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ARTICLE

# Climate Adaptation Planning for Resilient and Sustainable Cities: Perspectives from the City of Rotterdam (Netherlands) and the City of Antwerp (Belgium)

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## Abstract

Climate adaptation planning in pursuit of resilient and sustainable societies has become a focal point in urban policy. Climate adaptation planning is generally regarded as separate from traditional urban planning practices. Globally and in Europe, however, cities are increasingly integrating climate adaptation planning into their traditional urban planning instruments and processes. Recent research indicates that the scope of such integration is at varying stages. The City of Rotterdam (Netherlands) and the City of Antwerp (Belgium) have been identified as two European cities that face similar climate impacts and risks given their proximity to a large river delta. Both cities aim to integrate climate adaptation into their respective urban planning policies, but the scope of their integration differs. This paper critically analyses the urban planning policies of these two cities to distil key lessons learnt that cities with similar climate impacts and approaches to urban planning may potentially face in integrating climate adaptation planning into urban planning policies. The paper finds that identifying and evaluating the synergies, co-benefits or trade-offs of adaptation measures is a key challenge to integrating climate adaptation into urban planning policy. It is a potential stumbling block for long-term sustainable development and climate resilience.

**Keywords:** Belgium; cities; climate adaptation; Netherlands; resilience; urban planning

## I. Introduction

Cities are considered to be the most visible expression of human influence on the planet. Virtually every aspect of daily life in cities, which spans buildings and development, transit, food supply and energy and water use, typically relies on the use of fossil fuels that contribute to climate change.[1] Cities consume two-thirds of the world's energy and contribute up to 70% of global carbon dioxide ($CO_2$) emissions.[2] Notably, the European Union (EU) contributes approximately 18% of global emissions, with the bulk of these emissions

[1] M Hajer, "On Being Smart about Cities: Seven Considerations for a New Urban Planning and Design" in A Allen, A Lampis and M Swilling (eds), *Untamed Urbanisms* (New York, Routledge 2016) p 56.

[2] S Porteron, J Leonardsen, F Hahn, K Attstrom and HA Pedersen, "Urban climate action impacts framework: A framework for describing and measuring the wider impacts of urban climate action" (*C40 Cities*, 2019), available at <https://c40-production-images.s3.amazonaws.com/other_uploads/images/1670_C40_UCAIF_report_26_Feb_2.original.pdf?1521042661>.

originating in large urban areas.[3] These emissions are projected to increase as the world becomes more urban.[4] The rapid development and expansion of cities (also in Europe) is further generally linked to the transformation of habitats, the destruction of ecosystems and the overexploitation of natural resources and materials.[5]

While cities are depicted by some as the focal points for the processes that lead to climate change,[6] they are also particularly vulnerable to the impacts of climate change. Approximately 70% of cities around the world, including almost every urban area in Europe, are already experiencing climate change.[7] Climate change exacerbates existing environmental challenges like the urban heat island effect, air pollution and food and water security.[8] The frequency and magnitude of climate-related hazards (natural disasters such as floods, droughts, earthquakes, tropical cyclones, etc.) wreak further havoc on infrastructure, supply chains and quality of life.[9] Coastal cities or cities situated in low-lying river deltas in particular are especially vulnerable to sea-level rise, flash flooding, cyclones and stormwater surges, amongst other climate threats.[10] The impacts of these events result in insurmountable damage and loss to cities in terms of physical assets, infrastructure and utilities.[11] They also cause disruptions to basic service provision and transport networks and increases the risks of death, injury and illness.[12] Climate change further deepens inequalities in cities, as low-income communities suffer disproportionately from climate events (extreme heat and flooding) given the location of low-income or informal housing and a general lack of financial or other resources and support to cope or recover from climate disasters.[13]

Given the physical, social, environmental and economic impacts of climate change, cities are increasingly turning to adaptation planning.[14] While climate adaptation planning is generally regarded as separate from traditional urban planning practices, globally and in Europe,[15] a significant number of cities are integrating or mainstreaming climate adaptation planning into their traditional urban planning instruments and processes. Recent research, however, indicates that the scope of such integration is in varying stages.[16]

[3] I Tiseo, "Emissions in the EU: Statistics and facts" (*Statista*, 2021), available at <https://www.statista.com/topics/4958/emissions-in-the-european-union/#dossierKeyfigures>; AH Baur, S Lauf, M Forster and B Kleinschmit, "Estimating Greenhouse Gas Emissions of European Cities: Modeling Emissions with Only One Spatial and One Socioeconomic Variable" (2015) 520 Science of the Total Environment 49.

[4] Supra, note 1.

[5] J Ihnji, *Cities in the Anthropocene: New Ecology and Urban Politics* (London, Pluto Press 2021) pp 1–7.

[6] S Pincetl, "Cities in the Age of the Anthropocene: Climate Change Agents and the Potential for Mitigation" (2017) 20 Anthropocene 74–82; M Hebbert and V Jankovic, "Cities and Climate Change: The Precedents and Why They Matter" (2013) 50 Urban Studies 1332–47.

[7] ClimateAdapt, "Climate change impacts on European cities" (2021), available at <https://climate-adapt.eea.europa.eu/knowledge/tools/urban-ast/step-0-2>.

[8] P Kumar, "Climate Change and Cities: Challenges Ahead" (2021) 3 Frontiers in Sustainable Cities 2.

[9] V Masson, A Lemonsu, J Hidalgo and J Voogt, "Urban Climates and Climate Change" (2020) 45 Annual Review of Environment and Resources 411–44.

[10] See the 2022 Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report on Impacts, Adaptation and Vulnerability of Coastal Cities published as B Glavovic, R Dawson and W Chow, "Cities and Settlements by the Sea" in *IPCC Climate Change Impacts, Adaptation and Vulnerability: Summary for Policymakers* (Geneva, IPCC 2022) 1–42.

[11] ibid.

[12] ibid.

[13] S Linda, "From Progressive Cities to Resilient Cities: Lessons from History for New Debates in Equitable Adaptation to Climate Change" (2021) 57 Urban Affairs Review 1442–79.

[14] M Araos, L Berrang-Ford, JD Ford, SE Austin, R. Biesbroek and A Lesnikowski, "Climate Change Adaptation Planning in Large Cities: A Systematic Global Assessment" (2016) 66 Environmental Science and Policy 9.

[15] European Environmental Agency, *Urban Adaptation in Europe: How Cities and Towns Respond to Climate Change* (Copenhagen, European Environmental Agency 2020) p 9.

[16] ibid.

Notably, there is a lack of comparative data on how coastal and delta city authorities in particular approach the integration of climate adaptation planning in their urban planning policies.[17] It is also agreed that more research is necessary to fully comprehend the general legal and governance challenges cities may face in the pursuit of climate adaptation as a means towards resilience.[18] The City of Rotterdam (Netherlands) and the City of Antwerp (Belgium) have been identified as two European cities that, because of their proximity to a large river delta, are particularly vulnerable to the impacts of climate change.[19] These cities have also made a concerted effort to integrate climate adaptation into their respective urban planning policies, albeit to different extents. This paper aims to critically analyse the urban planning policies of these two cities to determine the extent to which each city authority has in fact integrated climate adaptation planning into their urban planning policies. This analysis will be informed by the available literature on the notion of "integration" and key features of "integration" as far as climate adaptation in urban planning is concerned.[20] Based on this analysis, the paper identifies and comments on key lessons learnt regarding some of the legal and governance challenges related to climate adaptation planning for urban resilience and sustainability. It is hoped that these lessons may assist other delta or coastal cities in Europe to enhance their urban planning functions, particularly as they pertain to fostering climate resilience and enhancing sustainable urban development.

