THE EUROPEAN ENVIRONMENT

STATE AND OUTLOOK 2010

URBAN ENVIRONMENT

European Environment Agency

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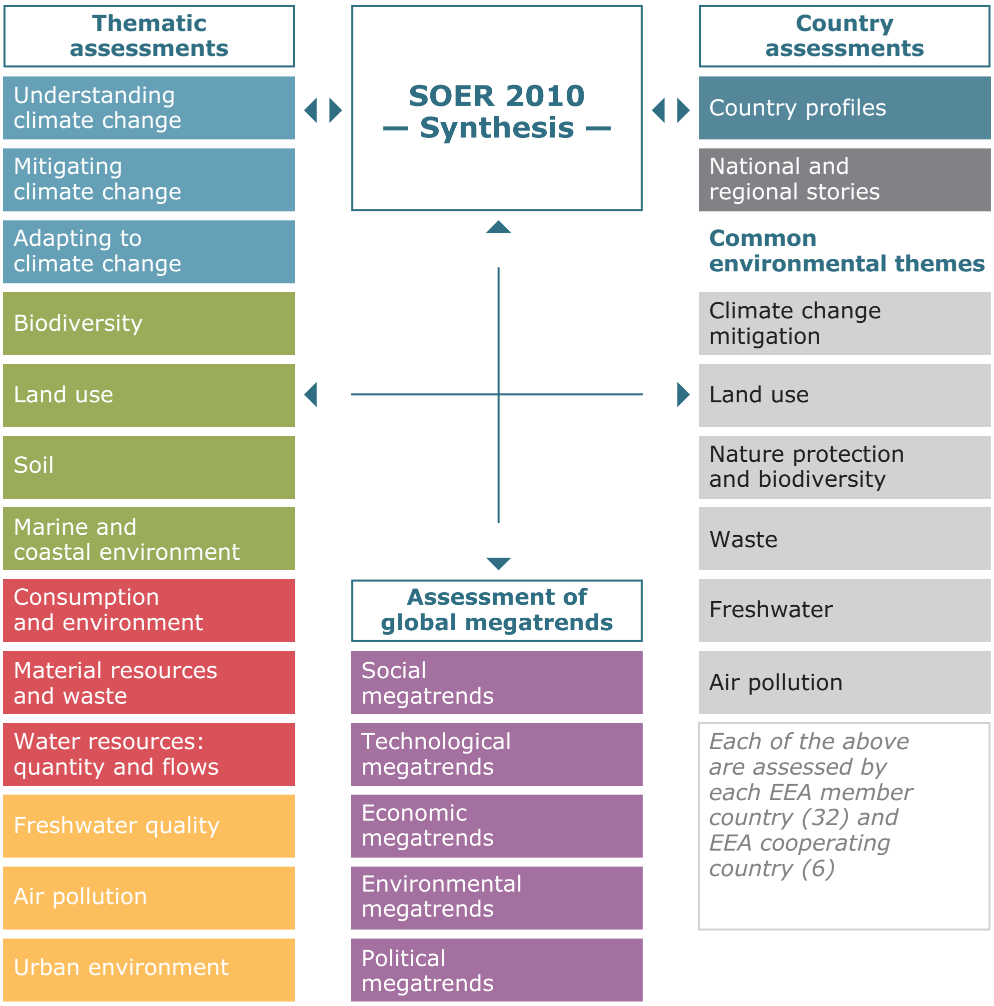
1. a set of 13 Europe-wide **thematic assessments** of key environmental themes;
2. an exploratory assessment of **global megatrends** relevant for the European environment;
3. a set of 38 **country assessments** of the environment in individual European countries;
4. a **synthesis** — an integrated assessment based on the above assessments and other EEA activities.

SOER 2010 assessments



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Urban environment

Summary

The global population is increasingly concentrating in cities. In Europe, around 75 % of the population live in urban areas and this is projected to increase to about 80 % by 2020. Our cities and urban areas face many challenges — economic, social, health and environmental. The impacts of cities and urban areas are also felt in other regions which supply cities with food, water and energy, and absorb pollution and waste. However, the proximity of people, businesses and services associated with cities also creates opportunities for improving resource efficiency. Indeed, well-designed, well-managed urban settings offer great opportunities for sustainable living, and partnerships and coordination from the local to European level can help improve them.

Urban areas and quality of life

For the three-quarters of Europe's population that live in cities and towns, a good urban environment is a precondition for a good quality of life. It seems, in part, that over the last decade, attitudes to living in cities have been changing. People are no longer moving away from city centres. In fact, people are returning to them and residential sprawl has slowed.

As the major function of cities is to provide places for people to trade, produce, communicate and live, the urban environment needs to be assessed from a very specific human perspective: to provide an agreeable place to live while minimising or balancing negative side effects.

Quality of life in cities relies on a range of components such as social equity, income and welfare, housing, a healthy environment, social relations and education. The environmental elements of good quality of life include good air quality, low noise levels, clean and sufficient water, good urban design with sufficient and high-quality public and green spaces, and a good local climate or opportunities to adapt to climate change. However, urban-specific data are patchy in Europe and, due to different timescales and reporting methods, are seldom directly comparable.

Urban challenges

Many of our cities struggle to cope with social, economic and environmental problems resulting from pressures such as overcrowding or decline, social inequity, pollution and traffic. The environmental impacts of cities also spread well beyond their physical limits as cities rely heavily on outside regions to meet demand for energy and resources and to accommodate waste. For example, a study of Greater London estimates that London has a footprint 300 times its geographical area — corresponding to nearly twice the size of the entire United Kingdom.

Climate change

Climate change has the potential to influence almost all components of the urban environment and to raise new, complex challenges for the quality of urban life, health and urban biodiversity. Some cities will experience droughts and higher temperatures. Others will experience floods. Climate change will affect many aspects of urban living from air quality to consumption patterns (e.g. energy for air conditioning).

Poor urban design can aggravate the impacts of climate change. For example, soil sealing — the covering of soil for housing, roads and parking lots etc. — increases the absorption of energy from the sun and leads to higher urban temperatures (the so-called 'urban heat island effect'). The impermeability of the sealed areas reduces natural drainage and increases water run-off, which in particular during heavy rains can lead to urban floods. However, urban design aimed at tackling climate change, as through boosting green infrastructure, could have numerous co-benefits, including improved air quality, support for biodiversity and enhanced quality of life.

Urban opportunities

The proximity of people, businesses and services associated with 'city living' means that there are opportunities and benefits associated with urban living, also in terms of sustainability and resource use. Already, population density in cities means shorter journeys to work and services, and greater use of walking, cycling or public transport, while living in apartments in multi-family houses or blocks requires less heating and less ground space per person. As a result, urban dwellers on average consume less energy and land per capita than rural residents.

Designing the future

Cities are ecosystems: they are open and dynamic systems which consume, transform and release materials and energy; they develop and adapt; they are shaped by humans and interact with other ecosystems. They must therefore be analysed and managed like any other type of ecosystem.

Through rethinking urban design, architecture, transport and planning, we can turn our cities and urban landscapes into 'urban ecosystems' at the forefront of climate change mitigation (e.g. sustainable transport, clean energy and low consumption) and adaptation (e.g. floating houses, vertical gardens). Furthermore, better urban planning will improve quality of life across the board by designing quiet, safe, clean and green urban space. It also creates new employment opportunities by enhancing the market for new technologies and green architecture.

Cities, due to their concentration of people and activities, matter for Europe. Their problems cannot be solved at the local level alone. Better policy integration and new governance, involving closer partnership and coordination at the local, national and European levels, are required.

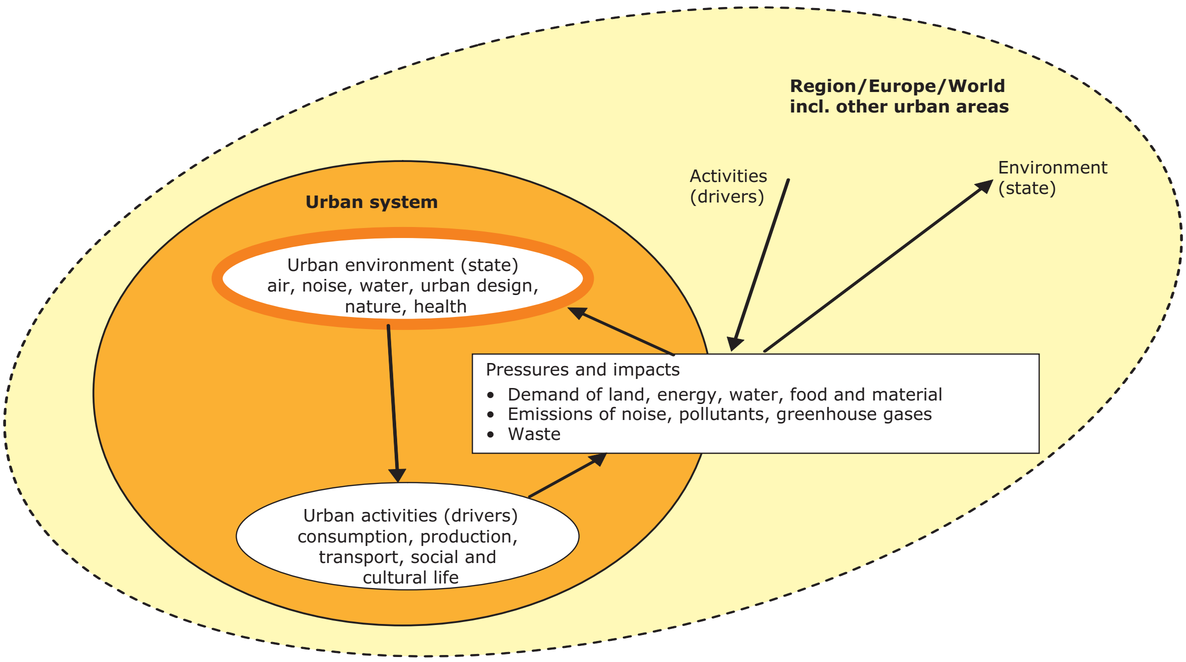
1 Introduction

Cities and towns grew as centres of trade and commerce on rivers, coasts, and at road or rail junctions. They are highly artificial ecosystems, created by humans to provide places to do business and communicate and to offer suitable and safe living conditions. In Europe, around 75 % of the population lives in urban areas and this is projected to increase to about 80 % by 2020 (EEA, 2006). As centres of innovation, economic development and wealth generation, they provide humans with many benefits including shelter and comfort, hygiene, and access to basic goods and services such as drinking water, and health and child care. They also provide jobs and centres for education, cultural and social interaction for Europe's rural population as well as for their own inhabitants. Moreover, cities set the trends for lifestyles and related consumption: most rural residents live an 'urban' life, using the services of the cities and having similar consumption styles for electrical appliances, buying food in supermarkets, etc. but travelling further to reach these services (IEA, 2008).

On the other hand, cities, due to high human activity and population density, are also the places where major environmental pressures are generated and where the related health effects concentrate. But cities do not generate all the goods and services they consume — building materials, energy, food, fibres, water, etc. These were drawn in — historically — from the cities' hinterland, but in this era of globalisation, come from an increasingly widespread number of sources. Thus cities impact not only their own territory but also places far afield both in Europe and other parts of the world. Nonetheless, the urban setting provides important potentials for eco-efficiency and the reduction of environmental pressures per person.

Figure 1.1 describes the position of the urban environment in its context. This assessment concentrates on the urban environment; the important external impacts are dealt with mainly in the SOER 2010 land use assessment (EEA, 2010e) and the SOER 2010 consumption and environment assessment (EEA, 2010f).

Figure 1.1 The urban environment in relation to areas and activities beyond cities and towns



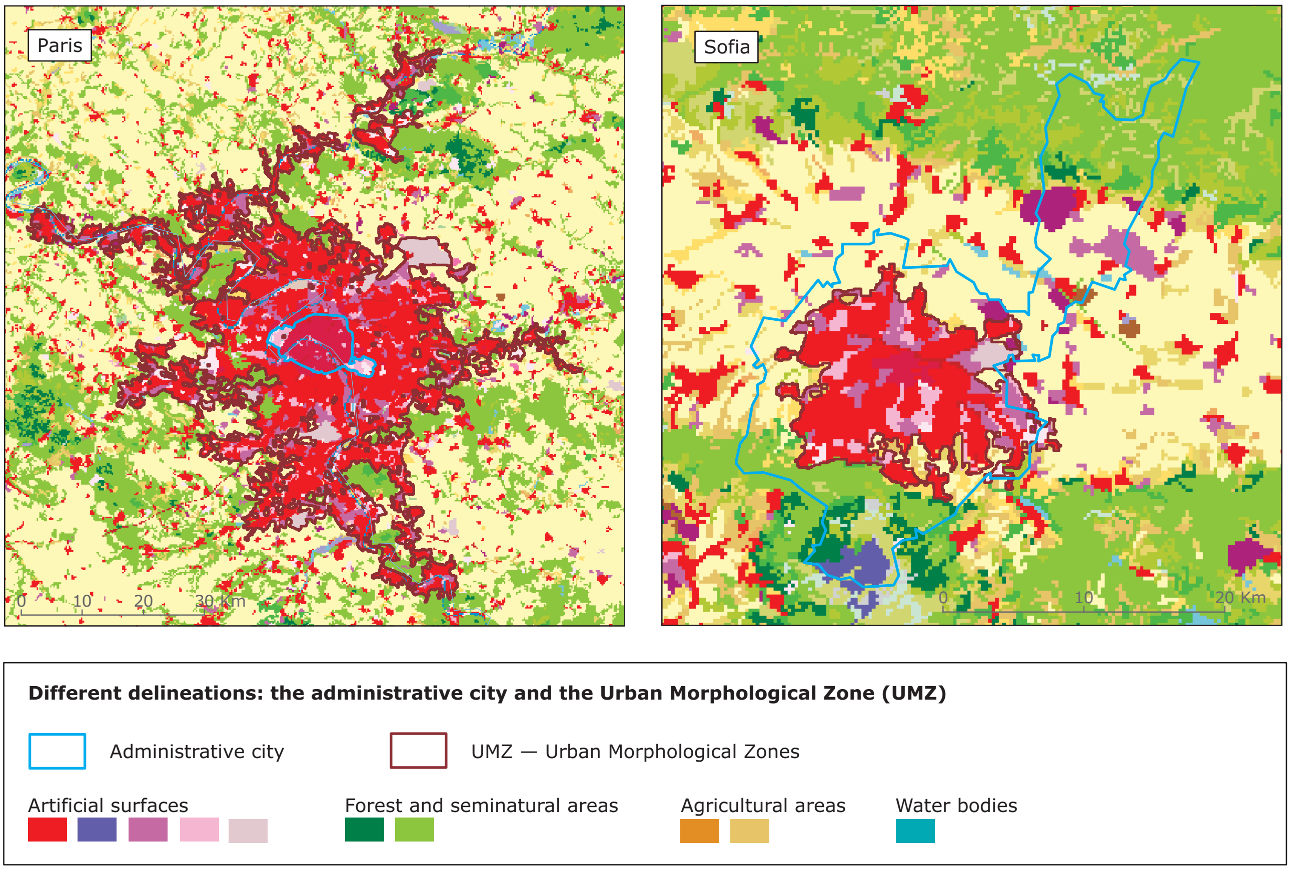
Source: EEA, 2010.

There are many ways to define 'urban'. These can differ substantially and describe totally different characteristics (Map 1.1). This report mainly uses the Urban Morphological Zone (UMZ) (EEA, 2006) as it provides the best fit to environmental characteristics. However, other descriptions, such as administrative delineations (e.g. Urban Audit (Eurostat, 2010) or functional urban areas (e.g. ESPON, 2010 or EU Territorial Agenda (EU, 2007b)), may also be used depending on the specific context, for example, when considering drivers or policy responses or for reasons of data availability.

