

CLIMATE-FRIENDLY CITIES

A Handbook on the Tasks and Possibilities of European Cities in Relation to Climate Change



Hungarian Presidency of the Council of the European Union

MINISTRY OF INTERIOR

CLIMATE-FRIENDLY CITIES
A Handbook on the Tasks and Possibilities of European Cities
in Relation to Climate Change

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Climate-friendly cities for a healthy and wealthy European Union

With the Europe 2020 strategy, the European Union has set itself the ambitious goal of recovering our economies and tackling future challenges at the same time. Growth in Europe needs to become smarter, socially more inclusive and – after all – more sustainable.

Making the strategy a success will require efforts and contributions from all levels of government, the private sector and NGOs. Undoubtedly, cities will have to play a crucial role in delivering our common priorities. Indeed, there are two good reasons why we need to create solid links between cities and Europe 2020: Firstly, because they have a unique potential for green, smart and socially inclusive growth. They are a key location for economic progress and innovation. It is in the cities, where we need to solve challenges related to social exclusion and poverty. And it is also in urban areas, where a great potential for energy saving lies. We also need the driving power of our cities for smart economic growth. The second reason is of course, that the necessary investment will require massive financial means. Cohesion policy can be one instrument to help our local authorities in their efforts. Implementing new energy schemes, creating new jobs and businesses or fostering social innovation at local level will remain priority topics on Europe's political agenda.

Ideally, this process is managed in an integrated manner. The question of climate change clearly underlines the need for such a holistic, well-coordinated approach. Creating synergies between economic development, social questions and environmental sustainability is crucial. It is probably in our cities where this triangle becomes most visible. Green businesses and eco-innovation can create new employment opportunities and reduce CO₂-emissions at the same time. Investment in eco-efficient urban infrastructures enables these businesses to flourish and bring more people into the labour market. And higher levels of employment will finally help to overcome income-related, negative energy consumption patterns and to generate the necessary financial resources to incentivise new, climate-proof ways of growth.

The maybe most remarkable feature of cities is that they are both, a major challenge and a key solution to climate change. According to world-wide estimations, cities use about two thirds of the final energy demand and generate up to 70% of all CO₂ emissions. To reduce these shares is indeed a challenge. However, thanks to their high density structure, cities also have the potential to work in a very energy-efficient way. This compactness which results in shorter ways has direct influence on comparatively low frequencies of car use and the functioning of clean urban transport systems. Equally, the success of resource extensive heating systems is linked to the assets of agglomeration and concentration.

Finally, cities are focal points for consumption behaviours and innovation. With over 73% of our population living in urban areas, they play a key role in promoting new consumption habits and applying green technology. As the first contact point between the citizen and the administration, activities at city-level are tangible and visible to citizens. Local empowerment is vital in this respect. In addition, networking among cities and local authorities across the Union will be essential for mutual learning and for disseminating innovative climate actions.

Given the fact that many cities neither have the power nor the financial means to implement efficient climate change plans, cohesion policy operations can indeed make a difference.

Already in the current 2007-2013 programming period, measures to combat climate change amount up to EUR 50 billion or 14% of the available budget for Cohesion Policy. Also in the future climate change actions will remain one of our top priorities. Together with our cities and regions, we will continue to invest in eco-innovation, in renewable energies and energy efficiency, in clean urban transport and in other climate-proof urban infrastructures. In all this, we need our cities to take a leading role.

Our cities are vital for making growth in Europe smart, sustainable and socially inclusive. They are our best bet in winning the race against climate change. We need our cities for a healthy and wealthy European Union.



Johannes Hahn
European Commissioner for Regional Policy

FOREWORD TO THE HANDBOOK

The issue of urban development represents a priority for the Hungarian Presidency of the Council of the European Union and special emphasis is placed on *sustainable* urban development in an age when the global challenges we face are able to significantly influence the life of every citizen of cities. For this very reason, the Hungarian Presidency wishes to contribute to the debate on European urban policy by focusing on two of the major challenges that our cities face, namely the global trends of climate change and demographic change. While urban demographic challenges have been covered by a comprehensive European evaluation report of the Hungarian Presidency, the handbook you are now holding wishes to contribute to the efforts of our European cities and towns as they combat climate change, by widening our knowledge base on this issue.

The first half of 2011 is an important period in terms of thinking about the future of the European Union as, building on the outcomes of the Fifth Cohesion Report and on the general directions identified by the EU 2020 Strategy adopted last year, the cohesion policy of the future is now being shaped. In our view, it is especially important that the greatest possible pool of relevant knowledge on cities is made available during this period in order to ensure that the urban dimension is appropriately reflected in the Cohesion Policy. At the same time, in order to successfully achieve the strategic goals of the Union, it is of fundamental importance that the various players, including the governing bodies of European cities, have the appropriate knowledge to perform their tasks, including, among other challenges, the fight against climate change.

Global changes are presenting us the challenges capable to influence the life of every human being thus mitigating the adverse processes and adapting to the impacts of the changes are our shared responsibility. This is especially true in respect of the climate change phenomenon, which, in geographically differing ways and to various extent, is capable of bringing changes and presenting new dangers to the most parts of the world. A significant part of both the fundamental causes and, even more so, the consequences of climate change are concentrated in urban areas. Even without the global climate change, the micro- and mesoclimates of towns and cities differ significantly from those of less urbanised areas, and these differences may be further reinforced by climate change.

Climate change and related urban policy responses have by now become part of the European thought, alongside with other integrated urban development issues. This is in fact reflected in a range of documents. Adopted in 2007, the **Leipzig Charter** on Sustainable European Cities underlines the need for defining integrated urban development policies with the aim of coordinating the spatial, sectorial and temporal aspects of the core areas of urban policy, while also focusing on the issue of climate change within the general context of sustainability. In order to improve the utilisation of integrated urban development policy, the Leipzig Charter offers recommendations on the creation and maintenance of high quality public space, for modernising infrastructure networks, and for increasing energy efficiency, marking the direction for climate-friendly urban development.

One of the three central thematic areas of the statement adopted by the meeting of ministers responsible for urban development which was organised during the French Presidency in 2008, in **Marseille**, explicitly urges that climate change is taken into consideration in relation to urban development. This document specifically draws attention to the possible role of cities in climate change adaptation and to the fact that investments are needed in this area. Furthermore, it calls for the exchange of knowledge and experience and the shaping of local energy, climate, and mobility

policies, emphasising the role of urban planning and the importance of support for compact and sustainable cities.

The **Toledo Declaration**, adopted on 22 June, 2010 during the Spanish EU Presidency, also call special attention to integrated urban development and lays particular emphasis on the necessity of having a common interpretation of the integrated approach. In the Toledo Reference Document, in respect of the environment, the Ministers emphasised, *inter alia*, the role of metropolitan regions and cities in combating climate change.

Again, the **Europe 2020 Strategy** also includes among its objectives the improved utilisation of renewable energy sources, the reduction of greenhouse gas emissions, and giving priority to eco-efficiency, which together influence changes in the urban climate.

The publication you hold in your hand has been prepared upon the initiative, and with the coordination, of the Hungarian EU Presidency, and has benefited from the welcome participation of several European countries and cities. Our initial assumption is that city-level responses and local action have a significant responsibility in protecting the climate and in achieving sustainability itself. This, in turn, requires an integrated strategic approach. In co-operation with the relevant national and EU policies, economic actors, and social partners, city and city region leaders are indeed capable of taking action at city level to mitigate climate change's influence on our lives and to ensure that, thanks to appropriate means of adaptation, the changes do not threaten the quality of life of European citizens.

This handbook has been created for city management teams, decision makers, public officials in charge of management processes and skilled staff to support their work. Adopting an integrated approach, the volume covers nearly all fields of city development and management. However, given its comprehensive nature, for specialised professionals it offers only a limited amount of in-depth technical knowledge.

This handbook is only one step amongst many to promote urban climate protection. This important field has already seen the publication of many studies and even methodological documents; our volume has been able to build upon these works. As an additional step, this handbook not only summarises some of the results achieved so far but also arranges them into an entirely new structure, from the perspective of the actual means and fields of interventions at the disposal of the local governments of European towns and cities.

We are fully aware of the fact that the knowledge of climate change adaptation expands on an almost daily basis. For this very reason we encourage readers to adapt the recommendations found in this handbook to their own cities' circumstances, to develop and expand them and thereby to contribute to the wealth of our commonly shared European knowledge on urban climate.



Dr. Sándor Pintér
Minister of Interior, Hungary

EXECUTIVE SUMMARY

Climate change is a serious global challenge, which will significantly influence the life of the citizens of European cities. Europe is an urbanised part of the world, where two thirds of population live in urban areas.

The role that towns and cities can play in tackling the effects of global climate change in terms of emission reduction, mitigation, and adaptation is fundamental. Cities and towns are responsible for most of the global energy consumption and global emissions. In Europe, 69% of all greenhouse gas emissions are generated in towns and cities. Besides the causes, the negative consequences of climate change are also concentrated in urban area, which are often more vulnerable to its impacts.

City-level response and local action are to shoulder a significant part of the responsibility for the creation of climate protection and, in general, sustainability. In co-operation with the relevant national and EU policies, the economic players, and the social partners, the leaders of cities and urban regions are indeed capable of taking action at city level in mitigation and adaptation, as well.

With the publication of the 'Handbook on Climate-Friendly Cities', the Hungarian Presidency has contributed to this issue with the aim of supporting cities and urban policies. To avoid the negative effects and benefit from the opportunities offered by climate change creative, well-prepared city leadership and flexible and adaptive management are needed. This publication aims to provide city management teams with European knowledge on cities' tasks and their opportunities.

Geographically, the climate challenges that cities and towns across the European Union face show a great deal of diversity, no unified policy model or standard solution exists. However, there are a range of approaches and possible measures that can be used effectively in most individual cases, with the necessary adjustments. The opportunities open to cities and towns for action address nearly every aspect of urban development and city management, all the way through to the everyday life of citizens and institutions. By cutting public budgets the economic actors will have to play a more and more important role, thus local governments should develop strong policies to encourage a green economy and local economic development.

The Handbook introduces the main areas in which cities can act in relation to climate change. It describes the means and possibilities - as pillars of climate friendly cities – potentially available to city authorities that can be put to good use in the areas of both mitigation and adaptation. Local authorities have many direct tools, such as their institutions, local regulations, taxes, financial incentives and investments, for the mitigation and adaptation. However, the means by which they can influence other actors are of the same importance. We have to emphasise the crucial importance of integrating strategies and governance aspects, which can ensure good combination of using the proper tools.

The Handbook's key messages, which together define the pillars of the climate-friendly city, can be summarised in the following 8 main points:

1. The 'climate partnership' and multi level governance in city regions

Cities and towns are recommended to create a broad and systematically organised partnership as follows:

- Co-operating with national, regional authorities, municipalities of the functional urban area as well as sectoral agencies.
- Shaping the urban climate policy within the framework of a widely based, permanent and well organised partnership that integrates both the residents and the civil and economic actors.
- Integrating climate-friendly aspects at every stage; from regulation and disseminating information among the population and the economic actors, to designing incentives, and the operation of public services. The more areas of competence city governance can rely on, the stronger urban climate policies will be.
- The city's economic policy may be an important tool in shaping an urban climate policy, if it is able to follow the goals and principles of green economy and strengthen the local economy based on local resources.
- Sharing the knowledge and the experience of climate policy initiatives with other cities and towns, and the national and EU institutions, preferably through city networks.

2. Climate planning in integrated strategies:

Cities and towns should integrate climate aspects into their strategies along the following principles:

- connecting urban climate planning to the development and management procedures of the city in an integrated, multilevel approach, dealing with opportunities for both mitigation and adaptation;
- indication of climate-awareness in all of its steps of planning (situation analyses, the objectives and means, follow-up, etc.) when performing urban strategic planning process involving the climate aspects.

3. Climate-friendly spatial structure of the city through planning and zoning

Cities and towns should aspire to

- create compact urban structure, in which interactions are intense, transport distances are moderate and urbanised land use is restricted in space with efficient energy networks;
- divide urban structures to non-built-in areas, green zones, zones ensuring ventilation;
- reduce travelling and transport needs within and outside the city; territorial optimisation of locations of jobs, residential areas, services and transport lines;
- develop polycentric pattern of the city region and in the inner structure of the cities;
- extend urban green spaces, and develop their quality, linking them into networks;
- prefer investments into brown field areas and avoid green field developments.

4. Urban - rural (city and its surroundings) co-operation

Local governments, relevant and private and societal actors should cooperate in order to

- strengthen the co-operation of the city and rural actors, based on division of labour in order to avoid urban sprawl, prevent the intergrowth of the built-up areas, increased energy consumption and loss of spaces with ecological function;
- limit the sprawl of built-up areas, avoiding rapid transformation of peri-urban rural and natural green areas; unavoidable extension of the city should follow linear community transport lines;
- increase the food supply the city obtains from its region, and with this, shorten the distribution chain within the region.

5. Disadvantaged social groups and social effects

In order to help disadvantaged social groups and consider social effects, cities and towns are recommended to

- take into account the interests and vulnerability of the deprived social groups, who also need additional support to adapt to the changing circumstances. Disadvantaged urban social groups are particularly vulnerable to the impacts of climate change;
- carefully monitor the possible negative social effects of the adaptation and mitigation measures and should any arise, take counterbalancing measures, paying particular attention to deprived urban areas.

6. Climate-aware architectural solutions

In the regulation and development of local architecture, culture cities shall put emphasis on

- *mitigation – energy-efficient building solutions (e.g. passive houses, low carbon building);*
- *reducing energy consumption of households (heating, lighting), alternative energies (e.g. solar, geothermal);*
- *water saving and recycling solutions in architecture;*
- *adapting buildings to extreme conditions;*
- *designing buildings using a holistic, energy-cost-emission assessment approach, for the whole life cycle.*

7. Climate-awareness and lifestyle

Local authorities are recommended to increase the environmental responsibility of the individuals.

The usual lifestyle can be influenced by education, cultural activities, communication campaigns, events and other investments in order to

- *strengthen shared responsibility for the state of the urban environment and common social values;*
- *encourage environmentally-aware lifestyle, transport, consumption and market demand;*
- *share knowledge on the consequences of climate change;*
- *promote the utilisation of local resources, marketing of local products;*
- *increase the ability of civil society and churches, cultural institutions and social groups to strengthen cohesion of local communities.*

8. Sector pillars supporting the climate-friendly city

Cities and towns should incorporate a climate-friendly approach into their sector policies, as a horizontal aim, by

- *helping prevent climate change by functioning as local markets and strengthening an autonomous economy encompassing both the city and its rural environment, which aims to satisfy local needs from local resources;*
- *creating low carbon urban transport systems, with competitive and safe public transport, giving preference to pedestrian and cycling mobility, technical adaptations to changed climate in services (shading, air-conditioning, infrastructural elements, etc.) and monitoring;*
- *ensuring efficient and energy-saving management of cities and towns by combining green and local energy production with local economic development, using renewable energies, biogas production from municipal waste, etc.;*
- *organising urban water management as natural hydrological systems, together with the settlements of the catchment area;*
- *preparing disaster management and health care services to manage the increasing risk of hazards (floods, sudden heavy rains, sea-level rise, heat waves, water scarcity, industrial disasters, etc.) and be ready to tackle sudden healthy, security, disaster challenges.*

This Handbook was written for decision makers, politicians, professionals and stakeholders; for those involved in urban, territorial and sector policies in the Member States, for those working at European level, and especially for those serving the cities and towns of Europe. They are recommended to use and disseminate this Handbook, act upon its recommendations, and initiate further national and local reflection and debate on this topic. This Document serves as a knowledge resource and a starting point to its readers who may feel free to acquire its recommendations and combine it with their own experiences.

INTRODUCTION

Global challenge with urban relevance

Climate change is one of the most important global challenges of our age, and there is an almost full consensus on it being an anthropogenic phenomenon. Over the past one hundred years, global surface temperature has increased by 0.74 °C and global average sea level has risen by 17 cm. Should the current trends continue without a significant reduction in the emission of greenhouse gases (GHGs), during the next few decades we will witness irreversible processes that might bring along major changes in our social, economic, and environmental systems. The impact of climate change is different in the various European regions and greatly depends on the extent of climate change, on the sensitivity and exposure of the various ecological, social, and economic systems, and on the adaptability of the given society. Facing up to these challenges in a satisfactory manner requires a paradigm shift in development thinking and makes the earliest possible transition to a low carbon economy an urging necessity.

The challenge of climate change, on the one hand, requires a fast and early reduction in greenhouse gas emission both in Europe and at a global level. Europe is responsible for approximately 12% of the annual global anthropogenic direct GHG emission and makes significant efforts to curb emissions both at the global and at the European level. The European states and the European Union take significant responsibility on the environmental status of our planet, Earth. This is directly addressed by the Europe2020 Strategy and the related efforts are supported by EU funds. In addition to reducing emissions, the issues of adapting to a changing climate are becoming more and more prominent as well, especially with a view to the facts that the effects of emission reduction will only emerge with a delay, and that by now climate change has become our unavoidable reality. Europe's regions and economic sectors are varied in terms of their climate change vulnerability; as a consequence, the peculiarities of the individual areas, among other considerations, must also be taken into account when elaborating strategies of adaptation. Various research projects have supplied proof that even though adaptation entails significant costs, timely and proportionate intervention is more efficient than not adapting to the inevitable changes.

Two thirds of Europe's population lives in urban spaces, and the role cities play in the context of climate change is undeniable. Cities are responsible for 60% to 80% of global energy consumption and of all global emissions. In Europe, 69% of all greenhouse gas emissions are generated by towns and cities.

