# Technical Note
# The Contribution of African Cities to the Economy and Climate
## Population, Economic Growth, and Carbon Emission Dynamics

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## *Summary findings*


- The population of Africa's cities is expanding rapidly. By 2050, Africa is likely to have an additional 1 billion new urban dwellers, and is projected to account for over a fifth of the world's urban population. About half of the world's top 20 countries with the highest projected growth in urban population are in Africa. The population of many African cities is expected to more than double by 2030, for example Lagos (Nigeria) will reach over 25 million people.
- Africa's cities are also the powerhouses of their national economies. While the largest 69 cities across 35 countries, assessed as part of this paper, together contribute 16% of the total population across the countries, they account for over 36% of combined GDP. GDP in these cities is also projected to grow by more than US$750 billion by 2030, an annual growth rate of 5.6% between 2012 and 2030.
- Africa's cities are rapidly transforming economically. Africa currently has very few high-income cities, but 10 of the 69 cities analysed as part of this paper are likely to graduate to high-income status by 2030. While there is a significant income disparity between cities across the continent, only four of those cities analysed here are likely to retain their low-income status by 2030 due to rapid projected economic growth (down from 15 today).
- While African cities have the lowest carbon emissions per capita of any region in the world at 1.8 tonnes per capita on average, "business as usual" economic growth is fuelling significant growth in aggregate emissions. Based on "business as usual" trends, emissions in the 69 African cities assessed as part of this paper will grow by over 60% by 2030 (to reach close to 400 million tonnes of $CO_2$ per annum).
- African cities can broadly be categorised into five groups: i) medium and large middle-income cities, ii) middle-income megacities, iii) small middle-income cities, iv) least developed cities, and v) others (high-income cities) – based on population and per capita income. Urban types can be a useful way to identify and compare groups of cities with common characteristics spanning multiple geographies. This

can help to identify the universe of policy solutions likely to be applicable to different groups of cities.

- Of those cities analysed, medium and large middle-income cities will contribute to more than half of the projected growth in GDP, emissions and population up to 2030. Middle-income megacities are also projected to contribute significantly to GDP (~50.1%) and emissions growth (~51.4%), with population growth of around 50% (~49.5%), while small middle-income cities and least developed cities combined are expected to contribute far less to GDP and emissions growth but a significant proportion of population growth (around 30%) up to 2030.
- Given the pace of the demographic and economic change in many African cities, the choices that African countries and these groups of cities make today about managing urban growth will lock in these cities' contribution to the continent's economic and carbon pathway for at least the remainder of the century.
- The choices that countries and cities make about transport modes will be particularly important. Analysis for this paper suggests that transformative investments in mass transit could reduce emissions from cities by between 50.2% (in South Africa) to 99.4% (in Benin). These measures could both support growth and set the stage for a low-carbon future.

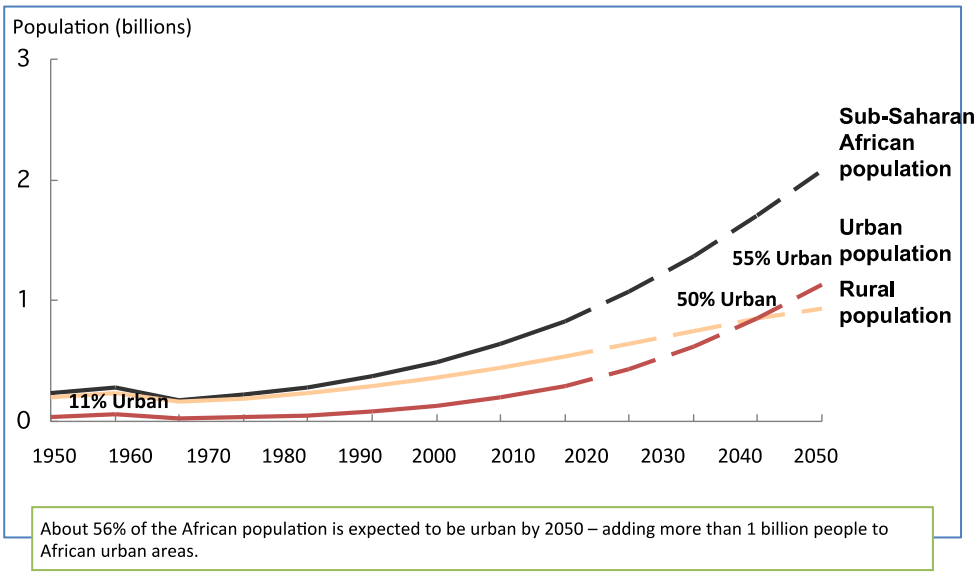
## Disclaimer

This paper was prepared as an input to the 2015 Africa Progress Report *'Power, People, Planet: Seizing Africa's energy and climate opportunities'* in partnership with the Africa Progress Panel led by Mr Kofi Annan which can be found at: www.africaprogresspanel.org. It builds on analysis undertaken by Oxford Economics and LSE Cities as part of Phase I of the New Climate Economy (NCE) project. Nick Godfrey is Head of Policy and Urban Development at NCE and Xiao Zhao is a Research Associate at NCE. The authors wish to express thanks to Philipp Rode, Graham Floater and Andrew Goodwin who reviewed and provided comments on previous drafts. The findings and conclusions in the paper are those of the author and do not necessarily reflect the positions or policies of the Africa Progress Panel and New Climate Economy.

# 1. Introduction

This paper provides population, GDP and carbon emissions estimates up to 2030 for 69 cities across 35 countries[1] in sub-Saharan Africa for which data is available (primarily with populations above 0.5 million based on new top-down analysis commissioned for the Global Commission on the Economy and Climate). Estimates of carbon emissions at the city level are typically unavailable – particularly for sub-Saharan African cities – and to our knowledge this is the first time that these calculations have been attempted. The analysis has been undertaken using the Oxford Economics' Global Cities 2030 database (covering 750 cities) and other published data.

Figure 1
Sub-Saharan African urban and rural population, 1950–2050




Source: *World Urbanization Prospects, 2014*.[2]

Sub-Saharan Africa is experiencing rapid urbanisation. The percentage of people living in urban areas has increased from 18.2% in 1970 to 37% in 2014, and the continent is expected to pass the point at which over half the population live in urban areas around 2040, as Figure 1 shows. Around 346 million people already live in urban areas in sub-Saharan Africa.[3] Between 2014 and 2050, the urban population in sub-Saharan Africa is projected to increase by almost 800 million, reaching 55% of sub-Saharan Africa's total population.[4] These 800 million new urban dwellers are expected to account for almost half of the projected global increase in urban population.[5] Nigeria, Democratic Republic of the Congo, Tanzania and Ethiopia are among the world's top 10 countries with the highest expected growth in urban

population.[6] By the end of 2050, Africa is expected to accommodate 21% of the global urban population.[7]

However, in some sub-Saharan African countries, the proportion of people living in urban areas is substantially lower, for example in Ethiopia (19%), Malawi (16%) and Burundi (12%), although this is rapidly changing. For example, in Ethiopia the level of urbanisation is projected to increase steadily to exceed 30% by 2030.[8] Countries in Western Africa tend to have higher urbanisation levels than other sub-regions south of the Sahara, ranging from 29% in Burkina Faso to 65% in Cape Verde.

