

# **Knowledge exchange and capacity building between Edinburgh and Copenhagen in climate change adaptation**

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## 1. Introduction

According to the United Nations Habitat Programme, cities are not only major contributors to climate change, due to their high energy consumption, but are also among the most vulnerable areas that are inhabited by human beings (UN Habitat 2012). Especially cities located along coasts face severe challenges with progressing climate change. The risks exist for floods in the wake of rising sea levels and increased precipitation as well as more extreme weather conditions such as periods of heat and cold. The cities of Copenhagen in Denmark and Edinburgh in Scotland have already experienced such challenges. On 2nd July 2011, Copenhagen was hit by a cloudburst that inundated the city within only three hours, causing damage to houses, streets, personal property such as cars and shop contents, as well as public infrastructure. It was described as chaos that paralysed the city for two days (BBC News, 03.07.2011; CPH Post, 04.07.2011). According to official calculations, the cloudburst “was the most costly single incident, with payments calculated altogether at DKK 6.2 billion [approx. GBP 732 million] for over 90,000 claims” (Danish Emergency Management Agency 2013: 14). Edinburgh, too, is susceptible to flooding. In July 2012 heavy rainfalls “affected dozens of homes and left many of the city’s parks underwater” (Edwards, The Scotsman, 07.07.2012). Not only were streets “turned into rivers” but the flooding of the Meadows, a big green space in the centre of Edinburgh, led to the cancellation of a long-planned cultural event, causing 25,000 visitors as well as sponsors, suppliers and exhibitors to lose their investments and anticipated profits respectively (BBC, 07.07.2012). Furthermore, just recently Edinburgh experienced the heaviest snowfall compared to other cities in the United Kingdom (UK) when in February 2018 extreme weather hit the UK. Red warning was given for Edinburgh by the meteorological office, schools were closed, public transport and traffic was impaired, and shops were emptied of worried residents (BBC, 28.02.2018).

The municipalities of Edinburgh and Copenhagen have recognised that climate change has adverse impacts on their environment, economy, and the lives of their citizens. Both have adopted climate adaptation plans that aim to increase resilience, providing solutions to identified challenges and even pointing out opportunities climate change could offer to the cities. The *Edinburgh Adapts Action Plan*, released in 2016, is the city’s first adaptation plan and provides an ambitious blueprint for action. It is described as “just the start of an in-depth, long term process to ensure Edinburgh remains a climate resilient city” (Edinburgh Adapts 2016: 6). Copenhagen has been implementing its *Climate Adaptation Plan* since 2011. Its Cloudburst Management Plan, which makes up a major part of the adaptation plan, was

awarded for being an innovative and inspiring urban planning project enhancing climate change resilience (Watts, Huffington Post, 12.01.2016).

Research on urban climate governance has shown that a great body of knowledge has been generated about approaches to the development of adaptation strategies, the incorporation of sustainable spatial planning frameworks, capacity building and other aspects of policy planning and implementation (Carter 2011; Broto 2017; Carter, Cavan, Connelly et.al. 2015). It is also acknowledged that transfer of knowledge and exchange of experience is helpful for stakeholders to learn from and inspire each other (European Environment Agency 2015). At the same time, differences of local contexts such as geographic, socio-economic, and institutional aspects need to be accounted for since adaptation plans have to be tailored to the local circumstances, needs, and opportunities (Fünfgeld 2015: 67). The goal of this study is to evaluate whether knowledge exchange and capacity building between the cities of Copenhagen and Edinburgh in the realm of climate change adaptation is sensible and viable. This will include sharing experiences, best practice, tools and, if possible, resources between the two municipalities, policy planners, and other stakeholders involved. The basis for this study are the two adaptation plans of Edinburgh and Copenhagen which will be compared in order to identify similar adaptation issues and approaches to these challenges. Semi-structured interviews with two stakeholders at the policy planning and implementation level gave insights about experienced challenges and how these were overcome or where there is still need for improvement.

