Targeted support to the update of analysis of global megatrends for the European Environment State and Outlook Report 2015 Global megatrends assessment

Living in an urban world: Analysis for update and improved assessment of this megatrend

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Chapter 1: Introduction

The European Environment Agency (EEA) is conducting an update of the assessment of global megatrends and their potential impact on Europe's environment, specifically to resource efficiency. The work will contribute directly to the 2015 European State of the Environment and Outlook Report (SOER 2015) and potential EEA briefings. BIO Intelligence Service supports the EEA in the update of the following three global megatrends: *increasing divergence in population trends*, *living in an urban world*, and *accelerating technological change: racing into the unknown*. This background paper presents the analysis for the megatrend of rapid global urbanisation.

This paper shall follow the demographic definition of urbanisation, whereby urbanisation is the growth in the proportion of people living in urban areas. Furthermore, the term urbanisation is often used to describe to separate processes: Firstly the movement of people from rural into urban areas and secondly, the movement of people out of densely populated cities into sprawling suburbs.[1] This paper shall focus on the first process, although the second will be discussed in section 5.2.1.1.

Approximately 3.5 billion people presently live in urban settlements worldwide, representing just above half of the global population. By 2050, this figure is projected to reach 6.3 billion people or approximately 67 per cent of the world population.[1],[2] The urban areas of the world are expected to absorb literally all the population growth over the next four decades and this trend is strongest in emerging economies. Between 2005 and 2010, the average urban population growth rates stood at 2.4 per cent per annum in developing countries and 0.7 per cent per annum in developed countries.[3] While the rate of growth in cities is expected to slow in the coming decades, the rapid expansion of cities leaves a large, newly-urban population, fundamentally changing the makeup of countries worldwide.

There are a number of key drivers that explain the modern urbanisation trend, such as better work opportunities and higher wages in cities. All these drivers are characterised by high uncertainties as to the extent to which and at what time they will affect urbanisation. In addition to this, a number of drivers of the urbanisation trend are interlinked, which means that they can either reinforce or weaken their respective impact.

Despite a total of 21 megacities globally, more than half of urban dwellers[2] live in settlements of less than 500,000 inhabitants.[4] One in every three city dwellers, almost a billion people, live in slums with oftentimes limited or no access to safe drinking water and waste and wastewater disposal facilities. This does not only pose substantial social but also environmental problems. Globally, cities are not only the source of the large majority of economic output, but also of 60 to

[1] Please note that this percentage is based on figures published in the UN World Urbanization Prospect 2011 Revision report, which projects a global population of 9.31 people globally by 2050. The UN World Population Prospects 2012 Revision, however, projects a global population of 9.6 billion by 2050.

[2] Please note that the terms 'urban population', 'urban dwellers' and 'city dwellers' are used interchangeably in this report.

80 per cent of energy consumption and approximately 75 per cent of CO_2 emissions.[3,5] This is not necessarily due to cities as such, but due to certain consumption and production patterns that city living brings about. Urbanisation and income levels are closely linked, which in turn leads to changing consumption patterns and larger ecological footprints of city dwellers compared to rural inhabitants.

Still, impacts of urbanisation on the environment and resource efficiency depend strongly on urban planning and management. Indeed, due to their dense living environment, cities can offer significant resource efficiency opportunities. However, countries with high urbanisation rates are currently facing this trend not only at an earlier stage of development but also at much higher speed than their developed counterparts did. This can challenge the capacity of governments to plan and manage urban growth in a sustainable way. The potential environmental and resource efficiency benefits urbanisation offers, are therefore often not realised. Given that city planning is by definition long term, the infrastructure that is being developed will influence the course of the continued development for decades, if not centuries, to come.

Impacts of the current urbanisation trend on the European environment and resource efficiency are largely indirect as the great majority of current and future urbanisation takes place in developing countries. Direct impacts do, however, include an increase in greenhouse gas emissions and increasing pressure on global resources. Nevertheless, risks and opportunities for European environmental policy are estimated to go little beyond the status quo and are mostly limited to knowledge and technology transfer.

Key changes to the 2010 background paper on this megatrend are presented in the box below.

Box 1: Key changes to the 2010 analysis

- General **update of information and figures**: All figures on global and regional urbanisation rates and growth are now based on data published since 2010, e.g. the UN DESA 2011 Revision of the World Urbanization Prospects.
- The 2010 paper included effectively two documents: One on urbanisation, the other on **consumption**. The latter issue is now integrated in the paper on urbanisation, in line with the 'Living in an urban world' chapter in the SOER 2010 and the ToR.
- A chapter on the impact of urbanisation on **European resource efficiency** (see section 5.2) was included.
- Potential **economic and social impacts** of the megatrend are no longer discussed. Instead, the discussion on potential environmental impacts has been deepened.
- **Other aspects** of the discussion have also been elaborated in order to provide a more detailed picture of the current situation, e.g. regional differences in urbanisation and slowdown of urban growth

[3] The latter figure, though widely published, is subject to discussion (see section **Error! Reference source not found.**).

Following this introduction, an overview of the urbanisation megatrend is presented in Chapter 2. Chapter 3 presents the main drivers of this trend, followed by a discussion of key uncertainties in Chapter 4. Potential environmental impacts are presented in Chapter 5 with a focus on European resource efficiency. Interlinkages between driving forces as well as with other megatrends are illustrated in Chapter 6. Finally, Chapter 7 provides a short Glossary, defining key terms used in this paper.

Chapter 2: Description of the megatrend

This chapter presents the most recent information on the global urbanisation trend with a special focus on regional differences. Variations in city sizes as well as living conditions are also discussed. Finally, consumption patterns and their links to urbanisation are presented. All figures already presented in the 2010 analysis were updated, e.g. while the former presented a projection of 6.4 billion urban dwellers by 2050, this has now been revised to 6.3 billion in line with the most recent UN estimates. More fundamentally, the 2010 analysis strongly focused on India and China, whereas this revision provides a more global view, especially as urbanisation is projected to be particularly pronounced not only in Asia but also in Africa over the next few decades.

In 2010, more than half of the global population lived in urban areas.[3] This trend has developed in breath taking speed, taking only a few generations to grow from approximately 10 to 15 per cent of the world population living in urban areas to the current 50 per cent.[6] Cities that grew significantly over the last 20 years tended to be located in developing countries that enjoyed strong economic growth.

According to UNEP, current urban development is characterised by fundamental changes that differentiate it from urban development of the past:

Box 2: Fundamental changes characterising urban development[4]

Three fundamental changes shaping urban development:

- The '**second wave of urbanisation**', i.e. entering the new era of more than half of the global population living in cities
- The era of **resource scarcity** and constraint
- The era of **increased uncertainty**, e.g. the increased unpredictability of resource availability

The first wave or urbanisation occurred in developed countries from 1750 and resulted in approximately 400 million urban dwellers within 200 years. The second wave, in contrast, is characterised by its speed in terms of the absolute number of new urban dwellers and is projected to add three billion city dwellers within just 80 years. Importantly, the second wave is mainly taking place in Africa and Asia, followed by Latin America and the Caribbean. In developing countries in general, the number of urban dwellers is expected to double from 2.6 billion in 2010 to 5.2 billion in 2050. A modest increase in comparison is projected to take place in developed countries from 0.9 billion urban dwellers in 2010 to 1.1 billion in 2050.[7]

Today, the global population has surpassed seven billion people[8] and is growing by approximately 1.1 per cent annually.[9] The UN projects that the global population will reach 9.6 billion by 2050.[4],[9] Virtually all of the global population growth projected until 2050 is expected to take place in urban areas[6] and by 2050, approximately 67 per cent of the global population are expected to live in cities.[5],[2]

At the individual level, urbanisation offers unique chances for improvement in the quality of life and environmental protection if urban development is governed effectively. At the macro-economic level, cities are important for facilitating economic growth, increasing productivity and rising incomes. However, rural-urban migration often happens in an unplanned and unregulated way. Informal settlements and slums which currently house more than 1 billion urban dwellers are of particular environmental concern as they are often not connected to even basic sanitation systems and other critical infrastructure. If left unchecked, the UN estimates that the number of global slum dwellers will multiply threefold to three billion people by 2050.[10]

2.1 Regional differences in urbanisation

In the 1950s, just over one-half of the population of the developed countries and just under one-third of the population of the entire world lived in urban areas. At that time, there were about 733 million people living in urban areas worldwide and 83 cities in the world that could boast a million or more residents. Continued urbanisation over the last 50 years has resulted in a situation where just above half of the world's population now lives in urban areas. In general, this trend towards greater urbanisation is occurring more quickly and with the greatest absolute impact in less developed regions.

As of 2010, approximately 3.5 billion people, or just over 50 per cent of the world's population, lived in urban settlements.[3] In contrast, in 1950 this figure stood at 29 per cent and by 2050 it is projected to have reached 69 per cent of the global population.[6]

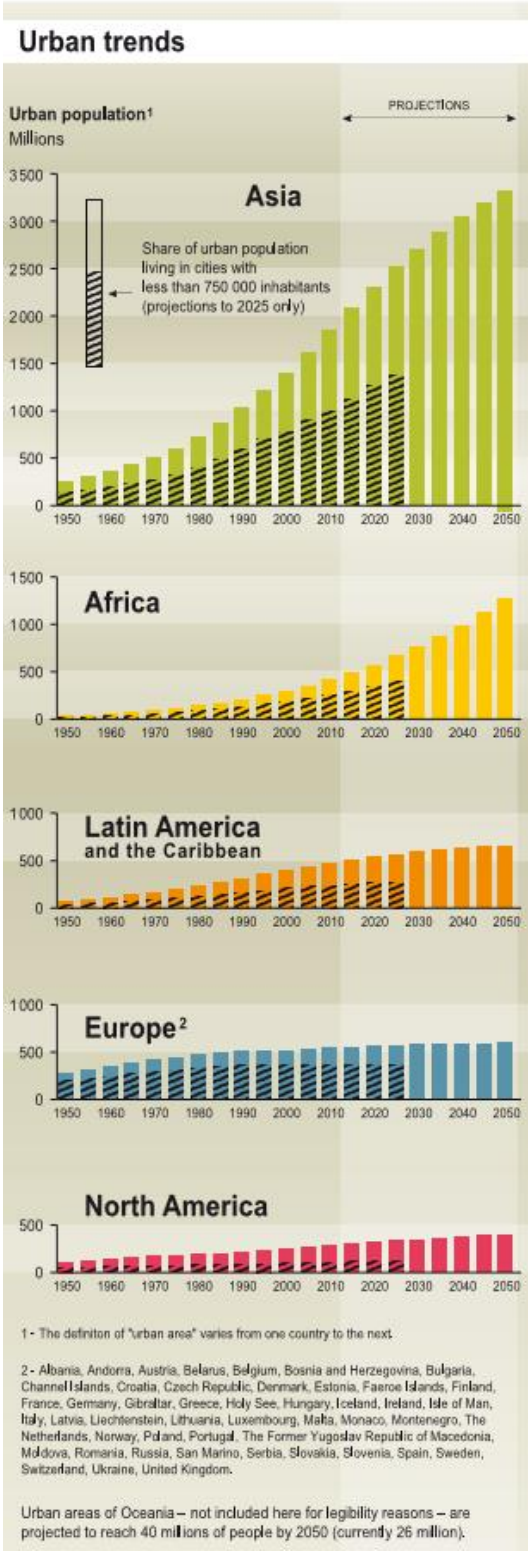
As detailed in Figure 1, urbanisation levels vary significantly across regions and countries.[6] Historically, societies in China, India and the Middle East were the most urbanised in the world. Now, however, North America has the highest rate of urban population as a percentage of total population (82 per cent), closely followed by Latin America and the Caribbean with 80 per cent. Asia and Africa currently have the lowest urbanisation levels with 42 and 40 per cent respectively.[3]

[4] However, it needs to be noted that this figure is only the medium variant, as the UN's estimates range from 8.3 billion to 10.9 billion people by 2050.[9] The medium variant is defined by certain assumptions about future fertility trends in developed and developing countries, and is not in any way a 'mean' growth estimate.

