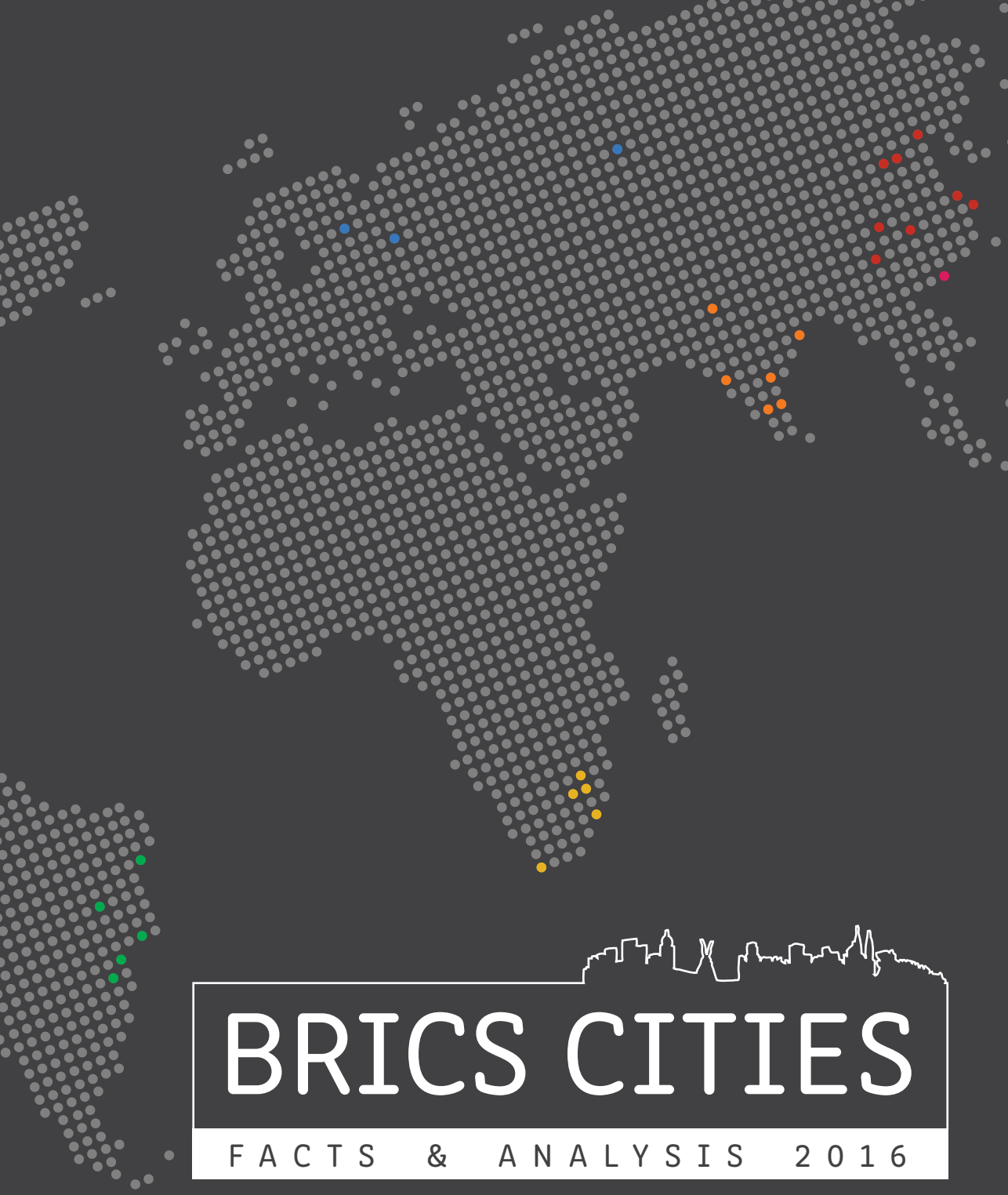

BRICS CITIES

FACTS & ANALYSIS 2016

South African CitiesNetwork

SOUTH AFRICAN RESEARCH CHAIR IN SPATIAL ANALYSIS & CITY PLANNING

SCHOOL OF ARCHITECTURE PLANNING

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

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BRICS CITIES

FACTS & ANALYSIS 2016

South African CitiesNetwork

SOUTH AFRICAN RESEARCH CHAIR IN SPATIAL ANALYSIS & CITY PLANNING

Sao Paolo

Mumbai

Suzhou

PREFACE

Following the early notion of a 'BRICs' league floated at Goldman Sachs in 2001, the idea of formal multilateral cooperation of these states developed over about a decade. There were initially four states: the Federative Republic of Brazil, the Russian Federation, the Republic of India, and the People's Republic of China. The Republic of South Africa was included in the club later, in 2010. The rationale was that these countries represented major emerging national economies, comprising a significant share of the world's production and population. They were also considered to represent the potential for a new, powerful South-South geopolitical association that could form a pressure group or even an alternative to the dominance of the post-World War II, western-dominated Bretton Woods system. A joint statement of the 2011 BRICS Summit indicated that "It is the overarching objective and strong shared desire for peace, security, development and cooperation that brought together BRICS countries with a total population of nearly three billion from different continents. BRICS aims at contributing significantly to the development of humanity and establishing a more equitable and fair world."[1]

The lofty expectations of what the BRICS might mean and accomplish were always somewhat tempered, however, by the reality that the BRICS countries are actually very different. The values, goals, resources, systems and structures of the five states vary, and are at variance in some cases.[2] The experience (which has mainly involved a consistent convening of the annual BRICS Summits, and the establishment of the New Development Bank, headquartered in Shanghai), fora and analyses over the past half-decade are beginning to indicate the potentials and weaknesses of the alliance.

In parallel with the evolution of the BRICS, the world has also been rapidly urbanising. There is increasing awareness of and concern with the processes of urban growth and development as a significant factor in local and global social, economic and political systems. It is on this basis that the BRICS Policy Centre (BPC) in Brazil created a city-focused BRICS programme – named BRICS-Urbe – in 2013. The programme initiated the earliest conceptual work on the consideration of BRICS cities as a potentially useful analytical category upon which comparative and innovative policy work and exchange might be built.[3]

The South African Cities Network (SACN) has been interested in BRICS and the role of cities for a number of reasons. The learning approach of the SACN has always taken an interest in international practices, and particularly in the opportunities for South-South learning. In addition, the SACN and its member cities (South Africa's largest cities) have regularly built direct networks (e.g. city-to-city cooperation) to support development cooperation and knowledge exchange. With this kind of active engagement at a sub-national level, it was important to find out what the new implications and prospects of a national-level BRICS formation might be for BRICS cities – which, in all cases, form a significant proportion of the BRICS countries' respective national economies.

1. *Sanya Declaration*. BRICS Leaders Meeting, Sanya, Hainan, China, 14 April 2011.
2. Observer Research Foundation, *A Long-term Vision for BRICS*, 2013.
3. http://bricspolicycenter.org.

While the importance of the urban dimension was being acknowledged within the high-level BRICS structures (e.g. with the establishment of an Urbanisation Forum, and as a topical area in the Academic Forum), cities themselves were not necessarily engaging directly in considering what the significance of the BRICS might be for them.

It was through a partnership between the SACN and the BPC that the idea of this *BRICS Cities* book project began to take form. The BPC's methodology in approaching new policy themes follows a simple cycle that begins with developing baseline 'factsheets' about the emerging area, on the basis of which emerging issues may be used to direct more detailed research investigations, whose findings might in turn be distilled to [in]form relevant policy papers and discussions. In 2014, the SACN initiated a similar cycle through the generation of BRICS city factsheets. In addition, the SACN decided to include some initial thematic investigations, based on areas that had been identified mutually between the SACN and the BPC. The idea was that besides compiling useful information, the process could also enable the development of the kinds of networks that might later enable useful research, dialogue and learning partnerships. In this sense, the project is exploratory; an ambitious fishing expedition intended to surface information, questions and resources.

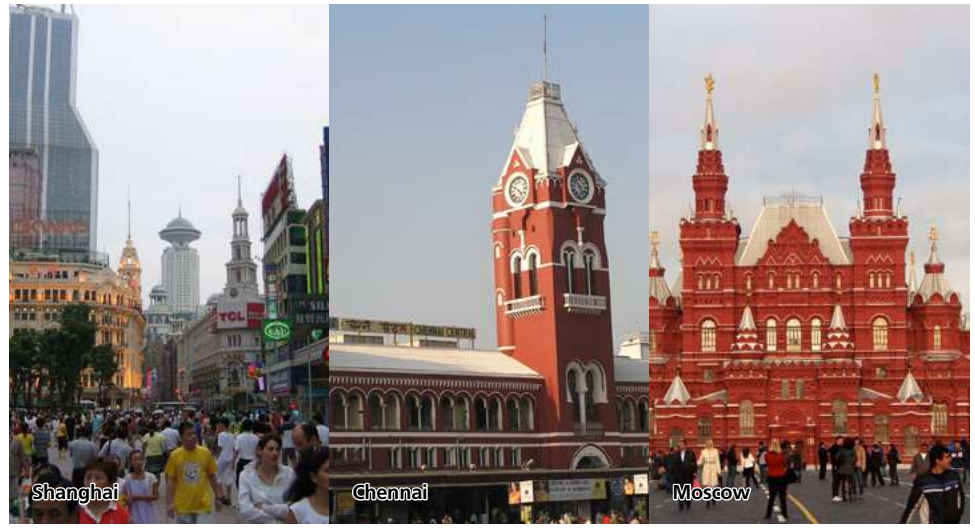
In fact, the seemingly simple approach of producing factsheets turned out to be quite intense and complicated. A first challenge for the project was in defining its scope – there are many, many cities across the BRICS. Defining logical and feasible criteria for prioritisation, and then selecting the 'facts' (data and indicators) to consider for the study were very difficult processes, which ultimately relied on the best collective judgement supported by limited existing knowledge. Then, the compilation of the data and information across five countries and over thirty cities was an extremely time-consuming and intensive process, riddled with a range of challenges regarding data availability and reliability. The contextual knowledge required to support the assessment and interpretation of information was also a challenge for a South Africa-driven and -based team. Various peers and institutions in all the BRICS countries were invaluable in providing research support and reviews, and in this regard it proved useful to be able to leverage existing university research linkages.

In addition to the BRICS nexus, however, the SACN also wished to include consideration of African cities more broadly. This was motivated on the basis of South Africa's peculiar role in BRICS. South Africa has always been an obvious dwarf among its BRICS peers, having by far the smallest economy and population. Its presence in the BRICS was often justified by its characterisation as a 'gateway': the idea that South Africa represents an entry point to Africa, which continent as a whole then begins to measure up to the growth figures and significance of the other four states[4]. However, the size mismatch is not only at a national level; it is also the case that several African cities are much larger and faster-growing than South Africa's largest cities. Given these anomalies, it seemed relevant to at least consider how the *BRICS Cities* story might consider an expanded regional consideration of South Africa's potential role and significance. However, this did complicate things even further.

So the project was an ambitious one. And while there is certainly value in the work ultimately presented here, there are of course also numerous limitations in the project-based 'expedition' approach taken. Firstly, while the study begins to develop some insights from its attempt to describe and compare the cities in terms of the data and themes, this does not mean that *comparability* could be either assumed or ascertained. As mentioned previously, the BRICS countries are quite different. These differences in make-up and history significantly influence how the data and trends can be read and understood. And there are other variables which might also be important to consider. The study does not attempt to contend fully with these issues, which would need to be considered as more in-depth research is pursued.

Given the variability in the data and information that could be found or accessed, as well as the team's somewhat imbalanced contextual knowledge and networks, the evenness of our consideration of the countries and thirty-one cities is not necessarily borne out in our findings, analysis and reporting. Some sections may be more substantial or insightful than others; but this is accepted, given the project's constraints and exploratory intentions. Gathering data for African cities was a particular challenge, and further exploration in this regard may be useful.

4. Oliver Stuenkel, *Post-Western World*, 2012.



The book also acknowledges that the main analytical themes chosen (transportation, green energy and innovation-driven economies) were pre-selected and imposed, rather than derived through any inductive process. As stated in the thematic chapter, other themes may have been as – or even more – relevant in studying BRICS urban dynamics. However, the three themes were deemed a good-enough starting point, based on the work and interests of the SACN and the BPC; and they cover the key considerations of productivity, inclusion and sustainability, which are among the key SACN thematic dimensions for city performance. This selection yielded some useful initial analysis, but of course this could be expanded or refined further.

There were also other specific limitations within the themes. For example, while a concept such as 'innovation' is acknowledged (particularly in India, Brazil and South Africa) to also include significant socio-economic activities in the non-formal sector, the standard economic measures do not account for these, and it was therefore difficult to include a consideration of informality in that particular thematic analysis. Again, limitations of this particular kind would have to be taken up in any future work.

The South African Research Chair in Spatial Analysis and City Planning of the University of the Witwatersrand was a welcome partner in the early days of the project, given the unit's own ongoing research and partnerships in various BRICS countries. The unit's conceptual, research and analytical capacity and support were crucial to the project's success. The Research Chair has been instrumental in setting up the BRICS+ City Lab, a partnership between research institutions across major cities in the BRICS, and convening the partners (to date) in Shanghai (2016) and Moscow (2017). This partnership is currently exploring processes of 'adaptive governance' within BRICS cities. In addition, the Research Chair (supported by the Gauteng Provincial Government and the Gauteng City Region Observatory) is engaged in work towards a book on the governance of large city-regions across the BRICS. Such work would be an important complement to this initial exploration of BRICS cities.

BRICS Cities represents the beginning of a journey of understanding and learning. Even in the face of uncertainties about the future and promise of the broader BRICS formation, this sub-national contribution opens the doors to a line of enquiry on the subject, at what might perhaps be a more tractable level for policy/planning analysis and learning.

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PART A: CHAPTER ONE

CITIES IN THE BRICS: A COMPARATIVE OVERVIEW

INTRODUCTION

This compendium and analysis of Cities in the BRICS was developed through a partnership between the South African Cities Network (SACN) and the South African Research Chair in Spatial Analysis and City Planning (SA&CP) at the University of the Witwatersrand. Since South Africa joined the BRICS in 2010, multiple connections have been forged between South Africa and its alliance partners. However, although there is a growing volume of engagements, there is still inadequate knowledge and understanding across the BRICS. There is a common understanding, for example, that BRICS countries share a range of challenges and possibilities in relation to urbanisation and urban growth; but real knowledge of each other's urban contexts remains sparse.

For example, there is a BRICS Urbanisation Forum and various sister-city agreements across the BRICS, as well as frequent inter-BRICS study tours; but we need to support ongoing 'deep learning' across city contexts. The initiative that has led to this publication was intended first to support city municipalities in South Africa in expanding their knowledge of counterpart cities in the other BRICS, and building the capacity for learning from these other cities. However, we hope that cities outside South Africa will also benefit from this material, and that it will be useful to the many other players in city development inside and outside government.

This publication has two parts. **Part A** is the comparative and analytical overview of urban development across the BRICS, also in relation to cities in Africa. This first chapter is a comparative introduction to large cities in the BRICS, providing an overview of different histories, demographic processes, economies and development challenges. Through a comparative perspective, the second chapter addresses three areas of thematic focus, namely transportation, green energy and innovation economies. Of course there are multiple themes that could be addressed in a report such as this, but these were selected for initial consideration for their immediate relevance to areas of concern and policy initiative among the member cities of the SACN. The third chapter compares and relates BRICS cities to Africa's cities. This addresses one of the challenges of South Africa's membership of the BRICS: South Africa is not comparable in size to other countries in the BRICS, especially China and India, with the real comparator in terms of economy and population being the entire continent of Africa.

Part B is the compendium of Factsheets on thirty-one of the BRICS cities. Each Factsheet has two sections. First, there is general information on each city, including on history, population, spatial form, economy, urban governance, and developmental challenges. Secondly, there is the section which deals with the three selected themes.

DELINEATING THE URBAN AGGLOMERATIONS

The Factsheets deal with *urban agglomerations* rather than municipal areas. An agglomeration is the full extent of a contiguous spatial spread of urban development around a core city, which only very rarely coincides with the boundaries of a municipality; when we use the term 'city' in this report, we mainly mean the urban agglomeration. In many case the urban agglomeration is far larger than the area governed by the core urban municipalities, as urban development has spilled over the municipal boundaries. However, there are cases where the municipal boundary has been widely drawn, and the municipal area is actually larger than the urban agglomeration. But there are a few complications. In the case of Gauteng in South Africa, and the Pearl River Delta and Yangtze River Delta in China, urban agglomerations have meshed together in spatially complex city-regions. In the case of the Gauteng City Region (GCR), we have provided Factsheets for each of the three major cities – although strictly speaking, these cities form a single, entangled multi-nodal agglomeration. In the case of China's large city-regions there are multiple interconnected cities and urban agglomerations, and it was not possible to provide a Factsheet for each. For the Pearl River Delta we have provided a Factsheet which includes two of the urban agglomerations, and for the Yangtze River Delta we have included three.

SELECTING THE CITIES

The cities selected for Factsheets were chosen on the basis of an initial scan across the urban centres of the BRICS. It was not a simple case of taking the Top Thirty, for example. The Top Thirty in terms of population is very different from the Top Thirty in terms of economy. In terms of population the distribution of the Top Thirty would be China (17 cities), India (9), Brazil (2), Russia (1) and South Africa (1)[1]. In terms of economy the dominance of China is even more extreme, with the numbers of cities in the Top Thirty ranked as China (23), Brazil (3), India (2), Russia (1) and South Africa (1).

We decided that instead of taking a simple ranking as the basis for inclusion, we would try to ensure a reasonable distribution across countries, with variation also across different types of cities (e.g. fast- and slow-growing, with different economic drivers). The final calculation was China (12), India (6), Brazil (5), South Africa (5) and Russia (3), giving a total of 31 cities. The selection was as follows:

- China ..... Beijing, Tianjin, Shanghai, Suzhou, Hangzhou, Guangzhou, Shenzhen, Wuhan, Chongqing, Chengdu, Xi'an and Shenyang.
- India ..... Delhi, Mumbai, Kolkata, Bengaluru (Bangalore), Chennai and Hyderabad
- Brazil ..... São Paulo, Rio de Janeiro, Brasilia, Curitiba and Salvador.
- South Africa ... Johannesburg, Tshwane (Pretoria), Ekurhuleni (East Rand), Cape Town, and eThekwini (Durban)
- Russia ..... Moscow, St. Petersburg, Novosibirsk

In retrospect, there are limitations to this selection. We made a decision, for example, to focus on the cities in mainland China. However, it is apparent that Hong Kong is so closely connected with the other large cities in southern China that it cannot be separated analytically. Hong Kong is the 22nd-largest city in the BRICS in population terms; and more significantly, the fourth-largest in terms of urban economy. Other Chinese cities that could be considered for incorporation in any revision to this document include Nanjing, Foshan, Dalian, Dongguan and Qingdao. The initial selection of cities from India was confirmed during the course of the study; but in the case of Brazil, Belo Horizonte – the third-largest city in the country – was not included. Admittedly, South Africa is over-represented in the sampling (a case of home-territory advantage!). The difficulty in relation to the Russian Federation is that there are only two large cities, in BRICS terms (Moscow and St. Petersburg), with a fairly large number of small cities following at a long distance. To provide some cross-national balance we added Novosibirsk to the selection, but this still totals only three cities from Russia. We have tried to compensate for some of the imbalance by including all major cities (not only those in the Factsheets) within the data tables and data sheets in Section A. A number of the cities selected do link together within broader city-regions or clusters. These are: Beijing and Tianjin, as part of the wider Jing-Jin-Ji City Cluster; Shanghai, Suzhou and Hangzhou, as part of the Yangtze River Delta Region; Shenzhen and Guangzhou, as part of the Pearl River Delta; and Johannesburg, Tshwane and Ekurhuleni, as part of the GCR. Although separate Factsheets are provided for the individual cities, their interconnectedness within the wider city-regions is emphasised, including in the use of coversheets for the regions.

1. South Africa would only qualify for one if Johannesburg and Ekurhuleni were regarded as a single urban agglomeration.

DATA

Sourcing, harmonising and presenting data is a difficult task, with two major challenges. The first is the challenge of cross-national comparison. Data is collected mainly on a national basis, using national definitions and protocols, and against different time frames. Secondly, some data sources are not disaggregated to city level. So, for example, Oxford University has developed an extensive database on poverty, but this is disaggregated to regional rather than city level. In the case of economic innovation, for example, city governments in China have developed a set of indices (e.g. spending on R&D as a proportion of the city economy); but in the other BRICS, this data exists only at national or provincial/state level.

We discuss the data issues in relation to each area of study in each of the sections below, but it should be noted that the primary sources of quantitative information for each country were the following:

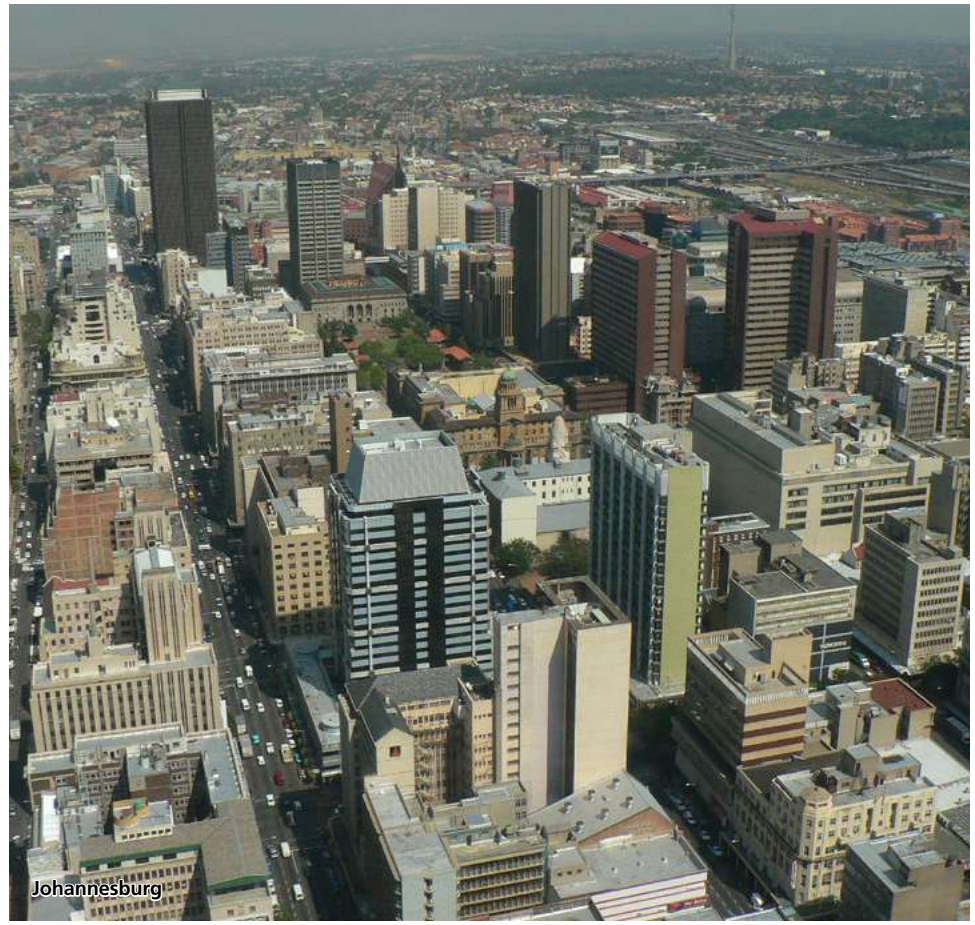
- » **Brazil** ..... The *Instituto Brasileiro de Geografia e Estatística* (IBGE), which conducted its last national census in 2010 [www.ibge.gov.br];
- » **Russia** ..... The *Federal State Statistical Service* (Rosstat), which conducted its last national census in 2010 [www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/en/main/];
- » **India** ..... The *Central Statistics Office* (CSO), which conducted the last national census in 2011, but also reports of the Indian Planning Commission and a variety of other state-level bureaus;
- » **China** ..... The *National Bureau of Statistics of the People's Republic of China* (NBS), which conducted the last national census in 2010;
- » **South Africa** ... *Statistics South Africa* (Stats SA), which conducted the last national census in 2011.

There have been some attempts to harmonise data across the BRICS, most notably the *BRICS Joint Statistical Publication* [www.gks.ru/free_doc/doc_2015/BRICS_ENG.pdf], but this data source has not been expanded yet to municipal or city level.

City-level data has also been a key source of information, although there is considerable variation between cities in the extent and availability of data. In China, for example, each city has a Local Bureau of Statistics, which produces an Annual Statistical Yearbook. In South Africa, this local statistical base is lacking; but there is valuable information on cities in the various municipal plans available online, and in the work of agencies such as the SACN and the Gauteng City-Region Observatory (GCRO).

While we have drawn heavily on the data sources indicated above, we were constrained by the many differences between the national statistical systems. Harmonising data for cities across national boundaries was a task too complicated for this study, so we did rely to some extent on agencies that have done so for some sectors, or indicators at least (for example, the UN Population Division for the population of urban agglomerations, the Brookings Institution for economic data, UN Habitat for development indicators, and the World Health Organisation for air quality). Unfortunately there are many areas (e.g. modal share of transport, energy data at city level, innovation indicators) for which comparative data is either lacking or inadequately developed.

There are a number of private or quasi-private agencies that have entered the market, providing data – often in the form of rankings – for some of these areas. Examples include: the BRT Global Data, which includes modal-share breakdowns in transport for a number of large cities; the Global Traffic Congestion Index, prepared by the mapping company TomTom; the *Forbes Magazine* rankings of wealthiest individuals and leading firms; the Innovation Cities Index, prepared by the innovation agency 2thinknow; the QS BRICS University rankings; rankings of container ports by Lloyds and the World Shipping Council; rankings of airports by the Airports Council International; and so forth. In some instances the criteria for ranking are clear (e.g. passenger traffic for airports); but in others, ranking is a complex matter using multiple criteria, with assumptions behind the data mix which are open to question. For example, the Fortune 500 and the Forbes Global 2000 global firm rankings are different, as a result of the varying criteria used to determine the strength of firms.


Johannesburg

Maps prepared with data layers from OpenStreetMap (http://download.geofabrik.de/) and GADM database of Global Administrative Areas (http://gadm.org/home).

We have had to make judgements in the use of data, but we have tried in the overall picture to ensure the use of the most updated and verifiable data, although this was balanced at times against the need for comparability. The detail on how this was done is provided in the sections below, which broadly follow the structure of the individual Factsheets.

REFERENCING

The Factsheets are information- and data-rich, and every piece of information in every sentence is informed by some source. We have decided not to overload the Factsheets with referencing. However, the key sources of data are apparent in this introductory chapter, and the Factsheets for each country are followed by lists of the major references used.

HISTORIES

Starting with histories helps us move beyond the simplistic statements of what our commonalities are. It is frequently stated, for example, that we are 'all in it together' because we are experiencing unprecedented rates of urbanisation. This may have been true in the mid- to late 20th century, but it is not true today. We need to begin by understanding that the BRICS are a diverse cluster of countries, with their cities even more variant in their histories and current forms. It is this diversity which provokes arguably the most interesting comparative insights.

Understanding the histories is also at least a partial antidote to the current tendency to compare cities by placing them in league tables in relation to each other. It is difficult, of course, to avoid the use of league tables, indexes and rankings, as much of the comparative information across cities – especially on a scale such as that of the BRICS – is contained within them. We use them quite extensively in this document, as a means of gaining perspective on cities in relation to each other. However, we use them with a degree of uneasiness for the way in which this form of comparison ignores history, and assumes that the worth of a city is inherent to its position within a ranking. As Jennifer Robinson reminds us in her book Ordinary Cities, we should not view a particular place as a pale or inadequate imitation of the city at the top of the league table; but rather as a city-in-itself, with its own history that has produced the configuration that it is.

CLASSICAL CITIES

The urban history of the BRICS goes back millennia, with China and India having some of the oldest continually inhabited cities in the world. Beijing and Xi'an in China, for example, were both founded around 1300 to 1000 BC (or more than three thousand years ago). Delhi's origins are shrouded in myth but may go back to 800 BC, which was the beginning of the Classical Age of Ancient India associated with the urban civilisation in the Indus Valley.

Histories rank Xi'an (Chang'an) in China as the largest city in the world in 1000 BC. It remained one of the greatest cities for over 1000 years, competing in earlier times with Babylon in present-day Iraq, and then with Rome and Alexandria on the Mediterranean (Chandler, 1987).

By the first century AD, Rome had consolidated its power as the world's leading city; but for nearly a millennium and a half, between 500 AD and around 1850 AD, China's cities dominated in size and imperial splendour. The great cities of the world were Xi'an, Hangzhou, Nanjing and Beijing, with Chengdu, Suzhou and Wuhan also important trading cities. Competing with the Chinese cities were Delhi in India and Istanbul (previously Constantinople) in Turkey. Only by the beginning of the 19th century did cities in the Western powers overtake those in China, largely as a result of the massive economic success of colonial enterprise[2] (Chandler, 1987).

The cities rose and fell as political dynasties and trading networks changed. The Mongol invasion of China in the 13th century, for example, led to the destruction of great cities, but also to the rise of Beijing as an imperial capital.

India had a complex history with multiple competing states. However, power gradually consolidated in the north of India, with Delhi as the political centre. In the 12th and 13th centuries Central Asian Turks invaded north India and established the Delhi Sultanate. By the 16th century the Mughal Empire was its peak, controlling nearly the entire Indian sub-continent, with Delhi as one of its capitals.

2. London emerged in the 19th century as the largest city in the world, overtaken in the early- to mid-20th century by New York and Tokyo.

In 1739 the Maratha sacked Delhi, displacing the Mughals. However, there were competing centres of power, with a Muslim aristocracy, the Nizams of Hyderabad, maintaining their autonomy, connecting into political and trading networks through Central Asia, the Middle East and North Africa.

Russia gradually emerged as a political entity from the 12th century. Also at this time, Moscow was established, although it was destroyed by Mongol invaders in the 13th century. The Grand Duchy of Moscow remained a vassal to the Mongols until the 15th century, when the Tsardom of Russia was established. Tsar Peter the Great built a huge empire, but moved the capital from Moscow to St Petersburg in 1712, after which St. Petersburg eclipsed Moscow in imperial grandeur and population size. In the 19th century the Russian Empire expanded across Asia, bringing wealth and power to its core cities.

COLONIAL CITIES

In the long sweep of history, the West only eclipsed China and India in power and wealth by the 19th century. However, from the 16th century the West was expanding its geographical power through colonial expansion, with the process of colonisation producing new urban centres.

Brazil's colonisation began in 1500, when the first European arrived under the patronage of the King of Portugal. Salvador was founded in 1549, as the first capital of the Colony of Brazil; and with its large port, it became the hub of Brazil's slave trade with Africa. São Paulo was established in 1554 by Jesuit missionaries, with Rio de Janeiro founded a decade later. In 1783 the capital was moved from Salvador to Rio de Janeiro, refocusing colonial attention from the north to the south of the colony. São Paulo and Rio became the base from which the Portuguese explored and exploited the southern interior of Brazil. Their growth until the end of the nineteenth century was driven by the success of a slave economy, with the development of gold mines, and coffee and sugar plantations in the near hinterland.

In 1652, the Dutch East India Company established a small trading post between Europe and Batavia (Java) at Cape Town, providing a base for a gradual expansion of Dutch settlement into the southern African interior. And from the beginning of the 17th century, the British East India Company began extending its trading networks through East Asia, establishing key enclaves of control in Bombay (Mumbai), Calcutta (Kolkata) and Madras (Chennai). By the mid-18th century, the British East India Company was in effective control of large portions of India, with its own private army and administrative apparatus. In 1803, Company troops entered Delhi, defeating the Maratha.

In the 19th century, Great Britain came to dominate the colonial enterprise. In 1806, during the Napoleonic Wars, Great Britain took control of the Cape, with Cape Town becoming the colonial capital. In 1824, a small British trading post was established at the Bay of Natal, around which the City of Durban eventually developed.

In 1858, the British Crown assumed direct control of India, although there were a number of princely states (including Hyderabad) which formally retained their autonomy. The capital of the so-called British Raj was Calcutta (Kolkata), where the new Indian elite emerged who were to form the vanguard of rising Indian nationalism. During the period of the British Raj, Indian cities developed along segregated lines, with dense settlements of Indian population and wealthy colonial enclaves known as cantonments.

In Brazil, however, direct colonial rule was coming to an end. In 1822 the Empire of Brazil was formed, independently of Portugal; and in 1889 the Republic of Brazil was created. Rio de Janeiro remained the national capital.

China did not experience direct colonisation in the way Brazil, India and South Africa did, but there were destructive colonial intrusions from the early 19th century. In the 18th century, the major relationship between China and West was through trade, with contact restricted to Canton (Guangzhou), which was China's only port open to international trade. In the early 19th century Great Britain developed a lucrative trade exporting opium into China, and war erupted when the Chinese imperial government banned this trade. Defeated in 1839, China was forced to open other

ports to the West – including Shanghai, which expanded rapidly into a large, cosmopolitan city, eclipsing ancient cities such as Hangzhou and Suzhou. As imperial China weakened, the colonial powers intruded further, with Anglo-French forces infamously looting the Old Summer Palace in Beijing in 1860.

THE RISE OF MODERN CITIES (LATE-19TH TO LATE-20TH CENTURIES)

In the late 19th and early- to mid- 20th centuries, the ancient and colonial cities of the BRICS countries evolved into cities with modern economies.

BRAZIL

The catalyst for Brazil's dramatic urbanisation, with the growth of the mega-cities of São Paulo and Rio de Janeiro, was the introduction of policies of Import Substitution Industrialisation (ISI) in the 1930s. These policies involved the replacement of imports with domestically produced goods, leading to the growth of manufacturing, which drew millions of people into the cities. However, Brazil was 'careless' in its management of urbanisation, and its cities developed under a military dictatorship, with huge socio-spatial inequalities – infamously associated with the mass growth of *favelas* (or informal settlements) on spatially marginal land (Turok, 2014).

Brasília was established in 1960 as one of the world's newest cities, as part of an ambitious plan to occupy and modernise the thinly-populated interior. The relocation of the national capital to Brasília meant a loss of position for Rio de Janeiro. Brasília's emergence as a modern city was paralleled by the rise of other, secondary cities. Curitiba, for example, was a small provincial city in 1950 but grew rapidly from that time, acquiring global recognition for its urban innovation, including the world's first Bus Rapid Transit (BRT) system. Across Brazil, however, innovation and development was stifled by the military dictatorship which came into power in 1964.

RUSSIA

Russia's economy had grown slowly through the nineteenth century, with the vast territories of the Russian Empire remaining largely rural and agricultural. Towards the end of the 19th century, there were reforms which allowed for the growth of industry – and of the working class, which was to topple the Tsars in the 1917 revolution. There was also large-scale expansion of rail and road networks which supported economic growth. Novosibirsk, for example, developed from the mid-19th century as a strategic crossing point on the Ob River along the Trans-Siberian Railway, which connected the vast territories of the Russian Empire. Under Soviet rule the economy was centrally planned, and there were periods of 'forced industrialisation' which led to the rapid growth of large cities, as well as the creation of new industrial cities. From the 1970s, however, Russia's economy skewed away from industry towards oil and gas, responding to the huge fuel-price increases in this decade. Moscow benefited enormously from the relocation of the capital from St. Petersburg in 1918, and eclipsed its competitor city in growth.

INDIA

India's modern urban economy began developing in the mid-19th century. In 1854, the first cotton mills opened in Bombay (Mumbai), with the city developing as the world's chief cotton production and trading market. Industry also developed around the ports of Calcutta (Kolkata) and Madras (Chennai). As poor rural people flocked to these developing cities, huge slums emerged which still characterise urban India. In the late 19th century India's massive railway system was built, which was a further catalyst for economic development, linking the colonial enclaves into a national economic system. Hyderabad, famous for pearl and diamond dealing, was also linked into the wider economy and developed an industrial sector.

Shenzhen

India had a traumatic birth as an independent nation in 1947, with the partition between mainly Hindu India and Muslim Pakistan. There were mass flows of refugees from and into cities, which played a major role in shaping the nature of current urban agglomerations. Hyderabad presented a curious case, as the Nizams resisted incorporation into India, prompting the Indian army to occupy the city. Some cities in India benefited from post-colonial rule and others lost position. Delhi's power and prestige was assured in 1949 when it was confirmed as the capital of the Union of India. Kolkata was the city that suffered the greatest loss in economic power, with civil strife, mass influx of refugees, and a state government hostile to business. After independence India continued to urbanise slowly, with a strong bias towards rural areas.

CHINA

China went through a turbulent period from the mid-19th to the mid-20th centuries, with many of its great cities in decline – though there were periods of growth for some cities. Wuhan, for example, emerged in the late 19th century as China's first modern industrial city, with heavy industry such as steelmaking linked to coal mining. Nanjing became the national capital during republican rule in the early 20th century, while Shanghai maintained its international and cosmopolitan reputation until the Japanese occupation in the late 1930s. During Maoist rule there was a short period of industry-led urbanisation in the 1950s, following the Soviet model, but the Cultural Revolution in the 1960s and 70s was associated with anti-urban policies, and the numbers of urban dwellers in China actually decreased in this period. Cities such as Shanghai were neglected – and declined, relatively – but there were some cities which did benefit. For example, heavy industry was concentrated in Manchuria in the north of China, with Shenyang, for instance, developing as a major industrial hub and as the third-largest city in the country. Mao Zedong also moved industry away from the coast into the more secure interior, benefiting cities such as Chongqing, Chengdu and Xi'an. Beijing benefited at Nanjing's expense in 1949, when it was confirmed as the new capital of the People's Republic of China.

SOUTH AFRICA

South Africa's modern urban economy emerged in the late 19th century with the discovery of diamonds and gold in the hinterland. Johannesburg was founded in 1886, along with a string of other gold-mining towns along the Witwatersrand. South Africa also followed ISI strategies from around

the 1940s, with the emergence of the East Rand (Ekurhuleni) as a major hub of industry by the 1960s, and industrial growth around the port cities of Durban (eThekwini) and Cape Town. Pretoria (Tshwane) and Cape Town were affirmed as joint capitals of the Union of South Africa in 1910, and retain key government functions. In 1948 the apartheid government came to power, and South Africa's cities were restructured along racial lines, creating massive urban inequalities. There were also controls on the movement of black Africans into cities, which slowed urbanisation processes.

RUPTURES IN THE LATE 20TH CENTURY (AND 21ST CENTURY DEVELOPMENT)

There were far-reaching political changes towards the end of the 20th century that were to change the trajectories of urban development.

BRAZIL

In Brazil, the military dictatorship came to an end in 1985. A new national constitution, which guaranteed personal freedom and which constituted the federal structure of Brazil, was approved in 1988. Within civil society structures in Brazil a National Urban Reform movement evolved, which rejected the idea of the city as a source of profit for the privileged and which called for 'rights to the city'. In 2003, the Workers Party (PT) came to power under President Lula da Silva, who initiated a series of progressive urban reforms including the regularisation and upgrading of the *favelas*. By the 2000s Brazil was a highly urbanised country, and the growth of large cities had slowed down considerably. However, within large cities there has been continued restructuring – with industry in São Paulo, for example, moving to the metropolitan edge, and the core city evolving as a hub of high-end tertiary activities such as financial services. Many of Brazil's cities suffered de-industrialisation in the 1980s, but stabilised and continued to grow in the 2000s; although the recent economic crisis in Brazil may have reversed some of these gains.

RUSSIA

In Russia, Soviet rule came to a dramatic end in 1991. Multi-party electoral politics was established by the shock therapy of a sudden introduction of a capitalist economy, which led to an economic crisis in the 1990s and the rise of private oligarchies. For many of Russia's cities these events were dramatic. St. Petersburg, for example, had developed as a hub of state-owned heavy industry, and the transition in the 1990s brought severe economic distress. Novosibirsk was a centre of defence-related industries, and was also badly affected. Moscow was the exception: in 1991 it was confirmed as the capital of the Russian Federation, and it consolidated its position as the financial, economic and political heart of Russia and the gateway to the global economy. In the 2000s, cities including St. Petersburg and Novosibirsk successfully transitioned to new economies, but many poorly-located cities in Russia's interior continued to experience decline.

INDIA

India is a possible exception to these trends, as it did not experience such a dramatic break in the late 20th century as the other BRICS did. However, there was a far-reaching shift in policy in 1991, with the launch – after four decades of strong state involvement in the economy – of a programme of economic liberalisation. This led to offshore investment in India by multinational companies, and the rise of cities such as Bengaluru (Bangalore), Chennai and Hyderabad as hubs of a 'new economy'. Nevertheless, the majority of the urban population in India remained in low-end service and informal employment.

CHINA

In China, Maoist rule ended in the 1970s, when Deng Xiaoping led China into a new era of experimental reform, associated with the opening of the national economy to the world and dramatic economic growth. The urban growth in this era was launched in 1980 with the designation of Shenzhen as a Special Economic Zone (SEZ). Shenzhen became China's 'instant city', developing in decades from a small fishing town into a large international city. Soon, the entire expanded city-region known as the Pearl River Delta had developed into a mega-urban agglomeration, with the rapid growth of cities including Guangzhou, Dongguan and Foshan. Beijing and its gateway, Tianjin, also developed rapidly during the reform era, with the headquarters of China's massive State-Owned Enterprises (SOEs) driving the growth of business services, including the finance industry.

In 1991 Shanghai was designated for development, ending decades of neglect. The Pudong New Area expanded dramatically as one of East Asia's leading hubs of financial services. There was also a revival in the fortunes of the ancient cities of Suzhou and Hangzhou, which developed around technology-intensive manufacturing and cultural industries.

Through the 1980s and 1990s the focus of growth was on the east coast of China, around the port serving the new export-oriented industry. Cities in the interior lagged behind, creating new spatial inequalities. But in 2000 the 'Go West' policy was launched, which brought massive new investments into cities such as Chongqing, Chengdu and Xi'an – with Chongqing, for example, emerging as possibly as the world's fastest-growing large-city economy. Not all cities have prospered in the reform era, however: cities dependent on state-owned heavy industry, such as Shenyang, have suffered employment loss and a relative decline in population.

SOUTH AFRICA

Apartheid rule came to an end in the early 1990s, with South Africa's first democratic election in 1994. With the removal of controls on rural-urban migration during the final years of apartheid rule, there was acceleration in the rate of urbanisation. Much of the growth has focused in the GCR, where Johannesburg has reinforced its position as the business hub of South Africa, with the financial sector as a leading driver of growth. Pretoria (Tshwane) diversified away from government services, while the East Rand (Ekurhuleni) has sustained a large manufacturing sector. The performance of the coastal cities has been variable; although Cape Town has consolidated its position as a global tourism hub.

SUMMARY

BRICS cities are too diverse to be regarded as an analytical category, but there are interesting points of comparison. The multiple histories suggest, for example, that access to political power has been an important factor in the performance of cities in the BRICS. Cities that have served as national capitals, for instance, have generally done well; and when they have lost this status, they have often experienced periods of decline.

Broadly speaking there are two categories of cities – those which had their origins in precolonial times, and those that are a product of colonialism. But since many of the precolonial cities have been affected by colonialism in some way during their long history, the effects of these diverse origins are blurred. To some degree, at least, the colonial experience is a point of commonality across BRICS cities (with Russia as an exception, and China as a partial exception).

The other point of commonality comes from the far-reaching political and economic transitions that all BRICS countries (even India, if we count the economic liberalisation of the 1990s) experienced towards the end of the 20th century. Urban processes have been significantly shaped by these transitions, although in diverse ways.

POPULATION

DATA

The key source of population data in the BRICS is the national census reports of the respective countries. The difficulty in relating this data to cities in the BRICS is that urban agglomerations are not contained within formal institutional boundaries. However, the UN Population Division World Urbanisation Prospects reports do provide comparative data across all countries globally on urban agglomerations with more than 300 000 people, matching population figures with the actual extent of the urban spread. A time series is provided since 1950, with projections to 2030 for cities and to 2050 for countries and global regions.

EMBEDDED IN THE NATIONAL

The demography of cities does need to be understood in relation to the broader national demography. In Russia, for example, the static or declining population of many cities must be understood in terms of a national population growth of near zero. Similarly, accelerating urban growth in some of India's cities could be understood in terms of relatively high national population growth and existing low levels of urbanisation.

Table 1.1 Population figures for BRICS countries

Country	Total population in millions, 2014	Annual rate of population change, 2010-2015	Total urban population in millions, 2015	Annual urban growth rate, 2010-15
BRAZIL	207.9	0.9	174.5	1.0
RUSSIA	143.5	0.0	105.2	-0.1
INDIA	1311.1	1.3	420.0	2.4
CHINA	1376.1	0.5	779.5	3.1
SOUTH AFRICA	54.5	1.1	34.7	1.6

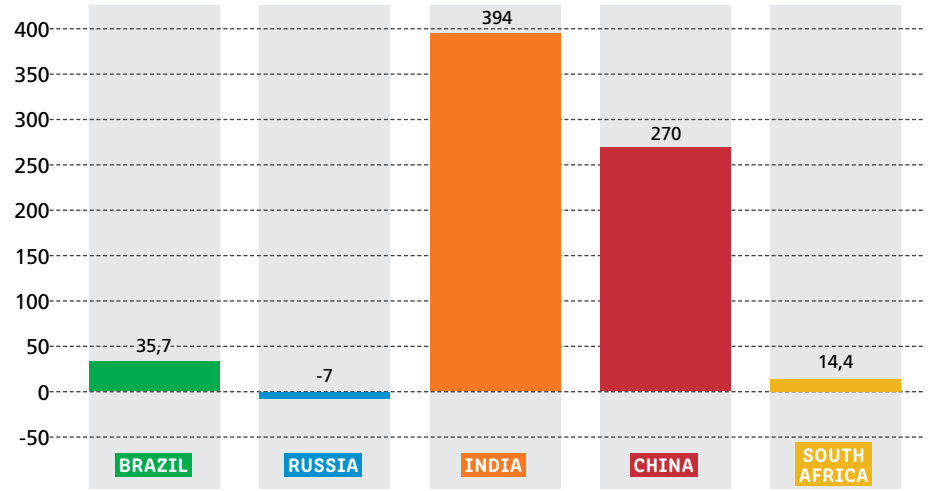
Sources: UN Population Division, 2016

The BRICS have a very large combined population, of 3.09 billion; but relatively slow annual growth rates, ranging from zero for Russia to 1.3% in India. The total urban population is 1.5 billion; and so the BRICS has an urbanisation rate of 50%, an even balance between rural and urban populations. However, this aggregate obscures the huge range in urbanisation rates, from 32.7% in India to 85.7% in Brazil. Urban growth rates over the past half-decade have ranged from -0.1% for Russia to a relatively rapid 3.1% for China. It is evident that we cannot generalise across the BRICS. It is not true, for example, that the BRICS are commonly experiencing high rates of urban growth.

The UN has made projections into the future. In the case of Russia, negative urban growth is expected to 2050, with the urban population gradually declining in real terms. Brazil's growth is expected to be less than 1% in 2016, with growth rates continuing to decline until near-zero in 2015. China's urban growth is currently high, but rates of growth may be less than 1% by 2030, with the possibility of negative rates by 2050. South Africa's urban growth is also expected to be less than 1% by 2030. The one exception is India, where rates of urban growth may be maintained at relatively high rates – above 2% per annum – until at least 2030.

While the BRICS may expect a steady fall-off in the rate of urban growth, even slow growth of a large population may result in significant additional urban population. The anticipated real change in urban population is indicated below. India and China are where the overwhelming bulk of new urban growth is expected; but significantly, India is expected to contribute more to this growth than China.

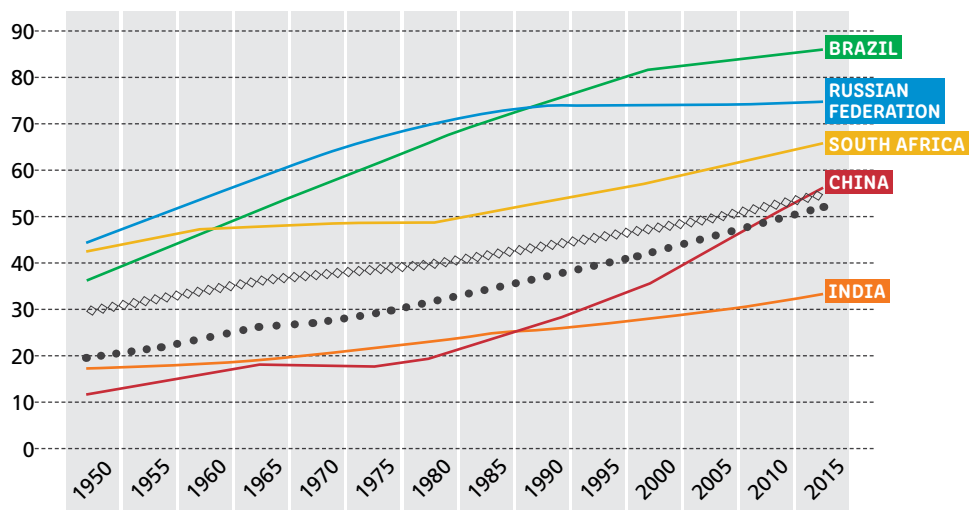
Figure 1.1: Anticipated urban population change in millions for BRICS countries, 2015-2050



Source: UN Population Division, 2016

Figure 1.2 below reveals the urbanisation trends in the BRICS between 1950 and 2015, with comparison to overall trends for the World and for Middle-Income Countries (see also DATA SHEET ONE in the Annexure at the end of the chapter). It reveals again the diversity in the BRICS, and the risks of generalisation.

Figure 1.2: Levels of urbanisation in BRICS countries, 1950-2015



Data source: UN Population Division, 2016

Urbanisation levels in the world have trended up, from around 30% to the current 54%, and middle- income countries in aggregate from 19% to 51%. Within the BRICS, of course, the overall pattern has been the upward trend; but with significant differences in terms of rate of increase, and even with periods of decline for individual countries. In 1950, Russia, South Africa and India were more urbanised than the world average, but were all less than 50%. Russia experienced a sustained

increase in levels of urbanisation until the end of Soviet Rule, around 1990, when 73.3% of the population was in urban areas. Here, urbanisation halted suddenly at that time. There was a dramatic and relentless increase in levels of urbanisation in Brazil from 1950, although with a slowdown from around 2000. The urbanisation level in Brazil in 2015 was 85.7%, similar to the most urbanised countries in Europe. By contrast, South Africa's rates of urbanisation were slow, constrained by race-based controls on migration. From the late 1980s, however, with the removal of the 'pass laws', urbanisation has accelerated, and in 2015 was at 64.8%.

In 1950 India and China had very low levels of urbanisation, at 17% and 11% respectively. They were both overwhelmingly rural countries. India's urbanisation level has trended up very gradually, constrained by anti-urban policies, but with modest acceleration over the past decade as more urban-friendly policies have been introduced. But urbanisation levels are still around 32.7%, leaving considerable space for further urban growth. China began to urbanise in the 1950s, but the anti-urban policies of the Cultural Revolution led to a decline in urbanisation levels in the 1960s and early 1970s. From around 1980, however, urbanisation resumed – this time, at an extremely rapid pace. In 1980 China was still only 19% urbanised; but this increased to 55.6% by 2015.

THE CITIES OF THE BRICS

In the section below we discuss the cities in the BRICS in terms of size distribution and ranking, population growth, population density, population diversity, and wealth and poverty.

SIZE DISTRIBUTION AND RANKING

The United Nation's Population Division has a database that includes 695 cities in the BRICS countries, each with a population of over 300 000 people. This is over 40 per cent of the total number of cities in the world that appear in this database.

Table 1.2: Number of cities across size range in the BRICS

Country	Small Cities (0.3-0.99)	Medium-sized Cities (1-3.99 mill)	Large Cities (4-9.99 mill)	Mega-Cities (10-19.99 mill)	Super-sized cities (20 mill plus)	Total Cities
BRAZIL	35	17	2	1	1	56
RUSSIAN FEDERATION	50	11	1	1	0	63
INDIA	109	49	5	2	2	167
CHINA	295	83	15	4	2	399
SOUTH AFRICA	4	5	1	0	0	10
TOTAL BRICS	**493**	**165**	**24**	**8**	**5**	**695**

Data Source: UN Population Division, 2016

DATA SHEET ONE in the Annexure provides a full listing of one million-plus cities in the BRICS, in rank order. The table below gives the Top Thirty BRICS cities in terms of population size. It indicates five super-sized cities: Delhi, Shanghai, São Paulo, Mumbai and Beijing. Each of these cities is in the Global Top Ten. The mega-cities with populations of over ten million people each are in the Global Top Thirty. Put differently, of the thirty largest cities in the world, thirteen are in the BRICS.

The table below also indicates the relationship between the Factsheets and the distribution of BRICS cities by size. There are some cities in the BRICS Top Thirty that are not included in the Factsheets (Dongguan, Nanjing, Ahmadabad, Hong Kong, Foshan, Pune, Belo Horizonte and Surat). But there are also cities ranked lower than the Top Thirty which are included (St. Petersburg, Brasilia, Cape Town, Salvador, Curitiba, Durban and Novosibirsk).

Table 1.3: Top Thirty BRICS Cities in Terms of Population Size, 2015 (with * indicating cities for which there are Factsheets)

City	Country	Population in 2015 (in millions)	World Ranking
1. Delhi*	INDIA	25.70	2
2. Shanghai*	CHINA	23.74	3
3. São Paulo*	BRAZIL	21.07	4
4. Mumbai (Bombay)*	INDIA	21.04	5
5. Beijing*	CHINA	20.38	7
6. Kolkata (Calcutta)*	INDIA	14.86	14
7. Chongqing*	CHINA	13.33	16
8. Rio de Janeiro*	BRAZIL	12.90	19
9. Guangzhou*	CHINA	12.46	20
10. Moskva (Moscow)*	RUSSIA	12.17	22
11. Tianjin*	CHINA	11.21	24
12. Shenzhen*	CHINA	10.75	26
13. Bengaluru (Bangalore)*	INDIA	10.09	29
14. Chennai (Madras)*	INDIA	9.89	31
15. Central Witwatersrand*	SOUTH AFRICA	9.40	35
16. Hyderabad*	INDIA	8.94	37
17. Wuhan*	CHINA	7.91	41
18. Chengdu*	CHINA	7.56	42
19. Dongguan	CHINA	7.43	43
20. Nanjing	CHINA	7.37	44
21. Ahmadabad	INDIA	7.34	45
22. Hong Kong (SAR)	CHINA	7.31	46
23. Foshan	CHINA	7.04	48
24. Hangzhou*	CHINA	6.39	52
25. Shenyang*	CHINA	6.32	54
26. Xi'an*	CHINA	6.04	56
27. Pune (Poona)	INDIA	5.73	59
28. Belo Horizonte	BRAZIL	5.71	60
29. Surat	INDIA	5.65	62
30. Suzhou*	CHINA	5.47	68
Factsheet Cities outside the BRICS Top Thirty			
32. St. Petersburg*	RUSSIA	4.99	74
37. Brasilia*	BRAZIL	4.16	91
46. Cape Town*	SOUTH AFRICA	3.66	106
48. Salvador*	BRAZIL	3.58	112
51. Curitiba*	BRAZIL	3.47	120
63. Durban (eThekwini Metro)*	SOUTH AFRICA	2.90	151
65. Pretoria (Tshwane Metro)*	SOUTH AFRICA	2.82	154
123. Novosibirsk*	RUSSIA	1.50	321

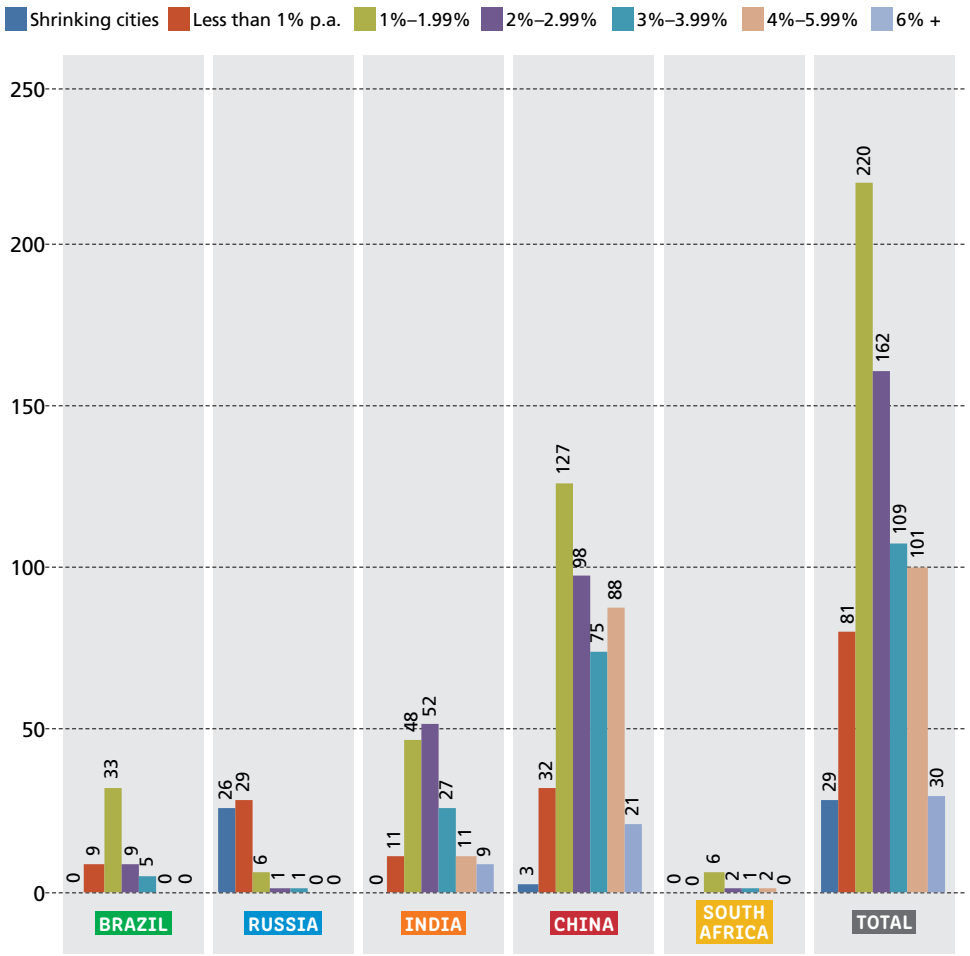
Data Source: UN Population Division, 2016

Note: The separately defined Pretoria and Soshanguve urban agglomerations in the UN data were combined in the table below, so there is a slight difference to the UN data in rankings.

POPULATION GROWTH

The table below indicates the wide variation in population change across the BRICS. Most BRICS cities are somewhere in the range between 0% annual growth and 6%, but there are cities shrinking and growing faster. The fastest-growing city in the BRICS in the period 2010-2015 was the small city of Miluo in southern China, with an average annual growth rate of 10.3% per annum, and the fastest shrinking city was Yichun, in northern China, with an average rate of change of -1.6% per annum.

Figure 1.3: Number of cities in each BRICS country in different categories of urban growth



Data Source: UN Population Division, 2016

Most of Brazil's cities are growing in the range of 1-1.99% per annum. They are slow-growing, mainly as a result of Brazil's already high rates of urbanisation. The fastest-growing cities in Brazil (3-3.99%) are mainly in the Amazon Basin, and are growing mainly through resource extraction.

The bulk of Russia's cities are either shrinking or almost static in growth, the result of a slightly declining overall national population and no further increase in urbanisation levels. Twenty-six of the 29 shrinking cities in the BRICS are in Russia. There are a few cities growing in the range of 1-1.99% – including Moscow, which has consolidated its position in the post-Soviet era as the political and economic hub of Russia; and also a small number of well-located cities in the east of the country, or cities growing through resource extraction. The fastest-growing city in Russia is Yakutsk (3%), a city north of the Arctic Circle which is a major supplier of diamonds.

Most of India's cities are growing moderately fast, in the range of 1-3%, although there are a number with higher rates. The fastest-growing city in India for 2010-15 was Hosur, a small industrial satellite city beyond the edge of Mumbai with an average annual growth rate of 9.9%. In general, the fastest-growing cities in India are small but on the edge of large urban agglomerations, and are benefiting from the growth of sectors such as IT. There are a number of large secondary cities in India growing relatively fast (in the range 3-5%), including Surat, Bangalore and Hyderabad; with the capital, Delhi, also growing relatively fast, at 3.2%. The other mega-cities in India are experiencing relatively slow growth.

China is enormously diverse and has a large range in its urban growth rates. Most cities fall within the range of 1-6%, but with negative growth at the one extreme and growth of around 10% at the other. Like India, the fastest-growing cities in China are mainly small. However, there are a handful of moderately large cities (populations of over two million) which have experienced average annual growth of more than 5% per annum since 2010, including Xiamen, Zhongshan, Suzhou, Huizhou and Huai'an. Xiamen, for example, is a city of 4.4 million people that tops the quality-of-life indexes in China, and is attracting hi-tech development supported by high-end professionals. Guangzhou and Beijing are the fastest-growing of the mega-cities, with average annual growth rates of 5.2% and 4.6% respectively. Many of the other fast-growing cities (3-5%) are moderately sized and are on the edges of the major city-regions such as the Pearl River Delta and Yangtze River Delta; or in the interior of China, benefiting from massive state investment in terms of the 'Go West' policy. Beijing is the fastest-growing of the mega-cities, with average annual growth of 4.1%, driven mainly by government and business services. The declining or static cities are mainly in the industrial 'rust belt' in the extreme north-east of the country.

Of course, South Africa is a small player in terms of urban development. Most of the urban agglomerations recognised in the UN Database are growing relatively slowly (1-2%). The faster-growing cities (3-4.5%) are in the Gauteng City Region (GCR), with the fastest-growing city being Rustenburg, in the Platinum Belt on the edge of the GCR, with average annual growth of 5.6%.

The average annual growth rates of the 30 largest cities in the BRICS are indicated below.

Table 1.4: Average annual growth of the largest BRICS Cities, 2010-15 (with * indicating cities for which there are Factsheets)

City	Country	Population in 2015 (in millions)	Percentage Average Annual Growth, 2015-15
Delhi*	INDIA	25.70	3.2
Shanghai*	CHINA	23.74	3.4
São Paulo*	BRAZIL	21.07	1.4
Mumbai (Bombay)*	INDIA	21.04	1.6
Beijing*	CHINA	20.38	4.6
Kolkata (Calcutta)*	INDIA	14.86	0.8
Chongqing*	CHINA	13.33	3.4
Rio de Janeiro*	BRAZIL	12.90	0.8
Guangzhou*	CHINA	12.46	5.2
Moskva (Moscow)*	RUSSIA	12.17	1.2
Tianjin*	CHINA	11.21	3.4
Shenzhen*	CHINA	10.75	1.0
Bangalore*	INDIA	10.09	4.0
Chennai (Madras)*	INDIA	9.89	3.0

City	Country	Population in 2015 (in millions)	Percentage Average Annual Growth, 2015-15
Central Witwatersrand*	SOUTH AFRICA	9.40	3.2
Hyderabad*	INDIA	8.94	3.3
Wuhan*	CHINA	7.91	1.0
Chengdu*	CHINA	7.56	3.8
Dongguan	CHINA	7.43	0.9
Nanjing	CHINA	7.37	3.6
Ahmadabad	INDIA	7.34	3.4
Hong Kong (SAR)	CHINA	7.31	0.7
Foshan	CHINA	7.04	1.1
Hangzhou*	CHINA	6.39	4.6
Shenyang*	CHINA	6.32	2.1
Xi'an*	CHINA	6.04	3.2
Pune (Poona)	INDIA	5.73	2.9
Belo Horizonte	BRAZIL	5.71	1.1
Surat	INDIA	5.65	4.8
Suzhou*	CHINA	5.47	4.7

Data Source: UN Population Division, 2016

In terms of UN data, the fastest-growing of the largest cities in the BRICS are Guangzhou, Suzhou, Hangzhou and Beijing in China, and Surat and Bangalore in India. The growth in China's cities relates to success in transition to high-end manufacturing, although Beijing's growth is driven mainly by government and business services. In India, Surat has captured a significant share of the world's diamond cutting and polishing, while Bangalore is a major hub of ICT. A number of other large cities are growing relatively fast (3-4%), but there are also slow-growing large cities, including those in China battling to transition from mass-production in the export market to high-end manufacturing (e.g. Shenzhen, Foshan, Dongguan); and those in Brazil and Russia, where a combination of already-high levels of urbanisation and low national growth rates are leading to slow city growth. There are some cities with their own particularities: such as Kolkata in India, which experienced decades of low economic growth (for reasons detailed in the Factsheet); and Hong Kong, a city with a large and mature economy, but which is partly separated politically from its hinterland, and relatively difficult to move into.

POPULATION DENSITY

It is extremely difficult to find reliable, updated comparative data on population density, and it is for this reason that we have not included the density calculations in the Factsheets. There are comparative sources that provide comparative gross densities by dividing total population into the area of urban municipalities; but this is often seriously misleading, as boundaries of municipalities and urban agglomerations rarely coincide. There have been attempts to calculate city footprint density by determining the ratio of total population to the total area of the urban agglomeration, but the use of different criteria to determine the extent of an urban agglomeration produces significant discrepancies between data sources. In the table below we draw on three sources. The first source, Demographia Urban Areas, is based on an attempt to link population to an extended urban agglomeration; while the second, City Mayors, only provides density figures for the core municipal areas (Demographia, 2016; World Mayors, 2007). In general, the densities for the urban agglomerations are lower than for the core cities.

Table 1.5: Population densities in large BRICS cities (with * indicating cities for which there are Factsheets)

City	Country	Demographia World Urban Areas, 2016 pp/km2 (urban agglomeration)	City Mayors, 2007 pp/km2 (core city)
Delhi*	INDIA	11 900	11 050
Shanghai*	CHINA	5 800	13 400
São Paulo*	BRAZIL	7 600	9 000
Mumbai (Bombay)*	INDIA	26 000	29 650
Beijing*	CHINA	5 200	11 500
Kolkata (Calcutta)*	INDIA	12 300	23 900
Chongqing*	CHINA	7 700	N/A
Rio de Janeiro*	BRAZIL	5 800	6 850
Guangzhou*	CHINA	4 900 *(Guangzhou-Foshan)*	N/A
Moskva (Moscow)*	RUSSIA	3 100	4 900
Tianjin*	CHINA	5 600	10 500
Shenzhen*	CHINA	7 000	17 150
Bengaluru*	INDIA	8 700	10 100
Chennai (Madras)*	INDIA	10 300	14 350
Central Witwatersrand*	SOUTH AFRICA	3 300	2 396
Hyderabad*	INDIA	6 300	9 100
Wuhan*	CHINA	5 800	N/A
Chengdu*	CHINA	6 300	N/A
Dongguan	CHINA	5 100	N/A
Nanjing	CHINA	4 800	N/A
Ahmadabad	INDIA	21 200	N/A
Hong Kong (SAR)	CHINA	25 600	N/A
Foshan	CHINA	4 900 *(Guangzhou-Foshan)*	N/A
Hangzhou*	CHINA	6 000	N/A
Shenyang*	CHINA	6 100	9 250
Xi'an*	CHINA	6 600	N/A
Pune (Poona)	INDIA	12 100	N/A
Belo Horizonte	BRAZIL	4 200	4 600
Surat	INDIA	24 400	N/A
Suzhou*	CHINA	4 200	N/A
St. Petersburg*	RUSSIA	3 800	8 550
Brasilia*	BRAZIL	3 800	2 800
Cape Town*	SOUTH AFRICA	4 700	3 950
Salvador*	BRAZIL	9 200	N/A

City	Country	Demographia World Urban Areas, 2016 pp/km2 (urban agglomeration)	City Mayors, 2007 pp/km2 (core city)
Curitiba*	BRAZIL	3 800	3 850
Pretoria*	SOUTH AFRICA	2 500	2 750
Durban*	SOUTH AFRICA	3 200	3 500
Novosibirsk*	RUSSIA	2 400	N/A

Sources: Demographia (2016) and City Mayors (2007)

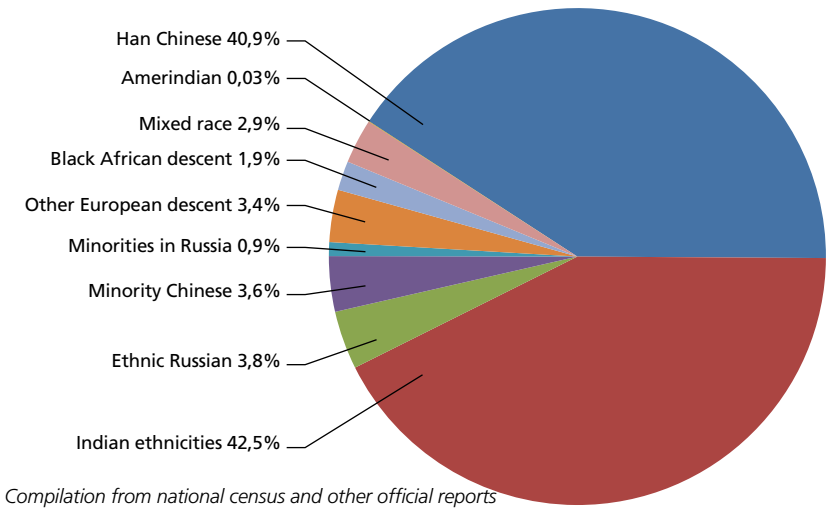
There are significant national variations in the data, although also intra-national variation. Demographia (2016) calculates the average density of large cities as 12 100 pp/km2 for India, 5 700 pp/km2 for China, 5 100 pp/km2 for Brazil, 3 300 pp/km2 for South Africa and 3 200 pp/km2 for Russia. India's urban densities are among the highest in the world, with comparable densities only in neighbouring Pakistan and Bangladesh, and in a few countries (Egypt, Yemen and Turkey) in North Africa and the Middle East. In terms of individual cities the densest in the BRICS (depending on exact calculation) may be Mumbai, followed by Hong Kong and Surat. The least dense cities are generally in South Africa and Russia, and include Novosibirsk, Durban, Pretoria, Moscow and the Central Witwatersrand (Johannesburg-Ekurhuleni).

POPULATION DIVERSITY

Of course, the BRICS are enormously diverse in population terms, in relation to categories such as ethnicity, language and belief system (and in relation to many other dimensions).

In terms of ethnicity there is diversity in the BRICS; but given the massive size of the populations of China and India, the ethnic preponderance is Indian (of various separate ethnicities) and Han Chinese, followed by ethnic Russian, minority Chinese, other European (mainly in Brazil), mixed race, and black African.

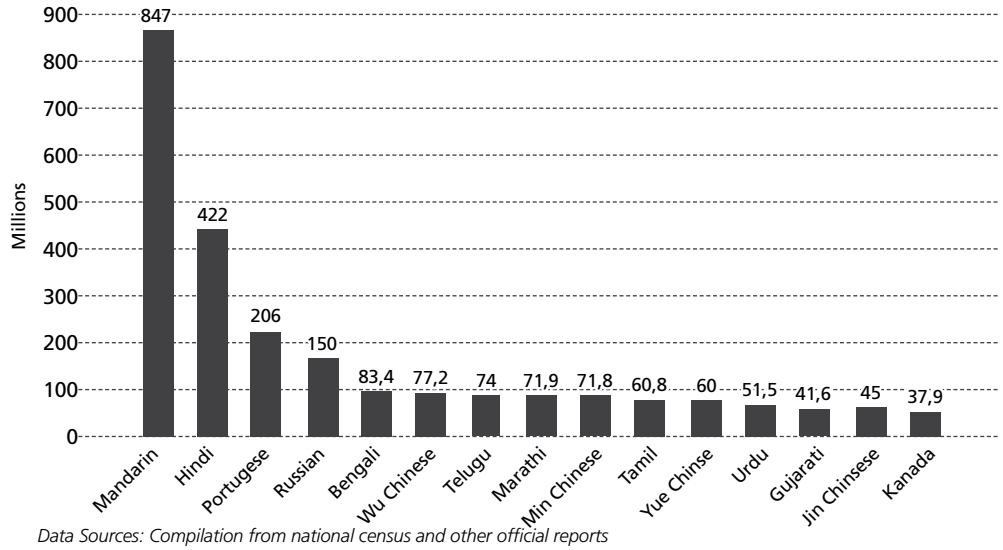
Figure 1.4: Ethnicity in the BRICS



Data Sources: Compilation from national census and other official reports

In terms of mother tongue the dominant languages are Mandarin Chinese, Hindi, Portuguese and Russian, with a number of other Chinese and Indian languages. There are of course hundreds of other languages spoken across the BRICS; but some have relatively few native speakers, with a number (especially in India and Brazil) endangered.

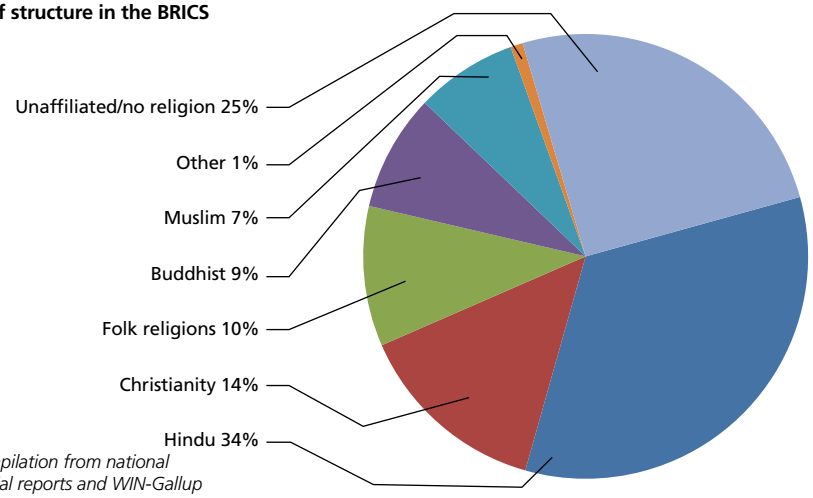
Figure 1.5: Mother-tongue speakers in the BRICS (Millions)



Data Sources: Compilation from national census and other official reports

For the comparative view on religion it is necessary to combine a number of sources, including the population census reports (although religion is not always included), national surveys, and the WIN-Gallup Global Index of Religion and Atheism. The largest single belief system in the BRICS is Hinduism (mainly in India), followed by the category 'non-religious', which largely reflects the large majority in China which is not formally affiliated to any religion. Christianity follows with 14%, but is divided between Russian Orthodox, Roman Catholic, mainstream Protestant and Pentecostal Protestant. Other significant minority religions in the BRICS are Buddhism and Islam, with a diversity also of folk religions.

Figure 1.6: Belief structure in the BRICS



Data Sources: Compilation from national census, other official reports and WIN-Gallup

Diversity is addressed differently across the various national census reports, so easy comparison is not possible. The Brazilians use skin colour; the Russians and Chinese emphasise ethnicity; India lays stress on religion; and South Africa categorises race.

BRAZIL

Brazilian society is a complex amalgam of people of different origins, including: the Native Americans (Amerindians); the black African slaves; the Portuguese colonisers; and a mix of other European, Asian and Latin American immigrants. The IGBE has simplified this complexity into Branco (white), Pardo (brown or mixed race), Preto (black), Amarelo (yellow), and indigenous. In 2010 Brazilians self-identified as 47.7% white, 41.1% brown, 7.6% black, 1.1% yellow and 0.4% indigenous. 99% of Brazilians speak Portuguese as a home language, but there are European and Asian immigrant languages still spoken; and a diversity of indigenous languages, some of which are endangered.

There are differences across Brazil's cities. Curitiba and São Paulo, for example, have a proportionately larger white population than most other cities (79% and 66% respectively) while Rio de Janeiro's population is closer to the national mix. Brasilia has a roughly equal proportion of white and brown, and Salvador is a city with a very high proportion of brown and black, reflecting a history of African slavery.

Although Brazil's urban population is overwhelmingly descended from immigrants, currently only a very small proportion is foreign born. The highest proportions are in São Paulo and Rio de Janeiro, but the figures there are only 1.3% and 1.1% respectively. Of the foreign born, many are from Paraguay and Bolivia, and provide low-wage labour in Brazil's manufacturing and service sectors.

RUSSIA

The Russian Federation has 185 designated nationalities, although there is huge variation in terms of the size of these groups. Census 2010 indicated that 80.9% of the residents of Russia are ethnically Russian, with the largest ethnic minorities being Tatar (3.9%), Ukrainian (1.4%), Bashkir (1.1%), Chuvash (1.0%), Chechen (1.0%), Armenian (0.9%), Avar (0.7%) and Mordvin (0.5%). Russian is the home language of 150 million people, but there are at least 35 languages that have official status in some form in different parts of Russia, and another 70 or so minority languages.

Russia's cities are overwhelmingly ethnic Russian (with far lower percentages of ethnic minorities in the large cities than elsewhere); but the composition of the minority population does differ between cities, with more Ukrainians, for example, in the east of Russia.

CHINA

92% of the population of China is ethnically Han, but there are 55 other recognized minority groups, the largest of which are Zhuang (1.27%), Hui (0.8%), Manchu (0.8%), Uyghur (0.8%), Miao (0.7%), Yi (0.7%), Tujia (0.6%), Tibetan (0.5%) and Mongol (0.4%). There is also significant language diversity in China. 70.9% have Mandarin as a home language, but other linguistic groupings include Wu (6.5%), Min (6%), Yue (5%), Jin (3.8%), Xiang (3.0%) and Hakka (2.5%), with many others in addition. The so-called Standard Chinese is based on the Beijing dialect of Mandarin.

All 55 ethnic minorities are present in China's large cities; but as in Russia, the minorities are still disproportionately in the rural areas, and the cities are overwhelmingly Han Chinese. The foreign-born population is proportionately very low, with the highest, in Shanghai, at 0.7%.

INDIA

According to the 2011 national census, 79.8% of the population of India practises Hinduism, with the minority religions including Islam (14.2%), Christianity (2.3%), Sikh (1.7%), Buddhism (0.7%) and Jain (0.4%). There is a massive diversity of languages in India. There are at least 122 languages spoken by more than 10 000 people each, and around 780 languages in total. The language return for the 2011 national census is still not available, but the 2001 return indicated the major home languages to be Hindi (spoken by 41% of the population), Bengali (8.1%), Telugu (7.2%), Marathi (7%), Tamil (5.9%), Urdu (5%), Gujarati (4.5%), Kannada (3.7%), Malayalam (3.2%), Oriya (3.2%) and Punjabi (2.8%).

Language is regionally concentrated, with no single language spoken across India. In Telangana (which includes Hyderabad) the official language is Telugu; in Maharashtra (Mumbai) it is Marathi; in Tamil Nadu (Chennai) it is Tamil; in West Bengal (Kolkata) it is Bengali; in Karnataka (Bengaluru) it is Kannada; and, in Delhi it is Hindi, Punjabi and Urdu. Although Hinduism is the majority religion across India, its dominance and the composition of minority religions varies. In Chennai, for example, around 9% of the population is Muslim; but this increases to 30% in Hyderabad.

SOUTH AFRICA

In terms of the 2011 national census, South Africa, colloquially known as the 'rainbow nation' was 79.2% black African, 8.9% each for white and coloured (mixed race), and 2.5% Indian/ Asian. In terms of language there was a diverse mix. There are 11 official languages, although English is dominant in business and politics. The major home languages are isiZulu (22.7%), isiXhosa (16%), Afrikaans (13.5%), English (9.6%), Sepedi (9.1%), Setswana (8%), and Sesotho (7.6%).

There are variations across cities. The cities in Gauteng, for example, are highly diverse linguistically – but in Durban, isiZulu is dominant; and in Cape Town, isiXhosa and Afrikaans are the two major languages. The Gauteng cities and Durban in KwaZulu-Natal are predominantly black African, but Cape Town has a roughly equal mix between white, coloured (mixed race) and black African.

SPATIAL FORM

The cities in the BRICS have evolved with different structures, although there are spatial processes common to a number of places that are reshaping cities.

BRAZIL

During the period of mid- to late-20th-century industrialisation, Brazil's large cities developed rapidly and haphazardly. A particular feature of the development was the large informal settlements (*favelas*), which developed on vulnerable land in the core and on the peripheries of cities. Growth spilled over in uneven ways across municipal boundaries, and was generally managed through the creation of new municipalities. In the contemporary period, city-regions have become increasingly complex. Many economic activities have deconcentrated from the core to the edge of the metropolitan areas, creating a network of new growth hubs and promoting further sprawl of metropolitan regions.

There have been exceptions to these patterns. Curitiba is renowned for its effective management of urban growth, with new urban development linked to transit corridors. Brasilia was developed as a new city, with a grand design and expansive modernist architecture, although a large number of mainly low-income commuting towns developed around the core.

RUSSIA

At different times, Moscow and St. Petersburg were capital cities of an imperial empire, and some of the physical adornment of the past survives in the physical heart of the cities. During the Soviet era, urban development was largely functionalist. Spaces were mono-functional, and development was on a monumental scale. There were large industrial zones, but very little provision for consumption (e.g. commercial precincts); and most of the population was housed in large-scale uniform housing estates, mainly towards the edge of the city. New industrial cities were created in many parts of Russia, including in remote locations.

There have been significant changes in the post-Soviet era. Many of the industrial spaces became derelict after the closure of state-owned industry, and many housing estates are in different stages of dereliction. The most severe problems are in the more remote cities, which have no locational advantage under a market-based economy. At the same time, however, the shift towards a tertiary economy and consumption-related activities, and the new role of private developers, has led to the creation of new offices and commercial spaces. The once clearly defined urban edge has blurred, as city-dwellers have built second homes (dachas) in what were previously green belts around the cities. Russian cities remain largely monocentric, but have become more spatially complex in the post-Soviet era because of these processes. The City of Moscow is attempting to resolve the problems of congestion associated with the monocentric urban form by developing a New Moscow, outside the current city footprint; but whether this proposal will be successful remains to be seen.

INDIA

India has a combination of ancient and early colonial cities. Ancient history has left its traces in terms of 'sacred spaces', for example, and the colonial divide between the densely-packed indigenous quarters and the low-density British cantonments is still visible in places. With urbanisation

Rio de Janeinro

throughout the twentieth century, massive, extremely high-density slums developed within and around the old cities. Densities were extreme in old Mumbai, for example, as the city that developed was contained within what was effectively an island. Densities were also high in Kolkata, where development was restricted to land along the riverine plain.

Patterns began to change towards the end of the 20th century, as core cities de-densified. There were patterns of irregular development around the fringes of cities, but also the development of planned New Cities, such as Navi Mumbai in the case of Mumbai. A network of satellite cities developed around Delhi, while India's economic liberalisation in the early 1990s led to the emergence of hi-tech industrial estates around the edges of cities such as Bengaluru, Chennai, Hyderabad and Pune. Currently, much of the new urban growth in India's large cities is happening along the edges of the emergent city-regions, with varying degrees of de-densification in the core.

CHINA

China's ancient cities were compressed within defensive walls. Although the cities have expanded far beyond these walls, the basic pattern was established of expanding concentric rings, now mainly structured around major freeways encircling the city. During the Maoist era, cities were structured around 'work units', which brought work and residence closely together in a pattern of small, self-contained neighbourhoods quite unlike the Soviet model of expansive mono-functional zoning.

In the Reform era, after 1978, there has been explosive growth of cities. In many cities the low-rise traditional neighbourhoods, including the work units, have been replaced by high-rise superblocks. There has been massive transformation of inner cities, but also large-scale new developments on the urban edge. A particular feature of development is the designated economic zones within and around the cities, which have produced hybrid new industrial-residential cities-within-cities. Famous examples are the Pudong New Area in Shanghai, and the Binhai New Area in Tianjin.

With the sprawling urban development of recent decades, huge city-regions have evolved. The most complex and sprawling city-region is the Pearl River Delta, which includes the old city of Guangzhou (Canton); but also new cities such as Shenzhen and Dongguan, which have developed around massive industrial zones. A particular feature of this region is the 'urban villages' that have developed as the cities have swallowed rural land, allowing the villagers to develop irregular tenements to house new migrants.

Government has attempted to shape new urban growth in various ways. In some cities (e.g. Beijing and Shanghai) there was an attempt to create a belt of satellite towns around the main city, but many of these new developments have failed or have become commuter towns. In other cities the focus of new growth is around axes of development, with growth structured around major transportation networks. In cases such as that of Wuhan, previous attempts at satellite cities are now being linked back into the core cities through axial development. In the major growth areas such as the Pearl River Delta the speed of growth has overwhelmed attempts at shaping cities through planning, and patterns of development have been somewhat haphazard.

SOUTH AFRICA

South Africa's cities developed through the colonial era as residentially segregated and generally low-density. This was reinforced under apartheid rule, with rigid forms of residential racial separation and the establishment of 'black townships' on the edges of cities. Car-oriented sprawl became a dominant feature of white residential areas. From the 1970s, economic activities decentralised from downtown locations to new urban nodes (e.g. Sandton in Johannesburg) in the mainly white, higher-income parts of the city. Informal settlements emerged as migrants moved into cities, despite official attempts to curb 'black urbanisation'.

There have been significant changes in the post-apartheid era since the early 1990s, although colonial history and apartheid history have left entrenched legacies that are difficult to remove. Cities have densified through formal and informal processes, as the removal of apartheid controls has accelerated urbanisation processes. There has been a degree of de-racialisation in some areas (e.g. previously whites-only, middle-class suburbs), and a complete demographic turnaround in other parts (for example, previously white working-class suburbs around inner cities, which are now entirely black-occupied). There has been accelerated decentralisation of economic activity from inner-city areas, with inner-city Johannesburg for example emerging as a residential node for migrants, and formal business, at least, having moved to decentralised business nodes. Cities have generally become more complex and multi-centred. Within the Province of Gauteng, a multi-centred city-region is formally recognised, but there are debates over the future spatial vision for the region, with ideas of urban compaction, densification and transit-oriented development in opposition to plans for new satellite cities.

SUMMARY

The BRICS cities do have variant spatial forms, including their densities and structures; but in recent decades almost all have experienced huge changes in their economic, political and demographic context. Across the BRICS, cities are becoming more complex, variegated or multimodal in their form, presenting great challenges for planning. A critical question, for example, is how to maintain the coherent spatial functioning of cities while supporting the locational needs of new industries. Different approaches to handling growth include support for more compact forms of urban development, diversion of further growth to satellite cities, and the development of axial corridors along transport networks.

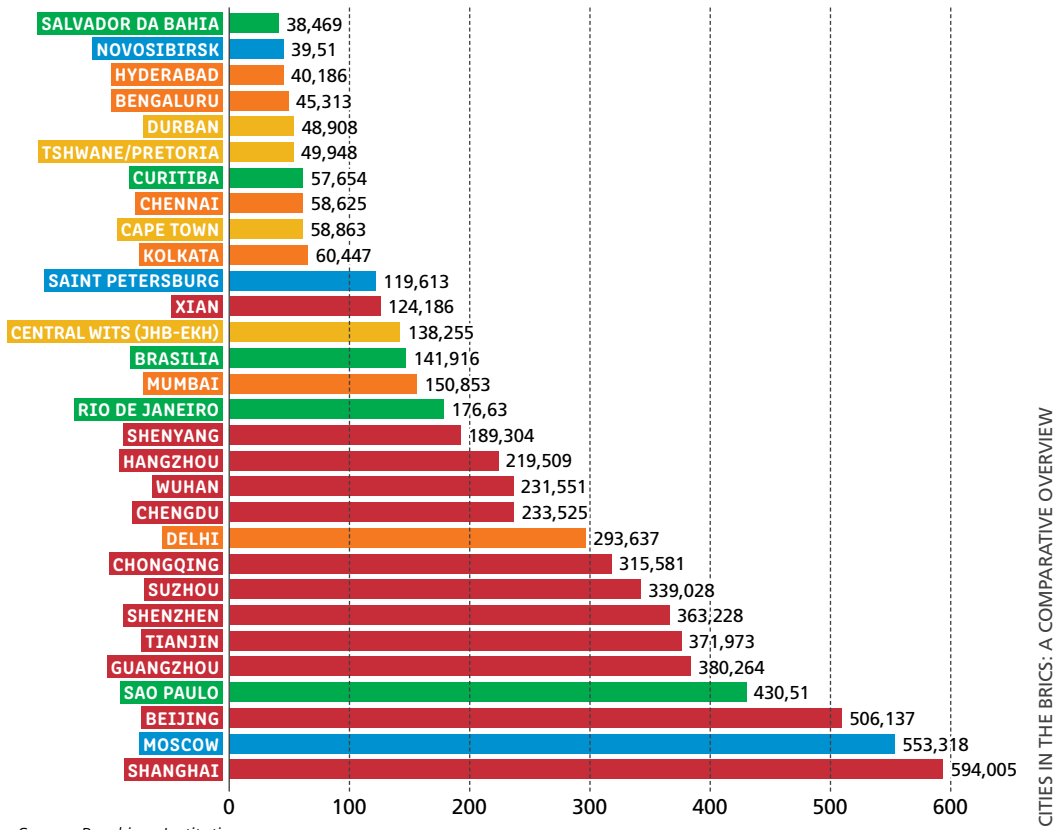
ECONOMY

The BRICS bloc currently contributes around 25% to the global economy, up from 11% in 1990, with its cities also increasingly playing a growing role within global economic networks (The BRICS Forum, 2016).

The Brookings Institution provides comparative data on urban economies, and this enables us to gain perspective on the comparative size of the BRICS city economies, included in the Factsheets. The graph illustrates the large range of urban economies, from the mega-economies of Shanghai, Moscow, Beijing and São Paulo, to small economies such as Salvador, Novosibirsk, Hyderabad, Bengaluru and Durban.

Russia's urban economies are relatively large, as the country has a mature and developed economy overall, and relatively high GDP per capita. China's urban economies have grown dramatically over the past two decades, with China accounting for seven of the top 10 in this listing. Brazil's cities have proportionately larger economies, as GDP per capita is higher than the BRICS average; while South Africa's has to do with the modest size of its cities (although its GDP per capita is still higher than that of China). India ranks low in terms of the economic size of cities, as GDP per capita is still very low. While cities such as Bengaluru, Hyderabad and Chennai have an advanced, modern economy, this is still a small segment of the overall underdeveloped urban economies.

Figure 1.7: Relative size of BRICS city economies – US$ billion in 2014

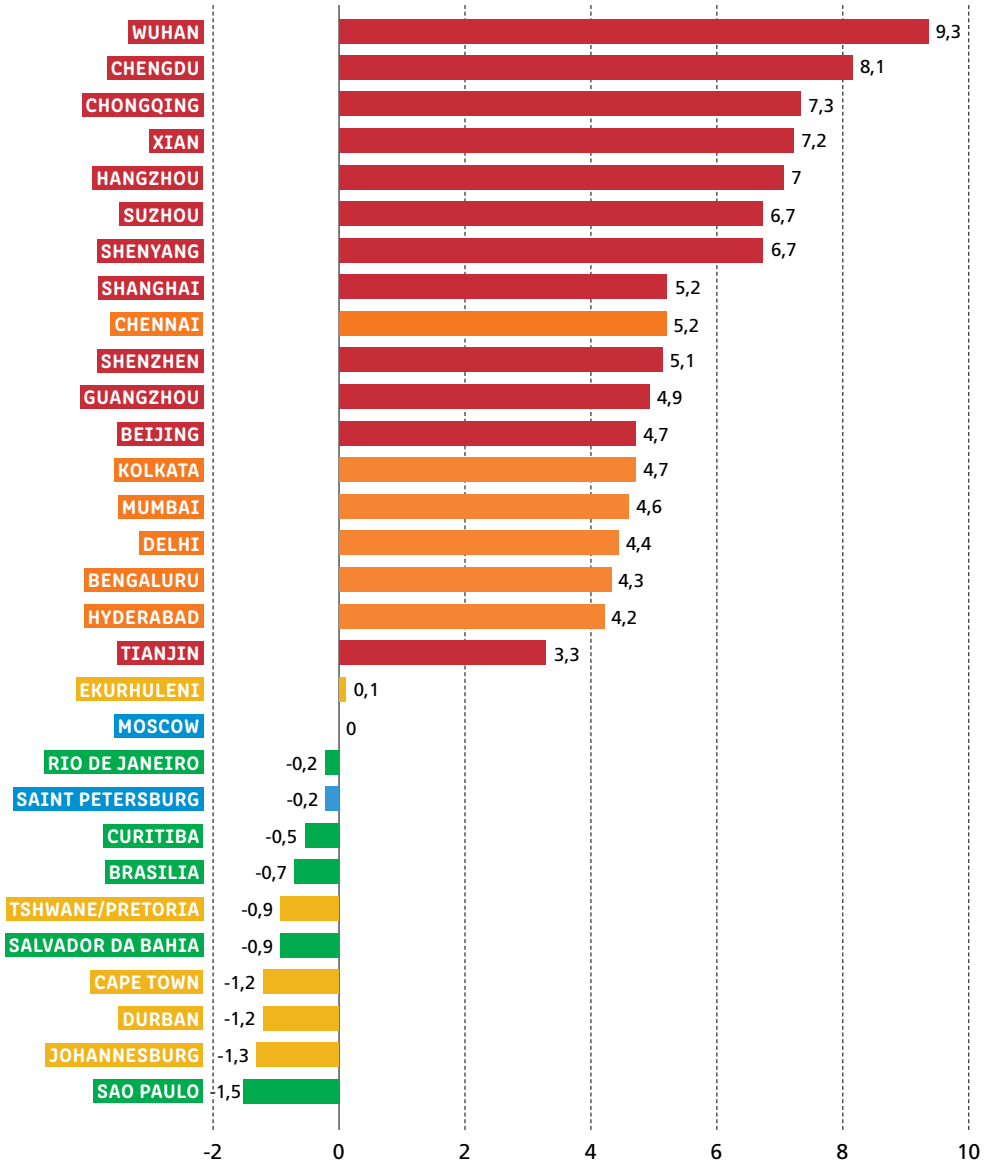


Source: Brookings Institution

Comparative growth figures are difficult to obtain, as economic data for cities is often not provided annually in national statistics, if at all. Some of the Factsheets use updated local sources for economic growth; but to provide a comparative indication at least, we draw on data from the Brookings Institution on annual change in GDP per capita by city for 2013-14. It should be noted that current growth rates may be significantly different.

The table below shows starkly the striking difference between the cities in the fast-growing economies of China and India, and those in the troubled economies of South Africa, Russia and Brazil. In per capita terms at least, many of the city economies in this latter category are in decline.

Figure 1.8: Percentage change in GDP per capita between 2013 and 2014



Source: Brookings Institution

A key question addressed in the Factsheets is what is driving growth and structural change in BRICS city economies. In simple terms, cities in the BRICS may be divided into those which remain predominantly industry-based, and those that are dominated by tertiary-sector activities – including, for example, the financial sector. Most cities, of course, have some mixture of industry and services; but there is generally an orientation towards one or the other. There is no easy way to compare the economic structures of cities, as industries are classified differently across cities, and some cities have no (or outdated) economic data. Cities with more than around 25% of GDP produced by manufacturing industries may be regarded as manufacturing cities. Although services may be important, many of the services may be oriented towards supporting manufacturing.

We may classify cities included in the Factsheets as follows:

PREDOMINANTLY MANUFACTURING

- » Bengaluru (growth-driven by offshore investments in ICT)
- » Kolkata (traditionally industrial, but a long-term decline in manufacturing)
- » Tianjin (port-related manufacturing)
- » Hangzhou (hi-tech manufacturing)
- » Suzhou (hi-tech manufacturing)
- » Shenzhen (initially mass-production manufacturing, but making a transition to higher-end manufacturing)
- » Chongqing (a traditional manufacturing economy that has successfully incorporated new industries)
- » Chengdu (traditional and new sectors, also with successful tertiary activities)
- » Shenyang (traditional heavy industry, struggling to transition to a new economy)
- » Wuhan (a traditional manufacturing economy but new industries emerging, and a strong service sector)
- » Ekurhuleni (traditional manufacturing, but some diversity)

PREDOMINANTLY SERVICES

- » Beijing (business services, supporting a large concentration of state-owned industry)
- » Shanghai (a global financial and business centre, although manufacturing is still significant)
- » Delhi (government, business and personal services)
- » Mumbai (service, including finances, but some hi-tech industry based in satellite cities)
- » Hyderabad (the new service economy, especially software service outsourcing)
- » Rio de Janeiro (with a strong shift from manufacturing to service activities)
- » Brasilia (government services)
- » Moscow (trade and services, with a strong post-Soviet shift from manufacturing)
- » Novosibirsk (a post-Soviet decline in industry)
- » Chennai (predominantly low-end services, but strong growth in ICT-related manufacturing)
- » Johannesburg (services, especially financial)
- » Cape Town (services, trade and tourism)
- » Tshwane/Pretoria (government, business and personal services)
- » eThekwini/ Durban (service, trade and transport dominant, but also significant manufacturing)

DIVERSE ECONOMIES WITH NO SECTORAL DOMINANCE

- » São Paulo (services in the core, and manufacturing on metropolitan periphery)
- » Curitiba (services in the core, and manufacturing in satellite towns)
- » Salvador (services in the core, and manufacturing in a satellite city)
- » St. Petersburg (manufacturing remains significant, despite the post-Soviet decline in heavy industry)
- » Guangzhou (a manufacturing hub, but also a service centre for the Pearl River Delta region)
- » Xi'an (a diverse mix of traditional and new industries, cultural industries and service outsourcing)

It is clear that there are very different economic drivers across the BRICS. Contrary to some perceptions, manufacturing remains a driver in a significant cluster of BRICS cities.

The manufacturing cities may be divided into at least four categories. First, there are those which are dominated by traditional forms of industry and are struggling to make the transition to new economies (for example Shenyang in China, Kolkata in India, and Ekurhuleni in South Africa). Secondly, there are cities which have had a traditional manufacturing base, but have already achieved considerable success in combining traditional industries with new economy industries (e.g. Chengdu, Chongqing, Wuhan, and possibly Tianjin, all in China). Thirdly, there is the case of Shenzhen, where rapid new forms of industrialisation happened initially through mass production for the export market, but where there is now some success in moving up the value chain. Fourthly, there are new industrialised cities where growth is happening through hi-tech and other advanced manufacturing, including through offshore location of transnational corporations (e.g. Hangzhou and Suzhou in China, and Bengaluru in India).

A number of city economies are developing primarily on the basis of tertiary activities, with the most successful being Beijing and Shanghai in China, and Delhi in India. Capital cities with government services and their access to political power have generally performed well (Beijing, Delhi, Brasilia, Moscow, Pretoria/Tshwane). In some cities there has been a strong shift towards tertiary activities, but manufacturing remains relatively strong (e.g. São Paulo, St. Petersburg, Guangzhou, Xi'an). In the case of Brazil's major cities, for example, the urban core has tertiarised, with manufacturing activity displaced to smaller cities along the edges of the metropolitan regions.

Some cities have emerged as nodes in the global financial sector, or as sites of corporate headquarters, as indicated in the tables below. The Global Financial Centres Index (GFCI produced by the Z/Yen group is a ranking of the competitiveness of financial centres. It indicates the emergence of BRICS cities within financial networks

Table 1.6: The Ranking of BRICS Cities within the Global Financial Services Index, 2016

City	BRICS Ranking	Global Ranking
HONG KONG (CHINA)	1	4
SHANGHAI (CHINA)	2	16
SHENZHEN (CHINA)	3	19
BEIJING (CHINA)	4	23
DALIAN (CHINA)	5	31
MUMBAI (INDIA)	6	42
SÃO PAULO (BRAZIL)	7	43
RIO DE JANEIRO (BRAZIL)	8	44
JOHANNESBURG (SOUTH AFRICA)	9	51
MOSCOW (RUSSIA)	10	67
QINGDAO (CHINA)	11	79
ST. PETERSBURG (RUSSIA)	12	82

Source: Z/Yen Group

While China dominated in terms of the BRICS presence within global financial networks, cities such as Mumbai, São Paulo, Rio de Janeiro, Moscow and St. Petersburg do have a presence. The situation is fluid, however. Over the past few years, Johannesburg, São Paulo and Rio de Janeiro have lost position in global markets; Moscow and Mumbai have gained; and China has had mixed fortunes.

Another major driver in the growth of the tertiary sector is the presence of corporate headquarters. The distribution of the Top 100 BRICS firms is indicated below. The data is drawn from Forbes, which provides ranking on the basis of a combination of corporate sales, assets, profits and market value. A full listing of the Top 100 firms is provided in the Chapter Annexure in DATA SHEET FOUR.

Table 1.7: Headquarters of the BRICS Top 100 Corporations, 2016

City	Number of BRICS Top 100 firms headquartered	Market value of firms headquartered – USD billions
BEIJING, CHINA	30	1588.6
HONG KONG, CHINA	17	730.8
MUMBAI, INDIA	9	290.5
SHANGHAI, CHINA	7	231.0
SHENZHEN, CHINA	6	434.3
MOSCOW, RUSSIA	5	204.6
JOHANNESBURG, SOUTH AFRICA	5	95.5
GUANGZHOU (INCL. FOSHAN), CHINA	4	75.1
SÃO PAULO (INCL. OSASCO), BRAZIL	3	99.0
DELHI, INDIA	3	44.0
RIO DE JANEIRO, BRAZIL	2	68.1
HANGZHOU, CHINA	1	200.7
FUZHOU, CHINA	1	47.3
BENGALURU, INDIA	1	41.7
DERAHDUN, INDIA	1	27.8
KOLKATA, INDIA	1	27.3
SURGUT, RUSSIA	1	19.7
BRASILIA, BRAZIL	1	17.0
WUHAN, CHINA	1	9.9
TOTAL	100	4252.9

Data source: Forbes 2000 in 2016

Corporate headquarters are highly concentrated. As indicated above, nearly half of the headquarters of the BRICS Top 100 corporations, accounting for 55% of the corporate value of these corporations, is located in only two cities: Beijing and Hong Kong. Beijing has a massive presence in terms of corporate headquarters, which has to do mainly with the huge concentration of state-owned mega-corporations (SOEs) in the city. Four of the world's Top Ten corporations listed in the Forbes 2000 (2016) are located in Beijing. Many of Beijing's mega-corporations are in the banking sector, but there are also firms in insurance and other financial services, oil and gas, and real estate. Hong Kong is home to a large number of private firms with concentrations in real estate, financial services, and telecommunications.

There is a secondary tier of cities with smaller but still significant clusters of BRICS Top 100 firms. These include Shenzhen, Shanghai and Guangzhou in China, but also São Paulo and Rio de Janeiro in Brazil, Mumbai and Delhi in India, Moscow in Russia, and Johannesburg in South Africa. Within these cities there are also areas of specialisation, such as oil and gas in Moscow and banking and financial services in Shenzhen.

There is a scattering of other corporate headquarters across other cities. In many cases these apparently isolated corporations are the result of place-specific entrepreneurialism. For example, the e-commerce giant Alibaba was established, incubated and developed in Hangzhou, China.

Despite their mainly middle-income status, there is an extraordinary concentration of personal wealth in the leading BRICS cities. Remarkably, BRICS cities account for six of the Top 10 cities in the world with the most dollar billionaires, with Hong Kong, Moscow and Beijing leading the way. The table below indicates the distribution of dollar billionaires across the leading BRICS cities, with DATA SHEET FIVE in the Annexure providing a list of the thirty wealthiest individuals in the BRICS by locality.

Table 1.8: Cities in the BRICS with the most dollar billionaires, 2016

City	BRICS Rank	World Rank	Number of billionaires	Combined net worth – USD billions
HONG KONG (SAR)	1	2	68	261.3
MOSCOW	2	3	60	217.6
BEIJING	3	4	51	149.9
MUMBAI	4	6	32	115.1
SHANGHAI	5	7	31	66.1
SHENZHEN	6	8	30	70.8
HANGZHOU	7	17	17	60.8
GUANGZHOU	8	18	16	38.1
SÃO PAULO	9	21	14	54.1

Source: Forbes 2000 in 2016

Again, there are differences in the sources of wealth according to location. Hong Kong, for example, has produced many dollar billionaires through wheeling and dealing in real estate, with Shenzhen and Guangzhou also producing wealth in this sector. In Moscow, oil and gas dominate; in Mumbai, pharmaceuticals, chemicals and ICT. In São Paulo, dollar billionaires were created through the success of the Brazilian brewery, AmBev.

THE REAL TEST OF SUCCESS

While the top-ranking BRICS cities have been relatively successful in producing wealth at the top end of the social spectrum, the real test of success is the ability of a city to generate wealth for the broad majority of its population. The degree to which cities in the BRICS have achieved equitable growth is explored below in the section on Development Challenges.

URBAN GOVERNANCE

There are many differences in the form and culture of governance across the BRICS, with city governance significantly shaped by national systems. Brazil, Russia, India and South Africa are multi-party democracies, although there is more top-down direction in Russia than in the other countries. China remains effectively a one-party state, but there are complex deliberative processes within party structures.

Brazil and Russia are federal states. Brazil is a federation of states and municipalities, with Russia a complex federation of 88 entities of different sorts. China is a unitary state with commanding authority at the centre, although with subnational governments with significantly devolved powers. India and South Africa have hybrid systems; with relatively strong central governments, but with national constitutions protecting the rights of the states (India) and provinces (South Africa).

The form and power of local governance also varies significantly. In Brazil, local governments are protected by the national constitution. They have legislative and executive powers with functions including basic services, primary education and urban planning, with transportation powers held concurrently with state governments. Russia's constitution also provides for local government, although there is flexibility and variance in the division of powers and the strength of local government across the Federation. India's local authorities are relatively weak in relation to those of the other BRICS. They are generally highly fragmented and have limited powers relative to those of the state governments, which are actively involved in local affairs through Development Authorities and other agencies which they constitute. As in Russia there is variation across the country, as each state has its own Local Government Act. China's governmental structure is famously hierarchical, but there is also a high degree of devolution to lower-level authorities. Instead of a division of power between the levels of government, as in the other countries, functions are replicated across each level. South Africa's local governments are protected by the national constitution, with the system including single-tier metropolitan authorities. However, the division of power is complex, with key functions such as transport and housing fragmented across the spheres of government.

In some countries, formal recognition is given to the role of the major cities through the provision of elevated status. Moscow and St. Petersburg, for example, are Federal Cities, with status equal to that of an Oblast (province). The largest cities in China also have a status equal to that of a province, and so report directly to national government.

Systems are evolving to handle the complexities of governance in expanded city-regions. In Brazil there is provision for the designation of Metropolitan Regions by state governments, but these structures are often weak; although recent legislation requires the development of Metropolitan Master Plans. In some places, there is voluntary cooperation and coordinated governance between separate authorities (e.g. the ABC Region in the São Paulo Metropolitan Region). India's state governments generally set up Development Authorities to coordinate planning and urban development across municipal boundaries, although the complexity of the institutional structure makes this a difficult task. China's municipalities are generally large, including entire urban agglomerations. However, complex networks of cities have evolved, with massive city-regions extending far beyond individual cities. China's central government has recently designated clusters of cities that require municipalities to move beyond their traditional mode of inter-city competition to new forms of collaboration. In South Africa, the Gauteng City-Region is now well-recognised as a cluster of cities, but the institutional mechanism to link these cities is still evolving.

The quality of governance in BRICS cities is extremely important in addressing the multiple development challenges outlined in Section 7.0 below; and BRICS cities are also faced with the challenges of low levels of accountability to urban citizens, institutional fragmentation, inadequate local powers, poor internal capacities, and governance jurisdictions that have little relationship to the actual scale and extent of urban agglomerations. Uneven progress has been made in relation to these issues.

DEVELOPMENT CHALLENGES

The large cities in the BRICS have multiple common and variant challenges, which relate to national differences as well as to city-specific histories, demographic pressures, economic patterns and performance, governance capabilities, environmental vulnerabilities, and more. In exploring commonality and difference it is clear that national context does matter, but that there are also dimensions of similarity that cross national boundaries in various ways.

COMMONALITIES AND DIFFERENCES

We begin with commonalities within countries – acknowledging, of course, that there is intra-national variation.

In **Brazil's large cities** the frequently shared challenges are: very high levels of income and spatial inequality; informal settlements (or *favelas*) in vulnerable places; high levels of violent crime (including murder and drug-related crime); and more recently, the negative effects of political instability and an economic recession.

In **Russia's large cities**, shared challenges include: increasing income and spatial inequalities; demographic ageing, with static or shrinking populations; deteriorating housing stock; severe congestion as a result of dramatically rising car ownership; inefficient and ageing infrastructure; and a high environmental footprint, with subsidised access to fossil fuels.

In **India's large cities**, challenges include: extensive urban poverty; low and unequal levels of access to basic services; large slum populations, associated with multiple social problems and health hazards; poor urban infrastructure, with severe problems in relation to water shortage, untreated sewage and congested transport infrastructure; chronic air and water pollution; and vulnerability to flooding and sea-level rise in the coastal and delta cities.

In **China's large cities**, challenges include: rapidly rising levels of inequality, with a continued divide between urban populations with full residential rights, and the 'floating population' without local registration; the severe environmental consequences of decades of rapid economic growth and high dependence on fossil fuels; and vulnerability to flooding and sea-level rise in coastal and delta cities.

In **South Africa's large cities** there are challenges of: extremely high income and social divides and inequality; high levels of unemployment; high rates of violent and other crimes; disease burdens including HIV/Aids; shack settlements and accommodation backlogs; and a high environmental footprint, with an excessive dependence on fossil fuels.

There are shared challenges across part or all of the BRICS. Inequality is one of these. South Africa and Brazil have the highest levels of inequality, but there is rapidly increasing inequality in China and Russia, and to a lesser extent in India. Slums or informal settlements are a highly visible challenge in India, Brazil and South Africa, but in China the 'floating population' is associated with inadequate forms of accommodation, and in Russia many of the large Soviet-era housing estates are becoming increasingly dilapidated. Safety and security is a particular concern in the violence-prone Brazilian and South African cities, but there are also concerns in Russia and India, where, for example, crimes against women have received recent publicity. Urban infrastructure is a challenge across the BRICS, although it is most severely experienced in India. Environmental problems such as air and water pollution are extreme in many cities in India and China, where there is also high vulnerability to the effects of climate change, including flooding and sea-level rise. Road congestion has become a critical challenge in most cities in the BRICS, as a result of rapidly increasing levels of car ownership.

Another way to understand the similarity and diversity of challenges is to cluster cities in ways that cross national boundaries. For example, rapidly-growing cities have challenges that may be different to those of cities that are in decline, or that have large and mature economies but are now growing slowly.

Rapidly growing cities in the BRICS (e.g. Beijing, Suzhou, Hangzhou, Chongqing, Chengdu, Xi'an, Bengaluru, Chennai, and cities in the Gauteng City-Region) experience problems of growth such as pressure on infrastructure, energy shortages, rapidly rising land and property prices, growing accommodation needs, increasing levels of congestion, and so forth. The pressures are managed with widely varying degrees of success.

Cities in relative or even absolute decline (e.g. Kolkata in India, Shenyang and other 'rust belt' cities in China, and many of the smaller cities in Russia) may experience critical challenges relating to an ageing population, social vulnerability, physical dereliction, rising unemployment, and the environmental legacies of heavy industry or mining, for example.

Large cities with mature economies but currently low to moderate levels of growth (e.g. São Paulo, Rio de Janeiro, Mumbai, Moscow and St. Petersburg) may still be dealing with the legacies of high growth in the past, but also have the challenge of steering development to prevent decline into the future.

In the section below we provide comparative data (to the extent such data exists) on: poverty and inequality; slums (and/or informal settlements); safety; and environmental threats.

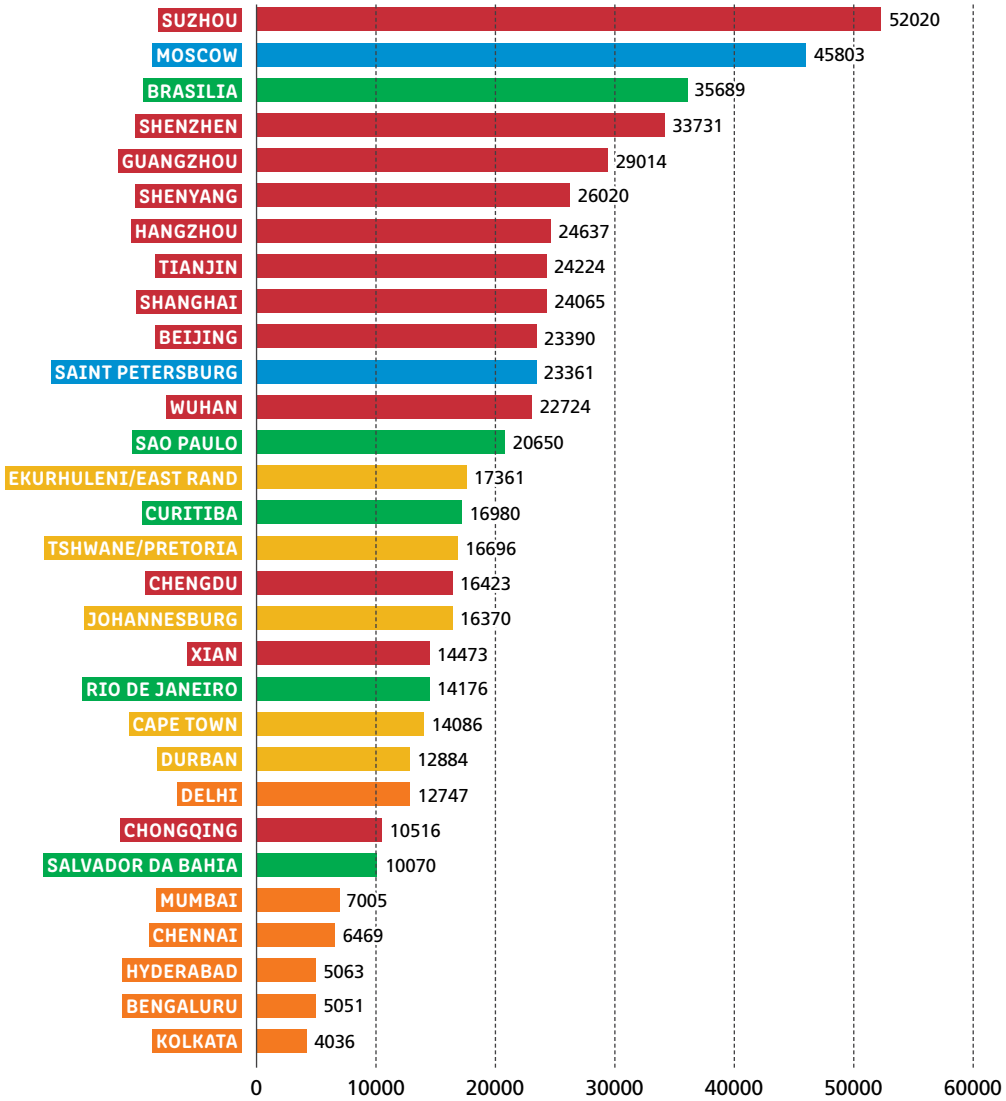
POVERTY AND INEQUALITY

Around a quarter of the world's wealthiest people are now in the BRICS, but poverty remains a persistent reality for a large proportion of the population. Describing poverty comparatively is difficult, as there is a lack of comparative poverty-related data at a city level; and there are also variations in official definitions across countries on what constitutes poverty. The Oxford Poverty & Human Development Initiative provides data on multidimensional poverty (i.e. not just income poverty at subnational level, although not at city level (Alkire et al, 2016). The data is elaborated at subnational level (states, provinces, regions) for Brazil, China and India, and is summarised in DATA SHEET SIX[3]. The key comparative point here is India's outlier status, as the country which has by far the highest levels of urban poverty. The data also reveals massive variation within individual countries.

Since comparative city-level poverty data is largely absent, we must use surrogate or proxy measures. GDP per capita is an inadequate proxy, as it is a simple measure of economic output in relation to population, without taking into account actual household incomes or the distribution of wealth. However, it does provide an indicator at least of the variation in wealth between cities. As indicated below, there is no simple clustering by country. India's cities are generally at the bottom of the range, but Delhi's GDP per capita is still several times greater than that of Kolkata, for example. China has a massive range, with cities in the interior of the country (e.g. Chongqing, Chengdu and Xi'an) still lagging far behind those on the eastern coast (e.g. Shanghai, Beijing, Guangzhou and Suzhou). Brazil's cities are in the intermediate range, but a relatively small city such as Brasilia is better off in per-capita terms than the mega-cities of São Paulo and Rio de Janeiro, and Salvador is as poor as some of India's cities.

3. The comparative data does not include South Africa and Russia, but South Africa is currently developing its own regionally-differentiated indicators for multidimensional poverty.

Figure 1.9: GDP per capita by city in the BRICS (USD by PPP, 2014)



Measuring inequality comparatively is a complex matter. While the Gini coefficient is a generally agreed measure for *income inequality*, it is mainly calculated at a national level. The Joint BRICS Statistical Release indicates national Gini coefficients as: 0.65 for South Africa; 0.497 for Brazil; 0.469 for China; 0.416 for Russia; 0.367 for urban India; and 0.28 for rural India.

For cities, the calculation of a Gini coefficient is often either lacking or is based on outdated or partial data. The best information on urban inequality is provided by Brazil's national statistical service (IBGE), which has calculated Gini coefficients for all metropolitan regions; data is also available for South African and Russia cities, although there is variation between sources. The data deficiency is in relation to India and China's cities. In India, the Gini coefficient is calculated for states and not cities, and China's municipal and state statistical bureaus generally do not provide data on inequality. The data provided for a limited number of China's cities by UN Habitat is outdated (for 2004/05) and must be used cautiously.

Table 1.9: Gini coefficients for large BRICS cities for which data is available

City	Country	Gini Coefficient	Notes
Delhi	INDIA	0.36	UN Habitat (2011)
Shanghai	CHINA	0.32	UN Habitat (2004/05)
São Paulo	BRAZIL	0.55 0.58	UN Habitat (2009) IBGE, Brazil (2010)
Rio de Janeiro	BRAZIL	0.58 0.61	UN Habitat (2009) IBGE (2010)
Moscow	RUSSIA	0.45	UN Habitat (2014)
Shenzhen	CHINA	0.49	UN Habitat (2004/05)
Central Witwatersrand	SOUTH AFRICA	0.75 0.67	UN Habitat (2005) GCRO
Wuhan	CHINA	0.37	UN Habitat (2004/05)
Hong Kong (SAR)	CHINA	0.54	UN Habitat (2011)
Shenyang	CHINA	0.37	UN Habitat (2004/05)
Xi'an*	CHINA	0.35	UN Habitat (2004/05)
Belo Horizonte	BRAZIL	0.61	IBGE (2010)
St. Petersburg	RUSSIA	0.44	UN Habitat (2014)
Brasilia	BRAZIL	0.67 0.64	UN Habitat (2009) IBGE (2010)
Salvador	BRAZIL	0.64	IGBE (2010)
Curitiba	BRAZIL	0.67 0.57	UN Habitat (2009) IBGE (2010)
Pretoria (Tshwane Metro)	SOUTH AFRICA	0.72	UN Habitat (2005 data)

Sources: As indicated in the table *Note: Data is not available for most cities in India and China*

While an accurate overall picture of income inequality across BRICS cities is partial at best, we can identify the general patterns using a combination of national- and city-level data. South Africa and Brazil have very high levels of urban income inequality (with Hong Kong also in this range). Russia has moderately high levels, closing in on the 0.5 mark. In 2004/05, China's levels of urban inequality were relatively modest, with the exception of the high levels in the new city of Shenzhen. However, it is highly likely that urban inequality in China has increased sharply since then, and may possibly be approaching the levels of Brazil's cities. The figures for Indian cities may still be modest in BRICS terms, but are likely to be trending upwards.

SLUMS AND INFORMAL SETTLEMENTS

The World Bank's data base suggests that there is a very similar proportion of people living in slums across the BRICS – 24% for India, 23% for South Africa, and 22% for Brazil, with no data provided for Russia and extrapolated data for China (World Bank, 2016). The figures must however be used cautiously, as definitions vary as to what a slum is. South Africa's census refers to 'informal dwellings' in informal settlements and back yards, India indicates 'slums', and Brazil has a category called 'sub-standard'. We have not been able to access comparative data for cities in China and Russia. A possible surrogate measure in China is the percentage of the population regarded as 'floating', as a large proportion of this population lives in inadequate accommodation. The World Bank (2016) places the figure for China as high as 25%. While Russia may not have

informal settlements in the way that South Africa, India and Brazil do, it clearly does have significant housing challenges. For example, the mass-scale tenements produced in the Soviet era were poorly built with cheap materials, and some are now seriously dilapidated.

Finding comparative city-level data is even more difficult than finding national-level data. South Africa, India and Brazil do provide varying measures of inadequate accommodation.