Section II of this paper provides some background and context regarding the role of cities in the pursuit of sustainability and climate resilience. The following section explains the nature and function of "adaptation planning" and discusses the significance of integrating climate adaptation into urban planning policies and processes for the pursuit of climate resilience and sustainability. Section IV briefly explains the rationale behind the selection of the City of Rotterdam and the City of Antwerp as illustrative examples of climate adaptation planning in delta cities in Europe. This section also provides a brief overview of the urban planning system in the Netherlands and Belgium. It also analyses the planning policies of the selected cities. Finally, the paper concludes with some critical comments on and lessons learnt for some of the legal and governance challenges related to climate adaptation planning for urban resilience and sustainability.

## II. Cities as key actors in the pursuit of sustainability and climate resilience

Cities are seen as the driving force behind the development and evolution of human societies.[21] Their significance as drivers of sustainable development and their role as actors in the climate governance arena are acknowledged in key international instruments, including the Paris Agreement,[22] the Sendai Framework for Disaster Risk Reduction,[23] the 2030

[17] M Francesch-Huidobro, M Dabrowski, Y Tai, F Chan and D Stead, "Governance Challenges of Flood-Prone Delta Cities: Integrating Flood Risk Management and Climate Change in Spatial Planning" (2017) 114 Progress in Planning 1–27.

[18] G Fedele, C Donatti, CA Harvey, L Hannah and DG Hole, "Transformative Adaptation to Climate Change for Sustainable Social-Ecological Systems" (2019) 101 Environmental Science and Policy 116–25.

[19] MJM De Wit, B van den Hurk, PM Warmerdam, PJJF Torfs, E Roulin and WPA van Deursen, "Impact of Climate Change on Low-Flows in the River Meuse" (2007) 82 Climatic Change 351–72.

[20] See the literature discussed in Section III.1.

[21] A Revi and C Rozenweig, *The Urban Opportunity: Enabling Transformative and Sustainable Development* (New York, Sustainable Development Solutions Network 2013) pp 9–12.

[22] Preamble of the Paris Agreement FCCC/CP/2015.

[23] See Arts 8 and 19 of the Sendai Framework for Disaster Risk Reduction 2015–2030 UN Doc A/RES/69/283 (2015).

Agenda for Sustainable Development[24] and the UN-Habitat III Declaration (the New Urban Agenda).[25] This recognition is echoed in the European context through several European Commission policies, namely the 7th Environmental Action Programme,[26] the European Green Deal[27] and the EU strategy on Adaption to Climate Change.[28] According to these,[29] a key feature of the pursuit of global and local (urban) sustainability includes strengthening resilience and enhancing climate adaptation.[30] The rationale behind this thinking stems from the fact that cities represent the level of government that operates closest to the citizenry, which makes them ideally placed to develop tailored responses to climate change that take into account local needs and vulnerabilities.[31] Depending on the system of government and level of decentralisation of government functions in a particular country, cities are also entrusted with the authority to develop binding law and policy instruments for a wide range of sectors that address the physical, social, economic and environmental interests of the community.[32] These sectors are typically linked to the public functions and service delivery mandates of city authorities and include, amongst others, land-use management and urban planning, infrastructure development, environmental conservation, pollution control and service provision in areas such as public transport, waste management, housing and water and sanitation.[33]

This paper maintains that, of these mentioned sectors, urban planning is arguably the best placed to facilitate climate adaptation. Through the function of urban planning, city authorities have at their disposal a wide range of strategic[34] and spatial planning[35] instruments that are aimed at reconciling overarching and often competing environmental, social, economic and spatial interests that impact the built environment of the city and the well-being of people.[36] These instruments are also aimed at identifying risks and challenges to development and articulating implementable plans of action to reduce

[24] Particularly goals 11, 13 and 15 of the Transforming our World: The 2030 Agenda for Sustainable Development A/RES/70/1 (2015).

[25] See, for instance, Arts 13 and 14 of the Habitat III New Urban Agenda UN Doc A/RES/71/256 (2016).

[26] See, amongst others, Priority Objective 8 of the European Commision 7th Environment Action Programme Decision no 1386/2013/EU.

[27] See para 2.1.7 of European Commission, The European Green Deal COM(2019) 640.

[28] See Arts 9 and 13 of European Commission, Forging a Climate Resilient Europe: The New EU Strategy on Adaptation to Climate Change SEC (2021) 89.

[29] See in particular Sustainable Development Goal (SDG) 11 and SDG 13 of the 2030 Agenda for Sustainable Development; supra, note 21; and the EU Strategy on Adaptation to Climate Change 2021.

[30] The concepts "resilience" and "climate adaptation" are explained in Section III below.

[31] H Fuhr, T Hickmann and K Kern, "The Role of Cities in Multi-Level Climate Governance: Local Climate Policies and the 1.5 C Target" (2018) 30 Current Opinion in Environmental Sustainability 1–6.

[32] M Glasser and S Berrisford, "Urban Law: A Key to Accountable Urban Government and Effective Urban Service Delivery" (2015) 6 The World Bank Law Review 212–19.

[33] ibid.

[34] Strategic planning instruments inform the short- and long-term development vision for the spatial area. They also contain operational strategies, facilitate the division of labour between sector or line departments in the city authority and stipulate performance and governance procedures. In the European context, such plans are referred to as Strategic Plans, Development Plans or City Development Strategies. See L Albrechts, "Strategic (Spatial) Planning Re-examined" (2004) 31(5) Environment and Planning B: Planning and Design 743–58.

[35] Spatial planning instruments serve to articulate a spatial vision for the urban area and to regulate land use for specific areas included in the jurisdiction of the city authority. In the European context, instruments that articulate the spatial vision for the urban area are referred to as Blueprint Plans, Master Plans or Structure Plans. Instruments that assign and regulate land use are referred to as town planning schemes or zoning schemes/land-use schemes. See W Fourie, "Sustainable Cities through Integrated Land Use Management Systems" (2014) 191 The Sustainable City IX: Urban Regeneration and Sustainability 189–97.

[36] P Berke and M Stevens, "Land Use Planning for Climate Adaptation: Theory and Practice" (2016) 36 Journal of Planning Education and Research 283; F Zucaro and R Morosini, "Sustainable Land Use and Climate Adaptation: A Review of European Local Plans" (2018) 11 TeMA Journal of Land Use, Mobility and Environment 7–26.

risks and address development challenges.[37] From this information, city authorities develop key development priorities and objectives to be carried out at various spatial and temporal scales.[38] As such, urban planning is focused on facilitating sustainable development for the entire spatial area of the city according to short- and long-term goals and growth/expansion predictions.[39] Urban planning instruments further have the force of law.[40] They serve to shape the physical fabric of the city and, by implication, influence settlement patterns, energy consumption and intensity and transport and mobility use.[41] Urban planning instruments are comprehensive and address a broad range of sectors across multiple levels of government and across various line departments in the city authority.[42] These sectors relate to the services city authorities provide and include, for instance, transport and mobility, building and construction, housing development, land administration and property rights, infrastructure development, environmental protection and biodiversity conservation.[43] These sectors are indispensable for sustainable urban development. By ensuring that planning instruments are sufficiently informed by climate risk and vulnerability and by adopting measures in the instruments that (1) facilitate emissions reductions, (2) promote behavioural changes and (3) place limitations on development in the mentioned sectors, city authorities can directly contribute to enhancing climate adaptation and resilience.[44]

## III. Climate adaptation planning towards more sustainable and climate-resilient futures

### *1. The nature and scope of climate adaptation planning*

Adaptation is the "process of adjustment to actual or expected climate and its effects which seeks to moderate or avoid harm and to, where possible, exploit beneficial opportunities".[45] In the context of the city, adaptation comprises a spatial and temporal dimension. The spatial dimension pertains to reducing climate risk and vulnerability and enhancing adaptive capacity in various spatial locations falling under the jurisdiction of the city authority.[46] Temporally, adaptation is aimed towards enhancing the short-, medium- and long-term adaptive capacity of cities.[47] In this context, adaptation can take multiple forms, in which "coping adaptation" refers to strategies that prepare a city for

[37] Spatial planning instruments are informed by detailed assessments of environmental risks and sensitives (and in relation to climate events) in the urban area. This information is used to determine the spatial location of infrastructure, housing developments, educational and health facilities, public areas, transport networks, etc. See D Rozas-Vásquez, C Furest, D Geneletti and O Almendra, "Integration of Ecosystem Services in Strategic Environmental Assessment across Spatial Planning Scales" (2018) 71 Land Use Policy 303–10.