[5] Please note that this percentage is based on figures published in the UN World Urbanization Prospect 2011 Revision report, which projects a global population of 9.31 people globally by 2050. The UN World Population Prospects 2012 Revision, however, projects a global population of 9.6 billion by 2050.

[6] Please see the discussion on 'urban versus rural' in the Glossary, Chapter 7:

Figure 1: Urban population by major geographical area (updated)



Source: UN DESA (2012) World Urbanization Prospects, The 2011 Revision[11]

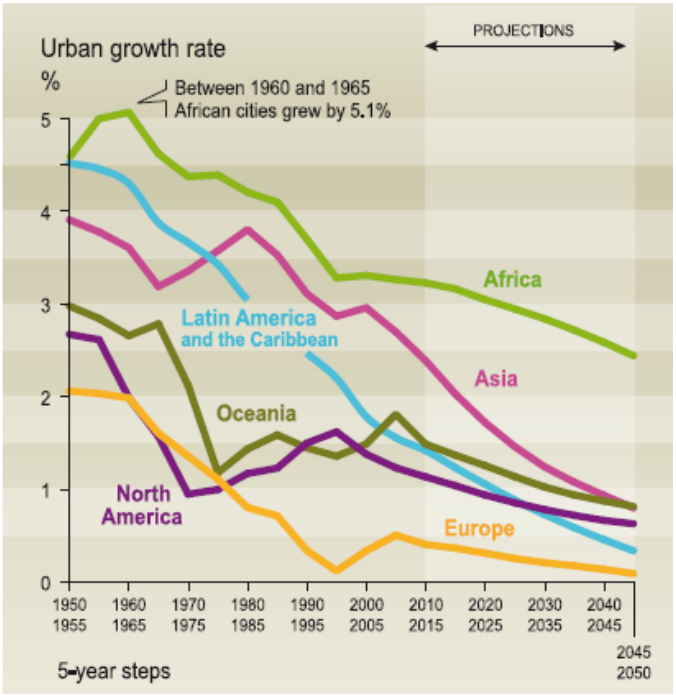
The current picture of regional urbanisation levels will change dramatically by mid-century, when all regions are projected to be more than 60 per cent urban.[7] This is explained by the significant difference in the urban population growth rate (national population growth rate *plus* urbanisation

rate)[7], which currently stands at 2.4 per cent per annum in developing countries and 0.7 per cent per annum in developed countries.[3] Europe has high urbanisation levels already but low urbanisation growth rates, which are in some cases even negative.[4] In contrast, Africa currently has the highest urban growth rate with an average of 3.4 per cent annually during 2005 to 2010[3], while Asia has the highest urbanisation rates.[8] According to United Nations' estimates, Africa and Asia alone will account for 83 per cent of urban growth globally.[7]

The absolute number of people being added every year to urban populations in many developing regions is unprecedented. Globally, growth of the absolute number in urban population stands at one million people a week.[6] Governments of many developing countries face rapid urbanisation not only at an earlier stage of development but also at much higher speed than their developed counterparts did. This can challenge the capacity of governments to plan and meet the needs of the rapidly growing number of urban dwellers. [7] The speed of China's urbanisation trajectory is of particular interest: by 1990, 26.4 per cent of its population lived in cities. By 2000, this had increased to 36.2 per cent and by 2011 it was 51.3 per cent of the total population being urban dwellers. [12] This trend is projected to continue with the United Nations estimating just under 80 per cent of the Chinese population living in urban areas by 2050.[13]

That said, as shown in Figure 2, in all regions the urban growth rates are slower now than in the past and are projected to significantly decline further between now and 2050.

Figure 2: Slowdown of urban growth (updated)



Source: UN Population Division: World Urbanization Prospects Database, The 2011 Revision

[7] National population growth rate *plus* urbanisation rate

[8] Natural population growth in Africa is considerable higher in Africa.

Urbanisation rate: Rate at which the urban population share is growing.

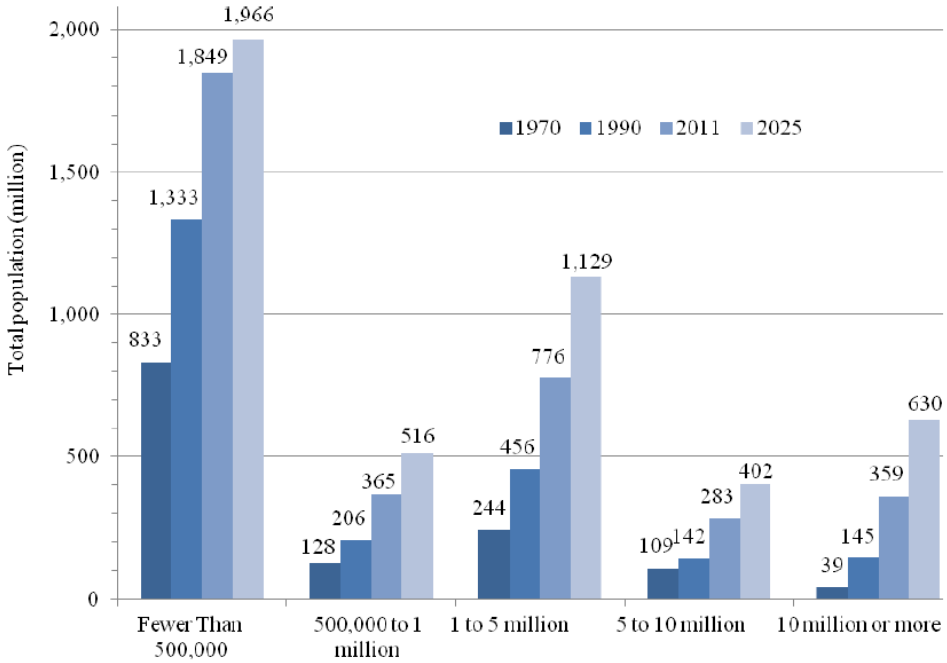
Nevertheless, the absolute increase in the number of urban dwellers is projected to remain high with an additional 25 million people per year in Africa and 35 million in Asia during 2045 to 2050.[7] This is particularly the case for countries with existing large populations, such as China.

2.2 Size of cities

In line with the urbanisation definition of this paper (the population share living in urban areas), the 'size of cities' refers to the city by population and not by area. The issue of urban sprawl and land use is briefly discussed in section 5.2.1.1.

While in 1950 there were only two megacities[9], today there are 21 of these cites with more than 10 million inhabitants, 17 of which in the developing world. Nevertheless, while much of the current debate on sustainable cities focuses on the formidable problems for the world's largest urban agglomerations, only ten per cent of the world urban population live in megacities.[7] 52 per cent of all urban dwellers globally, on the other hand, reside in small urban settlements of less than 500,000. [4] Figure 3 illustrates that globally the largest number of people reside in cities of less than 500,000. This is projected to still be the case in 2025 although growth rates are higher in cities above 500,000.

Figure 3: Total population in millions by city size class (1970, 1990, 2011 and 2025) (new)



Source: UN DESA: World Urbanization Prospects, The 2011 Revision

Again, regional differences are significant, with the majority of African and European urban populations living in small cities of less than 500,000 inhabitants, while urban dwellers in Asia,

[9] Cities of more than 10 million inhabitants. However, the definition of a 'megacity' is somewhat problematic, as it does not take into account other important factors, such as population density.

Latin America and the Caribbean and North America tend to live in significantly larger urban settlements. [14] In some high-income countries or areas, a process of de-urbanisation (or, more correctly, demetropolitanization) became apparent in the 1970s with people moving from large to smaller cities and suburbs.[15]

Box 3: The rise of the small city[4]

Cities do not necessarily develop from small to megacity. Urbanisation has resulted in far more **small and medium size cities** than megacities:

- Between 1990 and 2000, 694 new cities developed
- 510 of these grew into small cities with less than 100,000 inhabitants
- 132 became intermediate sized cities with 500,000 to one million inhabitants
- Only 52 developed into big cities of one to five million inhabitants

The challenges of the second wave of urbanisation are consequently expected to play out at the small and intermediate-sized city level. [4]

2.3 Living conditions in cities

As discussed above, the unprecedented absolute number of people being added every year to urban populations can result in limited planning and hence the needs of urban dwellers risk not to be met. Socio-economically disadvantaged populations within cities, often consigned to segregated areas generically called 'slums'[10], are not a uniquely modern phenomenon. The difference today is one of scale. Slum dwellers of the new millennium are no longer a few thousand in a few cities of a rapidly industrializing continent. They include one out of every three city dwellers, almost a billion people.[6]

The most rapid urbanisation currently takes place in less and least developed regions with the least capacities for orderly urban planning. In the least developed countries, approximately 71 per cent of urban dwellers live in slums, while this figure can reach 94 per cent in a country like Sudan. In Asia, the percentage or city dwellers living in slums lies at 33 per cent. [3]

Slums are typically characterised by their crowdedness and lack in urban development standards, including a lack of access to safe drinking water and waste and wastewater disposal facilities. In 2008, in the least developed countries, 20 per cent of the urban population had no access to safe drinking water and 51 per cent lacked adequate sanitation. [3] As access to safe water and sanitation

[10] Slums are regarded as "settlements in urban areas in which more than 50 per cent of their inhabitants live in inadequate housing and lack basic services" (UN DESA 2011)

are indicators of environmental sustainability of a city, urbanisation planning, or a lack thereof and the resulting development of slums, has a direct impact on the sustainability of cities.

2.4 Increased consumption

With a growing global population, it is projected that the planet will need to be shared with an additional three billion middle class[11] consumers by 2030.[16] In connection with rising urbanisation levels, this means not only more consumers but also significantly different consumption patterns.

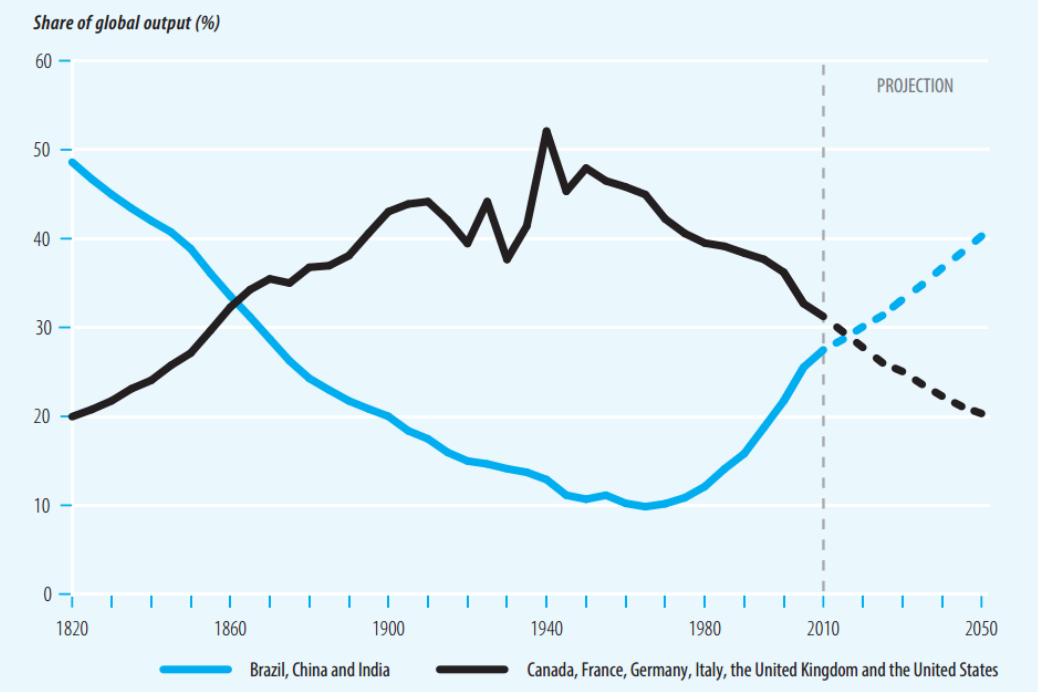
In many emerging economies, there are still large differences between the life-styles and spending patterns of people in urban and rural areas. People in rural areas tend to have lower average incomes and more conservative spending habits than those in urban areas. Changes in consumption patterns related to urbanisation are of particular interest here because of their potential impact on the environment and changes in land-use:

