustainable Infrastructure Finance – Finance and Economic Development Initiative*. Website article. Available at: www.c40.org/networks/sustainable_infrastructure_finance

CDP (2014) *Klimawandelvermeidung und Anpassung im Transport und Logistiksektor Deutschland, Österreich und Schweiz*. Available at: <http://www.climate-service-center.de/imperia/md/content/csc/cdp-csc-climate-change-transport-logistic-2014-german.pdf>

CEMR (2013) *Factsheets – A figure-based portrait of local and regional Europe*. Available at: www.ccre.org/img/uploads/piecesjointe/filename/FINAL_CEMR_factsheets_2013_EN.pdf

CEMR & DEXIA (2012) *Subnational public finances*. Available at: www.ccre.org/img/uploads/piecesjointe/filename/subnational_public_finance_2012_en.pdf.

Cities Climate Finance Leadership Alliance (2014) *Climate Summit 2014 Action Statement*. Available at: www.un.org/climatechange/summit/wp-content/uploads/sites/2/2014/09/CITIES-Cities-Climate-Finance-Leadership-Alliance.pdf

D'Ippoliti, D., P. Michelozzi, C. Marino, F. de'Donato, B. Menne, K. Katsouyanni, U. Kirchmayer, A. Analitis, M. Medina-Ramón, A. Paldy, R. Atkinson, S. Kovats, L. Bisanti, A. Schneider, A. Lefranc, C. Iñiguez & C. A. Perucci (2010) *The impact of heat waves on mortality in 9 European cities: results from the EuroHEAT project*. *Environmental Health*, 9(37). Available at: www.ehjournal.net/content/9/1/37

E3G (2014) *Energy, Climate and European Reform: 7 propositions for the new Commission*. Available at http://www.e3g.org/docs/E3G_7_propositions_for_the_new_Commission_September_2014.pdf

E3G (2011) *Degrees of Risk: Defining a Risk Management Framework for Climate Security*. Available at http://www.e3g.org/docs/E3G_Degrees_of_Risk_Defining_a_Risk_Management_Framework_for_Climate_Security_Full_Report.pdf

EASAC (2013) *Trends in extreme weather events in Europe: implications for national and European Union adaptation strategies*. EASAC policy report 22. Available at: www.easac.eu/fileadmin/PDF_s/reports_statements/Easac_Report_Extreme_Weather_Events.pdf

Eurocities (2013) *Green growth*. Eurocities website article. Available at: www.eurocities.eu/eurocities/issues/green-growth-issue.

European Environment Agency (2014) *National adaptation policy processes in European countries*. EEA Report No 4/2014. European Environment Agency, Brussels. Available at: www.eea.europa.eu/publications/national-adaptation-policy-processes

European Environment Agency (2013) *Adaptation in Europe – Addressing risks and opportunities from climate change in the context of socio-economic developments*. EEA Report No 3/2013. European Environment Agency, Brussels. Available at: www.eea.europa.eu/publications/adaptation-in-europe/at_download/file

European Environment Agency (2012a) *Damages from weather and climate-related events (CLIM 039)*. European Environment Agency, Brussels. Available at: www.eea.europa.eu/data-and-maps/indicators/direct-losses-from-weather-disasters-1/assessment

European Commission (2013a) *Adaptation strategies for European cities*. Prepared by Ricardo-AEA. European Commission, Brussels. Available at: http://climate-adapt.eea.europa.eu/documents/18/11155975/Adaptation_Strategies_for_European_Cities_Summary_Report.pdf

European Commission (2013b) *An EU Strategy on adaptation to climate change*. COM(2013) 216 final. Available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013DC0216&from=EN>

European Commission (2013c) *Green paper on the insurance of natural and man-made disasters*. Available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013DC0213&from=EN>

European Commission (2013d) *An EU-budget for low-carbon growth*. Press release. Available at: http://ec.europa.eu/clima/policies/budget/docs/pr_2013_11_19_en.pdf

European Commission (2012) Report on the Implementation of the Soil Thematic Strategy. COM(2012) 46. Available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012DC0046&from=EN>

European Commission (2011) *Investment needs for future adaptation measures in EU nuclear power plants and other electricity generation technologies due to effects of climate change*. Prepared by Ecorys. European Commission, Brussels. Available at: http://ec.europa.eu/energy/nuclear/studies/doc/2011_03_eur24769-en.pdf

Favier L., G. Durand, S.L. Cornford, G.H. Gudmundsson, O. Gagliardini, F. Gillet-Chaulet, T. Zwinger, A.J. Payne & A.M. Le Brocq (2014) *Retreat of Pine Island Glacier controlled by marine ice-sheet instability*. Nature Climate Change, 4, 117-121.