The Thematic Strategy on the Urban Environment (EC, 2006a), in the framework of the 6th Environment Action Programme (6EAP), highlights the fact that the environmental challenges facing cities have significant consequences for human health, the urban quality of life and the performance of the cities. It aims, therefore, to improve the urban environment, making cities more attractive and healthier places in which to live, work and invest while trying to reduce their adverse environmental impacts on the wider environment. Better implementation at the local level of existing EU environmental policies and legislation, such as the EU directives on air quality, environmental noise, and urban wastewater treatment, could be achieved by supporting and encouraging local authorities to adopt a more integrated approach to urban management and inviting Member States to support this process (EC, 2006a).

The Leipzig Charter on Sustainable European Cities (EU, 2007a) aims to protect, strengthen and further develop European cities. It uses the definition of sustainable communities provided in the Bristol Accord (UK presidency, 2005) as 'places where people want to live and work, now and in the future. They meet the diverse needs of existing and future residents, are sensitive to their environment, and contribute to a high quality of life. They are safe and inclusive, well planned, built and run to offer equality of opportunity and good services for all'.

Map 1.1 Different urban delineations: the administrative city and the Urban Morphological Zone (UMZ) of Paris and Sofia



Source: Urban Audit database (Eurostat, 2010).

2 State, trends and impacts

2.1 Urban environment and quality of life

As the major function of cities is to provide places for people to trade, produce, communicate and live, the urban environment needs to be assessed from the very specific human perspective of the Bristol Accord — providing an agreeable place to live while minimising or balancing negative side effects. Nevertheless, cities are ecosystems: they are open and dynamic systems, which consume, transform and release materials and energy; they develop and adapt; and they interact with humans and with other ecosystems. Therefore, providing quality of life in cities functions only in interaction with its different components such as social equity, income and welfare, housing, a healthy environment, social relations and education (EEA, 2009).

A healthy environment is an important and indispensable part of quality of life. Experience of a city combines objective environmental conditions, such as pollution levels, and the individual characteristics of a person. Under disadvantageous conditions perceived as stressful coping mechanisms are triggered. If these are not successful, stress may continue and lead to illness and mental disorders (Pacione, 2003). Although most environmental and health issues are not exclusive to cities, some are exacerbated within them, because of the specific urban complexity of interrelations between environmental, social and economic demands (RCEP, 2007; DEFRA, 2008).

The environmental elements of a good quality of life are good air quality, low noise levels, clean and sufficient water, good urban design with sufficient and high-quality public and green spaces, an agreeable local climate or opportunities to adapt, and social equity. Urban-specific data are patchy in Europe and, due to different timescales and reporting methods, seldom comparable. The following analysis therefore draws on the limited Europe-wide data available and combines them with lessons learnt from specific cities.

Air quality

A significant proportion of Europe's urban population is exposed to air pollution concentrations exceeding the EU air-quality limits. Over the period 1997 to 2008, 13–62 % may have been exposed to concentrations of particulate matter (PM_{10}, less than 10 micrometres diameter), ozone (O_3) or nitrogen dioxide (NO_2) above the EU air-quality limits or targets. The number of people affected varies from year to year as a result of variability in emissions, pollution build-up and dispersion/deposition conditions, controlled mainly by weather processes.

Table 2.1 lists the ten most polluted cities in Europe in 2008 in terms of a subset of three indicators chosen to quantify air pollution exposure: PM_{10} exceedance days,

Table 2.1 The 10 most polluted cities for daily PM_{10}, O_3 concentrations and NO_2 annual mean concentration in the urban background, 2008

Number of days of PM_{10} exceedances of EU limit value of 50 ug/m³ (daily mean)		Number of days of O_3 exceedances of EU target value of 120 ug/m³ (maximum daily 8 hours mean)		NO_2 annual mean concentrations in ug/m³ (the EU limit value is 40 ug/m³)	
Plovdiv, Bulgaria	208	Turin, Italy	77	Brescia, Italy	62
Pleven, Bulgaria	185	Campobasso, Italy	74	Turin, Italy	60
Sofia, Bulgaria	176	Bologna, Italy	72	Brasov, Romania	58
Krakow, Poland	152	Bergamo, Italy	69	Modena, Italy	50
Timisoara, Romania	136	Athens, Greece	68	Milan, Italy	49
Rybnik, Poland	122	Novara, Italy	65	Trieste, Italy	48
Nowy Sacz, Poland	116	Cremona, Italy	64	Rome, Italy	43
Craiova, Romania	112	Brescia, Italy	64	Athens, Greece	42
Zabrze, Poland	108	Milan, Italy	62	Padua, Italy	41
Turin, Italy	106	Reggio nell Emilia, Italy	61	Genoa, Italy	41

Note: Turkish PM_{10} data are not validated and therefore not part of this table reflecting the situation in 2008.

Source: AirBase, 2010.

O_3 exceedance days, and NO_2 annual mean concentrations. The figures are for the urban background, which is broadly representative of urban residential areas and the majority of the urban population. The worst-case exposure of individuals in cities is generally in street canyons with intense traffic. The number of exceedances in such areas can be far greater than reported in the urban background areas. Traffic is a main source of PM_{10} emissions together with industry, commercial and residential sources (EEA, 2010a). Map 2.1 shows, as an example, the regional pattern across Europe for NO_2 annual mean concentrations (see the SOER 2010 air pollution assessment (EEA, 2010g)).

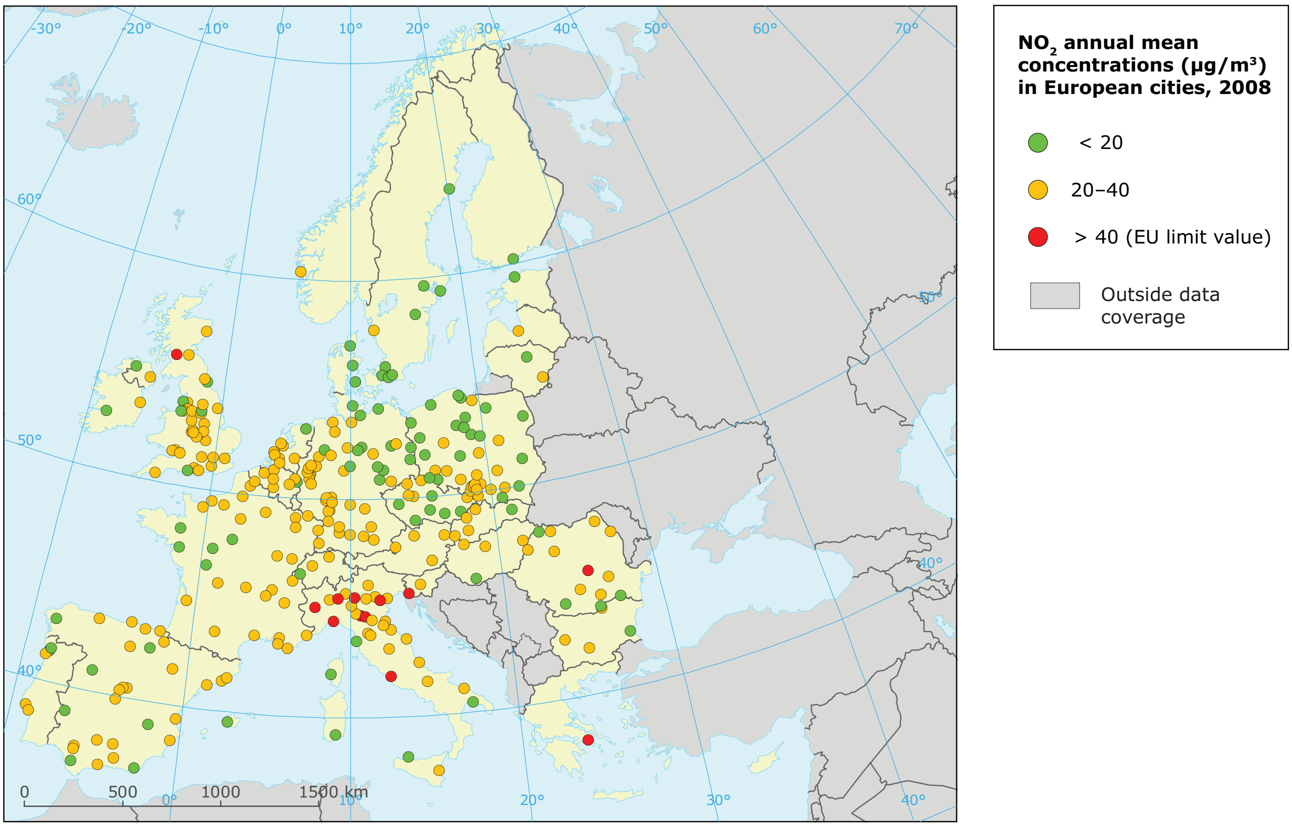
All people are potentially exposed to air pollution. Even at moderate concentrations, sensitive groups, including people with respiratory diseases or heart conditions and older adults and individuals performing activities that lead to increased breathing rate, suffer from air pollutants. Ambient air pollution, notably particulate matter and O_3, has been associated with increases in morbidity and mortality in many European urban studies (De Leeuw and Horalek, 2009; Barrett et al., 2008).

PM_{10} consists of fine particles with diameters smaller than 2.5 microns ($PM_{2.5}$) and coarse particles of between 2.5 and 10 microns. Fine particles can penetrate deeper into the lungs and cause more harm than coarse particles, and long-term exposure to $PM_{2.5}$ is associated with serious health outcomes. The evidence from epidemiological and toxicological studies indicates that there is a causal relationship between long-term $PM_{2.5}$ exposure and cardiovascular effects, mortality, and probably for effects on the respiratory system (USEPA, 2009). For long-term exposure to $PM_{2.5}$ the mortality hazard rate for every additional 10 ug/m³ contribution to the average concentration is estimated at 6 %. Acute health effects are also assumed to vary linearly with exposure to particulate matter (PM_{10}, $PM_{2.5}$) at concentrations below 100 ug/m³ (Barrett et al., 2008). Katsouyanni et al. (2001) estimate that overall mortality increases by 0.6 % per 10 ug/m³ increase in acute exposure to PM_{10}. For ozone, mortality increases by 0.3 % per 10 ug/m³ increase in an 8-hour average concentration. Combined exposure to both pollutants has been shown to increase the above-mentioned mortality rate for $PM_{2.5}$ (Barrett et al., 2008; EEA, 2010b, Chapter 5).

Noise

Another problem about which urban citizens increasingly complain is noise. Data reported in accordance with the Environmental Noise Directive

Map 2.1 NO_2 annual mean concentrations (µg/m³) in the urban background for a subset of European cities, 2008



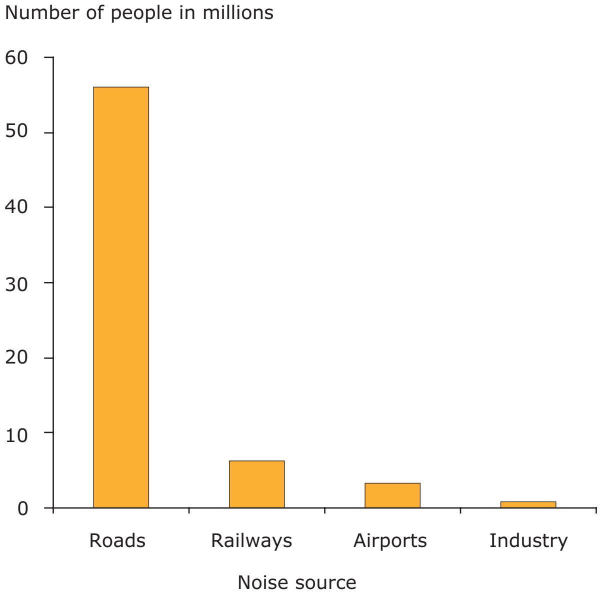
Source: AirBase, 2010.

(EC, 2002) show that transport sources cause a large number of people to be affected by noise (see Figure 2.1). As many as 56 million people in the largest cities in the EU-27 are exposed to long-term average road traffic noise levels exceeding 55 dB L_{den}, approximately 53 % of the population living in agglomerations with a population of more than 250 000. At night, almost 40 million people may be exposed to long-term average road noise levels exceeding 50 dB L_{night}, a level at which adverse health effects become measurable (see Table 2.2). The number of people affected can differ widely between and within cities. Social gradients may play a role — for example in Germany, children with low socio-economic status were more annoyed by road traffic noise during the day than children with higher socio-economic status (Babisch, 2009).

Exposure to noise can have several adverse non-auditory effects. It disturbs and interferes with concentration and activities such as communication, relaxation and sleep. In addition, there are concerns about the health impacts of transport noise including effects on the cognitive development of children, sleep disturbance, endocrine balance, and cardiovascular disorders (Babisch, 2002). The Aircraft and road traffic noise and children's cognition and health (RANCH) study in the Netherlands, Spain and the United Kingdom found that chronic aircraft noise exposure impaired the reading comprehension and recognition memory of 9–10-year-old children by up to 2 months, after taking a range of socio-economic and confounding factors into account (Stansfeld et al., 2005). In the long run, chronic noise stress may affect homeostasis and metabolism due to disregulation, incomplete adaptation and/or the physiological costs of adaptation (Babisch, 2006).

The WHO Night Noise Guidelines for Europe (WHO, 2009a) describe levels above 55 dB L_{night} as 'increasingly dangerous to public health'. Figures 2.2 and 2.6 show the situation in selected European agglomerations over more than 250 000 people.

Figure 2.1 Reported noise exposure of more than 55 dB L_{den} in European agglomerations with more than 250 000 inhabitants based on the results of strategic noise mapping



Source: NOISE, 2010.

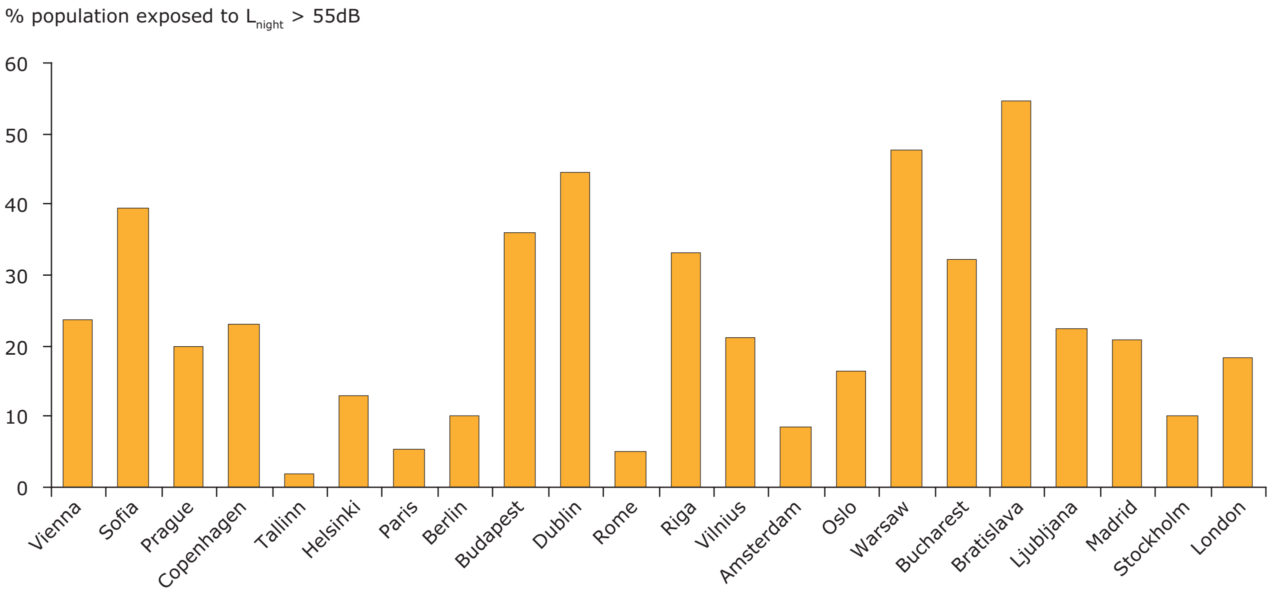
In some cities, close to half the population is exposed to 55 dB L_{night} or more (see Figure 2.2). However, for the primary prevention of sub-clinical adverse health effects related to night noise in the population, the guidelines recommend that the population should not be exposed to night noise levels greater than 40 dB L_{night} outside. This can thus be considered a health-based limit. The target of 55 dB L_{night} outside is not a health-based limit, being equivalent to the lowest observed adverse effect level, and should be considered only as an interim target for situations where the achievement of the guidelines is not feasible in the short run.