Climate change challenges and the Europe 2020 headline targets

The target values of some main indicators of EU 2020 Strategy can be achieved through a sound support of climate change related urban development interventions:

- The climate and energy target of '20/20/20' (**Target 3 on cutting greenhouse gas emission, increasing energy efficiency, and supplying energy needs from renewable sources**) has a direct relation to cities, as the source and focus of energy emission and consumption.
- **Target 1, increasing the employment rate (from the 69% to 75%) of the population (aged 20-64)** can be supported through the green economy and local economic development that are key elements of the economic policy of climate-friendly cities. These green-growth related interventions have a high labour intensity requiring qualified and untrained employees as well.

- The climate-friendly urban development and management activities may significantly contribute to **Target 2, on raising investment in R&D (to 3% of the EU's GDP)**. The often technology-intensive mitigation and adaptation actions require innovative solutions; these rapidly spreading, innovative solutions are frequently locally developed or require local adaptation and improvement. However, climate change itself, especially as an urban phenomenon, requires a lot of applied research on global, regional and particularly on local level.
- Social groups living in poverty and suffering from exclusion are more vulnerable to the negative effects of climate change. The climate change adaptation actions of the cities and towns – especially if they take affordability and the special position of disadvantaged social groups into account – can significantly improve the living conditions of these groups as well. These efforts can create new opportunities for **Target 5, to lift these groups out of poverty contributing to the target on reducing the number of Europeans living below the national poverty line (by 25%)**.

Because of their location and nature (e.g. towns and cities built near the sea or on floodplains), the high rate of disadvantaged and elderly people living in urban spaces, and the high concentration of infrastructure systems and economic activity in urban areas, cities are especially vulnerable when it comes to rising sea levels and extreme weather events. Without appropriate measures, this vulnerability represents an increasing challenge to both central and local authorities, local enterprises, and local residents. Thus cities are key areas of climate protection, where efforts can be more effective than in other areas. At the same time, it also presents an opportunity for adopting timely and appropriate decisions and measures.

The causes of climate change, and especially the causes of warming, are highly concentrated in cities, and this is where the effects and the emerging problems are also most prominent. The built-in surfaces of urbanised areas warm up to a greater extent. Greenhouse gas emission is also concentrated here mostly because of the intense traffic; this is where the contribution of the direct heat impact of infrastructure systems, heating systems, traffic, and production – something we call heat pollution – is also the greatest; at the very same time, densely built-in urban spaces allow for less air displacement and thereby less natural cross-ventilation. Of course, other than warming, built-up areas also experience dynamic changes in a range of other ecological conditions such as changes in air humidity and water balance. Potential risks related to climate change - such as natural disasters, shortage of food or increase of food prices, etc. - threaten more intensively urbanised areas, where more people are influenced by certain impacts.

All this means that the role towns and cities play in tackling the effects of global climate change in terms of emission reduction, mitigation, and adaptation is fundamental.

Goals and approaches of the Handbook

Entitled *Climate-friendly cities*, this Handbook has been created with the mission of helping city management teams and their specialised expert staff as well as various urban development practitioners make urban settlements climate-friendly by summarising and building on the European knowledge and experience thus far accumulated in the area of climate change and especially its urban aspects. The objective of this volume is to take account of the means and possibilities potentially available to city authorities that can be put to good use in the areas of both mitigation and adaptation. This Handbook identifies the opportunities at the local, that is, city and urban region level. For this very reason, it does not cover national policies (regulation, investments, etc.) even though their importance in the context of combating climate change is more than obvious. The Handbook addresses not only the cities, but also towns and all the settlements of an urban character, even in rural areas.

Geographically, the climatic challenges that cities across the European Union face show a great deal of diversity, while they remain an issue affecting nearly every sphere of urban development and city management, all the way through to the everyday life of citizens and institutions. Obviously different geographic locations provide totally different circumstances and in some types of territories the essential core of economic activity can be modified by climate change. For example, cities in costal

zones and particularly on islands are particularly affected by changes in sea-level, river basins and plains can be threatened by the increased risk of floods, whilst winter sport opportunities can be limited in the mountainous region.

Consequently, no unified policy model or standard solution exists; however, there are a range of approaches and possible means that can be used effectively in most individual cases with the necessary adjustments.

Beyond the climate protection issues, the Handbook adopts also the approaches of pro-activity and utilisation of existing possibilities. Climate change is not only an environmental challenge for governments and cities but also an economic opportunity to strengthen their competitiveness at a European and global level and to create new jobs. Innovation in tackling and mitigating the effects of climate change and adapting to its consequences is a factor in increasing the attractiveness of particular areas; in addition, it is also a factor in conserving resources – more particularly, water resources. At the same time, we also draw attention to the potential social effects of urban climate change, as well as to the potential social effects of the climate protection measures proposed in this Handbook.

This Handbook cannot address all the issues of urban climate; it concentrates on the practical solutions, which are relevant for local level authorities. This volume dedicates only a limited amount of space to theoretical considerations and analytical background; instead, it places emphasis on practical action, providing a toolkit for city management.

At the same time, the volume makes an effort to present all major groups of action at the level of cities and urban regions, using specific examples of best practices elaborated by various European cities. The comprehensive nature of this approach clearly allows only a limited amount of in-depth technical knowledge to be included for the specialised expert. The primary function of the document is to **offer a summary of the knowledge** that is already available to us and that is expanding almost on a daily basis, while it only occasionally endeavours to elaborate new solutions; an example for the latter could be our methodology for climate-integrated strategic planning.

The efforts of the Hungarian Presidency in the field of urban climate change is supported by the European Urban Knowledge Network (EUKN, www.eukn.org), which dedicated a specific key dossier to the issues of the Handbook in its e-library under the coordination of the Hungarian EUKN focal point. The development of this urban climate knowledge is also coordinated with the Reference Framework for Sustainable Cities (RFSC) initiative.

The volume has had the chance to build on the technical documents and good practices of a large number of European cities and countries. Many policies of the European Union have also provided fundamental cornerstones for developing this Handbook; in addition to policy documents related to climate change and urban development, we have also considered EU transport policy and energy policy. Special mention must be made of the European strategy for sustainable development and urban environment and other international agreements on sustainable development, as well as the European Commission's Green Paper on adapting to climate change in Europe.

Quite a range of technical documents have already been drafted on the issue of cities and climate change. We must mention the Organisation for Economic Co-operation and Development (OECD) 2010 publication entitled *Cities and Climate Change*; this reviews the relevant trends, the relevant competition policies, and the related governance issues with scientific accuracy. This OECD volume, which reviews the overarching processes of climate change, is well complemented by the Handbook prepared by the Hungarian Presidency, as it endeavours to present the available means and opportunities in a practical manner and with a focus on Europe. It is important to mention that OECD reports explored other climate-related aspects in a comprehensive way, with a strong focus on the economic consequences, providing a crucial contribution to common efforts in the field.

We believe that cities can apply various approaches and instruments to implement their climate change policies. The cities' competency in selecting the proper elements of their climate governance is determined by their legal status in the state administration. However, there is always an opportunity for creative actions. In our opinion, creative solutions can serve as inspiration for other cities; accordingly, the volume dedicates much of its space to good European examples in each thematic area. The best practices described in inserts have been realised with the direct contribution of EU member state ministries and European cities.

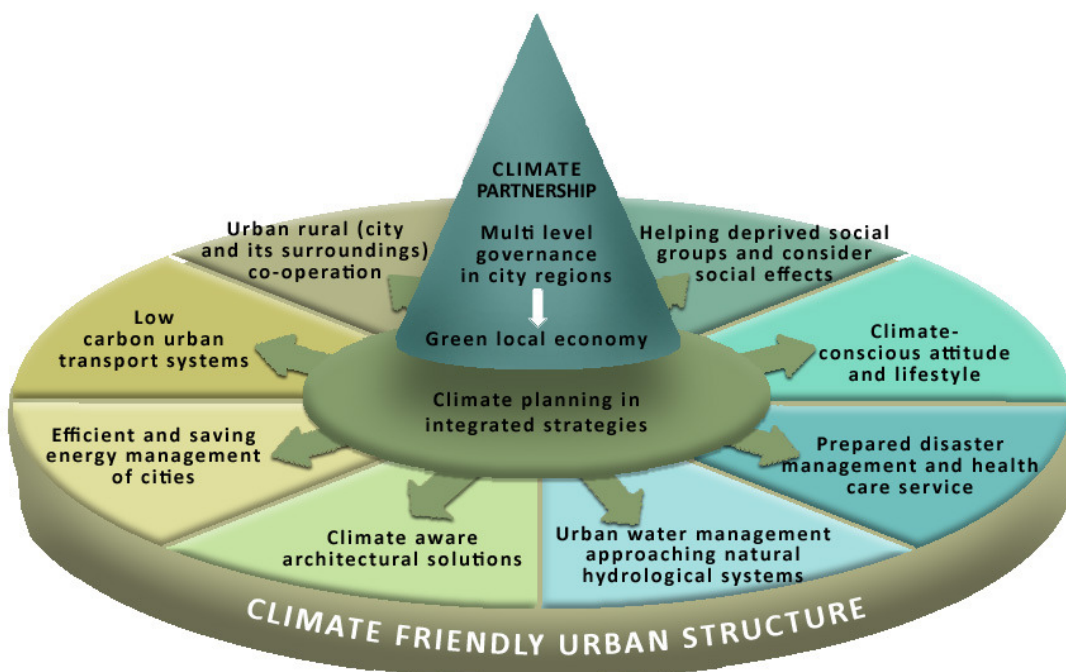
The real strengths of this volume lie in its integrated approach, which is geared to utilising the existing possibilities, and in its practical focus. The real novelty that this volume brings is its structural approach: it reviews, from the perspective of urban climate related considerations, those sets of instruments that local governments are able either to create or to influence.

The logic of the Handbook - The pillars of the climate-friendly city

The structure of the handbook follows the different fields of possibilities and tasks of cities related to urban climate.

The general idea behind the Handbook is that the climate-friendly city as a concept can be realised via various types of activities in quite a wide range of sectors and spheres of city management. In this concept there are different pillars - fields of intervention with proposed approaches - which can ensure the climatically positive development and character of the cities.

Most of them are different sectors of urban management such as transportation, energy management, certain public services, architecture, water management, etc. However, there are three key pillars, which have more horizontal and outstanding importance: governance, climate-aware, integrated strategic planning and the proper spatial structure of the city supported by zoning policy, which has significant influence not only on the climate itself, but also on the opportunities of all other pillars in different locations. The pillar model of the climate-friendly city can be seen in the diagram below.



The pillar model of the climate-friendly city as the logic of the Handbook

How to use the Handbook – The structure

Let us provide some help on how to use this publication efficiently.

The general structure of the Handbook follows the pillars of the climate-friendly city as introduced in the previous subchapter. The colours of the above diagram help the reader to navigate within the Handbook as these colours are used in the table of content indicating the relevant chapters. In discussing the tasks and opportunities cities have in relation to combating climate change, the chapters of the Handbook almost always cover both mitigation and adaptation. These two aspects appear in separate subchapters, where relevant.

This publication is an extensive Handbook, which provides different options on how its content can be used. Due to its remarkable length **reading the whole document** is quite challenging. This is not expected from most readers.

You can gain a quick overview of **all the chapters**, to a certain extent if you look at the **brief recommendations** at the end of each chapter. These are summaries of the main messages of the given chapter. In many chapters illustrations also help understanding.

If you need detailed information on a certain area then you should read the given chapter in detail.

If you need good examples or want a more practical insight into a particular theme you can find **good practice** from all around Europe in the boxes. 78 excellent case-studies were contributed by urban authorities and ministries of the EU member states, plus Switzerland and Norway. In each box you can find a link to contact the relevant organisation, to get more information, or to build co-operation.

The **Appendix** of the document provides more practical information for the readers. The list of the most relevant European regulations, directives, climate related urban policy documents and the main European networks of organisations in the field are important starting points to find additional official information and to build partnership and cooperate in this field. The set of urban climate-related indicators provide assistance for the implementation of the proposed measures of this Handbook and for the evaluation of their results.

In the following we intend to help the readers to get a very basic understanding of the **content of the chapters** of the Handbook, which might help when searching for particular information.

The Handbook starts with the identification of the phenomena of **urban climate** and the impacts global change has on it. The first chapter of this volume aims to identify the peculiarities and the possible impacts of **urban climate** and its changes, focusing on the significance of such impacts, while taking geographic differences within Europe into account.

The authors believe that the first pillar of all the efforts is the appropriate **governance**, which must be multilevel and ensure the ongoing partnership in climate protection. Furthermore, integrated planning should be the general tool of coordination. The second chapter also addresses some key cross-cutting issues, such as climate-friendly public procurement and ensuring climate justice.

Chapter 3 of this volume offers a more detailed and, one might say, innovative methodology to support the elaboration of **integrated strategies**, which deeply include climate aspects. Step by step guidance for integrating climate aspects in strategic planning is a practical tool for all cities in this chapter. Decision-making and planning must be based also on climatic models, predictions/forecasts.

Regular urban environmental data collection, monitoring, communication and also the transparency of information are essential aspects of climate-friendly governance and planning.

The volume places special emphasis on **shaping the structure of cities**. Spatial structure is best shaped through zoning policies. However, since the spatial structure that is most favourable in terms of climate considerations can be very different from one region to another and from one city to another, we introduce a set of general criteria that may be valid for most regions, dedicating special attention to the relationship between urban and rural areas and the phenomenon of urban sprawl. The relations between the city and its rural surroundings are important in almost all cases from the point of sustainability. The issue of green surfaces also gets increased attention in the 4th chapter.

Transport is the main source of urban GHG emissions, therefore it is a priority field where cities can act. Preferred types of urban transport, attitudes to transport, and also adaptation possibilities are addressed in the 5th chapter.

As described in chapter 6, cities have instruments to influence the **energy management** of the city to enhance energy efficiency and conservation.

When it comes to urban development, the importance of architecture, its local regulation, and its local practice is more than obvious. Today, European **architects must** realise how important sustainability and climatic considerations are. The possibilities of building regulation, methodological development and sharing knowledge in the context of climate change related adaptation and mitigation are expanding spectacularly. Key approaches and good solutions of architecture are introduced in chapter 7.

Chapter 8 gives guidelines for integrated **urban water management**, which should shift towards the natural hydrological systems, conserving and retaining water and being prepared to manage sudden events, sea level rise, and other risks.

Local authorities have a huge responsibility in managing different natural disasters, and health consequences. The institutions responsible for disaster **management and health care** services must be ready and prepared to tackle sudden events.

As introduced in chapter 10, local authorities and also national, regional urban policies can increase the people's awareness and promote climate- and environmentally-friendly attitudes and lifestyles.

Disadvantaged urban social groups are particularly vulnerable to the impacts of climate change. Their interests and risks must be taken into account and they need additional efforts to adapt to the changing circumstances, particularly in the deprived urban areas.

There is a separate chapter dedicated to the **economic consequences** of both mitigation and adaptation and to strengthening urban economy. The green economy and the development of the local economy are introduced in the 12th chapter. Although it emphasises the economic dimension of the climate change issue, it neither undertakes to give a general overall picture on public funding opportunities nor introduce methods to measure economic impacts. However, in this respect we recommend the Computable General Equilibrium Model of Cities and Climate Change published in the 'Cities and Climate Change' (OECD, 2010).

Urban adaptation and mitigation measures might have **social affects**, which need higher attention and might need counterbalancing measures.

This knowledge introduced in different chapters of the Handbook are recommended to combine with the locally accumulated experiences of the readers. We do hope, that this joint effort of readers and authors can contribute to complete your urban climate related tasks more affectively in the future.

1. 'URBAN CLIMATE' AND ITS EXPECTED MODIFICATION DUE TO THE IMPACT OF CLIMATE CHANGE

1.1. URBAN CLIMATE

The determinant characteristics of cities, i.e. high level of built-up density prevailing in large areas, significant industrial activity and heavy traffic, fundamentally influence the factors responsible for the development of the climate. As a result of this a mezz climate largely different from that of neighbouring regions evolves in cities. Owing to its prevalence and typicality, this mezz climate with special features has even been given an individual name: urban climate. Understanding its characteristics, its forecasting, as well the development of preventive actions are the subjects of serious scientific research.

The most thoroughly studied partial phenomenon of the urban climate is the '**urban heat island**'. This definition refers to the fact that the surface temperature of cities significantly exceeds the values measured in surrounding areas of settlements. This holds serious public health risks for city dwellers. According to measurements, the annual average surface temperature of Paris is higher than that of its outskirts by 1.7°C; this value with respect to Budapest is 1 to 1.5°C and in the case of London 1°C. In winter time and at night there are more favourable conditions for the formation of urban heat islands; at the same time, increased wind speed and the growing extent of cloud cover have a balancing effect to the differences between the temperatures of cities and their outskirts.

The development of the urban heat surplus is the common result of several factors. The most important of these are the accumulation of dust and greenhouse gases in the air layers above cities, and the low albedo and fragmented morphology of city surfaces. A further factor is due to the high reliance of cities on external energy sources which leads to additional heat emissions.

Due to typical urban activities the radiation balance of large settlements is significantly different from that of the natural environment surrounding them. A large quantity of aerosol and greenhouse gases gets into the atmosphere as part of transport and industrial emissions. Aerosols are tiny, colloidal-size particles serving as condensation cores in the generation of precipitation. Therefore, their presence increases air moisture content. As a result of high vapour, dust and greenhouse gas concentration, a dome containing these substances forms over cities, which leads to a significant (15 to 20%) decrease in short-wave radiation reaching the surface. At the same time warm air gets stuck close to the surface because of the retention of long-wave radiation. Consequently, owing to anthropogenic pollution, an increased greenhouse-effect prevails in the air layers over large settlements.