Glaas, E. & S. Juhola (2013) *New levels of climate adaptation policy: Analyzing the institutional interplay in the Baltic Sea Region*. Sustainability, 5(1), 256-275. Available at: www.mdpi.com/2071-1050/5/1/256

Haghighatafshar, Salar, Jes la Cour Jansen, Henrik Aspegren, Viveka Lidström, Ann Mattsson and Karin Jönsson (2014) *Storm-water management in Malmö and Copenhagen with regard to climate change scenarios*. Journal of Water Management and Research, 70, 159-168. Available at: http://www.tidskriftenvatten.se/mag/tidskriftenvatten.se/dircode/docs/48_article_4750.pdf

Hare et al. (2014) *China, US and EU post-2020 plans reduce projected warming*. Climate Action Tracker policy brief. Available at: http://climateactiontracker.org/assets/publications/briefing_papers/CAT_Briefing_10122014.pdf

Heidrich, O., R.J. Dawson, D. Reckian & C.L. Walsh (2013) *Assessment of the climate preparedness of 30 urban areas in the UK*. Climatic Change, 120(4), 771-784.

Hunt, A. & P. Watkiss (2011) *Climate change impacts and adaptation in cities: A review of the literature*. Climatic Change, 104(1), 13-49.

IPCC (2014) *Fifth Assessment Report*. Available at: <http://www.ipcc.ch/report/ar5>

Jendritzky, G. (2007) *Folgen des Klimawandels für die Gesundheit*. In: W. Endlich, F.-W. Gerstengarbe *Der Klimawandel – Einblicke, Rückblicke, Ausblicke*. Potsdam Institute for Climate Impact Research & Humboldt University Berlin, Berlin & Potsdam.

Joint Research Centre (2014) *Climate impacts in Europe*. JRC PESETA II Project, Final Report. Available at: <http://ftp.jrc.es/EURdoc/JRC87011.pdf>

Koehring, M. (2014) *Rapid urbanisation, climate change and resource scarcity: a disaster in the making?* The Economist, 22 September 2014. Available at: www.economistinsights.com/sustainability-resources/opinion/rapid-urbanisation-climate-change-and-resource-scarcity-disaster

Levermann, A., J. Bamber, S. Drijfhout, A. Ganopolski, W. Haerberli, N. Harris, M. Huss, K. Krüger, Ti. Lenton, R. Lindsay, D. Notz, P. Wadhams & S. Weber (2012) *Potential climatic transitions with profound impact on Europe: Review of the current state of six 'tipping elements of the climate system*. Climatic Change, 110, 845-878. Available at: www.pik-potsdam.de/~anders/publications/levermann_bamber12.pdf

OECD (2014) *Glossary of statistical terms*. Available at: <http://stats.oecd.org/glossary/detail.asp?ID=4511>

OECD (2010) *Plan or React?: Analysis of adaptation costs and benefits using integrated assessment models*. OECD Environment Working Papers, No. 23. OECD, Paris. Available at: www.oecd-ilibrary.org/docserver/download/5km975m3d5hb.pdf?expires=1418063505&id=id&accname=guest&checksum=CF1DC80877F1C842B10A0F9E0E3B7B94

Partnership for European Environmental Research (2009) *Europe adapts to climate change: Comparing national adaptation strategies*. PEER Report No. 1. Partnership for European Environmental Research, Helsinki, Available at: www.peer.eu/fileadmin/user_upload/publications/PEER_Report1.pdf

Pidcock, R. (2014) *What happens if we overshoot the two degree target for limiting global warming?* The Carbon Brief, 10 December 2014. Available at: www.carbonbrief.org/blog/2014/12/what-happens-if-we-overshoot-the-two-degree-target-for-limiting-global-warming

Pindyck, R.S. (2013) *Climate change policy: What do the models tell us?* Journal of Economic Literature, 51(3), 860-72.

Reckien, D., J. Flacke, R. J. Dawson, O. Heidrich, M. Olazabal, A. Foley, J. J.-P. Hamann, H. Orru, M. Salvia, S. De Gregoria Hurtado, D. Geneletti & F. Pietrapertosa (2014): *Climate change response in Europe: what's the reality? Analysis of adaptation and mitigation plans from 200 urban areas in 11 countries*. Climatic Change 122, 331-340.