Rapid urbanisation will have huge economic, social and environmental implications. In this paper, we summarise the urbanisation dynamics of sub-Saharan Africa's largest cities using new data on population, GDP and carbon emissions up to 2030, to provide an understanding of the scale and pace of change in sub-Saharan Africa's cities and their contribution to the economy and climate. The paper then outlines a range of "what if" scenarios to assess the potential for reducing carbon emissions through transformative shifts away from "business as usual" investments in the transport sector. We then identify five major groups of cities (or urban types) based on population and levels of income, and examine the dynamics of these different groups in terms of population size, GDP per capita and carbon emissions. Urban types can be a useful way to identify and compare groups of cities with common characteristics spanning multiple geographies. This can help to identify the universe of policy solutions likely to be applicable to different groups of cities.

Estimates of city-level carbon emissions are based on top-down analysis derived from estimates of national emissions. Hence, they are not typically reliable for comparing emissions between cities. Here, we are careful not to provide emissions estimates for individual cities but instead aggregate the results on a country-wide basis. Care should therefore be taken in interpreting the estimates: more accurate estimates of current and projected carbon emissions at the city level should be determined using detailed case studies, but the data is useful for approximate cross-country comparisons.

The database used in this paper covers 69 cities across 35 countries, primarily with populations above (or close to) 0.5 million. While Africa has a significant proportion of smaller urban areas, unfortunately data is not available at sufficient granularity to provide reliable estimates. That said, the database covers over 138 million people, currently nearly one-fifth of the population of the 35 countries included. By 2030, the population of these cities will grow by 74.9% to 241 million (equivalent to an average annual growth rate of 3.2%).

In this technical note, we use the term "cities" to mean metropolitan areas above 0.5 million people. This follows the distinction made by the United Nations between cities (above 0.5 million) and urban areas below 500,000.[9] It uses a definition of a city

based on an urban agglomeration and metropolitan area, which includes the built-up area outside the historical or administrative core (i.e. city proper).[10]

## *2. Population growth*

Sub-Saharan Africa's urban transition is happening at pace, underpinned by a rapid rural to urban shift. The level of urbanisation in sub-Saharan Africa was approximately 37% in 2014, and the continent is expected to pass the point at which over half the population live in urban areas by around 2040.[11] The average projected annual growth rate of sub-Saharan Africa's urban population is the highest in the world and is expected to be more than twice that of the world's urban population. Comparisons of average projected annual population growth rate up to 2030 are shown in Table 1 for the 69 cities covered in the Oxford Economics' Global Cities 2030 database, as well as for urban areas more broadly.

Table 1
Population growth rates up to 2030 for Africa's urban areas

| Average annual population growth rate | 69 cities | 35 countries | African urban areas | Africa | World urban areas | World |
|---|---|---|---|---|---|---|
| | 3.2% | 2.3% | 3.3% | 2.3% | 1.3% | 0.9% |

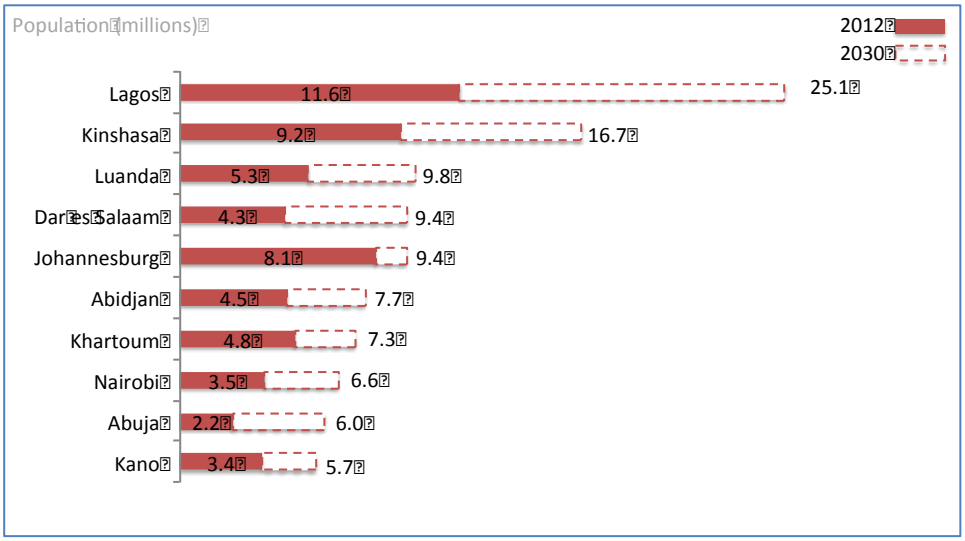
Note: The average annual population growth rates of 69 cities, 35 countries, world urban areas and world are based on Oxford Economics' Global Cities 2030 data. The average annual population growth rates of African urban areas and Africa are based on *World Urbanization Prospects, 2014*.[12]

About half of the world's top 20 countries with the highest projected growth in urban population are in sub-Saharan Africa.[13] Nigeria is projected to have the third highest contribution to the global increase in urban population.

Figure 2 outlines the projected population of the 10 most populous cities in sub-Saharan Africa in 2030. It is projected that the population of the most populous city, Lagos (Nigeria), will more than double to over 25 million by 2030. Kinshasa (Democratic Republic of the Congo) is the second most populous cities in sub-Saharan Africa, and is projected to have a population far in excess of 10 million people by 2030. In total, across the 35 countries analysed as part of this paper, 14 cities are projected to have more than 5 million people by 2030, including cities such as Dar es Salaam, Khartoum, Nairobi and Dakar.