[38] T Frazier, CM Thompson and RJ Dezzani "Spatial and Temporal Quantification of Resilience at the Community Scale" (2013) 42 Applied Geography 95–107.

[39] ibid.

[40] Supra, notes 34 and 35.

[41] C Kennedy, S Pincetl and P Bunje, "The Study of Urban Metabolism and its Application to Urban Planning and Design" (2011) 159 Environment and Urbanization 1–10.

[42] J Levy, *Contemporary Urban Planning* (New York, Routledge 2017) p 152.

[43] ibid.

[44] Supra, note 15.

[45] IPCC, *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Geneva, IPCC 2007) p 56.

[46] Spatial scales of relevance for urban adaptation include the neighbourhood, the ecosystem, the city and the urban region or the bioregion in which a city is embedded. Overall, the aim is to enhance the adaptive capacity of the entire urban area as a whole. See N Adger, I Brown and S Surminski, "Advances in Risk Assessment for Climate Change Adaptation Policy" (2018) 2121 Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences 1–13.

[47] ibid.

hazardous events or shocks and enable it to respond to these.[48] It focuses on the short-term consequences of hazardous events and developing preparedness and response actions for these.[49] "Incremental adaptation", in turn, refers to actions "where the central aim is to maintain the essence and integrity of the urban system at any given scale".[50] It builds on vulnerability assessments and focuses on individual measures as appropriate (and as opportunities appear) for maintaining stability during and after a hazardous event.[51] It further focuses on the short- to medium-term consequences of hazardous events and on ensuring the stability of certain identified "at-risk" or vulnerable systems or groups of people.[52] In contrast, full or transformational adaptation refers to actions that "change the fundamental attributes of the city (i.e., the city's approach to governance and policy development, its physical attributes, infrastructure, socio-economic conditions, ecosystems and technologies) as a whole in response to climate change and its effects".[53] Transformational adaptation seeks to address the root causes of vulnerability. Such root causes may be broad and can include large-scale transformation, such as redesigning and retrofitting infrastructure or the physical and built environment of the city to cope with the long-term effects of climate change.[54] Ultimately, the end goal of transformational adaptation is resilience.[55] Transformational adaptation towards climate resilience is closely associated with adaptive management/governance in terms of which the governing instruction (city authority) fosters innovation through the creation of new policies (supported by new or emerging technologies) and informed by lessons learnt from ongoing experiments towards enhancing climate adaptation.[56] Adaptive governance follows a systems approach to addressing risks and vulnerabilities relating to climate change over time. Overall, the aim is to address the underlying failures of development and to follow a multi-sectoral approach to adaptation and sustainable development.[57]

Depending on their needs and resources, cities can choose to combine methods and strategies for coping, incremental and transformational adaptation. Whether in isolation or in combination, each category of adaptation can be attained through adaptation planning. In this context, adaptation planning entails the identification and assessment of vulnerabilities and risks to the effects of climate change and identifying and developing a selection of strategic and implementable actions that will enable the city authority either

[48] Supra, note 15.

[49] ibid.

[50] G Parsons, *Pressing the Accelerator for Urban Climate Adaptation: Identifying Critical Factors for Success Among Europe's Frontrunner Cities* (MSc thesis in Water Science and Management, Utrecht University, Netherlands 2020) p 10.

[51] M Heikkinen, T Ylä-Anttila and S Juhola, "Incremental, Reformistic or Transformational: What Kind of Change Do C40 Cities Advocate to Deal with Climate Change?" (2019) 21 Journal of Environmental Policy & Planning 90–103.

[52] ibid.

[53] A Revi, I Anguelovski, W Leal Filho, M Olazabal and E Chu, "Transformative Adaptation in Cities" (2020) 3 One Earth 384–87.

[54] Supra, note 18.

[55] Resilience broadly relates to the "ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous or climatic event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions". See SC Holling, "Resilience and Stability of Ecological Ecosystems" (1973) 4 Annual Review of Ecology and Systematics 1–23. Resilience is an ongoing, iterative process that recognises that vulnerability and climate risk are constantly evolving as cities and their systems (infrastructure and ecosystems), local communities (with specific social and cultural norms and values) and institutional structures (laws, policies and political parties) within them evolve and interact. See S Tyler and M Moench, "A Framework for Urban Climate Resilience" (2012) 4 Climate and Development 311–26.

[56] M Hurlbert and J Gupta, "Adaptive Governance, Uncertainty, and Risk: Policy Framing and Responses to Climate Change, Drought, and Flood" (2016) 63(2) Risk Analysis 339–56.

[57] ibid.

to cope with and respond to hazardous events, to maintain the essence and integrity of the specific parts of the urban area or its systems or to fundamentally alter the urban system to be resilient to certain identified climatic events.[58] In short, the three main features of adaptive planning include risk identification and assessment; formulating strategic approaches and translating strategies into implementable plans of action; and implementing the actions with ongoing monitoring and evaluation.[59] The first feature of adaptive planning entails a detailed and thorough climate risk assessment of the city, including an assessment of the current adaptive capacity of the city.[60] The climate risk assessment includes the identification of climate change-related hazards (whether in terms of extreme heat, water scarcity and drought, sea-level rise and flooding, severe storms such as rain, wind, hail, monsoons, tornadoes and hurricanes and/or wildfires) and a prediction of the frequency of the hazards, as well as an evaluation of the extent to which the people, assets and infrastructure are vulnerable to these occurrences.[61] The second feature pertains to developing strategies to minimise climate risk and to reduce vulnerability.[62] These strategies should be overarching and strategic in nature and address multiple aspects of the urban system.[63] The strategies must also be formulated into implementable plans of action. The plans of action must be prioritised and linked to necessary resources that will ensure their implementation, namely human, financial and technical resources.[64] Implementation of the plans must take place in accordance with continued performance management (the third feature of adaptation planning), which entails monitoring and evaluating whether the actions are reducing risk and vulnerability and whether the actions should be improved or updated.[65]

## 2. *Integrating climate adaptation in urban planning*

As alluded to earlier, climate adaptation planning is arguably more effective if it is integrated with the function of urban planning and the relevant urban planning instruments.[66] However, limited information and tools exist to guide city authorities on what integration entails and what steps need to be taken to ensure integration.[67] Much of the available literature explains why integrating climate adaptation into urban planning is important, but it neglects to explain in detail what integration is and how it should be achieved.[68] Recently, the UN Division for Public Administration and Development Management referred to integration as a "set of practices subject to overlapping conditions and conceptual fuzziness" and reiterated that greater clarity is needed in the context of

[58] Supra, note 38.

[59] C40 Cities, *Climate Action Planning Framework* (Bonn, C40 Cities 2018) pp 24–36.

[60] ibid.

[61] N Badaoui et al, *Integrating Climate Adaptation: A Toolkit for Urban Planners and Adaptation Practitioners* (Bonn, C40 Cities 2020) p 20.

[62] UNDP, *A Toolkit for Designing Climate Change Adaptation Initiatives* (New York, UNDP 2010) pp 20–24.

[63] Supra, note 50.

[64] ibid.

[65] ibid.

[66] W Lyles, P Berke and K Heiman Overstreet, "Where to Begin Municipal Climate Adaptation Planning? Evaluating Two Local Choices" (2018) 61 Journal of Environmental Planning and Management 1994–2014; UN Habitat, *Planning for Climate Change: A Strategic Value Based Approach for Urban Planners* (Nairobi, UN Habitat 2014) p 1.