> “Cities per se are neither drivers of climate change nor the source of ecosystem degradation, but certain consumption and production patterns as well as certain population groups within cities are.
>
> *GER Cities chapter, 2011*[5]

Today, the combined output of Brazil, China and India equals the output of Canada, France, Germany, Italy, the United Kingdom and the United States together.[17] By as early as 2016, China is projected to overtake the USA to become the world's largest economy and India will soon exceed the collective economies of the G7 countries.[18] As illustrated in Figure 4, by 2050 it is projected that Brazil, China and India together will account for 40 per cent of global output, exceeding by far the output of the Group of Seven bloc in the North.[19]

[11] Please note that there is no one commonly agreed definition of the term middle class. Rather vaguely, it is normally understood as being able to meet all basic needs plus 'a few extras' (Wheary). More specifically, the term middle class can be defined in relative terms as 'the middle income range of each country' or in absolute terms as 'a fixed band for all countries' (defined by Kharas and Gertz as between USD 10-100 a day per person at purchasing power parity (PPP)). The absolute definition of middle class allows for one common definition for all countries and therefore international comparisons. However, it also excludes many people that are recognisably middle-class but earn less than USD 10 a day. As this report is looking at the emerging global middle class and comparisons of middle class developments for different countries and regions, the term middle classed is based on the absolute definition, despite its shortcomings. For more information, please see the ESPAS Report 'Global Trends 2030', accessible at http://www.iss.europa.eu/publications/detail/article/espas-report-global-trends-2030-citizens-in-an-interconnected-and-polycentric-world/ and 'Who's in the middle?', accessible at http://www.economist.com/node/13063338

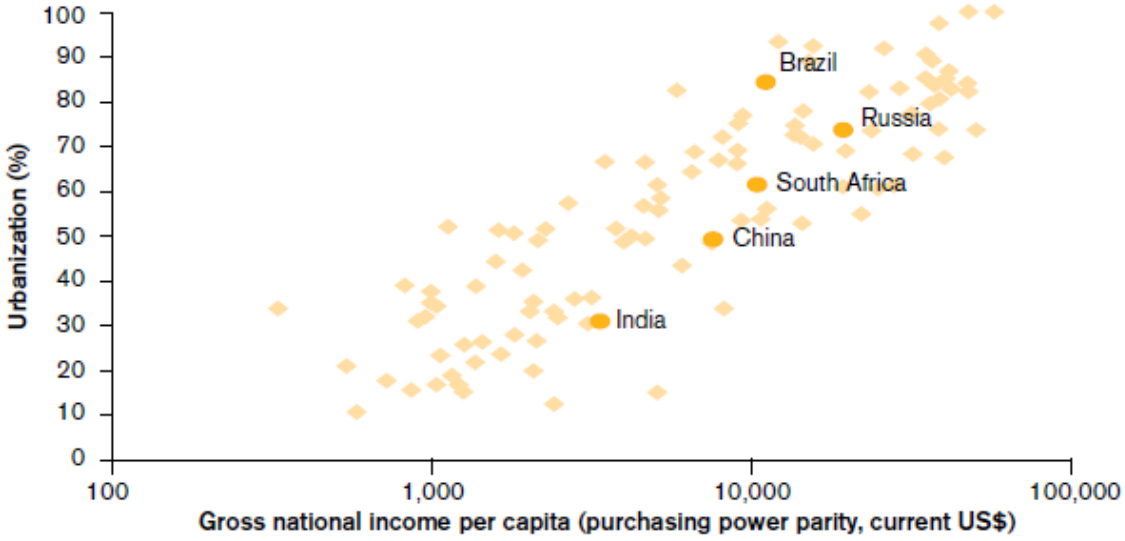
Figure 4: Share of global output (new)



Source: UNDP Human Development Report 2013

The drivers of this increasing wealth are part of a complex matrix of social, economic and political variables. While the complexity of the various influences makes it difficult to determine clear lines of causation with currently available data, urbanisation and changes in consumption patterns are both deeply associated with and related to this global trend towards increasing wealth. Cities are on the forefront of economic wealth creation as most economic growth, innovation and paid employment tends to be located in urban areas. Figure 6 illustrates how higher levels of urbanisation are closely linked to higher levels of income.

Figure 5: Levels of urbanisation plotted against gross national income per capita in 2010 (new)

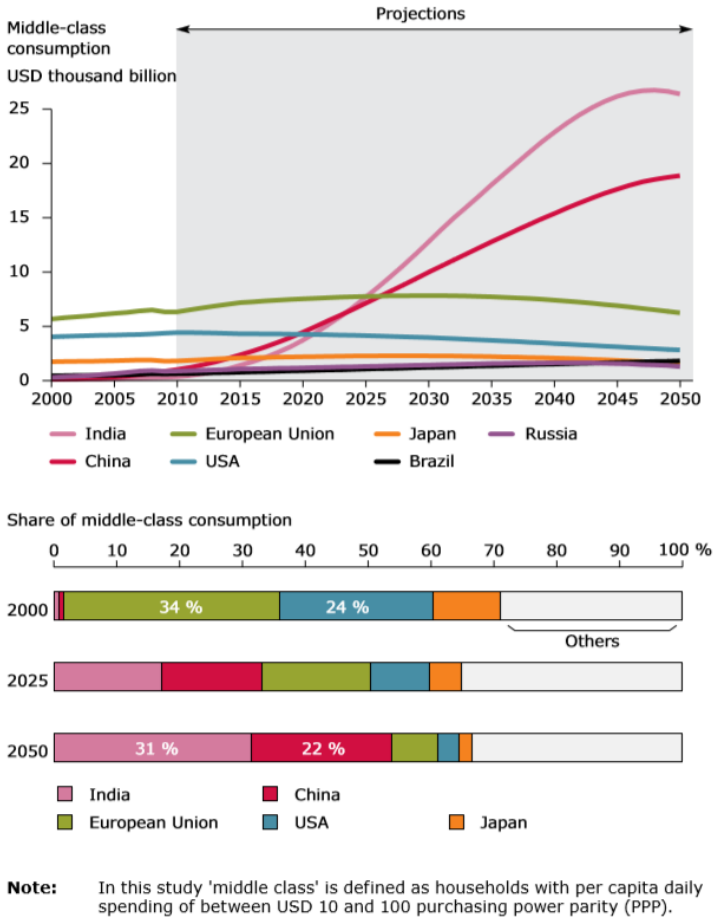


Source: IIED 2012, Urbanization and development: Policy lessons from the BRICS experience

Due to this increasing wealth, many of the new city-dwellers are likely to enjoy a level of material well-being considerably beyond that of their forbearers. In fact, despite remaining urban and rural poverty in certain segments of societies, the rise of a middle-class in those countries means that we are currently observing a rapid rise of a global consumer society, driven in particular by developments in the BRICS countries and most notably China and India.[20] This trend is likely to continue with the 2008 financial crisis accelerating the shift of economic mass to emerging economies.[21]

In the ESPAS Global Trends 2030 report, it is projected that in 2022 time more people in the world will be middle class rather than poor for the first time. While in 2009 1.8 billion people belonged to the global middle class, this is estimated to increase to 4.9 billion people by 2030 with 85 per cent of that growth taking place in Asia.[22] Figure 6 illustrates the increasing number of people now entering the middle class, increasing average incomes and spending power. By 2050 it is projected that India and China combined account for over 50 per cent of global middle class consumption. [23] Whereas India's middle class currently represents 5-10 per cent of its population, this is estimated to increase to 90 per cent within just 30 years. Although India will remain poorer than China, its middle class may outnumber China's by 2020.[22]

Figure 6: Changing consumer spending of the middle class (not updated)



Note: In this study 'middle class' is defined as households with per capita daily spending of between USD 10 and 100 purchasing power parity (PPP).

Source: Kharas, H. (2010) The emerging middle-class in developing countries[24]

The middle class is growing not only in size but also in median income. Annual consumption in emerging markets is projected to increase to US$ 30 trillion by 2025, which means that the South would make up three-fifths of the one billion households globally that earn more than US$ 20,000 per year.[25]

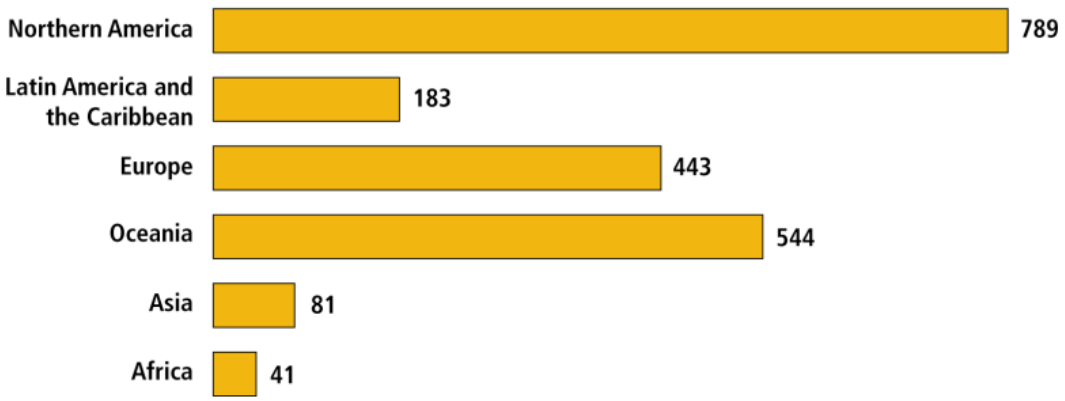
With rising income and consumption levels come higher resource use, changing waste patterns and environmental degradation.[5] The focus of spending in many emerging economies changes from basic to optional goods.[26] One example of changing consumption patterns is the increasing demand of non-traditional, non-seasonal and imported food. This new type of diet tends to be resource-intensive with saturated fats, sugar, and large amounts of meat and fish with links to obesity and related diseases(see Megatrend 3: Disease burdens and the risks of new pandemics).

Another example of changing consumption patterns due to rising income levels that is of particular environmental interest is that of light-duty vehicle ownership rates. While purchase rates are low when incomes are low, they significantly increase as income rises but then slow down again when incomes are high. The relationship, therefore, tends to depend on income levels. However, this relationship varies significantly among countries and non-OECD countries have shown higher vehicle purchase rates at lower income levels than OECD countries have in the past. One among a number of explanatory factors for this phenomenon is the low quality of transport alternatives, especially in urban areas where the high number of migrants put pressure on the quality of public transport. This means that the relative costs of purchasing a vehicle might be lower than in countries or cities with higher quality public transport systems. [27] However, whether this is the case will depend on the type of densification and urbanisation and the resulting congestion in the city in question.