Figure 2

Lagos is projected to double its population to 25.1 million in 2030



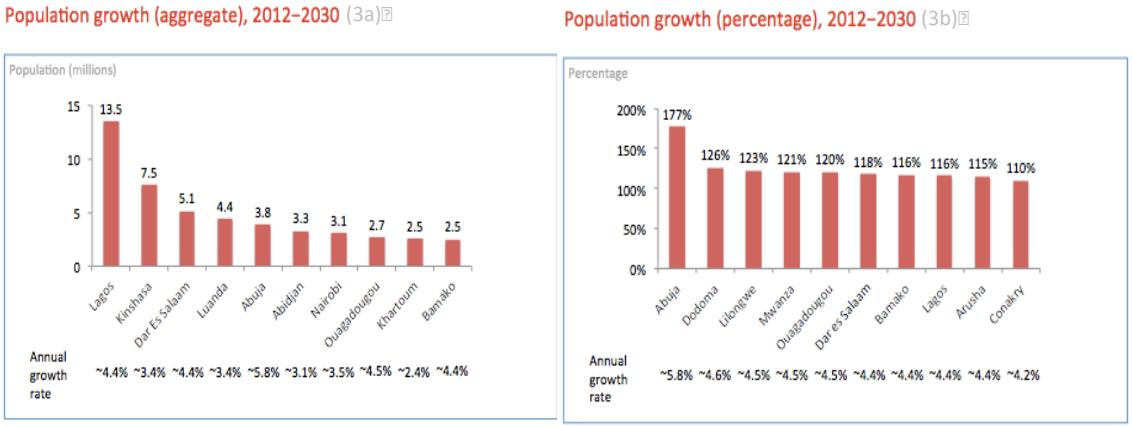

Sources: NCE analysis based on Oxford Economics/LSE Cities data (see Floater et al., 2014).[14]

Figure 3 shows the cities with the largest projected urban population growth in terms of aggregate number and percentage respectively. As shown in Figure 3a, Lagos will see the largest absolute urban population increase: around 13.5 million additional people will live in Lagos by 2030. There are seven cities in Africa notable for their size and projected population growth: Lagos, Kinshasa, Dar es Salaam, Luanda, Abidjan, Khartoum and Nairobi are all large and rapidly growing cities. See Figures 2 and 3a.

The chart in Figure 3b shows that Abuja, at 177%, is projected to have the highest urban population growth rate in terms of percentage change, equivalent to an average annual growth rate of around 6% from 2012 to 2030. In total, 13 cities will at least double their population, i.e. have an average annual growth rate above 4%. Lagos and Dar es Salaam are particularly notable for their size as well as rapidly growing populations.

Figure 3

Cities with largest population growth, 2012–2030




Source: NCE analysis based on Oxford Economics/LSE Cities data (see Floater et al., 2014).[15]

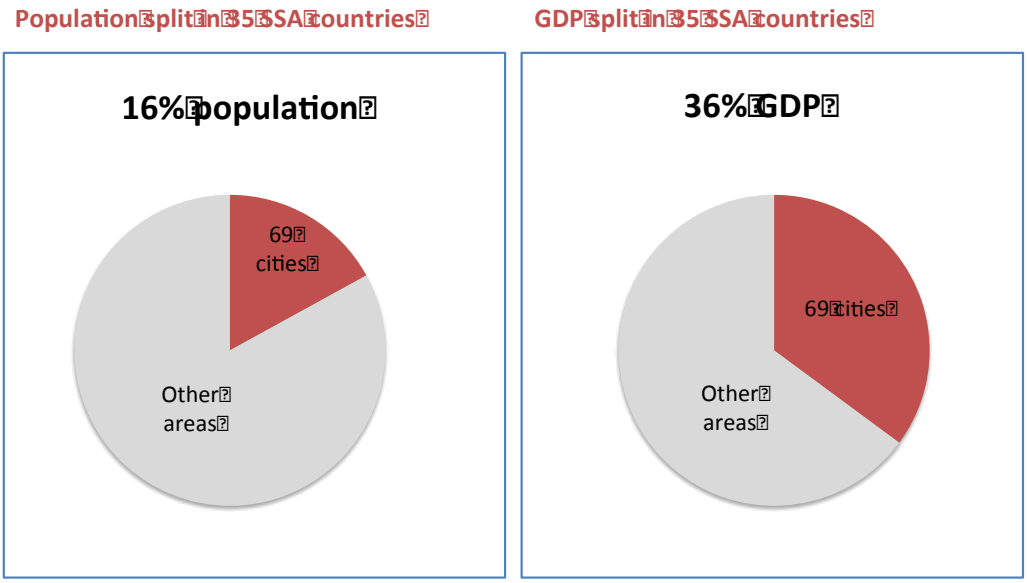
South Africa's cities are generally expected to see the slowest population growth rates across the continent. For example, Port Elizabeth will see both the smallest increase in population (around 33,000) and the lowest urban population increase rate (less than 3%), equivalent to an average annual growth rate of less than 0.2% from 2012 to 2030.

## *3. GDP growth*

Figure 4 shows that, although the total population of the 69 sub-Saharan African cities analysed here is 16% of the total population of the 35 countries, the combined GDP of the 69 cities accounts for 36% of the total GDP for the 35 countries in 2012. The GDP of the 69 cities is about US$455 billion in 2012; this is projected to increase – based on "business as usual" economic growth – by more than US$750 billion by 2030, equivalent to a cumulative increase of 167% and an annual growth rate of 5.6% between 2012 and 2030.

Figure 4

## Population and GDP share

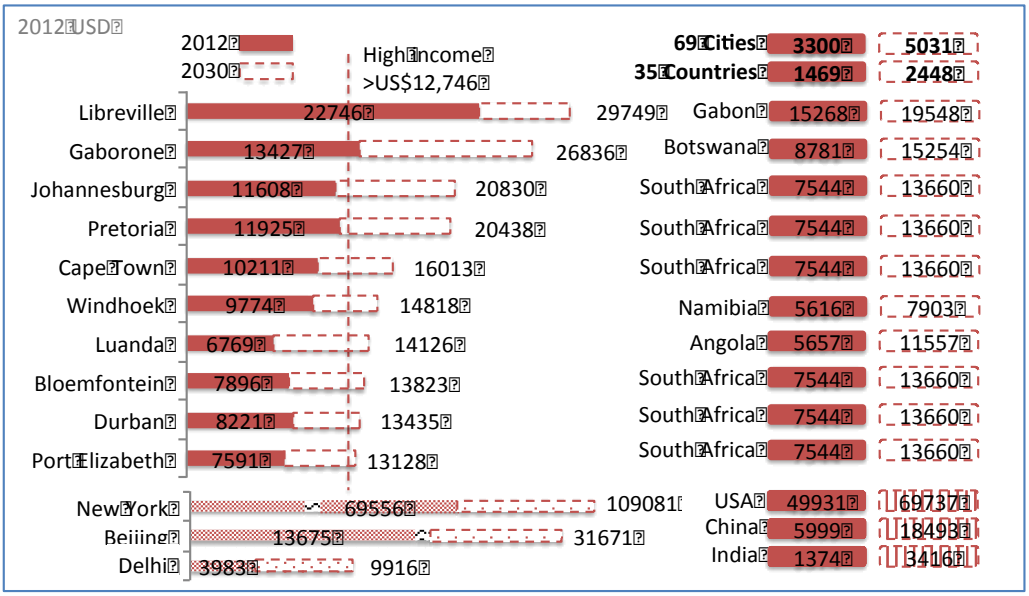



Source: NCE analysis based on Oxford Economics/LSE Cities data (see Floater et al., 2014).[16]

Figure 5 shows the 10 cities with the highest per capita GDP among the 69 cities analysed. There are only two cities with GDP per capita above the high-income threshold defined by the World Bank at US$12,746. These include Libreville (Gabon) and Gaborone (Botswana). However, 10 cities are projected to achieve high-income level status by 2030, more than half of them from South Africa, with the others located in Botswana, Namibia, Angola and Gabon.