The low albedo of the urban ground surface plays a significant role in the formation of urban heat islands. Of construction materials used, asphalt has a particularly low albedo, while concrete and brick

walls also absorb a significant quantity of short-wave radiation. Due to fragmented morphology of the surface, the stored energy quantity can leave in the form of long-wave radiation only to a limited extent. This occurs because part of the emitted heat gets absorbed again on the surface of buildings and plants and is radiated back towards the surface. As a consequence of all the aforesaid, reemission of heat absorbed during the daytime reaches into the night. This prolongs the starting time of relief from heat in the evenings, which predominantly contributes to the increase of the daily mean temperature and the formation of the urban heat island phenomenon. At the same time, by careful city planning, the fragmented surface may contribute to the formation of cold inflows mitigating the urban heat surplus by creating the possibility of cross-ventilation.

Residential, industrial, commercial and transport heat energy emissions originating from the burning of fossil fuels also play a role in the formation of urban heat islands. Measurements indicate however that the significance of anthropogenic heat production in the formation of urban heat islands is only secondary compared to the surplus heat originating from the different heat economy of artificial surfaces. This is well proven by the fact that, based on examinations carried out in cities located in plain areas and far from open water surfaces, there are significantly higher heat island intensity values in non-heating periods than in heating ones. In addition to the direct effect occurring through the emission of heat energy, the burning of fossil fuels contributes also in an indirect way to the formation of urban heat islands through the greenhouse-effect caused by the emitted pollutants.

The surface temperature of cities is further increased due to the high proportion of paved surfaces, as the majority of the rainwater flows off and, therefore, less moisture gets into the surface ground layer. Consequently, in the dry periods less water is available for the evaporation, which has a cooling effect. This in turn increases the warming of the urban atmosphere. As a result of the low extent of evaporation, the humidity of the air layers near to the surface of larger settlements develops in a peculiar way. Relative humidity is considerably lower in settlement districts characterized by high built-up density than in the outskirts and districts comprising large green areas. The difference is especially significant in periods with low air motion, when atmospheric humidity of districts may differ by several percentage points. In extreme cases an **artificial desert climate** may develop in downtown areas with 20 to 50% relative humidity values.

As a result of the high warming experienced in inner districts of settlements, in these areas the air strongly rises and its place is taken by the inflow of cooler air coming from the outskirts of the settlements and neighbouring regions. In case of clear and calm weather an individual local wind system, so-called **urban wind** develops in areas that can be characterised with high built-up density. Urban wind has a dual significance. On the one hand, being particularly strong in the evenings it helps to mitigate and to bear more easily the urban heat island effect. On the other hand, it helps to clear the polluted air of cities. In forming the urban structure, the prevalence of these favourable impacts is assisted by taking the wind directions and channel effects into account and preventing or terminating the establishment of potential blocks. In case of settlements located on hillsides with surrounding areas covered with forest (which warm up less during the daytime) cold air ‘flowing down’ from the higher levels has great significance. Favourable effects similar to those mentioned with respect to urban wind can be achieved by developing the urban structure optimally, enabling cool air coming from higher parts of the hill to flow unobstructed towards the slopes. As a result of special urban circulation systems (characterised by frequent lifting) and the great number of condensation cores originating from dust pollution, the **quantity of precipitation** in densely inhabited settlements is on average 5 to 10% higher than in the neighbouring areas.

1.2. CONSEQUENCES OF CLIMATE CHANGE IN EUROPEAN REGIONS

Impacts of climate change (e.g. the increase of annual average temperatures and the temporal and spatial modification of the quantity of precipitation) appear in an intensified and concentrated manner in cities. The above described characteristics of the urban climate show the relatively higher

proportion of extreme periods compared to surrounding areas. The climate of peri-urban regions becoming more extreme further enhances unpredictability of the urban climate, which is anyhow inclined to extremities. The exposure of cities to climate change is topped by the consequences of climate change affecting large geographical regions (sea level rise, droughts, floods), that appear in cities, as well. However, the extent of the expected changes and major hazard factors show significant differences between individual regions of Europe (EEA, 2008b)



Figure 1: Most important sector specific impacts of climate change and their consequences in the major European biogeographical regions. (Source: EEA 2008b)

1.2.1. Expected tendencies of major climate determining factors

Since the beginning of regular measurements based on a uniform method (1850), the **annual average temperature** has shown a clearly increasing tendency all over Europe. In the 12-year period between 1996 and 2007 eight years are among the twelve hottest ones ever measured. Based on the forecasts of climate models, the tendency continues: in the last two decades of the 21st century the annual average temperature of Europe will exceed the average temperature of the period from 1966 to 1990 on average by 1.0 to 5.5°C, depending on the models applied. However, there are great regional and seasonal differences behind the even increase of the annual average temperature. A significant increase (which might even exceed 5°C) of average winter temperatures is expected in the Northern part of Europe (mainly in the region of Scandinavia and Finland) as well as in Central and Eastern Europe, and an increase of similar magnitude in average summer temperatures is expected in area of the Mediterranean.

Out of the **periods of extreme temperatures** the length and intensity of the summer heat waves have increased in the entire territory of Europe, while the number of frosty days has decreased in the past century. According to the forecasts of climate models, the greatest increase of the daily maximum temperature values can be expected in the currently already hottest Mediterranean region. By the end of the 21st century, the number of tropical nights causing public health problems (minimum temperature of over 20°C) may reach even 30 to 40 in the non-upland areas along the Mediterranean and Black Sea, and 20 to 30 in the Carpathian Basin and in the South-Western regions of France. Furthermore, the number of frosty days may considerably decrease also in Scandinavia, which is already affected most by periods of extreme temperatures.

Past and expected future development of **precipitation conditions** shows significant regional differences. Based on the calculations of climate models, tendencies started in the 20th century continue further. Accordingly, in Northern Europe the annual quantity of precipitation increases, particularly in the winter period (by approx. 20%), while in the rest of Europe the annual quantity of precipitation is expected to decrease, to an increased extent to the South. On the Iberian, Apennine and Balkan peninsulas the average summer precipitation of the last two decades of the 21st century may even halve compared to the last two decades of the 20th century.

Out of the periods that can be characterised by **extreme precipitation conditions**, the frequency of both high-intensity precipitation conditions and dry periods are expected to permanently increase in most of Europe. The number of extreme precipitation events is expected to further increase in accordance with the tendencies experienced at end of the 20th century, even in regions (the Mediterranean and Central Europe) where annual volumes of precipitation are expected to decrease. The number of extreme precipitation events will increase by 17% in Northern Europe and by 13% in Central Europe, at the same time no significant change is expected in Southern Europe in this respect. It is particularly alarming that, according to the results of the climate models, the length of extreme precipitation events also shows an increasing tendency. As a consequence it is expected that the number of periods characterized by ideal conditions for the formation of floods will increase. Based on the data of the past 50 years, increase of the length of dry periods can only be demonstrated in the winter, mainly in Central and Eastern Europe and Western Russia. At the same time, according to the forecasts, long summer drought periods are expected to occur in the basin of the Mediterranean Sea. Here by the end of the 21st century the length of dry periods characterised by less than 1 mm of daily precipitation quantity may exceed the current length even by a month. In Central Europe the length of drought periods will ‘only’ increase by a week, while in other parts of Europe periods characterized by permanent drought are not yet expected to develop.

1.2.2. Expected changes in the climate of European cities

Based on all the aforesaid, the climate of European cities is expected to develop in geographic regions of Europe as follows.

According to the forecasts, the climate of the **Northern region of Europe** (i.e. Scandinavia, Finland and the region of the Baltic Sea) will, all in all, be milder and rainier. Significant changes in comparison with today's climate are expected especially in the winter time. Average temperature increase in the winter months will gradually increase towards the North (in Lapland it may reach even 7°C). At the same time, summer average temperature will also be augmented and the difference may even reach 3°C. The quantity of precipitation may increase in most of Scandinavia and in Finland by 20 to 30% on annual average. In winter it may even exceed current values by 50%. As a consequence of warming tendencies, the number of snow-covered days may halve in the southern areas of Finland, in the territory of the Baltic States and in the coastal belt of Norway.

The increasing quantity of precipitation and the rising temperature tend to prevail more in cities than in the neighbouring areas as a result of the urban climate effect. As a consequence of all this, in cities located in the Northern region of Europe preparations must be made for draining and utilising the large quantity of precipitation in winters and for dealing with heat waves during the summers. The growing quantity of precipitation is expected to decrease winter energy demand for heating. At the same time in southern areas during the summer demand for cooling is expected to increase. However, hydro power being currently available in large quantities, mainly in the territory of Scandinavia, remains to be easily accessible.

In the **Atlantic region** (comprising the British Isles, Ireland, North-western parts of France and Germany, the Benelux States and the islands of the North Sea) yearly temperature is expected to rise in a nearly uniform extent of 2 to 3°C compared to the values experienced at the end of the 20th century. In most of the region the expected annual amount of precipitation will remain nearly unchanged compared to present values; an increase slightly exceeding 5% is expected in Scotland, and a similar decrease in Western and central areas of France. However, the seasonal distribution of precipitation will fundamentally change in the forthcoming decades: winter precipitation will increase considerably, by 15 to 50%, while the summer one will decrease everywhere; to a higher extent towards the south. The only exceptions will be in the northernmost territories of Scotland. Great storms accompanied by high winds will become more frequent and intensive in the entire territory of the region. In coastal cities in settlements located little above and particularly in those which lie below the sea level the expected water level rise poses a significant challenge.

As a consequence of all these, in the cities of the Atlantic region the main challenge will be the drainage of the excess waters in winters, drought appearing as a result of the decreasing quantity of precipitation and high temperature in the summers. Therefore, in this region it is practical to elaborate and apply technological solutions for retaining the immense amount of winter precipitation and storing it for the summer season. In the southern part of the region (especially in France) and even in northern areas, preparations must be made to deal with the significant increase in the frequency of heat waves. In the territory of France 20 to 30 tropical nights are expected by the end of the 21st century. This combined with a result of the urban climate will render night time relief from heat almost impossible in settlements with high built-up density during most of the summer.

In Central Europe (i.e. in the coastal regions of Germany and Poland, as well as in the Czech and Carpathian Basins) annual average temperature is expected to increase by a nearly identical extent, by 3°C. The climate models forecast an average temperature rise which is higher by 1°C in Poland during winters and in the Carpathian Basin during summers. The amount of precipitation is not expected to change in the southern parts of the region. In the northern parts a slight increase of 5% is expected. Similarly to the Atlantic region the annual distribution of precipitation will transform here, as well; in winters the quantity of falling precipitation will rise in the entire region, to an increased extent towards the North, while in summers it will decrease everywhere, showing an increasing tendency towards the South. This will cause serious damages particularly in the Carpathian Basin as here the annual amount of precipitation is the lowest within the region, already in current conditions. In Central Europe the number of drought days will grow from 20 to 25, typical of the end of the 20th century, to 30 to 35 by the end of the 21st century.

In cities of the region the biggest problem is expected to be the increase in the duration and intensity of summer heat waves, particularly in southern areas. In addition, challenges will include the increasing length of highly moist periods and increased quantity of the precipitation falling during such periods in winters. Due to the change of the nature of winter precipitation from snow to rain, the above conditions potentially lead to high floods suddenly cascading down. The drought during the summertime is expected to cause further problems.

In the **Mediterranean region**, with the exception of the islands of the Mediterranean Sea, the annual average temperature will increase everywhere by at least 3°C. In Andalucía and on the plains of Bulgaria the rise will be even higher. The increase of the average temperature of the summer period will be particularly high and may, with the exception of Southern Italy, even exceed 4°C. The quantity of precipitation shows a (in winter slight and in summer strong) diminishing tendency. In the western part of the Iberian, the central region of the Apennine and in the entire area of the Balkan peninsulas only two third of the total precipitation typical of the end of the 20th century is expected in the summertime. However, this region is not expected to be affected by exposure to the increasing threat from storms that is characteristic in other parts of Europe.

The climate of Mediterranean cities may become particularly extreme because of the urban climate effect. This is especially true for the summer period when a further increase compared to contemporary heat conditions is expected. Even in areas without buildings the number of tropical nights may reach 40 to 50. In cities this number is expected to be even higher as a consequence of the urban climate effect. In summer the heat can be accompanied by serious water shortage. This is made even more serious by the decreasing tendency in winter precipitation, which contributes to the insufficient filling of natural and artificial water storage facilities.

1.2.3. Social, economic and environmental impacts of the changing urban climate

The climate determines the life of cities in multiple sectors through in an interconnected system of relations. Therefore the changing thereof also effects many areas, sometimes causing simultaneous multidirectional changes. The situation is complicated also by basic local differences caused by geographical location. It is hard to set up a general scheme or lesson for these effects even within Europe. However, it is true by all means that the changing of environmental conditions fundamentally influencing the life of society sets new challenges exceeding usual duties, dangers and possibilities for the inhabitants, institutions and service providers of cities. Settlements react to these challenges according to their possibilities, socio-economic power and ability for renewal. Furthermore, for the elaboration of truly efficient and forward-looking answers, well-founded knowledge, rationality, inventiveness and collaboration are needed.

It seems to be unquestionable that climate change will not settle in a balanced state within a foreseeable timeframe. Therefore, the society too has to prepare itself for not a single transformation but for continuously changing environmental impacts. Consequently, permanently changing adaptation is required, comprising enhanced and renewing tasks in all affected fields.

As a consequence of climate change, the following natural conditions are expected in Europe:

- More frequent and longer lasting summer heat waves.
- Annual precipitation decreasing and becoming more and more irregular.
- High-intensity precipitation, increased frequency of rainstorms and hails.
- More variable weather.
- Prolongation and increased frequency of frost-variable periods in regions with long and cold winters.
- Strengthening and more frequent storms; increased chance for the appearance of tropical cyclones in the coastal regions of oceans, with simultaneously strengthening abrasion.
- Storms accompanied by stronger winds reaching previously protected regions, mainly in Central Europe.
- Strengthening and more frequent storm tides along seashores.

- Rising sea level.
- Permanent rising of the groundwater-level in coastal areas; local and periodical rise in areas prone to floods; decrease of the groundwater-level in most areas.
- By the general tendency of decreasing water yield of rivers, the likelihood of local inundations originating from sudden floods and downpours increases and the peak height of floods is expected to rise.
- Due to drier vegetation and high-intensity precipitation, surface erosion increases, mainly in Southern and Central Europe.
- Due to the varying groundwater-level the load bearing capacity of the soil may change and land slides may develop.
- As a result of the rise of winter temperature, less cold tolerant organisms appear and gain ground particularly in areas outside the Mediterranean region.

Concrete impacts are evidently connected the adaptation side of climate change. In connection this here we do not address mitigation of the emission of greenhouse gases, i.e. the modification of the factors bringing about the change. Furthermore, it is worth separating direct and indirect impacts. Direct impacts are settlement processes directly influenced by climate and weather, while indirect effects often appear as part of other, already existing socio-economical processes, strengthening, controlling, even hindering them. Evidently, direct effects are rather of ecological, healthcare and technical nature, while indirect effects can influence every segment of the life of settlements. In the following we summarise briefly from both aspects the impacts of climate change according to the life in, as well as in terms of fields of operation of settlements.

Among direct effects, those exercised on **health and the institutional system of healthcare** are of key importance. The impact of heat waves occurring parallel to increasing temperatures are well-known. Currently, summer heat waves are mainly typical of Southern Europe. However, as a result of climate change these are expected to occur more frequently in Central and Western Europe, as well. At the same time the inhabitants of countries located in these regions are less accustomed to high temperatures. Therefore the increase of the frequency of periods characterized by extreme temperatures entails an unusual risk for those living in a cooler climate. General warming is accompanied by the spreading of pathogens and their vectors, the extension of their activity periods (e.g. in the case of mosquitoes). Furthermore milder winters enable the settling of organisms that under earlier conditions have not been able to subsist in a natural way. The change in vegetation composition, and independent of this, the increase of periods with hot, non-refreshing air cause an increase in pollen concentration and resulting allergic symptoms. The expected more variable weather disproportionately impacts the sick and the elderly. Therefore not only the development of extreme temperature levels but also the speed of the change becomes a risk factor. UV radiation increasing parallel to warmer and fairer weather is also a significant risk factor, rising with less striking speed, however.

Indirect impacts of climate change, including the increase in weather-related disease and sickness, increased danger of epidemics, more frequent accidents due to floods, damages caused by storms, entail special duties as on the **institutional system of healthcare**. These also include taking care of the inhabitants affected by emergencies. Furthermore, as a result of summer warming, the energy demand of buildings increases. This may in turn influence the safety of energy supply. These are already direct effects.

The scope of the impacts of climate change is the widest with respect to **buildings and the built infrastructure**. The generally higher peak temperatures may cause obstructions in railway transport on the entire continent, as a result of the breaking of overhead lines and the deformation of rails. In the northern European regions frost variability with increasing impact can be highlighted. At the same time this also appears in the Central European region to a smaller extent, causing damage in buildings, pedestals, sculptures and road paving. The increased frequency and strength of storms damages buildings and transport cables all over the continent, both directly and through the of falling trees and posts. Current failures caused by the breaking of electric wires affect almost every field of

contemporary life. Of the impacts of the more intensive precipitation, downpours and thunderstorms, the increased lightning activity and hails are the most dangerous for buildings as well as for almost every freestanding man-built structure. Downpours occurring in the summer period or at thaw may cause increased soil erosion, lead to the formation of gullies, the scouring of roads and buildings, and may trigger collapses practically anywhere in Europe. Subways, tunnels and underground systems are primarily endangered by inundations related to such events. At the time efficient ventilation in time of heat waves is also a difficult task to solve. Furthermore, changes of the groundwater-level may cause the shifting, dislocation, deformation and break of the soil, as well as of buildings and conduits.