In 1975, 85 per cent of the global light-duty vehicle stock was in OECD countries and by 2010, this share had declined to 70 per cent. Figure 7 shows the number of motor vehicles[12] in use per continent as of 2010, with Africa and Asia still having the lowest numbers by far. By 2050, however, it is projected that the stock of light-duty vehicles and two-wheelers in non-OECD countries will be ten times as large as in 2010 (Figure 8). In the high car ownership scenario, India and China are responsible for 56 per cent of total growth between 2010 and 2050, rising from 30 to 70 per cent of the vehicle stock in non-OECD countries.[27] This figure might prove conservative, as China's car ownership numbers grew faster than any predictions estimated, with 18.6 per cent between 2003 and 2010. [28]

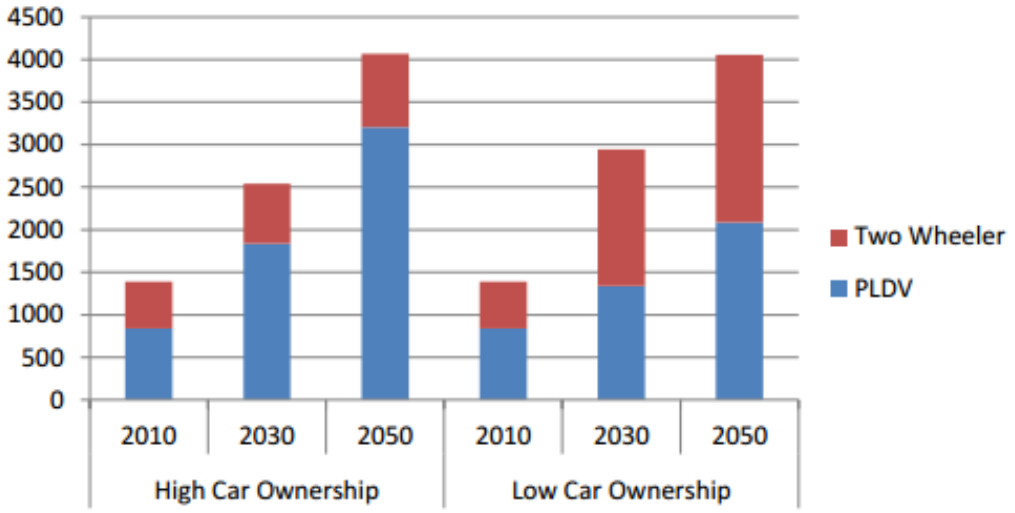
[12] Definition includes passenger cars, trucks, buses and minibuses

Figure 7: Motor vehicles in use (per 1,000 population) [3] (updated/new)



Source: UN DESA, Urban Population, Development and the Environment 2011

Figure 8: Global Private Vehicle Stock, light-duty vehicles and two-wheelers, 2010-2050, high car ownership and low car ownership (million) (updated/new)



[13]

Source: OECD/ITF (2012) Transport Outlook: Seamless Transport for Greener Growth

The low car ownership scenario assumes stronger constraints on ownership and use, such as more pronounced congestion effects of urbanisation. Growth in two-wheeler travel would be more significant in this scenario and is estimated to be 3.2 times higher in 2050 than in 2010.[27]

[13] PLDV: Passenger light-duty vehicle, includes cars and light trucks

Chapter 3: Key drivers

The discussion on key drivers of urbanisation has evolved substantially from the 2010 analysis. The most important change is based on the clarified definition of urbanisation that this paper is based on: Urbanisation as the growth in the population share living in urban areas (see Chapter 1:). *High fertility rates are a driver of an increase in the absolute number of people in urban areas and not of the growth of the urban population share*. High fertility rates are therefore no longer listed as a key driver of urbanisation.

In line with this definitional clarification, key drivers of urbanisation are a combination of increasing urban opportunities (driven in turn by returns to agglomeration and hence better work opportunities and higher wages as well as the better provision of services) and declining rural opportunities (in turn driven by agricultural mechanisation, declining rural wages and rural environmental degradation). Table 1 presents these principal and sub-drivers of urbanisation, which will be discussed in more detail below.

Table 1: Main drivers influencing urbanisation

Principle driver	Sub-driver	STEEP category
Increasing urban opportunities	Returns to agglomeration / work opportunities	Economic
	Better services	Social
Declining rural opportunities	Agricultural mechanisation	Technological
	Declining rural wages	Economic
	Rural environmental degradation	Environmental

3.1 Increasing urban opportunities

When countries begin their transformation from an agrarian to an industrial economy, there is usually a significant difference in income and living standards between rural and urban areas. This divergence in living standards typically narrows with growing development. In England, for example, urban wages were more than 70 per cent higher than rural wages in the 1830s while today disposable incomes are very similar, if not higher in rural areas.[29] In developing countries, however, significant differences in work opportunities, wages and services between rural and urban areas, will drive further rural residents to search for a better life in cities.

Cities offer a concentration of investment as well as work and education opportunities. Industry and services tend to be clustered in or around cities and approximately 80 per cent of the world's GDP is generated in urban areas.[2] Research has shown that when a city's population doubles, economic productivity increases by 130 per cent and that physical proximity is the main driver of this superlinear scaling.[30] Because these urban opportunities, together with falling transport and communication costs, draw in rural inhabitants, economic growth drives urbanisation (at least

until a certain stage of development is achieved) but urbanisation in turn also drives economic growth. However, whether the potential of urbanisation to fuel economic growth and innovation is fulfilled will depend on infrastructure and institutional settings.[31]

Demand originating in Europe and other developed countries plays a role in this process taking place in developing countries. As demand for cheaper manufactured goods in developed countries increases, manufacturers seek low-cost production facilities in developing countries, drawing in ever more rural inhabitants to these new economic opportunities in the cities. While China has been the centre of much of this production in recent decades, increased labour costs and an increase value-added production and services, might shift this to other regions — e.g. Latin America and/or Africa.

3.1.1 Returns to agglomeration / work opportunities

Companies can benefit significantly from being located close to each other. The advantages, which are also called 'agglomeration economies' stem from the ability to reduce transaction costs, such as transport and communication costs, and from positive network effects. Easy access to workers, suppliers, customers, competitors and other companies are all part of agglomeration economies.[31] Proximity is of particular importance for the service sector, where face-to-face interaction is essential. Because of these agglomeration economies, companies are more likely to be located in urban than in rural areas.

Economic density (the economic mass or output generated on a unit of land)[29] is highest in cities and lowest in agricultural areas. What is more is that the unevenness of economic mass within a country tends to increase with a country's land area. Returns to agglomeration, discussed above, is both a consequence of economic density as well as a cause of it. [29] Because of this concentration of economic mass, there are substantial differences in work opportunities and wages between rural and urban areas, especially at the earlier stages of development.

India's wage structure, for example, used to be characterised by a significant difference in wages between its urban and rural population, thereby promoting rural-urban migration. Research now shows that with increasing development, this gap in wages is narrowing: The median urban wage premium declined from 101 per cent in 1983 to 11 per cent in 2010.[32] In China, average household incomes are now nearly three times higher in urban than in rural areas.[31]

The benefits of agglomeration economies can, however, be offset by problems due to congestion, overcrowding, pressures on infrastructure and ecosystems, as well as higher costs of living, labour and property in cities. [31] City planning and sufficient investment in infrastructure are therefore key to returns to agglomeration. China's spending policy is of interest here because of its strong focus on urban infrastructure: "In the early 2000s, China spent 12.6 per cent of GDP on infrastructure – more than twice of that of India. It was stated recently that: 'For every pound Indian authorities invest in urban infrastructure, their Chinese counterparts spend seven.'"[31]

3.1.2 Better services

Cities offer greater availability and a more diverse range of goods and services, including basic infrastructure and public health services.[29] As illustrated in Figure 9, these differences in services are substantial at lower stages of development but narrow as development progresses. In urban Malawi, for example, the infant mortality rate stood at 83 per 1,000 live births in 2000 compared to 117 per 1,000 live births in rural areas.[29]

Figure 9: Rural-urban disparity in basic services (new)

Urban population share (mean GDP per capita)	Disparity in access to clean water (percentage points)	Disparity in access to sanitation (percentage points)	Examples of countries in the sample
75% or higher (mean GDP per capita: $21,602)	8	8	United States, Norway, Switzerland, Spain, Germany, Canada, Mexico, Chile, Brazil, Argentina, Gabon, R. B. de Venezuela, Djibouti, Lebanon, Jordan, United Kingdom
50%–70% (mean GDP per capita: $9,672)	15	20	Estonia, Panama, Turkey, Hungary, Ecuador, Colombia, Malaysia, Syria, Azerbaijan, South Africa, Rep. of Congo, Algeria, Tunisia, Bolivia
25% or lower (mean GDP per capita: $2,585)	24	26	India, Rep. of Yemen, Madagascar, Chad, Tajikistan, Bangladesh, Tanzania, Kenya, Nepal, Cambodia, Malawi, Uganda, Sri Lanka, Bhutan

Source: World Bank (2009) World Development Report 2009, Chapter 1

The absence of a well-developed state pension and health care systems in many developing countries will continue to fuel urbanisation. Albeit decreasingly so, children often remain essential to ensure their parents' income and security in old age.[33]

3.2 Declining rural opportunities

3.2.1 Agricultural mechanisation

Agricultural productivity has seen continuous growth throughout the past decades.[34] This is due in part to an increased use in fertilisers and pesticides but also to further mechanisation of agriculture more generally. These trends result in smaller workforces needed in rural areas to achieve increasing levels of agricultural yields.[35] While yields still increase in absolute terms, against a backdrop of global population growth, arable land per person declined globally by roughly 40 per cent, from 0.43 ha in 1962 to 0.26 ha in 1998.[36] Looking ahead, the rate of growth of agricultural

production is expected to fall to 1.5 per cent per year between now and 2030, compared with 2.3 per cent per year since 1961.[37] The decrease in required agricultural workforce leads to a further increase in rural-urban migration.

3.2.2 Declining rural wages

Agricultural mechanisation does not only lead to a smaller workforce but also to lower wages for those who still work in the sector. This trend is reinforced by trade liberalisation measures, which tend to encourage the development of export-oriented cash crop agriculture while inviting cheap imports of basic food products, thereby depressing prices for domestic produce. This leads to marginalisation, displacement, loss of land and greater poverty among small farmers who are thus led to seek wage-paying employment.

3.2.3 Rural environmental degradation

Environmental migration plays an increasingly important role in internal migration. Rural inhabitants are particularly vulnerable to the impacts of climate change as they tend to depend heavily on activities and resources which are especially sensitive to such changes, e.g. arable farming, animal husbandry and light industry reliant on local resources.[38] As temperatures and/or rainfall patterns change, regions that currently offer favourable conditions for such climate-sensitive activities might see their productivity decline, at least in specific areas.[39] Migration pressure from regions affected by such changes, leading to rural-urban migration, are likely to increase, possibly further contributing to the growth of urban areas. A 2008 study from Bangladesh shows, for example, that 22 per cent of households affected by tidal-surge floods and, and 16 per cent affected by riverbank erosion, moved to urban areas.[40] It should be noted, however, that most of environmental migration, which can be either slow-onset or sudden disaster induced, is short term.[7] Putting figures to environmentally induced internal migration remains a difficult task given that the difference between other forms of migration and environmental migration is not always clear cut.

Furthermore, the displacement of rural residents by major infrastructure development projects can also be a driver of migration towards cities. A prime example is hydroelectric dam construction in China. During the period of the 1950s and 1960s more dams were built than ever before in China's history and about 7.8 million people were moved to make way for these water control works.[41] More recently, the Three Gorges Dam has been a major driver for migration towards cities with Chinese officials stating that "at least 4 million people from the Three Gorges Reservoir area are to be relocated to cities in the next 10 to 15 years".[42]

Chapter 4: Uncertainties

In line with the revised discussion of key drivers, this Chapter on uncertainties has also been revised considerably from the 2010 analysis. As increasing urban opportunities and declining rural opportunities have been identified as key drivers of urbanisation, future GDP growth and development as well as their impact on urban and rural opportunities and consumption patterns are the key area of uncertainty for future urbanisation. In addition, uncertainties regarding resource availability, urbanisation policies, climate change impacts and technological innovation are also discussed.

General uncertainty is increased as a result of the constant possibility of low-probability, high-impact events — e.g. major wars, natural disasters, and economic upheavals. These events could influence the relative impact of the various drivers and could potentially alter, or even reverse, these megatrends. While the probability and potential impact of such events is particularly difficult to predict, given that they may fundamentally change the direction and degree of current megatrends, they must not be entirely ignored.