Table 2.2 Health effects associated with different noise levels at night (individual sensitivities and circumstances might differ)

L_{night} outside noise level	Associated health effects
< 30 dB(A)	No substantial biological effects are observed.
30–40 dB(A)	A number of effects increase. However, even in the worst cases, the effects seem modest. Vulnerable groups, for example children, chronically ill people and the elderly, may be affected to some degree.
40–55 dB(A)	Adverse health effects become measurable. Many people have to adapt their lives to cope with this level of noise during sleep. Vulnerable groups are more severely affected.
> 55 dB(A)	The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep is disturbed. There is evidence that the risk of cardiovascular disease increases.

Source: WHO, 2009a.

Figure 2.2 **Percentage of people exposed to levels above the WHO interim target for night-time noise in Europe from road transport (> 55 dB L_{night})**



Note: Noise assessment methodologies between countries' as well as cities' structures, road network and population density might differ and affect this comparison.

Source: NOISE, 2010.

Light pollution

Satellite photos show that the amount of outdoor lighting in Europe is increasing, with the highest intensity in cities. Outdoor illumination provides valuable opportunities for social use of public spaces at night and can contribute to improving traffic safety and crime prevention (RCEP, 2009). However, experimental research has shown that light can affect people's day-night rhythm, and disturbances can have noticeable physical and psychological effects such as jet lag and on brain activity patterns. Although generally little is known about the effects of environmental light pollution on humans, it may, together with other stress factors, affect mental health. For example, people living close to greenhouses or sports fields that are lit at night feel annoyed by the illumination (HCN, 2000). However, knowledge of this area is very limited.

Water

A sufficient supply of good quality water for drinking and other uses is vital for cities. The International Water Association (2008) shows a wide range of water use in European cities, 150–400 l/person/day. In the past, with growing populations and increasing demand for water, European cities generally relied on the surrounding regions to provide their water. Athens, Istanbul and Paris, for example, have all developed wide-reaching networks and infrastructures for transporting water, often over more than 100–200 km (Box 2.1).

Box 2.1 Sufficient water for Ankara, Turkey?

In Ankara, intensive drought conditions occur at least once in each eight-year period, the last being in 2007. Although such events are natural, the situation of Ankara has changed dramatically: from a small town with some 74 000 inhabitants in 1927 it had become a metropolis of more than 3 million by 2000, expanding its area over the years more than 650-fold. This growth is expected to continue, and water consumption per person is also expected to increase as a result of changing lifestyles and economic activities. However, the water resources are limited and insufficient to meet current demand. Climate change, with an expected decrease of annual precipitation and river flows in the region, is projected to further aggravate the situation and make a drought management plan a priority.

Source: Ceylan, 2009.

Some cities face water shortages, others too much water due to storm water or river flooding or heavy rainfall with high run-off (see the SOER 2010 water resources: quantity and flows assessment (EEA, 2010h) and the adapting to climate change assessment (EEA, 2010i) and others may be confronted with both situations. Urban areas built on flood plains are increasingly vulnerable to flooding (see Box 2.2). But the urban fabric itself can also worsen the situation — urban sprawl with moderate to high soil sealing over a large area reduces the infiltration potential of the soil and increases the flood risk of urban areas at lower elevations while high soil sealing inside cities produces higher run-offs, that can reduce the effectiveness of the sewage system and lead to urban flooding. Indeed, much of the flooding in England in the summer of 2007 was caused by high soil sealing (Pitt, 2008). As well as causing economic damage, urban flooding can be a public health risk when sewage backs up into homes and can also threaten urban water supply. Additionally, storm overflows threaten aquatic life through the discharge of pollutants to watercourses.

The Urban Waste Water Treatment Directive (EC, 1991) has led to a marked improvement in the collection and treatment of wastewater in the EU. As a result, much of Europe has seen a decline in the discharge of a number of pollutants to receiving waters. The treatment process is not, however, 100 % effective, and the discharge, for example, of endocrine disrupting chemicals is still sufficient to raise environmental concerns (see the SOER 2010 freshwater quality assessment (EEA, 2010j)).

Climate

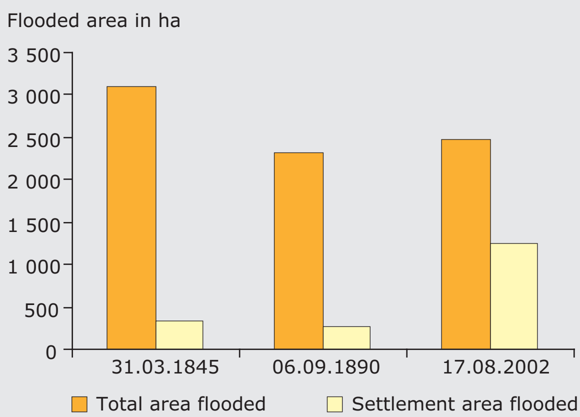
Climate change may influence almost all components of the urban environment, and raise new, complex challenges to the quality of urban life, health and urban biodiversity. Increases in flooding or temperatures may result not only in deaths, but also in water-borne disease outbreaks and increased stress, and may affect mental health (Reacher et al., 2004; Ahern et al., 2005). Changes in urban ecosystems, like changes in the wind flow, temperature, humidity, and precipitation, may alter patterns of vector-borne diseases. Health effects related to the limited availability and quality of drinking water and increases in episodes of food poisoning cannot be ruled out (Costello et al., 2009; RCEP, 2007; Suk and Menne, 2009). Also green urban areas and species could suffer from climate changes such as temperature and precipitation and could no longer provide ecosystem services. Furthermore, climate change may exacerbate existing environmental problems including those related to air pollution due to increased particulate matter and ground-level O_3 concentrations, flooding, and water supply problems. As a feedback loop, climate change can influence people's consumption, for example energy demand for cooling and heating, or irrigation of urban green spaces. That could cause further environmental burdens.

Heat waves as well as droughts are mainly associated with the southern parts of Europe, where cities are already under water stress and have the highest population growth. However, there may not be a simple north-south distribution of the threat.

Box 2.2 Flood events and flooded built-up areas in Dresden, Germany

Comparing three major flood events of the river Elbe in Dresden in 1845, 1890 and 2002 shows that the built-up area flooded had increased dramatically over time. Although the total flooded area in 2002 was only slightly bigger than in 1890 and smaller than in 1845, the settlement areas in flood plains had grown considerably over the past century (EEA, 2009, page 48).

Figure 2.3 Flood plains of the river Elbe in the municipality of Dresden, Germany, during different flooding events

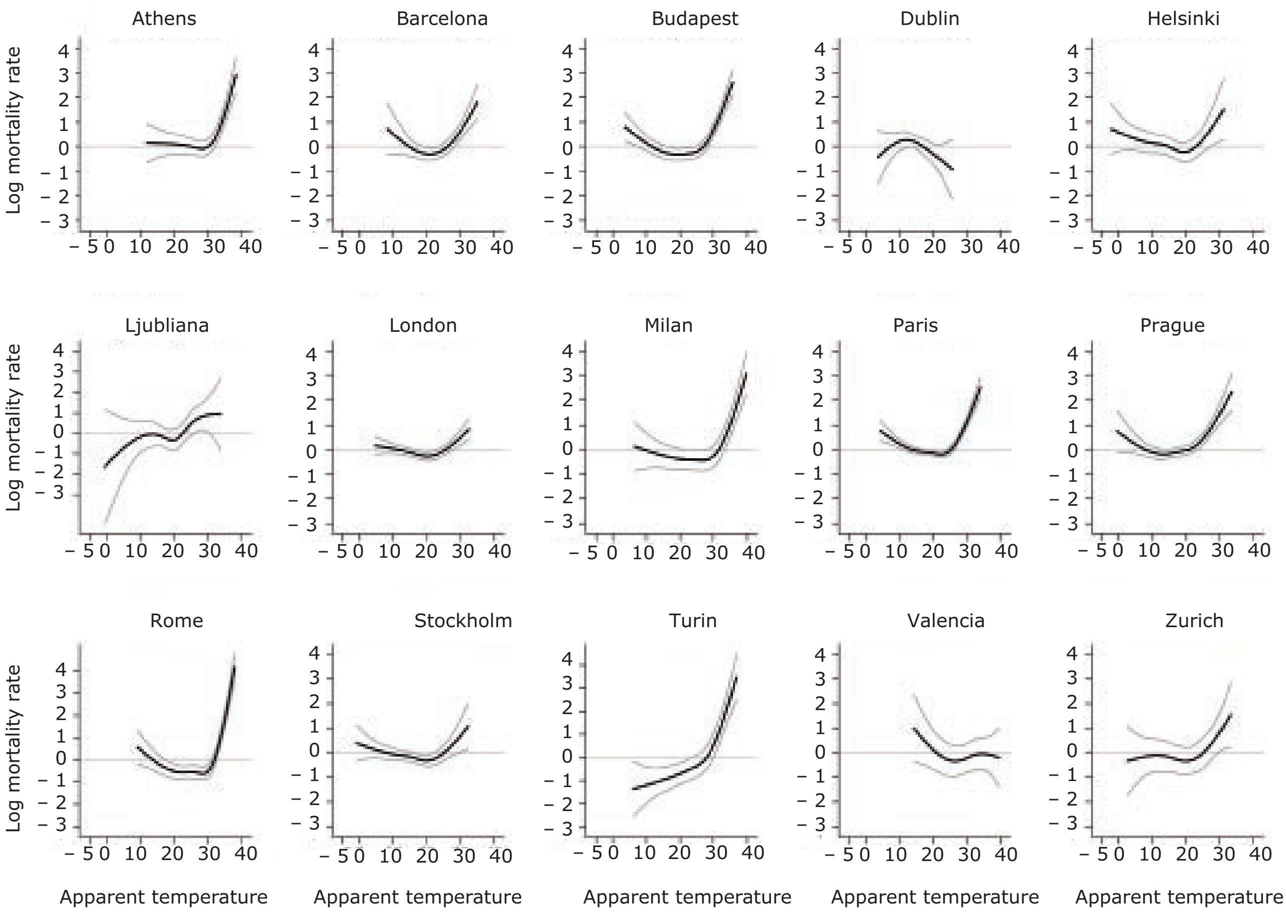


Source: Schumacher, 2005.

Heat waves ([1]) — currently the most prominent natural hazard leading to human fatalities in Europe — are projected to increase in frequency, intensity and duration (EEA, 2010i). Mortality for populations in the EU has been estimated to increase by 1 to 4 % for each degree increase of temperature above a (locally specific) cut-off point (WHO, 2008). The heat wave of 2003, with an estimated 70 000 excess deaths across 12 European countries, including in such non-southern countries as Belgium, England and Wales, France, Germany, Luxembourg the Netherlands and Switzerland highlights the need for climate change adaptation (Robine et al., 2008). The EuroHEAT project estimated that in nine European cities mortality during the heat-wave episodes increased by 7.6–33.6 %, with high heterogeneity between cities and populations (WHO, 2009b). The same study emphasised the combined effect of temperature and air pollution could lead to further increased mortality on hot days when the population is exposed to high concentrations of PM_{10} and ozone.

Temperature thresholds over which a heat wave can be defined differ from city to city. Populations typically display an optimum temperature at which the death rates are lowest. Mortality rates rise with temperatures beyond this comfort zone. The strength of the relationship between daily outdoor temperature and health outcomes differs between countries, between cities and even in the same location from one year to the next (WHO, 2009; Baccini et al., 2008). The observed mortality rate and temperatures in Figure 2.4 show such relationships. Observed differences among cities and between regions

Figure 2.4 Daily mortality rates in 15 European cities by apparent temperature in summer time



Note: City-specific estimates of the relevant parameters were obtained from 15 years (1990–2004) of data by specifying a marginal Poisson model for the daily count of deaths.

Source: Baccini et al., 2008.

([1]) There is no standard definition of a heat wave. Qualitatively, it is a 'prolonged period with an unusually high heat load'. The EuroHEAT project defined heat wave as: 'a period when maximum apparent temperature and minimum temperature are over the 90th percentile of the monthly distribution for at least two days' (WHO, 2009).

could also reflect demographic, cultural, socio-economic, and technological circumstance (Baccini et al., 2008).

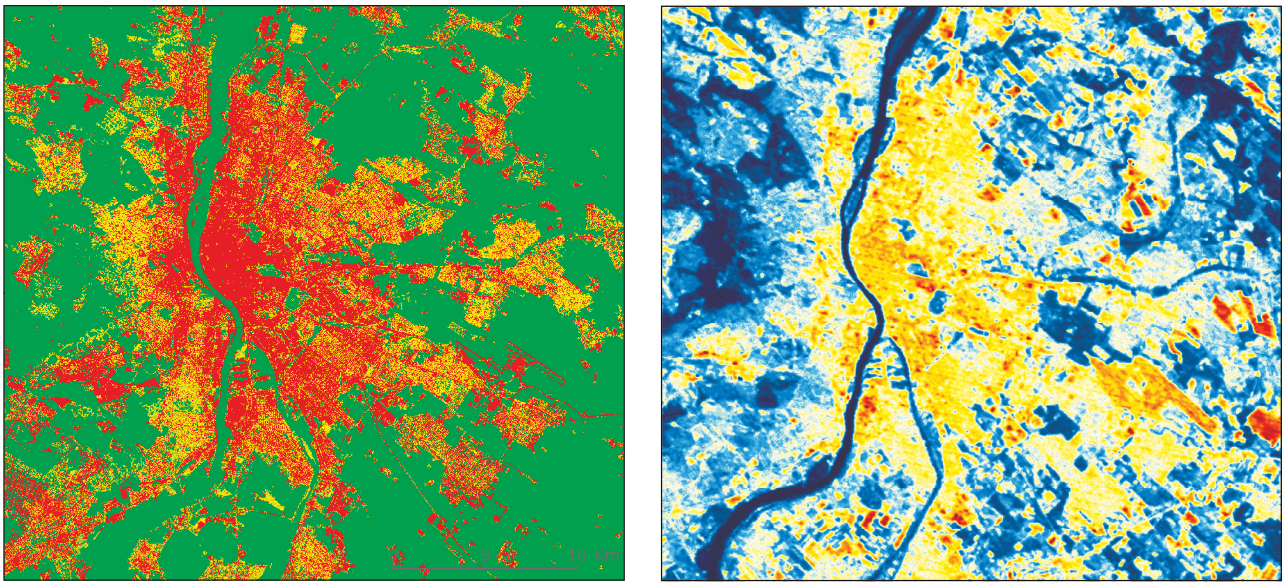
Local conditions and urban design can aggravate climate effects. High soil sealing can aggravate the urban heat island effect and increase further temperatures in the city (see Map 2.2); it may also increase water run-off during heavy rain — one important characteristic of the 2007 flooding events in United Kingdom was that a high proportion of overland flooding was trapped in areas with poor drainage (Pitt, 2008). The mean soil sealing in the UMZ of European cities varies from 20 % to nearly 80 %, resulting in different vulnerabilities, depending on the projected climate changes (see Map 3.2 and EEA, 2010e). Building on low-lying land or flood plains increases flood risks (see Box 2.2), but urban green areas can buffer such extreme events by reducing temperatures, increasing ventilation, storing water and reducing run-off.