In respect of **transport**, the most important are the impacts due to the above mentioned exposure of the infrastructure. In addition to the aforesaid, however, very important are also the impacts affecting people on the go, mainly in road transport. Heat waves in vehicles not supplied with air conditioning devices decrease the ability to concentrate and may cause sicknesses, which endangers not only the driver but passengers, too. The increase of the frequency of the extraordinary weather conditions (sleet, thunderstorm, strong wind) means a serious risk for unprepared vehicle drivers. Strong storms entail increase problems for sailing and aviation, too. However, the weaker winter ice cover lasting for a shorter time creates new and favourable possibilities for North-European sailing.

The impact appearing in the field of **water management and surface drainage** is also complex. In most of the continent, the water shortage due to droughts becoming more frequent and serious and the extraordinary danger of floods caused by downpours occur or appear simultaneously. Also from the aspect of the danger of floods, particularly important are such local floods and inundations caused by downpours as cannot necessarily be related to any watercourse. The groundwater-level may decrease or rise depending on the development of the precipitation and the infiltration but at the coastal areas increasing will be determinant due to the rising of the sea level. In terms of **drinking water supply**, the subsurface water resources providing the drinking water base are also endangered accordingly. At the coasts, the infiltration of the seawater into the sweet water layers because of the decreasing surface water recharge is particularly dangerous and may cause the deterioration of the drinking water base and an increased decay in buildings being in touch with the salty water. In case of drinking water exploited from surface and shallow water bodies the main problem is that the accessible quantity of water will be the least even in periods with increased water demand. The decreasing recharge may also cause the deterioration of the water quality.

In respect of **wastewater treatment**, problems are caused by floods in the combined sewer systems and by wastewaters being more concentrated due to the decreasing water consumption in the operation of wastewater treatment plants. In the field of **waste management**, the climate change effects to the greatest extent waste deposits being inappropriately designed and exposed to the danger of erosion.

In most of Europe the **urban green areas** are ab ovo exposed to increasing environmental stress due to the growing heat, drought and the spreading of thermophilous species and plant damaging insects. This is further increased by the increased use by the urban inhabitants as in warmer weather more and more people use the city parks more and more intensively. The vegetation exposed to greater environmental stress is less resistant to storms even when they are becoming stronger and more frequent. At the same time, thanks to the longer and warmer vegetation period, warming-up is beneficial to the flora of areas with a cooler climate.

In respect of settlement-level **energy supply**, at the time of the summer heat waves the most important impact is the growing energy demand of air-conditioning, but the damages caused by storms and the wind in the infrastructure and the line breaks are at least of the same importance, although rather unique events. On the other hand, because of the large electric networks overloading may occur also in systems not affected by any direct impact or damage. Finally, the mitigation and adaptation solutions of the other sectors may indirectly increase the demand for electric energy (switching from bus transport to subway or tram), which, from an energetics point of view, is a

concomitant of the climate change. A favourable impact is the decrease of the heating demand because of the expectably rising average temperature and shortening, warming winters.

The direct impacts of the climate change firstly appear in the field of **economy**. The impacts outlined so far are primarily of technological and technical nature and their effect upon the economy clearly manifest themselves in the expenditures of production and services becoming more costly, since the effects of technical nature, even if less harmful, entail utilisations different from the usual loads and specifications, which requires either new (even if not necessarily more expensive) solutions or the strengthening and transformation of the existing technology. Depending on the climatic exposure, sometimes these expenses are quite high in certain partial fields in terms of national economy, e.g. in case of flood protection. The nowadays characteristic large supply systems, which are exposed to the environmental changes through transport and infrastructure, are more sensitive and vulnerable to these impacts. At the same time, the impacts of the climate change can be beneficial in many fields for the economy. The changing possibilities of agriculture appear in an indirect manner, in the strengthening or weakening of the situation of the neighbourhood of the cities. The generally decreasing heating demands are, theoretically, also beneficial but, due to the more variable weather, the costs can develop even reversely. With the exception of the Mediterranean region, the extension of the touristic season is a favourable effect but in the South the more and more serious heat waves may diminish the summer guest turnover. In the mountains the drastic rearrangement of ski tourism is already a currently existing process. The favourable ice conditions will have a beneficial effect on maritime trade in the coastal areas of the Northern, Baltic and Black seas.

The mitigation and adaptation solutions entail not only extra costs but with reasonable economy management they even may result in the appearance of new products and sectors, e.g. in the field of producing green energy. In case of a prepared economy, the expenditures of technical adaptation can also be kept in place, i.e. they may strengthen the local economy. Meanwhile, the economy is also the load bearer of social effects; the changes of the society appear here, too, although in a multiply indirect way. For the society, adaptation mostly entails extra costs and new tasks, which can only partly be entrusted to the civil sphere. The local governments and the state withdraw, even if obliquely, from the economy the money necessary for financing the aforesaid. At the same time, the impacts of the climate change can lead to beneficial changes in many fields of the economy. The production of modern and eco-friendly products and technologies is the so called sector of green economy. This new sector and its technical solutions that contribute to the adaptation to climate change can be a potential employer in the future. Creating new jobs can be an important step in the development of the local economy while cities can become more climate-friendly.

The **social effects** belong to the most varied impacts that are the hardest to forecast as mostly they are related to the natural processes triggered by the climate change only in an indirect manner. In cities, similarly to the environmental impacts, the social effects also appear in a concentrated and more acuminated manner. The changes mainly affect the disadvantaged groups (the poor, the old, the ill, the disabled and the minorities) as they have the least reserves that can be mobilised for adaptation. From a material point of view, the unfavourable change of the housing conditions (due to e.g. the heat waves, floods, more quickly deteriorating buildings) and the damages caused in movable assets and in properties by the extraordinary weather conditions, storms, floods and soil motions make these groups defenceless. Many times their preparedness is hindered by the lack of information either because of cultural segregation (e.g. in case of immigrants) or the low level of education. The changing of the urban climate may influence the status of certain city quarters, too, causing the dropping behind of quarters hit more strongly and the rise of others. The regional and even the international economic changes may improve or worsen the status of a settlement in the settlement network. And the changing of the economy or merely the living conditions causes more and more significant migration. The settlements are very sensitive to all economic changes; the regional and even the international economic changes may influence – improve or worsen – the situation of a settlement in the settlement network. This is one of the main problems that threatens us even nowadays. While taking efforts adapting to climate change we must support deprived social groups

and the cities they live in. The aim of both the adaptation to climate change and the spatial planning as well is to decrease the territorial differences.

The role of **environmental safety** and disaster protection is generally important both from social and economic point of view. The most serious problem will be the increase of the frequency and intensity of floods, in particular quick and local floods. In addition, the growing frequency and intensity of forest fires is to be highlighted, especially because they have to be reckoned with in regions where, so far, they have occurred rarely and with little intensity, like in Central Europe. The variable weather endangers transport safety mainly in the winter period (stormy winds, sleet, lengthening of frost-variable periods in Northern Europe). Emergency situations may develop also because the increasing load on buildings and the infrastructure. All these will necessarily cause the spreading of **insurances** and, if not efficient measures are taken for increasing adaptation, also their becoming more and more expensive. From the aspect of the social and economic effects, the settlements and regions having larger reserves, technical and mental potential, stronger collaboration and a well-thought-out management can adapt themselves with better chances; therefore, the change may, theoretically, sharpen the regional differences. At the same time, these regions might have thanked their so far favourable position to environmental features whose change exceeds the adaptive capacity of the society, while elsewhere even the challenges of adaptation create new possibilities.

1.2.4. The role of modelling and the vulnerability assessment

The ongoing and foreseeable changes of the environment make the traditional planning methods obsolete in some respects. Not only in the case of technical details, but for certain development aims, it is not sufficient to build on recent data but the results of climate models have to be also taken into consideration. **Modelling** must be one of the underpinnings of the planning process. This is the case in the fields of flood prevention, land use, water supply and management, health services, and the provision of technical infrastructure. In coastal regions, for instance, it affects almost every aspect of urban development. Only this paradigmatic change can make the adaptation efforts effective enough. However, the greatest problem with modelling is a high level of uncertainty. Climate models provide different scenarios about future weather events so their impacts can be even more unpredictable. A wise solution is to consider the main trends of change (they can be more certain than concrete data) and the use of more (two or three) climate models.

Furthermore, the evaluation of foreseeable environmental changes leads to the necessity of **vulnerability assessments**. Vulnerability is in itself a very broad concept, and as a general term, it has a very limited usability. As every field and aspect of human activity and environment has its own interaction system, vulnerability also differs from case to case. Because the scale and characteristics of climate change vary across regions, the success of adaptation efforts depends on their regionally specific approaches. So, instead of conceiving vulnerability of a city in general, it is better to use this term for a particular city specifically related to floods, health, water supply etc. In concrete cases, the evaluation of vulnerability become not just useful but almost fundamental since it highlights the regions and activity fields where there is the greatest need for intervention.

The methods of vulnerability assessment use several indicators to predict the impacts of changing circumstances. For example, the Climate Change Vulnerability Index (CCVI), released by Maplecroft, evaluates 42 social, economic and environmental factors to assess national vulnerabilities. One of the widely used models for the assessment is the CIVAS (Climate Impact and Vulnerability Assessment Scheme) model, developed in the CLAVIER project carried out under the 6th Framework Program of the EU. In this method, a region's or a city's vulnerability is evaluated on the basis of their exposure (to the changes in meteorological parameters), sensibility and adaptive capacity. The complex socio-economical and environmental climate-vulnerability evaluation of the LAU1 regions in Hungary has been performed relying on the CIVAS model. Vulnerability of the micro-regions has been assessed along four topics related to climate change: drought, loss of biodiversity, forest fire, heat waves. The evaluation has resulted in an overview of the prospective spatial differences in climate change effects in Hungary.

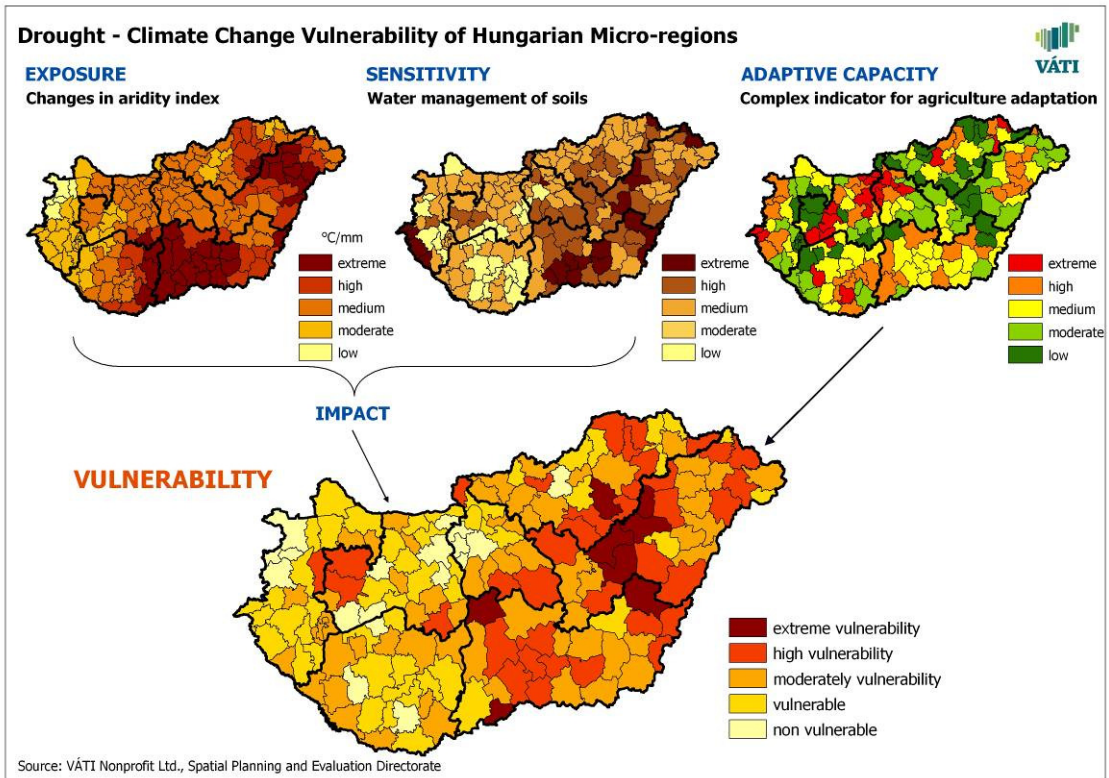


Figure 2: Vulnerability of Hungarian micro-regions related to drought (Source: The 4-Year Development Program to Prevent the Adverse Effects of Climate Change 2010-2013, VÁTI 2009)

European Environment Agency (EEA) has an important role in supporting data collection and management from different sources related to environmental processes and problems. With the help of this diverse database, European countries and organisations can make assessments and models of their own questions. Also, the Agency helps the Member Countries providing a decent background for creating policies on the adaptation to climate change. Overall, EEA is the main scientific institution in Europe that issues researches about climate change.

2. CLIMATE-FRIENDLY URBAN GOVERNANCE FOR FORMING ECONOMIC AND OTHER URBAN POLICIES

The concept of an urban climate policy – a policy that deals with climate protection and adaptation to climate change – and its governance issues can look back at a much shorter history than other urban policy related activities such as, for example, environmental and urban development policies. As a result, clear-cut, fully-fledged urban climate policy systems have not yet emerged almost anywhere. In fact, this is an ongoing process. Currently cities enjoy a great degree of freedom in shaping their climate policies and climate policy related partnerships. For example, they can freely decide what messages they adopt and/or adjust to their own specificities, and from what sources – these may be either the climate plans of any national, regional, or international organisation, or those of a partner city. However, too much freedom can cause vagueness. With this manual, we would like to help make these governance and policy forming choices easier and thereby to contribute to the shaping of a common European urban climate policy.

2.1. THE SYSTEMS OF THE EUROPEAN URBAN CLIMATE POLICY

Despite its short, a decade-and-a-half history, urban climate planning has become by now more than an activity carried out by various cities in isolation. In fact, it takes the shape of formal or informal systems. The top-down approaches start out generally from the national level and require cities to perform a number of climate planning related mandatory obligations. The system may also be built in a bottom-up approach, when the individual cities or groups of cities join forces in implementing their respective initiatives; they may go as far as elaborating international recommendations within the framework of regional, national, or cross-border co-operation schemes.

2.1.1. Building bottom-up and top-down simultaneously

A future European urban climate policy must be built by blending bottom-up and top-down approaches.

On the one hand, it is important to strengthen the community of climate-friendly cities and to develop further the existing European networks of climate-friendly cities that already have many members and significant achievements. This way, cities and their networks are empowered to initiate national and European regulation and policy intervention as well as the elaboration of co-operation schemes for sharing technical and methodological knowledge.

At the same time, urban climate policy frameworks must also be created both at the national and the European levels, for which the following need to be done:

- monitoring the climate policies implemented by European cities and systematically publishing the messages of these city initiatives;
- ensuring that the messages of the international initiatives in climate policy and the related scientific and technical achievements reach each and every city;
- elaborating a regulatory framework in the field of urban climate policy that provides the individual towns and cities with support and guidance to shape their own climate policies while at the same time, defining a set of minimum climate policy expectations that each and every city must comply with;
- integrating instruments serving as incentives for cities to introduce climate-friendly initiatives into all specialised policies, including especially EU-level development policies and support policies. The best example for this is when funding for urban development is made conditional on the adoption of certain climate-friendly actions.

2.1.2. Applying an integrated approach to sustainability

The climate change problem has a central part in the conceptualisation of environmental integration and ecology, both linked to the idea of sustainability. When we try to prevent climate change or prepare for its effects, we are in fact moving towards sustainability. Any sound environmental integration or sustainability policy must include preparatory measures for climate protection and climate change. Urban climate policy is a policy with an integrating force, it requires close interaction and co-operation with other policy areas.

2.2. 'CLIMATE PARTNERSHIP': A RESPONSIBILITY SHARED BETWEEN SECTORS

All stakeholders and interested parties must inevitably be involved in shaping urban climate policy, as only initiatives accepted by all city actors can possibly result in a legitimate policy. During policy shaping, the first step in creating partnership is to identify the potential target groups and all stakeholders of the proposed development and regulations. As the next step, the city's residents, enterprises, and non-governmental organisations must be addressed and informed about the situation of the urban climate and about the developments planned to improve it.

Any climate policy is a common endeavour – an endeavour to which the whole community of a city dedicates itself. Of all the interventions involved, some are beyond the responsibility of city leadership or city management. The city's non-governmental organisations, local residential communities, and even enterprises may play a role and take on responsibility in implementation. Of course, this can only happen if the climate policy is widely known and accepted as a result of public consensus achieved during the initial shaping of such policy, and if stakeholders have assumed due responsibility in implementation. These in turn, require genuine partnership and co-operation from the very beginning.

In an ideal scenario, even the very first decision – namely: *Is there a need for a climate policy?* – should be approached in a partnership, which then is also sustained during the formulation of the initial concepts and basic ideas. Hence partnership will not be restricted to merely commenting on the political intentions already expressed in basic documents.