The first section of this report will give an overview of geographic features and administrative structures with special regard to climate change issues for both cities. The second section encompasses a comparative study of the urban adaptation plans, ascertaining action areas in each programme suitable for knowledge exchange. Finally, the conclusion will show whether cooperation between the two municipalities is feasible and whether their local contexts are hindering or benefiting the cities' collaboration.

## 2. The local context: comparison of topography and political factors

### *Geography and Topography*

Edinburgh and Copenhagen are coastal cities. With an area of 264 km<sup>2</sup> and over 507.000 citizens, Edinburgh is located at the East coast of Scotland. It has a coastline of 27.5 km at the North Sea and is restricted by the Pentland Hills to the West. The Scottish capital is often described as being built on seven hills in poetic allegory to Rome. In reality, some lower vantage points and some high points can be found in the city. These include the so-called Castle Rock and Calton Hill in the city centre, Arthur's Seat in central East, Corstorphine Hill in the West, as well as Blackford Hill, the Braid Hills and the Craiglockhart Hills in the South. These elevations range from 103 m (Calton Hill) to 251 m (Arthur's Seat) and are defining elements of the city's topographic character. Between these hills, a few waterways meander mainly from the Southwest to Northeast which include the River Almond near the Edinburgh airport in the Western part of the city, the Water of Leith running directly through the city ending at Edinburgh harbour, as well as smaller waters in the Southeastern part around Arthur's Seat. Worth mentioning is that even along the coast, Edinburgh has no wide area of low lying ground due to post-glacial changes in sea level which raised the land resulting in terraces with some 20-30 metres above sea level (City of Edinburgh Council, n/a).

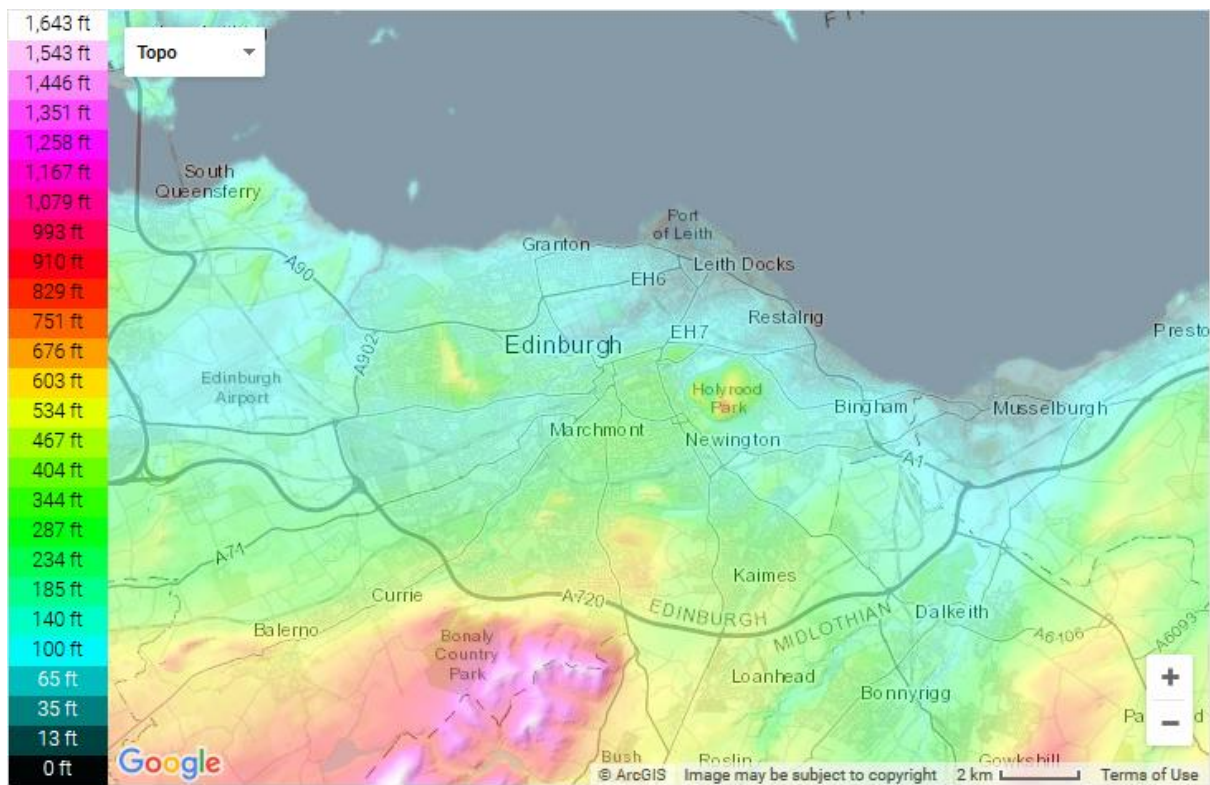
Copenhagen is located at the very Eastern part of Denmark, facing the Swedish city of Malmö to the East only separated by the Øresund (The Sound), a strait that links the North Sea with the Baltic Sea. As a traditional harbour city with an area of more than 86 km<sup>2</sup>, Copenhagen is closely connected to the sea with several beaches, islets, an extensive harbour "circle" with 13 km of waterside and various canals running through the city. Its over 613.000 inhabitants can enjoy several natural as well as artificial lakes such as Sortedams Sø, Peblinge Sø and Sankt Jørgens Sø, which cover areas close to Copenhagen's centre. The Danish capital is a low-lying terrain with 2% of the population living in districts below an elevation of 1 m, 4% below 2 m, and 13% below 5 m above sea level (Climate Change Post 2018). Only to the Northwest of the city do hilly areas reach heights of up to 50 m.