Figure 5

Projected GDP per capita of sub-Saharan African 10 richest cities

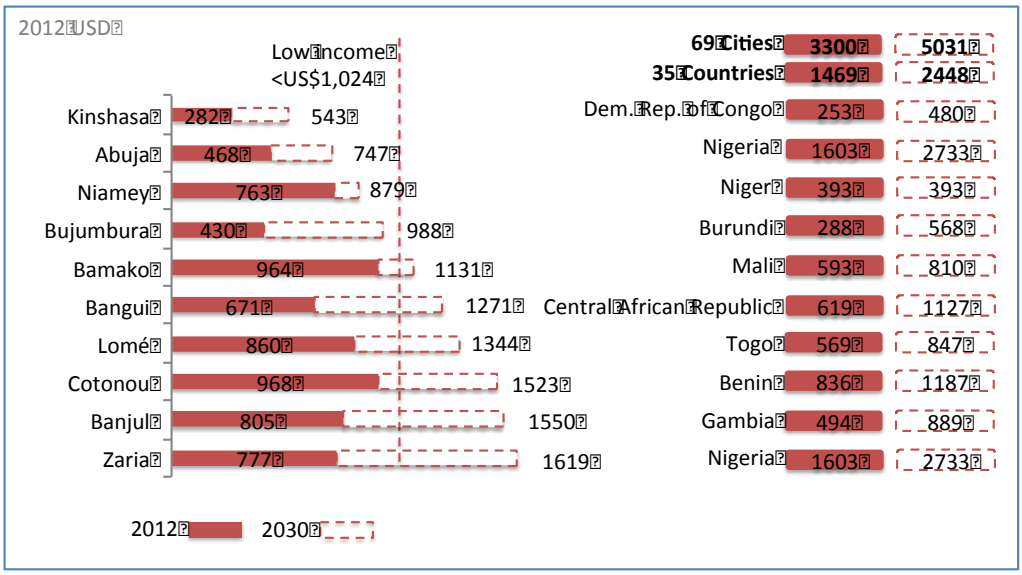



Source: NCE analysis based on Oxford Economics/LSE Cities data (see Floater et al., 2014).[17]

GDP per capita in the 69 sub-Saharan African cities analysed here varies considerably with the gap between cities with highest and lowest GDP per capita standing at about US$22,500. Figure 6 shows the cities with the lowest GDP per capita. Kinshasa is the city with the lowest current GDP per capita of US$282, although this is projected to almost double to US$543 by 2030 (still far below the middle-income threshold of US$1,045). It is projected that there will still be four low-income cities – Kinshasa (Democratic Republic of the Congo), Abuja (Nigeria), Niamey (Niger) and Bujumbura (Burundi) – in 2030, down from 15 in 2012, due to the rapid economic growth projected across the continent over the next 15 years.

Figure 6

Projected GDP per capita of sub-Saharan African 10 poorest cities



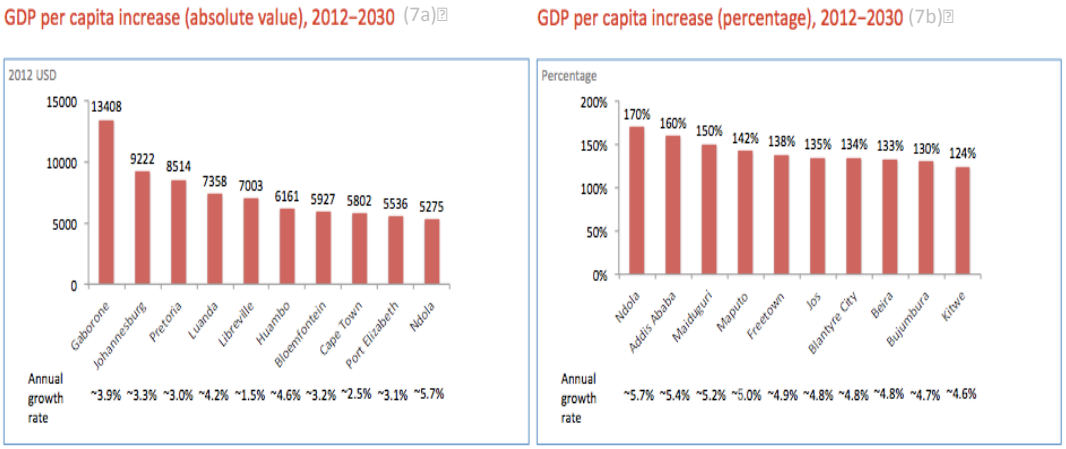

Source: NCE analysis based on Oxford Economics/LSE Cities data (see Floater et al., 2014).[18]

Figure 7 outlines the cities with largest projected increase in GDP per capita in terms of absolute value and percentage. Comparing Figure 5 and the chart in Figure 7a, cities with the highest projected growth in the absolute value of GDP per capita are generally those with the highest initial GDP per capita in the 2012 base year, i.e. success sets the stage for continued success. Eight out of the 10 cities in Figure 5 are on the list of cities with the highest GDP per capita increase in absolute value terms (although for cities with a higher income per capita, the percentage increase is not as marked as the increase in terms of absolute value).

Ndola (Zambia) is projected to have the highest GDP per capita growth of 170%, equivalent to an annual growth rate of about 6% from 2012 to 2030. There are 23 cities projected to at least double their GDP per capita from 2012, i.e. have an average annual growth rate of GDP per capita above 4%, between 2012 and 2030.

Figure 7

GDP per capita increase, 2012–2030




Source: NCE analysis based on Oxford Economics/LSE Cities data (see Floater et al., 2014).[19]