Green infrastructure — a backbone of human health, biodiversity and ecosystem services

Urban green infrastructure is important for both biodiversity and people. Urban ecosystems are artificial, providing specific habitats, but can only survive and deliver good quality of life by using the basic ecosystem services provided by nature and biodiversity, both of which originate from green areas within and outside cities (EEA, 2010d).

Urban biodiversity, bound to urban green infrastructure and the backbone of ecosystem services in cities, is highly specific and varies according to the different levels of human influence (BfN, 2009). The very intensive human influence in cities often results in the number of available ecological niches, and thereby species, being higher than in the countryside. At the same time, the share of introduced non-native species in the overall species inventory — and in many cases also their absolute number — is continuing to rise everywhere (Tait et al., 2005). Across the most diverse taxonomic groups, more than half of the regional or even national species assemblages are to be found in the cities of the northern hemisphere. For instance, more than half of the flora species of Belgium can be found in Brussels (Godefroid, 2001), in Rome about half of the bird species that occur in the surrounding landscape are also found in the city itself (Cignini and Zapparoli, 2005), and half of vertebrate species and 65 % of the bird species of Poland are found in Warsaw (Luniak, 2008). However, it has to be noted that this high level is ensured by the larger number of generalist species, which are able to thrive in a wide variety of environmental conditions (Adams, 2005). Furthermore, urban flora composition,

Map 2.2 Comparing the degree of soil sealing (impermeability) and surface temperatures in Budapest, Hungary



Degree of soil sealing (impermeability) of Budapest, 2006

Degree of soil sealing (%)

0 30 50 80 100

Surface temperature of Budapest, 1 August 2005, 9:30 CET

Temperature (°C)

≤ 15 16 19 22 25 28 31 34 35 36 37 40 43 ≥ 45

Source: EEA, 2010c; Ongjerth et al., 2007; Gábor et al., 2008.

and with it, the fauna, continues to show a high dynamic of change and adaptation developments (BfN, 2009). Continuing urbanisation (see EEA, 2010e) is projected to further alter biodiversity due to the loss of habitats and green spaces in densely populated inner-city areas and urban sprawl in the wider countryside, if not balanced by appropriate urban and landscape planning (see EEA, 2010e and EEA, 2010k).

Urban green infrastructure, depending on its quality in terms of naturalness and biodiversity, variability, size, form and distribution, can provide an important variety of ecosystem services for quality of life in the city and makes cities resilient to climate and other changes, among others by:

- **Regulating the micro-climate by providing shade, thermal isolation, and moisture and wind protection** Green urban infrastructure can lower the heat-island effect, which is projected to become even more important with increasing temperatures as a result of climate change. For example in the city of Zaragoza, Spain, temperatures differ across the city with green urban areas clearly being cooler than high-density ones (Cuadrat-Prats et al., 2005). Map 2.2 shows such an inter-relationship in Budapest, Hungary.

- **Maintaining or increasing the infiltration potential of an area, while also avoiding high run-off and relieving canalisation systems** Anticipating high precipitation and, in particular, the projected higher frequency of extreme weather events, this is an important free service. Thus, London, for example, is considering actions like improving drainage systems and using green spaces and roofs to deal with storm-water run off and increased heat island effects in its climate change adaptation strategy (City of London, 2010).

- **Improving air quality and noise conditions** Dense shrub and tree plantings can absorb large amounts of dust and pollutants while also acting, to a certain extent, as a filter for noise (Chih-Fang Fang, 2003).

- **Linking city residents to their natural foundation in terms of live supporting** By providing education, experience, and creating awareness, residents can realise the importance of ecosystem services such as the provision of food or clean water.

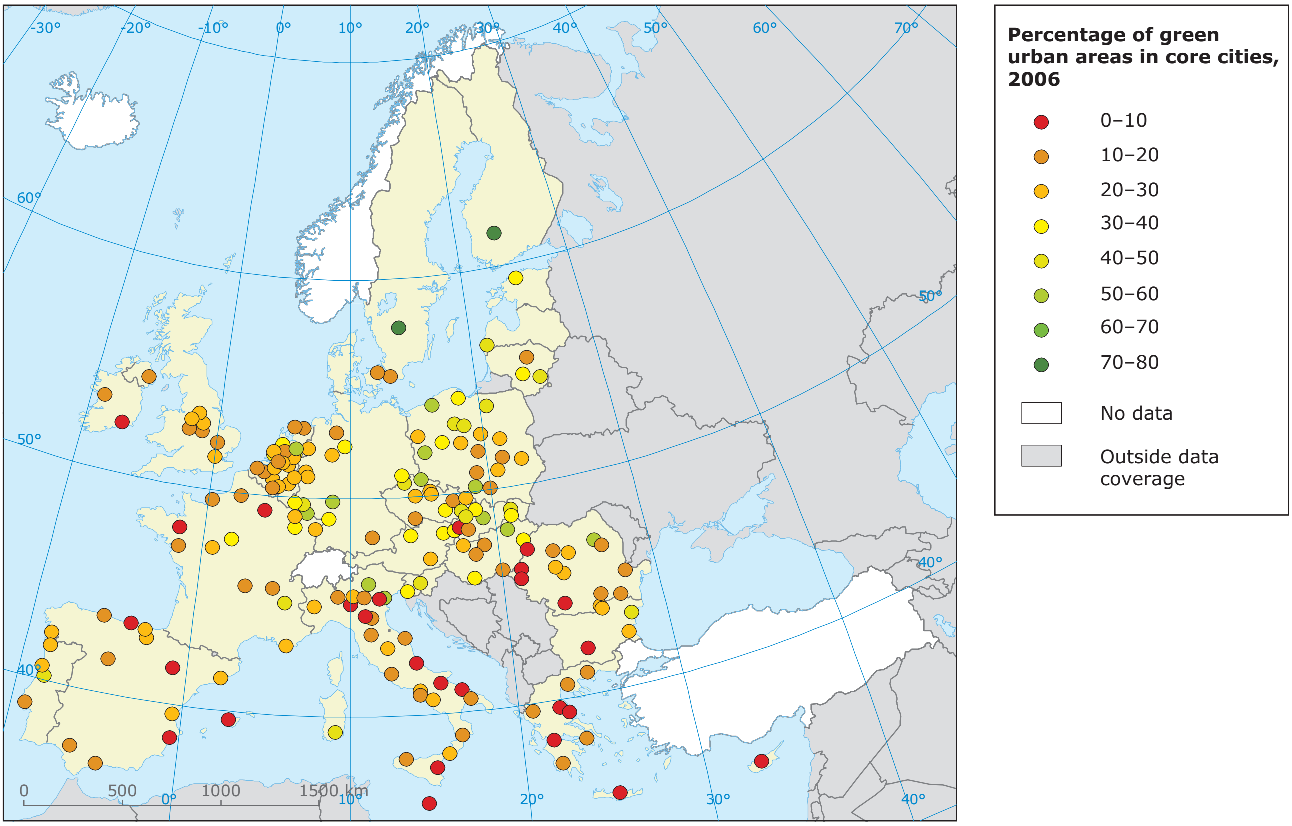
- **Providing synergistically physical, mental and social wellbeing** (Newton, 2007; Tzoulas et al., 2007) The likelihood of being physically active may be up to three times higher in residential environments with high levels of green space while the likelihood of being overweight or obese may be up to 40 % lower (Ellaway et al., 2005). Availability of local walkable green spaces has been shown to increase the longevity of urban senior citizens (Takano et al., 2002).
  Exposure to nature can provide relief and recovery from cognitive mental fatigue; it can significantly affect physiological systems, for example reduced blood pressure; cognitive abilities, improving performance on an attention test, and emotional states including increased feelings of happiness; and lowered feelings of anger/aggression (Gidlof-Gunnarsson and Ohrstrom, 2007). For example, residents in urban social housing who had views of trees and open spaces demonstrated a greater ability to cope with stress (HCN, 2004; Newton, 2007).
  People benefit emotionally and physically from inter-personal relationships. The quality of a neighbourhood, including good quality public space, is critical for enabling contacts and strong social ties among neighbours, which might be of greater importance for low-income people (Putnam, 2000).

The share of green urban areas in cities varies across Europe. Map 2.3 shows examples of regional patterns with a lower share of public green areas more frequent in southern and western European cities. The Urban Audit Perception surveys that asked residents in 75 European cities about their personal perception of green areas in their city revealed that the majority were more or less satisfied with the supply and quality of green areas with higher rankings in mostly — but not exclusively — northern parts of Europe (EC, 2005, 2007a, 2010a).

As well as the amount of green urban areas, their quality, size and distribution are important for biodiversity and the delivery of ecosystem services (URGE, 2001). These criteria matter also to people; the perception of urban green areas can differ markedly from their share in the city (EEA, 2009; Brownson et al., 2009). This leads to the assumption that the distribution, accessibility, size and form, variety, quality and safety of urban green infrastructure are similarly important to people. Further studies confirm that and show, for example, that nature within a short walk of 400 m or 5 minutes encourages the use of outdoor spaces and the enjoyment of health-promoting activities (Gidlof-Gunnarsson and Ohrstrom, 2007; HCN, 2004; Greenspace Scotland, 2007).

Boosting urban green areas in a way that supports a maximum of ecosystem services makes cities more independent from services provided just outside the city or far beyond it (see Section 2.3). However, within cities there is still a conflict regarding land-take for buildings and infrastructure. On the one hand, a low-density built city — one with single family houses

Map 2.3 **Share of green urban areas in European cities, 2006**



Note: Cities are core cities following the Urban Audit definition (Eurostat, 2010). In most cases the delineation of the core city matches the urban built-up area. But in some cases the delineation also includes substantial areas outside the urban built-up areas (parts of the urban fringe and hinterland); in other cases, it includes only city centres (for more explanation, see also Map 1.1).

Source: Urban Atlas (GMES, 2010), 171 available cities.

with private gardens — provides more green but that is highly artificial and barely a substitute for natural and semi-natural areas. On the other hand, the compact city concept aims at high inner-city densities and results in usually less area per person. This saves open space for nature and may therefore the better choice from a wider European perspective.

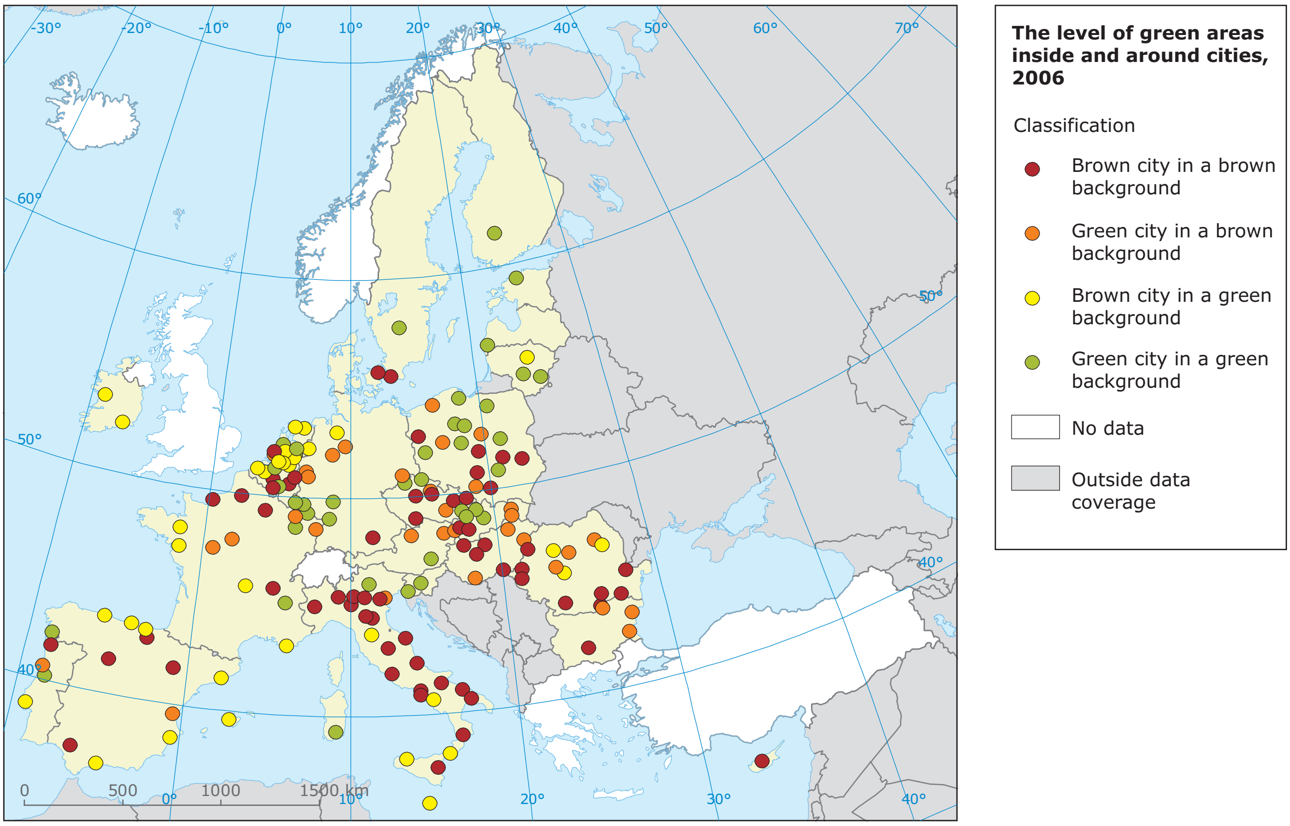
The problems compact cities face from less green space per person can be minimised by removing all unnecessary soil sealing in yards, parks, along streets etc., and boosting and diversifying green infrastructure in every niche — not only parks and gardens but also pocket parks, trees on streets, green walls and roofs. For example, a very densely populated city like Barcelona with 164 inhabitants/ha over its entire area has a very low rate of soil sealing per person — only 34 m^2 — and 99.4 % of its citizens have public green within 300 m (EEA, 2010c; Barcelona City Council, 2010).

In addition, compact cities provide short distances to outer green spaces and can ensure their easy accessibility and better infiltration of their ecosystem services, such as climate regulation, into the city. Map 2.4 shows that even cities with a relatively low share of public green urban areas can balance that with a green hinterland — brown cities in a green hinterland. Such cities can be found mainly in Malta and the Netherlands as well as in parts of France, Italy, Portugal, Romania and Spain. The opposite are cities with a lot of green urban areas but a hinterland with urban sprawl or intensive agriculture — these green cities in a brown hinterland are mainly in Eastern Europe and Germany. Particularly problematic for the quality of life in cities as well as the pressure on nature outside is the combination brown/brown frequently found across Europe other than in most of Scandinavia and in the Baltic states.

For methodological limitations, the green background does not include sea areas. Therefore some coastal cities might perform actually better than the map shows.

In conclusion, by using intelligent design cities can better maintain ecosystem services within and outside their area and thus reduce their environmental impact and dependence on services from the wider hinterland.

Map 2.4 The level of green areas inside and around cities, 2006



Note: 'Brown' considers cities with a below average share of green urban areas or green background while 'green' signifies above average. As noted for Map 2.3, different urban delineations might also influence some values of the urban background.