Table 1.10: Percentage of total city population in 'slums'

City	Country	% in slums
Delhi	INDIA	14.6%
São Paulo	BRAZIL	10% in core city, up to 18% on periphery
Mumbai (Bombay)	INDIA	41.3%
Kolkata (Calcutta)	INDIA	29.6%
Bengaluru (Bangalore)	INDIA	8.5%
Chennai (Madras)	INDIA	28.5%
Central Witwatersrand	SOUTH AFRICA	18% (Johannesburg) 22.6% (Ekurhuleni)
Hyderabad	INDIA	31.9%
Brasilia	BRAZIL	4.7%
Cape Town	SOUTH AFRICA	20.5%
Salvador	BRAZIL	32%
Curitiba	BRAZIL	8.5%
Pretoria/Tshwane	SOUTH AFRICA	18%
Durban/eThekwini	SOUTH AFRICA	18%

Source: National census reports

There is considerable variation, even among the cities for which we do have data. In Brazil, for example, only 4.5% of the people in Brasilia, the capital city, live in substandard accommodation, compared with 32% in Salvador. In India, 8.5% of people in Bengaluru live in slums, compared with over 41% in Mumbai. In South Africa there is less variation, with one-fifth of the population in all the major cities living 'informally'.

SAFETY

While comparative city-level data is not readily available for all cities, national-level data provides an indicator of relative levels of safety. For South Africa and Brazil, the national homicide rates are around 33 and 24 per 100 000 respectively. The figure for Russia is 9.5, India 3.2, and China 0.8.

Annually updated comparative data on homicide rates for the 50 most dangerous cities in the world is provided by the Mexican Citizens Council for Public Security and Criminal Justice. This database indicates that the BRICS account for 24 of the 50 most dangerous cities in the world (outside war zones); 20 of these are in Brazil, and four in South Africa, the two most unequal countries in the BRICS. Within these cities, homicide rates range between 30 per 100 000 and 66 per 100 000, with Cape Town having the dubious distinction of being the most dangerous city in the BRICS. In addition to homicide, cities in South Africa have very high levels of other crimes, including assault, rape, and robbery. Brazil has similar problems, including a very serious challenge in terms of drug trafficking.

This does not mean that crime is not a major problem in BRICS cities outside of South Africa and Brazil. In China, homicide rates are very low in international terms, but there are problems of corruption, and drug and human trafficking. India's crime challenges are quite regionally-defined, as is clear, for example, in places where there are high levels of crime against women. Russia's homicide rates, although significantly lower than those of Brazil and South Africa, are nevertheless high in international terms; and there are problems of corruption and the trafficking of people, drugs and weapons.

Table 1.11: Most Dangerous Cities in the BRICS, 2014

City	Homicide rate per 100 000	World Ranking for highest homicide rate
CAPE TOWN (SOUTH AFRICA)	66	9th
FORTALEZA (BRAZIL)	61	12th
NATAL (BRAZIL)	61	13th
SALVADOR (BRAZIL)	61	14th
JOÃO PESSOA (BRAZIL)	58	16th
MACEIÓ (BRAZIL)	56	18th
SÃO LUÍS (BRAZIL)	55	21st
CUIABÁ (BRAZIL)	49	22nd
MANAUS (BRAZIL)	48	23rd
BELEM (BRAZIL)	46	26th
GOIÂNIA Y APARECIDA DE GOIÂNIA (BRAZIL)	43	29th
TERESINA (BRAZIL)	43	30th
VITORIA (BRAZIL)	42	31st
VITÓRIA DA CONQUISTA (BRAZIL)	38	36th
RECIFE (BRAZIL)	38	37th
ARACAJU (BRAZIL)	38	38th
CAMPOS DOS GOYTACAZES (BRAZIL)	39	39th
CAMPINA GRANDE, (BRAZIL)	36	40th
DURBAN (SOUTH AFRICA)	36	41st
NELSON MANDELA BAY (SOUTH AFRICA)	36	42nd
PORTO ALEGRE (BRAZIL)	33	43th
CURITIBA (BRAZIL)	35	44th
JOHANNESBURG (SOUTH AFRICA)	30	47th
MACAPÁ (BRAZIL)	30	48th

Source: Mexican Citizens Council for Public Security and Criminal Justice, 2015

ENVIRONMENTAL PROBLEMS

The growth of the BRICS mega-cities has come with major environmental degradation and resource depletion. As a consequence, cities in the BRICS generally do not do well in terms of environmental or broader sustainability indicators. The Arcadis Sustainable City Index, for example, which brings a

range of indicators together for 50 of the world's largest cities, ranks leading BRICS cities towards the bottom: São Paulo 31st; Shanghai 35th; Johannesburg 37th; Beijing 39th; Rio de Janeiro 40th; Moscow 42nd; Mumbai 47th; Wuhan 48th; and Delhi 49th. Hong Kong is the only high-ranking city, at eighth position.

On the environmental component only of the Sustainable City Index, the ranking is São Paulo 16th; Rio de Janeiro 17th; Hong Kong 19th; Shanghai 33rd; Johannesburg 35th; Mumbai 36th; Moscow 41st; Beijing 46th; Wuhan 48th; and Delhi 49th. These rankings reflect major environmental concerns in relation to cities in India, China, Russia and South Africa, which include extreme dependence on fossil fuels, threatened water supply, loss of green space, and air pollution. Brazil's cities generally have a lower environmental footprint, as energy supplies are largely from non-fossil fuels (hydro for electricity, and biofuels in the transport sectors), but there are problems in terms of water supply and quality.

In Chapter Two of this report, details are provided on the environmental effects of the transport sector, and on the use of fossil fuels. The data on air pollution provided by the World Health Organisation (WHO) is used below as illustrative of an environmental challenge. Delhi is the most air-polluted large city in the world, with severe problems in other cities in India, and also across China. The city for which we have a Factsheet with the lowest level of air pollution in the BRICS is Curitiba in Brazil, which has famously pursued environmentally-friendly policies for decades. The other Brazilian cities also have relatively low levels of air pollution; at least, compared to other BRICS cities.

Table 1.12: Levels of ambient air pollution by city (from worst to best)

City	Country	Air quality – Annual Mean PM 10	Air Quality – Annual Mean PM 2.5
Delhi	INDIA	229	122
Xi'an	CHINA	189	70
Tianjin	CHINA	150	87
Chengdu	CHINA	150	71
Nanjing	CHINA	137	72
Kolkata (Calcutta)	INDIA	135	61
Shenyang	CHINA	129	72
Wuhan	CHINA	124	80
Bengaluru (Bangalore)	INDIA	118	63
Mumbai (Bombay)	INDIA	117	63
Beijing	CHINA	108	85
Chongqing	CHINA	106	61
Hangzhou	CHINA	106	61
Surat	INDIA	97	52
Suzhou	CHINA	97	64
Pune (Poona)	INDIA	92	49
Central Witwatersrand	SOUTH AFRICA	85	41
Shanghai	CHINA	84	52
Ahmadabad	INDIA	83	100
Foshan	CHINA	83	44
Hyderabad	INDIA	79	59
Guangzhou	CHINA	72	48
Dongguan	CHINA	65	43
Pretoria (Tshwane Metro)	SOUTH AFRICA	63	41
Shenzhen	CHINA	61	34
Chennai (Madras)	INDIA	57	44
Rio de Janeiro	BRAZIL	49	16
Hong Kong (SAR)	CHINA	49	29
São Paulo	BRAZIL	35	19
Moscow	RUSSIA	33	20
Curitiba	BRAZIL	24	11

Source: World Health Organisation, 2016 updates

Many of the BRICS cities are highly vulnerable to climate change, including to the effects of sea-level rise, flooding, and heat waves. The BRICS include a number of the large cities most at risk globally from flooding: Kolkata, Mumbai and Surat in India; and Guangzhou, Shanghai, Tianjin, Qingdao, Xiamen and Ningbo in China (CERICS 2016). The BRICS also include a number of the cities most exposed to sea-level rise. Kolkata and Guangzhou are generally identified as the cities in the world most vulnerable to sea-level rise, with other BRICS cities of high vulnerability including Mumbai, Shanghai, Shenzhen, Tianjin and Ningbo (Business Insider, 2014; Climate Central, 2016; Hallegate et al., 2013). Heat waves are also likely to be a major concern. In 2015, a heat wave in India left around 2 000 people dead.

CONCLUSION

The overwhelming conclusion is that BRICS cities are enormously complex, with considerable variability across and within national contexts.

Simple generalisations – for example, about rapid urban growth across the BRICS – should be avoided. Instead, we need to explore the diversity of places in terms of their respective histories, national contexts, demographic specificities, economic drivers, different governance arrangements, diverse challenges, and more. It is through engaging with specificity that we can draw insights that may be useful across contexts.

Although each urban context is different, we can identify shared challenges or experiences across two or more cities, and potentially bring these cities into a helpful dialogue. We know, for example, that there are groupings of cities that are struggling to manage growth, but others that are battling with the effects of weak economies, and even of population and economic decline. There are cities across contexts which share similar problems in terms of slum upgrading, or of high levels of violence, or extreme environmental vulnerability; and the sharing of lessons and insights is potentially extremely valuable. The point overall, however, is that the specificity of places and the details of context should not be overlooked; and we need to progressively develop our understanding of individual cities, and of cities in a comparative perspective.

While the countries of the BRICS do not form an easy analytical category, there is one aspect of shared experience. All countries in the BRICS have experienced major transitions in recent decades, and the effects of these transitions have played out within urban development. South Africa shifted from apartheid rule to a post-apartheid democracy; Russia experienced a dramatic and sudden shift away from state socialism; China has experienced sweeping although incremental economic reforms since around 1978; while India went through a period of far-reaching economic liberalisation in the 1990s. To a large extent, the urban changes over the past few decades are a consequence of these transitions. A potentially valuable point of engagement may be around the management of change in a way that supports visions for more inclusive and sustainable urban futures.

KEY REFERENCES

Alkire, S., Jindra, C., Robles, G. and A. Vaz (2016) Multidimensional poverty index, 2016: Brief methodology and results, Oxford Poverty and Human Development Initiative, University of Oxford, OPHI Briefing. No. 42

Angel, S., Sheppard, S. and D. Civco (2005) The Dynamics of Global Urban Expansion, A report for the World Bank, www.siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/dynamics_urban_expansion.pdf

Arcadis (2015) Sustainable Cities Index, 2015. www.s3.amazonaws.com/arcadis-whitepaper/arcadis-sustainable-cities-index-report.pdf

Brookings Institution (2016) Cities Database. www.brookings.edu/topic/cities-regions/

Business Insider (2014) Rising Sea Levels Could Cause Staggering Damage To These Cities. www.businessinsider.com/cities-exposed-to-rising-sea-levels-2014-4

CERICS – Climate Service Centre, Germany Cities and Climate Change. 2015. zClimate Focus Paper: Cities and Climate Changewww.kfw-entwicklungsbank.de/PDF/Entwicklungsfinanzierung/Themen-NEU/Focus-Paper-Cities-and-Climate-Change.pdf

Chandler, T. (1987) *Four Thousand Years of Urban Growth: An Historical Census*, Lewiston, NY: The Edwin Mellen Press

City Mayors (2007) The largest cities in the world by land area, population and density. Online at www.citymayors.com/statistics/largest-cities-density-125.html

Climate Central (2016) Surging Seas: Risk Zone Map. www.ss2.climatecentral.org/#6/28.777/64.490?show=satellite&projections=1-RCP85-SLR&level=5&unit=feet&pois=hide

Demographia (2016) Demographia World Urban Areas 12th Annual Edition: 2016:04, www.demographia.com/db-worldua.pdf

Forbes Global (2016) Forbes 2000 www.forbes.com

Hallegate, S., Green, C., Nicholls, R. and J. Corfee-Morlot (2013) Future flood losses in major coastal cities, *Nature Climate Change*, 3, 802–806.

Mexican Citizens Council for Public Security and Criminal Justice (Consejo Ciudadano para la Seguridad Pública y la Justicia Penal - CCSPJP) (2015) Top 60 most violent cities in the world, 2014.www.seguridadjusticiaypaz.org.mx/biblioteca/prensa/summary/5-prensa/199-the-50-most-violent-cities-in-the-world-2014

Pew Research Centre, The global religious landscape, 2012 .www.pewforum.org/files/2012/12/globalReligion-full.pdf

The BRICS Forum (2016) The evolving role of the BRICS in a changing world, www.gdforum.org/balkanssecurity-2-2/

UN Habitat (2016) World Cities, UN Habitat: Nairobi

WIN/Gallup International (2012) Global Religiosity Index, www.wingia.com/web/files/news/14/file/14.pdf

WHO – World Health Organisation (2016) Ambient Air Pollution by City – 2016 Update, www.who.int/phe/health_topics/outdoorair/databases/cities/en/

World Bank (2016) Country database, www.data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS

Z/Yen (2016) Global Financial Centres Index, www.zyen.com/research/gfci.html

ANNEXURE

DATA SHEET ONE

Levels of urbanisation in the BRICS in comparison with the world and middle-income countries, 1950-2015

Year	World	Middle-income countries	SOUTH AFRICA	CHINA	INDIA	RUSSIAN FEDERATION	BRAZIL
1950	29.55	18.97	42.23	11.80	17.04	44.09	36.16
1955	31.58	21.17	44.41	13.86	17.58	48.95	41.06
1960	33.69	23.52	46.62	16.20	17.92	53.73	46.14
1965	35.56	25.67	47.25	18.09	18.79	58.17	51.04
1970	36.58	26.80	47.81	17.40	19.76	62.47	55.91
1975	37.70	28.36	48.11	17.40	21.33	66.43	60.79
1980	39.32	30.68	48.43	19.36	23.10	69.75	65.47
1985	41.18	33.46	49.37	22.87	24.35	71.92	69.86
1990	42.95	36.10	52.04	26.44	25.55	73.39	73.92
1995	44.73	38.75	54.49	30.96	26.61	73.37	77.61
2000	46.61	41.51	56.89	35.88	27.67	73.35	81.19
2005	49.11	44.82	59.54	42.52	29.24	73.46	82.83
2010	51.64	48.13	62.22	49.23	30.93	73.69	84.34
2015	54.03	51.32	64.80	55.61	32.75	74.01	85.69

Source: UN Population Division, 2016

DATA SHEET TWO

Cities in the BRICS with more than one million people, 2015 (cities with Factsheets indicated with *)

City	Country	Population in 2015 in millions
Delhi*	INDIA	25.70
Shanghai*	CHINA	23.74
São Paulo*	BRAZIL	21.07
Mumbai (Bombay)*	INDIA	21.04
Beijing*	CHINA	20.38
Kolkata (Calcutta)*	INDIA	14.86
Chongqing*	CHINA	13.33
Rio de Janeiro*	BRAZIL	12.90
Guangzhou*	CHINA	12.46
Moskva (Moscow)*	RUSSIA	12.17
Tianjin*	CHINA	11.21
Shenzhen*	CHINA	10.75
Bengaluru*	INDIA	10.09
Chennai (Madras)*	INDIA	9.89
Central Witwatersrand*	SOUTH AFRICA	9.40
Hyderabad*	INDIA	8.94
Wuhan*	CHINA	7.91
Chengdu*	CHINA	7.56
Dongguan*	CHINA	7.43
Nanjing, Jiangsu	CHINA	7.37
Ahmadabad	INDIA	7.34
Hong Kong (SAR)	CHINA	7.31
Foshan	CHINA	7.04
Hangzhou*	CHINA	6.39
Shenyang*	CHINA	6.31
Xi'an*	CHINA	6.04
Pune (Poona)	INDIA	5.73
Belo Horizonte	BRAZIL	5.72
Surat	INDIA	5.65
Suzhou*	CHINA	5.47
Haerbin	CHINA	5.46
Saint Petersburg*	RUSSIA	4.99
Qingdao	CHINA	4.57
Dalian	CHINA	4.50
Xiamen	CHINA	4.43
Zhengzhou	CHINA	4.39
Brasília*	BRAZIL	4,16
Ji'nan, Shandong	CHINA	4.03
Shantou	CHINA	3.95
Fortaleza	BRAZIL	3.88
Kunming	CHINA	3.78
Changchun	CHINA	3.76
Changsha	CHINA	3.76
Recife	BRAZIL	3.74
Zhongshan	CHINA	3.69
Cape Town*	SOUTH AFRICA	3.66
Pôrto Alegre	BRAZIL	3.60
Salvador*	BRAZIL	3.58
Ürümqi (Wulumqi)	CHINA	3.50
Taiyuan, Shanxi	CHINA	3.48
Curitiba*	BRAZIL	3.47
Jaipur	INDIA	3.46
Hefei	CHINA	3.35
Fuzhou, Fujian	CHINA	3.28
Shijiazhuang	CHINA	3.26
Nanning	CHINA	3.23
Lucknow	INDIA	3.22
Wenzhou	CHINA	3.21
Ningbo	CHINA	3.13
Wuxi, Jiangsu	CHINA	3.05
Campinas	BRAZIL	3.05

City	Country	Population in 2015 in millions
Kanpur	INDIA	3.02
Durban*	SOUTH AFRICA	2.90
Guiyang	CHINA	2.87
Pretoria	SOUTH AFRICA	2.82
Tangshan, Hebei	CHINA	2.74
Lanzhou	CHINA	2.72
Nagpur	INDIA	2.68
Taipei	CHINA	2.67
Changzhou, Jiangsu	CHINA	2.58
Coimbatore	INDIA	2.55
Nanchang	CHINA	2.53
Kozhikode (Calicut)	INDIA	2.48
Indore	INDIA	2.44
Zibo	CHINA	2.43
Kochi (Cochin)	INDIA	2.42
Thrissur	INDIA	2.33
Huizhou	CHINA	2.31
Goiânia	BRAZIL	2.28
Malappuram	INDIA	2.22
Patna	INDIA	2.21
Weifang	CHINA	2.20
Belém	BRAZIL	2.18
Kannur	INDIA	2.15
Yantai	CHINA	2.11
Bhopal	INDIA	2.10
Shaoxing	CHINA	2.08
Manaus	BRAZIL	2.039
Luoyang	CHINA	2.01
Huai'an	CHINA	2.00
Nantong	CHINA	1.98
Vadodara	INDIA	1.99
Agra	INDIA	1.97
Thiruvananthapuram	INDIA	1.96
Baotou	CHINA	1.964
Visakhapatnam	INDIA	1.94
Xuzhou	CHINA	1.92
Haikou	CHINA	1.90
Hohhot	CHINA	1.78
Nashik	INDIA	1.78
Yangzhou	CHINA	1.77
Vijayawada	INDIA	1.76
Ludhiana	INDIA	1.72
Linyi, Shandong	CHINA	1.71
Taizhou	CHINA	1.65
Grande Vitória	BRAZIL	1.64
Handan	CHINA	1.63

City	Country	Population in 2015 in millions
Daqing	CHINA	1.62
Liuzhou	CHINA	1.62
Rajkot	INDIA	1.60
Yinchuan	CHINA	1.60
Madurai	INDIA	1.59
Jiangmen	CHINA	1.57
Anshan	CHINA	1.56
Meerut	INDIA	1.55
Zhuhai	CHINA	1.54
Varanasi	INDIA	154
Baixada Santista	BRAZIL	1.54
Xiangyang	CHINA	1.53
Datong	CHINA	1.53
Kaohsiung	CHINA	1.52
Jilin	CHINA	1.52
Novosibirsk*	RUSSIA	1.50
Qiqihaer	CHINA	1.45
Jamshedpur	INDIA	1.45
Putian	CHINA	1.44
Grande São Luís	BRAZIL	1.44
Yancheng	CHINA	1.44
Srinagar	INDIA	1.43
Wuhu, Anhui	CHINA	1.42
Kollam	INDIA	1.41
Quanzhou	CHINA	1.40
Jining, Shandong	CHINA	1.38
Yekaterinburg	RUSSIA	1.38
Raipur	INDIA	1.37
Aurangabad	INDIA	1.34
Jabalpur	INDIA	1.34
Chaozhou	CHINA	1.33
Huainan	CHINA	1.33
Xining	CHINA	1.32
Asansol	INDIA	1.31
Cixi	CHINA	1.30
Hengyang	CHINA	1.30
Fushun, Liaoning	CHINA	1.30
Allahabad	INDIA	1.29
Jodhpur	INDIA	1.28
Maceió	BRAZIL	1.26
Amritsar	INDIA	1.26
Yichang	CHINA	1.26
Ranchi	INDIA	1.26
Dhanbad	INDIA	1.25
Tiruppur	INDIA	1.23
Taichung	CHINA	1.22

City	Country	Population in 2015 in millions
Gwalior	INDIA	1.22
Taian, Shandong	CHINA	1.22
Joinville	BRAZIL	1.22
Nizhniy Novgorod	RUSSIA	1.21
Taizhou, Jiangsu	CHINA	1.18
Florianópolis	BRAZIL	1.18
Port Elizabeth	SOUTH AFRICA	1.18
Natal	BRAZIL	1.17
Samara	RUSSIA	1.16
Kota	INDIA	1.16
Kazan	RUSSIA	1.16
Omsk	RUSSIA	1.163
Chelyabinsk	RUSSIA	1.16
Vereeniging	SOUTH AFRICA	1.16
Zhanjiang	CHINA	1.15
Anyang	CHINA	1.14
Chandigarh	INDIA	1.13
Durg-Bhilainagar	INDIA	1.13
Bareilly	INDIA	1.1
Qinhuangdao	CHINA	1.11
Tiruchirappalli	INDIA	1.11
Baoding	CHINA	1.11
Lianyungang	CHINA	1.10
Rostov-na-Donu	RUSSIA	1.10
João Pessoa	BRAZIL	1.09
Zhuzhou	CHINA	1.08
Mysore	INDIA	1.08
Yiwu	CHINA	1.08
Benxi	CHINA	1.07
Ufa	RUSSIA	1.07
Mianyang, Sichuan	CHINA	1.06
Rizhao	CHINA	1.06
Zhenjiang, Jiangsu	CHINA	1.05
Suqian	CHINA	1.05
Nanchong	CHINA	1.05
Guwahati (Gauhati)	INDIA	1.04
Guilin	CHINA	1.04
Aligarh	INDIA	1.04
Jinzhou	CHINA	1.034
Zaozhuang	CHINA	1.03
Yingkou	CHINA	1.03
Moradabad	INDIA	1.02
Volgograd	RUSSIA	1.02
Hubli-Dharwad	INDIA	1.02
Chifeng	CHINA	1.02
Nanyang, Henan	CHINA	1.01

City	Country	Population in 2015 in millions
Xiangtan, Hunan	CHINA	1.01
Krasnoyarsk	RUSSIA	1.01
Puning	CHINA	1.00
Salem	INDIA	1.00
Baoji	CHINA	1.00

Source: UN Population Division, 2016

DATA SHEET THREE

Size of city economies for cities included in the Factsheets

City	GDP PPP USD billions, 2014	GDP per capita, 2014 (PPP, USD 1000s	Percentage Change in GDP per capita – 2013 to 2014
SHANGHAI	594.005	24.1	5.2
MOSCOW	553.318	45.8	0
BEIJING	506.137	23.4	4.7
SÃO PAULO	430.510	20.7	-1.5
GUANGZHOU	380.264	29.0	4.9
TIANJIN	371.973	24.2	3.3
SHENZHEN	363.228	33.7	5.1
SUZHOU	339.028	52.0	6.7
CHONGQING	315.581	10.5	7.3
DELHI	293.637	12.7	4.4
CHENGDU	233.525	16.4	8.1
WUHAN	231.551	22.7	9.3
HANGZHOU	219.509	24.6	7
SHENYANG	189.304	26.0	6.7
RIO DE JANEIRO	176.630	14.2	-0.2
MUMBAI	150.853	7.0	4.6
BRASILIA	141.916	35.7	-0.7
XIAN	124.186	14.4	7.2
SAINT PETERSBURG	119.613	23.4	-0.2
JOHANNESBURG	82.918	16.4	-1.3
KOLKATA	60.447	4.0	4.7
CAPE TOWN	58.863	14.1	-1.2
CHENNAI	58.625	6.5	5.2
CURITIBA	57.654	17.0	-0.5
EKURHULENI/EAST RAND	55.337	17.4	0.1
TSHWANE/PRETORIA	49.948	16.7	-0.9
DURBAN	48.908	12.9	-1.2
BENGALURU	45.313	5.1	4.3
HYDERABAD	40.186	5.1	4.2
NOVOSIBIRSK	39.510	N/A	N/A
SALVADOR DA BAHIA	38.469	10.1	-0.9

Source: Brookings Institution

DATA SHEET FOUR

BRICS top 100 corporations, 2016 (Source: Forbes 2000)

Top 100 BRICS Companies

Company	BRICS Rank	World Rank	City Headquarters	Market Cap – billion USD	Sector
ICBC	1	1	BEIJING, CHINA	198.0	Banking
China Construction Bank	2	3	BEIJING, CHINA	162.8	Banking
Agricultural Bank of China	3	3	BEIJING, CHINA	152.7	Banking
Bank of China	4	6	BEIJING, CHINA	143.0	Banking
PetroChina	5	17	BEIJING, CHINA	203.8	Oil and gas
China Mobile	6	18	HONG KONG, CHINA	241.0	Telecommunications
Ping An Insurance Group	7	20	SHENZHEN, CHINA	90.0	Insurance
Sinopec	8	31	BEIJING, CHINA	89.9	Oil and gas
Bank of Communications	9	36	SHANGHAI, CHINA	55.7	Banking
China Merchants Bank	10	38	SHENZHEN, CHINA	66.8	Banking
China Life Insurance	11	49	BEIJING, CHINA	55.7	Insurance
Gazprom	12	53	MOSCOW, RUSSIA	57.1	Oil and gas
Shanghai Pudong Development	13	57	SHANGHAI, CHINA	55.2	Development finance
Industrial Bank	14	59	FUZHOU, CHINA	47.3	Banking
Citic Pacific	15	61	HONG KONG, CHINA	45.4	Iron and steel
Itaú Unibanco Holding	16	63	SÃO PAULO, BRAZIL	50.5	Banking
China Minsheng Banking	17	65	BEIJING, CHINA	49.3	Banking
Rosneft	18	75	MOSCOW, RUSSIA	51.1	Oil and gas
Banco Bradesco	19	78	OSASCO, BRAZIL	41.5	Banking
China Citic Bank	20	79	BEIJING, CHINA	40.5	Banking
Sperbank	21	102	MOSCOW, RUSSIA	39.2	Banking
China State Construction Engineering	22	114	BEIJING, CHINA	25.6	Construction
SAIC Motor	23	120	SHANGHAI, CHINA	34.4	Automobile manufacturing
Reliance Industries	24	121	MUMBAI, INDIA	50.6	Oil and gas
Luk Oil	25	122	MOSCOW, RUSSIA	36.8	Oil and gas
China Telkom	26	124	BEIJING, CHINA	41.0	Telecommunications
AIA Group	27	126	HONG KONG, CHINA	72.7	Insurance
CK Hutchison	28	127	HONG KONG, CHINA	48.2	Conglomerate
China Pacific Insurance	29	131	SHANGHAI, CHINA	37.1	Insurance
CNOOC	30	134	HONG KONG, CHINA	58.0	Oil and gas
China Everbright Bank	31	139	BEIJING, CHINA	25.7	Banking
State Bank of India	32	149	MUMBAI, INDIA	23.3	Banking
China Communications Construction	33	151	BEIJING, CHINA	26.5	Construction
Banco do Brazil	34	153	BRASILIA, BRAZIL	17.0	Banking
China Railway Group	35	163	BEIJING, CHINA	25.5	Construction
China Shenhua Energy	36	167	BEIJING, CHINA	43.1	Metals and mining
Alibaba	37	174	HANGZHOU, CHINA	200.7	Personal and business services (e-commerce)
China Railway Construction	38 tie	180 tie	BEIJING, CHINA	21.6	Construction
Peoples Insurance Company	38 tie	180 tie	BEIJING, CHINA	18.3	Insurance
China Vanke	40	185	SHENZHEN, CHINA	27.7	Real estate
Dalia Wanda Commercial Properties	41	190	BEIJING, CHINA	29.9	Real estate
Jardine Matheson	42	199	HONG KONG, CHINA	42.1	Conglomerate
Tencent Holdings	43	201	SHENZHEN, CHINA	198.4	Computing services
China Unicom	44	218	HONG KONG, CHINA	29.1	Telecommunications
Oil and Natural Gas	45	220	DERAHDUN, INDIA	27.8	Oil and gas
CRRC	46	221	BEIJING, CHINA	38.8	Heavy equipment
Surgutneftegas	47	242	SURGUT, RUSSIA	19.7	Oil and gas
Huaxia Bank	48	245	BEIJING, CHINA	16.7	Banking
Bank of Beijing	49	254	BEIJING, CHINA	20.0	Banking
ICICI Bank	50	266	MUMBAI, INDIA	22.0	Banking
HDFC Bank	51	275	MUMBAI, INDIA	41.5	Banking
Tata Motors	52	278	MUMBAI, INDIA	20.4	Automobile manufacturing
New China Life Insurance	53	297	BEIJING, CHINA	16.2	Insurance
Sun Hun Kai Properties	54	299	HONG KONG, CHINA	36.8	Real estate, investment holdings
Citic Securities	55	309	SHENZHEN, CHINA	31.9	Financial products
Standard Bank Group	56	317	JOHANNESBURG, SOUTH AFRICA	14.4	Banking
Poly Real Estate	57	322	GUANGZHOU, CHINA	15.2	Real estate
Greenland Holdings	58 tie	323 tie	SHANGHAI, CHINA	24.2	Real estate and financial products
Huaneng Power International	58 tie	323 tie	BEIJING, CHINA	16.2	Energy
Haitong Securities	60	334	SHANGHAI, CHINA	25.1	Investment services
China Resources Land	61	340	HONG KONG, CHINA	17.4	Real estate
China Huarong Asset Management	62	348	BEIJING, CHINA	14.3	Financial services
Baidu	63	349	BEIJING, CHINA	66.1	Computer services
Evergrande Real Estate	64	355	GUANGZHOU, CHINA	10.0	Real Estate
Transneft	65	361	MOSCOW, RUSSIA	20.4	Oil services and equipment
Indian Oil	66	371	DELHI, INDIA	15.6	Oil and gas
Sinohydro Group	67	372	BEIJING, CHINA	13.3	Construction

Company	BRICS Rank	World Rank	City Headquarters	Market Cap – billion USD	Sector
China Cinda Asset Management	68	374	BEIJING, CHINA	12.2	Financial services
Tata Consultancy Services	69	385	MUMBAI, INDIA	71.6	IT and business solutions
NTPC	70	400	DELHI, INDIA	17.7	Electricity utility
Cheung Kong Property Holdings	71	401	HONG KONG, CHINA	25.9	Real estate
Midea Group	72	402	FOSHAN, CHINA	20.2	Household appliances
HDFC	73	404	MUMBAI, INDIA	26.9	Financial Services
Petrobras	74	411	RIO DE JANEIRO, BRAZIL	42.1	Oil and gas
Fosun International	75 tie	434 tie	SHANGHAI, CHINA	12.6	Iron and steel
Metallurgical Corporation of China	75 tie	434 tie	BEIJING, CHINA	11.0	Engineering and construction
Steinhoff International	77	440	JOHANNESBURG, SOUTH AFRICA	22.8	Investment company
CLP Holdings	78	442	HONG KONG, CHINA	23.6	Electricity
Country Garden Holdings	79	444	HONG KONG, CHINA	9.1	Real estate
GF Securities	80	446	GUANGZHOU, CHINA	18.8	Investment services
Bharti Airtel	81	453	DELHI, INDIA	21.2	Telecommunications
Sasol	82	462	JOHANNESBURG, SOUTH AFRICA	20.9	Oil and gas
Coal India	83	465	KOLKATA, INDIA	27.3	Metals and mining
China Reassurance Group	84	470	BEIJING, CHINA	11.0	Insurance
Axis Bank	85	484	MUMBAI, INDIA	17.0	Banking
Swire Pacific	86	487	HONG KONG, CHINA	15.8	Conglomerate
First Rand	87	502	JOHANNESBURG, SOUTH AFRICA	18.5	Banking
Larsen & Toubro	88	505	MUMBAI, INDIA	17.7	Construction services
Dongfeng Motor Group	89	509	WUHAN, CHINA	9.9	Automobile
JBS	90	519	SÃO PAULO, BRAZIL	7.0	Food Processing
MTN Group	91	523	JOHANNESBURG, SOUTH AFRICA	18.9	Telecommunications
China Taiping Insurance	92	545	HONG KONG, CHINA	7.7	Insurance
New World Development	93	548	HONG KONG, CHINA	9.4	Real estate
Guosen Securities	94	550	SHENZHEN, CHINA	19.5	Investment services
MTR	95	557	HONG KONG, CHINA	29.1	Railroad operations
Vale	96	559	RIO DE JANEIRO, BRAZIL	26.0	Mining
Wheelock	97	563	HONG KONG, CHINA	9.5	Real estate
Infosys	98	590	BENGALURU, INDIA	41.7	Computer services
Huatei Securities	99	598	NANJING, CHINA	19.2	Financial services
China Eastern Airlines	100	607	SHANGHAI, CHINA	10.9	Airline

Source: Forbes International

DATA SHEET FIVE

The thirty wealthiest individuals in the BRICS, 2016

Individual	City and Country	BRICS rank	World rank	Net worth – billion USD	Sector
Wang Jianlin	BEIJING, CHINA	1	18	28.7	Real estate
Jorge Lemann	BRAZILIAN RESIDING IN SWITZERLAND	2	19	27.8	Beer
Li Ka-shing	HONG KONG, CHINA	3	20	27.1	Diverse
Lee Shau Kee	HONG KONG, CHINA	4	31	21.5	Real estate
Jack Ma	HANGZHOU, CHINA	5	33	20.5	e-commerce (Alibaba)
Mukesh Ambani	MUMBAI, INDIA	6	36	19.3	Petrochemicals, oil, gas (Reliance)
Joseph Saffra	SÃO PAULO, BRAZIL	7	42	17.2	Banking
Dilip Shanghvi	MUMBAI, INDIA	8	44	16.7	Pharmaceuticals
Ma Huateng	SHENZHEN, CHINA	9	46	16.6	Internet services
Azim Premji	BENGALURU, INDIA	10	55	15.0	Software services (Wipro)
Cheng Yu-tung	HONG KONG, CHINA	11	58	14.5	Diverse
Leonid Mikhelson	MOSCOW, RUSSIA	12	60	14.4	Gas, chemicals
Mikhail Fridman	RUSSIAN RESIDENT IN LONDON	13	63	13.3	Oil, banking, telecomms
Joseph Lau	HONG KONG, CHINA	14	65	13.1	Real estate
Thomas & Raymond Kwok	HONG KONG, CHINA	15 tie	68 tie	13.0	Real estate
Marcel Herrmann Telles	SÃO PAULO, BRAZIL	15 tie	68 tie	13.0	Beer (Anheuser-Busch InBev)
Alisher Usmanov	MOSCOW, RUSSIA	16	73	12.5	Steel, telecomms
Vladimir Potanin	MOSCOW, RUSSIA	17	78	12.1	Metals
Gennady Timchenko	MOSCOW, RUSSIA	18	85	12.1	Oil and gas (Norilsk)
Carlos Alberto Sicupira	BRAZILIAN LIVING IN SWITZERLAND	19	87	11.3	Beer (Anheuser-Busch InBev)
Shiv Nadar	DELHI, INDIA	20	88	11.1	Software services
Robin Li	BEIJING, CHINA	21	90	11.0	Internet search (Baidu)
Alexey Mordashov	MOSCOW, RUSSIA	22	93	10.9	Steel (Severstal)
Viktor Vekselberg	MOSCOW, RUSSIA	23	98	10.5	Metals, energy
Lei Jun	BEIJING, CHINA	24	107	9.8	Smartphones (Xiaomi)
Vladimir Lisin	MOSCOW, RUSSIA	25	116	9.3	Steel, transport (Novolipetsk)
He Xiangjian	FOSHAN, CHINA	26	122	9.0	Home appliances
Vagit Alekperov	MOSCOW, RUSSIA	27	124	8.9	Oil
German Khan	MOSCOW, RUSSIA	28	128	8.7	Oil, banking, telecomms
Hui Ka Yan	GUANGZHOU, CHINA	29	129	8.6	Real estate
Cyrus Poonawalla	PUNE, INDIA	30	133	8.5	Vaccines

DATA SHEET SIX

A summary of subnational data on poverty for Brazil, China and India (Source: Alkire et al, 2016)

Country	Region	% of population in multidimensional poverty	% of population in severe poverty	Multidimensional poverty index
BRAZIL	Amazonas	10.3	1.7	0.044
	Bahia	7.0	1.3	0.029
	Ceará	7.0	1.1	0.029
	Distrito Federal	2.3	0.1	0.008
	Espírito Santo	4.8	0.3	0.018
	Goiás	4.2	0.5	0.017
	Maranhão	10.2	2.4	0.046
	Mato Grosso	4.5	0.5	0.019
	Mato Grosso do Sul	4.3	0.5	0.019
	Minas Gerais	5.4	0.7	0.021
	Paraná	4.0	0.3	0.016
	Paraíba	7.6	1.8	0.032
	Pará	7.8	1.6	0.035
	Pernambuco	6.5	1.3	0.027
	Piauí	8.8	1.6	0.039
	Rio Grande do Norte	7.2	0.6	0.023
	Rio Grande do Sul	3.2	0.3	0.012
	Rio de Janeiro	2.9	0.2	0.011
	Rondônia	5.6	0.5	0.024
	Roraima	7.1	0.4	0.029
	Santa Catarina	4.9	0.6	0.019
	Sergipe	8.0	1.4	0.034
	São Paulo	3.4	0.2	0.012
	Tocantins	7.3	0.7	0.030
CHINA	Central	3.4	0.3	0.014
	East	2.7	0.1	0.010
	West	11.3	3.2	0.051
INDIA	Andhra Pradesh	44.5	18.5	0.209
	Arunachal Pradesh	53.0	28.9	0.274
	Assam	60.1	32.5	0.316
	Bihar	79.3	53.5	0.479
	Chhattisgarh	69.7	37.6	0.367
	Delhi	12.4	3.4	0.054
	Goa	20.0	4.8	0.085
	Gujarat	41.0	18.5	0.200
	Haryana	39.3	16.0	0.186
	Himachal Pradesh	29.9	7.0	0.125
	Jammu and Kashmir	41.0	16.7	0.194
	Jharkhand	74.8	51.0	0.441
	Karnataka	43.2	18.7	0.206
	Kerala	12.7	2.1	0.051
	Madhya Pradesh	68.1	40.5	0.373
	Maharashtra	37.9	14.7	0.180
	Manipur	40.8	15.4	0.191
	Meghalaya	56.6	33.9	0.307
	Mizoram	21.0	7.0	0.093
	Nagaland	51.7	26.2	0.264
	Orissa	63.2	34.3	0.339
	Punjab	24.6	9.0	0.112
	Rajasthan	62.8	35.6	0.338
	Sikkim	31.8	12.1	0.150
	Tamil Nadu	30.5	8.7	0.130
	Tripura	54.6	25.5	0.269
	Uttar Pradesh	68.1	39.3	0.369
	Uttarakhand	39.5	15.8	0.185
	West Bengal	57.4	30.6	0.304

PART A: CHAPTER TWO

Thematic Analysis: Transportation, Green Energy and Innovation Economies

INTRODUCTION

SELECTED THEMES

In addition to providing an overview of the histories, demography, economy, spatial structure, governance and development challenges of the selected cities, the Factsheets offer an analysis of three specific themes in urban development, namely 'transportation', 'green energy', and 'innovation economies'. As indicated in Chapter One, there are multiple possible areas of analysis, and the selection of these three does not indicate any form of prioritisation. We may for example put forward a strong argument that comparative urban analysis across the BRICS should explore practices of slum upgrading, or technology as an instrument of change or participatory governance. Nevertheless, the three selected themes are important.

Transportation is of course the lifeline of cities. Inter-city connections allow for exchange, trade and travel – indispensable for economic and social development. Within a city, transport networks allow for movement and access, but if they are deficient they cause congestion and pollution. Energy in the form of electricity or fuel is also critical to the survival and functioning of modern society and the economy. Maintaining supplies of energy sufficient to grow the economy is essential. However, the production and consumption of energy is also destructive to the environment, and therefore to human well-being, especially if the energy sources are fossil fuels. Finally, innovation is a key element of economic success, and therefore also of human well-being. Economies may be driven by different factors, including the endowment of natural resources, and cheap labour; but it is innovation that allows for the progressive upgrading of an economy, and a constantly improving quality of life.

DATA CHALLENGES

Problems with data proved to be an enormous challenge in addressing these themes. We drew extensively on the city-based Factsheets, but there is a serious lack of comparative data. In terms of transport, there is basic comparative data for the large-scale economic infrastructure, with information, for example, on airport traffic (national aviation authorities) and container port traffic (Lloyds and World Shipping Council). But there is a real challenge in relation to mobility networks within cities.

Key data requirements for comparative research include modal split by transport type, share of different forms of public transport, and the relative growth and decline of the different modes and forms of transport. There is a hotchpotch of data in these areas, with major problems including:

- Outdated data, with transport surveys conducted erratically;
- Variations in the spatial units studied (e.g. inner cities, core cities, urban agglomerations);
- Different data sets including or excluding 'walking' in their calculations, with major consequences for modal splits;
- Different forms of travel measured (e.g. 'work trips', 'most frequent trips', 'all trips'); and
- Measurement of all modes of transport in a single trip, or the dominant mode of transport.

There have been a few attempts to provide comparative global data, most notably the BRT Global Data and Urban Age, but these sources are limited by the variation in original sources. Given these challenges, we are cautious in the presentation of transport data. We cannot provide a comprehensive comparison across all cities in terms of modal split, but we do provide data where comparison is possible (for example, individual modes of transport for selected cities where data is in an equivalent form).

The data issues for 'green energy' are less complex than for transport, but remain challenging. Definitions vary; for example, some sources consider hydro to be a form of green energy, and others do not[1]. But the greatest problem in relation to data on energy is the general lack in disaggregation to city level. Energy systems (production, transmission and distribution networks) are often spread across national or subnational territories, and data is mainly provided at this scale. There are similar challenges in terms of innovation economies. Data on innovation indicators is often provided at the national level, and sometimes for subnational territories, but only in the case of China is there detailed information on innovation at a city level (supplied by Municipal Statistical Offices). There is a comprehensively developed Global Innovation Index comparing across countries, which is produced on an annual basis as a partnership between leading academic institutions and a UN agency. At city level, the private consulting company 2thinknow produces an index of city-level innovation which offers a perspective on the relative position of cities in the BRICS in terms of innovation – although there is always 'the devil in the detail'.

1. The more commonly agreed approach is to include small-scale hydro as green energy but not large-scale hydro, which often has major environmental consequences through the construction of large dams and turbines.

TRANSPORTATION

In the field of transport, we distinguish between the large-scale economic infrastructures that connect cities to other places, and the systems and practices which allow for mobility within cities. Both are enormously important.

ECONOMIC INFRASTRUCTURE (INTER-CITY)

All cities are connected to other places in multiple ways, although levels of connectivity do vary. Some cities are central to global communication hubs, and others to national, regional and local hubs. The major means of linkage are road, rail, sea, inland waterways, and air. The large BRICS cities are generally well linked into national road networks, and the current focus is on the other major connecting infrastructures. However, there have been some large-scale investments in roads in the fairly recent past; including, for example, the 2 275km highway linking Brasília with Belem in north-east Brazil.

According to the International Union of Railways (UIC), all BRICS countries have significant rail networks: China (121 000km), Russia (86 000km), India (67 000km), South Africa (31 000km) and Brazil (29 000km). In terms of population per kilometre of track, South Africa and Russia are the best serviced, but in terms of the actual use and importance of rail, India ranks first. Railway connections have played a key role in the development of many cities; some more than others. The City of Novosibirsk, for example, exists largely because of its strategic position along the Trans-Siberian railway line at the crossing of the Ob River. Wuhan has a strategic position at the first-ever railway crossing of the Yangtze River, and it is here that the railway networks of north and south China were connected.

China's extensive network of high-speed rail may be the most significant recent innovation in major inter-city transport infrastructure. The first major inter-city high-speed railway service in China was introduced in 2007; since then there has been rapid development, with China now dominating globally in terms of high-speed rail[2]. By the end of 2014, China had nearly 20 000km of high-speed rail track, including the world's longest high-speed rail line, the 2 300-kilometre connection between Beijing and Guangzhou. The expansion of the network continues, with the massive Beijing-Guangzhou-Shenzhen-Hong Kong high-speed network, for example, scheduled for completion in 2018.

The other major new development in rail was the opening in 2013 of the 11 000-kilometre express railway line between Chengdu in central China, and Rotterdam in Europe. While use of this line has not reached its full potential, it will potentially reinforce cities such as Chengdu and Xi'an as international logistics hubs, and as gateways in China to Central Asia and Europe.

While the focus is clearly China, there have been developments elsewhere in the BRICS, including the high-speed rail link between Moscow and St. Petersburg opened in 2009. There is a planned high-speed rail service between Rio de Janeiro and São Paulo, but there have been delays in implementation, complicated by the current political and economic circumstances of Brazil. More ambitious is the plan for the Bi-Oceanic Railway, which would join the Port of Santos with the Port of Ilo in Peru, but there are also uncertainties around this. A high-speed rail service between eThekwini (Durban) and Johannesburg-Ekurhuleni has been mooted, but projected cost remains a major obstacle.

Sea trade has a long history among BRICS countries, with many cities developing initially as ports.

2. High-speed rail was first introduced by Japan in the 1960s, and then introduced to Europe, but China has now surpassed both.

Today the BRICS has seven of the world's 10 largest container ports, although all of them are in China (see DATA SHEET ONE, in the Annexure). The Ports of Shanghai, Shenzhen and Hong Kong are the world's largest, third- and fourth-largest respectively. According to the World Shipping Council, 23 of the world's largest 100 container ports are in China, with other BRICS ports in this category being Jawaharlal Nehru (Mumbai) and Mundra (in Gujarat State) in India; Santos (Greater São Paulo) in Brazil; Durban in South Africa; and St. Petersburg in Russia. There is continued major investment in port infrastructure, including (most recently) the construction of the Yangshan Port in the Hangzhou Bay, which is connected to the Shanghai mainland by the world's largest bridge (32.5km). Among plans for future development is the proposal for a major expansion to the Port of Durban in South Africa, including a dug-out port on a previous airport site, and the expansion and modernisation of the Port of Salvador in Brazil. There are nevertheless still problems with port capacity constraining economic growth, such as in the Port of Santos in the greater São Paulo region.

A number of the BRICS cities are on inland waterways. St. Petersburg, for example, plays the hub role in the extensive network of waterways that link the Volga River and the Baltic Sea. Hangzhou and Suzhou are at the southern end of the Grand Canal, which was constructed nearly a millennium ago, and which connects to Beijing. Cities such as Chongqing and Wuhan are strategically located on the Yangtze River, which carries traffic to the Port of Shanghai.

The BRICS has 11 of the world's top 50 airports in terms of total passenger numbers[3], of which eight are in China (see DATA SHEET TWO). This includes the airports in Beijing, Hong Kong, Shanghai and Guangzhou, which are in the world's top 20. Outside of China, the world's top 50 airports include those in Delhi, Mumbai and São Paulo.

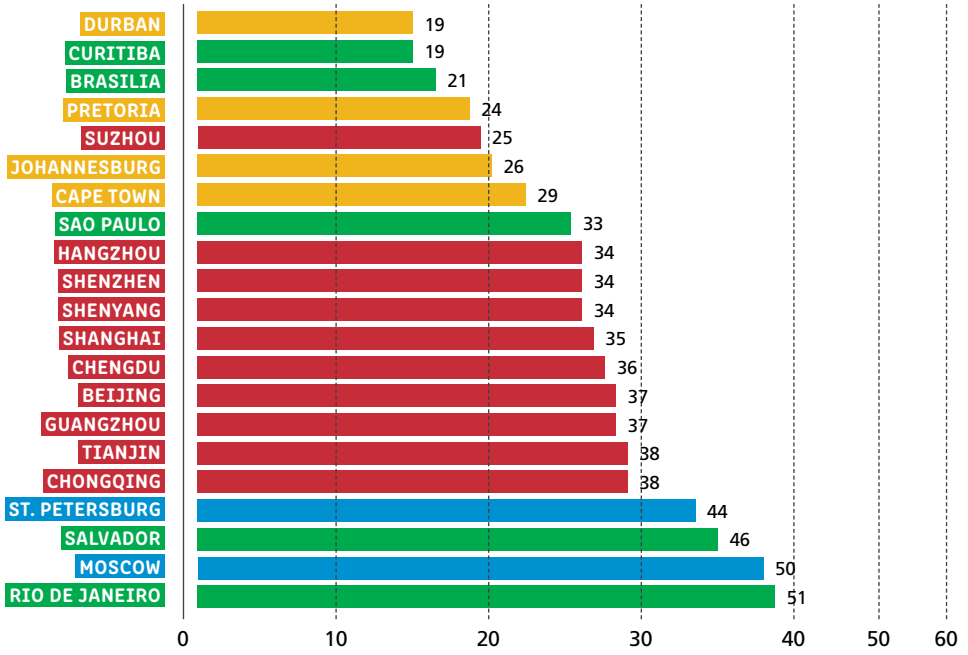
The significance of airports is not only in their size but also in the extent to which they act as hubs for major airlines. The large airports in China are hubs for massive national airlines, of which three are among the 10 largest in the world[4]. Airports in Delhi, Mumbai and São Paulo are also hubs for major national and regional carriers[5]. However, cities in the BRICS are lacking a role as major international airline hubs, having been eclipsed by cities such as Dubai, Abu Dhabi and Singapore. The one exception is Hong Kong International Airport (eighth-largest in the world), which is the hub for Cathay Pacific, a highly-regarded international carrier (rated fourth-best airline in the world in 2015). The airports in Johannesburg-Ekurhuleni and Moscow are secondary international hubs, hosting the international carriers South African Airways and Aeroflot respectively. The terrain is fluid, as cities may rise or fall as airport hubs. Bengaluru, for example, lost position when the airline it hosted lost its operating licence and shut down. By contrast, Chengdu is rapidly emerging as an international airport hub[6].

URBAN MOBILITY (INTRA-CITY)

Almost all large BRICS cities have experienced a rapid rise in private vehicle ownership, and growing congestion on their roads. In many instances, the change has been extreme. The TomTom Traffic Index gives a comparative sense of congestion levels, measuring the additional travel time in peak hours compared to normal traffic (although unfortunately it does not have data for India's cities). In terms of the Index, the BRICS includes 5 of the top 10 most congested cities for which data was collected, namely Rio de Janeiro, Moscow, Salvador, Recife and St. Petersburg.

3. Measured in terms of passenger traffic, which is roughly consistent with the BRICS proportional contribution to the global economy.
4. Namely: China Southern Airlines and Air China in Beijing, and China Eastern Airlines in Shanghai.
5. Namely: Indigo and Air India in Delhi; Jet Airways in Mumbai; and Tam in São Paulo.
6. Since 2013, international routes have been opened which connect Chengdu directly to cities including San Francisco, London, Moscow and Melbourne, with 55 international non-stop routes planned by 2020.

Figure 2.1: Levels of congestion in BRICS cities (excluding India) as rated in the TomTom Traffic Index 2016.



Source: TomTom, 2016

With their monocentric spatial forms and extremely rapidly increase in private-vehicle ownership, Russia's cities are highly congested. Under the Soviet Union, car ownership was very limited. In 1985 it was 45 per 1 000 people (up from 27 per 1 000 in 1977), but car ownership is now around 290 per 1 000[7]. In Moscow, car ownership is around 380 per 1 000, and growing at around 8-10% per annum.

Brazil's cities also face congestion problems; but Rio de Janeiro, Salvador and Recife have especially severe congestion challenges, because of their extreme topographical conditions. In Brazil, urban mobility has become a major political issue, with street protests in cities across the country in 2013 and 2016 directed at concerns with transport. Curitiba, which has pursued public transport-friendly policies since the 1970s, is relatively less congested.

China's cities are also congested, in international terms. These cities had grown up around non-motorised transport. For example, as late as 1986, 86% of trips in Beijing were by bicycle, with only 5% by private motor vehicle. In the 1990s there was massive and rapid investment in road infrastructure, with the construction of a huge network of roads, highways, tunnels and bridges. China's entry into the World Trade Organisation in 2001 supported the rise in car ownership, allowing for the easy import of popular international vehicle makes. This motorisation process led to congestion and severe air pollution, affecting the quality of life in cities. Finally, in the early 2000s, China began the shift towards active investment in and promotion of public transport, but severe damage had already been done.

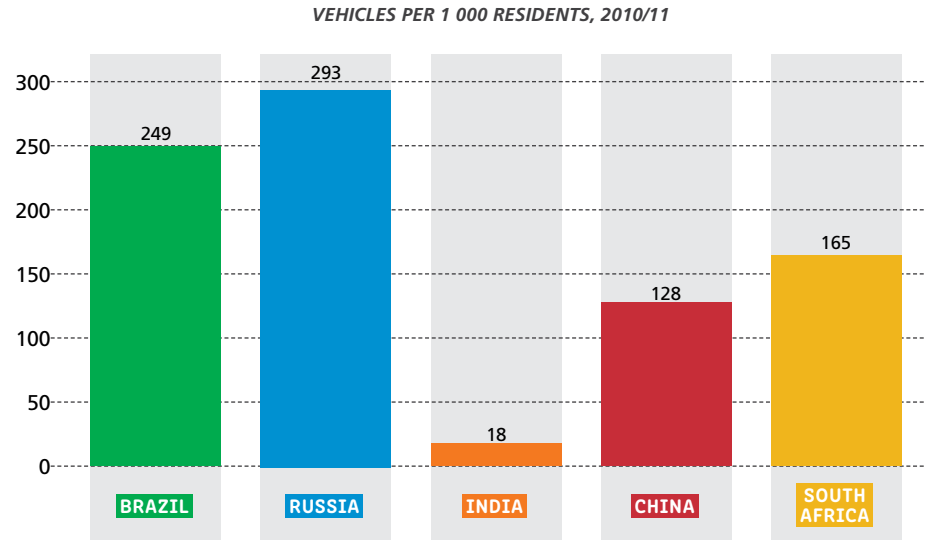
South Africa's cities are the least congested, because of their modest size in relation to the other cities measured. However, the TomTom measurement may not reflect the actual experience of commuting in South Africa. Instead of relying on travel-time measurement, the IBM Global Commuter Pain Index uses a survey method, asking commuters for their perceptions of 'travel pain'. The 2011 survey included 20 large cities globally, with Johannesburg rated the fifth-worst in terms of travel pain – higher than Moscow and cities in India.

7. See Siegelbaum (2006)

Although TomTom does not provide data for India, any visitor to India will attest to the congestion of its roads. The congestion comes from both the large number of different forms of vehicles (travelling at very different speeds) and from poor traffic management. India's population is far poorer than in the other BRICS, so private-car ownership is low; but there is growing ownership of two-wheelers (motorcycles). The UNEP nevertheless reports that between 2001 and 2011, ownership of private motor cars in urban areas roughly doubled, from around 5% to 10%, with an increase from about 25% to 35% in two-wheeler ownership. Car ownership currently stands at a very modest 30 per 1 000 for urban areas (18 for the country as a whole); but there is of course the danger of a dramatic increase in this number, with dire consequences for India's cities.

Figure 2.2 below indicates the still-considerable variance in private-car ownership across the BRICS.

Figure 2.2: Levels of car ownership across BRICS countries



Source: National census reports

Private vehicle ownership and use may indeed be the most severe challenge for managing congestion in BRICS cities. The private car is a potential symbol of status for many, with levels of car ownership commonly associated with modernisation and progress; but there are other challenges – including, for example, urban form.

The dysfunctional urban form in South Africa, a legacy of colonial and apartheid rule, is well-known. It forces many poor people into long and costly commutes to jobs. In Brazil, urban agglomerations have sprawled far beyond the boundaries of the core municipalities, also leading to long commutes[8]. Russia's cities remain largely monocentric, with jobs concentrated in the core but with large numbers of people still living in the Soviet-era apartments on the urban edge. The result is massive commuting flows during peak hours. China's cities had a stronger link, historically, between places of work and residence; but this has changed with the dramatic expansion of the cities. A number of new towns, for example, have been built without adequate employment, resulting in long-distance commuting to core cities.

Of course, there are multiple other challenges facing BRICS cities. These range from the physi-

8. The 'planned new city', Brasília, is one of the worst in this regard. It was designed for the automobile, with large non-pedestrian-friendly spaces – a problem now compounded by the emergence of satellite settlements spatially separated from the core city.

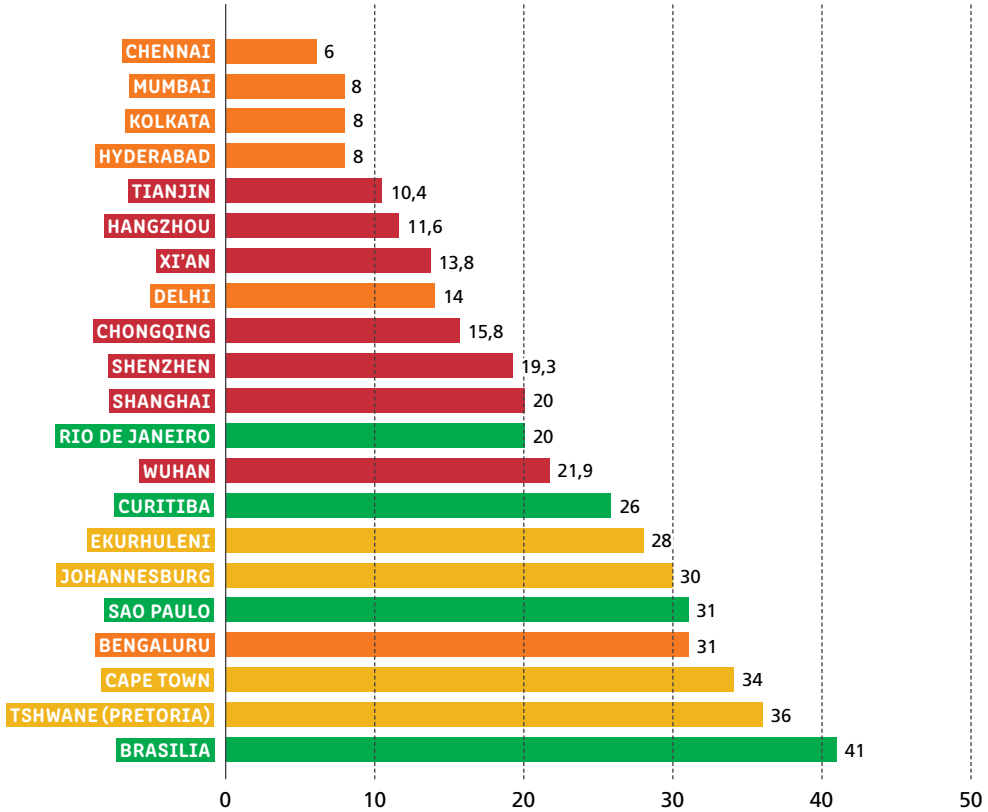
cal or topographical challenges in cities such as Rio de Janeiro, Salvador and Chongqing, to the massive institutional challenges of coordinating mobility networks across large and complex urban agglomerations.

MODAL SPLITS

The modal share of different forms of transport is one indicator of mobility conditions in a city. As indicated, comparative data across the BRICS is impossible to produce, because of the different ways in which data is collected and compiled. What we have done below is to provide comparisons where they are possible. This is for individual modes of transport, for a select number of cities. For example, we have excluded the data from cities where walking as a mode of transport has been excluded (e.g. Beijing and Guangzhou). The major gap is Russia, for which we were unable to secure adequate data.

Data on modal share of transport by city is extremely difficult to compile because of the different methods used in compiling the statistics. To at least provide a comparative indication, we have taken different modes of transport – private motor cars, public transport, walking, and cycling – and provided information for the cities for which data is available. The data is only for those cities that include walking in their calculations, meaning we had to exclude cities such as Beijing, Guangzhou and eThekwini (Durban), for example.

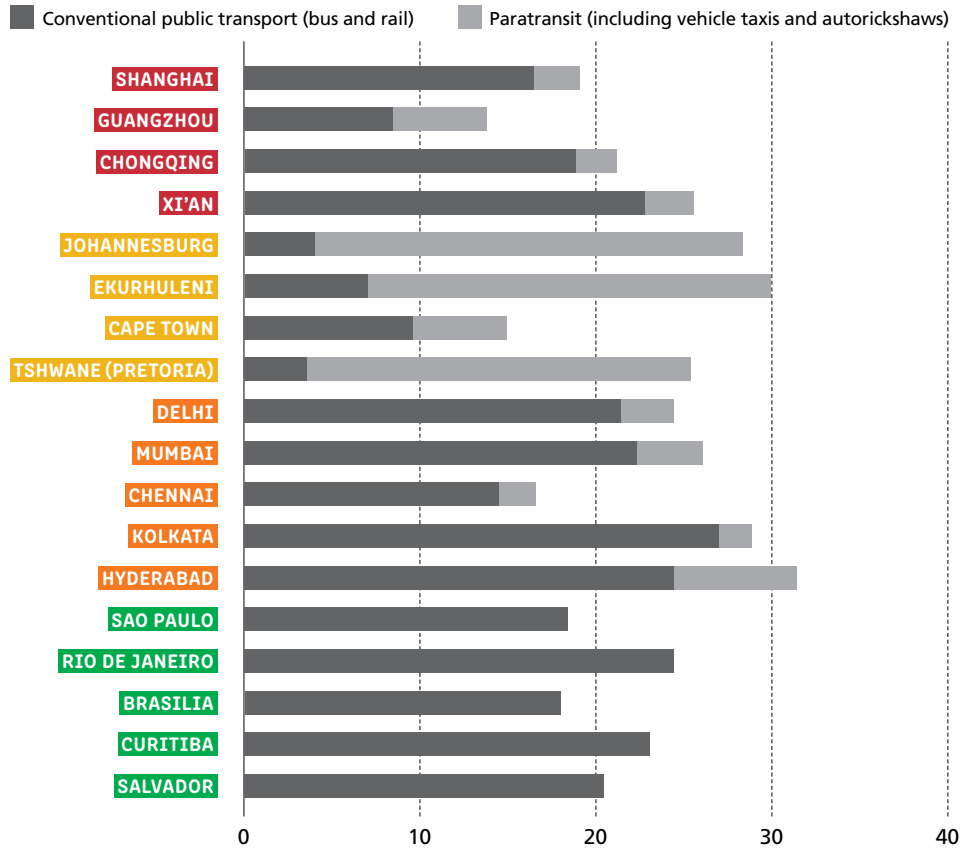
Figure 2.3: Modal share of private cars (for calculations including walking)



Sources: Multiple, as indicated in the Factsheets

There are massive differences across the BRICS in terms of private-car use. In general, cities in South Africa and Brazil have the highest levels of car usage. The lowest modal shares are for cities in India, with the notable exception of India's 'Silicon Valley' city, Bengaluru. But the figures above do not reflect the ownership of two-wheelers, which are common in India. In Mumbai, for example, 8% of trips are in a private automobile, but a further 7% are on a two-wheeler. There are only a few Chinese cities for which there is data on paratransit and public transport, but this gives an indication of the range. For China, taxis are regarded as a form of paratransit. There is no data on paratransit for Brazil's cities.

Figure 2.4: Modal share of public transport, including paratransit (except for Brazil)

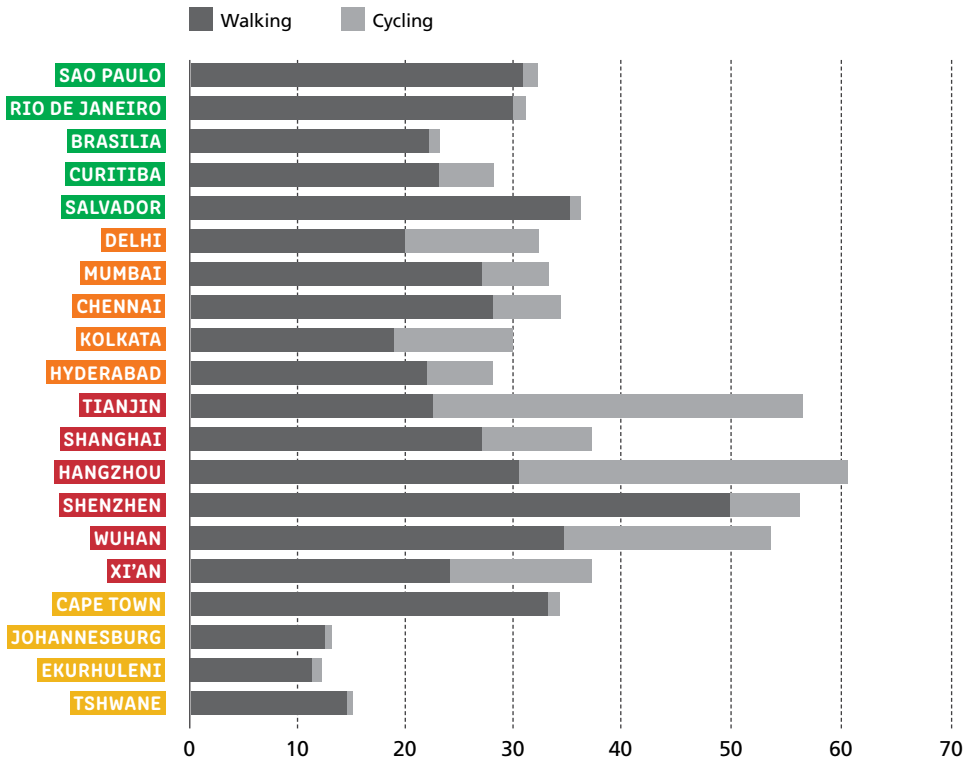


Sources: Multiple, as indicated in the Factsheets

Data must be interpreted carefully. South Africa's cities have a high modal share of both private and public transport, but this is because non-motorised transport has a very low share. However, within the category 'public transport', South Africa's cities are mainly dominated by minibus taxis, a form of paratransit, with other forms of public transport poorly developed. Brazil's cities have a similar structure, with relatively high levels of public and private transport, and relatively low levels of non-motorised transport; although public transport is dominated by bus and rail.

The situation is very different in the much-higher-density cities in India and China. Here, both private and public transport use is comparatively lower than in South Africa and Brazil, but this is because the cities have far higher levels of non-motorised transport, including walking and cycling. In India, proportions using public transport are higher than in China because private vehicle use has such a low share.

Figure 2.5: Modal share of non-motorised transport



Sources: Multiple, as indicated in the Factsheets

In South Africa (with the notable exception of Cape Town), levels of non-motorised transport are very low. Brazil has an intermediate position, with variation between its cities. India's cities have roughly the same level of walking as cities in Brazil, but there is more use of cycling. It is in China's cities that non-motorised transport remains very important. With the exception of the densely-packed new city of Shenzhen, where walking accounts for 50% of all trips, the difference between China and other BRICS cities remains the extent to which cycling is still practised. Cycling is especially important in Hangzhou, Tianjin and Wuhan; but in wealthier Shanghai, there is a higher share of both private and public transport.

PUBLIC TRANSPORT

In almost all large BRICS cities there has been a substantial response to the challenge of congestion; with large-scale investment (and other forms of improvement) in public transport over the past decade. There are significant variations across the BRICS in terms of forms of public transport that dominate. In Brazil, bus services dominate, although large cities do have metro systems that generally account of around a fifth of commuter traffic. Data for Russia's cities are not available, but Moscow and St. Petersburg have large and well established metro systems. India has a complex mix of rail, bus and various forms of paratransit, with China's cities increasingly characterised by a mix of transport types, with a broad balance between bus and rail (mainly metro). South Africa's cities are an exception, with the overwhelming dominance of the minibus taxi – a form of paratransit, although other forms do exist. Each of the forms of public transport is discussed in turn below, with a particular focus on innovation in public transport.

BUS (INCLUDING BRT)

Bus services are generally well established across most cities, but operate with varying degrees of efficiency. There are three main models for delivering this service. First, there are municipally-owned bus companies that run the service. This is the case in Russia and China, for example, although there is increasing experimentation with service delivery in some of China's cities, including the use of Public Private Partnerships (PPPs). The second model is of a state-controlled regulatory body that offers operating concessions to private companies. This is common in Brazil, for example, where the model works with widely varying degrees of effectiveness[9]. The third model is the hybrid of direct public delivery, contracting arrangements and purely private arrangements, which is generally the case for cities in India and South Africa[10].

In many places the quality and performance of bus services has declined. However, there have been recent innovations. These include the introduction of minibus services which allow for greater route flexibility (e.g. Wuhan, which has launched 42 micro circular routes that serve as the 'last kilometre of travel' for bus users). The second, and most significant, is the introduction of Bus Rapid Transit (BRT) systems, which provide a high-quality, high-speed service along dedicated bus lanes, and platform-level boarding.

The world's first BRT system was in fact in Curitiba, Brazil. The system in Curitiba was introduced in 1974, but went largely unnoticed until 1998, when the Mayor of Bogotá in Colombia borrowed from Curitiba in developing the Transmilenio BRT, inaugurating a global revolution in public transport. In recent years the system was taken up again in Brazil, in the run-up to the 2014 FIFA World Cup. The cities of Rio de Janeiro, Belo Horizonte, Porto Alegre and Brasília inaugurated their new BRT systems in 2013/14. São Paulo also has dedicated lanes for buses, although not yet a fully-fledged BRT. A number of smaller Brazilian cities are also now implementing BRT (or partial-BRT) systems.

There was early development of BRT in China, in anticipation of the 2008 Olympics, but these were often partial systems with limited networks[11]. The major development was the launch of the Guangzhou BRT in 2010, which now carries around a million passengers and is the second-largest BRT in the world after Bogotá. The success of the Guangzhou system lies in the extent to which it has integrated with other modes of transport, especially the Metro. Other cities have followed suit, including Chengdu and Wuhan in 2013, while a number of first-generation BRTs are being upgraded to fully-fledged systems. There have been some challenges, however. In topographically-constrained Chongqing, for example, the road reservation for BRT exacerbated congestion, and the system was discontinued. There are important new innovations and developments in BRT in China, including Tianjin's proposals for elevated expressways for buses. Xi'an is currently developing a BRT, and is linking this to the development of a local industry for bus manufacture, through a partnership between local corporations and Volvo.

In South Africa, Johannesburg and Cape Town launched the first phases of their BRT systems in time for the 2010 FIFA World Cup, in the face of opposition from some segments of the minibus taxi industry. Tshwane (Pretoria) introduced a BRT in 2014, while Ekurhuleni anticipates a launch in 2016.

India has also introduced BRT systems, although there have been serious challenges in terms of operational delays and local opposition. A BRT was introduced in Delhi in 2008, ahead of the 2010 Commonwealth Games, but it proved hugely controversial, as a result of its use of road space and

9. In Curitiba, for example, the regulatory agency is highly acclaimed for the way it licences, regulates and coordinates the activities of private operators, ensuring also that fares remain affordable and that buses are well maintained. In Salvador, however, there are frequent complaints about the poor coordination of the scheduling, routes and fares of the 13 private operators.
10. Arrangements across India are extremely diverse, as different states have taken different approaches. While there are municipal bus companies, and regulatory bodies, there is also a plethora of private bus companies, many of which operate effectively outside municipal regulation. In South Africa, there are municipal bus companies (e.g. Metrobus in Johannesburg), but also government-subsidised contracted operators. In the case of eThekwini (Durban), the municipal bus company was (controversially) privatised.
11. They included, for example, Beijing, where the BRT was launched in 2005; Hangzhou, in 2006, Shanghai, Suzhou and Chongqing, in 2008.

its effect on other forms of transport. In 2015 the Chief Minister of Delhi announced the scrapping of the BRT. Bengaluru's BIG Bus Network was launched in 2013 to improve bus efficiency and speed along major movement corridors, and the Kolkata BRT was inaugurated in 2015. There are also advanced plans for introducing BRT systems in Chennai and Hyderabad.

In Russia, Novosibirsk has dedicated bus lanes which are to be expanded along major thoroughfares, while Moscow introduced dedicated lanes in 2016.

RAIL (INCLUDING METRO AND LRT)

Rail takes different forms in BRICS cities. There is the traditional suburban commuter rail, but also (the mainly underground) metro systems, and Light Rail Transit (LRT).

In India, a number of cities have suburban commuter rail, some systems going back to the time of the British Raj in the 19th century. These systems are operated by subsidiaries of the state-owned Indian Railways. The most famous commuter rail network is in the Mumbai Metropolitan Region (MMR), which goes back to 1853 and which currently carries around 7.4 million people daily. While the rail system has increased in its capacity around 2.3 times over the past four decades, suburban rail traffic has increased by over six times, and so the MMR railway system is congested. Kolkata's suburban railway is almost as old, going back to 1854, although it was never developed as extensively as in Mumbai. Chennai has a suburban rail network that goes back to 1931, and which currently carries daily traffic of around 1.46 million. Delhi's suburban railway (introduced for the 1982 Asian Games) has been far less successful than in other cities, failing to develop as a key component of the overall transit network[12]. Hyderabad introduced suburban rail in 2003, using existing tracks, but the current ridership is a modest 175 000 per day; while Bengaluru's commuter rail is currently under construction.

China's commuter rail is operated by regionally-based subsidiaries of the state-owned China Railway Corporation. The Beijing Suburban Railway was inaugurated only in 2008, connecting the core city with outlying towns and districts within the greater metropolitan region. There are also commuter rail systems serving Shanghai, Guangzhou, Wuhan, Chengdu and Xi'an, among other cities in China.

Russia's commuter rail system (Elektrichka) is owned by the Central Suburban Passenger Company, which was previously a subsidiary of the state-owned Russian Railways, but has now largely been privatised.

South African cities also have commuter rail networks, operated by Metrorail – a division of the national parastatal, the Passenger Rail Agency of South Africa (PRASA). The system mainly serves the black African townships around the metropolitan cities, and is heavily subsidised by national government. There has been severe underinvestment in the rail system over a number of decades, and ridership share has declined steadily relative to minibus taxis and private vehicles[13].

The major disadvantages of traditional above-ground commuter rail are the extreme difficulty in expanding the system in already developed and crowded cities, and the generally negative effects on the city structure. Increasingly, attention is more on the development and expansion of (mainly) below-ground metro systems.

The oldest metro in the BRICS is in Moscow. It was built in 1935 as a flagship development of the Soviet era. Like other forms of public transport, it was neglected following the fall of the Soviet Union; but it has recently been refurbished, and remains one of the most significant metro systems in the BRICS and in the world. In 2016 it was carrying around 6.5 million passengers daily, ranking third in the BRICS and fourth in the world in terms of ridership. The St. Petersburg Metro was opened in 1955; and like the Moscow Metro, it is run efficiently, but is a popular mode of transport, and so does get crowded during peak hours. Novosibirsk has the third metro in Russia, but it is a small network carrying around 250 000 people per day.

12. This is largely because of poor connections to other modes of travel.

13. Cape Town is a partial exception; rail retains a key share of ridership.

China followed the Soviet Union with the opening of the Beijing Metro in 1969. The system, which is wholly owned by the Municipality of Beijing, developed slowly until 2000, after which there was rapid expansion in support of the 2008 Olympics. The system continued to expand, and is currently the largest metro in the BRICS and in the world, with a ridership of around 9.8 million people per day.

The second metro opened in China was in Tianjin in 1984, but the system remains small in relation to that of Beijing, although major expansions are planned to support the Binhai New Development Area. The third metro was in Shanghai, opened in 1995. Within a decade it had expanded into the longest metro network in the world – and with a daily ridership of around 8.4 million people, making it the second-largest in the world in terms of passenger numbers after Beijing[14].

The fourth metro was in Guangzhou, opened in 1997. With a ridership of nearly 6.6 million, it is the third-largest in China, and the sixth-largest in the world. In 2004, metro systems were inaugurated for Wuhan and Shenzhen, with the former being the first metro to cross the Yangtze River, and the latter linking into the suburban rail system of Hong Kong, creating an integrated cross-border network. In 2005, Chongqing's rather unusual system was opened. Responding to the extremely difficult topography of the city, the Metro has incorporated 80km of monorail, the largest monorail line in the world. New metro systems continue to be opened in China, including in Shenyang (2009), Chengdu (2010), Xi'an (2011), Hangzhou (2012), and Suzhou (2012). There are established metros in at least 14 other Chinese cities, with a further 12 under construction. China's metros are generally owned by municipal corporations, although private companies are contracted for operations and management.

In Brazil, metro systems are a significant (although not dominant) form of public transport. São Paulo's Metro, which has around three million daily users, goes back to 1968. The smaller system in Rio de Janeiro was inaugurated in 1979. Metros were established in Porto Alegre, Recife and Belo Horizonte, followed in 2001 by Brasília. The construction of Salvador's Metro was completed in 2014 after more than fourteen years, delayed by a lack of resources and poor management capacity. Curitiba resisted the introduction of a metro system, preferring to focus on its now-famous BRT network. Work did eventually commence on a metro, but this was suspended by court action when a controversy erupted over the bidding process.

The development of metro systems in India (and in South Asia) is more recent. The first metro was in Kolkata, opened in 1984; but it has remained a fairly small network, with a current daily ridership of around 650 000. This was followed by Delhi in 2002, which serves the core and satellite cities of the urban agglomeration, with a current daily ridership of around 2.4 million. There has been significant recent development, with the opening of metro systems in Bengaluru (2011), Mumbai (2014), Chennai (2015), and Jaipur (2015). Systems are currently under construction in other cities, including Ahmedabad, Hyderabad, Chandigarh, Noida, Kochi and Lucknow. The metros in India were commonly initiated by state governments, which delegated responsibility for delivery to regional development authorities. Operations are managed by joint-venture companies.

South Africa has no fully-fledged metro system. However, the 80-kilometre Gautrain Rapid Rail Link was inaugurated in 2011, connecting the cities of Johannesburg, Tshwane (Pretoria) and Ekurhuleni. It was developed as a concession by provincial government to a private consortium.

While much of the focus and expenditure in recent years has been on metro systems, LRT has emerged as an affordable alternative in recent years. The tramways, a historical form of LRT, have been in decline for decades. In the Soviet era, St. Petersburg was known as the 'City of Trams', with around 340km of track, but this has declined to a little more than 200km. Kolkata still has a tramway in place, but there has been little improvement or investment in it since 1947.

With the new focus on environmentally-friendly transport, a new era of tramways and other LRT has commenced. In 2007, a tramway was re-introduced into Tianjin, providing a link between downtown and the Binhai New Area. In a joint venture with a French company, the Shenyang city

14. In 2013, the Shanghai Metro was extended to Kunshan in Jiangsu Province, making it the first metro to cross provincial boundaries.

government opened a 70-kilometre LRT in 2013, in time for the 12th China National Games. In 2014, the municipally-owned Suzhou Hi-tech Company opened a tramway between downtown Suzhou and the Suzhou New Area. In Moscow, a 54-kilometre circular railway has been built around the central city which could transport about 400 000 passengers daily, relieving pressure on the metro. An LRT was to be opened in Brasília in time for the FIFA World Cup in 2014, but following allegations of fraud in the bidding process the project has been delayed. Currently there are also efforts to rejuvenate Kolkata's historical system.

PARATRANSIT

Paratransit is a form of transportation that falls somewhere between individual private vehicles and conventional forms of public transport, which may be either privately or government owned. Paratransit has gradually been accepted as part of public transport systems, although full recognition is resisted in some cities. Paratransit is more irregular and unscheduled than institutionally structured public transport, often providing services that are more adaptable and affordable than institutional public transport. The downside is that paratransit is less regulated in terms of safety, pollution and comfort.

In South Africa, the minibus (small passenger van) offers a flexible alternative to state-owned transportation systems. In some cities (Cape Town being a notable exception) they account for 80-90% of trips on public transport, and 40-50% of all trips. The taxis are privately owned but are organised within cartels known as taxi associations. The industry, which developed rapidly from the 1970s, is a celebrated success of black entrepreneurialism. It is a flexible mode of transport suited to the spatial form of South Africa's cities. However, minibus taxis have problems of user safety, a poorly-maintained fleet, and conflict between associations over routes which turn violent on occasion. The minibus is making its appearance in other cities in the BRICS. In Brasilia, for example, they now account for around 17% of all trips. And in Moscow and St. Petersburg, minivans known as marshrutniye taksi are becoming increasingly popular.

In India, a common form of paratransit is the three-wheeled auto-rickshaw (also known as the tuk tuk). There are a large number of auto-rickshaws in India's cities – for example, 150 000 in Mumbai, 140 000 in Bengaluru, 90 000 in Delhi and 60 000 in Chennai. They are a cheap and flexible form of transport, and provide employment to large numbers of people living in slums. They do bring challenges, however; for example, their slow speed contributes to traffic snarl-ups. They also present environmental problems, as their conventional two-stroke engines – frequently combined with poor maintenance and a lack of catalytic convertors – contribute significantly to emissions from the transport sector. In some cities (including Delhi), however, auto-rickshaws have been adapted to run on natural gas, and their environmental impact is significantly lower.

NON-MOTORISED TRANSIT (NMT)

NMT comprises mainly cycling and walking, although there are other forms, such as pedal rickshaws. Cities in China and India were once highly dependent on cycling as a form of mobility, but there has been a sharp drop in the use of bicycles with the rise of the private motor car. Increasingly, cycling has become associated with poverty.

Currently, cycling accounts for around 12% of all trips in China's cities, making a significant (although diminished) contribution to mobility. But there are exceptions. In Shenzhen, a comparatively new city, cycling only accounts for around 6% of trips; and in topographically-challenged Chongqing, cycling is also limited. In some cities, however, cycling remains a significant mode of transport. In Tianjin, it still accounts for 33% of trips, and in Chengdu, 35%. In India, cycling retains a modest trip share, ranging from 6% in Mumbai, Chennai and Hyderabad to about 12% in Kolkata and Delhi. In Russia, South Africa and Brazil cycling is a very minor mode of transport, with generally less than a 1% share. An exception is NMT-friendly Curitiba in Brazil, with a 6% modal share.

Across the BRICS, attention is newly being given to cycling, with cycling infrastructure having been introduced in cities including Johannesburg, Cape Town, São Paulo, Rio de Janeiro and Moscow.

An important innovation is the introduction of bike sharing, with Hangzhou and Wuhan in China being global leaders. The Municipality of Hangzhou introduced bike sharing in 2008, and by 2014 there were 280 000 passengers using 66 000 shared bicycles daily, with a similar scale of development in Wuhan[15]. Tianjin is developing an extensive scheme for NMT, building on the already high levels of cycling. There, NMT is being popularised under the label 'slow transport'. There are modest-sized bike-sharing schemes in Brazil's cities, including São Paulo and Rio de Janeiro, run by private concessionaires, while India is also experimenting with small schemes.

Walking remains a key mode of transport across most cities, although often out of necessity rather than choice. Walking figures are often higher in the poorer cities, such as Salvador in Brazil, and in densely-packed cities such as Mumbai and Chennai in India, and Shenzhen in China. In Johannesburg, a key intervention has been the establishment of a designed walkway between the densely-populated Alexandra township and the growth node of Sandton.

OTHER INTERVENTIONS

There are various other interventions to reduce congestion and increase the use of public transport. A number of leading cities in China (e.g. Beijing, Shanghai, Shenzhen and Suzhou) have introduced measures to reduce the number of cars entering inner-city areas (e.g. by number-plate restrictions), and to cap additional numbers of cars on the road annually through car-licence lotteries or auctions, extra car-registration charges, and reduced periods for validity of licences. Similar initiatives are also being introduced in large cities in Brazil. A creative response in Brazil's cities (São Paulo, Rio de Janeiro and Curitiba) has been the closure of freeways and the creation of linear public parks and busways.

Among the most important interventions is institutional reorganisation, with the creation of integrated transport authorities across major urban agglomerations. This is particularly important for cities where the institutional framework is highly fragmented, such as in India. Currently, transport authorities are being established for a number of India's cities, and for the Gauteng City-Region in South Africa. These authorities are intended to ensure coordinated planning and investment, but also integrated operations, including rationalisation of routes, common timetables, common standards, integrated ticketing, and so on.

The other important form of integration is between transit networks and land-use planning. Curitiba was an early leader in this regard. Here, the urban-planning system promotes high-intensity land development along corridors, with a zone of mixed commercial-residential development within two blocks of the busway, and residential development tapering in density beyond. Other cities have now also adopted policies of transit-oriented development (TOD). São Paulo has adopted innovative funding mechanisms, including the trading of density rights through the issuing of bonds known as Certificado de Potencial Adicional de Construção (CEPACS). In South Africa, the City of Johannesburg is also implementing a TOD programme, dubbed the Corridors of Freedom – mainly around the BRT network, which is aimed at spatially stitching together a city fragmented by apartheid.

PLANS FOR THE FUTURE

The BRICS have been through a period of extraordinary investment in public transport. With BRICS economies generally growing at a slower pace than previously, and with high levels of debt as a result of large-scale infrastructural development, this rate of investment may not be sustained. However, even with a possible slowdown we may still expect significant levels of investment.

For the next decade or so we are likely to see a continued expansion of metro systems, BRT, LRT and NMT, with improvements in the institutional structures and operational systems that support this infrastructure. The key improvement is likely to be strengthened integration between the various modes of transport, and linkages between systems across city boundaries, even to regional scale.

15. However, the operational models are different. In Hangzhou, the scheme is a municipal operation; while in Wuhan, it is a concession to a private company.

There are similarities in the plans across most of the large cities. They are mainly developing diverse but integrated transportation networks. There is some variation: Delhi, for example, is focusing mainly on the development of a rail-based mass transit system, with the metro as the backbone but also with LRT, including monorail. Even in Curitiba, the city that has steadfastly maintained bus services as the backbone of its transport system, a metro is planned, although also with the expansion of busways and NMT.

India, Brazil and South Africa face the challenge of speeding up implementation of major infrastructural development in contexts where there have been delays in relation to tendering, corruption, cost overruns and political instability. China's infrastructural investments have proceeded at a much greater pace; but there are problems of overinvestment in places, and also of local indebtedness as a result of the huge levels of investment. Public transport networks in China will nevertheless continue developing, though with the new priorities being seamless integration of systems, and regional integration within city clusters. Into the longer term, public transport may develop in still unanticipated ways, with innovations reshaping practice.

CONCLUSION ON TRANSPORTATION

BRICS cities are among the most congested in the world – the result of both rapid growth in size, and a massive shift towards the use of the private motor car. However, over the past decade or so there has been a near-revolution in mobility, with major investments in public transport across the BRICS. A major catalyst for this investment has been mega-events, such as the Olympic Games, the FIFA World Cup and the World Expo; but there is also a growing recognition of the consequences of private transport-led growth. Although the interventions have been investment-led, there have also been institutional and operational improvements, including the establishment of city-region-wide transportation authorities. Although the scale of investment may not be sustained, there is considerable momentum, and improvements are likely to continue for the foreseeable future.

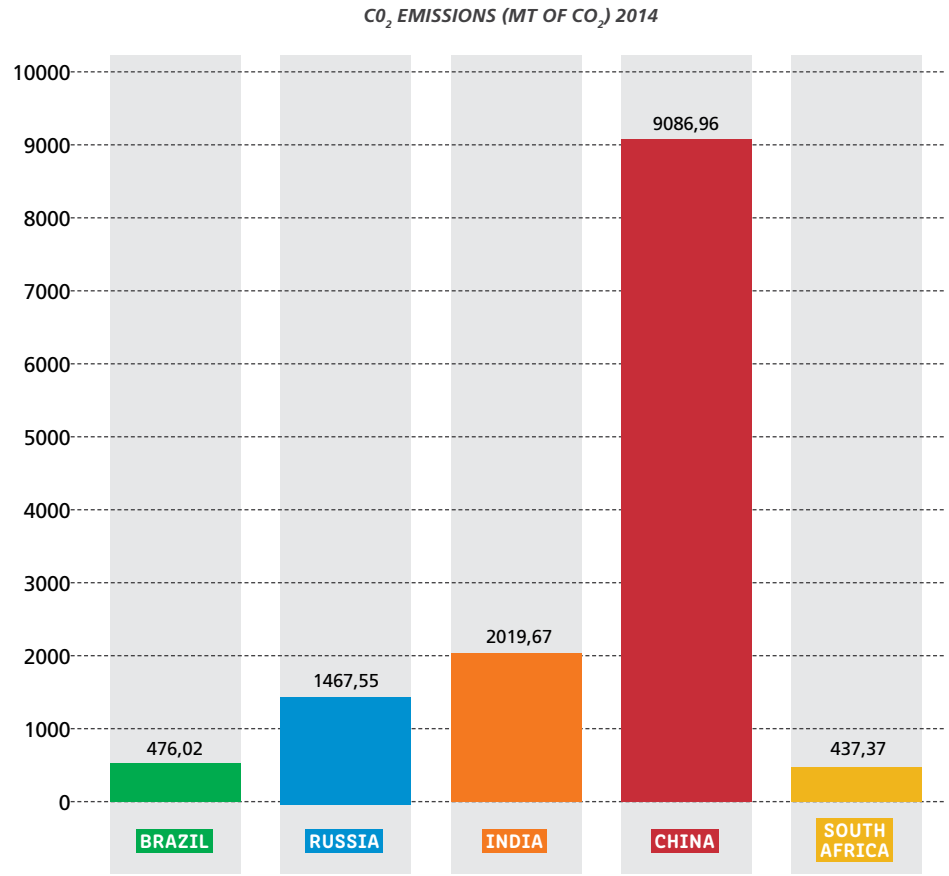
Though there is commonality across many cities in terms of investment in metros and BRT, and to some extent also in LRT and NMT, there is of course variation across BRICS cities. Conditions are different across the BRICS. In Russia's main cities there is the advantage of long-established, high-quality metro systems, but the massive growth of private motor-car ownership in the context of monocentric urban structures has created enormous congestion. In Brazil there are also good public-transport systems, but urban form, topography, rising car ownership, construction delays and political and economic uncertainty are creating complications. India still has very low levels of car ownership, but roads are congested because of poor traffic management and a large variety of transport types operating together. The major risk is that sustained economic growth will be accompanied by a simultaneous increase in private car ownership. China has been effective in rapidly delivering infrastructure for public transport, but is facing challenges of local indebtedness as a result. South Africa has a different transport profile, with both the private motor car and the minibus taxi (a form of paratransit) being significant. One of its challenges is better management of the minibus taxi industry, and its integration into other modes of transport. This is a reminder that although there is an element of commonality across the BRICS, and shared challenges, we do need to give careful consideration to context, and translate lessons across countries and cities with some circumspection.

GREEN ENERGY

INTRODUCTION

According to the World Energy Council, the BRICS account for around 41.7% of global CO_2 emissions, which is significantly higher than its contribution of around a quarter of the world's GDP. The BRICS is an energy-intensive and high-emitting block of countries, although China alone contributes about 70% of the BRICS total, or 29% of the global total.

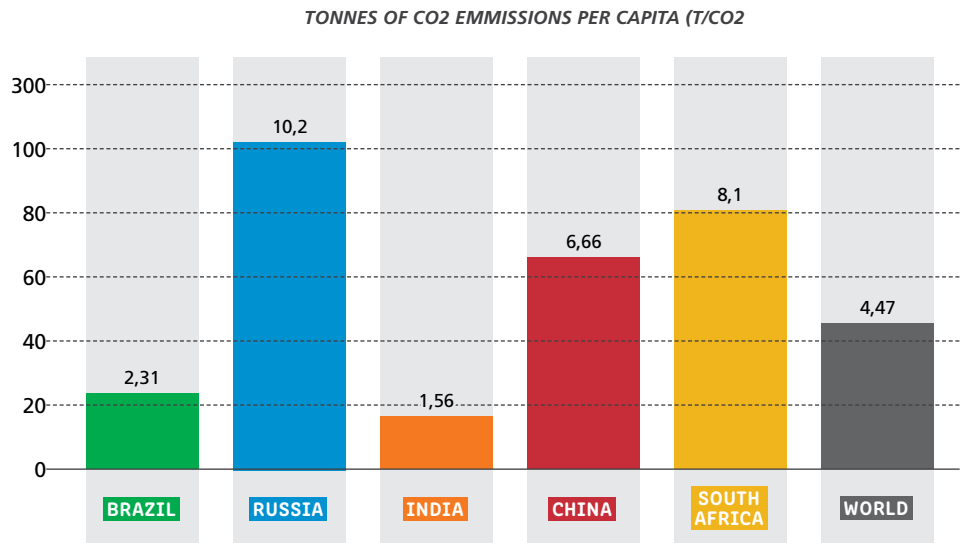
Figure 2.6: Total $C0_2$ emissions per country, 2014



Source: International Energy Agency, 2016

The situation is different if we consider emissions from a per capita perspective. China is indeed a high emitter in global terms, but per capita, Russia and South Africa are in fact worse. Brazil performs well, mainly because of its low dependence on coal for electricity; while India, which is still a low-income country where use of energy, has the lowest emissions.

Figure 2.7: Per capita CO_2 emissions



Source: International Energy Agency, 2016

It is because of the significant contribution of the BRICS to emissions – and therefore to the global challenges of climate change – that we need to take renewables (or green energy) seriously. Non-renewable sources of energy are mainly oil, coal and natural gas, which are the fossil fuels; but also uranium, which is used for nuclear-energy production. The renewable sources include solar, wind, tidal, falling water (hydro), biomass (from organic material) and geothermal. The one area of some ambiguity is hydro-produced energy. In most measurements, large-scale hydro plants are not included as a source of renewable energy, reflecting the negative environmental impact of large hydro schemes. However, small hydro plants are generally regarded as a source of renewable energy.

Table 2.1: Primary energy consumption by fuel, 2015, in percentages

Country	Oil	Natural Gas	Coal	TOTAL FOSSIL	Nuclear	Hydro	Renewable	TOTAL
BRAZIL	46.89	12.57	5.94	65.40	1.13	27.90	5.57	100.00
RUSSIA	21.45	52.83	13.30	87.58	6.63	5.77	0.01	100.00
INDIA	27.91	6.50	58.13	92.53	1.23	4.01	2.21	100.00
CHINA	18.57	5.89	63.72	88.18	1.28	8.46	2.08	100.00
SA	25.28	3.62	68.44	97.34	1.93	0.16	0.81	100.00
BRICS	22.23	12.85	52.49	87.58	2.02	8.41	1.99	100.00
WORLD	32.94	23.85	29.21	86.00	4.44	6.79	2.78	100.00

Source: BP, 2016

In terms of overall energy profile, the BRICS are slightly more dependent on fossil fuels than globally, but there is significant national variation. Brazil does significantly better than globally and the other BRICS, because of its very low coal consumption. China and South Africa are especially high users of fossil. In terms of the different types of fossil fuels, Brazil has large reserves of oil, and is also a significant oil consumer. Russia is largely dependent on natural gas, while South Africa and China are highly dependent on coal.

The use of other energy sources varies. Nuclear features in the case of Russia, while Brazil has a very high proportion of hydro use. Renewables are a modest proportion, with the BRICS still lagging behind globally. Brazil is doing well, but all the other BRICS are still proportionately low, with Russia extremely so.

However, while renewables are still low in terms of proportion to the total, there has been a rapid rise in renewables. Globally, the BP survey indicates a 15.2% increase in the consumption of renewable energy for the year 2014/15; but the increase for the BRICS was 75.3% for South Africa, 23% for Brazil, 20.9% for China, 13.7% for India and 6.8% for Russia. South Africa was doing very well off a low base, but Brazil and China – which have a higher base – were also improving significantly above the world average.

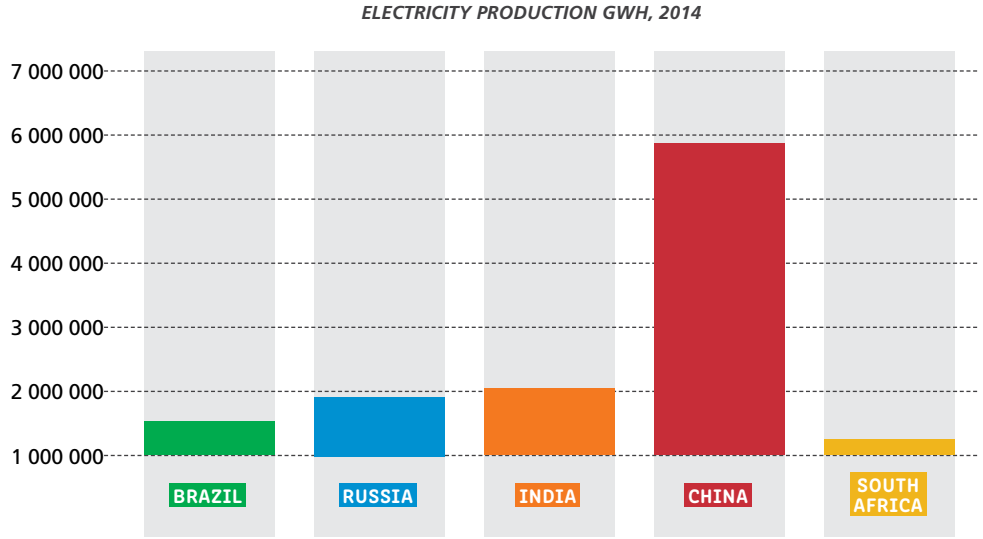
In modern economies there are two major uses of energy: for electricity, and for vehicle fuels – although household heating is an important use of energy in Russia and parts of China. The focus below will be on the first two, specifically in relation to green energy sources.

ELECTRICITY

NATIONAL PROFILES

The BRICS are electricity-intensive countries, accounting for around 38% of the world's electricity production. All BRICS countries are in the top 20 electricity producers in the world – China in first place, then India (third), Russia (fourth), Brazil (eighth) and South Africa (18th). Among these, China is the giant, producing significantly more electricity than either the USA or the European Union.

Figure 2.8: Electricity production in BRICS countries



Source: BP, 2015

There is significant variation across the BRICS in terms of the sources of electricity production. Brazil has by far the lowest dependence on fossil fuels, with more than 80% of its electricity being hydro-produced. Russia has huge reserves of natural gas, which are used to produce around half of its electricity, with the remainder coming from coal, hydro and nuclear. India, China and South Africa are overwhelmingly dependent on coal for electricity production; South Africa extremely so.

Table 2.2: Share of electricity production by energy source, 2011

	BRAZIL	RUSSIA	INDIA	CHINA	SOUTH AFRICA	WORLD
Coal	2.3	15.5	67.9	79.0	93.8	41.2
Natural Gas	4.7	49.3	10.3	1.8	0.0	21.9
Oil	2.8	2.6	1.2	0.2	0.1	3.9
TOTAL FOSSIL	9.8	67.4	79.4	81.0	93.9	67.0
Hydro	80.6	15.7	12.4	14.8	0.8	15.6
Nuclear	2.9	16.4	3.2	1.8	5.2	11.7
Other Renewable	6.6	0.1	5.0	2.2	0.2	4.2

Source: World Bank, 2016

Within the BRICS there is a mix in terms of who produces electricity. Most BRICS countries have been through reform in the electricity sector, and as a result the state's role in electricity production has shifted. In Brazil there is a rough equivalence between state and private production of electricity. In Russia, the Soviet-era state monopoly on electricity production was dismantled, but production is now in the hands of a few large companies that are either state-owned or strongly influenced by the state[16]. In India, 25% of electricity is produced by agencies of central government, 34% by state governments, and 42% privately. In China, electricity is produced mainly by State-Owned Enterprises (SOEs) that fall under the supervision of a commission of central government's State Council[17]. In South Africa, the government-owned national power utility Eskom continues to dominate the electricity sector, producing around 95% of the total electricity supply.

Renewables still account for a modest percentage of the total energy profiles of BRICS countries, but they are growing in significance. Brazil has the lowest level of fossil-fuel-based electricity production, and the highest proportion from renewables. The major challenge in Brazil is that the high dependence on large-scale hydro makes Brazil's electricity sector extremely vulnerable to drought. Brazil is therefore attempting to diversify its energy mix, and this may result in a greater use of coal and nuclear energy. However, there is also a focus on wind- and biomass-produced electricity. The first wind-energy auction was held in 2009, and there has been a rapid escalation in wind-energy production since then, reaching 8 700MW in 2015. Biomass is being produced from eucalyptus trees, and the government has significantly increased incentives to increase the scale of forests.

Russia has had an abundance of oil and natural gas and this has skewed the economy towards the use of high-carbon energy sources. About half of Russia's electricity is sourced from natural gas and oil, and a further 15% from coal. Nevertheless, Russia is close to the world average in terms of reliance on fossil fuels for energy production, and is better placed than the other BRICS with the exception of Brazil. This is because over 30% of its production comes from hydro and nuclear combined, far higher than the other BRICS (again, with the exception of Brazil). However, there are significant inefficiencies in the use of electricity, a result of the availability of cheap energy sources, and subsidised electricity usage. Beyond hydro, Russia's use of renewables for electricity production is minimal; but there has been recent progress, including the introduction of subsidies for renewable producers in 2013.

India has historically had a higher level of energy production from renewables, but this is largely because of the traditional small domestic-scale digesters for cooking, mainly in rural areas without electricity supply. In terms of electricity production, India has been coal-reliant, although not to the extent of China and South Africa. In recent years there has been good (though spatially uneven) progress with the development of modern renewables, especially wind and solar PV. The major instrument used to support green energy is Renewable Purchase Obligations (RPOs), which require municipal governments to produce a specified (and annually increasing) level of electricity from renewables.

16. Inter RAO UES, Gazprom, Rosenergoatom and RusHydro.

17. There are five major state-owned power producers in China, but each of these has a number of subsidiary companies which act mainly independently of the mother companies, and are counted as Independent Power Producers (IPPs).

With its massive economic expansion, China has become the world's largest producer and user of electricity. However, the country has also emerged rapidly as a leader in renewable energy systems, having recently overtaken the USA in scale. The Economist, for example, referred to China as "the world's worst polluter, but highest investor in green energy" (10 August 2013). The big story is the rise of wind power. By 2013, China had the largest installed capacity for wind in the world: 62 400MW, compared with the USA's 47 100MW. China is also the world's top generator of solar power, having overtaken Germany in 2015. The progress is driven by targets in China's Five-Year Plans, which in addition to renewable production also focus on significant improvements in energy efficiency. The BP Statistical Review reports that for 2015/16, there was a modest 1.5% growth in China's energy consumption – but there was also a 2% decline in coal production, and a 20.9% increase in renewables. There was also the first decline in emissions since 1998. There is clearly a significant transition underway, although it will take time to complete.

South Africa is one of the most coal-dependent countries in the world. However, the Integrated Resource Plan (IRP), compiled by the Department of Energy, has proposed a radical overhaul of the electricity mix, with a reduction in the contribution of coal to less than 50% by 2030, with the gap being addressed by an expansion in electricity produced from gas, nuclear and renewables. At least 30% of new electricity production must come from renewables if these targets are to be met. This may involve an additional 11 400MW of additional capacity in renewables by 2030 (excluding the requirement for hydro). In 2011, the national Department of Energy launched the Renewable Energy Programme for Independent Power Producers (REIPPP) to procure clean energy from private producers, which was linked to twenty-year purchase agreements with Eskom. Significant progress has been made since 2011, with the OECD identifying South Africa as the fastest-growing renewable-energy market in the G20 group[18]. There are concerns, however; recent indications from the national power utility are that it is less committed to renewables than before.

CITY LEVEL

In general, city governments have a limited role in the production of electricity, although they may be able to influence production through electricity procurement policies.

In Brazil, cities are attempting to diversify production through local projects such as landfill-to-energy plants and waste-to-energy plants, although the significance of these initiatives may arguably be measured more in terms of reduction in carbon emissions than in electricity production. São Paulo pioneered the use of the Clean Development Mechanism (CDM) provided for in terms of Article 12 of the Kyoto Protocol by holding the first public auction of Certified Emission Reductions (CERs) in the world, with landfill gas plants earning significant numbers of CERs. Projects of important symbolic value include the use of solar energy to power the stadiums for the Olympic Games (e.g. Rio de Janeiro, Brasilia and Salvador).

In Russia there are large municipal power plants, but these are run by power utilities that are mainly owned by the large power companies, including the energy giant Gazprom. There is some regional variation, with, for example, more use of hydro for the production of electricity for St. Petersburg than for Moscow, where gas dominates. There are attempts to improve the efficiency of electricity production. In the case of Moscow, for example, there is a new generation of gas plants developed in partnership with global companies. But attention to renewables is lagging behind. However, Moscow's city government is experimenting with an initiative which gives city residents a choice between using traditional sources of energy or (slightly more costly) energy from small hydro and incineration plants. Novosibirsk is emerging as a centre of research in the energy field, including wind and solar energy, battery technologies, and even the possible use of 'fire ice' (methane trapped in Siberia's permafrost) to produce electricity.

18. Renewable energy is expected to expand from 1% of the mix in 2012 to 12% in 2020, a significant leap; projections are that South Africa will significantly surpass its target of 14% by 2030.

The governance arrangements in India mean that it is mainly state governments and not municipal governments involved in initiatives to support renewables. The main mechanism to achieve this is the RPO, which requires a progressively higher level of procurement from renewable sources. There is considerable variation in results. Delhi, for example, has fallen short of its RPO requirements, and West Bengal (Kolkata), with its large resources of coal, is also struggling to make a transition to renewables. However, Maharashtra (including Mumbai) is said to have the strongest enforcement of RPOs nationally, with a 2015 requirement for local bodies to purchase at least 9% of their electricity from renewable sources. The states of Karnataka (Bengaluru), Tamil Nadu (Chennai) and Telangana (Hyderabad) have made rapid progress in the shift to renewables, partly as a result of power shortages that are forcing them to diversify electricity supply.

In China, municipalities are actively involved in electricity production, and have played an important role in the shift from coal-fired energy. In the north of China, municipalities including Beijing, Tianjin and Shenyang have made a remarkably rapid transition from coal to natural gas. The catalyst was the massive pollution in these cities, as a result of both large-scale coal-fired power stations and the thousands of small, coal-fired boilers dispersed around the cities. A natural gas pipeline through the region completed in 1997 offered gas as an alternative energy source. In Beijing, no new coal-fired power stations were built after 1997, and in 2010 a firm decision was made to switch entirely to gas by 2017. In Tianjin the Electric Power Company is closing its five coal-fired power stations, replacing them with new gas-fired plants. In 2014, Shenyang city administration announced plans to shut down 800 coal-fired furnaces, replacing them with natural gas or electric furnaces. Many of the spaces made available by these closures are to be turned into public parks.

Shanghai has a range of strategies to reduce its extreme dependence on coal. These include: developing nuclear plants in neighbouring provinces; importing natural gas from offshore platforms in the China Sea; growing the import of hydro-produced power from the Three Gorges Dam; and investing heavily in solar, wind and also biomass production through the incineration of municipal waste. The Shanghai Green Electricity Scheme offers electricity consumers in Shanghai the opportunity to 'green' their electricity consumption by buying some amount of electricity sourced from renewables. Shanghai is perhaps most notable for its innovative wind farms. The municipality had very little land for wind farms, so it launched an ambitious programme to create 13 offshore wind farms by 2020, which would produce around 2 000MW of electricity. Two windfarms were completed in 2013, and the construction of a further 9 began in 2014, gaining international accolades for Shanghai for environmental best practice.

The municipalities of Hangzhou and Suzhou in the wider Yangtze River Delta region are also making significant progress in the development of green energy. Hangzhou offers a comprehensive package of support for green energy producers, and is investing heavily in a high-voltage energy transmission line that would enable it to import cleaner forms of electricity from outside the region. In Suzhou, around half of the waste produced in the city is processed in a waste-to-energy plant.

Unlike the north of China, where natural gas is the preferred alternative to coal, cities in the Pearl River Delta generally favour nuclear energy. However, there is also some focus on renewables, especially wind, solar and biomass. Shenzhen is the site of the world's largest planned waste-to-energy plants, which will incinerate a third of the waste produced by the city. Guangzhou has emerged as a hub of innovation in the field of green energy, with a renewables industry developing in the local manufacturing sector.

In Chongqing, in inland China, levels of air pollution have dropped significantly as pollution-control measures have been introduced into coal-fired plants. The municipality of Wuhan is also working hard to promote R&D into the energy field, and to attract domestic and international investment in green-energy-related industries to the city. Even in Xi'an, in the heart of China's coal fields, there has been a recent drop in the use of coal, thanks to greater efficiencies in the use of energy, and through the development of hydro power.

In South Africa, municipalities have a minimal role in the production of electricity, but there are

some initiatives to diversify electricity production and procurement. Johannesburg launched a landfill-to-energy project in 2007, and has recently issued a green bond to fund green initiatives such as biogas-to-energy at the city's wastewater treatment plants. Tshwane (Pretoria) has a number of micro-biogas, -solar and -hydro initiatives, and has introduced wheeling agreements that allow large corporations to access green energy directly using the municipal distribution infrastructure. Cape Town is experimenting with Green Electricity Certificates (GECs), which allow consumers to buy electricity from a wind farm in the city's hinterland. The Western Cape provincial government is seeking to develop a hub of green technology and production in the Atlantis industrial area. eThekwini (Durban) has an energy office that is actively exploring a range of production options, including 'water-reticulation mini-hydros' at reservoir turbine sites.

While the role of city governments in producing electricity is highly variable, all city governments have the opportunity to promote greater efficiency in the use of electricity. Most city governments in the BRICS have in fact introduced measures to promote efficiency. These commonly include retrofitting of municipal buildings for energy efficiency; regulations for energy efficiency in new buildings; the requirement to use solar water heaters; the replacement of street lights and traffic lights with LED lighting; incentives for energy-efficient household appliances; solar rooftop projects; and smart meter systems. These may now be regarded as the basics, and the general expectation of all city governments.

However, there are additional practices from particular cities. Russia has an especially enormous challenge, as its energy intensity is 2.5 times the world's average, and much of its energy-related infrastructure is in a poor state. In Moscow there is an energy savings programme with the aim of reducing energy use by 2020 to 40% off the 2007 level. This includes the replacement of around 70% of the extensive district heating infrastructure.

There are a number of major demonstration projects for low- or zero-energy building, mainly in China. Guangzhou has a major demonstration project in the iconic 71-storey Pearl River Tower, which is aiming at zero net energy impact through both generation and efficiency in energy use. Wuhan has a number of creative demonstration buildings including the Wuhan Greenland

Centre, which is planned to be the world's fourth-largest building; and Energy Flower, designed to resemble a lily, which is said to be the most energy-efficient building in the world. The Tianjin Eco-City is a partnership with the Government of Singapore. It is to be completed by 2020, and will house around 350 000 people. Its energy will come from renewable sources, and energy efficiency will come from the building systems and eco-mobility networks. Chengdu is developing a satellite eco-city with the construction of the Tianfu District Great City, which is intended as a self-sustaining city with green energy sources. Then there is the planned Guangzhou Knowledge City, also a partnership with Singapore, which would house around 77 000 people in an energy-efficient environment.

Some cities are working closely with industry to promote efficiencies in industrial processes. Chengdu's municipality has worked with domestic and international industries to develop standards of energy management that far exceed those of China nationally, and even those of the more energy-stringent European Union. Wuhan is also a leader in promoting energy efficiency, with increasingly stringent regulations for energy use in manufacturing and buildings.

There are also innovative initiatives for achieving greater efficiencies through integration of transmission networks. Tianjin, for example, is an active participant in the plan to create a 'Global Energy Internet', which was proposed initially by China's State Grid Corporation. The initiative will begin with the construction of a massive electricity transmission network in China that will allow for the sharing of renewable energy, to be followed by the global linkage of grids (at an estimated cost of $50 trillion of investment by 2050). In 2016 Tianjin issued a 'White Paper on the Development of the City's Energy Internet', indicating how electricity sharing could happen within the city as an initial contribution to the wider scheme. Shenzhen has been the site of national experimentation with new models for electricity supply and transmission. In 2015, central government selected Shenzhen for a pilot programme for the introduction of independent transmission and distribution tariffs that will incentivise the connection of renewables to the grid.

FUELS

A number of BRICS countries are playing a leading role in transitioning away from fossil-based fuels. The leader is Brazil, reflecting its position as the world's second-largest producer of ethanol after the USA. Although Brazil is the world's 12th-largest producer of oil, it also accounts for around 24% of the world's biofuel production, with 6.8% annual growth for 2014/15. Brazil has produced ethanol from sugar cane since the early 20th century, although it was the global oil crisis of 1973 that impelled a national shift to the use of ethanol in the automobile industry. By the early 1980s 75% of Brazilian passenger cars were manufactured with ethanol engines. But engines that ran purely on ethanol were not always reliable, and so larger vehicles remained oil dependent. In the early 2000s, however, a flexi-fuel technology was introduced which combined two or more fuels (including ethanol, methanol and gasoline) in a single engine. By 2015, around 88% of light passenger vehicles in Brazil were flexi-fuel, and there has been progress in converting larger vehicles to this technology. São Paulo municipality is aiming to convert 100% of its extensive bus fleet to flexi-fuels by 2017. Other cities which have made significant progress in this direction include Rio de Janeiro, Curitiba and Brasilia.

In Russia the interest is in promoting natural gas as an alternative fuel to petroleum, but in 2014 a law was passed allowing for the use of bioethanol and biodiesel. In Moscow, the bus fleet runs on gas, and biofuels may be a future option.

In 2008 India launched its national biodiesel programme, with biofuels developed through the processing of the oil-rich seeds of the Jatropha plant. In 2015, India accounted for only 0.5% of the world's biofuel production; but there was 13% growth from 2014, suggesting that India may be a rising biofuel producer. A number of state governments, including Maharashtra, Tamil Nadu and Karnataka, are actively promoting the planting of Jatropha, and are supporting the introduction of bio-diesel in their cities. In some cases the bio-diesel programme includes handing over wasteland to landless farmers to grow Jatropha. Maharashtra (Mumbai) is developing its own biofuel industry, but it has also recently dropped the import tariffs on ethanol to accelerate the conversion of the automobile industry to biofuels. A number of cities are beginning the processes of converting their bus fleets to biofuels, and some cities have also introduced incentives and regulations to convert auto-rickshaws to greener fuels, including the propane-based Liquefied Petroleum Gas (LPG) in the case of Chennai. However, there is a problem with regulation and implementation capacity. In the case of Kolkata, for example, there are regulations requiring full conversion; but only 10% of auto-rickshaw owners have complied.

In 2015, China produced 3.2% of the world's biofuel, with a 10% annual growth. In 2015, national government announced zero-emission targets for urban bus fleets, which are to be achieved through progressive decreases in subsidies for carbon-based fuels, and progressive increases and incentives for green fuels. There is also an incentive-based programme to retrofit taxis from carbon-based to green fuels.

As early as 1999, Beijing introduced the methane-based Compressed Natural Gas (CNG) to its bus fleet, and it soon had the largest bus fleet using this fuel in the world. In 2006, Beijing introduced its first hydrogen-powered bus. Shanghai's transition to CNG was constrained by the uncertainty of gas supplies, but in the lead-up to the 2010 World Expo the city introduced a range of green fuels (gas, hybrid, hydrogen) to its bus fleets, with incentives for conversion of taxis and private vehicles. Shanghai also comprehensively reorganised its bus service (e.g. optimising routes, relocating bus stations, and new routing and scheduling) to achieve greater fuel efficiencies.

Hangzhou is known for its leadership in terms of new-energy vehicles, and especially electric vehicles. In 2010, Hangzhou was selected as one of five cities to be granted subsidies by central government for new-energy vehicles in the private automobile market. However, Hangzhou has gone even further by providing additional city-level subsidies to purchasers of electric vehicles, and providing a free charging service. In 2013 the municipality procured 20 000 electric vehicles for what may be the world's largest electric-car leasing and sharing programme, and is also increasing its stock of electric bicycles for its bicycle-sharing programme.

In South China, Guangzhou has taken the LPG route, and now has 10 000 buses using this fuel, the largest number in the world. It also has over 2 000 electric and hybrid buses. Shenzhen is also emerging rapidly as a global leader in terms of new-energy vehicles. It now has the largest fleet of electric vehicles (buses, taxis and private vehicles) in the world. The municipality is supporting the use of energy-efficient vehicles in the private sector through its increasingly stringent fuel economy standards, financial incentives for the purchase of small-engine vehicles, annual licence charges that penalise large vehicles, permission for electric vehicles to use reserved bus lanes during peak hours, and free-of-charge electric-vehicle charging poles.

In Chongqing, too, considerable progress has been made with green fuels. By 2012, 85% of the taxi fleet in the city used LNG. The bus fleet has been converted to electricity, with around 30 electrical charging stations under construction. In Xi'an, almost all taxis now use CNG. Wuhan is emerging as a manufacturing hub for new-energy vehicles. The Dongfeng Motor Corporation, for example, is partnering with the Detroit Electrical Corporation in the production of 100 000 hybrid and 50 000 fully electric vehicles; Renault-Nissan is building a plant for electric cars; and a number of biofuel production facilities have been opened.

In South Africa the shift has been on a smaller scale, but there has been recent progress. The development of a biofuel industry has proven controversial and difficult due to concerns about food security, but in 2015 the government set mandatory requirements for blending diesel with biofuels. In 2016, Mango Airlines inaugurated its first flight using a biofuel derived from a tobacco plant. In terms of technology, South Africa's major contribution may be the development of platinum-using fuel cells, although this is still in an early experimental stage. At city-level, Johannesburg and Tshwane have begun the process of transitioning their bus fleets to CNG, while the City of Cape Town is procuring electric buses, and provincial agencies are investigating the use of waste-based bioethanol for fleet transport.

CONCLUSION ON GREEN ENERGY

The BRICS countries contribute disproportionately to carbon emissions through their dependence on fossil fuels. However, as in the case of the other themes we address, there is massive variation across the BRICS. Brazil, for example, has a clean profile in global terms, largely because of its use of hydro for electricity producers, but also because of biofuels. China is the world's largest emitter, but in per capita terms South Africa and Russia are doing worse. India is performing well, but this is largely because of the poverty of its population, raising the question of whether India can evolve towards a higher-income status along a greener path than its BRICS counterparts.

In general, the BRICS have made progress towards the greening of energy supply and consumption, and in some areas have even emerged as world leaders. It is not a simple process; the greening of energy must be balanced with the need for energy security. For example, there is no easy transition from fossil fuels to renewables, as there is still a long path to walk before renewables are a major component of electricity supply. However, progress is being made, especially in China and South Africa, and this needs to be sustained for long-term benefit. There is also the question of 'transitional energy sources'. These are sources which may be less damaging to the environment than coal-fired energy, for example, but which do not have the status of renewables. In different contexts there are debates around the use of large-scale hydro, nuclear and natural gas as alternatives.

Much of the progress, and of the debate, is happening at national level, as energy supply networks are generally managed at a scale much larger than that of the city. In the case of China, however, cities have a strong role in electricity production, and are shaping choices in the energy field through (for example) the bold moves by Beijing, Tianjin and Shenyang to replace coal with natural gas. In Russia, the power rests largely with utilities that may be at city scale, but which report to the powerful national energy conglomerates. In India, the states have instruments for procurement such as the RPO, which allow them to influence electricity supply and consumption. In Brazil and South Africa, cities have the opportunity for limited but symbolically important interventions. However, all municipalities have the possibility of influencing the efficiency of energy use. There is already a raft of measures to do this that are now commonplace across the BRICS, but also a number of new and innovative approaches in a few cities.

In terms of fuels for transportation, national policies, targets and programmes play an important role in incentivising local actions; but there is a key role for subnational governments. Nationally, the development of a biofuels industry may be important, and here Brazil is leading the way. At a local level, city government can play a key role in transitioning their own transportation fleets to greener fuels, and in encouraging a shift in private transportation through incentives and regulations. Most large cities are now playing some role in this regard. In the leading cities in China and Brazil, for example, the introduction of green fuels to bus fleets is completed or nearly completed. In India, South Africa and Russia, the process has at least begun. There is clearly enormous opportunity for mutual learning along the path towards greener energy.

INNOVATION ECONOMIES

THE IMPORTANCE OF INNOVATION

The importance of innovation for producing high-quality economic growth that progressively improves the quality of life is now well understood. While economies may grow on the basis of natural endowments or on improved efficiencies, sustainable growth into the long term requires continued innovation.

Among emerging economies the BRICS are innovation leaders; but there is still a significant gap in innovation performance between the BRICS and high-income economies. Traditionally, economies in the BRICS have grown because of factor endowments such as minerals or cheap labour, producing basic commodities and competing mainly on the basis of price. China and India have the considerable advantage of large populations and a cheap labour force, while Brazil, Russia and South Africa have large endowments of natural resources. It is these advantages that have suppressed the need for innovation, and that continue to threaten the future sustainability of economic growth. It is because of this that the BRICS are at real risk of being caught in the 'Middle-Income Trap'. Fortunately, as we show below, there are definite indications in the BRICS of a strong trend towards innovation-driven economies.