[67] M Landauer, S Juhola and J Klein, "The Role of Scale in Integrating Climate Change Adaptation and Mitigation in Cities" (2019) 62 Journal of Environmental Planning and Management 741–65.

[68] See, amongst others, T Rauken, K Mydske and M Winsvold, "Mainstreaming Climate Change Adaptation at the Local Level" (2015) 20(4) Local Environment 408–23; S Woodruff, "Coordinating Plans for Climate Adaptation" (2018) 42(2) Journal of Planning Education and Research 218–30.

sustainable development and related challenges, such as climate change.[69] It has also been recognised that there is a need for a European or international database to gain a better understanding of climate change adaptation planning and to enable a more consistent comparison of climate plans and policy over time.[70]

In the literature on climate change, the integration of climate adaptation policies and measures into planning and decision-making processes is referred to as "mainstreaming".[71] At a minimum, mainstreaming implies considering the implications of future climate change impacts and including measures to respond to these in existing and future policies and plans.[72] It is aimed at increasing coherence between policies and reducing duplication and contradiction.[73] Kivimaa and Mickwitz identify four indicators for policy integration: inclusion, consistency, weighting and reporting.[74] According to the authors, inclusion pertains to ensuring that all policies refer to the issue at hand and to the related risk.[75] This requires a normative shift in policy development from focusing on sectors in isolation to ensuring that all sectors include measures aimed towards climate adaptation.[76] Consistency, in turn, translates into a shared understanding of the issue – both impacts and measures – among actors, in policy documents or in policies in general.[77] All policies must be informed by the most recent climate science to provide a basis for developing measures to adapt to climate impacts.[78] Weighting refers to the priority given to the issue in relation to the other objectives involved.[79] As such, climate adaptation should be prioritised but in a manner that optimises benefits to development in all sectors.[80] Integration or mainstreaming must further be supported by ongoing reporting and evaluation in the form of feedback that can stimulate a learning process.[81] Mainstreaming is linked to the idea that the governmental landscape is traditionally organised around functional sectors (such as mobility, water, nature and energy) and that major societal challenges, such as climate adaptation and decarbonisation, require a nuanced understanding of the complex relations between these sectors and movement towards cross-sectoral thinking.[82] Mainstreaming calls for vertical integration between levels of government (ie the city, the province or region and

[69] United Nations, *Policy Integration in Government in the Pursuit of the Sustainable Development Goals* (New York, UN 2016) p 3.

[70] FC Aguiar, J Bentz, JMN Silva and AL Fonseca, "Adaptation to Climate Change at Local Level in Europe: An Overview" (2018) 86 Environmental Science and Policy 38–63.

[71] The terms "mainstreaming" and "integration" are often used interchangeably. See RJT Klein, SHE Eriksen, LO Naess and A Hammill, "Portfolio Screening to Support the Mainstreaming of Adaptation to Climate Change into Development Assistance" (2007) 84(1) Climatic Change 23–44; H Runhaar et al, "Mainstreaming Climate Adaptation: Taking Stock about What Works from Empirical Research Worldwide" (2018) 18(4) Regional Environmental Change 1201–10; European Commission, White Paper Adapting to Climate Change: Towards a European Framework for Action COM/2009/0147 final.

[72] Supra, note 68.

[73] ibid.

[74] P Kivimaa and P Mickwitz, "The Challenge of Greening Technologies – Environmental Policy Integration in Finnish Technology Policies" (2006) 35 Research Policy 729–44; E Brendehaug, C Aall and R Dodds, "Environmental Policy Integration as a Strategy for Sustainable Tourism Planning: Issues in Implementation" (2017) 25(9) Journal of Sustainable Tourism 1257–74.

[75] ibid.

[76] C Vellema, *The Implementation of Characteristics of Transformative Adaptation into Spatial Planning to Decrease Pluvial Flood Risks – A Comparative Study* (Groningen, University of Groningen 2021) pp 7–9.

[77] ibid.

[78] ibid.

[79] ibid.

[80] ibid.

[81] ibid.

[82] C Uittenbroek, L Janssen-Jansen and H Runhaar, "Mainstreaming Climate Adaptation into Urban Planning: Overcoming Barriers, Seizing Opportunities and Evaluating the Results in Two Dutch Case Studies" (2013) 13(2) Regional Environmental Change 399–411.

national government) and horizontal integration across multiple sectors and/or government department integration (ie water, housing, sanitation, transport, energy, waste management, environmental management, etc.).[83] Such integration requires city authorities to pay attention to and understand the climate risks and plans of actions to address risk in each of the mentioned sectors.[84] It also necessitates an understanding and evaluation of the potential synergies, conflicts or trade-offs inherent in the pursuit of climate adaption and to ensure that the best possible solutions that address multiple sectors are articulated in policies.[85] Finally, it is important to note that a city's ability to design climate adaptation policies in a manner that promotes integration differs from the ability of a city authority to implement integration.[86] Without implementation, any tangible "on-the-ground" progress towards climate resilience is lost. The ability to implement the integration of adaptation policies essentially depends on the availability of resources and skills, institutional accountability and political commitment towards integration.[87]

## IV. A tale of two cities: climate adaptation planning in the City of Rotterdam (Netherlands) and the City of Antwerp (Belgium)

In the European context, climate adaptation plans and strategies are typically implemented at sub-national (regional and local) administrative levels in accordance with national legislation.[88] The European Commission explicitly encourages cities to undertake climate adaptation planning and to integrate climate adaptation in urban planning.[89] In the Netherlands and in the Flemish region of Belgium in particular, city authorities have the main responsibility for spatial and land-use planning.[90] They also have relative freedom (autonomy) to make decisions regarding the scope of their urbanisation policies and development plans.[91] Due to the country's history with flood management and prevention, Dutch cities have long been involved in climate adaptation practices.[92] Climate adaptation has only recently become an area of focus in Belgian cities.[93] The City of Rotterdam (Netherlands) in particular has built a reputation as a pioneer in addressing climate change, sustainability and resilience in its policies.[94] Of the cities in Belgium that are active

[83] Supra, note 51.

[84] S Grafakos, K Trigg, M Landauer, L Chelleri and S Dhakal, "Analytical Framework to Evaluate the Level of Integration of Climate Adaptation and Mitigation in Cities" (2019) 154 Climate Change 87–106.

[85] ibid.

[86] R Biesbroek, "Policy Integration and Climate Change Adaptation" (2021) 52 Current Opinion in Environmental Sustainability 75–81.

[87] For more information on the conditions for successful implementation, see D Braunschweiger and M Pütz, "Climate Adaptation in Practice: How Mainstreaming Strategies Matter for Policy Integration" (2021) 31 Environmental Policy and Governance 361–73.

[88] O Heidrich et al, "National Climate Policies across Europe and Their Impacts on Cities Strategies" (2016) 168 Journal of Environmental Management 36–45.

[89] See the New EU Strategy on Adaptation to Climate Change, supra, note 28, and the European Green Deal, supra, note 27. Also see the EU Covenant of Mayors Initiative, available at the European Climate Adaptation Platform "Covenant of Mayors" <https://climate-adapt.eea.europa.eu/eu-adaptation-policy/covenant-of-mayors>.

[90] G Larsson, *Spatial Planning Systems in Western Europe* (Amsterdam, IOS Press 2006) pp 34–35.

[91] ibid.

[92] M van den Berg, "Climate Change Adaptation in Dutch Municipalities: Risk Perception and Institutional Capacity" in K Otto-Zimmermann (ed.), *Resilient Cities: Cities and Adaptation to Climate Change* (Dordrecht, Springer 2011) pp 265–72.

[93] Supra, note 82.