The possible partners in shaping an urban climate policy include especially the following important groups:

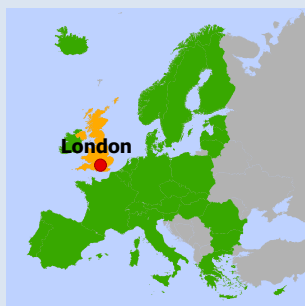
- industrial firms (e.g. in reducing emissions);
- commercial enterprises (e.g. in decreasing emissions in transportation and in reducing the need for transportation by increasing the proportion of local products);
- service providers (e.g. climate-friendly or air-conditioned service spaces; climate alarm co-operation);
- employers (e.g. climate comfort solutions; climate alarm co-operation);
- research and development institutions and institutions of education (e.g. urban climate research; forecasting; information dissemination services);

- communities of homeowners and apartment block communities (e.g. climate comfort solutions, energy consumption);
- organisations of the elderly and of persons with health-related problems;
- local and national/regional non-governmental organisations (e.g. undertakings related to emissions, and the endeavours by employers and service providers);
- municipal institutions and services (water and energy supply, waste management, local transport, health, and rescue management).

An aim is to ensure that the stakeholders involved in the partnership are as representative of the city community as possible. This is the key to ensuring that all local actors assume common responsibilities. An additional important factor in forging appropriate partnership in the city is the involvement of various actors from neighbouring regions and settlements.

Any forum organised to engage actors, on the one hand, has to facilitate the dissemination of information, and on the other hand, should provide space for dialogue. It is the responsibility of the parties preparing the plans to find the most efficient ways to promote co-operation and involvement (these may include, among other things, hearings, campaigns organised by individual city districts, Internet sites and forums, electronic newsletters, etc.), the suitability of which vary across the various target and age groups. (It is important to note that while the elderly urban population, who are especially at risk in the context of climate change, are a key target group in climate planning, they are also a group that enjoys only limited access to some of the currently most popular electronic channels of communication.)

Creating a partnership is useful not only in the context of episodic policy shaping or planning actions. It is favourable to permanently maintain, institutionalise, and continuously expand such partnership. Doing so facilitates the easy involvement of the partners into the highest possible number of planning and political decision making processes.



London Climate Change Partnership

The London Climate Change Partnership consists of 30 member organisations, but involves a large number of further organisations in its activities, whereby the overall number of participants is in excess of 200. The members include local, regional, and national government agencies, several non-governmental organisations, and even market players and their associations (such as, for example, an association of insurance companies).

The most exemplary aspect of this initiative is that it is a permanent and institutionalised co-operation that has its own management group with the ability to support several planning processes. Obviously, one of the main objectives of the partnership is to support the shaping of London's climate change adaptation strategies. However, the partnership also participates in other city planning processes as well, including some of the most important ones such as the London Plan (London's spatial structure development plan). The group places special emphasis on facilitating information exchange and on sharing best practices and experiences.

Contact:

Web: www.london.gov.uk/lccp

2.3. WHAT CAN WE DO AT LOCAL LEVEL GOVERNANCE?

Cities can apply various governance approaches to implement their climate change policies. The cities' competency in selecting the proper elements of their climate governance is determined by their legal status in the state administration. However, there is always an opportunity for creative actions.

A sound urban climate change policy can be formed via the following fields of urban governance:

1. Converting institutions run by the city in an effort to reduce climate change by:
 - improving energy efficiency, and by;
 - using renewable energy sources.
2. Elaborating corporate climate-friendly policies for the enterprises supervised by the city (such as public service providers and city development agencies) and integrating such policies mutually with one another and with the city's own urban climate policy (e.g. energy supply, public transportation, waste management, public sanitation).
3. Encouraging and supporting the climate change mitigation efforts of the local population and economic actors
 - by disseminating information on climate change processes and their potential local effects;
 - by providing financial support for climate-friendly investments;
 - by providing consulting services in preparation for climate protection activities and disaster situations;
 - by creating a permanent partnership, by organising a climate-friendly community, and by building networks.
4. Strategic planning opportunities available to the city management with a view to climate protection (the integration of the city's climate strategies and/or climate protection concepts into other strategies of the city).
5. Regulatory tools available to city management with a view to climate protection:
 - urban structure plans serving aims of climate protection (e.g. the proportion of built-in areas and green areas);
 - building regulations contributing to climate protection (e.g. architectural design principles);
 - transportation regulation and transportation management activities of the city management with a view to climate protection (e.g. restricting individual motor vehicle traffic and giving preference to public transportation);
 - incorporating climate protection considerations into the system of local taxes (e.g. tax reductions as an incentive for curbing emission or special taxes on development projects in city districts where public transportation is insufficient);
 - regulating public utilities (water, waste, energy, public lighting) and consumption; applying climate-friendly incentives (e.g. for selective waste collection and saving water) and restrictions (e.g. on night-time lighting and on advertisement-related lighting);
 - introducing climate protection criteria into public procurement procedures at the level of the municipal government.
6. Climate-aware local economic policy: green economy and increasing regional self-reliance in production.
7. Organising the institutions of city management and city-level decision making in a climate-aware manner.
8. Also: even a city can act up to improve global climate justice.

An OECD Working Paper ('Cities, Climate Change and Multilevel Governance' ©OECD [CORFEE-MORLOT et al., 2009]) defines four modes of urban governance to implement climate change policies (according to the regulatory modes or urban governance):

- **Self-governing: the municipality as consumer.** Sub-national governments can limit their own consumption and ecological footprint through municipal operations management, including such efforts as promoting the energy efficiency of municipal buildings and the greening of public transport vehicles. This is the most widespread form of local action, driven in many cases by the direct financial benefits of energy savings.
- **Governing through enabling: the municipality as a facilitator.** The municipality can facilitate coordination with private and community actors, such as by establishing public-private partnerships for the provision of services and infrastructure. For instance, [...] the municipal energy plan of the City Council of Venice [...] includes a series of intention protocols involving a number of joint venture projects between private companies, municipal transport companies, housing administrators' associations and associations of planners, architects and engineers.

- **Governing by provision: the municipality as provider.** Governing by provision is accomplished through the use of material and infrastructural means in the provision of direct services (water, electricity, public housing etc.). By influencing infrastructure development and service delivery, local governments can modify public consumption and waste disposal patterns. A local or regional government can thus impact local climate change action as the majority shareholder in the local utility companies for utilities and other public goods in the field of energy, transport, water and waste services. However, this potential for influencing the supply side of energy has been considerably eroded by the deregulation of energy markets and the privatisation of public utilities may have changed ownership structures and the policy levers for local authorities to intervene in this area.
- **Governing by authority: the municipality as regulator.** Local governments may enact regulations to curb CO₂ emissions if they have legal jurisdiction over relevant policy areas such as energy, transport, land use and waste. Examples include Barcelona’s solar thermal ordinance; [...] and restrictions on the use of cars in Munich and Paris. The extent of such a mode of authoritative governance, however, is closely linked with the municipal regulatory mandate in areas related to climate change, which in turn is determined by national law and regulation. Depending on the political system, states, prefectures, and provinces may have considerable autonomy in establishing climate change targets, renewable energy and energy efficiency strategies, transportation planning, and regional development schemes or regulations in the relevant areas. Even with a strong mandate, however, identifying public financing to leverage private investment locally may ultimately constrain or enable effective action.

The more integrated a city’s climate policy is – the more it pervades city governance – the stronger it is. It is therefore reasonable to propose that cities take climate-friendly steps in as many areas of governance as it is possible.

2.4. MULTILEVEL GOVERNANCE

The climate change related – and, more generally, sustainability related – tasks of cities cannot be suspended by the city borders. Larger cities and their wider surroundings inevitably form closely interrelated systems through their increasingly intensive socio-economic and environmental interrelations. Within such a system, in addition to transport links and commuting, the city also relies ecologically on its rural and natural environment, while the dependence of rural areas on their urban centres is something quite obvious.

Accordingly, issues and their interrelations do not emerge strictly within administrative boundaries, and they can hardly be tackled in a framework restricted by those administrative boundaries. It is therefore of utmost importance that the legitimate actors at the various levels – the settlements and regions concerned as well as the ‘owners’ of specialised policies – share efforts in tackling climate change mitigation and adaptation tasks of the city and its wider rural environment.

In addition to the municipal governments of settlements that coexist in a functional whole (at the level of urban region and/or agglomeration), and besides regional authorities, the national level also plays a influential role in how successful the creation of sustainable structures will be within the urban regions (e.g. through environmental transportation, regional development policies, and even through tax policy defined at the national level). At the same time – in addition to the administrative authorities – citizens, economic and market players, as well as their communities and networks also play a key role. Accordingly, creating and maintaining appropriate, transparent, and continuous partnership with the various non-governmental organisations and market actors is of key importance.

At the very same time, this governance approach relies not only on partnership but also on strategic planning, where flexibility and a proactive approach rather than a bureaucratic attitude are crucial. Promoting the multilevel governance approach is therefore of utmost importance in tackling and mitigating climate change at the level of cities and urban regions. Chapter 4 ‘*Climate-friendly urban structure*’ will detail the challenges related to rural areas around cities as well as the possible solutions, with a special emphasis on the urban sprawl phenomenon, how it can be managed, and what planning tasks arise.

2.4.1. Governance co-operation between cities and regional/national levels

Urban climate change policy needs the following types of governance co-operation between cities and other levels of territorial administration (OECD, 2009):

- **Regionally coordinated actions:** Co-operation between the regional and the city levels leads to climate policies that mutually strengthen one another. Co-operation makes it possible to up- and downscale climate change related issues in order to select a proper set of multilevel actions. Thus, for example, a successful energy initiative of a city may become a regional standard. In turn, a climate-aware regional disaster management plan can, on the one hand, harmonise the flood protection plans of the individual cities (pointing out where buildings should not be located even if they would be otherwise highly energy-efficient), and, on the other hand, it may serve as the basis for elaborating the site-specific details of the cities' flood protection plans (such as, for example, exploiting and depositing materials required for flood protection operations).
- **National and European level mainstreaming:** The co-operation between the national level policy forming bodies and the cities supports the mainstreaming of the cities' progressive climate change initiatives into the national climate policy, and even into other relevant policies, such as transport, health, education, water management. It also means that regional and national climate protection and adaptation actions should not merely be organised around large projects or flagship initiatives (such as, for example, a power plant conversion programme, a river regulation project, etc.), as these do not offer a chance for bottom-up city initiatives or to the emergence of solutions tailored to the local conditions.

The co-operation between the cities and higher levels need well organised mechanisms and a strong vertical partnership in planning and policy forming.

MODEL project for the support of local authorities in rational energy use

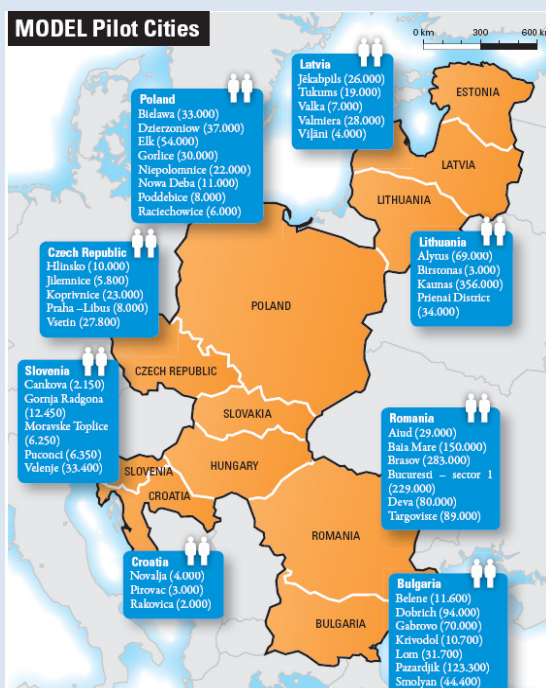
MODEL (Management of Domains Related to Energy in Local Authorities) is a programme to reduce the energy gap in the European Union and beyond. It encourages volunteer municipalities to become models for their citizens, other municipalities and local stakeholders in the field of rational use of energy. It was launched in 2007 with the support of the Intelligent Energy Europe programme.

The objectives of the project were:

- assisting its pilot cities to plan, implement and evaluate a full set of activities meant to improve local energy efficiency, focusing on their overall process management; and
- improving their practical capacities in the field of energy efficiency and communication with their citizens on this issue.

To achieve this goal, MODEL was organised to act at 3 different levels:

- European level: Energy Cities, EnEffect and the 8 MODEL national partners were involved in a constant process of exchange of experience, EU added value, common training and events, coordination, etc.
- National level: the 8 MODEL national coordinators organised various activities to support the pilot cities and promote the MODEL common framework methodology towards several other municipalities: training, promotion, information, technical assistance, etc.
- Local level: thanks to the MODEL support, the pilot cities developed their human skills, technical capacities and communication activities and implemented a full set of practical activities including ones to raise awareness among their citizens.



43 pilot cities from 10 new EU member states and Croatia decided to join the project. The 43 pilot cities represent over 2 million citizens. The authorities have taken the next concrete steps in the field of energy saving:

- appointing municipal energy managers;
- organising an energy unit within their administration;
- developing a local energy action plan and energy information systems;
- looking for funding for concrete investments;
- improving the communication of energy issues towards citizens.

For the future, the MODEL project is now addressing 6 new pilot cities from Armenia, Georgia, Moldova and Ukraine.

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Investment Programmes in Sweden: Stimulating local initiatives for an ecologically sustainable society (source: www.naturvardsverket.se)

In 1996, to promote the transition to an ecologically sustainable society in Swedish municipalities, the government decided to start funding Local Investment Programmes (LIP). In 2002, Local Investment Programmes were replaced by Climate Investment Programmes (Klimp), more specifically aiming at reducing the emissions of greenhouse gases.

The Swedish government's support to Climate Investment Programmes is a tool for reaching the Swedish climate objective as formulated in the Swedish Climate Strategy in 2002. Klimp has enabled municipalities to receive grants for long-term investments addressing the reduction of greenhouse gas emissions. Klimp is contributing to achieving the climate objective in three ways. The investments lead to reduced emissions of greenhouse gases. The work on a climate investment programme strengthens local climate work and co-operation between various actors, and by means of collecting and disseminating knowledge and experience of climate investments, encourages climate work in other parts of the country.

In order to achieve its aims, the Klimp initiative takes a holistic view into consideration and the investments are made in the sectors that have the largest impact on climate. This applies measures in the transport and energy sectors, but they focus on the results, not on certain technologies. They include expansion of district heating, transition to biofuels, measures to boost energy efficiency and local information about the climate related issues and the ongoing projects. Almost one third of the Klimp grants have been invested in biogas measures.

Applying a bottom-up approach, local authorities have been required to make priorities based on their local condition and local policy. Only the best measures in the best climate investment programmes have received funding which means approximately 25% of the total budget of each programme. The programmes have been awarded points depending on how well they demonstrate good climate strategies, overall perspectives, collaboration, efficient use of funding and environmental effects. The competition has facilitated the co-operation between the local actors, while giving priority to sustainability issues. The results of the Klimp initiative are showcased by the website of Green Investments in Sweden (MIR), where detailed information can be found on the projects within the LIP and Klimp programmes.

Between 2003 and 2008, Klimp funding of SEK 1.8 billion was granted for 126 climate investment programmes. Together, the programmes comprise about 900 measures and an investment volume of just over SEK 8 billion. The grants have been distributed five times by the Swedish Environmental Protection Agency between 2003 and 2008. The outcomes of the investments are: the reduction of up to 2 million tons of carbon dioxide per year (the total greenhouse gas emissions in Sweden were almost 64 million tons in 2008); saving of 3.3 TWh of energy per year and conversion of 3.2 TWh of fossil energy by renewable energy (the total energy use in Sweden was 397 TWh in 2008).; reduction of waste to deposit by 460,000 tons per year.

Between 2008 and 2010 a new programme was launched aiming at contributing towards creating attractive, ecologically, socially and economically sustainable urban environments that can serve as models for integrated sustainable town planning and applied environmental technology and disseminate knowledge of such urban environments. The government has appointed the Delegation for Sustainable Cities with the role of managing and awarding the financial support for the development of sustainable cities. This support is intended to stimulate urban development projects that help to reduce emissions of greenhouse gases. Support can be

provided for investment projects that preferably relate to new construction or reconstruction in an urban district, residential area or block and relate to energy, water, waste or transport. The support is also intended for planning projects, i.e. measures for example in the form of feasibility studies, programme writing, cross-sectoral planning and information measures or efforts. The total level of support for the period 2009-2010 was SEK 340 million.

Further information can be available at www.hallbarastader.gov.se

Finnish municipalities for the handling of climate change

ALFRA is an umbrella organisation of cities and municipalities aiming to promote opportunities for local authorities to co-operate in order to enhance their vitality for the benefit of the residents.

In 2010 the ALFRA adopted guidelines with recommendations on how to handle climate change at the local level adjusting to the National Energy and Climate Strategy of 2008. Part of the municipalities has already initiated campaigns to encourage the citizens to contribute to combating climate change. In the local government climate campaign, there are 45 municipalities, representing more than one half of the Finnish population. In addition to that, climate strategies have been worked out in 71 municipalities out of what 42 municipalities have already completed them. These municipalities represent almost three out of four Finns.

During the recent years, there has been a growing interest in the role of local actors in the implementation of climate policy. In Finland, this interest has resulted in several projects on various climate activities at the local level. In the following, there are brief presentations of two nationwide networks that involved local governments in Finland in an active role in combating climate change.

Since 1997, there has been a national campaign named Cities for Climate Protection. The ALFRA has been the co-ordinator of the network offering its members a variety of meetings, seminars and conferences. Since 1997, five municipal climate conferences have been held. These conferences provided opportunity for municipalities to share experience and best practices with colleagues from other parts of the country. Up until this time, 46 municipalities have joined the network.