The section below begins with a comparative national view across the BRICS, before moving to city level. At national level, we use the Global Innovation Index (GII) to provide the comparative perspective. The GII goes beyond traditional measures of innovation such as patents filed and R&D expenditure, using around 80 innovation indicators. The GII is a highly regarded set of indicators co-published by Cornell University, the INSEAD Business School, and the World Intellectual Property Organisation (WIPO, an agency of the United Nations). There is no innovation index for cities with the same degree of recognition, but the Australia-based consulting agency 2thinknow has developed a City Innovation Index using an extensive benchmarking data set.

Given the availability of comparative data we have followed a fairly conventional approach to the meaning of innovation in the section below. It focuses largely on product and process innovation in the formal sectors of the economy. It is necessary to note however that not all forms of economic innovation are adequately recognised in mainstream measurements. Bound and Thornton (2012), for example, refer to India's "frugal innovation" where a lack of resources is creating innovation out of necessity, but innovation of a sort that is often hidden in an informal economy.

NATIONAL COMPARISONS

Table 2.3 below reveals the generally middle-ranking position of the BRICS countries in the innovation landscape. The most innovative country in the BRICS according to the GII ranking is China, which entered the ranks of the world top 25 in 2016. Importantly, China has been progressively improving its position over the past decade, and may enter the top innovation league globally during the next decade or so. The situation in relation to the other BRICS is more mixed. Russia, ranked second, presents something of an enigma in global innovation stakes. It is a world leader in terms of concentrations in the knowledge economy, but is lagging behind in terms of translating knowledge into actual products. South Africa is ranked as the third most innovative BRICS

country, roughly maintaining its position over the past decade. India and Brazil are fourth and fifth respectively, although there has been some variation over time. In the section below we explore the strengths and weaknesses of each country in more detail.

Table 2.3: Ranking of BRICS Countries in terms of the Global Innovation Index, 2008/09-2016

Country	2008/09	2009/10	2011	2012	2013	2014	2015	2016
BRAZIL	50	68	47	58	64	61	70	69
RUSSIA	68	64	56	51	62	49	48	43
INDIA	41	56	62	65	66	76	81	66
CHINA	37	43	29	34	35	29	29	25
SOUTH AFRICA	43	51	59	54	58	53	60	54
NUMBER OF COUNTRIES	130	132	125	141	142	143	141	128

Source: Cornell INSEAD WIPO (2016)

BRAZIL

Brazil is underperforming in terms of innovation. It does have a number of advantages, including a relatively large market; accessible and high-quality financial services; relatively high business sophistication; good tertiary institutions; broadband speed and coverage; improving environmental performance; cluster development; and firm-based training. Also, in 2004 an Innovation Law established a number of programmes to support innovation, and there has been a steady increase in public funding for research.

Despite all of this, Brazil is still struggling to turn these innovation inputs into new products and services. There are a number of challenges. Brazil's economy, for example, has historically been inwardly focused, and the global networks and collaborations that support learning and innovation are still underdeveloped. Secondly, human capital remains underdeveloped, with a relatively low proportion of the population having completed tertiary education. At school level, the performance in science and mathematics is poor in global terms. Although there are good tertiary institutions, the linkages between academia and industry are weak, with the focus in education on pure academic training. Spending on R&D is a modest 1.2% of GDP, although it has been increasing. Finally, there are the broader problems of continued dependence on resource extraction, a relatively closed economy, high levels of corruption, and political and economic instability.

These problems notwithstanding, there are some sectors and industries where Brazil is leading in terms of innovation. A number of Brazil's large firms are innovation leaders, including Petrobras (oil and gas), Embrapa (agriculture), Embraer (aircraft manufacture), Vale (mining), Volkswagen do Brasil (automotive and biofuels), Halliburton and Schlumberger (oil and gas) and General Electric, Brazil (equipment/machinery).

RUSSIA

Russia has arguably the most advanced economy of the BRICS, with a historically large R&D base and high levels of investment in education at all levels, including in mathematics and science. Patents applied for and granted have also been high historically, with Russia having been a world leader in technological fields including metallurgy, precision instruments, space technologies, computer software, aircraft building, and development of new materials. Russia also has the advantage of good broadband width and coverage, market size, a high-quality health system, and high levels of female participation in the economy. By international standards Russians are highly educated, with over 50% having a tertiary education. While there was a 'brain drain' from Russia, the numbers of skilled personnel working in science and technology remain high, even in relation to OECD countries.

However, despite all these advantages there is reference to an 'innovation gap' in Russia. The country should arguably be a global leader in innovation, rather than having a current ranking of 43rd. The major challenge, arguably, is that the talent and innovation capacity of the Russian people is constrained by an economy that remains strongly biased towards the extraction of natural resources, and relatively isolated from global networks. Other problems include the weak Intellectual Property (IP) regime, and a gradually declining rate of investment in R&D (from over 2% in 1990 to the current 1.2%, significantly below the OECD average of 2.2%).

Despite these challenges, recent indicators do suggest an improvement in innovation performance – either because of or despite tough economic conditions and international economic sanctions. Russia's government has indicated its commitment to supporting innovation, introducing ambitious targets in 2012 which include raising the contribution of R&D to GDP to around 1.8%.

INDIA

India is an innovation leader in its income category globally, but in overall and BRICS terms it does still lag behind. It has the advantage of being a very large country, with a fast-growing emergent economy. It has experienced rapid growth of higher education over the past 30 years, especially in professional fields such as engineering and management, and has a growing number of globally-ranked universities. It has also emerged as a global hub for offshore knowledge-intensive software and other IT services. The government of India is also determined to promote innovation, with a target, for example, to increase R&D as a proportion of GDP from the current 0.8% to 2% by 2020. India also has strong financial markets, a high rate of venture capital formation, and a well-developed creative goods industry.

However, there are significant challenges. The most severe may be in terms of human capital: a large proportion of India's population still remains largely excluded from the growing modern economy, with vulnerable employment and low human-development indicators. For innovation, a major challenge is the state of primary and secondary education, with low levels of per capita expenditure on education. While tertiary education has expanded, much of the focus has been on teaching, with a low proportion of active, internationally-recognised researchers (although this is changing). Other contextual challenges in India include low female participation in the workforce, infrastructure deficits, obstacles in establishing a formal business, and corruption in the bureaucracy.

CHINA

China is now well ahead of the BRICS pack in terms of innovation, and the gap is widening. In the early years of the Reform Era, China achieved growth through the efficiencies created through mass production of cheap goods. Innovation was very low, with technology copied from the West. This has changed rapidly over the past decade, as China has moved up the value chain. China is a latecomer to innovation, but is making spectacular progress.

China has the advantage of its massive size; strong macro-economic performance; high levels of trust in the ability of the state to deliver; strength in mathematics and science education at school and tertiary level; business expenditure on R&D; rapid growth in gross capital formation; and a large proportion of high-technology exports. There has also been a continuing and steady increase in R&D expenditure and R&D performance, with R&D contributing 2.1% of GDP currently, close to the OECD average. There is also rapid growth in the proportion of the population with tertiary education, and a rising rate of scientific contribution through internationally cited academic scholarship.

China's 13th Five-Year Plan (2016-2020) identifies innovation as the prime development-driving force in the country. The Five-Year Plan is supported by a national scientific, technological and innovation plan which aims to catapult China into the top 15 innovation economies in the world by 2020. By then China will be a leading scientific and technological power globally. Spending on R&D as a proportion of total GDP is expected to rise to 2.5% by 2020, significantly exceeding OECD averages.

China has become particularly important globally in fields such as mobile and internet technologies and e-commerce, with demand for innovation stimulated by the consumer demands of the rising urban middle class. China developed initially in these areas by following the USA models, but is now well-established in its own right, benefiting from its huge domestic markets. Currently, four of the world's largest ICT companies are in China (Alibaba, Baidu, Tencent, and Xiaomi).

There are nevertheless challenges that constrain the pace of innovation, and may potentially undermine the sustainability of innovation. For example, although education is steadily improving in China, quality is uneven and spending per capita is still very low in comparative terms. There are also concerns about heavy bureaucracy, legal frameworks (e.g. in relation to IP), regulation of the banking sector, and the lack of openness of the internet, which constrains online creativity.

SOUTH AFRICA

South Africa's middle-ranking performance in the BRICS is a result of its peculiar mixture of advantage and disadvantage.

South Africa ranks highly in terms of the quality of its institutions; for example, judicial independence – legal frameworks that deal with protection of intellectual property, property rights, dispute resolution, and the accountability of private institutions. It also has relatively high levels of business and market sophistication. Its financial markets are among the best in the world, with South Africa ranked first in the world, for example, in terms of the efficiency of security exchanges, and third for the soundness of banks.

But these positives are seriously undermined by various problems, including the poor productivity and education of the workforce; corruption in the state, and loss of faith in politicians; crime and violence; very high youth unemployment; deficiencies in primary and secondary education, including in the teaching of mathematics and science; instability in the higher-education sector; troubled labour relations; and low levels of expenditure in R&D (only 0.7% of GDP).

CITY-LEVEL COMPARISON

Within countries, innovation is 'spiky' – it is concentrated in places that have the required densities of assets, institutions and capabilities to support innovation. The big cities in BRICS countries are generally where innovation is focused. Cities are significantly embedded in their national innovation ecosystems, and so the features discussed above are of direct relevance to an understanding of innovation in urban agglomerations. However, within countries there is also significant variation, with some cities rising to the top in terms of innovation.

The 2thinknow Innovation Cities Global Index reveals the generally good performance of China's cities in the BRICS, but even within China the ranking of cities ranges from 20th to 408th on an index of 442 cities globally[19].

The index suggests that the leading innovators in the BRICS are Shanghai, Hong Kong, Beijing, Moscow, St. Petersburg, Mumbai and Shenzhen. With the exception of high-ranked Hong Kong, which may be gradually losing position, and Shenzhen, which may be stable, these are cities on the rise globally. At the next level are the leading cities in Brazil and India, and Cape Town in South Africa. Unfortunately we have had to exclude Johannesburg from the analysis, as there is a probable data confusion which may be significantly affecting the ranking of this city[20].

19. The 2011 index only ranked the top 100 cities globally, and so is not included below. The 2014 and 2015 rankings provide a full listing.

20. The UN Population Division gives a population of over nine million for Johannesburg, as it refers to the wider agglomeration that includes the East Rand-Ekurhuleni. However, other data may be drawing on figures for the Municipality of Johannesburg, which has a population of less than five million. Indicators that use per capita calculations are likely to be significantly distorted.

Table 2.4: 2thinknow Innovation Cities Global Index, 2014 & 2015

City	2014 global ranking	2015 global ranking
Innovation Leaders (1-100 Global Ranking)		
SHANGHAI, CHINA	35	20
HONG KONG, CHINA	20	22
BEIJING, CHINA	50	40
MOSCOW, RUSSIA	63	45
ST. PETERSBURG, RUSSIA	81	48
MUMBAI, INDIA	91	74
SHENZHEN, CHINA	74	75
Emerging Innovators (101-200)		
SÃO PAULO, BRAZIL	123	102
NANJING, CHINA	127	121
CAPE TOWN, SOUTH AFRICA	128	125
RIO DE JANEIRO, BRAZIL	138	139
SUZHOU, CHINA	182	184
BENGALURU, INDIA	184	185
CHENGDU, CHINA	189	192
GUANGZHOU, CHINA	190	193
Middling innovators (201-300)		
CHANGCHUN, CHINA	232	211
HANGZHOU, CHINA	208	216
YEKATERINBURG, RUSSIA	213	220
CHENNAI, INDIA	262	222
KAZAN, RUSSIA	222	223
TIANJIN, CHINA	234	238
DALIAN, CHINA	236	240
NOVOSIBIRSK, RUSSIA	253	244
MACAU, CHINA	249	251
DELHI, INDIA	256	256
CURITIBA, BRAZIL	293	263
DONGGUAN, CHINA	268	265
XI'AN, CHINA	272	270
NIZHNY NOVGOROD, RUSSIA	282	273
KRASNOYARSK, RUSSIA	303	280
SAMARA, RUSSIA	266	282
PUNE, INDIA	267	283
CHONGQING, CHINA	365	286
ROSTOV-NA-DONU, RUSSIA	317	289
XIAMEN, CHINA	277	290
WUHAN, CHINA	280	293

City	2014 global ranking	2015 global ranking
Middle to Low levels of Innovation (301-400)		
KALININGRAD, RUSSIA	314	303
BRASILIA, BRAZIL	301	314
HYDERABAD, BRAZIL	340	315
ZHUHAI, CHINA	319	338
TOMSK, RUSSIA	343	339
PERM, RUSSIA	354	340
SARATOV, RUSSIA	355	341
AHMEDABAD, INDIA	363	342
SALVADOR, BRAZIL	357	351
QINGDAO, CHINA	352	354
HARBIN, CHINA	367	357
SHENYANG, CHINA	362	359
OMSK, RUSSIA	371	362
VOLVOGRAD, RUSSIA	378	365
BELO HORIZONTE, BRAZIL	366	366
VLADIVOSTOK, RUSSIA	381	367
RECIFE, BRAZIL	374	370
ZHENGZHOU, CHINA	370	373
SURAT, INDIA	375	380
DURBAN, SOUTH AFRICA	380	385
PORTO ALEGRE, BRAZIL	383	386
LUCKNOW, INDIA	406	391
Low levels of innovation (400 and less)		
IZHEVSK, RUSSIA	394	400
KOLKATA, INDIA	422	401
ORENBURG, RUSSIA	407	406
TOLYATTI, RUSSIA	408	407
YANTAI-WEIHAI, CHINA	409	408
JAIPUR, INDIA	414	414
KANPUR, INDIA	415	415
MADURAI, INDIA	422	428

THE INNOVATION LEADERS IN THE BRICS

Shanghai has emerged as the innovation leader in the BRICS, displacing Hong Kong. It is the one city in the BRICS that has the clear potential to become a world leader in the city innovation stakes in the next decade or two. Shanghai's position as a leader in innovation clearly draws on a long history and culture of openness to the global economy, cosmopolitanism, and intellectual enterprise. It is a city of business, but with an edge of creativity that is very evident; for example, in the digital media, finance, arts, fashion and entertainment. Shanghai is also investing heavily in R&D, with 3.7% of its GDP from R&D, far above the 2.1% average for China.

The major agent of innovation in Shanghai is private enterprise. A large number of transnational corporations have located their R&D centres in Shanghai, benefiting from the rich knowledge assets in the city, and creating new knowledge spillovers into local firms, with some of these centres now in partnership with local universities.

Beijing has the significant advantage of a massive concentration of Science and Technology (S&T) resources in the city. Around a third of the nation's intellectual and academic resources are located in the city, and 50% of China's Academicians (full members of China's Academies of Science or Engineering) are located there. Beijing has emerged as an R&D-intensive city, with an extraordinary 6% of GDP from R&D expenditure. But unlike Shanghai, in Beijing the investment comes mainly from the public sector, reflecting the presence of China's leading SOEs and state-funded government science and technology institutions in the city. However, with knowledge spillovers from the state sector, Beijing is also emerging as a centre for hi-tech incubation in the private sector, and has been referred to as 'China's Silicon Valley'.

Shenzhen developed initially on the back of low-end copycat manufacturing, drawing on reservoirs of cheap labour; but since around 2000 there have been active attempts to upgrade manufacturing and promote innovation economies. Shenzhen has achieved notable success with this strategy and is now widely cited as a new technological frontier, drawing a growing number of innovation-intensive firms. Hi-tech giants such as ZTE, Huawei and Tencent are based in Shenzhen, and there is a growing number of innovative small- and medium-sized enterprises (SMEs) drawn to Shenzhen by the well-established manufacturing infrastructure, financial infrastructure and a culture of relative openness and experimentation. Patent applications from Shenzhen have grown 15-fold in one decade, and the proportion of GDP from R&D for Shenzhen is over 4%, which is twice the national average. In addition to hi-tech industry, Shenzhen is emerging as a hub of innovation in the financial services industry – and in cultural and creative enterprises, with Shenzhen having been awarded 'Design Capital' status by UNESCO.

Moscow's integration into the global economy has been facilitated by its pool of young, talented entrepreneurs; the huge concentration of science-based research in the city; and a local leadership which has been strongly focused on positioning Moscow globally. A high proportion of Russia's intellectual potential rests in Moscow, while Moscow is home to no fewer than 709 organizations involved in science- and R&D-related activities. Moscow holds 32% of Russia's science-related employment. Moscow's innovation in nuclear energy, aerospace, and microelectronics and instruments goes back to the Soviet era, but new areas of innovation are emerging in business services, ICT, pharmaceuticals, and culture and media.

St. Petersburg also has a strong historical concentration of research-based activity. Around 10% of Russia's national research staff is located in St. Petersburg, with around 300 research-based organisations. St. Petersburg also has a favourable geographical position for developing strong linkages across international boundaries. In the 1990s the city faced severe industrial decline, but it has managed a turnaround – partly because of its high investment in R&D (over 4% of GDP), and its success in supporting product innovation in industries including pharmaceuticals, medical equipment, telecommunications and aerospace.

Mumbai is the one city in India rated as an innovation leader in the BRICS. Much of its innovative capacity has come from its openness to the global economy. In the early 1990s, economic liberalisation brought in a large number of leading global corporations, which also stimulated the growth of financial services. The major domestic corporations are also becoming more innovative, with Mumbai-based Tata Motors now on The Economist's Global Top 50 R&D firms. Outside manufacturing, the major innovation impulse is in financial services and the cultural industries.

There are still challenges for these cities. Beijing, for example, remains overwhelmingly dependent on R&D spending by the public sector, and vulnerable to any cutback on this spending. This is also a challenge for Moscow and St. Petersburg. Relative to leading innovation cities in the West, for example, these cities still struggle to attract truly world-class innovation talent, teams and partnerships, and leading-edge innovators of a global standard. There are also city-specific challenges. Shenzhen, for example, is a new city in global terms, and hasn't had time to develop leading-edge academic and research-related institutions. Innovation in Mumbai is constrained by the overall challenges in innovation nationally, including inadequate levels of infrastructure and human capital.

THE SECOND TIER (WITH SOME EMERGENT LEADERS)

There is a second ranking of innovative cities which may emerge to challenge the leaders. These include some of the largest cities in the BRICS, such as São Paulo and Guangzhou, that are not in the top ranks of the innovators; but also some smaller cities, such as Cape Town, Bengaluru and Suzhou, where there are strong emergent impulses for innovation.

Brazil's leading cities are constrained by limitations nationally, but are nevertheless important sites of innovation. The São Paulo metropolitan region has reinforced its national dominance in high-technology and advanced business services, even though it has lost relative position in Brazil overall. There are major research laboratories for motor vehicle engineering, pharmaceuticals, software engineering, biotechnology, genetics and renewable energy production. Much of this development is around national science institutes and the headquarters of large national corporations, such as Embraer. São Paulo is also a centre of innovation in the financial sector.

Rio de Janeiro has had a volatile ride. It was seriously affected by the economic crisis of the 1980s and 1990s, and lost position as manufacturing relocated from the city. However, in the 2000s there was a revival, with a number of major multinational and national corporations recognising the innovation potential of the metropolitan region, and establishing state-of-the-art R&D laboratories. With its attractive physical environment, it is also attracting hi-tech innovators; Rio was recently included in a global list of the top 50 innovative cities in technology.

Cape Town in South Africa has similar advantages to Rio de Janeiro. It also has appeal for talented young people. Recent studies suggest a concentration of firm start-ups and entrepreneurial ventures in leading-edge sectors such as ICT and health technology, supported by the presence of leading universities. The data concerns mentioned previously mean that we cannot compare Cape Town with cities in the Gauteng City-Region (GCR) in South Africa. In conventional measurements of innovation, the GCR is leading Cape Town. The OECD Territorial Review for Gauteng indicates that 61.2% of public-sector R&D expenditure – and 52% of R&D expenditure in total, in South Africa – was concentrated in Gauteng, with the region also contributing 57% of patents. However, in terms of new start-ups, and progress in new-economy industries, Cape Town may well be leading Johannesburg and other cities in the GCR.

Nanjing, Suzhou, Chengdu and Guangzhou are recognized as the second-tier innovation cities in China. Nanjing is an ancient city – a previous capital of China – that maintains its advantage through a large concentration of knowledge enterprise. Guangzhou is a mega-city at the heart of the dynamically developing Pearl River Delta, and yet lags behind other mega-cities in China in terms of innovation, including neighbouring Shenzhen. As an older city, it may lack the entrepreneurial dynamism of Shenzhen, and does not have the leading educational institutions of Beijing and Nanjing, for example. Nevertheless, Guangzhou is a significant secondary hub of innovation in China, with the local government now working hard to position the city higher in the innovation rankings.

Suzhou is a newcomer. Its rapid development has happened mainly through large-scale FDI drawn to free trade zones, and in this respect its growth has not been innovation-intensive. However, as with Shenzhen there is a shift towards innovation. One of the strategies has been to build educational institutions that are strongly oriented towards innovation in industry. This has included the establishment of the Suzhou Dushu Lake Higher Education Town within the Suzhou Industrial Park, which houses among its institutions the first major Sino-British educational partnership, a joint university established between Xi'an Jiaotong University and the University of Liverpool.

Innovation in China is spreading from the coastal cities in the east towards the interior. Historically, Chengdu was an isolated city in the interior of China without the global networks that stimulate innovation, and with a preponderance of innovation-shy state-owned companies. This is changing rapidly, as entrepreneurial start-ups challenge the dominance of established state-owned industry, and as the internet and increasingly frequent international flights rapidly connect Chengdu to global innovation networks. In 2015, Chengdu received more venture capital than any other Chinese city except for Beijing and Shanghai, with rates of investment similar to those of North American and European cities.

In India, Bengaluru – the 'Silicon Valley of India' – is the emergent innovation hub. Bengaluru's growth happened initially because multinational ICT firms located their software service industries in the city. This investment has been followed by the establishment of offshore R&D activities. In 2015/16 Bengaluru was a world leader in terms of the development of new innovation centres.

THE MIDDLE RANK

The middle rank consists of a mixture of cities of different scales and in different countries. Some of these cities may be emerging as innovation hubs (e.g. Chongqing and Chennai), and others may be static or declining. In China, the middle rank includes Hangzhou, Chongqing, Tianjin, Wuhan and Xi'an. These are emerging innovation hubs, with the potential to considerably expand innovation capacity.

Hangzhou is a city to watch. While it may only rank in the middle category, a number of recent studies suggest significant creative energy in the city. They include the 2016 Chinese Cities of Opportunity study, which identified Guangzhou, Shenzhen and Hangzhou as the top three regional cities in China for business opportunity. The study ranked Hangzhou second in China out of 15 regional cities studied in terms of intellectual capital and innovation (after Nanjing), and joint third in terms of technological readiness. Importantly, Hangzhou is home to the Alibaba Group, which leads globally in terms of e-commerce. The spillover effect from Alibaba is the concentration of skills in Internet services, which is attracting other ICT firms to the area. In addition, the city, with its attractive location, is becoming increasingly known for innovation in the cultural and creative industries (film, media, entertainment and the arts).

Chongqing has been one of the world's fastest-growing cities over a sustained period, although much of the growth was the result of efficiencies through economies of scale rather than through leading-edge innovation. The industrial structure of Chongqing was characterised by large SOEs, which were slow in adopting new technologies and management structures. However, Chongqing may be the most rapidly emerging innovation hub in China, and possibly in the BRICS. Industries in this massive complex of automobile manufacturing are now taking the lead in the production of new-energy vehicles, drawing on local R&D. Recent innovations are also allowing civilian applications for military hardware, while survey data reveals increasing levels of innovation in small- to medium-scale enterprise, suggesting steady progress in establishing a local culture of innovation. According to the 2thinknow Index, Chongqing increased its global position by 79 places between 2014 and 2015.

Tianjin is outclassed by its twin city, Beijing. It does however have areas of niche advantage. Although R&D accounts for only 3% of GDP in Tianjin compared with 6% in Beijing, spending in Tianjin is mainly by the private sector, with a significant proportion coming from SMEs; again unlike Beijing, where spending is by large-scale SOEs.

Wuhan is an old industrial city with state-owned traditional industries, and this may have suppressed innovation capacities. However, there are strongly emerging areas of innovation, including in optical electronics, bio-industry and green energy vehicles, with more than 3% of GDP derived from R&D spending. An important advantage for Wuhan is its role as one of the leading educational hubs in China. Xi'an is also an old industrial city. It is a centre of research, with more than 5% of GDP coming from R&D-related expenditure, especially in defence- and aerospace-related industries. The challenge for Xi'an, however, is that many of its innovation products are used elsewhere, and are not converted into productivity gains locally.

Delhi is the largest urban agglomeration in the BRICS, and yet it ranks fairly low in terms of innovation. This partly reflects the broader innovation challenges India faces, but also the extent to which development in Delhi has been driven by government administration rather than innovation-intensive industries. Chennai is following the model established by Bengaluru in attracting offshore investment in ICT. The question is whether – like Bengaluru – it will begin attracting R&D facilities.

In Brazil, Curitiba has made its mark globally through innovations in governance, and is a widely acclaimed model for urban planning. It is perhaps less well-known for innovation in economic sectors, although automobile manufacturers in the city are acquiring a reputation for innovation in production processes.

There are a number of Russian cities in this category; Novosibirsk is an example. The city has an extensive infrastructure for academic research and innovation, with numerous institutions involved in R&D, and an enviable concentration of scientists. Novosibirsk is drawing on these resources to make the transition from traditional industries (including military hardware) to leading-edge new industries such as biopharmaceuticals. However, as with Russia more generally, the link between science and innovation products in industry requires further development.

LAGGING?

Cities lag behind in innovation for a number of reasons. Cities focused on government, for example, may lag because attention is focused on public services and not on the industrial sector, which is mainly where innovation is measured. There are also cities with a traditional industrial structure where innovation is stifled.

Brasilia is a city of government, so conventional measures of innovation may not easily apply. However, Brasilia does have critical R&D functions, as it is a base for large public research institutes. It is also promoting innovation in high-technology knowledge, products and services. Salvador has been a fairly marginal city in Brazil, and its industry has been structured towards traditional sectors. However, it is developing an innovation niche in supercomputing and robotics, and is also becoming known for new ventures, products and services in heritage and tourism.

Hyderabad in India lost status after its imperial dynasty ended and it was brought into the Indian Union, in 1948. However, it has recently resurfaced as a new site for the offshore operations of multinational corporations. Research institutions are being set up for these industries, with a strong focus on biomedicine, so Hyderabad may potentially be an emerging innovation hub.

This is different from the case of Kolkata, a once-leading city in India where innovation was suppressed over a long period by a political leadership hostile to entrepreneurialism and private-sector-led development. Kolkata remains one of the cities that is lagging behind; but there are recent indications of a possible turnaround, and Kolkata may be one of the cities to watch over the longer term.

Shenyang is a 'rust belt' city in China, burdened by its history as a hub of state-owned heavy industry. Nevertheless, Shenyang is maintaining levels of R&D expenditure at the national average, and is working to transition away from traditional to new hi-tech industries, through strategic innovation-led alliances with major international partners.

In South Africa, Durban (eThekwini metro) falls within this category. Its industrial structure has not shifted significantly away from traditional industries. However, the city does have individual firms that rank highly in global innovation indices.

KEY THEMES IN INNOVATION

In this section we provide a comparative view on three key themes in innovation across BRICS cities – the strength of the higher education sector, policy initiatives to support innovation, and innovation clusters.

STRENGTH OF HIGHER EDUCATION

Education is a critical resource, and BRICS cities are not evenly endowed.

Table 2.5: Top 50 BRICS universities by city, QS rankings

City	2016 Rankings
BEIJING	Tsinghua University (No. 1) Peking University (No. 2) Beijing Normal University (No. 11) Beihang University (No. 26) Beijing University of Technology (No. 28) Renmin University (No. 33)
MOSCOW	Lomonosov Moscow State University (No. 7) Bauman Moscow State Technical University (No. 38) Moscow State Institute of International Relations (MGIMO University) (No. 44) Moscow Institute of Physics and Technology (MIPT/Moscow Phystech) (No. 47) National Research Nuclear University MEPhI (Moscow Engineering Physics Institute) (No. 50)
SHANGHAI	Fudan University (No. 3) Shanghai Jiao Tong University (No. 5) Tongji University (No. 17) Shanghai University (No. 32)
(GREATER) SÃO PAULO	Universidade de São Paulo (No. 10) Universidade Estadual de Campinas (Unicamp) (No. 12) The Universidade Estadual Paulista (UNESP) (No. 36) Universidade Federal de São Paulo (No. 45)
NANJING	Nanjing University (No. 8) South East University (No. 42)
(GREATER) CAPE TOWN	University of Cape Town (No. 14) Stellenbosch University (No. 35)
WUHAN	Wuhan University (No. 16) Huazhong University of Science and Technology (No. 34)
DELHI	Indian Institute of Technology Delhi (No. 15) University of Delhi (No. 41)
RIO DE JANEIRO	Universidade Federal do Rio de Janeiro (No. 29) Pontifícia Universidade Católica do Rio de Janeiro (No. 46)
TIANJIN	Nankai University (No. 30) Tianjin University (No. 30)
HEIFEI (ANHUI PROVINCE)	University of Science and Technology in China (No. 4)
BENGALURU	Indian Institute of Technology, Bangalore (No. 6)
HANGZHOU	Zhejiang University (No. 9)
MUMBAI	Indian Institute of Technology, Bombay (No. 13)
CHENNAI	Indian Institute of Technology, Madras (No. 19)
ST. PETERSBURG	Saint Petersburg State University (No. 20)
NOVOSIBIRSK	Novosibirsk State University (No. 20)
KANPUR	Indian Institute of Technology Kanpur (No. 22)
GUANGZHOU	Sun Yat-sen University (No. 23)
XI'AN	Xi'an Jiaotong University (No. 24)
KHARAGPUR (WEST BENGAL)	Indian Institute of Technology Kharagpur (IIT-KGP) (No. 25)
JOHANNESBURG	University of the Witwatersrand (No. 26)

City	2016 Rankings
XIAMEN	Xiamen University (No. 37)
ROORKEE (UTTARAKHAND)	Indian Institute of Technology Roorkee (IITR) (No. 39)
CHANGCHUN	Jilin University (No. 40)
TOMSK	Tomsk State University (No. 42)
PORTO ALEGRE	Universidade Federal do Rio Grande Do Sul (No. 46)
TSHWANE (PRETORIA)	University of Pretoria (No. 49)

Source: QS Rankings 2016

The leading sites of tertiary education in the BRICS are Beijing (six universities in the BRICS top 50), Moscow (five), Shanghai (four) and the Greater São Paulo region (four). The next tier is cities which have at least two universities in the BRICS top 50; these are Nanjing, Cape Town, Wuhan, Delhi, Rio de Janeiro and Tianjin.

There is no direct correspondence between size and educational stature. India's large cities (Delhi, Mumbai, Kolkata), for example, are still lower on the educational rung than their size would suggest. In China, the mega-cities of Beijing and Shanghai are major hubs of tertiary education, but the secondary cities of Nanjing, Wuhan and Tianjin rank higher than the mega-cities of Guangzhou, Chongqing and Shenzhen. In South Africa, modestly-sized Cape Town ranks high in terms of tertiary education.

Of course, it is not just the quality of tertiary research and educational institutions but also the focus of these institutions on innovation, and the links between these institutions and industry, that matter. While there is no comparative data on this, city-specific information suggests considerable variation in this regard.

INNOVATION POLICY

There are multiple factors that influence the innovative capacity of cities. They include, for example, the history of the city (e.g. Shanghai's cosmopolitanism), its educational strengths, and even its physical attributes (as in the case of Cape Town, Rio de Janeiro and Hangzhou). It is evident, however, that policy does matter; and that determined action across the levels of government can improve a city's innovation prospects.

All the BRICS countries have policies at national level to improve innovation, although with varying success. China is arguably the country with the most resolute and successful policies and programmes in building national innovation systems, but the other countries are all supporting innovation through national initiatives to varying degrees.

There is more scope for supporting innovation through city-level interventions in some contexts than in others. In China, city governments play a significant role in economic development policy, and often have highly sophisticated policies in support of innovation. In India, local governments are weak, but state governments play key although highly varying roles. An exception may be Mumbai, where a local growth coalition, Mumbai First, has been active in support of innovation.

City governments generally have less power in this area in Brazil, South Africa and Russia, but proactive city governments such as São Paulo, Moscow and St. Petersburg do have active programmes in support of innovation.

Among leading cities in the BRICS are those with high ambitions for innovation:

» In 2015 the Mayor of Shanghai announced that his number-one priority was to ensure that the city becomes a "globally influential technological innovation hub"[21];

21. In 2016, these local ambitions were recognised nationally when China's State Council resolved to transform Shanghai into a global innovation centre.

» Shenzhen municipality is determined to upgrade innovation capacity and has created the cross-border 'Shenzhen-Hong Kong Innovation Circle' to compensate for its internal lack of leading research institutions;

» The Government of Moscow is actively promoting innovation through its programme 'Moscow – innovation capital of Russia';

» The St. Petersburg city government has been actively supporting innovation in terms of its overall strategy of building a 'global, smart, humane city';

» In 2015 the Guangzhou Municipality released its 'Decision to speed up implementing the innovation-driven development strategy' with an ambitious ten-point action plan; and

» In 2016, Tianjin released its new policy on city innovation, with a focus on developing technology in small- and medium-scale enterprise – the so-called 'little giants in S&T'.

There are many ways in which innovation is supported by these and other cities. These include:

» Programmes to attract world-class talent to a city;

» City investment in broadband, supercomputing and the cloud;

» Municipal procurement policies to support self-innovation;

» Entrepreneurship schools and virtual university campuses;

» Inter-city learning networks;

» Direct investment in R&D, and incentives to support private investment in R&D;

» Development of hi-tech infrastructure for start-up firms;

» Linking firms to venture capital;

» Creation of innovation teams;

» Regulatory reform including IP protection (in countries such as China, where powers do vest at local level);

» Special financial instruments to support innovation (e.g. risk sharing, venture capital, equity shares, specialised credit services);

» Special incentives, ranging from tax breaks to innovation awards;

» Common service technology platforms;

» Special training programmes, with a focus on technology and management;

» Improved (streamlined and deregulated) procedures for business registration;

» Business incubators, technology parks, innovation centres and other spaces that have the hard and soft infrastructure to support innovation; and more.

There are a number of cities in the BRICS that have implemented some or all of these measures; but there are many which are lagging behind, and which have little or no specific effort directed towards economic innovation. The most successful cities are those taking a systemic approach to supporting innovation, rather than implementing projects on an ad hoc basis.

INNOVATION CLUSTERS

One of the key approaches in supporting innovation is the grouping of innovation support into spatial clusters.

Spatial targeting has been a strong element of China's industrial policy since the creation of the first Special Economic Zones (SEZs) in the early 1980s. At first these zones were mainly about attracting inward investment, through offering generous incentives such as tax breaks and exemptions from import duty. In recent years a similar approach has been taken to innovation, with various measures in support of innovative firms offered in special zones. These zones have a hierarchy of status. The

most important are those recognised and supported by central government, but there are also zones with provincial or city-level status.

Some of the most important innovation zones in China are:

- Zhongguancun Self-development Innovation Demonstration Area in Beijing (in which around 16 000 firms have already been incubated);
- Binhai New Area in Tianjin (as part of the Tianjin Economic-Technological Development Area);
- Shanghai Free Trade Zone, including the Zhangjiang Hi-Tech Industrial Park
- Suzhou Industrial Park;
- Shenzhen Hi-Tech Industrial Park (home to ZTE and Tencent)
- National Independent Innovation Demonstration Zone in Wuhan;
- Chengdu Hi-Tech Industrial Development Zone;
- Xi'an Hi-Tech Industrial Development Zone;
- Chongqing Hi-Tech Industry Development Zone.

In Russia, there is a history of innovation clusters around major science and other educational institutions. Russia now has a formal strategy of supporting at least 13 pilot innovative regional clusters. Two of these are in Moscow: one focusing on IT and nuclear physics, and the other on nanotechnology. The other 11, however, are scattered across Russia, including one each in St. Petersburg (IT, radio electronics and instrumentation) and Novosibirsk (IT and biopharmaceutical). These clusters will complement established clusters such as around the Russian Academy of Science and Moscow University in the south-west of Moscow; the St. Petersburg-Pushkinskaya industrial zone; and the satellite city of Akademgorok outside Novosibirsk, famous for 'Lavrentyev's triangle', which brings together specialist academic science institutes, and a large cluster of public and private R&D facilities.

India is now also following a model of spatial targeting. With the trade liberalisation of the 1990s, zones of offshore investment in high-technology services emerged on the edges of Bengaluru, and then around cities such as Chennai, Hyderabad and Pune. As firms established R&D facilities in these cities, they emerged as incipient innovation zones. Hyderabad, for example, now has the Genome Valley, which specialises in biomedical research, while Chennai has the Mahindra Research Valley, where automobile-related R&D is clustered. A major cluster of hi-tech innovation has also emerged in Navi Mumba, a satellite city of Mumbai. There is now a more deliberate attempt to create innovation zones, with the National Innovation Act of 2008 making provision for the designation of such zones, although progress with their establishment has been slow. Prime Minister Modi has launched a major new initiative with the designation of 100 'smart cities', which will be provided with central government resources for infrastructural and technological development. This is likely to be the focus of city-level innovation efforts under the current political administration.

Industry innovation clusters have emerged organically in parts of Brazil. For example, there is an innovation cluster that has emerged around the University of Campinas (Unicamp) within the Greater São Paulo Region, including the Unicamp Science and Technology Park, established as a university-industry partnership. Similar clusters are emerging around the Universidade Federal do Rio de Janeiro and around the Pontíficie Universidade Católica, located in Porto Alegre. Other innovation clusters have developed around the headquarters of major corporations such as Embraer in São Jose dos Campos. In Recife, a hi-tech innovation cluster known as Porto Digital has developed as a result of a state government initiative launched in 2000.

In South Africa there are emergent innovation clusters in places such as Cape Town, Johannesburg and Tshwane (Pretoria). Although there is no effective national programme for the development of these clusters, there are subnational and local initiatives. The Stellenbosch Technopark, for example, is the result of a partnership between the University of Stellenbosch and the local municipality. The Silicon Cape initiative, with its focus on venture capital and business networking, is a private-sector-initiated project, while the Innovation Hub in Pretoria was established by provincial government.

CONCLUSION ON INNOVATION ECONOMIES

The BRICS are leaders among their peers in middle- and low-income economies in terms of innovation, but they still lag behind the advanced economies of the global North. Given the ambition of the BRICS to enter the ranks of these advanced economies, innovation capacity has to be significantly expanded. Instead of relying on resource endowments, or even the efficiencies produced by economies of scale, innovation will allow for longer-term sustainability, and will lift the economy progressively higher along the value chain, leading to improving incomes and quality of life.

Cities do not exist independently, and so must be understood as being at least partially embedded in the national innovation ecosystem. Cities in China, for example, have the advantage of a national economy that is becoming increasingly more innovation-driven. Russia has the historical advantage of a huge concentration of intellectual resources; but there is an 'innovation gap', as this is not translated proportionately into new products, services and processes. South Africa has high-quality institutions that support innovation; but also deficiencies, such as in quality of education, and in human-resource capacity. Brazil has similar advantages, but is lagging behind because of problems including education and its relatively closed economy. India is making progress, especially in expanding education, and is attracting international investors who are forming innovation partnerships; but serious problems remain in terms of human capital, inequality of opportunity, and deficient infrastructure.

Despite the significance of these national contexts, each country includes cities of high and low innovation performance. Leading the way are Shanghai, Hong Kong, Beijing, Moscow, St. Petersburg, Mumbai and Shenzhen. These are all innovators, but for different reasons: Shanghai, for example, has a long history of cosmopolitan openness, but there is enormous attention being given to improving innovation capacity by the city government, strongly supported by central government. Beijing's innovation is jointly produced by massive investment in R&D by the SOEs concentrated in the city, and by hi-tech incubation in the SME sector, which is supported by the knowledge spillovers from a huge concentration of educational institutions. Moscow and St. Petersburg have the historical advantage of large concentrations of knowledge-based institutions, but are also Russia's two gateway cities to the rest of the world. Mumbai's innovation comes from its openness to the global economy, and a strong combination of advanced manufacturing, financial services and cultural industries. Shenzhen is a new city, without the baggage of history and with an ethos of creative experimentation.

While most cities in the BRICS are not among the world leaders in innovation, many have a strong innovation impulse in one or more aspects of their economy. Some cities which may currently be ranked quite low are nevertheless rising rapidly (e.g. Chongqing and Chennai), and may be the innovation hubs of the future.

One of the key factors in terms of innovation is the quality of tertiary education. Beijing, Shanghai, Moscow and São Paulo are obvious examples, but there are smaller cities such as Cape Town, Nanjing and Wuhan that have comparative strength in education, and therefore have innovation advantages. However, education must be translated into innovation potential, through partnerships and other linkages between tertiary education and industry.

Innovation may be supported through policy. Here, national governments play a key role in incentivising and supporting local action, but city governments have a crucial role to play. Not all city governments work actively in support of innovation, but many do; and there is a range of possible instruments and interventions that could be used to strengthen local innovation.

Finally, even within specific cities, innovation is spatially uneven. It often happens within clusters where the conditions to support innovation are well-developed, e.g. infrastructure, dense networks of relationship between innovation actors, special incentives, and human-resource capital. Some of these clusters have emerged organised (for example, around major universities in Brazil), but many have been deliberately created through national and local programmes, including through the designation of special innovation zones where special support measures are provided.

CONCLUSION

This chapter has dealt with three out of many possible themes to do with urban development. In relation to each of these themes, cities in the BRICS face considerable challenges. Almost all large cities in the BRICS face massive problems of congestion, for example, which is a consequence of both economic and population growth and of a rapid increase in the level of vehicle ownership. Cities in the BRICS face considerable challenges in terms of energy, in relation to both the security of supply and the emissions and pollution that are produced from using fossil fuels. Cities in the BRICS also face challenges in moving their economies up the value chain, from a dependence on factor endowments to innovation-driven development.

However, although the challenges are considerable, cities in the BRICS have made significant (though uneven) progress in addressing them. Over the past decade, for example, there has been unprecedented improvement in public transport networks, with large-scale investments in new metro, BRT, LRT and NMT networks. These investments have been accompanied by innovations in regulations, management, and institutional coordination. At the same time there has been a shift towards more environmentally-friendly ways of producing electricity, and greener fuels. There is also increasing recognition of the importance of innovation in driving economic growth and change, and a number of cities in the BRICS are emergent hubs of innovation globally.

There is immense opportunity for learning across city contexts in each of these areas of focus. There are also some general lessons. The first is that national policies, targets, incentives, regulations and programmes really do matter. In all three focus areas, national governments played a critical role in provoking or inducing local actors to respond to challenges in particular ways. A decentralisation programme that reduces the capacity of national government, or undermines the willingness of national government to influence outcomes, may be seriously counterproductive. Second is that clearly, local actions also make a difference. Within any country there is huge variation in effectiveness across cities, partly shaped by the effectiveness of local institutions in responding to both the inducements of national government and the contingencies of context.

In general, it is the already-dominant cities that are best able to respond to challenges. Cities such as Beijing, Shanghai, Moscow, São Paulo and Mumbai emerge as leaders time and again. But second-tier and smaller cities do feature significantly in some areas of focus: Curitiba, for its bus services and sustainable urban planning; Hangzhou, Wuhan and Tianjin, for cycling; Guangzhou, for its BRT; Chengdu, for the way in which it is emerging as a global airline hub; Shenzhen for innovation; Shenyang for its courage in closing down coal-fired plants and furnaces; Cape Town for tertiary education; Wuhan and Hangzhou, for new-energy vehicles; Bengaluru and Chennai, for attracting international investment in IT services; Novosibirsk for its innovation linkages between academia and industry; and many more.

The analysis gives a sense of hope. The cities of the BRICS provide a dynamic environment, where challenges are being confronted and where there are notable successes. However, for cities that lack progressive thinking and action, the message is more sobering – their peers in the BRICS are moving ahead, and the task of catching up is becoming ever greater.

KEY REFERENCES

This chapter draws primarily on the information in the various city Factsheets. However, additional sources were consulted, including:

2thinknow (2016) Innovation Cities Index, www.innovation-cities.com/innovation-cities-index-2015-global/9609

Airports Council International (2015) Annual Traffic Data, www.aci.aero/Data-Centre

Awan, A. (2012) 'Diverging trends of human capital in BRIC countries', International Journal of Asian Social Science, 2(12), pp. 2195-2219

Bagchi, N. (2011) 'A comparative analysis of the factors for fostering innovation in BRICS countries from 1995 to 2009', ASCI Journal of Management, pp. 1-20

Bound, K. and I. Thornton (2012) Our frugal future: lessons from India's innovation system, www.nesta.org.uk/sites/default/files/our_frugal_future.pdf

BP (2016) BP Statistical Review of World Energy-2015, www.bp.com/content/dam/bp/pdf/energy-economics/statistical-review-2016/bp-statistical-review-of-world-energy-2016-china-insights.pdf

Cai, Y. (2011) 'Factors affecting the efficiency of the BRICSs' national innovation systems: A comparative study based on DEA and Panel Data Analysis', Economics Discussion Papers, No. 2011-52, www.hdl.handle.net/10419/52679

Cornell INSEAD WIPO (2016) Global Innovation Index, www.globalinnovationindex.org/

EMBARQ (2016) Global BRT Data, www.brtdata.org/

Gupta, M., Weber, C., Peña, V., Shipp, S. and D. Healey (2013) Innovation policies of Brazil, a report for the Institute of Defence Analysis, www.ida.org/idamedia/Corporate/Files/Publications/STPIPubs/2014/ida-p-5039.ashx

IBM (2011) Frustration rising: IBM 2011 commuter pain survey, www.profacility.be/piclib/biblio/pdf_00000552UK.pdf

Innovation Policy Platform (2016) Database, www.innovationpolicyplatform.org/content/statistics-ipp

International Energy Agency (2015) World Energy Outlook, 2015, www.worldenergyoutlook.org/

International Energy Agency (2016) World Energy Statistics, www.iea.org/publications/freepublications/publication/KeyWorld2016.pdf

Lloyds (2016) Lloyds List – 100 Ports, www.lloydslist.com/ll/incoming/article506151.ece

NTDPC – National Transport Development Planning Committee (2013) Urban Transport, www.planningcommission.nic.in/sectors/NTDPC/voulme3_p2/urban_v3_p2.pdf

OECD (2011) OECD territorial reviews: the Gauteng City-Region, South Africa, OECD Publishing, www.dx.doi.org/10.1787/9789264122840-en

QS (2016) Qs University Rankings BRICS – 2016, www.topuniversities.com/university-rankings/brics-rankings/

Rezende, S. (2010) 'Innovation policy around the world: Brazil: challenges and achievements', Issues in Science and Technology,www.issues.org/26-3/rezende/

Siegelbaum, L. (2006) 'Cars, cars and more cars: the Faustian bargain of the Brezhnev era', in L. Siegelbaum (Ed.) Borders of Socialism: Private Spheres in the Soviet Era, Palgrave Macmillan, pp. 83-107

The Economist Intelligence Unit (2013) Hotspots: Benchmarking Global City Competitiveness, available on www.economistinsights.com/sites/default/files/downloads/Hot%20Spots.pdf

The World Bank (2009) Promoting Enterprise Led Innovation in China, www.siteresources.worldbank.org/CHINAEXTN/Resources/318949-1242182077395/peic_full_report.pdf

TomTom (2016) TomTom Traffic Index, www.global-traffic-congestion-index.silk.co/

Torvinen, P, and V. Vaatanen (2013) 'Review of the competitiveness of Russia's manufacturing industry', International Journal of Business Excellence, 6(3) pp. 293-309

Trade Mission of the Russian Federation in Germany (2016) Innovative and Industrial Clusters in Russia: Current Agenda of the State Policy, www.innovationpolicyplatform.org/system/files/Russia_PPT07042016_.pdf

UIC – International Union of Railways (2016) UIC website, www.uic.org/

UNEP – United Nations Environmental Programme (2015) Transport Scenarios for India: Harmonising Development and Climate Benefits, www.unep.org/transport/lowcarbon/PDFs/TransportScenarios.pdf

World Bank (2016) Energy Data, www.data.worldbank.org/indicator/EG.ELC.COAL.ZS?locations=ZA

World Economic Forum (2013) Global Competitiveness Report, 2015-2016 www.reports.weforum.org/global-competitiveness-report-2015-2016/

World Shipping Council (2016) Top 50 container ports, www.worldshipping.org/about-the-industry/global-trade/top-50-world-container-ports

Yao, X., Watanabe, C and Y. Li (2009) 'Institutional structure of sustainable development in BRICs: focusing on ICT utilisation', Technology and Society, 31, 9-28.

ANNEXURE

DATA SHEET ONE: LARGEST CONTAINER PORTS IN THE BRICS, 2014 (SOURCE: WORLD SHIPPING COUNCIL & LLOYDS)

Port	BRICS rank	World Rank	Million TEU
SHANGHAI, CHINA	1	1	35.3
SHENZHEN, CHINA	2	3	24.0
HONG KONG, CHINA	3	4	22.2
NINGBO-ZHOUSHAN, CHINA	4	5	19.5
QINGDAO, CHINA	5	7	16.6
GUANGZHOU, CHINA	6	8	16.2
TIANJIN, CHINA	7	10	14.1
DALIAN, CHINA	8	14	10.1
XIAMEN, CHINA	9	17	8.6
YINGKOU, CHINA	10	27	5.8
LIANYUNGUN, CHINA	11	29	5.0
JAWAHARLAL NEHRU, INDIA	12	32	4.5
SUZHOU, CHINA	13	33	4.5
SANTOS (GREATER SÃO PAULO), BRAZIL	14	38	3.7
TAICANG, CHINA	15	47	3.1
DONGGUAN, CHINA	16	54	2.8
NANJING, CHINA	17	55	2.7
MUNDRA, INDIA	18	57	2.7
DURBAN, SOUTH AFRICA	19	58	2.7
RIZHAO, CHINA	20	63	2.4
ST. PETERSBURG, RUSSIA	21	67	2.4
YANTAI, CHINA	22	68	2.4
FUZHOU, CHINA	23	73	2.0
DANDONG, CHINA	24	85	1.7
CHENNAI, INDIA	25	88	1.6
ZHONGSHAN, CHINA	26	94	1.3
HAIKOU, CHINA	27	95	1.3
SHANTOU, CHINA	28	97	1.2

DATA SHEET TWO: AIRPORTS IN THE BRICS RANKED BY PASSENGER NUMBERS, 2015 (SOURCE: AIRPORTS COUNCIL INTERNATIONAL)

Airport	City & Country	BRICS rank	World Rank (top 50 only)	Passenger Numbers 2015 (million)	Major carriers in hub
Beijing Capital International Airport	BEIJING, CHINA	1	2	89.9	Hainan Airlines China Southern Air China
Hong Kong International Airport	HONG KONG, CHINA	2	8	68.3	Cathay Pacific Dragon Air Hong Kong Airlines
Shanghai Pudong International Airport	SHANGHAI, CHINA	3	13	60.1	China Eastern Spring Airlines Juneyao Airlines
Guangzhou Baiyun International Airport	GUANGZHOU, CHINA	4	17	52.2	China Southern
Indira Gandhi International Airport	DELHI, INDIA	5	25	46.0	Indigo Spice Jet Air India
Chengdu Shuangliu International Airport	CHENGDU, CHINA	6	32	42.2	Sichuan Airlines
Chhatrapati Shivaji International Airport, Mumbai	MUMBAI, INDIA	7	35	40.6	Jet Airways
Shenzhen Bao'an International Airport	SHENZHEN, CHINA	8	39	39.7	Shenzhen Airlines
São Paulo-Guarulhos International Airport	SÃO PAULO, BRAZIL	9	41	39.2	TAM airlines
Shanghai Hongqiao International Airport	SHANGHAI, CHINA	10	42	39.1	
Kunming Changshui International Airport	KUNMING, CHINA	11	46	37.5	
Xi'an Xianyang International Airport	XI'AN, CHINA	12	-	33.0	
Chongqing Jiangbei International Airport	CHONGQING, CHINA	13		32.4	
Sheremetyevo International Airport	MOSCOW, RUSSIA	14		31.3	Aeroflot Nordwind
Domodedovo International Airport	MOSCOW, RUSSIA	15		30.5	VIM Airlines
Hangzhou Xiaoshan International Airport	HANGZHOU, CHINA	16		28.4	

Airport	City & Country	BRICS rank	World Rank (top 50 only)	Passenger Numbers 2015 (million)	Major carriers in hub
Xiamen Gaoqi International Airport	XIAMEN, CHINA	17		20.8	Xiamen Airlines
Nanjing Lukou International Airport	NANJING, CHINA	18		19.2	
OR Tambo International Airport	JOHANNESBURG EKURHULENI	19		19.1	South African Airways Kulula Mango
Kempegowda International Airport	BENGALURU, INDIA	20		19.0	
Wuhan Tianhe International Airport	WUHAN, CHINA	21		18.9	
Changsha Huanghua International Airport	CHANGSHA, CHINA	22		18.7	
Ürümqi Diwopu International Airport	ÜRÜMQI, CHINA	23		18.5	
Qingdao Liuting International Airport	QINGDAO, CHINA	24		18.2	
Zhengzhou Xinzheng International Airport	ZHENGZHOU, CHINA	25		17.3	
Congonhas Airport	SÃO PAULO, BRAZIL	26		17.1	Gol Linhas Aéreas Inteligentes S.A
Galeão International Airport	RIO DE JANEIRO, BRAZIL	27		17.1	
Presidente Juscelino Kubitschek International Airport	BRASILIA, BRAZIL	28		16.5	
Sanya Phoenix International Airport	SANYA, CHINA	29		16.2	
Haikou Meilan International Airport	HAIKOU, CHINA	30		16.2	
Vnukovo International Airport	MOSCOW, RUSSIA	31		15.8	
Chennai International Airport	CHENNAI, INDIA	32		15.2	
Tianjin Binhai International Airport	TIANJIN, CHINA	33		14.3	Tianjin Airlines
Dalian Zhoushuizi International Airport	DALIAN, CHINA	34		14.2	
Harbin Taiping International Airport	HARBIN, CHINA	35		14.1	
Guiyang Longdongbao International Airport	GUIYANG, CHINA	36		14.2	

Airport	City & Country	BRICS rank	World Rank (top 50 only)	Passenger Numbers 2015 (million)	Major carriers in hub
Pulkovo Airport	ST. PETERSBURG, RUSSIA	37		13.5	
Shenyang Taoxian International Airport	SHENYANG, CHINA	38		12.6	
Netaji Subhash Chandra Bose International Airport	KOLKATA, INDIA	39		12.4	
Rajiv Gandhi International Airport	HYDERABAD, INDIA	40		12.4	
Nanning Wuxu International Airport	FUZHOU, CHINA	41		10.4	
Tancredo Neves-Confins International Airport	BELO HORIZONTE, BRAZIL	42		10.3	Azul
< Airports linked to cities in factsheets – not ranked					
Santos Dumont Airport	RIO DE JANEIRO			9.2	
Cape Town International	CAPE TOWN, SOUTH AFRICA			8.6	
Salvador International Airport	SALVADOR, BRAZIL			8.6	
Afonso Pena International Airport	CURITIBA, BRAZIL			6.7	
King Shaka International	DURBAN, SOUTH AFRICA			4.5	
Tolmachevo Airport	NOVOSIBIRSK, RUSSIA			3.7	

PART A: CHAPTER THREE

AFRICA'S CITIES AND THE BRICS

INTRODUCTION

In this chapter we position Africa's cities in comparison with, and in relation to, cities in the BRICS. But before doing so, we introduce the cities in Africa. Of course, Africa is a massively varied continent, and it would be misleading to speak generically of 'African cities'. As in the case of the cities in the BRICS, we must explore the cities of Africa in their diversity.

We begin in Section 2 by providing a history of cities in Africa. We show that some cities are ancient in origin. They were founded either by indigenous African states or by early waves of colonisers such as the Phoenicians, Romans or Arabs. By the beginnings of modern European colonisation there was already a significant network of urban settlement across Africa; but this was severely disrupted by colonial rule. Nevertheless, new settlements were established by the colonists, mainly for administrative reasons.

By the end of the colonial era in the mid-20th century, Africa's cities were fairly small in international terms, and levels of urbanisation were low. The post-colonial era, however, has been characterised by rapid urbanisation, and the emergence of an extensive urban network – which includes mega-cities such as Cairo, Lagos and Kinshasa, as well as a large number of large, medium and small cities. However, as the section illustrates, in relation to levels and rates of urbanisation, processes of urban development are extremely uneven across the continent. It introduces the 54-million-plus urban agglomerations in Africa, in terms of size and growth of population, and size of the urban economy. It confirms that the major challenge for Africa remains the small size of urban economies relative to urban populations. While a number of Africa's cities now rank highly in global terms for population size, it is only cities in Egypt and South Africa that feature in global rankings in economic terms.

Section 3 positions cities in Africa alongside cities in the BRICS. It shows that Africa's total urban population is still significantly lower than the urban population of the BRICS. However, into the future, Africa's urban growth is likely to be significantly higher than that of the BRICS, and will add more people to the world's urban population by 2050 than the BRICS will. However, the BRICS are likely to remain overwhelmingly dominant in relation to new economic output.

The section also considers cities in Africa and cities in the BRICS in relation to each other. There are historical linkages, including ancient trade routes between Africa and the East, and the trans-atlantic slave trade. There are also shared colonial histories. In the current era there are powerful linkages between cities in the BRICS and in Africa, through trade, investment and flows of people.

SOURCES OF INFORMATION

We have used the UN Population Division for all data on population. For economic data we have drawn on data provided by Oxford Economics. The historical information is drawn from multiple online sources, while the information on contemporary linkages is drawn largely from recent media reports. The information provided on the history and context of Africa's cities is invariably very scanty relative to the long and rich histories of these cities – and the huge current complexities. We refer readers to a number of key texts for the detail and the texture (see in the References at the end of this chapter: Davidson, 1995; Mamdani, 1996; Mazrui, 2002; Simone, 2004; Murray & Myers, 2006; Freund, 2007; Myers, 2011; Parnell & Pieterse, 2014).

We acknowledge the anomaly of having South Africa in both Africa and the BRICS. We indicate in the text where there is double counting. Finally, we note that – as with the BRICS – we use the term 'cities' to refer to urban agglomerations rather than to areas defined by municipal or other boundaries.

AFRICA'S URBAN CONTEXT

HISTORY OF CITIES IN AFRICA

CLASSICAL HISTORIES

Africa has had a long urban history, and there have been times when its urban history eclipsed that of Europe. The Nile River civilisation coalesced around 3000 BC, and is associated with many ancient cities. In the period 1600 BC to 700 BC the seats of Egypt's Pharaohs were among the largest and wealthiest cities in the world. These include the cities of **Avaris**, **Thebes** and **Memphis**, whose ruins today are UNESCO World Heritage Sites and of great archaeological significance.

In the ninth century BC Phoenicians established **Carthage** in present-day Tunisia as a trading hub. Carthage gained its independence and became the hub of an empire stretching across North Africa, and challenged the power of the Greeks and then the Romans. In 146 BC Carthage fell to the Romans. It was destroyed and rebuilt by Julius Caesar, and then finally ruined in AD 698 when it was overrun by the advancing Arab armies. The modern city of Tunis is built on the ruins of this ancient city. **Algiers** and **Tripoli** (present-day Libya) were also founded by the Phoenicians, around the seventh century BC, and prospered under Roman rule. They were rebuilt in the early Middle Ages under Arab rule. **Tangier** in present-day Morocco was a Phoenician commercial outpost from around the fifth century BC.

In 332 BC Alexander the Great conquered Egypt and established **Alexandria** as a Hellenic city. It was to remain the capital of Egypt for a thousand years. In the period 300 BC to 100 BC it may have been the largest city in the world, and under Roman rule it was the second-largest city in the Roman Empire after Rome.

The Berbers, an indigenous people in North Africa, were also to establish some of Africa's greatest cities. There were the ancient Berber Kingdoms of Numidia and Mauretania in North Africa around 200 BC to 40 BC, but it was the Berber dynasties of Morocco in the Middle Ages that produced many famous cities which still survive today. The Berbers founded **Casablanca** (then known as Anfa) in AD 744; **Fez** in AD 789; **Meknes**, **Salé** and **Marrakesh** in the 11th century; and **Rabat** (the present-day capital of Morocco) in the 12th century. Marrakesh in particular was for centuries one of the great cities of Africa and the Muslim world. The Berbers were also to invade the Iberian Peninsula (present-day Spain and Portugal) in the eighth century, establishing the cities of Seville, Cordoba and Granada.

The other powerful trading kingdoms of the time were in present-day Somalia. The Somalis had trading networks that connected the Mediterranean with Arabia, Persia, India and even China. The Somali port cities included **Mogadishu**, **Barawa** and **Berbera**. Although early histories are uncertain, these ports were well established by the ninth century, AD and were at the zenith of their prosperity around the 14th century.

The Arab and Muslim conquests of North Africa began around AD 640, with Muslim rule firmly established by AD 670. **Cairo** was established by the Arabs in AD 642 as a military camp and reached levels of great prosperity by the 13th century, by which time it was competing with cities in China as the largest in the world. By the late 16th century the Turkish Ottoman Empire controlled most of the Arab world including North Africa, and Cairo was in decline. Apart from Cairo, hubs of

trading and intellectual activity under Muslim rule were **Kairouan** in Tunisia, **Tlemcen** in **Algeria**, and most famously **Timbuktu** in Mali.

The Mali Empire in the Sahel was at its peak in the 13th and 14th centuries, and was ruled from Timbuktu. This empire is reputed to have been one of the wealthiest in the world, with Timbuktu significantly larger than London at the time. It was famous for its scholarship; the Sankore University was one of the world's great classical universities. Timbuktu was to go into severe decline, but thousands of manuscripts from its intellectual heyday have survived in the city.

The Arabs established a network of trading settlements down the East coast of Africa, extending southwards from Somalia, and linking into trading networks established by Swahili and other indigenous Africans. **Mombasa** in present-day Kenya was founded around AD 900, and had become a prosperous hub for trade in gold, ivory and spices by the 12th century. **Kilwa** in present-day Tanzania was also established in the ninth century, and by the 14th century was reputed to be one of the most beautiful cities in the world. Zanzibar was an important city, as its island location offered a safe haven for Arabs trading along the African coast. Other trading towns were **Malindi**, **Brava**, **Merca** and **Pemba**. The networks extended down to the seaports of **Sofala** and **Mozambique** (located on a coral island) in present-day Mozambique. These trading routes connected Africa to Arabia, Persia, India and China, but also provided the networks for the Arab slave trade. In 1865, as Arab dominance on the East Coast was being challenged by European powers, the Sultan of Zanzibar established **Dar es Salaam**.

Khartoum, capital of Sudan, was established as an outpost of the Egyptian army in 1821, by the son of an Egyptian ruler. There were other indigenous kingdoms in East Africa with large settlements. **Kampala** was the capital of the Buganda Kingdom. **Antananarivo** in Madagascar was founded around 1610 by an indigenous ruler, as a defensive settlement. The Ethiopian Empire (also known as Abyssinia) survived from the 12th century to the 20th century, successfully resisting Arab and European incursions. In the late 19th century, Emperor Menelik II established **Addis Ababa** as his capital city.

From the sixth century there was a succession of indigenous kingdoms in West Africa; and at a time when Europe was in decline, West Africa was enjoying economic and political prosperity. The Kingdom of Ghana, which emerged in the eighth century, dominated the region until the 11th century, and was succeeded by polities such as the Songhai Empire, Mossi Empire, Benin Empire, Ashanti Kingdom, Fulani Empire, and Hausa city-states.

Kumasi was the capital of the Ashanti Kingdom from the 10th century, until it was ravaged by the British at the end of the 19th century. **Ouagadougou** (capital of present-day Burkina Faso) was established in the 15th century, becoming the capital of the Mossi Empire. The Songhai Empire was ruled from the city of **Gao** on the Niger River from the 11th to the 16th century, a rival to Timbuktu in Mali. From the 11th to the 19th century the Benin Empire was ruled from **Benin City**, in present-day Nigeria (then called Erdo). The Fulani Empire (or Sokoto Caliphate) was a Muslim state across northern Nigeria and neighbouring territories that defeated a number of Hausa city-states; of which the largest was **Kano**, which was founded in the 10th century. Many of the settlements in West Africa served also as hubs in the transatlantic slave trade (15th to 19th century), with local leaders selling slaves on to European slave-traders. **Lagos**, established as a vassal outpost of the Benin Empire around the 14th century, was a major centre for slave trading. In Central Africa, **Douala** in present-day Cameroon was established around 1650 by immigrants from present-day Congo, and was also a key hub for slave trading.

In Southern Africa, there were few large, permanent settlements from the pre-colonial period. **Great Zimbabwe**, which was at its peak from the 13th to the 16th century, linked through the Limpopo Valley into the Arab trading networks on Africa's East Coast. The Ndebele king Lobengula established **Bulawayo** (in present-day Zimbabwe) in the 1840s, as the pre-colonial era was ending.

There are two cities in Africa that have a particularly unusual history, and cannot easily be categorised as either indigenous or colonial. **Freetown**, capital of Sierra Leone, was founded in 1787 by freed American slaves; as was **Monrovia**, capital of Liberia, in 1822.

EUROPEAN COLONISATION

Africa had a long urban history before European colonisation; although of course it was not a simple history, with the establishment of Africa's towns and cities often the product of complex interactions between outsiders (such as Phoenicians, Greeks, Romans and Arabs) and indigenous peoples. In 1800, before European colonisation reached its peak, Africa's cities were more important in global terms than in 1950, at the end of the colonial era. Colonialism massively disrupted the existing urban networks, leading to the decline of many important cities; but the colonial era also led to the establishment of new cities, some of which have emerged as mega-cities in the post-colonial era. Colonial cities integrated Africa into the then-European-dominated networks of global capitalism, although mainly as nodes in a chain of resource extraction.

European civilisation had a fairly slow onset around the 15th century, reaching its peak at the end of the 19th century. Colonisation took different forms, the most vicious being the transatlantic slave trade between the 15th and 19th centuries, which dislocated tens of millions of people and enmeshed many indigenous elites in the trading network.

The modern colonial era began in the 15th century, with Portuguese seafarers exploring the coastline of Africa. Bartolomeu Dias famously rounded the Cape of Good Hope in 1488. The Portuguese established a network of trading outposts along the African coastline, linked into the slave trade. In Morocco, the Portuguese destroyed the historical Berber city of Anfa in 1468, and then built the modern city of Casablanca. The Portuguese established **Dakar** (then called Gorée) in 1536 as a base for the export of slaves, with the settlement falling to the French in 1677. **Luanda** (known then as São Paulo da Assumpção de Loanda) was founded by the Portuguese as a military fortress in 1576. In 1786 the Portuguese established a fortress at the entrance of Delagoa Bay in present-day Mozambique, which later became the site of the city of **Maputo** (called Lourenço Marques by the colonists). The city of Beira in Mozambique was established by the Portuguese in 1890. The Portuguese colonial cities were strongly linked with Brazil, initially as nodes within the transatlantic slave trade, but also with Portuguese colonies in the East, including Goa in India and Macau in China.

The Portuguese were a declining colonial power by the eighteenth century, although they held onto their colonies until the 1970s. The other early colonial power was The Netherlands. The Dutch Empire was mainly in the East, with the Dutch East India Company (VOC) headquartered at Batavia in present-day Indonesia. However, the Dutch did establish **Cape Town** in 1652, as a refreshment station on the VOC shipping routes, and controlled the Cape Colony until British occupation in 1806. They also colonised the island of Mauritius, although it later fell under French occupation. In 1855 the Boers – descendants of the Dutch settlers in the Cape – established **Pretoria** in the Transvaal. In 1886 gold was discovered in the Transvaal, and **Johannesburg** was founded. Both Pretoria and Johannesburg fell to the British in 1900, and in 1910 the Transvaal was incorporated in the Union of South Africa. Spain was a minor colonial power in Africa, at various times holding parts of Morocco, and also Western Sahara and Equatorial Guinea.

Up until the late 19th century, colonial occupation of Africa was mainly limited to coastal enclaves. From around the 1880s, however, there was a massive 'scramble for Africa', with the British and the French the main players, although the Germans, Belgians and Italians were also implicated. In 1870 only 10% of Africa was formally occupied by European powers; but in the period between 1881 and 1914, almost all of Africa was partitioned by European states. In 1914, 90% of Africa was occupied. Only Ethiopia and Liberia remained independent.

The French took possession of large portions of North, West and Central Africa, as well as Madagascar and various scattered islands in the Indian Ocean. Major colonies included Algeria, Tunisia, Côte d'Ivoire (Ivory Coast), Senegal, Chad, Sudan, Niger, Guinea, Mauritania and Burkina Faso. Many of the cities that the French used as administrative outposts had existed from pre-colonial times, but the French established: **Brazzaville** in the Congo in 1880; **Conakry**, the capital of Guinea, in 1887; and **Abidjan**, now the largest city in Côte d'Ivoire, in 1896, as a safe place for a colonial population after a series of deadly disease epidemics in other locations. **Niamey**, the capital of Niger, was developed by the French as an administrative outpost from the 1890s, while **N'Djamena**, the capital of Chad, was founded as Fort-Lamy in 1900.

The British had a massive empire, holding territory across Africa, with major colonies including present-day South Africa, Zimbabwe, Zambia, Botswana, Malawi, Tanzania, Kenya, Uganda, Sudan, Egypt, Nigeria and Sierra Leone. In South Africa, **Port Elizabeth** was established as a military outpost during the Napoleonic Wars in 1799, but was developed from 1820 with the arrival of British settlers in the Eastern Cape. In 1824, **Durban** was established as a trading outpost in the Colony of Natal (later part of South Africa). The British expansion northwards from South Africa happened from the 1890s. **Harare** (then Salisbury) was established in 1890 as a military fort by Cecil Rhodes' British South Africa Company. **Blantyre** in present-day Malawi was founded by the Church of Scotland in 1876, and **Lilongwe** in the same country was established as a colonial trading post in 1906.

Lusaka, the capital of Zambia, was established in 1905. By the 1930s Zambia's copper-belt towns (e.g. **Ndola** and **Kitwe**) had expanded, with the opening of mines in the region. **Nairobi**, the largest city in present-day Kenya, began as a tiny railway siding in 1899, but quickly developed as a commercial and administrative centre, replacing Mombasa as the capital of British East Africa. In 1890, the British seized the Buganda settlement of Kampala in Uganda, and built a new colonial city.

In North Africa, the British occupied Egypt in 1882, and also attempted to gain control of the Sudan. Their attempt to capture Khartoum famously led to the death of General Gordon in 1885, but the city eventually fell to the British in 1889. In West Africa the major British colony was Nigeria. Although British influence had been strong since the 18th century, full control was only established by the end of the 19th century. The British in Nigeria inherited an established network of settlements. Lagos was annexed by the British in 1861, Ibadan in 1893, and Benin City in 1897; but Kano was captured only in 1903.

Belgium became a colonial power when it annexed the Congo (now the Democratic Republic of the Congo, or DRC) in 1885. This vast territory was infamously ruled as the personal property of King Leopold II. **Kinshasa** was established initially as a trading outpost by a British explorer in 1881, but it was taken over by the Belgians and called Léopoldville. **Kisangani** (Stanleyville) was founded as a trading post in the vast interior of the Congo Basin in 1886, while **Lubumbashi** (Elisabethville) was established by the Belgians in 1910 to support copper mining, and **Mbuji-May**i started as a diamond-mining town in 1914.

The Germans colonised Tanzania, Cameroon, Burundi, Namibia, Rwanda, and Togo, losing the colonies to the other European powers (and also Namibia, to South Africa) after World War One. **Bujumbura**, capital of Burundi, was established as a military outpost in German East Africa in 1889; and **Kigali**, capital of Rwanda, in 1907. **Windhoek**, capital of Namibia, was established by the German Imperial Army in 1890, on the site of an earlier settlement. **Yaoundé** in Cameroon was established by German explorers as a forest settlement for the rubber and ivory trade, in 1889. **Lomé** was a British and German trading outpost, which became the capital of German Togoland in 1897.

During the scramble for Africa, the Italians acquired Eritrea and parts of Somaliland as a colony, and also administrative authority in Tunisia and Libya. In the 1930s, during the period of Fascist rule, the Italians invaded Ethiopia; but their rule of this country was very short-lived. It is generally thought that **Asmara** in Eritrea was established by the Italians in 1889, but the city is in fact an old pre-colonial settlement.

POST-COLONIALISM

Colonialism began unravelling from the end of World War Two. Most countries in North Africa were granted independence from the colonial powers in the 1950s, and in the rest of Africa in the 1960s. Among the last countries to receive independence were Angola and Mozambique in 1975, and Namibia in 1990. The white settlers of Rhodesia declared independence from Great Britain in 1964, but majority rule was only established in 1980. South Africa was effectively independent of Great Britain from 1910, but full democracy was only established in 1994.

While many settlements had been established in Africa during the colonial era, they were mainly very small, playing a largely administrative role. Also, most of the pre-colonial settlements had either been destroyed or had experienced severe decline. In 1950 – which may be regarded as roughly the end of the colonial era – there were only three cities with more than one million people. These were Cairo (2.5 million), Johannesburg-East Rand (1.7 million) and Alexandria (1 million). Cities with 0.5 to 1 million people were Casablanca and Cape Town, with about 0.6 million each, and Algiers, Tunis, Durban and Ibadan with 0.5 million. Almost all of Africa's larger cities were in North Africa or South Africa, which were already fairly urbanised. The rest of Africa was very rural. In 1950, Lagos was a small city of around 350 000 people, with Kinshasa around 200 000, and Luanda 140 000. Places such as Dar es Salaam, Abidjan, Yaoundé, Nairobi and Ouagadougou were large towns at most.

As the controls of colonial rule were reduced, urbanisation increased massively. Between the 1950s and the 1970s there were cities in Africa that had average annual growth rates that were over 10% per annum for prolonged periods (e.g. Abidjan, Libreville, Conakry, Lusaka, Kisangani, Nouakchott, N'Djaména and Lomé). Of the larger cities, Dar es Salaam and Kinshasa were the fastest-growing, with growth of more than 8% per annum. From the 1980s, cities such as Monrovia, Abuja, Kigali and Rustenburg (on South Africa's platinum belt) were among the world's fastest-growing. Currently, growth rates of cities across the world are slower than in the past, but cities in Africa that are among the world's fastest-growing include Mogadishu in Somalia and Ouagadougou in Burkina Faso.

There were a few new cities built in Africa in the post-colonial era. Abuja was constructed in the 1980s, officially replacing Lagos as the capital of Nigeria in 1991. In the early 2000s it was the world's fastest-growing city. Dodoma, which existed previously as a small colonial town, became the capital of Tanzania in 1996, replacing Dar es Salaam, although its growth has not been as spectacular as that of Abuja. Nouakchott was only a village until 1958 when it became the capital of Mauritania. It emerged as one of Africa's fastest-growing cities over an extended period, and is now a million-plus city.

In present-day Africa, among the fastest-growing cities in the world are Mogadishu, Somalia (8.1% per annum)[1]; Ouagadougou, Burkina Faso (7.2%); Abuja, Nigeria (5.9%); Dar es Salaam, Tanzania (5.6%); Yaoundé, Cameroon (5.3%); Bamako, Mali (5.3%); and Huamba, Angola (5.3%). But urban growth is highly variant. Some cities are growing only moderately fast, at rates close to the global average (e.g. Cairo, Khartoum and Cape Town), while others are slow-growing, as a result of factors that include political conflict (e.g. Tripoli and Kaduna). The data on urbanisation shown below provide an indication of urbanisation in Africa.

URBANISATION IN AFRICA

Africa as a continent is around 40% urbanised, which is still markedly less than the figure of 54% globally; but within Africa, levels of urbanisation range from 12.1% in Burundi to 87.2% in Gabon and 95% on the island of Réunion. In global terms Africa has high levels of urban growth, at around 3.6% per annum compared with the global 2.05%; but the countries range from real decline on some of the islands to 6.4% per annum in Rwanda.

1. Mogadishu may in fact be the world's fastest-growing million-plus city. Governance in Mogadishu collapsed in 1991, with the near-failure of all infrastructure and social services; although there was some private provision. There was also mass outmigration. However, with the restoration of some degree of security in recent years, many exiles have returned to the city, and through their entrepreneurial talent have kick-started the local urban economy.

Table 3.1 : Levels and rates of urbanisation by country in Africa

Country/Territory	Level of Urbanisation 2015 est. – %	Annual Urban Growth Rate, 2010-15	Total urban population, 2015 est. – millions	Predicted additional population, 2015 to 2050 – millions
RÉUNION	95.0	1.4	0.9	+0.2
GABON	87.2	2.7	1.5	+1.5
WESTERN SAHARA	80.9	3.3	0.2	+0.4
LIBYA	78.6	1.1	5.0	+2.2
DJIBOUTI	77.3	1.6	0.7	+0.3
ALGERIA	70.7	2.8	28.7	+16.0
TUNISIA	66.8	1.4	7.5	+2.6
CABO VERDE	65.5	2.0	0.3	+0.2
CONGO	65.4	3.2	3.1	+5.1
SAO TOME AND PRINCIPE	65.1	3.6	0.1	+0.2
SOUTH AFRICA	64.8	1.6	34.7	+14.4
MOROCCO	60.2	2.3	20.4	+11.3
MAURITANIA	59.9	3.5	2.4	+3.4
GAMBIA	59.6	4.3	1.2	+2.3
BOTSWANA	57.4	1.3	1.2	+0.8
CAMEROON	54.4	3.6	12.7	+21.3
CÔTE D'IVOIRE	54.2	3.7	11.5	+18.5
GHANA	54.0	3.4	14.6	+17.6
SEYCHELLES	53.9	1.1	0.05	+0.01
LIBERIA	49.7	3.4	2.2	+3.9
GUINEA-BISSAU	49.3	4.1	0.9	+1.4
NIGERIA	47.8	4.7	87.7	+207.8
MAYOTTE	47.0	1.9	<0.1	<+0.1
NAMIBIA	46.7	4.2	1.1	+1.4
ANGOLA	44.1	5.0	10.0	+24.6
BENIN	44.0	3.7	4.8	+8.8
SENEGAL	43.7	3.6	6.5	+13.4
EGYPT	43.1	1.7	36.5	+32.3
DEMOCRATIC REPUBLIC OF THE CONGO	42.5	4.0	30.3	+63.6
ZAMBIA	40.9	4.3	6.4	+19.4
CENTRAL AFRICAN REPUBLIC	40.0	2.6	1.9	+2.9
TOGO	40.0	3.8	2.9	+5.5
SIERRA LEONE	39.9	2.8	2.5	+3.4
EQUATORIAL GUINEA	39.9	3.1	0.3	+0.5
MALI	39.9	5.1	6.5	+20.7
MAURITIUS	39.7	-0.1	0.5	0.0
SOMALIA	39.6	4.1	4.4	+11.3
SAINT HELENA	39.4	-0.6	<0.1	<0.1
GUINEA	37.2	3.8	4.6	+9.2
MADAGASCAR	35.1	4.7	8.5	+22.0
SUDAN	33.8	2.5	13.4	+25.0
ZIMBABWE	32.4	2.3	4.9	+6.6
MOZAMBIQUE	32.2	3.3	8.7	+20.7
TANZANIA	31.6	5.4	16.5	+52.0
BURKINA FASO	29.9	5.9	5.3	+16.0
RWANDA	28.8	6.4	3.6	+9.8
COMOROS	28.3	2.7	0.2	+0.4
LESOTHO	27.3	3.1	0.6	+0.7
KENYA	25.6	4.3	12.0	+30.7
ERITREA	22.6	5.1	1.5	+4.5
CHAD	22.5	3.4	3.1	+9.4
SWAZILAND	21.3	1.3	0.3	+0.2
ETHIOPIA	19.5	4.9	19.3	+51.3
SOUTH SUDAN	18.8	5.1	2.3	+6.1
NIGER	18.7	5.1	3.6	+20.9
MALAWI	16.3	3.8	2.8	+9.6
UGANDA	16.1	5.4	6.5	+26.9
BURUNDI	12.1	5.7	7.0	+5.7
AFRICA	40.4	3.6	471.6	+867.0

Source: derived from UN, 2016

The highest levels of urbanisation are mainly in North Africa, where cities are ancient and urban patterns well established. Annual urban growth rates in these countries are generally slow (for example, 1.1% in Libya and 1.7% in Egypt), and the additional urban population by 2050 is anticipated to be mainly less than the existing urban population. There are exceptions, such as the relatively high urban growth rates in Western Sahara and Mauritania, but these are off a tiny base. The major exception is Sudan, which still has low urbanisation and will contribute an additional 25 million urban people by 2050. In terms of absolute numbers, Egypt and Algeria remain urbanisation hotspots, with an expected additional 32.3 million and 16 million urban dwellers by 2050 respectively.

The small island states off Africa's coast are also generally highly urbanised and have low urban growth, with static or declining urban populations in a few. However, overall numbers are low, and the islands do not contribute significantly to the urban story.

Southern Africa is now also a region of relatively high levels of urbanisation and slow urban growth. South Africa has an urbanisation level of around 64%; and annual urban growth rates of around 1.6%, but these are declining, after the growth spurt immediately following the ending of apartheid. Urban growth is also low in Botswana and Swaziland; and in Zimbabwe, where the urban economy has weakened substantially, and where national government has actively displaced people from urban areas. There are exceptions in the region, with Lesotho, Namibia and Mozambique experiencing moderately fast to rapid urban growth, although off a small base.

In most other parts of Africa, rapid urbanisation is still a major feature of the current reality. There are some countries, mainly in West Africa, with urbanisation levels well over Africa's average, where rates of urban growth are still moderately high to high (for example, Côte d'Ivoire, Ghana, Liberia, Benin and Senegal). Despite their small size, a number of these countries will individually contribute more new urban dwellers than far larger South Africa.

The big story, however, is Nigeria. Although this country already has by far the largest urban population in Africa (87 million, followed by Egypt at a distant 36.5 million), it is still less than half-urbanised. There is therefore considerable opportunity for expanded urbanisation. This, combined with continued high fertility rates, may result in an additional 208 million new urban dwellers by 2050. This is a massive number, even in international terms; the only countries that are likely to contribute more additional urban people than Nigeria are India (394 million) and China (270 million).

The other region of extremely high urban growth in Africa is the Sahel. Burkina Faso has current urban growth rates of 5.9% per annum, with Niger and Mali following at 5.1%.

Middle Africa has urbanisation levels around Africa's average (40%), but cities are growing fast. The DRC has a current urban population of 30.3 million and is expected to add a further 63.6 million. There is similarly rapid growth in Cameroon, with an expected additional 21.3 million urban people. Zambia's urban population is growing even faster, with current annual rates of 4.3%. The fastest anticipated growth is in Angola, where there are current rates of 5% urban growth per annum and a predicted additional urban population of 24.6 million.

East Africa has among the lowest urbanisation rates on the continent, ranging from 12% in Burundi to 32% in Tanzania. However, current and expected growth rates are generally the highest in Africa, and among the highest in the world. Countries with current growth rates close to or over 5% per annum include Tanzania, Ethiopia, Uganda, South Sudan and Burundi. Rwanda has the extraordinary rate of 6.4% per annum. Even Kenya, with its relatively mature national economy, has a rate of 4.3%. Tanzania and Ethiopia are each likely to contribute more than 50 million new urban dwellers by 2050. As a region, East Africa may add 277 million urban people, making it the third-most important numerical contributor globally after South Asia and West Africa.

Africa's story is clearly highly varied, and it would be incorrect to stereotype the entire continent as a region of low but rapidly increasing urbanisation levels. This should not detract from the realisation that rapid rates of population growth will present both an enormous challenge and an opportunity for large parts of the continent.

CITIES TODAY

UN population data records 183 urban agglomerations in Africa with more than 300 000 people each, and 56 with more than a million people. The largest concentrations are on the north and west coasts of Africa.

There are three mega-cities in Africa with over ten million people each (Cairo, Lagos and Kinshasa); six large cities with four to ten million people; and 47 medium-sized cities with one to four million. All of Africa's million-plus cities are growing, although at differential rates. A scatterplot reveals no correlation between size and growth, with regional and national factors clearly being far more important in shaping growth performance than size. At the top end, for example, cities such as Lagos, Kinshasa, Dar es Salaam and Luanda are continuing to grow rapidly, although others such as Cairo, Khartoum and Alexandria are growing at modest rates.

Table 3.2: The million-plus cities in Africa, as of 2015

Urban agglomeration	Country	2015 pop. in millions	Annual growth rate, 2010-15
Mega-cities			
1. Cairo	EGYPT	18.8	2.1
2. Lagos	NIGERIA	13.3	3.9
3. Kinshasa	DRC	11.6	4.2
Large cities			
4. Johannesburg-Ekurhuleni	SOUTH AFRICA	9.4	3.2
5. Luanda	ANGOLA	5.5	4.0
6. Khartoum	SUDAN	5.1	2.5
7. Dar es Salaam	TANZANIA	5.1	5.6
8. Abidjan	CÔTE D'IVOIRE	4.9	3.1
9. Alexandria	EGYPT	4.8	2.0
Medium-sized cities			
10. Nairobi	KENYA	3.9	3.8
11. Cape Town	SOUTH AFRICA	3.7	1.8
12. Kano	NIGERIA	3.6	2.2
13. Dakar	SENEGAL	3.5	3.7
14. Casablanca	MOROCCO	3.5	0.6
15. Addis Ababa	ETHIOPIA	3.2	2.1
16. Ibadan	NIGERIA	3.2	2.3
17. Yaoundé	CAMEROON	3.1	5.3
18. Durban	SOUTH AFRICA	2.9	1.1
19. Ouagadougou	BURKINA FASO	2.7	7.2
20. Antananarivo	MADAGASCAR	2.6	5.1
21. Kumasi	GHANA	2.6	5.1
22. Douala	CAMEROON	2.4	4.4
23. Algiers	ALGERIA	2.6	1.3
24. Bamako	MALI	2.5	5.3
25. Abuja	NIGERIA	2.4	5.9

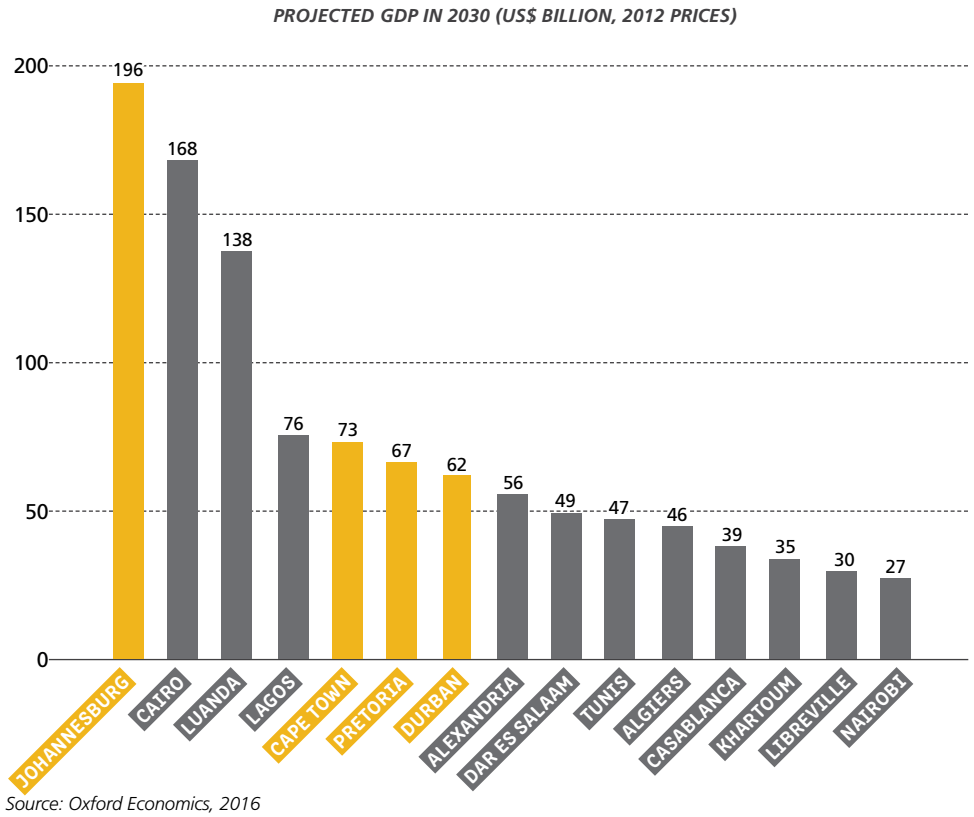
Urban agglomeration	Country	2015 pop. in millions	Annual growth rate, 2010-15
26. Port Harcourt	NIGERIA	2.3	5.1
27. Accra	GHANA	2.3	2.0
28. Lusaka	ZAMBIA	2.2	4.8
29. Mogadishu	SOMALIA	2.1	8.1
30. Pretoria	SOUTH AFRICA	2.1	4.2
31. Mbuji-Mayi	DRC	2.0	4.6
32. Lubumbashi	DRC	2.0	4.1
33. Tunis	TUNISIA	2.0	0.8
34. Rabat	MOROCCO	2.0	1.8
35. Kampala	UGANDA	1.9	3.9
36. Conakry	GUINEA	1.9	3.0
37. Brazzaville	CONGO	1.9	3.6
38. Harare	ZIMBABWE	1.5	0.4
39. Benin City	NIGERIA	1.4	2.9
40. Huambo	ANGOLA	1.3	5.3
41. Monrovia	LIBERIA	1.3	3.6
42. N'Djaména	CHAD	1.3	3.9
43. Kigali	RWANDA	1.3	3.7
44. Port Elizabeth	SOUTH AFRICA	1.2	1.3
45. Maputo	MOZAMBIQUE	1.2	1.0
46. Fès	MOROCCO	1.2	2.0
47. Kananga	DRC	1.2	4.4
48. Vereeniging (the Vaal)	SOUTH AFRICA	1.2	1.5
49. Marrakech	MOROCCO	1.1	3.0
50. Tripoli	LIBYA	1.1	0.6
51. Onitsha	NIGERIA	1.1	4.9
52. Mombasa	KENYA	1.1	3.2
53. Niamey	NIGER	1.1	2.9
54. Kaduna	NIGERIA	1.0	1.2
55. Kisangani	DRC	1.0	3.8
56. Freetown	SIERRA LEONE	1.0	2.5

Source: derived from UN, 2016

With differential growth rates, the ranking of Africa's cities continues to shift. The details of changes in ranking between 1950 and 2015, within projections to 2030, are provided in ANNEXURE ONE. Briefly, Cairo has maintained its position as Africa's largest city, and is still expected to be so in 2030, though with Lagos and Kinshasa closing in. Cities which have moved rapidly up the size rankings since 1950 are Lagos, Kinshasa, Luanda, Dar es Salaam, Abidjan, Nairobi, Yaoundé and Ouagadougou. Cities that have largely retained their positions are Johannesburg-Ekurhuleni, Antananarivo and Dakar, while others such as Cape Town, Durban, Tunis, Port Elizabeth, Algiers and Port Said have declined relatively. The broad shift has largely been from cities in North and Southern Africa to cities in West, East and Middle Africa. Moving towards 2030, cities such as Cape Town, Durban and Casablanca may fall off the top 20 in terms of size, being replaced by others such as Bamako, Abuja and Douala.

However, rankings are very different if related to economic size and growth. Oxford Economics provides projected rankings for the top cities in Africa in terms of GDP and GDP per capita for 2030.

Figure 3.1 : Projected Economic Rankings for Cities in Africa, 2030



Source: Oxford Economics, 2016

Cities in South Africa and countries in North Africa will continue to dominate in terms of the size of urban economies, although Luanda, Lagos, Dar es Salaam, Libreville and Nairobi also feature as a result of the sheer weight of population size and/or economic base, especially oil extraction. Although population size does matter (even poor populations collectively produce significant-sized economies in mega-cities), there is clearly no direct relationship between size and economy. Kinshasa, for example, is one of Africa's mega-cities, but does not feature in terms of economy. South Africa's cities are only modestly sized in terms of population, but continue to dominate in terms of urban economies.

CITIES IN AFRICA AND THE BRICS

Cities in Africa and the BRICS can be related to each other in at least two ways. First, we may draw comparisons. We do this below, in reference to urban histories and population and economic data. These comparisons provide us with a helpful perspective on the relative position and significance of cities in Africa and the BRICS. However, more important perhaps is the relationship between cities in Africa and those in the BRICS, and this is then addressed.

COMPARING CITIES IN AFRICA AND THE BRICS

There are multiple comparisons that can be made, revealing both similarities and differences. We may start with history. For example, Africa shares with China and India an urban history of great antiquity. Among the world's ancient civilisations which produced the cities of classical times were: the Ancient Egyptian civilisation (from 3150 BC); the Yellow River civilisation in China (2700 BC); and the Indus Valley civilisation in India (from 2600 BC). North Africa was also to form part of the Ancient Greek, Roman and Persian civilisations. Among the surviving great cities from these times are Alexandria, Tunis (built on the ruins of Carthage), Tripoli and Algiers in Africa; Delhi in India; and Xi'an, Beijing and Hangzhou in China.

In the middle period (from around the first century AD until the modern colonial period), Africa and the BRICS experienced complex histories, with powerful indigenous states; but also various invasions from outside powers, often producing new hybrid political and urban formations. There were also times when states in Africa and the BRICS created their own empires (for example the Mongols, who created a great dynasty in China, ruled a vast empire, and even invaded Europe; the Berbers of North Africa, who occupied present-day Spain; and the Russians, who created a vast empire across Asia).

From the modern period, a shared colonial history brings countries in Africa and the BRICS together in a comparative and practical way. Brazil, for example, shares the history of Portuguese colonialism with Angola, Mozambique, Equatorial Guinea and Guinea Bissau, with cities including São Paulo, Rio de Janeiro, Luanda and Maputo having been founded by the Portuguese[2]. Of course there are also important differences; with Brazil, for example, having achieved independence from Portugal in the nineteenth century, and the African colonies only in the 1970s. Nevertheless, connections of history, language, religion and more continue to link Brazil and Africa, also providing a basis for present-day economic relations. India shares a British colonial history with many countries in Africa; and like Africa, was only decolonised in the mid-twentieth century. One of the consequences of being with much of Africa in the British Empire was the movement of people from India to Africa, with communities of Indian descent in many parts of Africa. There are numerous cities in Africa and India that were created by the British colonisers (in India, by the British East India Company). China of course was never entirely colonised, but there were colonial intrusions as far as Shanghai by the British, French, Germans and other Europeans. In more recent times, Africa and the BRICS have shared a 'post-colonial solidarity', with Russia also actively engaged in supporting anti-colonial struggles in Africa during the Cold War.

2. There were also small Portuguese enclaves in India (Goa) and China (Macau).

Addis Ababa

In the present age, both Africa and the BRICS are hotspots for urban growth, although with variations. Currently 50% of the world's urban population is in Africa and the BRICS combined (19% from Africa, and 31% from BRICS), but 66.1% of growth in the world's urban population until 2015 is likely to come from the BRICS and Africa (with 36.4% from Africa and 31.7% from the BRICS).

Table 3.3 : Comparing urban numbers in Africa and the BRICS

Territory	Level of Urbanisation 2015 est. – %	Annual Urban Growth Rate, 2010-15	Total urban population, 2015 est. – millions	Predicted additional population, 2015 to 2050 – millions
AFRICA	40.4	3.6	471.6	+ 867.0
BRAZIL	85.7	1.0	174.5	+ 35.7
RUSSIA	74.0	-0.1	105.2	- 7.0
INDIA	32.7	2.4	420.0	+ 394.0
CHINA	55.6	3.1	779.5	+ 270.0
SOUTH AFRICA#	64.8	1.6	34.7	+ 14.4
WORLD	54.0	2.0	3 957.3	+ 2 381.3

 # Note: Also incorporated in the figures for Africa *Source: UN Population Division, 2016*

Currently, Africa is lagging behind the BRICS in terms of urbanisation and city size; but the rate of urban growth is slowing in the BRICS (with the possible exception of India), while urban growth rates remain very high in large parts of Africa. Table 3.4 below shows that four of the top 20 BRICS-Africa combined cities are in Africa. In 2030 the number will be five, but with the exception of the Central Witwatersrand, Africa's cities will have moved up the hierarchy. By 2030, Cairo, Lagos and Kinshasa will be 20-million-plus cities.

Table 3.4: Cities in the BRICS and Africa by population for 2015, and projected for 2030

City Ranking, 2015	2015 population in millions	Projected City Ranking, 2030	2015 Population in millions
1. DELHI (INDIA)	25.7	1. DELHI (INDIA)	36.1
2. SHANGHAI (CHINA)	23.7	2. SHANGHAI (CHINA)	30.8
3. SÃO PAULO (BRAZIL)	21.1	3. MUMBAI (INDIA)	27.8
4. MUMBAI (INDIA)	21.0	4. BEIJING (CHINA)	27.7
5. BEIJING (CHINA)	20.4	5. CAIRO (EGYPT)	24.5
6. CAIRO (EGYPT)	18.8	6. LAGOS (NIGERIA)	24.2
7. KOLKATA (INDIA)	14.9	7. SÃO PAULO (BRAZIL)	23.4
8. LAGOS (NIGERIA)	13.3	8. KINSHASA (DRC)	20.0
9. CHONGQING (CHINA)	13.3	9. KOLKATA (INDIA)	19.1
10. RIO DE JANEIRO (BRAZIL)	12.9	10. GUANGZHOU (CHINA)	17.6
11. GUANGZHOU (CHINA)	12.5	11. CHONGQING (CHINA)	17.4
12. MOSCOW (RUSSIA)	12.2	12. BENGALURU (INDIA)	14.8
13. KINSHASA (DRC)	11.6	13. TIANJIN (CHINA)	14.7
14. TIANJIN (CHINA)	11.2	14. RIO DE JANEIRO (BRAZIL)	14.2
15. SHENZHEN (CHINA)	10.8	15. CHENNAI (INDIA)	13.9
16. BENGALURU (INDIA)	10.1	16. HYDERABAD (INDIA)	12.8
17. CHENNAI (INDIA)	9.9	17. SHENZHEN (CHINA)	12.7
18. CENTRAL WITWATERSRAND (SOUTH AFRICA)	9.4	18. MOSCOW (RUSSIA)	12.2
19. HYDERABAD (INDIA)	8.9	19. CENTRAL WITWATERSRAND (SOUTH AFRICA)	11.6
20. WUHAN (CHINA)	7.9	20. DAR ES SALAAM, TANZANIA	10.8

Source: UN Population Division, 2016

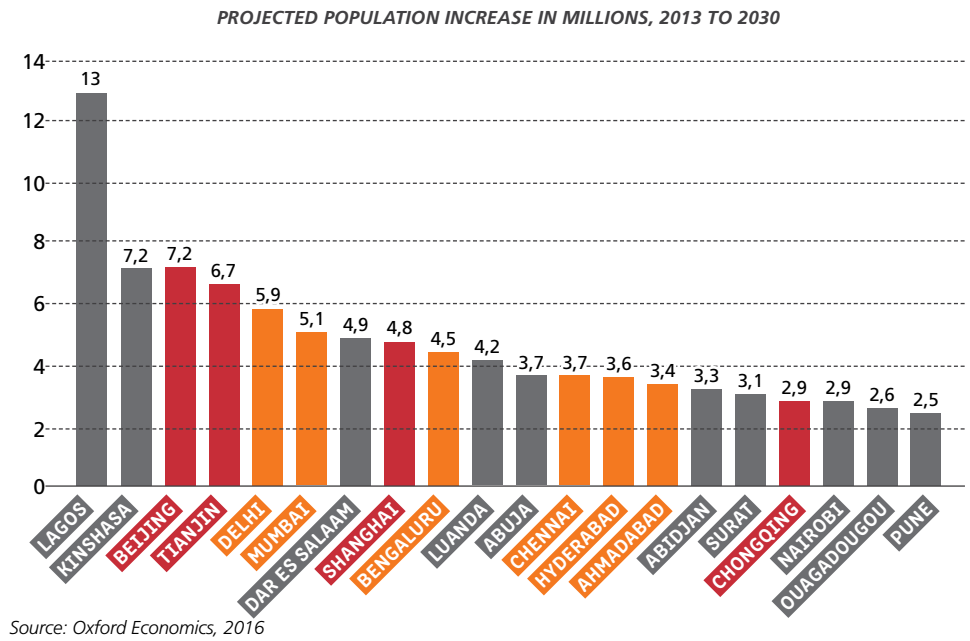
The current 20 fastest-growing cities in the BRICS and Africa in terms of population are:

1. Mogadishu, Somalia (8.1%)
2. Ouagadougou, Burkina Faso (7.2%)
3. Abuja, Nigeria (5.9%)
4. Dar es Salaam, Tanzania (5.6%)
5. Yaoundé, Cameroon (5.3%)
6. Bamako, Mali (5.3%)
7. Huamba, Angola (5.3%)
8. Guangzhou, China (5.2%)
9. Antananarivo, Madagascar (5.1%)
10. Kumasi, Ghana (5.1%)
11. Port Harcourt, Nigeria (5.1%)
12. Onitsha, Nigeria (4.9%)
13. Lusaka, Zambia (4.8%)
14. Surat, India (4.8%)
15. Suzhou, China (4.7%)
16. Mbuji-Mayi, DRC (4.6%)
17. Beijing, China (4.6%)
18. Hangzhou, China (4.6%)
19. Douala, Cameroon (4.4%)
20. Kananga, DRC (4.4%)

Notably, 15 of the top 20 in terms of growth are from Africa.

As indicated in Figure 3.2 below, Oxford Economics data suggests that 20 of the anticipated top 30 cities in the world for additional urban population are in the BRICS and Africa combined. The biggest expected increase in urban population in the world to 2030 is for Lagos, with an anticipated 13 million additional people; but the world top 10 also includes Kinshasa (4th), Beijing (5th), Tianjin (6th), Delhi (8th), Mumbai (9th) and Dar es Salaam (10th).

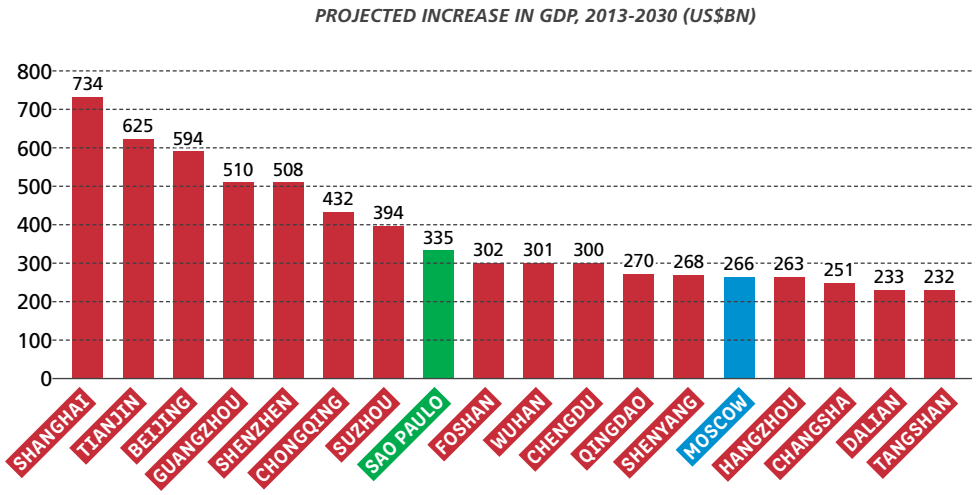
Figure 3.2: Projected absolute population Increase between 2013 and 2030 among BRICS and African cities in the top 30 globally



Source: Oxford Economics, 2016

As indicated in Figure 3.3, the situation in terms of projected economic change is very different. Again, two-thirds of the global Top 30 are in these lists, but they are all from the BRICS. There is projected economic growth for Africa's cities; but the growth is off a low base, and so the cumulative effect is limited. For this reason there are no cities in Africa which feature in Figure 3.3.

Figure 3.3: BRICS and African cities in the Top 30 globally in terms of projected GDP increase between 2013 and 2030.



Source: Oxford Economics, 2016

CITIES IN AFRICA AND THE BRICS IN RELATION TO EACH OTHER

HISTORICAL

The BRICS have had long historical relationships with Africa. There is evidence of contact between **Africa and China** as early as the second century BC. As the Silk Roads were developed, trading links were gradually strengthened. By the 10th century AD, Africa was frequently mentioned in China's official documents, and by the 13th century there were well-established maritime routes between China and North Africa, China and East Africa, and China and Madagascar. Guangzhou was the key maritime port for China in this trading network. In 1418, the Chinese Admiral Zheng sailed a fleet of 62 ships across the Indian Ocean to Africa, decades before Vasco da Gama sailed around the Cape. By the 17th century contact had dwindled, with European links to China largely replacing connections with China. In the late 19th century, however, there was Chinese migration to the Indian Ocean islands of Mauritius, Seychelles, Réunion and Madagascar, and also to the gold fields of the Transvaal (South Africa). From the 1950s, China supported Africa's wars of national liberation; and in the early 1970s, famously built the TAZARA railway line between landlocked Zambia and the port of Dar es Salaam in Tanzania.

The trading relations between **Africa and India** go back into antiquity. There are records of formal trading relations between Egypt and India that go back to Ptolemaic rule (305 BC to 30 BC), and this continued during the period of Roman rule. Arab traders brought African slaves to India. While many Africans in India had marginal status, others became an elite class of military officers and administrators. Sixteenth-century European travellers, for example, referred to the Abyssinian (Ethiopian) courtiers as the rulers of Bengal. Africans in India were generally known as Siddis. Over time they were assimilated into Indian society through intermarriage, but there are still around 55 000 Siddis in India (Schonberg Centre for Research on Black Africa, 2016).

Indians began settling in Africa from the mid-19th century. The first wave of Indians was brought to Natal (South Africa) and the Indian Ocean islands (Mauritius, Réunion, Seychelles) as indentured labourers on sugarcane plantations. Indian migration to Kenya began with the construction of the Uganda railway from 1896, when over 30 000 indentured labourer were brought from British India. The indentured workers were followed by Indian merchants and artisans, who settled in the Transvaal, for example, or who migrated to East Africa following the old trade routes through Mombasa, Zanzibar and Lamu. After South Africa, where there are over 1.3 million people of Indian descent, the largest numbers of individuals of largely Indian descent are in Mauritius (900 000), Réunion (220 000), Kenya (110 000), Tanzania (70 000), Uganda (50 000), Mozambique (40 000) and Madagascar (25 000).

There is a strong historical link between **Brazil and Africa** as a result of the transatlantic slave trade and the history of Portuguese colonialism, shared between Brazil and African states including Angola and Mozambique. Afro-Brazilians account for around 7.6% of Brazil's total population, or around 14.5 million people. Africa has contributed in multiple ways to the cultures of Brazil, including to food, music and religion. There are especially strong links to Salvador da Bahia, where the UNESCO World Heritage Site Pelourinho was the first slave market in the New World. In the late 19th century some freed slaves returned to Africa, many settling in Lagos, where they became part of the local social elite (Paris, 1998)[3]. Brazil has retained particularly strong links with Angola. Many Portuguese Angolans moved to Brazil at the time of Angola's turbulent independence in 1975, while the new Angolan elite commonly send their children to school and university in Brazil.

3. The Campos Quarter of Lagos is noted for its Brazilian influences and Afro-Brazilian architecture, but it is becoming increasingly dilapidated; there are fears that the existing traces of the Brazilian heritage are fading quickly (*Mail Online,* 28 May 2016).

The relationship between Russia and Africa expanded during the Cold War, as proxy battles were fought in Africa between the Soviet Union and the West. A strong network of political, military and technical assistance developed linking Russia and many African countries. Large numbers of Africans were also brought to the Soviet Union for professional and military training. The 40 000 or so Afro-Russians in present-day Russia are mainly the progeny of Russian mothers and African fathers who studied in the Soviet Union during the Cold War era (*The Guardian*, 15 February 2016).

CONTEMPORARY

China

China leads the way in its connection with Africa. In the 1980s, many Western countries cut their spending on infrastructure in Africa, which contributed to an infrastructure deficit that China is now addressing through investment. Initially, China's investment was focused on regions where needed mineral and other resources were being extracted; but China's investments have broadened, and many are now focused on various forms of urban infrastructure. Apart from the BRICS, which direct China's attention to South Africa in particular, the New Silk Road initiative is focusing attention on countries along the East Coast of Africa which lie along ancient trading routes that connected Africa to the Far East.

Resource extraction does of course remain a major interest for China in Africa. The presence of oil and gas explains the strong Chinese interest in Angola, Nigeria, Gabon, Cameroon and South Sudan, for example. Africa also features highly in China's search for mineral resources, with a Chinese presence in mining across most countries in Southern, Central and Western Africa. For example, there is major interest in uranium in Namibia; copper, cobalt and diamonds in the DRC; chrome, platinum and manganese in South Africa; diamonds in Botswana; lithium and platinum in Zimbabwe; bauxite in Guinea; and heavy metals in Mozambique.

While around 30% of China's investment in Africa is in commodities, around 20% is in finance, 16% in construction, and 15% in manufacturing. China has invested heavily in the banking sector in South Africa and Nigeria, buying equity, for example, in the Standard Bank of South Africa, the First Bank of Nigeria, and the Nigeria Import-Export Bank. China is also showing growing interest in Morocco, where Casablanca has recently overtaken Johannesburg as Africa's leading financial centre (China Daily, 25 April 2015; Arab Weekly, 17 April 2016).

There are major Chinese investments in construction across Africa. In some cases (e.g. Nigeria) this investment is the direct result of a deal that allows China access to oil, gas or mineral resources in exchange for investments in infrastructure. China is investing heavily in roads, rail, ports, airports and energy-related infrastructure. Major regional-scale investments with importance for cities include the high-speed rail link between Cairo and Alexandria in Egypt; a new coastal railway line linking Lagos and Calabar in Nigeria; the railway line linking Mombasa and Nairobi, which is eventually intended to connect with cities in Uganda, Rwanda, Burundi and South Sudan; the Yaoundé-Douala Highway in Cameroon; nearly 3 000 kilometres of road and rail in the DRC; new deep-water ports in Tanzania and Cameroon; the fibre link between Kinshasa and Brazzaville across the Congo River (The Guardian, 31 July 2013; Mining Weekly, 27 February 2015; Railway Gazette, 20 November 2014; Mada Masr, 20 January 2016; Global Construction Review, 22 June 2015; The Diplomat, 27 February 2015; China Daily, 5 April 2016).

Increasingly, Chinese enterprise is investing in manufacturing in Africa. Lagos is a case in point; the Chinese have partnered with the Lagos State Government in setting up a Free Trade Zone, and are also investing directly in the industries established there. In Ethiopia, the Chinese have set up a light industrial zone outside Addis Ababa where there is labour-intensive production in sectors such as clothing and footwear.

At city scale, major Chinese investments in Africa's cities include:

- New international airports in Khartoum, Addis Ababa and Maputo, and upgrades of airport terminals in Lagos, Abuja, Port Harcourt and Kano in Nigeria (*Engineering News-Record*, 1 October 2012; *AFK Insider*, 12 April 2016);
- Port upgrades for Abidjan, Nouakchott, Maputo and Alexandria (*China Africa Reporting Project*, 20 May 2014; *The Diplomat*, 27 February 2015);
- The construction of light-rail systems in Addis Ababa, Lagos and Abuja (*Al Jazeera*, 20 October 2015; *CNC International*, 6 January 2016);
- The construction of the African Union headquarters in Addis Ababa, and the planning and construction of Juba, the new capital of South Sudan;
- New economic zones outside of Lagos (Lekki Free Trade Zone), Abidjan, Lusaka and Addis Ababa (*The Guardian*, 30 April 2013; *Business Day*, 9 November 2015)
- Satellite city development outside Cairo, Nairobi, Addis Ababa, Dar es Salaam and Dakar (*Wall Street Journal*, 3 May 2016; *Daily News Egypt*, 27 May 2016; *Global Construction Review*, 16 April 2014; *Bloomberg*, 16 September 2015)
- The construction of the mega Kilamba Kiaxi housing development on the outskirts of Luanda in Angola (as part of an oil-for-development deal), as well as real estate development in Nairobi, Mombasa, Johannesburg (Modderfontein), Kigali and elsewhere; and
- Diverse other investments in urban infrastructure, in roads (e.g. Nairobi, Dakar and Kinshasa), football stadia (e.g. Kinshasa and Abidjan), water supply upgrades (e.g. Abidjan) and hospitals (e.g. Nairobi) (*Christian Science Monitor*, 4 September 2013; *Financial Mail*, 17 December 2015; *African Independent*, 4 March 2016).

These major investments are mainly directed by China's major state-owned enterprises – the banks and construction companies – headquartered in Beijing. However, there is also a growing presence of China's large private corporations, which are forging new connections between cities in China and cities in Africa.

Huawei Technologies, a state-private hybrid headquartered in Shenzhen, is now present in most large African cities. The Beijing-based private electronics and web-services companies Xiaomi and Baidu have recently targeted Africa for expansion, with Baidu having entered into a partnership with France's Telecom-Orange to create a browser for low-cost smartphone use in Africa. Smaller firms are also investing in Africa. The real estate developer Zendai Shanghai has purchased a 3 500ha tract of land in Johannesburg for mega property-led development. Wuhan Iron and Steel is investing heavily in Mozambique and Liberia, while Chongqing-based firms are targeting Addis Ababa for relocation of labour-intensive segments of manufacturing.

Of course there are also tens of thousands of micro-scale Chinese entrepreneurs in Africa's cities. They occupy stalls on streets and open marketplaces, and in formally planned malls. In Johannesburg, for example, there are around twenty Chinese malls and also a 'Chinatown', but there are also visible concentrations of Chinese in cities including Dakar, Lagos, Nairobi, Dar es Salaam, Kinshasa, Kampala and Antananarivo. These traders generally bring in mass-produced goods from China, selling cheaply to low-income market segments. There are tensions in some cities around the Chinese entrepreneurial presence. In 2015, for example, tensions in Kinshasa turned violent. In Kano in Nigeria, large-scale protests erupted when the closure of tanneries in the city was blamed on imports of cheap Chinese leather (*Mail Online*, 24 May 2015).

Most of the development and investment traffic is one-way, from China to Africa; but there are exceptions. The Cape Town-based media firm Naspers has an extremely lucrative minority shareholding in the Shenzhen-based e-commerce and social-networking firm Tencent. The Johannesburg-based Sasol Chemicals had major plans for joint-venture investment in China, but these have been scaled back, as Sasol has shifted its attention to the USA. However, Sasol does have production facilities in Nanjing, and in Lianyungang, Jiangsu Province. Other forms of African presence in China include the large, mainly West African trading communities in the cities of Guangzhou and Yiwu, and the African student presence in cities such as Wuhan and Shanghai.

Addis Ababa

India

There is growing investment from India in Africa, and also expanding trade relations, with India now Africa's fourth-largest trading partner after the EU, China and the USA. The bulk of India's approximately $50 billion annual investment in Africa still goes to tax havens in the island state of Mauritius, but there is expanding investment elsewhere. The historical connections between India and countries in East Africa and Southern Africa do facilitate business links, but India's investments are also growing in West Africa and North Africa.

Among India's leading companies in Africa are the Tata Group, Vedanti Resources, Essar, and telecommunications giant Bharti Airtel. Tata Africa Holdings, a subsidiary of the Mumbai-headquartered Tata Group, is based in Johannesburg, and has a presence in at least eleven African countries. Tata has a majority holding in South Africa's Neotel telecommunications group. Vedanta Resources – founded in Mumbai, but now headquartered in London – has large-scale mining investments in South Africa, Namibia and Zambia. Mumbai-based Essar has a 50% stake in Kenya Petroleum Refineries, owns a steel company in Zimbabwe, and runs coal and iron ore mines in Mozambique. Delhi-based Bharti Airtel is a telecommunications giant with a presence in 17 African countries, and is the market leader in mobile phones in a number of these, including Zambia, Tanzania, the DRC, Madagascar and Chad. A particular area in which Indian investment is making a positive impact in Africa is in the manufacture and supply of affordable medicine, including critically needed antiretrovirals (ARVs) (*Doctors without Borders*, 6 July 2016).

India has not invested in Africa's infrastructure in the same way that China has. India's private firms do not have access to finance in the same way that the state-owned Chinese firms have, and there are still massive opportunities to develop infrastructure in India. However, the Indian Exim Bank has recently extended a $7.5 billion line of credit to firms operating in Africa, and has set up a Project Development Company in partnership with the African Development Bank to support Indian companies investing in infrastructure and other construction projects in Africa (*Dollar Business Bureau*, 7 July 2015).

As indicated previously, there is a historical African presence in India. In recent decades too, around 30 000 Africans have gone to India to study. However, tensions have emerged around the new African presence, with recent attacks on Africans in Delhi (International Business Times, 3 July 2016; *Daily Maverick*, 1 June 2016).

Russia

Russia's reconnection with Africa after the political changes of the early 1990s is very recent. Like China and India, Russia has found Africa to be a source of strategic commodities, and a potential market for its products.

Egypt in particular has positioned itself as the gateway for Russian investment into Africa, with the Russian Investment Fund already having invested $7 billion in Egypt. The focus of the investment is on power, agriculture, tourism and logistics, for example with Russia assisting Egypt with the development of its first nuclear power station, and also partnering in the establishment of a free trade zone (*Cairo Post*, 15 March 2016).

The Moscow-based oil and gas giant Gazprom has a strong presence in Algeria, Libya and Nigeria, and has recently started a coal gasification project in South Africa (*Bloomberg*, 26 November 2016). The Gazprombank, one of Russia's largest financial institutions, has set up regional headquarters in Johannesburg.

Evraz bought Highveld Steel and Vanadium Corporation in eMalahleni (Witbank) in Mpumalanga, South Africa, but recently closed the plant due to market conditions. The Russian diamond company Alrosa is active in Angola, Namibia, Botswana and Sierra Leone; Renova has manganese, platinum and energy-related interests in South Africa; VTP Capital has a majority share in an Angolan bank; Lukoil had a major exploration and prospecting presence in West Africa; and Russian Railways has a cooperation agreement with South Africa's Transnet to support the modernisation of South Africa's railway system.

Russia's major engagement with urban development has come through investment by Moscow-based Renaissance Capital. Renaissance has offices in Johannesburg, Nairobi and Lagos, and has financed mega-developments including Tatu City in Nairobi, Appolonia in Accra, King City in Takoradi (Ghana), Kiswishi in Lubumbashi (DRC), and Roma Park in Lusaka. These are mainly satellite-city developments around existing cities. Renaissance Capital also owns 25% of the shares in Ecobank, one of the largest Nigerian banks (UNCTAD, 2013).

While there are few Russian migrants in Africa, there is a large but vulnerable tourism flow to Africa. In 2014, three million Russians visited Egypt, with Egypt having become the number-one tourist destination for Russians globally. Terror attacks involving the downing of two passenger planes led to Russia suspending flights to Egypt, which dealt a severe blow to the Egyptian economy (*The Atlantic*, 6 November 2015; *US News*, 16 March 2016). Russian tourism is also important for Tunisia and Morocco, although numbers are also erratic in these countries.

In addition to the 40 000 Afro-Russians, there are around 100 000 or so African immigrants in Russia. There have been recent concerns about violence towards Africans by extremist groups (*Los Angeles Times*, 2 November 2014).

Brazil

Brazil's trade with and investment in Africa is still fairly limited, but has been increasing. The links are spatially concentrated, and mainly with South Africa, Nigeria, Angola and Mozambique – the latter two because of the connections of history and language. The focus of investment has mainly been in oil, energy (biofuels) and mining, but there has been a recent increase in financial services. Brazil's investment is mainly by private firms, but the Brazilian Development Bank and the Bank of Brazil have helped finance some of the projects. Brazil's involvement in Africa expanded significantly during the presidency of Lula da Silva, but has recently been negatively affected by recession, political turmoil and corruption probes in Brazil.

The major companies involved in the African investments are Itau-Unibanco (banking), Vale (mining), Odebrecht (construction) and Petrobras (hydrocarbons). The São Paulo-based Itaú Unibanco is expanding into Africa, although it has been negatively affected by the recession in Brazil. The Rio de Janeiro-based Vale owns coal mines in Mozambique, and also has interests in the DRC, South Africa, Angola, Zambia and Guinea. Vale is constructing a railway line from its mines in Tete Province in Mozambique through Malawi to its port facilities in Beira (*Market Watch*, 6 February 2013; *Engineering News*, 8 December 2015). Odebrecht, headquartered in Salvador da Bahia, is the largest petrochemical producer in Latin America, but also has key engineering and construction interests. It has regional offices in Johannesburg and large construction projects in Angola, including dams, airports, railways, roads, and water supply. Oldebrecht has also built new terminals at the Tripoli International Airport in Libya, and is refurbishing power stations in Liberia. However, the company has been negatively affected by a corruption probe, which has led to a long-term jail sentence for its founder and CEO (*Wall Street Journal*, 22 March 2016). State-owned Petrobras, headquartered in Rio de Janeiro, has interests in oil and minerals in Angola, Benin, Gabon, Namibia, Nigeria and Tanzania, but has also been fingered in the exposure of corruption problems, which extend to its dealings in Africa (*Bloomberg*, 27 May 2016).