[94] K Hölscher, N Frantzeskaki and D Loorbach, "Steering Transformations under Climate Change: Capacities for Transformative Climate Governance and the Case of Rotterdam, the Netherlands" (2019) 19 Regional Environmental Change 791–805.

in climate adaptation initiatives, Antwerp appears to be the most ambitious.[95] These two cities represent neighbouring countries with similar climate risks and similar approaches to urban planning.[96] As will be illustrated below, these cities are, however, at different stages of integrating climate adaptation into their planning policies. The following sections provide a brief overview of the planning systems and climate risks in each country. Thereafter, the main strategic and spatial planning instruments and the relevant sectoral planning instruments of the City of Rotterdam and the City of Antwerp are discussed in order to determine the extent to which the planning instruments are informed by or integrated with climate adaptation planning. The discussion also focuses on what can be learnt from these cities as far as the legal and governance challenges facing climate adaptation planning for urban sustainability and resilience are concerned.

## *1. City of Rotterdam, Netherlands*

The Netherlands is a unitary state with three levels of government: the national level, twelve provinces and 345 (in 2022) municipalities (city authorities or *Gemeente* in Dutch).[97] All three levels of government must develop their own spatial vision.[98] Municipalities have the primary authority to develop and implement a strategic long-term vision for their spatially demarcated area of jurisdiction.[99] Because 25% of the country lies below sea level, approximately two-thirds of the country is at risk of flooding when storms come inland from the sea or rain causes rivers to overflow.[100] Recent research indicates that Dutch cities will increasingly experience climate-related hazards such as intensive rainfall, longer periods of drought and longer hotter periods in summer.[101] The City of Rotterdam in particular faces significant threats to long-term sustainable development and climate resilience due to its location in the delta of the rivers Rhine and Meuse and due to most of the city being below sea level.[102] The city also faces challenges related to the urban heat island effect, as differences in temperature between the city and the surrounding countryside can reach as high as 8°C.[103]

Climate adaptation strategies in Rotterdam are relatively well resourced and advanced. Urban planning is focused on promoting sustainable land use, responsible water management and climate adaptation. The City of Rotterdam's overall development vision is established in its main spatial planning instrument: the *Stadsvisie* Rotterdam 2030 (structure

[95] Supra, note 82.

[96] The Flemish region of Belgium and the Netherlands both follow similar local planning systems with structure plans and destination plans (*bestemmingsplanne*) covering the whole territory of the municipality. See L Albrechts and K Oleson, *Changing Planning Discourses and Practices: The Flanders Structural Plan* (Brussels, Aesop Young Academics Booklet Series Reading 2017) p 11.

[97] W Zonneveld and D Evers, "Dutch National Spatial Planning at the End of an Era" in M Remier, P Getimis and HH Blotevogel (eds), *Spatial Planning Systems and Practices in Europe: A Comparative Perspective on Continuity and Changes* (New York, Routledge 2014) pp 63–64.

[98] According to the new *Omgevingswet*, which will come into operation in January 2023. See Rijksowerheid, *Onderwerpen: Omgevingswet*, available at <https://www.rijksoverheid.nl/onderwerpen/omgevingswet>.

[99] Informatiepunt Leefomgeving, *Gemeentelijke Omgevingsvisie: Dit Staat Er*, available at <https://iplo.nl/regelgeving/instrumenten/omgevingsvisie-gemeente/staat-erin/>.

[100] S van Alphen, "Room for the River: Innovation, or Tradition? The Case of the Noordwaard" in C Hein (ed.), *Adaptive Strategies for Water Heritage: Past, Present, Future* (Cham, Springer 2020) p 309.

[101] Minister for the Environment, *National Climate Adaptation Strategy* (The Hague, Minister for the Environment, Kingdom of the Netherlands 2016) pp 5–10.

[102] G Beane, K Bruebach and E Louise, *The City Water Resilience Approach: City Characterisation Report for Rotterdam* (New York, Rockefeller Foundationa and ARUP 2019) pp 16–32.

[103] ibid.

plan).[104] This document envisions Rotterdam as a "leading and world-class Port City" with a robust and modern economy, an aesthetically pleasing and healthy built and living environment and sustainable transport and mobility systems.[105] In terms of the indicators for integration discussed earlier, the *Stadsvisie* does not appear to explicitly include climate change as it does not mention climate adaptation nor does it clearly link any of the climate risks that Rotterdam faces to any of its development strategies. The measures mentioned in the *Stadsvisie* do, however, indicate implicit mindfulness of climate impacts in specific sectors. The *Stadsvisie* does consistently include measures to reduce climate risk in specific sectors. Examples in this regard include implementing measures in the built environment, specifically in terms of energy use in the transport, building design and electricity sectors to reach a 50% reduction of carbon emissions by 2025; investing in cleaner transport and fuel technologies for public transport fleets (buses, trams, etc.); improving cycling and walking infrastructure in the city; and planting more trees in the inner-city centre to assist with shade and cooling.[106] The *Stadsvisie* is, however, silent on how much weight or priority such measures enjoy over other development objectives in the city. It is also silent on the level of reporting and monitoring of the progress of these measures in reducing climate risk, which, in turn, raises questions regarding implementation and tangible ground-level progress towards advancing climate adaptation and resilience.

It is important to note that the *Stadsvisie* will be replaced in 2024 by the city's *Omgevingsvisie* (environmental vision).[107] This strategic spatial plan aims to regulate land use, water, environment, nature, landscape, traffic and transport, infrastructure and cultural heritage in the urban area.[108] The *Omgevingsvisie* includes detailed short- and long-term development goals and strategies for the entire spatial area of the city. Climate adaptation and the energy transition are identified as normative goals that guide the development in all sectors, and particularly the mobility (transport) and building sectors.[109] The *Omgevingsvisie* is arguably more ambitious than the *Stadsvisie*, as it aims to work towards reducing emissions by 49% by 2030 and to achieve climate neutrality by 2050.[110] In contrast to the *Stadsvisie*, the plan further explicitly refers to climate change impacts in every sector and includes measures for each sector to enhance adaptation.[111] For example, for the transport sector, the plan recognises the infrastructure risks that flooding and heat stress pose, and it acknowledges the contribution of transport to emissions.[112] The plan aims to prioritise non-motorised transport such as walking and cycling and to establish "no-vehicle" zones.[113] In terms of the built environment, the *Omgevingsvisie* identifies at-risk areas for heat and/or flooding and provides detailed measures to enhance adaptive capacity in these areas (such as strengthening dykes and increasing greenery).[114] The *Omgevingsvisie*

[104] G Rotterdam, *Stadsvisie Rotterdam: Ruimtelijke Ontwikkelingsstrategie 2030* (Rotterdam, Gemeente Rotterdam 2007) pp 34–44.

[105] ibid.

[106] ibid.

[107] This is due to legislative changes in Dutch environmental and planning legislation. The newly adopted *Omgevingswet* requires city authorities to develop a single strategic spatial planning instrument to replace all other planning instruments. Cities have until 2024 to adopt such an instrument. The City of Rotterdam is one of the first Dutch cities to develop their *Omgevingsvisie*. For now, this document will be implemented alongside the structure plan. See Gemeente Rotterdam, *Omgevingswet* (Rotterdam, Gemeente Rotterdam 2022), available at <https://www.rotterdam.nl/wonen-leven/omgevingswet/>; and T van der Schoot and D Spel, *De Gemeenteraad en De Omgevinswet* ('s-Hertogenbosch, Van Leijen Academie 2020) p 17.

[108] ibid.

[109] Gemeente Rotterdam, *Omgevingsvisie Rotterdam: De Veranderstad* (Rotterdam, Gemeente Rotterdam 2021) p 11.

[110] ibid.

[111] ibid.

[112] ibid.

[113] ibid.