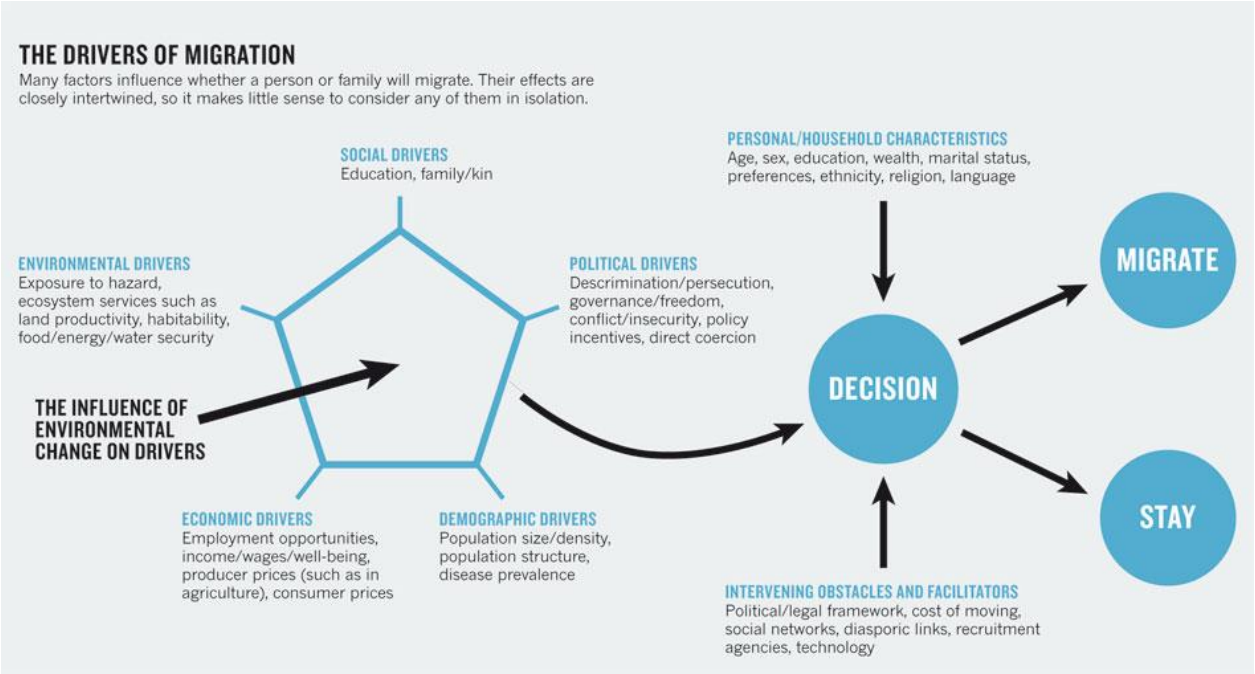
Uncertainties regarding the drivers of urbanisation are manifold and will be discussed below. It is therefore not surprising that projections of urbanisation levels by 2050 differ. While the UN estimates a total of 6.3 billion urban dwellers by 2050 that represent approximately 67 per cent of the global population, the German Advisory Council on Global Change projects a total of 6.5 billion urban dwellers by 2050, representing 75 per cent of the global population.[2]

In addition to uncertainty regarding the future urbanisation and population trends, uncertainty also stems from the lack of reliable data. Given the speed as well as the oftentimes unplanned and unorganised nature of urban growth, many local governments lack data and many official statistics do not adequately represent the local reality. The Beijing Municipal Bureau of Statistics, for example, reports that Beijing had 15.38 million long-term residents and 3.57 million temporary migrants in 2005, while the World Urbanization Prospects of the United Nations[14] reports that Beijing had a population of 11.45 million in 2005.[7] Furthermore, urban areas are not always distinguishable from rural ones and definitions vary widely among countries and regions.

Figure 10 below illustrates the multitude of factors influencing the decision to migrate or stay, whereby migration here could be internal or external, to urban or rural areas. The fact that these factors cannot be considered in isolation adds to the uncertainty.

[14] The 2009 Revision

Figure 10: The drivers of migration (new)



Source: Black R. et al. (2011) Migration as adaptation

The discussion below will highlight what has been identified as key uncertainties regarding future urbanisation levels, but by no means does it represent a comprehensive list of uncertainties.

4.1 GDP growth and development

As discussed above, differences in work opportunities, wages, and the standard of services between rural and urban areas tend to be substantial at low development levels but decrease as development progresses. The appeal of urban living is therefore likely to decrease with rising levels of development and urbanisation levels should stabilise. China's and India's share of global GDP is projected to increase significantly: From seven per cent in 2011 to 11 per cent in 2030 in the case of India and from 17 per cent to 28 per cent respectively in the case of China.[18] In line with the argument above, the differences between rural and urban work opportunities, wages and services in China and India should therefore narrow significantly over the next few decades. For other countries, in particular many other Asian as well as African ones with lower growth rates than China and India, urbanisation is still driven by continually high differences in work opportunities, wages, and services. How these discrepancies will develop and how quickly they will narrow is highly uncertain and will depend not only on a country's political situation, it's urban and rural policy but also on GDP growth, which in turn is a function of consumption, government spending, investments and net exports.

4.2 Development of domestic consumption

The degree to which urbanisation influences changes in consumption patterns remains the subject of debate among scholars. When attempting to understand the drivers of consumption change, the key challenge is separating the effect of increasing incomes — which is a significant driver for both urbanisation and changing consumption patterns — from the process of urbanisation itself. Furthermore, in certain cases, urbanisation may lead to a reduction in consumption of certain resources as well-planned cities can provide services more efficiently than rural settlements.[43]

The influence of these factors on increasing per capita meat consumption illustrates the disagreement. The UN's Food and Agriculture Organization argues that, independent of increasing incomes, urbanisation is an important factor in changing consumption habits, as urban inhabitants typically consume more food outside the home and larger amounts of pre-cooked, fast and convenience foods than people in rural areas. The overall effect is an increase in meat consumption, independent of the effect of increasing incomes.[44] This change in consumption could also result from and/or be reinforced by easier access to supermarkets and other convenient shopping options in urban areas. Other studies, however, have concluded that household expenditure on meat depends more on income than it does on whether the household lives in a city or not.[45]

Another key uncertainty regarding urbanisation and consumption patterns is projected car ownership and usage. While the number of cars tends to be closely linked to income and therefore also to urbanisation (see 2.4), urbanisation can be a driver of lower ownership and usage levels because of public transport and higher competitiveness of two- and three-wheelers in urban areas. Furthermore, rising congestion, and in some cities policies that aim to control congestion, can discourage car usage and thereby also ownership. Whether urbanisation plays out in favour of lower car ownership and usage depends, among others, on the type of densification and urbanisation as well as public transport options. As these issues are characterised by long life cycles, choices made now have a lock-in effect for decades. [46]

Although Western lifestyle patterns have so far proved to be very attractive to the emerging middle classes in developing countries, simply assuming that the spread of Western lifestyle patterns will continue in a linear way, not encountering cultural obstacles or institutional barriers would overly simplify the picture. Increasingly, the consensus around the Western lifestyle and consumption patterns has eroded and these are contested both in Western countries themselves and increasingly in developing countries, which are affected by the environmental consequences of past and present unsustainable consumption patterns of the industrialised world. The economic system, which is constructed around this lifestyle is also increasingly contested and has proved very vulnerable in the global economic and financial crises of 2008. An economic paradigm shift organising the most important world economies around stability and sustainability rather than profit maximisation and consumption could, through changes of fundamental parameters, have important implications on the kind of goods produced and the way in which they are manufactured.

4.3 Resource availability

An increase in consumption levels (together with GDP growth and development) presupposes the availability of resources to satisfy this demand. While the growth model of the past two centuries was based on cheap and abundant resources, this can no longer be taken for granted. Resource vulnerability is most significant in the least developed countries, which have some of the highest poverty and population growth rates, and which are already facing shortages in certain critical resources[47]. Resource prices have already steadily increased since 2000. Between 1998 and 2011 real prices for resources increase by over 300 per cent on average.[48]

4.4 Urbanisation policies

Although the strong relation between urbanisation and economic growth is well recognised, urban trajectories are not explained by economic growth alone, as the example of the BRICS[15] shows. While Brazil, Russia and South Africa had relatively high urbanisation rates already in the 1960s, Brazil has urbanised most rapidly since then. South Africa's urbanisation only picked up again in the 1990s with the end of apartheid and Russia urbanised steadily until the dissolution of the Soviet Union with a significant slowdown since then. China and India had comparatively low urbanisation levels until the 1980s when China's urban growth increased significantly and India's also gathered pace. [49]

Uncertainties regarding urbanisation policies are twofold: Firstly, about the nature of future urbanisation policy and secondly, to what extent future policy will be effective. Many governments, especially those of low-income countries, have attempted to control migration to urban areas, especially to big cities. In 2005, 73 per cent of low-income countries had put policies in place to lower migration to cities. In most cases, however, these attempts have not been successful.[7] In fact, efforts to curb rural-urban migration often lead to unorganised and unequal urbanisation with new arrivals largely located in informal settlements and slums. Organising urban growth only once it is recognised that rural-urban migration cannot be prevented, is not only more expensive but also less effective. [49]

Ongoing processes of economic liberalisation, whereby government regulations and restrictions on the economy are systematically reduced or eliminated, may alter the value of land and labour which could, in turn, change the migratory decisions of certain rural populations. While, at present, it is often profitable to convert agricultural land into urban land, an increased demand for cash crops could increase the value of the land and the labour of the rural inhabitant.[Error! Bookmark not defined.] Furthermore, the loss of agricultural land, either as a result land-use changes (urbanisation) or environmental degradation, would tend to increase the value of the remaining land.

How cities will be governed is going to affect and shape urbanisation. Well-planned urbanisation, where urban sprawl is avoided and the construction of dense cities and high quality urban spaces is allowed, can result in important efficiency gains, for example with regard to efficient waste collection, recycling and transport systems. The extent to which urbanisation will be managed in a

[15] The emerging national economies of Brazil, Russia, India, China, and South Africa

centralised or decentralised way, the inclusion of the larger public in the resolution of environmental problems, the successful implementation of plans for urban development, and the integration of urban design with local cultural traditions are aspects, which may allow urban growth to take place in a less environmentally harmful way than is currently projected.

4.5 Climate change impacts

The degree to which environmental migration will play out is far from certain and depends largely on the extent to which urban and rural regions in developing countries will be affected by climate change impacts, which is still subject to a high level of uncertainty given the complexity of climate science and the difficulty in predicting human behaviour.[50] While environmental change can increase migration levels, it can also limit the capacity of people to move. Furthermore, decreasing environmental quality can foster migration but also policies to counteract the negative impacts and increase attractiveness of rural regions.

4.6 Technological innovation

One of the elements, which makes basing forecasts imperfect, is the rate at which technological leapfrogging will take place, be it as a result of foreign direct investment (FDI), within the context of a global climate scheme, or because of domestic innovation. Any of these processes would create conditions for cleaner technologies to be transferred to developing countries, allowing them to leapfrog a polluting development path by making a facilitated transition to alternative sources of power generation. Domestic innovation in response to global competition, and, to a lesser extent, international policy instruments such as the Clean Development Mechanism (CDM) and FDI, have already contributed to greening Indian energy policy, for example, by enhancing renewable energy deployment through domestic development, technology transfer and by instilling a political re-orientation through norms diffusion.[51]

Uncertain future energy mix of the countries, and the related technological development, is a considerable source of uncertainty for urbanisation and is related to several of the drivers. For example, the increasing mechanisation of agriculture will result in the reduced use of human and animal labour as a primary source of energy. As a result, human food and animal fodder will be displaced by liquid fuels for farm implements as the primary fuel for these activities. The ultimate source of the liquid fuel remains uncertain. The mining of fossil fuels could have significant environmental impacts in rural areas, further driving urbanisation. Concurrently, the large-scale of production of biofuel feedstocks would upset the current balance of agricultural production, which could, in turn, alter the value of agricultural land and labour, influencing the migratory decisions of rural farmers[52].

The development of certain energy and transportation and communication technologies could result in reduced migratory pressure towards urban areas as they could increase the economic opportunities and standard of living in rural areas. For example, the further development of decentralized energy production systems, such as the solar home systems distributed in India by *Grameen Shakti*, could provide rural inhabitants with basic services such as lighting and water pumping, as well as increased opportunities for income-generating activities, further decreasing

migratory pressure towards urban areas. Similarly, the development of high-speed rail networks in China and India could reduce migratory pressure towards urban areas as rural and near-urban residents would gain easier access to the economic opportunities and activities of the urban centres.