As indicated, Brazil has strong historical connections with Africa, with the large Afro-Brazilian population as a legacy. Brazil remains a popular destination for Angolans studying at schools and universities abroad.

South Africa

South Africa, of course, is both a country in Africa and a member of the BRICS. It is far beyond the scope of this chapter to explore the complex and multi-faceted engagement between South Africa and other countries in Africa, but two key elements of these relationships should be noted.

First is the expansion of South Africa's corporate sector across Africa after the ending of apartheid in 1994. In fact, South Africa is the leading source of both inflows and outflows of FDI in Africa, and about 14% of the income of South Africa's listed companies comes from other African countries (Engineering News, 24 June 2015). South Africa's corporate investment is extensive, but geographically uneven. It has strong presence in Namibia, Botswana, Lesotho, Zambia, Mozambique, Tanzania, Kenya, Nigeria, Ghana, Zimbabwe, Malawi, Uganda, the DRC and Angola; but a weak presence in North Africa, and in countries such as Madagascar, Cameroon and Gabon.

The South Africa investment has been diverse, but mainly in retail, banking, construction, telecommunications, and mining. In retail, Shoprite is the market leader, with around 200 stores in Africa outside of South Africa; but Massmart (Game) and the Edcon group also have a strong presence. Standard Bank has the strongest financial presence in Africa, followed by Nedbank and Investec. In construction, Aveng, Murray & Roberts, and WBHO have expanded aggressively in recent years. South Africa's property developers have been involved in the construction of malls across Southern and West Africa. The telecommunications firm MTN has 41 million subscribers in Africa, in addition to 22 million in South Africa, with a major presence in countries including Nigeria, Uganda, Côte d'Ivoire, Zambia, Rwanda and Guinea. Its South African competitor Vodacom is the market leader in Tanzania, the DRC and Mozambique. South Africa's mining companies have traditionally focused on local production, but do have interests in Ghana (AngloGold Ashanti), Mali, Zimbabwe and the DRC.

A number of previously South African companies have been fully acquired by foreign companies, or have moved headquarters offshore, particularly to London. These include Old Mutual, Anglo American, Dimension Data and SAB-Miller. These companies have managed to expand aggressively into Africa, with SAB-Miller, for example, having a presence in over 30 African countries, (NEDLAC, 2012).

Secondly, since 1994 large numbers of Africans have moved into South African cities. The 2011 national census recorded around 2.2 million foreign-born individuals in South Africa. Of the foreign arrivals, the large majority are from Africa. The origins of African migrants is very uneven, spatially. For arrivals in 2010, for example, the top sending countries were Zimbabwe (39.2% of arrivals), Mozambique (14.2%), Malawi (7.1%), Lesotho (6.3%), Somalia (2.8%), Ethiopia (2.5%), Swaziland (1.6%), Nigeria (1.3%), Congo (1.2%) and DRC (1.2%).

CONCLUSION

With Africa and the BRICS currently hosting half of the world's urban population, and expected to provide around two-thirds of additional urban growth until 2050, there is a strong reason to focus on urban study and analysis in these regions of the world.

There are important comparisons to be made. At an aggregate level, the BRICS is relatively highly urbanised, with many of the world's mega-cities, while Africa is still relatively under-urbanised and has fewer of the world's mega-cities. Into the future, however, this will change, with Africa catching up with the BRICS through rapid urbanisation. However, there is significant diversity in Africa and within the BRICS. India, for example, has more in common with much of Africa in terms of levels and rates of urbanisation than other BRICS countries; while, for example, North Africa and Southern Africa are similar to China in levels of urbanisation and expected declining rates of urban growth. We clearly need a complex matrix of comparison that allows us to explore within and between Africa and the BRICS in a disaggregated way.

Of critical importance for the future are the economic and human relationships that have been forged across cities in Africa and the BRICS. Some of these have been built on long historical connections, but others are new. BRICS economies are benefiting from the resources that Africa is providing, and arguably, Africa is benefiting from investment by the BRICS, although there are controversies around this.

The United Nations' Economic Commission for Africa (ECA) has explored the implications of Africa-BRICS cooperation for Africa. The ECA does acknowledge the dangers:

> The risks are that the Africa-BRICS engagement could lock African countries into specialising in primary commodities, crimping the strong productivity gains needed to sustain high growth and sharpening socio-economic inequalities, sidelining some people from the benefits of participation. (ECA, 2013, pp. 3)

At the same time, however, it advises that "Africa's resource endowments create opportunities to leverage Africa-BRICS cooperation for embarking on an industrial strategy for maximising backward and forward processing linkages with the commodity sectors" (ECA, 2013, p. iii). To achieve this would

> fundamentally require Africa to upgrade its strategies and capacities when dealing with the BRICS, specifically including negotiating favourable trade concessions from the BRICS and understanding their needs better – in order to anticipate trends (p. 3).

The possibility at least exists for a mutually beneficial relationship between cities in Africa and cities in the BRICS.

KEY REFERENCES

Davidson, B. (1995) *African in History*, Penguin, Simon & Schuster

Freund, B. (2007) *The African City: A History*, Cambridge University Press: Cambridge

International Trade Forum (2010) What are Chinese and Indian firms doing in Africa? www.tradeforum.org/What-are-Chinese-and-Indian-Firms-doing-in-Africa/

Mamdani, M. (1996) *Citizen and Subject: Contemporary Africa and the Legacy of Late Colonialism*, Princeton University Press

Mazrui, A. (2002) 2002: *Africa and other Civilisations: Conquest and Counter-Conquest, The Collected Essays of Ali A. Mazrui*, Vol. 2, Africa World Press: Trenton, NJ and Asmara, Eritrea.

Mohan, G., Lampert, B., Tan-Mullins, M. and D. Chang (2014) *Chinese migrants and Africa's development: New imperialists or agents of change?* Zed Books: London

Murray, M. and G. Myers (2006) *Cities in Contemporary Africa*, Palgrave MacMillan

Myers, G. (2011) *African City: Alternative visions of urban theory and practice*, Zed Books: London

NEDLAC (2012) The role of South African business in Africa: South African outward investment, www.new.nedlac.org.za/wp-content/uploads/2014/10/RegionalInvestmentDevelopment20Nov2012.pdf

Oxford Economics (2016) Database on Forecast and Models, www.oxfordeconomics.com/

Parnell, S. and E. Pieterse (2014) *Africa's Urban Revolution*, Zed Books: London

PwC (2009) Global cities by GDP, www.pwc.blogs.com/files/global-city-gdp-rankings-2008-2025.pdf

Schonberg Centre for Research on Black Culture (2016) The African Diaspora in the Indian Ocean World, www.exhibitions.nypl.org/africansindianocean/essay-south-asia.php

Simone, S. (2004) *For the City Yet to Come: Changing African Life in Four Cities*, Duke University Press

UNCTAD (2013) The Rise of BRICS FDI and Africa, Global Investment Trends Monitor, Special Edition, 25 March, www.unctad.org/en/PublicationsLibrary/webdiaeia2013d6_en.pdf

UNCTAD (2015) World Investment Report. Online at www.unctad.org/en/PublicationsLibrary/wir2015_en.pdf

UN Population Division (2016) World Population Prospects: 2015 Revision www.un.org/en/development/desa/population/

ANNEXURE

DATA SHEET ONE

Top 20 cities in Africa in terms of population between 1950 and 2030 (predicted)

City	1950 pop.	1950 rank	1980 pop.	1980 rank	2015 pop.	2015 rank	2030 pop.	2030 rank
Cairo	2.5	1	7.4	1	18.8	1	24.5	1
Lagos	0.3	11	2.6	3	13.3	2	24.2	2
Kinshasa	0.2	16	2.1	6	11.6	3	20.0	3
JOHANNESBURG-EKURHULENI	1.7	2	3.2	2	9.4	4	11.6	4
Luanda	0.1	(28)	0.8	(22)	5.5	5	10.4	6
Al-Khartum (Khartoum)	0.2	19	1.2	14	5.1	6	8.2	7
Dar es Salaam	<0.1	(58)	0.9	20	5.1	7	10.8	5
Abidjan	<0.1	(70)	1.4	9	4.9	8	7.8	8
Al-Iskandariyah (Alexandria)	1.0	3	2.5	4	4.8	9	6.3	10
Nairobi	0.1	(29)	0.9	19	3.9	10	7.1	9
CAPE TOWN	0.6	5	1.6	8	3.7	11	4.3	(24)
Kano	0.1	(33)	1.3	10	3.6	12	6.2	11
Dakar	0.2	14	1.0	16	3.5	13	6.0	12
Dar-el-Beida (Casablanca)	0.6	4	2.1	5	3.5	14	4.4	(23)
Addis Ababa	0.4	10	1.2	13	3.2	15	5.9	14
Ibadan	0.5	9	1.2	12	3.2	16	5.5	15
Yaoundé	<0.1	(109)	0.4	(45)	3.2	17	5.2	17
DURBAN	0.5	7	1.2	11	2.9	18	3.3	(31)
Ouagadougou	<0.1	(107)	0.3	(77)	2.7	19	5.9	13
Antananarivo	0.2	20	0.6	(28)	2.6	20	5.1	18
El Djazaïr (Algiers)	0.5	6	1.6	7	2.6	(23)	3.4	(30)
Tunis	0.5	8	1.1	15	2.0	(33)	3.4	(40)
PRETORIA	0.3	12	0.7	(23)	2.1	(30)	2.7	(35)
Wahran (in Algeria)	0.3	13	0.5	(32)	0.9	(65)	1.1	(92)
Marrakech	0.2	15	0.4	(44)	1.1	(49)	1.6	(59)
PORT ELIZABETH	0.2	17	0.6	(27)	1.2	(44)	1.4	(73)
Bur Sa'id (Port Said)	0.2	18	0.3	(64)	0.7	(98)	0.9	(108)
Accra	0.2	(21)	0.9	17	2.3	(27)	3.3	(32)
Bamako	0.1	(56)	0.5	(36)	2.5	(24)	5.2	16
Abuja	<0.1	(134)	0.1	(126)	2.4	(25)	4.9	19
Douala	0.1	(47)	0.6	(29)	2.4	(22)	4.8	20

Source: Data from UN Population Division

PART B

Compendium of City Fact Sheets

BRAZIL

BASIC FACTS

» Level of urbanisation (2015) – 85.7%
» Total urban population (2015) – 174.5 million
» Annual rate of urban growth (2010-2015) – 1.17%

MAJOR URBAN CLUSTERS/CITY-REGIONS (2015 POPULATION)

» Complexo Metropolitano Estendido de São Paulo ou Macrometrópole Paulista (Extended Metropolitan Region of São Paulo or Paulista Macro Metropolis) – 32.2 million

MAJOR URBAN AGGLOMERATIONS ("REGIÕES METROPOLITANAS") WITH 2015 POPULATION (FACTSHEETS INDICATED WITH *)

» São Paulo – 21.07 million*
» Rio de Janeiro – 12.9 million*
» Belo Horizonte – 5.7 million
» Brasília – 4.16 million*
» Fortaleza – 3.88 million
» Recife – 3.74 million
» Pôrto Alegre – 3.6 million
» Salvador – 3.58 million*
» Curitiba – 3.47 million*
» Campinas – 3.05 million
» Goiânia – 2.28 million
» Belem – 2.18 million
» Manaus – 2.03 million

BRIEF HISTORY OF URBAN DEVELOPMENT

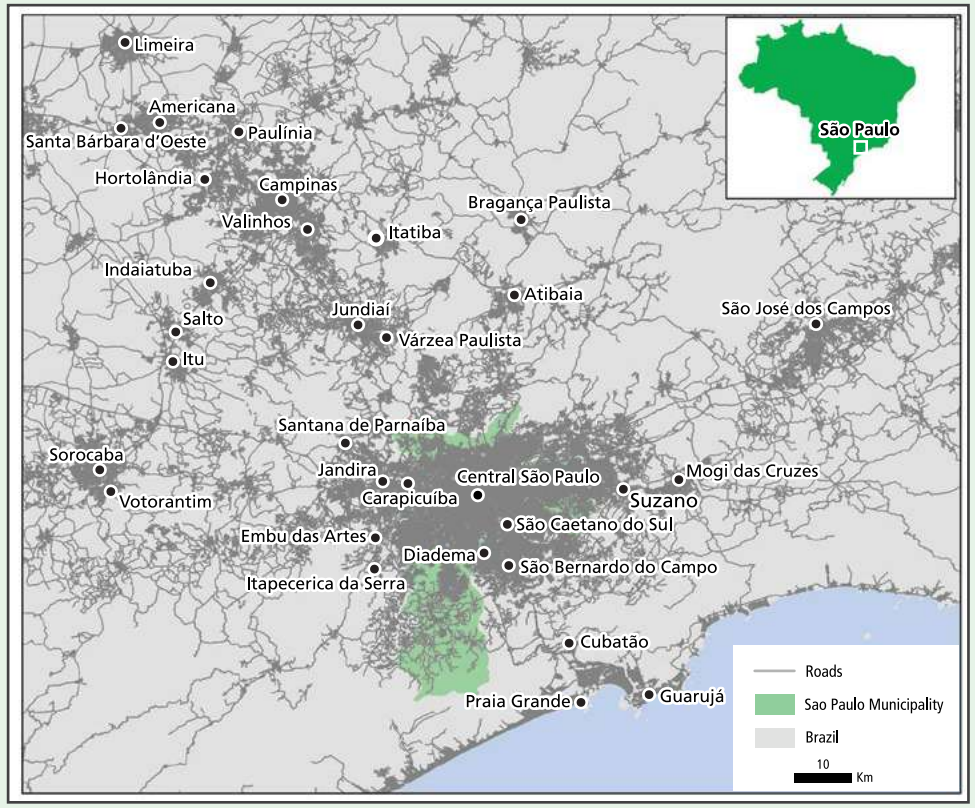
Brazil's cities were initially established as colonial settlements, to administer and service a mainly agricultural economy. In 1950, the country was still only 36% urbanised. However, Brazil's policy of import-substituting industrialisation drew millions of people off rural land, with extremely rapid levels of urbanisation from the 1950s until the 1980s. By 1990, the country was already 74% urbanised, and had two of Latin America's mega-cities: São Paulo and Rio de Janeiro. However, Brazil's urbanisation was poorly managed, with the military governments of the mid-1960s to the mid-1980s paying little attention to the welfare of the urbanising masses. Large numbers of people could only access precarious land in vulnerable places, such as steep hillsides and swamplands; consequently, large informal settlements, commonly known as *favelas*, emerged in many cities. However, there were also ambitious schemes to develop new, modern urban areas in the hinterland of the country, including the creation of the new Federal Capital, Brasilia. With the restoration of democracy there have been systematic and innovative efforts to improve the quality of life in cities, and reduce the extreme spatial inequalities.

URBAN GOVERNANCE

In terms of the 1988 National Constitution, Brazil is a federation of states, one Federal District (Brasília), and municipalities. The Constitution protects the independence of municipalities, giving them legislative and executive powers and providing for directly elected mayors. The municipalities have primary powers for urban planning, land regulation, primary education, and basic services such as health and solid waste. However, some powers are held concurrently with state governments, including urban transportation and water and sewage. While municipalities receive their funding through property taxes, services charges and transfers from federal and state government, states are able to raise funding through their control of Value-Added Taxation. The National Constitution also makes provision for the creation of metropolitan regions, which have structures of cooperation between the municipalities. At present there are 66 metropolitan regions across Brazil.

THE EXTENDED METROPOLITAN REGION OF SÃO PAULO

(Complexo Metropolitano Estendido de São Paulo)

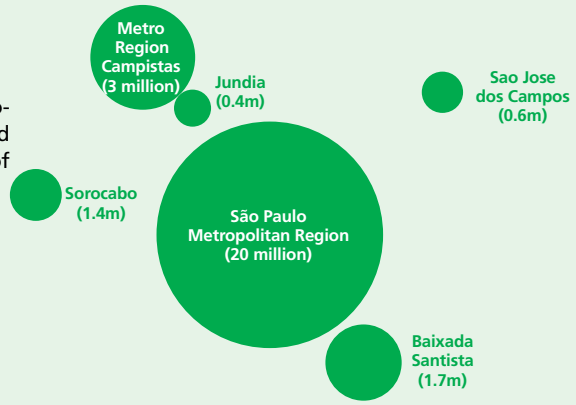


DESCRIPTION

This city-region is dominated by the metropolitan region of São Paulo at its core, but also includes two other metropolitan regions, one 'unitary region' and three 'micro-regions'. There are 172 municipalities within this region, which extends over a 200-kilometre radius of the City of São Paulo, and contributes four-fifths of the GDP of the State of São Paulo and one-third of the GDP of Brazil.

POPULATION

The population of the Extended Metropolitan Region of São Paulo is around 32.2 million (or 75% of the population of the State of São Paulo)

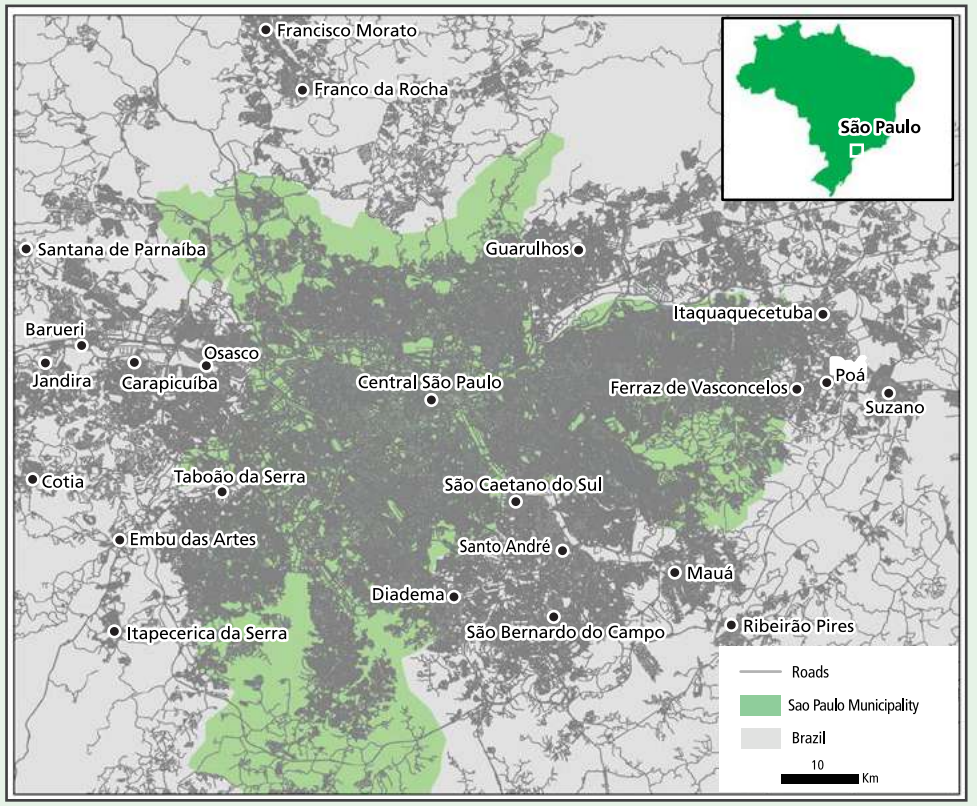


STRUCTURE

(See figure on the left).

SÃO PAULO METROPOLITAN REGION

Região Metropolitana de São Paulo (RMSP)



CONTEXT

LOCATION AND STATUS

The São Paulo metropolitan region, including the City of São Paulo, is located in São Paulo State in south-eastern Brazil. The City of São Paulo is the state capital. The metropolitan region is the largest and most complex urban region in Brazil – and, in fact, in all of Latin America.

HISTORY

São Paulo was established by Jesuit missionaries in the mid-sixteenth century. With its excellent location near both the coast and the fertile land in the west, São Paulo rapidly developed as a base for the Portuguese bandeirantes (explorers, prospectors, and slave-masters) who were exploring and exploiting the southern interior of Brazil. In the 17th century, São Paulo became one of the gateways to the gold discovered in the nearby region of Minas Gerais. The associated trade and wealth-generation led to investments in sugar plantations and further economic activity. In 1711, São Paulo was officially declared a city; and in the 19th century, a massive boom in coffee production led to growing prosperity, and to the arrival of waves of immigrants. They came first from

southern Europe, then from East Asia, and finally from all other parts of Brazil. This established São Paulo as Brazil's most multicultural city.

The coffee industry collapsed in the 1920s; but by then, São Paulo was well established as an urban agglomeration, with extensive infrastructure connecting the city to the interior. The city industrialised rapidly from the 1930s on, supported by a federal policy of import-substituting industrialisation. In the 1950s, for example, São Paulo was established as a centre for the automobile industry.

In the period 1950 to 2000, São Paulo went through a massive demographic transformation; its population expanded five-fold, as migrants poured in from all parts of Brazil and internationally. São Paulo developed into one of the world's great mega-cities. In the 1970s, its economy diversified, as services sectors began expanding. Industrial production contracted in the 1980s, and the city suffered a severe economic recession. In the 1990s began a process of economic restructuring, as industry dispersed from the core to a region within a radius of 150km. The prosperity of the core was re-established, with rapid growth of high-order services, including finances. The previous rapid population growth slowed down considerably. As the core prospered, so rising land prices and a high cost of living led to the displacement of the poorer segments of the population to the metropolitan edge.

POPULATION

POPULATION SIZE

The UN Population Division estimates a 2015 population for the São Paulo metropolitan region of around 21.07 million, which forms the largest component of the extended metropolitan region, which has a total population of around 32.2 million.

POPULATION RANKING

The UN Population Divisions ranks the São Paulo metropolitan region fourth globally after Tokyo, Delhi and Shanghai; third in the BRICS; and first in both Brazil and Latin America as a whole.

POPULATION GROWTH

Population growth rates are continuing to decline. They peaked at around 6.5% per annum in the 1960s; but the UN Population Division estimates current annual growth to be only around 1.38%.

POPULATION DIVERSITY

The ethnic breakdown of the City of São Paulo, according to the 2010 Census, was 65.6% white, 26.5% mixed race, 5.5% black, 2.2% Asian, and 0.2% Amerindian, making the city significantly more white than Brazil as a whole. Most residents of São Paulo are descendants of immigrants from Europe, with the largest number from Italy, followed by Portugal, Spain, Germany, France and Greece. Although this was a city created through transnational migration, the percentage of foreign-born residents has been dropping steadily, and is now only around 1.3% (although this may not take adequate account of the growing numbers of migrant workers from Bolivia, Paraguay, Haiti and some countries in Africa).

STRUCTURE OF THE METROPOLITAN REGION

Around one-half of the population of the RMSP is within the City of São Paulo, with the remaining half contained in 38 other urban municipalities. The largest cities in the urban agglomeration are:

- City of São Paulo (11.25 million)
- Guarulhos (1.22 million)
- São Bernardo do Campo (0.77 million)
- Osasco (0.7 million)
- Santo André (0.68 million)
- Diadema (0.42 million)
- Mauá (0.4 million)
- Carapicuíba (0.4 million)
- Itaquaquecetuba (0.35 million)
- Suzano (0.29 million)
- Embu das Artes (0.26 million)

The core city of São Paulo is the financial and business heart of the region. Densely populated Osasco, immediately to the west of São Paulo, has also transitioned from an industrial to a high-order tertiary economy. Guarulhos, to the east of the core – the second-largest city in the agglomeration – is an industrial node, but also the location of Brazil's largest major international airport. São Bernardo do Campo to the south is the historical centre of the automobile industry in Brazil, but is now a focus of hi-tech industry. The adjacent city of Mauá has a large petrochemical complex, including the refineries of state-owned Petrobas. A number of the smaller cities specialise in particular industries, for example Diadema (in healthcare) and Embu das Artes (in the arts).

Spatial policy recognises four concentric rings of development in the metropolitan region, each with their own challenges:

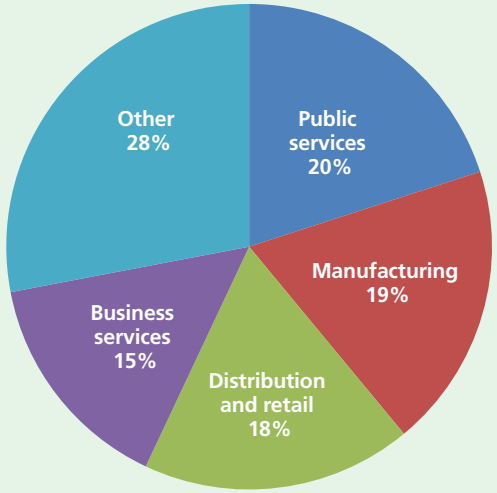
- The Central Areas, which are well provided for in terms of services and infrastructure. In the 1990s there was a 'hollowing out' of these areas, as middle-class households moved into gated estates on the city's edge; but there was a reversal in the 2000s, with a return to central areas. These areas have densified, with high-rise development.
- The Intermediate Areas, which are high-rise and high-density, with intense residential occupation – but they are also nodes of mixed-use activity, and still require significant investment in infrastructure, jobs and services. There are also underutilised industrial areas which are now being targeted for densification and mixed-use development.
- The Peripheral Areas, which are mainly occupied by a low-income population living in irregular settlements (*favelas*), subject to serious environmental risk. However, there are also important tertiary and business centres in nodes on the edge (e.g. in Osasco, Santo André, and São Bernando do Campo), as well as fortified enclaves of high-income development.
- The Conservation Areas, which are still not formally urbanised and are critical for water production in the city, but which are under pressure from irregular urban development.

ECONOMY

IN 2014, the metropolitan region had a GDP of USD 430 billion (Brookings). This made São Paulo the fourth-largest urban economy in the BRICS (after Shanghai, Moscow and Beijing). São Paulo contributed around 16% of Brazil's GDP. Although this is a significant contribution, in relative terms it has declined steadily, due to the decentralisation of economic activity away from this historical economic core, and growth in the more peripheral regions of the country. In 1970, the São Paulo metropolitan region contributed a massive 43% of the national GDP.

As indicated below, the structure of the economy of the metropolitan region is very diverse.

SECTOR CONTRIBUTION TO GDP



Manufacturing was the driver of the metropolitan economy through most of the 20th century. Since the 1970s, the relative share of the city-region's economy claimed by manufacturing has declined. In 1985, manufacturing still contributed 46% of the metropolitan GDP, more than twice its current relative contribution. Nevertheless, the region still hosts around 60 000 manufacturing firms, accounting for about half of Brazil's industrial output. Overall, the São Paulo metro region has managed to sustain the competitiveness of its manufacturing industry – despite extreme competition from China, and from low-wage locations in north-eastern Brazil – both by entering niche markets and by securing low-wage migrant labour from Bolivia and Paraguay. Within the metropolitan region, manufacturing has shifted to the more peripheral locations.

Within the metropolitan region, and especially within the spatial core, the fastest growth has been in business services (including finances and information). The City of São Paulo has become increasingly knowledge-intensive and service-oriented. It is a city of malls, entertainment centres, business tourism (hosting hundreds of domestic and international events annually), expert consultancies, creative industries, and the business headquarters of national and multinational firms. The city includes the São Paulo stock exchange (BOVESPA), which is by far the largest stock exchange in Latin America.

With its success in the tertiary economy, and also the overall success of Brazil's economy in the 2000s, São Paulo has done well economically. However, in the second half of 2014 the economy of Brazil slid into recession, and was still in decline in 2016. These economic difficulties, combined with political turbulence, present a deep challenge for São Paulo; and especially for the smaller cities in the metropolitan region, which are highly dependent on troubled industries.

GOVERNANCE

The RMSP falls within the governance arrangements indicated on the cover sheet for Brazil. The entire metropolitan region is under the jurisdiction of the State of São Paulo, which is the most wealthy and populous state within the Federative Republic of Brazil. At local level, there are 39 municipalities across the RMSP, although one-half of the population falls within the jurisdiction of the Municipality of São Paulo.

Administrative fragmentation, both horizontally and vertically, has led to serious challenges of coordination, and to inter-governmental rivalry and tensions. The RMSP was in fact established in 1973, long preceding the 1994 legislation for designating metropolitan regions. The cooperative structures of the RMSP assist in managing this massive urban region, but can hardly resolve all the challenges of coordination. In addition, a more bottom-up approach has emerged, with seven municipalities in the south-east of the metropolitan region coming together to form the ABC Region, with collaborative structures including the municipalities but also business and civil society.

DEVELOPMENT CHALLENGES

São Paulo is a global metropolitan region of extreme inequality, with an affluent, internationally-oriented elite. The UN Habitat places the Gini coefficient of São Paulo at 0.56, marginally lower than the national 0.59. This is extremely high in global terms, and exceeded in the BRICS only by cities in South Africa. There are spatial divisions in terms of poverty, with higher incomes in the core of the city-region and greater poverty along the spatial periphery.

In recent decades, the City of São Paulo has made good progress with the reduction of poverty and improvements in the standard of living. This was partly because of progress in Brazil generally, but also because lower-income people were gradually being displaced from the urban core. The Human Development Index (HDI) for the Municipality of São Paulo improved significantly, from 0.626 in 1991 to 0.805 in 2010. However, the recent economic recession is threatening to reverse some of these gains. In 2016, the unemployment rate for the metropolitan region was 8.3%, gradually trending upwards, with the worst levels of unemployment on the metropolitan edge.

São Paulo is known for its large informal settlements, or *favelas*, mainly on marginal, risky land. There was indeed massive expansion in *favelas* until the 1990s, at which time around 20% of the population lived in these areas. However, there has been a steady decline, with the proportion decreasing to 14% in 2007. The 2010 national census indicated that 9.94% of the households in the municipality of São Paulo lived in 'sub-normal accommodation', although the proportion is higher in some of the outlying municipalities. The figures for Guarulhos and São Bernardo do Campo were 16% and 18% respectively.

With a relatively stable population the São Paulo metropolitan region has been able to improve its levels of infrastructure and servicing, even within the *favelas*. Household access to potable water, sanitation and electricity is significantly higher than 90%. But there are still significant challenges facing residents of irregular settlements, including serious environmental risk on marginal land that includes steep hillslopes.

While many Brazilian cities are among the most violent in the world, São Paulo has bucked the trend. Murder rates in the city have declined by nearly two-thirds, and in 2015 were only 11.5 per 100 000. This was significantly lower than even the national rate of 25.2.

However, other problems have emerged. São Paulo faced a major water crisis in 2014 – which was partly to do with a nationwide drought, but also to do with water-management problems linked to irregular land development and deforestation on the urban edge, causing the destruction of wetlands as well as sewage pollution. The water crisis also caused power shortages in the city, as most electricity in Brazil is hydro-produced. Dengue fever has long been a concern in São Paulo State, but the Zika virus has emerged as an additional threat; although it is less prevalent there than along the more humid coastline.

THEMATIC REPORTS

TRANSPORT

ECONOMIC INFRASTRUCTURE

The State of São Paulo is an important gateway into the southern interior of Latin America. The Port of Santos in the expanded metropolitan region, for example, is the 38th-largest container

port in the world, 14th-largestin the BRICS, and the largest in Latin America. It handles 31% of port exports and 33.8% of port imports in Brazil.

There are three major airports within the metropolitan region and adjacent: Guarulhos (39 million passengers annually), Congonhas-São Paulo (17 million), and Viracopos International Airport in Campinas (9 million), ranking first, third and seventh respectively in Brazil. In terms of trade, Guarulhos and Viracopos compete for top position nationally. Guarulhos International Airport is ranked 41st in the world, ninth in the BRICS and first in Latin America in terms of passenger traffic, carrying around 39 million passengers annually. In terms of air cargo, the Viracopos and Guarulhos airports in the region handle 70% of the exported volume and 59% of the imported volume by air in Brazil. However, there are infrastructure and operational bottlenecks at both the Port of Santos and the airports in the region, which constrain further growth.

Despite an extensive rail network across the country, most transport (both passenger and freight) is undertaken by road, resulting in congestion and deterioration of road surfaces. The road infrastructure is good around the major cities, but deteriorates into the interior.

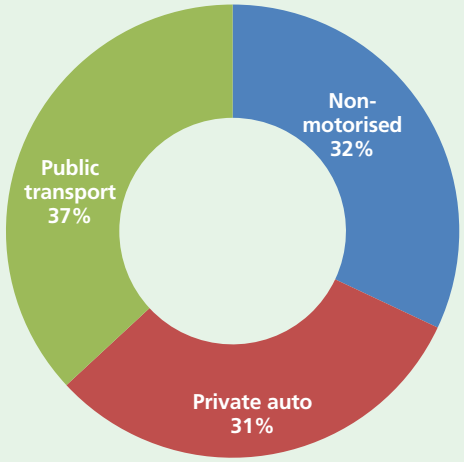
In 2015, as a stimulus to revive growth in Brazil, the government announced a USD 66 billion infrastructure investment programme. The flagship for this programme is the Bi-Oceanic Railway to connect the Atlantic and Pacific coasts of South America, which would join the Port of Santos with the port of Ilo in Peru. This would create a major new development corridor for Brazil, strengthening the role of the São Paulo region.

PUBLIC TRANSPORT

Street protests in São Paulo and other Brazilian cities in 2013 and 2016 following increases in public transport fares have dramatically directed attention to the challenge of delivering quality and affordable public transportation. The sheer numbers of people that must be moved about the metropolitan area, and the large number of private motor cars, all put pressure on São Paulo's extensive public transport system.

The 2012 Mobility Survey for the São Paulo Metropolitan Region indicated the following modal split.

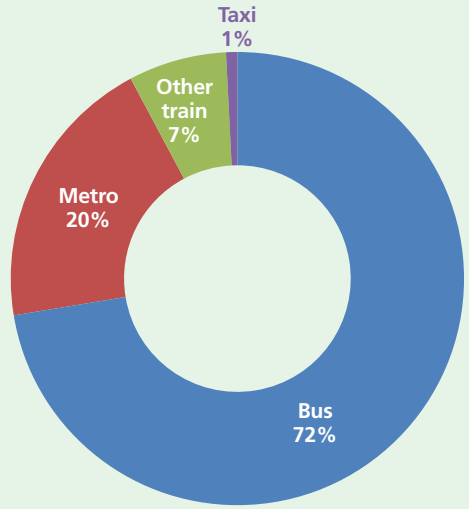
MODAL SPLIT, ALL TRIPS



Source: Metro SP, 2012

As indicated above, there is a relatively even split between walking, the private motor car, and public transport. Given the huge size of the metropolitan population, the 31% of trips by private automobile creates massive congestion. The figure below for public transport only indicates the dominance of bus services in public transport, although the metro system does account for one-fifth of all trips, with other forms of rail responsible for an additional 7%.

SPLIT OF PUBLIC TRANSPORT, ALL TRIPS



Source: Metro SP, 2012

BUS

The backbone of the public transport system is a fleet of around 16 000 buses, carrying an estimated 11.6 million people daily. The buses are operated by concessionaires under the oversight of São Paulo Transporte SA (SP Trans), a municipal company. São Paulo has introduced dedicated bus lanes, Corredores de ônibus, but these are not as segregated from other traffic as the Trans-Milenio in Bogotá, for example, with lower speeds than expected from a Bus Rapid Transport (BRT) system. They are also still very limited in scale, with only 154km of dedicated bus lanes, in comparison to a total of 4 400km of regular bus lanes.

RAIL

There is a light rail and underground rail system, carrying around 5 million people per day. It is run by various operators, including Companhia Paulista de Trens Metropolitanos (CPTM) and São Paulo Metro, but is supported by an integrated ticketing system operated by Bilhete Único (Unified Ticket) which links the metro, bus and rail system within the core municipality. The metro is regarded as one of the world's safest and most efficient rapid-transit rail systems, and is NBR ISO 9001 certified. However, in international comparative terms the system is rather limited. It has only six lines and less than 80km of track; compared, for example, with 400km of track in New York, which is a city of similar scale to São Paulo.

OTHER

A large number of informal transport vans have been registered by the municipality, and now operate under the supervision and branding of the municipality's SP Trans.

CONTINUED CHALLENGES

While the core city of São Paulo has a relatively efficient transport system with integrated ticketing and operations, integration at the metropolitan scale is still weak. The transport system in São Paulo municipality is not adequately linked to the services in the other municipalities, and there is also very little integration across the other municipalities. The ABC Region, however, is currently working towards greater integration. One of the specific problems with the system is that the metro system does not extend beyond the boundaries of the core municipality.

FUTURE PLANS

The alignment between federal and municipal government policy in support of public transport has been uneven. A decision by federal government in 2008 to zero taxes on car production led to increased use of private vehicles. However, Urban Mobility legislation in 2012 mandated all municipalities to develop a Mobility Plan by 2015 in order to access federal government funds, thereby incentivising innovation in sustainable urban transport.

The São Paulo metropolitan region has a plan known as PITU 2025, which aims to fundamentally shift the balance between public and private transport. The aim is to significantly expand all elements of the existing network, including: expanding the BRT; increasing the existing 49km metro network to over 170km; expanding the 30km-long suburban rail lines to 100km; and building 95km of new light-rail track on the metropolitan periphery. There is also a plan to build a ring road at a radius of roughly 40km around São Paulo, which is intended to keep heavy freight traffic out of the more central parts of the city, and make movement in the periphery easier. A special monorail is planned to connect the airports to the urban centre. Although the historical model has been state funding of transport investments, there are now efforts to develop new financing models, bringing in private funding.

In addition, there are numerous other initiatives to reduce congestion and improve efficiency, including: the rodizio (number plate restriction), aimed at reducing access to the inner city for private cars by 20% during peak hours; increased supply of dedicated cycle lanes; 15 new inter-modal transport terminals; and an ambitious and innovative programme to replace an elevated freeway with a linear public park. Significantly, they will largely be funded by an increased fuel tax. These initiatives have contributed to São Paulo's 'above average' transportation ranking for Latin American cities awarded by the Economist Intelligence Unit in 2013.

LAND VALUE CAPTURE

The City of São Paulo has developed an innovative financing instrument for new infrastructure and housing. Once a new redevelopment zone is designated, the municipal government issues bonds, which are sold to developers at an auction managed through the Bank of Brazil. These bonds, known as Certificado de Potencial Adicional de Construção (CEPACS), allow developers to build at extra density. They are widely traded as a form of investment, and raise significant capital for new investment in public infrastructure.

GREEN ENERGY

NATIONAL CONTEXT

Around 77% of Brazil's installed capacity for electricity production comes from hydroelectric generation, with a further 5% from renewables (biomass and wind). This means that Brazil has a far greener energy profile than the BRICS countries that are dependent on coal. However, it also means that Brazil's electricity production is vulnerable to water shortage; and during the national drought of 2014, there were severe power shortages.

Production of electricity is still dominated by large government-owned companies, but production by private companies (currently at 27%) is expanding rapidly, and is expected to reach over 50%. There is a national grid which connects large regional transmission grids. Brazil is actively expanding renewables, with most new projects in biomass, hydro and landfill-to-energy.

Brazil also ranks highly in terms of green fuels: it is the world's second-largest producer of ethanol after the United States, and the world's largest producer of biodiesel. These fuels are produced mainly from sugar cane. Since the 1970s there have been legal requirements to blend gasoline with ethanol, and there are now vehicles using pure ethanol fuel.

SÃO PAULO

São Paulo ranks very highly in terms of green energy, because of both hydro-generated electricity and green fuels. With per capita emissions of 1.47 tons of CO_2, the City of São Paulo is said to have the lowest GHG-emission footprint of the 50 richest cities in the world. It is also the highest-ranking of the 17 cities in the Latin America Green Cities Index in terms of Energy and GHG emissions. The economy of São Paulo is relatively energy-efficient, with the metropolitan region consuming 553 megajoules (MJ) of electricity per USD 1000 of GDP, compared with the average for the 17 ranked Latin American Cities of 761MJ.

However, there are considerable challenges with the electricity sector in São Paulo, mainly to do with unreliable supply during increasingly frequent years of drought, and continuing expansion of demand. It is a challenge to maintain the green profile of electricity production with reduced supplies of hydro, but there have been serious attempts to fill the gap through the use of renewables. Siemens, for example, is producing electricity for São Paulo using sugar cane and alcohol to drive a steam turbine.

In 2009 the State of São Paulo passed the Climate Change Law, setting a target of a 20% reduction in CO_2-equivalent emissions by 2020, with the Municipality of São Paulo setting a more ambitious target of a 30% reduction. The municipality has pioneered the use of the Clean Development Mechanism (CDM) provided for in terms of Article 12 of the Kyoto Protocol, which included the first public auction of Certified Emission Reductions (CERs) in the world, and significant CER-earning projects, such as the (now discontinued) Bandeirantes Landfill Gas to Energy Project (BLFGE). São Paulo is regarded as a world leader in the reduction of carbon emissions, and the Economist Intelligence Unit cites its initiatives as "exemplar projects".

The city of São Paulo also leads in terms of the reduction of energy use in buildings. With water heating accounting for around 40% of energy use, the city passed an ordinance in 2007 – known as the Solar Law – that mandates solar water-heating systems. The municipality is also continuing to support the introduction of green fuels; for example, aiming at converting 100% of the extensive bus fleet to green fuels (including use of electricity) by 2017.

INNOVATION-DRIVEN ECONOMY

The São Paulo metropolitan region has the largest single cluster of economic enterprise in Brazil, despite its relative decline. While there has been a gradual loss in position in mainstream industry, São Paulo has reinforced its dominance in high-technology and advanced-services industries in Brazil – sectors where innovation is of critical importance. In 2010, nearly half of all employment nationally in information technology was in the adjoining metropolitan regions of São Paulo and Campinas.

These metropolitan regions also benefit from the presence of major research institutions. In terms of QS University rankings for 2016 there are four of the top 50 BRICS universities in this region: Universidade de São Paulo (10th in BRICS); Universidade Estadual de Campinas (Unicamp) (12th); Universidade Estadual Paulista (Unesp) (36th); and Universidade Federal de São Paulo (45th). The Universidade de São Paulo has its own Innovation Agency, which works with state and private partners.

There are key sectors where the metropolitan region is a leader in science and technology, including agri-industry; deep-sea oil production and energy; space, remote sensing and aircraft manufacture. Brazil's National Institute for Space Research (INPE) is located in São José dos Campos, within the São Paulo extended metropolitan region. INPE is a key partner in the China-Brazil Earth Resources Satellite program (CBERS), which operates Earth observation satellites and is making important progress in the fields of space and atmospheric sciences, space engineering, and space technology. The headquarters of Embraer, one of the world's top aircraft companies after Boeing and Airbus, is located in São José dos Campos – outside the metropolitan region, but within the expanded metropolitan region. Embraer has been leading internationally in the development of aviation biofuels and composites for aircraft design.

Within the metropolitan region there are also key research laboratories for motor-vehicle engineering (seven world-leading motor vehicle companies have production plants in the region); pharmaceuticals; software engineering; biotechnology and genetics; and renewable energy production. Given the concentration of Brazil's major banks in São Paulo, it is also a centre of innovation in the financial sector.

The State and municipalities pursue various strategies to support innovation. The State government has initiated the São Paulo Research Foundation (Fapesp), which supports R&D investments in the private sector, and promotes exchange and dissemination of the science and technology produced in the state. One of the key projects managed by the State administration is the São Paulo Technological Park System (SPTec), which is creating an integrated network of technology parks. The municipality of São Paulo, for example, pursues joint research and collaborative actions (with key partners in the academic and private sector) in the development of business incubators, technology parks, technology transfer, specific training, and providing technical and management support.

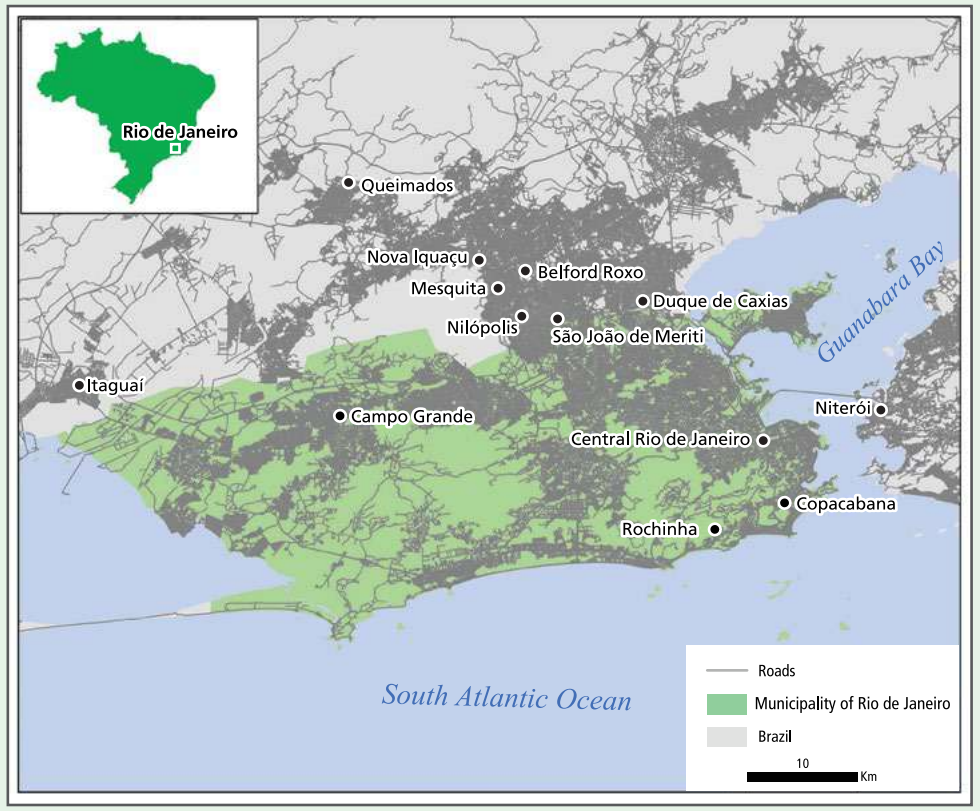
Within the City of São Paulo there is a node of innovation around the campus of Universidade de São Paulo; for example, there is a strong health and biomedical community supporting innovation in biotechnology and medical equipment. Another innovation hotspot in the wider region is São José dos Campos, around the Embraer headquarters but also around the Instituto Tecnológico de Aeronáutica – a leader in education and research in aeronautical engineering. Then there is Campinas, with its technology hub around the university leading in areas such as biotechnology, fibre optics, bio-fuels and telecommunications. The municipality offers a 60% service tax reduction for firms in this cluster.

While there are significant strengths in the region, there are also challenges, including low rates of patent applications, and the generally short-term nature of collaborations between academic researchers, industry and government.

In 2015, São Paulo ranked 102nd globally in the 2thinknow Global Innovation Cities Index. Although this is modest in international terms, it does place São Paulo eighth in the BRICS and first in Latin America, narrowly edging out Rio de Janeiro, Mexico City and Buenos Aires.

GREATER RIO DE JANEIRO

Grande Rio



CONTEXT

LOCATION AND STATUS

Rio de Janeiro (commonly referred to as Rio) is located on the southern coast of Brazil. It is the second-largest city in Brazil and the capital of the State of Rio de Janeiro.

The City of Rio de Janeiro is the core of the officially designated Região Metropolitana do Rio de Janeiro (Metropolitan Region of Rio de Janeiro), a territory also referred to as Grande Rio (Greater Rio de Janeiro).

HISTORY

Rio de Janeiro was founded as a Portuguese settlement in 1565. Like São Paulo, it benefited from the discovery of gold and diamonds inland, in the State of Minas Gerais; and from the development of the slave-based sugar and coffee plantations. Rio became the major port for the export of these goods, eclipsing the Port of Salvador in the north of the country. The mining activities

attracted many European settlers, and Rio had a population of 24 000 by 1749. In 1763, Rio became the capital of Portugal's Brazilian Empire. By the end of the 18th century, however, mining activities had slumped; and with them, the export economy of Rio.

In 1808 the Portuguese royal family relocated to Rio de Janeiro, making it the capital of the United Kingdom of Portugal, Brazil and Algarve. The arrival of the royal family (and large numbers of other aristocracy), as well as a boom in coffee production, changed the fortunes of the city. Once more, wealth flowed into Rio, and many grand buildings were erected. In 1822, Rio became the capital of independent Brazil; and when Brazil became a republic in 1889, Rio was the Federal Capital of Brazil.

From 1888, when slavery was abolished, large numbers of freed slaves moved off the coffee plantations into Rio, many living in precarious settlements that later developed into *favelas* (informal settlements). There were various attempts from the early twentieth century to modernise the city: streets were widened, swamps were drained, and modern infrastructure was introduced. During this process, however, the urban poor were marginalised, and forced into increasingly peripheral settlements.

Rio industrialised from the 1940s and experienced a rapid influx of rural migrants, with the city population increasing to an estimated 3.3 million by 1960. A large proportion of the new migrants moved into *favelas*. From the 1970s, however, the rate of population growth gradually decreased.

In 1960 the capital of Brazil was relocated to Brasilia, and the City of Rio de Janeiro briefly became a state in itself, known as Guanabara. This federative status was removed in 1975, and Guanabara was merged with the larger State of Rio de Janeiro. The relocation of the capital slowed the rate of growth in the city; and in the 1980s and 90s, Rio's economy performed poorly. In addition, the period of military dictatorship in Brazil from 1964 until the mid-1980s stifled cultural and economic development; but with democratisation came greater economic stability, and cultural and global openness, with Rio emerging as a cultural hub in Brazil, and a leading international tourist destination.

POPULATION

POPULATION SIZE

The estimated population of the metropolitan region in 2015 was 12.9 million. This represents 6.2% of Brazil's total population.

POPULATION RANKING

The metropolitan region of Rio de Janeiro is ranked 19th in the world; eighth in the BRICS; and second in Brazil.

POPULATION GROWTH

The population growth rate peaked at over 4% per annum in the 1960s, but is now only around 0.84% per annum.

POPULATION DIVERSITY

Rio de Janeiro is highly diverse demographically: 51% identified as white in the 2010 census, 36.5% as mixed race, and 11.5% as black. A recent genomic study revealed, for example, that 55% of the population was of predominantly European ancestry, compared with 31% African and 14% Amerindian. Despite the historical importance of immigration to the development of Rio, only 1.1% of the current population in the Municipality of Rio de Janeiro is foreign-born.

STRUCTURE OF THE METROPOLITAN REGION

Grande Rio includes the municipality of Rio de Janeiro and 15 others. As indicated below, the Municipality of Rio de Janeiro dominates, with 6.4 million people, or just over half of the population of the metropolitan region. There is one other city with a population of over one million, and five cities between 400 000 and one million. The major municipalities are

- Rio de Janeiro (6.4 million)
- São Gonçalo (1.0 million)
- Duque de Caxias (0.9 million)
- Nova Iguaçu (0.8 million)
- Niterói (0.5 million)
- Belford Roxo (0.5 million)
- São João de Meriti (0.5 million)

The Municipality of Rio de Janeiro is located to the west of the Guanabara Bay. It includes a long and scenic bay and ocean coastline, as well as large areas of mountainous terrain, forest and swamplands. The urban fabric is thus fragmented by natural features. Space is divided socially, with the higher-income, mainly white population living in neighbourhoods such as Flamengo, Copacabana, Ipanema-Leblon, Jardim Botânico and Gávea in the South Zone, and Tijuca near the city centre. The extensive northern parts of the city are poorer, with mainly mixed-race and black populations. The largest neighbourhood in the west of the city is Campo Grande, which is relatively affluent, with a large student population. In the far west is Santa Cruz, an industrial zone with the largest steel mill in Latin America, and a mainly working-class population. The *favelas* are scattered across the city and have the poorest population, with the largest and most famous, Rocinha, located to the west of affluent Ipanema.

To the east of Guanabara Bay is Niterói, one of the richest cities in Brazil, famous as a centre of research and culture. To the north-west is São Gonçalo, which is a large urban centre with a high poverty index, and a mainly mixed-race and black population. In the far west is the emergent city of Itaboraí, with its rapidly growing chemical and petroleum industries and high numbers of migrant workers.

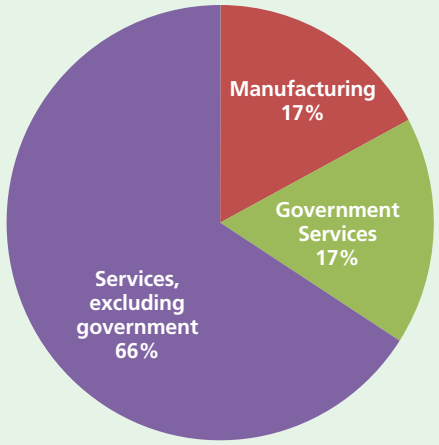
To the north of Rio are the adjoining cities of Duque de Caxias, Nova Iguaçu, São João de Meriti and Belford Roxo. Duque de Caxias is an industrial city, with chemical and oil-refining industries; but the other cities are mainly commuter satellites of Rio, with varying levels of poverty and affluence.

In broad structure, the centre of the metropolitan region is characterised by old and deteriorating neighbourhoods, with the next ring having the most prosperous areas, and the poorer communities on the far edge. However, this pattern is hugely complicated by geographies, and there is a complex patchwork of affluence and poverty, with the poorest residents often on steep hillsides and undesirable swamplands close to wealthier neighbourhoods.

ECONOMY

Grande Rio had a GDP in 2014 of around USD 176.6 billion, or 6.7% of Brazil's national figure (Brookings). Rio is similar in economic size to cities such as Rome, Sydney, Mumbai and Abu Dhabi. In Latin America it ranks after São Paulo, Mexico City and Buenos Aires. In the BRICS it ranks 16th.

SECTOR SHARE OF MUNICIPALITY OF RIO DE JANEIRO'S ECONOMY



Source: IGBE National Census 2010

The region has a diverse economy, but is clearly dominated by services. The core city in particular has become increasingly important in terms of financial and high-end business services. The city hosts a number of financial and banking institutions, as well as the headquarters of Brazil's National Development Bank.

However, it remains the second-largest manufacturing hub in Brazil, despite relative decline, with concentrations of firms in petrochemicals, steel, shipbuilding, pharmaceuticals and textiles, among others. Given the offshore reserves, the petroleum sector is important to the economy, with more than 700 petroleum firms (including the large multinationals) represented in the region. Brazil's largest petroleum corporation, the partially state-owned Petrobras, is headquartered in Rio. Brazil's mining multinational, Vale, is also headquartered in Rio.

Rio suffered an economic crisis in the 1980s and 90s, with large-scale de-industrialisation. In this period, one-fifth of the major industrial companies headquartered in Rio transferred to other regions; and the Rio Stock Exchange migrated to São Paulo, where it amalgamated with the BOVESPA. During this period, social problems intensified, crime increased, and the *favelas* grew disproportionately fast. However, from the second part of the 2000s there was a turnaround, prompted in part by major investments in urban infrastructure in preparation for the 2014 FIFA World Cup and the 2016 Olympics, but also by new discoveries of offshore oil. Major global companies in the energy and ICT sectors, in particular, have invested heavily in the metropolitan region. The region has become a significant focus of R&D, and is being confidently projected as a Latin American hub for business, tourism and hi-tech industry. However, the national economic recession since 2014 has presented a significant challenge to the city, with the oil and gas sectors being severely affected.

GOVERNANCE

The metropolitan region of Rio de Janeiro, also known as Rio Grande, was established in 1974, with the merger of the States of Rio de Janeiro and Guanabara. The Development Council for the region supports coordination between municipalities in areas such as water supply and metropolitan transport.

Although there is a degree of coordination, the separation of powers between state and municipal government is often blurred, and there are tensions between these spheres of government. With the Municipality of Rio de Janeiro almost equivalent in size and wealth to the state of Rio de Janeiro, there is no easy hierarchy.

DEVELOPMENT CHALLENGES

Rio de Janeiro faces many of the challenges common to large urban agglomerations in the global south, but there are arguably three major challenges that are a characteristic feature of Rio (and a number of other large Latin American cities): high levels of inequality; crime; and informal residence (including *favelas*). As indicated below, there has been progress in recent decades in dealing with all three challenges.

The Gini coefficient for Rio de Janeiro is a very high 0.58, despite inequality steadily decreasing from 1991 figures. The decrease has been attributed to an expanding middle class, a growing demand for less-skilled labour, and increases in social spending by the government (for example, through the Bolsa Família scheme, which provides conditional cash transfers to poor families).

Crime in Rio is largely associated with narcotics trafficking and gang violence in the *favelas*, although low-level criminal activity is widespread across other areas. However, Rio's murder rate has been trending consistently downwards. This has been attributed in part to the initiation of the Favela Pacification Programme in 2008, although this has been (controversially) associated with an increase in the number of deaths attributed to police. Rio no longer ranks in the Top 50 cities worldwide in terms of homicide rate (unlike 21 other Brazilian cities).

Favelas remain a significant feature of the city, with 20% of households in the Municipality of Rio de Janeiro in 2015 living in 'sub-normal accommodation'. This is twice the proportion of São Paulo, for example. During the 1990s, the comprehensive Programa Favela Barrio (Slum Upgrading Programme) upgraded 147 of the city's *favelas*, and improved the lives of 710 000 residents. The current Programa Morar Carioca (Rio Living Programme) is an ambitious project aiming to formalise all the city's slums by 2020.

While the core city of Rio has high levels of access to basic services, conditions do vary considerably between municipalities. In the peripheral municipalities, less than half the households are connected to a public sewage system. The relatively low levels of access to key services overall (less than 90% of households) has to do with the proportionately greater numbers of people living in *favelas*.

In addition to these challenges, Rio is facing new problems; including the effects of the economic recessions, and the Zika virus, which is putting a damper on the tourism industry, for example.

THEMATIC REPORTS

TRANSPORT

ECONOMIC INFRASTRUCTURE

Historically, Rio de Janeiro was one of the major seaports in Latin America; but in the second half of the twentieth century, the shipping industry shifted to the State of São Paulo, and there was a sharp decline in port-related activities in Rio. But it remains the third-largest port in Brazil. Rio de Janeiro-Galeão International Airport ranks second in Brazil with around 17 million passengers annually, rating highly as a tourism gateway.

Rio is linked to all neighbouring states and cities by a road and rail network, with some of the inter-city highways toll-based and operated by concessionaires. There is a plan to build a high-speed rail system between Rio de Janeiro and São Paulo, which would reduce the current travel time from six hours to 80 minutes. It was initially planned for completion by the 2016 Olympic Games, but delays in commencement mean construction may only be completed in the 2020s.

There were general improvements in the regional infrastructure in preparation for the 2016 Olympic Games, with government focusing more on funding from capital markets and infrastructure debentures – although Brazil's development bank, BNDES, continues to play an important role.

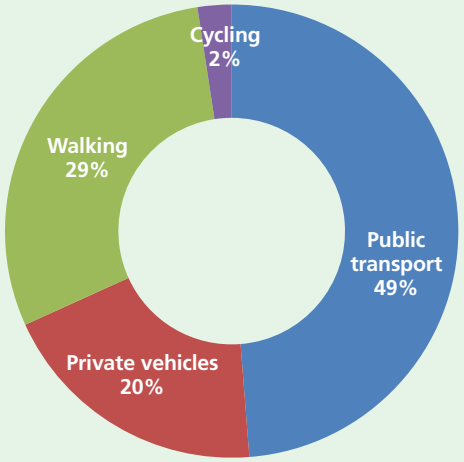
PUBLIC TRANSPORT

Although Rio is a complex city-region, most jobs (55%) remain in the central core, resulting in long commutes for the large numbers of residents living in peripheral locations. This makes an effective and affordable public transport system essential. Rio de Janeiro has a diverse range of transportation modes; but historically the system has been weakened through under-investment, a lack of modal integration, and little communication between the municipality, the state and private enterprise. Deficiencies in transport have emerged as a key point for social mobilisation, with large street protests in 2013, and again in 2016, in response to fare increases and lack of investment in public infrastructure. Rio ranks worse in a nationwide index of well-being than far poorer cities in the north-east of the country, largely because of deficiencies in public transport.

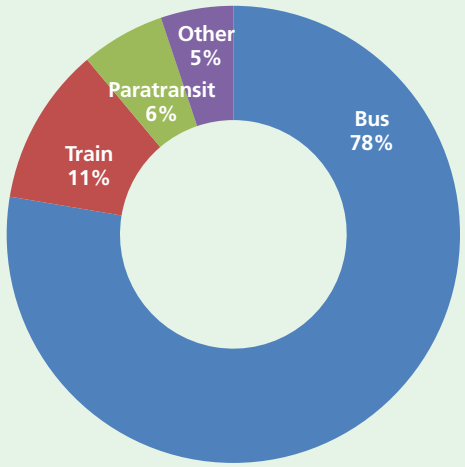
However, there has been a turnaround recently, with significant investment in public transport systems in preparation for the FIFA Soccer World Cup and Olympic Games. These investments have included doubling the capacity of the existing two metro lines and building a third line; creating extensive cycling paths and a bike-sharing system; and introducing a Bus Rapid Transit (BRT) system along two corridors (TransOeste and TransCarioca). In 2010, 37% of the population lived within a kilometre of rapid transit (then only metro and commuter rail); but by 2015, with the development of the BRT, the figure had increased to 47%. In 2013, a further key intervention symbolising the shift away from private transport was the demolition of the Perimetral highway overpass in the centre of the city.

The figures below reveal that Rio has a larger share of public transport (49%) than the São Paulo metropolitan region (37%), largely the result of Rio's extremely fragmented form and long commuting distances, which make non-motorised transport difficult. Like São Paulo, however, buses dominate, with the metro and other rail systems still underdeveloped in relation to the scale of the metropolitan region.

MODAL SHARE, MOST FREQUENT TRIPS,2012



SHARE OF PUBLIC TRANSPORT, MOST FREQUENT, 2012



BUSES

Bus transport, across more than 800 routes, remains overwhelmingly important in terms of public transport. The underinvestment in this sector has been addressed recently with the introduction of the two BRT corridors. The first route was completed by 2013; and by 2016, there were 270 000 daily users of the BRT, making it one of the most rapidly developing BRT systems globally. Rio is also making progress with new technologies, with a local company, for example, marketing hybrid diesel-electric buses and developing a fuel-cell hybrid bus.

METRO AND OTHER TRAINS

The Rio Metro was inaugurated in 1979, and now consists of two lines in a 41-kilometre network with 35 stations, operated by the Metrô Rio concessionaire. It is a relatively small network in relation to the population of the metropolitan region, carrying around 630 000 passengers daily. An above-ground rail network was established in 1998 to serve the wider metropolitan region, and transports around 500 000 passengers daily. It is operated by the SuperVia concessionaire, which also manages an aerial gondola or cable car that services a cluster of *favelas* on hilly terrain in the north of the city.

A limited system of Light Rail Transit (known as VLT Carioca) was introduced for the 2016 Olympic Games.

OTHER

Rio has a ferry service that connects centres around Guanabara Bay, with the Rio-Niterói route the most important. Ferries carry more than 100 000 passengers daily. Rio also has a limited tram route – of historical importance – that operates between the city centre and the suburb of Santa Teresa; but this serves mainly as a tourist attraction.

FUTURE PLANS

There was massive investment in public transport in the run-up to the 2016 Olympic Games, and this momentum is unlikely to be sustained. But there are plans for the continued expansion of the system, with the opening of two additional BRT corridors (TransOlimpica and TransBrasil) by around 2020, and the further expansion of the metro and light rail system.

GREEN ENERGY

The national energy profile is discussed in the São Paulo Factsheet. As part of the national grid, Rio de Janeiro also benefits from the relatively green profile of electricity production in Brazil. The metropolitan area is significantly above average in Latin America for environmental performance. However, at the same time, the region with its offshore deposits produces 80% of Brazil's oil, and over 40% of its natural gas.

The State of Rio de Janeiro and the municipalities have been trying to compensate by greening the profile of the metropolitan region. In 1988 Rio became the first city in Latin America to publish an inventory of CO_2 emissions. In 2009 the Municipality of Rio de Janeiro unveiled its comprehensive climate-change programme, 'Rio Sustainable', aimed at a 20% reduction in emissions by 2020, followed in 2012 by the Rio Low Carbon City Development Programme; and in 2010, the State passed into law the Policy on Global Climate Change and Sustainable Development (PEMC), which aims to have carbon emissions in 2030 below the levels of 2005, and in 2011 instituted the River Capital Energy Programme, to concentrate green energy production in the state. The total clean energy generated in the State of Rio de Janeiro is expected to increase by 40% between 2010 and 2030.

Rio is attempting to build a green-energy sector, and is using the Olympic Games as a catalyst. For

example, there was a large solar project to power the stadiums for the Games. The municipality is also involved in landfill-to-gas projects, while there are at least two manufacturing plants converting waste to energy. The 2014 energy crisis as a result of the drought has given impetus to municipal programmes aimed at energy efficiency, such as LED street lighting and traffic lights, and the use of solar thermal water heaters in new housing projects. In terms of green fuels, the Rio municipality has converted around 8 500 buses to hybrid fuels (20% biodiesel).

INNOVATION-DRIVEN ECONOMY

Innovation in Rio was negatively affected by the economic crisis of the 1980s and 90s, but there has been a recent resurgence, with a number of major multinational corporations recognising the innovation potential of the metropolitan region and establishing state-of-the-art R&D laboratories. In 2010, IBM established its first research laboratories in Latin America, in São Paulo and Rio. Intel has launched an R&D facility in Rio, focused on the Internet of Things, Big Data, and High-Performance Computing; while General Electric has built its first new global R&D facility in a decade in Rio, calling Rio a "compelling draw". Brazil's Petrobras, headquartered in Rio, is also investing heavily in R&D, supporting a major technology centre and six experimentation centres.

There are also significant innovations in government, with IBM and other ICT companies working with the Municipality of Rio de Janeiro to create 'smart city' infrastructure and systems. A state-of-the-art Operations Centre has been established within the municipality to process live data in support of city decision-making.

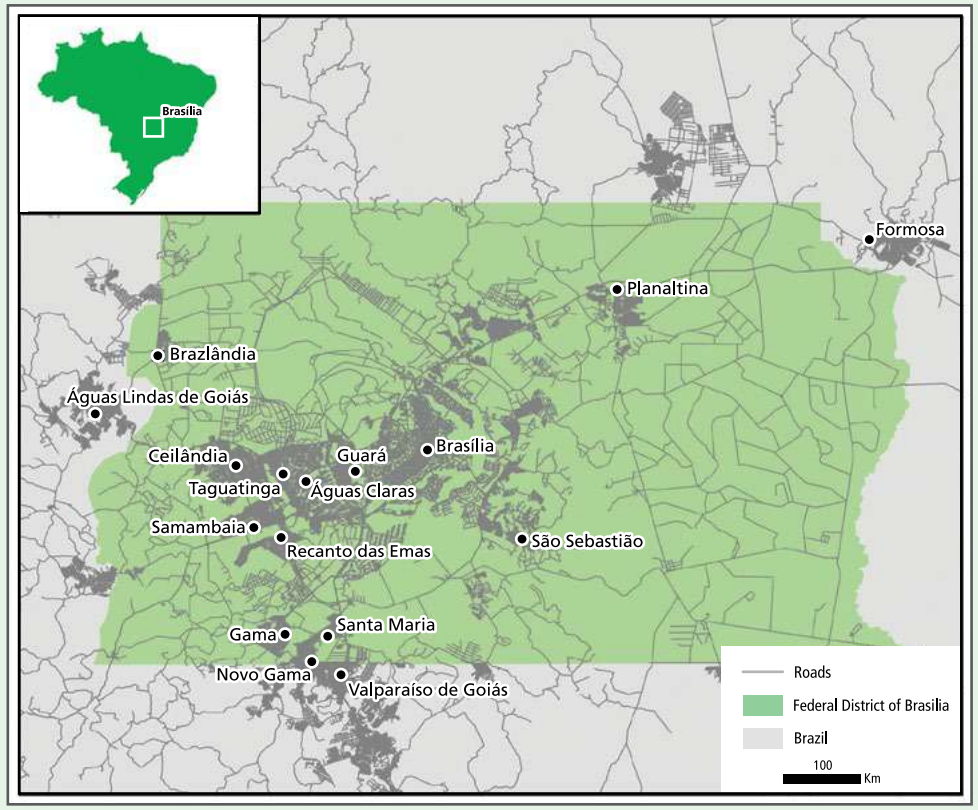
The universities are playing a leading role in supporting innovation. The metropolitan region has two universities in the QS BRICS Top 50 for 2016: Universidade Federal do Rio de Janeiro (29th), and Pontifícia Universidade Católica do Rio de Janeiro (46th). Universidade Federal do Rio de Janeiro in particular is an innovation hotspot, with a range of key research centres, an Innovation Agency, and a Technology Park developed in partnership with major corporations such as Petrobras. Increasingly, there is networking between innovation centres, with the non-profit organisation REDETEC, for example, bringing together 53 universities, research centres and development institutions across the state of Rio de Janeiro in support of technological, scientific and cultural innovations.

With this new energy in the field of innovation, Rio is receiving new recognition as an innovation hub. At a 2015 conference on Connected Smart Cities, for example, it was referred to as the 'smartest city in Brazil'. Rio was also recently included on a global Top-50 list of innovative cities in technology.

Rio de Janeiro ranked second in Latin America after São Paulo and 11th in the BRICS in the 2thinknow 2015 innovation Cities Index (although the global ranking was a modest 139th).

BRASÍLIA METROPOLITAN REGION

Distrito Federal



CONTEXT

LOCATION AND STATUS

The Brasília urban agglomeration, administratively known as the Integrated Region of Economic Development (IRED) of the Federal District and Surroundings, is located on Brazil's central plateau in the mid-west of the country. Brasília is the Federal Capital of Brazil.

HISTORY

Brasília is one of the world's newest large urban agglomerations. It had its origins in the 1940s, when a decision was taken to relocate the national capital from Rio de Janeiro as part of the 'march to the West', a programme to occupy and modernise the thinly-populated interior. However, the idea only became a reality in 1956, when Juscelino Kubitschek was elected president. He saw the creation of the new capital as a powerful symbol of national identity and progress.

Kubitschek appointed Oscar Niemeyer as chief architect and Lúcio Costa as chief planner for his award-winning Plano Piloto (Pilot Plan). The proposed city, designed for 500 000 people, resembled from above either an aeroplane or bird in flight. The city was officially opened by Kubitschek in 1960, although it would take another two decades or so to complete the move of government departments from Rio.

The city was intended to accommodate white-collar bureaucrats and the political elite; but during the construction period, large numbers of migrant workers known as cadangos arrived from the poorer north and north-east of Brazil. Many remained after construction was completed. Unable to access accommodation within the new city, these workers occupied emerging settlements in a belt around the city. The government was concerned that *favelas* would emerge in the region, detracting from the image of a modern city, and so reluctantly agreed to the development of satellite cities (cidades satélies). A large city-region (the IRED) thus emerged, with daily commuting into the modern core.

After Kubitschek, Brazil descended into a dark period of military dictatorship, which left the emerging national capital globally isolated. But democracy was restored in 1985, and in 1987, Brasília was designated a UNESCO World Heritage Site for the grandeur of its modern architecture. It is the only twentieth-century city in the world with this status. As Brazil emerged as an emergent power on the global stage, so Brasília expanded in population and economy into one of Brazil's leading metropolitan regions. However, it remains a city of controversy. For some, it is a remarkable achievement; but for others, it's a sterile and isolated city, a product of modernist design that stands in stark contrast to gritty but vibrant cities such as São Paulo and Rio de Janeiro. There are others, however, who view Brasília as an emergent city that will establish its energy over the longer term. It is a city somewhere between utopia and dystopia.

POPULATION

POPULATION SIZE

The United Nation's Population Division estimates the Brasília IRED population at 4.16 million in 2015, an increase from about 3.9 million in 2010.

POPULATION RANKING

In 2015, Brasília IRED ranked 91st globally as an urban agglomeration; 37th in the BRICS; and fourth in Brazil.

POPULATION GROWTH

The population growth rate of the Brasília IRED is estimated at 2.27% per annum, among the highest of Brazil's metropolitan regions.

POPULATION DIVERSITY

The population of Brasília in 2010 was 48.2% mixed race, 42.2% white, 7.7% black, and 1.6% Asian. The foreign-born population is negligible, and consists mainly of the staff in international embassies.

STRUCTURE OF THE URBAN REGION

The urban region is focused around the Plano Piloto, of course, with its grand design and expansive modernist architecture. The city was never intended to house more than 500 000 people, and the huge national park to the north and the lake surrounding Brasília to the south-east largely prevent contiguous spatial expansion. The wealthiest parts of the region are contained within the original design (for example, Asa Norte, Asa Sul, Lago Norte and Lago Sul).

However, large satellite towns and cities have emerged beyond the edge of the original city, in both the Federal District of Brasília and neighbouring states. The low-density, meticulously-designed and wealthy urban core remains mainly physically separate from the sprawling low- to middle-income satellite settlements, but is connected by daily commuting flows. There are at least 29 satellite settlements of varying sizes. Some are very poor, but others are experiencing a gradual increase in property value.

Some of these settlements are in the Federal District – including, for example, Ceilândia (398 000 people), Taguatinga (222 000), Guará (112 000), Sobradinho (85 000) and Brazlândia (54 000). The origin of these settlements is evident, for example, in the name Ceilândia, with the CEI standing for Centro de Erradicação de Invasões (or 'Squatters Eradication Centre').

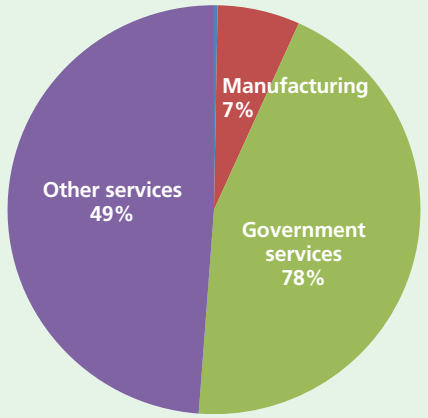
Some settlements in the extended region fall immediately outside the boundaries of the Federal District, in the States of Goiás and Minas Gerais. Águas Lindas de Goiás, for example, currently has a population of over 105 000, and is one of the fastest-growing cities in Brazil, serving as a low-income dormitory settlement for Brasília. Valparaíso de Goiás (population of 146 000) – built in 1979, for construction workers – is also fast-growing, as is Novo Gama (94 000), Planaltina (76 000) and Cidade Ocidental (60 000).

The urban agglomeration clearly remains deeply divided in class and spatial terms between the core and the satellites; and it is still to be seen whether a new socio-spatial structure will emerge, with (for example) connecting development between the city and the satellites.

ECONOMY

Despite its recent origins, the Brasília urban agglomeration has the third-largest GDP in Brazil, after São Paulo and Rio de Janeiro. In 2014 the GDP was USD 141.9 billion, or 3.97% of the GDP of Brazil. Within the BRICS it ranked 18th, between Mumbai and the Central Witwatersrand. Brasília has the highest GDP per capita, nearly double that of São Paulo.

GDP BY SECTOR FOR FEDERAL DISTRICT, 2013



Source: IGBE National Census 2010

Brasília's economy is overwhelmingly dominated by services, reflecting the city's status as the federal capital. Apart from government departments, Brasília hosts the headquarters of some of the nation's largest public agencies, such as Brasil Telecom, Itaipu (hydroelectric power), the Brazilian post office, and the Bank of Brazil. While there is a small industrial sector, the government has encouraged non-polluting industries such as software production, film and video, medical services and publishing.

Brasília's economy has performed well in national terms. Among the metropolitan regions, its growth since 1990 has been second only to Manaus in Amazonia, and it has the lowest unemployment rate (around 5%).

GOVERNANCE

The Distrito Federal (Federal District), a rectangular block of land, was carved out of the State of Goiás. It forms one of the 27 federative units of Brazil (the others being the states) with its administration headed by a governor. The Federal District has the legislative powers of state and municipal government, and may collect both state and municipal taxes. In terms of the Brazilian Constitution, the Federal District cannot be divided into municipalities. However, the Federal District is divided into 31 administrative regions, each of which is governed by a regional administrator appointed by the governor. The portions of the metropolitan region (the IRED) outside of the Federal District fall under municipalities and state administration, as per the rest of Brazil.

DEVELOPMENT CHALLENGES

In some respects, the metropolitan region is privileged in Brazilian terms. It has the highest per capita income, the highest share of its population with a tertiary education, and the lowest unemployment rate of all metropolitan areas in the country. Although Brasília has been a magnet for migrants, only 4.7% of its households lived in 'sub-normal accommodation' in 2010, reflecting both the relative socio-economic wealth of the region and also the efforts of government to ensure that *favelas* did not develop within the Federal District.

However, Brasília is an urban agglomeration with significant socio-spatial inequality. Residents living in the poorer satellite cities face long and expensive daily commutes, and have much poorer levels of servicing and infrastructure than in the core. This applies particularly to the settlements outside the Federal District in Goiás and Minas Gerais, which do not benefit from the efforts of national government to ensure a positive image for the capital city. Within the core city itself, low-density sprawl creates a mobility challenge, and reinforces dependence on the private automobile.

Organised crime is an issue for Brasília, but on a significantly smaller scale than for the larger cities of São Paulo and Rio de Janeiro. There are recent reports of increasing levels of crime, in the satellite cities in particular. While the Zika virus is a major threat for Brazil, incidence levels on the high-lying plateau on which Brasília is situated are low.

THEMATIC REPORTS

TRANSPORT

ECONOMIC INFRASTRUCTURE

There is an extensive road network linking Brasília to other areas, with the intention of making the capital accessible to the rest of the country. The longest highway in this network is the 2 275-kilometre Belem-Brasília highway, linked to north-east Brazil. The railway system is far less developed, but a fast-track train connecting Brasília to Goiânia is under construction.

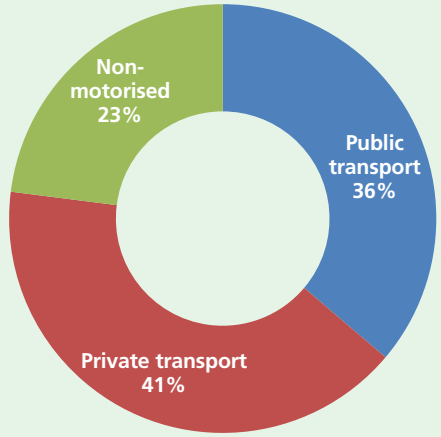
The Brasília-Presidente Juscelino Kubitschek International Airport serves the Brasília IRED, accommodating major domestic and international flights. Owing to its central location in the country, it is the fourth-busiest Brazilian airport based on passenger numbers (16 million annually).

PUBLIC TRANSPORT

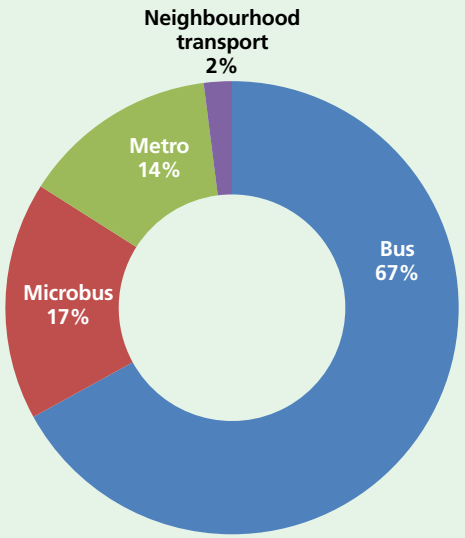
Brasília was designed for the automobile, with large, non-pedestrian-friendly spaces separating the grand modernist constructions. This was reinforced by the emergence of the satellite settlements, spatially separated from the core city. The daily reality in the core city is traffic jams, lack of parking space, and high levels of noise, air and visual pollution; but with the city's World Heritage Site status, there is little flexibility for urban design change. For residents of the satellite settlements, the reality is long and costly commuting times.

The overall modal share for Brasília differs from other Brazilian cities, with its greater share of private automobiles and lesser share of pedestrian activity – reflecting the history and spatial form of the city-region. As in other major urban regions, the bus dominates in terms of public transport, with a minority metro share. However, transport studies in Brasília have identified the minibus as an important form of transport, with other forms of neighbourhood transport also featuring.

MODAL SHARE



MODAL SHARE OF PUBLIC TRANSPORT



Source: Governo dos Distrito Federal, 2010

BUS

The bus system covers the entire region, but in many of the outlying settlements the service is unreliable, expensive and not well connected to other modes of transport. Buses converge on Central Station in the central area of Brasília, as most jobs are still located in this core. In 2014, Brasília inaugurated its first Bus Rapid Transit (BRT) system, Expresso DF, connecting the core city with the satellite towns of Gama and Santa Maria. There has been an estimated 55% reduction in commuting time along these routes. In 2016, Global BRT Data reported that the system was already carrying 40 000 passengers daily.

METRO AND LIGHT RAIL

The Metrô de Brasília introduced in 2001 is Brasília's underground metro system. The subway system has 29 stations on two lines covering a total network of 42km, but is very partial in its coverage of the metropolitan region, serving mainly the two large, fairly well-located satellite cities of Ceilândia and Taguatinga. In 2010, construction began on a new light metro transport system which was to link the core city to the international airport and a major regional hospital, with completion in time for the 2014 FIFA World Cup. However, following allegations of fraud in the bidding process, construction was put on hold, and the system is now part of longer-term planning for the region.

FUTURE PLANS

DFTRANS (Urban Transport of the Federal District) is a public entity charged with integrating the public transport system. The Federal District has adopted an urban transport plan, the Urban Transport Plan 2014, in line with the Brazilian City Statute that requires all cities with more than 500 000 inhabitants to do so. There are plans to systematically expand the BRT system to 150km of dedicated lanes, carrying around 600 000 people daily. There are also plans to develop the new light rail system, which was put on hold.

GREEN ENERGY

With 98% of Brasília's electricity produced through hydro, the city has one of the lowest carbon footprints in Latin America, and in the BRICS. However, there has been some criticism that the Federal District has failed to adopt clear CO_2 emission targets, and has delayed implementing green energy standards.

There are some well-known green initiatives in Brasília. For the 2014 FIFA World Cup, Estádio Nacional de Brasília in Brasília became the first sports stadium in the world to boast zero net energy. It achieved this through careful design and choice of materials, and solar energy production. The north-west of the core city (Setor Noroeste) has been selected as a laboratory for more sustainable living, with special attention to pedestrian walkways, bicycle paths, sustainable building design, solar generation, waste recycling, and so forth. However, this is a high-end development that is not easily replicated.

Beginning in 2013, Brasília has made significant investments in the renovation of its bus fleet. In total, 90% of the fleet has already been replaced by buses with improved fuel and emissions technology, and vehicle routes have been restructured to improve travel and energy efficiency.

INNOVATION-DRIVEN ECONOMY

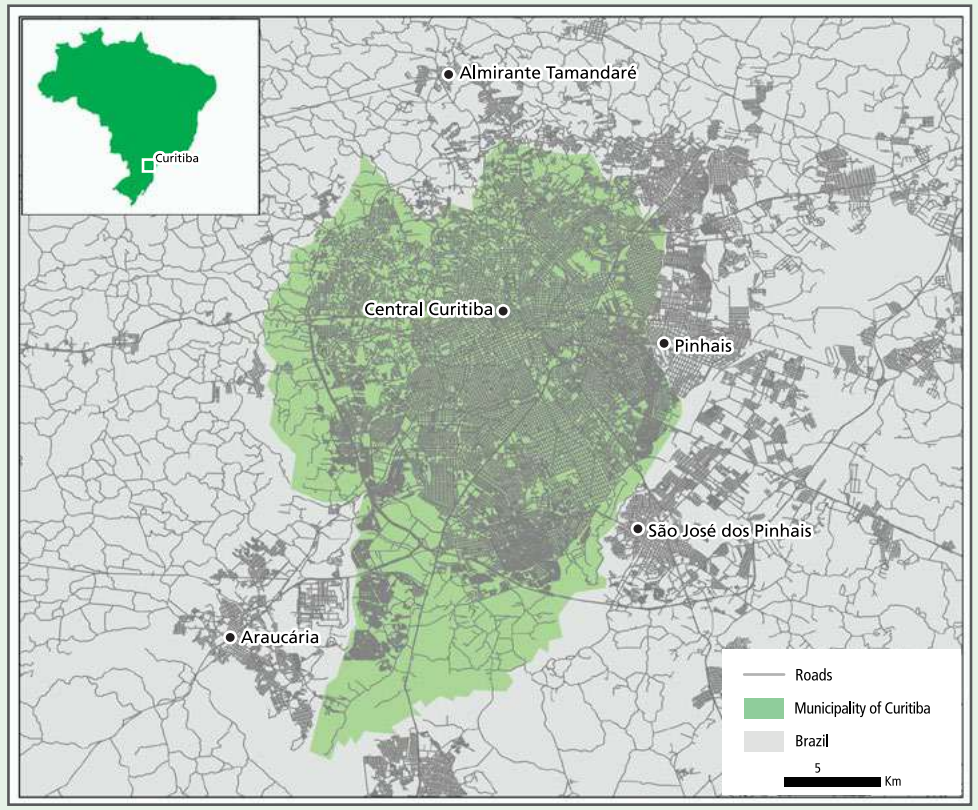
Brasília lags behind most other large cities in the BRICS in terms of the 2thinknow Innovation Cities Global Index. It ranked a fairly lowly 314 globally in 2015. One of the challenges is that as a city of government, Brasília does not have a large manufacturing economy – where innovation is mainly measured, through mainstream indicators. However, there are critical R&D functions in the region related to state-owned institutions. The Brazilian Agricultural Research Corporation (Embrapa), for example, is headquartered in Brasília, and also has key research functions in the city. Embrapa has played a key role in the development of the national economy, including in the development of biofuels such as ethanol.

Since the Federal District has some of the highest levels of education in the country, the Secretary of Science, Technology and Innovation (SECTI) has identified it as a potential centre for high-technology knowledge, products and services. There are a number of initiatives to promote innovation in this area, including: the launch in 2014 of Sinal Livre as the largest public metropolitan wireless internet (Wi-Fi) network design in Latin America; the establishment of the Instituto Brasília de Tecnologia e Inovação (Brasília Institute of Technology and Innovation); and the creation of the Centre for Support of Technological Development at the University of Brasília, which manages a Science and Technology Park.

Of course, the Federal District sits at the heart of government. Government in Brasília is actively involved in promoting innovation at various levels. The National Strategy on Science, Technology and Innovation 2012-2015 is focused on supporting innovations in areas such as biotechnology, the low-carbon economy, and the reduction of poverty and inequality.

CURITIBA METROPOLITAN REGION

Região Metropolitana de Curitiba



CONTEXT

LOCATION AND STATUS

Curitiba is located in the south of Brazil. It is the capital and largest city of the State of Paraná.

HISTORY

Curitiba developed gradually from the 17th century as an agricultural service centre, settled mainly by Portuguese immigrants and a native Amerindian population. In 1853 the State of Paraná was granted autonomy from São Paulo, and Curitiba became its capital. The arrival of a railroad opened large tracts of land for production of coffee, mate (traditional tea), lumber and soybeans, and brought in immigrants from Germany, Italy, Poland, the Ukraine, and elsewhere in Europe. The Japanese arrived early in the twentieth century.

By 1950 Curitiba was still a small city, with a population of around 150 000. However, driven by the Paraná coffee boom and improved infrastructure connections, the city began to expand rapidly, with annual growth of around 8% in the 1950s and 7% in the 1960s. The city developed an innovative, planning-led approach to the management of this growth. The design of the Curitiba Master

Plan and the creation of the Instituto de Pesquisa e Planejamento Urbano de Curitiba (Institute of Urban Planning and Research of Curitiba, also known as IPPUC) in the mid-1960s initiated a process that gained international accolades for the city.

In 1971 one of the founders of the IPPUC, Jaimie Lerner, was appointed Mayor of Curitiba, and he drove the creation of the world's first Bus Rapid Transit (BRT) system, with its dedicated bus lanes along the city's main transit arteries. The BRT provided the 'structural axes' for high-density, mixed-use development. Lerner also developed expansive green areas, and ensured an equitable distribution of social services and urban infrastructure across the city, including within the city's slums. Initially, Curitiba's success with public transport went unnoticed; but in 1998, the Mayor of Bogotá in Colombia borrowed from Curitiba in developing the Transmilenio BRT, which inaugurated a global revolution in public transport.

Until the 1970s Curitiba was almost entirely dependent on service industries. However, in this decade the IPPUC planned and developed an 'industrial city' to the south west of Curitiba, which emerged as the second-largest hub of the automobile sector in Brazil. With rising levels of employment and high quality of life, which included the convenient and affordable public transport system, Curitiba has continued to attract new migrants, creating continuing challenges for the management of urban growth.

POPULATION

POPULATION SIZE

The metropolitan region of Curitiba had an estimated population of 3.47 million in 2015.

POPULATION RANKING

The metropolitan region is the 120th-largest urban agglomeration in the world, 51st in the BRICS, and ninth in Brazil.

POPULATION GROWTH

Curitiba's estimated annual growth of 2.16% for the period 2010-2015 is moderate in the context of the BRICS but relatively fast for Brazil, where urban growth rates overall are very low.

DIVERSITY

The 2010 census indicated that Curitiba's population was 79% white, 17% mixed race, 3% black and 1% Asian. Curitiba is whiter in racial composition than most other metropolitan regions of Brazil.

STRUCTURE OF THE URBAN REGION

Curitiba has quite a compact, monocentric structure. The city has expanded along the five radial corridors (the structural axes) as indicated in the 1966 Master Plan. The Municipality of Curitiba has a population of around 1.8 million people.

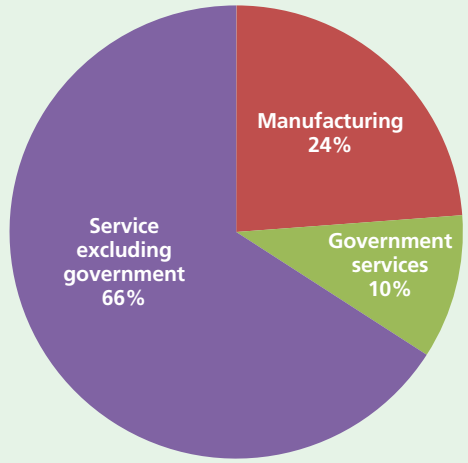
However, the urban area does extend over the municipal boundary. The second city in the conurbation, São José dos Pinhais, is located south-west of the core city, separated from Curitiba by the Iguazu River, and has a population of around 280 000. It is the site of the Afonso Pena International Airport, and a cluster of large automobile plants. In the north-west the urban agglomeration has spilled over into the Colombo Municipality, which has a population of around 230 000. There are a few satellite dormitory towns such as Araucária (133 000), Campo Largo (124 000), Piraquara (104 000) and Fazenda Rio Grande (90 000), which are mainly far poorer than the core city.

ECONOMY

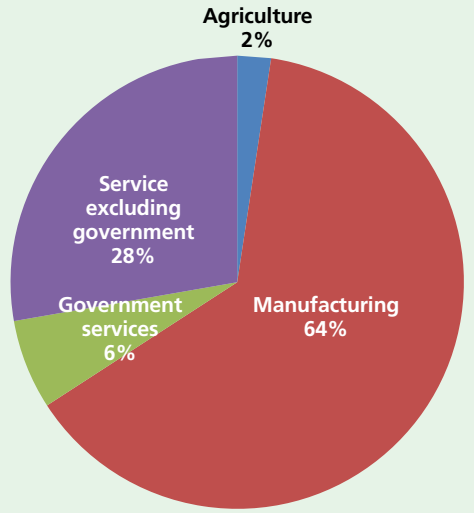
In 2014 the GDP of Curitiba was USD 57.65 billion, or 2.23% of the GDP of Brazil (Brookings). Its economy was similar in size to that of Cape Town in South Africa.

The figure below shows the sector composition of the economy of the core city (i.e. the Municipality of Curitiba) and the key secondary city (i.e. the Municipality of São José dos Pinhais). The core city has an economy that is dominated by the service industry, although it is does have a manufacturing presence, mainly on the southern edge. São José dos Pinhais, however, is an industrial city with an overall economy one-third the size of the core city.

SECTOR COMPOSITION OF CURITIBA'S GDP



SECTOR COMPOSITION SÃO JOSÉ DOS PINHAIS



Source: IBGE National Census, 2010

Curitiba has a long history of servicing an agriculturally rich hinterland, and as the state capital also provides government services. The largest manufacturing industry is automobiles. Volvo, Chrysler, Renault, Volkswagen-Audi, and New Holland all have factories within the urban region, and there is a large cluster of smaller factories around these major plants. Although there is an irony in a city internationally famous for public transport producing automobiles on this scale, the Volvo plant produces BRT buses for Curitiba and other cities across the world. The next-largest industries are information technology and communications software. The Municipality of Curitiba has supported the development of highly-skilled, non-polluting industries, and the city has emerged as the second-largest IT cluster in Brazil after São Paulo, with the presence of major corporations such as Motorola, Siemens, Brasil Telecom, and Impstat. The city has succeeded in creating wealth, with a 30-year average annual growth rate of 7.1%, compared with Brazil's 4.2%.

GOVERNANCE

While the Municipality of Curitiba succeeded famously with urban planning and the development of a transportation system, regional coordination has proven more difficult, with tensions

across the scales of government and competition between municipalities. As the quality of life (and living costs) has risen in the core city, growing numbers of poorer people have been diverted to the more peripheral areas, with the growth of slums a major challenge for weaker municipalities. Also, while the core city has excellent public transport, some of the surrounding settlements are not connected to it, encouraging the use of private vehicles for longer-distance commuting.

In 1974 Consejo Metropolitano de Curitiba (COMEC) was established as an agency to coordinate infrastructure and development across the metropolitan region. It now exists as a structure of coordination among the 29 municipalities in the region, with a focus on inter-municipal public transportation, and functions such as water supply and waste management. Recognising the historical deficiencies in metropolitan scale coordination, the Municipality of Curitiba is now paying more attention to inter-municipal partnerships and building capacity for regional planning.

DEVELOPMENT CHALLENGES

The overall quality of life and wealth per capita is significantly higher for Curitiba than for Brazil as a whole, and for most other metropolitan regions. Its Human Development Index is equivalent to that of countries in Latin America such as Chile and Argentina. The metropolitan region also scores very well on environmental indicators.

There are challenges, however. The relatively high population growth rates, for example, are putting pressure on the regional infrastructure. For example, there is evidence of a rising level of car usage in recent years, reversing some of the gains made by public infrastructure. Despite success in distributing services equitably across the city, there are still slums. The 2010 census indicated that in Curitiba, 8.5% of households live in 'sub-normal accommodation'. There are severe vulnerabilities in terms of water supply, with reservoirs having run dry in drought years, and severe water restrictions imposed.

Violent crime remains a problem. In 2015 Curitiba was ranked the 44th most violent city in the world, with a murder rate of 34.7 per 100 000 (comparable to Johannesburg in South Africa). Gun-related crime is concentrated in the south of the city in the industrial areas, and in working-class Pinheirinho.

THEMATIC REPORTS

TRANSPORT

ECONOMIC INFRASTRUCTURE

The State of Paraná has a well-developed transport infrastructure, which includes the most developed highway system in Brazil, an extensive network of waterways, and rail. Curitiba is an important hub in the network. The bulk of Paraná's exports, for example, pass through Curitiba to the deep-water port of Paranaguá, which is Brazil's second-largest port, and Brazil's largest exporter of agricultural produce.

The Alfonso Peña International Airport in São José dos Pinhais, adjoining Curitiba, ranks only 10th in Brazil in terms of passenger traffic (around 7.4 million passengers annually), and seventh in terms of cargo traffic. It was upgraded for the 2014 FIFA World Cup.

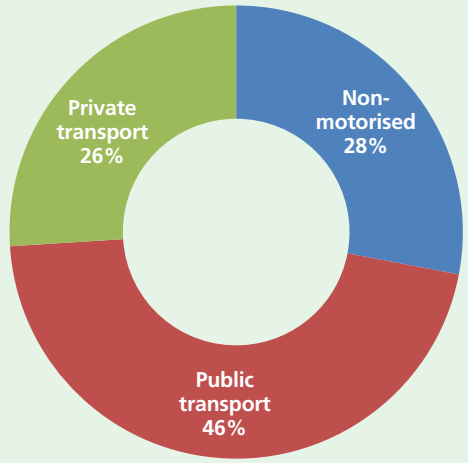
PUBLIC TRANSPORT

More than anything else, Curitiba is most famous for its public transport systems, and especially for its pioneering BRT network. Curitiba has Brazil's second-highest rate of private car ownership (at 0.5 vehicles per person), but has a relatively low car use on a daily basis.

The success in this area is reflected in the modal share across the metropolitan region, with a significantly lower proportion of private transport and a higher proportion of public transport than in other metropolitan cities in Brazil. As elsewhere, there is a significant share of non-motorised transport, but Curitiba is significant for the relatively high modal share (5%) of the bicycle, reflecting the attention given to cycling infrastructure.

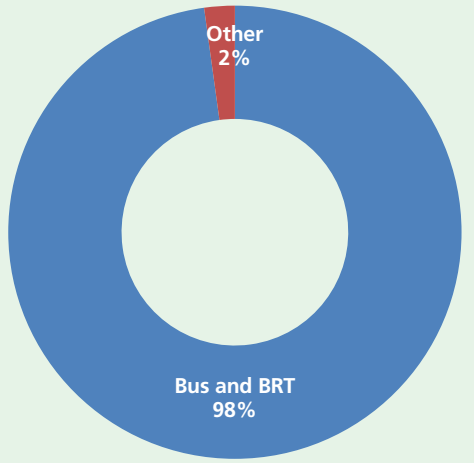
The share of forms of public transport is also different. In most metropolitan cities in Brazil, bus dominates but rail transport does have a share. In Curitiba, public transport is almost entirely by bus, including the famous BRT system. There was a deliberate choice not to include rail.

MODAL SHARE OF ALL TRIPS



Source: URBS - Unidade de Gestão de Informação & Global BRT Data, 2016

SHARE OF PUBLIC TRANSPORT



Source: URBS - Unidade de Gestão de Informação & Global BRT Data, 2016

BUS (INCLUDING BRT)

The centrality of bus as a mode of transport was established in the 1966 Master Plan, which dealt with congestion by proposing more connectivity rather than more road space. The Rede Integrada de Transporte (RIT, or Integrated Transport Network) – which focused on high-capacity, high-frequency bus services – developed progressively from its inauguration in 1974, with buses now accounting for 1.9 to 2.1 million passenger trips per day (563 000 on the BRT).

The core of the RIT is the five structural axes along which the BRT operates. These axes have centre lanes dedicated to buses, and outer lanes for private vehicles. The urban planning system promotes high-intensity land development along these corridors, with a zone of mixed commercial-residential development within two blocks of the busway, and residential development tapering in density beyond. The system comprises around 80km of busway.

Beyond the structural axes there is a much larger, citywide mass transit system comprising around 340 bus lines, 1 600 buses, and 1 100km of bus routes. The transport system is carefully managed by the municipally-owned Urbanizacao de Curitiba S.A (URBS), which plans and regulates not only buses but also taxis, parking lots and shopping areas. The buses themselves are operated by private companies; but these are licensed, regulated and coordinated by the URBS, which also collects and distributes the fares. The different bus operations are spatially linked in integration terminals. The URBS ensures that only well-maintained buses operate on the routes, and that fares remain affordable.

While acclaimed overall as a considerable success, in recent years concerns have been expressed about declining bus patronage and the growing use of private motor cars. An argument has surfaced that the bus system served Curitiba well when it was a small city; but now, as a growing agglomeration, rail transport is needed.

FUTURE DEVELOPMENTS

There are initiatives planned, or in early stages of implementation, to revitalise public transport in the city.

Most significant is an initiative to reinvigorate the busways in Curitiba by constructing a sixth axis, referred to as the Green Line. A former Federal highway is being shut down and converted into an 18-kilometre busway, surrounded by a linear-shaped biodiversity park with pedestrian and cycling networks.

Other initiatives outlined in the revised city master plan include the construction of a monorail connecting the international airport to the city centre, 300km of new bicycle lanes, the restoration and upgrade of sidewalks across the city, and the refurbishment of the existing busways. A controversial plan to build a metro system for Curitiba appears to be on hold.

GREEN ENERGY

The Latin American Green City Index put together by the Economist Intelligence Unit rates Curitiba as the greenest of the large cities in Latin America. It is assisted by the fact that around 84% of its electricity is produced by hydro; but the city itself has invested heavily in eco-friendly policies, especially in terms of public transport, waste reduction and bio-fuels. Curitiba's major contribution to international practice has been to achieve greater energy efficiency through the way the city is designed, and especially through the link between density and mobility.

Although hydro has a far lower environmental footprint than carbon-based fuels, large hydro schemes do have significant environmental (and social) impacts. There is also the severe vulnerability for energy security during years of drought. Curitiba is therefore promoting initiatives that would replace hydro with various other sources of renewable energy. The challenge is that this comes at increased cost, and the residents of Curitiba have become used to a long period of cheap hydro-produced electricity.

Although Curitiba is already relatively efficient in terms of fuel usage, the city administration is working to ensure that all diesel fuels in public transport will be replaced with low-emission biofuels. Other initiatives to increase efficiency include the introduction of 'smart city' technologies such as real-time monitoring to improve the efficiency of infrastructure usage.

INNOVATION ECONOMY

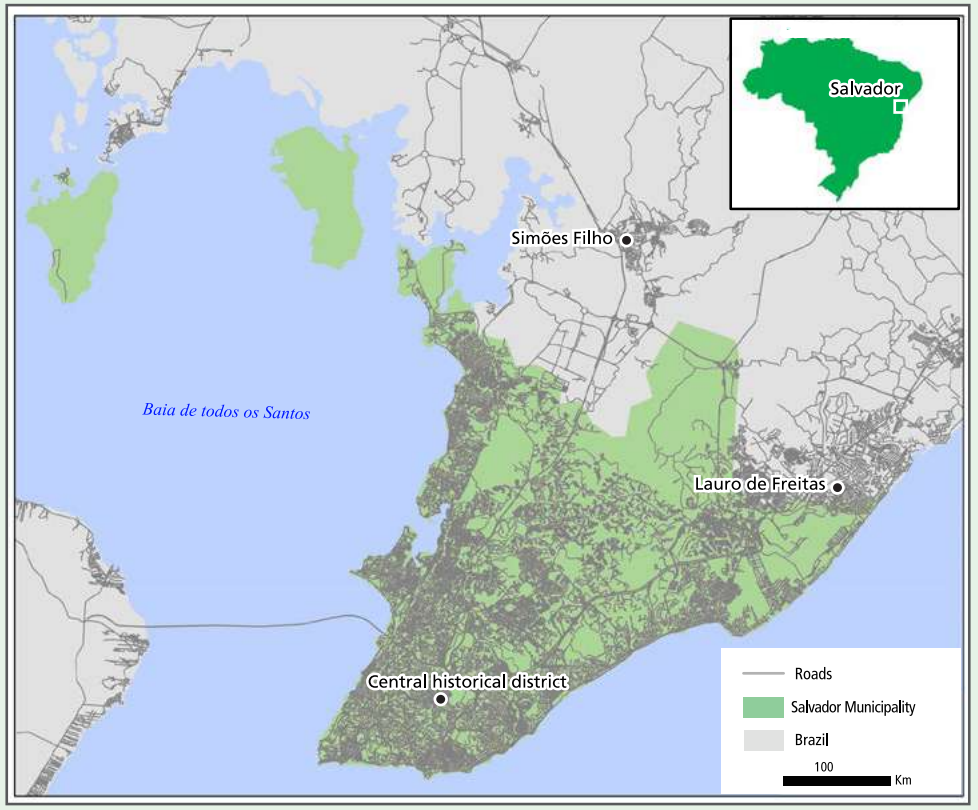
Curitiba has made its mark globally through innovations in governance. It is widely recognised as a model for urban planning, and delegations from across the world travel to Curitiba to observe its success. Of course the city is best known for its innovative transport system, but there are a range of other innovations that have attracted attention, including low-cost housing design, waste-management practices, the Citizen Streets (where public transport is linked to clusters of public services), and the FarÓis do Saber ('Lighthouses of Knowledge'), which provide libraries and public computers for every sector of the city. It is difficult to sustain success, however, and there are concerns that Curitiba is becoming a victim of its own success, as the high quality of life attained for the city is creating new development pressures that are difficult to manage.

Curitiba is less well-known for innovation in economic sectors, ranking 263rd globally in 2015 in the 2thinknow Innovation Cities Global Index. In BRICS terms Curitiba is a 'middling innovator', with indications that it is moving up the rankings. A focus of innovation may be the automobile industry: ironically, given its reputation as an icon of public transport, Curitiba has a large car manufacturing industry. Both the VW-Audi and Dana-Chrysler plants in Curitiba have been recognised for their innovation in production processes. Curitiba has also received recognition for innovation in the creative industry sector.

There are multiple initiatives at state and municipal level to support economic innovation. The State of Paraná has plans and programmes to promote competitiveness and innovation in areas including agro-biotechnology, informational technology, energy products and educational technology (e.g. Programa Paraná Competitivo). The support includes matching funding for R&D, tax incentives, technology parks with incubator support, and active programmes of partnership, with industry and local academic institutions.

SALVADOR METROPOLITAN REGION

Região Metropolitana de Salvador (RMS)



CONTEXT

LOCATION

Salvador, the capital city of the State of Bahia, is located on the north-east coast of Brazil. The city of Salvador forms the core of a wider urban agglomeration, known as the Região Metropolitana de Salvador (RMS) or Salvador Metropolitan Region.

HISTORY

Historically, Salvador is an important colonial city. It was founded in 1549 as the capital of the Colony of Brazil. With its large port, it became the hub of Brazil's slave trade with Africa, and also of burgeoning slave-produced sugar exports. By the end of colonial rule, nearly 80% of the population of the city was of black African descent.

Salvador had a complex early history, with conflict between the colonial and settler populations, and a long struggle between the Portuguese and the Dutch for control of this strategic location. In 1763, the colonial capital was moved to Rio de Janeiro; and although Salvador remained the maritime heart of a rich agricultural region, it became somewhat marginal to the economic modernisation of Brazil.

Salvador became a large whaling port in the nineteenth century, and was also a port of call for steamships trading between Europe and Latin America. There was also gradual industrialisation. The nineteenth and early- to mid-twentieth centuries were nevertheless a period of continued relative decline. The oil and gas sector was established in the 1950s, and a large petrochemical complex in the 1970s.

In 1985 the historic centre of the city was designated as a UNESCO World Heritage Site and from 1992 there was large-scale restoration of the old city, with Salvador emerging as a major tourism hub – second in Brazil only to Rio de Janeiro. However, the restoration was also associated with large-scale displacement of the Afro-American population into *favelas* and other settlements on the margins of the city, with allegations that the regeneration of Salvador has led to the further marginalisation and exclusion of the poorest segments of the population.

There was a severe fiscal crisis in the city administration in the early 2000s, though finances were stabilised; but the current economic troubles in Brazil do pose a new set of challenges for the city.

POPULATION

POPULATION SIZE

The UN estimate for the population of the RMS in 2015 was 3.58 million, with 2.92 million for the City of Salvador.

POPULATION RANKING

The RMS ranks 112th globally as an urban agglomeration, 48th in the BRICS, and seventh in Brazil.

POPULATION GROWTH

The RMS' population growth rate was estimated at 1.6% per annum between 2010 and 2015. While this is only moderately fast growth, it is significant in relation to the near-static growth of the State of Bahia.

POPULATION DIVERSITY

As a historical hub of the trans-Atlantic slave trade, Salvador has a large proportion of its population that is of African origin. A 2015 autosomal DNA study found Salvador to be 50.8% African, 42.9% European and 6.4% Native American. In the 2010 national census, residents of the Municipality of Salvador self-identified themselves as Pardo (mixed race) (51.7%), Black (27.8%), White (18.9%), Asian (1.3%) and Amerindian (0.3%). The African ancestry is mainly from Angola, Benin, Congo, Ethiopia, Nigeria, Senegal and Mozambique. Today the percentage of the population born outside of Brazil is negligible.

STRUCTURE OF THE METROPOLITAN REGION

The physical landscape is a powerful shaping force. Salvador is on the tip of a peninsula between Todos os Santos (All Saints Bay) and the Atlantic Ocean. It has an 80-kilometre waterfront. There is a major geographical divide in the city, with steep cliffs separating the Lower Town from the Upper Town. In 1873 an elevator was constructed to connect the lower and the upper, which still transports about 9 000 people a day; but the local topography remains a powerful constraint on mobility.

As indicated in the list of municipalities below, the core city of Salvador dominates the metropolitan region. It accounted for 75% of the population in 2010, slightly down from 80% in 2000.

- City of Salvador – 2.6 million
- Camaçari – 0.29 million

» Lauro de Freitas – 0.16 million

» Simões Filho – 0.11 million

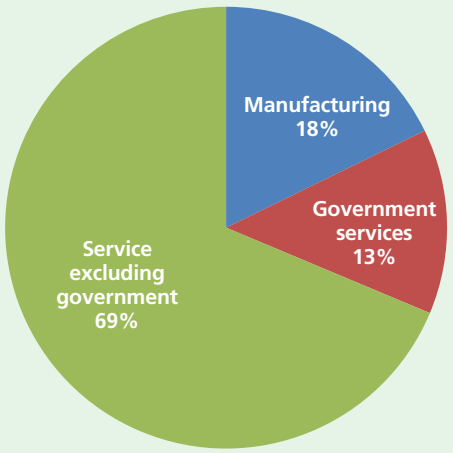
In general in the City of Salvador, the wealthier people live along the coastline, with the poorer population living inland. A significant number of households have been displaced to the city edge by tourism-led gentrification of the inner city. The municipalities outside the core city have both the wealthiest and the poorest people in the region. The so-called North Coast of the RMS is an area of hotels, upmarket gated complexes and tourist beaches. The Municipality of Lauro de Freitas is one of the most affluent. Most residents commute into Salvador on a daily basis. On the inland edge of Salvador, however, is Simões Filho, which has a much poorer population, with many residents living in precarious shelters. Further to the north-east is Camaçari, a petrochemical and automobile industrial complex, with a growing working population.

ECONOMY

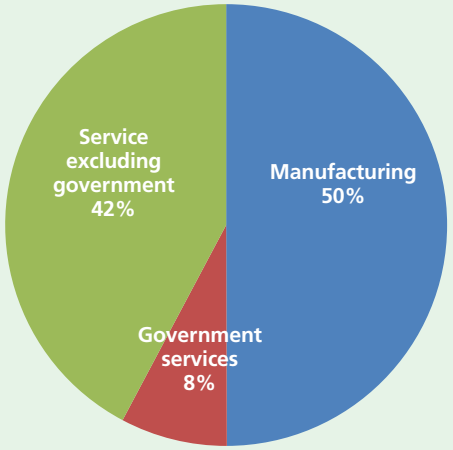
In 2014, the GDP of Salvador was around USD 38.5 billion, or 1.8% of the economic output of Brazil (Brookings). Historically, the economy of Salvador was dependent on the export of agricultural produce, and the city remains a hub for exporting crops such as cocoa, sisal and soya beans. However, the region is now dominated by heavy manufacturing and services, especially linked to tourism.

The economy is segmented between two hubs. The core city of Salvador, which accounts for 75% of the population of the urban agglomeration, only provides around one-half of the economic output. The other major economic node is Camaçari with its large petrochemical and automobile plants. In the figures below we indicate the sectoral structure of the economy separately for the Municipalities of Salvador and Camaçari, using data from the 2010 national census.

CITY OF SALVADOR



CAMAÇARI



Source: IGBE National Census 2010

Salvador is an overwhelmingly service-oriented city, although there is a modestly-sized manufacturing sector linked to port-related activity. There is a high-end business sector, including in ICT, requiring high-level business services; but also, a large tourism sector. Tourism took off from the 1990s as Salvador emerged as the second-most popular urban destination in Brazil after Rio de Janeiro, with the focus on the city's extraordinary architectural heritage, cultural diversity, and tropical beaches.

Camaçari, on the other hand, is an industrial city, with a service sector strongly present but oriented to the needs of manufacturing. The first major industrial investment was in the oil and gas sector, by Petrobras, in the 1950s. In 1978 the Camaçari petrochemical complex began operations, developing as the largest of its kind in Latin America and the Southern Hemisphere, with a cluster of more than 90 chemical and petrochemical factories. In 2001, Ford opened its most advanced motor vehicle assembly plant in Camaçari, producing more than 200 000 cars annually.

The economy of the metropolitan region grew strongly from the 1980s, but has been affected badly by the post-2014 national economic recession. Ford has laid off workers, and the oil and gas sector has been especially troubled.

GOVERNANCE

The Salvador Metropolitan Development Agency (CONDER) was established in 1974 as a public corporation. Under authoritarian rule it was widely viewed as a mechanism to exercise control from Brasilia. After the 1988 constitution was implemented, however, CONDER has acted more informally as an instrument of coordination between the 10 municipalities in the metropolitan region. Historically, the policy culture and institutional set-up in the region has been hierarchical and top-down, with low levels of popular participation; but there has been some progress in institutionalising a more participatory approach, and in decentralising functions and fiscal authority.

DEVELOPMENT CHALLENGES

Salvador is a poorer and more marginal metropolitan region than those in the south of the country, although comparable to metropolitan regions in the north such as Fortaleza, Recife or Natal. In 2016, official statistics indicated that Salvador had an unemployment rate of 14.8%, which was the highest of the 21 leading metropolitan regions in Brazil. Since the recession, unemployment has trended up rapidly.

There are entrenched historical patterns of class- and race-based inequality, with white workers, for example, having an income level 3.2 times higher than black workers. This is reflected spatially as well, with the wealthier living in desirable and well-serviced locations, and the poor mainly in spatially marginal or vulnerable areas, with limited infrastructure and facilities.

The region has a higher proportion of the population living in slums than most other city regions in Brazil. According to the 2010 census, 32% of the population of the Municipality of Salvador lived in 'subnormal accommodation'. There was a 70% increase in slum dwellers between 2000 and 2010. There has been some success with slum upgrading, most notably with the Alagados shanty town.

Salvador is considered to be one of the most violent cities in the world. In 2015, Salvador was ranked 14th in the world for homicide by Mexico's Citizens' Council for Public Security and Criminal Justice, at 60.6 murders per 100 000. The United Nations Office on Drugs and Crime has placed it at 13th for violence globally. The crime is concentrated in the poorer areas, with the outlying municipality of Simões Filho regarded as one of Brazil's top-ten hotspots for gun-related crime.

The region also faces environmental challenges. The Institute of the Environment and Water Resources survey has indicated that 81% of rivers within the boundaries of the Salvador Municipality are highly polluted, with beach and air pollution also at unacceptably high levels.

THEMATIC REPORTS

TRANSPORT

ECONOMIC INFRASTRUCTURE

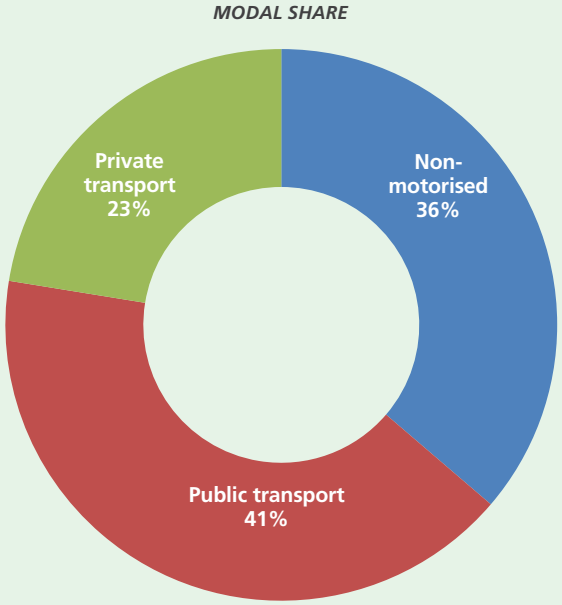
The Port of Salvador has the highest movement of containers in the north and north-east of Brazil, especially for the export of fruit. A recent expansion and modernisation project has doubled its capacity to handle containers, resolving a bottleneck. Deputado Luís Eduardo Magalhães International Airport ranks eighth in Brazil, with around 8.8 million passengers annually. It is significant as a tourism gateway, and a large upgrade is planned.

PUBLIC TRANSPORT

The metropolitan region of Salvador has long historical challenges with transport. Underinvestment in maintenance and new infrastructure has compounded the effects of the difficult topography. The lack of integration between different modes of transport, planned and run by different public and private agencies, has made it difficult to resolve the challenges.

The 2012 mobility survey sponsored by the state government indicates the following modal share of most frequent trips in the metropolitan region. Relative to the metropolitan regions of São Paulo and Rio de Janeiro, for example, there is more dependence in Salvador on public transport than on the private automobile, reflecting the generally poorer population in this city region.

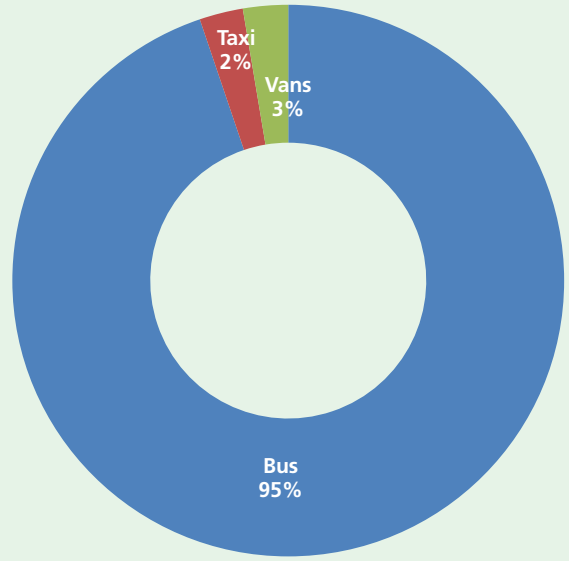
MODAL SHARE



Source: SEINFRA, Bahia State Government (2012)

For public transport only, the story is one of overwhelming dependence on bus-related transport – even more so than in other metropolitan regions where there is some commuter rail transport, for example. However, 2012 was before the launch of Salvador's metro system, and there may be a shift in the future.

MODAL SHARE OF PUBLIC TRANSPORT



Source: SEINFRA, Bahia State Government (2012)

BUSES

Most commuters are carried on municipality-contracted buses, with smaller proportions of scholar transport and chartered buses. In the Municipality of Salvador there is a System of Public Transport by Bus (STCO) which consists of over 500 bus lines operated by 18 companies with a fleet of around 2 500 vehicles, carrying an average of 1.5 million passengers per day. The seven next-largest municipalities in the region, including Camaçari, Lauro de Freitas and Simões Filho, have established a System of Intercity Passenger Transport that has around 80 bus lines operated by 13 companies. There have been frequent complaints of overcrowding, poor maintenance of buses and irregular scheduling, with one of the problems being competition on the same routes by multiple companies, often creating chaotic conditions. However, the 2014 FIFA World Cup was a catalyst for some improvement, with the introduction of customer information, complaint and assistance services.

METRO

The major advance in terms of public transportation has been the launch of the Salvador Metro, though the project has taken more than 14 years to be realised. Construction of the first stage of the project commenced in 2000, with completion scheduled for 2003; but it was postponed to 2008 and then to 2012, when a small, experimental section of the metro was opened.

The municipality was initially responsible for the project, but struggled with lack of resources and management capacity. In 2013, the state government took charge, and proceeded with a Build, Operate and Transfer (BOT) arrangement with a consortium of companies, including Spanish firms. In 2014, in time for the FIFA World Cup, Phase One of the metro was completed, with around 13km of track and eight stations.

OTHER

There are a number of other modes of transport, although they are minor in relation to the dominant bus services. These include taxis, the paratransit vans, a bike-sharing scheme (Bike Salvador), ferries, and the urban elevators between the lower and upper town.

FUTURE

There are multiple challenges still to be addressed, especially in terms of multi-modal integration across the agencies of government and the private sector. In the meanwhile, there are plans to expand the metro into Phase Two, with the State of Bahia also considering the construction of a Light Rail Transit (LRT) system to connect the peripheries of the city to the centre.

GREEN ENERGY

Progress with green energy has happened mainly through support from federal and state government, with municipalities still generally uninvolved. The State of Bahia is now a hotspot for energy production from renewables in Brazil, benefiting from incentives provided in terms of the federal government's Incentive Programme for Alternative Energy Sources, and from the auctioning of rights to produce green energy. Bahia, for example, was the 2014 winner of the Reserve Energy Auction held in São Paulo, and as a result, the state will receive 773.1MW in new solar and wind power-generation projects, with an investment of USD 3.4 billion in new investments.

The Italian energy company Enel Green Power has developed six wind farms in Bahia and is continuing to expand, but companies from France, Spain and Brazil are also involved. Enel is also involved in the development of a 254-megawatt solar farm in Bahia, which is said to be the largest of its kind in Latin America.