Source: Urban Atlas (GMES, 2010) (171 available cities) and Corine, 2006.

Social equity

Health risks related to environmental conditions are often not distributed equitably and can also be linked to inequities between rich and poor, territorial habitability and migration pressures (Costello et al., 2009). Studies show that many environmental and health problems are concentrated in the most deprived areas. Here, a poor environment imposes additional burdens on people of low socio-economic status. This combination, often in addition to a concentration of more vulnerable individuals — children, the elderly and people with an already lower health status — in deprived areas, leads to poor outcomes and lower life expectancy (RCEP, 2007; Pye et al., 2008).

Only limited research and fragmented information is available at the European level on inequities in the distribution of urban environmental quality, coming mainly from the United Kingdom, but also the Netherlands and Germany (see Box 2.3). Furthermore, the problem is multidimensional and interacts with cultural, community and lifestyle factors; but, even given this complexity, the relationship between social characteristics and human health has usually been studied separately from environmental characteristics.

Additional inequities can exist between people who cause environmental problems and those who suffer from them. People with higher income generally consume more, producing more emissions and waste, but quite often live away from the areas in which the goods are produced, the emissions released or the waste dumped (see EEA, 2010f). Also people who choose to move from the inner-city to the suburbs or the countryside and commute further to their jobs and services in the city cause higher transport emissions, in particular, concentrated in the city threatening the health of people living there.

The urban environment — an interwoven network

As the previous paragraphs suggest, the urban environment cannot be understood by considering its components separately. Environmental challenges, socio-economic factors and culture are strongly inter-woven. For example, people affected by high levels of air pollution are also often affected by higher noise levels as the source of both, in particular urban transport, is often the same. This creates complex physical and psychological health problems that can be altered by a change of socio-economic status and the ability to adapt

Box 2.3 Social inequities, environment and health — some examples

- In Scotland, mortality rates among those under 75 in the most deprived areas are three times higher than those for the least deprived areas (RCEP, 2007).
- In the United Kingdom, eight times more people in the most deprived 10 % of the population live on tidal floodplains than the least deprived 10 % (Environment Agency, 2004).
- People in the most deprived 10 % of areas in England experience the worst air quality and 41 % higher concentrations of NO2 from transport and industry than the average. (Environment Agency, 2004).
- In the most deprived areas in England, up to 50 % of watercourses are extensively modified, providing fewer experience of nature and wildlife (Environment Agency, 2004).
- In Germany, children from families of low socio-economic status are more heavily exposed to traffic — 27 % live on busy streets compared to 10 % of children with a high socio-economic status (Seiwert et al., 2009).
- In Italy, the increase in daily mortality associated with PM10 is more pronounced among people with lower incomes and low socio-economic status than among upper income groups with high socio-economic status (Forastiere et al., 2007).
- Whilst at a superficial level Leicester, United Kingdom, provides substantial public green space — 3.5 ha per 1 000 people, the distribution and access to certain categories of green space is uneven. Limited access is found in areas with high populations of certain ethnic and religious groups (Comber et al., 2008).

to the environmental challenge. Single environmental problems like air pollution, noise, or the lack of green areas can be perceived differently, but if they are perceived in the context of culture, the ability to adapt, and the overall experience of the environment, an attractive city might be perceived as less polluted then an unattractive, littered city although pollution levels might be the same (see Box 2.6). Also, the 2009 urban perception survey confirms that there was a correlation between people who considered the city as clean and those who disagreed that air pollution was a big problem (EC, 2010a). Perception might therefore be a more appropriate indicator of mental health than measured data alone.

2.2 Cities' functionality, urban design and driving forces

The type and extent of impacts on the environment and quality of life in cities depends on the functionality of the urban system and its interaction with other urban areas and regions. (Note: the drivers of urbanisation, related land take and impacts on the European environment are dealt with in the SOER 2010 land use assessment (EEA, 2010e)).

Urban design sets the frame

The history of most European cities is many centuries if not thousands of years old. Their design reflects their socio-economic and political development over time, for example, the compactness of old city centres relates to the need to defend the city behind walls; good railway networks encouraged suburbanisation which was later enforced and further spread by the broad availability of the car. Nowadays, many cities are again in transition: from industrial centres to knowledge-based business and service centres and having to cope with industrial brownfields, abandoned or deprived urban areas.

Urban design sets the physical frame for a city's functionality. An appropriate urban design can provide people with opportunities to choose more sustainable and healthier life styles as well as to modify the impacts of environmental pressures such as noise (see Boxes 2.4 and 2.5). Urban design lasts for decades or centuries and cannot be changed in the short term — it will be hard, if not impossible, to remove areas of urban sprawl or increase their density, but we can stop urban sprawl now and at least avoid the need for future generations to cope with its associated higher transport and energy demands. The challenge is to cope with the built heritage under changing socio-economic conditions and to set the framework for the future now — by establishing smart design that enables a city to function well and be a healthy place in which to live.

Another main driver of the urban system is people. It is people's behaviour that determines the direction in which cities develop, how they function and what environmental pressures this generates. Population growth or decline, the demographic mix, migration, societal values and cultures, including planning and policy cultures, and individual lifestyles all demonstrate particular consumption patterns (EEA, 2009, Section 2.2). Cities are the main places to which foreigners migrate and in which new cultures and lifestyles develop and spread. These dynamics are reinforced by cities being part of global networks with increasing exchange of goods, services, ideas and cultures. The environmental impacts depend on these specific dynamics that determine people's choice of food, leisure activities,

Box 2.4 Multiple benefits of smart urban design

Good design:

- mitigates the effects of air pollution and noise — urban green areas can filter particles and create quiet areas;
- improves the local climate by providing ventilation, reducing the heat-island effect by increasing green areas and reducing the level of soil sealing;
- supports mental health by providing attractive, quiet and safe places including green areas;
- reduces overall transport demand — the length and number of trips — and enables more sustainable transport modes — walking, cycling and public transport — through increased urban density and a functional mix with shorter distances to jobs and services and a convenient infrastructure for these transport modes (see EEA, 2010f);
- reduces energy demand through intelligent building design and urban density as multi-storey houses need less energy for heating and cooling per living area due to a lower proportion of outside walls and roof area than single family houses (JRC, 2008);
- reduces land demand within and outside the city through attractive urban design, encouraging people to live in the city (see EEA, 2010e);
- sets framing conditions for the adoption of more sustainable lifestyles by supporting physical activities such as walking, cycling, outdoor play and sports, which can reduce obesity and cardiovascular problems;
- supports social inclusion and equity.

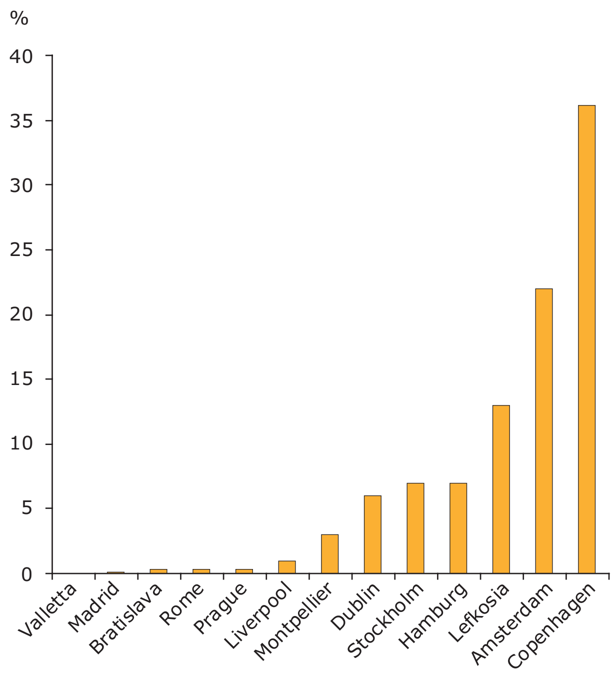
forms of housing (see EEA, 2010e and 2010f) encouraged and supported by appropriate urban design.

For example, mobility, which is vital to keep a city functioning, can be achieved by different means. Currently in most cities individual transport by car has a major share of urban transport. Therefore not surprisingly, road transport is by far the major source for noise in cities, one of the principal sources of air pollution and land-take for roads and parking areas (Figure 2.1; EEA, 2010a). Transport demand and modal choice differ widely between European cities (Figure 2.5), and also depend on urban design and infrastructure (Box 2.4). However, the reality is more complex. In addition to the structure of the city, social and economic factors, such as income, car ownership, family size and structure, employment, speed and traffic calming as well as life styles, culture and behaviour affect transport demand (Bannister, 2007; Clifton et al., 2008).

As most European cities currently move away from being centres of industrial production to being centres of services, buildings, together with transport and food consumption, are increasingly accounting for a major share of a city's energy consumption and related emissions (SEI, 2009). Although data for urban Europe are rare and differ depending on the applied methodology, there is little doubt about this. Usually a share above 50 % is stated in literature. In London for example, according to Siemens (2008), the energy used within London's buildings — residential, commercial, public, industry — accounts for nearly three quarters of the city's total carbon footprint.

The environmental quality of a city, as part of the overall quality of life, is an important factor when

Figure 2.5 Proportion of cycle trips to work in a selection of European cities, 2004



Source: Urban Audit database (Eurostat, 2010).

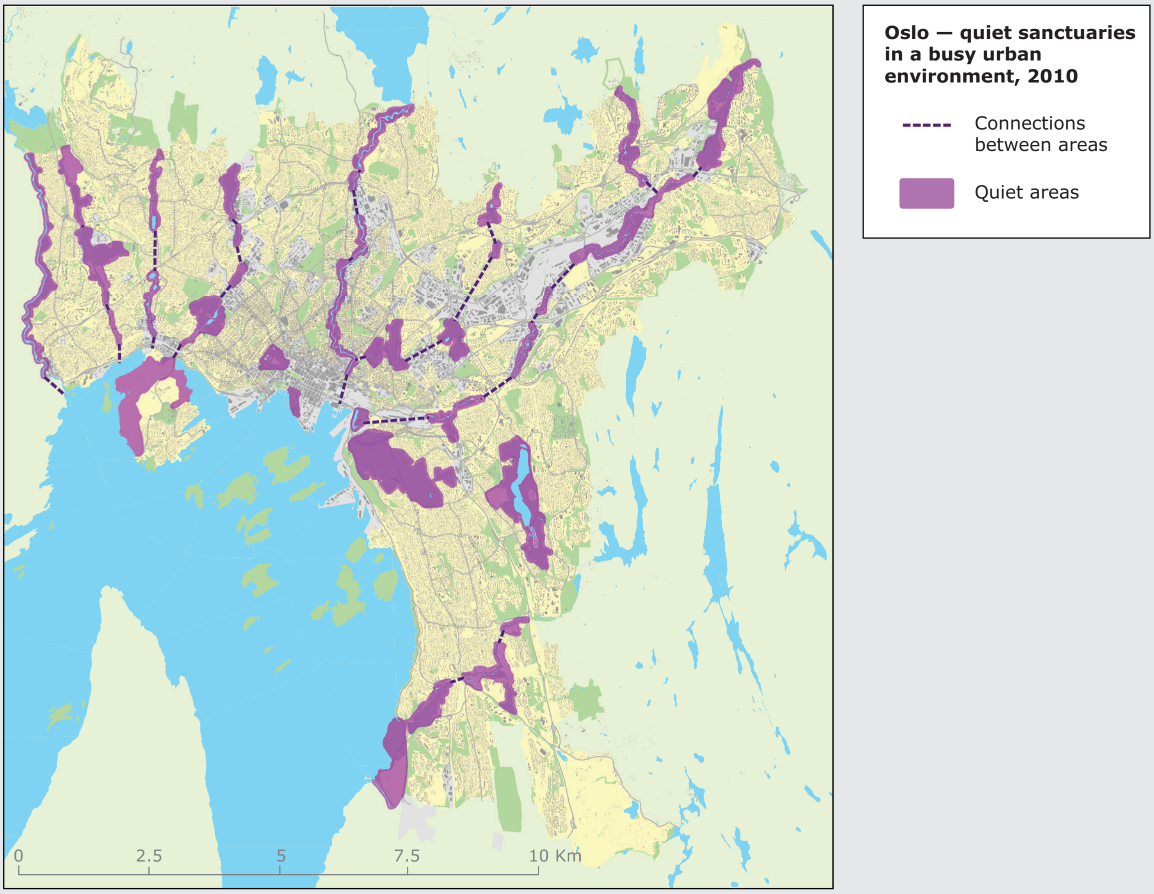
people choose to live there or settle in the suburbs or rural areas. Interestingly, people's perception of the quality seems to be a stronger driver than the reported situation itself. Comparing the results of the 2004 Urban Audit Perception Survey (EC, 2005) with the population movements between core cities and their surrounding Larger Urban Zones indicates that nearly all cities with perceived bad air quality and major noise problems

Box 2.5 In search of quiet — Oslo, Norway

In an effort to protect environmental noise quality where it is already good, the Environmental Noise Directive (EC, 2002) requires that quiet areas are designated within urban agglomerations. These could be based upon the results of the noise mapping.

The city of Oslo has so far designated 14 quiet areas (see Map 2.5) which cover a total area of 13 km^2 representing 9 % of the city's built up zone. Approximately two thirds of these quiet areas have long-term average noise levels below 55 dB L_{den}. Around 55 % of the population has access to these vital quiet sanctuaries within 10 minutes walk from their residences.

Map 2.5 Oslo — quiet sanctuaries in a busy urban environment, 2010



In defining these areas the city not only considered the levels of noise, but also the land use and the type of activity that is associated with. Oslo is seeking to protect these areas from ongoing building or transport development. Hence, exposure assessment and noise measurements will form a key part of the planning and development of new projects. Noise reduction strategies at source and detailed acoustic design of public spaces with high levels of exposure to noise are part of the city's action plan and will be tested by pilot and research projects. For example, Elgsletta activity park, a small urban park along the main river Akerselva, is noise-shielded by a tree-planted soil embankment and equipped with sand volleyball and barbecue facilities and is now intensively used by the public.

The Environmental Noise Directive (EC, 2002) gives Europe's largest cities the opportunity to follow the example of Oslo and implement measures to reduce high noise levels and protect areas with a currently good acoustic quality.