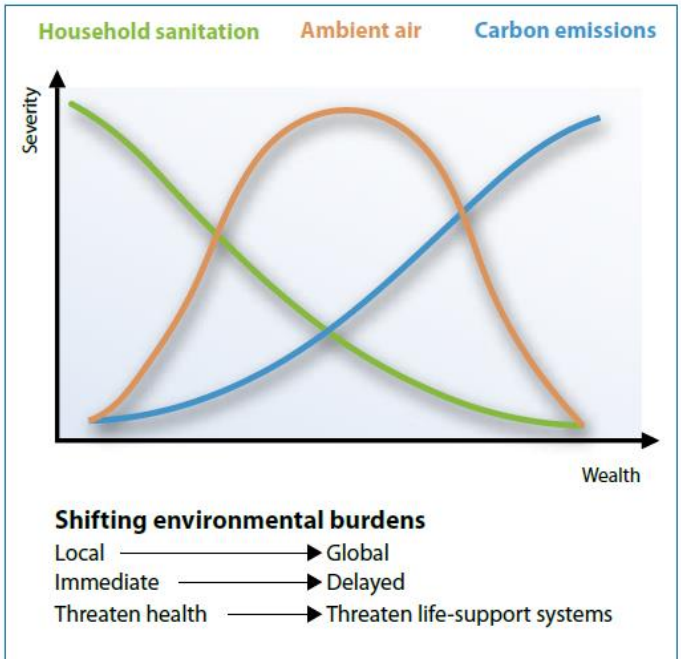
The past has, however, also shown that technological innovation that was thought to decrease urbanisation pressures has not done this to the extent expected. The internet, for example, was thought to decrease levels of rural-urban migration, as location would become less important for business as well as social contact. Experience has shown though that far beyond work opportunities alone, the cultural complexity that cities offer is of great importance to city dwellers.[53]

Chapter 5: Potential environmental impacts

Impacts of future global urbanisation on the European environment are manifold, albeit many of them indirect. The most significant direct impacts on the European environment has been identified as an increase in global air pollution as well as an increase in the competition for resources due to changing consumption patterns that are linked to urbanisation.

Expert opinion on the environmental impacts of the global urbanisation trend has undergone significant changes over the last few decades. While the environmental Kuznets curve[16] suggested that environmental problems first worsened but then improved with rising incomes, the urban environmental transition theory[17] questioned this view by pointing out that different environmental challenges arise at different stages of development and that some of these challenges do not follow the Kuznets curve. The theory is illustrated in Figure 11, showing that, as urban areas become wealthier, environmental impacts shift from local and immediate health-threatening issues, to global and delayed issues that threaten ecosystems.

Figure 11: Urban environmental transition (new)



Source: UNEP (2011) Cities: Investing in energy and resource efficiency [5]

The impact of the speed of current urbanisation trajectories is highlighted by the notion of 'time-space telescoping'[18], which states that for developing countries, urban environmental priorities progressed from brown issues (waste disposal and water quality) to grey issues (air and chemical

[16] World Bank's World Development Report 1992
[17] Gordon McGranahan et al., 2001
[18] Marcotullio, 2005

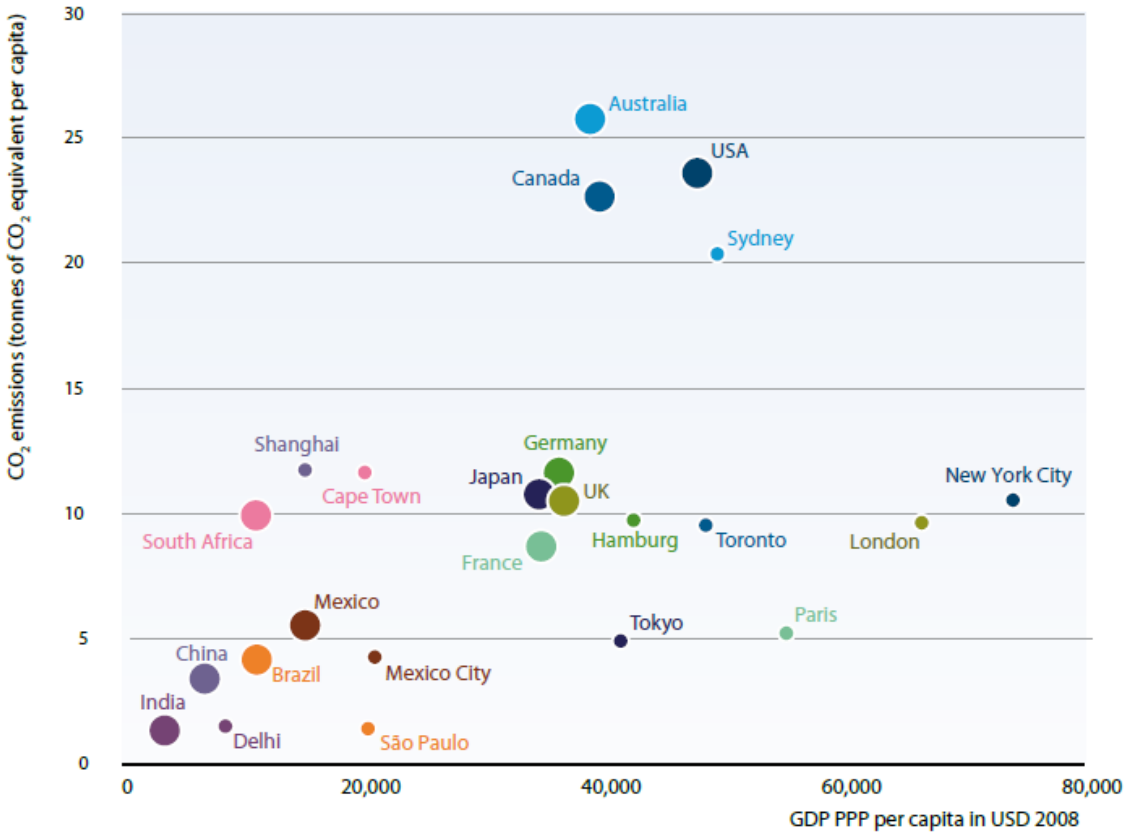
pollutants) to green issues (sustainability). Many developing countries will experience all three issues simultaneously, while they are also trying to move out of poverty.[7]

As discussed above, cities per se are neither beneficial nor harmful for the environment. Whether it is one or the other depends on how cities are organised and managed. Cities can offer significant advantages to rural areas as they provide savings in the cost per unit of water and electricity supply; more efficient resource management opportunities; and the protection of rural ecosystems through a denser urban living environment. The latter also allows for reduced travel distances, favouring walking, cycling, as well as the use of public transport and thereby reducing the energy footprint. A more indirect beneficial impact is that the innovative environment in cities can lead to new technologies that benefit the environment. Nowadays, cities are therefore frequently seen as the solution rather than the problem as long as urban growth is well managed and sustainability issues are taken into account.[7] However, urbanisation often overwhelms city authorities, which can result in negative environmental consequences. These consequences are likely to be lasting as city planning is by its nature difficult and costly to reverse once it is in place.

Just over half of the world's population that currently lives in urban areas occupies less than two per cent of the earth's surface but is, according to the UN, responsible for 80 per cent of economic output, 60 to 80 per cent of energy consumption and approximately 75 per cent of CO_2 emissions.[5] The latter figure, though widely published, is subject to discussion (see section **Error! Reference source not found.**). Research has shown that cities with larger populations tend to be more energy and emissions efficient than smaller cities, albeit only to a small extent.[54]

As discussed in section 2.4, urbanisation as well as increased consumption levels and CO_2 emissions are closely linked. Figure 12, however, shows that the relationship between a rise in incomes and CO_2 emissions is not straightforward. Cities such as Tokyo and Paris produce relatively low levels of CO_2 emissions for their income level group, while a city like Shanghai produces more than double the amount of CO_2 emissions with less than half or a third of GDP per capita of Tokyo or Paris respectively. It should be noted though, that this analysis is significantly impacted by the existing energy mix in each country: France and Japan, for example, were, until recently, largely dependent on nuclear energy, which explains their relatively low CO_2 emission rates compared to their income group.

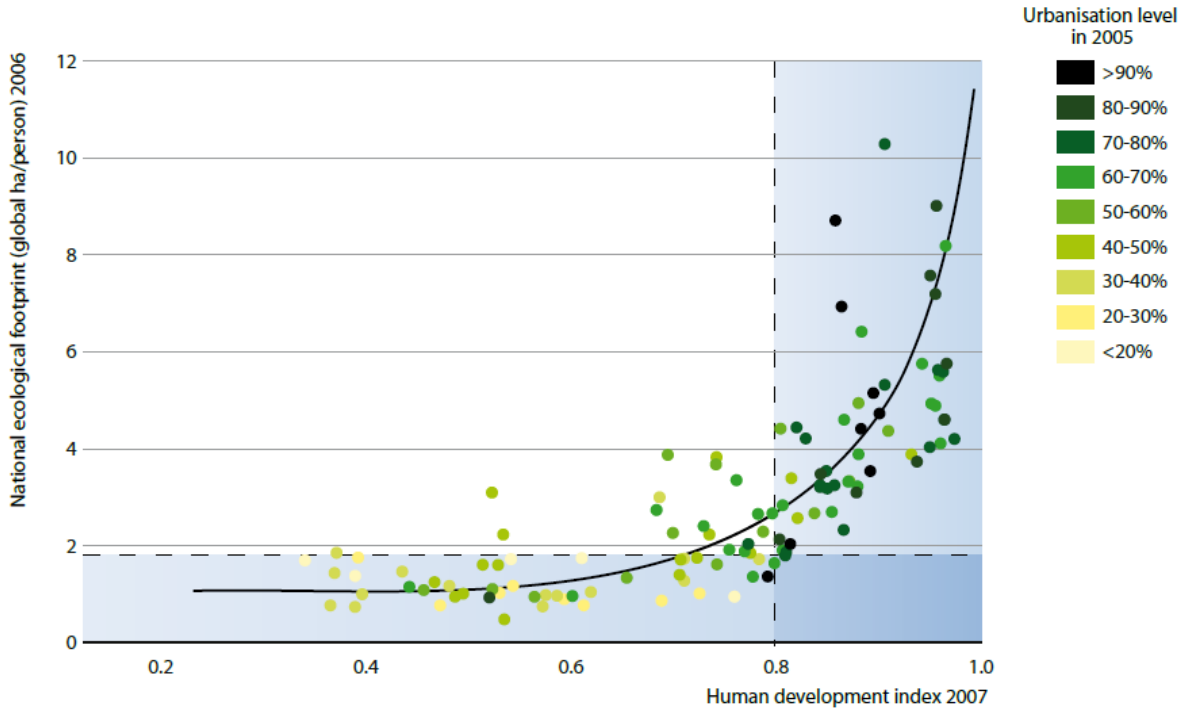
Figure 12: Carbon emissions and income for selected countries and cities (new)



Source: UNEP (2011) Cities: Investing in energy and resource efficiency [5]

Nevertheless, on average, urbanisation still goes hand in hand with increased resource consumption and therefore also with an increase in the ecological footprint. This is illustrated in Figure 13, which puts the National Ecological Footprint of a country in relation to the Human Development Index (HDI) for countries worldwide, while also providing information on their urbanisation levels. This shows that, in general, the higher the urbanisation level of a country, the higher its HDI but also its national ecological footprint. There are clearly exceptions to this rule, such as countries with high rates of urbanisation with a relatively low ecological footprint (Brazil, for example) and vice versa.[5]

Figure 13: Ecological footprint, HDI and urbanisation level by country (updated/new)



Source: UNEP (2011) Cities: Investing in energy and resource efficiency[5]

When looking at the wider environmental impact of cities[19] this also needs to be considered in comparison to the respective country as a whole. Here it becomes clear that cities in Europe, the USA and Brazil have a lower environmental impact compared to their national averages while this tends to be higher for cities in China and India.[5]

Densification in cities is the source of potential environmental and resource efficiency benefits of urbanisation. However, poor living quality in cities caused by poor air quality and high noise levels, for example, can lead to urban sprawl, which does not offer the same environmental potential as dense inner city environments do.