The State of Bahia's electricity distribution company, Coelba, is also involved in the micro-generation of various initiatives to improve energy. The best-known initiative is a solar plant to power a soccer stadium in Salvador, as a partnership with the State government and a German aid agency. Coelba has approval, under the Clean Development Mechanism (CDM) of the United Nations (UN), to generate carbon credits, and has a scheme to incentivise consumers to use low-energy-usage home appliances. In addition, the State of Bahia offers state tax exemption for micro and mini energy production.

INNOVATION-DRIVEN ECONOMY

As one of Brazil's poorer metropolitan cities, Salvador may seem out of the innovation mainstream. Its international ranking in the 2015 2think now Innovation Cities Global Index was 251, making the city a middling to low innovator in BRICS terms. However, Salvador has achieved considerable success in innovation in particular niche areas.

Salvador hosts one of the most advanced technology centres in Brazil, the Salvador Research Park, providing engineering and technological services, as well as product development in industries including mechanics, automotives, polymers, electronics and renewable energy. The Park encourages innovation partnerships among the public, private and academic sectors.

Salvador has established a strong niche in super-computing and robotics. The Centre for Integrated Manufacturing and Technology (Senai CIMATEC) in Salvador was founded in 2002. Senai CIMATEC has collaborated in creating the fastest-ever supercomputer in Latin America. The Brazilian Institute of Robotics (BIR) was opened in Salvador in 2013, and has quickly emerged as a leader in Latin America.

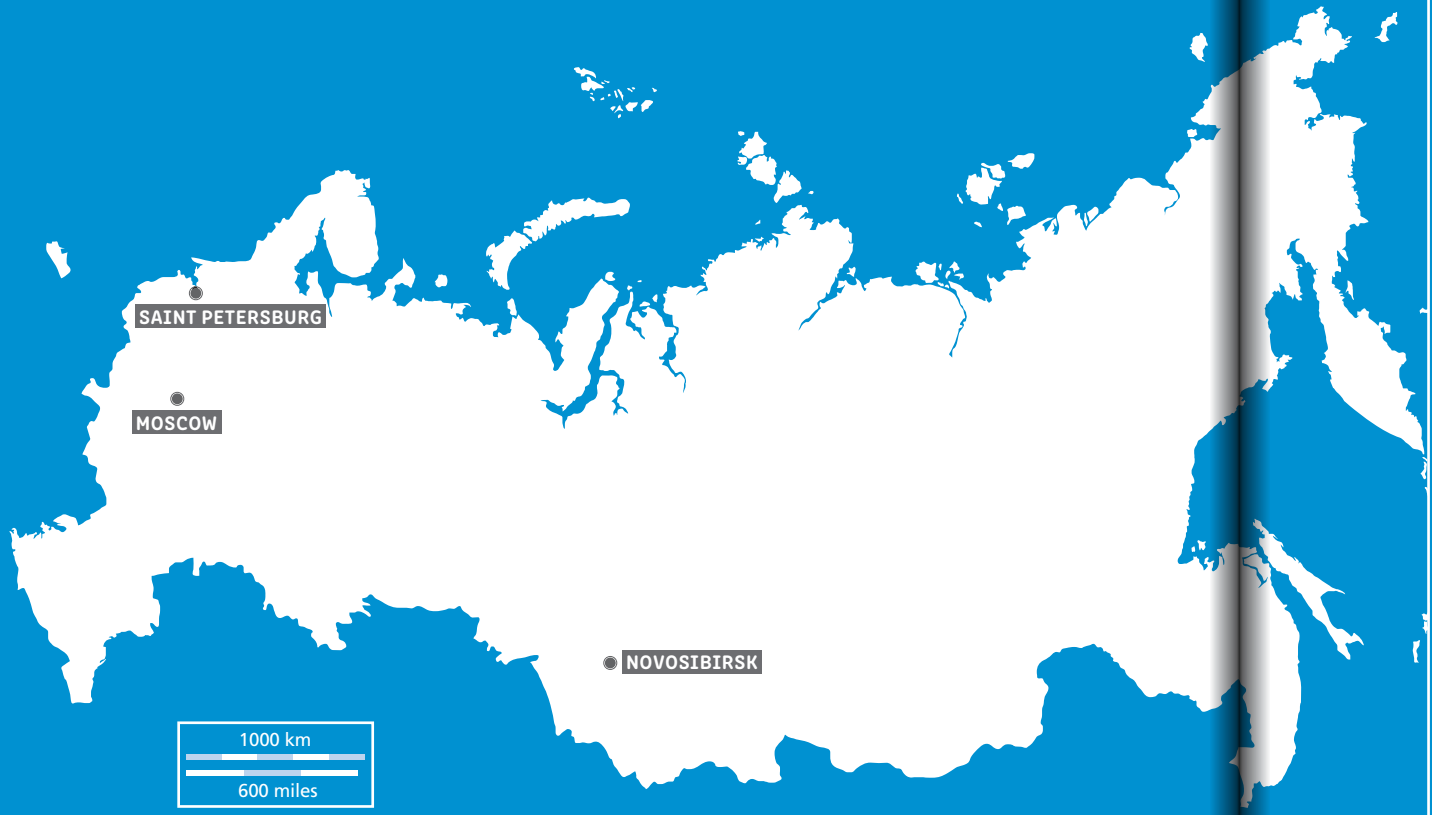
Innovation has happened in other ways too. Salvador has been lauded, including by the President of the World Bank, for a state-of-the-art medical facility opened in 2010, which provides high-quality healthcare to low-income families. The Hospital do Suburbio is Brazil's first full, large-scale health facility established and run through a Public-Private Partnership. The process of establishment was innovative in other ways too, as the equipment and medical and administrative services were open for bidding through the Brazilian Stock exchange (BOVESPA), which produced considerable savings.

With its strong cultural heritage, Salvador is also becoming known for new ventures, products and services. Attempts to develop legacy cultural programmes for the 2014 FIFA World Cup and 2016 Olympic Games have also strengthened the advantage in this area. Finally, Salvador is known for the innovative slum-upgrading programmes that have been implemented in partnership with the Italian government and the international agency Cities Alliance.

THE RUSSIAN FEDERATION

BASIC FACTS

» Level of urbanisation (2015) – 75%
» Total urban population (2015) – 105.16 million
» Annual rate of urban growth (2010-2015) – minus 0.13%



MAJOR URBAN AGGLOMERATIONS WITH 2015 POPULATION (FACT SHEETS INDICATED WITH *)

» Moscow – 12.17 million*
» Saint Petersburg – 5 million*
» Novosibirsk – 1.5 million*
» Yekaterinburg – 1.4 million
» Nizhniy Novgorod – 1.2 million
» Chelyabinsk – 1.16 million
» Kazan – 1.16 million
» Omsk – 1.16 million
» Samara – 1.16 million
» Rostov-na-Donu – 1.1 million
» Ufa – 1.1 million
» Krasnoyarsk – 1.0 million
» Volgograd – 1.0 million

BRIEF HISTORY OF URBAN DEVELOPMENT

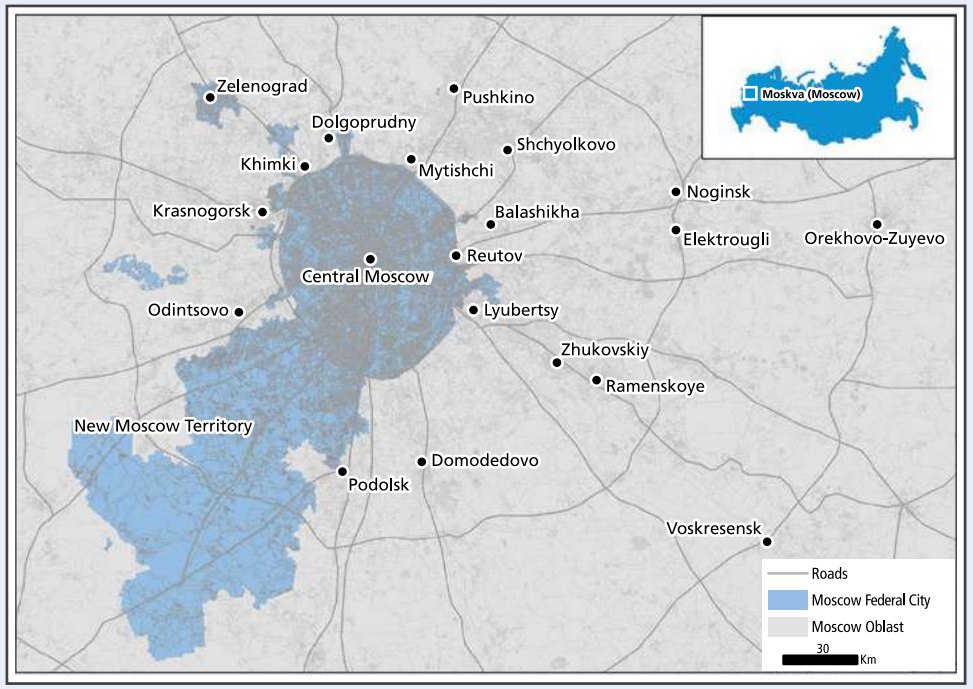
Russia's cities have evolved through the complex history of the last thousand years. As Russia gradually coalesced into an extended empire, cities rose and fell. However, by the 19th century two cities had emerged as the leaders: Moscow and St. Petersburg. The 20th century was turbulent for Russia, with wars and revolutions; many cities were nearly destroyed, but recovered. The rapid increase in levels of urbanisation happened mainly in the Soviet era, because of a large-scale, state-led programme of industrialisation; but came to a halt around 1990, as state-owned industries were privatised and rationalised. For a decade or so there was even a modest level of reverse urbanisation. This has also happened within the context of overall negative population growth, with low national levels of fertility. There was economic recovery in the 2000s, but many Russian cities still have unchanged or declining populations. Moscow emerged as the main gateway to the world in the post-Soviet era and has done well economically, and other cities, including St. Petersburg and Novosibirsk, have also experienced renewed growth.

URBAN GOVERNANCE

Russia is a federation of 88 entities of different sorts, although it has a strong central government with an executive president. Among these entitles are 'autonomous republics' for ethnic or linguistic (non-Russian) minorities. There are also oblasts or regions, each named after their capital city. They have elected legislatures and appointed governors. Moscow and St. Petersburg, and now also Sevastopol in the annexed region of Crimea, are federal cities. Federal cities are municipalities but are also entities of the Federation, and so have a status equal to an oblast. Moscow is headed by a mayor and St. Petersburg by a governor. There are over 12 000 municipalities across Russia, of which around 600 are recognised as cities. The division of power between the centre and the subnational entities varies, with some flexibility in the way the constitution has been interpreted. There has been an attempt to ensure greater central authority with the grouping of federal units into federal districts, each of which has a presidential envoy titled a Plenipotentiary Representative of the President of the Russian Federation.

MOSCOW URBAN AGGLOMERATION

Moskva or Москва



CONTEXT

LOCATION AND STATUS

Moscow is situated on the Moskva River, in the Central Federal District of the Russian Federation. It is the capital city of the Russian Federation, and also the cultural and economic hub of the country.

HISTORY

Moscow is said to have been founded in the 12th century, although there were settlements there going back to more ancient times. It was a defensive settlement, on a relatively high spit of land alongside the Moskva River. Moscow was burnt to the ground in the 13th century by Mongol invaders; and although rebuilt, had a turbulent history for centuries to follow.

During the 14th to 17th centuries, Moscow developed into one of the most powerful cities in Russia; serving as the capital of a progression of states, from the Grand Duchy of Moscow to the subsequent Muscovy State (Tsardom of Russia). In 1571 an invasion of Crimean Tatars led to the near-destruction of the city, but again it was rebuilt and defences improved. There were various other disasters and political crises; nevertheless, they did not stop the growth of Moscow as the capital of a fast-developing country. However, in 1712 Peter the Great moved the capital of Russia from Moscow to St. Petersburg, which led to a decline in Moscow's fortunes. But from 1750 the population began increasing, and the economic strength of Moscow improved.

In 1918, Vladimir Lenin returned the capital to Moscow. The city was the centre of Soviet rule and developed rapidly through the twentieth century, surviving Nazi invasion during World War II. In 1935 the Moscow Metro was opened as a flagship urban project. In the 1950s and 1960s there were many large, centrally-planned development projects in and around Moscow, and the growing demand for labour brought large numbers of migrants to the city. The growing population was largely accommodated in industrially-produced blocks of flats in neighbourhoods called microraion ('micro-neighbourhoods') that were planned for 5 000 people each and had supporting services and facilities.

With the collapse of the Soviet Union in 1990, Moscow became the capital of the Russian Federation. It became the gateway to the global economy, and consolidated its position as the financial, economic and political heart of Russia. While Moscow has around 8.5% of Russia's population, it accounts for more than half of Russia's banking activity and a third of its retail trade.

POPULATION

POPULATION SIZE

According to the Russian Federal State Statistics Service (Rosstat) the 2016 population of the City of Moscow is 12.3 million, although the actual figure may be higher due to the presence of undocumented migrants. The UN figure for 2015 was 12.17 million.

POPULATION RANKING

In terms of UN data the Moscow urban agglomeration is ranked 22nd in the world, 10th in the BRICS, and first in the Russian Federation.

POPULATION GROWTH

The annual estimated growth for the period 2010 to 2015 is 1.19%. This is in the context of actual shrinkage in urban population nationally (-0.13%). The growth of the urban agglomeration is driven by migration from parts of Russia (especially the Urals, Siberia and the Far East), ex-Soviet republics, and poorer parts of Europe such as the Balkans.

POPULATION DIVERSITY

The 2010 census indicated that 91.6% of the population was ethnic Russian, with the remainder including Ukrainians (1.4%), Tatars (1.4%), Armenians (1%), Azerbaijanis (0.5%), and a range of other minority groups in smaller numbers. However, the proportion of minorities may actually be higher; the Federal Migration Service reports that there are around a million migrants in Moscow, the larger proportion undocumented.

STRUCTURE OF THE URBAN AGGLOMERATION

The City of Moscow, with its population of 12.3 million, is surrounded by the Moscow Oblast (or Moscow region), which has a population of seven million. Since the Moscow Oblast is around 80% urbanised, we may speak of an extended urban region for Moscow of around 17.9 million people. After Moscow, the largest cities in the extended region are Balashikha (580 000), Podolsk (361 000), Korolev (254 000) and Khimki (240 000). These cities are more manufacturing-based than Moscow, which has a predominantly service economy.

The City of Moscow is enormously dominant within its immediate urban agglomeration. The city has developed in concentric rings, and remains predominantly focused on the historic urban core. In the post-Soviet era, however, this monocentric city has developed a somewhat more complex and polycentric urban structure, with new business nodes emerging outside the core. The outer areas of Moscow city have grown about twice as fast as the inner areas in this latter period.

The inner area remains the major employment generator, and there is massive congestion daily as Muscovites move between the suburbs and the core. This congestion has prompted Moscow authorities to initiate a hugely ambitious scheme to de-concentrate Moscow's development. The initial intention was to relocate federal government functions to New Moscow but this is now unlikely to happen. There is however already significant residential development with projections of 1.5 million inhabitants by 2025.

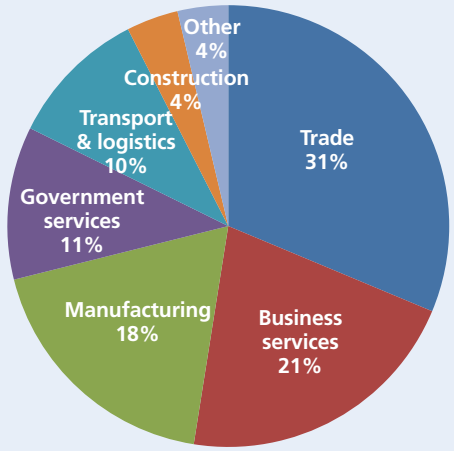
A spatial challenge into the future is the possibility of extended urban sprawl. In the post-Soviet era, many middle-class and wealthier Muscovites took up second homes (dachas) in the green belt around Moscow. Currently the Russian government is trying to counter the declining national population; a new era of housing expansion is on the cards which could lead to further urban sprawl, as the Russian government is trying to counter the declining national population by granting land to families with three or more children for single-family houses with plots of up to 1 500m2, many of which are likely to be developed on the outskirts of Moscow.

ECONOMY

In 2014, Moscow had a GDP of USD 553.3 billion (Brookings). This made Moscow the second-largest urban economy in the BRICS, having recently been overtaken by Shanghai.

Moscow has a diverse economy, not dissimilar to many large urban agglomerations internationally. Trade is the largest sector, but there are significant contributions from business services, manufacturing, government services and transport.

SECTOR SHARE OF CITY GDP, 2013



Source: Brookings Institution, with data from Moscow City Investment Agency

With the ending of communist rule, Moscow's economy has been through major transitions. The first was the decline in state employment and the rise of the private sector. There has been a significant shift from a manufacturing to a tertiary economy, with the rapid growth of trade and business (especially financial) services. There was also a dramatic decline in employment in government-owned enterprises (from 73% to 42% between 1992 and 1996).

For Moscow's population, these changes were double-edged. Many individuals were far more vulnerable than before, but some were well-placed to benefit from the privatisation of Russia's mainly Moscow-headquartered state corporations. In 1990, about a tenth of personal wealth in Russia was in Moscow; this has since increased to a quarter, while Forbes Magazine lists Moscow as second in the world, after New York, in terms of dollar billionaires.

Moscow has performed relatively well in terms of economic and employment growth, with an average of 3.5% GDP growth per annum in the 15 years until 2014. However, Russia is facing difficult economic times, and this is affecting the city's prospects. Moscow has the potential to develop further into an open, global city, but it is constrained by cyclical and structural weaknesses in the Russian economy, which include high dependence on oil and gas exports in the context of a volatile commodities market.

GOVERNANCE

Moscow – together with Saint Petersburg and Sevastopol – has special status in the Russian system. It is a federal city with powers to raise its own taxes, which are not available to other cities. In effect, Moscow is equal in status to a second-tier government, not a municipality.

In the post-Soviet era, Moscow's governance was fundamentally transformed. The legislative authority is the Duma, with 35 elected Deputies, and there is also a city-level judicial authority. Executive power rests in the Mayor's office, with a directly-elected Mayor and Seven appointed Vice-Mayors. The Mayor is effectively the Prime Minister of Moscow, and holds enormous power in relation to functions such as the city budget, taxation, planning, service provision, municipal international relations, regulation of property markets, transportation, business development and city development programmes. Since the city administration retained its ownership of much of the property in Moscow, it has a strong influence over business ventures, and is deeply involved in property-development initiatives.

There has been considerable continuity in terms of city leadership. Yuriy Luzhkov was elected Moscow Mayor in 1992 and served five terms, until 2010. The current Mayor is Sergey Sobyanin who was initially appointed by the Federal President on the removal of the previous Mayor but then successfully stood for election. In terms of administration – without New Moscow, added in 2012 – Moscow is divided into 10 administrative districts with 125 local areas (uprava) but these have very little power. Urban planning responsibility rests with the Central Research and Design Institute of Master Plans of Moscow.

DEVELOPMENT CHALLENGES

In relation to Russia and to the BRICS, Moscow is a wealthy city. It has a large middle class, and a per-capita income that significantly exceeds that of any of the other regions in Russia, except for a few oil-extraction regions.

However, Moscow does face developmental challenges. There is growing social polarisation in Moscow. Post-Soviet privatisation has led to massive wealth creation for the elite, but greater economic insecurity for many others; and to an influx of migrants, who often live illegally and vulnerably in run-down ghettoes. The UN Habitat's World Cities Report (2016) gives a Gini coefficient of 0.45 for Moscow, with an official figure of 0.43.

Although Russia's overall population may be declining, Moscow still experiences the challenges of a large, growing city. Issues of traffic congestion, environmental pollution, dilapidated housing and high cost of living are often cited as major urban challenges for Moscow, and account for its relatively low position in quality-of-life rankings. In the Mercer's Quality of Living Survey (2012), Moscow ranked only 154th in 2012, behind other large BRICS cities with lower average incomes such as Shanghai (86th), Rio de Janeiro (98th), Johannesburg (111th), São Paulo (116th) and Mumbai (134th).

Housing is a major challenge for Moscow. Housing was mass-produced during the Soviet era. Problems of quantity were largely resolved, but quality became a major problem; over the past four decades, many apartment buildings have deteriorated to slum-like conditions.

The environmental problems of Moscow are also a major concern. These relate to the footprint of an economy that developed on the back of plentiful and cheap oil and gas reserves, but also to the

effects of traffic congestion, pollution from inefficient and ageing industry, the inefficiencies and costs of heating systems for buildings, and a serious lack of green space in the city.

THEMATIC REPORTS

TRANSPORT

Moscow has become one of the world's most congested cities, thanks to a combination of a massive increase in private car ownership since the 1990s; a largely monocentric urban form (with 70% of all jobs within 6.5km of the Kremlin); and city-government investments in new freeways (with two new ring roads constructed, and two further freeways under construction).

In 2012 Moscow was rated in terms of the TomTom Index as the most congested city of 161 cities investigated across in the world. With around 4.5 million private motor vehicles Moscow was on course to overtake cities in Germany as the most car-oriented society in Europe. However, by 2016 Moscow had dropped to 5th position on the TomTom Index, suggesting possible improvement as a result of a concerted shift towards the support of public transportation under Mayor Sobyanin.

In 2010, the development of transport infrastructure to address the massive congestion in the city was defined by the Mayor as the city's top strategic objective. Public transport is the key element of this development, but there is still conflict between continued expenditure on freeway development and investments in rail, tram and bus infrastructure. The expansion of this infrastructure must be seen together with the ambitious scheme to de-concentrate residence and employment in the city through the development of New Moscow.

Figures on the modal share of public and private transport are not available, but both are likely to feature strongly, with the metro the major mode of public transport.

RAIL

The Moscow Metro, run by a public utility called Moscovsky Metropoliten, is the public transport flagship. It was opened in 1935 with a single line, but now has 12 lines and around 200 stations. It carries around 6.5 million passengers a day, and is ranked fourth in the world in terms of ridership. The challenge of the metro may be that it is too popular, leading to serious congestion during peak hours. The metro was refurbished between 2012 and 2016, with an additional 86km of track, 13 new stations, 2 200 new rolling stock, and a state-of-the-art new information system for passengers. It is anticipated that this will support an 18% increase in commuter traffic on the metro, and reduce the number of residential districts in Moscow without a subway station from 22% to 13%.

There are other forms of rail in Moscow as well. Commuter trains (Elektrichkas) linked to the long-distance rail system are served by nine stations in Moscow, while the monorail – a light-rail system, on elevated tracks – was opened in 2004.

In September 2016, Moscow took a significant step forward with the opening of the Central Ring. This is a light rail system similar to Germany's S-Bahn which encircles the core city of Moscow following a belt of derelict industrial land which is targeted for rehabilitation.

BUS AND TRAMS

Moscow has an extensive bus system supporting the metro, with routes radiating out from the metro stations. The system is currently being upgraded, with refurbishment of the bus fleet, the construction of new bus stations, and the introduction of intelligent transport systems. There is an old tram and trolleybus system, but it only accounts for 5% of commuter ridership. The bus and trams are managed by Mosgortrans, a public utility that is the largest of its kind in Europe.

OTHER

A highly flexible form of transportation is the microbus (small passenger van), which offers a 'private alternative' to the state-owned transportation systems. In addition there are official and private metered taxis, and river transport between early April and mid-October.

FUTURE

In the post-Soviet era there was general neglect of the public transport system, but finally, ambitious plans for the modernisation of public transport are coming to life. This includes current upgrades to the metro and bus system and attempts to promote non-motorised transport, such as bicycle sharing. However, there is continual tension between budget allocations for new freeway development, and allocations for improvements to public transportation. Interestingly, in the case of the new Moscow ring road there are plans to construct a series of interchange terminals along the road, which would allow it to be used for high-speed public transport instead of private motor cars.

Within the wider region, an ongoing problem is the lack of proper coordination and cooperation between the City of Moscow and Moscow Oblast but a joint co-ordinating commission between the City and Oblast was established at the instigation of federal government and this has led to collaborative initiatives such as the Central Ring..

GREEN ENERGY

Russia has had an abundance of fossil fuels; this has skewed the economy towards the use of high-carbon energy sources, and also contributes to many inefficiencies in the use of energy. A powerful player in the field is Gazprom, Russia's energy giant, which produces 75% of the world's gas.

Renewables continue to play a very minor role in total energy production. In 2008, only 0.2% of electricity nationally came from renewables, compared with 68% from fossil fuels, 16% from nuclear, and 16% from large hydro. Targets were set for up to 10% production from renewables by 2030; but there is a very powerful in-built bias toward gas, coal and oil technologies, with domestic consumption from these sources heavily subsidised. The result is that there has been very little progress towards renewables, and it is anticipated that at the current rate of development the share of renewable in total electricity production by 2030 will only be 1.5%. The challenges in moving towards green energy have to do with the lack of market competitiveness of renewable energy sources in relation to carbon fuels; the lack of legal and regulatory frameworks to support renewable energy production; and the powerful interests of companies producing fossil fuels. Market price reform is seen as especially critical for creating an environment in which renewables become market-competitive, but this is taking time.

There are some signs of new interest in renewables nationally, although there is still a long road to travel. In 2013, for the first time, Russia introduced subsidies for renewables. In the same year 39 projects were approved to produce 504MW of electricity using green sources. The major areas of possibility are diverse: biofuels, small and micro hydro energy, geothermal, biomass, wind, tidal, and solar.

The City of Moscow has its own municipal power plants, run by the power utility Mosenergo, now owned by Gazprom. The nearly-13 000MW production is predominantly gas-based with little attention paid to renewables, but there are efforts to increase the efficiency of production with a new generation of gas plants, in partnership with global companies. The City of Moscow did introduce a measure in 2011 – the Green Energy Project – that gives city residents a choice between using traditional sources of energy, or (slightly more costly) energy from small hydro and incineration plants.

With the slow and erratic pace of development of production from renewables, the greatest progress towards a more environmentally-friendly energy sector is likely to come from greater ef-

ficiency in the use of energy, however it is produced. Energy intensity in Russia is 2.5 times higher than the world average, with most of the inefficiency coming from both the historical practice of subsidising energy costs, and from ageing and inefficient equipment, buildings and technology. Russian buildings, for example, are twice as energy-inefficient as buildings in Canada, a country with similar climatic conditions, and there are large gains to be had overall from improving efficiency in buildings. The major contributor to the inefficiency in buildings is space heating (58% of energy used), followed by water heating (25%), cooking (10%), appliances (4%) and lighting (2%). In addressing this, standards for new buildings are necessary; but far more important is retrofitting most Russian buildings, as there is a strong negative correlation between energy efficiency and building age.

In 2008, the federal government identified energy efficiency as one of five strategic priorities for modernising Russia, and identified mandatory targets for improving efficiency. Moscow took the lead in 2011 in implementing this national programme with the introduction of a comprehensive energy-savings programme for the city, with the aim of reducing energy use by 2020 by 40% off 2007 levels. The city now has a number of projects to ensure compliance with energy-efficiency measures in new buildings (for example, the Vorontsovo, Nikolino and New Circle developments), and has decreed that energy efficiency will be a major factor in development approvals in Moscow's new boundary-expansion programme. There are also projects for the retrofitting of old buildings (beginning with government buildings). Apart from the problems of heating and energy efficiency in buildings, Moscow is faced with the immense task of replacing more than 70% of the infrastructure of its outmoded district-heating system.

INNOVATION-DRIVEN ECONOMY

According to the 2thinknow 2015 Innovation Cities Global Index, Moscow was ranked 45th out of 442 cities surveyed in 2015. Moscow is now rated fourth in the BRICS after Shanghai, Beijing and Hong Kong, and may be regarded as one of the BRICS innovation leaders, although arguably it should be performing even better in global terms given its large concentration of intellectual resources.

Moscow's integration into the global economy has been facilitated by its pool of young, talented entrepreneurs; the huge concentration of science-based research in the city; and a local leadership strongly focused on positioning Moscow globally. A high proportion of Russia's intellectual potential rests in Moscow. For example, the proportion of the population with higher education in Moscow is 42.1%, compared with 23.4% for Russia as a whole.

Moscow is home to numerous research centres, governmental and corporate think tanks, and state academies of science (most importantly, the Russian Academy of Science); also, informally, prominent universities, IT companies and industry R&D centres. In 2014 there were 709 organisations undertaking science studies and R&D activities in Moscow, and a further 241 in the Moscow Oblast, with around 169 000 researchers in total. Moscow's share of national science employment is 32%. Moscow has the-second highest concentration of high-ranking universities in the BRICS, after Beijing. It has five universities in the QS BRICS Top 50 for 2016: Lomonosov Moscow State University (7th), Bauman Moscow State Technical University (38th), Moscow State Institute of International Relations (MGIMO University) (44th), Moscow Institute of Physics and Technology (MIPT/Moscow Phystech) (47th), and the National Research Nuclear University (50th).

But there are a number of challenges. R&D investment is still mainly from state investment and state-owned companies, with R&D by private companies fluctuating but at relatively low levels. After the collapse of the Soviet Union there was a substantial cut in state investment in science-related research, with a significant drop in science-related personnel and also a decline in tertiary students. However, there are indications that this trend may be shifting, with increases since 2013.

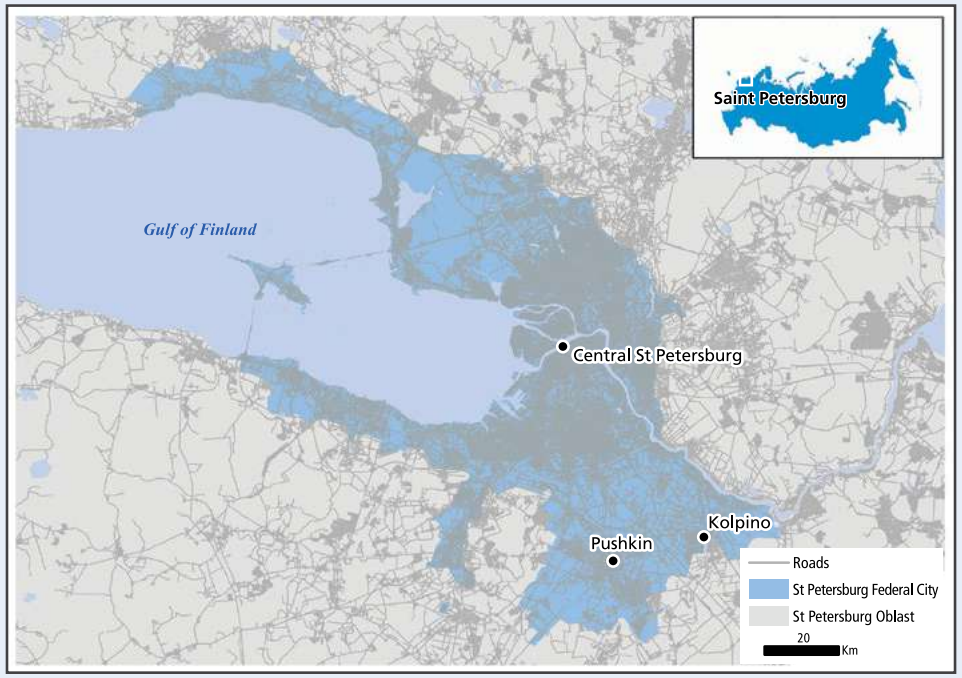
Moscow's nodes of innovation in high technology have existed since the Soviet era, and include nuclear energy, aerospace, and microelectronics and instruments, with major research centres for each of these industries. There are also new areas of innovation that reflect post-Soviet economic trends, including business services, ICT, pharmaceuticals, and culture and media. For example, PwC ranked Moscow eighth by number of Global 500 headquarters in 2014, which provides a key stimulus for innovation in business services.

There are specific hubs of innovation across the city-region. In the Soviet era, specialist research was located in different cities. There were distantly-located science cities, but also R&D centres in smaller cities on the edge of Moscow, for example. This geography of research and innovation is shifting, however; although there is still a legacy. One of the major groupings of science and research institutions is in the south-west of Moscow, around Moscow University and the Russian Academy of Science.

The Government of Moscow is actively promoting innovation through its programme 'Moscow – innovation capital of Russia'. There are 558 facilities of various kinds supported by the city administration (for example, co-working spaces, R&D institutions, techno parks, and the special economic zone in Zelenograd satellite city). There is also the Agency for Innovative Development, which undertakes promotion of innovation activity for youth, and a series of cooperative developments with federal government. Moscow is also establishing a profile as a 'Smart City' with leading-edge introduction of technology in the fields of transportation and health management in particular.

SAINT-PETERSBURG URBAN AGGLOMERATION

Sankt-Peterburg and Санкт-Петербу́рг



CONTEXT

LOCATION

Saint-Petersburg (also spelled St. Petersburg) is located at the mouth of the Neva River, in the Gulf of Finland in the Baltic Sea. It is the second-largest city in Russia.

HISTORY

St. Petersburg was founded by Tsar Peter the Great in 1703, as a fortress on the delta of the Neva River. In 1712 this new settlement became the official capital of the Russian Empire. St. Petersburg was a planned city that was constructed rapidly, over a single generation.

In its development, there were strong connections with Europe, and St. Petersburg is said to have developed as the most 'European' of Russia's cities. In the 18th century St. Petersburg is said to have surpassed Moscow in its capital splendour, and in the first half of the 19th century it surpassed Moscow in terms of population.

In 1918, however, Vladimir Lenin moved the national capital back to Moscow; and St. Petersburg (then Petrograd) was reduced to provincial-city status, as administrative centre of the Leningrad Region. St. Petersburg continued to grow, although at half the rate of Moscow, and suffered a series of severe setbacks.

During World War II, the city was devastated by the 872-day Siege of Leningrad. More than a million citizens died, mainly from starvation, and the city was depopulated. At the beginning of World War II it had around three million residents; by the end of the war, only 546 000. But the city recovered, and the population curved upwards to a peak of five million in 1990. The post-Soviet era began badly for St. Petersburg, as large numbers of workers in public enterprises lost jobs. The population dropped slightly, food rationing was introduced, and the city received international humanitarian aid. The economy stabilised by around 2000, and since then economic growth rates have significantly exceeded those of the national economy. The traditional manufacturing economy has revived, and St. Petersburg has gained an enviable reputation as a cultural and tourist hub.

POPULATION

POPULATION SIZE

The 2015 population of the St. Petersburg urban agglomeration was estimated by the UN Population Division as almost five million – up from 4.5 million at the time of the National Census of 2010. However, there are alternative estimates, with a figure of close to six million for the urban region provided by the St. Petersburg Science Research and Design Institute of Town Planning.

POPULATION RANKING

In terms of UN data, St. Petersburg is ranked 74th in the world, 32nd in the BRICS, and second in Russia.

POPULATION GROWTH

The annual population growth in the period 2010 to 2015 is estimated as 0.49%. There were points of dramatic population collapse during the twentieth century, and a slight decline after the collapse of the Soviet Union, with population declining from five million in 1989 to 4.8 million in 2002; but modest growth has been restored.

POPULATION DIVERSITY

In terms of the 2010 National Census, 92.5% of the St. Petersburg urban agglomeration was ethnic Russian; followed by 1.5% Ukrainian, 0.9% Belarussian, 0.7% Tatar, 0.6% Jewish, 0.5% Uzbek and 0.5% Armenian, with a large variety of other groups in lesser concentrations.

CITY-REGION STRUCTURE

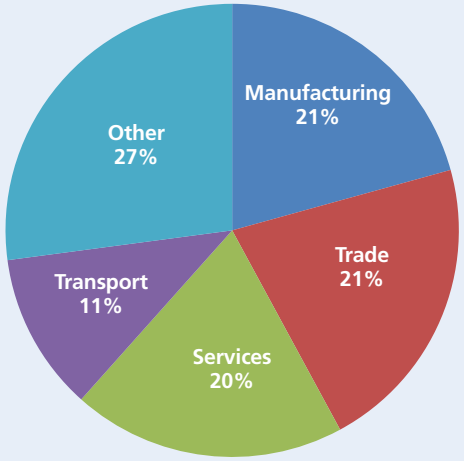
St. Petersburg is a highly monocentric city-region. The core city radiates out from a dominant core, and entirely dominates the region. The urban agglomeration extends in a radius of about 50km from the centre of St. Petersburg, including the City of St. Petersburg and part of the Leningradskaya Oblast. The core city has a dense urban fabric, but some of the highest residential densities are on the urban edge, where large, communal residential facilities were built during the Soviet era. Immediately surrounding the core are small satellite cities. Kolpino (population 139 000) is a steel-making city and Vsevolozhsk (60 000) has a Ford automobile plant; but Petergof (73 000) and Pushkin (93 000) are cultural hubs and university cities, and Sertolovo (50 000) is a military town. Further out is a second ring of satellite cities, including Gatchina (90 000), a cultural centre and railway hub, and Sosnovy Bor (60 000), the site of Leningrad Nuclear Plant.

ECONOMY

In 2014, St. Petersburg had a GDP of USD 119.6 billion, or 4.5% of the economy of Russia (Brookings). This is only one-fifth the size of Moscow's economy, indicating the large differential between the first and second city in Russia. St. Petersburg is also lagging in terms of GDP per capita, which is only around 62% of that of Moscow. However, while St. Petersburg lags behind Moscow by a long distance, it is nevertheless well in advance of most of the rest of Russia.

As indicated below, St. Petersburg had a well-balanced economy in 2012. Manufacturing still contributed significantly, although other sectors also had a strong presence.

SECTOR CONTRIBUTION TO ST. PETERSBURG'S GDP, 2012



Source: Russian Statistical Agency, Rosstat, 2015

In the late Soviet era, half of the working population of St. Petersburg was in manufacturing and the building trades – a figure that has declined to (a still substantial) quarter. The city specialised in heavy industries, and these were most affected by the ending of state socialism. St. Petersburg's economy was embattled in the 1990s, as Russia made its complex transition to a market economy. There were massive job losses following the closure of the most inefficient of the previous state-run industries, leading to large swathes of derelict industrial land in the city (which the city is currently attempting to deal with through land rehabilitation and rezoning).

The economy stabilised in the 2000s, as the growth of sectors such as trade, tourism, real estate and transport compensated for the decline of manufacturing, and also as manufacturing itself experienced some revival. In relation to many other large cities in the BRICS, St. Petersburg still has a large manufacturing base. The traditional sectors are shipbuilding, heavy engineering, automobile manufacturing (the city has been called the 'Detroit of Russia'), transportation machinery, chemicals and pharmaceuticals, and brewing. However, the city has also seen the emergence of 'new economy' sectors such as aerospace, electronics, and computer software.

Ironically for a hub of heavy industry, St. Petersburg is also informally known as the 'cultural capital of Russia'. The city centre is a UNESCO World Heritage site famous for its historical monuments, but it also has many festivals and cultural institutions, including theatres, museums, galleries and libraries. There has been a significant increase in tourist numbers, with local government reporting, for example, that visitors to city museums and galleries increased from 17.7 million in 2010 to 22.9 million in 2014.

Under the auspices of the Russian President, the city hosts the St. Petersburg International Economic Forum (SPIEF) on an annual basis. This major event brings together political leaders in Russia with national and international business leaders, in an effort to overcome barriers to economic growth.

GOVERNANCE

St. Petersburg is an administrative unit equivalent to a region or Oblast. It has a Legislative Assembly (the Duma), and an executive headed by a Governor rather than a Mayor. The Governor is directly elected by the citizens of St. Petersburg, and if the Duma does not approve the Governor , the President has the power to dissolve the Duma.

Within St. Petersburg there are around 111 municipal authorities, with their own charters, budgets and elected municipal councils. The city therefore has a highly decentralised form of government; which has the advantage of administration that is very close to the local populace, but the disadvantage of huge coordination challenges. The administration of St. Petersburg is thus very different from that of Moscow, which has a directly-elected Mayor who presides over a single city administration administering a population of over 12 million. St. Petersburg also has a significantly smaller administration than Moscow does. Its budget revenue in 2010 was 381 billion rubles, compared with Moscow's 1 304 billion rubles.

Adjoining St. Petersburg is the Leningrad Oblast, with its own appointed Governor. Although these are two separate Federal subjects they do share certain services, including specialist courts, postal services and police services.

URBAN CHALLENGES

The urban challenges of St. Petersburg are framed by the turbulent transition from a planned to a market economy. There have been many job losses in public enterprise, and also job losses in the manufacturing sector, which was previously sheltered from global market competition. In the 1990s the transition took a heavy toll, and there was rising unemployment, increasing poverty, a declining city population, and increasing crime and violence. At the same time there was underinvestment in public infrastructure, with a deterioration in public transport and other infrastructure systems, and a loss of social space. About a fifth of the city population lived in poverty by the end of the 1990s. The transition to a market economy was also associated with an increasingly polarised socio-spatial structure, as new high-end real estate, often in gated communities, emerged alongside severe neighbourhood decay in the Soviet-era housing estates.

The official Gini coefficient for St. Petersburg is 0.42, marginally less than that for Moscow.

In the late 1990s city government introduced a Strategic Plan built on four pillars: a favourable business environment; integration into the world economy; an improved urban environment; and an improved social environment. There was improvement in social conditions in the 1990s, but significant challenges remain.

Housing quality, for example, is still a significant concern. St. Petersburg entered the post-Soviet era with around a quarter of its population living in communal facilities (the 'bedroom communities'). These facilities, mainly on the urban periphery, had deteriorated over time – some into slums, or near-slums – and the waiting list for relocation into better housing remains long.

The Soviet administration left a relatively high level of access to public services (water, sanitation, solid waste, power and heating), but with serious operational efficiencies. To ensure the sustainability of local government, the extent to which these services are subsidised has been reduced. The downside, however, is that the resulting tariff increases are burdensome for poorer households.

There are serious environmental problems. The historical lack of a tariff-related system for services such as water consumption and household heating has left a legacy of wasted resources. In 2000, for example, the average level of water consumption in Russian cities was about a third higher than in cities in Western Europe. Pollution is a problem because of heavy industry (especially chemicals) and still undeveloped environmental controls, and also because of rising car ownership. Green spaces are being built over, and there are challenges in protecting the heritage precincts for which St. Petersburg is famous.

In addition, St. Petersburg faces a challenge common to much of Russia – declining fertility rates. Old-age pensioners are said to account for a quarter of the population in central St. Petersburg.

THEMATIC REPORTS

TRANSPORT

ECONOMIC INFRASTRUCTURE

St. Petersburg is a major transport hub for north-west Russia and the Baltic. It is at the western end of the Trans-Siberian Railroad, which links areas across Russia into China, and is connected by rail to Finland, Germany and all former Soviet republics. There are now fast rail lines to Moscow (opened in 2009), and to Helsinki in Finland (opened in 2010). St. Petersburg is also a hub in a road network linking Russia with Eastern Europe and Scandinavia.

In addition, St. Petersburg plays an important role within an extensive network of waterways. It is situated at the terminus of the Volga River-Baltic and White Sea-Baltic waterways, and has cargo and passenger ports in the Neva Bay on the Baltic Sea, as well as river ports higher up on the Neva River. In the summer, hydrofoils link St. Petersburg to a number of coastal towns, and there are also ferries to Helsinki and Stockholm.

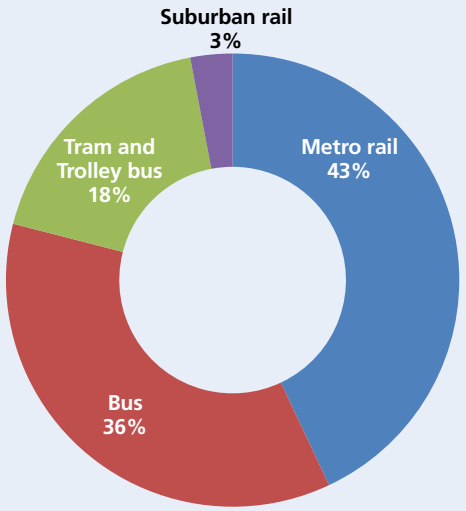
St. Petersburg is served by the Pulkovo International Airport, and three smaller cargo airports. Pulkovo is the fourth-busiest airport in Russia in terms of passenger traffic, with around 13.5 million passengers annually, ranking after Moscow's three main airports.

PUBLIC TRANSPORT

In terms of transportation, St. Petersburg has similar problems to Moscow, although on a smaller scale. It has a well-developed public transport system, but has suffered from underinvestment in recent decades. In 1992 there were only 41 cars per 1 000 population, but this had increased to 310 per 1 000 by 2010. The consequence for St. Petersburg has been pollution and traffic jams (which are often exacerbated by heavy snowfalls). This increase has been facilitated to some degree by government investments, which have included the construction of a new ring road, the decommissioning of tram routes, and free parking.

The modal share across public, private and non-motorised transport is not available, but the share in terms of public transport only is indicated below:

SPLIT OF PUBLIC TRANSPORT, 2011



Source: Petrovich, 2011

METRO

As with Moscow, the public transport flagship is the metro. The system was opened in 1955 (two decades later than Moscow), and has five lines of 113km in total, and 67 stations. It serves around 2.1 million people per day. It is extensive and efficient, but does get overcrowded in peak hours. Possibilities for expanding the metro are seriously affected by the underlying geology of the city, directing planners towards light rail as an alternative.

BUS

After the metro, the next-largest mode of transport is the bus system, which carries around 1.6 million passengers a day. There are around 200 bus routes covering 4 800km, and a bus fleet of around 3 200. The bus system reached its peak in the 1980s, and has been declining gradually relative to rail.

TRAMS AND TROLLEYBUSES

St. Petersburg was once proudly called the 'City of Trams', as it had the largest tram network in the world, with 340km of track. In the post-Soviet era the tramways was unable to compete with the rise of the private motor car, and large segments of the tramway track were demolished to make more space available for private transport. By 2011 there was only around 228km of track on 39 routes, and further withdrawals were anticipated.

However, there was also a trolleybus network of 43 routes and nearly 500km. The trolleybus shares with the tram the distinction of being the most environmentally friendly mode of transport in the city; but there has also been underinvestment in the system, which is often overcrowded.

OTHER

Apart from state-owned public transport, there are also privately-owned forms of public transport – most notably the taxi vans known as marshrutniye taksi or marshrutka, which are common in the newer parts of the city.

FUTURE

The relative underinvestment in public transport in the post-Soviet era is to be rectified over the next decade. A Transport Master Plan for 2030 was released in 2011. The major focus of the plan is investment in the metro, and a 30-kilometre light rail – the Nadzemny Express – across the southern suburbs of the city. The implementation of these plans will involve an anticipated expenditure of USD 50 billion, of which 60% will come from national and regional budgets, and 40% from non-budgetary sources such as loan financing and infrastructure bonds.

GREEN ENERGY

St. Petersburg is located within a national energy complex that is massively oriented towards oil and gas, and is dominated by the energy giant Gazprom. Because of a history of heavily subsidised gas-generated electricity and household heating, there are high inefficiencies in the use of energy. There is significant potential for the generation of electricity using renewables, but the structural constraints are considerable. The major advances are being made in the field of nuclear energy, where Russia has a major advantage in terms of technologies, rather than in renewables.

The major producer of electricity in St. Petersburg and the Leningrad Oblast is Territorial Generating Company 1 (TGC-1), which has an installed capacity of around 7 200MW, and also supplies around 17 100MV of district heating. The company has 55 thermal, hydro and co-generation power stations. Gazprom, the majority shareholder in TGC-1, was identified in 2009 as one of the few major oil & gas companies globally that are not actively investing in renewables. Since then, however, there have been indications of some interest in renewables from Gazprom, with the introduction of Power Purchase Agreements, and with private producers of energy from renewable sources. In 2015 the Russian Federation became a member of the International Renewable Energy Agency (IRENA), also indicating a gradual shift in the direction of renewables.

In St. Petersburg and Leningrad Oblast, hydro is more important than gas in the production of electricity, with 4 000MW of the city's requirements produced in hydro plants along the major rivers in the extended metropolitan area. There is a current agreement between state-owned company RusHydro and the Power Construction Corporation of China to revive an old pumped storage plant near St. Petersburg, with an investment of USD 2.97 billion.

The greatest progress towards a less environmentally damaging energy profile is likely to come from increased efficiency in the use of energy. The national context and initiatives in terms of energy efficiency are provided in the Moscow Fact Sheet. As with Moscow, St. Petersburg has introduced programmes for energy efficiency, with targets in line with those nationally. For example, there is a programme to improve efficiency during the transport of energy, which includes projects to reduce energy losses in boilers, pipes and service equipment. There is also a programme supported by the German government to improve energy efficiency in residential buildings, also cooperating with agencies in Finland on the design of energy-efficient buildings. In addition, there are programmes to raise popular awareness of the need for greater energy efficiency.

The World Bank argued in 2008 that Russia could save 45% of its total primary energy through the introduction of energy-efficiency measures, while the US Department of Energy calculated in 2012 that energy intensity in Russia is 2.5 times higher than the world average, with only modest improvements in the post-Soviet era. Much of the energy inefficiency comes from the historical practice of subsidising energy costs, but there is also the problem of ageing and inefficient equipment, buildings and technology for heating and power systems.

INNOVATION-DRIVEN ECONOMY

According to the 2thinknow 2015 Innovation Cities Global Index, St. Petersburg was ranked 48th out of 442 cities surveyed in 2015. This was a significant improvement on its 84th position in 2013. St. Petersburg is now rated fifth in the BRICS after Shanghai, Beijing, Hong Kong and Moscow, and may be regarded as one of the BRICS innovation leaders.

St. Petersburg has a strong historical concentration of research-based activity. Around 10% of Russia's national research staff is located in St. Petersburg, in around 300 research-based organisations. Although there has been fluctuation in the numbers of research-related professionals in the city in the post-Soviet era, this has recently stabilised. St. Petersburg has a qualified and well-educated population in terms of both Russia and the BRICS, with 36.5% of the population having a tertiary education, compared with the national average of 23.4%. St. Petersburg also has a favourable geographic location to support research and innovation, with its ability to link across international boundaries and its strong logistical and economic ties with countries including Germany, Poland and Finland.

St. Petersburg also has very high levels of connectivity to ICT networks. Russia's statistical agency (Rosstat) reported in 2015 that 85.5% of households and nearly 98% of organisations were connected to the Internet.

St. Petersburg has a number of the leading universities in Russia, with six of the institutions formally recognised by the national Ministry of Education and Science as universities with innovative characteristics. The flagship is the St. Petersburg State University, which comes in at 20th in the QS BRICS university rankings for 2016. There are specific fields of advantage in terms of innovation. St. Petersburg, for example, is well-known for its high-quality training in industrial engineering. The powerful Russian Academy of Science has a strong presence in St. Petersburg. However, since 2010 there has been a decline in the number of students in the city as a result of the reform of higher education, which included the consolidation of educational institutions.

Around 4% of St. Petersburg's GDP is allocated to R&D – which is high, in relation to Russia and the BRICS, and has been increasing since 2010. However, the bulk of the expenditure (63%) still comes from the state and state-owned companies, and further development is required in the private sector.

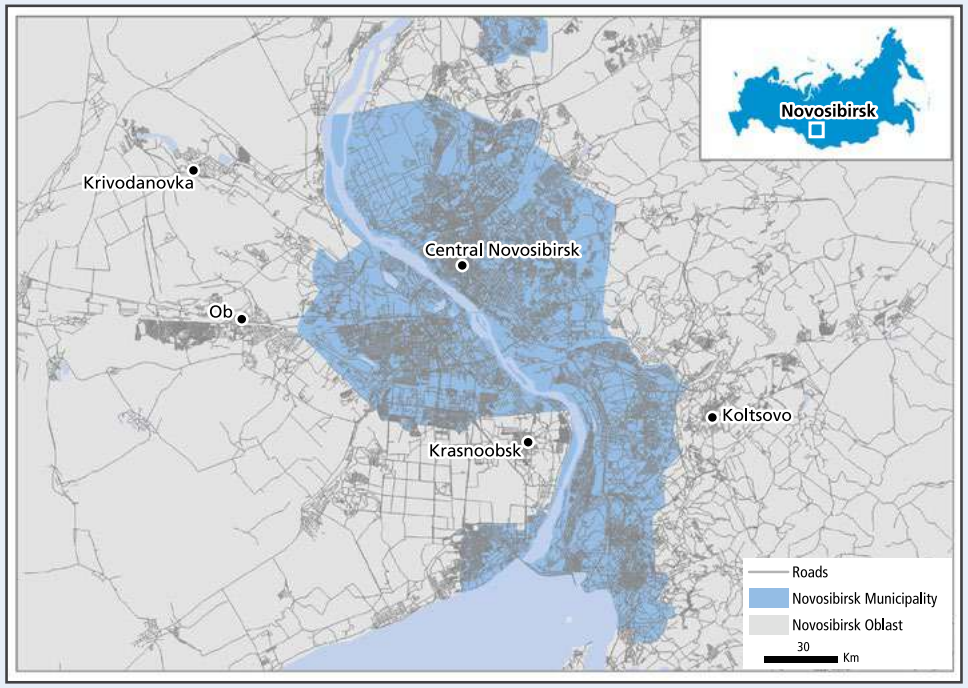
While many large cities in the world have moved into post-industrial economies, St. Petersburg survived the trauma of the transition to a market economy and has maintained a manufacturing base. This has happened partly because of the innovative response of the industrial sector to the turbulence of the 1990s and early 2000s.

The city government has been actively supporting innovation in terms of its overall strategy of building a 'global, smart, humane city'. There are at least 50 agencies related to the city administration that are involved in some way in supporting innovation, including eight business incubators, eight techno parks, eight centres for the shared use of technology, five engineering centres, and six institutions providing venture and investment funds. An important development was the establishment of a Special Economic Zone, in 2005. St. Petersburg has made particular progress with funding both the start-up and the implementation stages of developing product innovation. Among other measures the St. Petersburg government has introduced a special award for the best city innovation product.

The government of St. Petersburg considers it crucial to get manufacturing industries much more innovation-friendly, and for the city R&D sector to become much more involved in interaction with industry. The administration target is for 30% of all products exported from the city to be recognised as innovative. This ambition is supported by Federal government, which has a programme to support territorial innovation clusters as an instrument of interaction and coordination between different components of local innovation systems. There are no fewer than 29 such cluster partnerships in St. Petersburg; most in manufacturing, but some in the service sectors and creative industries. Currently, major hubs of hi-tech innovation are in pharmaceuticals, medical equipment, telecommunications and aerospace; but there is also significant innovation in the more traditional industries, such as the shipbuilding industry, production of power-generation equipment, and the automotive cluster. Spatially, there are clusters of innovation in the Special Economic Zone (SEZ) and in the Pushkinskaya industrial zone, which has a specialisation in the medical and pharmaceutical industries.

NOVOSIBIRSK URBAN AGGLOMERATION

Новосиби́рск



CONTEXT

LOCATION

The city is located in the central part of Russia on the eastern part of Novosibirsk Oblast (Novosibirsk Region) in Siberia. Novosibirsk is the administrative centre for both the Novosibirsk Oblast and the Siberian Federal District.

HISTORY

Novosibirsk was originally a small and remote village called Krivoshchekovskay, located on the Ob River. During the 19th-century reign of Tsar Nicholas II, construction of the Trans-Siberian Railway began, in order to connect western Russia to Vladivostok on the eastern coast. Because of the construction work, a migrant population moved to the village, which had a strategic position alongside the bridge over the Ob.

In 1907, the name of the growing town was changed to Novonikolayevsk, in honour of Tsar Nicholas. With the railway line becoming increasingly important for transport of agricultural produce, the town continued to grow, and also developed a good processing industry. The Russian Civil War (1918-20) took a severe toll on Novonikolayevsk, as the town was a battle-ground between the White and Red armies, and the bridge was destroyed. There was gradual reconstruction from 1921 under Lenin's New Economic Policy, and the city's name was changed to Novosibirsk.

The 1930s was a period of great expansion, as the Turkestan-Siberia Railway was built, which connected Russia with Central Europe and the Caspian Sea. Under Stalin's rule a number of large industrial plants were located in the emergent city. During the Great Soviet Famine (1932-33), the city received 170 000 refugees, many of whom were accommodated in slums on the fringes of the city. Between 1940 and 1942, more than 50 great industrial plants were reallocated from western Russia to Novosibirsk to avoid destruction in a possible war, and the city became a major supply centre for the Red Army. However, it also received a further 140 000 refugees.

In the 1950s the dam on the Ob River was built, forming the 'Ob Sea', a giant water reservoir that is now a tourist and leisure destination. Also in the 1950s, the Soviet government created a multi-facility scientific research complex in Akademgorodok, 30km south of Novosibirsk, as the Siberian branch of the Academy of Sciences of the USSR.

In 1962, the population of Novosibirsk reached one million; in 1985, the city acquired a metro system. On the eve of the economic reforms that marked the end of the Soviet government, more than half the jobs in Novosibirsk were in manufacturing, and half of these were in the defence industry. In the 1980s and early 1990s, as the economic and political crisis expanded and demand for military equipment declined, the city faced massive job losses, with growing unemployment.

However, the economy of the city was stabilised by the 2000s, with a concentration of highly-skilled jobs in industrial engineering, for example, assisting the development of new industries. Also in 2000, Novosibirsk became capital of the Siberian Federal District, bringing in administrative services and jobs.

POPULATION

POPULATION SIZE

In terms of UN data, the 2015 population of the urban agglomeration of Novosibirsk (also known as Greater Novosibirsk) was 1.5 million. There are definitional issues, however. If the satellite cities around the agglomeration were included, the population would be 1.9 million.

POPULATION RANKING

Novosibirsk only ranks 321st in the world, and 123rd in the BRICS. It is however the third-largest city in Russia, reflecting the peculiar structure of Russia's urban network; which has only two large cities (Moscow and St. Petersburg), and then a large number of much smaller cities. It should be noted that in 1950, Novosibirsk ranked 111th in the world and 26th in the BRICS, and has therefore declined relatively, in international terms.

POPULATION GROWTH

The UN data reflects an average annual growth rate for the period 2010 to 2015 of 0.34%. With Russia's overall urban growth now negative, this figure is slightly better than the national average.

POPULATION DIVERSITY

The 2010 census revealed that there are around 80 ethnicities and nationalities in Novosibirsk. According to the 2010 Census, the ethnic composition of the oblast was 93.1% Russian; 1.2% German; 0.9% Ukrainian; 0.9% Tatar; 0.5% Uzbek, 0.4% Kazakh; 0.4% Armenian; 0.3% Azeri; and 0.2% Belarussian. Interestingly, there are reports of a Siberian regionalism emerging, with a growing number of individuals identifying themselves as 'Siberian', which has never previously been recognised as an ethnic group.

STRUCTURE OF THE URBAN REGION

The urban region is overwhelmingly dominated by the Municipality of Novosibirsk, a city divided physically by the Ob River. In the UN data, the total 1.5 million inhabitants of the urban agglomeration are in this municipality. However, an extended boundary for the region includes a further 400 000 people in satellite settlements.

There are twelve such settlements within a radius of 100km of the centre of Novosibirsk, but many of these are small. The major settlements are Berdsk (100 000), which is a military production centre; Iskitim (58 000), with its large concentration of Romani people; Ob (25 000), site of the international airport and headquarters of Russia's largest domestic airline; and Koltsovo (18 000), a science town with a research centre in virology and biotechnology.

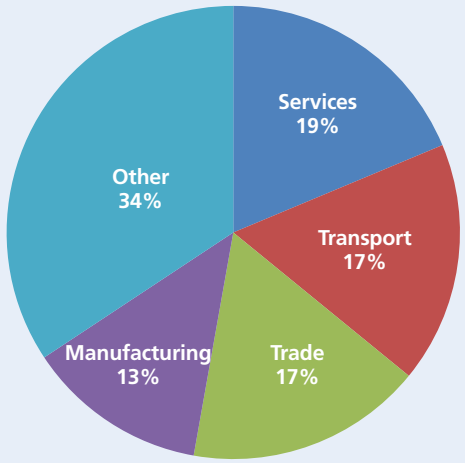
There is a plan for a New Town beyond the edge of Novosibirsk that would accommodate around 250 000 residents, including many who are currently living in decaying Soviet-era housing estates. There is also a plan for a smaller settlement that would be for students and academics. Both settlements would be connected to the city by a new regional highway.

ECONOMY

In 2014, Novosibirsk had a GDP of around USD 39.5 billion, or 1.5% of Russia's economy.

The largest sectors in Novosibirsk's economy are services, transport, and trade, with manufacturing a smaller proportion than for Moscow and St. Petersburg. There is a diversity of other sectors represented in the large share labelled 'other'.

SECTOR SHARE OF NOVOSIBIRSK GDP



Source: Rosstat, 2015

The relatively small share of manufacturing is despite the fact that historically, Novosibirsk was a major site of manufacturing investment by the Soviet government. However, the surviving industry is concentrated in leading-edge growth sectors, and is science-intensive. In terms of manufacturing, Novosibirsk has a more sustainable profile than many cities in the interior that are based largely on resource extraction.

The city's key industrial branches include nuclear fuel, aerospace and ICT, with high specialisation in the production of medical equipment such as diagnostic agents, x-ray machines, medical software and laser systems. The high-technology sectors are located mostly in Akademgorodok, which is on the far southern edge of the city. There are also more traditional sectors in the wider region, such as power generation, wood products, chemicals, and metalworking. As Novosibirsk re-established a competitive edge in the post-Soviet era, so there has been renewed expansion in industry. Between 1999 and 2008, for example, industrial output grew by 170%, significantly exceeding the Russian average.

The significance of transport is related to the strategic position of Novosibirsk on cross-Russia networks. As the main business centre of Asian Russia, Novosibirsk features high levels of business activity, including a concentration of financial services. As the unofficial capital of Siberia, the city also offers many government-related services.

In response to the crisis of post-Soviet political transition, the City of Novosibirsk developed a four-pillar strategy to reposition the economy:

1. Internationalisation: This drew on the city's position between European and Asian markets, and involved attempts to position Novosibirsk as a regional international hub (e.g. through the upgrade of the passenger and cargo airport).
2. Science and Technology: While the city served as a military technology hub during the Soviet era and has since suffered decline, it has a large reservoir of skills and an extensive research infrastructure which can be re-aligned to support new forms of hi-tech development.
3. Financial Services: While Moscow invariably dominates in terms of international financial markets, Novosibirsk has emerged as the most important financial hub east of the Urals.
4. Government Services: The city is strengthening its status as the unofficial capital of Siberia, and supports a cluster of government services.

GOVERNANCE

Novosibirsk is the capital of the Siberian Federal District – which is a vast area, but has a modest population of 19 million people. The Federal District is headed by a Plenipotentiary appointed by the Russian president, and effectively functions as an Office of the President established to ensure that the regions are implementing federal laws and programmes. Novosibirsk is also the capital of the Novosibirsk Oblast, which has a population of around 2.7 million and is a much smaller territory. The Oblast is headed by a Governor, with oversight from the Legislative Assembly of the Oblast. Novosibirsk is also a municipality headed by an Executive Mayor, with oversight from the legislative assembly for the municipality.

DEVELOPMENT CHALLENGES

Novosibirsk has a GDP per capita less than one-third that of Moscow, and less than the average for Russia as a whole. In comparative terms – for Russia, at least – it is not a wealthy urban region. As with other Russian cities, inequality has risen significantly in the post-Soviet era, but its Gini coefficient of 0.37 is less than that of the larger cities of Moscow and St. Petersburg.

The city faces problems similar to those of other Russian cities. The Soviet-era housing estates have been deteriorating, and the more affluent members of the population have moved to single-family homes in the suburbs. There are also severe inefficiencies in energy, waste and water systems. During the economic crisis of the 1990s, budgets for maintenance of public facilities were cut sharply; and the city has not yet recovered from the deterioration in its infrastructure. There are also serious environmental challenges. Water and air pollution are above World Health Organisation (WHO) standards, with heavy industry and a mainly road-based transportation system the source of the air pollution. There is also a lack of green open space in the city.

The city is attempting to respond to these challenges through programmes to provide a new stock of safe and affordable new housing, modern utilities and modern infrastructure, and through the development of the proposed New Town.

THEMATIC REPORTS

TRANSPORT

ECONOMIC INFRASTRUCTURE

Novosibirk is a key node in Russia's transport and communications network. It is here that almost all the most important transport lines in Russia intersect, and connect with Central and East Asia. As the largest transport hub in western Siberia, the city has four major railway stations, and is home to Russia's largest sorting depot for cargo. Rail transport is hugely important, accounting for 96% of cargo turnover in 2011. The Novosibirsk Tolmachevo Airport is located in Ob, 16km from the city. This is the largest airport in Siberia and the eighth-largest in Russia in terms of passenger traffic. A new terminal has been added for international traffic, as part of a strategy to develop the airport into a large regional and international aviation hub. The significance of the airport is also enhanced by a high-speed rail network, which links it to other regional cities such as Omsk and Tomsk.

PUBLIC TRANSPORT

The modal share of transport is not available, but the 2010 National Census indicates that levels of car ownership are comparable to those of Moscow and St. Petersburg, and that there has been a similar rapid increase in levels of ownership. There has also been massive investment in car-related infrastructure, including the sixth motor bridge over the Ob River – one of Russia's megaprojects.

Despite this orientation towards the automobile, Novosibirsk does have a public transport network. Most importantly, it has Russia's third metro, with 13 stations on two lines, and the iconic 2.1-kilometre bridge over the Ob River. It is nevertheless still of a modest scale, carrying only around 250 000 passengers each day, or 16% of commuters in the city. Urban passenger services also include buses, trolleybuses and trams, while many local residents also use the minibus or marshrutka shuttle. A form of BRT – a bus-only lane – has been successfully introduced along the city's main thoroughfare. Another recent innovation has been the introduction of a mobile-phone-based ticketing system for public transportation, introduced through a partnership between a Dutch and a Russian company, which has eliminated the need for long passenger queues.

New attention is being given to public transport, with a new Concept Plan for Public Transport 2015-2020. There are plans to introduce two further bus-only lanes on major thoroughfares, link the regional rail network more effectively into the urban transport system with new stations, and reform the bus service for greater efficiency, with changes in the contractual relationship between the municipality and bus operators. While progress is being made at city level, there is no institutional mechanism for coordination at regional level.

GREEN ENERGY

As explained in the Moscow Fact Sheet, Russia remains dominated by the oil and gas sector, and there is only limited (and recent) interest in renewable energy. The Novosibirsk Oblast has large gas, oil and coal reserves and produces a surplus of energy, mainly in thermal power plants. However, at least 30% of the region's electricity requirement is produced by the Novosibirsk Hydroelectric Power Station. While there is no immediate incentive to shift towards renewables in the production of electricity, Novosibirsk is a centre of research in the energy field. There is research into wind and solar energy, and into more efficient ways of storing energy with new battery technologies. Scientists are even exploring the possible use of the 'fire ice' trapped in Siberia's permafrost to produce electricity.

As with other cities in Russia, however, the most immediate potential for greening Russia's energy profile comes from the opportunities for significantly improving the efficiency of energy usage. The Federal government has set targets for increased energy efficiency, and municipalities are responsible for implementing programmes to achieve them. There are research teams in Novosibirsk working on energy efficiency in the industrial and household sectors and in district heating, and a network of energy centres has been set up to support the implementation of energy-efficiency measures.

INNOVATION-DRIVEN ECONOMY

The 2thinknow Innovation Cities Global Index places Novosibirsk at 244th globally, which is a middling ranking for the BRICS. Novosibirsk is ranked as the fifth innovation centre in Russia, after Moscow, St. Petersburg, Ekaterinburg and Kazan. Like Russia overall, Novosibirsk faces the challenge of translating its considerable intellectual- and research-related resources into innovative outputs.

Novosibirsk is the largest academic and research centre in the Asian part of Russia. The region has high intellectual capacity, with 31.2% of the residents of Novosibirsk having a tertiary education, compared with 23.4% average for Russia. There is also an extensive infrastructure for academic research and innovation. There are 51 institutions directly involved in R&D, and 74 institutions offering doctoral studies. There has been a decline in the numbers of R&D establishments, and also in R&D-related staff, in the post-Soviet era; but this has stabilised since 2010.

The network of support for innovation includes techno parks, academic science institutes (in areas such as nuclear physics, biosciences, chemistry and computing technologies), and universities. Much of the international reputation enjoyed by Novosibirsk comes from the Novosibirsk Science Centre, which was established in the satellite city of Akademgorodok, 21km to the south of the centre of the city. Its position is an example of 'Lavrentyev's triangle', meaning the joint location of a classical university with a number of specialist academic science institutes, and a large cluster of public and private R&D facilities. The university is the highly-regarded Novosibirsk State University, which is ranked by QS Higher Education as 20th in the BRICS for 2016, far higher than the city's ranking in terms of population (123rd).

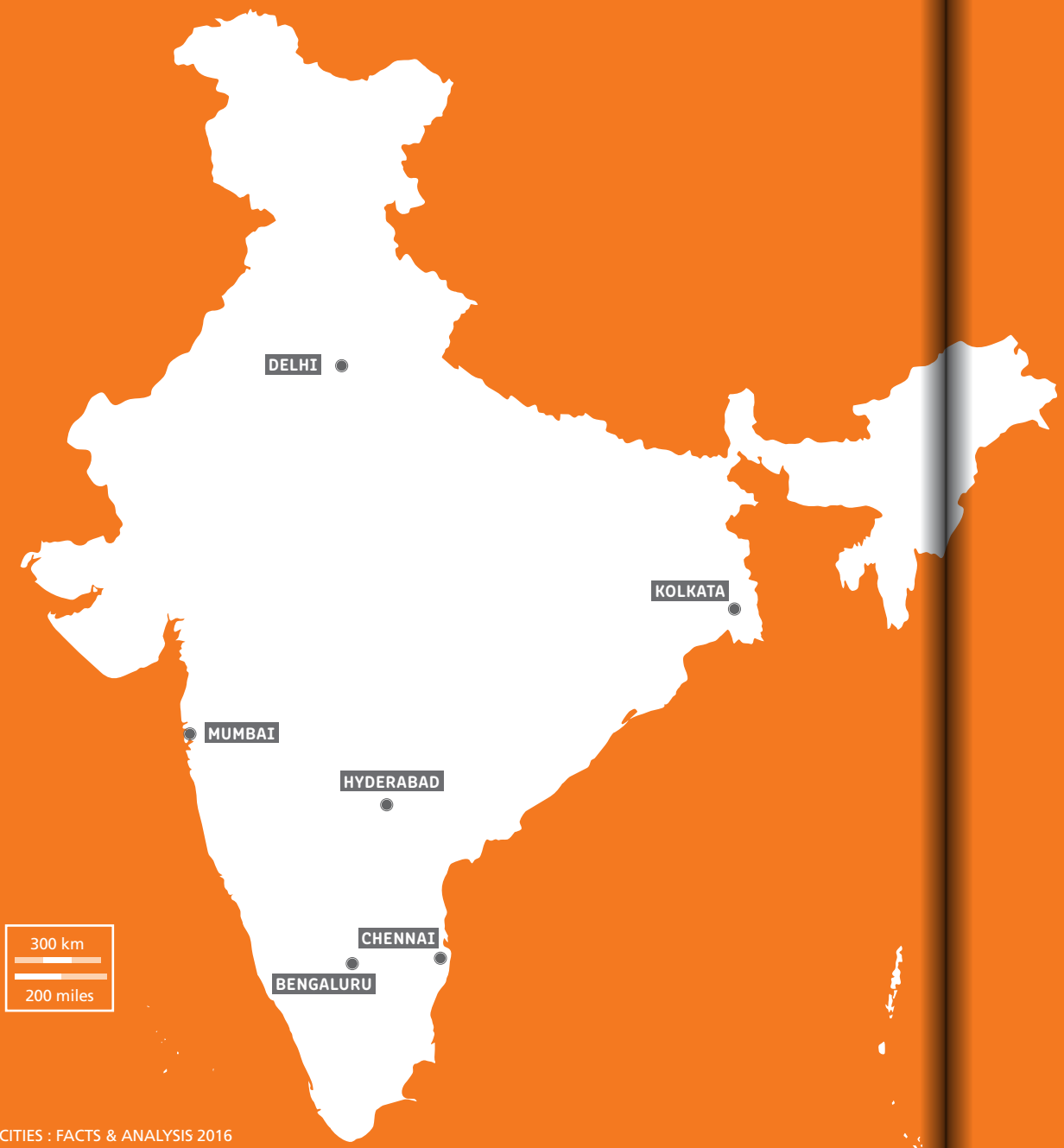
Akademgorodok was established in the late 1950s, but went through a period of decline after the end of Soviet rule; however, since the 2000s it has been revitalised, with major investment in support of hi-tech R&D. There are now at least 300 private innovation companies in Akademgorodok, and a number of major research institutions – many developed in partnership with leading international companies.

About 40 state development programmes are in place to support the development of a more innovative and dynamic economy in Novosibirsk, including making the region more attractive for highly qualified people and long-term investment. A programme for the reindustrialisation of Novosibirsk by 2025 involves some highly complex projects for the modernisation of traditional industries through new technologies, as well as the development of leading-edge industries through advanced R&D. Programmes include: the development of a fund for supporting innovation activities, business incubators, the creation of an 'innovation observatory', the further development of the biopharmaceutical cluster in Koltsovo city, the development of an advanced ICT cluster in Akademgorodok, and three new specialised techno parks, including a medical technopark.

INDIA

BASIC FACTS

» Level of urbanisation (2011) – 31%
» Level of urbanisation (2014) – 32.4%
» Total urban population (2011) – 377 million
» Total urban population (2014) – 410 million
» Annual rate of urban growth (2001-2011) – 2.76%
» Annual rate of urban growth (2010-2015) – 2.38%



MAJOR URBAN CLUSTERS/CITY-REGIONS (2015 POPULATION)

» Delhi City Region [National Capital Region Territory] – (46 million)

MAJOR URBAN AGGLOMERATIONS WITH 2015 POPULATION (FACTSHEETS INDICATED WITH *)

» Delhi – (25.7 million)*
» Mumbai (Bombay) – (19 million)*
» Kolkata (Calcutta) – (14 million)*
» Bengaluru – (8 million)*
» Chennai (Madras) – (8 mill)*
» Hyderabad – (7. 5 million)*
» Ahmedabad – (6 million)
» Pune (Poona) – (5 million)
» Surat –(4 million)

BRIEF HISTORY OF URBAN DEVELOPMENT

India's urbanisation has been relatively slow, taking almost 40 years to rise to just over 30% of the population. The pace of urbanisation increased after independence and the rise of a mixed economy. The high rates of urbanisation in the preceding decades have been despite the large anti-urban bias in policy, government spending and social consciousness. Urban growth has taken place through a fairly well distributed network of different-sized cities, rather than in a few first-order cities. Current trends indicate a slowing down of urbanisation in the largest cities; but given the vast extent of many of the agglomerations, it is important to note that higher growth rates are now being seen in peripheral areas, rather than in the original cores of these regions.

URBAN GOVERNANCE

India has a federal system and each state has its own municipal act, allowing for significant variation in the mandate and purview of local authorities. Municipal government in India is generally weak, with most local functions performed by agencies of state-level government. State governments have generally established Development Authorities that attempt to oversee and coordinate planning and urban developments across metropolitan regions There are many different types of municipalities within these regions ranging from panchayats (or village councils) to municipal corporations for the larger urban areas. Although these municipalities mainly have elected councils, key functionaries are often appointed by state governments.

DELHI

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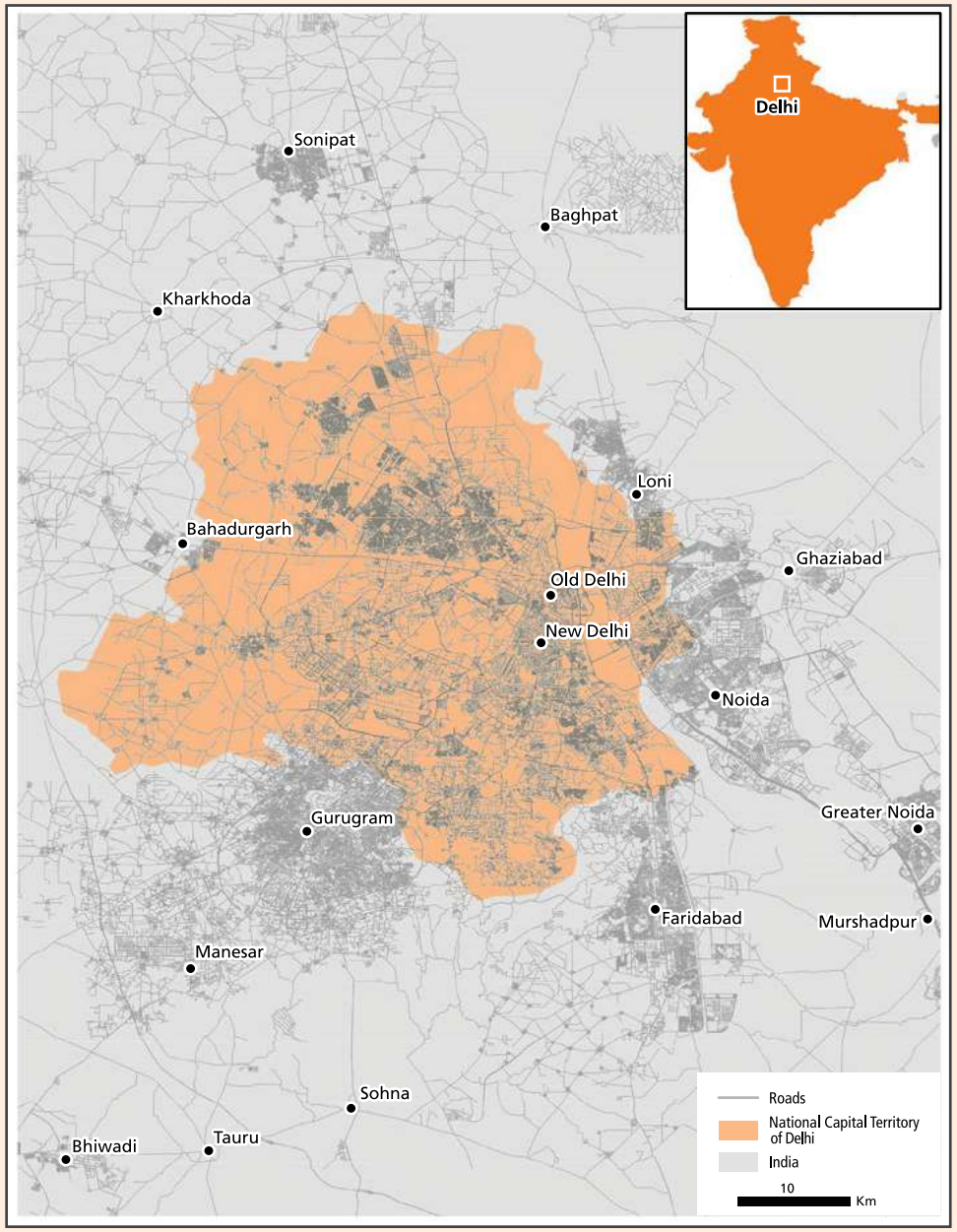


CONTEXT

LOCATION

Delhi is located in the north of India. It shared borders with the States of Uttar Pradesh and Haryana. It is the Federal Capital of India, and its urban region is known as the National Capital Territory of Delhi (NCTD).

HISTORY

Delhi is an ancient settlement, and has served as the capital of various empires. Its origins are shrouded in myth, but purportedly began in approximately 800 BC; though this has yet to be established by archaeological investigation. It has been home and capital to a number of empires, with a succession of rulers and dynasties, and a series of new settlements built on and around the ruins of the old. In 1526 the Mughal Empire was established, which ruled from Delhi for around three centuries. In 1739 the Maratha defeated the Mughals and ransacked Delhi, beginning a protracted struggle for the control of the city between the Mughals, Maratha, Afghans and Sikhs.

There was a new factor from the beginning of the 19th century, as the British East India Company entered the city, defeating the Marathas in the Battle of Delhi in 1803. In 1858, the British established direct control over Delhi. Delhi was declared the capital of British India in 1911, replacing Calcutta (now Kolkata). The architect Sir Edwin Lutyens designed New Delhi, the administrative heart of the city, which was completed in 1931. New Delhi was declared the Capital of the Union of India in 1949, receiving large numbers of Hindu and Sikh refugees from the Muslim territories of Pakistan and Bangladesh, but also losing Muslim population to these territories. As capital of one of the world's largest countries, Delhi enjoyed enormous prestige. In 1956 it was granted the status of a Union Territory with a Lieutenant-Governor, a status that it has maintained until the present day. In recent decades Delhi has emerged as one of the world's fastest growing large cities.

POPULATION

POPULATION SIZE

In terms of the UN estimates, Delhi's urban agglomeration had a 2015 population of 25.7 million.

POPULATION RANKING

Delhi ranks second in the world as an urban agglomeration, after Tokyo in Japan. It is the largest urban agglomeration in India, and in the BRICS.

POPULATION GROWTH

In the period 2010 to 2015, Delhi's average annual growth rate was 3.17%. This is lower than the peak rates of around 5.5% in the 1980s, but is nevertheless high in international terms.

POPULATION DIVERSITY

The demographic breakdown in terms of religion in 2011 was: Hindu 81.7%, Muslim 12.9%, Sikh 5%, Jain 1%, and others 1%. Hindi is the native language of nearly 81% of the population, followed by Punjabi (7%) and Urdu (6%). English is the principal written language of the city, and the most commonly used language for official purposes.

STRUCTURE OF THE URBAN REGION

In 2011, around 11 million people lived in the densely-packed Old Delhi, the historical core of the city, which predates colonial rule and in the newer and generally poor eastern parts of the city. Only around 250 000 people live in the much lower-density New Delhi to the south. This was the city that was planned under colonial rule, and opened in the early 1930s. Much of the remainder of the population of Delhi proper lives in newer suburbs, mainly in the south-west of the city. The population of the City of Delhi is around 18 million.

However, around Delhi are a number of cities which are mainly spatially contiguous to the core, but were outside the National Capital Territory at the time of the 2011 National Census, and are therefore excluded from official estimates of the Delhi Urban Agglomeration (DUA), although included in the UN estimates for the Delhi urban agglomeration. These cities are:

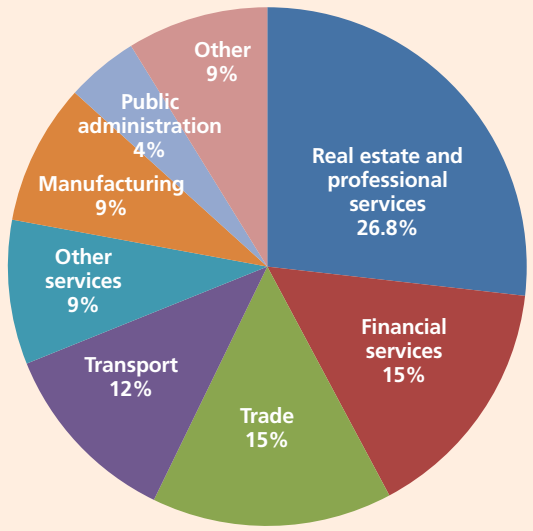
- Faridabad, a leading industrial city with a population of around 1.4 million people;
- Gurgaon, a financial and industrial hub, with the presence of at least half of the Fortune 500 companies, and a population of nearly 900 000;
- Ghaziabad, a real-estate hub accommodating mass overflow from Delhi, with a population of around 2.4 million and reputedly one of the fastest-growing cities in the world; and
- Noida, a wealthy, high-end industrial city with a population of around 640 000.

Subsequent to the 2011 Census, the National Capital Territory of Delhi was expanded by 34% to include the cities indicated above; but also to include a number of outer-lying cities that are not necessarily spatially contiguous with Delhi. This has created an administrative city region of approximately 46 million people.

ECONOMY

According to the Brookings Institution, the 2014 GDP for Delhi was USD 293. 64 billion. It has only the 11th-largest urban economy in the BRICS, but is an economically fast-growing city. In 2014/15 the annual growth in GDP was 8% and in 2015/16 it was 8.3%, compared with national growth of 7.2% and 7.6% respectively. In 2016, Delhi contributed 4.12% of national GDP; and with higher-than-national growth rates, this proportion is gradually increasing.

DIVISION OF GDP BY SECTOR, 2015



Nearly 83% of Delhi's GDP comes from tertiary activities, with real estate, professional services, financial services and trade being especially important. It should be noted however that manufacturing is a rapidly growing sector, although off a fairly low base. In 2015/16, manufacturing increased by an extraordinary 39%, following on from a 24% increase the previous year. This is contrary to India as a whole, where manufacturing growth has remained slow, with overall growth being driven almost entirely by the service sectors. The government has recognised the potential significance of manufacturing in the Delhi region, and is developing the Delhi-Mumbai Industrial Corridor (DMIC) as a global manufacturing and investment destination along a high-capacity dedicated rail-freight corridor.

Other fast-growth sectors in the economy in 2015/16 were real estate and professional services (an 11% increase), trade (10%), and transport and communication (8.6%). There was negative growth in construction (-4%), and slow growth in agriculture and mining (1.3%) and in financial services (1.9%).

GOVERNANCE

Delhi's institutional structures are complex. The National Capital Territory (NCT) of Delhi is a Union Territory with a special status. It is jointly administered by the Government of the National Capital Territory of Delhi (NCT), and the Union Government of India.

The parallel administration for the territory consists of the NCT of Delhi, which has its own legislative assembly, executive and judiciary; and the Municipal Corporation of Delhi (MCD), which has its own elected councillors and civic administration (but which has recently been divided into three smaller corporations). The NCT of Delhi is formally headed by a Lieutenant Governor appointed by Central Government, although the power is shared with the Chief Minister, who is the leader of the majority party in the NCT legislative assembly. The MCD is formally headed by a Mayor, chosen by the elected councillors; but the civic administration is headed by a Commissioner, who is appointed by Central Government.

There is an intricate division of power within the system. The MCD controls the water and electricity boards, and also roads and infrastructure. However, the Central Government, through its agencies, is responsible for law and order, including policing. Through the powerful Delhi Development Authority (DDA), chaired by the Lieutenant Governor of Delhi, Central Government is also responsible for urban planning, public housing, and land management.

While the parallel structure of the NCT, MCD and DDA administer around 97% of Delhi, there are anomalous arrangements. New Delhi is fully and directly under the administration of Central Government, with the local administration headed by a Commissioner who is a senior official of Central Government. There is also the Delhi Cantonment, which administers spaces occupied by the Indian military.

There is complex politics in the region. In 2015 the newly formed Aam Aadmi Party (AAP) won a landslide victory in the legislative assembly of the NCT, with its leader, Arvind Kejriwal, becoming Chief Minister of Delhi; while the central government, which appoints the Lieutenant Governor of Delhi, has been dominated by the Bharatiya Janata Party (BJP) since 2014.

DEVELOPMENT CHALLENGES

Delhi has the double challenge of being in a poor country, and growing rapidly in economic and population terms. Although doing far better than the national average in developmental indicators, Delhi still lags behind most cities in the BRICS. Delhi's GDP per capita of around USD 6 000 is the fourth-highest of the 30 states and other federative units, but it is still around half of that of Brazil, China and South Africa, and one-third of that of Russia.

Delhi is a city of rising inequality, although the Gini coefficient of just below 0.4 is still significantly lower than for cities in South Africa and Brazil, and possibly less than in China, where inequality has

been rising sharply (but where cities generally do not release Gini coefficients). Crime is a problem in Delhi, with a particular concern being violence towards women. Nearly one-third of reported rape cases from India's 35 largest cities are from Delhi.

Delhi has a long history of slums, the most famous being the riverbed settlements of Yamuna Pushta, where about 100 000 people lived for around 40 years before the settlements were demolished in time for the 2010 Commonwealth Games. However, after Mumbai, Delhi still has the largest slums in India in total size, with around two million residents. In proportional terms, however, there has been a decline in households living in slums. According to the 2011 Census, 14.6% of the households in the area under the Delhi Municipal Corporation lived in slums.

Delhi is facing massive environmental challenges. According to the World Health Organisation (WHO), Delhi has almost the worst air pollution of any large city in the world. The annual mean PM10 of 198 ug/m3 is only marginally less than for Lahore in Pakistan, and is significantly more than the 121 ug/m3 for Beijing in China. The main cause of this pollution is automobiles – with diesel-powered buses and trucks, and two- and three-wheelers a major problem – and crop burning in neighbouring states. The river Yamuna, the main watercourse in Delhi, is severely polluted. In the 1990s around half of the sewerage in the city went into the river untreated, but this has improved in recent years. The remaining challenge is the sewerage from the approximately 1 500 informal slums.

There are also major challenges in terms of infrastructure. Delhi is facing a crisis in energy supply, and is forcing the Federal Government to divert electricity from Maharashtra State to Delhi. Power cuts are common, with an electricity deficit during the hot months of around 800MW. Water shortages are a problem, because of the depletion of the groundwater table and the cost and complexity of treating highly-polluted river water. Stormwater drainage is also a challenge, because of frequent flooding and waterlogging. Road conditions are also deteriorating, because of rapid growth in the number of vehicles (including private cars, taxis and auto-rickshaws).

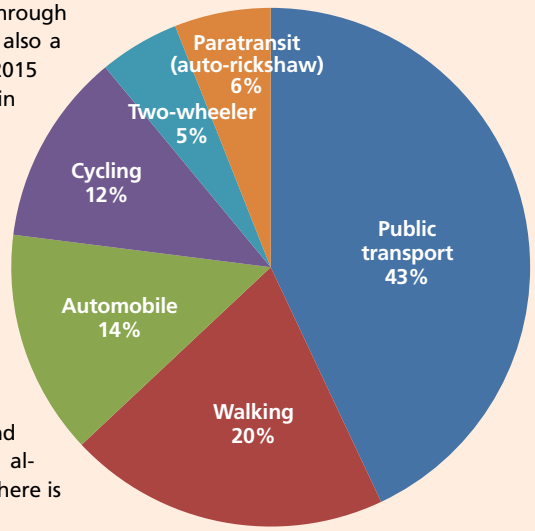
THEMATIC REPORTS

TRANSPORTATION

ECONOMIC INFRASTRUCTURE

Delhi is connected to regions across India through the extensive India Railways network, and also a network of highways and other roads. In 2015 the Indira Gandhi International Airport in Delhi was the 25th-busiest in the world, with around 46 million passengers. It was the busiest in India, and fifth in the BRICS.

MODAL SHARE 2011, CENSUS OF INDIA



PUBLIC TRANSPORT

The number of motor vehicles on the roads of Delhi has been growing at around 7% per annum, and this – together with poor traffic management – means that roads are now highly congested. With around 7.4 million vehicles on the roads, and a road length of 33 000km in 2014, which already exceeds 21% of the total land area, there is little space for any further development.

Automobiles and two-wheelers account for nearly 20% of trips, and for much of the road congestion. However, walking, public transport and intermediate public transport (or 'paratransit') is very significant in a city which is still poor by international standards. The forms are discussed below.

Each mode is discussed in turn in order of declining importance, with reference also to new and planned developments.

BUS SYSTEM

The bus system has historically been dominant in the public transport system, but is gradually being challenged by a variety of other systems, with a decline in bus use in relative and absolute terms. In 2000, for example, there were seven million passengers carried daily on buses, but this declined to six million in 2008. However, the bus system remains the single largest provider of public transport. It is managed by the state-owned Delhi Transport Corporation (DTC).

A BRT system was introduced in 2008, ahead of the 2010 Commonwealth Games; but it proved to be hugely controversial, as a result of its use of road space, and its effect on other forms of transport. There were various court challenges to the system, although the High Court eventually ruled in its favour. In 2015, however, the Chief Minister of Delhi announced the scrapping of the BRT.

RAIL (INCLUDING METRO)

The city has historically lacked a suburban train system, and so is very different to Mumbai, for example. But there is a metro system, which opened in 2002 and which serves Delhi and the satellite cities of Faridabad, Gurgaon, Noida and Ghaziabad. By 2015, it had track of 213km and a daily ridership of 2.386 million along six lines.

PARATRANSIT

Forms of paratransit are increasing rapidly in the city. Cycle rickshaws are a popular form of transport for short distances, with minimal environmental footprint; but the slow speed of the cycle rickshaw does lead to traffic snarl-ups. There are around 55 000 registered and 15 000 illegal auto-rickshaws ('tuk-tuks') in Delhi. Since most of these vehicles run on natural gas, they result in a far lower environmental footprint than for other cities in India. They are also a cheap and flexible form of transport, and provide employment to large numbers of people living in the slums. However, there are attempts by city authorities to phase out auto-rickshaws and replace them with electric cars.

BICYCLE

Bicycles do maintain a trip share in Delhi – although there has been a dramatic decline from the 60% of trips in the 1960s – and are being promoted by the city authorities as a response to the growing traffic chaos in the city. There are now bicycle-sharing facilities, while the metro system includes bicycle feeder routes. The challenge in Delhi is to change the mindset, in which the bicycle is regarded as transport for the poor only.

FUTURE DEVELOPMENTS

One of the aims of the Delhi Master Plan 2021 is to create a fully-fledged (mainly) rail-based mass transit system. A 245km metro system is planned which would cover large areas of the city. The metro is developing quickly, and an additional 136km of network is expected to be completed between 2013 and 2016, with the system being extended to cities such as Noida and Gurgaon. In addition, two existing railway lines into neighbouring states are to be upgraded to commuter rail, while 74km of Light Rail Transit (LRT) is also planned for the central parts of the city, including 48km of elevated monorail. To bring all of this together an Integrated Metropolitan Transportation Authority is to be set up, which will ensure not only coordinated infrastructural development but also rationalisation of routes, common timetables, common standards, integrated ticketing, and so on.

GREEN ENERGY

NATIONAL CONTEXT

India faces massive challenges in terms of energy production. The rapid growth of the national economy has placed growing demands on the energy sector. Energy comes largely from coal and petroleum, which together accounted for 66.8% of energy produced in the commercial sector. Significantly, however, around a quarter of India's energy production comes from traditional biomass, such as firewood and dung. These sources still provide the majority of energy production for India's 800-million-strong rural population, although the country is making the gradual transition to electricity for household use.

In 2013, the breakdown of the installed 223 000MW of electricity-generation capacity was:

- Coal – 58.3%
- Hydro – 17.7%
- Renewables – 12.3%
- Gas – 9%
- Nuclear – 2.1%
- Oil – 0.5%

At 12.3%, the share of renewables is relatively high in international terms, having increased from 7.8 % in 2008. Wind accounts for 68% of the installed capacity for renewables, followed by small hydro (12.9%), biomass (12.8%) and solar (6%).

The government is playing an active role in the development of the renewables sector. The National Action Plan on Climate Change released in 2008 was a key catalyst in the process. In 2008, the Federal Government introduced Renewable Purchase Obligations (RPOs), which required state energy utilities to purchase an increased share of their energy from renewable sources. Incentives were also introduced for wind and solar production. A National Clean Energy Fund was introduced in 2009, and Renewable Energy Certificates (RECs) were introduced as a tradeable mechanism for renewable energy. Since 2010, there has also been a Federal initiative to support energy efficiency known as the National Mission on Enhanced Energy Efficiency (NMEEF), which involved promoting energy-efficient homes, smart grids, energy-storage technologies and micro-grids.

DELHI

The electricity sector in Delhi is complicated. Across the NCT of Delhi there are two power generation companies, one transmission company, and three distribution companies, which were formed after 1999 when the state electricity board for the region was unbundled. It is only in New Delhi, where the government bureaucrats live, that the government is fully in control of the transmission and distribution of electricity. For the rest of the region there are three distribution companies that are 51% privately owned, with the state maintaining minority holdings. However, the private distribution companies procure around 70% of their power from state-owned producers such as the National Thermal Power Corporation and the National Hydroelectric Power Corporation. Tariffs are regulated by the state-run Delhi Electricity Regulatory Commission.

With a rapidly-growing economy and population, Delhi struggles to manage demand for electricity. In 2013, for example, there was a 26% price increase to contain demand, and in 2016 there were rolling blackouts.

Despite these pressures, Delhi has not done well in comparative terms in promoting renewables. It remains dependent on coal and gas for electricity production, and has fallen far short of RPO requirements. In 2012, Delhi's renewables consisted only of 16MW of waste-to-energy and around 2MW of solar – only 0.3 % of total electricity production; and there has been relatively little progress since.

The reason Delhi is underperforming is complex: there are political concerns, and technical challenges such as the shortage of land for land-intensive projects such as solar farms. There is also the still-relatively-high cost of renewables increasing the pressure on already strained tariffs. The new AAP-led urban government has made the reduction of electricity tariffs one of its key promises. If implemented, this may make the shift to renewables even less likely.

However, there are some positive developments in Delhi's energy sector. These include methane recovery and energy production at three landfill sites; innovative rooftop solar power projects including on metro stations; an ambitious greening programme for Delhi, which has increased urban forest cover from 3% to 19%; retrofitting buildings for energy efficiency; the replacement of conventional fuels with Compressed Natural Gas (CNG) in the bus fleet; and the use of CNG in the auto-rickshaw market.

INNOVATION-DRIVEN ECONOMY

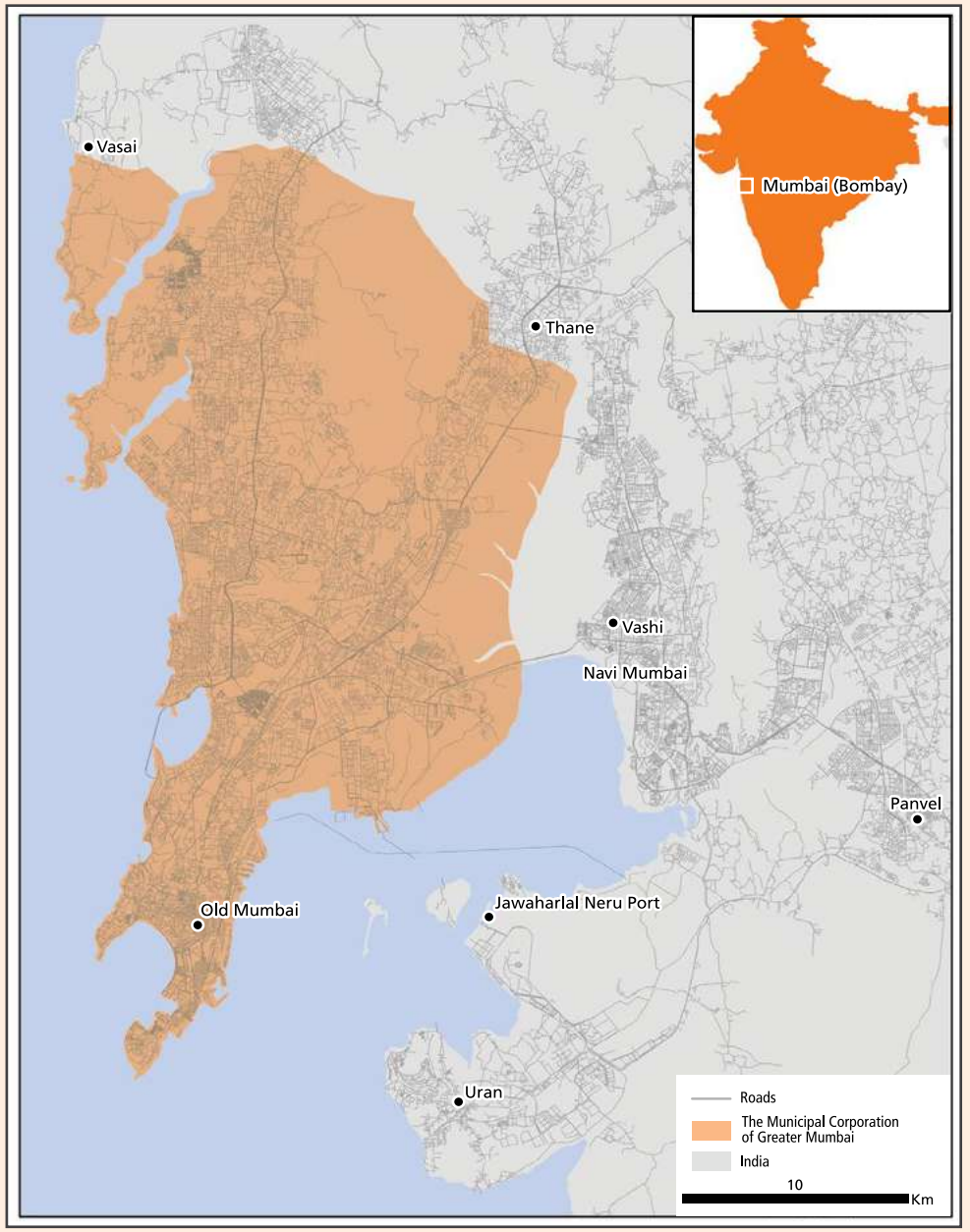
In 2015 Delhi was ranked only 256th globally and 22nd in the BRICS in the 2thinknow Cities Global Innovation Index. This reflects the challenges of achieving innovation in India more broadly. The Information Technology Foundation, for example, has ranked India 54th of the 56 countries studied (after South Africa at 30th, Brazil at 41st and Russia at 42nd). India's challenges include low per capita spending on education, low levels of government funding per capita on university research, fragmented production markets, a weak intellectual-property regime, and service trade restrictiveness; although there are also strengths, such as generous tax incentives for R&D. Even within India, Delhi was not at the top, ranking fourth after Mumbai, Bangalore and Chennai.

India has a National Innovation Council, which has developed an 'Innovation Roadmap to 2020' that involves a range of programmes to improve innovation nationally. However, innovation programmes are still relatively underdeveloped at local level. While Delhi may not have a local innovation strategy, it does have a number of strengths on which innovation could develop. For example, there are a number of national research councils based in Delhi, such as the Indian Council of Social Science Research (ICSSR), the Council of Scientific and Industrial Research (CSIR), and the National Council for Science & Technology Communication; and also innovation laboratories in the private sector, such as the Samsung and Hillman Labs.

Delhi has a number of universities: four central universities, five state universities, and 13 deemed universities. In the QS BRICS University Rankings for 2016, the Indian Institute of Technology Delhi was ranked at 15th and the Delhi University at 41st. For example, Delhi University has been at the forefront of innovation in the academic sector, having begun an undergraduate innovation project in 2013. Students could apply 'for any project that they can conceive of in any area of human endeavour and [that] is trans-disciplinary, hands-on, and has real-world application'. The project has been deemed a success and has resulted in a number of solutions to everyday problems facing the city, as well as new knowledge, patents and research papers. The success of the project has led to the establishment of incubation centres that fund start-ups. In the period 2013-2015, 36 start-ups were in the pipeline.

MUMBAI

मुंबई



CONTEXT

LOCATION

Mumbai (formerly Bombay) is located on the west coast of India around a natural harbour. It is the capital of Maharashtra State.

HISTORY

Mumbai began as a cluster of small fishing villages, scattered across seven islands, that fell under the rule of a succession of Indian states. The Portuguese took possession in 1535, but the British were soon vying with them for control; they gained effective control in 1688, and leased the islands to the British East India Company, which moved its headquarters from Surat to Bombay in 1687. As a key administrative post, Bombay grew rapidly, although there were bitter struggles in the 18th century between the British and Maratha for control of the area.

There was large-scale land reclamation in the early 19th century, which merged the islands; and when the Suez Canal was opened in 1869, Bombay was well-positioned as a global shipping port. In 1854 the first cotton mills opened in Bombay, and with the growing port, Bombay emerged as the world's chief cotton-trading market.

With the independence of India in 1947 Bombay became the capital of the extensive Bombay state, with its municipal boundaries significantly expanded to include adjoining towns. However, there was sectarian violence, and in 1960 the Gujarati-speaking areas of Bombay State were segmented off into the Gujarati State. Bombay became the capital of a reconstituted Maharashtra State, which also included regions from neighbouring states. Religious and ethnic conflicts continued to mark the development of the city, as a Hindu (or Marathi) nationalist movement responded to the influx of other groupings, including south Indians and Muslims, into the growing city.

Bombay nevertheless expanded into one of the most dynamic cities in South Asia. In the 1970s it was still largely dependent on textiles and the port, but has diversified significantly since then with the growth of industries such as information technology, diamond-cutting, finances and entertainment ('Bollywood' films).

In 1996 the city confirmed its name as Mumbai to commemorate a local Hindu deity, and subsequently a number of older colonial place names have been changed to reflect local histories.

POPULATION

POPULATION SIZE

According to the UN Population Division the 2015 population of the Mumbai urban agglomeration was 21.04 million.

POPULATION RANKING

In terms of UN data, the Mumbai urban agglomeration was ranked fifth globally, fourth in the BRICS (after Delhi, Shanghai and Sao Paulo), and second in India.

POPULATION GROWTH

The population of the Mumbai urban agglomeration was growing at a relatively slow average annual rate of 1.6% for the period 2010 to 2015 – considerably less than the peak growth of around 4% in the late 1980s. However, growth rates are likely to increase slightly towards 2030, as urbanisation in India accelerates.

POPULATION DIVERSITY

Mumbai is a diverse city. In terms of religion, 66% of the population is Hindu, but there are large minorities of Muslims (20.7%), Buddhists (4.8%), Jains (4.1%), Christians (3.3%) and Sikhs (0.6%). The major language group is Maharashti, spoken by 42% of the population; although Gujarat is also significant, at 19%. English is widely spoken as a second language, and is used in all official documentation. Around 1.4% of the population is foreign-born.

STRUCTURE OF THE URBAN AGGLOMERATION

The core of the urban agglomeration is the City of Mumbai, which is officially known as the Municipal Corporation of Greater Mumbai (MCGM) and is comprised of the original archipelago and the older suburbs. There are around 12.7 million people living in this still very dense core. Much of the density is a result of the containment of the population in an area that is surrounded on all sides by water (the Arabian Sea, Harbour, Thane Creek and Vasai Creek); it is effectively an island. The island also contains the Sanjay Gandhi National Park, which is completely encircled by urban development.

The urban agglomeration has extended beyond the island to incorporate smaller cities such as Thane, Kalyan, Ambernath, Ulhasnagar, and Mira-Bhayander, all of which have populations of more than a million people. Navi Mumbai, on the east shore of the Harbour, is also included. This was a new city planned in the 1970s to accommodate overflow from Mumbai, with a current population of around 1.1 million. This extended urban region is known as the Mumbai Metropolitan Region (MMR), or the Mumbai Urban Agglomeration (MUA), and is the basis of the UN calculation of around 21 million people. However, there is also a wide area of urban settlement – though not all contiguous – which is sometimes referred to as the Mumbai Metropolitan Region, and which includes an additional two or so million people.

There are significant differences across the MMR in terms of population growth. In the old, historic core of the city at the tip of the peninsula, population is actually declining at a rate of around -0.6% per annum. In the suburban extension on the island, growth rates are fairly slow, at around 2.5%. But the major growth is happening in the wider region, with Navi Mumbai growing at more than 5% per annum, and the southern edge of the MMR at more than 15%.

ECONOMY

According to the Brookings Institution, the 2014 GDP for Mumbai was USD 150. 85 billion (PPP). The MMR contributes about 40% of the GDP of Maharashtra State, and about 7% of India's total. The average annual GDP growth in the period 1993 to 2012 was 6.2%.

Updated data on the structure of the economy is not available but data from the Economic Census of 2004-5 indicates that at the time, 41% of GDP came from traditional non-government services, 13.3% from modern non-government services, 8.4% from social services, 26.6% from manufacturing, and the rest from construction, public utilities and the primary sectors. What the data does indicate is a city that is highly tertiarised, although there is still a manufacturing base.

Mumbai experienced dramatic economic shifts from the 1970s, with the decline of the textile mills. There was a period of de-industrialisation and high job losses, with only partial compensation from the growth of the service sectors; which led to the rapid growth of the informal sector. The 1990s were a period of economic liberalisation which brought in foreign capital and shifted the formal economy further towards services, finances and ICT. At the same time there was massive growth in cultural industries, with the expansion of the Hindi-language film industry known as 'Bollywood' into international markets.

Although most textile producers had closed their operations by the 1980s, Mumbai retains a strong position in manufacturing industries such as gems and jewellery, leather products, IT, and chemicals and pharmaceuticals. IT is a particularly important area of growth. India's now-thriving IT industry began in Mumbai, although the city lost some of the impetus to Bangalore. But the Infotech Park and Special Economic Zone in Navi Mumbai have attracted many software companies, and have assisted the MMR in regaining its position in the industry.

Mumbai has also emerged as an important headquarters economy. It is home to five of the Fortune 500 companies, namely Bharat Petroleum, Tata Motors, State Bank of India, Hindustan Petroleum and Reliance Industries, and 54 companies in the Forbes Global 2000. It is also home to the three largest private companies in India – Reliance, Tata, and the Aditya Birla Group. The clustering of major corporations has given impetus to the development of high-end business services, including the financial sector. Mumbai is South Asia's financial hub, and is home to major financial institutions including the Reserve Bank of India, the Bombay Stock Exchange, and the National Stock Exchange of India. The city accounts for four-fifths of the national turnover in foreign exchange. According to the Global Financial Centres Index, Mumbai ranks 42nd in the world but sixth in the BRICS (after Hong Kong, Shanghai, Shenzhen, Beijing and Dalian). Mumbai is the centre of the financial-services sector in India.

Entertainment is a major sector in the local economy, including music, film and live entertainment. Mumbai is especially famous for Bollywood. Around 1 000 films are produced a year, reaching an audience of 3.6 billion people. Real estate is also a major area of development, with large tracts of land used previously for textiles mills or port-related activities now available for development.

GOVERNANCE

The governance of Mumbai is complex. Within the core area the primary local authority is the Municipal Corporation of Greater Mumbai (MCGM), although it is known as the Brihanmumbai Municipal Corporation (BMC). There are local government elections every five years, with the leader of the majority party in the municipal legislature generally being the Mayor. However, the Mayor's role is largely ceremonial; true executive authority rests with the Municipal Commissioner, who is an official appointed by the Maharashtra state government. The Municipal Commissioner is responsible for the sewage system, the school divisions, power companies, roads, and other aspects of local infrastructure.

Within the wider region, each urban area or township has its own local self-government, which is a corporation, a council or a panchayat (village). Navi Mumbai was developed by the City and Industrial Development Corporation of Maharashtra (CIDCO), and is now administered by the Navi Mumbai Municipal Corporation. Most of the other larger centres are administered by Municipal Corporations, which have powers for delivering public transport and electricity, but which have also recently received devolved powers that enable them to deal with urban planning, slum upgrading, and poverty-alleviation initiatives. The smaller urban centres fall under Municipal Councils with lesser powers.

This is a complex patchwork of local government which makes overall coordination of regional development extremely difficult. In addition to these local structures there are multiple non-elected bodies responsible for providing some form of technical service, with jurisdictions that often overlap or contradict those of other authorities. To achieve some degree of regional coordination, the Mumbai Metropolitan Region Development Authority (MMRDA) was set up as an agency of the Maharashtra State Government in charge of town planning, development, transportation and housing in the region. The organisation is tasked with projects, plans and challenges that cross municipal boundaries.

DEVELOPMENTAL CHALLENGES

Mumbai is a mega-city facing enormous challenges, including a lack of affordable housing, deficiencies in urban infrastructure, growing inequality, crime, and air and water pollution.

Mumbai's population remains poor in international and BRICS terms. While urban areas of India average around 17% of their population in slums, the figure for the Mumbai Municipal Corporation in the 2011 National Census was 41.3%, the highest proportion for any major urban agglomeration in India. The most famous of the slums is Dharavi, in the heart of the city, home to between 600 000 and a million people. The slums are associated with serious social problems including high levels of infant and maternal mortality, child labour, and high disease rates.

Mumbai is a city of extreme wealth and extreme poverty, although the Gini coefficient (in the range 0.3 to 0.39) is below the 'international alert' line, and lower than figures for cities in South Africa and Brazil. Crime is a problem – including organized crime, in the 'Mumbai underworld' – but less so than in other parts of India, including Delhi; and homicide rates are minimal compared with those of cities in South Africa and Brazil.

Mumbai faces major challenges in terms of urban infrastructure. The congestion in the transportation system is dealt with below, but there are also severe problems in terms of water supply and sewerage. Current water supply in Mumbai is inadequate; and when the monsoon fails, Mumbai experiences severe water shortages. The problem is exacerbated by the 38% of water unaccounted for as a result of leakage or irregular connections. Mumbai's sewerage system too is a major challenge. In 2005, only 15% of Mumbai's sewerage was treated. This is reportedly improving, but there is still an estimated 2 000 million litres per day of raw sewage spilling into the ocean and harbour, creating massive health challenges.

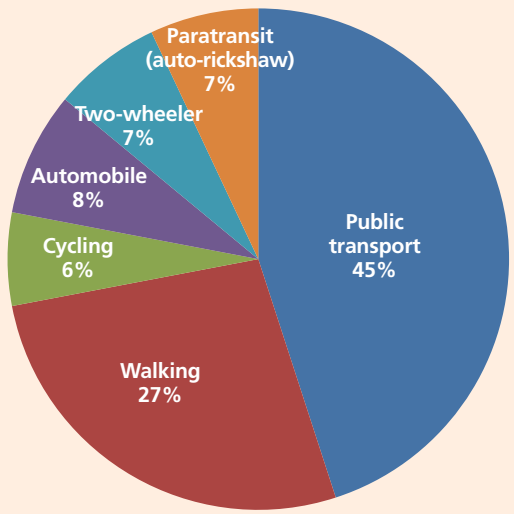
There are other serious environmental problems. The long history of poor enforcement of environmental regulations has led to the rapid destruction of wetlands, destruction of urban space, and severe air pollution. The annual mean PM10 for Mumbai of 132ug/m3 exceeds that of Beijing, at 121.

THEMATIC REPORTS

TRANSPORTATION

The MMR is in the unusual position of having among the highest levels of public transport use in the world; but also among the highest levels of congestion in transport networks, with 11 million people using the system each day. Although the share of private automobiles is relatively low in this mainly low-income city, the roads are nevertheless congested with multiple forms of poorly-regulated and -coordinated vehicles, with the added difficulty of narrow roads and a complex geography of islands connected by relatively few bridges. Also, despite the extensive public transport systems, investment has not kept pace with massive population increases, giving Mumbai the dubious reputation of having the most congested public transport in the world. And despite the high levels of public transport use, Greater Mumbai also has among the highest annual levels of CO_2 emission from the transport sector (around 0.11 ton per capita per year); mainly the result of long trip-lengths in the MMR, and high-emission two-wheelers.

MODAL SHARE, 2011 (MUMBAI)



Census of India, 2011

In terms of the share of motorised transport, the modal split is public transport (67%), private transport (22%), and paratransit (10%). In terms of public transport only, rail accounts for nearly 70% of trips, with bus taking up most of the remainder.

BUS

Although the public transport system was predominantly railway-based, an extensive network of bus operators also emerged. In Mumbai, the Brihanmumbai Electric & Transport (BEST) developed comprehensive coverage of the city, and today operates a fleet of 4 500 buses, which run on compressed natural gas and cover 350 routes. Elsewhere in the MMR there are other municipal bus companies, run for example by Navi Mumbai Municipal Transport and the Thane Municipal Corporation.

SUBURBAN RAIL

The first railway in India was developed in the MMR, connecting the cities of Mumbai and Thane, and the Indian Railways went on to develop a comprehensive commuter rail system in the region. Over the past four decades the capacity of the suburban rail system increased by 2.3 times; but suburban rail traffic increased by six times, to 7.4 million passengers a day. The transport authority reports that an average of 4 500 people travel on each train, with each train having a carrying capacity of only 1 750.

MUMBAI METRO

The Mumbai Metro became operational in 2014, to support the massively overcrowded suburban rail. It has one operational line and a daily ridership of around 280 000, which is small in relative terms, but there are significant expansion plans. The project was initiated by the state government, which delegated responsibility for delivery to the Mumbai Metropolitan Region Development Authority (MMRDA). The metro is run by Metro One Operation Ltd (MOOPL), a joint-venture company, under a 35-year contract.

PARATRANSIT

There are over 150 000 auto-rickshaws in Mumbai, accounting for 11% of all vehicles. Auto-rickshaws are relatively safe because of their low speeds and lighter weights, and are a highly flexible form of transport, allowing for door-to-door coverage; but they do present environmental problems, as the conventional two-stroke engines – combined with poor maintenance, and a lack of catalytic convertors – contribute significantly to the emissions from the transport sector in Mumbai.

FUTURE PLANS

The development of the metro has been the major advance in terms of public transport, and there are evolving plans for a significant extension to the network, with three additional lines already being planned. However, the Mumbai Urban Transport Project also includes proposals for significant upgrades to the suburban rail network. A major new development in terms of road construction is the Mumbai Trans Harbour Link, which will connect Mumbai and Navi Mumbai with a 22-kilometre sea bridge, the longest of its sort in India. However, there are enormous institutional challenges in the delivery of these projects.

GREEN ENERGY

Power is supplied by the plants of the Maharashtra State Power Generation Company Ltd. (MSPGCL), Independent Power Producers (IPPs), Central Sector allocation, and renewable energy producers. The MSPGCL produces around 40% of the electricity, mainly from thermal, gas and hydro. About 13% comes from the IPPs, using similar sources, and nearly 30% from a central allocation, which includes some renewable-energy sourcing. The renewable-energy producers in the state account for under 4% of production, but are increasing in numbers.

Mumbai has three power utilities for distribution – Tata Power Company, Suburban Electric Supply (BSES), and Brihanmumbai Electric & Transport (BEST). For the rest of the state, electricity is provided by the Maharashtra State Electricity Board (MSEB), with a few smaller private distributors.

Greater Mumbai is doing comparatively well in terms of green energy (or the use of renewable resources to produce electricity). The PricewaterhouseCoopers (PwC) report Cities of Opportunity (2012) recently rated Mumbai top out of 27 large cities assessed in terms of the use of renewables.

Overall, India has been proactive in the development of green energy. It established a Ministry of New and Renewable Energy (MNRE) and also the Indian Renewable Energy Development Agency (IREDA), as early as the 1980s. A series of fiscal incentives – including tax depreciations, tax holidays, low import tariffs, and direct subsidies for capital generation – have been given to private-sector operators to promote growth in renewable-energy production.

Maharashtra followed the national lead, with the creation in the 1980s of the Maharashtra Energy Development Agency (MEDA) to promote non-conventional energy sources. Initially the focus was on rural areas, but MEDA now promotes a more comprehensive initiative. Maharashtra also produced around one-tenth of India's renewable energy production, with a strong focus on wind power. By 2015, around 10% of energy production in Maharashtra was from renewable sources.

Given the higher tariffs, however, the challenge is to ensure that the energy utilities procure this renewable energy. In this, the Maharashtra Electricity Regulatory Commission (MERC) has been highly proactive. It has issued Renewable Purchase Obligations (RPOs) for electricity distributing and utilising, and also for large industrial users of electricity. The RPOs require the procurement of a certain percentage of electricity from renewable sources. Each year this percentage is increased by around 1%. High fines are imposed for lack of compliance, with Maharashtra said to have the strongest enforcement of RPOs by any regulatory commission in India. In 2011, the minimum quantum of purchase was 6%, but this will be increased to 9% in 2015, with at least 0.5% to be procured from solar energy. The annual reports of the MERC show a fairly wide variance in compliance with the RPOs; but the trend is upwards.

In additional to greening electricity, Mumbai is paying attention to biofuels in the transportation sector. In 2016, Mumbai dropped its 7% import tax on ethanol, making biofuels significantly more competitive. Mumbai also has one of the world's largest biodiesel programmes, for a municipal bus fleet. While biofuels are now mainly imported, India is developing its own biofuel sector, mainly using palm oil.

INNOVATION-DRIVEN ECONOMY

As indicated in the Delhi Factsheet, India has many limitations in innovation, and ranks low internationally and in the BRICS in innovation capacity. Mumbai, however, is an exception. In the 2thinknow Innovation Cities Global Index, 2015, it ranked 74th globally, and sixth in the BRICS, making Mumbai one of the innovation leaders in the BRICS.

Much of Mumbai's innovative capacity has come from its openness to the global economy. In the early 1990s, economic liberalisation brought in a large number of leading global corporations, which also stimulated the growth of financial services. The city government adopted a more internationalist and pro-global approach, which was crystallised in the 1996 Vision Mumbai: Transforming Mumbai into a World-Class City. The process of creating this vision harnessed a coalition of public- and private-sector leaders to address the city's economic future now known as Mumbai First, which has supported innovation in the urban sector.

A number of large transnational corporations have set up R&D centres, with a large clustering of pharmaceutical and IT-related activity in Navi Mumbai. The major domestic corporations are also becoming more innovative, with Mumbai-based Tata Motors now on The Economist's Global Top 50 R&D firms. There are some challenges, however, with the Mumbai-based pharmaceutical firm Novartis, for example, insisting that it would not invest in R&D in India, as the ecosystem to support R&D is still lacking. In this respect, Mumbai's progress is being hamstrung by national limitations. Although there is a National Innovation Council that has an Action Plan to support innovation, progress has reportedly been slow.