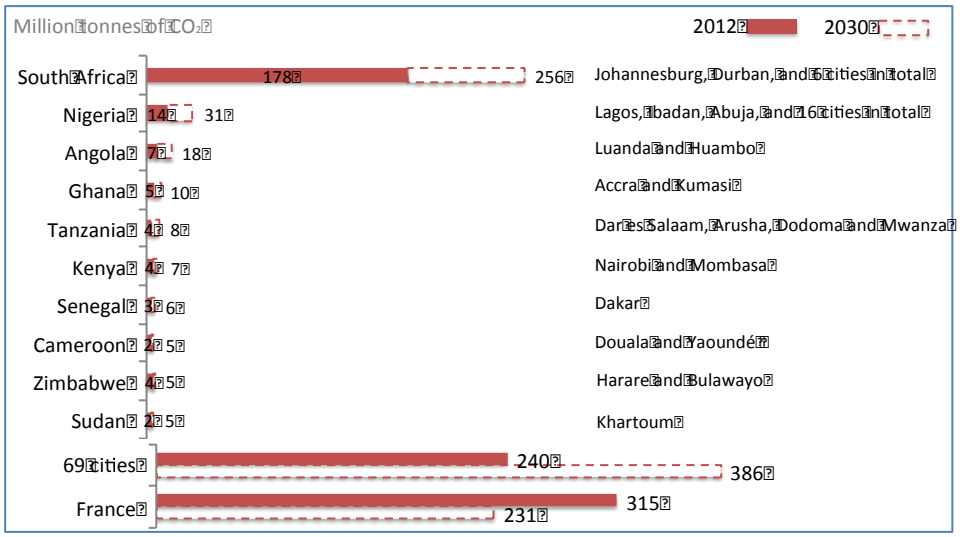
## 4. Emissions

African cities have the lowest carbon emissions per capita of any region in the world. The 69 largest sub-Saharan African cities from the 35 countries assessed as part of this paper emitted about 240 million tonnes of $CO_2$ (43% of the total emissions in the 35 countries) and have average per capita emissions of 1.8 tonnes of $CO_2$ in 2012. There are 16 countries among the 35 sub-Saharan African countries with average urban per capita emissions below 0.5 tonnes of $CO_2$ and four of them have average urban per capita emissions below 0.1 tonnes of $CO_2$. Only nine countries have per capita emissions above 1.0 tonnes of $CO_2$. Figure 8 shows the emissions of the 10 countries. South Africa has the highest per capita emissions of 8.8 tonnes of $CO_2$.

However, under "business as usual", the total emissions of the 69 African cities is projected to grow to around 386 million tonnes of $CO_2$ in 2030, a 61% increase with cumulative emissions from 2012 to 2030 projected to be around 6.0 billion tonnes of $CO_2$ (although per capita emissions are unlikely to rise significantly).[20]

Figure 8

Urban emissions of 10 largest sub-Saharan African emitters, 2012

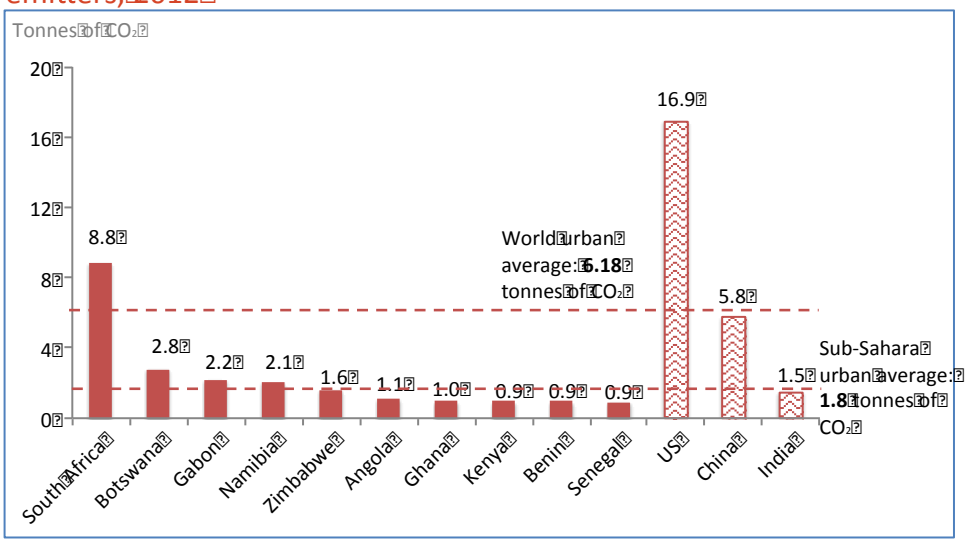



Source: NCE analysis based on Oxford Economics/LSE Cities data (see Floater et al., 2014).[21]

Moreover, given the pace of the demographic and economic change in many sub-Saharan African cities, as outlined above, the choices that sub-Saharan African countries and cities make today about managing urban growth will lock in the future emissions pathway until well past 2030. The life spans of capital-intensive, largely irreversible urban infrastructure investments, such as roads and buildings, typically range from 30 to 100 years, and the path dependencies created by different types of urban form are sustained over centuries. Historical path dependencies can be seen today in the widely varying rates of energy consumption and greenhouse gas emissions among cities with similar per capita income and climate, due to past policy decisions that have shaped their urban form, transport systems and building energy efficiencies.[22] Hence, the pathway to 2030 is only the first part of the story and the choices made now will lock in the contribution that sub-Saharan African cities make to the continent's economic and carbon pathway for at least the remainder of the century.

Figure 9

Average urban emissions per capita in 10 largest sub-Saharan African emitters, 2012




Source: NCE analysis based on Oxford Economics/LSE Cities data (see Floater et al., 2014).[23]

NOTE: The average of urban per capita emissions is calculated from the 69 sub-Saharan African cities. We use the total amount of carbon emissions of city/cities in a given country divided by the total population of the city/cities.

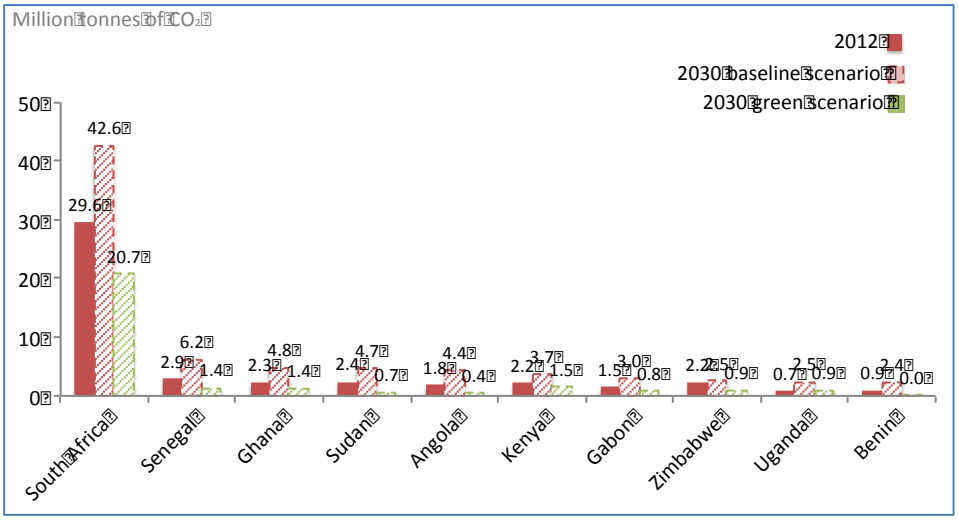
## Emissions reduction scenarios from transport modal shifts

As part of the carbon emissions analysis, a "what if" scenario was used to assess the potential for carbon abatement in the city transport sector. The baseline scenario assumes carbon emissions growth for the cities under "business as usual" urban economic growth from 2012 to 2030. An alternative pathway ("green scenario") was envisaged to explore the potential impact on city emissions of more efficient urban land use (using reduced rates of physical urban expansion as an indicator) and a shift towards more energy efficient transport modes (using lower levels of fossil fuel car ownership as an indicator to proxy transformative transport model shifts in favour of mass transit).[24] No other policy changes are assumed in this scenario.[25]

Car ownership was capped so that by 2030 the number of cars per 1,000 people cannot exceed that of a benchmark city in the same world region. Benchmark cities were identified by LSE Cities in Phase I of the NCE project as based on having low car ownership levels, but above average income levels in their respective region. The benchmark cities are used as the "ceiling" motorisation rate for cities in the rest of the region. In case a city's original forecast value is less than this cap for its region, the original forecast was retained in order not to artificially inflate the motorisation rate in some cities, which will cancel out savings elsewhere. The benchmark cities used for

the Africa region are Suez for North Africa and Dar es Salaam for mid-latitudinal Africa.