Table 1 Comparison of area and population figures of Edinburgh and Copenhagen

	<i>Edinburgh</i>	<i>Copenhagen (municipality)</i>
<i>area</i>	264 km <sup>2</sup>	86,6 km <sup>2</sup>
<i>population</i>	507,170 (2016)	613,288 (2018)

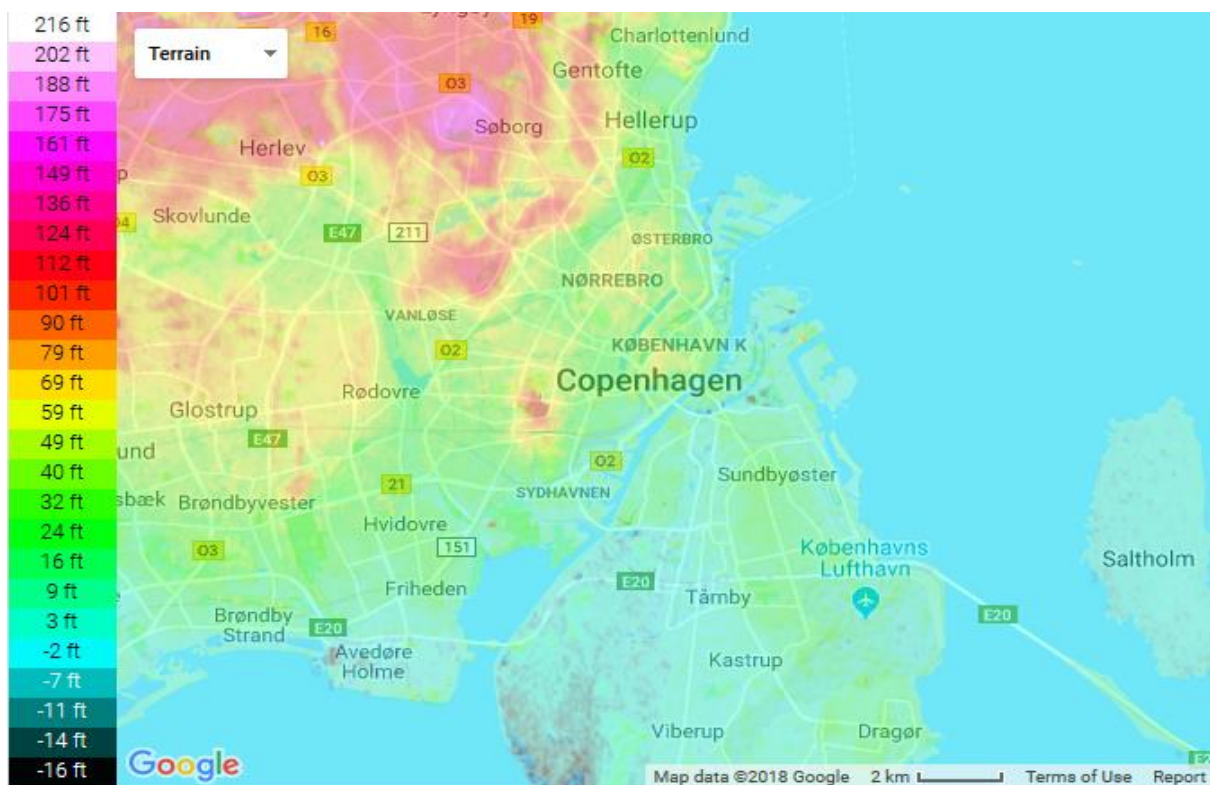
Sources: Edinburgh Council; Statistics Denmark.