[114] ibid.

also includes dedicated climate adaptation guidelines that underscore the intent of the city to follow a nature-based[115] approach to planning and development. In this regard, the city intends to pursue a large-scale adaptation project in terms of which existing buildings and public spaces such as public parks and squares will be retrofitted to store water or to incorporate greenery.[116] The inclusion of climate adaptation guidelines in the *Omgevingsvisie* arguably speaks to the weight and priority climate concerns hold in the planning and development of the city, especially in light of the regime changes in the Dutch planning landscape from 2023 onwards.[117] Notably, the *Omgevingsvisie* attempts to secure implementation by explicitly stating that, in order to enhance adaptive capacity, strategies and plans aimed at addressing climate change will be reviewed, reported on and adjusted as necessary every two years.[118]

In addition to the above, the city has also developed a dedicated detailed Climate Change Adaptation Strategy (2019) (CAS).[119] This strategy must be read with the Rotterdam Resilience Strategy (2016).[120] Together, these plans aim to make the city "climate proof by 2025", which means that by 2025 measures will already have been taken to ensure that each area in the city is minimally disrupted by climate change both then and in the following decades.[121] The plans specifically emphasise that spatial development planning in Rotterdam must take into account long-term foreseeable climate change while allowing for uncertainty in these eventualities.[122] In terms of integration, the CAS stipulates that climate impacts must be included in all sectors that affect the urban built environment. In this regard, the CAS identifies land-use zoning and building codes as central to addressing frequent and heavy rainfall. The CAS stipulates that spatial planning instruments must lead to the development of a "waterproof city" by shaping and engineering the built environment for optimal capture and storage of rainwater.[123] It also states that building codes must require that paving must be replaced with greenery or green facades or porous paving stones.[124] The strategy further requires "large development projects" to construct underground water storage infrastructure to capture rainfall water and to, when necessary, release the water into ditches, canals, waterways and lakes to control water levels and water quality in periods of drought.[125] The plans also recognise the heat challenge in Rotterdam and indicate that spatial planning instruments such as land-use or zoning schemes should incorporate greenery into the city.[126] Building codes must further

[115] Nature-based solutions to climate change involve taking measures to conserve, restore or better manage existing ecosystems in order to reduce $CO_2$ and to make full use of the services (whether recreational, provisioning, regulating, supporting or cultural) that the natural resources provide. Such measures typically involve working with nature rather than against it. In the context of the city, naturally occurring resources are integrated with or supported by existing infrastructure. See J Bush and A Doyon, "Building Urban Resilience with Nature-Based Solutions: How Can Urban Planning Contribute?" (2019) 95 Cities 1–8.

[116] ibid.

[117] J Spaans, M Winters and R van der Hulle, "The Environment and Climate Change Law Review: Netherlands" (*Law Reviews*, 2022), available at <https://thelawreviews.co.uk/title/the-environment-and-climate-change-law-review/netherlands>.

[118] Supra, note 107.

[119] Gemeente Rotterdam, *Rotterdam Climate Change Adaptation Strategy* (Rotterdam, Gemeente Rotterdam 2013) pp 1–136.

[120] Gemeente Rotterdam, *Rotterdam Resilience Strategy: Ready for the 21st Century* (Rotterdam, Gemeente Rotterdam 2016) pp 1–136.

[121] Supra, note 117.

[122] ibid.

[123] ibid.

[124] ibid.

[125] Supra, note 119.

[126] ibid.

include requirements for making buildings "heatproof".[127] Measures in this regard include the installation of green roofs and façades and designing green inner courtyards and gardens. New buildings will be required to include white or green roofs, easy-to-open windows and placing bedrooms on the lower floors and on the north side of buildings. Greenery will also be added in the streets and along the infrastructure (boulevards, quays and cycle and walking routes).[128] Existing flora, parks and gardens will remain protected, and several areas in the city have been identified as "green zones" to include greenery, whether in terms of forests or nature parks.[129] Notably, the city regularly reports on the implementation of these measures and the outcomes that the measures have on reducing climate risk.[130]

The city has further found innovative ways to assist planners in making informed decisions regarding development, especially as it pertains to climate risk and identifying strategic areas of opportunity for climate adaptation. These tools include an Interactive Climate Atlas[131] and a Climate Adaptation Barometer.[132] The Climate Atlas provides a digital overview of the climate. It is a collection of diagrams and graphs providing general information about climate change, climate scenarios and the consequences for Rotterdam's vulnerable areas and buildings.[133] The Climate Atlas also makes it possible to compare the consequences of various climate scenarios with each other in order to assist planners in developing suitable strategies for adaptation and resilience. The Climate Adaptation Barometer, in turn, provides insights into how far along the city is in terms of developing policies and implementing plans of action specifically geared towards climate adaptation in the city.[134] It does not include climate data, but rather provides an overview of where policies or implementation plans are lacking. While these are not planning instruments in the traditional sense, they arguably enable the city to pursue long-term adaptation in that these instruments are used to guide and inform future policy development, and they serve as a means to foster ongoing learning and innovation.

### 2. *City of Antwerp, Belgium*

In Belgium, planning occurs in a federal system of government comprising the State (national level), three regions (Flanders, Brussels and Wallonia), ten provinces and 589 city authorities.[135] At the national level, the State guides land-use planning only through national legislation, which broadly covers some aspects for building activities in the Belgium Territory.[136] At the regional level, the three regions undertake regional planning for matters that transcend municipal borders.[137] Provinces act at the intermediate level of

[127] Supra, note 117.
[128] Supra, note 119.
[129] Supra, note 117.
[130] For an overview of the report on implementation and progress, see C40 Cities, "Delta Cities of the Future: Rotterdam Climate Change Adaptation Strategy" (2021), available at <https://www.c40.org/case-studies/c40-good-practice-guides-rotterdam-climate-change-adaptation-strategy/>.
[131] Gemeente Rotterdam, "Klimaateffectatlas Rotterdam" (*Climate Adaptation Services*, 2013), available at <https://www.climateadaptationservices.com/en/projecten/climate-adaptation-atlas-for-the-city-of-rotterdam/>.
[132] SmartPort NL, "Haven innovatie barometer: Rotterdam" (*SmartPort NL*, 2018), available at <https://smartport.nl/project/haven-innovatie-barometer-2018/>.
[133] Supra, note 131.
[134] Supra, note 130.
[135] L Albrechts, "Belgium" (2015) 51 The Planning Review 22.
[136] ibid.
[137] ibid.

government and predominantly serve a coordinating role between city authorities.[138] Detailed planning at the local level is delegated to the city authorities.[139]

The City of Antwerp is the third-largest city in Belgium. It is located on the right (eastern) bank of the River Scheldt, which is linked to the North Sea by the Westerschelde Estuary.[140] The city is home to one of the largest seaports in Europe. Sustainable water management and flood risk prevention are identified as key strategic areas in Antwerp's planning policies.[141] Although Antwerp has avoided major floods so far, the city is at risk of fluvial flooding, sea-level rise and storms.[142] Antwerp also suffers from increasingly extreme temperatures and heat stress.[143]

The overall development vision underpinned in Antwerp's planning instruments is to ensure "sustainability in a growing City". The main instrument giving effect to this vision is the Strategic Spatial Structure Plan (*s-RSA* in Dutch).[144] As far as inclusion as an indicator for integration is concerned, it is important to note that the *s-RSA* and the development plans and strategies included in this instrument are informed by detailed climate impact studies.[145] Notably, flooding and the urban heat island effect are identified as key hinderances to long-term growth, sustainability and climate adaptation.[146] The plan gives considerable weight to measures that will facilitate emissions reductions in specific sectors, such as the built environment (which includes the transport sector), and water management and flood prevention. In terms of the built environment, the *s-RSA* aims to promote high-density, low-carbon and mixed-use development.[147] However, it indicates that in order to deal with the urban heat challenge in particular, such development must be encouraged in a manner that preserves the integrity of existing green spaces.[148] It also identifies several areas in the city where greenery must be added in the form of public parks and gardens and through the designation of biodiversity conservation areas.[149]

The *s-RSA* further determines that the built environment should become energy efficient through the use of eco-friendly materials for the building of streets and squares and the construction of houses.[150] Nature-based solutions are consistently emphasised for reducing climate impacts and risks. For instance, all new or renovated roofs with a

[138] L Albrechts, "Devolution, Regional Governance and Planning Systems in Belgium" (2001) 6 International Planning Studies 167.