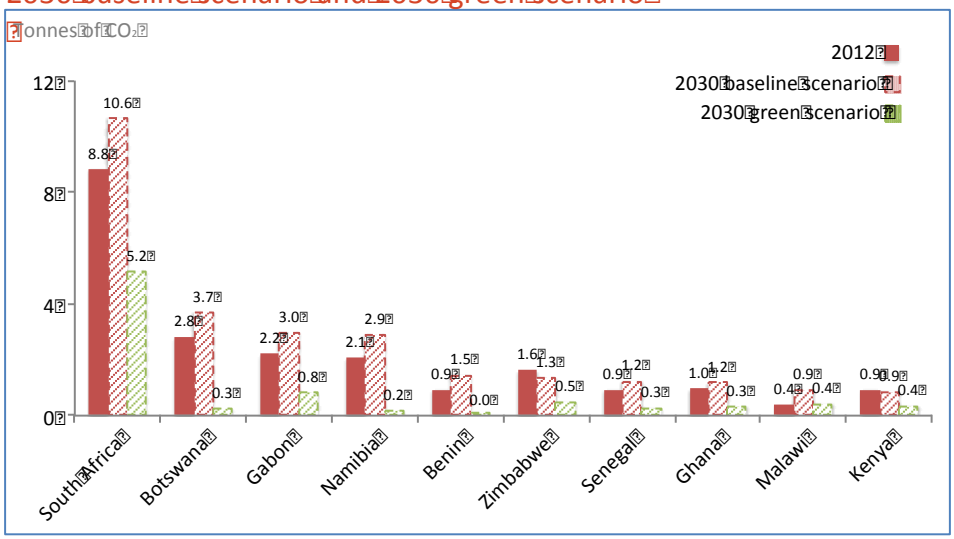
Figure 10
Average urban emissions, 2030 baseline scenario and 2030 green scenario




Source: NCE analysis based on Oxford Economics/LSE Cities data (see Floater et al., 2014).[26]

Figure 10 shows the average urban emissions in 10 countries with the highest carbon emissions in Africa in 2012, the 2030 baseline scenario and the 2030 "green scenario". South Africa is projected to have the highest average emissions in cities in 2012 and in both scenarios in 2030. As shown in Figure 10, there will be a projected 30–120% increase in city-level emissions in the 2030 baseline scenario compared with emissions in 2012 for cities in all 10 countries. However, for the alternative ("green") scenario in 2030, emissions could fall to between one-eighth and a half of those in the baseline scenario in 2030. Figure 11 shows similar results in emissions per capita.

Figure 11
Emissions per capita of 10 largest sub-Saharan emitters, 2030 baseline scenario and 2030 green scenario

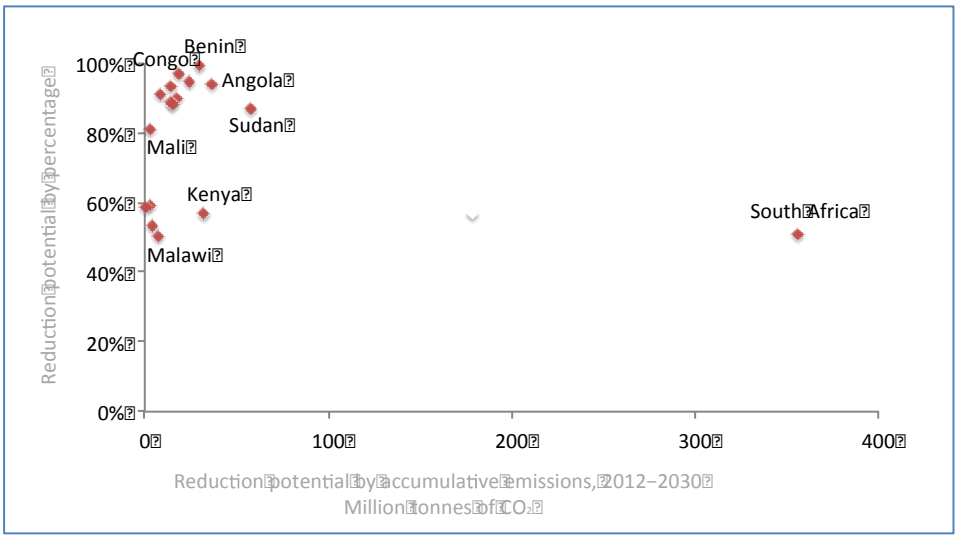



Source: NCE analysis based on Oxford Economics/LSE Cities data (see Floater et al., 2014).

In percentage terms, the difference between the two scenarios ranges from 50.2% in South Africa to 99.4% in Benin (as shown in Figure 12). Benin has the largest urban emissions reduction potential (although the absolute value is relatively small, at only 29.7 million tonnes of $CO_2$). South Africa has the smallest urban emissions reduction potential of 50.2%, but the absolute value of the reduction potential is the most significant at 365.5 million tonnes of $CO_2$. Cities with larger emissions reduction potential tend to be those from smaller countries or those with lower emissions in 2012. Larger cities are likely to have smaller emissions reduction potential in terms of percentage, but larger absolute reduction potential.

Figure 12

Average urban emissions reduction potential, 2012–2030




Source: NCE analysis based on Oxford Economics/LSE Cities data (see Floater et al., 2014).[27]

## *5. Key groups of cities*

We categorise the 69 sub-Saharan African cities into five groups of cities: i) medium and large middle-income cities, ii) middle-income megacities, iii) small middle-income cities, iv) least developed cities, and v) others (high-income cities). Figure 13 shows the distribution of these cities based on population and per capita income.