Fig. 1 Topography of Edinburgh



Source: topographic-map.com

Fig. 2 Topography of Copenhagen



Source: topographic-map.com

### *Political Structure*

The City of Edinburgh is a local government area of Scotland. It is governed by The City of Edinburgh Council which decides on issues such as healthcare, housing, infrastructure, education, and business matters. The City Council is chaired by a Council Leader and a Chief Executive, who is responsible for the implementation of the Council's policies. Within the council, 63 elected councillors represent 17 wards of the city. Apart from the full council, which meets once a month and is mainly responsible for budgeting and investments, there are six executive committees as well as sub-committees meeting more frequently, which are responsible for a specific issue (e.g. the transport and environment committee). Councillors within these committees can make policy decisions at meetings within their responsibility areas. With regard to climate change, the City Council has established a framework for the sustainable development of Edinburgh: *Sustainable Edinburgh 2020* (SE2020). As part of SE2020, three action plans were adopted. These include the Sustainable Energy Action Plan 2015-2020, Resilient Edinburgh 2014-2020, and Edinburgh Adapts 2016-2020. Edinburgh Adapts, the current adaptation action plan, builds on the Resilient Edinburgh framework, which was adopted by the Transport and Environment Committee of the City Council. The three mentioned programmes are endorsed by a partnership network consisting of the City Council, several universities, trusts, as well as public and private associations: the *Edinburgh Sustainable Development Partnership* (ESDP). The ESDP meets four times a year and is chaired by Mariana Trusson, who is the Associate Director of Sustainability at Cundall. It is again part of a body of seven strategic partnerships that make up the *Edinburgh Partnership*, a platform for cooperation on community planning in Edinburgh.

The City of Copenhagen, too, is governed by a City Council which consists of 55 members chaired by the Lord Mayor and which serves as the supreme political authority in the city. The City Council's administrative management is divided into seven committees, each headed by a chairman. Together these chairmen make up the seven mayors of Copenhagen, who share the responsibility for the city's management but have their distinct task areas. Six of the committees are standing committees. The seventh is the finance committee which is chaired by the Lord Mayor and comprises the other six mayors as well as another six members of the City Council. Other committees are for instance the Culture and Leisure Committee or the Technical and Environmental Committee. The tasks of the committees are assigned by the City Council. Although the City Council makes overall decisions, the committees are allowed to make final decisions regarding their responsibility areas. The Copenhagen Climate Adaption Plan was

adopted by the City Council and draws on initial work on the issue of climate adaptation in form of the 2009 City of Copenhagen Climate Plan. The current adaptation plan outlines four legislation areas which all adaptation actions need to be in line with. These include municipal planning, the planning act, the building act, and other or special legislation concerning the issue at stake.