[139] ibid.

[140] H Mees, C Suykens and A Crabbé, *Analysing and Evaluating Flood Risk Governance in Belgium: Dealing with Flood Risks in an Urbanised and Institutionally Complex Country* (Utrecht, Utrecht University and Star-Flood Consortium 2016) p 19.

[141] ibid.

[142] ibid.

[143] GS Martinez et al, "Heat and Health in Antwerp under Climate Change: Projected Impacts and Implications for Prevention" (2018) 111 Environment International 135–38.

[144] This instrument was adopted in 2006 but is continuously updated. See Stad Antwerpen, *Strategisch Ruimtelijk Structuurplan: Antwerpen Ontwerpen* (Antwerp, Stad Antwerpen 2006) pp 1–344.

[145] The climate impact studies pertain to heatwaves, drought and rainfall. See Stad Antwerpen, "Klimaatimpactstudies: Neerslagstudie, Hittekaart, Droogtestudie" (*Stad Antwerpen*, 2021), available at <https://www.antwerpenmorgen.be/nl/projecten/klimaatimpactstudies/over>.

[146] ibid.

[147] Such development must, amongst others, reduce emissions by prioritising walking, cycling and the use of public transport over private vehicle use. For this purpose, the *s-RSA* identifies areas in the city that will be declared as "restricted traffic zones". These areas will be redeveloped to make room for walking and cycling lanes. Supra, note 144.

[148] ibid.

[149] The *s-RSA* must be read with the Stad Antwerpen, *Groenplan Antwerpen: Visienota 2030* (Antwerp, Stad Antwerpen 2013) pp 1–30 (Green Plan). The Green Plan requires that future development must incorporate nature and naturally occurring ecosystems into the urban fabric of the city to assist with climate control and related matters such as air purification and cooling.

[150] Supra, note 144.

slope of less than 15% and a surface area of more than 20 $m^2$ must be fitted with a green rooftop.[151] According to the *s-RSA*, this drastically lowers the temperature of the roof and cools air temperature by retaining and evapo-transpiring rainwater.[152] Additionally, green roofs provide extra thermal isolation for the building, reducing the need for heating and cooling.[153] Other measures include the repainting of buildings in light colours to reflect heat instead of absorbing it.[154] Moreover, in terms of transport, the *s-RSA* requires the city to reduce emissions by prioritising walking, cycling and the use of public transport over motor vehicle use. For this purpose, the *s-RSA* identifies areas in the city that will be declared as "restricted traffic zones".[155] These areas will not include parking and the streets will be redeveloped to make room for walking and cycling lanes. Other low-carbon measures for the transport sector include the installation of solar panels on the roofs of car park buildings to charge electric vehicles.[156]

The *s-RSA* also takes a nature-based approach to water management and flood prevention. It identifies the river as the most important ecological system in the city and identifies specific areas around the river that, because of the natural landscape, have the potential to provide protection against flooding. The *s-RSA* aims to develop some of these areas as recreational parks and stipulates that the development must use existing slopes, grasslands, trees and meadows to act as flood barriers, while adding docks or piers so that residents can enjoy recreational activities on the water.[157] The *s-RSA* further states that, throughout the city, infrastructure will be retrofitted to capture rainwater. Where possible, rooftop water collection systems will be installed to maximise the use of rainwater. Rainwater can be collected in tanks and used for toilet flushing, the watering of gardens or the washing of cars.[158] The city has further included climate adaptation measures in its sectoral plans. The Water Plan,[159] for instance, echoes the aims of the *s-RSA* to utilise the river for flood protection. According to the Water Plan, small changes will be made to the river embankments to divert rainwater towards ditches, fields and open land to release pressure from water flow in the event of flooding.[160] The estuary in particular is identified as a high-flood-risk area. As such, the city intends to raise the flood protection level around the estuary from 8.3 to 11.0 metres.[161]

In addition to the above instruments, the city adopted its Climate Plan 2030[162] in 2020. The climate plan is comprehensive and deals with a broad range of issues and sectors related to climate adaptation. The plan identifies climate change as the biggest threat to long-term sustainable development.[163] It also declares that Antwerp must become climate neutral by 2050. For this purpose, the plan stipulates emission reduction targets for the energy sector, the built environment sector and the transport sector.[164] The plan specifically indicates that the targets must be reached through the measures described in the

[151] These requirements are stipulated in the Building Code, which is implemented in parallel to the s-*RSA*. see Stad Antwerpen, *Gemeentelijke Stedenbouwkundige Verordening Bouwcode* (Antwerp, Stad Antwerpen 2017).

[152] ibid.

[153] D Lauwaet and G Lambrechts, "Adapting to Heat Stress in Antwerp (Belgium) Based on Detailed Thermal Mapping" (*Climate Adapt*, 2020), available at <https://climate-adapt.eea.europa.eu/metadata/case-studies/adapting-to-heat-stress-in-antwerp-belgium-based-on-detailed-thermal-mapping>.

[154] Supra, note 144.

[155] ibid.

[156] ibid.

[157] ibid.

[158] ibid.

[159] Stad Antwerpen, *Waterplan Antwerpen* (Antwerp, Stad Antwerp 2019) pp 1–108.

[160] Supra, note 144.

[161] ibid.

[162] Stad Antwerpen, *Antwerpen Voor Klimaat: Klimaatplan 2030* (Antwerp, Stad Antwerpen 2020) pp 1–60.

[163] ibid.

[164] ibid.

*s-RSA* for each sector. The Climate Plan further acknowledges the important role that the *s-RSA* plays in enhancing climate adaptation. However, it cautions that the *s-RSA* should be updated to incorporate strategies specifically aimed towards fostering climate resilience in the city.[165] It further acknowledges that climate adaptation in the city is fragmented and uncoordinated.[166] To ensure that the *s-RSA* is adequately updated and to assist with improved decision-making and cohesion, the Climate Plan indicates that the city is working towards establishing a "Climate Governance Model". This model will form a new system within which governance and decision-making for climate policies must take place. Key decision-makers in this system include a "Climate Committee" serving under the leadership of a "Climate Director". The Climate Committee will serve to initiate and facilitate public engagement and debate for all matters relevant to climate policy development.[167] The Climate Director, in turn, will develop and manage climate projects and advise the City Mayor and other sectoral departments in the city authority on climate matters.[168] It is envisioned that this new system will bring climate change adaptation and resilience to the forefront of policy development and ensure an integrated and cohesive approach to climate adaptation planning is taken.[169]

It is also worth noting that in addition to the planning instruments already discussed, the city recently developed a "Green Tool".[170] This tool uses interactive technology that is integrated with the spatial data in the city. It can be used to indicate to city planners which parts of the city are facing specific environmental risks, whether in terms of heat stress, air quality, $CO_2$ emissions or the quality of biodiversity systems.[171] The city has also established a Climate Fund that aims to ensure that projects identified in the planning instruments that are essential for climate adaptation (such as the plans relating to urban greening or flood risk management) are prioritised and linked to available funds.[172] This funding mechanism can arguably also enhance implementation.

## V. Discussion: lessons for law and governance

The discussion of the City of Rotterdam and the City of Antwerp's planning instruments serves to illustrate that climate adaptation planning, when integrated with urban planning, can significantly strengthen the ability of a city to better plan for, respond to, cope with and withstand the impacts of climate change. Adaptation planning is about identifying and reducing climate risks and vulnerabilities and identifying measures and opportunities to enhance adaptive capacity. Urban planning such as strategic or spatial planning further serves to establish and guide development in the urban area and to ensure that such development meets people's needs, while minimising harm to the environment. Through climate adaptation planning, city authorities can identify and develop strategies to strengthen adaptation and eventually resilience. Spatial planning instruments give effect to the climate strategies by linking them to specific spatial areas in the city. Climate adaptation-informed spatial planning further enables city authorities to shape the physical fabric of the city and to influence settlement patterns, energy consumption and natural resource use in a manner that is mindful of and mitigates climate risk.