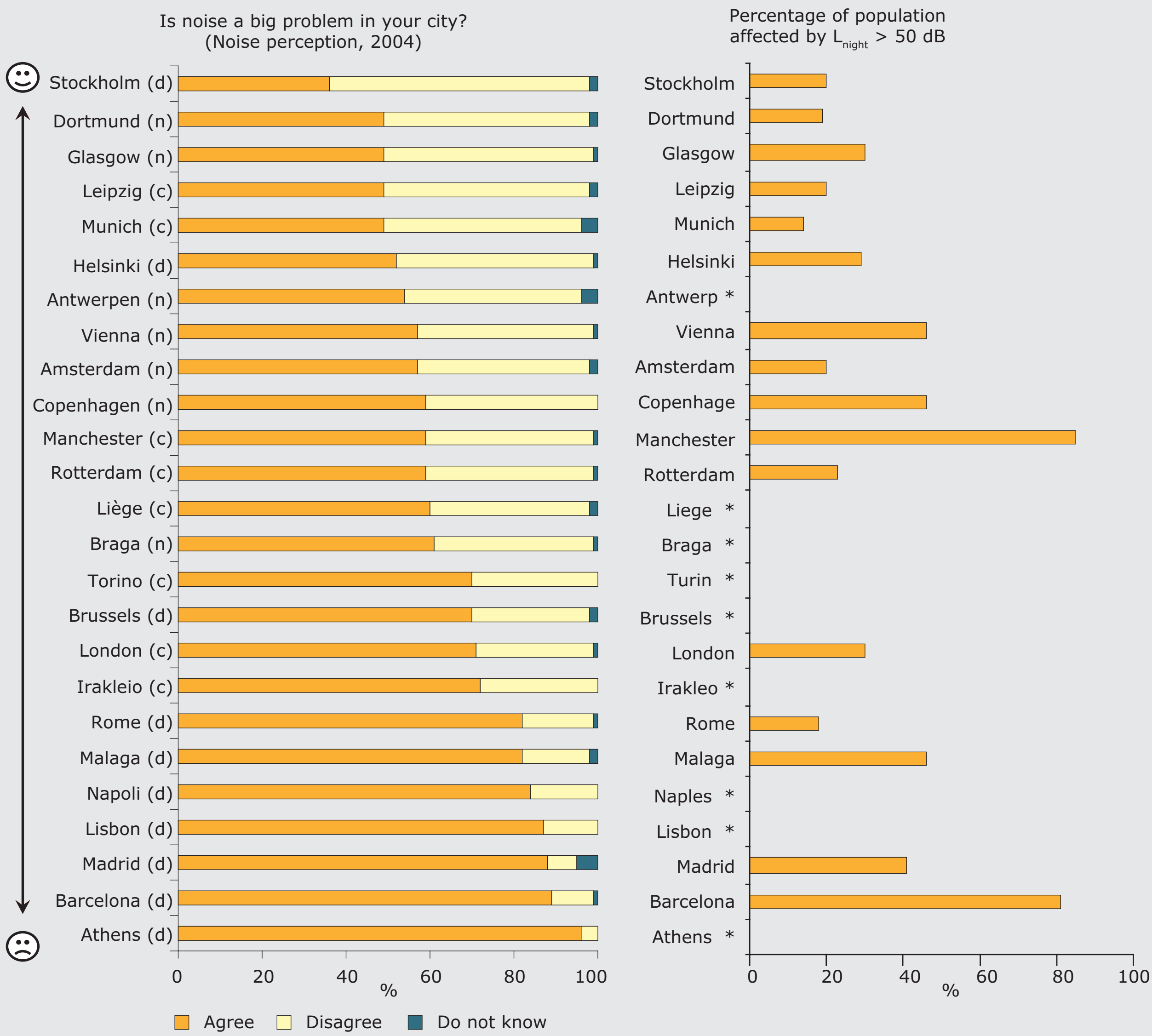
Source: Sofie Yvling and Tore Mauseth from the City of Oslo, pers. com., 2010.

are de-concentrating. In contrast, there is no apparent correlation of this behaviour with the reported noise or air quality data. Thus, a perceived poor environmental quality in cities, among many other drivers like land prices, is contributing to urban sprawl (see Box 2.6 and EEA, 2010e).

Box 2.6 What drives — the perceived or the reported environmental quality?

The 2004 Urban Audit Perception Survey (EC, 2005) asked inhabitants of European cities if they consider noise as a big problem in their city. The left diagram in Figure 2.6 shows the results ranking from relatively low perceived noise problems down to cities with high perceived noise problems. The right diagram shows the reported data under the Environmental Noise Directive (EC, 2002) which partially follow the same trend as the perception yet partially show a contrary result. It needs to be noted that data are limited and relate to the reference year 2007 and it cannot be ruled out that methodological problems partially cause some differences. However, comparing both with the population movements between cities and their hinterland, indicated by the colours of the city names, shows a correlation of a bad perceived noise situation with people moving out of the city rather than any correlation with the reported situation. It seems that a bad perceived noise situation can be one driver, amongst others, for people to move out of the city. The example of some other decentralising cities, despite good perceived acoustic quality, suggests the presence of some oppositional drivers. The indications of this comparison need to be explored through further research.

Figure 2.6 Perception of noise (all sources) as a problem in European cities compared to road noise (major source of environmental noise) levels reported in the urban agglomerations correlated to processes of centralisation (c), decentralisation (d) and no change (n) in the density gradient of populations



Note: * no noise data available. (c) = centralisation, (d) = decentralisation, (n) = no change.

Sources: EC, 2005; Urban Audit database (Eurostat, 2010) — population trends between 2001 and 2004; NOISE, 2010.

External drivers

In the same way that cities can affect their hinterland (see Section 2.3), external drivers, including national and European policies, can influence environmental quality within cities. Natural conditions are set by the area in which the city is embedded, but climate change depends in part on activities and sources around the globe. Although cities are part of the climate change problem because of their own greenhouse gas emissions, a single city's action can only make a limited contribution to either causing or solving the problems.

Air pollutants, including fine particles and ozone precursors, can travel thousands of kilometres across the continent through the air. In many cities, only a part of local air pollution is generated by the city itself, for example in Vienna only a quarter of the air pollution in the urban background is generated in the city, while in Rotterdam, 80 % of particulate matter (PM_{10}) comes from sources that are not local (Province of South Holland, 2005; EEA, 2009).

Even an apparently local problem like noise may be determined by major external drivers such as regional, European and even global transport by road, rail, water and air which reaches or passes near the city. Other influencing factors include the setting and implementation of European noise and air emission standards for vehicles and tyres.

The demand for urban land is driven by the migration of people and businesses inwards and outwards, as well as by regional demographic trends, such as ageing, growth and decline. Growth can put pressure on green areas and open spaces inside the city as well as at its edge, and also increase demand for transport and energy. Decline can provide the opportunity to reclaim green areas and improve the quality of urban space, although this has proved to be quite a challenging task as many East German examples show. The drivers of urbanisation are further described in the SOER 2010 land use assessment (EEA, 2010e) and the related urban consumption patterns in the SOER 2010 consumption and the environment assessment (EEA, 2010f).

2.3 Environmental impacts of urban systems on Europe and beyond

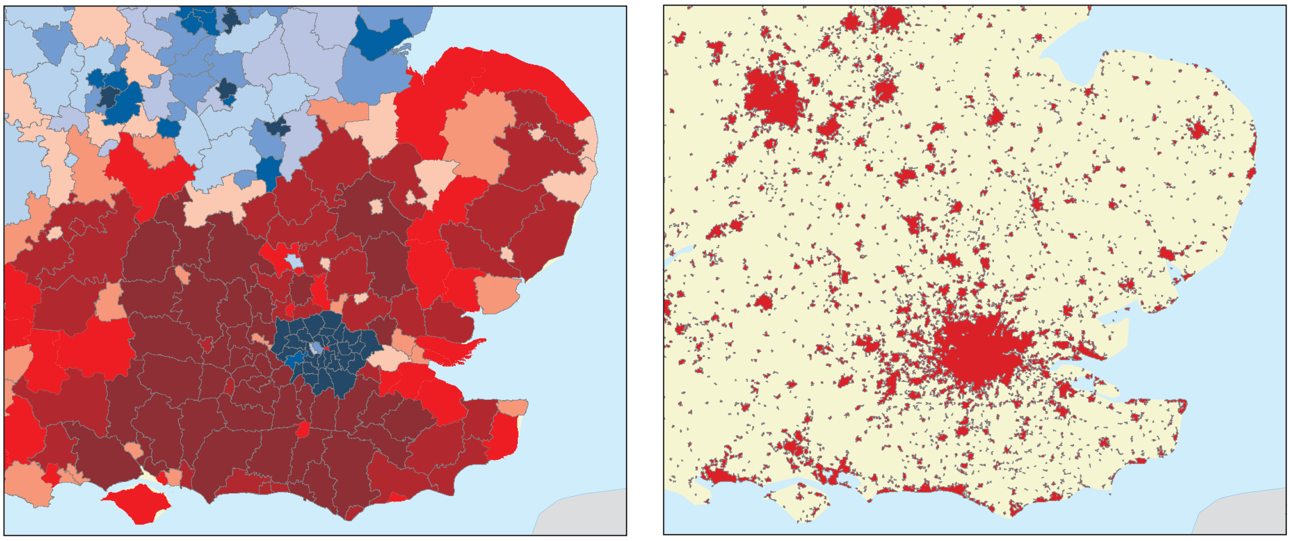
Urban systems affect not only their own environment: emissions and wastes for disposal mostly cross urban borders, and food and other resources, including land-take, are drawn from areas beyond city borders. For example, the impact of city greenhouse gas emissions go far beyond Europe, affecting the global climate. Similarly the demand food from all over the world is responsible for land take in other continents, threatening biodiversity there (see also EEA, 2010l). Currently:

- cities emit 69 % of Europe's CO_2 (IEA, 2008; source refers to a share of 73% urban population of overall population);
- urban transport accounts for 70 % of the pollutants and 40 % of the greenhouse gas emissions from European road transport (EC, 2007d);
- the impact of cities' activities affect an area much larger than their own — in the hinterland or in distant regions. For example, London alone is thought to need an area of almost 300 times its geographical size to satisfy its demands and dispose its waste and emissions (Best Foot Forward Ltd, 2002);
- the increase of artificial areas in European countries varied between just above zero and 5 % annually between 2000 and 2006, reducing or fragmenting open space, distributing urban influences over a wider area and thus risking the loss of biodiversity and ecosystem services (see EEA, 2010e, 2010k).

Urban design and urban density are important factors in determining other external impacts of cities as well as those on the environment. The concentration of people in cities currently helps to keep down energy consumption and the demand transport in Europe. While a rural dweller in Europe consumes 4.9 tonnes of oil equivalent (toe) per year, an urban dweller consumes only 3.5 toe. It is assumed that rural and suburban dwellers in Europe have more or less adopted urban life styles by using all the services cities usually offer, but in addition they use larger and more energy-consuming forms of housing and travel further to reach urban services (IEA, 2008). Such differences between low-density settlement structures like rural or peri-urban areas and dense urban structures can be seen in the example of transport footprints per local authority in and around London (see Map 2.6). In other regions, however, this relationship might be different as a result of factors such as an efficient public transport infrastructure, low car ownership and transport pricing. The relationship between the urban layout and the potentials for energy and transport efficiencies is complex and needs further research

The overall trend of urban development in Europe remains urban sprawl — urban areas are growing more rapidly than populations, leading to decreasing population densities, although the trend is not uniform across Europe (see EEA, 2010e). This development threatens the eco-efficiency advantage of cities. Lower population densities demand more energy for transport and housing, and more built-up area per person, and result in less or more-fragmented open space for biodiversity and ecosystem services. If this trend can be reversed towards higher urban density in a way that ensures a good quality of life in cities with sufficient quiet, clean and green space, further urbanisation

Map 2.6 Greenhouse gas footprints per capita for transport in UK local authorities and urban-rural pattern



Transport greenhouse gas footprint per capita, 2006

Tonnes CO_2 equivalent

1.75 5.47

Urban/rural land use pattern, 2000

Urban Morphological Zone (UMZ)

Rural background

Sources: SEI, 2009; EEA, 2000.

may even contribute positively to the environment in Europe, in particular, if embedded in a wider urban-rural development approach as, e.g. envisaged with the planned EU strategy on green infrastructure (EC, 2010b). Roughly a third of larger European cities show that this is actually possible (see Figure 4.1 and EEA, 2010e).

3 Outlook 2020

Despite some common characteristics, Europe's cities and regions are diverse, as are their drivers of change and development paths. Providing a detailed and comprehensive outlook for the development of the urban environment in Europe is therefore a complex task. However, some assumption can be made.

Urban, as well as peri-urban and rural areas, will benefit from national, European, and global action to mitigate climate change, to generally improve air and water quality, and to reduce overall noise. This can be realised through EU and national measures and regulations such as directives on buildings, air quality and noise as well as EURO norms for vehicles. Apart from measures concerning overall conditions and background levels, local factors, such as geographical conditions, urban design and local action, can influence the situation.

Europe's population is expected to grow slightly from 495 million in 2008 to 521 million in 2035, and thereafter gradually decline to 506 million by 2060 (Eurostat, 2008). The growth is expected to be more rapid in urban areas, which are expected to contain 80 % of the population by 2020 (EEA, 2006). Higher population leads to more demand for housing and services. These are likely to face further pressure from the trend towards smaller households due to changing family models and aging, as well lifestyle changes as such as the demand for more living space per person. Depending on the way this demand is met — edge or centre development — impacts on the urban environment will differ:

- urban sprawl will trigger more transport, particularly by car, and, together with the higher demand for heating and cooling of housing, this will contribute to greenhouse gas emissions and regional and local air and noise pollution. It is also likely to decrease the green background of urban areas and reduce accessibility to green spaces at the edge cities (see EEA, 2010e).
- while increased population density in cities may increase pressure on green urban areas, it could also protect the green hinterland and reduce overall demand for transport and energy and related emissions.

Currently, both trends appear in parallel throughout Europe (see EEA, 2010e) and are expected to continue, depending on local and regional planning and particular management decisions.

The overall urban population growth will not be distributed evenly. Some urban areas will be, or are already, faced by population decline, and according to the ESPON scenarios, the current north/east to west polarisation in Europe will continue (ESPON, 2008). The lower densities are likely to result in relief from some environmental pressures and create opportunities for green space. On the other hand, decreasing density can aggravate the problems typically attributed to urban sprawl described above. After 2035, allowing for the expected European population decline (Eurostat, 2008), many more cities will have to cope with the problems of low density settlements.

The trend towards a more service-oriented economy in cities, while shifting production to other parts of the world, is likely to continue, and would reduce environmental pressures from economic activities — while increasing them elsewhere. However, the overall demand for transport is expected to increase further and affect the urban environment. Rising car ownership in Eastern Europe and changes in the mobility of older people — the new generation of older people will probably continue to drive cars for as long as they are able — will contribute to this trend. Even so, the extent of impacts will depend on local action to promote demand for the less environmentally damaging modes of transport, and, at national and European levels, the introduction of measures to improve vehicle technology. Currently, progress in reducing the environmental impacts of transport in urban areas is still limited and change will require more significant enforcement of existing strategies and measures.

Despite European and national regulations, many experts believe that the problem of noise is likely to increase (EPON, 2010). Limiting the areas affected by noise and creating quiet areas will require urban and building design measures, such as enclosed block designs, noise barriers and sound-proof windows.