### 3. Comparison of Adaptation Plans

For the comparison of the two cities' climate adaptation action plans this study looks at three areas to examine shared adaptation issues: (1) which climate risks were identified, (2) which actions are planned and taken, and (3) how are the processes monitored and the results reviewed.

#### 3.1 Assessment of climate risks

Both adaptation plans begin by identifying the risks the cities are exposed to with progressing climate change. Edinburgh Adapts states several climate risks for the city and labels them with different levels of confidence starting from low (L) to medium (M) to high (H). It thereby builds on expertise by the independent climate change research centre Climate X Change, which supports the Scottish government in climate policy development as well as Adaptation Scotland, a government funded support programme. The Copenhagen adaptation plan follows the A2 emission scenario developed by the United Nations Intergovernmental Panel on Climate Change (IPCC) as a basis for the assessment of future climate impacts in the city. This scenario calculates how the climate will change under specific assumptions and projects a global temperature rise by around 3°C during the 21<sup>st</sup> century. Below are the climate change impacts assessed by both adaptation plans in comparison.

Table 2 Comparison of climate impacts on Edinburgh and Copenhagen

	<b>Edinburgh</b>	<b>Copenhagen</b>
<b>Temperature increase</b>	all seasons (H), greatest in summer (M), more frequent heatwaves (M)	all seasons, longer periods of droughts in summer, increase in number and intensity of heatwaves
<b>Risks/Challenges</b>	growing season will lengthen, over-heating, biodiversity change and loss, environmental degradation, affects infrastructure and (historic) buildings and sites	urban heat islands (exposure to more UV radiation and heat), extension of pollen season, lowering of quality of life, increased public expenditure on energy consumption and health, minor fall in groundwater level, pressure on biodiversity



<b>Precipitation</b>	more seasonal, increase in winter and autumn (M), decrease in summer (L), more frequent heavy rainfall events (M), less frequent snowfall (H), more frequent winter storms (L)	all seasons, fewer but more extreme rain events (intensity is expected to rise by 20-50%), 25-55% more p. in winter and 0-40% less in summer by 2100, intensity of heavy rain event occurring once every 10 years increases by ca. 30% by 2100
<b>Risks/Challenges</b>	greater surface water run-off, increased flooding, disruption to power and water supplies, affects infrastructure and (historic) buildings and sites, habitat fragmentation, increased incidence of pests and disease	substantially greater surface run-off, increased flooding, problem for drainage system (sewers), minor fall in groundwater level, water pollution, disturbance of biological balance, damage to buildings, safety risks
<b>Sea level rise</b>	certain (H)	up to 1 metre over the next 100 years
<b>Risks/Challenges</b>	risk of erosion, flooding, storm surges	flooding, damage by high waters, rises in the level of groundwater at the coast

Sources: Edinburgh Climate Change Adaptation Action Plan 2016-2020; Copenhagen Climate Adaptation Plan 2011.

### 3.2 Actions: planned and implemented projects

The adaptation plans of Edinburgh and Copenhagen both adopt a whole city approach. Edinburgh concentrates on five action areas: Governance (9 actions), Natural Environment and Greenspace (21 actions), Built Environment and Infrastructure (25 actions plus 6 historic environment actions), Flood Prevention (22 actions), and Society and Economy (21 actions). The plan also includes 10 additional or aspirational actions that stakeholders pointed out as desirable. The governance section states the establishment of an Edinburgh Adapts Steering Group that shall ensure the successful implementation of the action plan. It also includes the intention of developing a communication strategy and to improve resilience planning through better access to climate change information and evidence of climate change impacts as well as the promotion of best practices. It is outlined that this could be reached through international cooperation and further development of networks and partnerships.