[165] ibid.
[166] ibid.
[167] ibid.
[168] ibid.
[169] ibid.
[170] Stad Antwerpen, "GroenTool" (*Stad Antwerpen*, 2020), available at <https://groentool.antwerpen.be/>.
[171] ibid.
[172] Stad Antwerpen, "Klimaatfonds" (*Stad Antwerpen*, 2021), available at <https://www.antwerpen.be/info/602280b6a6bd7b9f50596662/klimaatfonds>.

Additionally, new or innovative advancements in risk assessment and climate mapping (Rotterdam's Climate Atlas and Climate Adaptation Barometer and Antwerp's Green Tool) further support and strengthen spatial planning for climate adaptation.

From the Rotterdam and Antwerp examples, it may be argued that possible challenges to law and governance in integrating climate adaption with urban planning include the complexity of climate adaptation; operationalising the alignment of goals, timeframes and objectives in different planning instruments; and enhancing cohesion between sector departments and line functions in the city administration. While Rotterdam and Antwerp's respective climate instruments are informed by climate risk and do strive to address climate risk in different sectors, the instruments discussed are notably silent on the synergies, co-benefits and trade-offs or tensions inherent in climate adaptation actions. The available research indicates that adaptation measures have the potential to address multiple climate hazards simultaneously or to provide additional co-benefits to the environment, society and economy.[173] However, they can also exacerbate certain hazards or have negative impacts on other aspects of sustainability, leading to potential maladaptation.[174] The research also indicates that identifying synergies, co-benefits, trade-offs or tensions is a complex task and that city officials are often ill-equipped with the necessary scientific or technical expertise to make such evaluations.[175] Notably, the extent to which Rotterdam and Antwerp have identified and considered potential synergies and co-benefits or accounted for trade-offs in the adaptation measures included in the planning instruments is unclear. Close monitoring of the adaptation measures and their outcomes and impacts is necessary not only to assess the effectiveness and cost-efficiency of adaptation measures, but also to identify and quantify the benefits or unintended disadvantages that they provide.[176]

Another challenge relates to ensuring that goals, actions and timelines for climate adaptation are aligned in planning instruments. For example, the timeline in Rotterdam's CAS for the city to be climate-proof by 2025 does not match the timeline in the city's *Omgevingsvisie* for the city to be climate neutral by 2050. In addition, the extent to which the concepts and implications of being "climate-proof" and "climate neutral" are similar to or different from each other is not explained. It is also not clear which of the city's actions will lead to climate proofing and which will lead to climate neutrality and whether such actions are mutually reinforcing. This situation can, however, be attributed to the fact that *Omgevingsvisie* is a new instrument to be implemented from 2024 onwards and the CAS has not yet been updated to match the timelines in the *Omgevingsvisie*. Nevertheless, this is an important reminder for city authorities to review and update existing planning instruments when new instruments are developed. A misalignment of actions, goals and timelines can lead to duplication, fragmentation and a waste of resources and time.[177]

It may further be argued that climate adaptation planning in Rotterdam and Antwerp is not completely integrated with urban planning. This finding is arguably related to the challenge of enhancing cohesion between sector departments and line functions. The climate adaptation and resilience plans and the spatial planning instruments (such as the structure plans) seem to be presented as being separate from each other. Except for Rotterdam's *Omgevingsvisie*, none of the other instruments discussed explicitly refer to

[173] V Viguié and S Hallegatte, "Trade-Offs and Synergies in Urban Climate Policies" (2012) 2 Nature Climate Change 334–37; R Newell, A Dale and M Roseland, "Climate Action Co-benefits and Integrated Community Planning: Uncovering the Synergies and Trade-Offs" (2018) 10 International Journal of Climate Change: Impacts and Responses 1–24.

[174] ibid.

[175] C Falduto and M Rocha, *Aligning Short-Term Climate Action with Long-Term Climate Goals* (Paris, OECD 2020) p 33.

[176] Supra, note 15.

[177] Supra, note 173.

climate adaptation or to climate adaptation plans, nor is "climate adaptation or resilience" identified as part of the spatial development vision in these cities. A possible explanation for this situation lies in the fact that different departments are responsible for developing and implementing these plans.[178] The spatial planning instruments are nonetheless informed by climate risk assessments, and the measures contained in these instruments (such as promoting high-density and low-carbon development and the incorporation of nature-based solutions) do serve to enhance the adaptive capacity of a city.[179] Notably, the City of Antwerp is going one step further than the City of Rotterdam by attempting to address issues of fragmentation and cohesion through their Climate Governance Model. This is a surprising finding given that Rotterdam is well known for being a leader in climate adaptation policy and has been active in climate adaptation planning for a longer period than Antwerp. Nevertheless, the Climate Governance Model is in the early stages of its development. Details regarding how the decision-makers and stakeholders in this model are selected and who they represent are not yet clear. The efficacy of this model for enhancing cohesive climate adaptation and ensuring the implementation of climate policies will have to be tested over the course of time.

## VI. Conclusion and way forward

There is no single approach to adaptation planning because of the complex, diverse and context-dependent nature of climate change.[180] Cities vary not only in their exposure to climate- and weather-related hazards, but also in their vulnerability and capacity to address climate change. Nevertheless, some cities such as Rotterdam and Antwerp share characteristics in terms of the climate risks that they face. Both cities are particularly vulnerable to flooding and heat stress. Both city authorities further strive to integrate climate adaptation planning into their urban planning instruments.[181] Analysing and comparing similar approaches in urban planning can help to facilitate the exchange of adaptation knowledge and experience. Of the challenges identified in the analysis of Rotterdam's and Antwerp's planning instruments it may be argued that identifying and evaluating the synergies, co-benefits or trade-offs of adaptation measures is the most significant. It represents a potential stumbling block for long-term sustainable development and climate resilience. The European Commission should play a supportive and capacity-building role in enhancing local climate adaptation planning. The Commission could, for instance, provide training for city authorities in translating climate data to policy-relevant indicators and offer support in the design and integration of adaptation strategies in planning policies. The training/capacity-building should also focus on assisting city authorities with acquiring the necessary expertise to identify the synergies and trade-offs inherent in climate adaptation and to understand the consequences and implications of these for long-term sustainable development. Such capacity-building should also focus on assisting cities

[178] Supra, note 15.

[179] See the following research in this regard: W Van Oijstaeijen, S van Passel and J Cools, "Urban Green Infrastructure: A Review on Valuation Toolkits from an Urban Planning Perspective" (2020) 267 Journal of Environmental Management 1–26; C Wamsler, S Pauleit, T Zolch, S Schetke and A Mascarenhas, "Mainstreaming Nature-Based Solutions for Climate Change Adaptation in Urban Governance and Planning" in N Kabisch, H Korn, J Stadler and A Bonn (eds), *Nature-Based Slutions to Cimate Cange Aaptation in Uban Areas* (Cham, Springer 2017) pp 257–27; C Pyke and S Andelman, "Land Use and Land Cover Tools for Climate Adaptation" (2007) 8 Climate Change 239–51.

[180] Z Allam, D Jones and M Thondo, *Cities and Climate Change: Climate Policy, Economic Resilience and Urban Sustainability* (London, Palgrave Macmillan 2020) pp 30–31.

[181] ibid.

with identifying opportunities and obstacles to implementation in order to ensure measurable progress towards strengthening climate resilience is achieved. The Commission could also consider providing funding and training to enable city authorities to appoint a lead department or unit within each city authority with specific tasks, responsibilities and resources to monitor progress towards policy integration and implementation.

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