Outside manufacturing, the major innovation impulse is in financial services and the cultural industries. There are initiatives to support new, innovation-driven growth in financial services, such as the Rise Mumbai, an innovation platform for financial technology start-ups. However, there are also challenges in this sector, including the apparent lack of support for Mumbai's financial-hub status from Central Government. Bollywood has also been at the heart of the city's re-entry into the global economy since the 1980s. It has boosted the profile of the city, and provided a platform for innovation in the cultural industries, although some critics have argued that levels of innovation in Bollywood are still low in international terms.

Mumbai is an educational hub, with a number of universities and colleges. In the QS BRICS Rankings, 2016, the Indian Institute of Technology, Bombay, was ranked 13th. However, Mumbai does not have the same concentration of top educational institutions as other leading BRICS cities. The other challenges limiting innovation include difficulties in attracting innovation-driven enterprise, because of the complex and fragmented system of governance, the inflexibility of many policies, and the severe deficiencies in urban infrastructure.

A new initiative which may offer prospects into the future is the mega-corridor initiative, around which smart-city initiatives and industrial zones are to be developed. Mumbai is at the intersection of the Delhi-Mumbai Industrial Corridor and the Mumbai-Bangalore Economic Corridor.

BENGALURU

(Bangalore)
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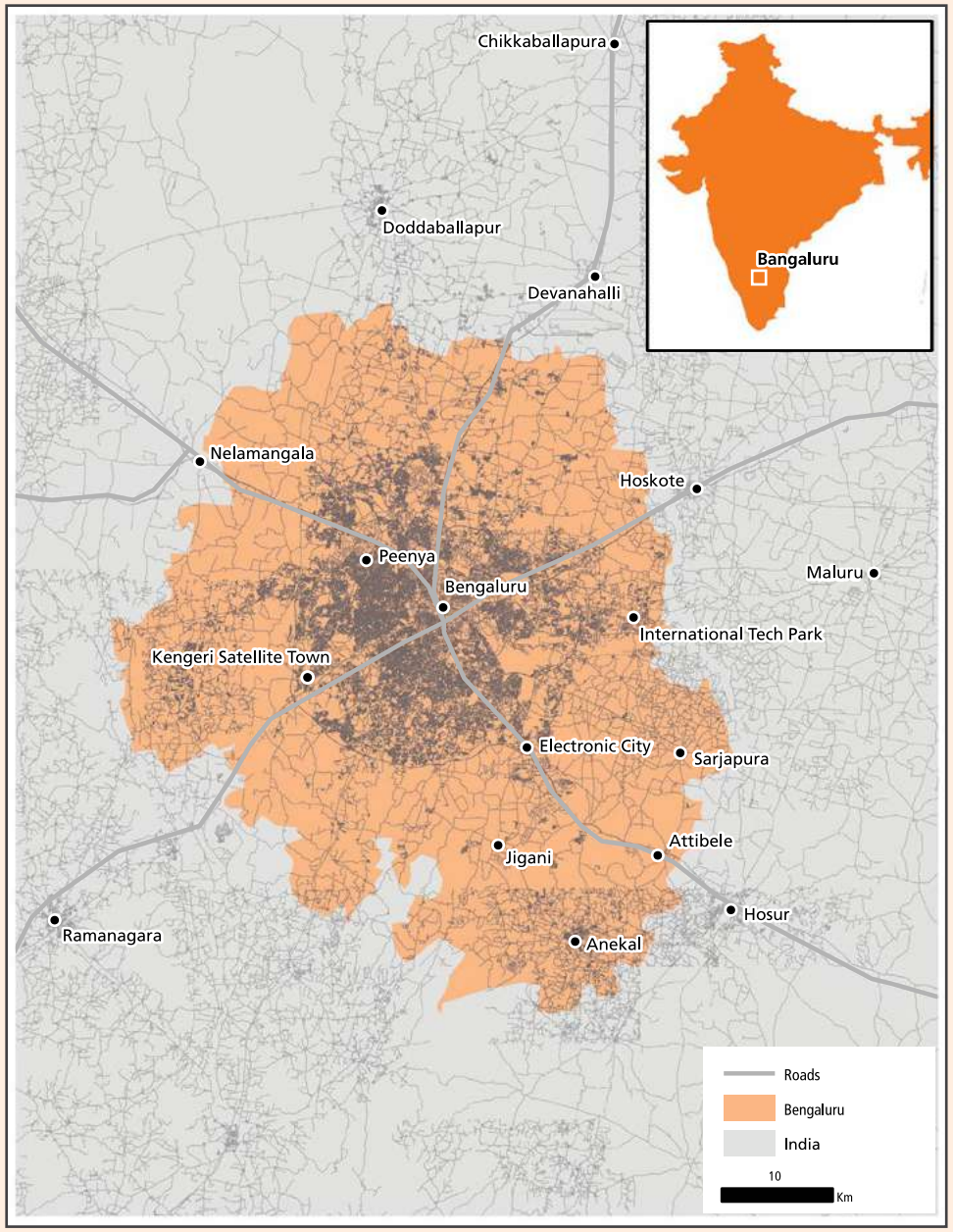


CONTEXT

LOCATION

Bengaluru (the official name of the city more often known as Bangalore) is located in central India on the Deccan plateau. It is the capital of the Indian State of Karnataka.

HISTORY

There are many stories – possibly apocryphal – on the origins of the settlement; but modern Bengaluru had its origins in 1537, when a mud brick fort was established on the site of the present-day city. A town grew up around the fort, which changed hands several times as kingdoms and dynasties rose and fell. The British captured the fort in 1791 but returned Bangalore to the Mysore Kingdom, although they maintained a strong colonial presence. In the nineteenth century, Bangalore was divided between the indigenous city and the enclosed Cantonment occupied by the colonial elite, with these two segments divided by a 1.5-kilometre separation zone.

After independence in 1947, Bengaluru became the capital of the Mysore state; and in 1949, the Cantonment and the old city merged into one administrative area, under the Bangalore City Corporation. By 1976 the City had become the capital of the newly-formed Karnataka state. The capital required capacity, and so the initial waves of migration and growth concerned the development of the public sector. This was followed by an increase in manufacturing, especially electronics and automobile-manufacturing in the 1970s. Initially this development was supported by state-owned firms, but after India's economic liberalisation in the early 1990s, Bangalore became hugely attractive to multinational firms in the ICT sector. In this decade there was massive growth as Bangalore transformed into the 'Silicon Valley of India', but with stabilisation in the 2000s. In 2007, the city was renamed 'Bengaluru' (also spelled "Bengalooru").

POPULATION

POPULATION SIZE

According to the UN Population Division, the 2015 population of the Bengaluru urban agglomeration was 10.09 million.

POPULATION RANKING

In terms of UN data, the Bengaluru urban agglomeration ranks 29th in the world, 13th in the BRICS, and fourth in India (after Delhi, Mumbai and Kolkata).

POPULATION GROWTH

For the period 2010 to 2015, the average annual growth rate was a rapid 3.96%.

POPULATION DIVERSITY

Hinduism is the majority religion in Bangalore city with 78.9% followers; Islam has 14%, Christianity 5.6% and Jain 1%, with small Sikh and Buddhist minorities. Linguistically, more than half the population speak Kannada, with minorities of Urdu-, Tamil- and Hindi-speakers.

STRUCTURE OF THE URBAN REGION

Central Bengaluru still has the legacy of the old 19th-century division between the densely-packed indigenous city and the low-density Cantonment, but the city has expanded outwards multiple times since then.

Since the 1970s, the growth of ICT has dominated the spatial development of the city. In the 1970s, Electronics City was established south of Bangalore, but there was also industrial development in Peenya in the north-east. To contain the growth of the city small satellite towns were developed in a belt around the city, although some of these developed rather slowly. Industry became gradually more diffused across the city, especially after the development of fibre optics allowed for more flexibility in location. In the 2000s, the State government designated 14 Special Economic Zones (including three clustered around Electronics City) in a belt around Bengaluru, and a Master Plan proposed tying these satellite industrial estates to the core city with development along radial axes. With the development of the SEZs, population growth was greater on the urban edge (over 10% per annum), with slow development (around 1% per annum) in the urban core. The 'Infotech Corridor' around the city was provided with high-quality industrial infrastructure, but also world-class amenities such as schools, recreational facilities, housing and offices – unlike in other parts of the city, where infrastructure has become increasingly strained.

In the wider region around Bengaluru there are a number of towns, such as the automobile-producing Hosur (population of 100 000) and Krishnagiri (70 000). The State government has identified an infrastructure corridor linking Bengaluru and Mysore, a city with a population of over a million, which is about 130km from Bengaluru. There are plans for significant investment along the corridor.

ECONOMY

The Brookings Institution reports that the GDP of Bengaluru in 2014 was USD 45. 31 billion. This amounts to around 0.7% of the total GDP of India. Bengaluru is known as the 'IT Hub of Asia' and also the 'Silicon Valley of India'. It has an international reputation as a destination for hi-tech industries, including IT and biotechnology, and is a hub of IT and tertiary and quaternary activities. While figures on economic structure are not available, it has been estimated that around 40% of the city's GDP comes from a combination of research and production in ICT.

Since the 1950s, Bengaluru has been identified by central government as a potential hub of new industries. Prime Minister Nehru directed industrial development towards Bengaluru as it was strategically located away from national borders, also emphasising the development of education and research in the city. In the early 1970s, national government established an Electronics Commission to develop the electronics sector in India. The first of the large state-owned electronics firms was Bharat Electronics, which established its headquarters in Bengaluru. Electronics City was established in 1976 on the southern edge of Bengaluru, by a development corporation owned by the state government. In 1978 IBM withdrew from India, creating a vacuum in the electronics sector. At first, firms in Mumbai moved to fill the gap; but soon the focused shifted to Bengaluru, where the infrastructure was already in place, levels of education were high, and the lifestyle was attractive to a high-end workforce.

In 1991, central government instituted a number of major reforms, liberalising and opening the national economy. It also established a scheme in which firms located in the newly-proclaimed Software Technology Park were exempted from tax on profits made on exports. India was suddenly attractive to multinational corporations in the location of branch plants – and Bengaluru, with its already-established infrastructure for electronics, especially so. Bengaluru became the premier location for the location of export-oriented ICT firms in India, with the value of ICT exports from Bengaluru rising at over 30% per annum through the 1990s. It is this growth which shaped the post-1990s City of Bengaluru, making the city hugely attractive to large numbers of migrants, including many high-level professionals, and driving its physical expansion. Bengaluru now has at least 14 special zones supporting various forms of industry, the largest by far still being Electronic City.

Bengaluru has become a significant player in the ICT industry globally, with the key debate around the extent to which it can sustain or even improve its position. With India's national economy now booming, and Bengaluru's well-established position in the ICT sectors, its prospects seem good; but Bengaluru is facing rising competition from cities such as Chennai and Hyderabad.

GOVERNANCE

The most powerful agency in the urban agglomeration is the Bangalore Development Authority (BDA), which is appointed by the Karnataka State government. The BDA has powers over spatial planning, the designation of economic zones, and the supervision of major infrastructure and other development projects.

The elected local government for the central core is the Bangalore City Corporation, which was formed in 1949, when the old Bangalore local government and the Bangalore Cantonment were amalgamated. In 2007 the municipal boundaries were redrawn to include eight other municipalities and 111 villages. This added 3.2 million people to Bangalore, and resulted in the creation of the Greater Bangalore City Corporation (Bruhat Bengalooru Mahanagara Palike). However, the Corporation is limited to certain service-delivery and maintenance functions, such as sanitation, roads, education, stormwater drainage, street lighting and healthcare. There are also a number of specialised agencies providing specific functions, such as the Water Supply and Sewerage Board, the Slum Clearance Board, the Metropolitan Transport Corporation and the Housing Board. There are also special development agencies for the management of the designated SEZs.

The Bengaluru Metropolitan Region Development Authority (BMRDA), appointed by the State government, attempts to coordinate across the wider region, bringing together urban and rural areas, and supervising the work of the BDA. There are also experimental efforts to bring government and civil society together through the 'Bengaluru Agenda Task Force (BATF)', which was instrumental in developing Vision Mumbai and in championing key projects in the region.

URBAN DEVELOPMENT CHALLENGES

Bengaluru has been a highly successful city in economic terms, but there are significant challenges. The city is becoming increasingly unequal. The workers in the ICT sector generally enjoy rising incomes and a high quality of life, living and working in environments that are planned and maintained to world-class standard. However, the majority of the population works in service industries outside the ICT sector, and lives in a city that has become increasingly strained in terms of infrastructure. The reported Gini coefficient is nearly 0.5.

According to the 2011 Census, around 15-18% of the population lived below the income poverty line, with around 43% suffering deprivation in terms of multidimensional indices. 8.5% of the population lived in the 640 slums across the city, which are largely un-serviced, and are vulnerable to disease and to flooding, especially during the monsoon season. The proportion of slum-dwellers may be less than in most other large Indian cities, but the absolute numbers are high for a city with world-class aspirations.

Infrastructure has become strained owning to the rapid growth of the city. Within the rising affluence of the middle-class, car ownership has expanded dramatically, creating severe road congestion. Solid-waste management remains a problem, with up to 20% of garbage in the city remaining uncollected. Drinking water presents perhaps the most difficult challenge. There is an acute shortage, with slum-dwellers most severely affected. The capacity of the sewerage system is another concern, with overflows into water supply a problem in the rainy season.

THEMATIC REPORTS

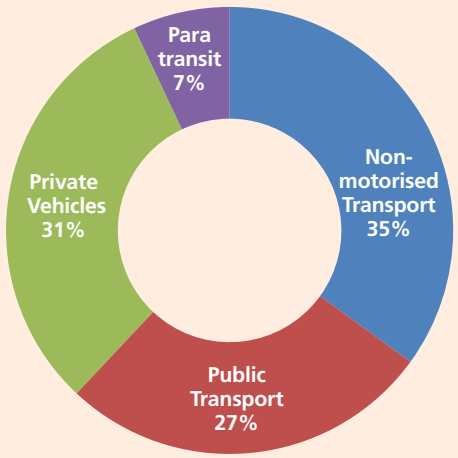
TRANSPORT

PUBLIC TRANSPORT

Bengaluru faces massive road congestion, with frequent gridlock. In 2011, the IBM Global Commuter Pain Survey rated Bangalore the sixth-worst of the 20 cities surveyed – even worse than Delhi.

Studies suggest that the average citizen of Bengaluru spends more than 240 hours a year stuck in traffic, and the average journey speed of a private vehicle is between 15 and 25 km/h. The modal split that provided the base of the 2007 transportation plan reveals a far higher proportion of private vehicles than in most Indian cities, reflecting in part the size of the middle class in Bangalore. Nearly 70% of the approximately four million motorised vehicles on the road are two-wheelers.

MODAL SHARE



Source: Census of India, 2011

BUS

Bus is the oldest and still the most important form of public transport in Bengaluru. The Bangalore Metropolitan Transport Corporation (BMTC) is a state-owned corporation that runs a massive bus service, carrying around five million passengers each day. The BMTC runs various types of services, from low-fare and basic to luxury. There is currently controversy over whether to privatise the BMTC. There was a proposal in the 2007 transport plan to develop a BRT system, but there has also been resistance to the idea from private vehicle-users reluctant to give up vehicle space. In 2016, the matter remained unresolved.

RAIL

The rail system operates mainly for long-distance inter-city travel, although there are relatively short-distance commuter passenger trains running from the small satellite towns in the region to Bengaluru. There are proposals for running a suburban railway service for the City of Bengaluru, with approvals granted in 2014/15, but with no implementation by 2016.

METRO

The Namma Metro (or Bengaluru Metro) is built and operated by the Bangalore Metro Rail Corporation, which is a joint venture between state and central government. There were many delays to the planning and construction but Phase I was completed in 2011. There are currently two lines, with a track of around 32km. There is a modest daily ridership of 240 000, but with significant expansion plans.

PARATRANSIT

The paratransit sector consists of taxis and auto-rickshaws, which are mainly owner-operated. In 2011 there were an estimated 82 000 vehicles on the road, with the numbers growing at over 5% annually.

PLANS

A comprehensive plan for a city-wide transportation system was released in 2007. The proposals were for at least 569km of mass transport, made up of a metro, monorail/Light Rapid Transit, BRT, and a suburban-commuter rail service. The challenge is that decision-making has been complex, and many of the proposals remain unimplemented. Implementing the BRT, LRT, monorail and suburban rail services has been delayed. The metro, however, has been implemented, with a Phase II which could increase the track to 114km expected by 2020. The intention ultimately is to have around 240km of track.

GREEN ENERGY

The production, procurement and distribution of electricity are handled at state level. In the early 2000s the Karnataka Electricity Board was unbundled to create a number of independent generation and distribution companies. In 2015, the total installed capacity in the state was 15 271MW, of which 42% was in the private sector. In terms of energy source, 43.5% was from coal and other fossil fuels, 23.6% from large hydro, 3.1% from nuclear, and 29.8% from renewable sources. The high level of renewable sources for electricity is unusual for India, and for the BRICS more widely, although almost all the renewables were procured from private sources. A PwC report indicated that Karnataka is the leading state in India in terms of the use of renewable sources.

Karnataka's enviable success in promoting renewables is partly in response to the growing problem of electricity shortage in the state, which prompted a search for multiple alternative sources of electricity production. The state government established the Karnataka Renewable Energy Developer Ltd (KREDL) as the facilitating agency for securing renewable energy. KREDL has used a multidimensional approach to identifying, procuring and developing sources of renewable energy. The most important instruments for promoting renewables are the Renewable Purchase Obligations (RPO), which compel state agencies to procure and annually increase the proportion of electricity from renewable sources; and differential tariffs, which provide higher returns to renewable producers. Producers selling energy from renewable sources may earn over 40% more than producers using fossil fuels for production.

The greatest success has been with wind energy, with existing projects at various stages of completion providing a potential 7 000MW of installed capacity. There are however a number of small hydro, co-generation, biomass and solar projects. For example, there are efforts to support solar production by promoting solar rooftop projects that are exempted from the regulations related to floor area ratio (FAR). Excess energy generated for domestic use is directed back into the local grid. The BDA is also actively working to achieve energy efficiency in domestic, industrial and commercial buildings, through introducing new regulations.

In terms of fuel use, there is growing attention to the development of biofuels. The Karnataka State Bioenergy Development Board has initiated the construction of Bioenergy Parks for research into and production of biofuels, using agricultural produce in the state. At least two biofuel plants have been opened. The Karnataka State Road Transport Corporation was reportedly in discussions with a major biofuel producer for a joint venture, which may result in a transport authority actually becoming a producer of biofuels. In the meanwhile, the BMTC has introduced fully-electric and hybrid-electric buses, and is planning to introduce solar-powered buses.

INNOVATION-DRIVEN ECONOMY

Bengaluru is a city now recognised as the 'Silicon Valley of India', and is a preferred destination for multinational investment in ICT; and yet, it does not yet rank as a global innovation hub. In 2015 it was ranked 185th globally in the 2thinknow Innovation Cities Global Index, 13th in the BRICS and second in India (after Mumbai).

There are indications however that Bengaluru is moving quite rapidly up the value chain, and that

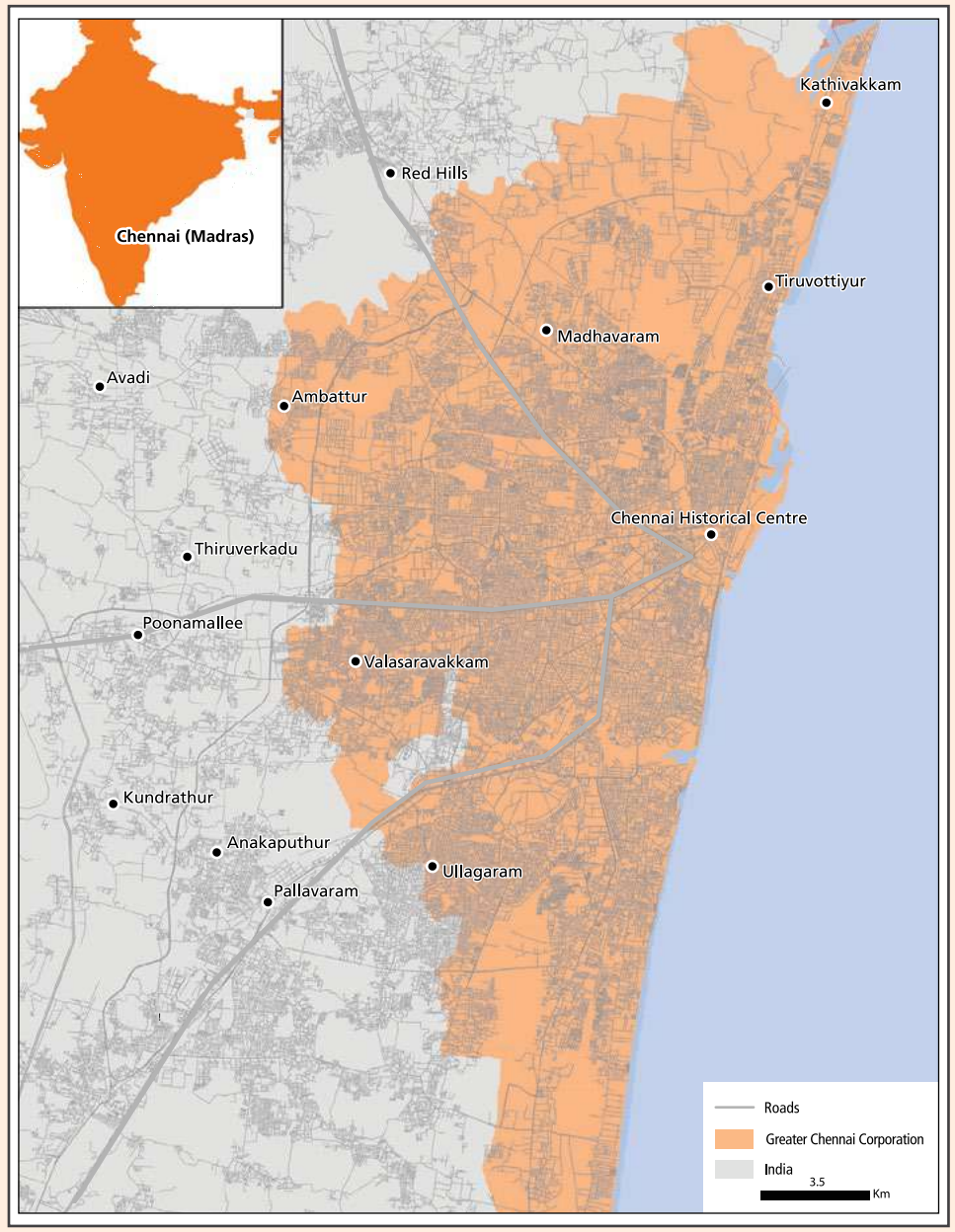
innovation capabilities are expanding. It is apparent, for example, that Bengaluru is becoming one of the most desirable locations worldwide for the location of innovation centres such as corporate research laboratories. The technology consulting and services firm Capgemini rates Top Locations for Innovation Centres Worldwide. In 2015, Bengaluru did not rate in the top 10, but in 2016 it was ranked fourth (after Silicon Valley, London, Paris and Singapore), beating Shanghai into seventh place). Among the corporations that have recently set up labs in Bengaluru are the multinationals Apple, Visa, Airbus and Intel, and large domestic software corporations such as Infosys and Wipro.

The advantages that Bengaluru has include: the now-substantial concentration of major domestic and international corporations, and the large knowledge spillovers that this presence brings; more than 100 R&D centres in the city; diverse cultures; plentiful venture-capital funding; a vibrant start-up culture; and a cluster of universities, including the highly regarded Indian Institute of Technology, Bangalore, which was ranked sixth in the BRICS in the QS index for 2016. There are challenges, however, including: the infrastructure deficiencies in the city (e.g. water shortages and road congestion); the lack of large research institutes; the lack of robust industry-academy partnerships; the overall national challenges in terms of innovation; and the (risky) overdependence on ICT, although there is now growth in knowledge-intensive industries such as aerospace, biotechnology and medicine.

The critical question for Bangalore is whether it will develop domestic innovation capabilities, or whether it will simply be a convenient site for IT production by multinationals which focus their real innovation activities elsewhere.

CHENNAI

(Madras)
சென்னை



CONTEXT

LOCATION

Chennai, formally known as Madras, is located on the south-eastern coast of India – the Coromandel Coast, in the Bay of Bengal. It is the capital of the State of Tamil Nadu.

HISTORY

The modern city of Chennai had its origins as a colonial settlement. At the beginning of the 17th century the area fell under the control of the Vijayanagara Empire, with the Portuguese, Dutch and British vying with each other for dominance of the coastal trading routes. The Vijayanagara king ceded a small slice of land near the mouth of the Cooum River to the British East India Company, who built Fort St. George there in 1644. The colonial settlement that grew around the fort was destroyed and rebuilt a number of times as a result of local resistance to British presence.

When the Mughal Empire (ruling from Delhi) took control of the region in the late 17th century, the East India Company was given a secure charter and an enlarged area of occupation. In the 18th century the colonial struggle was between the British and the French; but by the late 18th century the British were firmly in control, and Madras was an important naval base and a significant hub of trade between Great Britain and India. There was continued expansion of commerce in the 19th century, but Madras remained a colonial enclave until the late 19th century, when India's railways were constructed, and the settlement was connected to important cities such as Bombay and Calcutta.

In 1947, when India gained independence, Madras became the capital of Madras State; but in 1968, after reorganisation of state boundaries along linguistic lines, Madras was designated capital of the State of Tamil Nadu. Although there were bitter conflicts between Hindi- and Tamil-speakers that turned violent on occasion, there were high levels of economic and population growth in the post-independence era, as Madras developed into a major manufacturing, transportation and services hub. Large numbers of migrants arrived, making Madras an increasingly diverse city, but also contributing to the mushrooming of slums. There was extremely rapid growth in the early 2000s, as the city attracted large numbers of Information Technology (IT) and Business Process Outsourcing (BPO) firms. In December 2006, tragedy struck when the coastline was hit by a tsunami; that and severe flooding in 2015 led to a decline in industrial production.

POPULATION

POPULATION SIZE

The UN (2014) estimates the population of the urban agglomeration for 2015 as 9.89 million people, which is consistent with official government figures for the Chennai Metropolitan Area (CMA).

POPULATION RANKING

In terms of UN data, Chennai is ranked 31st in the world, 14th in the BRICS, and fifth in India (after Delhi, Mumbai, Kolkata and Bengaluru).

POPULATION GROWTH

The average annual growth rate of the urban agglomeration for the period 2010 to 2015 was 2.98%, and relatively fast growth is anticipated until 2030.

POPULATION DIVERSITY

Chennai is a relatively diverse city, although the capital of a state set up for Tamil Hindus. In 2011, 80.7% of the population was Hindu, but with significant Muslim (9.5%) and Christian (7.7%) and Jain (1.1%) minorities. The 2001 census had indicated that 78.8% of the population spoke Tamil, followed by Telugu (9.7%), Urdu (4.1%), Malayalam (2.6%) and Hindi (2.5%). An idiomatic slang spoken in the city, known as Madras Bashai, combines a number of languages and is widely spoken.

STRUCTURE OF THE URBAN REGION

Chennai is one of the most densely-packed cities in the world; and unlike many other cities in India, the core continues to densify. The historical centre is George Town, which is located adjacent to the port and contains the CBD and a large proportion of the city population. The wealthier population in the core live largely in lower-density areas along the beachline, with a large proportion of the population in slums slightly inland.

While the centre remains vibrant, there is sprawl along the edge, driven in part by the development of the IT, automobile, shipbuilding and entertainment industries. The Master Plan for the area supports these developments through the designation of the IT, Automobile and Entertainment Corridors. Among the scattered industrial poles on the southern edge of the metropolitan agglomeration are: Maraimalai Nagar, with its clusters of automobile plants including Ford India and BMW, and IT firms; Oragadam, the largest automobile hub in South Asia; Mevalurkuppam, with its massive Hyundai plant; Sriperumbudur, a Special Economic Zone (SEZ) with IT and automobile industries; and Mahindra World City, which was India's first operational SEZ, developed as a PPP between the Mahindra Group and the government of Tamil Nadu. The World City is being developed as a multi-product SEZ, with a balance of industrial parks, retail, and social amenities.

There is now also development of new industries to the north of the city. The Mahindra Group is planning to set up another World City in the north, replicating developments to the south. There is also the large new Kattupalli Port Complex being developed north of Chennai, a partnership between the state government and a large Indian corporation. It aims to compete with Japanese and Korean shipyards in building naval and other specialised ships.

The urban agglomeration coincides with the formally-designated Chennai Metropolitan Area (CMA), which is one of the 32 districts of the State of Tamil Nadu. However, there is a wider cluster of urban centres that fall within the jurisdiction of the Chennai Metropolitan Development Authority.

ECONOMY

According to the Brookings Institution, the GDP of Chennai in 2014 was USD 58.63 billion (PPP). GDP growth is provided at state rather than city level. In the period 2005 to 2014, the average annual growth of Tamil Nadu was 9.2% per annum, compared with India's 7.6%; peaking at 15% in 2006/07, with another peak of 13% in 2010/11. The current performance of the city and the region is uncertain, with growth in 2013/14 being only 2.8%, although growth did increase in 2014/15 to 7.4%, close to India's average.

While details of the industry breakdown are not available at city level, there are statistics for 2010/11 for the distribution of GDP in the Chennai district for primary, secondary and tertiary sectors:

» Primary – 1.1%

» Secondary – 13.9%

» Tertiary - 85.1%

This shows that despite the hype in the IT sector in particular, Chennai is still a predominantly service-oriented city, which is confirmed by recent labour-force statistics. However, it's likely that the underlying growth driver in recent years has been high-end manufacturing.

Chennai has a broad-based manufacturing sector, supplying the automobile, software services, textile, medical tourism, hardware manufacturing, petrochemicals and aerospace industries. The biggest of these is the automobile industry, with Chennai the largest cluster in South Asia, producing around 1.5 million vehicles annually. With production plants for BMW, Hyundai, Ford, Nissan, Renault, Ashok Leyland, Caterpillar, Daimler, Yamaha, Royal Enfield and TVS Motors, among others, Chennai accounts for 30% of India's motor production and 35% of its auto components.

In the late 1990s, BPO firms began locating in Chennai, which was also linked to software services. It became an attractive location for offshoring services, with most global software companies establishing a base in the city (e.g. Oracle, Cisco, IBM, Symantec, eBay, Honeywell). The city developed as India's largest exporter of IT and IT-related services after Bengaluru, with the firms in the sector clustering in the technology zones in the south of the city-region. Chennai also developed as a hub for electronic hardware manufacturing plants, with a large cluster developing in the Sriperumbudur Electronics SEZ. By 2010, Chennai accounted for around 35% of India's electronic hardware exports. The Chennai Aero Park, which is home to Ashok Leyland Defence Systems, is being set up to lead India's entry into the global aerospace industry, with specialist shipbuilding also emerging around a new port in the north of the city. More traditional industries in the city are textiles, clothing and petrochemicals, and they remain a significant part of the industrial base.

The bulk of employment positions are to be found in the services sector, and much of this is at the low end of the industry. However, Chennai has emerged as a financial hub, and may be the second-most important in India after Mumbai. The city is home to the Madras Stock Exchange (which is now to merge with the Bangalore Stock Exchange). Chennai is also a leader in the health sector, with a number of India's leading hospitals, attracting medical tourists from across the world. Chennai is a hub of the creative and cultural industries, with many venues for music, the visual arts and theatre, and is also the home of Tamil entertainment, with the city the second-largest hub of filmmaking after Bollywood in Mumbai.

While Chennai has a strong underlying economic base, in recent years concerns have been expressed about the state of the economy. The local economy is no longer growing faster than the national economy, and is struggling with competition from Bengaluru and Hyderabad. There are particular challenges in the IT industry, with slower growth and squeezed profit margins. There has also been a slump in the real estate market, with many vacancies in new high-end developments. However, Chennai remains well-positioned (with its port, high-level skills, existing hi-tech infrastructure and firms) to remain one of the drivers of India's economy.

GOVERNANCE

As with many other Indian cities, the governance of the Chennai urban agglomeration is a complex matter. The State government of Tamil Nadu maintains strong control over strategic decision-making for the urban agglomeration through the Chennai Metropolitan Development Authority (CMDA), which holds the planning powers in the region. The CMDA has been responsible for the designation of SEZs and other industrial zones, and for the implementation of development in these areas, often in PPP arrangements with large private enterprise.

The largest elected municipal authority is the elected Corporation of Chennai (CoC) which handles service-delivery functions such as parks, roads, education, stormwater management, solid-waste management, and health. There is a mayor and a deputy mayor elected by the CoC legislature, but the real power vests in the Corporation Commissioner, the head of the administrative wing of the CoC, who is appointed by the State Governor. There are also many other technical agencies responsible for specific functions.

Within the wider metropolitan region there are many other local governments with varying forms and status, around 16 Municipalities, 20 Town Panchayats and 214 Village Panchayats.

URBAN DEVELOPMENT CHALLENGES

Chennai has many contradictions. On the one hand it is an economically successful city, with a per capita income 60% higher than the average for urban India as a whole; yet 28.9% of its households live in slums, far higher than the average of 17.3% for urban India. A large proportion of the population live in extremely cramped accommodation, as a result of ongoing subdivision and partitioning of apartments.

There are also problems on the edge of the metropolitan region, where civic infrastructure has not kept pace with residential and industrial construction – for example, with roads, lighting and recreational open space. A major challenge throughout the city is the shortage of water. During the non-monsoon months (nine to 10 months each year), water is scarce, resulting in some residents having water supply only every alternate day, sometimes once every three days. Some suburbs – including the newer ones – do not have a piped water supply. During the monsoon there is often severe flooding; overflowing sewers infiltrate the water supply, with severe health implications.

The environmental challenges are severe, with all three of Chennai's rivers heavily polluted, posing health hazards to residents along the river banks. Levels of air pollution reached record levels in 2015, with levels of Particulate Matter (PM) 2.5 higher than those in Delhi (the city generally regarded as being the most air-polluted large city in the world).

THEMATIC REPORTS

TRANSPORT

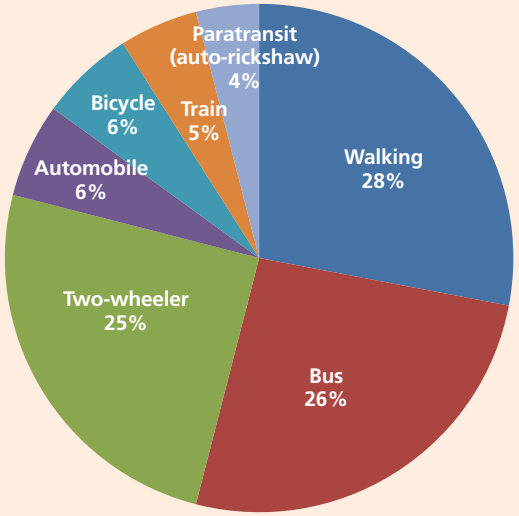
ECONOMIC INFRASTRUCTURE

In 2013, Chennai had the world's 92nd-largest port in terms of container traffic (24th in the BRICS and third in India, after Mumbai and Mundra). It has the fourth-largest airport in India (with around 15 million passengers annually). Chennai is the headquarters of the Southern Railway. It has two main railway terminals: the largest is Chennai Central Station, which links to national hubs throughout India as well as smaller towns in the southern parts of the country. The second main station is Chennai Egmore, which links areas within Tamil Nadu and has a few inter-state links.

PUBLIC TRANSPORT

As with other cities in India, Chennai's roads are badly congested. Over the past decade there has been a 95% increase in automobile ownership and a 100% increase in the ownership of two-wheelers. At the same time there has been a significant reduction in the use of public transport (from 53% in 1970 to 30% in 2008), although the public transport systems remain badly overcrowded. Until very recently the focus has been overwhelmingly on the development of infrastructure for the private motor vehicle; but in 2010, 15 separate state departments were amalgamated to form the Chennai Unified Metropolitan Transport Authority (Cumta) to reroute Chennai towards a sustainable, integrated transport system.

MODAL SHARE, 2008 (CHENNAI)



Source CMDA

What is significant about Chennai is the large number of trips by two-wheelers, and the dominance of the bus service within the public transport network.

BUS (INCLUDING BRT)

Buses are the main form of public transport in Chennai. The bus service is operated by the government-owned Chennai Metropolitan Transport Corporation, which has a fleet of around 3 800 buses and carries 5.18 million commuters a day on 806 routes. During peak hours buses are still massively congested (around 150% of capacity); but average occupancy has gradually been dropping, as the result of a deficient bus fleet and service. A BRT system has been planned with five proposed corridors, which may significantly improve levels of servicing, but there have been long delays in implementation.

SUBURBAN RAIL

There are in fact two largely separate systems in operation, both of which are operated by Southern Railways, a subsidiary of the massive, state-owned Indian Railways. The Chennai suburban rail network goes back to 1931. It has a track of around 300km within suburban Chennai, and a further 610km that links across a wider region. It carries a daily flow of 1.46 million people. The much smaller Chennai Mass Rapid Transit System (CMRTS) is an elevated railway system, the first of its kind in India. It opened in 1996, has a track length of 19.3km, and an average daily ridership of around 100 000. A major challenge of the system is its lack of integration into other modes of public transit.

METRO

The Chennai Metro began operations in July 2015. The initial length was 23km but there are significant expansion plans. The system is operated by Chennai Metro Rail Ltd., a joint venture of the Government of India and the Government of Tamil Nadu, with equal equity holdings. The metro will eventually absorb the current CMRTS to create a more integrated mass transit system.

PARATRANSIT

There are approximately 62 000 auto-rickshaws operating in the CMA, with around 1.5 million commuters using their services daily; although often for supplementary rather than main trips. Auto-rickshaws offer door-to-door transportation, and generally do not have defined routes.

THE FUTURE

There are fairly ambitious plans for public transport; but as with other cities in India, there have been long delays in decision-making and implementation. The merger of the CMRTS with the metro would support integration, but there are additional proposals to link bus services with rail in a single-ticketing system. The planned BRT would also be integrated.

In addition to bus and rail, the state government is investing in dedicated pedestrian paths, an upgraded bus infrastructure (e.g. bus shelters) and a bicycle sharing system.

GREEN ENERGY

In 2015, the State of Tamil Nadu had an installed capacity for electricity of 15 271MW, of which 44.8% was in the private sector. Of this installed capacity, 43.6% is from coal-fired production, 4% gas, 1.7% diesel generators, 9.4% large-scale hydro, 4.2% nuclear, and 36.5% in renewables and new energy (such as co-production).

There is a very high percentage in renewables and new energy, the bulk of which is in the private sector. Tamil Nadu is clearly a leader in renewables in India. Although the state accounts for 8.2% of total installed capacity in India, this includes 23% of India's installed capacity for renewables.

The Government of Tamil Nadu set up the Tamil Nadu Energy Development Agency (TEDA) in 1985, to promote electricity generation from renewable energy sources and to support energy conservation. TEDA has been immensely successful since 1986 in developing wind energy. Initially, TEDA developed state-owned wind-energy demonstration farms; but the private sector became interested in the 1990s, and Tamil Nadu now produces between a third and half of all wind energy in India. The Muppandal Wind Farm in Tamil Nadu is the largest wind farm in India, producing 1 500MW of electricity. There are much smaller proportions of co-generation, biomass and solar production, although even these are significant in national terms, with Tamil Nadu, for example, producing one-third of India's biomass-produced electricity.

To achieve this success with renewables TEDA used a variety of mechanisms, including depreciation benefits and subsidies. Currently the tariff structure makes it more profitable to generate using renewables than traditional sources, and this is driving significant growth in the sector. With the increase in production, the state – which suffered a severe deficit of energy in the recent past – is now turning a large surplus, and is able to earn additional income through exporting energy. However, a challenge is that while production from renewables has increased dramatically, the transmission infrastructure remains weak, resulting in delays to key projects.

Energy efficiency remains a challenge for Chennai, with unreliable transport systems, energy-inefficient buildings and the growth of manufacturing. However, there is a Bureau of Energy Efficiency in the state government that is driving a programme to achieve greater efficiencies.

The state government has also initiated a programme to promote the conversion of petrol and diesel auto-rickshaws to Liquefied Petroleum Gas (LPG), offering large subsidies for conversions. There is also a bio-diesel initiative, which involves distributing wasteland to landless farmers for the productions of Jatropha, a crop that can be turned into fuel. A large bio-diesel plant was completed recently. However, there are some challenges with this initiative, including competition with other small farmers for access to scarce water resources.

INNOVATION-DRIVEN ECONOMY

The 2thinknow Innovation Cities Global Index ranked Chennai at 222nd globally, 19th in the BRICS, and third in India after Mumbai and Bangalore. Although rated relatively well nationally, Chennai has a long way to go before it is recognised as a global hub of innovation. The danger is that Chennai will remain an offshore site for transnational corporations who focus their innovation capabilities elsewhere.

There are areas in which innovation capabilities are expanding or have significant potential. Chennai now has some of the largest automobile R&D facilities globally, as a part of firms such as Nissan, Hyundai, BMW, Caterpillar and Daimler, and clustered mainly within the so-called Mahindra Research Valley.

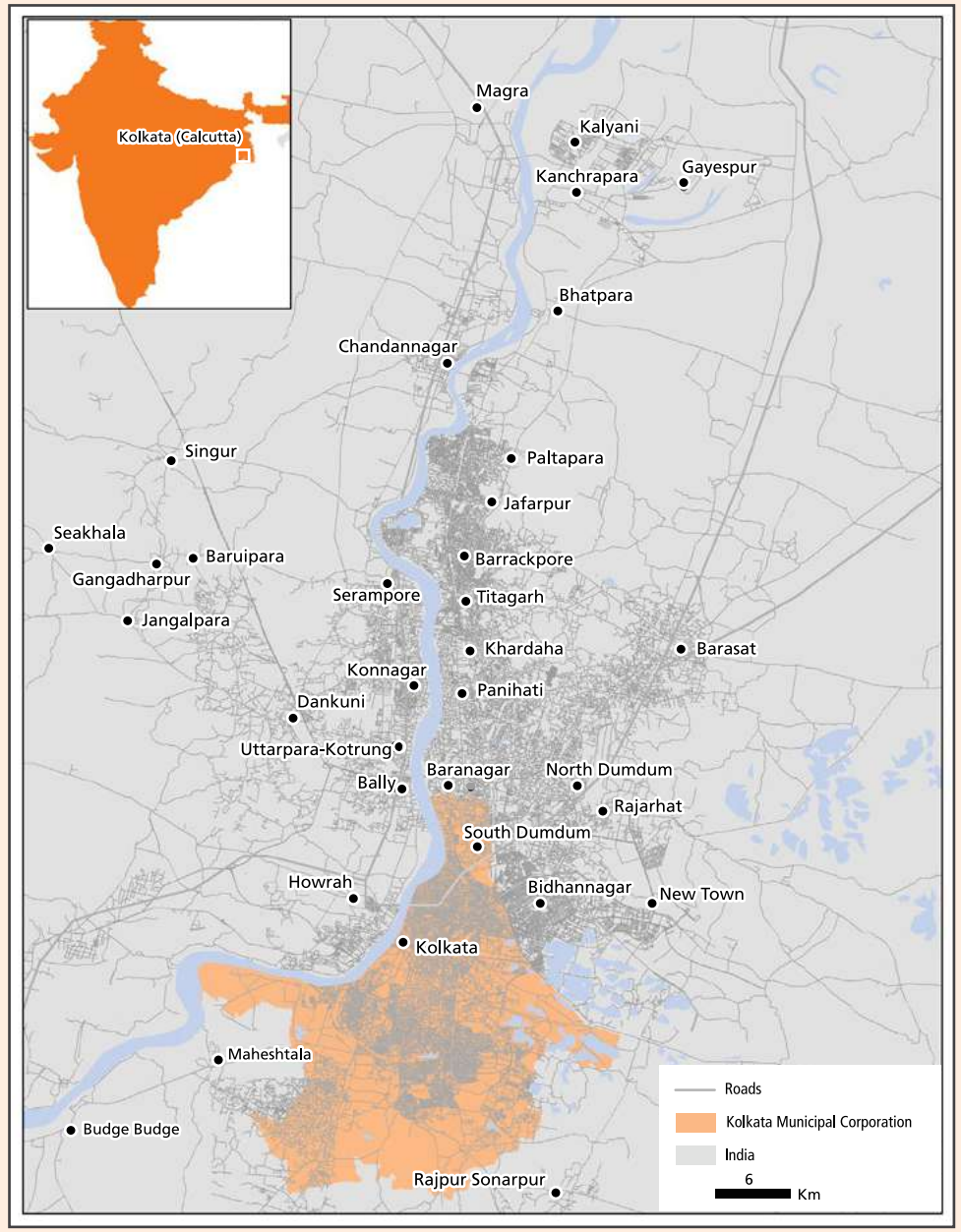
Chennai is also emerging as an offshore engineering R&D hub, with the presence of a number of major research institutes. The Indian Institute of Technology, Madras, is the 19th-ranked University in the QS BRICS index, 2016. There are also significant research institutes at Anna University; and specialist universities, such as the Indian Maritime University. There are particular strengths in materials science and energy studies. With the large number of professionals in IT and electronics, there are significant opportunities for innovation in these fields, and the Government of India hopes to position Chennai as a global electronics R&D hub within 15 years. Physically, this innovation is focused on the IT corridor in the south of the city, which links the various IT-focused SEZs and industrial estates. There is also emergent innovation in medicine, including eye care; and biotechnology, with at least two biotechnology parks.

While there are national and local constraints to innovation, the strong educational and research base, the clustering of professionals, the relatively liberal economic environment (Tamil Nadu having been voted first among the states for economic freedom) and excellent business infrastructure for sectors such as IT, all position Chennai as a potentially vibrant innovation hub. Apart from its development of the supporting infrastructure for SEZs and other economic zones, the state government has launched the 'Tamil Nadu Innovative Initiative' to encourage new ideas and innovative activities.

KOLKATA

(Calcutta)

কলকাতা



CONTEXT

LOCATION

Kolkata (formerly Calcutta) is located in the eastern part of India. It is on the banks of the Hooghly River, part of the Ganges Delta, and is the capital of West Bengal State.

HISTORY

Kolkata started as three small villages, belonging to the estate of the Mughal emperor; but by the late 17th century, the British East India Company had been granted a trading licence and took effective control of the area. The Company used its trading post in Calcutta to sustain its monopoly over the opium trade. From Calcutta, opium was smuggled into China, where it was banned. From its base in Calcutta the British East India Company managed to gain control of vast areas of India, and by 1850 effectively had control of the entire Indian sub-continent. In 1857, after an Indian rebellion, power was transferred to the British Crown; and Calcutta became the capital of British India.

From the 1850s Kolkata emerged as an industrial city, with growing textile and jute industries. With the prosperity in the late 19th century, a social and economic elite of upper-class Bengali Hindus emerged in the city. However, the expansion of trade and industry also attracted large numbers of migrants from poor areas of India, who were housed in the city in insanitary conditions; gaining Kolkata the reputation of a city of slums.

There was a cultural renaissance among the Bengali upper class in the late 19th century, with many creative and intellectual achievements, but also with a stirring political consciousness associated with the rise of Indian nationalism. In 1911, the capital of British India was moved from this hotbed of political agitation to Delhi.

The partition of India, with independence in 1947, created great social turbulence. Calcutta's Muslim residents fled to East Bengal (now Bangladesh), with a reverse flow of tens of thousands of Hindu refugees. In 1950, Calcutta was the largest city in India, and the ninth-largest in the world, with a population of over 4.5 million.

However, during the second half of the twentieth century, Calcutta experienced economic stagnation and a relative decline in position, both globally and nationally. There was severe civil strife in the 1960s, which damaged the economy; and in the 1970s, large numbers of refugees fled the war in Bangladesh, creating huge pressures on infrastructure and the local economy. The Communist Party-led government in West Bengal was hostile towards private business, and the economy stagnated until the 1990s. Recently, however, there have been signs of revival, with new industries such as IT emerging. In 2001 the name of the city was changed to 'Kolkata'.

POPULATION

POPULATION SIZE

According to the UN Population Division the 2015 population of the Kolkata urban agglomeration was 14.86 million.

POPULATION RANKING

In term of UN data, Kolkata is the 14th-largest urban agglomeration in the world, the sixth in the BRICS, and the third in India (after Delhi and Mumbai).

POPULATION GROWTH

During the period 2010 to 2015 the average annual population growth of Kolkata was a slow 0.8%. It is anticipated that growth rates will increase towards 2030, as urbanisation in India accelerates.

POPULATION DIVERSITY

According to the 2011 population census, 76% of the city's population is Bengali Hindu, 20% Muslim, 0.9% Christian, and 0.5% Jain. Nearly two-thirds of the city residents speak Bengali as a home language, and one-fifth speak Hindu, followed by a small Urdu minority. English is used for official purposes.

STRUCTURE OF THE URBAN REGION

The Kolkata urban agglomeration sprawls out along the banks of the Hooghly River in a south-north axis. It is about 50km long and 10km wide. The area governed by the Kolkata Municipal Corporation has a population of about 4.5 million people and is the historical core of the city.

Across the river immediately to the west of Kolkata is Howrah, an industrial city and railway junction with large slum districts and a population of over 1.072 million. To the south of Kolkata is Ranjpur Sonapur, a historically religious city with over 400 000 people, and Maheshtala, also with around 400 000. To the east of Kolkata is the planned satellite city of Bidhannagar, which was developed in the 1960s to contain the overspill from the core city. It has a present-day population of 220 000, and has become an information technology hub. To the north is a linear string of small cities stretched out along the river, including: the military town of South Dum Dum (100 000 people), the Rajarhat New Town (183 000), the industrial and education city of Baranagar (250 000), Panihati (350 000), Barrackpore (144 000), and Hooghly-Chinsura (180 000). Collectively, this extended area forms the formally designated Kolkata Metropolitan Area (KMA), which largely coincides with the urban agglomeration of nearly 15 million people as defined by the UN Population Division.

ECONOMY

According to the Brookings Institution, the 2014 GDP for Kolkata was USD 60.45 billion (PPP), or 3.7% of the GDP for India.

The Economist magazine has referred to Kolkata as "the city that got left behind", with Kolkata said to have suffered de-industrialisation in the second half of the twentieth century on par with that of Detroit in the United States. In 1950, Kolkata accounted for around 25% of the industrial stock in India, dropping to 13% in 1960 and 7% by 2000. A number of reasons have been given for the decline of Kolkata, going back to the loss of capital-city status in 1911, but also including the conflicts and refugee flows at the time of partition in 1947 and the independence of Bangladesh in 1971, the hostility of the long-ruling Communist Party towards private business in the state, and the freight-equalisation policy with heavy government subsidy which allowed industry to locate profitably in any part of India.

In recent years, however, there has been an apparent turnaround in the fortunes of Kolkata and West Bengal State in which it is located. In 2011, the All India Trinamool Congress led by Mamata Banerjee, which has actively promoted economic development, took control of the Government of West Bengal. In 2014/15 the GDP of West Bengal grew at 10.5%, compared with India's 7.5%, with the manufacturing sector growing at 8.3%, compared with India's 5.6%. In growth of GDP per capita, Kolkata and West Bengal outranked even Delhi. The Brookings Global Monitor 2014 ranked Kolkata's economic performance as 32nd of the 300 cities studied, surpassed in India only by Delhi. There is a persisting legacy of past rule, with many private firms still wary of investing in West Bengal, and so the turnaround may be fragile; but it has nevertheless been impressive.

There is a paucity of city-level economic data, with the last economic census held in 2004/5. At

the time, the share of GDP in the metropolitan region was 30% manufacturing, 44% traditional non-government services, 8.1% modern non-government services, another 8.1% in social services, 5.5% government services, and 2.7% in primary sectors. Kolkata was an old manufacturing city, where the service sectors had increased in proportion by default as manufacturing shrank. However, this may change in the future, with the real growth of both manufacturing and services.

GOVERNANCE

The KMA has a complex governance structure. The State of West Bengal, of which Kolkata is the capital, has a largely ceremonial Governor appointed by the President of India, and a Chief Minister who is vested with the real executive power. Among the key powers of the state are health, cultural affairs, transportation, energy and education.

At municipal level there is fragmentation. The core city is administered by the Kolkata Municipal Corporation, but the Kolkata Metropolitan Area also includes at least 40 other elected local authorities. There are three other municipal corporations for the larger satellite cities and 37 municipalities for the smaller cities and towns, as well as over 500 other authorities, including at village level (governing areas that are effectively urban). The main functions of local government include water supply, drainage and sewerage, sanitation, solid waste management, street lighting, and building regulation. The port of Kolkata is managed at national government level through the Kolkata Port Trust.

There have been some attempts at metropolitan-wide coordination. The Kolkata Metropolitan Planning Commission (KMPC) was established in 2001, and is constituted of indirectly elected representatives and senior-level bureaucrats. The KMPC attempts to coordinate the development activities of the different agencies of government across the levels within the region. The Kolkata Metropolitan Development Authority (KMDA) is effectively the technical secretariat of the KMPC, responsible for a range of planning, regulatory and project implementation functions.

URBAN DEVELOPMENT CHALLENGES

Kolkata is a poor city by any measure. The GDP per capita of Kolkata in 2014 (PPP) was USD 4 036, the lowest of the large cities in India – far less than the USD 12 747 for Delhi, USD 7 005 for Mumbai and USD 6 469 for Chennai. The differences are not as stark for human development, as under Communist Party rule Kolkata did reasonably well in terms of healthcare, for example, with indicators for infant mortality ranking well against other Indian cities.

Kolkata is a city of slums, despite the fact that it has not experienced significant levels of in-migration for a number of decades. The 2011 National Census indicated that 29.6% of the households under the jurisdiction of the Kolkata Municipal Corporation live in slums. This is significantly greater than the average for India's urban areas of around 17%, although less than Mumbai's 42%. There are around 5 500 slums (referred to locally as bustees) in the Kolkata urban agglomeration, which house over four million people, with the Muslim population in the city disproportionately represented. However, there is a difference between the 2 000 registered bustees where the residents have a form of tenure and are not subject to evictions, and the 3 500 unregistered (mainly newer) slums where there is no security of tenure and almost no services. There are slum upgrading projects, but there are institutional complexities that make implementation difficult.

The state of urban infrastructure is poor. The sewage system was planned in the colonial era for around 600 000 people, and cannot cope with the current 14 million or so. Garbage collection is infrequent, and there have been times when the military has been called in to help clean up the streets. The water system is antiquated, with frequent breakdowns, and also suffers the ingress of salt water.

Kolkata has severe environmental degradation problems, with air and water pollution among the highest of any large city in the world. The annual mean PM10 for Kolkata of 148 ug/m3 is second among the large cities in India only to Delhi, and after Delhi is the second-worst in the world for a major urban agglomeration. Around 70 per cent of the residents of Kolkata are said to suffer from some form of respiratory disorder because of pollution, while levels of lung cancer are among the highest in the world. The air pollution is said to reduce the average life expectancy of residents of Kolkata by four years. The 50 000 auto-rickshaws in the city are said to be a major source of air pollution, but a large number of illegal tanneries also contribute to a stench in the air. Levels of water pollution are also dangerously high, with toxic levels of zinc and heavy metals. There are high levels of contaminants in the Ganges River from upstream activities, but Kolkata contributes with uncontrolled dumping and wastewater from the illegal tanneries. There are regular outbreaks of cholera and other waterborne diseases.

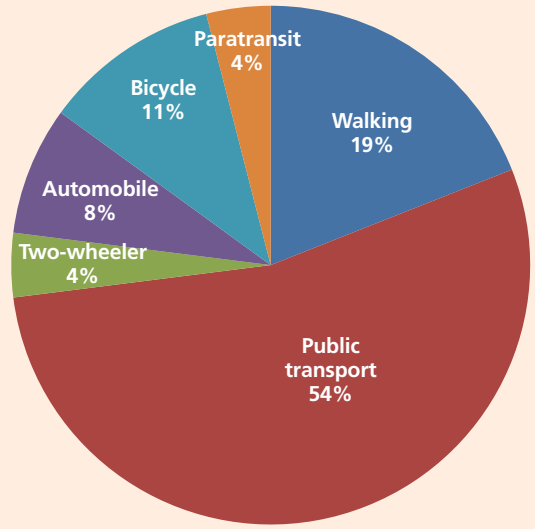
Since Kolkata was originally built on swamps surrounding the Ganges, it is one of the most flood-vulnerable cities in the world. The problem is likely to increase with global warming, with predictions of huge damage by sea-flooding by 2050.

THEMATIC REPORTS

TRANSPORT

Kolkata is a congested city, with traffic chaos a common problem. It has a historically well-developed public transport system, a legacy of the period in which Kolkata was the capital of India; but the system has deteriorated, and has been poorly managed over a large period of time.

MODAL SHARE OF TRANSPORT



BUSES

Buses comprise the largest share of Kolkata's modal split. The majority of the bus service is provided by private enterprise, and includes minibuses and larger buses. The public bus system is operated by a number of authorities, including: Calcutta State Transport Corporation (CSTC), South Bengal State Transport Corporation (SBSTC). There is very little integration of the various transport networks, resulting in overlapping routes and an inefficient service. The major recent change has been the introduction of a BRT system, in 2015.

TRAMS

Kolkata is the only city in India to have a tramway system in place. It is operated by the Calcutta Tramways Company and has nearly 30 routes in the central parts of the city, with about 125 cars. But the tramway has seen little improvement or investment since 1947, and has gradually declined. The trams today are generally inefficient and underutilised, despite their clean-energy benefits.

METRO

The Kolkata Metro has one operational line, although five others are under construction. First conceived in the late 1940s, the line has been operational since 1984, and has a ridership of around 650 000. This was the first metro system in South Asia. However, the system has expanded very gradually, and remains underdeveloped relative to the size of the city, although there are plans to accelerate construction.

TRAINS

Kolkata has above-ground rail services including a Circular Rail system that encircles the city in a continuous loop, and also has a line extension to the international airport. The suburban railway is an extensive above-ground railway network operated by two companies: Eastern Railway (ER) and South Eastern Railway (SER). The network serves the KMA and beyond, and since 2009 some routes and times have offered trips for women only, known as matribhumi.

PARATRANSIT

Taxis and auto-rickshaws form the main part of the paratransit system in Kolkata. With more than 50 000 vehicles, IPT is a significant contributor to mobility in the city, but it is also responsible for much of the air pollution in the city as many operators use a potent concoction of kerosene and petrol for fuel.

PLANS

The government of West Bengal has a project to modernise public transport, but has been criticised for its attempts to eliminate rickshaws and bicycles, contrary to global trends of supporting non-motorised transport. There is currently an extensive project under way to extend the existing single 25-kilometre line on the metro to a 110-kilometre network of five lines in total.

GREEN ENERGY

In 2012, West Bengal's installed capacity for electricity generation was 7 620MW, of which 85% was coal-based, 13% from hydro, and a mere 2.5% from renewables, mainly biomass and small hydro. One of the reasons for this coal dependence is that West Bengal has fairly extensive coal deposits (around 10 per cent of the national total) which historically have provided a cheap source of electricity.

Given the bias towards coal, it took time for a renewable-energy programme to develop; though in fact, West Bengal was an early leader in renewable energies, with India's first off-grid solar plant installed in the state in 1992, and the West Bengal Renewable Energy Development Agency established in 1993. But the momentum was lost; and in 2015, West Bengal was not among the top ten states for renewables listed by the Times of India.

In 2012, however, the state government released the West Bengal Policy on Co-generation and Generation of Electricity from Renewable Sources of Energy, which sets specific targets for each form of renewable energy, and offers a series of incentives for production of renewables. It indicated that the existing installed capacity of renewables of 193MW was to be increased to 1 040MW by 2017 and 2 706MW by 2022, with the bulk of the increase coming from biomass, small hydro and co-generation. It also indicated that by 2018, 6 per cent of electricity should be purchased from renewable and cogeneration sources. There are now a number of renewable generation projects underway in West Bengal, including solar PV, a wind-farm project, a wind-diesel-gasifier hybrid project, energy parks, a tidal energy project, and biomass generating energy from rice husks. The projects are mainly small but they do have potentially significant demonstration potential.

Energy policy has been the responsibility of state government, with state-owned utilities responsible for the procurement, transmission and distribution of electricity. At the level of the municipality – the municipal corporation – the major focus is on promoting energy efficiency. In Kolkata the main project has been the introduction of LED street lighting. The Municipal Corporation has also encouraged the use of a bio-diesel blend in its bus fleet.

The attempt to switch fuels, in the case of auto-rickshaws, has been bedevilled by a lack of enforcement and implementation capacity. In 2005, for example, the government ordered that all vehicles manufactured before 1990 had to be taken off the road or converted to using greener fuel. This applied to around 80 per cent of buses and 50 per cent of auto-rickshaws. The order was largely ignored, and only 10 per cent of vehicles implemented the conversion.

INNOVATION-DRIVEN ECONOMY

The 2thinknow Innovation Cities Global Index for 2015 ranked Kolkata 401st of the 442 cities included in the study. In terms of this index Kolkata is rated as one of the least innovative cities in the world. It is also near the bottom of the list for both India and the BRICS. Decades of policies antagonistic to entrepreneurialism and enterprise have had a significant effect on the innovation capacity of the city.

While there is clearly a long way to go, the new emphasis on supporting enterprise does offer a degree of hope. There are significant educational resources in the city. There are ten federal- or state-level universities in the urban region, as well as a number of science councils and large research institutes. In 2016, the University of Calcutta narrowly missed the BRICS Top 50, ranking 54th.

There are some significant early initiatives to support innovation. In January 2016 the State Start-up Policy was launched to nurture a start-up ecosystem in West Bengal that will facilitate about 10 000 start-ups in the next 10 years. Science City in Kolkata is also supporting innovation, while the Indian Institute of Management Calcutta has recently announced the creation of the IIMCalcutta Innovation Park to nurture start-ups. A growing number of firms in the region are setting up innovation labs to support R&D in their industries.

HYDERABAD

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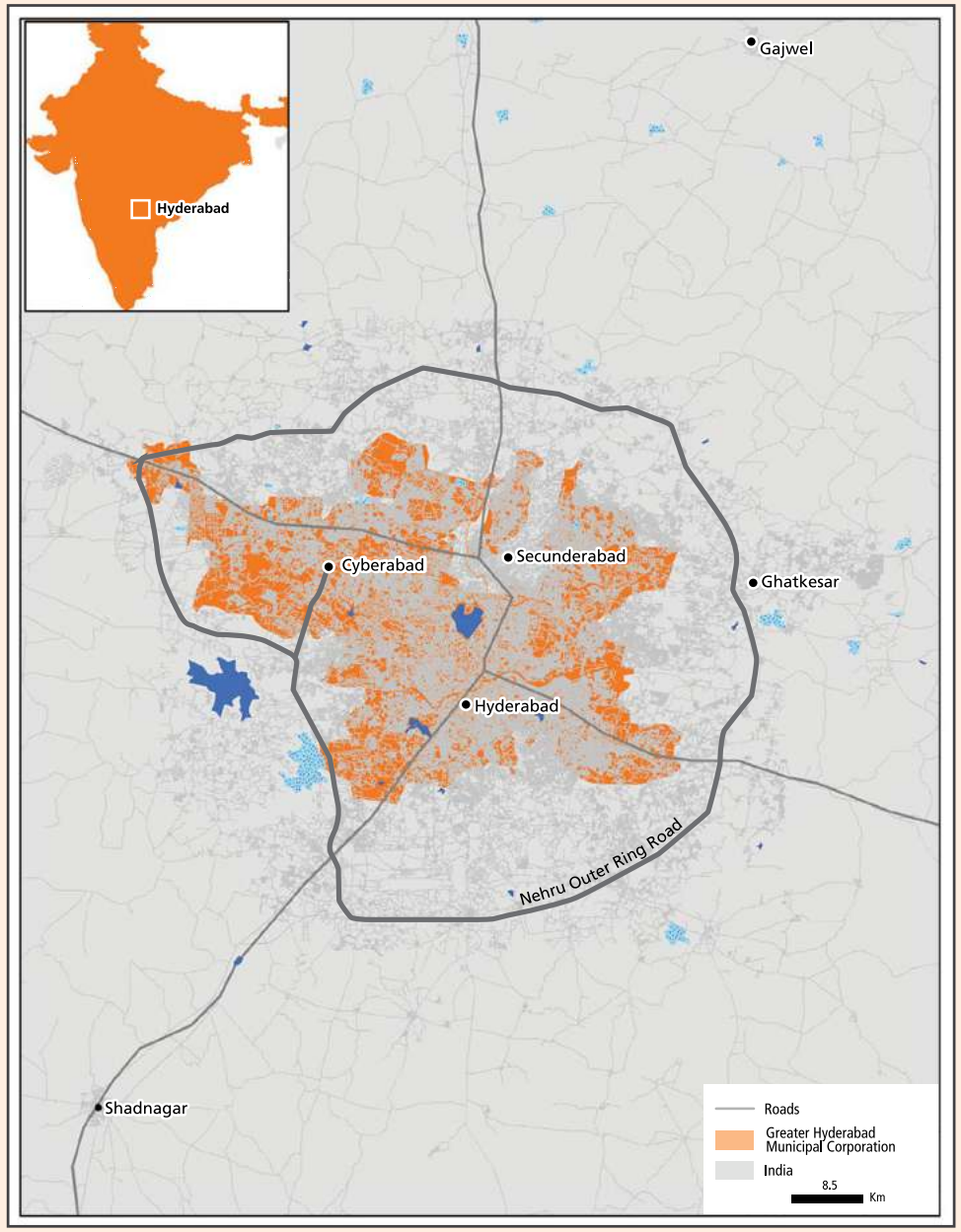
حیدرآباد



CONTEXT

LOCATION

Hyderabad is located in the interior of southern India on the Deccan Plateau, within Telangana State. Uniquely, it is the capital of two states – Telangana and Andhra Pradesh.

HISTORY

Hyderabad was founded in AD 1591 by a Sultan of the Qutb Shahi dynasty. The design of the town was strongly influenced by Persian thought. A century later the Mughals captured the region, but a local ruler, or Nizam, declared Hyderabad independent of Mughal rule from the capital, Delhi. During the time of British rule, Hyderabad remained a semi-sovereign state under the Nizams of Hyderabad. The Muslim rulers of Hyderabad were patrons of art and culture, and also developed modern infrastructure and education, connecting to the wider Arab, Persian and Muslim world.

At the time of India's independence the Nizam of Hyderabad refused to accept Indian rule, declaring his intention for the princely state to remain autonomous. In 1948 the Indian army forcibly entered Hyderabad, deposing the Nizam and annexing the territory into the Indian Union. However, Hyderabad remained the capital of Hyderabad State; and when state boundaries were redrawn in 1956 along linguistic lines, Hyderabad became the capital of (the Urdu and Telugu) Andhra Pradesh State as well.

Hyderabad remained volatile, with periodic violence over cultural, religious and linguistic differences. Between 2002 and 2013 there was a bitter struggle, with Telangana separatists fighting for their own state. In 2014, Andhra Pradesh State split in two, with Telangana carved out as a Telugu state. Although Hyderabad was no longer part of Andhra Pradesh, it was to remain the joint capital of the two states for a period of not more than ten years.

Hyderabad was historically a pearl and diamond trading centre (it is still known as the 'City of Pearls'), famous for its commercial quarters or bazaars. But from the late 19th century, after the city was connected to India's expansive railway system, Hyderabad began to industrialise. From the 1950s Hyderabad attracted large-scale state-owned enterprise and research institutions.

Following the liberalisation of India's economy in the early 1990s, the State of Andhra Pradesh actively promoted Hyderabad as a centre of IT services. Large global conglomerates (including Microsoft, Google and Oracle) and leading Indian IT and BPO firms set up in the city, with the western areas of Hyderabad becoming known as Cyberabad (or Cyber City). From the early 2000s there were attempts to position Hyderabad as a hub for research and production in biotechnology, with the development of the 'Genome Valley of India' about 30km north of the city centre.

Despite considerable gains in advanced industry, a large proportion of Hyderabad's population remains outside the mainstream economy. The informal sector accounts for around two-thirds of total employment.

POPULATION

POPULATION SIZE

The UN (2014) estimates the population of the urban agglomeration for 2015 as 8.94 million.

POPULATION RANKING

In terms of UN data, Hyderabad is ranked 37th in the world, 16th in the BRICS, and sixth in India.

POPULATION GROWTH

The average annual growth rate of the urban agglomeration for the period 2010 to 2015 was a moderately fast 3.31%, with a gradual slowing anticipated towards 2030.

POPULATION DIVERSITY

At the time of the 2011 Census, 64.9% of the city population was Hindu, with a large Muslim minority (30.1%) and smaller Christian, Jain, Buddhist and Sikh minorities. The joint official languages are Telugu and Urdu, with the majority population speaking dialects of the languages; but with a significant minority speaking a diversity of other languages, including Hindi, Marathi, Tamil, Bengali and Kannada. There are also descendants of Arab, Armenian, Abyssinian, Iranian, Pathan and Turkish communities which historically enjoyed the patronage of the Nizam rulers, although these groups have declined since Hyderabad joined the Indian Union.

STRUCTURE OF URBAN REGION

The Hyderabad Metropolitan Region is encircled by the 158-kilometre, eight-lane ring road expressway known as the Nehru Outer Ring Road. The city has a radial structure, as most of the main roads and highways spread out from Hyderabad's core into the surrounds.

The current city of Hyderabad is essentially an amalgamation of twin cities – the Hyderabad of Nizam rule, and Secunderabad, which was established in 1806 as a British cantonment. The two cities were separated by the famously heart-shaped Hussain Sagar lake. The city has long since been administratively and also physically amalgamated, as development spread out around the Lake.

Hyderabad experienced rapid physical restructuring as the IT industry developed since the 1990s. The state government pursued a strategy of developing 'knowledge enclaves' around the city, modelled on the Malaysian example, with the development of the Cyberabad IT complex on the western edge of the city, and Genome Valley for biotechnology north of the city, which was developed as a PPP. These developments have been associated with sprawl on the periphery of the city, including gated communities and malls. With these enclave-type developments, Hyderabad is becoming an increasingly multi-modal city.

ECONOMY

According to the Brookings Institution the GDP of Hyderabad for 2014 was USD 40.19 billion PPP.

The official statistics on GDP and GDP growth are for state- rather than city-level. In 2014/15, Telangana State experienced GDP growth of 5.33%, slightly higher than the 4.76% of the previous year. This growth is less than India's average, and also significantly less than the average annual growth for the period 2004 to 2014, which was 9.8%.

There are no recent figures for the economic structure of Hyderabad, with the last economic census taking place in 2004-05. At the time, the largest employer was 'traditional non-government services' (44%); followed by 'manufacturing' (23%), 'modern non-traditional services' (12%), 'social services' (11%), the primary sectors (6%), and 'traditional government services' (5%).

Hyderabad has been primarily a service centre, though also a hub of trade and regional logistics, and a centre of government activity; although there were also traditional industries such as clothing and leather, and since the 1960s, pharmaceutical manufacturing (mainly bulk drugs). More recently, however, Hyderabad has developed as a hub of 'new economy' services.

In 1991 India famously liberalised its economy, and the Chief Minister of Andhra Pradesh used the opportunity to reform a stagnant state economy. He controversially reduced welfare expenditure and prioritised the attraction of foreign investment. The Chief Minister was strongly influenced by a Malaysian model, in which new industries were developed within designated enclaves and corridors. The 'Andhra Pradesh Vision 2020' (released in 1999) envisaged the state developing on the back of high-end services, and proposed a focus on IT-related services, biotechnology, tourism, logistics, healthcare and educational services, with the City of Hyderabad being the focus of the IT services. There was strong investment in IT-related infrastructure, and generous incentives were offered to IT firms establishing software centres in Hyderabad. One of the initiatives was the development of HITEC City as a Special Economic Zone (SEZ) within the broader hi-tech cluster known as Cyberabad. The strategy secured early success, with Hyderabad emerging as an IT hotspot in competition with Bangalore and Chennai. About 16% of India's IT exports come from Hyderabad, with the sector growing at up to 25% per annum in its peak years in the 1990s and early 2000s. In 2001 a further strategy was introduced to make Hyderabad a biotech destination; and Genome Valley was built to the north of the city, with an advanced R&D infrastructure.

Hyderabad has experienced high growth until recently. There are current concerns that Hyderabad is becoming less attractive, because of serious problems with urban infrastructure and because of competition from up-and-coming centres such as Pune. However, the city does have significant strengths, and could reposition itself for restored growth.

GOVERNANCE

The history of local government goes back to the late nineteenth century, with municipal corporations for Hyderabad and Secunderabad developing in parallel. In 1960 the two corporations were merged into the Hyderabad Municipal Corporation. The rapid development of the city created an extensive urban agglomeration, divided between a number of separate local authorities. In 2007, 12 municipalities were merged to form the Greater Hyderabad Municipal Corporation. Among other services, the GHMC is responsible for providing: public health; sanitation; solid waste management; provision and maintenance of roads, storm water drainage, parks and playgrounds, and markets; regulation of building construction, town planning; issuing of trade licences; and the collection of property tax. Local government is also able to draft its own by-laws to ensure the smooth running of the municipality, but these must be approved by the state government.

However, as in many other Indian cities, the state government played an increasingly important role in the planning and management of metropolitan development, and in the promotion of economic growth. In 1975, Andhra Pradesh State established the Hyderabad Urban Development Authority (HUDA) to coordinate development in the wider metropolitan region. The HUDA planned a ring of satellite towns, but these did not materialise. In 2008, the HUDA was replaced with the Hyderabad Metropolitan Development Authority (HMDA), responsible for an urban region with boundaries far beyond those of the Hyderabad urban agglomeration. A mega-urban region had been created, with a single planning authority.

At the same time, however, special development authorities were created for the new economic development zones around Hyderabad, including the Cyberabad Development Authority (CDA) for the HITEC City area, and the Hyderabad Airport Development Authority (HADA). These special agencies were appointed by state government.

The redrawing of state boundaries with the creation of Telangana State in 2014 has initiated a new era of institutional fluidity. The new state government is currently in the process of creating its own legislation for local government, and restructuring state agencies that were created previously for planning and economic development.

URBAN DEVELOPMENT CHALLENGES

Although Hyderabad has enjoyed economic success, it has major social challenges. The development of hi-tech industry has created a bifurcated city. A relatively small proportion of the population has been incorporated in the modern economy, with the majority reliant on employment in the low-end service industry, and in the informal sector. Census 2011 indicated an unemployment level of 9.4%, which is high in Indian terms. The city also has relatively high levels of inequality, with a

Gini coefficient of 0.5, according to the Indian Human Development Survey. Census 2011 revealed that 31.9% of the residents of the GHMC lived in slums, a significantly higher proportion than the 17% average for urban India. Many of the nearly 1 500 slums in the city region are located on flood-plains and the banks of Hyderabad's lakes, and have limited infrastructure and services.

The rapid growth of the urban agglomeration has led to major pressures on urban infrastructure. The city is notorious for road congestion, and there are also serious problems in terms of power supply, with regular power cuts. Civic amenities are also sparse, relative to the population, and reliable water supply is a challenge.

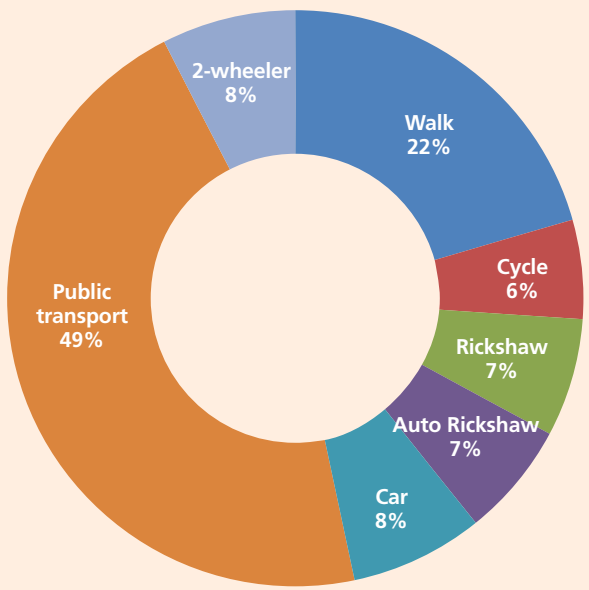
A major environmental challenge is the encroachment of development onto the lakes in the region. The number of lakes decreased from 925 to 521 over a twenty-year period, and most lakes could disappear in the near future. Many of the lakes are severely polluted by untreated domestic and industrial discharge, while much of the ground water in the region is now unfit to be consumed.

THEMATIC REPORTS

TRANSPORTATION

Hyderabad is an extremely congested city, with the development of the transportation system having failed to keep pace with the rapid population, economic and physical growth. Personal vehicle ownership has risen sharply, with nearly three million vehicles (cars and two-wheelers) on the road, increasing at 200 000 per year.

MODAL SHARE OF TRIPS



The modal split shows that public transport remains highly significant, accounting for around 44% of the eight million trips made in Hyderabad each day; but there are frequent complaints that this transport is overcrowded and inefficient. Around one-fifth of the trips are made on foot, but there is a serious lack of pedestrian facilities.

BUS

Bus remains the staple of public transport. The bus services are run by the Telangana State Road Transport Corporation (TSRTC), which runs a fleet of around 3 800 buses and carries around 3.3 million passengers per day. The slow-moving traffic takes a heavy toll on the bus fleet, and maintenance is a critical problem. There are proposals to develop a BRT for Hyderabad, with 32km of dedicated bus lanes on two corridors. This would be a joint initiative of the state and municipal governments.

RAIL

In 2003, suburban rail known as the Multi-Modal Transport System (MMTS) was launched as a partnership between the State government and South Central Railways, a subsidiary of Indian Railways. Since the system used existing railway tracks it was regarded as extremely cost-effective; though ridership has remained limited, reaching 175 000 per day in 2015.

The Hyderabad Metro Rail was approved in 2003 but there were long bidding delays, although construction has been quick. Trial operations began in 2015, with the public launch expected in late 2016 or 2017. Phase I has three lines, with a system length of 73km. It is one of the world's largest elevated rail systems. It is built and operated by L&T Metro Rail Hyderabad Limited (LTMRHL), which is a PPP in which the state government has a minority equity stake.

PARATRANSIT

There are about 84 000 auto-rickshaws in Hyderabad, making up an important part of the city's overall transport system.

PLANS

Hyderabad's major transport intervention has been the construction of the Outer Ring Road, but there is a growing focus on public transport. Among the major initiatives are the completion and expansion of the MMTS, metro and BRT to create a fully integrated transport system across the metropolitan area. To assist with this task, a Unified Metropolitan Transport Authority (reporting to the HMDA) was formed for the metropolitan region, which is now coordinating authority for decision-making and allocation of budget for transportation.

GREEN ENERGY

In 2015, the State of Telangana had an installed capacity for electricity of 9 583MW, of which 21.4% was in the private sector. Of this installed capacity, 58.4% is coal-fired production, 33.2% gas, 18.3% large-scale hydro, 1.3% nuclear, and 21.4% renewables and new energy (such as co-production). The State is doing well in terms of renewables, having recently been presented with an award for its success by central government. Telangana State also has a state company called the Telangana New & Renewable Energy Development Corporation Limited, whose purpose is to generate electricity through renewable sources such as wind, solar, and biomass in a decentralised manner.

A major problem for Hyderabad and for the state more widely is the shortage of electricity, which leads to frequent power cuts. This shortage is prompting greater attention being paid to renewables. The state government, for example, is launching a number of tenders for renewable-energy production, with a particular focus on solar and wind energy. Private renewable energy developers are taking advantage of the electricity problems by approaching the state government with the intent to generate 800MW of renewable energy for the state on the basis of power purchase agreements with government. Enrich Energy Ltd., for example, received approval in August 2014 to set up a 60MW solar park in Telangana, the first private solar initiative in the newly formed state. The state government is encouraging rooftop solar energy systems to help alleviate pressure on the grid, using a 30% subsidy for the domestic sector.

Hyderabad has adopted many policies promoting and prioritising energy efficiency in buildings, and is leading the way in India in this area. The HMDA has guidelines and standards for energy-efficient buildings, although it is not mandatory for these to be followed.

Telangana has been struggling to meet targets for producing biofuels because of a lack of raw material for production; but the Telangana State Road Development Corporation is beginning the process of converting its bus fleets to bio-diesel blends.

INNOVATION-DRIVEN ECONOMY

Hyderabad ranks only 315th in the 2thinknow Innovation Cities Global Index, 2015, and sixth in India, after Mumbai, Delhi, Bangalore, Chennai and Pune. It has been disadvantaged both by the limitations of India's national innovation infrastructure, and by a recent growth path built on the offshore operations of multinational corporations rather than endogenous innovation.

However, innovation has been identified by state authorities as the next driver of growth. One of the most significant spatial hubs of innovation is Genome Valley, which has already accumulated an impressive array of globally recognised research institutes in the biomedical field, including: the Indian Institute of Chemical Technology; the Centre for Cellular and Molecular Biology; the Centre for DNA Fingerprinting and Diagnostics; the National Institute of Pharmaceutical Education and Research, Hyderabad; the Centre for Computational Natural Sciences and Bioinformatics; IIIT Hyderabad; the Indian Institute of Biotechnology; the Centre For Sustainable Agriculture, Hyderabad; the Apollo Cell and Molecular Biology Research Centre; and the American Oncology Institute. In 2016, the central government approved the setting up of a National Resource Facility for Bio-medical Research (NARF) in Genome Valley by the Indian Council for Medical Research, which is intended to be one of the leading applied biomedical research facilities in India. This will build on recognised strengths in Genome Valley, including its leading position in the development of vaccines.

The innovation facilities in IT are lagging behind those of the biomedical field, but there are well-known facilities such as the International Institute of Information Technology. A number of large corporations are opening innovation facilities in the city, including Apple, for example, which is to open its first technology development centre outside the United States in Hyderabad.

Much of the innovation has focused on the needs of large firms, but there is new attention being paid to venture capital for start-ups and supporting the growth of small- and medium-sized innovation-intensive enterprise. For example, a hi-tech venture fund has been set up by the state government in partnership with a major corporation.

The state government has identified a gap in the relationship between research institutions and the innovation-entrepreneur-investment ecosystem, and has created a platform called the 'Research and Innovation Circle of Hyderabad' (RICH), which is a non-profit organisation that will link research institutions, academia, and industry, along with venture capitalists, angel investors, and incubation funds. The Government of Telangana intends to invest substantially in RICH so that it becomes a self-sustaining organisation. There are 13 universities in Hyderabad – 10 state universities and 3 private universities – although none are highly ranked internationally. The IIIT Hyderabad is giving strong emphasis to innovation, having structured its operations around research centres and labs rather than around schools and departments.

CHINA

BASIC FACTS

» Level of urbanisation (2015) – 55.6%
» Total urban population (2015) – 775.5 million
» Annual rate of urban growth (2010-2015) – 3.05%

MAJOR URBAN CLUSTERS/CITY-REGIONS (2015 POPULATION)

» Beijing-Tianjin-Hebei (Jing-Jin-Ji) (109.5 million)
» Yangtze River Delta (88 million)
» Pearl River Delta (70 million)

MAJOR URBAN AGGLOMERATIONS WITH 2015 POPULATION (FACT SHEETS INDICATED WITH *)

» Shanghai (23.74 million)*
» Beijing (20.38 million)*
» Chongqing (13.33 million)*
» Guangzhou (12.46 million)*
» Tianjin (11.2 million)*
» Shenzhen (10.75 million)*
» Wuhan (7.9 million)*
» Chengdu (7.6 million)*
» Dongguan (7.4 million)
» Nanjing (7.4 million)
» Hong Kong (7.3 million)
» Foshan (7.0 million)
» Hangzhou (6.4 million)*
» Shenyang (6.3 million)*
» Xi'an (6.0 million)*
» Suzhou (5.5 million)*
» Haerbin (5.5 million)
» Qingdao (4.6 million)
» Dalian (4.5 million)
» Xiamen (4.4 million)
» Zhengzou (4.4 million)
» Ji'nan (4.0 million)
» Shantou (3.9 million)
» Kunming (3.8 million)
» Changchun (3.8 million)
» Changsha (3.8 million)
» Zhongshan (3.7 million)
» Ürümqi (3.5 million)
» Taiyuan (3.5 million)
» Heifei (3.4 million)
» Fuzhou (3.3 million)
» Shijiazhuang (3.3 million)
» Nanning (3.2 million)
» Wenzhou (3.2 million)
» Ningbo (3.1 million)
» Wuxi (3.0 million)

BRIEF HISTORY OF URBAN DEVELOPMENT

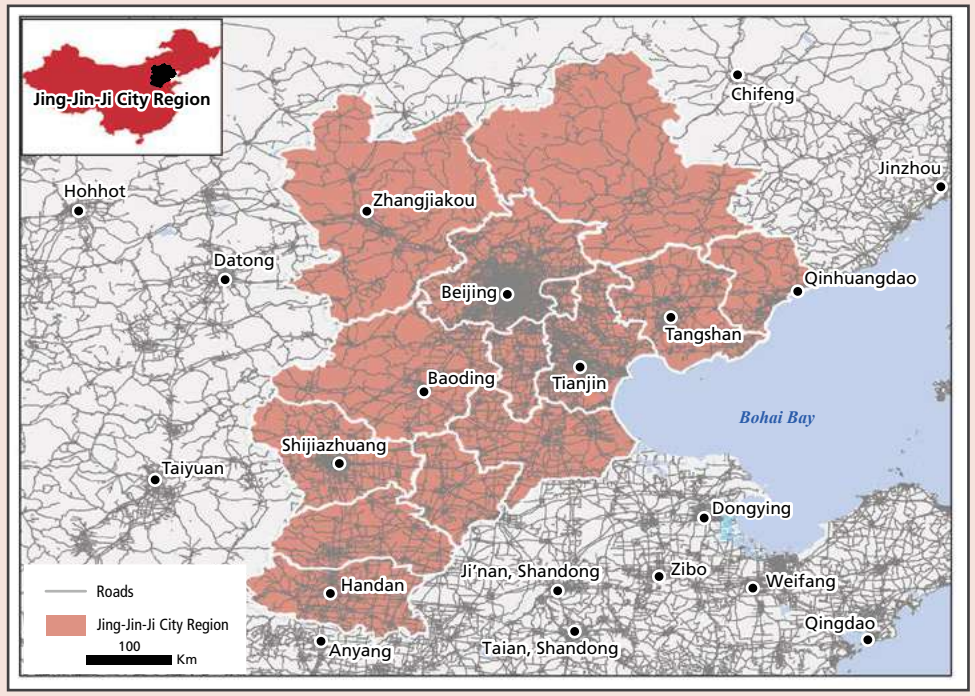
China has an ancient urban history. Over the past 2000 years or so, a number of Chinese cities have been among the largest in the world. From the mid-19th century Imperial China was in a period of decline, and many urban areas reduced in size. Modern China was a slow starter in terms of urbanisation. In 1950, only 11.8% of China's population was urbanised. With industrialisation in the 1950s and early 1960s there was a gradual upward trend in urbanisation to 18% in 1965. However, with the anti-urban policies of the Cultural Revolution, urbanisation trends were reduced; and on the cusp of the Reform Era in 1975, only 17% of China's population lived in urban areas. The hukou (a system of residential registration) was used to control movement into urban areas, and to maintain a strict rural-urban divide. The situation changed dramatically with the economic reforms instituted in the late 1970s, and a policy of opening the economy to the world. The designation of Special Economic Zones (SEZs) in coastal cities led to rapid export-oriented manufacturing driving the demand for labour, and unprecedented rural-urban migration. In 1990, 26% of the population was urbanised, rising sharply to around 53% by 2015. From around 2000 the focus shifted from the coastal areas only to the development of inland cities, and urbanisation moved into the interior. While China has been enormously successful in many respects, the rapidity of urbanisation has led to challenges, including environmental damage; inequalities between the permanently settled population and the so-called floating population; and the dangers of a housing bubble and high levels of local debt.

URBAN GOVERNANCE

China's system of governance is famously hierarchical. Each level reports upwards to the level above, and the higher the level, the greater the prestige and autonomy. The Chinese constitution does not provide for a division of powers between the levels of government. Instead, the same government functions are replicated at each level. The basic hierarchy from top to bottom is central government-provinces-municipalities-counties/districts-towns-villages. However, there are anomalies, with one of the most significant being that there are four cities in China that have the status of a province (Beijing, Shanghai, Tianjin and Chongqing) reporting directly to central government. While the governance system is hierarchical, there is also a significant level of devolution of powers to lower levels. The magnitude and complexity of the country invariably means a significant degree of discretionary power away from the centre. The activities of government are structured by the targets and goals of the National Five-Year Plan, which is replicated at each level. China effectively has a one-party system, with the ruling Communist Party of China (CCP) playing a key role in governance processes. The hierarchical structure of the CCP, which extends downwards to neighbourhood units, is in parallel to the hierarchical governmental structure, and most senior government officials are members of the CCP, reporting through the party structures to the Politburo Standing Committee of the Communist Party. Governance systems are evolving, with one of the most recent innovations being the concept of city clusters. These clusters require networks of collaboration and partnerships between cities within regions.

BEIJING-TIANJIN-HUBEI EXTENDED CITY REGION

(Jing-Jin-Ji City Region 京津冀城市群)



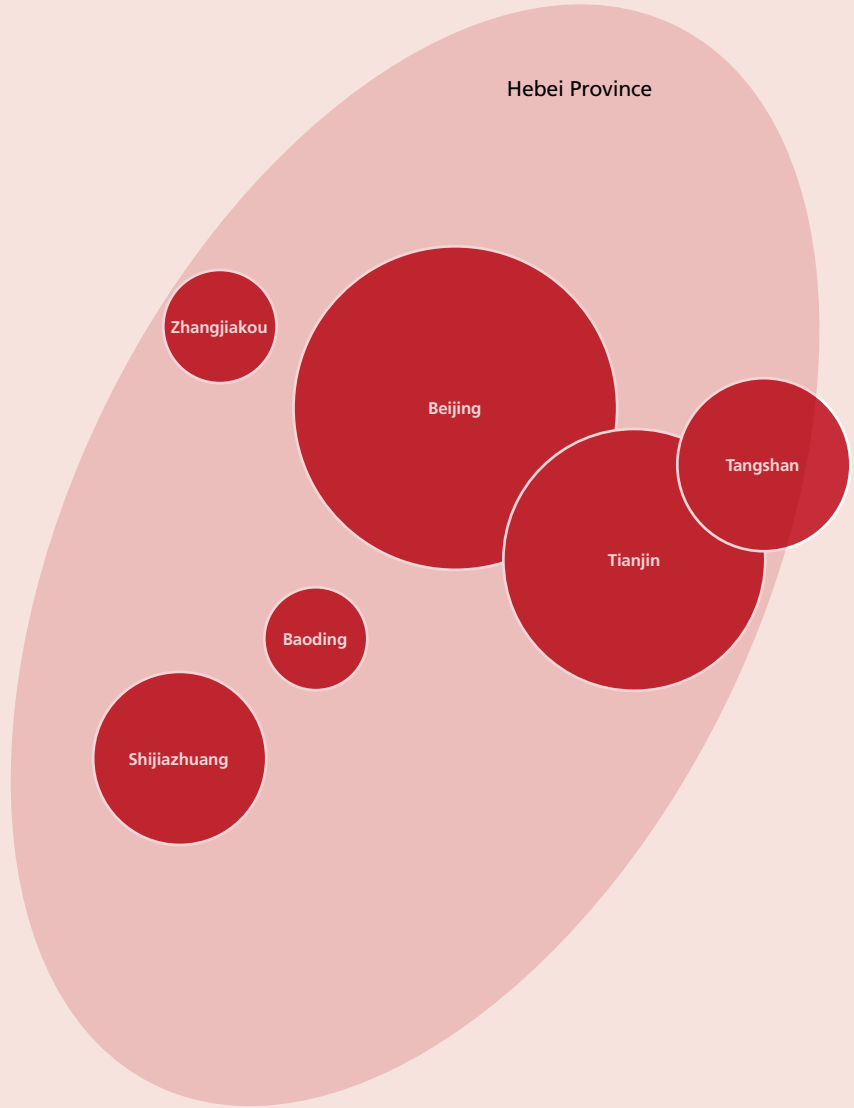
DESCRIPTION

This newly defined extended city-region in north China rivals the Pearl River Delta and Yangtze River Delta as the largest city-region in China and in the BRICS. The core of the city-region is the integrally linked cities of Beijing and Tianjin. However the city-region also includes a number of medium-sized cities in Hebei province including Baoding, Shijiazhuang, Tangshan, Cangzhou, Langfang and Zhangjiakou. The economy of the region is based historically on heavy industry, government services and port logistics, but new economy manufacturing is growing.

POPULATION

There is an estimated population of 109.5 million people in the region (although estimates may differ depending on where boundaries are draw). The largest urban concentrations are Beijing (20.38 mill), Tianjin (11.2 mill) and Shijiazhuang (3.3 mill).

STRUCTURE

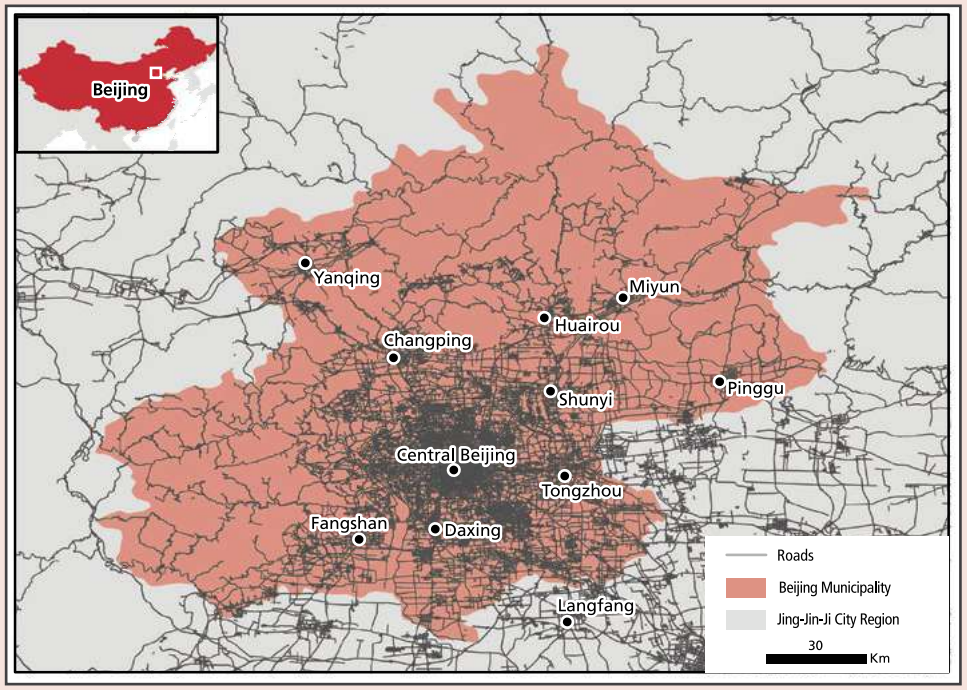


GOVERNANCE

Beijing and Tianjin are cities with a status equivalent to a province. The other city governments report in the hierarchy to Hubei Province.

BEIJING

北京



CONTEXT

LOCATION AND STATUS

Beijing is located in the north of China, surrounded by Hebei Province. It is the capital of the People's Republic of China.

HISTORY

The city's history dates back three millennia, with a walled city-state established in the 11th century BC. During China's long and complex history, Beijing (referred to by various historical names such as Jicheng, Yanjing, Zhuojun and Fanyang) played various political and administrative roles, including as a regional capital or as a capital of one of multiple kingdoms that made up greater China. In 1215, Beijing was razed to the ground by Genghis Khan's invading Mongolian army, but towards the end of the 13th century, Kublai Khan built the capital of his Yuan Dynasty adjacent to the ruins of the old city. In the earlier part of the Ming Dynasty, beginning in 1368, Beijing was a co-capital with Nanjing; but in 1420, Beijing (then called Jingshi) was officially designated the sole capital of the Ming Dynasty, and many of the great historical attractions of present-day Beijing, such as the Forbidden City, the Temple of Heaven, and Tian'anmen, were built at this time. Beijing was a walled city, and for much of the period between the 15th and 18th centuries, it may have been the largest city in the world.

Beijing was the sole capital during the Qing Dynasty (1644-1912), but during the latter part of this period, China's power waned. In 1860, Anglo-French forces invaded Beijing, looting and burning the Emperor's Summer Palace. In 1912, the Qing Dynasty collapsed and the Republic of China was formed, which eventually degenerated into the rule of competing warlords commanding regional armies. In 1928, the capital was relocated to Nanjing, and Beijing's position declined sharply. In 1937 the city, then called Beiping, fell to the Japanese, and became the seat of the occupying regional administration. In January 1949, however, the People's Liberation Army entered the city, and Mao Zedong declared Beijing the capital of the newly formed People's Republic of China. With its new status, Beijing grew rapidly in the 1950s. The city wall was torn down, making way for the new subway system and the second ring road (although this was only completed in 1981). In the 1960s and early 1970s, however, the population of Beijing grew slowly, as a result of the anti-urban policies of the Cultural Revolution, and the relocation of many urban professionals to the countryside.

However, with China's rapid economic development during the reform era from the late 1970s, Beijing's growth was renewed. The city expanded dramatically in physical terms, with the construction of the third, fourth, fifth and sixth ring roads. Beijing was at the heart of major political developments, including the dramatic protests on Tiananmen Square in 1989. It has also been the site of major global events, such as the Summer Olympics of 2008. With the rapid urban development came many challenges, including severe road congestion, extreme air pollution, an influx of migrant workers leading to housing shortages, and the destruction of historic neighbourhoods.

Beijing has attempted to deal with its challenges through a succession of city plans. The 1958 City Plan attempted to modernise Beijing for large-scale industrialisation, but much of the development in the 1960s was haphazard and unregulated. The 1983 City Master Plan established the concentric form of city development, but this changed with the City Master Plan 2004-2020, which shifted new development towards a multi-centred pattern, decentralising activities from the core into suburban and satellite settlements. The most recent development has been the designation of the Beijing-Tianjin-Hebei city region (Jing-jin-ji), with Beijing signing various cooperation agreements with neighbouring cities from 2014. High-speed rail networks have played an important role in connecting this newly-recognised city-region.

Present-day Beijing remains one of the fastest-growing large cities in the BRICS. It is the seat of political power in China, the headquarters of most of China's major state-owned corporations, and a national cultural and tourism hub with no fewer than seven UNESCO World Heritage Sites.

POPULATION

POPULATION SIZE

The UN Population Division estimates a 2015 population of 20.38 million for the Beijing urban agglomeration. Note that this is slightly less than the municipal population, as over two million people within the borders of the municipality were living in non-urban settlements.

POPULATION RANKING

In terms of UN data the Beijing urban agglomeration is ranked seventh in the world, fifth in the BRICS, and second in China after Shanghai.

POPULATION GROWTH

Beijing's average annual growth rate of 4.61% for the period of 2010-2015 is the highest in the world for a mega-city.

POPULATION DIVERSITY

The 2010 national census shows that 95.9% of the Beijing population was ethnic Han Chinese, followed by Manchurian (1.7%), Chinese Muslim (1.3%), Mongolian (0.4%) and Korean (0.2%). The foreign-born population was 0.46%.

STRUCTURE OF THE URBAN AGGLOMERATION

Although Beijing has developed a more complex, multi-centred structure in recent decades, the city core remains highly dominant, and the concentric pattern of development, following the seven ring roads, is still the major spatial structure. However, 11 satellite cities have also been planned to structure the mass sprawl of the urban agglomeration separated from the core city by a green belt, and there are also numerous other suburban and county towns.

The metropolitan agglomeration may be divided into four regions. The first is the inner city, defined on its perimeter by the third ring road and comprising the city districts of Xicheng, Dongcheng, Xuanwu and Chongwen. The second is the outer centre, comprising the city districts of Haidian, Chaoyang, Shijingshan and Fengtai, and around ten major suburban centres. These centres were the satellite cities of the 1980s but have since been swallowed up by the core city. The third is the inner periphery, with the districts of Mentougou, Fangshan and Daxing and the edge cities of Tongzhou, Shunyi and Changping. Finally, there is the outer periphery, with the counties of Huairou, Pinggu, Miyun and Yanqing.

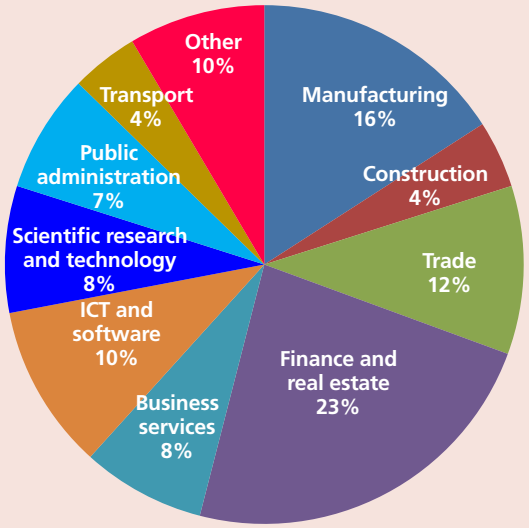
The 11 satellite cities are located in the inner and outer peripheries, with the more successful and faster-growing of the cities in the inner periphery. Although the satellite cities were planned to be self-contained, with both residential and economic activity, many are now 'sleeping towns' with mass daily commuting into the centre of Beijing. The largest satellite city in terms of population is Changping (1.6 million people), followed by Daxing (1.37 million), Tongzhou (1.18 million), Fangshan (0.94 milliion), and Shunyi (0.88 million). The other six are under half a million each.

ECONOMY

According to the Brookings Institution, the GDP for Beijing is USD 506.14 billion (PPP). It has the third-largest urban economy in the BRICS after Shanghai and Moscow. During the period 2011 to 2015 (12th Five-Year Plan), the average annual GDP growth for Beijing was 7.5%, which was very high in international terms, although lower than the average of 11.4% for the period 2006-2010 (11th Five-Year Plan).

In terms of economic structure, Beijing has a diverse economy. It is dominated by government and business services, but also has a sizeable manufacturing sector.

SECTOR SHARE



Manufacturing was the bedrock of Beijing's economy from the 1950s through to the end of the 1970s. The central government of China had concentrated heavy industry (including petrochemicals and steel) in Beijing. From the 1980s, however, there was a dramatic shift in the structure of the economy. Almost all the heavy industry has now been moved out of the city, in an effort to improve air quality and provide space for new forms of economy activity. For example, the city's single largest polluter, and also one of the largest employers, moved most of its operations from Beijing to Tangshan. In the place of heavy industry, the government has promoted science-manufacturing and research-intensive activities. Two new 'cities' (Zhongguancun and Future Science Technology City) and two new 'belts' of industry (North R&D and South Hi-Tech) have been created as the physical space for this high-end manufacturing.

But the major change has been the rise of tertiary sectors, with Beijing emerging as China's first major post-industrial city. The speed of change from a manufacturing to a service economy has been nearly unprecedented globally. In 1980, tertiary sectors accounted for around 27% of the city economy, increasing to 50% by 1995 and then to 78% in 2014. Major drivers have been China's opening to the global economy; the rise of the Chinese middle class, with the related demand for consumption of services; the concentration in Beijing of the headquarters of the largest of China's growing state-owned enterprises; and the connections that business in Beijing has with government. There has a major expansion in finances, tourism, media, ICT, and other business services. Significantly, Beijing ranks first in the world for having the most number of Fortune 500 Companies. No fewer than 52 of the Top 500 companies globally were headquartered in Beijing in 2014, most state-owned. Three companies – China Petrochemical Corporation (Sinopec Group), China National Petroleum Corporation (CNPC) and the State Grid Corporation (State Grid) – were among the top 10 in the world, with other major companies including the Industrial and Commercial Bank of China (ICBC), China Construction Bank, China Mobile, Bank of China, China Railway Group, China Life Insurance, and Sinochem.

The new economy of Beijing is reflected in the spatial structure of the city, with corporate headquarters clustered in the CBD (Guomao district), financial services in Fuxingmen and Fuchengmen, ICT in Zhongguancun (China's 'Silicon Valley'), and other high-end manufacturing in Yizhuang.

The shift towards high-end manufacturing and services is supported by China's five-year planning system. The 12th Five-Year Plan aims to make Beijing 'a world city with a Chinese character' through the continued strengthening of the service and knowledge economies, the further clustering of corporate headquarters, and the building of a green economy. Innovation-driven growth is at the centre of the strategy.

However, Beijing does face economic challenges, which relate in part to China's current transition away from export manufacturing to a consumption-driven economy, and in part to Beijing's major environmental challenges, especially air pollution and road congestion. There are plans to further decentralise economic activity from the core city, to Tianjin and smaller cities in Hebei. This may mean a further reduction in the economic growth of Beijing, which is already less than that of many other city economies in China.

GOVERNANCE

The urban governance structure for China is explained on the coversheet. Beijing does have its peculiarities. As with Shanghai, Guangzhou, Tianjin and Chongqing, Beijing has a city administration with the status of a provincial government, reporting directly to national government within the governmental hierarchy. As it is the capital city of China, national government is also more involved in local matters, with more centralisation of governance-related activity than in cities more distant from the centre of national power. However, Beijing municipality is well resourced, receiving around 30% of the tax payments to the central treasury back from national government.

DEVELOPMENT CHALLENGES

Beijing is a large, fast-growing and economically prosperous city; but it does have severe challenges, many associated with the pace of economic and population growth. The environmental problems in Beijing are enormously challenging, and are seriously affecting quality of life in the city. The Annual Mean PM10 of 121ug/m3 makes Beijing one of the most polluted large cities in the world. Air pollution is a regional problem, remaining high despite the decentralisation of polluting industry away from the city, with vehicle emissions, construction dust, coal-fired boilers and residential heating contributing to the problem. Beijing has introduced a comprehensive pollution-control system, with early indications of possible positive results. Water shortages and water pollution are other persisting environmental challenges.

Rapid urban growth creates considerable pressure on the provision of infrastructure for water, energy, education, health, medical facilities, transport, and so forth. The government has invested heavily in infrastructure, but keeping pace with growth remains a persistent challenge. With population growth, the cost of housing has increased sharply, making access to affordable accommodation a growing challenge. In the modernisation process, historical neighbourhoods have been destroyed, undermining cultural heritage.

Beijing is a city of rising inequality. An updated Gini coefficient for the city has not been released, but the official national figure has risen sharply, from 0.3 in the 1980s to around 0.48 in 2012; which places China nearly at the same level as Latin American countries. A major dimension of urban inequality is the divide between the approximately 13 million residents who have local hukou (residency) permits and the eight million or so who do not. The former have full access to urban services, while the latter (comprising the so-called 'floating population') have only restricted access. Many of the non-hukou residents are forced to live on the urban periphery because of high land and housing costs in the centre, and have lengthy daily commutes to work.

THEMATIC REPORTS

TRANSPORTATION

ECONOMIC INFRASTRUCTURE

Beijing is the major national hub for economic logistics, with a sophisticated network of road, rail and air travel. In 2015, the Airports Council International ranked the Beijing Capital International Airport as the second-busiest in the world with 90 million passengers internationally, increasing at 4.4% per annum. It is by far the busiest airport in the BRICS, followed by Shanghai Pudong International with 60 million passengers.

There are eight major railway lines radiating out from Beijing, including the Trans-Siberian Express connecting through Russia into Europe, and international services to North Korea and Vietnam. There are high-speed rail networks to Shanghai, Tianjin and Shijiazhuang. There are also nine road expressways heading out from Beijing in all compass directions, linking the city into the national road network. A feature of the city is the system of ring roads. The system consists of completed Ring Roads 2 to 6 (there is no Ring Road 1), and Ring Road 7, which is due for completion in 2017. Ring Road 7 is 940km in length, extending deep into Hebei province.

PUBLIC TRANSPORT

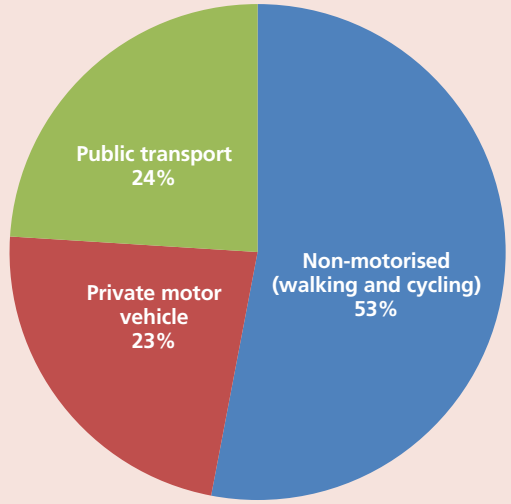
Between 1949 and the 1980s, travel by foot and bicycle was dominant, and the number of motor vehicles increased very slowly. Even by 1986, 86% of trips were by bicycle, with only 5% by private motor vehicle. In the 1990s there was a strong focus in China on the development of the automobile industry. Combined with rapid economic growth, and the completion of Ring Roads 3, 4 and 5, this led to an unprecedented expansion in the ownership of private vehicles (a 25-time increase), with the proportion of trips made by private motor vehicles increasing to 23%. From around 2000, however, the focus shifted to the development of public transport networks. Private car usage continued to grow, reaching nearly 30% of trips by 2005, but not at the same rate as before.

The Municipality released its Beijing Transportation Development Plan (2004-2020) in 2004; and following this, investment in public transport infrastructure as a proportion of total investment in municipal fixed infrastructure increased from 45% to 70%. In the period 2005-2012, twelve new metro lines were built for Beijing, adding an additional 328km of rail. There was also success in integrating modes of transport, with a Public Transportation Card enabling access to almost all forms of transport service. Nevertheless, the number of private vehicles has continued to increase, with nearly six million cars in Beijing by 2016, placing the city in the same category of per capita car ownership as Tokyo and Seoul. The continued concentration of jobs in the central core of Beijing (despite policies to disperse employment to satellite cities) means that there are massive tidal flows of commuters during the morning and evening rush hours.

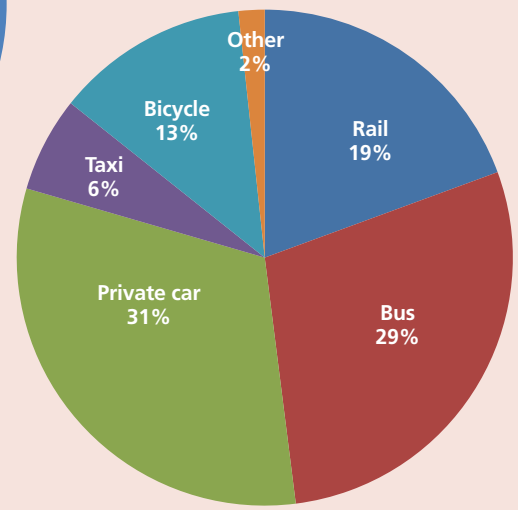
The Beijing Transport Annual Report (2015) published by the Beijing Transport Development Research Centre provides the modal share for 2014. The modal share is for the core city contained within Ring Road 6 (it excludes the satellite cities and other peripheral towns).

The challenge with the recent data is that walking trips are excluded, with the most recent data including walking for 2005 only. The data below includes both the 2014 and the (admittedly very outdated) 2005 figures.

MODAL SPLIT: PERCENTAGE OF ALL TRIPS, 2005, SOURCE ITA ACADEMY



MODAL SPLIT: PERCENTAGE OF TRIPS EXCLUDING WALKING, 2014



(Source: Beijing Transport Development Research Centre)

The high percentage of non-motorised transport in 2005 suggests that the exclusion of (the walking component of) this mode in 2014 is a major deficiency. Bicycle use may be high in international terms, but it is far less than it has been historically. In 1986, nearly 63% of trips were made by bicycles. From the 1990s, however, there was a sharp drop in the use of bicycles, with 38.5% of trips in 2000, and a continuous decrease since then. Taxis have emerged as an important part of the transport system, with minibus taxis appearing in the 1980s, and growing rapidly in the 1990s. With stronger regulation and the development of other modes of transport, the number of taxis stabilised in the 2000s.

In terms of public transport, to be detailed below, bus services are still most important in terms of passenger numbers, accounting for nearly 60% of trips on public transport; although rail is also significant .

BUS SERVICES

Public bus services began in 1921 when a trolley bus company was created, followed two years later by the opening of a tram service. By 1949, however, there were still only 61 buses and 103 trams in the city. There was some expansion in the 1950s, with buses imported from Eastern Europe. In the 1980s and 90s there was growth in ridership but little expansion in capacity, leading to increasing overcrowding of the bus service.

There was renewed expansion of the bus system from the 2000s. By 2013, China had the highest number of buses per capita of China's cities, with 24.8 buses per 10 000 people (compared, for example, with Shanghai, at 12.1). There was a 20% increase in bus ridership in 2006 alone after a fixed-fare rate was introduced, and generous discounts were introduced for students and transit-card holders. This system was modified in 2014, with a flat fare applicable for the first 10km, with distance-based increments thereafter. By 2014, there were over 24 000 buses operating along nearly 900 bus routes, mainly by Beijing Public Transport Holdings, Ltd, the primary state-owned public bus services operator.

A Bus Rapid Transit (BRT) system was introduced in 2005 in preparation for the 2008 Olympics. The BRT system now has four corridors with a combined length of 75km, carrying 305 000 passengers daily. Although of some local significance, the BRT is only of a very modest scale for the size of the city, ranking about sixth in China in terms of ridership.

BEIJING SUBWAY

The Beijing Subway is the oldest metro system in China. It is wholly owned by the Municipality of Beijing, with two operators – the first wholly state-owned, and the second a public-private partnership. In 2015 the Beijing Subway had 18 lines, with a total track length of over 550km. It was the world's busiest metro, with a weekday average of 8.9 million passengers; and yet it was still not adequate to meet demand for ridership, with calls to expand the track to over 1 000km by 2020.

The Beijing Subway had a slow start. It was first proposed in 1953, with initial technical work by a delegation of Soviet engineers drawing on experience in developing the Moscow Metro. With the break in relations between China and Soviet Russia in the early 1960s, plans were delayed, and the then-21km Beijing Subway was only opened in 1969. The system expanded very slowly, with only two lines by 2000. The catalyst for rapid expansion was Beijing's successful 2001 bid to host the 2008 Summer Olympics. By the time of the Olympics there were ten lines, and the system has continued to expand rapidly since then. Ridership has expanded dramatically since 2004, peaking at 9.3 million per day in 2014; there was a slight dip in 2015, when there was a change from a flat fare to a distance-based fare.

CONTINUED CHALLENGES

The major challenge remains the high level of car ownership despite the significant improvement in public transport, and controls on the use of cars in the core city (e.g. through number-plate restrictions). The resultant road congestion is exacerbated by the spatial structure of the city.

There are also still inefficiencies in the development of public transport. The financing of public transport remains overwhelmingly dependent on the public purse, which is hardly sustainable in view of the increasing indebtedness of public bodies. While Beijing has achieved relative success in coordinating public transport within the core city, there are still major coordination deficiencies within the wider urban agglomeration. New towns are still often inadequately connected to the core city, and there is a need for stronger connections between the Beijing Subway, suburban railways, and the rapidly developing inter-city high-speed rail transit system.

FUTURE PLANS

The development of the transit network is still managed in terms of the Beijing Transportation Development Plan (2004-2020). The plan attempts to manage the use of private motor vehicles to less than 25% of total trips, and has been associated with significantly accelerated investment in public transport, increasing efficiencies in transport (e.g. the introduction of intelligent transportation systems), and the greening of public transport fuels.

Plans are in place for the continued rapid development of the public transport system. The main interventions are in expanding the Beijing Subway, with no fewer than 40 lines planned by 2020. Work is to be speeded up on 16 lines under construction, with a further two lines to be introduced. The efficiency of the bus service is to be improved, and new infrastructure is to be provided for cyclists and pedestrians, who are to enjoy priority in future developments. The number of additional cars in Beijing is to be limited to 100 000 each year, with a cap of 6.3 million by 2020, which is a third of the current growth. New controls will include car-licence auctions, extra car registration charges, and reduced periods for validity of licences.

GREEN ENERGY

NATIONAL PERSPECTIVE

With its massive economic expansion, China has become the world's largest user of energy, and also the largest emitter of greenhouse gases. Ninety per cent of its energy consumption comes from coal and oil, with around 70 per cent of electricity produced from coal, reflecting the fact that China has the third-largest coal reserves in the world.

At the same time, however, China has the world's largest renewable energy system, having overtaken the USA. China has rapidly put in place a policy and institutional framework to support a large-scale transition to renewable energy. The Economist has referred to China as "the world's worst polluter, but highest investor in green energy" (10 August 2013).

In 2013, China had an installed capacity for the production of electricity of 1 250 000MW, which had been increasing annually for a decade at 10.8 per cent, adding the equivalent of the UK's entire generating capacity every year, and doubling every seven years. While there is steady increase in demand from the residential and commercial sectors, the bulk of the increase is driven by industrial demand.

In terms of total capacity the breakdown was coal (69%), hydro (23%), nuclear (1%), wind (6%) and solar (1%). Coal was still dominant, followed by hydro, from major installations such as the Three Gorges Dam; but the big story was the rise of wind-generated power, which was non-existent in 2005. In terms of wind, China now has the largest installed capacity in the world. In 2013, it had capacity of 62 400MW compared with the USA's 47 100 MW. The wind farms are being established by large state-owned power companies, and are being developed in the north and west of the country, and offshore.

China's shift towards green-energy policies and practices began around 2006/07, prompted in part by the Kyoto Protocol of 2007 which China signed but with no binding commitments. The 11th Five-Year Plan (2006-2010) set strategic goals for China's energy transition. Energy consumption per unit of GDP was to be cut by 20% over the course of the Plan, with a 10% reduction in the discharge of major pollutants.

In 2006, China passed a Renewable Energy Law, and in 2007 the State Council approved a Development Plan for Renewable Energy, which set the target to increase the production of renewable energy to 10% of the national electricity mix by 2010, and up to 15% by 2020. There was also the China National Climate Change Programme (CNCCP), launched in 2007, and a White Paper in 2008, which provided explicit guidelines, sector by sector, for achieving targets. Interventions in support of green energy included feed-in tariffs, which give producers of renewables a higher price per unit of electricity generated than from traditional sources; a variety of subsidies and tax incentives; and tighter regulations on inefficient power plants.

The focus has not only been on production. Significant attention has been given to efficiencies in the use of energy. In 2006, the Top 1 000 Energy-Consuming Enterprises programme set energy-saving targets for China's 1 000 highest energy-consuming enterprises. In the 11th Five-Year Plan a target was set of a 20% reduction in energy use per unit of GDP by 2010; and the government stepped up its enforcement, shutting down heavy polluters and manufacturers with obsolete, energy-inefficient technology.

During the period of the 11th Five-Year Plan (2006-2011) there were significant investments in industrial energy efficiency, and a 19% fall in energy intensity per unit of GDP. In the period of the 12th Five-Year Plan (2011-2015) the targets are a 16% cut in energy use per unit of GDP, and a 17% cut in carbon emissions per unit of GDP. The longer-term aim is to reduce the energy intensity per unit of GDP in 2020 by 40 to 45% over the 2005 level.

While considerable progress has been made, there have also been limitations. Deficiencies in the infrastructure for the transmission of electricity affect the prospects for all forms of renewable energy. With the dominance of the state sector there is also a lack of independent innovation in the energy field, with support from banks for new green initiatives also deficient.

BEIJING

China does not have a unified national electricity grid; it is divided instead into regional supply networks, including the Beijing Electricity Power Company. There is therefore a Beijing-specific story in relation to the supply of electricity and the transition to more environmentally friendly sources of electricity.

Historically, Beijing was dependent on coal-fired electricity production, with four coal-fired power stations within the boundaries of the municipality. Although in the early 1980s Beijing made a transition away from heavy industry, the dramatic growth of the city meant that electricity consumption grew rapidly from this period. At the same time there was an exponential growth in the number of motor vehicles, and the quadrupling of oil consumption. The burning of coal in both the large-scale power stations, and in thousands of boilers dispersed around the city, contributed significantly to the growing challenges of air pollution in the city.

From the late 1990s a strategy evolved to replace coal with gas. In 1997, the Shaanxi-Beijing natural gas pipeline was completed, which provides a less polluting form of energy; and from 1998, no new coal-fired power stations were built. Ahead of the Summer Olympic Games, new emissions standards were set, with existing coal-fired power stations and boilers required to cut emissions by 30%. In 1999, China's National Energy Administration (NEA) made a proposal for the wholesale switch from coal to gas in the generation of electricity for Beijing. There was resistance from electricity producers, and concern within the Municipality of Beijing at the costs involved. But there was growing public concern over air pollution – the 'haze fog' across the city – and conviction from national government that the national capital should lead the way in improving air quality.

In 2010 a firm decision was made to switch to gas-fired electricity production by 2014, although this meant a level of subsidisation from the municipality. The plan now is to complete the switch by 2017, and also to connect the satellite cities around Beijing to the natural gas pipeline. The 2013 Beijing Clean Air Action Plan also proposed to cap the use of coal overall at 150 million tons annually by 2017, down from the 200 million at the time.