Case studies in the other sections illustrate the need for the actions outlined in the adaptation plan. Furthermore, they show that some projects have already been implemented and generated useful results. A study of climate change impacts on the Royal Botanic Garden has resulted in adaptation measures such as planting a mix of species in order to avoid diseases and pests in future milder winters. A case study by the Heriot Watt University calculated the quantity of



rainwater runoff generated by a typical Edinburgh front garden and showed a significant difference between a completely paved over front garden and a permeable garden providing a benchmark for garden adaptation planning. In general, adaptation actions cover the use of green infrastructure such as sustainable urban drainage systems, planting of street trees, and linking green networks. Because it is the first adaptation action plan of the City of Edinburgh, most actions refer to a more detailed assessment of climate change effects and their impact on the city's green and blue space, the engagement of stakeholders, the creation of new funding mechanisms, and the need for raising awareness of climate impacts and sustainable solutions. Furthermore, already existing action plans, such as the Biodiversity Action Plan or the Habitat Action Plan, are frequently referred to and actions include reviewing them. In this sense, the Edinburgh adaptation plan brings together several single actions and existing action plans and thereby serves as a platform for collaboration.

The Copenhagen adaptation plan applies a staged approach with three levels of adaptation: (1) to reduce the likelihood of the event happening, (2) to reduce the scale of the event, and (3) to reduce vulnerability to the event. At level one, prevention measures are adopted such as the establishment of dikes, the enhancement of the sewage system, or to raise buildings higher above sea level. Level two includes warning systems, waterproofing buildings' basements and adapting public spaces for flood events. The last level refers to the least wanted case in which levels one and two were not sufficient or successful and emergency actions have to be taken such as the use of pumps or similar measures to clean up after a flood for instance. The actions at the three levels are also allocated with regard to their geographical applicability ranging from the wider region down to the single building. Flexible solutions, secondary gains and synergies are pointed out as key factors of the adaptation strategy. Apart from temperature rises and subsequent urban heat islands, water related climate change impacts are the major concern in the adaptation plan. More and heavier downpours as well as rising sea levels are identified as primary challenges - changes in groundwater levels as secondary. One project tackling the problem of flooding is to expand the 150 year old sewers in the city in order to absorb larger amounts of water in case of torrential rainfall. A mathematical runoff model named MIKE URBAN was developed to calculate the amount of water that needs to be accommodated by the sewers and to simulate the flow in the sewer network and in watercourses. With this model different scenarios were calculated and problematic areas in the city could be identified that are prone to suffer from flooding.

However, the Copenhagen climate adaptation plan does not only assess the challenges climate change poses but recognises climate adaptation as having positive effects. The action plan says that climate adaptation “offers us a unique opportunity to develop Copenhagen to continue to be one of the world’s best cities to live in.” (Copenhagen Adaptation Action Plan, p.57). The greening of the city by maintaining parks and gardens, planting trees and creating green roofs as well as the maintenance and development of blue spaces such as lakes and rivers is acknowledged as not only helpful in extreme weather events but also improving the quality of life of Copenhagen’s citizens. The opportunity of experiencing nature and doing outdoor activities is not only good for peoples’ health but makes the city also attractive to tourism and thereby can create growth and economic development.

### 3.3 Monitoring and reviewing

The Edinburgh adaptation plan contains a clear outline of the monitoring process. The action plan will be reviewed annually regarding its accuracy and annual progress reports will be submitted to the Edinburgh Sustainable Development Partnership (ESDP). For the assessment of the progress of the action plan a number of indicators are developed and a RAG assessment will be made for each project. The development, implementation as well as the monitoring process are overseen by the Edinburgh Adapts Steering Group with support from the City Council’s Strategy and Insight Division.

The Copenhagen action plan contains references to monitoring in the description of the overall adaptation strategy which says that the action plan must be regularly revised and updated every four years. It is argued that in order to remain up to date, the revisions must incorporate new knowledge regarding climate change and technical developments. The publication of the updates is also made for reasons of informing the public and the approval of the City Council’s work. An evaluation of the projects’ progress is indirectly made by incorporating the results of the adaptation planning into all forms of urban planning including local, sector and municipal plans.