[19] Taking into account carbon emissions, energy, electricity and water consumption, dwelling and transport patterns and motorisation

5.1 Impacts on the European environment

In this section, the potential direct and indirect impacts on the European environment resulting from increased urbanisation are explored.

5.1.1 Indirect impacts on Europe

While these impacts may be felt most acutely in the developing countries where the current second wave of urbanisation is prevalent, as a result of the interconnectedness of ecosystems, economies, and political systems, they are likely to have indirect impacts on Europe as well.

5.1.1.1 Waste generation

In many developing countries, sewage systems are far better at meeting the needs of upper- and middle-class neighbourhoods than they are of servicing poorer neighbourhoods, particularly unregulated neighbourhoods and slums on the urban periphery. These are, however, the neighbourhoods, which grow most rapidly. Hence, improving public sanitation is a major urban environmental challenge that needs to be addressed in many large and middle-sized cities in developing countries. Currently, all too often, failure to collect garbage as well as inadequate waste management and recycling policies and practices result in many cities being inundated in their own waste.[55]

While the consequences of ill-managed waste generation and treatment are felt most severely in the developing countries themselves, there is a risk to the European environment in that the increase in the quantity of landfilled waste in developing countries is an additional source of greenhouse gas emissions. This could offset European efforts to reduce the generation of such gases to mitigate global warming.

5.1.1.2 Water pollution and coastal degradation

Demographic processes such as population growth, age distribution, urbanisation and migration create some of the greatest pressures on water resources quantity and quality. These processes directly affect water availability and quality through increased water demands and consumption and through pollution resulting from water use.[56] Water quality both, in rivers and coastal areas is likely to decline further as fast growing cities in developing countries discharge ever increasing amounts of untreated water and waste into water bodies.[55] A direct, local environmental impact of coastal urban areas and increased aquaculture is offshore water pollution. In these areas, large-scale development results in excessive nutrient inputs from municipal and industrial waste. Eutrophication contributes to the creation of dead zones, areas of water with low or no dissolved oxygen. Fish cannot survive, and aquatic ecosystems are destroyed.[57] An indirect impact of urbanisation is the result of intensive aquaculture to meet both the local demand in seafood of the growing urban population and supply the global markets, which is degrading coastal regions and harming fragile mangrove ecosystems. This increased pressure on the fisheries of developed countries may result in additional pressure on already-stressed European fisheries as global

demand for seafood continues to increase. Water pollution and use is likely to become a severe challenge, in particular in proximity of megacities.

5.1.1.3 Local air pollution

Increased urbanisation results in the convergence of a number of air pollutant emission drivers, such as industry, transportation, and energy production and consumption.[58] As discussed above, the so-called 'grey issue' of air pollution is inversely correlated with the level of development, at least until a certain level is reached (see Figure 11). An example for this is the concentration level of particulate matter in Africa, which on average is 6.5 times higher than in Europe and North America. [3]

Despite rising emissions efficiency and standards, the rising vehicle ownership numbers, particularly in developing countries, combined with severe congestion in many of their cities will continue to adversely affect urban air quality. More than 80 per cent of air pollution in developing countries can be attributed to the transport sector.[4] While air pollution was traditionally regarded as a local issue and climate as a global one, they are in fact closely linked. When source regions where air mass originates are strongly polluted, they can have an impact from regional to hemisphere level and therefore also affect the climate. However, the impact of cities on air pollution and climate depends not only on their emissions but also on their geographical situation and meteorology. [58]

5.1.2 Direct impacts on Europe

5.1.2.1 Global air pollution

For GHG emissions stemming from urban areas, it is important to differentiate between 'production based' emissions, that are actually produced in urban areas and 'consumption based' emissions taking into account GHGs emitted to support urban consumption.[1] The latter include emissions generated outside urban centres linked to urban-based demands, such as GHG emissions generated by fossil-fuel power stations, oil wells, and farms that are outside urban boundaries but where the electricity, oil, and farm products are destined for urban producers or consumers. One major factor also contributing to this is a trend towards greater mobility associated with rising levels of urbanisation, e.g. increasing levels of flying, driving and train travel among a growing part of the population. In addition, continuing trends towards increased meat consumption will further increase the emission of greenhouse gases, in particular through the methane emissions of cattle and the deforestation cattle rearing might require. As most GHG emission data for cities is production based, cities with strong service sectors tend to show significantly lower GHG emissions than their more production-oriented counterparts. The most widely published figures of the amount of GHG emissions that cities are responsible for range from 75 to 80 per cent.[59] These figures have been criticised as too high with less than 50 per cent being regarded as more accurate[60] but also as too low as the emissions share would be higher than 80 per cent if figures were consumption based.[61]

In any case, these figures are neither equally applicable to all cities nor do all city inhabitants contribute equally to this amount. As discussed above, it is not cities themselves that cause environmental harm in general and increased greenhouse gas emissions in particular, but changing consumption patterns and the resulting waste generation linked to city living. GHG emissions are lowest for poor cities and the urban poor. Average per capita GHG emissions can range from more than 15 tonnes CO_2eq for a city like Stuttgart (Germany) to 0.5 tonnes for several cities in Nepal, Bangladesh and India. [61] In India, average greenhouse gas emissions of someone earning more than US$ 700 are more than four times higher than those of an Indian earning less than US$ 23 per month.[62]

As shown in Figure 14, the literature suggests a direct link between urban density and greenhouse gas emissions, with the more densely populated cities having lower greenhouse gas emissions per capita (as well as using less energy for private passenger transport). Exceptions to this are the Chinese cities included because of their particularly high levels of manufacturing emissions. More generally, urban per capita emissions tend to be lower than average per capita emissions in the respective country. In the UK, for example, London's greenhouse gas emissions are substantially lower than the relatively rural northeast.[62]

Figure 14: Private passenger energy use, urban density and GHG emissions[20] (new)

Private passenger transport energy per person (lowest to highest)	Urban density (highest to lowest)	GHG emissions per capita (lowest to highest)
Shanghai	Seoul	São Paulo
Beijing	Barcelona	Barcelona
Barcelona	Shanghai	Seoul
Seoul	Beijing	Tokyo
São Paulo	Tokyo	London
Tokyo	São Paulo	Beijing
London	London	New York City
Toronto	Toronto	Shanghai
New York City	New York City	Toronto
Washington DC	Washington DC	Washington DC

Source: Dodman, D (2009) Blaming cities for climate change? An analysis of urban greenhouse gas emissions inventories

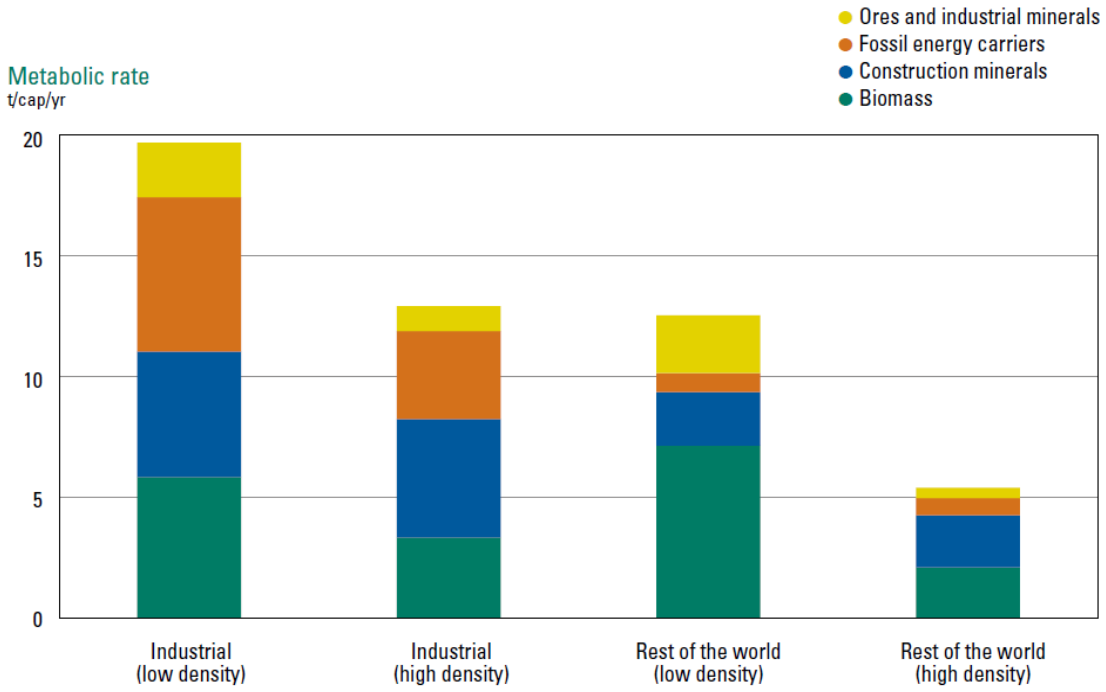
5.2 Urbanisation and resource efficiency

Globally, between 60 and 80 per cent of resource consumption can be attributed to cities. Urban resource consumption is therefore an issue of utmost importance for resource efficiency policies. If well managed, resource efficient cities can combine productivity increases and innovation with reduced environmental impacts.[4] Resource efficiency potential includes savings in the cost per unit of water and electricity supply; more efficient heating and less need for transport fuel, to name just a few. On average, urban dwellers consume less energy and land for living per capita than rural residents and have fewer requirements for transport.

[20] Please note that GHG emissions per capita are 'production based' and do not take into account the emissions caused by products consumed in the city but produced elsewhere.

Two key factors that influence direct resource use are the level of development (given by GDP per capita) and population density[63]. Each factor seems to double the per capita consumption of resources. When comparing the rates of resource use per capita of regions and areas with the same level of development, it appears that densely populated areas, such as urban areas, need fewer resources per capita, for the same standard of living (see Figure 15).[64] In particular, the amount of biomass, metals and industrial mineral resources needed seem to differ the most between high and low density areas.

Figure 15: Average rates of resource use (in tonnes/capita) by development status and population density (new)



High-density means a population density of 50 people/km² or higher. Share in world population: 13% industrial, high density, 6% industrial, low density, 62% rest of the world, high density, 6% rest of the world, low density.
Source: Krausmann *et al.*, 2008

UNEP (2011) Decoupling natural resource use and environmental impacts from economic growth[64]

The apparent difference in biomass may be due to the indicator used to measure resource use: Domestic Material Consumption (DMC). DMC measures all resources by mass (tonnes) when extracted domestically or imported. DMC does not distinguish between different food items. In rural areas with agriculture all biomass resources used (e.g. crop residues, grazed grass) contribute significantly in weight to DMC. In urban areas most of the food is produced elsewhere. Here DMC only measures the weight of the food in its processed form, e.g. meat, milk, wine. This would explain why low density areas seem to use more biomass resources than high density areas. In fact, low density areas bear the burden of producing biomass resources for high density areas.

Manufacturing industries are often located in low density areas, which explains why the higher consumption of metal ores and industrial minerals per capita in sparsely populated areas. Again, these resources are often produced in low density areas, but consumed elsewhere.

As one could expect, construction materials are used more efficiently in densely populated areas as people live closer together, but at the same time more infrastructure is required. Although not

very apparent for developing countries, in developed countries the need for fossil fuels is significantly lower in high density areas. This is thought to be due to less need for transport fuel and more efficient heating. More efficient power and heat generation including nuclear power could also explain this difference.

Cities and towns require infrastructure and even existing urban areas will need to upgrade and develop their infrastructure to prepare for the future[65]. This could result in a surge of demand for construction materials (minerals and metals) in the short to medium term, which once built and in place could result in more resource efficient cities and towns.