Reuters (2014) *U.N. talks agree building blocks for new-style climate deal in 2015*. Available at: www.reuters.com/article/2014/12/14/us-climatechange-lima-talks-idUSKBN0J504520141214

Rignot E., J. Mouginot, M. Morlighem, H. Seroussi & B. Scheuchl (2014) *Widespread, rapid grounding line retreat of Pine Island, Thwaites, Smith, and Kohler glaciers, West Antarctica, from 1992 to 2011*. Geophysical Research Letters, 41, 3502-3509.

Robine, J., Cheung, S., Leroy, S., Vanoyen, H., Griffiths, C., Michel, J. & Herrmann, F. (2008) *Death toll exceeded 70,000 in Europe during the summer of 2003*. Comptes Rendus Biologies, 331(2), 171-178.

Stern, N. (2007) *The economics of climate change – The Stern review*. Cambridge University Press, Cambridge.

Tyndall Centre for Climate Change Research (2009) *Adaptation and mitigation strategies – Supporting European climate policy*. ADAM project final report. University of East Anglia, Norwich. Available at: www.tyndall.ac.uk/sites/default/files/adam-final-report-revised-june-2009.html_pdf

UNEP (2014) *Climate finance for cities and buildings – A handbook for local governments*. Available at: http://apps.unep.org/publications/index.php?option=com_pub&task=download&file=-Climate%20finance%20for%20cities%20and%20buildings%20a%20handbook%20for%20local%20governments-2014Carbon%20Finance%20for%20Cities%20and%20Buildings.pdf

UNFCCC negotiations, *Opening Plenary held in Assembly Hall*, [Photograph] Available at: <https://www.flickr.com/photos/unfccc/16472954052/in/set-72157650018947887>

UNFCCC (2007) *Investment and financial flows to address climate change*. Available at: http://unfccc.int/resource/docs/publications/financial_flows.pdf

Urban Land Institute (2014) *Extreme weather events and property values: Assessing new investment frameworks for the decades ahead*. Urban Land Institute, London. Available at: <http://europe.uli.org/wp-content/uploads/sites/3/ULI-Documents/Extreme-Weather-Report-20141.pdf>

Van Heel, O. director of Aldersgate Group, cited in J. Confino (2014) *Kerry's and Miliband's climate change speeches should mobilise business*. The Guardian, 17 February 2014. Available at: www.theguardian.com/sustainable-business/john-kerry-ed-miliband-climate-change-business-action

Washington Post (2014) *Climate Change: Get Ready or Get Sued*. Available at: <http://www.washingtonpost.com/news/morning-mix/wp/2014/05/19/climate-change-get-ready-or-get-sued/>

World Bank (2014) *Turn down the heat: Confronting the new climate normal*. Prepared by Potsdam Institute for Climate Impact Research. World Bank, Washington, DC. Available at: www.worldbank.org/en/news/feature/2014/11/23/climate-report-finds-temperature-rise-locked-in-risks-rising

World Economic Forum (2015) *Global Risks 2015: 10th Edition*. Available at: http://www.zurich.co.uk/internet/home/sitecollectiondocuments/brokerzone/global%20risks%202015%20report_final_z.pdf

Zukunftsforum Öffentliche Sicherheit (2008) *Risiken und Herausforderungen für die Öffentliche Sicherheit in Deutschland – Szenarien und Leitfragen*. Oktoberdruck GmbH, Berlin. Available at: www.zukunftsforum-oeffentliche-sicherheit.de/downloads/Gruenbuch_Zukunftsforum.pdf



E3G

Cities are Europe's social, economic, and cultural centres. However, a growing number of climate risks – including external shocks to resource supplies, extreme weather and food prices are challenging their role as growth engines and innovation hubs. The majority of Europeans live in urban areas and nearly 85% of the EU's total GDP is generated in cities. This makes urban vulnerability to climate change a major challenge for Europe.

All levels of government have to work together to make Europe climate resilient. Cities and regions need their national governments to pursue ambitious positions in international negotiations to secure an agreement to limit dangerous climate change. They also need better guidance and financial support from the EU and national governments to address gaps in capacity and funding.

However, solutions must go beyond better risk assessments, increased funding or improved cooperation. Structural reforms are needed to move risk management functions to the appropriate level, and ensure cities are fully involved in risk-management processes.