Beijing's switch-over from coal to gas is an important case for China and internationally. Other cities including Shanghai and Chongqing are taking Beijing's cue, but there is also strong resistance from within the energy sector – including in Guangzhou, for example, where energy producers are strongly opposed to a switch-over plan.

The focus for Beijing has been on the switch-over rather than on growth in renewable energy sources. Nevertheless, there has been some progress here. In 2006, 1.5% of total energy production was from renewable sources, increasing to 3.2% in 2010, with an anticipated 6% by 2025. In 2010, the structure of Beijing's renewable energy production was 44% solar, 35% geo-thermal, 16% biomass, 4% wind and 1% hydro. With its geographical location on the southern edge of a vast desert region, Beijing does have a particular advantage in solar production. There are in fact a number of municipal initiatives in this area, including the 'solar garden' and 'solar campus' projects, which provide heating and lighting in public spaces, universities, colleges and schools through PV generation. There has also been progress with geothermal production, with heat pumps converting recycled water and industrial activity into geothermal energy; and in biomass, with the conversion of industrial, domestic and agricultural waste into energy. Wind production is lagging behind, although there are wind farms in the mountainous areas on the northern edge of the municipality; and hydro power stations have declined, because of lack of water, and ageing facilities.

Overall, the renewable energy sector is still underdeveloped for Beijing relative to potential.

The regional integration of Beijing-Tianjin-Hebei however may offer new possibilities for coordinated renewable-energy production. To achieve full potential, attention must be given to persisting challenges such as the quality of the transmission infrastructure, the policy and regulatory environment, and the financing of green energy.

Beijing has taken the lead in terms of the greening public transport. In 1999 it introduced Compressed Natural Gas (CNG) to its bus fleet, and by 2000 had the largest CNG-powered bus fleet in the world. In 2003, Beijing introduced its first electric buses, and in 2006 the first hydrogen-powered bus was introduced. In 2015, national government accelerated the process of greening transport with zero-emission targets for urban bus fleets, achieved through progressive decreases in subsidies for carbon-based fuels, and progressive increases in annual targets for green-energy buses, by giving subsidies of up to RMB 50 000 for the retrofitting of up to 62 000 taxis from carbon-based to green fuels.

INNOVATION-DRIVEN ECONOMY

The 2thinknow Innovation Cities Global Index rankings for 2015 places Beijing at 40th in the world (comparable with cities such as Kyoto, Montreal and Abu Dhabi) and third in the BRICS after Hong Kong and Shanghai. Beijing is an innovation leader in the BRICS.

Building an innovation-led economy has become central to policy in Beijing, as in China more broadly. Innovation was a key feature in the 11th and 12th Five-Year Plans, and is even more central in the 13th Five-Year Plan (2016-2020). The Municipality of Beijing has responded by making entrepreneurship and innovation one of the key elements of its city vision.

Beijing has major advantages, but also some drawbacks, in terms of innovation. On the positive side, the most significant advantage is the massive concentration of science and technology (S&T) resources within the city. Around one-third of the nation's intellectual and academic resources are located in Beijing. There are around 400 research institutions in the city, including more than 90 higher education institutions. Nearly 50% of China's Academicians (full members of China's Academies of Science or Engineering) are located in Beijing, and 30% of individuals who are part of China's 'Thousand-Talent Plan'. Also, Beijing accounts for around a quarter of China's S&T firms, with 40% of the nationally registered industrial innovation technology partnerships.

Even in the broader BRICS context, Beijing has a remarkable concentration of high-level research institutions. The QS Higher Education BRICS ranking for 2016 places six Beijing universities in the

top 50, including in first and second place. These include Tsinghua University (1st in the BRICS), Peking University (2nd), Beijing Normal University (11th), Beihang University (26th), Beijing University of Technology (28th), Beihang University (30th) and Renmin (People's) University of China (33rd). Beijing has the largest concentration of high-ranking universities of any city in the BRICS.

Beijing has also experienced rapid growth in R&D spending, and has emerged as an R&D-intensive city. During the 11th Five-Year Plan period (2005-2010), average annual growth of R&D expenditure was an extremely high 16.7%, dropping to around 11% for the 12th Five-Year Plan (2011-2015). There were similarly high growth rates in terms of applications for intellectual property, patents, and technology contracts. By 2014, the ratio of R&D expenditure to GDP for Beijing had reached 6.03%, which was far higher than the national 2.05%. R&D investment intensity was the highest for any city in China. In 2014, Beijing accounted for 9% of China's total GDP.

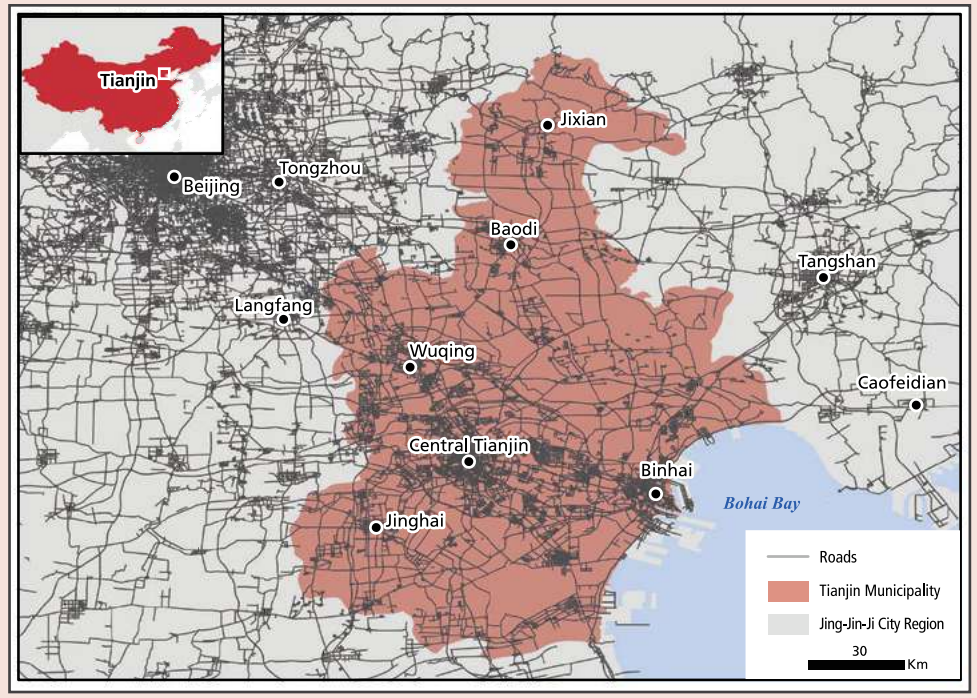
Beijing has emerged as a centre for hi-tech incubation. In 2014, one-fifth of China's hi-tech firms were located in Beijing. The greatest concentration of these firms was in the Zhongguancun Self-development Innovation Demonstration Area in Beijing, which has been referred to as 'China's Silicon Valley'. Around 16 000 firms have been incubated in this zone, which is the most successful of its type in China.

While Beijing has made significant progress, with strong evidence that technological innovation is driving economic development in the city, there are challenges. To begin with, R&D in Beijing is overwhelmingly driven by state investment, and so there are questions about long-term sustainability. During the 11th Five-Year Plan period (2005-2010), for example, the average annual growth of state expenditure was over 20%, compared with 11% growth for corporates, and 8% for foreign enterprise. This was the reverse of trends in China as a whole, where the growth in private-sector-led R&D was significantly greater than the growth in government-led R&D. Premier Li Keqiang has called for a far greater role for private enterprise in boosting innovation, but in the case of Beijing there is some distance to travel. Compared with other global S&T innovation centres such as Silicon Valley in California, Zhongguancun still lacks the world-class innovation talent, teams and partnerships, and leading-edge innovation of global standard is still lacking. In addition, partnership-based innovation is lacking. Higher-education institutions still rely overwhelmingly on government for research partnerships, with the relationship with private companies remaining very limited. Similarly, as indicated in a recent survey, 80% of private firms develop their technologies entirely within their companies, without the use of partnerships with research institutions.

There are active attempts to address the constraints to innovation, with numerous incentives (including government procurement, finance and taxing mechanisms) and support programmes. There is a specific focus on attracting world-class innovation talent and upgrading the many research-related agencies in the city to world-class standard. There is an emphasis on creating a favourable environment for innovators, and on providing incubation for innovating firms. For example, an S&T business incubator (of which there are more than 150 in the city) can receive up to RMB 5 million in rent subsidies. The early success of Zhongguancun is being used as a platform for further upgrading of innovative capacity in the city, but there are also new clusters of innovation, such as the Changping Educational and Innovation District, where there are already 38 institutions of higher learning, 106 research institutes, 4 national industrial parks and over 1 500 hi-tech businesses, with an expanding agglomeration of energy technology and bio-pharmaceutical industries, as well as cultural and creative industries.

TIANJIN

天津



CONTEXT

LOCATION

Tianjin is located 120km from Beijing in Northern Coastal China, at the estuary of the Haihe River on the Bohai Gulf of the Yellow Sea. It is one of China's major port cities.

HISTORY

Navigation and port activity along the lower course and estuary of the Haihe River may go back over a thousand years. As Beijing grew, so activity in this maritime gateway zone also expanded. With Beijing a co-capital with Nanjing during the early Ming Dynasty, the need for a port city grew, and in 1404, the walled city of Tianjin was constructed to protect the harbour. However, during the Ming and Qing dynasties there were long periods of official hostility to sea trade, and attacks by sea pirates depopulated the coastline. In the early nineteenth century, Tianjin emerged as an important coastal fortress, defending China from invasions from European colonial powers. In 1860, after the Second Opium War, the Treaty of Tianjin opened Tianjin to trade with the West; they were able to establish Foreign Concessions in Tianjin, which led to significant expansion of the city. Tianjin was the site of major battles with Western powers during the Boxer Rebellion at the beginning of the twentieth century. Foreign occupation of Tianjin was granted after the signing of the Boxer Protocol, with British, American, German and Japanese companies building their own wharves along the northern banks of the Haihe River.

Construction of the Port of Tanggu in Tianjin began during the Japanese occupation (1938-1945), but development slowed under nationalist rule (1945-49) and then under the People's Republic of China (from 1949). Official policies did not favour Tianjin, and there was also a severe setback in 1976 with the damage caused by the massive Tangshan earthquake.

By 1979 port infrastructure was in poor shape, and Tianjin was ill-prepared for its role as a major maritime centre in reform-era China. In the 1980s there was partial liberalisation, with control of the port shifting from a national ministry to a Port Authority set up jointly by national and municipal government. However, it was in the 1990s that the dramatic expansion of the port commenced. In 2004, the Port Authority became a corporation listed on the Hong Kong Stock Exchange. As Beijing has expanded, so Tianjin has grown as its maritime gateway, developing both as a logistics centre and as a manufacturing centre.

Manufacturing was launched in the reform era, with the proclamation of the Tianjin Economic-Technological Development Area (TEDA) as a free-market zone in 1984. In the 1990s, TEDA was consolidated within the Binhai New Area established as a Special Economic Zone (SEZ), on a scale similar to that of the Shenzhen SEZ or the Pudong New Area in Shanghai. Rapid industrial development followed, with an industrial base developing around industries such as automobile manufacture and petrochemicals. Binhai was highly successful in attracting large-scale foreign investment. A major setback, however, was the industrial explosion in 2015 which caused huge damage, with nearly 200 deaths and 800 injuries.

POPULATION

POPULATION SIZE

The UN Population Division estimates a 2015 population of 11.2 million for the Tianjin urban agglomeration. This is less than the municipal population, as there is a rural component within the borders.

POPULATION RANKING

In terms of UN data the Tianjin urban agglomeration is ranked 24th in the world, 11th in the BRICS, and fifth in China.

POPULATION GROWTH

Tianjin had a moderately high average annual growth rate of 3.4% for the period of 2010-2015.

POPULATION DIVERSITY

97.6% of the 2010 population of Tianjin was Han Chinese, with the largest minorities including Hui (Chinese Muslim) and Manchurian.

STRUCTURE OF THE URBAN AGGLOMERATION

Tianjin falls within the orbit of Beijing, and is strongly connected to this city through logistics networks. The completion of Ring Road 7 around Beijing, which would pass through Tianjin, would connect these cities even more closely. However, Tianjin is an urban centre in its own right, forming the core of the Tianjin urban agglomeration.

Tianjin's core city is about 30km from the coast, but there is a linear axis of development linking the city to Binhai, a new city development on the coast around the port with a population of around one million people. There is also an axis going inland, connecting Tianjin to Wuxing New Town, and weaker north-south axes linking to satellite towns such as Jinghai and Ninghe. Although there are these smaller centres, the urban agglomeration is effectively a dual city, with the major node being historical Tianjin and the secondary node being the much-newer Binhai.

The Municipality of Tianjin still has large areas of rural land, and it is likely that into the future, Tianjin will receive a significant share of the residential growth that would otherwise have gone to Beijing.

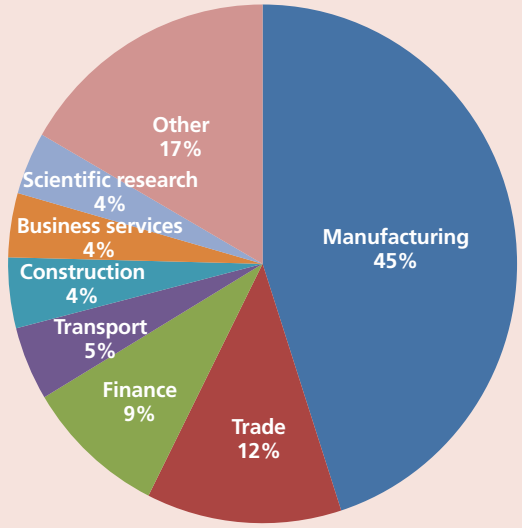
ECONOMY

According to the Brookings Institution, the 2014 GDP for Tianjin was USD 371.97 billion (PPP). Tianjin had the seventh-largest urban economy in the BRICS and the fifth in China.

During the 11th Five-Year period (2006-2010) the economy of Tianjin boomed, with an average annual GDP growth rate of 16.1%. In 2010, growth peaked at an extraordinary 17.4%, gradually trending down to 9.3% for 2015. The growth rates for Tianjin are significantly higher than those for Beijing, and for China as a whole, with Tianjin arguably a major engine of development for the newly-designated Beijing-Tianjin-Hebei (Jing-Jin-Ji) region.

In 2014, the broad structure of the economy was 1.3% primary, 46.7% secondary and 52% tertiary. With a growth rate of 9.6%, the tertiary sector was only slightly outperforming the secondary sector, which was growing at 9.2%.

STRUCTURE OF TIANJIN'S GDP – 2014



Source – Tianjin Statistical Yearbook

The economy of Tianjin is based on port-related manufacturing. Tianjin remains a manufacturing economy, and has not developed as a post-industrial city in the way Beijing and Shanghai have, for example. However, there has been a shift within manufacturing, away from traditional towards new industries. Currently the pillar manufacturing industries for Tianjin are aviation, specialised equipment, electronics, automobiles, bio-pharmaceuticals, new material, and national-defence-related equipment. For example, Tianjin has emerged as the world's third-largest aviation manufacturing hub.

A significant feature of the development of Tianjin has been its attractiveness to foreign investment, with nearly 290 of the Fortune 500 companies investing in the city. Foreign investment is supported by high-level infrastructure, especially in the Binhai New Area (which now accounts for around 55% of Tianjin's total GDP), and by a package of benefits including tax incentives.

GOVERNANCE

The urban governance structure for China is explained on the coversheet.it should be noted that Tianjin is one of the five city administrations in China with the status of a Provincial Government, reporting directly to National Government within the governmental hierarchy. As with other municipalities Tianjin is divided into various county-level, township and sub-district areas.

A particular issue is the governance of the Binhai New Area. A special governance structure has been set up which allows for flexibility in decision-making in a special industrial zone which attracts foreign and domestic capital. However, issues of governmental fragmentation do arise, requiring new forms of collaboration between agencies. On a broader scale, the designation of the Beijing-Tianjin-Hebei City-Region may also result in the evolution of governance structures, with cooperation agreements between cities already signed.

DEVELOPMENT CHALLENGES

Tianjin is a city that has experienced massive economic growth and newfound prosperity since at least the early 1990s. Even during this period of slowdown in the global and national economies, Tianjin continues to grow at enviable speed. Growth has brought challenges, however.

The levels of air pollution are a little lower than those of Beijing, assisted by the coastal winds, but at an Annual Mean PM10 of 101ug/m3 they are still among the worst in the world. There is also serious congestion in the city's transport network following an exponential growth in private car ownership. With rapid development, land-use planning has been poorly coordinated, and there are severe inefficiencies in the use of land.

With the development largely driven by the manufacturing industry, service industries have lagged behind, with negative consequences for quality of life and social access within the urban agglomeration. Also, inadequate attention has been given to human safety, as illustrated for example by the massive industrial explosion in 2015.

THEMATIC REPORTS

TRANSPORT

ECONOMIC INFRASTRUCTURE

According to the World Shipping Council (2014), Tianjin was the world's tenth-largest container port in 2014. It was the seventh-largest in China (and in the BRICS) after Shanghai, Shenzhen, Hong Kong, Ningbo, Qingdao and Guangzhou. Tianjin was slightly larger than Rotterdam, which is Europe's largest port. The Tianjin-Binhai International Airport is modestly sized, ranked 20th in China in terms of passengers; but there is a strategic cooperation agreement between Tianjin Port (Group) Co and Tianjin Binhai International Airport to create a combined seaport-airport transport hub. Tianjin is also strategically placed within the expressway and highway network of China, and is connected to Beijing with fast rail. There are three ring roads around Tianjin, but these are affected by extreme traffic congestion.

PUBLIC TRANSPORT

Tianjin faces the same challenges as Beijing in terms of exponential growth in privately-owned vehicles, with levels of congestion rated as being slightly worse even than those of Beijing. The Global Congestion Index ranks Tianjin as the second-most road-congested city in China after Chongqing, and the 18th in the world.

Updated information on modal share is not available. However, sources suggest that Tianjin retains a very high share of cycling relative to most other cities in China with the use of private vehicles generally lower. In terms of public transport, bus dominates (with 85% of trips) followed by rail (14%) and other minor forms (>1%).

A significant feature of Tianjin's profile is the continued significance of cycling. Together with walking, non-motorised transport accounted for 56.4% of all trips in 2009. Although the proportion of trips by private vehicle may seem low, the sheer size of the population, with nearly three million vehicles, accounts for the high levels of road congestion. In terms of public transport, bus is overwhelmingly dominant, although there is an established metro system.

BUS

Bus services along over 900 lines are operated by the state-owned Tianjin Public Transport Group, which also runs taxi services and other transport-related business. There are innovations in bus transport with the introduction of a BRT system, and ambitious plans for constructing elevated expressways for buses. Tianjin Municipality is transitioning its fleet to pure electric buses, thereby creating a manufacturing opportunity for the construction of these buses in the Wuqing Auto Industrial Park.

METRO

The Tianjin Metro is the second in China, having been opened in 1984. However, the system is still relatively underdeveloped with a daily ridership of around 700 000, or less than 10% of that of Beijing, a city almost twice the size of Tianjin. The metro has three operational lines, but an additional two are under construction, and nine more are planned. The track is currently 132km long. The metro is jointly operated by the Tianjin Metro Group Company and the Binhai Mass Transit Development Company, companies part-owned by the Tianjin Municipal Government.

Historically, there was a tramway in Tianjin, which was built by the Belgians and began operating in 1906. The system was closed in 1972. In 2007, however, trams were re-introduced, with the opening of the TEDA Modern Guided Rail Tram as part of the larger metro system. This tramway is in addition to a light railway which runs between downtown Tianjin and the TEDA precinct within Binhai New Area.

FUTURE PLANS

Tianjin Municipality is continuing to invest heavily in both private and public transport networks. In terms of public transport the focus is on the expansion of the metro system to around 375km by 2020. While rail is intended as the backbone, the BRT system will be an important complementary network, with 194km of road reserved for buses by 2020. The Municipality also plans to develop an extensive system for non-motorised transport (also referred to as 'slow transport'), building on the continued significance of cycling and walking in the city. In addition, there is strong emphasis on improving efficiencies in managing transportation.

A further key strategy is regional integration. The Tianjin Binhai High-Speed Rail station is located in Binhai, and serves as a major point of interchange between local, regional and national rail, bus and taxi services. By 2017, Public Transportation Cards for the region, which includes the cities of Beijing, Tianjin, Langfang, Zhangjiakou, Baoding, and Shijiazhuang, are expected to be fully integrated. There are also plans to connect the BRT systems of Beijing and Tianjin.

GREEN ENERGY

The national profile for green energy is provided in the Beijing Factsheet.

Tianjin has a similar energy history to Beijing, with reliance on coal-fired power stations within the municipal area. Like Beijing, the Tianjin Electric Power Company is closing its five coal-fired power stations, replacing them with gas-fired ones to cut pollution. In 2011, Tianjin's No. 1 Thermal Power

Plant, which was opened in 1932, was closed down, with the second-largest power station also now closed. In 2013 a plan was adopted with the target of reducing PM 2.5 pollution levels by 25% by 2017, achievable mainly by the reduction of coal consumption.

Tianjin is an active participant in the plan to create a 'Global Energy Internet', which was proposed initially by China's State Grid Corporation. The initiative will begin with the construction of a massive electricity transmission network in China that will allow for the sharing of renewable energy, to be followed by a global linkage of grids (at an estimated cost of $50 trillion of investment by 2050). In 2016 Tianjin issued a White Paper on the 'Development of the City's Energy Internet', indicating how electricity-sharing could happen within the city, as an initial contribution to the wider scheme. The city is aiming to become a leader in energy network construction, operation and management.

As with Beijing, the focus for Tianjin has been on the transition to gas rather than on the development of renewables. However, an important demonstration initiative is the development of the Tianjin Eco-City as a partnership with the Government of Singapore. It is to be completed by 2020 and will house around 350 000 people. Tianjin Eco-City will be required to source at least 20% of its energy from renewable sources, and will also emphasise energy efficiency through its building systems, cooling and heating systems, and eco-mobility networks.

INNOVATION-DRIVEN ECONOMY

Tianjin is not as well-positioned as Beijing for supporting innovation, ranking only 238th globally in the 2thinknow Innovation Cities Global Index 2015, which is only middle ranking for the BRICS. Tianjin does however have some significant advantages, including a strong network of educational and research institutes. There are for example two universities equally ranked in the QS BRICS Top 50 for 2016 – Nankai University (30st) and Tianjin University (30th).

Tianjin's expenditure on R&D as a proportion of GDP was 3% in 2015, which was significantly less than Beijing's 6%, although higher than the national 2%. However, there are indications of dynamism in the innovation sector, with the Statistical Yearbook indicating a 26% annual increase in IP applications for 2015. Also, a far higher proportion of R&D expenditure is from private enterprise than is the case in Beijing. There is also apparently more energy than the average among small- to medium-sized firms, which spend around 5.4% of their income on R&D and account for 44% of patent applications.

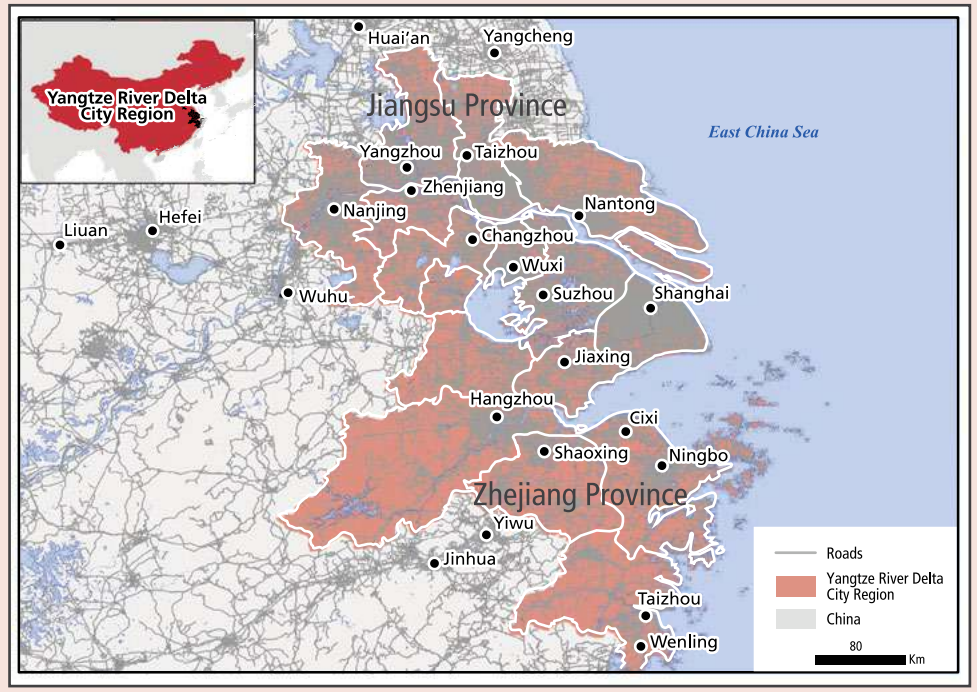
The innovation focus in Tianjin, understandably, is on technology in manufacturing. Innovative enterprise is clustered around TEDA and the Binhai New Area, in numerous specialised industrial parks and development zones. Clusters of innovation are developing around industries such as electronic component manufacturing, pharmaceuticals and green energy.

The Municipality of Tianjin actively supports innovation in industry through reforms to its regulatory mechanisms, procurement policies and financial services. In 2016, Tianjin released its new policy on city innovation, responding to a new national policy. A particular feature of the approach in Tianjin is the focus on developing technology in small- and medium-scale enterprise – the so-called 'little giants in S&T'. The municipality is working with enterprise to upgrade equipment and technology, improve business operations, and optimise industrial structure. It is focusing on the potential winners, while pushing for the closure of low-efficiency, low-competitive and high-polluting firms.

A major new development is the innovation reform trials proposed for the Beijing-Tianjin-Hebei city-region. This region has been designated as an innovation demonstration zone for China, with a regional innovation system to be developed through collaboration between the municipal and provincial governments, and other state agencies.

YANGTZE RIVER DELTA EXTENDED CITY REGION

(Chang San Jiao City Region长江三角洲城市群)



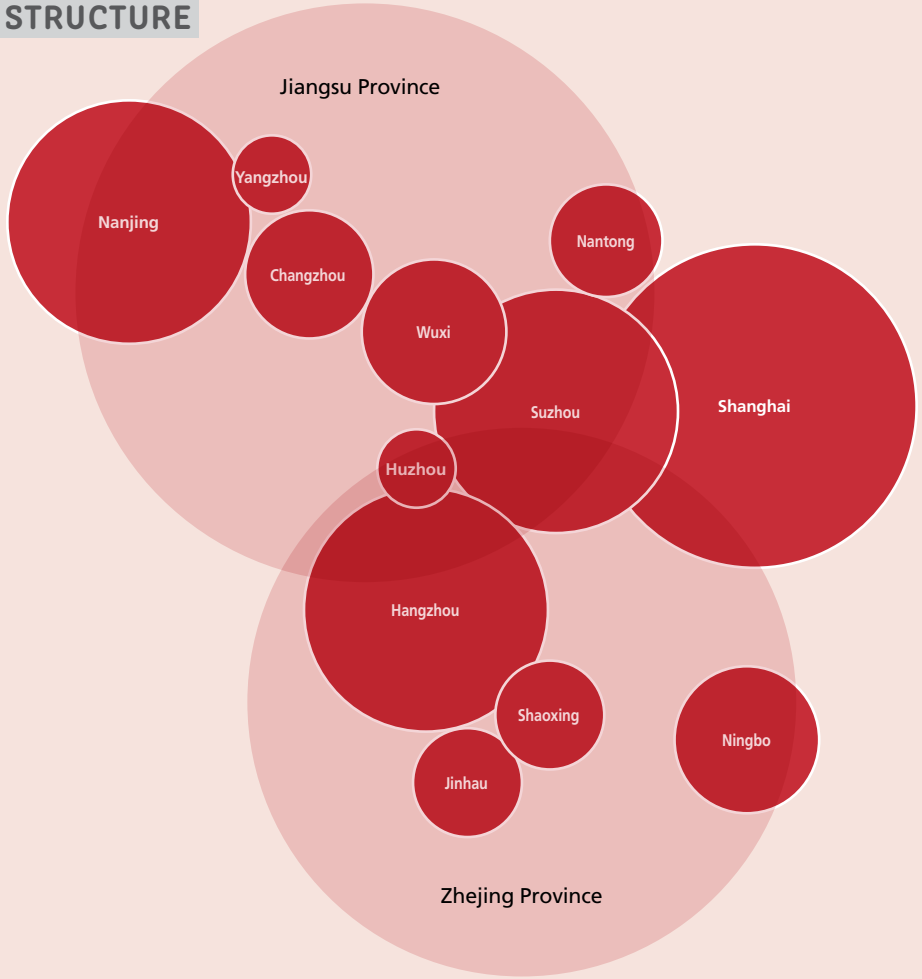
DESCRIPTION

The Yangtze River Delta is eastern China is a roughly triangular-shaped cluster of cities which includes the largest number of adjacent urban agglomerations of any city region in the world. It has an ancient urban history, and has revived in recent decades as a major urban global power. The major urban agglomerations include Shanghai, Nanjing, Hangzhou, Suzhou, Ningbo, Wuxi, Changzhou, Nantong, Shaoxing, Jinhua and Jiaxing. The region has a strong manufacturing and service economy, with major seaports and other transport infrastructure.

POPULATION

There is an estimated population of 88 million people in the region (although estimates may differ depending on where boundaries are draw). The largest urban concentrations are Shanghai (23.7 million), Nanjing (7.4 mill), Hangzhou (6.4 mill) and Suzhou (5.5 mill).

STRUCTURE

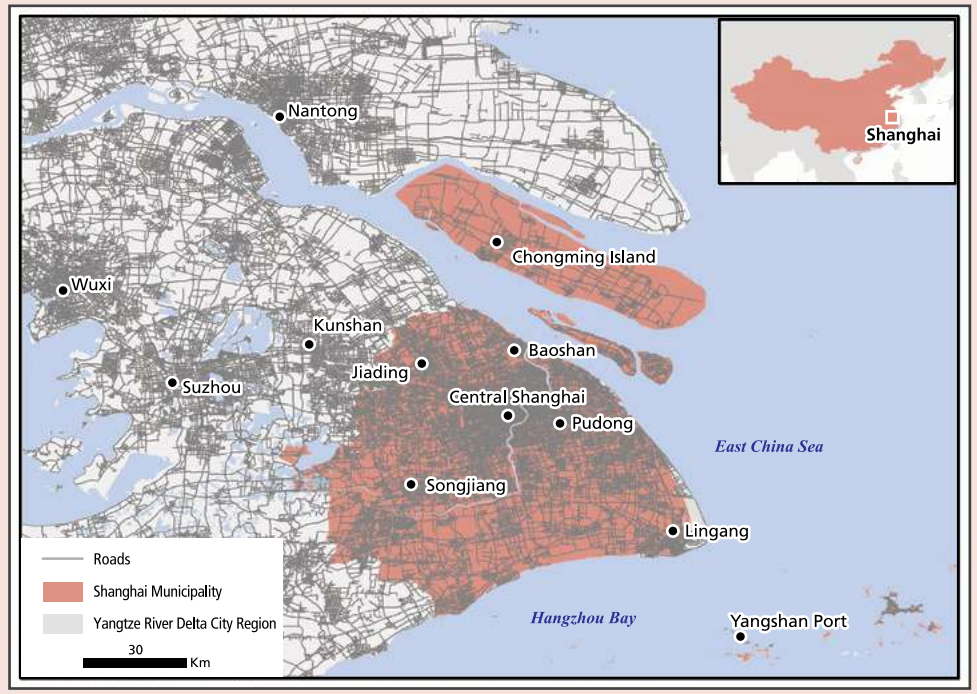


GOVERNANCE

Shanghai has a city government with a status equivalent to that of a provincial government. The other cities fall mainly under the jurisdiction of the Jiangsu and Zhejiang provinces.

SHANGHAI

上海



CONTEXT

LOCATION

Shanghai is located at the confluence of the Huangpu Rivers, on the south-east edge of the Yangtze Delta on the east coast of China.

HISTORY

With its fertile lands, the Yangtze River delta became the cradle of China's agricultural civilisation, and eventually a political and economic hub. Many great trading towns emerged in the delta, trading in silk, tea, salt and other products. For most of its history, however, Shanghai was in the shadow of cities such as Nanjing, Hangzhou and Suzhou, serving as a modest-sized trading town and district port.

This changed in 1842 after the First Opium War, when Shanghai was opened to trade with the West. After the Second Opium War in the 1860s, Shanghai was divided into French, British and American concessions, in addition to a Chinese walled city, each of which had its own culture, society and architecture. Shanghai became a truly international city, with large numbers of Jews and Russians as well. In the 1930s Shanghai was billed the 'Paris of the East'. It was a hub of trade and finance, famed also for its social decadence. At the time it was already a city of four million people.

Shanghai lost its position as a cosmopolitan and global city with the Japanese occupation of 1937.

While it emerged as a manufacturing hub under Communist rule from 1949, it was heavily taxed by central government, stagnating under the burden. Even during the early reform era from 1978, Shanghai was neglected, with the newly-proclaimed Special Economic Zones in the south of the country in the Pearl River delta. Shanghai lagged behind the development of other coastal cities.

However, this changed dramatically in the 1990s. In 1990, Pudong – a swampy tract of land across the Huangpu River from the centre of Shanghai – was designated a Development Zone, and the Shanghai Stock Exchange was established. In 1992 the 14th Session of the National Congress of the Communist Party of China resolved that Shanghai should become one of the world's leading financial and trade centres.

This was followed by a frenzy of building development. Shanghai developed with extraordinary speed into a major global business hub, with Pudong New Area providing one of the most spectacular urban skylines in the world. Shanghai hosted the World Expo of 2010, which symbolically represented Shanghai's new status among world cities. It had developed rapidly into China's most globally open and cosmopolitan city, and the leading business centre in East Asia. Also, between 1990 and 2010 the population of Shanghai doubled. There was a recent boost in 2013, when the China (Shanghai) Pilot Free-Trade Zone, the first of its kind in mainland China, was established.

POPULATION

POPULATION SIZE

The UN Population Division estimates a 2015 population of 23.74 million for the Shanghai urban agglomeration.

POPULATION RANKING

In terms of UN data the Shanghai urban agglomeration is ranked third in the world (after Tokyo and Delhi), second in the BRICS, and first in China. It should be noted that in terms of size of municipal population only, Shanghai has the largest city population in the world, followed by Karachi, Beijing and Lagos.

POPULATION GROWTH

Shanghai grew at the moderately average annual rate of 3.45% in the period 2010 to 2015, down from a peak growth rate of 5.8% in the 1990s.

POPULATION DIVERSITY

In 2010, 98.8% of the population of Shanghai was Han Chinese, with all 55 minorities represented in small proportions. According to 2015 data, the foreign-born population was 0.7%; a small proportion, but significantly more than the less than 0.1% in most of China's cities.

STRUCTURE OF THE URBAN REGION

Shanghai is strongly shaped by physical features. It is located on a triangle of land bounded by the delta of the Yangtze River on the first side, and the Hangzhou Bay on the Yellow Sea on the second. The only expansion area is to the west.

During the Reform Era Shanghai has evolved from a dense mono-structure on the western banks of the Huangpo River (a tributary to the Yangtze) to a far more complex, polycentred city expanding across much of the municipal area. The most significant change was the move across the Huangpo River in the early 1990s, with the development of the Pudong New District as a major new node with the Lujiazui International Financial District at its core. Also in the 1990s was large-scale redevelopment in the historical inner city, with large numbers of people moved out and rehoused in gated superblock developments in new areas. All manufacturing activities in the centre were moved out to more peripheral areas.

In the early 2000s there was a decentralisation strategy known as 'one city, nine towns', with the development of the satellite settlements of Baoshan, Jiading, Qingpu, Songjiang, Minghang, Nanqiao, Jingshan, Anting and Lingang, each planned for around a million people. Since then a further 60 smaller settlements have been planned, but there has also been a strong focus on settlement integration through transport infrastructure. The major settlements were planned with a new economic base – for example, Baoshan with precision steel, Anting with automobiles and Lingang with equipment manufacturing.

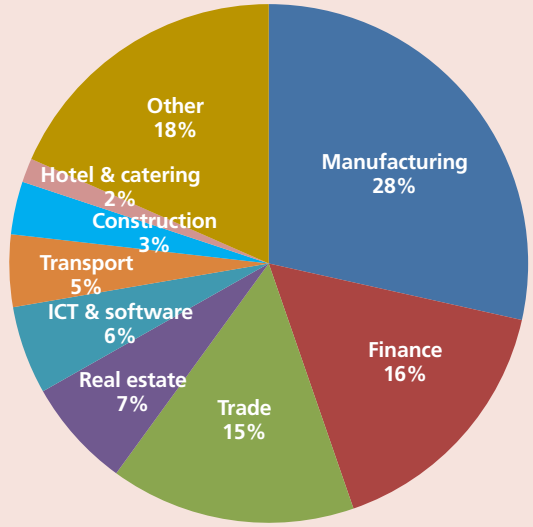
The Pudong development has been enormously successful, but there is some debate over the success of the satellite settlements. For example, financial difficulties have delayed the expansion of the German-themed Anting New Town, which still has fewer than 60 000 people; and Lingang New City, serving the new deep-water port, is also struggling to achieve population targets.

ECONOMY

According to the Brookings Institution, the 2014 GDP for Shanghai was USD 594 billion (PPP). Shanghai had the largest urban economy in China, and also the largest urban economy in the BRICS, having overtaken Moscow in size.

Shanghai's economy grew at rates of over 10% per annum over an extended period from the early 1990s until the 2010s. In the period 2011-2015 the average annual growth was 7.5%. When growth rates dropped below 7% in 2015, the Mayor of Shanghai announced that the city was abandoning growth targets, and would focus on quality rather than quantity. Growth rates are expected to remain between 6% and 7% in the 13th Five-Year Plan period, until 2020.

SECTOR SHARE OF THE ECONOMY – 2014



Source: Shanghai Statistical Yearbook

Shanghai has a well-diversified economy. Manufacturing is still significant, but far less than it was. In 1990, 60.1% of GDP was from manufacturing industry, with 30.9% in tertiary industries. There was a near-reversal by 2014, when only 28.5% came from the manufacturing industry, and 64.8% from tertiary sectors. This change came mainly from the twin processes of relocating traditional manufacturing industries – mainly textiles and heavy equipment - from Shanghai to smaller cities in

the Yangtze River Delta, and the strategic efforts to develop Shanghai into a global financial and business centre through the development of the Pudong New Area.

The biggest sub-sectors in manufacturing in 2014 were the automotive industry, information electronics, chemical products, biomedicine, fine steel and complex machinery. While Shanghai has made a transition to higher-end manufacturing, economic statistics revealed a real decline in manufacturing output in 2015, with a more than 5% drop in manufacturing exports, compared with an 11% increase in the service sector.

Shanghai's development as one of China's leading financial hubs has been the main driver in post-1990s growth. By 2014, there were over 1 300 financial institutions in Shanghai, including the Shanghai Stock Exchange (the third-largest in the world) and the headquarters of the People's Bank of China. Shanghai has become the world centre for the trading, pricing and clearing of financial products in the Chinese currency. Apart from finances, the other major business service is ICT and software.

Shanghai has also experienced continued growth in real estate. While real estate has declined in many cities in China, there was a 13.7% increase in investment in the property sector in Shanghai in 2014, and an 8.2% increase in 2015. The property game in Shanghai is changing as the growing shortage of well-located land is prompting developers to focus more on higher-quality projects.

Much of the current drive in the local economy is the expansion of the consumer market – mainly the result of the growing domestic middle class, with its demand for household appliances, lifestyle products and fashion. Shanghai's retail sector, for example, has continued to expand significantly despite the slow-down in other sectors. The growth of the consumer market is also supported by tourism. In 2014, the number of domestic tourists grew by 3.2% to 268 million, with international tourists increasing by 4.5% to 7.9 million.

While there is a shift towards the domestic market, internationalisation remains Shanghai's key strength. With its cosmopolitan nature and educated and skilled workforce, it remains highly attractive for international investment. In 2014, nearly 500 multinational companies had their East Asian headquarters in Shanghai. Shanghai's 12th Five-Year Plan (2011-2015) aimed to make Shanghai a 'global financial, trade, shipping and economic centre through innovation-driven development and structural adjustment of the economy', and this is likely to be reinforced by the 13th Five-Year Plan.

GOVERNANCE

The overall urban governance structure for China is explained on the coversheet. Within the governmental hierarchy, Shanghai has the status of a Province, reporting directly to National Government. The central government has delegated to Shanghai officials the authority to identify, appraise, approve, finance and execute very large projects, and local officials have been given the power to deal with state enterprises, with direct authority to hire and fire officials and workers. There is also a special tax-sharing arrangement in which Shanghai receives around 30 per cent of its tax payments back from national government, and is also authorised to borrow funds directly from domestic and international sources. The high-level support for the growth of Shanghai and the consolidation of authority and power in the Shanghai Municipality has been important for the rapid growth of the urban economy.

DEVELOPMENT CHALLENGES

Many of the development challenges relate to the rapid pace of economic and population growth. Shanghai faces environmental pollution, rising land and housing costs, overcrowded dwelling space, long commutes, and rising inequality.

The relationship between environmental degradation and economic development in Shanghai is complex. While growth is leading to more vehicles, and more absolute use of water and energy, it is also associated with the shift from polluting industry to tertiary activities and greater efficiencies in resource use per unit of GDP. The government has responded to the environmental threats by setting up institutions such as the Shanghai Environmental Protection Bureau, and strengthening regulatory controls. The government has made substantial progress in dealing with heavy-metal pollution and sewage in waterways. In 2000, for example, only 55% of Shanghai's sewage was treated before entering waterways, but the city is now well on track towards 90% treatment by 2020. In an innovative move, the city has constructed new wetlands for sewage treatment. There has also been a huge effort to clean up rivers, but this is difficult because of upstream pollution, over which the city administration has no control.

With the growth in the number of motor vehicles, the control of air pollution has been more difficult. However, over the past decade, ambient air quality has improved as emission standards have been tightened; older, polluting cars have been taken off the road; and power stations have been desulphurised. However, there has been a rising occurrence of acid rain.

The rise in house prices in Shanghai has been relentless, but with some slowdown after 2008. At the same time, living space has declined. Income inequality is on the rise, with the major divide between the permanent residents of Shanghai and the floating population who have temporary residence permits. In 2015, it was reported that 40.6% of the population had no local hukou registration.

Shanghai's 12th Five-Year Plan emphasises the importance of a 'liveable city' and builds on the theme of the World 2010 Expo, 'Better Life, Better City'. The focus is on both environmental protection (better air and water quality, and recycling), and on greater investment in social programmes, including increased retirement pensions and minimum wages.

THEMATIC REPORTS

TRANSPORT

ECONOMIC LOGISTICS

Shanghai is a major transportation hub for East Asia, with a significant presence in global networks. The World Shipping Council ranks the Port of Shanghai as the largest in the world in terms of container traffic (35.3 million TEU in 2014), overtaking the Port of Singapore in 2010. A major development was the construction of Yangshan Port, a deep-water port for container ships in Hangzhou Bay, connected to the Shanghai mainland by the world's longest bridge (32.5km).

In terms of air traffic, Shanghai has two major international airports. The Shanghai Pudong International Airport caters mainly for international traffic. In 2015, it was the 13th-busiest in the world (and the third-busiest in China, after airports in Beijing and Shanghai), with 60 million passengers. At 16% annual growth, it was the fastest-expanding large airport in the world. The Shanghai Hongqiao International Airport, catering mainly for domestic flights, is ranked 44th in the world and seventh in China, and is the hub for a number of regional airlines.

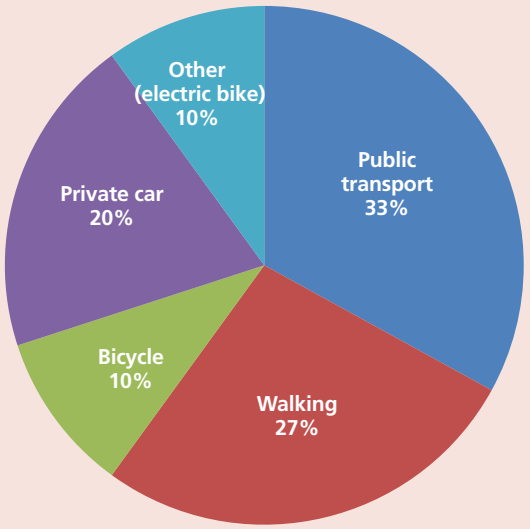
The new generation of inter-city transport is high-speed railways. The Beijing-Shanghai high-speed railway was opened in 2010 as the world's longest high-speed line constructed in a single phase. The Shanghai-Guangzhou high-speed line opened in 2014.

PUBLIC TRANSPORT

Shanghai grew up around non-motorised transport. At one time, Shanghai had 10 million bicycles and almost no motor vehicles. The dramatic growth of the city from around 1990 changed all of this. At first there was a car-oriented strategy, and there was massive and rapid investment in road infrastructure, with the construction of a huge network of roads, highways, tunnels and bridges within a period of one decade. In the 1990s, 11-14% of GDP was spent on infrastructure development, with the motorisation process peaking in 1998. As in other cities, this resulted in massive road congestion and severe air pollution, seriously affecting the quality of urban life.

A shift in approach began from the late 1990s, and by the early 2000s Shanghai was committed to providing 'efficient, comfortable, affordable, and sustainable transport for all of its citizens'. In 2002 Shanghai was the first city in China to release a White Paper dealing with public transport. In the lead-up to the 2010 World Expo, Shanghai Municipality launched 'The Three-Year Action Plan on Prioritising the Development of Urban Public Transport in Shanghai, 2007-2009', which catalysed major improvements in the systems and secured Shanghai's position as one of the most successful cities in middle-income economies for the development of public transport. The massive investments in various modes of public transport were complemented by institutional reforms for better coordination; efficiency improvements; the Shanghai Public Transportation Card, which can be used to access almost all forms of public transport; and the creation of interchange hubs such as the massive Hongqiao Transportation Hub, which integrates high-speed rail, air, metro and bus routes, but also about 60 smaller inter-modal hubs. The city has also introduced car growth-restriction measures, such as auctioning vehicle licences, car-free days, and restricted access to the inner city.

MODAL SHARE – 2010



Significantly, around 37% of passenger trips remain non-motorised (walking and cycling). Although there are large numbers of cars on the road, the majority of motorised trips are by public transport.

BUS (AND RELATED) SERVICES

Shanghai has one of the world's most extensive bus systems, with nearly a thousand bus lines, operated by numerous transportation companies. There are around 17 000 buses in service and nearly 1 000 bus routes. However, the number of bus users is static, with bus services declining relative to rail. In 2008, Shanghai introduced dedicated lanes for buses, and a portion of the network is being upgraded into a fully-fledged BRT. Completion of Phase I is expected in 2017; but the problem with BRT is a lack of road space for the lanes, and the difficulties of enforcement. The system is being considered for Shanghai's new towns, where it may be more appropriate.

Shanghai has the oldest continually operating trolleybus system in the world; but it is in decline, with only 12 lines still in operation. However, new technology has been introduced in the inner city, where 14 trolley buses operate on a circular route, using supercapacitors which allow for on-board energy storage and do not require overhead cables. Shanghai's old tram system was closed in 1963, but a modern tramline was opened in 2010 in the Zhangjiang Hi-Tech District in Pudong.

METRO

The major recent change in the public transport network has been the development of the Shanghai Metro. It opened in 1995 with a single line; the second and third lines were introduced in 2000. In the period leading up to the 2010 World Expo, the Shanghai Metro was the most rapidly extending system of its type in the world. By 2010 it was the longest metro network in the world, with nine lines and 273km of track. By 2015 there were 14 lines, 364 stations, and 588km of track. With a daily weekday ridership of 8.4 million, it is the second-largest in the world after the Beijing Subway. In 2013, with the extension of the track into Kunshan in Jiangsu province, the Shanghai Metro became the first rapid transit system in China to provide a cross-provincial service.

A significant debate in China has been over the use of conventional rail technologies versus the high-speed magnetic levitation (maglev) system pioneered in Germany. The world's first commercial maglev was opened in Shanghai in 2003, between a subway station in Pudong and the new Pudong International Airport. Normal operating speeds on the line are around 430km/hr. However, a lack of commercial success discouraged the further extension of the system.

FUTURE PLANS

Shanghai has already made huge strides with public transportation, and is correcting its earlier focus on private transport. With the system in place, the focus is on extension and on continually improving efficiencies. There will be tighter controls on private cars and taxis. A major initiative will be the linking of Shanghai's public transport into an integrated network that extends across the Yangtze River Delta, linking Shanghai, for example, into the metro and BRT systems of cities such as Suzhou, Hangzhou, Wuxi and Nanjing. The one criticism of Shanghai's impressive public transport system is that there is a lack of attention to non-motorised transport. The municipality is experimenting with incorporating cycling into transport hubs, but this is an area that could be significantly expanded.

GREEN ENERGY

In terms of electricity production, Shanghai is overwhelmingly coal-dominated. In 2010, 95% of electricity came from coal, with renewables accounting for only 2%. However, Shanghai has the opportunity to change the mix, as it has its own power-producing company – the Shanghai Municipal Electric Power Company (SMEPC), which produces about two-thirds of the required electricity. It is anticipated that Shanghai's electricity demand will eventually stabilise at around 44 000MW, and that the SMEPC will be able to provide around half of this from within the municipality, with the remainder being imported.

Shanghai has a range of strategies to reduce its extreme dependence on coal. For example, it is funding the development of nuclear energy in neighbouring Zhejian province, with a view to importing around 1 000MW of electricity. There is strong interest in natural gas, which is sourced mainly from offshore platforms in the China Sea, and then imported via Xinjiang Province. But the supplies and transmission infrastructure are inadequate, and gas-produced electricity is used mainly for peak load generation. However, a special Liquefied Natural Gas regasification terminal has been built at the new Yangshan deep-water port to allow Shanghai an import capacity of 1.65 million tons, and so gas is likely to increase its contribution to the electricity mix. Shanghai is also increasing its imports of hydro-generated power, especially from the Three Gorges Dam in Hubei (which, on completion, will be able to generate a massive 18 200MW of power).

There is interest in supporting the growth of renewables, but there is a lack of space within the municipality for the large-scale development of wind and solar energy. Previously, for example, there were only three small wind-parks, producing a mere 24.4MW of wind power. But the Shanghai Municipality identified large potential for offshore wind production, and launched an ambitious programme is to create 13 offshore wind farms by 2020, which would produce around 2 000MW of electricity. Two windfarms were completed in 2013, and the construction of a further nine began in 2014, gaining international accolades for Shanghai for environmental best practice. The 12th Five-

Year Plan also supported the development of around 150MW installed capacity of solar-generated electricity. While there is no space for large solar farms, generation happens on the roofs of public buildings, in industrial parks and in new residential estates. The municipality also plans to build a number of biomass demonstration projects generating electricity from the incineration of municipal waste. Apart from its own power-generating initiatives, Shanghai is entering into grid-joining and electricity-purchase agreements with a variety of renewable-energy power enterprises. There is also the Shanghai Green Electricity Scheme, which offers electricity consumers in Shanghai the opportunity to 'green' their electricity consumption by buying some amount of green electricity, although a premium needs to be paid.

On the demand side the municipality is working hard to promote greater efficiencies and reduction in use where possible. In the Shanghai 11th Five-Year Plan, there was a requirement for 20% energy savings. Measures include: incentivising and regulating industry towards the use of more energy-efficient technologies; using regulation and subsidies to ensure the retrofitting of buildings for an eventual 65% energy saving; public education; and the introduction of trading in pollution-discharge rights (in terms of the Clean Development Mechanism of the Kyoto Protocol).

Shanghai is also leading the way in reducing the use of fossil fuels in the transport sector. Shanghai began introducing cleaner fuel for the bus fleet in the 1990s, beginning with Compressed Natural Gas (CNG). At the time, the transition was limited by the uncertainty of gas supplies, and lack of incentives for operators to make the switch. However, rapid progress was made in the lead-up to the 2010 Expo – with the use of gas, but also with hybrid vehicles combining oil and electricity, and with hydrogen-cell engines.

Shanghai has been successful in the development and implementation of technology for new-energy buses, and the 2010 Expo provided an opportunity to showcase these developments. There are also efforts to support a transition to environmentally-friendly fuels for the fleet of around 45 000 private taxis in Shanghai, and to use the reorganisation of the bus service (e.g. optimising routes, relocating bus stations, and new routing and scheduling) to achieve greater fuel efficiencies.

INNOVATION-DRIVEN ECONOMY

Shanghai is the highest-ranking Chinese city on the 2thinknow Innovation Cities Global Index, coming in at 20th globally in 2015. It is also the highest-ranking BRICS city. It is clearly the one city in the BRICS that has the potential to become a world leader in innovation in the next decade or so.

In a 2014 survey by KPMG of around 800 technology and business executives globally, Shanghai was identified as the city in the world most likely to be the new hi-tech leader (followed by Beijing in third position, and Shenzhen in 14th). Shanghai is also investing heavily in R&D, with 3.7% of its GDP from R&D in 2014, far above the 2% average for China.

Shanghai's position as a leader in innovation clearly draws on a long history and culture of openness to the global economy, cosmopolitanism, and intellectual enterprise. It is a city of business, but with an edge of creativity that is very evident, for example in digital media, finance, arts, fashion and entertainment.

There is a strong concentration of knowledge resources in Shanghai. It has the third-largest concentration of high-ranking universities in the BRICS after Beijing and Moscow. Four of the BRICS Top 50 Universities are in the city, including two of the Top 10 – Fudan University (3rd), Shanghai Jiatong University (5th), Tongji University (17th) and Shanghai University (32nd). A large number of transnational corporations have located their R&D centres in Shanghai, benefiting from the rich knowledge assets in the city, and creating new knowledge spillovers into local firms. By 2014, the nearly 500 TNCs with regional headquarters in Shanghai had set up over 380 R&D centres, some in partnership with local universities.

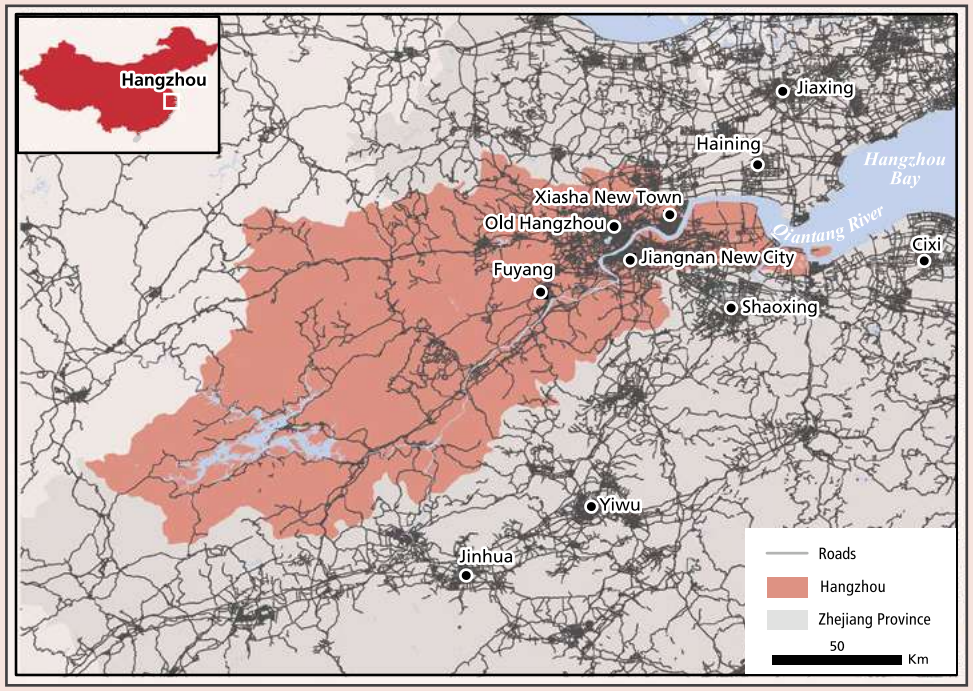
The major agent of innovation in Shanghai is private enterprise – in contrast to the city's closest competitor, Beijing, where innovation is driven largely by the concentration of leading state-owned enterprises. In terms of sectors, innovation has been focused in hi-tech manufacturing, financial services, and the cultural and creative industries. However, a challenge for Shanghai is to promote R&D in small- and medium-scale enterprises, as the large TNCs are still dominant in the field. There is also a need to support innovation in Chinese-owned firms.

The Municipality of Shanghai has been promoting innovation since the 1990s, recognising that it had major deficiencies at the time, including its then-dependence on state-owned Maoist-era heavy industry. The municipality aimed to create an industrial structure around knowledge and innovation clusters, knowledge-intensive industry, and industry with self-owned intellectual property (IP). An important development in this regard was the establishment of Zhangjiang Hi-Tech Industrial Park in the 1990s, which has emerged as a leading centre of innovation in industries such as IT and biopharmaceuticals. By 2010 there were around 3 900 graduates with a doctoral degree working in this cluster. The municipality has supported innovation in multiple other ways, including through a RMB10 billion fund for innovation and research; a smart city initiative to build innovation through large-scale investment in broadband, the cloud and supercomputing; a programme to attract world-class talents and improve existing competencies; a municipal procurement policy to support self-innovation; entrepreneurship schools; and a collaboration and sharing network across the Yangtze River Delta region.

With the success of these efforts, ambitions have been extended. Shanghai is aiming to be one of the top three financial centres in the world, and also one of the innovation capitals of the world. In 2015 the Mayor of Shanghai announced that his number-one priority was to ensure that the city becomes a "globally influential technological innovation hub". In 2016, these local ambitions were recognised nationally, when China's State Council resolved to transform Shanghai into a global innovation centre. Key initiatives in this regard include significantly raising R&D expenditure in the city (to around 3.7% of GDP); developing the Zhanjiang Hi-Tech Zone into a National Innovation Demonstration Zone with a world-class science and technology park, with world-leading hi-tech research facilities; new entrepreneurial residential and immigration policies to bring in foreign and domestic talent; a technology research university; and more. Shanghai is potentially on the cusp of a new phase of innovation-driven development, even at a time of more restrained economic growth nationally and locally.

HANGZHOU

杭州



CONTEXT

LOCATION AND STATUS

Hangzhou is located on Hangzhou Bay on the east coast of China, in the Yangtze River Delta Region. It is the capital of Zhejiang Province.

HISTORY

Hangzhou is an old city with an illustrious history. Settlement in this fertile region goes back millennia, but a walled city was built in around AD 590 as a county capital. The city was strategically placed at the southern end of the 1 800km network of waterways that became known as the Grand Canal. Hangzhou is listed as one of the 'Seven Ancient Capitals of China', as it was the capital of the Wuyue Kingdom during the late ninth century, and of China's Southern Song dynasty from 1127 to 1276. Hangzhou was a cosmopolitan centre famous for its beauty, art and learning. Because of trading networks, Hangzhou had a large number of Arab traders, with a strong and continuing Muslim presence.

It is estimated that by the 13th century, Hangzhou had a population of over one million people and was probably the largest city in the world at the time, with Marco Polo referring to Hangzhou as a city that was "greater than any in the world". With the Mongol invasion and the collapse of the dynasty in 1276, Hangzhou went into a long period of decline, worsened by the gradual silting of the harbour.

Hangzhou revived during China's reform era, after 1978. Redevelopment began in the early 1990s with the establishment of the Hangzhou Hi-Tech Industrial Development Zone in 1991, and then the Hangzhou Export Processing Zone in 2000. The economy advanced rapidly with the development of industries such as electronic information, biological medicine, machinery and household-appliances manufacturing, and food processing. The city also developed as a major tourism attraction famed for its beauty and cultural heritage, with the West Lake Cultural Landscape designated a UNESCO World Heritage Site.

POPULATION

POPULATION SIZE

The UN Population Division estimates a 2015 population of 6.39 million. Note that this is lower than the population of the municipality, which also includes other urban agglomerations and rural areas.

POPULATION RANKING

In terms of UN data the Hangzhou urban agglomeration is ranked 52nd in the world, 24th in the BRICS, and 13th in China.

POPULATION GROWTH

The average annual growth rate for the period 2010 to 2015 was a high 4.58% per annum.

POPULATION DIVERSITY

The population of Hangzhou is overwhelmingly Han Chinese (over 98.5% in 2010), with a scattering of ethnic minorities. The proportion of foreign nationals is very small.

STRUCTURE OF THE URBAN AGGLOMERATION

The spatial form of the city is shaped by a Master Plan which reflects industrial development, tourism and landscape as the three key structuring concerns. The plan aims to make Hangzhou a global tourism centre, a national hub of hi-tech industry, and an ecological city.

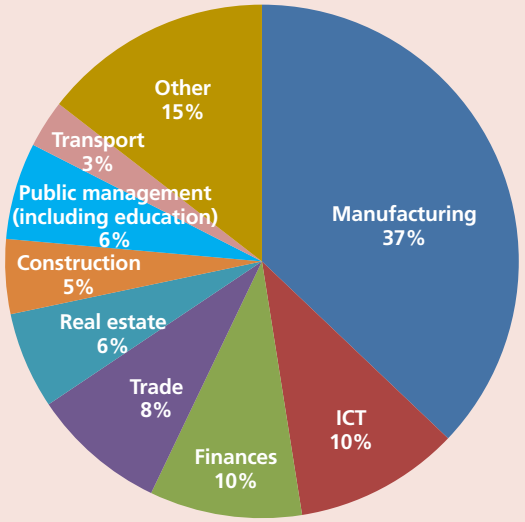
There is one concentrically structured core city to the north of the river. Surrounding this are three secondary cities. The most important, the Jiangnan Satellite City, is directly south of the Qiantang River, but this is effectively a major expansion to the existing urban area from the 1990s, as a result of the immense development pressures in the north. There are two other secondary cities to the north-east, Xiasha and Liping New Towns, which surround new industrial development zones. In addition, there is a circle around the core city of smaller towns, separated from each other and from the core by a green belt which protects the scenic nature of the city.

Hangzhou is connected to the south-east by linear development along the major road network to Shaoxing, which has around two million people; but this urban agglomeration is counted separately by the UN Population Division, and has its own municipality.

ECONOMY

According to the Brookings Institution, the 2014 GDP for Hangzhou was USD 219.5 billion (PPP); significantly larger than the economy of Rio de Janeiro, for example. The economy has been growing extremely fast. During the 11th Five-Year Plan period (2006-2010), the average annual growth rate was 12.4%, slowing slightly to 9.1% for the 12th Five Year Plan period (2011-2015). There are indications that Hangzhou is bucking the trend towards slower growth in China, with a growth rate of 10.2% for 2015.

STRUCTURE OF THE ECONOMY



Hangzhou is first and foremost a manufacturing city, with the designation of development zones the primary instrument in the growth of the industrial economy. The Hangzhou Hi-Tech Industry Development Zone was created in 1990, and provided the platform for the city's extraordinary performance in the ICT sector and in a range of other industries, such as equipment manufacturing, photovoltaics, IC design and digital television. This zone is taking a global lead in the development of the Internet of Things, e-commerce, and software and service outsourcing. In 1993, the Hangzhou Economic & Technological Development Zone and the Xiaoshan Economic & Technological Development Zone were set up. The former has specialised in machinery and electronics, biology and pharmaceuticals, hi-tech chemistry, textiles and chemical fibre, and food processing; while the latter is focused on the machinery, textile and garment industries. The Hangzhou Export Processing Zone was established in 2000, and the Hangzhou Qianjiang Economic Development Zone in 2006, which includes a Science and Technology City. These zones have successfully attracted foreign investment through a range of preferential policies, including tax incentives, financial support and subsidies, although there has been growing competition from other cities in the wider region doing the same – including for example Ningbo, which has the advantage of port facilities.

While manufacturing remains the basis for the local economy, the municipality has deliberately supported the growth of the service sector, which reached over 50% of GDP by 2012. However, many of the services target the business sectors (including, for example, ICT support). Hangzhou is the headquarters of the Alibaba Group, one of the world's leading e-commerce ventures. With the cluster of companies around Alibaba, Hangzhou now has the largest concentration of privately-owned companies in China.

Tourism is also an important part of the economy. In 2015 there were no fewer than 120 million domestic visitors and 3.4 million foreign visitors to Hangzhou, with 17% annual growth in tourism income.

GOVERNANCE

The urban governance structure for China is explained on the coversheet. The Hangzhou Municipality reports directly to the Provincial Government, and is subdivided internally into district and county governments. As with Suzhou, a particular feature of the city is the presence of the economic development zones. The Municipality of Hangzhou has set up special management commissions for the administration of the zones.

URBAN CHALLENGES

While Hangzhou has been extremely successful in terms of economic growth, it has experienced multiple challenges relating to rapid urban development. Hangzhou is regarded as a relatively well-managed city, so urban problems may not exist to the same degree as elsewhere; but they are considerable. Major problems include environmental degradation, road congestion and social inequalities associated with the divide between those with and without the local hukou.

The levels of air pollution are not the worst in China, but at an Annual Mean PM10 of 97 ug/m3 they are nevertheless very high in international terms. The major challenges are industrial pollution, the burning of coal, and vehicle emissions. Among the measures that have been introduced to deal with this problem has been the closure of the worst-polluting industries. Recently, for example, a 59-year-old iron and steel plant in the city was shut down in an effort to improve air quality. In terms of road congestion, the Global Road Congestion Index places Hangzhou only slightly better than Shanghai, and significantly worse than Suzhou.

With its economic growth, there is a proportionately large migrant population without the local hukou (residential registration). A large proportion of the 'floating population' in Hangzhou is young women working in the silk and textile industries.

THEMATIC REPORTS

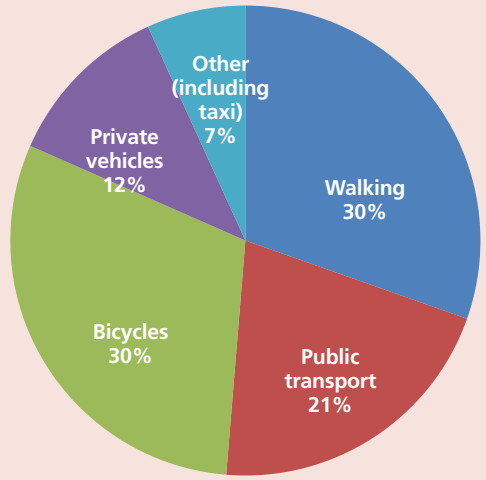
TRANSPORT

ECONOMIC INFRASTRUCTURE

Hangzhou is a hub of communication on the south-east coast of China. Historically it is part of a massive network of waterways that are still important in terms of the movement of freight. Hangzhou is also on the high-speed train network that links Shanghai and Guangzhou, and is home to the Hangzhou Xiaoshan International Airport, which in 2015 was the tenth-busiest in China in terms of passenger numbers (23.5 million).

PUBLIC TRANSPORT

MODAL SHARE – 2010



Source: Municipality of Hangzhou

A significant feature of the modal split for Hangzhou is the continued importance of cycling, and this has formed the basis of Hangzhou's now-famous public cycling scheme. However, in the 12th Five-Year Plan period (2011-2015) Hangzhou has also worked to incorporate a range of other public transport forms.

PUBLIC BICYCLES

Hangzhou has the world's largest public bicycle programme. In 2008, the Municipality of Hangzhou set up the Hangzhou Public Bicycle Service Company, and 2 800 bicycles were made available in 61 outlets in a trial operation. The project was highly successful, and by 2014 there were 280 000 passengers daily using around 66 000 bicycles from 2 700 stations. The system uses smart cards for automated check-in and check-out, and the first hour of rental is free. Increasingly, the cycling network is being integrated into the broader system of public transport, complementing the metro and BRT systems. In 2014, Hangzhou won the Guangzhou International Urban Innovation Award for this programme, and Hangzhou is now assisting around 80 other cities in China to develop similar schemes. Hangzhou has also been developing electric bicycles since 2000, and there is now a huge market across China for these vehicles.

METRO

The Hangzhou Metro opened in 2012, and by 2015 had three lines and an 81.5 km track. It was the result of a long process, with planning beginning in the 1990s and initial construction in the early 2000s suspended due to escalating costs. However, the system is now fully operational under the municipally-owned Hangzhou Subway Group Company and has a daily ridership of over 700 000.

BRT

The Hangzhou BRT, with its dedicated bus lanes, was introduced in 2006 and has a daily ridership of over 53 000. With operating speeds of 60km/hr it is relatively efficient in global terms, but there are local challenges, including the practical enforcement of BRT lanes and the reduction of road space as a result of BRT construction. The BRT was initially poorly integrated into other modes of transport, but there are initiatives to ensure strong linkage, including a provision that BRT passengers can take subsequent bus rides free.

WATER TRANSPORT

In 2004, the municipality's transport bureau introduced the first water bus service line in China. Initially, the water service served mainly tourist demand, but the municipality has since added two additional lines to attract more local ridership.

PLANS

Hangzhou's strategy to simultaneously develop these four main modes of public transport is yielding good results. There are plans to extend each of the modes, although the priority is on developing the metro system to eight lines and a track of 278km. An ambitious plan to build a 170-kilometre maglev line between Hangzhou and Shanghai, using German magnetic levitation technology, was announced in 2010; and then suspended, amid concerns about cost and competition with the existing high-speed rail network. There is a strong emphasis into the future on integrating transport systems. A public transport card which integrates bus, taxi, rail, waterway and public bicycle services has been operational since 2003, with the emphasis now on the development of an interchange network for seamless connections.

GREEN ENERGY

The national profile for green energy is provided in the Beijing Fact Sheet. Like many other cities in China, Hangzhou is dominated by the use of fossil fuels, but there are concerted attempts to change the profile. In 2015, around 5% of energy consumed in Hangzhou was from renewables, still far short of the nationally determined target of 15%. In 2014, however, the Municipality of Hangzhou released a comprehensive policy and regulatory framework for promoting renewable energy, including revenue, tax, finance, and energy-efficiency measures. Hangzhou is currently building a high-volt energy transmission line which would enable it to import cleaner forms of electricity from outside the region, shifting the profile away from coal; and it's also improving energy efficiencies through the development of a smart grid. There are also programmes to support generation of electricity from solar, wind and biomass.

Hangzhou is best-known for its leadership in terms of new-energy vehicles. Hangzhou was one of 13 pilot cities in China designated by the State Council for the promotion of new-energy vehicles, and one of five cities chosen in 2010 to be granted subsidies by central government for new-energy vehicles in the private automobile market. However, Hangzhou has gone even further than the provisions made by central government. Individuals purchasing a new-energy vehicle qualify for a subsidy of around USD 18 000, and those buying an electric vehicle are provided a free charging service. This is the highest level of subsidy of this sort in the country. In 2013 the municipality procured 20 000 electric vehicles, for what may be the world's largest electric-car leasing and sharing program. Hangzhou is also well known for its leading contribution to China's rapidly increasing stock of electric bicycles.

INNOVATION-DRIVEN ECONOMY

Hangzhou is a city receiving growing recognition as an innovation hub. It still ranks relatively low on the 2thinknow Innovation Cities Global rankings, coming in at 216th globally in 2015, which makes it a middle-ranking innovator in BRICS terms. There are however recent studies and reports which identify significant creative energy in the city. The 2016 Chinese Cities of Opportunity study jointly launched by PwC China and the China Development Research Foundation (CDRF) identified Guangzhou, Shenzhen and Hangzhou as the top three regional cities in China for business opportunity. In the fifteen regional-city studies, Hangzhou ranked second in terms of intellectual capital and innovation (after Nanjing), and joint third in terms of technological readiness. However, there were challenges in terms of cost, transportation and quality of life. The high ranking in terms of intellectual capital and innovation is at least partly a result of the presence of high-level research institutions and the world-leading corporation Alibaba. Zhejiang University in Hangzhou, for example, was ranked ninth in the BRICS in the 2016 QS release. With the presence of the Alibaba Group, Hangzhou is China's 'capital of e-commerce', with studies indicating that the use of e-commerce in this city is at least three times greater than the national average. The spillover effect is that there is a growing concentration of skills in this area, which is attracting a cluster of related firms. Alibaba also has the resources to support R&D in the field.

The information industry (which feeds into e-commerce) is where Hangzhou has its greatest levels of innovation. The China Daily reports that Hangzhou may be the only city in China that truly has a global reputation for IT software, integrated circuit design, ICT services outsourcing, and contributing to the 'Internet of Things'. But the city is also becoming increasingly known for innovation in the cultural and creative industries (film, media, entertainment and arts). It has successfully capitalised on its cultural histories and legacies, and its natural beauty, in attracting talent in this area, with a recent report released by the National Research Centre of Culture Industries at Tsinghua University indicating that Hangzhou follows Beijing and Shanghai as the major hub of cultural and creative industries in China. In segments of the industry, such as animation, Hangzhou is the national leader, and has an emergent global profile.

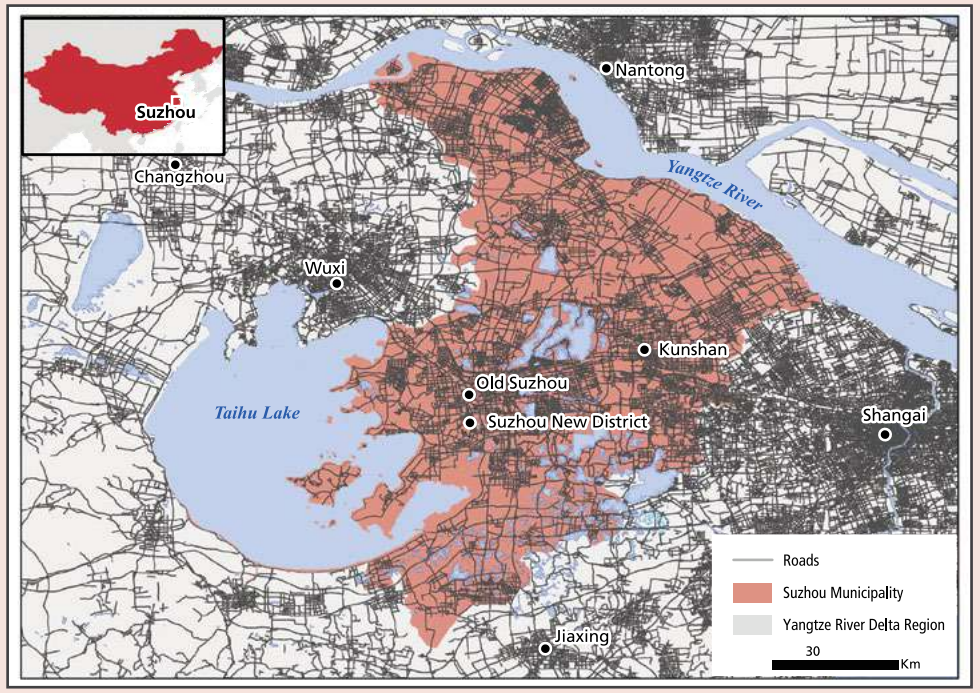
However, there are still significant challenges to be overcome before Hangzhou develops a significantly broad innovation base. At 3% of GDP, investment is still inadequate, and lagging behind the

bigger cities. Innovation partnerships are still underdeveloped, with only around 15% of enterprises in the city having an active partnership with a university or research institution. While Hangzhou is doing well in information technology and services, and the cultural and creative industries, there is the need for a breakthrough in other industries, with the municipality targeting (for example) high-end equipment manufacturing, automobiles and new-energy cars, environmentally-friendly materials, bio-pharmaceuticals, high-quality medical facilities, and fashion.

The municipality is determined to recreate Hangzhou as a global innovation hub, and is supported in this by central government's designation of Hangzhou as one of the pilot cities of China's 'Innovative Cities' and 'Demonstration Cities for IP Development' programmes. In support of innovation, the municipality has a comprehensive set of measures including subsidies for start-ups and product commercialisation, hi-tech enterprises, incubator space, R&D centres, university partnerships, digital business platforms, and education and training programmes; and a specialised innovation team. A particular focus is on attracting Chinese returning to Hangzhou from abroad, through talent recruitment and careful attention to the quality of working and living environments, with improvements to residency, education, medical services, social security and financial support.

SUZHOU

苏州



CONTEXT

LOCATION AND STATUS

Suzhou is located in the Yangtze River Delta about 100km west of Shanghai, within the Jiangsu Province of East China.

HISTORY

Suzhou is an ancient city that was founded around 500 BC by the Wu Kingdom. The Great City of Helu (as Suzhou was then known) flourished, becoming the centre of Wu culture and possibly one of the ten largest cities in the world by around AD 100. With its strategic location along the Grand Canal – an 1 800-kilometre series of waterways between Beijing and Hangzhou – Suzhou (which was given its current name in AD 589) was one of China's most important commercial centres. In 1860, however, Suzhou suffered near-destruction, as it was invaded by the Taiping soldiers (part of a rebellious Christian sect). It was also soon eclipsed by the growth of nearby Shanghai, a Treaty Port which became a gateway to the world. As Shanghai prospered during the period of Western domination, Suzhou declined.

In 1980, despite its illustrious history, Suzhou was only a small city of just over 500 000 people. It re-emerged forcefully during China's reform era. In the 1980s the State Council took the decision to develop Suzhou as a national hub for foreign investment targeted at the export industry, and a number of large development zones were established, including the Suzhou Industrial Park, the Suzhou New District, the Kunshan Export Processing Zone, the Wujiang Economic Development

Area, and the Zhangjiagang Tariff-Free District. Suzhou was enormously successful in attracting investment, and became one of the fastest-growing cities in China (and indeed in the world). At the same time, however, Suzhou was identified as a city for cultural and historical protection, and rapid modernisation happened together with the preservation of heritage and rapid development in tourism. In 1997, the classical gardens in the city were proclaimed a UNESCO World Heritage Site.

POPULATION

POPULATION SIZE

The UN Population Division estimates a 2015 population of 5.47 million for the Suzhou urban agglomeration. It is noted that this figure is smaller than the 10.5 million for the municipality as a whole, but UN figures have separated Suzhou from other urban agglomerations within the municipality, and linked part of the municipal population to the Shanghai urban agglomeration.

POPULATION RANKING

In terms of UN data, the Suzhou urban agglomeration is ranked 68th in the world, 30th in the BRICS, and 16th in China. The rankings would be significantly higher if the municipal population were to be used as the basis for calculation.

POPULATION GROWTH

Suzhou's average annual growth rate of 6.28% for the period of 2010-2015 is one of the fastest in the world for a large city.

POPULATION DIVERSITY

97.6% are ethnic Han Chinese, with the remainder various minorities. In 2013, it was reported that there were around 60 000 foreign nationals in Suzhou, many linked to international companies.

STRUCTURE OF THE URBAN AGGLOMERATION

The Suzhou urban agglomeration is wedged between the Shanghai and Wuxi agglomerations, and is also shaped physically by the Taihu Lake and the many other water bodies in the area.

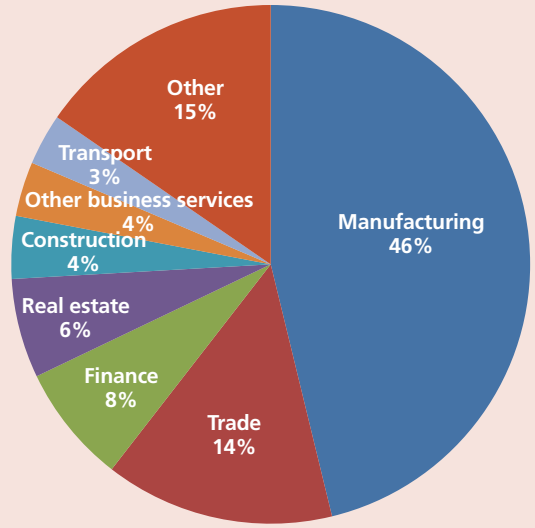
The city has an ancient historical core, but the major expansion has happened since the 1980s around designated development zones. These zones are primarily industrial and business, but they have emerged as hybrid industry-park cities which also contain large residential components and supporting administrative, commercial, recreational and other supporting services. The Suzhou Industrial Park to the east of the historical core, for example, has a population of over 800 000 people.

The spatial pattern is therefore the old city surrounded by industry-park cities, and then a connecting linear pattern of development linking Suzhou to Shanghai in the east and to Wuxi in the north-west, with no effective break between these three agglomerations. However, Suzhou also has satellite cities. The largest is Kunshan, which is located between Suzhou and Shanghai but falls within the administrative jurisdiction of Suzhou. Kunshan is an industry-park city built around economic development zones, but with a residential population of around 1.8 million. To the north of Suzhou, separated by a green belt, is the satellite city of Changshu, which has a population of around a million. It is an old port city on the Yangtze River but has experienced dramatic industrial growth in recent years, driven in part by large-scale investment from Taiwan. Taicang is a satellite city with a population of just under a million, but it adjoins Shanghai and is effectively part of the Shanghai urban agglomeration, despite falling under Suzhou's jurisdiction. Zhangjiagang, a port city on the Yangtze River, is the core of its own urban agglomeration, although it too falls under the jurisdiction of Suzhou.

ECONOMY

According to the Brookings Institution, the GDP for Suzhou in 2014 was US 339 billion (PPP). It was the sixth-largest urban economy in China and the ninth in the BRICS; larger, for example, than Delhi, Mumbai and Rio de Janeiro. GDP growth has been extremely high over an extended period. Average annual growth was around 15% between 2000 and 2005, and 12% between 2005 and 2010. There has been a slight decline since then, with growth in 2014 at 8.3%, and in 2015 at 7.5%.

STRUCTURE OF THE ECONOMY – 2014



Source: Municipal Yearbook

It is clear from the structure of the economy that Suzhou is a manufacturing city. There are a range of other sectors, but many of these exist in support of manufacturing. Real estate and construction are also important, reflecting the massive physical growth of Suzhou. But the city remains an important tourism centre, although tourism is not indicated in the sector breakdown. However, there are statistics indicating the continued development of this sector, with an 11% increase in tourism numbers in 2015. In that year there were 106 million visitors in Suzhou, no doubt contributing to a significant share of trade in the overall economy.

But it is high-end industry, and foreign capital and partnerships, that are the main drivers of growth. The major mechanism for development was the use of development zones which offered a range of incentives, including tax breaks, to attract foreign and other investment. Although there were initiatives from the mid-1980s, the major developments happened from the early 1990s, with the establishment of economic zones with national status. The Suzhou National New & Hi-Tech Industrial Development Zone (now called the Suzhou New District) was established in 1990 and given national status as a hi-tech industrial zone two years later. It specialises in information technology, electronics, pharmaceuticals, fine chemicals and auto parts. The Wuzhong Economic Development Zone was established in 1993 and has grown to more than six thousand enterprises focused on precision machinery manufacturing, electronics and IT, bio-medicine, and new energy and new materials.

The most important development was the opening of the Suzhou Industrial Park to the east of the city in 1994, as a collaborative venture between the governments of China and Singapore. The initiative emerged as a model for international economic cooperation, and was the largest of Singapore's foreign investments. The Xiangcheng District was established in 2012 to the north of Suzhou as the most recent development zone, focusing on precision machinery, auto parts, and energy-saving and green technology.

It should be noted that there is a debate in China over the development model pursued by Suzhou, which has been anchored on export-oriented FDI. An alternative model is more internally-focused, and has been successfully pursued by cities such as Shunde (in Foshan Municipality, in Guangdong Province).

GOVERNANCE

The urban governance structure for China is explained on the coversheet. Suzhou is a prefectural-level city, reporting directly through the hierarchy to the Province of Jiangsu. There are a number of county-level cities (e.g. Kunshan, Taicang and Changsu) and also various districts which report to the prefecture.

A specific feature of governance in Suzhou follows from its economic growth path. Within the municipality are two large industrial parks which have their own governmental structure. The Suzhou Industrial Park (SIP) is governed in terms of an international agreement signed by China and Singapore in 1994. The governing structure reports to the China-Singapore Joint Steering Council, chaired by the Vice-Premiers of both countries, which meets on an annual basis. The SIP is managed for profit, with the two national governments and the Suzhou municipality having shares. In 2001, the Singapore government reduced its shares to 35%, raising the shareholding from the Chinese side to 65%. The Suzhou New District, by contrast, is governed by the New Hi-Tech Industrial Company, which is wholly owned by the Municipality of Suzhou.

With the focus on attracting foreign investment, the mode of governance has been largely entrepreneurial and competitive, placing Suzhou against other municipalities in the region that are also chasing FDI. The new city-cluster approach will require new forms of cooperation; but how this will develop is still to be seen.

URBAN CHALLENGES

In many respects, Suzhou has been a hugely successful city in terms of both economic growth and the provision of urban infrastructure. It has one of China's highest levels of GDP per capita. Significantly, it has managed to achieve this development while also preserving cultural and historical heritage, and has remained an important tourism city while developing a massive manufacturing base. It has also managed to ensure housing provision for the burgeoning population. In 2014, Suzhou was awarded Singapore's Lee Kuan Yew World City Prize for its success in achieving sustainable development (perhaps not surprising, given the strong link between Suzhou and Singapore).

A rate of growth at the scale Suzhou has experienced invariably presents challenges; the municipality, for example, is continually forced to keep up in terms of infrastructural development, and to address the environmental and social consequences of change. There are land-use conflicts along the rural-urban interface, as the city continues to expand into previous agricultural land. The rapid increase in private motor cars has resulted in major inner-city congestion. There is also a major social divide between residents with and without the local hukou (local registration). In the period between 2000 and 2010, the number of residents with a local hukou increased by only 10%; but those without a hukou (the 'floating population') increased by 265%. By 2013 there was an equal division between the two categories, with the non-hukou population proportionately far more significant in numerical terms than in most cities in China.

A major challenge into the future may be the sustainability of an economic growth path based largely on FDI. China as a nation is currently making a difficult transition from a mainly export-led growth path to a growth path shaped more on domestic consumption and internal innovation. For a city so dependent on exports and FDI, this may present a particular challenge.

THEMATIC REPORTS

TRANSPORT

ECONOMIC INFRASTRUCTURE

Suzhou is the logistics centre of Jiangsu Province, and is also situated along a major transportation corridor between Shanghai and Nanjing. While the east-west routes are well developed, since the opening of the Sutong Yangtze River Bridge in 2008 there are now also strong north-south linkages. Suzhou is part of an extensive network of rivers, canals and lakes, and has three large river ports at Zhangjiagang, Changshu and Taicang. It is well-linked by rail, including being an important stop on the high-speed rail link that connects Shanghai and Beijing. The local airport is a military base, but Suzhou is well served by international airports in the neighbouring cities of Shanghai and Wuxi.

PUBLIC TRANSPORT

Suzhou faces the combined challenges of massive urban expansion and rapid growth in levels of car ownership. The problem is most acute in the old city, where the historical urban form is a poor match for the requirements of car use. The public transport network still has to catch up with the scale of urban development, and is still seemingly underdeveloped in relation to the size of the city.

Comprehensive data on the modal split in transport is unfortunately not available, but data for 2014 indicates that excluding walking, public transport accounts for 31.5% of total journeys, with around 1.75 million people using public transport on a daily basis. The split between private motor vehicles and public transport for motorised trips was a relatively even 45.7% to 54.7%. The public transport system is being developed around buses, trams and the metro, although there is also the innovative use of public bicycles.

BUSES

Bus services remain the core of the public transport network, with 332 lines and a network length of over 7 000km. There are over seven companies operating buses, including the development agencies which run the industrial parks. Suzhou did introduce a BRT system in 2008, one of the first in China. It now has five lines and 106 stations, mainly serving the industrial parks; but its ridership is still low, at around 50 000 persons per weekday. A particular innovation in Suzhou is the use of small buses on 'micro-circulation' networks.

METRO

The Suzhou Rail Transit (SRT) is the metro system for the city. It began operation in April 2012, with the opening of the first line. The second line opened in December 2013, and lines 3 and 4 are under construction. In 2015 there was a daily ridership of 370 000. The city is building extensive parking space around the metro stations to promote the use of the system.

TRAMWAY

Suzhou Tram is one of China's innovative new tramways, with commercial operations having opened in October 2014. The trams were developed for West Suzhou because of the high cost of extending the metro to the Suzhou New District. The tram system, which currently has one line and 22 stations, is operated by the municipally-owned Suzhou Hi-Tech Company Limited.

PUBLIC BICYCLES

A system of public bicycles was launched in 2010. By 2015 there was a stock of 30 000 bicycles, with 1 130 stations and a daily use of about 15 000.

PLANS FOR THE FUTURE

Suzhou is expanding all of its public transport systems. For the metro, for example, the aim is to expand to eight metro lines by 2020, along a 140-kilometre track. The Suzhou New District will have three tram lines by 2020, with a planned 358-kilometre extension to link downtown Suzhou to Wuzhian and Kunshan. The bus system has been reorganised, with bus routes being aligned to feed into the metro system. The BRT system is being extended, and 50 new minibus routes are being introduced as part of the micro-circulation network. Other plans to deal with congestion in the historical core of the city include differential parking charges, traffic calming, vehicle restrictions based on licence-plate numbers, and park-and-ride sites near suburban transit interchanges.

GREEN ENERGY

Suzhou, like many other Chinese cities, is highly dependent on fossil fuels. In 2010, a mere 0.23% of total energy use was from non-fossil fuels. A major challenge for Suzhou is the structure of the economy, with its high dependence on relatively energy-inefficient industry.

But Suzhou is responding to national imperatives for a transition to low-carbon development. On the supply side, Suzhou imports three-quarters of its energy requirements, and is limited in what it can do in terms of changing the profile of energy production. It is however committed to reducing the procurement of coal-fired electricity and petroleum fuels, with a transition in the electricity sector to the use of gas. There are some initiatives aimed at the use of renewable energy; but by 2020, it is expected that non-fossil production will still be only 0.6%. Dispersed across the municipal area are projects for the production of renewable energy through solar, wind, geo-thermal, and small-scale hydro, although this remains small in absolute and relative terms. The most significant project is in biomass. Around half of the city's waste is processed in the Suzhou Waste to Energy Plant, where 3 500 tonnes of municipal waste are incinerated daily, and 350 million kilowatt-hours of electricity are produced annually, which is used for lighting homes and businesses. The plant was developed by Hong Kong-listed China Everbright International, as part of China's first waste-disposal-zone initiative. In terms of vehicle fuels, new-energy buses are being introduced. By 2012, 6.5% of buses in Suzhou used these fuels, and the numbers were growing.

On the demand side there are clear initiatives to improve efficiency in energy usage. The biggest users are in industry, and so programmes to promote efficiency in this sector are critical. A star-rating system for the grading of industry in terms of energy efficiency has been introduced, and the municipality is working with industry in the development of new energy-efficient technologies, including new materials. A digital mapping system for energy management has been introduced as part of an initiative to create a smart electricity grid. In addition, there are initiatives to promote low-carbon civic and residential buildings.

INNOVATION-DRIVEN ECONOMY

Suzhou's dramatic development since the early 1990s has been driven largely by large-scale FDI drawn by free-trade zones, rather than innovation. Nevertheless, Suzhou is recognised as an emerging innovator in the BRICS. The 2thinknow Innovation Cities Global Index 2015 ranked Suzhou as 184th globally, which is 13th in the BRICS and sixth in China.

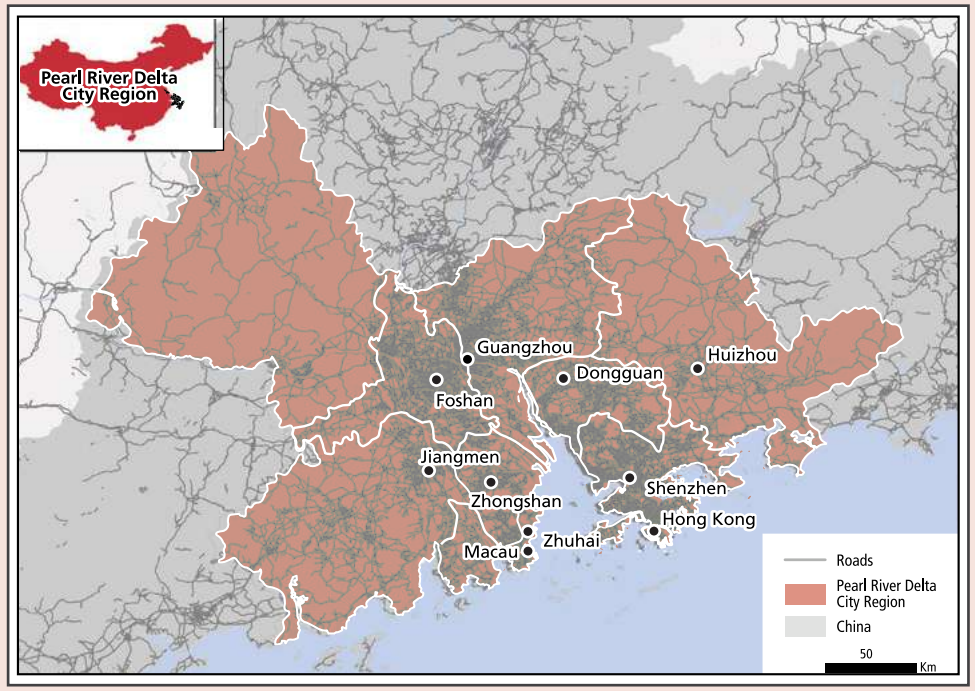
With the modern city having developed mainly since the 1990s, there is a lack of established research institutions for a city with such a large manufacturing base. An important initiative however is the development of the Suzhou Dushu Lake Higher Education Town, within the Suzhou Industrial Park. A population of 400 000 people is anticipated, of whom 100 000 will be students. A number of higher-education institutions have opened here, including the Xi'an Jiaotong-Liverpool University, which is the first major Sino-British educational partnership, a joint university established between Xi'an Jiaotong University and the University of Liverpool.

With Suzhou mainly the site of branch plants of large Transnational Corporations (TNC), it tends not to have the sort of R&D functions that are usually clustered around TNC headquarters. Also, local partnerships are weak, with the companies in-sourcing R&D. The proportion of R&D to the total GDP of the city was 2.86%, which is higher than China's average of 2%, but significantly lower than for other large cities. Most of the R&D is company-related, with few partnerships with government or the still-underdeveloped academic sector. The spillover effects from TNCs to Chinese firms have been limited.

There have been shifts, however. In 2015, for example, China's State Council and the Government of Singapore signed an agreement to further develop the Suzhou Industrial Park as a pilot zone for innovation-intensive development. Suzhou has been identified as one of the national pilots for the development of innovation-focused industry. It remains to be seen what the effects will be of the new initiative to position Suzhou as an innovation-driven city.

PEARL RIVER DELTA EXTENDED CITY REGION

(Zhu San Jiao City Region 珠江三角洲城市群)



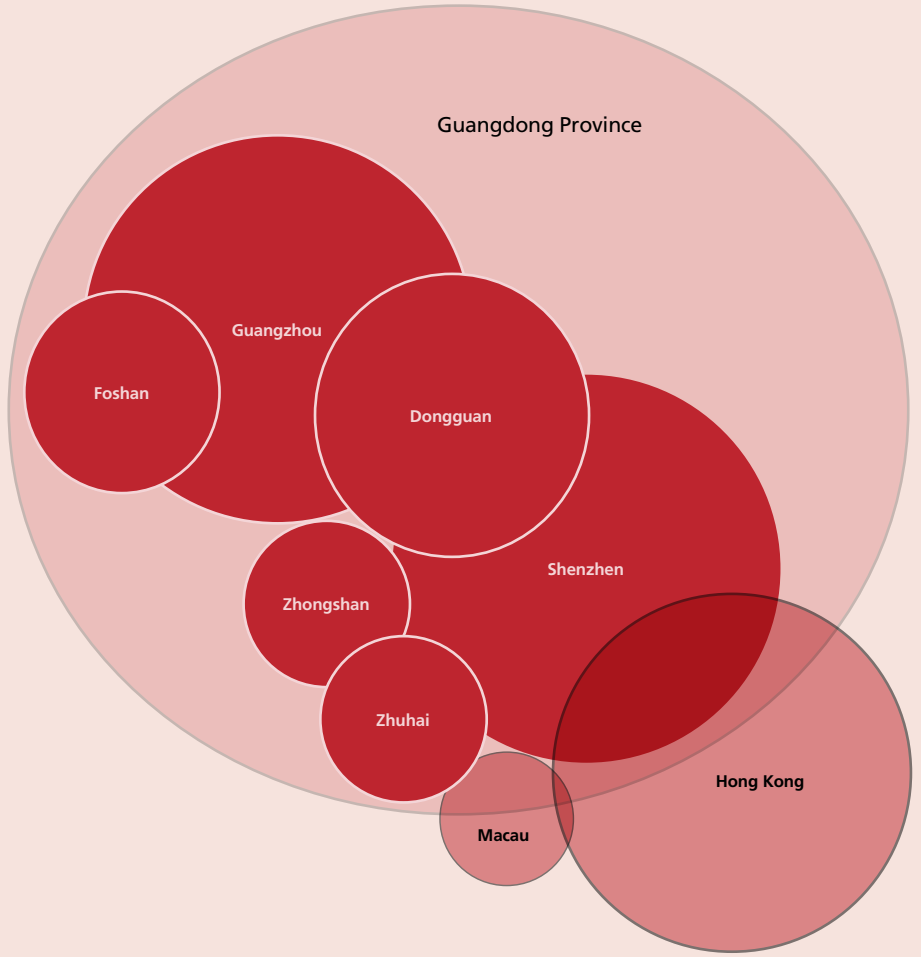
DESCRIPTION

The Pearl River Delta in southern China is now perhaps the world's largest manufacturing hub but also includes major financial and services centres, and global ports. It has experienced dramatic growth since the late 1970s when Shenzhen was designated as a Special Economic Zone. The region has an extremely complex, diverse and sprawling spatial structure. It includes the major urban agglomerations of Guangzhou, Shenzhen, Hong Kong, Dongguan, Foshan, Macau, Huizhou, Zhongshan and Jiangmen.

POPULATION

There is estimated population of 70 million people in the region (although estimates may differ depending on where boundaries are draw). The largest urban concentrations are Guangzhou (12.46 mill), Shenzhen (10.75 mill), Dongguan (7.4 mill) and Hong Kong (7.3 mill).

STRUCTURE

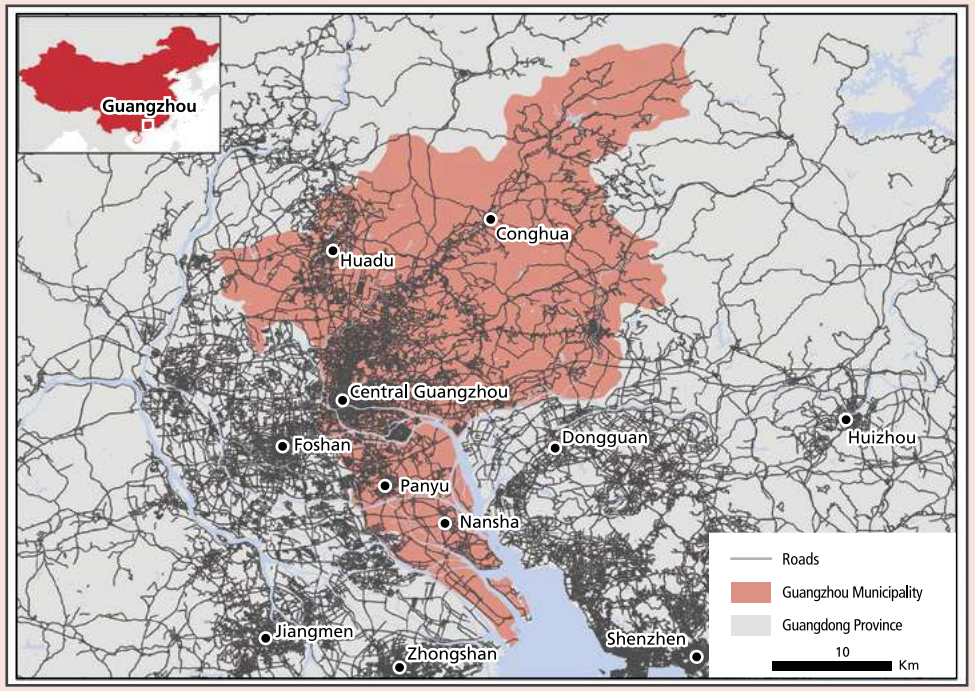


GOVERNANCE

The cities in the delta fall within Guangdong Province, with the exception of Hong Kong and Macau which are Special Administrative Regions with significant degrees of autonomy.

GUANGZHOU

广州



CONTEXT

LOCATION

Guangzhou is situated in the Pearl River Delta in south-east China, close to the Special Administrative Districts of Hong Kong and Macau. It is the capital of Guangdong Province.

HISTORY

Guangzhou has long been an important port city in China. Records of settlement go back over 3 000 years, with the City of Panyu established on the banks of the Pearl River in 214 BC. Panyu became a provincial capital within the Han Empire, and an important trading port in southern China. In the 16th century the city was occupied by the Portuguese, but they eventually retreated to the small enclave of Macau. By the eighteenth century, Guangzhou was a great global meeting place, with all trade between the West and China concentrated in this port in terms of the Canton System, in which all foreign trade was supervised by the Guangdong Customs Supervisor.

Guangzhou lost its monopoly on international trade in the mid-19th century after the Opium Wars, when other ports were opened up to the West. From the same time, Guangzhou went through a nearly century-long period of great turbulence, including famine, rebellion, and foreign occupation. The most recent occupation was by the Japanese, from 1938 to 1945. Guangzhou experienced slow growth under Mao Zedong's rule, but dramatic industry-led growth during the reform era, from the 1980s.

The first major spurt of growth in the Pearl River Delta came with the designation of Shenzhen as a Special Economic Zone (SEZ) in 1980; but the Guangzhou Economic and Technological Development Zone (now known as the Luogang District) was designated in 1984, followed by the Guangzhou Free Trade Zone in 1992 and the Guangzhou Nansha Export Processing Zone in 2005. These were the catalysts for extraordinary rates of urban growth, as Guangzhou emerged together with Shenzhen as the leading cities of the world's most populous urban region.

POPULATION

POPULATION SIZE

The UN Population Division estimates a 2015 population of 12.46 million for the Guangzhou urban agglomeration.

POPULATION RANKING

In terms of UN data the Guangzhou urban agglomeration is ranked 20th in the world, ninth in the BRICS, and fourth in China.

POPULATION GROWTH

The Guangzhou urban agglomeration has grown at a rapid average annual rate of 5.17% in the period 2010 to 2015, down from peak rates of 8.7% in the late 1990s.

POPULATION DIVERSITY

In 2010, 98.3% of the population was Han Chinese. The largest minorities were from the south-west of China (e.g. Zhuang, Tujia and Miao). In 2014, the proportion of the foreign-born population was 0.9%, high for a Chinese city.

STRUCTURE OF THE URBAN AGGLOMERATION

Guangzhou is part of the massively sprawling urban agglomeration known as the Pearl River Delta, and it is difficult to disentangle Guangzhou from neighbouring city agglomerations. The neighbouring Foshan urban agglomeration, which has around seven million people, is the most intertwined with Guangzhou, although separated by a tributary to the Pearl River.

The urban patterning within the Guangzhou agglomeration is complex, with sprawling industrial estates interspersed with the irregular tenement structures of the 'urban villages' and modern high-rise superblocks. Much of the urban growth is concentrated in the suburban areas in the core agglomeration, and not (as in the case of Beijing and Shanghai) in outer satellite settlements. The municipal area of Guangzhou consists of:

» City Core (Yuexiu; Liwan; Haizhu; Tianhe districts) – 5 million

» Suburban (Baiyun; Huangpu; Panyu; Huadu districts) – 5.4 million

» Industrial (Nansha; Luogang districts) – 0.6 million

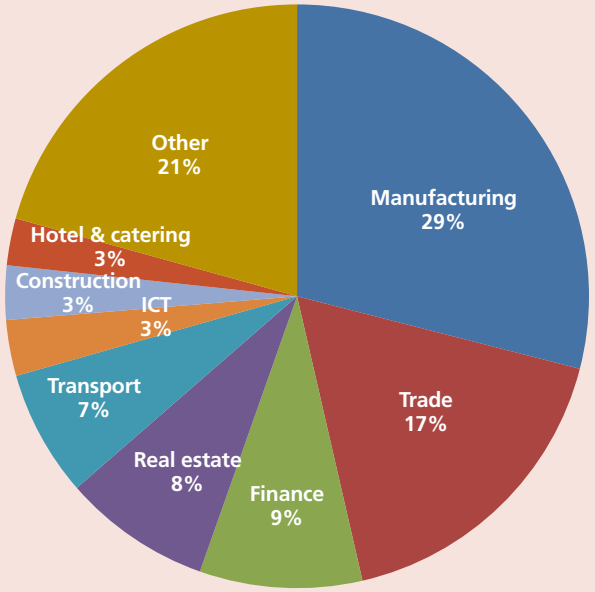
» County-level towns (Zengchen & Conghua) – 1.6 million

ECONOMY

According to the Brookings Institution, the 2014 GDP for Guangzhou was USD 380.26 billion (PPP). It was the third-largest urban economy in China (after Shanghai and Beijing) and the sixth in the BRICS following São Paulo.

When the dramatic growth of the Pearl River Delta was unleashed in the early 1980s, Guangzhou was already an established city. While most other cities in the region grew from villages or towns into urban agglomerations, Guangzhou expanded as a city. With its infrastructure and services it played a leading role in the development of the region; but it also faced tough competition from brash newcomers such as Shenzhen and Dongguan. While these new cities experienced GDP growth rates in excess of 30% per annum for extended periods, growth in Guangzhou was around 10 to 12% per annum. In the period 2011 to 2015, the average annual growth in GDP was 10.1%.

SECTORAL SHARE OF GDP



Source: Municipal Yearbook

While manufacturing did expand significantly in Guangzhou from its established base, the economy has also gradually tertiarised since 1978, when 59% of GDP was from the secondary sector providing the high-level services needed for the wider economy of the Pearl River Delta. In 2014, 65% of Guangzhou's GDP was in services, with the largest sectors in trade, finance, real estate and transport. In terms of manufacturing, the major industries are electronic-appliance manufacturing, automobiles and petrochemical; but the biggest growth is in hi-tech sectors, reflecting Guangzhou's shift to innovation-intensive activities.

Guangzhou is a key node within a region that is far more entrepreneurial, experimental and market-oriented than much of the rest of China, but it has also benefited from its relationship with Hong Kong. Much of the early investment in the Reform Era came from Hong Kong, and Hong Kong and Guangzhou are said to have complementary economies.

As with China more generally, Guangzhou is facing challenges such as land and labour costs, export market volatility, and extreme competition from an increasing number of localities in East and South Asia. The strategic focus is on moving up the industrial value chain, expanding the service sector, and protecting core competitiveness through expanding innovation capability.

There are some concerns, however, that Guangzhou is lagging behind cities such as Beijing, Shanghai, Shenzhen and Hangzhou in terms of innovation and competitiveness. However, the development of the Maritime Silk Road may provide a boost to Guangzhou. Another major new initiative is the pilot Guangzhou Free Trade Zone, which will also involve greater economic integration with Hong Kong and Macau.

GOVERNANCE

The overall urban governance structure for China is explained on the coversheet. Within the governmental hierarchy Guangzhou holds sub-provincial status, and so reports through the Province of Guangdong to central government. However, Guangzhou is formally recognised as one of China's Five National Central Cities (the others being Beijing, Shanghai, Tianjin and Chongqing), which are tasked with playing a leading role in national economic, cultural and political development.

DEVELOPMENT CHALLENGES

Guangzhou and the Pearl River Delta more broadly face the challenge of being one of the world's fastest-growing urban regions. There is a constant struggle to provide infrastructure to meet the expanding demand. Cities in the Delta have not always been able to keep pace, resulting in traffic congestion, poor public transport, and poor waste management, for example. The growth has also resulted in energy shortages and high land costs. Enormous housing projects have been constructed to meet the demand, but these projects are often unaffordable for residents, and often lack social and urban infrastructure in the form of schools, shops and transportation.

Environmental challenges are immense, and a major threat to the sustainability of growth into the future. The Delta is severely polluted with sewage and industrial waste, including heavy metals; although levels of air pollution are not as severe as in cities in the north of China, and the Guangdong Environmental Protection Bureau is strengthening its regulatory authority.

Guangzhou has a large 'floating population' which has allowed it to maintain a flexible labour market. In 2015, 36.7% of the registered population did not have a local hukou registration. This is a source of inequality in the city, as the floating population does not have full rights to social services, and is often housed in inferior accommodation.

THEMATIC REPORTS

TRANSPORTATION

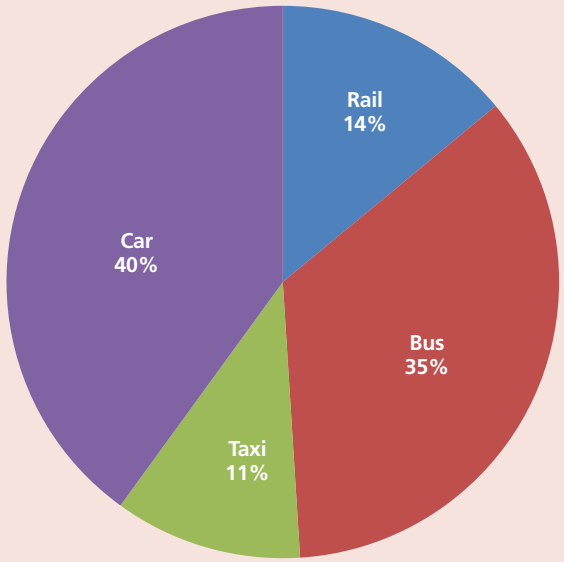
ECONOMIC LOGISTICS

Guangzhou is an important transport hub for south China. The World Shipping Council ranks the Port of Guangzhou as the world's eighth-largest port in terms of container volume (16.2 million TEU in 2014), and it is complementary to the Port of Hong Kong, which is the world's fourth-largest. The new Guangzhou Baiyun International Airport was opened in 2004. It is now the 13th-busiest in the world, and the fourth-busiest in China (after the major airports in Beijing, Hong Kong and Shanghai), with 55.2 million passengers in 2015. Importantly, Guangzhou is also being linked into China's expanded high-speed rail network. The massive Beijing-Guangzhou-Shenzhen-Hong Kong High-Speed Railway network should be completed in 2018. The connection between Guangzhou and Wuhan was opened in 2009 and between Guangzhou and Shenzhen in 2011, with the Hong Kong link expected in 2018.

PUBLIC TRANSPORT

Guangzhou has experienced a massive increase in the number of private vehicles on the road, from 490 000 in 2003 to 2.5 million today (of which 1.8 million are small passenger cars). This has created growing congestion, with the speed of cars on a third of the main roads in the city being less than 20km/hour, the international congestion-warning level. There is also the problem of automobile emissions, which are contributing significantly to air pollution in the city.

MODAL SHARE – 2010 (EXCLUDING WALKING)



BUSES

The major transport mode is the bus service, which has a mixture of public and private ownership. In 2012 there were 776 bus lines in operation, covering a total length of 12 251 km. The number of buses is so great that they cause congestion in rush hour; and the municipality has had to introduce a number of measures to alleviate the pressure, such as sub-dividing bus stations and building more bus lay-bys.

There are electric trolley buses on 15 of the bus routes in Guangzhou, and tram lines have also been planned in some of the districts, but they are still in the initial stages of development. In 2007, the city administration introduced the minibus in order to cover those areas with low density and narrow roads, and there are over 100 lines now serviced by this form of transport.

The major innovation however has been the Guangzhou Bus Rapid Transit (GBRT) system, modelled on the TransMilenio in Bogotá, Colombia. The GBRT system, which was opened in 2010, is the world's largest BRT after the TransMilenio, with nearly one million passenger trips daily. It was because of the BRT that Guangzhou won the Institute for Transportation and Development Policy's Sustainable Transport Award for 2011, and the 2012 United Nations Lighthouse Award for Climate Change.

METRO

The other major development in terms of public transport has been the creation of the metro, which is operated by the state-owned Guangzhou Metro Corporation. When the first line of the Guangzhou Metro opened in 1997, Guangzhou was the fourth city in mainland China to have an underground railway system, behind Beijing, Tianjin and Shanghai. In 2015, the metro network was made up of nine lines, covering a total length of 267km, with 167 stations. With a ridership of 6.58 million per day, the Guangzhou Metro is the sixth-largest in the world after Tokyo, Seoul, Moscow, Beijing, and Shanghai.

PLANS

Guangzhou has ambitious plans for the further extension of the transportation network, which include: expanding the metro system to over 500km with 15 lines by 2020; a much-expanded BRT; new tram lines; an intelligent transportation system; and a comprehensive City Centre Transport Project, which includes footpaths, bicycle routes, improved traffic management and control, vehicle-emission control, automated pollution monitoring, and more.

Plans for a regional rapid-rail transit network have been approved that would bring together the major existing systems in the region, which are the Guangzhou Metro, the Shenzhen Metro, and the Mass Transit Rail (MTR) Hong Kong, as well as lesser systems such as the Dongguan Rail Transit and Macau Light Rail Transit. This would also link into the fast rail network, creating an inter-city mass transit system across the Delta that would ensure that no city is more than one hour distant from Guangzhou by public transport.

GREEN ENERGY

With rapid economic growth for 30 years, Guangzhou's energy consumption has also increased dramatically. As in the rest of China, there is an overwhelming dependence on coal-fired power stations. There has been growing public resistance to further expansion of coal-fired electricity generation, and in 2013 this resistance led to the abandonment of a plan to build a new coal-fired station. Central government followed this with an overall ban on new coal-fired plants in regions where air pollution is high, including the Pearl River Delta.

While cities in the north such as Beijing and Tianjin have shifted towards gas-fired electricity production, those in the south (including Guangzhou) have focused more strongly on nuclear production, although gas will still play a role. There is also some attention to renewables in the mix, with a provincial-level fund that is investing in solar and wind power plants, hydropower stations, waste-to-energy power stations and biomass energy projects. The region has been identified at national level as a demonstration zone for distributed PV power generation.

Guangzhou has also emerged as an important hub in terms of related R&D, with a series of patents in research areas including solar photovoltaic energy, biomass gasification and power generation, biomass synthetic fuel, biodiesel, fuel ethanol, biomass hydrogen, marsh gas, and fuel cells, which has stimulated the growth of a renewables industry in Guangzhou's manufacturing sector.

Guangzhou has been making significant progress with energy efficiency, although this mainly has to do with Guangzhou's manufacturing sector moving up the value chain into higher-tech development. But the Guangzhou Municipality is also playing a proactive role, as it positions itself as one of the world's most progressive cities in terms of energy. It is promoting itself as the 'City of New Energy' and 'China's Energy Capital'. Major initiatives in the city include: retrofitting of public buildings for energy efficiency, and regulations for new buildings; solar-powered traffic lights and street lamps; China's first electricity-trading centre opening in 2016 in Guangzhou; and, the planned Guangzhou Knowledge City as a partnership with Singapore, which would house around 77 000 people in an energy-efficient lifestyle. A major demonstration project in the city is the iconic 71-storey Pearl River Tower, which is aiming at zero net-energy impact through both generation and efficiency of energy.

In terms of fuel use, the municipality is working to introduce environmentally-friendly fuels in the city's transport fleet, and locally-built electric and hybrid automobiles into the private market. With more than 10 000 buses using Liquefied Petroleum Gas (LPG), Guangzhou currently has the most LPG-fuelled vehicles in the world. At the same time, there are over 2 000 hybrid or electric buses.

The overall aim is to reduce the consumption of energy by 15% by 2020, despite continued economic growth. In order to reach this, an estimated investment of RMB 100 billion will be required, equivalent to over 1% of the annual GDP of the city.

INNOVATION-DRIVEN ECONOMY

Guangzhou is moderately successful in terms of innovation, but lagging behind some of the other large cities in China; including its brash neighbour, Shenzhen. The 2thinknow Innovation Cities

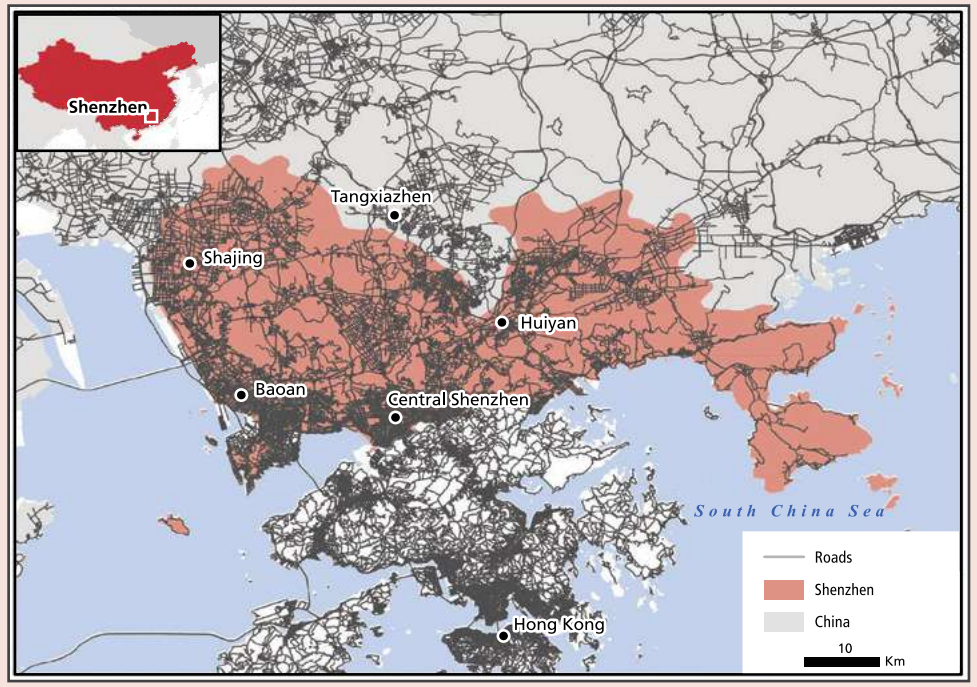
Global Index ranks Guangzhou 193rd globally and eighth in China (after Shanghai, Beijing, Hong Kong, Shenzhen, Nanjing, Suzhou, and Chengdu). R&D spending in 2013, for example, was 2.26% of GDP, which is higher than China's average but less than that of competing cities. Guangzhou filed less than half the patent applications of Shanghai and Beijing, but also of smaller cities such as Hangzhou and Nanjing.

There is a concern, officially expressed in Guangzhou's 11th Five-Year Plan for Science and Technology, that investment in R&D and other innovation-related activities is inadequate in comparison with competing cities. Particular problems mentioned include the lack of integration between innovation and financing, the slow growth of venture capital, a lack of support for independent innovation by state procurement, and insufficient high-level talent. A particular problem is the shortage of platforms for innovation, including research laboratories of national significance, R&D centres, and high-level research institutions. Guangzhou does however have an institution ranked in 2016 among the Top 50 universities in the BRICS, in the Sun Yat-Sen University (ranked 23rd).

According to Guangzhou's 12th Five-Year Plan, the city aims at a modern industrial structure based on a service economy, with an organic integration of modern service industry, strategic new industry, and advanced manufacturing industry. This will involve the sustained upgrading of its industrial base, requiring high levels of innovation. In 2015, the Guangzhou Municipality released its 'Decision to speed up implementing the innovation-driven development strategy'. There is an ambitious ten-point action plan to support innovation, and a strong focus on creating new innovation platforms, including leading-edge innovation centres and R&D laboratories. There is also a strong focus on developing the financial instruments required to support innovation (e.g. risk-sharing, venture capital, equity shares, and specialised credit services). Finally, the idea of a 'smart city' is receiving priority attention. Science and Technology is being applied in new ways to deal with city challenges such as public health, energy consumption, air pollution, traffic congestion, and food security. This focus is emphasised, for example, in the municipality's initiative to host the Global Guangzhou Urban Innovation Awards.

SHENZHEN

深圳



CONTEXT

LOCATION AND STATUS

Shenzhen is located north of the Hong Kong Special Administrative Zone within the Pearl River Delta in Guangdong Province, in the South of China. It is one of the largest industrial cities in China.

HISTORY

Shenzhen has been referred to variously as 'a city without a history', and an 'instant city', and this is because it barely existed before 1980. In 1975 it was a small market town with a population of about 38 000. In May 1980, Shenzhen was selected to be one of China's five Special Economic Zones (SEZs), which were introduced experimentally to test the impacts of more free-market and export-oriented approaches (the other zones being Zhuhai and Shantou, also in Guangdong Province, and Xiamen in Fujian Province). The SEZs introduced tax and other incentives to attract foreign investment, and more flexible management, allowing local agencies to make key decisions on economic strategy and investment. The programme as a whole was extremely successful, with the highest-achieving SEZ being Shenzhen. The growth model was based on low-cost, mass, export-oriented industrialisation, with the city benefiting considerably from its position on the border of Hong Kong, and from the excellent port and logistics facilities in the region. The GDP of the city is now the equivalent of entire countries, such as the Republic of Ireland, or Vietnam. In many respects, Shenzhen was the birthplace of China's economic miracle.