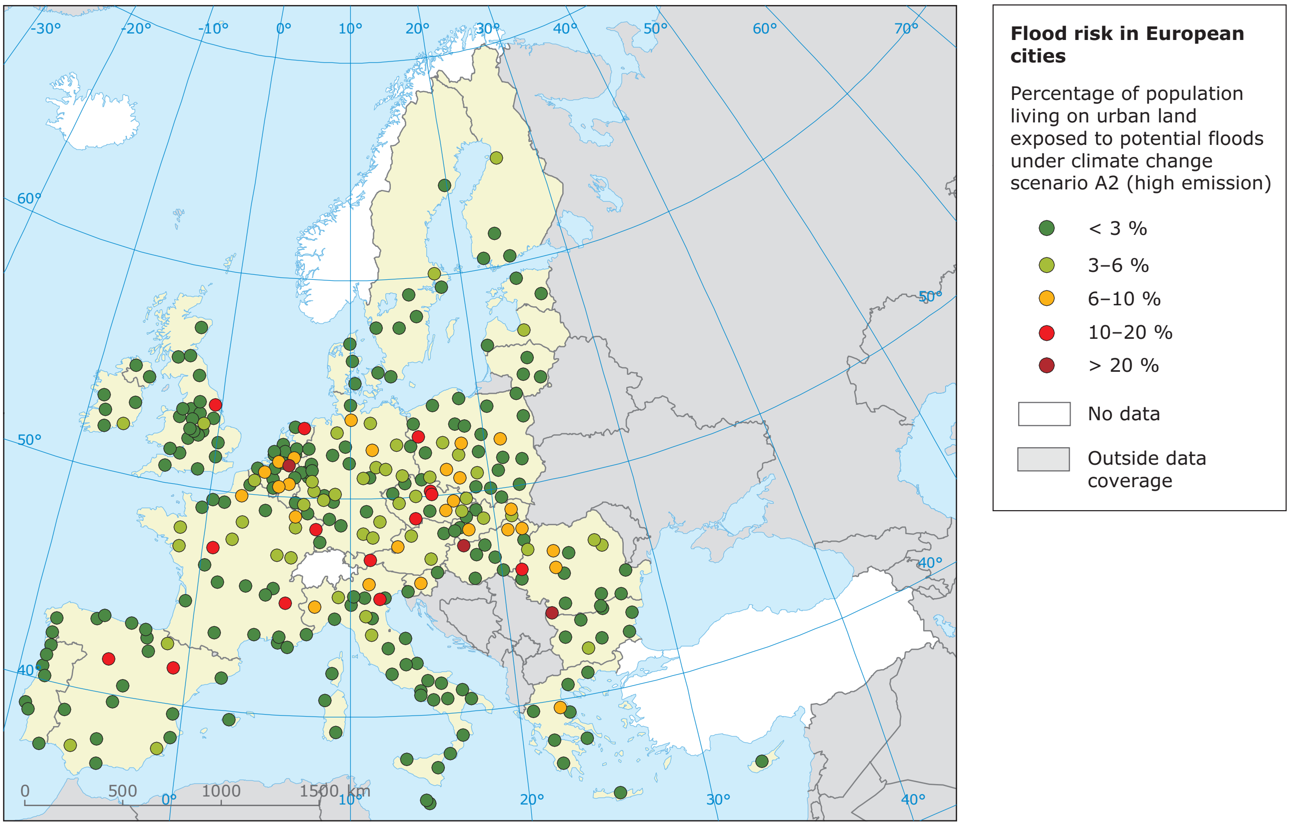
The overarching challenge that cities are likely to face is climate change (see EEA, 2010i). The mean annual temperature in Europe is expected to rise and projections indicate an increase in the severity and frequency of droughts, floods, heat waves, and other extreme weather events that are expected to have major impacts during this century (IPPC, 2007; EEA, 2008). These impacts will differ widely across Europe with cities suffering or benefiting differently.

In coastal areas, sea levels are likely to rise between 18 and 59 cm by 2100 (IPCC, 2007). Many cities are sited on coastlines and as many as 4 million people in major coastal European cities are expected to be exposed to sea level rise in the coming century, assuming no adaptation measures (EEA, 2008). Even for cities that have some knowledge or experience of coastal flood risk management, the potential severity of some projected impacts mean that the effects may be unmanageable without innovative solutions. In addition, many inland cities will be faced by increasing risks of river flooding, as shown in Map 3.1.

The continuation of some urban patterns will make cities even more vulnerable to climate change: if urban areas continue to expand into flood plains or dry lands with limited regional water resources, their vulnerability to flooding or water scarcity will increase (see Box 3.1). Cities with high soil sealing and a low level of green infrastructure in areas with expected temperature increases — in particular but not only in the southern part of Europe (see Map 3.2) — need to be aware of the risk of exacerbated heat waves and adapt their urban design. In other regions, a high level of soil sealing combined with heavy precipitation increases the risk of surface flooding. However, adaptation in the health sector, like better treatment of vulnerable groups or better catastrophe management, could reduce the number of casualties.

In summary, as a consequence of the uncertainties of the different possible development paths, the overall outlook for the future urban environment of Europe is unclear. Despite some improvements in air quality, water quality, and mitigation of and adaptation to climate change as a result of national, European and global actions, European cities will still face a number of environmental challenges. These include coping with climate change, air pollution, water stress, noise, and further urban land-take.

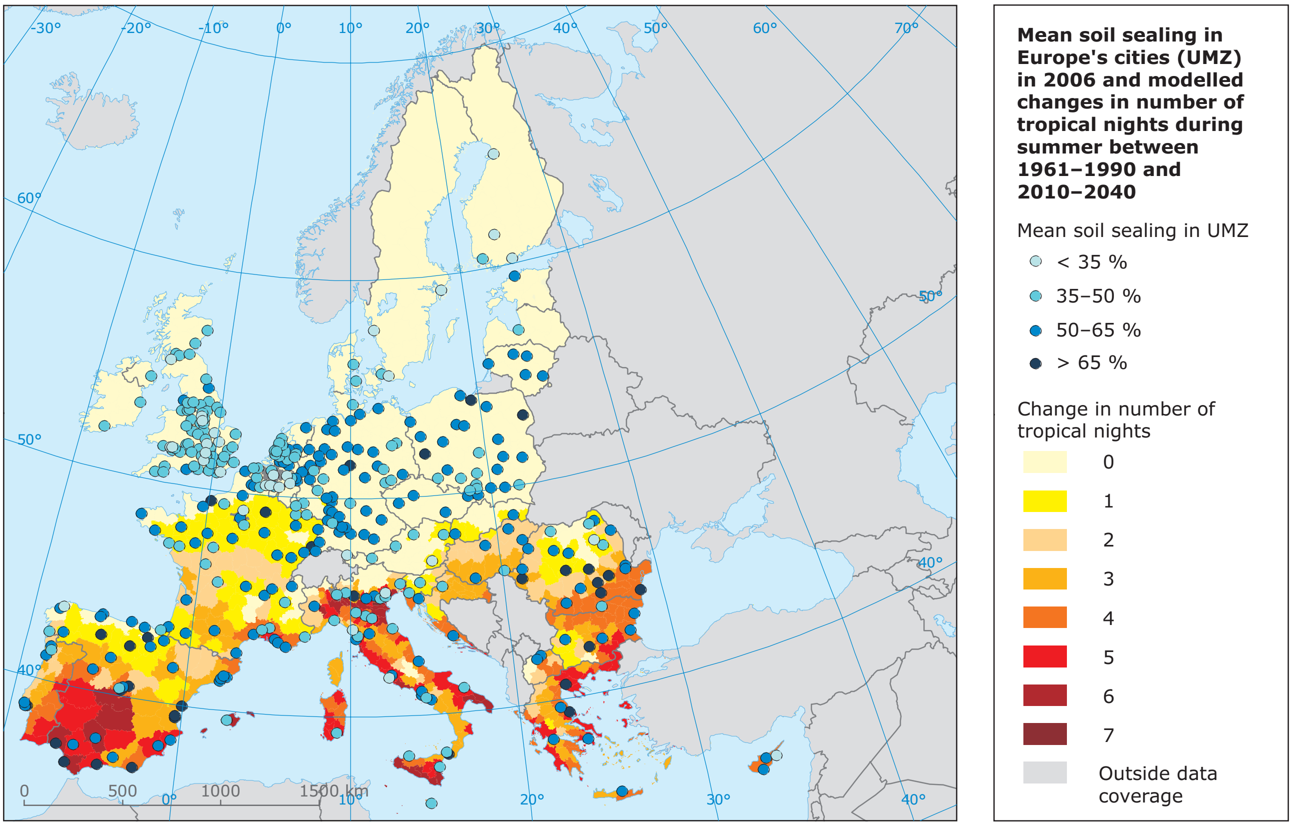
Map 3.1 Exposure of population in European cities to flood risk under climate change (scenario A2 — high emissions; 100-years flood)



Note: Per city, the population living in the Larger Urban Zone as described in the Urban Atlas/Urban Audit definition (GMES, 2010 and Eurostat, 2010) is considered. The calculation uses the population distribution on urban land-use classes from Corine land cover 2000. Furthermore, neither coastal floods nor flood protection measures are considered in the calculation. Based on the hydrological model LISFLOOD.

Sources: Dankers and Feyen, 2008; Dankers and Hiederer, 2008; Dankers, Feyen and Christensen, 2009; Gallego, 2010.

Map 3.2 **Mean soil sealing in Europe's cities (UMZ) in 2006 and modelled change of number of tropical nights (T_{min} > 20 °C) during summer between 1961–1990 and 2010–2040 indicating higher risks of heat waves**



Source: Dankers and Hiederer, 2008; EEA, 2010c.

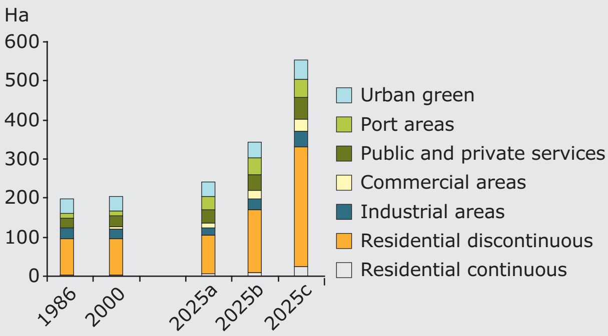
Box 3.1 Case study Pärnu (Estonia) and projected climate change

Pärnu is located on the coast of the Baltic Sea at the confluence of the Pärnu and Audru rivers both part of the largest Estonian river systems. Built on land just 10 metres above sea-level, the city is extremely vulnerable to flood events. The historic centre, spas, hotels and the harbour are all are located in the area of direct impact of storm inundation. And more than half of the area is residential. Coastal erosion and landward intrusion of marine water are affecting beaches and lowland coastal ecosystems.

A business-as-usual scenario and an optimistic scenario for the city's development from 2000 to 2025, based on the visions of the Pärnu City Council planning authorities and the Local Agenda 21 process, both assume no significant urban sprawl. Expansion outside the existing city core will be limited by an increase in its urban density and by developing barren and abandoned land on the edges of the city.

Depending on the climate change scenario, the increase of overall urban areas likely to be at risk of flooding in the future varies from 20 % to more than one and a half times the currently affected area (see Figure 3.1). Sea-level rise would mostly affect the port area, the beaches and the city's green areas. The maximum impact of flooding is expected in the city centre with its many municipal buildings, which would seriously affect the coping capacity of the city. The impact on the natural and semi-natural coastal areas would be devastating — even the average scenario would lead to the complete loss of the sand beaches; they cannot be shifted landward as this would conflict with already built-up areas.

Figure 3.1 **Urban land-use classes in sea-level rise and surge-prone areas**



Note: Pärnu, Estonia, case study. Historical (1986), present (2000) situations and assessment of the optimistic urban development scenario (2025) for three different hazard scenarios: a: Low impact scenario; b: average impact scenario, and c: High impact scenario (scenarios following Schmidt-Thome, 2003).

Source: Sagris et al., 2005.

4 Response

Conflicts in cities between people and nature are continuous and unavoidable, but they can be minimised by a mixture of measures and good urban design. In order to reduce the pressures on the urban environment and ensure good quality of life:

- current legislation on air quality, noise, water, climate change, land use, etc. needs to be fully implemented and further developed;
- urban design needs to be improved to increase the eco-efficiency of cities and enable the adoption of more sustainable lifestyles;
- driving forces from outside urban areas need to be managed.

4.1 Existing policies and action

EU legislation

In addition to more general EU, regional, national, and local legislation, some EU legislation is designed to tackle specific urban environmental challenges directly, in particular air quality, noise and wastewater.

Current European air quality legislation is based around the principle that EU Member States divide their territories into a number of air quality management zones, which include agglomerations. Countries are then required to assess air quality using measurements, modelling or other empirical techniques. In most urban environments, exceedances of the daily mean PM_{10} limit is the biggest problem; the majority of EU Member States have still not reached the limits defined in Directive 1999/30/EC although 2005 was the attainment year. 2010 is the attainment year for NO_2 and benzene limits, but a critical issue for European urban areas is still exceedances of the annual NO_2 limit value, particularly at urban traffic measurement stations.

According to the new Air Quality Directive 2008/50/EC, Member States may notify the European Commission if, in their opinion, conditions in a zone justify an exemption from the limit values, for example because of specific air dispersion characteristics, adverse climatic conditions or transboundary air pollutant transport. For PM_{10}, the extension of the compliance year offered by Directive 2008/50/EC is to 2011 and for NO_2 to 2015. Twenty EU Member States have submitted notifications for time extensions for PM_{10} limits, and notifications for NO_2 and benzene are on the way. Commission decisions are or will be made publicly available on http://ec.europa.eu/environment/air/quality/legislation/ (see EEA, 2010g).

Directive 2008/50/EC includes further new standards for fine particulate matter — $PM_{2.5}$. These limits have to be attained in two stages: by 2015 and 2020. Further, the directive defines an average exposure indicator (AEI) for each Member State based on measurements at urban background stations and the required and absolute reduction targets for AEI for attainment by 2020.

European legislation on environmental noise has traditionally had two major strands: legislation on noise emission by cars, lorries, aircraft and industrial equipment — essentially market access laws for type-testing for conformity — and Member States' legislation on permitted noise levels or nuisance in the environment. The 1996 EU Green Paper on Future Noise Policy tried to bring these strands closer together and identified three key areas for improvement:

- gaps in knowledge should be filled to enable better assessment of noise exposure situation in Europe;
- the public should be better informed and more involved;
- noise abatement should be part of an integrated strategy towards a better quality of life.

Directive 2002/49/EC was introduced in 2002 to tackle noise issues across the EU. It requires Member States to monitor the situation and produce strategic noise maps for major roads, railways, airports and agglomerations, using harmonised noise indicators in order to show the number of people annoyed or sleep-disturbed. Furthermore, it requires the production of action plans with the aim of protecting quiet areas in agglomerations and reducing exposure to noise where it is high. This will contribute to the further development of a long-term EU policy on noise. In addition, the WHO Night Noise Guidelines for Europe set a clear and very challenging guideline of 40 dB L_{night}, which is equivalent to the Lowest Observed Adverse Effect Level (WHO, 2009a).

Currently, countries are in the process of reporting their environmental noise action plans. When fully evaluated, the results will contribute to the review of the Environmental Noise Directive (EC, 2002) and an evaluation of policy effectiveness.

Driven by legislative requirements under the Urban Waste water Treatment Directive (EC, 1991), ongoing improvement in the collection and treatment of wastewater is anticipated across the EU, which would result in further reductions in the discharge of pollutants to receiving waters. Tackling storm overflows in the urban environment and their associated pollution remains a significant challenge (see EEA, 2010j).

EU guidance and support

Good urban design and the way in which urban transport and other functions are organised are key to sustainable urban development. Cities may have the responsibility, for example, for urban land-use planning, housing and urban transport, but the impacts of how they manage them are felt across Europe. Activities, some drawing on the many tools available, vary, as initiatives in cities and city-networks show, and major improvements have been achieved over recent years as shown, for example, by the excellent performance of the applicants for the European Green Capital Award (EGCA, 2010).

At the European level, one measure that supports cities to improve know-how and funding is the Thematic Strategy on the Urban Environment (EC, 2006a). Its two guidance documents on integrated environmental management and sustainable urban transport plans aim to support local authorities to better implement existing EU environment policies and legislation at the local level (EC, 2007b and c). Further guidance is provided by the EU Green Paper on Urban Mobility and its related action plan (EC, 2007d; EC, 2009c). Urban-related research and pilot projects — including FP7, LIFE-Programme, CIVITAS, INTERREG, URBAN initiative, URBACT and others — should substantially increase the knowledge about local solutions. However, the exchange of good practice still occurs mostly inside these different programmes but seldom across them. Moreover, exchanging good practice alone is no guarantee of its successful transfer. The actual circumstances can differ substantially between cities and a transfer thus requires a process for adapting central ideas to different conditions. Therefore, the exchange needs to be accompanied by measures such as twinning, coaching, and staff exchange.

Today, the challenge is about turning know-how into action and making good practice mainstream (EEA, 2009). The EU can support this process by direct funding, for example through the Structural Funds. Hence, for the period 2007–2013, the Operational Programmes funded by the European Regional Development Fund (ERDF) have directly earmarked EUR 10 billion for urban development and many other projects indirectly related to urban areas (EC, 2008a; EC, 2009b; EEA, 2009).