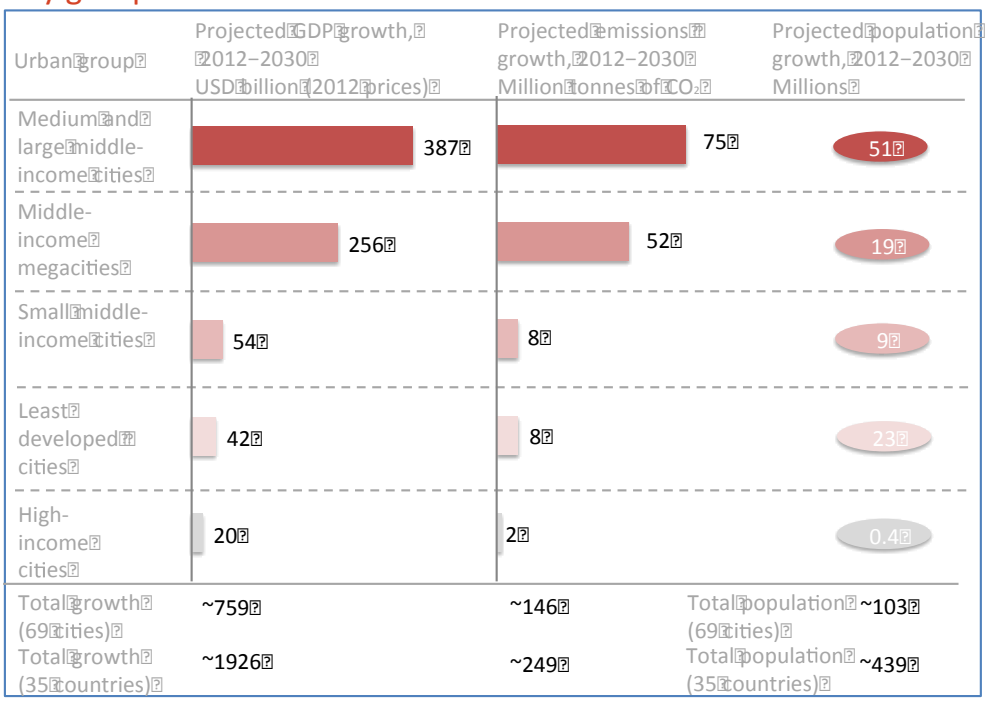
Figure 13
## Categorisation of cities

| | | GDP per capita | | |
|---|---|---|---|---|
| | | Low-income <$1,045 | Middle-income $1,045 to $12,746 | High-income >$12,746 |
| Population | >5m | 1 | 3 | 0 |
| | 3-5m | 2 | 7 | 0 |
| | 1-5m | 4 | 23 | 0 |
| | <1m | 8 | 19 | 2 |

| Categorisation | |
|---|---|
| Type 1 | Medium and large middle-income cities |
| Type 2 | Middle-income megacities |
| Type 3 | Small middle-income cities |
| Type 4 | Least developed cities |
| Others | Small high-income cities |

Source: NCE analysis based on Oxford Economics/LSE Cities data (see Floater et al., 2014).[28]

Figure 14
## Key groups of cities




Source: NCE analysis based on Oxford Economics/LSE Cities data (see Floater et al., 2014).[29]

## Medium and large middle-income cities

We define *medium and large middle-income cities* as middle-income (per capita income between US$1,045 and US$12,746 according to the World Bank) cities with populations between 1 million and 5 million. Among the 69 sub-Saharan African cities, there are 30 medium and large middle-income cities including cities such as Cape Town, Dar es Salaam and Nairobi.

Under "business as usual", medium and large middle-income cities will contribute more than any other group of cities to GDP growth, emission growth and population. These cities are projected to account for more than half of the GDP growth, emission growth and population of the 69 sub-Saharan African cities from 2012 to 2030.

In 2012, gross value added (GVA) from industry represents more than a quarter (~28.4%) of economic activity in this group, as shown in Figure 15. The consumer services sector is also projected to grow rapidly to catch up with the industry sector, accounting for 24–26% of GVA in 2030, with a high projected average annual growth rate of ~7.4%. The transport sector is projected to grow the most rapidly with an average annual growth rate ~7.6%.

Figure 15
Medium and large middle-income cities (GVA), 2012–2030

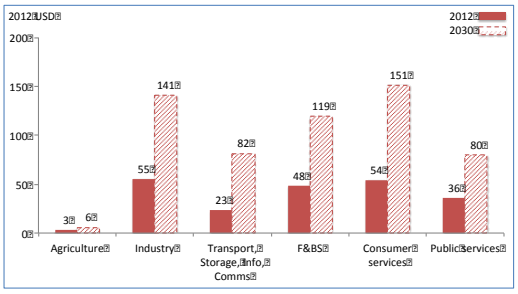
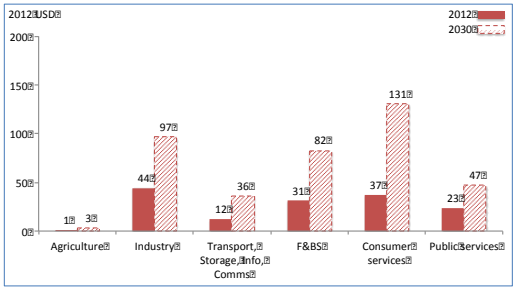



Figure 16
Middle-income megacities (GVA), 2012–2030




Source: NCE analysis based on Oxford Economics/LSE Cities data (see Floater et al., 2014).

## Middle-income megacities

We define *middle-income megacities* as cities with a population of over 5 million and with per capita income between US$1,045 and US$12,746. There are three cities in this group: Johannesburg, Lagos and Luanda.

These cities have important features. They are large economies and normally act as hubs of regional economic growth. Despite the small number of megacities, under "business as usual", they contribute to about one-third of the GDP growth and emissions growth, and less than one-fifth of the population growth of the 69 sub-Saharan African cities from 2012 to 2030.

In middle-income megacities, the industry sector is the largest sector (29.7%) in 2012, as shown in Figure 16. However, by 2030, the consumer services sector is projected to play a more significant role (at around 33% of GVA). The highest average annual growth rate of GVA is projected to be in the consumer service sector (7.3%).

## Small middle-income cities

We define *small middle-income cities* as middle-income cities with a population less than 1 million. A total of 19 cities are in this category. Examples are Bloemfontein, Bulawayo, Constantine and Lilongwe.

Despite the relatively large number of cities in this group, the projected contribution to GDP growth and emissions growth is less than one-tenth (around 7%).

By 2030, the industry and consumer service sectors are expected to contribute almost equally to the economy (~34% of GVA), as shown in Figure 17. The transport sector and consumer service sector are projected to have the highest average annual growth rate of ~7.7% and ~6.6% respectively.