Another project is called the Climate Change and Municipalities' Decision-Making. It runs from 2009 to 2011. The project is led by the ALFRA – and three ministries (Ministry of Environment, Ministry of Employment and Economy and the Ministry of Transport and Communications) finance the project. The aim of the project is to improve municipalities' ability to make climate-related decisions which are also economically correct and support the overall development of the municipalities. Under the project, a number of meetings, seminars and experience and best practice sharing take place. A large number of municipalities/regions are involved in the project (in total 34 municipalities).

Reference Framework for Sustainable Cities (RFSC) – A toolkit for the integrated approach

In May 2007 the European Ministers responsible for urban development signed the 'Leipzig Charter on Sustainable European Cities' with the aim of improving the policy setting for integrated urban development, with a particular focus on deprived areas. In November 2008 they called for the implementation of the Charter in the Marseille Statement. As a result France and the French Ministry of Ecology, Energy and Sustainable Development set up a high level European working group to develop – with and for the cities – a reference framework for the European sustainable cities. They also wished to increase the focus on climate change in recognition of its rising importance. This working group – including the EU Member States, European institutions, and European organisations representing cities and local governments – has developed a set of tools during the years 2009-2010 that could support local authorities and different stakeholders in making decisions aligned with their urban strategy, policies and plans. In 2010, in Toledo, the European Ministers responsible for urban development confirmed their wish that the reference framework should be disseminated and that its testing phase should be implemented by European cities.

The Reference Framework is an on-line toolkit to assist actors of urban management and development to improve dialogue and actions on sustainability. The aim is also to encourage local authorities to develop their own measures or actions, which best suit them and which are possibly not fully reflected in the Reference

Framework. In doing so the tool is structured in the following way:

- questions and tools aiming at helping to characterise the current situation of the city and identify its main information and key urban development issues;
- questions and tools supporting the adaptation of an integrated urban development approach;
- a set of suggested indicators and visualisation tools in order to monitor the progress of the territory;
- relevant documentation with direct access to European or national reference texts, city illustrations and other interesting documents related to the European sustainable city;
- the basis for a common platform of dialogue between European local authorities and professionals, linked with other networks.

Following the testing phase with a wide range of European cities, the final version of the prototype and its entire operability are planned for the end of 2011, under the Polish presidency of the European Union. Its wide dissemination and communication will be scheduled for the first half of 2012, under the Danish Presidency of the European Union.

More information is available at www.rfsustainablecities.eu.

2.4.2. Networks of climate-friendly cities

Creating networks of climate-friendly cities is a well embedded governance form of the urban climate actions. The Annex of this Handbook includes additional material on such initiatives.

- Organised into networks, cities implementing similar climate policies can jointly present significant interventions to mitigate climate change (especially because the activities causing climate change are concentrated in cities).
- Networks organised based on a geographical principle facilitate more efficient preparation for climate change adaptation thanks to the harmonisation of protection efforts and the exchange of experience (e.g. the cities of a river valley can harmonise their flood protection strategies, while Mediterranean cities may exchange their experiences about shading techniques in public outdoor spaces).

Covenant of Mayors

The Covenant of Mayors is a bottom up initiative, a city network which aims at reducing CO₂ emission, and at increasing energy efficiency, clearer energy generation and consumption in accordance with the energy policy of the European Union. The signatories of the Covenant of Mayors are local authorities, which were 2357 on 24th March 2011.

The Sustainable Energy Action Plans (SEAP) sets out the specific reduction targets and defines the concrete measures that the local authorities will undertake to achieve it by 2020. The local authorities ensure the necessary human and financial resources to implement actions set out in their SEAPs.

The Covenant of Mayors is open to cities of all sizes in Europe. Those cities and towns which do not have sufficient resources to draft and implement their own action plan can be supported by administrations with such capacities. These supporting structures can be regions, counties, provinces, agglomerations, NUTS III areas, or mentor cities. The Supporting Structures are defined as those entities that are in a position to provide strategic guidance, technical and/or financial support to municipalities with the political will to sign up to the Covenant of Mayors, but lacking the skills and/or resources to fulfil its requirements, namely the preparation and implementation of Sustainable Energy Action Plan.

The EU Committee of the Regions stresses the need to combine the local and regional forces, as multilevel governance is an effective tool to enhance the efficiency of the actions to be taken against climate change. Therefore, the involvement of regions into the Covenant of Mayors are promoted.

EUROCITIES

EUROCITIES is a network of major European cities which bring together the local governments of more than 140 large cities in over 30 European countries. 'EUROCITIES provides a platform for its member cities to share knowledge and ideas, to exchange experiences, to analyse common problems and develop innovative solutions, through a wide range of forums, working groups, projects, activities and events.' One of the EUROCITIES' policy priorities is to fight against climate change.

'EUROCITIES joins forces with other city networks in the 'Local Government Climate Roadmap' to work together for recognition of local governments' role and contribution in fighting climate change. This roadmap is a multiannual process closely following COP13 (Bali), COP14 (Poznan), COP15 (Copenhagen), COP16 (Cancun) and currently COP17 (Durban).' 'EUROCITIES plays an active role in several European initiatives like the Sustainable Energy Europe Campaign, Covenant of Mayors, COMMERCE, the European Mobility Week EPOMM-PLUS, CIVITAS Catalist and CIVITAS Guard'.

'In October 2008, EUROCITIES launched its 'Climate Change Declaration' [...] The declaration testifies to their commitment towards ensuring that action is undertaken at the local level against climate change. Cities are best placed to speak with their citizens on global matters such as climate change, and to show how changes made at the local level in all areas of public life, from waste management, to public transport, to cultural events, among others, can contribute to facing this global challenge.'

Source: www.eurocities.eu

Furthermore, through their practice-oriented bottom-up initiatives, city networks have the power to shape national and international climate policy as a form of feedback. For this to happen, regional, national, and EU climate policy must ensure the following:

- openness in taking aboard initiatives arriving from the climate policy networks of cities;
- the participation of such networks in higher-level climate policy governance using institutionalised instruments.

2.4.3. Climate-friendly relations between cities and their regions

The inter-settlement co-operations organised at a lower geographic scale (at the level of microregions and regions) present additional peculiar dimensions of climate protection. These are typically co-operation schemes between cities and their immediate environments, or between metropolitan areas and their surroundings. The work performed together at this level offers practical opportunities for organising all areas of climate-friendly urban governance at the regional level. The following climate protection related aspects are especially suitable to be managed with a regional approach that looks beyond city limits in its perspective:

- Particularly the adaptation policies – planned and implemented typically at a regional level – need collaboration between the municipalities (for example, water management systems and precautionary flood protection measures along rivers). (OECD, 2009)
- Mitigation policies also need collaboration, as they are frequently related to the technical infrastructure cutting city borders (e.g. power supply and transport, or see even some ideas and attempts related to regional emission quota trading between cities). (OECD, 2009)
- Organising public services and supply at the regional level: ensuring that public services and commercial retail are accessible by consuming the lowest possible amount of energy, e.g. by setting up local service points, by improving public transportation, and by facilitating e-access.
- Elaborating common standards for operating institutions, securing common climate-friendly energy supply, and implementing energy efficiency investments.
- Joint regional strategic planning and a joint visioning of the settlements' structure, taking into account the urban and rural processes relevant in the region (such as, for example, the urban sprawl phenomenon or rural depopulation, respectively). Chapter 4 '*Climate-friendly urban structure*' will discuss additional aspects of settlement structure related to the rural environment of cities, with special emphasis on urban sprawl.
- Creating co-operations based on climate partnership of the economical actors and the civil society with a perspective beyond city limits, covering the entire region. (Note that production plants with large emission rates are often located outside city limits.)
- The local and regional climate-friendly economy and energy policies may be implemented in an approach that views the city and its rural environment as a single unified system. See detailed in Chapter 12 about economy policy.

2.5. HIGHLIGHTED GOVERNANCE ISSUES FOR MANAGING CLIMATE CHANGE

2.5.1. Supporting global climate justice at city level

European cities are given the option to balance the environmental damage they cause by supporting less affluent communities in the 'developing' world outside the EU. The environmental load generated by the population of the developed world, including the EU, is usually several times as high as that of the population of the developing world, primarily because of higher levels of consumption. However, the environmental load behind such higher level of consumption often hits developing communities harder and more directly than developed ones. (A typical example is tropical deforestation, where major climatic and other detrimental environmental consequences represent the cost of meeting the demands of mostly well-to-do societies for wood and food.) The adverse effects of climate change also often have the hardest impact on less well-to-do countries, as these countries have limited resources and can therefore prepare much less efficiently for preventing disasters (e.g. the coastal cities of the developing world can do much less against the more and more frequent sea floods than the European cities can do).

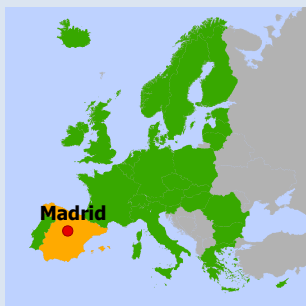
The technical and financial support offered by local communities in the developed world can help those in the developing world protect their natural environment, and to prepare for climate protection as well as for the adverse effects of climate change. It is also important to help the communities of these settlements or regions in ways which ensure that their development will not be solely dependent on the fluctuating demand and the changing consumption patterns of the developed world. Support and consultation may also help these areas avoid those development mistakes which had already been made in the wealthier part of the world (e.g. the introduction of resource-wasteful technologies, or the creation of a consumption society).

2.5.2. Climate-friendly public procurement

Climate-friendly public procurement is an instrument of climate policy that is closely related to both the city's economic policy and to regulation as a whole. Cities integrate their climate-friendly expectations into their public procurement calls for tender. In evaluating the proposals, they take into account the environmental load resulting from implementation as well as how and to what extent the given development project serves the purposes of local climate protection in the future.

The following possibilities are available in support of the above efforts:

- Calls for tender for technical and technological equipment can directly include climate protection requirements.
- A number of criteria may be used to screen applicant organisations based on, for example, whether they implement the required climate-friendly corporate policy. Alternatively, preference may be given to companies supporting climate-friendly initiatives.
- An additional, indirect way to enforce the above ideals is for the municipal government to encourage the participation of those enterprises that are either locally based or rely on local resources. This maintains the sustainability principle that local communities and/or local enterprises should primarily rely on local resources, and, conversely, local resources should be primarily utilised by local communities and/or local enterprises. For instance, the transportation needs and its harmful effects on the climate can be reduced this way.



Madrid, public procurement for environmentally friendly transportation

The Spanish capital, Madrid has a population of over 3.9 million people, its metropolitan area included.

In 2008 the City Council of Madrid decided to implement two plans in order to reduce air pollution. One of the plans received the name 'Green Fleet'. As part of this project, the municipal government started replacing its own public service vehicles (buses and waste collection trucks) with motor vehicles propelled by alternative energy sources instead of fossil fuels. By 2011 the city's plans foresee the complete shift over to alternative vehicles that are either greener or are fully environmentally friendly. The other plan targets the corporate sector. So far the city has succeeded in convincing 35 major corporations to support the cause. These companies can network and exchange their experiences at 'Foro Pro-clima Madrid', the Madrid Climate Protection Forum. Each and every member of the Forum has accepted that by 2012 at least 6% of the motor vehicles in their corporate fleets will be propelled by clean fuels.

Today, as many as 1,800 vehicles of the municipal government are either certified as Category 'A', a rating that reflects their top-notch energy efficiency, or they run on alternative fuels. 41 vehicles run on bioethanol; this small fleet of vehicles alone saves as much as 104 tons in CO₂ emission. The municipal government acquired its bioethanol vehicles through BEST, an action of the EU's Sixth Framework Programme designed to promote the wider use of bioethanol as a fuel. The city's costs related to the BEST project amounted to one million EUR; 50% of this was financed by the EU.

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2.5.3. Building a climate-aware institutional system

Another important governance related issue is the institutionalisation of urban climate policy. The best proposal for managing climate policy is an integrated, project-oriented institutional structure instead of the traditional city management structures that rely on sector-oriented organisational units. This is the best way to ensure that urban climate plans are implemented with the participation of all stakeholders and responsible parties within the city management structure. A city's climate change organisation cannot possibly be tied to a single institution or organisational unit because of the wide-ranging sectoral linkages the issue has. In a favourable situation, this work is implemented through the institutionalised co-operation of the organisational units (e.g. joint committees and working groups). Creating such co-operation between the city's political leadership and the organisational units of its management is also most valuable.

An OECD working paper ('Cities, Climate Change and Multilevel Governance' ©OECD [OECD – CORFEE-MORLOT et al., 2009]) introduces the integrated institutional model of the City of Zurich for urban climate policy. The city established a unit for environmental protection in charge of supervising the city's climate policy with cross-departmental tasks within the city administration. This unit is responsible for assessing every planned development and construction project in terms of their impacts and the departments responsible for the implementation of these developments need to account for the results of this assessment. To guarantee that this model works properly requires, first, strategic plans comprising sectoral targets, policies and measures (such as the combination of a general master plan for the environment and a specific master plan for energy in the city of Zurich); and, second, a project-based approach which prevents departmental segregation.

2.5.4. The city's economic policy: green economy (green growth) and local economic development

The local and regional economic policies implemented by cities or jointly shaped by cities and their regions offer unique climate protection opportunities. A city's economic policy is one of the most important areas of competency in urban governance – one that requires the harmonisation of several sectoral activities. (See detailed in Chapter 12 about economy policy.)

BRIEF RECOMMENDATIONS

- It is imperative to ensure that the climate policy initiatives of cities and networks of cities are widely known both at the European and national levels, and to integrate the experiences they accumulate.
- The more areas of competence in city governance they rely on, the stronger urban climate policies can be. Climate-friendly ideas may be integrated at every stage from regulation and disseminating information among the population and the economic actors, through designing incentives, and all the way through to the operation of public services.
- A city's climate policy requires multilevel governance co-operation. Accordingly, the actors of governance outside the city must be involved in shaping the policy. These include, for example, the following:
 - the largest possible number of settlements within the geographical landscape (e.g. river valley) wherein the city is located;
 - the city's catchment area, including the rural settlements therein;
 - the members of the city network co-operation set up for climate policy; and
 - the relevant regional and national agencies, even if these levels do not yet have any elaborated climate policy of their own.
- The owner of an urban climate policy is not the city management but the entire city community. Accordingly, urban climate policy must be shaped within the framework of a widely based, permanent, and well organised partnership that integrates both the residents and the economic actors of the city.
- European cities shall feel responsibility towards global climate change mitigation and adaptation efforts, and shall find the way of supporting the climate actions of the cities and organisations in the less developed countries.
- Applying green public procurement, building integrative institutions for managing climate change, and greening the urban policies on economic development are the main fields of climate-aware urban governance.

3. INTEGRATED STRATEGIC PLANNING FOR CLIMATE-FRIENDLY CITIES

Urban environments are extremely sensitive to the effects of climate change, while the cities themselves are principal contributors to climate change. Adverse effects may be reduced and the urban climate may be significantly improved by integrated and complex urban strategic planning. As a result, in developing urban areas, the type of urban planning that needs to gain prominence is one that takes into account both the peculiarities of the urban environment and the diverse impacts of climate change. This may be implemented effectively through the harmonisation of the individual sectoral plans and development concepts, and through mainstreaming the concept of sustainability.

The fact that the phenomenon of climate change is widely known, the large number of people it affects, and the imminent threat of its consequences are three very good reasons for cities to engage in strategic climate planning.

Urban climate planning can take the form of an independent planning procedure or it can form part of other city-level planning processes (such as, for example, energetics or environmental planning). Regardless of its form, urban climate planning must always apply an integrated approach. When working on climate planning, it is a good idea to adopt the integrated methodology used in environmental/sustainability planning and evaluation.

This chapter offers an overview of the planning and methodological possibilities of climate change integration for those experts familiar with the systematic strategic planning, programming, and evaluation practices that the European Union itself follows, among others. Interpreting the messages of this chapter may require a degree of background knowledge.

All over Europe, a range of widely diverse urban planning systems have emerged. Because of the differences in both regulation and actual practice from one country to another, it is impossible to elaborate concrete planning guidelines that each and every European actor can apply. For this very reason, the focus of the following paragraphs will be restricted to the possible principles and tools of climate planning integration.

3.1. CONSTRAINTS OF MULTI-DIMENSIONAL INTEGRATION IN URBAN CLIMATE PLANNING

In today's planning practices, using an integrated approach is a basic expectation. Both urban planning and climate change offer an especially wide range of opportunities to rely on various modes of integration:

- **The climate-friendly city as an ideal testing ground for the integration of ecotechnologies and developing green infrastructure**
Urban development offers an excellent ground for integrated climate-friendly development and operation of the various infrastructure systems and technologies serving housing needs. The

reason for this is the specific urban context which combines production capacities and consumer demand in close vicinity of one another and offers highly varied natural and environmental conditions, while transportation needs are limited to relatively short distances. All this results in the fact that the products, emissions, or, as the case may be, waste materials of any given sectoral activity (especially agriculture, landscaping, water management, waste water treatment, solid waste management, transportation, and heating) can easily be utilised as a source of energy or raw material for another local activity. Technological integration schemes can thus serve the basic principle of preventive climate protection and climate adaptation efforts: energy saving, reducing the production of waste heat, curbing air, water, and soil pollution, and creating the healthiest possible urban ecosystems. An added significant advantage of climate-friendly technological innovation is the fact that it is not only climate-friendly, but it also supports sustainable development and environmental integration, as its technical solutions rely primarily on renewable energy sources and serve green economic activities.