Managing the complexity of drivers — policy integration

Urban environmental quality is the result of drivers in many areas at different scales and policy levels. Policy response on urban matters from all governmental levels — besides the local level also the regional, national and European level — is necessary. The complexity of urban systems requires integrated and balanced solutions rather than isolated measures. The complexity of drivers also offers an opportunity: joint integrated approaches can tackle multiple problems with a single measure. For example, promoting energy-efficient housing or speed limits can both reduce global greenhouse gas emissions and contribute to improving the local air quality and reducing noise. Another example is the integration of air quality and noise planning, as in the example of Berlin (see Box 4.1).

Local, national and European policies need to be supportive of and build on one another other. European and national legislation is usually essential to achieving good environmental quality in cities — for example the EU measures on fuel quality and product standards such as for the so-called EURO standards for new vehicles; national measures concerning tax incentives for clean or retrofitted vans and trucks; and national labelling schemes for vehicles with relatively low air pollutant emissions.

4.2 Is the response sufficient?

Cities are the motors of regional development: making them strong and competitive is key for ensuring Europe's place in the world (EC, 2009b; EC, 2010c). Sustainability and a healthy environment are important factors for liveable cities to achieve comprehensive and long-term competitiveness. 'Improving the quality of the urban environment, making cities more attractive and healthier places to live, work and invest in, and reduce the adverse environmental impact of cities on the wider environment' is consequently the target of the Thematic Strategy on the Urban Environment (EC, 2006a).

Progress to the achievement of this target is difficult to evaluate as it is not supported by measurable indicators. In this situation, information about people's living preferences can provide some indirect information about the quality of life in a place — in particular how that is perceived. It seems that the various rehabilitation measures in cities over recent decades to improve the quality of housing, public space, and local environments, and thus the attractiveness of cities, are finally starting to pay off. As well as continuing urban sprawl, population growth or shifts have centralised in the cores of cities in a third of Urban Audit city regions and the situation has stabilised in a further third (see Figure 4.1). Thus overall, residential urban sprawl, often seen as a way to

Box 4.1 Integrating air quality and noise planning — experiences from Berlin, Germany

Situation
Berlin, Germany's largest city with about 3.4 million inhabitants, had to cope with high noise levels and commonly exceeded air quality standards; for example in 2002, the health of 190 000 residents was affected by excessive PM_{10} pollution and about 339 000 residents were exposed to traffic noise of more than 55 dB(A) at night. In both cases, car traffic was the most important source, although the degree of car ownership in Berlin, 314 cars per 1 000 inhabitants, was the lowest of all German cities.

Solution
Berlin decided to tackle the noise and air quality problems by combining the development of a Clean Air and Action Plan and a noise reduction plan. The concentration of work in one administrative unit facilitated the development and use of a common database to calculate air pollution and noise in street canyons since most of the input data, such as traffic data and geographical coordinates, applied to both problems.

Potential synergetic abatement measures were identified, such as speed limits, low emission zones, street design, traffic avoidance and reduction plans, and restrictions on access for heavy-duty vehicles. These measures to reduce noise also had a positive impact on air quality and complemented the more technical approaches of clean air measures. For example, a speed limit of 30 km/h, implemented for 16 main road sections, resulted in a 10 % reduction in ambient air concentrations of NO_2 and a 6 % reduction in particulate matter. Calculations also showed a decrease in noise levels of about 3 dB(A). Road safety and the quality of the city as a place to live were also enhanced.

Furthermore, potential conflicts could be identified and avoided. For example, further concentrating traffic in priority networks was an effective way of reducing noise in smaller streets without significantly increasing levels in principal streets. However, this measure could impair air quality substantially in the principal streets as air pollutant concentrations, in contrast to noise levels, increase with traffic volumes.

Results and lessons learnt
By working in tandem, the cost of preparing air pollution and noise maps was reduced by about 40 %.

Learning from other approaches to evaluating environmental problems has led to more convincing arguments — even for less popular measures such as low emission zones. Noise mapping usually presented the number of affected residents for each street section, but it also proved to be the smartest way of showing the positive effects on air quality. The calculated mean ambient air concentration of particulate matter in 2010 decreased by about 10 %, but the number of residents exposed to levels above the limit fell by 20–25 % compared to a business-as-usual scenario for 2010.

This integrated planning and evaluation process was important in reconciling the noise abatement and clean air guidelines with other planning concepts. It has resulted in more effective integrated strategies for traffic, environmental and urban development of the whole city and a higher acceptance by policy-makers and other stakeholders. Agreeing on similar timelines for the EU's air quality and the environmental noise directives, for example on reporting, could support such integration.

Source: Annette Rauterberg-Wulf from the City of Berlin, pers. com., 2010.

an environmentally better place to live, has slowed over recent years (see EEA, 2010e).

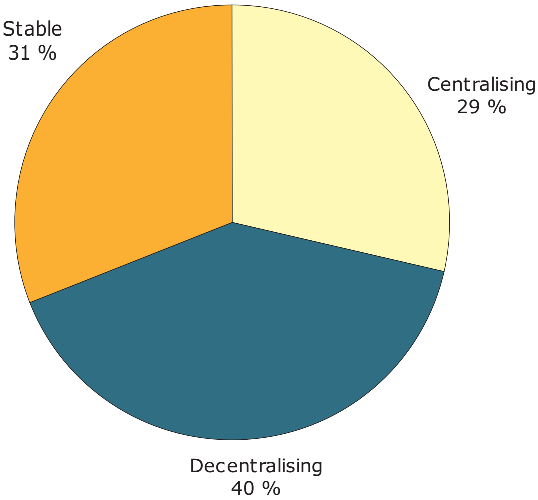
The success of single EU policies for the urban environment has been mixed. In the case of air quality, substantial reductions of some air pollutants, such as sulphur dioxides, stand in contrast to still high concentrations of others including ozone, particulate matter and nitrogen dioxide over the past decade. The Urban Waste Water Treatment Directive shows a positive trend but for noise, data do not yet allow an overall European evaluation. However, this sectoral legislation aims at only a few components of the urban environment: issues like climate change mitigation and adaptation, health and biodiversity are not covered, neither is the interconnectivity of these components and overall urban environmental quality. For these, supporting programmes and policy coherence have become even more important, but because of missing quantitative targets and agreed indicators, success, apart from individual pilot projects, is hard to evaluate. However, the generally weaker emphasis on integrated urban development in the new Member States Operational Programmes seems to be linked to too little experience or to not having been able to benefit from the URBAN initiative (EC, 2008a).

Overall, there seems still to be a long way to go to achieving sustainable urban development. Response measures need to be more strongly enforced and supplementary action is needed.

4.3 Challenges

The fact that urban issues are dealt with locally but impact and depend on services from rural areas, other cities, Europe and other regions world-wide is a big challenge. A balanced urban-rural concept and a strong cooperation between all relevant stakeholders at all levels is an obvious need; but despite the strong need for integration, a piecemeal approach still dominates.

Figure 4.1 Population development between 2001 and 2004 in major city regions in Europe



Note: Centralising, decentralising and stable population gradient measured as population shifts between core cities and their Larger Urban Zones; data for 258 city regions were available.

Source: Urban Audit database (Eurostat, 2010).

The multitude of urban initiatives and programmes under different EU directorates and EU presidencies, such as the Thematic Strategy on the Urban Environment (EC, 2006a), the Urban Dimension in Cohesion Policy (EC, 2006b), the EU Territorial Agenda (EU, 2007b) and the Leipzig Charter (EU, 2007a), run in parallel, are rarely coordinated, and seldom build on one another. Despite the existence of integration initiatives such as the EC communication Sustainable urban development in the European Union: a framework for action (EC, 1998), the general situation, apart from a greater awareness, has hardly changed for more than a decade. The EU Inter-service Group on Urban Development has been set up 'to move towards coordination between the departments of the European Commission which are directly or indirectly concerned with urban issues'. The Guide on the Urban dimension in European Union policies 2010 (EC, 2010c), developed by this group, presents the very broad range of initiatives concerned with urban issues across the different EU directorates and could be a tool for better co-ordination and efficient policy-making in the future.

Decisions in many other non-urban and non-environmental EU policy areas also have major impacts on the situation in cities and towns and could even be contradictory; the same goes for the national and regional levels. For example, the development of the Trans-European Transport Networks (TEN-T) as well as the promotion of rural development through the Common Agricultural Policy could — if they do not carefully consider possible negative side effects — attract urban sprawl at the local level (see EEA, 2010e; EEA, 2009, pp. 24–25), or European or national initiatives for more energy-efficient buildings could negatively affect indoor air quality.

Supplementary EU action helps to solve problems at the local level (see Box 4.2). However, delays at the EU and national level in introducing ambitious new norms, standards, tax incentives and other upper-level measures are seen as the reason why many cities are not meeting air quality limit values or reducing high environmental noise levels (EEA, 2009).

Despite the need for integration, cities have to fight hard to participate in European policymaking. For example, local actors had to initiate the Local Government Climate Roadmap towards COP15 to gain the necessary attention for the role and potential of cities in climate change

Box 4.2 Outlook for air quality in Copenhagen

The modelling approach used for Copenhagen assesses the impact of different abatement measures and evaluates the feasibility of the measures for solving compliance problems with the air quality directives. The chosen abatement measures included:

- traffic management;
- reductions in transport by toll ring or road pricing;
- cleaner transport emission technologies as part of an environmental (low emission) zone.

The studies have shown that the annual mean NO_2 limit value is likely to be exceeded in 35 out of 138 streets in 2010. However, the number of exceedances will decrease to only a few in 2020 due to the penetration of more stringent vehicle emission (EURO) standards already adopted at the EU level. The specific case of Copenhagen indicates that the requirements of cleaner emission technology such as Selected Catalytic Reduction on heavy-duty vehicles will be the most effective measure to ensure future compliance, whereas further traffic management and economic measures have limited potential as the city has already adopted a number of such measures.

Source: Jensen and Ketzel, 2009.

mitigation (ICLEI, 2009). And despite the accepted urban dimension of cohesion policy, opportunities for cities to participate in the Operational Programmes, and thus get environmental actions funded, vary widely between Member States. The European Sustainable Cities and Towns Campaign (ESCTC, 2010) and joint development of the Thematic Strategy on the Urban Environment (EC, 2006a) were important steps in European/local cooperation but have come to an end. Meanwhile, the Covenant of Mayors initiative (2010) to tackle climate change mitigation is making another attempt. The recently increased attention to urban issues at the EU level might, however, indicate the beginning of a more systematic collaboration.

Fragmented data on urban issues have hindered the development of appropriate and coherent policies at all levels and the evaluation of their success by integrated urban assessments. There is a lot of local data, but it is often not comparable with other local data. At the European level, information on urban issues is patchy, spread across different directorates and often not compatible in terms of time or spatial dimensions. Also, data refer to different urban area delineations. Therefore, harmonised approaches, tools and methodologies are needed to:

- make data more comparable across Europe;
- allow meaningful data integration despite different urban delineations;
- facilitate comprehensive assessment of urbanisation and its impacts from a European or national perspective, while taking the diversity of regions into account.

To overcome the barriers to a more integrated approach, the concepts of quality of life, human wellbeing, and public health might be good entry points because they are broadly understood and accepted. For example, reducing car traffic and promoting public transport, walking and cycling improves health through less air pollution and noise, encourages physical activity and reduces traffic injuries and, at the same time, contributes to a reduction of greenhouse gases emissions (WHO, 2010). The potential, however, is not yet used enough, as the examples of Box 4.3 show.

In summary, Europe's need for an urban approach that is multi-level and integrated across the different policy areas is obvious (CoR, 2009; EC, 2008a and 2009; European Parliament, 2008). While respecting the principle of subsidiarity and responsibilities of each level, it should focus on the integration of actions at different governmental levels to minimise negative side-effects and increase the synergetic benefits (CoR, 2009). This demand for an urban approach at European, national and regional levels is neither a new policy area nor a top-down, 'one-size-fits-all' administrative process. It does, however, require an audit of the likely impacts at the local level and the development of supportive cross-sectoral and multi-level policies for urban areas (EEA, 2009).

To achieve this new governance, closer partnership with the local level is vital, while respecting the spatial functionality of Europe and respective responsibilities (see further EEA, 2009, Chapter 3). The case study in Box 4.4 demonstrates a successful example of vertical integration. The follow-up process of the Leipzig Charter (EU, 2007a), the action programme of the EU Territorial Agenda (EU, 2007b), the recent discussion under the theme of territorial cohesion and the urban dimension of EU policies, and the Action Plan on Urban Mobility (EC, 2009c) might support the bringing forward of such an integrated urban approach.

Box 4.3 Human health aspects in spatial and urban planning — different experiences

The integration of human health concerns in spatial planning has been a legal requirement since the introduction of the EU Directive on Strategic Environmental Assessment (SEA) (EC, 2001). An analysis of the Danish SEA guidance and municipal practice, based on a review of 100 environmental reports, shows that health is receiving more attention, although only seven of the reports treat human health under an independent heading. Noise, drinking water, air pollution, recreation and outdoor life, and traffic safety frequently included health aspects. However, although a cross-disciplinary organisation of SEA work is recommended, only one authority explicitly refers to the health department in the report (Kørnøv, 2008).

In the east of England, very limited consideration has been given to human health in land-use plans prior to the implementation of an SEA. The capacity of the planning system to affect human health is clearly understood by those responsible for producing SEAs, but they lack the expertise to consider the complex health implications of their plans. Nevertheless, closer involvement of the health sector is recommended as an important institutional mean to secure cross-disciplinarily and higher quality assessment (Burns and Bond, 2008).

Box 4.4 Local participation in European transport policy — *Magistrale für Europa*

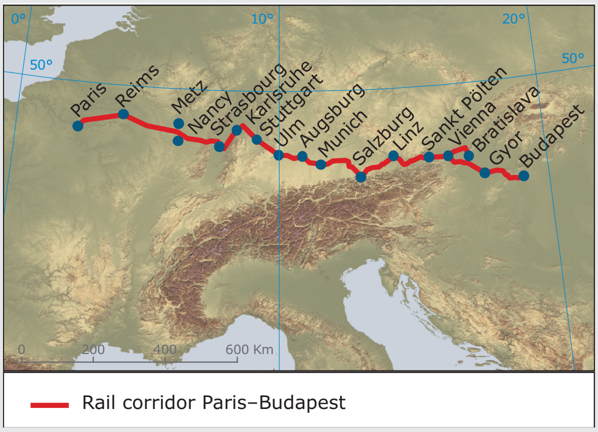
The aim of the European transport policy is to improve accessibility by building the Trans-European Transport networks (TENs). However, although the cities along the routes are substantially affected by the projects, they are not formal partners in project planning and implementation. This is a particular problem as the TENs will only generate their benefits for cities and regions if the European network is complemented by appropriate local and regional infrastructure, transport and spatial planning.

However, in the case of the TEN project 17 — a cross-border railway along the Paris-Strasbourg-Karlsruhe-Stuttgart-Munich-Salzburg-Vienna-Budapest corridor — the EU assigned a European coordinator to the project bringing together the different stakeholders concerned in the area. The director has also built substantially on the alliance *Magistrale für Europa* founded in 1990, in which around 30 cities and some regional organisations along the corridor cooperated to obtain the necessary European and national support. Thus, the EU gained from the comprehensive regional and local knowledge and local engagement, and the cities gained from a much better integration of the TEN-project into regional and local infrastructure.

More information: www.magistrale.org.

Source: Ismaier and Seiß, 2005; EEA, 2009.

Map 4.1 ***Magistrale für Europa***



Source: EEA, 2009.

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