Figure 17
Small middle-income cities (GVA), 2012–2030

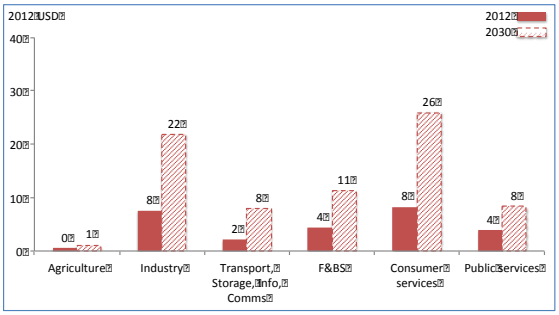
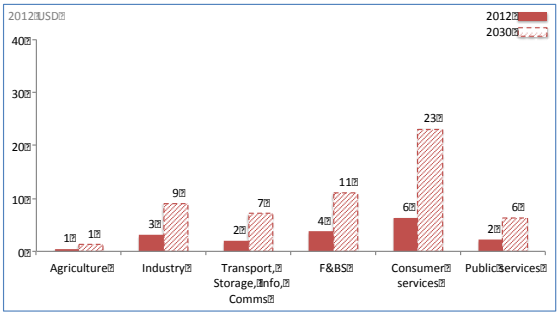



Figure 18
Least developed cities (GVA), 2012–2030




Source: NCE analysis based on Oxford Economics/LSE Cities data (see Floater et al., 2014).[30]

## Least developed cities

We define *least developed cities* as cities with low income (per capita income below US$1,045). There are 15 less developed cities, including 1 megacity (Kinshasa). Examples in this category include Addis Ababa, Abuja, Banjul and Bujumbura.

As shown in Figure 18, all the sectors in this group of cities are projected to grow rapidly. The consumer service sector is projected to have the fastest growth with an ~7.4% average annual growth rate.

The least developed cities are projected to contribute to GDP growth and emissions growth less than is proportionate, relative to their population.

### Others (high-income cities)

There are only two cities in this category – Libreville and Gaborone. They are both small urban areas with a high income level. The group only contains less than 2% of the total population in the 69 cities. We will not examine this group in detail.

Overall, the economies of the 69 cities are projected to grow fast, especially the consumer services sectors. Medium and large middle-income cities are projected to contribute the most proportionately to GDP growth (~50.9%) and emissions growth (~51.3%), with population growth around 50% (~49.5%). Middle-income megacities are also projected to contribute significantly to GDP growth (~33.7%) and emissions growth (~35.6%), with population growth of around 20% (~18.4%), while small middle-income cities and least developed cities combined are expected to contribute far less to GDP and emissions growth (less than 15%), but will account for a significant proportion of population growth (around 30%).

## *6. Conclusion*

Sub-Saharan African cities are growing rapidly and their contribution to the region's economy and emissions is significant. They are still at a relatively early stage in terms of managing their urban growth in a way that both supports continued economic prosperity but also minimises the anticipated growth in carbon emissions. The choices that sub-Saharan African countries and cities make today – particularly in relation to urban transport – will be especially important as they will lock in future economic and emissions pathways for at least the remainder of the century.

Unfortunately – while outside the scope of this paper – the emerging evidence suggests that many sub-Saharan African cities are not yet taking decisions likely to set the stage for the adoption of a model of urban development that can support economic prosperity and manage the rate of growth of carbon emissions. This is indicated by the prevalence of congestion, growing informality, and low densities in urban cores, which undermine the benefits that come from urban agglomeration and the ability to cost-effectively provide mass transit options for the urban poor and growing businesses.

[1] List of countries: Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Egypt, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Madagascar, Malawi, Mali, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe. The dataset covers 35 of the 55 countries in Africa, and 35 of the 47 sub-Saharan countries.

[2] UN DESA, 2014. *World Urbanization Prospects, 2014.* United Nations Department of Economic and Social Affairs. Available at: http://esa.un.org/unpd/wup/.

[3] UN Habitat, 2014. *The State of African Cities, 2014.* United Nations Human Settlements Programme. Available at: http://unhabitat.org/books/state-of-african-cities-2014-re-imagining-sustainable-urban-transitions/.

[4] UN DESA, 2014. *World Urbanization Prospects, 2014.*

[5] Ibid.

[6] Ibid.

[7] Ibid.

[8] Ibid.

[9] Ibid.

[10] Ibid. A detailed description of the data sources and methods used for the analysis are set out in the Appendix to Floater, G., Rode, P., Robert, A., Kennedy, C., Hoornweg, D., Slavcheva, R. and Godfrey, N., 2014. *Cities and the New Climate Economy: the Transformative Role of Global Urban Growth*. New Climate Economy contributing paper. Available at: http://newclimateeconomy.report/misc/working-papers/.

[11] UN DESA, 2014. *World Urbanization Prospects, 2014.*

[12] See: Oxford Economics, 2014. Global Cities 2030. Available at: www.oxfordeconomics.com/cities/report.

UN DESA, 2014. *World Urbanization Prospects, 2014.*

[13] UN DESA, 2014. *World Urbanization Prospects, 2014.*

[14] Floater et al., 2014. *Cities and the New Climate Economy.*

[15] Ibid.

[16] Ibid.

[17] Ibid.

[18] Ibid.

[19] Ibid.

[20] Although there is projected to be a significant increase in emissions up to 2030, the sheer scale of projected demographic change means that emissions per capita are not likely to rise significantly (and may even fall slightly: the analysis suggests emissions per capita could fall from 2.1 to 2 tonnes per capita).

[21] Floater et al., 2014. *Cities and the New Climate Economy.*

[22] See Floater et al., 2014. *Cities and the New Climate Economy.*

[23] Ibid.

[24] See Floater et al., 2014. *Cities and the New Climate Economy*. Analysis of emissions under this alternative pathway aimed to explore the potential impact on greenhouse gas (GHG) emissions of two key changes: more efficient urban land use (using reduced rates of physical urban expansion as an indicator), and a shift away from personal vehicle use in favour of more energy efficient forms of transport (using lower rates of fossil-fuelled car ownership as an indicator). The analysis assumes that car ownership is brought down to the level of a leading benchmark city in each world region (e.g. New York for North America), which reduces GHG emissions by 1.4 billion tonnes of $CO_2e$ in 2030. The lower-end estimate of 0.7 billion tonnes of $CO_2e$ assumes that cities lower car ownership to double the levels of benchmark cities, based on NCE staff assumptions. Urban land area is assumed to grow, at most, in proportion to population

growth; this reduces GHG emissions by another 0.1 billion tonnes of $CO_2e$ in 2030, which should be considered conservative. Further research and analysis is needed to provide more robust estimates.

[25] Thus, the alternative scenario includes improvements related to motorisation and density but uses the same baseline figures for the national context as the baseline scenario. For instance, national total emissions in each scenario are simply calculated as baseline national emissions less the reduction in the scenario from changes in the metro areas. Therefore, each city's share of national emissions would not vary if the national total emissions figure changes (but it does vary if population density and car ownership change).

[26] Floater et al., 2014. *Cities and the New Climate Economy.*

[27] Ibid.

[28] Ibid.

[29] Ibid.

[30] Ibid.