5.2.1 Impacts on European resource efficiency

Urbanisation and changes in consumption patterns are key drivers of global resource demand and environmental change. Given limited resource availability, urbanisation and changes in consumption patterns will in turn also be shaped by how these limited resources are managed. Europe is a resource scarce continent, especially for metals, and it is highly dependent on resource imports. More than half of the materials used in Europe are imported and net imports of resources per person are the highest in the world.[48] Some of its neighbour regions, such as the Middle East and North Africa, are very vulnerable to sources of instability, global environmental change and economic and/or political disruptions. The way urbanisation and in particular changes in global consumption patterns develop has thus multiple knock-on effects, in terms of increasing or decreasing global resource exploitation and competition.

5.2.1.1 Rising demand for biofuels and pressure on forest and water resources

The global biofuels market is a new and significant source of demand for some agricultural commodities such as sugar, maize, cassava, oilseeds and palm oil. These commodities, which in the past were predominantly used as food, are now being grown as feedstock for producing biofuels. Significant increases in the price of crude oil allow them to become viable substitutes in certain countries that have the capacity to use them. This possibility is increasingly leading to the implementation of public policies to support the biofuels sector, which further encourages the demand for such feedstock.[66]

This rise in demand for biofuels is also likely to lead to more pressure on forested areas in Europe and throughout the world, which could face the threat to be replaced by agricultural land to grow biofuels. In addition, the cultivation of biofuels can trigger water crises.[67]

Water supply is becoming increasingly scarce and it is projected that in 20 years global water supply will only cater for 60 per cent of world demand.[4] Increased urbanisation and changing consumption patterns have a strong impact on water resource quantity and quality.

5.2.1.2 Rising demand for energy

On average, developed countries consume several times more energy per capita than developing countries, although this varies significantly among countries within each group. [3] However, with

increased urbanisation, rising incomes and changing consumption patterns, energy consumption is likely to increase significantly in developing countries too.

In addition to rising energy demands due to changing consumption patterns, urbanisation is also linked to an increase in energy demand for cooling. Cities are subject to the 'urban heat island effect', which means that temperatures in cities can be up to ten degrees Celsius higher than more rural environments. This leads to an increase in energy demand for cooling in summer.[4]

With fossil fuels already being scarce, this development will increase the competition for these resources and it will therefore have a direct impact on Europe. On the other hand, as discussed above, with efficient urban planning cities can provide substantial energy economies.

5.2.1.1 Rising demand for land / land-use changes

As discussed above, the term urbanisation is frequently used not only for the growing proportion of people living in urban areas, but also for the physical growth of cities per se and people moving out of high-density areas into less densely populating sprawling suburbs.

Densities of built-up areas vary widely with those of developing countries being approximately double of those in Japan and Europe and four times those of the United States, Canada, and Australia. Between 1990 and 2000, the average density of built-up areas declined by approximately two per cent per annum.[1] In 2000, average density was estimated at 28±5 persons per hectare in cities in land-rich developed countries, 70±8 in cities in other developed countries, and 135±11 in cities in developing countries.[68] Currently it is estimated that this decline in urban density accounts for circa half of the expansion of urban land, while only a quarter of this expansion is due to demographic urbanisation.[1] Urban sprawl hinders cities from fulfilling their environmental and resource efficiency potential. Studies have shown that the sustainable density threshold lies at 50 to 150 people per hectare.[72] Below this threshold, urban energy use increases significantly.

In addition to a decrease in urban density, land-use changes also stem from changing consumption patterns linked to urbanisation. Changing diets, for example can increase the demand for crops and meat, thus leading to an increased pressure to convert forests into agricultural land. At present, most of the world's feed-crop production occurs in OECD countries, but some developing countries are rapidly expanding their production of feed crops, some of which is exported to the OECD countries to serve as animal feed. Intensive feed-crop production can lead to severe land degradation, water pollution and biodiversity losses.[69] This increased competition for land and agricultural resources in developing countries risks impacts in Europe and around the world. The stability of global production systems may be threatened, potentially increasing demand in European agricultural resources, thus making a decrease in the intensity of European agriculture difficult.

5.2.1.2 Increasing pressure on renewable resources

Changing consumption patterns that are linked to increased urbanisation put additional pressure on global renewable resources. To take one example, Chinese rubber imports made up 23 per cent of world supply in 2003, overtaking the US as the biggest consumer of natural rubber in the world. This has resulted in acquisition of land for rubber production in countries neighbouring China, for

example Laos and Myanmar.[70] Since 2004 in Ethiopia, Ghana, Madagascar, Mali and Sudan, 2.5 million hectares of land have been acquired by foreign governments and corporations for the purpose of agricultural exploitation. China and India have been major players in this process and the Food and Agriculture Organization (FAO) argues that population growth, increasing urbanisation rates (which expand the share of the world's population that depends on food purchases) and changing diets (particularly the growth in meat consumption by middle classes in large industrialising countries) appear among the factors pushing up global demand for food and resources, driving these countries to seek available resources elsewhere.[70] These trends together will increase pressure also on renewable resources in Europe, risking further environmental degradation.

5.2.1.3 Rising demand for mineral resources

Adverse environmental impacts of mineral resource extraction are likely to increase across the globe. As a number of these resources, in particular rare metals, become scarcer, irreversible changes to the earth's surface and its landscape can be expected as increasing amounts of land need to be displaced to retrieve metals and minerals from the ground. Beyond the increased profitability of the exploitation of lower-grade ores resulting from the declining availability of certain raw materials, technological progress will facilitate access and exploitation of these resources. As a result, larger areas will have to be cleared of natural vegetation and higher amounts of mining waste will be generated in the course of progressing mineral resource use, thus increasing the risk of interference with natural systems.[71]

This increasing demand for mineral resources could have similar effects on the European environment, as pressure on remaining resources in Europe will increase as well.

5.3 Risks and opportunities from an environmental policy perspective

It becomes clear from the above, that cities do not only drive economic growth but through their impact on consumption habits also resource consumption, waste production and GHG emissions. Cities therefore have to be key to sustainability strategies and environmental policymaking. Furthermore, increased urbanisation in developing countries does have impacts on the European environment and resource efficiency, albeit several of them only indirect. However, as the second wave of urbanisation takes place predominantly in Africa and Asia, followed by Latin America and the Caribbean, the influence European environmental policy makers have on future urban sustainability policy is limited.

Direct influence can be exerted through the transformation and modernisation of existing inefficient urban infrastructures. This includes further investments into energy efficiency, the modernisation of urban transport systems, the management of urban sprawl, etc.

Indirect influence can be exerted through the support of developing countries in sustainable urbanisation trajectories through knowledge and technology transfer, in particular in the following sectors[4, 72]:

- Urban density and form

Urban structures determine activity patterns and thereby energy use. Urban sprawl hinders cities from fulfilling their environmental and resource efficiency potential.

- Urban transport policy

The implementation of energy-efficient and eco-friendly public transport can lead to significant energy savings and improved air quality

- Energy efficiency in buildings

Lower energy use of buildings can significantly alleviate the pressure on the energy sector and global energy sources. Policies should tackle the design, technology as well as behaviour-related strategies.

- Waste management

The improved management of solid waste can lead to less waste on landfill sites and thereby to a decrease in GHGs, water and soil pollution and energy use. Furthermore, an increase in recycling rates can lead to lower amounts of imports and resource use.

- Sustainable urban transport

Sustainable urban transport systems can significantly contribute to lower energy consumption, reduced congestion and better air quality.

- Water and wastewater management

Water availability and quality is not only essential for peoples' health but also agriculture and industry. Water quality is also key to ecosystem services.

- Ecosystem services

The provision of ecosystem services by green open spaces, such as parks and gardens, is key to tackling air pollution and wastewater management. These spaces also provide habitat for wildlife.

- Urban ecosystem management

The integrated management of urban activities on the environment addresses the critical linkages between ecosystem components.

Chapter 6: Interlinkages

Interlinkages between the driving forces of urbanisation as well as between an increasingly urban world and other megatrends are manifold and complex. This section will highlight the most significant interlinkages.

6.1 Interlinkages between driving forces

Strong interlinkages exist between many of the previously discussed driving forces, which influence the relative impact of each. These interlinkages are evidence of the complexity of the causal relationships between the various drivers and contribute to the uncertainty of future predictions of urbanisation rates and levels.

Many of the driving forces stand in a mutually reinforcing relationship, to each other as well as to urbanisation itself. Urbanisation drives economic growth but economic growth also drives urbanisation. Returns to agglomeration are both the cause and consequence of economic density, which in turn leads to increased work opportunities and higher wages. Better services have been shown to be the result of GDP growth but the latter also depends on better services, to maintain a healthy and qualified workforce, for example.

Increasing incomes combined with changing lifestyles and patterns of consumption can influence many of the previously discussed drivers. For example, the increased energy use of urban inhabitants will increase the demand for greater domestic energy production, which could have environmental, economic and social consequences as a result of the damming of rivers, the extraction of fossil fuels, and the displacement of food crops by biofuel feedstock. As these impacts would essentially be felt in rural areas, further increasing rural-urban migration, the process of urbanisation itself may lead to ever greater urbanisation.

6.2 Interlinkages with other megatrends

Urbanisation, defined as the share of the population living in urban areas, is less strongly linked to **population growth** than noted in the 2010 analysis. High fertility rates in urban areas will drive an increase in the absolute number of people living in urban areas and therefore the urban growth rate but not urbanisation levels as such.

As discussed in section 2.4, urbanisation and **economic growth** are closely linked as economic growth drives urbanisation and cities are on the forefront of economic wealth creation. Most economic growth, paid employment, innovation and technology development tends to be located in urban areas. Linked to this is the impact urbanisation can have on **accelerating technological change**. If the innovation and economic growth in cities is well managed and education is promoted, this can have significantly positive impacts on R&D, which in turn can fuel further growth. More indirectly, urbanisation also contributes to the trend from a unipolar to a multipolar world.

Urbanisation and **climate change** can have reciprocal impacts: As discussed in Chapter 5:, increased urbanisation can have direct as well as indirect impacts on the environment and climate. But cities can also be victims of climate change: A large percentage of urban areas is located in coastal areas, which are particularly vulnerable to the effects of severe weather events and rising sea levels linked to climate change. Coastal cities in developing countries are particularly exposed to these risks and less prepared for their consequences. Urbanisation will therefore also contribute to **increasingly severe consequences of climate change**.

On average, urban residents have better access to education and health care as well as other basic services such as clean water, sanitation and transportation than rural populations. If well managed, urbanisation can offer important opportunities for economic and social development. However, the speed and scale of urbanisation in developing regions challenge the capacity of Governments to adequately plan and meet the needs of the growing number of urban dwellers. As discussed in section 2.3, just under one billion urban dwellers live in slums. Frequently, these settlements lack basic living standards, such as clean water, and waste and wastewater disposal facilities, which makes them a significant source of **diseases and new endemics**. On the other hand, urban areas provide better quality of and access to healthcare services.

The link between urbanisation and changing consumption patterns means that increased urbanisation has a direct impact on an increase in resource consumption. The **competition for scarce resources**, which is intensifying globally, is therefore likely to increase with the current urbanisation trajectories in the developing world. Hand in hand with this, urbanisation will also contribute to a further **decrease in natural resource stocks**.

Chapter 7: Glossary

Urbanisation: This paper is based on the demographic definition of urbanisation whereby urbanisation is the growth in the proportion of people living in urban areas

Urbanisation level: Percentage of people living in urban areas

Urbanisation rate: The rate at which the proportion of people living in urban areas increases

Urban growth rate: Rate of urbanisation *plus* population growth rate

Urban versus rural: As explained in the Methodology section of the UN DESA World Urbanization Prospects: The 2011 Revision (page 5), there are no universal criteria to define the term 'urban'. Calling an aerial unit of at least 5,000 people urban, for example, might make sense in little populated countries, but does not make sense in populous countries such as China or India. The projections are therefore based on definitions established by the countries themselves. Population size and density are among the most frequently used criteria. It should be noted, however, that the lower population size limit ranges from between 200 to 50,000 inhabitants. For more information, please see http://esa.un.org/unup/pdf/WUP2011_Methodology.pdf.

Urban area versus city: Similarly to the discussion on urban versus rural above, there is no consensus on when an urban area becomes a city. For convenience, these terms are used interchangeably in this report.

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