## 4. Areas for knowledge exchange and cooperation

Through interviews with two climate adaptation policy experts this study could identify areas in which knowledge exchange is desired and would be helpful. Fiona Macleod, Senior Policy Officer at the City of Edinburgh Council and a main driver behind Edinburgh’s adaptation action plan offered insights into successes and challenges that Edinburgh Adapts faces. René

Sommer Lindsay, Special Advisor on Climate Change Adaptation for the City of Copenhagen, shared his perspective on best practices in urban climate adaptation from his experiences in Copenhagen.

#### *Successes in Edinburgh's adaptation*

The Edinburgh adaptation plan states that Edinburgh shall remain a climate resilient city. Fiona Macleod pointed out that “Edinburgh is already one of the greenest city in Great Britain”. It has placed first in green rankings of cities across the UK ([as noted by mapping software company Esri UK](#)). Flood prevention is already a topic addressed by national law and has seen progress as evident in the progress report by the Climate Change Scotland Act of 2009. Ms. Macleod stated that “there are success stories” such as the nationwide coastal change assessment, a high-level analysis of the impact of sea level rise on Scotland’s coasts which Edinburgh Adapts can build upon. She sees specific strengths in the Edinburgh adaptation programme in the area of greening and protecting public green space and the natural environment with its added value for people’s health through the improvement of leisure activities in the outdoors.

#### *Challenges for Edinburgh's adaptation*

As stated in the Edinburgh adaption plan, Edinburgh is working on a whole city approach to adaptation. However, it is also admitted that there “will be gaps, which will be addressed as the Action Plan progresses” (Edinburgh Adaptation Action Plan, p. 5). Answering the question, which gaps she would identify in the current state of the plan, Ms. Macleod indicated that it is a challenge to further develop the action plan into a strategic policy which is “more than just a nice add-on but a naturally included issue in policy-making”. Furthermore, the implementation process could be supported by results of an extended risk analysis, which is needed for gathering all the information regarding the identification of the communities, habitats, people and areas most hit by climate change effects. The results of a study on ecological value of trees in the city (i-Tree Edinburgh) could help to reduce resistance towards expensive maintenance of green space in the city, which faces a loss of trees due to diseases. In the end, an expanded risk analysis will help to develop the whole city approach Edinburgh Adapts is aiming at, including all areas and all sectors of the city.

These evaluations expose challenges in generating approval and raising awareness of stakeholders in the city as well as securing financing and finding the right governance approach.

### *Financing and Governance*

In an interview with René Sommer Lindsay the project manager pointed out that in Copenhagen the planning of the first demonstration project for climate change adaptation involved only 25 people and the city funded mainly small projects. Today climate adaptation is a local government issue, carried out by up to 50 people (in both planning, development and construction) and covers 300 projects with a funding of approximately £100 million. Mr. Sommer Lindsay also stated that the planned adaptation projects are completely implemented by the public sector and no private businesses are involved, however businesses and private homes are responsible for securing their property. The Copenhagen adaptation plan lists the central government, Copenhagen Energy (now named HOFOR), CPH City and Port Development, and Copenhagen Metro as major stakeholders which are financing and implementing the adaptation projects. As Mr. Sommer Lindsay says, there is a direct and close cooperation between the planner and the implementing agent, with a move to co-location, which is still to be achieved in Edinburgh. However, also in Copenhagen there is resistance within the City Council regarding maintenance, for instance in the area of water management.

### *Governance Approach, "Selling Adaptation" and Storytelling*

Another difficulty identified by Ms. Macleod is bridging the gap between the current state of Edinburgh's adaptation and the desired involvement of all sectors of society - the whole city approach. She says, "selling adaptation is hard" and political and managerial changes make it difficult to maintain continuing support for adaptation. Looking back at the beginnings of Copenhagen's adaptation planning, Mr. Sommer Lindsay remembered that it was important to be precise, defined and not think too big in the strategic action plan. He personally believes that it is more helpful to "do the adaptation neighbourhood by neighbourhood". In order to develop a whole city approach, it is better to start small rather than trying to implement a giant plan for the whole city from the beginning.