In addition to technological integration, planning the urban infrastructure in a proactive, integrated approach and developing green infrastructure bring further significant climate advantages and sustainability performance (some examples could be internal spaces of ample size and quality, a street structure guaranteeing ample cross-ventilation, etc.; the following main chapters will present a wide range of solutions).

– **The city and climate change: multiple pressures towards integration**

– **The city as a classic site of integrated management**

Urban centres are where economic and social actors, decision makers, the managements of the individual economic sectors, and the institutions of the public sector concentrate. Harmonising and integrating the varied interests and visions they represent is in itself a major challenge.

– **Climate change as an inevitably integrating global force**

In our age, when more and more problems, symptoms of crisis, and, of course, opportunities are increasingly global in nature, one of the typical functions of urban planning is to look for local responses to global challenges. However, no thorough answers can possibly be identified just by looking at global challenges in isolation. Moreover, such a challenge is an integrated phenomenon even in itself with economic, social, and environmental aspects alike, whose treatment requires complex intervention.

The topic of this volume – climate change – is closely linked to phenomena as diverse as floods directly threatening human lives, a downturn in agricultural production, the pressing need to rethink construction activities, and even massive public sanitation crises. It is therefore possibly the best example of the complexity described above. Climate change related issues must therefore be inevitably considered in an integrated approach. In turn, the complex world of cities calls for even more deeply integrated adaptation measures and preventive urban climate strategies.

– **The city and climate: models of sectoral integration applying a regional approach**

The territorial structures of towns and cities are diverse; different urban districts are characterised by different weaknesses and opportunities. Accordingly, urban planning must be territorial and regionally integrated in its approach. On the one hand, any given sectoral intervention must be designed differently for each city district, adjusting it to the local conditions. On the other hand, the various sectoral interventions applied within the same city district must be coordinated among themselves.

Another important feature of climate change phenomena is that they appear in widely different forms from region to region. This is especially true when it comes to urban climate, because a relatively small-sized urban area can show widely varying physical and natural characteristics. Identifying and tackling these diverse challenges therefore requires a sound territorial approach and integration.

– **Integration in planning: the approach to be followed in climate planning**

When planning urban climate strategies, both objectives and interventions must be embedded into the economic and social structure of the cities and must be adjusted to their geographic characteristics. It is therefore reasonable to design these climate strategies not as separate plans in their own right but either as part of other fundamental urban development planning documents of adequate legitimacy or as plans prepared in close integration with those standard plans.

3.2. OVERALL URBAN CLIMATE OBJECTIVES AND PRINCIPLES

Climate protection objectives and principles have gained in popularity over the past several years. Promoting these is made easier by putting climate protection thinking into the wider context of environmental integration and sustainability efforts. If a city is climate-aware and wishes to act in order to protect the climate, it also inevitably integrates environmental objectives and promotes sustainability. The reverse is also true: a sustainable city always performs well in terms of climate protection. Therefore when preparing urban climate plans, many well-known environmental and sustainability related objectives and principles can be applied, most of them being easy to adapt to the more specialised climate context. Of course, there are additional, unique objectives beyond these that are only meaningful in the narrower context of urban climate protection.

Preventing climate change in towns and cities: possibilities on a global scale and in local urban spaces (mitigation)

In the case of cities, mitigation offers unique opportunities. A significant proportion of carbon dioxide and other GHG emissions and the activities generating those emissions, which in turn are responsible for climate change, are either concentrated in cities or serve to meet the demands of cities. Accordingly, any efforts that cities take can be significant in helping mitigate global climate change. However, the typical backdrop for urban mitigation efforts is not the global dimension. Cities and towns have their own characteristic local climate that is prone to change along with global climate. Reducing the environmental load generated by urban activities does not only help in a timescale of several decades and on a global scale, which is what otherwise normally happens. In many cases, these actions can lead to noticeable changes within the city and its environment in a matter of just months. This offers unique opportunities for presenting spectacular success stories thanks to which it becomes much easier to involve citizens, institutions, and enterprises and convert them into active stakeholders.

Preventing climate change in towns and cities using the tools of regional sustainability

The increase in the environmental load that leads to climate change is mostly driven by increasing consumption and rising demand for mobility. A city and its region offer excellent opportunities to mitigate both. If a city and its environment form a unified urban-rural space, a whole range of opportunities opens up to reduce their dependence on global processes to optimum levels. Organising urban markets can re-establish the unified system of products and services that the co-operating rural and urban areas can mutually offer to one another. Stimulating local production and service relationships help curbing reliance on external resources, reducing the need for transporting them and thereby decreasing the environmental load involved in transportation and travelling.

The sustainability of a region is also served by the efforts to involve more efficient technological solutions into construction, production, or transportation that rely either on less energy consumption or on renewable energy sources.

Changing the consumer's mentality by raising awareness of sustainability is also a climate-friendly measure. A decrease in consumer demand for new products that involve high energy consumption, the increase in product life cycles and reusability, or a rise in demand for energy efficient and climate-friendly products and services are examples for this.

Special climate protection tools to prepare towns and cities for climate change (adaptation)

Adapting to climate change should be at least as important an intention in urban climate planning as prevention. Adaptation is often relegated to a subordinated role in the climate policies of cities.

Several factors explain this. On the one hand, research and regulatory frameworks related to prevention go back to quite a history and are fairly advanced when compared to adaptation. As a result, the specific effect of climate change on any given city and the appropriate ways to adapt to those effects most often require additional separate analysis even before the climate planning process begins. (Of course, this requires more resources for planning, something that is often out of the question.) Adaptation may also be pushed into the background by the fact that the proposed means of adaptation often seem to be at odds with prevention (e.g. when the only proposed measure to adapt to ever more frequent heat-waves is installing additional air-conditioners).

The adaptation opportunities available to cities are different from the mitigation objectives feeding on general environmental considerations: many adaptation interventions can only be justified in the context of climate protection without direct environmental concerns (such as, for example, protection against strong solar radiation or ensuring thermal comfort). Separate climate protection objectives may be defined for each segment of city management and urban development; this manual offers detailed information in this respect. In particular those specialists who are responsible for shaping the urban structure, construction regulation, housing policy, organising public transportation, and disaster management cannot ignore adapting urban climate protection objectives to their respective areas.

The climate change adaptation objectives of cities can fulfil two fundamental functions regardless the area of specialty concerned. (1) Objectives related to tackling regular or permanent weather phenomena implied by climate change and often intensified by the urban climate (such as, for example, the climate regulation of indoors spaces). (2) Objectives linked to the management of episodic disaster situations (which may be natural, technical, or public sanitation and health related) which are caused by extreme weather events becoming increasingly frequent as a result of climate change (these are of special importance because they threaten many human lives and valuable assets in urban areas and because they call for specialised solutions due to the peculiarities of the urban setting). This manual discusses both groups of urban climate protection objectives in detail.

3.3. THE TOOLS OF INTEGRATION IN CLIMATE PLANNING

We have already demonstrated how both climate change and urban planning are issues that require an integrated approach equally touching on environmental, social, and economic structures. Both issues necessitate a regionally differentiated approach and interventions that encompass several economic sectors and are harmonised within each region. As a result, urban climate planning cannot do without an integrated approach either.

In the following paragraphs we expand on the fact that integration is not restricted to harmonising various themes and economic sectors; it actually means the integration of the planning processes themselves: formulating an urban climate strategy only makes sense if it takes the form of a planning document elaborated through processes that are fully and organically integrated into the city's own planning system.

3.3.1. The optimum levels of climate planning

Ambitious-sounding declarations of intent need to be supported by real climate-friendly development

Considering the fact that climate strategies can only be successful through harmonised interventions involving a wide range of actors and economic sectors, confining them into high-level policy documents (such as, for example, position statements, political declarations, guidelines) is just not sufficient. It is therefore reasonable to shape the climate planning process at planning levels where they formulate unambiguous messages not only about the objectives but also about the most important parameters of the actions (resources needed, scope and principles to follow, timetables to adhere to), about scopes of responsibility, and about the measurability of effects and achievements.

3.3.2. The types of integrative strategic planning for climate change

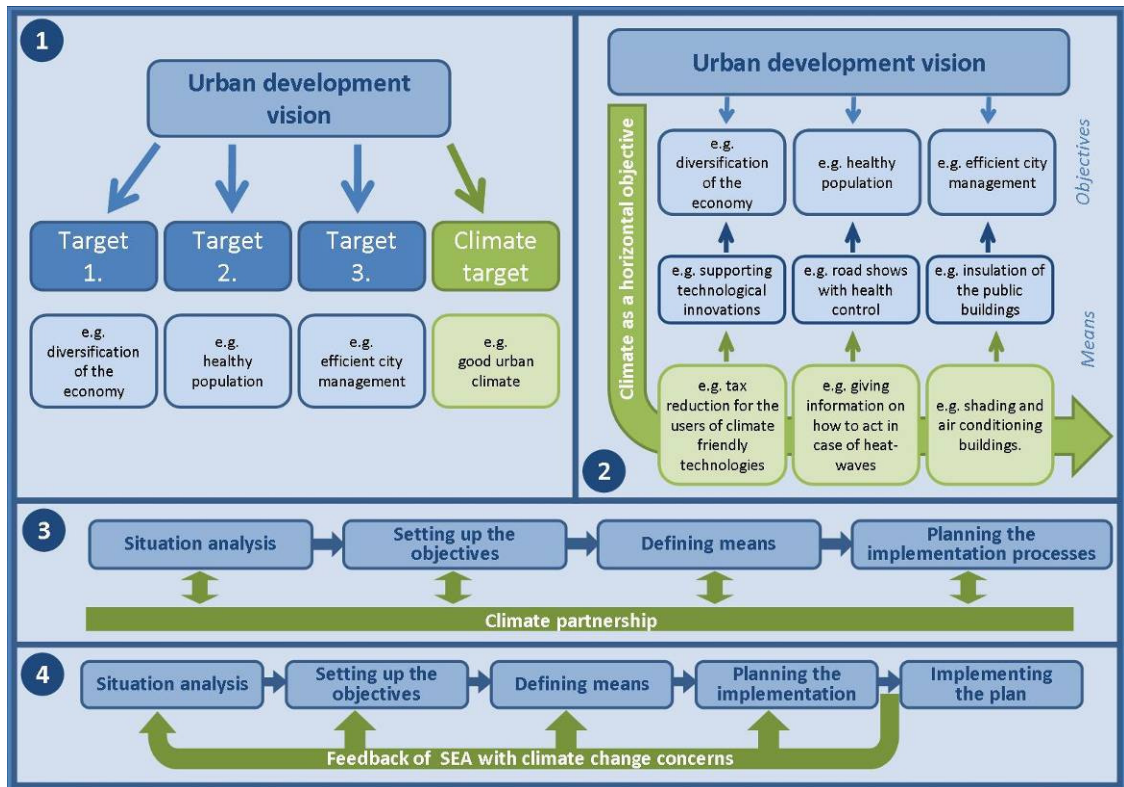


Figure 3: The basic types of the integrative planning

Strategic planning based on stakeholder involvement, communication and iteration, and system approach offers several integration possibilities. During the strategic planning process, as a first step, the planner has to create the form of the integration that is customised for the given planning purposes. Generally, combinations of the following four basic integration types make up the form of planning integration. (These fundamental types are also the building blocks of the possible integration forms of climate planning – discussed in the next part of the chapter.)

- **Integration realized through partnership:** Partnership shall follow each step of the planning process, starting from situation analysis, through setting the targets, up to the appointment of the parties responsible for implementation.
- **With horizontal objectives and measures:** In this case, climate specific considerations are to supplement the city's other, not climate-related, development targets and actions. In order to achieve this, climate change shall be present as a horizontal principle (i.e. all lines of development have to show some kind of positive effect on climate change) or as a horizontal objective (e.g. every relevant development activity should help the city reach given target numbers in terms of outdoor shading) in the urban development planning document.
- **With direct, climate-targeted objectives and measures:** Climate objectives and measures can be defined which directly and exclusively serve mitigation or adaptation purposes.
- **Complementary planning procedures ensuring integration:** Additional procedures which follow the planning process in order to secure integration along environmental and sustainability aims may also be implemented in climate planning. The so-called strategic environmental assessment (SEA) is such a procedure. SEA became a mandatory process in the EU by the approval of the Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment. By SEA, prior to the implementation phase, planning can be informed and amended with suggestions related to climate change concerns.

3.3.3. Direct and embedded urban strategic climate planning procedures and plans

The climate planning process and its documentation are worth to be treated in an integrated way, and to connect these to other planning processes. (Climate planning will not lose from its value and effect merely for the reason that its outcome does not take shape in a separate, individual strategy but is part of another planning documentation.) The following models offer opportunities for favourable planning integration through the preparation of a climate strategy:

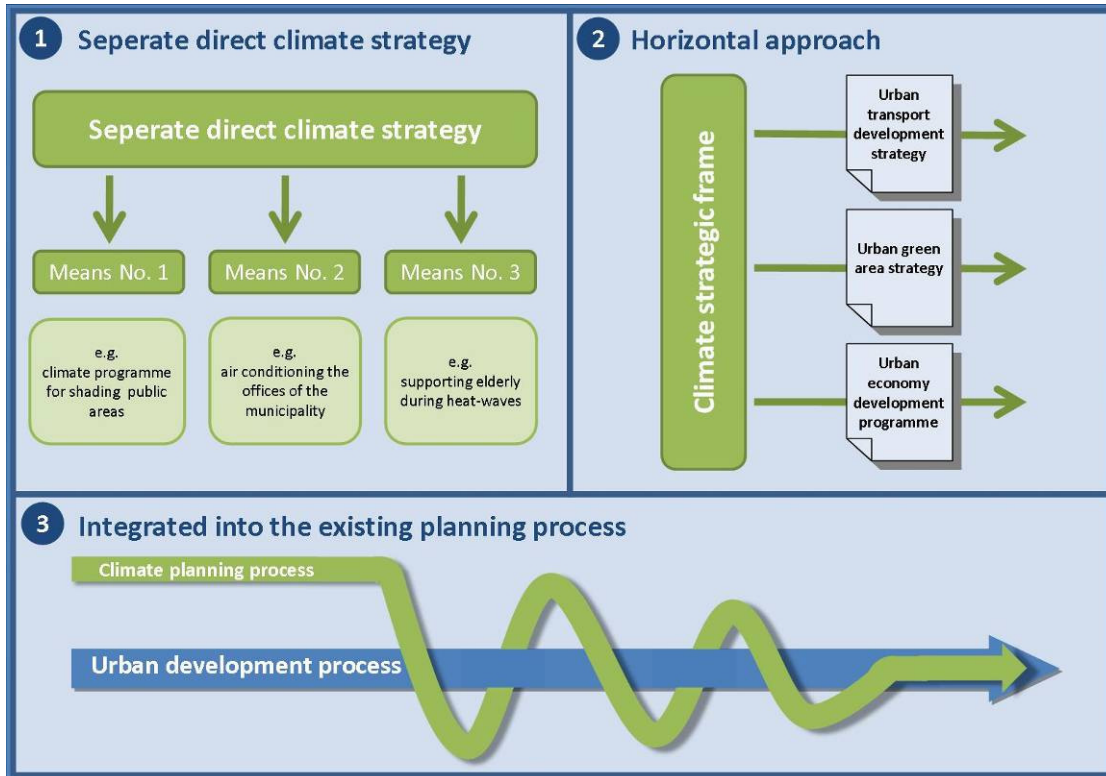


Figure 4: Integration possibilities of urban climate planning

(1) Separate direct climate planning and (2) urban climate strategic frames: our climate strategy is prepared by means of a separate planning process and/or planning document, first of all, it has to be decided whether our strategy will be only a framework document (i.e. implemented by urban programmes which do not have climate change as their main focus), or if it will declare own interventions.

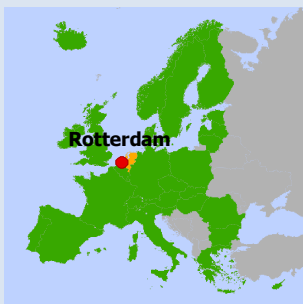
- In case our climate strategy serves only as a framework:
 - It has to contain targeted climate-related messages to all relevant and valid plans and programmes of the city that are about to be realised or are already under implementation. Furthermore, in case the climate strategic framework intends to launch interventions that are not shown in any other plan, the **position of the framework strategy** has to be unambiguously defined **in the hierarchy of plans**. Decision makers of the city accept the climate strategic framework being aware of the fact that it causes automatic changes in other plans.
- **A monitoring and evaluation system** providing proper supervision and feedback is the key to the effective implementation of strategic frameworks. This is the only way to find out if a programme falls behind its expected climate performance.
- It is important that if a climate strategy has a framework nature (i.e. other plans or programmes contain its elements) but also includes direct measures in its own competence, these two types of messages have to be clearly separated in its planning document. These two categories are often confused in planning documents, which makes it difficult to unambiguously identify **liabilities**, and thus endangers implementation.