Being asked, in what area she would like to see knowledge exchange with Copenhagen, Ms. Macleod mentioned the issue of mainstreaming the topic of climate adaptation and making sustainability a standard. In Copenhagen, sustainability is not only seen as a climate adaptation issue, argued Mr. Sommer Lindsay, but also an issue of efficiency. Furthermore, image building is of supreme importance. Copenhagen branded itself as a cycling city, a sustainable city. Cycling in Copenhagen is popular not only because it is ecologically sustainable but

because it is efficient. Hence, the incorporation of the social culture in adaptation projects is necessary. During his visit in Edinburgh he observed that it is a very walkable city. Due to the hilly topography people decide rather to walk than cycle and the locations of primary tourist spots, the city centre and the old town among other places make walking a good choice. He proposed that for instance the creation of pedestrian areas could be a feasible project in Edinburgh. The first step for the acceptance of these kinds of projects is to change the mindset of the people. The establishment of “stories” and cultures was a crucial development in Copenhagen’s starting phase of adaptation. This could be a leverage point for Edinburgh as well. Edinburgh is a walkable city and this should be spoken about. That would create a new mobility and infrastructure ideology which in the end would contribute to the desired whole city approach with broad acceptance by the public.

## 5. Conclusion

This study had the goal to draw a comparison between the urban adaptation action plans of the cities of Edinburgh and Copenhagen to identify areas suitable for knowledge exchange and eventually capacity building. The geographical juxtaposition showed that both are coastal cities but with different topography regarding their elevation above sea level and the character of their coastline. However, both cities’ adaptation plans have identified flooding as a potential current and future threat not only due to waterways running through the cities but also more extreme weather events and increased precipitation.

Copenhagen is a very densely populated city whereas Edinburgh’s population is more spread out but at the same time is still a walkable city due to the locations of its major historic and modern touristic sites or the Universities’ campuses. The political structure of both municipalities is similar with a City Council as the highest political decision-making body and subordinate committees with distinct areas of responsibility, most of them affected by climate change adaptation issues. However, in Copenhagen the planning and implementation of the adaptation action plan is organised in a top-down approach whereas Edinburgh follows a partnership based implementation approach with over 50 stakeholders and partly overlapping partnerships.

Due to Copenhagen’s earlier development of its adaptation plan, it is more advanced and experienced in implementation and adaptation governance in general. Edinburgh faces challenges in raising awareness among the public and generating approval in terms of the

necessity of adaptation which is closely related to “storytelling” of the city’s adaptation journey. Regarding this as well as the issues of financing and the most effective governance approach, Edinburgh could benefit from Copenhagen’s experiences and knowledge. An issue in which Edinburgh Adapts is clearer than the Copenhagen action plan is monitoring of adaptation processes and the regular review of the projects’ progress, with exception of the Cloudburst Management Plan which has close yearly follow up on its implementation.

However, a challenge for cooperation between both cities could be the lack of a main responsible actor and thus a main contact person in Edinburgh for partners from outside, as Mr. Sommer Lindsay suggested. The partnership approach taken in Edinburgh is difficult to match with the top-down structure in Copenhagen. Nevertheless, the climate change impacts the two cities have in common such as flooding and greater surface water run-off, heatwaves, pressure on biodiversity, habitat fragmentation, and negative impacts on infrastructure, make the exchange of experiences and best practices as well as risk analysis methods and technical knowledge beneficial. Further on, more in-depth studies of the current state of single projects and subsequent collaboration between different areas in the cities that share common climate adaptation issues and approaches could help overcome the differences in the overall structure of urban climate adaptation implementation in the nearer future. This would incorporate the advice for Edinburgh to start small and grow bigger in the long-term.

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