(3) Climate strategies embedded in urban planning: Climate planning may be embedded in an already existing, legitimate planning process (e.g. in an urban development strategy). Importantly, behind this inclusive planning process, there has to be true dedication by the decision makers in urban policy, and thus implementation of the plan is guaranteed. The most important forms of embedded climate planning are as follows:

- **Integration by parallel planning:** A way for integration is when the team of climate planners and their partners follows an otherwise primarily non-climate-oriented planning process (e.g. general urban development planning) from beginning to end. On the one hand, this provides step-by-step feedback to the planners concerning their non-climate-related ideas from a climate change point of view, and supplements each planning phase with climate change considerations.
- **Integration by strategic environment assessment (SEA):** SEA (Directive 2001/42/EC), which follows the course of urban development planning, can also facilitate the inclusion of climate considerations. SEA has two fundamental types. The externally integrated SEA examines an already drafted planning document, and in case it is necessary, suggests modifications to it. By contrast, the internally integrated SEA starts earlier, even prior to drafting the messages of the plan, which makes it similar to parallel planning introduced above. In this latter case, we may have greater influence on planning.
- **Horizontal integration:** Climate change may be introduced as a horizontal principle or objective into an inclusive non-climate-oriented planning process. In this case, climate change has to be taken into consideration during every intervention of the plan. Horizontal integration can be effective only if the significance of including climate considerations into particular policy areas is clearly explained in relation to each and every relevant tool. For example, the action to modernise urban public transportation may also be achieved with low emission and/or air-conditioned vehicles, which may be the means of prevention and adaptation.

An important condition of success horizontal integration is the measurability of performance by a suitable **monitoring system**. Therefore, climate change related indicators have to be defined in connection to each intervention (e.g. when modernising public transport, data has to be collected not only, for instance, on the frequency of service but also, about emission levels). Compliance with the target values of these horizontal climate indicators has to be considered as a responsibility of the city management.

Exclusively horizontal integration is adequate and sufficient only in those cases where no large-scale climate development actions are necessary in order to protect the climate of the city or to perform proper adaptation interventions. Those would be difficult to be 'smuggled' (integrated) into other developments.



Rotterdam Climate Proof Adaptation Strategy

Rotterdam is the second largest city in Holland with population around 600 000. The city located in a low-lying delta will be confronted with rising sea level and exceptionally high or low river levels and floods. Furthermore, the temperature in the city will rise, and heat stress will affect increasing numbers of people. In order to manage the challenge of climate change as an opportunity rather than a threat, the City of Rotterdam has set up the Rotterdam Climate Proof programme. Rotterdam Climate Proof will make the city climate change resilient by 2025. The permanent protection and the accessibility of the Rotterdam region are key elements. The central focus of the programme is to

create extra opportunities to make Rotterdam a more attractive city to live, work, relax, and to invest. This substantial ambition will be realized on the basis of three guiding principles:

- Rotterdam will develop into and present itself on a national and international level as a leading centre for water knowledge and climate change expertise.
- Investments in climate solutions will enhance the attractiveness of the city and the port for residents, companies, and knowledge institutes.
- Innovations and knowledge are developed, implemented, and marketed as an export product.

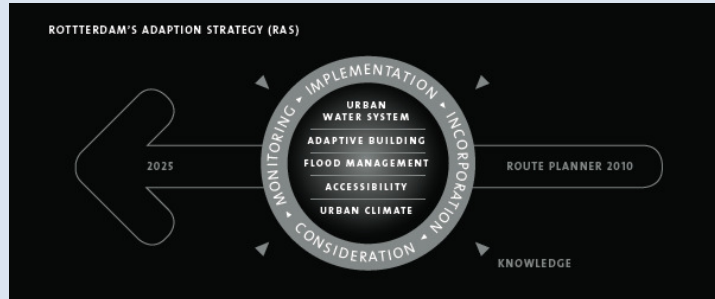
Climate adaptation and spatial development are inextricably intertwined in Rotterdam. The approach applied by the strategy allows urban planners to create designs that effectively address the issue of climate change.

Climate change resilience in Rotterdam will first and foremost involve protection against flooding in the areas inside and outside the dikes in a sustainable way. In addition to flood management, the city will have to focus on other ways to prepare for the consequences of climate change as well, such as higher incidence rates of heat waves, increased heavy precipitation, groundwater salinization, changing ways of water transport, and increased volatility of groundwater levels. What is essential for this adaptive strategy is that it is implemented proactively and that it can be adjusted to changing circumstances. The Rotterdam Climate Adaptation Strategy (RAS) clearly defines the measures that shall be taken to make the area climate proof. The programme consists of five substantive themes which focus on knowledge development and application:

- flood management,
- accessibility,
- adaptive building,
- the urban water system,
- the urban climate.

A number of strategic projects were defined within the programme as well. The focus of these projects is on introducing Rotterdam as a model city and a living example,

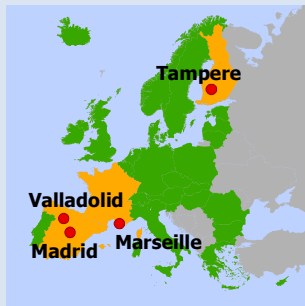
and on the relating marketing activities. Besides that, the projects will also contribute to knowledge development. These projects include the development of the National Water Centre, Connecting Delta Cities, the floating pavilion in Rotterdam, Smart Delta City, and the implementation of the Water and Climate Marketing Plan.



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Examples of climate initiatives embedded in different urban planning processes

In **Madrid**, the capital of Spain (approximately 3.2 million inhabitants) the strategic document entitled the 'City of Madrid Plan for the Sustainable Use of Energy and Climate Change Prevention' contains the targets of the city in connection with climate change and the energy sector and the measures to be implemented until 2012. The plan treats the management of climate change as tightly connected to the energy sector. Regarding renewable energy, the plan gives the most attention to the use of solar energy as well as to waste management. The plan refers to other plans of the city as well, e.g.

it aims at the afforestation of a total area of 8,000 hectares in the Madrid Region, at creating bicycle lanes as part of developing transport, as well as arranging free courses to vehicle owners about economical driving.

In the case of another Spanish city, **Valladolid** (approx. 320,000 residents), the climate issues are also part of an integrated planning process: they are embedded in the framework of the so-called Third Action Plan based on the Agenda 21 programme. The Action Plan has ten project packages, and one of these is expressly about the urban aspects of climate change dealing with, among others, energy and traffic related interventions.

The ECO2 Eco-Efficiency Programme of **Tampere**, a Finnish city, also combines climate protection and energy issues, supporting especially climate friendly urban energy solutions. By 2020 the city would like to reach a reduction by 20% in CO₂ emissions, and furthermore, by 2040, it would like to cover 80% of its energy needs by renewable energy. The plan is closely connected to other urban transport and environmental actions.

Following the individual climate strategy of 2007 in **Marseille**, a document (Charte Qualité Marseille) was published dealing with the environmental issues of architecture and city planning. Its second chapter integrates climate change related ideas. According to its suggestions, for example, green and shaded pedestrian areas have to be preserved despite the increasing building density and number of residents, and covered bicycle storage places shall be installed.

Marseille: www.marseille.fr/sitevdm/document?id=3742&id_attribute=48

Madrid: www.c40cities.org/docs/ccap-madrid-110909.pdf

Valladolid: www.aytovalladolid.net

Tampere: www.eco2.fi

Integrated Urban Development Strategy: Creation of a cooperating and competitive network of vital and liveable cities in Hungary

It was an important step in Hungary in the field of urban development that urban rehabilitation planned and implemented along integrative urban strategies gained greater significance. During the EU-financed development programming period of 2007-2013, according to the urban rehabilitation tenders of the larger cities, a so-called Integrated City Development Strategy (ICS) is obligatory to be drafted based on a predetermined thematic structure. This takes the targets and experiences of the earlier URBAN community initiative into consideration; Hungarian cities can apply for funding on the one hand, to broaden the functions of their centres, and on the other hand, with the aim to undertake the social rehabilitation of their underdeveloped quarters.

The ICS is a long-term strategic document of the cities, which delineates the mid- and long-term objectives based on an initial detailed analysis of the various parts of the city. In order to implement the strategy, the cities indicate action areas, and define the projects targeting the goals. An obligatory part of the ICSs' is the so-called anti-segregation plan, within which the cities make assessments of their significantly deprived areas, and they determine a rehabilitation plan for these. Through the creation of these strategies, the enforcement of local partnership and participation is required. Between 2007 and 2013, a sum of approximately 360 billion Hungarian Forints (1.28 billion EUR) has been allocated on such rehabilitation targets.

Integrated urban development based on the principles of the Leipzig Chart, and the actualisation of the climate change objectives pose a new challenge to the cities. Based on the experience from ICSs, the central government inserted this type of plan also into the law on construction, so it has become mandatory for Hungarian cities to prepare ICS type of plans. The newest methodological instructions regarding these integrated urban development strategies draw attention to the analysis of the climatic situation, and to the consideration of climate change. These aspects have to be strengthened further so that the ICS will be able to deeply integrate and reflect on the climate concerns in all phases of its planning course.

3.4. THE MAIN STEPS OF URBAN CLIMATE PLANNING

3.4.1. A basic precondition in planning: climate-friendly political climate in cities

A basic requirement for effective urban climate planning is an inclusive political environment. In the most favourable situation, this is declared by launching a local climate policy or by assessing the climate effects of certain local political decisions. In case there are no such special political measures present, at least the political leaders have to be committed towards the issue of climate change. It is also important, that this commitment remains across the different political cycles, since both the problem of climate change itself and the tasks involved in its mitigation and adaptation look far into the future.

The cities are encouraged to create climate strategies by different incentives (Cities, Climate Change and Multilevel Governance, OECD, 2009). The most important ones are the legal requirements. Initiatives on the part of local communities and economic actors may also stimulate the preparation of an urban climate policy. Basically, the following factors can influence the motivation and the interest of the city management in a positive way:

- Increased sensitivity towards the long-term environmental, health, and social effects;
- Economic interest formed primarily by climate change mitigation related energy efficiency issues;
- The job creating effects of the new technologies assisting both adaptation and mitigation (green and eco-technologies);
- However, when planning for climate at this local level, we also have to pay attention to the limiting factors. The legislative and decision making competences and authority of cities restrict the extent to which the climate strategy of a city can influence local climate change issues.

3.4.2. 'Planning climate planning'

Considering the fact, that currently there are no obligatory provisions for the preparation of complex, integrated strategic urban climate plans, there is significant freedom in designing the planning process.

In the beginning of the planning process, the responsible parties of planning (in general, the management of the city) and the planning experts have to design the urban climate planning procedure and the characteristics of the planning document to be created: (1) the topic and function, (2) the level, and (3) its actors, as well as, (4) the parameters of the process itself (the schedule, resource needs, etc.).

Favourably, a committee of experts gives further and effective support to the municipality divisions in charge. The committee may be divided into subcommittees based on sectors or other topics. The committee can also provide a framework for building the climate partnership by involving also civil activists and economic actors in their work.

Before starting planning, we have to choose the proper integration form as well (see details in the former subchapters). No matter what kind of solution we choose, it is advisable to consider the partnership in each case as a means of integration. Proper climate planning is participatory planning which results in a plan that may be implemented in a corporate responsibility system. So we have to involve as wide and as colourful part of the community as possible. (We will deal with the partnership later in a more detailed way.)

3.4.3. How to start? – Situation analysis in climate planning

The analysis must assess the future dynamics of the city's climate. The results of climate models have to be considered. Although numerous climate models can be applied, the modelling of a city's climate change can easily exceed the resource and time frames of a planning project conducted by a city. However, it is always possible to utilise the published results of the already developed and applied climate models regarding the encompassing region or macro-region. The climate change vulnerability of the city has also to be investigated. A city's vulnerability shall be assessed according to sectors (health care, heating, water management etc.) and districts. (See Chapter 1 for further ideas on climate modelling and vulnerability assessment.)

In the course of analysis, those sectors and policy areas also have to be studied which are either having an influence on or are being influenced by, climate change. This analysis has to incorporate aspects of both adaptation and mitigation. The climate-relevant urban-ecological elements (e.g. green and water surface systems, solar radiation) and parameters of the built-up environment (e.g. patterns and number of buildings and the housing conditions) have to be investigated. Social and economical trends concerning water and energy management (e.g. consumption patterns), traffic (passenger and goods), and industrial and agricultural production have also to be analysed.

Furthermore, we have to go through the other city development plans and programmes that are in effect and under implementation. We have to try to expose the possible climate consequences of the existing urban development initiatives.

During urban planning, it is not allowed to treat the cities as homogeneous units, since the city districts with diverse characteristics need different interventions regarding the improvement of the urban micro-climate (e.g. densely built-in downtown areas, agglomeration areas with extensive green areas). Therefore, the investigations have to outline the spatial structure of the city in terms of climate change sensitivity, and the varying climate change scenarios of the city districts. We have to assess the individual themes not only separately, but in a complex analysis as well.

The analysis may not be conducted exclusively of the territory within the borders of the city: the climatic characteristics of the surrounding area have to be also taken into account, as well as their

effects on the climate of the city (adjacent natural environment may significantly modify the anthropogenic effects on urban climate).

In the course of the analysis, we have to investigate the current and possible local effects of the global climate change (extreme weather, heat waves, radiation, etc.) on the urban environment and on human health, as well as its social and economical consequences.

3.4.4. What is our destination and how do we get there? – Setting up aims and objectives, defining measures

Determining the objectives and the means to achieve them is a very important phase of urban climate planning. The objectives and means of the urban climate strategy – in a proper interpretation – are the measurable and controllable undertakings. Favourably, situation these are not only the undertakings of the leadership or the management of the city but of a large number of city inhabitants, business and civil actors as well.

We may set objectives in connection with urban climate directly and separately (mitigation and adaptation), or we may integrate the climate aspects into other general objectives. These both can be important in planning the climate strategy of the cities.

We may also define climate objectives referring to certain city parts (e.g. increasing the surface of the downtown green areas, enhancing the climate comfort of the residential areas of the Eastern European style block houses built of industrially prefabricated elements, or afforestation in the suburbs). Due to the diversified spatial structure of the cities, an urban climate strategy has to have spatial objectives among its aims which target particular areas or districts; lacking these, it may remain shallow without exact messages.

However, climatic objectives may also be incorporated in the planning documents as horizontal objectives. This solution is necessary especially when the climate strategy is prepared not through a separate planning process and not in the frame of an individual planning document but as part of another urban development planning processes.

In the urban climate strategy, we also determine the means serving the climate objectives. We have a chance to choose from among a large number of different means in the case of each city. Investments performed by the city (e.g. afforestation, locating shading street furniture, installation of air conditioning devices), organisation and mobilization (e.g. organizing afforestation realised by the residents) or consultation (e.g. a campaign for residents on how to regulate the temperature of their flats) may be among the means. A further important means may be the financial support of citizens or enterprises (funding for afforestation or shading), but legislative measures as well (e.g. climate friendly construction regulation). Naturally, the city leadership and management are not solely responsible for the application of these means. Moreover, an urban climate strategy will be successful if it is realized in the co-operation of different groups of the community.

One of the most important factors in the choice of the urban climate political priorities is the time frame for the objectives and interventions. We may separate short-term and long-term interventions both regarding mitigation of the harmful effects of, and the adaptation to, climate change. For example, the construction of a shading system, or the reduction of the greenhouse effect of transport may be implemented on a short-term basis (even in a three-year action plan) in a specific action area of a certain part of the city. These all, of course, do not mean that a short-term climate plan should not have to indicate the (small) steps towards a long-term objective, but these are worth to be treated separately during planning and evaluation.

3.4.5. Measuring success – monitoring, evaluation and indicators in climate planning

We continuously have to follow the situation of the urban climate. We have to collect the relevant climate data and create databases with a proper time scale and territorial breakdown, based on which

we may apply climate models providing forecasts, and other scientific examinations may also be supported.

Besides the collection of the data regarding the climate, we have to monitor the results of our climate change interventions. Therefore we have to define an indicator for each case in the climate strategy which shows the output of the interventions (i.e. output indicators, e.g. the number of insulated flats, the size of the green area), the results (result indicators, e.g. the size of the public area affected by direct sunshine, number of residents living and working in the area whose climate comfort has been enhanced), and effects (effect indicators, e.g. reduction of the energy required for cooling). Compared to other urban planning documents, the implementation of our climate strategy has to be also regularly evaluated, at least once during implementation (on-going), and following the end of implementation (ex-post evaluation). Based on these evaluations, by examining the data collected via the monitoring system, we may have to intervene in the implementation, or modify the strategy.

During the evaluation of the climate strategy, it is worth assessing the progress of the other plans and programmes of the city. We have to consider what kind of results and effects the other urban developments have. Above all, attention has to be brought to developments having unfavourable climate effects, and we have to initiate their amendment as well in time.

3.4.6. Who is responsible for what? – Creation of the implementation system in climate planning

The political and professional representatives of the climate strategy have to be nominated as well. Besides this, it is also important that the cities possess a group of experts which is able to collect the data and information about changes in the urban climate, and who can plan the adaptation interventions. These experts will be able to evaluate the climate strategy of the city. As already mentioned above, we have to try to involve further urban actors into implementation with defined responsibilities.

In a favourable situation, the implementation of the plans in connection with climate change is not only the responsibility of a designated organisational unit, but instead, it takes place in co-operation; and it is a common responsibility of different urban institutions.

BRIEF RECOMMENDATIONS

- Urban climate planning cannot be a separate process, but has to connect to the development and management procedures of the city in an integrated way.
- During their climate planning, the cities have to deal with their mitigation and adaptation possibilities. Especially the latter one is a slightly less significant element of contemporary urban climate plans, and it has to be enhanced further.
- The planning principles and means becoming part of the current strategic planning practice may and shall be applied in urban climate planning for the enforcement of the horizontal policy of sustainability. Therefore, in the different planning activities of the cities:
 - The implementation of strategic planning has to involve the partners affected by climate change.
 - Strategic environmental assessments going parallel with planning have to incorporate climate change as an aspect.
- When we perform an urban strategic planning process involving climate aspects, we have to indicate the climate-political ideas in all of its phases (situation analysis, setting up the objectives and determining actions, planning of monitoring and evaluation, and implementation).