With the dramatic development of export-oriented industry, Shenzhen grew at breakneck speed into a major city. Initially, the SEZ was fenced off from the city, and special permission was required to enter; but the boundaries have been removed and the SEZ itself has been extended to include the whole city. Shenzhen has some of the largest public projects and tallest buildings in China, achieving an impressive urban landscape in an exceptionally short period of development.

The extraordinary expansion of Shenzhen has slowed considerably in recent years, as China makes its difficult transition from export-oriented manufacturing to manufacturing and services geared more towards the internal market, and as sky-high housing prices are driving many people to find more affordable accommodation in the region in other cities. Shenzhen has been attempting to navigate the change by a transition to hi-tech manufacturing and financial services.

POPULATION

POPULATION SIZE

The UN Population Division estimates a 2015 population of 10.75 million for the Shenzhen urban agglomeration.

POPULATION RANKING

In terms of UN data, the Shenzhen urban agglomeration is ranked 26th in the world, 12th in the BRICS, and sixth in China.

POPULATION GROWTH

Shenzhen has grown at an average annual rate of 1% in the period 2010 to 2015, a dramatic reduction of the growth rate of more than 20% per annum for the extended period from 1980 to 2000. Growth rates peaked at 32% per annum in the late 1980s. For much of this period, Shenzhen was the fastest-growing city in the world.

POPULATION DIVERSITY

According to the 2010 national census, 95.7% of the population is Han Chinese, although all 55 recognised minorities in China are represented in this city of migrants. The largest proportion of minorities, including the Zhuang, Miao, Tujia and Yaozho, are from the south-western provinces of China.

STRUCTURE OF THE URBAN AGGLOMERATION

Shenzhen is a sprawling and complex urban agglomeration – a complicated patchwork of dense urban areas, irregular urban villages, and open spaces. It is defined in the south by the boundary with the Hong Kong Special Administrative Region (SAR), and in the west by the Zhujiang River estuary; but in the north and east it spreads in an uneven pattern, linking up with the cities of Dongguan and Huiyang, which in turn link through continuous urban sprawl to Guangzhou, Foshan and Huizhou. The complex geography is in part because of the difficult terrain. The urban agglomeration has a near-donut shape, with the geographic centre taken up by woodlands and lakes in the Yangtaishan Forest Park, and a number of major reservoirs and other mountain reserves.

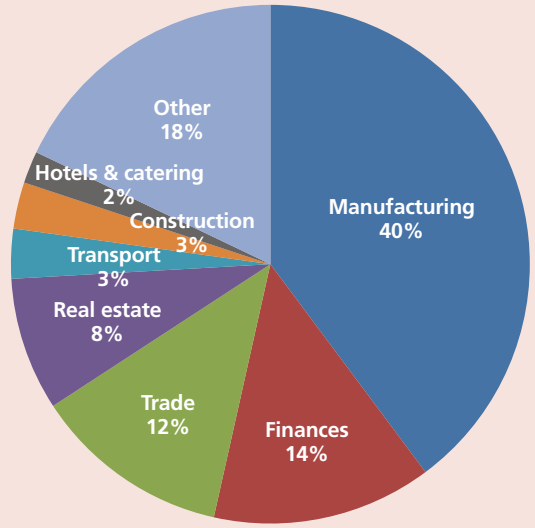
The development of the agglomeration has partly been shaped by a quick succession of Master Plans. In the early 1980s the new city was planned around three nodes along the boundary of the Hong Kong SAR (Nantou, Louhu-Shangbu and Shatoujiao). These were three beads along a linear east-west string. As development pressures expanded, a second line of east-west development was constructed a little to the north; but by the 2000s, it was necessary to expand south-north along three major axes connecting to the other cities in the wider region. The master plans were bold, but the speed of development overwhelmed the planning, resulting in an urban form more expansive and haphazard than was initially anticipated. Large areas of land are given over to manufacturing, with residential development interspersed between the industrial areas. As the city expanded, so traditional villages were surrounded by urban development. The villagers turned to real estate for an income, renting out accommodation in irregularly-structured tenements, creating the famous phenomenon of 'urban villages'.

There are currently plans to build three satellite cities across the border from Shenzhen, in the Hong Kong SAR, but this has provoked some resistance from within Hong Kong, with claims that this is a plan to link Shenzhen spatially with Hong Kong, with the ultimate goal of subsuming Hong Kong within the mainland.

ECONOMY

According to the Brookings Institution, the 2014 GDP for Shenzhen was USD 371.97 billion (PPP). It was the fifth-largest urban economy in China and the eighth in the BRICS. Shenzhen has experienced dramatic economic growth, although initially off a low base. During the period 1984 to 1994, average annual GDP growth was 30% per annum. In the period 1995 to 2006, growth rates ranged between 14% and 20%, dropping to 11% during the 11th Five-Year Plan period (2006-2011), and 9.6% in the 12th period (2011-2015).

COMPOSITION OF THE ECONOMY – 2014 (MUNICIPAL YEARBOOK)



As indicated above, Shenzhen is fundamentally a manufacturing economy, but there are services supporting manufacturing. The manufacturing boom was the direct result of the designation of the SEZ in 1980. Initially, however, Shenzhen's development was driven almost entirely by investment from neighbouring Hong Kong, with the exorbitant land prices in Hong Kong driving development across the border into the conveniently established SEZ. In 1982, China agreed to a flat-rate 15% business tax for the Shenzhen SEZ, which compared with the 17% for Hong Kong and 33% for mainland China, with an exemption for export duties. This move unleashed massive development, bringing investment in from many other parts of the world, with the success prompting the Chinese government to open up other cities to foreign investment, including Shanghai, Dalian, Ningbo and Tianjin. The initial focus was on low-cost manufacturing, supported by the cheap labour of the Chinese mainland, with the factories of Shenzhen churning out cheap electronics, toys and clothes. Much of the success came from cheap imitations of goods produced in the West. There were growing allegations of counterfeit

production, and also of inadequate protection of intellectual property and contractual obligation. While the SEZ encouraged mass-scale foreign investment, it did not necessarily support productivity growth and innovation. Also, as an increasing number of cities introduced special zones, the efficacy of Shenzhen's zone declined, forcing the municipality to consider other means of sustaining growth.

Already, by the late 1990s, the focus had shifted to moving up the value chain through the focus on hi-tech industry, and there was a shift from attracting foreign investment to internal innovation. In 1996, for example, the Shenzhen Hi-Tech Industrial Park was established, followed in 2001 by the Shenzhen Software Park. Shenzhen achieved fair success in the transition to higher-end industry, focusing on six strategic industries: biotechnology, information technology, new energy, new materials, telecommunications, and the cultural and creative industry. This was in contrast to other industrial cities in the region, such as neighbouring Dongguan, which struggled to adjust to the relocation of low-wage industries to countries such as Bangladesh.

The other success has been the growth of the business services sector, and especially finances, which is now the second-largest component of the economy. The Shenzhen Stock Exchange opened formally in 1991, and is now the eighth-largest in the world and the fourth-largest in Asia. It differs from other large stock exchanges in its focus on small and medium enterprises (SMEs). In 2009 the Shenzhen Stock Exchange opened the ChiNext, an exchange for high-growth, hi-tech start-ups. The city is also the headquarters of the China Merchant Bank and Ping An Bank, with the city administration aiming to establish Shenzhen as a global financial centre by 2020, as significant as Hong Kong and Shanghai.

While Shenzhen has seemingly performed better than other cities in making the necessary transitions, the outcomes remain uncertain. The 'gold rush' is now clearly over, and the question is whether Shenzhen can achieve sustainable development on a new growth path. Key elements of the new growth path as indicated by the municipal government are: promoting service clusters; regional integration, including stronger linkages with Hong Kong; developing the financial sector; and promoting independent innovation.

GOVERNANCE

The urban governance structure for China is explained on the coversheet. Shenzhen is a sub-provincial city, with a status between that of a prefecture-level city, and cities such as Beijing and Shanghai, which have the status of provinces. In relation to many other cities, Shenzhen has enjoyed a high level of administrative autonomy, which was the result of both its geographical position on an international border, and the willingness of central government to experiment with various forms of economic and administrative liberalisation in the city. In terms of economic planning and decisions on land development, Shenzhen was given powers at least equivalent to those of a province. Into the future, the major governance-related innovation is likely to be the development of the Pearl River Delta cluster of cities, which will require far higher levels of inter-city cooperation than previously.

URBAN CHALLENGES

Given the extraordinary speed of economic and population growth until fairly recently, there will invariably be challenges. A major problem, for example, was the pollution of waterways with industrial waste. Air pollution is a concern, but is far less severe than in Beijing and other cities in the north-west of China. Official data published by the Ministry of Environmental Protection for 2013 indicate, for example, that the average of the maximum daily PM2.5 level (micrograms per cubic metre) for Shenzhen was 131, compared with Beijing's 646.

Urban sprawl has led to the conversion of large tracts of land to urban development, but the forested land on the hills of Shenzhen has largely (though not entirely) been left intact – unlike many other cities, where there has been wholesale destruction. However, there are serious vulnerabilities in areas of urban pressure on steep topography. In 2015, for example, there was a construction-waste landslide that swallowed houses and factories, and killed around 85 people.

As with many other Chinese cities there are growing inequalities, related in part to the division between those with and without the local hukou (household registration). Given the scale of migration, at least 78% of the population lacks the Shenzhen hukou (although a proportion of this number may have a local hukou in other cities in the region).

THEMATIC REPORTS

TRANSPORTATION

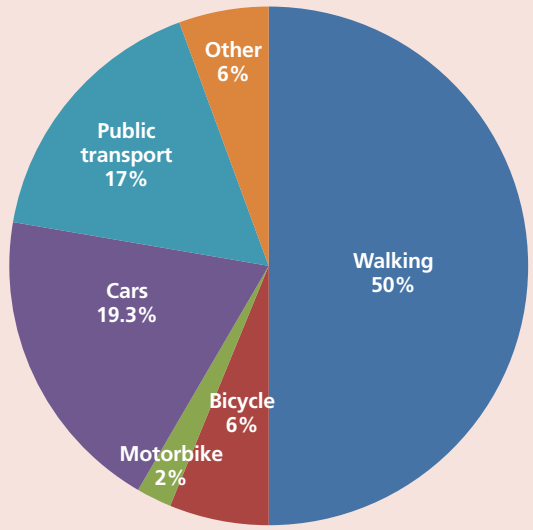
ECONOMIC INFRASTRUCTURE

The scale and efficiency of transport infrastructure has played a major role in the rapid development of Shenzhen's economy. According to World Shipping Council statistics, Shenzhen is the world's third-largest port in terms of container traffic (after Shanghai and Singapore). The Shenzhen Bao'an International Airport is the world's 39th-largest, and the fifth-largest in mainland China, carrying 39.7 million people in 2014. The airport is under considerable pressure, and there are plans to build three further airports around Shenzhen. The Guangzhou-Shenzhen expressway has also played a major role in the development and integration of the region, while the high-speed railway connecting Beijing, Shanghai, Shenzhen and Guangzhou is one of the great achievements of the recent past in infrastructural development, in China and globally. The Guangzhou-Shenzhen segment of the railway was opened with considerable fanfare in 2011.

PUBLIC TRANSPORT

The rise in car ownership – especially since China's entry into the World Trade Organisation in 2001 brought significant price reductions for cars – presents a major challenge for Shenzhen. Car ownership has outstripped the provision of road space in a city that is dispersed and fragmented in spatial terms. The Global Traffic Congestion Index reveals a congestion level only marginally lower than that of Shanghai, for example. Until recently, Shenzhen was following the conventional approach of road-based transportation networks around superblock developments.

MODAL SPLIT 2010 (MUNICIPALITY OF SHENZHEN)



Source: Municipal Yearbook

In terms of modal split, walking is still important within the city, but for motorised transport only, private automobiles account for a high 40% of total trips, more than public transport. In recent times, however, there have been important moves by the Municipality of Shenzhen to shift the modal share away from private vehicles. These have included the expansion of the metro; a major increase in the size of the bus fleet; municipal subsidies for public transport; a quota policy limiting the number of new cars on the road each year; park-and-ride schemes; and public bicycles.

METRO

The flagship for public transport is the Shenzhen Metro which opened in 2004, making the city the sixth in China to introduce a subway system. The system has six lines with a track of 230km, and substantial daily ridership of over three million people. The system is run by the Shenzhen Metro Group Co., Ltd., which is a wholly-owned subsidiary of the Shenzhen Municipality. An important development has been a move to integrate the metro with its sister system in Hong Kong. Currently lines 1 and 4 run to the border with Hong Kong, where riders can transfer to Hong Kong's MTR East Rail Line. The travel cards for Hong Kong and Shenzhen have also been integrated.

BUS

Bus services in Shenzhen have been significantly improved. The number of buses more than doubled between 2000 and 2014, and there has also been an improvement in service quality. A subsidy scheme was introduced by the Shenzhen Municipality to ensure that bus operators maintain a 6% level of profit, notwithstanding fluctuations such as the price of fuel. There were plans to introduce a BRT, but these were postponed, as resources were channelled into the development of the metro system.

PLANS

In 2014 the municipality introduced a policy for the restriction of private motor vehicles. To contain the increase in vehicles to 100 000 per year, a quota system has been introduced which allocates the right to car ownership by lottery and auction – 20% for electric cars by lottery, 40% for conventional cars by lottery, and 40% for conventional cars by auction. The major investment plan for public transport is to eventually increase the metro to 20 lines with a track of 720km, linking into the systems of neighbouring cities. It remains uncertain whether the BRT will be developed.

GREEN ENERGY

The massively expanding cities in the Pearl River Delta have had the enormous task of securing electricity supply. No fewer than 34 coal-fired power stations have been built in the region, which account for around three-quarters of the electricity supply. But Shenzhen has had proportionately more opportunity for hydro production than other cities, with a profile of around 51% fossil-fuel production, 40% hydro, 2% wind and 7% other.

In 2009 a decision was taken to outlaw the development of any new coal-fired power stations, and to actively work towards diversification of supply. In the proposed mix, however, there is a strong focus on the development of nuclear power (with a proposed USD 17.8 billion investment) followed by wind (USD 3.6 billion) and solar (USD 1.6 billion).

Shenzhen has been the site of national experimentation with new models for electricity supply and transmission. In 2011, for example, Shenzhen was one of the first cities in China to introduce a carbon-trading market. In 2015, central government selected Shenzhen for a pilot programme for the introduction of independent transmission and distribution tariffs that will incentivise the connection of renewables to the grid. It would allow, for example, direct purchase of renewables by municipalities, using the state grid for transmission. While there has been strong resistance to this by the major state grid corporations, the more flexible and experimental culture in Shenzhen offers the scheme a possible site for success.

Shenzhen is the site of the world's largest planned waste-to-energy plants. It will deal with a third of the waste produced in the city, producing electricity in the process. However, the importance of the plant lies more in terms of waste disposal than in its role in electricity production, although the plant is also designed to include 44 000m2 of solar panels.

Shenzhen is emerging as a global leader in terms of new-energy vehicles. It now has the largest fleet of electric vehicles (buses, taxis and private vehicles) in the world. The municipality is supporting the use of energy-efficient vehicles through its increasingly stringent fuel-economy standards, financial incentives for the purchase of small-engine vehicles, annual licence charges which penalise large vehicles, permission for electric vehicles to use reserved bus lanes during peak hours, free-of-charge electric-vehicle charging poles, and active procurement of electric vehicles for the public transportation fleet.

INNOVATION-DRIVEN ECONOMY

Shenzhen developed initially on the back of low-end copycat manufacturing, drawing on reservoirs of cheap labour; but since around 2000, there have been active attempts to upgrade manufacturing and promote innovation economies. Shenzhen has achieved notable success with this strategy and is now widely cited as a new technological frontier, drawing a growing number of innovation-intensive firms.

Hi-tech giants such as ZTE, Huawei and Tencent are based in Shenzhen, but there are a growing number of innovative small- and medium-sized enterprises (SMEs) drawn to Shenzhen by the well-established manufacturing infrastructure, financial infrastructure, and culture of relative openness and experimentation. In 2015, for example, there was a 27.6% annual increase in the number of SMEs receiving a business licence in Shenzhen. These emerging industries now account for around 40% of Shenzhen's economic output.

There is some debate over where Shenzhen should be placed in the rankings. 2thinknow placed Shenzhen at 75th globally in the 2015 innovation rankings , after Hong Kong (20th), Shanghai (35th), and Beijing (50th). However, in the competitiveness rankings of the Chinese Academy of Social Sciences (CASS), Shenzhen was ranked first out of 294 cities in China, even higher than Hong Kong. While 'innovation' and 'competitiveness' are clearly not equivalent concepts, there are indications that Shenzhen should perhaps be more highly ranked than in the 2thinknow index. There has for example been an extraordinary increase in technology-related patent applications, with Shenzhen accounting for no less than 44.6% of all patent applications in mainland China, the annual applications from this city having grown 15-fold in one decade. The proportion of GDP from R&D for Shenzhen is over 4%, which is twice the national average and high for a Chinese city (with the exception of Beijing, where there is massive government spending on R&D).

Hi-tech industry is the staple for innovation in Shenzhen, which has, for example, three of the five largest mobile handset companies in the world (Huawei, Lenovo and ZTE), and strengths in areas such as the design and manufacture of drones, intelligent automation, the Internet of Things and smart grids. A specific cluster of hi-tech innovation is the Shenzhen Hi-Tech Industrial Park, which was established in 1996 as one of China's six pilot world-class Science and Technology Parks, and which is home to ZTE and Tencent. This cluster is Shenzhen's most significant base for self-developing innovation enterprise, and is now ranked first nationally for productivity in hi-tech industry.

There are other areas of innovation beyond hi-tech, including for example in the logistics industry. China International Marine Containers is the largest container-manufacturing company in the world, and together with the Port of Shenzhen, supports innovation in logistics. Shenzhen is emerging as a hub of innovation in the financial services industry, and especially in venture capital and the financing of hi-tech enterprise. There is also innovation in cultural and creative enterprises, with Shenzhen having been awarded 'Design Capital' status by UNESCO.

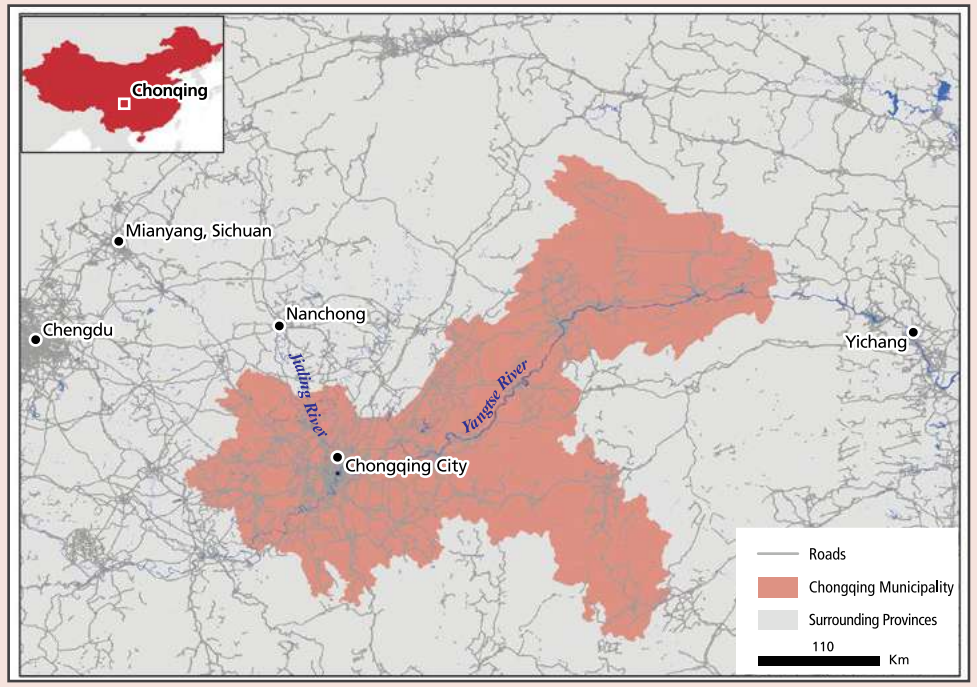
However, despite these advantages, there are challenges. The expenditure on R&D, for example, is highly concentrated in large firms; with Huawei, for example, claiming that it spends up to 15%

of income on R&D, but with many of the smaller firms struggling to find the resources for R&D. A recent survey suggests that most of these firms are simply trying to squeeze greater income and efficiency out of existing technologies. The city has also not had the time to develop leading-edge academic and research-related institutions. There are no top-ranking universities in the city, and very few nationally recognised research laboratories. This means also that the capacity does not yet exist for major research-based collaborations. The city also battles to attract and retain high-level talent, which is drawn rather to cities such as Beijing and Shanghai.

Shenzhen Municipality is determined to upgrade its innovative capacity. It is responding to the lack of high-level academic and research institutions with the creation of the Shenzhen-Hong Kong Innovation Circle, which supports resource-sharing, joint R&D, the virtual university campus, and other innovation partnerships linking enterprise in Shenzhen to high-ranking institutions across the administrative boundary. A special fund has been created to support this activity. The relatively free environment within which companies operate in Shenzhen is arguably the most important driver of local innovation, but there is also an understanding that enterprise requires an effective institutional environment, with legal protection for intellectual property, and well-regulated financial institutions. The city government has therefore focused on institutional and regulatory reform, in addition to initiatives such as the establishment of common service technology platforms for identified industries; attracting talent from outside the city; funds supporting innovation; and the creation of high-level innovation teams with international partnerships.

CHONGQING

重庆



CONTEXT

LOCATION AND STATUS

Chongqing is located in south-west China, 1 400km inland along the Yangtze River, in the transitional zone between the middle reaches of the river plain and the mountainous terrain of the Qinghai-Tibet region.

HISTORY

Like most other Chinese cities, Chongqing has a settlement history that goes back to ancient times. It has had various names and roles across the different dynasties. A town with the current name was established in AD 1189. In the centuries that followed, Chongqing was the capital of a number of short-lived kingdoms.

In 1890 Chongqing became the first inland commercial port to be opened to foreigners, and a number of international consulates were established in the city. It was the provisional capital of China when other parts of the country were occupied by the Japanese between 1938 and 1945. At this time, many factories relocated from Japanese-occupied territory to Chongqing, establishing the role of the city as a manufacturing hub.

After 1949 Mao Zedong supported the continued industrialisation of Chongqing, as he considered it to be a strategic site, far from the coastal ports which were vulnerable to foreign invasion. It became

a hub for producing weapons and military vehicles. Chongqing lost some strategic importance in the early Reform Era from the late 1970s, when the focus shifted to the coastal ports. This changed in the late 1990s, with the introduction of the 'Go West' policy. Chongqing was central to the new policy of balancing development between the coastal areas and the interior of the country, and received massive investment from national government. The consequence was dramatic levels of economic growth. However, in Chongqing there was also attention to social redistribution – and to improved environmental policies, in response to the city's status as one of the most polluted cities in China.

A major development in 2010 was the designation of the Liangjiang New Area in Chongqing, which is one of the three major state-level development zones in China; the others being the Pudong New Zone in Shanghai, and the Binhai New Area in Tianjin. Chongqing's economy has surged forward since around 2003, and it is now the fastest-growing urban economy in China, and the most spectacular example of the growth of an inland city.

POPULATION

POPULATION SIZE

The UN Population Division estimates a 2015 population of 13.33 million for the Chongqing urban agglomeration. Note that this agglomeration forms part of a significantly larger municipality, much of which is rural.

POPULATION RANKING

In terms of UN data the Chongqing urban agglomeration is ranked 16th in the world, seventh in the BRICS, and third in China.

POPULATION GROWTH

Chongqing grew at the moderately fast average annual rate of 3.41% in the period 2010 to 2015, down from a peak of 6.7% in the late 1990s.

POPULATION DIVERSITY

According to the sixth national population census 2010, Han Chinese accounted for 91.5% of the total population. About 5% were from the Tujia minority, and 1.7% were Miao.

STRUCTURE OF THE URBAN AGGLOMERATION

Chongqing is at the confluence of the Yangtze and Jialing rivers, and is nestled between two parallel elongated folded mountains. It is an extremely difficult topography, which has contained the growth of the city. In a unique spatial structure, the city is segmented by the rivers and mountains into six spatially separate districts, each of which forms its own borough, and there are also the satellite towns of Lianglu and Beibei. Although structurally fragmented, large-scale investment in connecting infrastructure is helping to knit the city together; and a large new central business district with high-rise skyscrapers, the Jiangbeizui CBD, is being constructed in the centre of the city as part of the Liangjiang New Area.

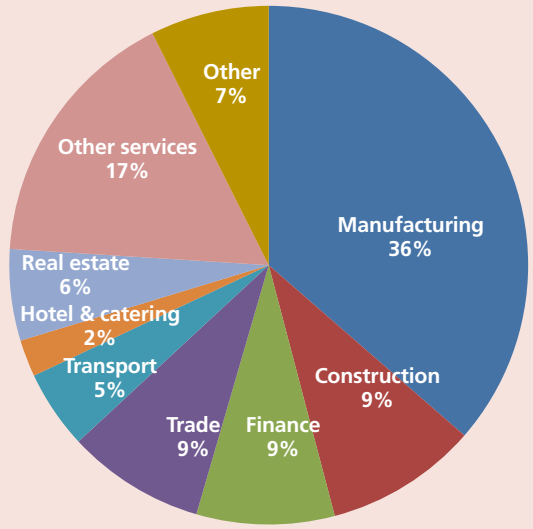
China's national government has recently designated the Chengdu-Chongqing Economic Zone, which links the twin cities of Chengdu and Chongqing (and 15 smaller cities) in an area of 206 000km2. The population is around 98 million, but this is a cluster of cities over a wide area, rather than an urban agglomeration. But rapid improvements in transport links are bringing these cities together as though they are in close proximity to each other. With the new bullet train, Chengdu and Chongqing, for example, are now only two hours apart.

ECONOMY

According to the Brookings Institution, the GDP for Chongqing in 2014 was USD 315.58 billion (PPP) . It was the seventh-largest urban economy in China and the 10th-largest in the BRICS. Outside of China in the BRICS, only Moscow and São Paulo were larger. During the period 2011 to 2015 (12th Five-Year Plan), the average annual GDP growth for Chongqing was 12.8%, which is very high in both international and national terms.

Chongqing is a city with soaring economic growth, and may be the world's fastest-growing large-city economy. The rapid growth followed the elevation of Chongqing in 1997 to a provincial-level municipality, and the designation of high-level development zones from the 2000s. Average annual GDP growth peaked at 17% in 2010; and despite the slowdown in China generally, has remained very high. In 2015, GDP growth was still 11%, compared with the national figure of 6.9%. It was the fastest-growing of the 31 provinces and major cities in China.

STRUCTURE OF THE ECONOMY, 2014



Source: Municipal Year Book

Chongqing's economy remains led by manufacturing, and it is one of the few major cities in the world where growth of manufacturing exceeds the growth of service sectors. In China generally the manufacturing sector has trended downwards from around 2005, but it has surged in Chongqing. The contribution of secondary industry to total GDP has in fact increased, from around 39% in 2000 to the current 46%. However, there is also rapid growth in the service sectors. This growth comes in support of manufacturing (e.g. financial and other business services) and from the high levels of social investment supported by the municipality.

Chongqing has the world's largest concentration of manufacturing output from the production of automobiles and motorcycles. There are no fewer than 24 manufacturers of finished vehicles in Chongqing, in addition to a large motor-vehicle components industry. A significant proportion of the production comes from the state-owned Changan Automobile Group, in partnerships with transnational firms such as Yamaha, Suzuki, Honda, Hyundai, Iveco, Ford, General Motors and BMW.

The ICT industry is the next-largest manufacturing sub-sector, with Chongqing having emerged as a global production hub for notebooks and laptops, aiming for 30% of global share. In 2014, ICT accounted for 40% of the value of exports from Chongqing.

The chemical industry is also large in Chongqing, with a strong focus on natural gas, chlorine

alkali and petroleum, with the automobile sector having catalysed the development of the synthetic rubber industry in the manufacture of vehicle tyres. There is also large-scale manufacture of pharmaceuticals and medical equipment, ships (especially pleasure yachts), textiles and clothing, and paper.

Much of the production in the city happens in Special Economic Zones, which provide preferential tariffs and other means of support for foreign investors. The two national-level zones are the Chongqing-Chengdu Economic Zone and the Liangjiang New Area zone, which in 2013 ranked as China's third-most competitive economic zone.

Beyond manufacturing, Chongqing is a base for the minerals and (shale) gas-producing companies operating in the western parts of China. With its rapid expansion the city has a massive construction industry, and is also known for its creative industries and tourism sector. There is also a fast-expanding wholesale and retail sector, responding to the growing wealth and population of the city. Transport and logistics are also a significant part of the economy, given Chongqing's strategic location on the middle reaches of the Yangtze River. A major advantage for Chongqing into the future is China's new 'One Belt, One Road' strategy, which involves revitalising the historical Silk Road Economic Belt and the Maritime Silk Road. Since Chongqing is located at the intersection of the Yangtze River and the Silk Road, it is likely to emerge as an inland international logistics hub. Chongqing has already positioned itself as the starting point for the Chongqing-Xinjiang-Europe International Railway.

The rise of foreign investment has been a strong factor in the growth of the city. Fixed investment also increased dramatically, from less than 200 billion Yuan per year to nearly 700 billion by 2010, with annual growth rates of 28%. No fewer than 243 of the world's top 500 companies have established themselves in Chongqing. Hong Kong, Taiwan, Singapore and Japan are key sources of investment. As Chongqing has upgraded its industry, local firms have moved some of their production into the lower-wage parts of China and elsewhere in Asia, but also further abroad into Africa, and especially Ethiopia.

Multiple reasons have been provided for Chongqing's economic success. The government's 'Go West' policy has clearly been of critical importance. In terms of this policy there has been mass investment in infrastructure, and special zones have been created where corporate tax is 15%, compared with 25% in the rest of China. There are incentives for investing in hi-tech and green industries, special concessions on the payment of duties, and reforms to the hukou system which have made it easier for migrants to enter and settle in the city. However, there is also a high level of social investment, with the combination of this form of public investment and the active promotion of industry known as the 'Chongqing Model'. Although Chongqing's growth has been driven mainly by investment in industry, social investment in housing and public services is raising household incomes and is likely to support higher consumption into the future, making the economic model more sustainable.

However, there are also economic challenges. Chongqing is in a relatively poor part of China, and so the transition to a higher-consumption society which will drive domestic demand may be more difficult than in the cities on the east coast, for example. There has also been a rapid rise in public indebtedness in Chongqing, with the ratio of outstanding bank loans to GDP having risen to 131% in 2011, from 112% in 2006.

GOVERNANCE

The overall urban governance structure for China is explained on the coversheet. Chongqing has the highest possible level for a municipality, falling directly under central government, with status equivalent to that of a province (and to the other province-level cities of Beijing, Tianjin and Shanghai). It was created at this level in 1997 when it split from the Sichuan Province, which is administered from Chengdu. The Municipality of Chongqing is an administrative unit that covers a wide area (83 000 km2), of which the urban component is spatially limited (6 300 km2), with a population of 16.2 million. There are 38 county-level divisions within Chongqing, of which 23 are urban districts. Chongqing has had controversial politics in recent years as the Party Secretary (2007-2012) was the charismatic Bo Xilai, who led a populist left wing of the Communist Party, but was charged with corruption in 2013 and sentenced to life imprisonment.

DEVELOPMENT CHALLENGES

Despite rapid progress in terms of economic and social development, Chongqing still lags behind the coastal cities in terms of GDP per capita and development indicators. In 2014, Chongqing had a GDP per capita (PPP) of USD 13 224, compared with USD 27 629 for Beijing, USD 26 896 for Shanghai, and USD 17 532 for Guangdong.

Many of the other problems, however, are a consequence of growth. Organised crime, for example, became a major concern in the early 2000s, as mafia-type organisations were attracted to the rapid growth of the area. As Chongqing is one of the world's most rapidly expanding cities, there are massive infrastructural and sustainability challenges. Waste management presents a huge logistical challenge for the city. Until recently, sewage was discharged directly into the Yangtze River through more than 600 outlets, creating severe water-pollution problems. There were also a number of insanitary open sites for solid waste disposal across the city. Fortunately, there has been a significant improvement in sewage and waste disposal through large infrastructure projects. Around 90% of sewage is now treated before entering the river systems, and modern landfill sites have replaced the open sites.

A more persistent problem is air pollution. The National Environmental Analysis released by Tsinghua University and the Asian Development Bank in 2013 ranked Chongqing as one of the ten most polluted large cities in the world. However, Chongqing has prioritised environmental improvement, and the World Health Organisation recorded a decline in average concentrations of PM10 (ug/m3) from 110 to 89 between 2011 and 2014.

Chongqing, like other growing cities in China, has a large migrant population. However, it is leading the way in terms of reforming the hukou system, by providing migrants with full access to urban services and housing support in the city.

THEMATIC REPORTS

TRANSPORT

ECONOMIC LOGISTICS

Chongqing has a strategic location on the Yangtze River, and about 90% of exports from Chongqing are carried along this river, from the two major ports in the city (the Ports of Cuntan and Guoyuan) to the Port of Shanghai. The ports handle around three million TEU of containers annually, and there is capacity for further expansion.

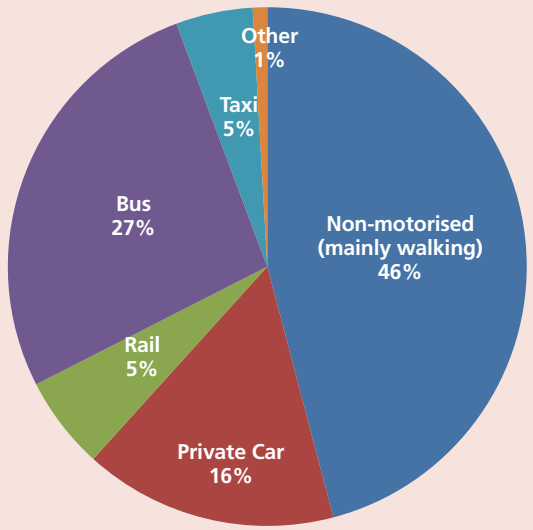
The Chongqing Jiangbei International Airport is the ninth-largest in China, with 32.4 million passengers in 2015; but this airport still has limited international connections. A significant recent development was the opening of the 11 000-kilometre Yu-Xin-Ou International Railway through Central Asia to Europe. The railway line has not yet reached its full potential, with significant competition from road and air travel.

Chongqing is also being connected to China's growing high-speed rail network. The Chengdu-Chongqing high-speed railway line was opened in 2015, and the extension to Kunming is under construction.

PUBLIC TRANSPORT

The two major mobility challenges faced by Chongqing are the speed of urban growth and the difficulties of the topography. The Arthur D. Little report on urban mobility in China commends Chongqing for having a "forward-thinking approach on transportation". It has a low motorisation rate (only 132 private vehicles per 1000 people), and the lowest share of motorised individual transport (17%) of all the cities in China that were surveyed. Time to work was also described as "reasonable", and despite the mountainous topography, transport-related fatalities were below average. However, overall Chongqing was still rated a little below the average for China in terms of urban mobility, as road congestion was high (the topography being largely to blame); and Chongqing's CO_2 emissions per capita were the highest of all cities surveyed. The use of bicycles is also extremely low in Chongqing, with only 1% of households using a bicycle compared with 39% for Beijing, for example; although again, this is understandable, given the difficult topography.

MODAL SHARE, ALL TRIPS – 2014



Significantly, public transport and walking take up a significant share; but even moderate use of automobiles on Chongqing's topography creates congestion.

BUSES

The public transport system has traditionally focused on bus transport. Today there are around four million bus rides in the city each day, along 300 lines. In 2008 a BRT system was introduced, but there were widespread complaints that the lane dedicated to BRT buses was causing road congestion. The municipality then permitted other buses to use the lane, but complaints from private car-owners continued, and the system was eventually demolished.

METRO

The metro system (known as Chongqing Rail Transit) opened in 2005, the first in western China, with funding from the Japan Bank for International Cooperation. Construction of the metro was a partnership between the Japanese company Hitachi and the Chinese company Changchun Railway Vehicles Co. Ltd, using high-end Japanese technology. It is an unusual system. It has two conventional subway lines and two overhead monorail lines – an innovative response to the difficult topography. The monorails, modelled on the system in Tokyo, are the first for a city in China. With 80km of monorail by 2015, Chongqing now has the world's largest monorail network. In total the Chongqing metro had six lines and a total track length of over 200km in 2015, with a daily ridership of 1.73 million.

PLANS

The metro system is to be massively expanded from six to 10 lines, with additional focus on the optimisation of existing networks.

GREEN ENERGY

Chongqing faces the mega-challenge of ensuring energy security in a city where the demand for electricity has been growing at more than 13% per annum for over a decade. However, in meeting this demand, Chongqing has also done relatively well with the greening of electricity production. The Chongqing Electric Power Corporation reported in 2013 that nearly 44.8% of its electricity was generated through hydro, compared with the 30% average for China.

There is of course a high level of lock-in, which makes the transition away from coal-fired electricity difficult. The Chongqing Electric Power Corporation owns four thermal power stations producing 4.6 million MWh of electricity annually, of which three million MWh comes from the Chongqing power plant. While it was not feasible to shut down this plant, which was causing very high levels of SO_2 pollution because of the high sulphur content in the coal from the region, it was possible to replace inefficient units at the power station, and introduce new technologies (a joint flue-gas desulphurisation unit) that has significantly reduced pollution and emissions in Chongqing.

Not only is there a structural shift in electricity production away from coal and towards hydro, but the energy intensity of the local economy is dropping, and the use of electricity may even have peaked. The Chongqing Statistical Yearbook for 2013 reports that energy consumption per unit of GDP in Chongqing declined from 0.953 in 2005 to 0.886 in 2012. In 2012, there was a reported annual GDP growth of 13.6%, but the growth in the use of energy was only 5.5%. In 2013 there was an actual 9.5% reduction in the use of electricity, following the introduction of a multi-step tariff penalising high-end users. Electricity use may also be declining because of the stringent regulations on energy efficiency in new buildings and the large-scale retrofitting of old buildings.

Given its position on the Yangtze River, there is enormous hydro potential in the region. By far the most ambitious initiative has been the construction of the Three Gorges Dam on the Yangtze River, downstream from Chongqing, which is the world's largest power station in terms of installed capacity (22 500MW). The dam was opened in 2003, with full production capacity reached in 2012.

The dam has significantly increased hydro production, reducing the use of coal; but it has also had negative effects, including the relocation of around 1.4 million people, the loss of habitat diversity, and reduced water levels downstream.

In terms of energy use in the transportation sector Chongqing is one of 19 cities in China in which the central government has been experimenting with the introduction of natural gas in the automobile sector. By 2012, 85% of the taxi fleet in the city was using Liquified Natural Gas (LNG), a fuel which produces far fewer harmful emissions than petroleum. An important innovation has been the development of electric-charging buses (full electric and hybrid), with an electric-bus charging station opened at Chongqing International Airport, and another thirty stations under construction.

INNOVATION-LED GROWTH

Chongqing has had both the advantages and the disadvantages of having an established industrial basis at the beginning of the Reform Era. Large state-owned enterprises with ageing technologies and hierarchical management structures were well-entrenched. While Chongqing has used its advantage to produce extraordinarily high levels of economic growth, this growth has been driven to a large degree by achieving efficiencies through economies of scale, rather than through leading-edge innovation.

In the 2thinknow Innovation Cities Global Index, Chongqing ranks only 286th globally, and 15th in China, far lower than its ranking for population and size of GDP. The proportion of GDP from R&D activities was only 1.53%, less than China's average of around 2%.

Performance on innovation is arguably one of the weaknesses in Chongqing's otherwise stellar success. However, new attention is being paid to this area, and Chongqing may be one of China's rising innovation labs. Chongqing does not have a university in the BRICS Top 50 ranking, but the University of Chongqing is a rising institution that is giving priority to innovation. The university is developing partnerships with business in Chongqing (including Changan Automobile and Tencent) in the development of specialised industrial parts and innovation incubators, and also has a large innovation fund for its own staff and students.

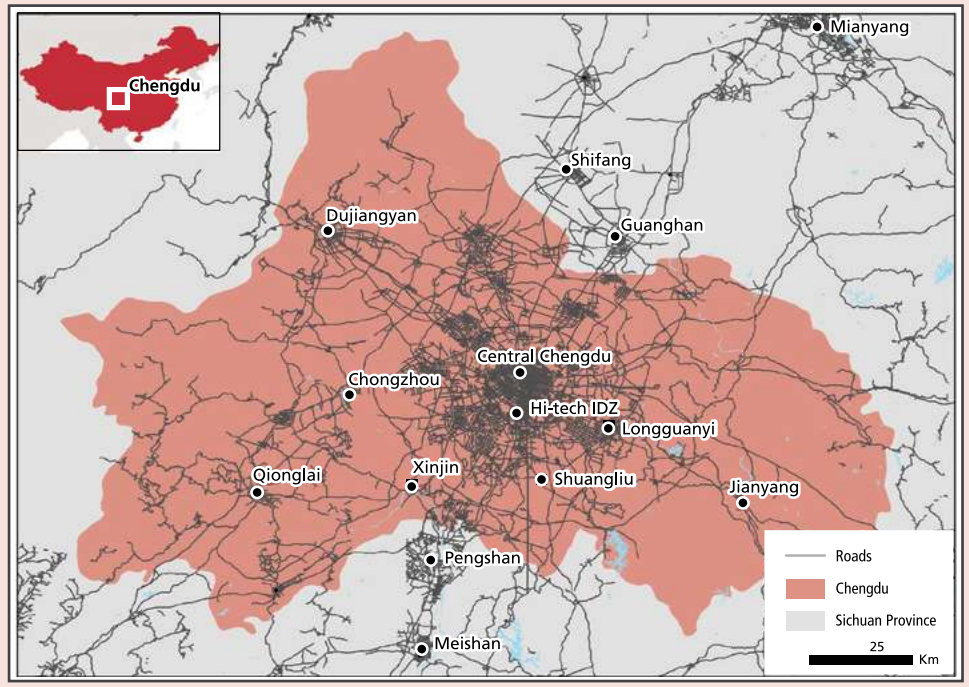
There are now significant signs of innovation in Chongqing's long-established industry. For example, the city has a long history in automobile production. Recently, local producers have taken the lead in innovation for new-energy vehicles, with Changan opening a new factory in Chongqing to produce zero-emission electric vehicles, drawing on locally-derived innovations. Chongqing also has a long history with military hardware, with recent innovations allowing for the civilian application of this hardware. New survey data also suggests higher levels of innovation within small- to medium-scale enterprise, suggesting progress in establishing a local culture of innovation.

The Municipality of Chongqing is actively supporting innovation. As in the case of other cities in China, innovation support is geographically focused within special development areas. In this case, the Chongqing Hi-tech Industry Development Zone has become a strong focus of innovation, specifically within electronic information, bio-chemical pharmacy and medical instruments, new materials, and automobile and motorcycle components. The municipality has established a Chongqing Science and Technology Commission to supervise support for innovation, which includes coordination of activities in the hi-tech zone and various science parks, the construction of research laboratories, and the development of research partnerships.

Central government has been actively urging and supporting greater innovation in Chongqing. In 2016, the State Council approved the Chengdu-Chongqing City Cluster Plan, which has placed the promotion of innovation at its core. National-local joint research centres have been established to give central-government support to local initiatives, and structural reforms are under way to unleash innovation in the region.

CHENGDU

成都



CONTEXT

LOCATION AND STATUS

Chengdu is located in south-west China in the Sichuan Basin, close to the mountainous terrain on the edge of the Qinhai-Tibetan plateau. Chengdu is the capital of Sichuan Province.

HISTORY

Chengdu was founded around 2 000 years ago during the Song dynasty, on a fertile plain that is known in Chinese as 'Country of Heaven' or 'Land of Abundance'. About 1 200 years ago, during the Tang dynasty, Chengdu was one of China's great commercial cities. During periods of political fragmentation in China, the city was the capital of independent kingdoms. Chengdu was where papermaking was invented and was a hub of cultural activity, including literature, music, dance and drama. In AD 1279, however, the Mongols sacked Chengdu, killing around one million people. The city went into decline, and at the end of the Ming dynasty in the 17th century it was a near-ghost city. During the Qing dynasty, large numbers of people were relocated to Chengdu to maintain the city.

In 1937, with the Japanese army advancing, the capital of China was moved from Nanjing to Wuhan, and then to Chengdu. In 1944, the Americans established a military presence in Chengdu as a base for attacks on the Japanese. In the 1950s, under Communist rule, Chengdu was regarded as

a city strategically sited in the secure interior of the country. Mao Zedong initiated his 'Third Line' development programme in the 1960s to relocate industry to the interior of western China, and by 1978, 47% of Chengdu's GDP was from (state-owned) industry.

During the early Reform Era after 1978, Chengdu was marginalised, with development focused on the coastal cities. However, with the 'Go West' policy from 2000, Chengdu began to develop as a modern, internationalised metropolis. In 2008, however, a devastating earthquake struck the region to the north of Chengdu, leading to large-scale displacement of people, and accelerated migration to the City of Chengdu.

POPULATION

POPULATION SIZE

The UN Population Division estimates a 2015 population of 7.56 million for the Chengdu urban agglomeration.

POPULATION RANKING

In terms of UN data the Chengdu urban agglomeration is ranked 42nd in the world, 18th in the BRICS, and eighth in China.

POPULATION GROWTH

Chengdu grew at an average annual rate of 3% in the period 2010 to 2015.

POPULATION DIVERSITY

In 2010, the Han Chinese accounted for 99.1% of the population of Chengdu, followed by Tibetan, Hui (Chinese Muslim), Yi and Qiang. The dominance of Han Chinese is in contrast to the smaller urban centres and rural areas of Sichuan Province, where ethnic minorities have a strong presence.

STRUCTURE OF THE URBAN AGGLOMERATION

Chengdu has the concentric structure typical of many Chinese cities, supported by ring-road development. However, Chengdu also has a ring of satellite towns and also axial development radiating outwards, connecting Chengdu to secondary urban agglomerations in the wider region.

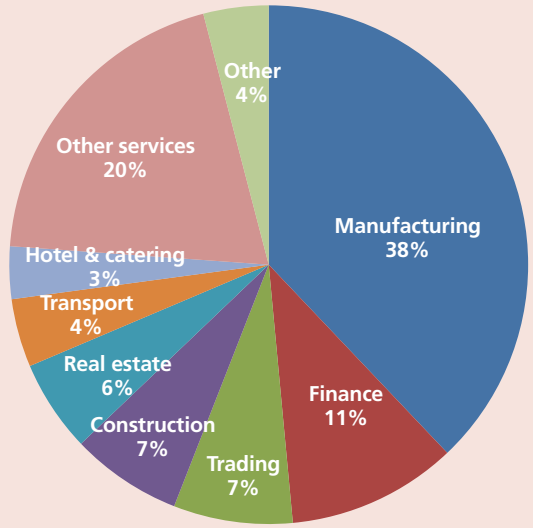
There are eight satellite settlements, which developed initially with the location of new state-owned industry in the 1970s, in terms of Mao Zedong's Third Line programme. There are plans to develop a new satellite city known as the Chengdu Tianfu District Great City. This will be a small city with a population of around 80 000, but it will be a demonstration city for applying eco-city principles. It is intended to be a low-energy, car-free city, with every resident being a two-minute walk from a park.

Chengdu is connected by axial development to cities that are counted separately as urban agglomerations by the UN Population Division. These include Deyang (630 000) and Mianyang (1.065 million) to the north, Dujianyan (346 000) to the west, and Ziyang (430 000) to the south-east.

ECONOMY

According to the Brookings Institution, the 2014 GDP for Chengdu was USD 233.5 billion (PPP). This made Chengdu the eighth-largest urban economy in China and the 12th in the BRICS following Delhi. Growth rates are extremely high. Between 2006 and 2010, the annual growth in GDP was 14.4% per annum. This reduced to a still-very-high 11% per annum between 2011 and 2015. However, in this latter period, growth reduced from 15.2% in 2011 to 7.9% in 2015. While the trajectory has been downwards in recent years, growth remains significantly higher than China's average. In 2015, the Milken Institute in the USA ranked Chengdu as the best-performing city in China (followed in second place by Shanghai), using a range of indicators, including growth, job creation, wage growth and FDI.

SECTOR SHARE OF ECONOMY, 2014



Source: Municipal Statistical Yearbook

Manufacturing continues to drive the economy of the city, although service sectors, especially finances, are becoming more important. Major clusters in the city include electronics, software, automobiles, aviation and aerospace, pharmaceuticals, petrochemicals, metallurgy, food processing and footwear. There has been a decline in metallurgy with the closure of a large steel mill in 2015, but growth in automobile manufacturing, with the opening of the Volvo plant in 2013. The major growth, however, has been in hi-tech industries. There are new areas of emerging strength. Chengdu has emerged, for example, as a centre of rail transit technology and production, which is developing in a complementary way to the rapid growth of rail transit in Chengdu and regionally. Green energy is also becoming an important area of research and production.

This growth has happened mainly in specially designated industrial zones, including: the Chengdu Economic and Technological Development Zone (established in 1990, and designated a national development zone in 2000); the Tianfu Software Park (established in 2005); and the Tianfu New Area (2014). A key recent development has been the designation of the joint Chengdu-Chongqing Economic Zone. There has been a long complementarity between the economies of these two cities, but also a degree of rivalry. New forms of cooperation are likely to emerge.

There are important domestic industries established from the 1950s which have achieved competitiveness in the new era of global competition and openness – including, for example, the Chengdu Aircraft Industry Group, a leading designer and producer of advanced military jets. However, much of the energy in the sector comes through strong flows of FDI, with half of the Fortune 500 companies now having a base in the city.

Beyond manufacturing there has been significant growth in Business Process Outsourcing (BPO) and financial services, with the new Chengdu Financial City reinforcing Chengdu's role as the leading financial centre in central and west China.

The growth of Chengdu has come from central government support in terms of the 'Go West' poli-

cies, tax and investment incentives to domestic and foreign firms from the province and municipality, the high domestic growth market in the interior of China, and the significant cost advantage in labour and land that Chengdu has in relation to the developed coastal cities. In the future, however, Chengdu may have to rely increasingly on capacity for innovation to sustain development.

GOVERNANCE

The urban governance structure for China is explained on the coversheet. Chengdu is a sub-provincial city with status between that of a prefecture-level city and cities such as Beijing and Shanghai, which have the status of provinces. A major recent innovation was the designation of the Chengdu-Chongqing City Cluster. In 2016, the State Council approved a plan for the development of the cluster, with an emphasis on "innovation, coordination, greenness, openness, and sharing". The emphasis of the initiative is on coordinated agreements between the two major cities – and also smaller cities in the region – in areas such as economic development, resource procurement, environmental policy, and the development of infrastructure.

URBAN CHALLENGES

Environmental challenges are severe in this rapidly expanding city. Chengdu is ranked by Greenpeace as the 15th-worst air-polluted city in China (Beijing is the 13th-worst), with an average annual PM2.5 level (micrograms per cubic meter) of 86.3. There are also major water-pollution problems, with the municipality having to cut supply in 2014 because of severe pollution levels in drinking water after local flooding.

Rising inequality is a major concern. As with many other Chinese cities, one dimension of inequality relates to the division between those with and those without the local hukou (household registration). About 16% of the local population is without the hukou. However, there have been recent local reforms to the hukou; including, for example, the extension of pension-insurance benefits to the 'floating population', and the expansion of access to services such as health and education. Although progress is being made, Chengdu does have the challenge of urban poverty, as many migrants come from deep rural areas (including remote mountainous areas), and are poorly prepared for the challenges of life in the teeming metropolis.

Corruption has also been identified as a concern, although there are concerted efforts to deal with it. The city has had high-profile corruption cases, including the arrests of numerous government officials involved in corruption in the construction of the mega-Global Centre. In 2012, a senior official fled to the US Embassy in Chengdu during a major corruption scandal.

THEMATIC REPORTS

TRANSPORT

ECONOMIC INFRASTRUCTURE

Chengdu is emerging as an international aviation hub. The Chengdu Shuangliu International Airport, previously a military airport, is now the 32nd-largest in the world, the sixth in the BRICS, and the fourth in China, carrying over 42 million passengers annually. Since 2013, international routes have been opened that connect Chengdu directly to cities including San Francisco, London, Moscow and Melbourne, with 55 international non-stop routes planned by 2020. There are plans to build a new airport to the south of the city which will handle over 40 million passengers when completed in 2025.

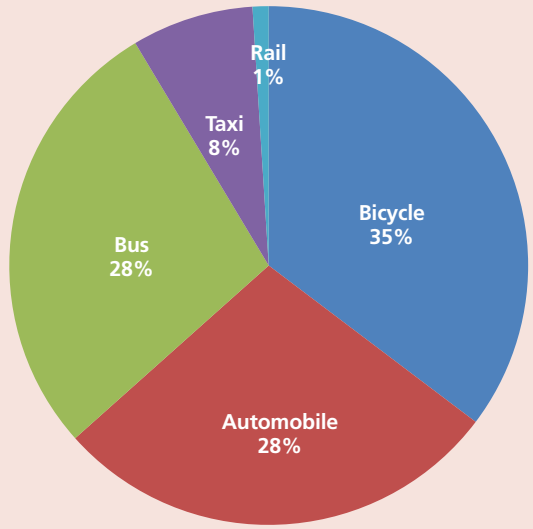
Chengdu is also the starting point of the new express-rail line to Europe opened in 2013, reinforcing

Chengdu's role as an international logistics hub and a gateway to Europe and Central Asia. This role was further reinforced by the completion of the Shanghai-Wuhan-Chengdu high-speed railway in 2013. Chengdu is planning to take advantage of the 'One Belt, One Road' initiative to position itself as the premier rail transportation hub in central and western China.

PUBLIC TRANSPORT

Road traffic is a major problem in Chengdu. The Global Cities Congestion Index shows that Chengdu is more congested than Shanghai, and only a little less congested than Beijing. Like other Chinese cities, the focus until recently was on making provision for the private automobile, by building and expanding the road network. There has been a recent turn to public transport, with massive new investments in the metro and BRT system, for example, and the introduction of new controls, such as restrictions on the movement of vehicles in the city centre based on the last two digits of their number plates.

MODAL SPLIT EXCLUDING WALKING – 2010



Source: Chengdu Municipal Year Book

The Chengdu Metro, run by the state-owned Chengdu Metro Company, was opened in 2010 with one line and a 23-kilometre track. By 2015 there were three lines in operation, with a track of around 88km. The average daily weekday ridership was around 930 000. A fourth line is expected to be open by the end of 2016. A significant innovation was the introduction of electric rail cars to the public transportation system. Unlike the metro, these operate above ground. They carry more people than traditional buses, but are considerably cheaper to construct than the metro. The first demonstration line was opened in December 2015.

BUS

Buses have historically been the basis of public transportation in the city. The state-owned Chengdu Bus Company, which has a fleet of over 4 000, is the primary operator. This company experienced a serious decline, but has enjoyed a turnaround in recent years, with improved management. With the reform of state-owned enterprise, some of the bus-line services have been turned over to private companies; joint-venture arrangements with firms in Hong Kong and elsewhere are helping to rejuvenate public enterprise. There have been recent innovations in an effort to increase bus ridership, including offering free rides in the city centre, and introducing a BRT system. The BRT opened in 2013, and consists of a 28-kilometre ring of dedicated bus lanes on the outer perimeter of the inner city.

PLANS

Major extensions to public transport are planned as part of Chengdu's 13th Five-Year Plan (2016-2020). There are plans for 500km of metro tracks operational and a further 150km under construction by 2020. Also by 2020, the new electric rail-car network will have a 100-kilometre track and a daily ridership of 600 000 to one million. It is anticipated that by 2030 this network will be over 800km in extent, and carry up to six million people daily in an expanded region. Importantly, Chengdu is linking this ambitious network expansion to the development of manufacturing, with transportation envisaged as a key driver of growth.

GREEN ENERGY

As a manufacturing city, Chengdu has historically been energy-intensive. It is also in an area with large coal resources, which has oriented energy use towards fossil fuels. However, the municipality – together with industry – is working to green the sources of energy, and to improve energy efficiencies. Among the many initiatives are:

- The greening of the roofs and walls of buildings across Chengdu;
- The development of a green belt around Chengdu;
- Active support from the municipality for companies seeking to improve energy efficiencies (from advice to financing);
- A national pilot project on the use of electric vehicles for public transport, including the development of a network of charging stations;
- Targeted research into green-energy-related technologies (including groundbreaking work on power storage for electric vehicles); and
- A strong partnership with the City of Bonn, Germany, for the development of low-carbon cities.
- A major internationally recognised demonstration initiative in the development of the low-energy-use Chengdu Tianfu District Great City.

The private sector, and especially international firms, are responding to the strong support given by government to the greening project. Volvo for example introduced standards of energy management in its new automobile plant in Chengdu that far exceed legal standards in China, and are also significantly higher than standards in Europe. Similarly, General Motors in Chengdu is emphasising green-energy production and energy efficiencies in its investments, having also established a China Innovation Centre in the city, with green energy as one of its areas of focus. Apple has established a partnership with a Chinese firm, Sun Power Corporation, to cooperate on solar-energy projects in the city.

INNOVATION-DRIVEN ECONOMY

Historically, Chengdu was an isolated city in the interior of China, without the global networks that stimulate innovation, and with a preponderance of innovation-shy state-owned companies; but this is changing rapidly, as the internet and increasingly frequent international flights are rapidly connecting Chengdu to global innovation networks, and as large numbers of entrepreneurial start-ups are challenging the dominance of established state-owned industry.

The 2thinknow City Innovation Index 2015 ranked Chengdu 192nd globally and seventh in China (after Shanghai, Hong Kong, Beijing, Shenzhen, Nanjing and Suzhou). Also, R&D expenditure has been relatively low – 2.5% of GDP in 2013; however, there are strong indications that Chengdu is on a rapid upward trajectory in terms of innovation. For example, in 2015 Chengdu received more venture capital than any other Chinese city except for Beijing and Shanghai, with rates of investment similar to those of North American and European cities. Also in 2015 there was a 103% year-on-year increase in registered capital for new market entrants, including many technology companies. This was partly the result of a concerted drive by local government to simplify procedures for business registration, support technology transfer and commercialisation, and protect IP.

Overall, there is a determined effort to promote innovation in Chengdu, across all levels of government. In 2015, the State Council designated the established Chengdu Hi-Tech Industrial Development Zone (CDHT) as the first National Innovation Demonstration Zone in the western part of China. It is the second-ranking zone of its type nationally after Beijing's Zhongguancun. There is already a strong base for innovation in the CDHT, which has over 6 500 technology companies that have applied for 18 000 patents. Among the recent innovations from the CDHT is the world's first 3D blood-vessel bio-printer. Also in 2015, the municipality launched its Entrepreneurship Tianfu Action Programme, which has already led to a sharp increase in entrepreneurial start-ups supported by venture capital. In December 2015, Chengdu hosted the Global Innovation and Entrepreneurship Fair.

There are almost 200 dedicated spaces for innovation across Chengdu, developed principally through international cooperation. These include the Sino-Korean Innovation and Start-up Park (focusing on cloud computing, big data and 3D printing), the Tianfu Jongrong Centre (intelligent manufacturing, IT and hi-tech service industries, including financing), Jingrong Town (robotics, biomedicine, the Internet+, intelligent manufacturing), MZQ Innovation and Entrepreneurship Area (mentoring to entrepreneurs and innovators, financing, music), Smart City (a university partnership focusing on rail-transportation technologies), and Thinkzone (a hi-tech business incubator). One of the larger new developments is the Singapore-Sichuan Hi-Tech Innovation Park in the newly developed Tianfu Great City, which supports innovation-centric and knowledge-intensive enterprise. It is owned by the Sino-Singaporean (Chengdu) Innovation Park Development Company, in which large firms from Singapore hold a 50% share, and the Chengdu Hi-Tech Investment Group holds the remaining 50%. It is planned to be one of China's leading centres for software and other information technology industries.

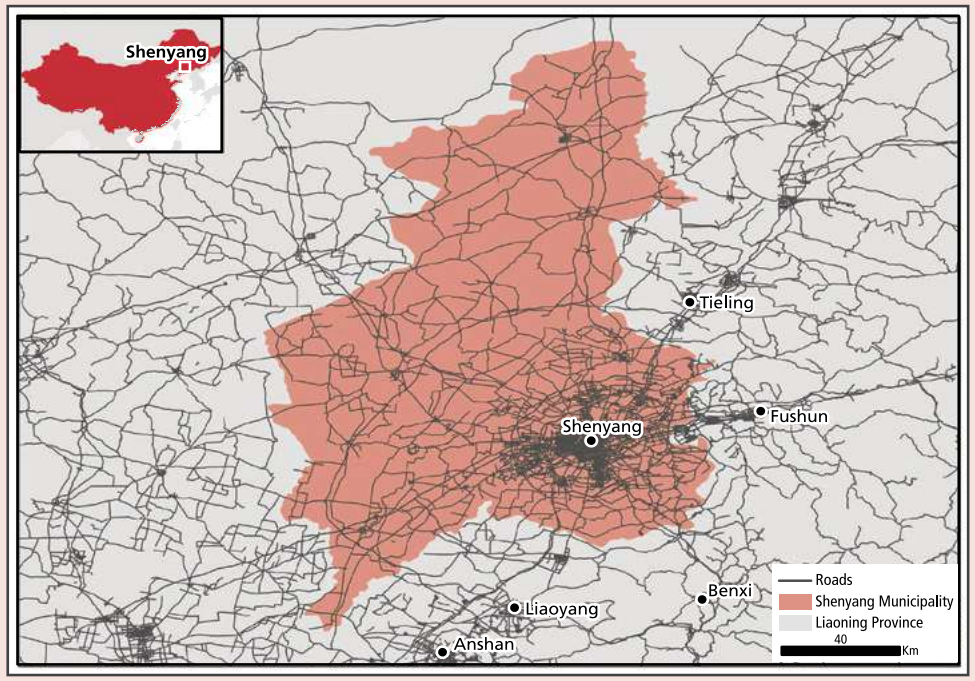
Chengdu's innovation drive is focused on hi-tech sectors such as IT and bio-medicine, and is having some success in moving local industry up the value chain. Siemens, for example, operates one of its most advanced factories globally in Chengdu, with exceptional levels of productivity and quality, drawing on local innovations in intelligent manufacturing.

Chengdu is also promoting innovation in industries apart from manufacturing. Financial Dreamworks (also known as the Chengdu Financial City) has recently been launched as the first space in China dedicated to innovation in the financial sector. The aim is to develop Chengdu as the financial centre of central and western China, and the fourth-largest financial hub in China after Beijing, Shanghai and Guangzhou-Shenzhen. Financial Dreamworks already has over 350 financial institutions located there. The municipality is also paying attention to cultural industries, positioning Chengdu (already famous for its Sichuan-style cuisine) as a 'City of Gastronomy' through innovation in the catering and entertainment industry.

Innovation across sectors is increasingly happening through partnerships between industry, government and universities. Chengdu does have a strong educational sector, with around 40 colleges and universities, and around 500 000 students (with more than 20% in IT-related courses).

SHENYANG

沈阳



CONTEXT

LOCATION AND STATUS

Shenyang, formerly known as Mukden, is located in north-east China (Manchuria). It is the capital of Liaoning Province.

HISTORY

In ancient times, Shenyang was a frontier settlement. It marked the northern limit of Chinese rule, and was established as a defensive outpost along the Great Wall. In the 13th century it was conquered by the Mongols and was given the name Shenyang. In the 17th century it was conquered by the Manchus, who renamed the city Mukden. From Mukden the Manchus conquered China, creating the Qing Dynasty in 1644. As the birthplace of the dynasty it was a very important city in China, and the site of the Mukden Imperial Palace. But it was the national capital for only around twenty years, losing its status to Beijing.

Towards the end of the 19th century and into the 20th century, Shenyang was caught up in the struggle between Russia and Japan for control of Manchuria. In the late 19th century Russia dominated Manchuria, and the industrialisation of the city began. After the Russo-Japanese War (1904-05) the Japanese established a concession in the city, and used Shenyang – which they called Mukden – as their base for expansion in Manchuria. In 1932 the Japanese created the puppet state of Manchukuo, with Mukden as one of its most important cities.

There was turbulence after World War II, with a period of Soviet rule, followed by Nationalist (Kuomintang) and then Chinese Communist control. Mao Zedong restored the name Shenyang in 1950. Shenyang was already a hub of heavy industry, and remained central to China's industrialisation strategy in the 1950s. In the 1960s and 1970s it was at its peak, as the third-largest city in China and a significant urban centre, even in global terms. The economic reforms after 1978, with the retreat of state-owned industry, had a severely negative effect on Shenyang, a city whose industrial infrastructure and management apparatus was becoming increasingly obsolete. While many other cities in China boomed, this old city went into decline, becoming part of China's 'rust belt'. Thousands of workers lost their jobs, as large state-owned factories – including some of China's largest steel mills – were allowed to go bankrupt. In the early 2000s, however, China's State Council implemented a revitalisation plan for Shenyang, kick-started when German manufacturer BMW set up a large plant in the city, targeting China's domestic market. Many other companies followed, and the city seemed set for a new era of growth. However, Shenyang has been negatively affected once more, by China's current economic slowdown; and prospects are uncertain – although improved by Shenyang's notable success in turning one of the most environmentally degraded cities in China into one of the greenest.

POPULATION

POPULATION SIZE

The UN Population Division estimates a 2015 population of 6.32 million for the Shenyang urban agglomeration.

POPULATION RANKING

In terms of UN data the Shenyang urban agglomeration is ranked 54th in the world, 25th in the BRICS, and 12th in China.

POPULATION GROWTH

Shenzhen grew at an average annual rate of 2.13% in the period 2010 to 2015.

POPULATION DIVERSITY

In 2010, Shenyang's population was 90.5% Han Chinese, with 9.5% minorities including 5% Manchu, followed by Mongolian, Korean, Hui (Chinese Muslim) and Xibo. The proportion of foreign-born is miniscule.

STRUCTURE OF THE URBAN AGGLOMERATION

Shenyang has the typical concentric spatial form of a Chinese city, with a series of ring roads around the centre. It is a monocentric city, with the Hunhe River dividing the historical centres to the north from the new areas to the south.

The bulk of the population lives within the five central districts. The most densely populated (and also the commercial centre) is Shenhe, which is the historical core of the city and was contained within the old walls. Tiexi district in the north-west of the city is where industry was developed from the 1930s. At its peak it employed nearly a million workers, but almost all these jobs were lost by the 1990s. However, the district is now the site of the Shenyang Economic and Technological Development Area. The most important addition to the city was in 2000, when the Hunnan New Area was opened south of the river. It includes a number of hi-tech industrial parks, and now has a population of over 400 000 people.

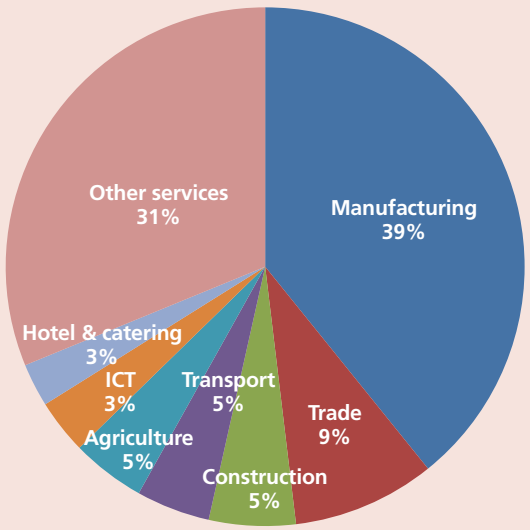
Beyond the immediate urban agglomeration is a 100-kilometre-radius city-region, with seven industrial cities: Anshan (1.56 million people); Fushun (1.3 million); Benxi (1.07 million); Yingkou

(1.03 million); Fuxin (0.8 million); Liaoyang (0.8 million); and Tieling (0.4 million). There is also an Extended Metropolitan Region (EMR), which is an urban corridor linking Shenyang to the dynamic port city of Dalian (population 4.1 million). This corridor has been referred to as one of East Asia's Extended Metropolitan Regions (EMRs), and has a total population of around 24 million.

ECONOMY

According to the Brookings Institution, the 2014 GDP for Shenyang was USD 189.3 billion (PPP). Shenyang's economy was comparable in size to that of Mumbai and Rio de Janeiro, and larger than South Africa's Central Witwatersrand.

SECTORAL SHARE OF GDP, 2014



Source: Shenyang Municipal Year Book

Shenyang remains a manufacturing hub, despite the decline in heavy industry over a number of decades.

Shenyang developed early into China's primary hub of heavy industry (iron and steel, oil, petrochemicals, shipbuilding, machine tools, aviation, and automobile manufacturing), drawing on the abundant natural resources (oil, coal, iron ore) in the greater Manchurian region. However, it went through a major and painful economic transition with the reform of state-owned enterprise in the 1980s and 1990s (in contrast, for example, to the port city of Dalian at the other end of the corridor, which experienced positive economic growth at this time, with high levels of investment). It was part of the 'rust belt' of reform-era China.

In 2003, China's State Council responded to the economic misfortunes of the city and its region with the 'Revitalise the North-East Plan'. The intention was to restart the economy by supporting new investment in industrials such as specialist steel manufacturing, petrochemicals, power-generation equipment, automobiles, software electronics, bio-engineering, and green-economy industries.

There was early success, including the decision by BMW to locate its largest production facility outside Germany in Shenyang, to cater to the growing Chinese market. By 2010 there were also four state-level SEZs in the city: Shenyang Economic and Technological Development Zone; Shenyang Hi-Tech Industrial Development Zone; Shenyang Export Processing Zone; and Shenyang Cross-strait Technological Park. An extended SEZ was proclaimed in 2010 – with Shenyang at the core, but with seven other participating cities.

The economy appeared to be doing well, with GDP growth of over 12% in the period 2008 to 2011, although the increase in jobs was only 0.9%. But the economic slowdown in China has had a disproportionately negative effect on Shenyang and neighbouring cities. After promising signs of a renaissance, China's old rust belt appears to be suffering a major setback, with Liaoning having the lowest growth of all provinces in China in 2015. In Shenyang, housing prices fell by 7.6% in 2015, with an oversupply in residential and commercial properties leading to high levels of vacancy and the threat of urban blight. The major reasons for this contraction include dropping oil prices, continued dependence on heavy industries badly affected by the economic slowdown, and the still disproportionate dependence on state-owned enterprises (50%, compared with the national average of 30%), many of which are struggling to adjust to new conditions.

GOVERNANCE

The overall urban governance structure for China is explained on the coversheet. In the governmental hierarchy the Municipality of Shenyang has sub-provincial status, reporting to central government through the Province of Liaoning. The emergent concept of city-clusters may be leading gradually to new forms of government through cooperation agreements between Shenyang and neighbouring municipalities.

DEVELOPMENT CHALLENGES

Shenyang is facing the troubling legacies of its industrial past. As indicated above, its orientation towards heavy industry has left it economically vulnerable, and job insecurity is a challenge for its residents. There is also the environmental cost of a long industrial history. Shenyang's Environmental Profile, prepared in 1997, is a sobering read. At the time there were massive challenges in terms of air pollution, water pollution, water scarcity, energy inefficiency, and waste production. However, Shenyang has prioritised efforts to clean the area's environment, with its Environmental Protection Bureau receiving global acclaim for its efforts. Air quality, for example, is now significantly better than in Beijing, ranking 28th-worst for a major city in China compared with 13th-worst for Beijing. A particular challenge now is the threat of urban dereliction, because of high vacancies in residential and commercial properties.

Shenyang does have a floating population but in 2015 this accounted for only 11.9% of the total municipal population, as the economic troubles in the city have dampened its attractiveness to migrants.

THEMATIC REPORTS

TRANSPORT

ECONOMIC LOGISTICS

Shenyang is the regional transportation hub in north-east China. It is at the centre of a network of roads and rail, and is the site of the Shenyang Taoxian International Airport, which is the 24th-largest in China, with 12.7 million passengers in 2015. The first inter-city high-speed railway in China opened in 2003, linking Shenyang with the Port of Qinhuangdao over a 400-kilometre track. The 700-kilometre Beijing-Shenyang high-speed line is under construction after long delays and protests by residents along the track, with an anticipated completion date of 2018.

PUBLIC TRANSPORT

Arthur Little (2014) uses a range of mobility indicators in a transport ranking that rates Shenyang as an average performer for a Chinese city. The modal split of 33% of total trips (43% in 2015, according to the government report) for public transport is similar to that of Shanghai, and close to

the average for large Chinese cities. On the downside is the higher-than-average level of pollution from the transport sector; the second-lowest safety levels in transport among the surveyed cities (74.5 traffic deaths per million citizens); the lowest level of bicycle use; and the second-lowest level of smart-card penetration. However, Shenyang sits alongside Tianjin as the city with the most rapid increase in the use of public transport, and the most dynamic development of public transport systems. Between 2005 and 2012 the modal share of public transport climbed steeply, from 19% to 33%. Shenyang's success is the huge improvement in public transport in recent years, partly prompted by the improvements needed to host the 12th China National Games in 2013.

BUS

The tram service was introduced in 1924 but was eventually closed in 1974, and replaced with buses and trolley buses. In 1999 the entire trolley-bus network was demolished, after five passengers died by accidental electrocution. The network was replaced with diesel-powered buses, and today there are over 3 000 buses on 160 lines.

METRO

As early as 1940 a Japanese company planned to build a metro in Shenyang. In 1965 the Chinese government revived the plan, deciding to build metros for the four largest cities in China at the time (Beijing, Tianjin, Shanghai and Shenyang); but they were only built for Beijing and Tianjin. Finally, in 2005, construction on the Shenyang Metro began, with Line 1 opened in 2009 and Line 2 following in 2011. By 2015, there was a daily ridership of 762 000 along the two lines.

LIGHT RAIL

In 2011 the Shenyang city government announced a plan to build a Light Rail Transit (LRT) system, in the form of a tramway. The 70-kilometre system with 65 stations was opened in August 2013, in time for the 12th China National Games. Daily ridership is around 150 000. This was the first system of its sort in mainland China, following the development of a modern tramway in Hong Kong. The city government has 51% ownership of the tramway, and 49% by a joint venture including French company the RATP Group, which also operates transport systems in Hong Kong and Nanjing.

PLANS

The structure of the public transport system for Shenyang is now in place, and future plans are for extensions. The key focus into the future will be the integration of the transportation system for Shenyang with the seven other cities in the wider city-region.

GREEN ENERGY

Shenyang has a long history of coal-fired electricity generation, but may be regarded as one of the most courageous cities globally in addressing the environmental consequences of this history.

In 2014, Shenyang city administration announced plans to shut down 800 coal-fired furnaces, replacing them with natural gas or electric furnaces. This followed a study which showed that coal accounts for 60% of the PM2.5 pollution levels in the winter months. Many of the spaces made available by these closures are to be turned into public parks. It is expected that this measure will reduce coal consumption by 1.5 million metric tons, and significantly reduce sulphur dioxide and PM 2.5 pollution. The number of days with blue skies is expected to increase by 49 to 240 by 2017. This initiative was made possible partly by large-scale funding from central government for air-pollution projects, but also represents the strength in Shenyang of its Environmental Protection Bureau.

Shenyang is also exporting its growing expertise in green energy. In 2009, for example, a joint venture was announced between the Shenyang Power Group and an American company to develop a 600MW wind farm in West Texas, at a cost of USD 1.5 billion. This is the largest China-USA joint investment in renewable energy in America.

INNOVATION-DRIVEN ECONOMY

Shenyang is a city still burdened by its history as a hub of state-owned heavy industry, and is not one of the leading hubs of innovation in China. The 2thinknow index for 2015 ranked Shenyang only 359th globally, and 21st among cities in China. In 2015, R&D expenditure as a proportion of GDP was 2%, close to China's average.

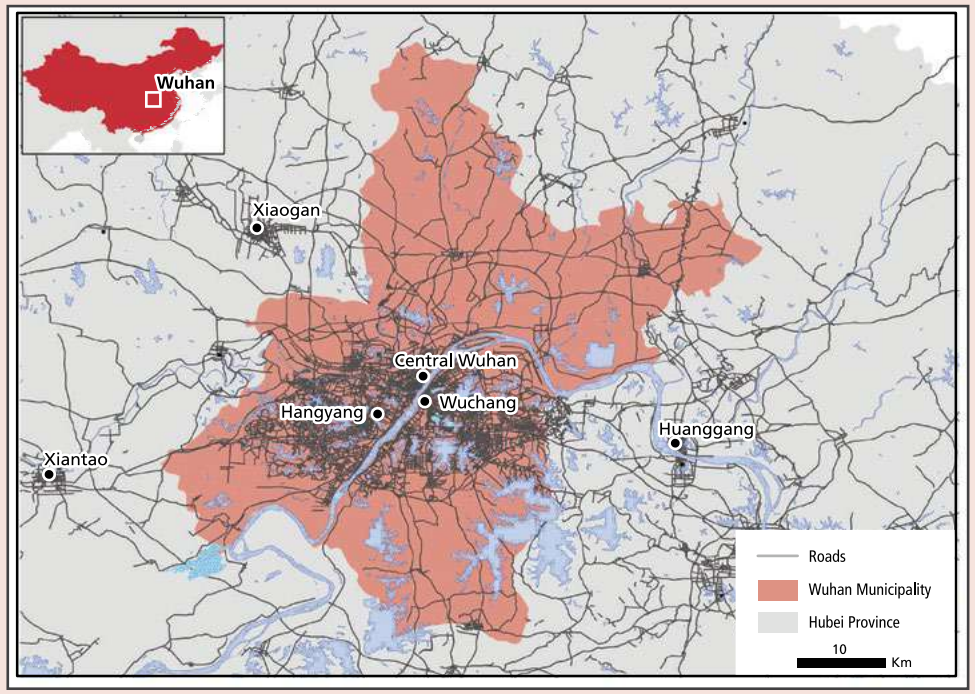
These challenges notwithstanding, there is a strong focus nationally and locally on promoting innovation in Shenyang, with a deliberate strategy to move away systematically from an obsolete economic base to a new economy. The municipality and provincial government are supporting a number of initiatives, including the development of the Shenyang International Software Park and the Shenshui Eco-Technology Innovation City.

Various partnerships are assisting in the development of innovation economies. Some of these involve strategic alliances between transnational and Chinese firms, such as the strategic alliance for robot industrial technology innovation between Royal Philips Electronics and Neusoft, a large Chinese corporation headquartered in Shenyang. While there is no top-rated university in Shenyang, there are a number of specialist universities (for example, the Shenyang Aerospace University, Shenyang Pharmaceutical University, and Shenyang Institute of Chemical Technology), which are increasingly entering into innovation partnerships with high-end business in the city. There is also a key collaboration between the municipality, IBM, and China's North-eastern University in a 'smart city' initiative. With BMW strongly invested in Shenyang, the relationship with Germany is important in supporting innovation-related initiatives. In 2016, the State Council approved the development of the Sino-German High-End Equipment Manufacturing Industrial Park, to help in the upgrade of Shenyang's old industrial base to a modern new economy.

In 2016, the central government gave new content to the city cluster initiative when it approved the construction of the Shenyang-Dalian National Innovation Demonstration Zone, which will see the construction of national-level hi-tech industry development zones in both cities, and the establishment of supportive linkages between the cities.

WUHAN

武汉



CONTEXT

LOCATION AND STATUS

Wuhan is in the eastern interior of China, at the confluence of the Han and Yangtze Rivers. It is the capital of Hubei Province.

HISTORY

Wuhan has an ancient history, with urban settlement of about 3 500 years. There were three cities that would eventually emerge to form present-day Wuhan – Wuchang, Hankou and Hanyang. Wuchang was an old provincial capital, while Hankou emerged by the 18th century as one of China's leading trading towns.

At the end of the 19th century the emerging urban region industrialised, as a far-sighted Governor of Hubei province set up mines (coal and iron) and industries (steel, arsenal and textiles), making Wuhan the birthplace of modern manufacturing in China. The railway was brought to the region, and Wuhan became an important transhipment hub for rail and river traffic. This attracted the attention of Western powers, who demanded mercantile concessions and set up foreign-controlled merchant districts in Hankou.

The urban region played a central role in the turbulence of the early 20th century. The uprising in 1911 that led to the collapse of the Qing dynasty began in Wuchang. For a while, in the 1920s, Wuhan was the capital of a regional government formed by a left-wing faction of the Kuomintang (Chinese nationalists), and the three cities were jointly administered as Wuhan; although they were separated again at the end of the decade, when Chiang Kai-shek's Kuomintang gained control. After the fall of Nanjing to the Japanese in 1937, Wuhan became the provisional capital of China. But it was soon the site of raging battles between the Chinese nationalists and the Japanese, falling to the Japanese in 1938. The Japanese made Wuhan a major logistics centre for their operations, and the city was badly damaged in 1944 when the Americans launched air strikes.

In 1949, when the urban region fell under the control of Mao Zedong's Communist Party, the three cities were reunited again as Wuhan. In 1957, the 1.1-kilometre Yangtze River Bridge was opened at Wuhan, linking China's previously separate railway systems and reinforcing Wuhan's position as a transport hub linking in all directions through China. There were eventually to be seven bridges and one tunnel across this great river. In 1967, at the height of the Cultural Revolution, there was civil strife between the People's Liberation Army and a left-wing faction, leading to the death of nearly a thousand people. In Reform-Era China, a number of development zones were established in Wuhan, beginning with the Donghu New Technology Development Zone (also known as Optics Valley) in 1988. Wuhan has retained its manufacturing base, but is also a major logistics, educational and governance hub. It is more than a provincial core, serving as the primary hub for Central China.

POPULATION

POPULATION SIZE

According to UN data the population of the Wuhan urban agglomeration in 2015 was 7.9 million. Note that this is less than the municipal population of around 10.6 million.

POPULATION RANKING

Wuhan is the 41st-largest urban agglomeration in the world, the 17th-largest in the BRICS, and the seventh-largest in China.

POPULATION GROWTH

In the period 2010 to 2015, the Wuhan urban agglomeration was only growing at 1.01% per annum, significantly less than its peak growth of around 6.6% per annum in the 1990s.

POPULATION DIVERSITY

According to the 2010 census, 99.1% of the population was Han Chinese, with the largest minorities being Hui (Chinese Muslim) and Tujia.

STRUCTURE OF THE URBAN AGGLOMERATION

The Yangtze River is the dominating physical element in the urban agglomeration, although there is also the Han River and many large lakes around which the city has developed. A quarter of the area of the city is covered by water. The three historical cities were divided from each other by the two rivers.

With the bridging of the Yangtze River in 1957 the old city cores became increasingly interconnected, and new development happened concentrically around the historical cores, reinforced by ring-road development connecting across the Yangtze River with new crossings. However, the three centres have each developed their own functions – Wuchang is the educational and administrative centre; Hankou is the commercial centre; and Hanyang is the industrial core. Since around 1990 there has been rapid spatial development. The 1995 Master Plan for Wuhan attempted to structure this growth through the development of seven satellite towns on the growing edge of the city.

These towns did not grow as expected; and since 2011, spatial planning for the city has combined the satellite towns into axes extending from the centre along major transport routes. Currently, the planning supports seven new town clusters strongly linked to the centre with private and public transport links. Also, with structural change in the economy, the old industrial areas in the core were replaced by residential real estate, with industry relocating to the urban periphery. The spatial structure is therefore a hybrid of ring-, satellite- and axial-type developments.

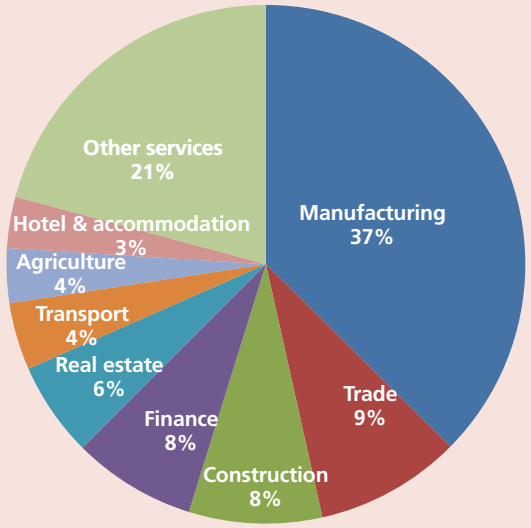
Wuhan has been identified as the hub of a city-region known as the 1+8 Wuhan City Circle. Apart from the core city of Wuhan it includes the cities of Huangshi (700 000), Ezhou, Huanggang, Xiaogan, Xianning (340 000), Xiantao, Tianmen and Qianjiang. The Wuhan City-Region in Hubei Province in turn forms part of a city-cluster that also includes the Changshan-Zhuzhou-Xiangtan City-Region (Hunan Province), and the Pan Boyang Lake City-Region (Hunan Province, Jiangxi and Anhui Provinces).

ECONOMY

According to the Brookings Institution, the 2014 GDP for Wuhan was USD 231.55 billion (PPP). Wuhan is an important second-ranking city in China. It is the ninth-largest urban economy in China and the largest in mid-China. Among the BRICS cities, it ranks 13th.

Wuhan had a strong pre-existing industrial economy, but with the focus on coastal cities in the early reform period, its development lagged. After 2000, however, Wuhan was a pilot city for reform in central China. Growth accelerated, reaching a peak of 15.8% in 2007; then after a slight dip, rose again to 14.7% in 2010. It has since slowed to 8.8% in 2015 – as a result of broader economic conditions, but also of problems in the steel-making and automobile industries. Growth in Wuhan still remains above the national average, and the city has an advantageous mix of manufacturing, trade and financial services.

SECTORAL STRUCTURE OF THE CITY ECONOMY, 2015



Source: Wuhan Municipal Year Book

Wuhan remains a manufacturing city, despite a relatively strong service sector. Wuhan's industrial pillar has been the iron and steel industry, with the Wuhan Iron and Steel Corporation (WISCO) the third-largest steel producer in China. However, steel is a troubled sector, and the city is attempting to reduce its dependence on this industry as WISCO and other producers restructure and downsize.

A number of downstream industries emerged from steel production, including equipment manufacturing (machine tools, mining equipment, petrochemical machinery, heavy engineering machinery, etc.); shipbuilding; and automobile manufacturing. It is the automobile industry that has emerged as the second-most important after steel-making, accounting for around 20% of Wuhan's total economic output. Wuhan now has ten automobile plants (including General Motors, Renault, Citroën, Shanghai Automotive Industry Corporation, and Dongfeng) producing around 1.1 million vehicles annually, making it the world's seventh-largest automobile-producing hub, and the second-largest in China after Chongqing. The domestic producer Dongfeng has significant joint ventures with Renault, Citroën, Nissan, Honda and Kia. Around the automobile plants is a cluster of component manufacturers.

While traditional industries remain important to Wuhan, the government has been actively supporting investment in the hi-tech sector. The development is focused in Wuhan's three national-level development zones (although there are also around 12 provincial-level zones). These are the Wuhan Economic and Technological Development Zone (known as the Zhuankou Development Zone); the East Lake Hi-Tech Development Zone (known as the 'Optical Valley of China'); and the Wuhan Wujiashan Economic and Technological Development Zone. Wuhan's optoelectronic information industry is world-leading, with Wuhan enjoying a 25% global market share in optical fibre and optical devices. Other growing industries in these zones include biological pharmacy, bio-energy, and other medical devices including laser equipment. The Wuhan BioLake is the third largest bio-industry park in China.

The development of manufacturing is strongly supported by FDI. Wuhan attracts a disproportionately large proportion of FDI from France, with the city accounting for around one-third of all French investment in China.

While manufacturing remains the single largest sector, Wuhan is also competitive in terms of trade, financial services and educational services. Many of the large department stores in China have their origins in Wuhan, reflecting the long trading history of this city. The city has also emerged as an important regional financial sector, with more than 400 registered financial institutions. The city is also highly ranked as an educational hub in China.

GOVERNANCE

The urban governance structure for China is explained on the coversheet. Wuhan is a sub-provincial city, with status between that of a prefecture-level city, and cities such as Beijing and Shanghai, which have the status of provinces. In parallel with the formal governance hierarchy, however, the urban governance system has evolved with the concept of the city-region and of clusters of cities, with outcomes that are not certain as yet.

URBAN CHALLENGES

Wuhan is a successful city economically, although it has extremely high levels of public debt (in excess of 220% of municipal revenues), which could threaten sustainability. It also faces the challenges of a fast-growing industrial city.

Air quality is a challenge. In the Greenpeace ranking of China's cities, which draws information from the official source, Wuhan is the 14th-worst city in China after Beijing, with an annual average PM2.5 level of 88.7. At the confluence of two major rivers, Wuhan also faces severe waterlogging and flooding problems, although it is implementing new measures such as expanding existing lakes to accommodate excess water, and building a deep-level drainage system. There are also severe road-congestion problems, exacerbated at times by flooding.

THEMATIC REPORTS

TRANSPORT

ECONOMIC INFRASTRUCTURE

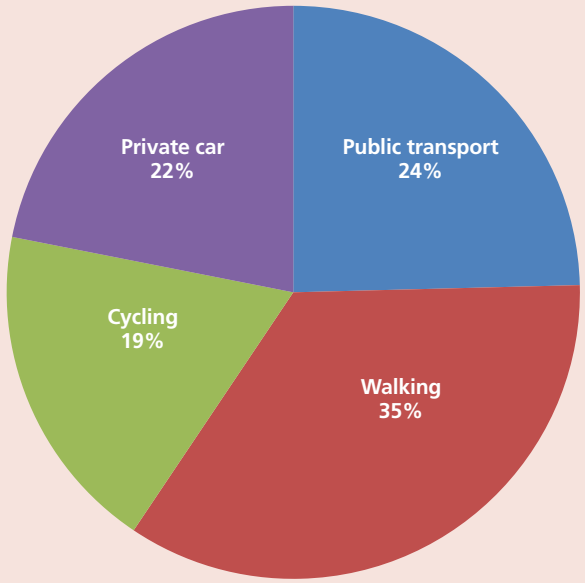
With its position in Central China at the confluence of the Yangtze and Han Rivers, Wuhan has historically been an important hub of river trade. The Port of Wuhan is still a major transhipment hub for cargo, including coal, steel, chemicals and automobiles. In 1957, the Wuhan Yangtze River Bridge was the first bridge in China across the Yangtze River, establishing the city as a critical node in the national transportation network.

Although there are now many other bridge crossings, Wuhan remains a central point in China's transport network, including within China's high-speed rail network. The nearly 1 000-kilometre Wuhan-Guangzhou high-speed rail opened in 2009, as one of the earliest of its sort in China. In 2013 the massive Shanghai-Wuhan-Chengdu line was opened, with other high-speed rail links between Wuhan and the cities of Hefei and Yichang, which also links Wuhan into networks connected to Beijing. The Wuhan Tianhe International Airport, opened in 1995, is the 13th-largest in China in terms of passenger numbers, carrying around 19 million people annually.

PUBLIC TRANSPORT

Wuhan is a highly congested city, and until recently focused mainly on supporting private transport through large-scale investment in new ring roads. Even at the beginning of the 11th Five-Year Plan period (2011-2015), investment in public transport construction only accounted for less than 20% of the total urban transport construction – although during this period, investment in rail grew rapidly.

MODAL SPLIT, 2014



Source: Wuhan Municipal Year Book

BUSES (INCLUDING BRT)

Bus remains the dominant form of public transport, accounting for 77% of public transport rides, although there is a shift to rail. In 2015 there were 467 bus routes and over 8 300 buses, all run by the Wuhan Public Transport Group Company (WPTGC). In 2007, the privately-owned bus companies that served the new towns around Wuhan were integrated into the public company. There have been some recent innovations. In 2013, for example, the WPTGC launched 42 'micro' circular routes that serve in the 'last kilometre' of travel for residents. A BRT system is also being introduced, with the first route of just over 10km opened in 2013, and another 3 routes planned connecting to metro stations.

METRO

The Wuhan Metro opened in 2004 – the fifth in China, as a system with both underground and elevated rail. It developed slowly, with a total length of about 29km by 2010. In December 2012 Line 2 opened, increasing track length to 57km. This was also the first metro line to cross the Yangtze River. The system has developed rapidly since then, with a fourth line opening in 2016, increasing the system to 125km. The daily ridership in 2015 was 1.56 million. The system is operated by the state-owned Wuhan Metro Company.

OTHER

There is a year-old 100 year-old public ferry service, although it has declined in importance thanks to the road and rail links across the two rivers. Wuhan has also introduced a public bike-sharing service. Although the local government has given active support to the scheme, the service is run by two private companies. The system has expanded rapidly, with around 70 000 bicycles and a daily ridership of over 110 000; but the 'Wuhan model' has had challenges, as the private companies have struggled to remain profitable.

PLANS

Although Wuhan came late to public transport, there are now ambitious investment programmes and plans. The national Ministry of Transportation has designated Wuhan as one of China's pilot Public Transportation Cities. There is massive expansion planned for the Wuhan Metro, with an eventual 25 lines and a route of over 1 000km planned. To achieve this objective, at least two new lines are being opened annually. Although rail will be the backbone, the system is intended to be multimodal. The BRT, for example, is planned to have nearly 200km of track and eight routes by 2020, and expansion is also planned for the public cycling network and the ferries. Trams are to be introduced in newly-developed areas, as they are more affordable than introducing underground metro services. In addition to further investment in infrastructure, there are ambitious plans to improve efficiency, and other measures to contain road congestion, such as electronic toll collection.

GREEN ENERGY

Wuhan has high energy consumption because of its heavy-industry-based economic structure. The bulk of the energy is sourced from outside the city because of the lack of coal, oil or gas in the environs of Wuhan. However, the world's largest hydro-power project, the Three Gorges Dam on the Yangtze River, is shifting Wuhan's electricity profile towards hydro, and the use of coal is trending downwards.

The city is actively promoting renewable energy sources, especially since its designation (in 2010) as one of China's first National Renewable Energy Application Demonstration Cities. As early as 2006 the municipality was supporting solar energy production linked to new construction projects. This has been up-scaled, with regulations requiring all buildings to have solar heating systems, and all buildings higher than 12 stories to have other forms of solar production. All three major railway stations in the city have applied advanced geo-thermal technology

for the production of solar energy. With productive agriculture in its hinterland, Wuhan has significant opportunities for biomass production. Across the region there are now a number of modest-sized biomass plants using straw, methane plants using waste from pig farms, and also bio-fuel plants from waste oils and fats.

The Municipality of Wuhan is working hard to attract R&D into the energy field, and to bring domestic and international investment into green-energy-related industries in the city. As a result, Wuhan is an emergent green-energy technology innovation hub.

Wuhan is also a leader in terms of promoting energy efficiency, with increasingly stringent regulations for energy use in manufacturing and buildings. The response has been impressive. WISCO, for example, is partnering with the General Electric Corporation (GE) to build a biomass power plant that could significantly reduce industrial emissions in the city. There are also a number of remarkable low- or zero-energy demonstration buildings – including the Wuhan Greenland Centre, which is planned as the world's fourth-largest building; and the new Energy Centre at Wuhan University, located in the 140-metre Energy Flower, designed to resemble a lily, which is said to be the most energy-efficient building in the world. The development of a smart grid by the municipality, supported by GE, is also supporting the shift towards energy efficiency.

There are ambitious targets in terms of electric vehicles and the shift to bio-fuels. The Dongfeng Motor Corporation, for example, is partnering with Detroit Electrical Corporation in the production of 100 000 hybrid and 50 000 fully electric vehicles, while Renault-Nissan is building an electric plant in Wuhan. There are also now a number of bio-fuel production facilities in Wuhan and surrounding cities.

INNOVATION-DRIVEN ECONOMY

Wuhan is a city experiencing strong growth momentum, but it is still relatively weak in terms of innovation economies, lagging behind major cities in China such as Beijing and Shanghai, and also behind second-tier cities such as Shenzhen and Hangzhou. A major challenge for Wuhan is clearly the need to move up the value chain, through building innovation capabilities. Wuhan ranks 293rd on the 2thinknow Innovation Cities Global Index – far behind China's top cities, but also behind Dalian, Xi'an, Dongguan, Chongqing and Xiamen.

Expenditure on R&D is relatively high at 3% of GDP, but many of the innovative products developed in Wuhan are used elsewhere rather than in city industries. A major challenge for innovation stems from the ownership structure of firms in Wuhan. Nine of the top 10 firms in the city are state-owned. Unlike the large state-owned firms in Beijing, those in Wuhan are mainly in traditional industries, and do not have a strong tradition of investment in R&D, or of innovation.

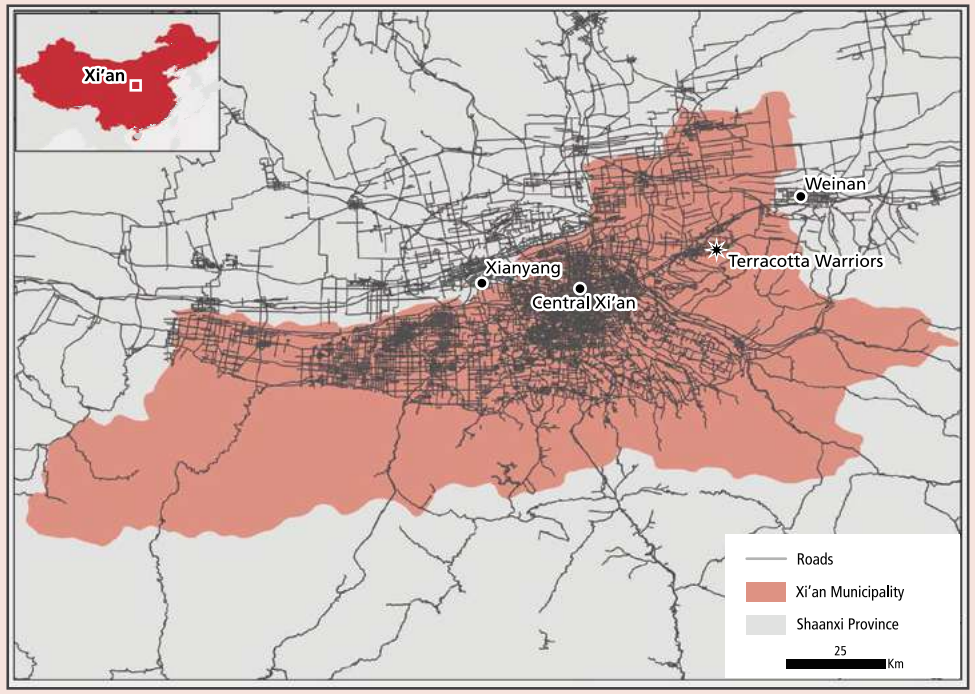
However, Wuhan does have areas of innovation that are emerging strongly, including in optical electronics, bio-industry, and green-energy vehicles; concentrated, for example, in clusters such as the Wuhan BioLake.

There is one area in which Wuhan has a major national advantage. After the major centres of Beijing and Shanghai, Wuhan is one of China's most celebrated centres of education. It is said to have the largest student population in the world. It is not simply about quantity; Wuhan hosts two of the QS Top 50 BRICS Universities for 2016 – Wuhan University (16th), and Huazhong University of Science and Technology (34th). There are also other up-and-coming universities including the Wuhan University of Technology, which is a recent amalgamation of specialist universities including a transportation university and an automotive university. Apart from universities there are other major research centres in Wuhan, such as the National Centre for Optical Communication Research in China. It is this strength in education and research that positions Wuhan as a potential new centre of innovation in China.

There are serious attempts to release this potential. In December 2009, Wuhan became China's second city with a National Independent Innovation Demonstration Zone (after Beijing's Zhongguancun). In 2011, Wuhan became the first of China's 16 pilot regions for 'promoting integration of S&T and finances'. In 2012 it was selected as one of the first National Culture and S&T Integration Demonstration Bases, and also become one of the first national Intellectual Property Demonstration Cities. In 2015 it was selected as a demonstration city for start-up and innovation for small and micro enterprise, and as an experimental zone for innovation and reform in finances. Also in 2015 it was selected as one of eight zones across China (the only one in mid-China) for experimentation with innovation across sectors. As a result of these designations, a number of R&D centres, incubators and technology transfer bases have been built.

XI'AN

西安



CONTEXT

LOCATION AND STATUS

Xi'an is located almost in the geographic centre of China, in the centre of the Guanzhong Plain. It is the capital of Shaanxi Province.

HISTORY

The Guanzhong Plain is often referred to as the 'cradle of China's civilisation'. It is an ancient hub of human activity and creativity. This was the region where the Zhou people lived; and when they conquered China around 3 100 years ago, they established Xi'an as the national capital. Xi'an was the political, economic and cultural hub of China, remaining the capital for around 1 200 years across thirteen dynasties. Xi'an was also the first city in China to open to the world, as the starting point of the famous Silk Road that connected central Asia to Europe.

During the short-lived Qin Dynasty (221-206 BC) the first emperor of a united China, Qin Shi Huang, ordered the construction of the famous terracotta warriors. During the Tang Dynasty (AD 818-904), Xi'an, then known as Chang-an, was the largest city in the world, with a population of one million. Xi'an was destroyed at the end of the dynasty; and when it was eventually rebuilt, during the Ming Dynasty, it was a shadow of its former glory.

In more recent times, during the Japanese invasion, Xi'an was so far inland that it was spared damage. Instead, large numbers of refugees arrived in the city from other provinces, boosting the city population. In the 1950s Mao Zedong supported the development of Xi'an, in an effort to rebalance development across the regions of China – but also because Xi'an was far less vulnerable to attack from foreign armies than the coastal cities. A number of industries were relocated to Xi'an, as well as important educational institutions such as the Xi'an Jiatong University, which was relocated from its original campus in Shanghai.

The strategic significance of Xi'an declined in the early years of economic reform after 1978. The focus at the time was on export-oriented industrialisation and the opening of the port cities to the global economy, with Xi'an, in the geographic centre of China, not well-placed. In 2000, China's State Council launched its 'Go West' policy, and this created the conditions for a massive new growth surge for Xi'an. Huge state investments went into western China, with Xi'an being one of the hubs of new growth. Annual growth in GDP has been greater than 13% since 2000, making Xi'an one of the faster-growing city economies in the world.

Xi'an also emerged as a national and global tourism hub, following the extraordinary discovery of the Terracotta Army in 1974, and the proclamation of the excavations as a UNESCO World Heritage Site in 1987.

POPULATION

POPULATION SIZE

The UN Population Division estimates a 2015 population of 6.04 million for the Xi'an urban agglomeration.

POPULATION RANKING

In terms of UN data the Xi'an urban agglomeration is ranked 56th in the world, 26th in the BRICS, and 13th in China.

POPULATION GROWTH

Xi'an has grown at the moderately fast annual rate of 3.2% in the period 2010 to 2015, down from peak rates of over 7%.

POPULATION DIVERSITY

In 2010, 98.5% of the population was Han Chinese, with 1% Hui (Chinese Muslim) and the remainder a scattering of other minorities. The proportion of the foreign-born population is miniscule.

STRUCTURE OF THE URBAN AGGLOMERATION

The basic structure is of a dominant core with outward sprawl and a highly irregular urban edge, as villages develop as urban centres in a largely haphazard way. In ancient times the city was contained within the city walls, which were destroyed at the end of the Tang Dynasty and rebuilt during the Ming Dynasty. The 12km2 within the walls remains the commercial and political centre of the city, although the city has since expanded far beyond these limits.

Beyond X'ian there are two small cities. Almost immediately outside of X'ian, north of the Weihe River, is Xianyang, with a population of around 324 000 people. Then there is Weinan, 50km to the east, with about 356 000. In 2010, China's State Council approved a plan for the Greater Xi'an Metropolitan area, which includes all the administrative districts of Xi'an, the two satellite cities, and a number of smaller settlements. The total population of the metropolitan area is around 10 million.

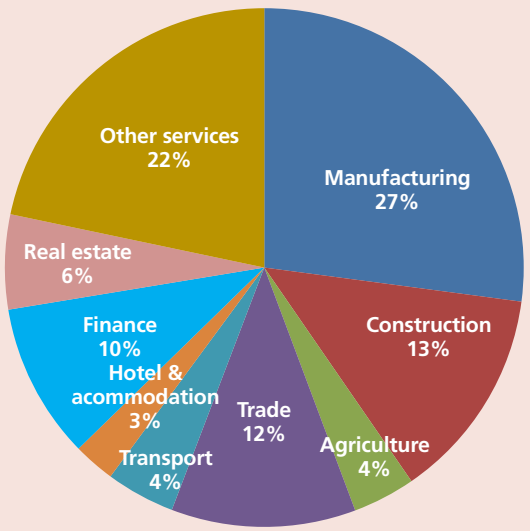
ECONOMY

According to the Brookings Institution, the GDP for Xi'an in 2014 was USD 124.19 billion (PPP). While it lagged behind other large Chinese cities, its growth performance was impressive. During the period 2011 to 2015 (12th Five-Year Plan), the average annual GDP growth for Xi'an was 10.96%. Within the BRICS it ranks around 20th, similar in size to Rio de Janeiro and the Central Witwatersrand.

The recent surge of economic development in Xi'an followed the launch of China's 'Go West' policy in 2000. Large-scale government funding was poured into key locations in Western China including Xi'an, and this stimulated massive growth in GDP. Since 2000, the GDP of Xi'an has been growing faster than 10% per annum. In the period 2001 to 2005, the average growth was 13.5%, increasing to 15% between 2006 and 2010, and declining to around 12% after 2011. Even at these extraordinary rates, Xi'an was lagging behind Chongqing and Chengdu, the other two cities in the West Triangle Economic Zone.

Although X'ian does have a large and growing manufacturing sector, the tertiary sector is larger, and growing slightly faster.

STRUCTURE OF THE ECONOMY, 2014



Source: Xi'an Municipal Year Book

Since the 1950s Xi'an has been a hub of heavy industry, but the catalyst for the recent growth of the city was the establishment of the Xi'an Hi-Tech Industries Development Zone (HTIDZ) in 1988, which received national-level status in 1991. This zone offers incubation and other specialised services for software, pharmaceutical, biomedicine and other hi-tech industries. It has attracted around 6 000 enterprises, including transnational corporations such as Philips Electronics, Bosch, Fujitsu and Pepsi.

The second major initiative was the Xi'an Economic and Technological Development Zone (ETDZ), established in 1993 and elevated to national status in 2000. This was the first Export Processing Zone (EPZ) in north-west China, and it has brought in 1 800 companies including major transnational companies such as Coca-Cola, Hitachi, Mitsubishi and Siemens, focusing on petrochemicals, electronics, food and beverages, and biopharmaceuticals. The zone is being expanded to include a focus on non-manufacturing sectors such as education, trade, finance, entertainment and catering, with the city's new railway station also included in the ETDZ.

There are other key zones around the city, including: the Xi'an Yanliang National Aviation Hi-Tech Industrial Base, established in 2004 as the only one of its kind in China, which has positioned Xi'an as the largest aviation R&D and production base in China; and the Qujiang New District, focusing on the culture and tourism industries.

The rapid growth of the tertiary sector mainly had to do with spectacular growth in the tourism industry, cultural industries, and service outsourcing. In 2013, Shaanxi Province, of which Xi'an is the capital, had 282 million domestic tourists, an increase of 22.8% on 2012, and 3.5 million overseas tourists. Software outsourcing is one of the major growth industries in the city, and a Software New Town has recently been opened.

The launch of China's 'One Belt, One Road' initiative presents major opportunities for Xi'an, which is strategically placed at the eastern edge of the inland Silk Road trade route. Xi'an has been preparing for this initiative, including through the development of the Xi-Xi'an New Area, which includes logistics and trade parks.

GOVERNANCE

The overall urban governance structure for China is explained on the coversheet. Within the governmental hierarchy the Municipality of Xi'an has sub-provincial status reporting to central government through Shaanxi Province. There have been suggestions that Xi'an be elevated to a province-level municipality, given its status as the leading city in north-west China, but it is unlikely that this status will be conferred for some time.

DEVELOPMENT CHALLENGES

Xi'an has a combination of problems, relating to both relative underdevelopment and rapid growth. Despite its recent spurt of growth, Xi'an still lags well behind the large coastal cities in terms of development indicators. In 2014, Shaanxi Province (of which Xi'an is capital) had a GDP per capita (PPP) of USD 12 967, compared with USD 27 629 for Beijing, USD 26 896 for Shanghai, and USD 17 532 for Guangdong. It also lagged slightly behind other regions in the interior, such as Chongqing at USD 13 224. Around 7% of the city's population does not have a local hukou, and therefore lacks access to full services.

Xi'an has a serious air-pollution problem. Its Annual Mean PM10 is 113, which is high even for China, where Xi'an is ranked as the sixth-worst city.

THEMATIC REPORTS

TRANSPORTATION

ECONOMIC LOGISTICS

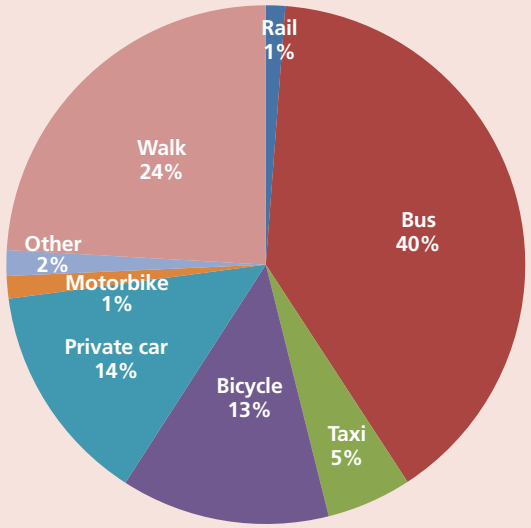
Xi'an has a central location in China, and is well linked to destinations across the country by road, rail and air. The Xi'an Xianyang International Airport is the eighth-largest in China, with nearly 33 million passengers in 2015. It connects across China and to other destinations in East Asia. Xi'an has no fewer than six major passenger-transport railway stations, including one of the eight major national railway stations. Xi'an North Railway Station connects to the high-speed trains of the Zhengzhou-Xi'an High Speed Railway (which also connects to Beijing), which was opened in 2010. The nearly-900-kilometre High-Speed Railway to Datong is under construction. Xi'an is also on the Eurasia rail link, which links through to Rotterdam in The Netherlands.

PUBLIC TRANSPORT

Xi'an has experienced a surge in private vehicle use over the past decade and a half, with resultant problems of pollution and congestion. The number of vehicles on the roads of Xi'an increased from 279 000 in 1999 to 1.86 million in 2013, facilitated by the rapid development of the three-ring-road freeway system.

The Arthur D. Little report on urban mobility ranked Xi'an below average for public transport among large cities in China. As the report states, "Xi'an is a car-loving city, where individual motorised transport accounts for 30% of all journeys, representing the highest value of all Chinese cities surveyed." Nevertheless, travel times to work are relatively low (around 29 minutes), with Xi'an ranking best in this regard out of the eleven cities surveyed. The city ranks poorly in terms of the use of bicycles, and also in terms of the use of existing public transport; and was the worst of all eleven cities in terms of carbon emissions per capita.

MODAL SHARE OF TRANSPORT, 2012



A particular feature of Xi'an is the significance of buses in the transport system, and the continued importance of bicycles.

BUSES

Xi'an has an extensive and economical bus system, which has been expanding progressively as the city has developed. There is local production of buses on a significant scale by Xi'an Silver Bus Corporation, jointly owned by the Volvo Bus Corporation and the Xi'an Aircraft Industry Group.

METRO

The major development is the ambitious metro expansion. Although planning of a metro system began in the mid-1980s, final approval was only granted in 2006. The intention is to create a 252-kilometre network covering the urban and suburban districts of Xi'an, and extending also to the city of Xianyang. New lines were opened in 2011 and 2013, and construction has begun on four further lines. Ridership is still relatively modest – an average of 849 000 commuters per day, in 2015 – but this is likely to increase significantly as the system extends. The metro is fully owned by the Xi'an Municipal People's Government.

GREEN ENERGY

Xi'an is in the heart of the coal fields of north-west China. While China as a whole is heavily dependent on coal as a source of energy generation, Xi'an is even more so. For Shaanxi Province as a whole, coal, petroleum and gas are the largest industries. In 2010, Shaanxi exported 23% of its electricity production to other parts of China.

However, there are major shifts under way which could have significant repercussions for the coal fields of Shaanxi. Data from 2014, and into the first half of 2015, suggest that there could be a major reversal happening in the use of coal across China. In the first half of 2015 domestic coal sales dropped by 8.1%, and domestic coal production by 5.8%. This is largely the result of the rise of renewables – wind, water and solar – in electricity production, but also the effects of more stringent environmental regulations.

The shift from coal may have short- to medium-term economic challenges to Xi'an and Shaanxi, but considerable environmental benefits. But it will not be an overnight process. There are at least five large coal-fired power stations still under construction in Shaanxi, to add to the existing eight. There was also one small hydro power station under construction, to add to the four small power stations on the Han and Yellow Rivers.

Within the municipal area of Xi'an, 184.5 billion kWh of electricity was generated in 2013, of which 88% was coal-fired (or thermal), and the remaining hydro. While electricity production remained overwhelmingly coal-based, there were indications of a shift. Between 2012 and 2013, there was a decrease of 1.8% in thermal generation, and an increase of 4.2% in hydro. There are also some reports of other forms of electricity production, although still on a small scale, such as a small power plant built by a Canadian company that produces electricity from crop stalks provided by farmers, and a landfill methane-recovery and electricity-generation project in the city.

The Xi'an Statistical Yearbook also suggests increasing levels of energy efficiency. The energy consumption per unit of GDP (ton of SCE/10 000 yuan) reportedly dropped from 1.03 in 2005 to 0.568 in 2013.

Some progress has also been made in moving away from petroleum as a fuel. Almost all taxis in the city now use Compressed Natural Gas (CNG).

INNOVATION-DRIVEN ECONOMY

Xi'an is a middle-ranking city in China. In the 2thinknow index, Xi'an ranks 270th globally and 14th in China. This is despite high expenditure on R&D. In 2014, for example, 5% of GDP came from R&D expenditure, far higher than the national average of around 2%. However, much of the research and many of the innovation products are used elsewhere, and are not converted into productivity gains in Xi'an. The Beijing Review referred to conservatism in Xi'an in adopting innovations.

Xi'an does have key strengths in terms of R&D that must be converted into economic gains for the locality. The most important may be its considerable strength in academic education and research, and its deep pool of technical expertise (although there is said to be a lack of management expertise). Xi'an's advantage goes back to the Maoist era, when a number of key academic institutions were relocated from coastal cities for strategic reasons. There are said to be around 37 public and 36 private universities, more than 660 research institutes, and 400 000 specialist technicians.

The universities include the Xi'an Jiaotong University, which was ranked by QS as 24th in the BRICS in 2016. This university has an innovation fund that allocated around RMB 50 million to graduate students annually. In 2015 the university launched a Technological Innovation Harbour in partnership with a number of corporations and global institutes, which supports leading-edge research in science and technology and the commercialisation of products.

Another advantage is the R&D and high-level skills that have developed around the aviation in-

dustry. There is a longstanding strategic partnership between the national defence and aviation industries of Xi'an and major university-based research centres in the city, with the city having the only design and research institute for medium- and large-sized aircraft in China. There is a key municipal and national strategy to develop Xi'an as a world-leading research and production base for aerospace.

As with other cities in China, innovation is supported in geographically targeted zones. The most important is the Xi'an Hi-Tech Industrial Development Zone, where thousands of start-ups in specialised activities have been supported. The significance of this zone has been considerably strengthened in recent years. In 2013 China launched its 'One Belt, One Road' (OBOR) policy, which positions Xi'an very strategically, as the city is on the historical inland Silk Road trading route, and in 2014 a large national fund was created for investment along the Silk Road routes. In 2016, President Xi launched innovation reforms for Shaanxi Province that were focused on Xi'an, with the Hi-Tech Zone upgraded to a national demonstration project for the support of innovation, aimed at accelerating innovation-driven growth in the province and wider region, and supporting the OBOR. An important task is to integrate military and civilian industries in the support of innovation.

SOUTH AFRICA

BASIC FACTS

» Level of urbanisation (2015) – 64.8%
» Total urban population (2015) – 34.66 million
» Annual rate of urban growth (2010-2015) – 1.59%

MAJOR URBAN CLUSTERS/CITY-REGIONS (2015 POPULATION)

» Gauteng City Region (>13.2 million)

MAJOR URBAN AGGLOMERATIONS WITH 2015 POPULATION (FACTSHEETS INDICATED WITH *)

» Johannesburg (5 million)*
» Cape Town (3.7 million)*
» Ekurhuleni (East Rand) (3.5 million)*
» Tshwane (Pretoria) (3.0 million)*
» Durban (2.9 million)*
» Nelson Mandela Bay (Port Elizabeth) (1.2 million)
» The Vaal Triangle (1.1 million)

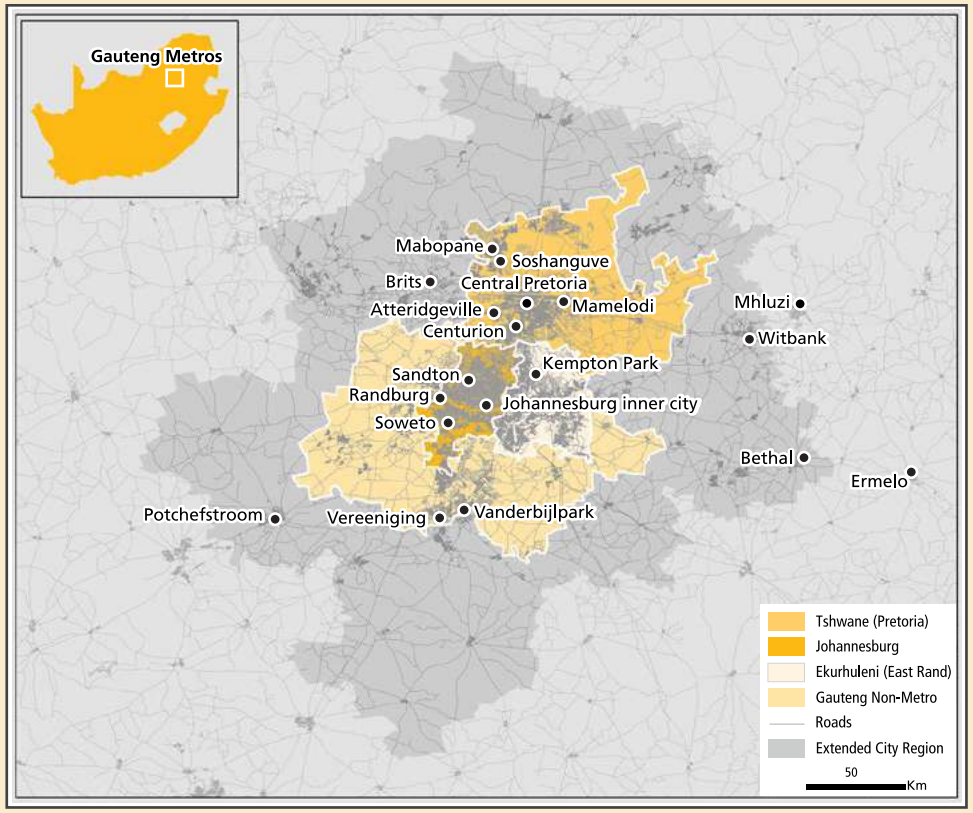
BRIEF HISTORY OF URBAN DEVELOPMENT

South Africa's urban growth has happened mainly around the gold fields of the Witwatersrand and around the coastal port cities, but there is also a network of secondary cities. Under apartheid rule, policies were introduced to constrain the movement of black Africans into these cities. Urban growth accelerated from the 1990s, since the ending of apartheid, but is currently slowing. Much of the recent growth has happened in the Gauteng City-Region, followed by Cape Town, with variable growth in secondary cities. South Africa's national urban policy, the Integrated Urban Development Framework (IUDF) was released in 2016.

URBAN GOVERNANCE

South Africa's major urban agglomerations are governed by metropolitan municipalities. These are single-tier metropolitan municipalities, unlike the non-metropolitan areas of South Africa where there is a two-tier system of district and local municipalities. The metropolitan municipalities have democratically elected councils with a mixture of proportional and ward-based representation. The councils have oversight over executive authorities in which power is vested in either a Mayor or an Executive Council. The powers and functions of South Africa's municipalities are protected by the national constitution, but must be exercised within a complex system of cooperative governance, with a mixture of exclusive and shared competencies across the national, provincial and local spheres of government.

GAUTENG CITY-REGION (GCR)



DESCRIPTION

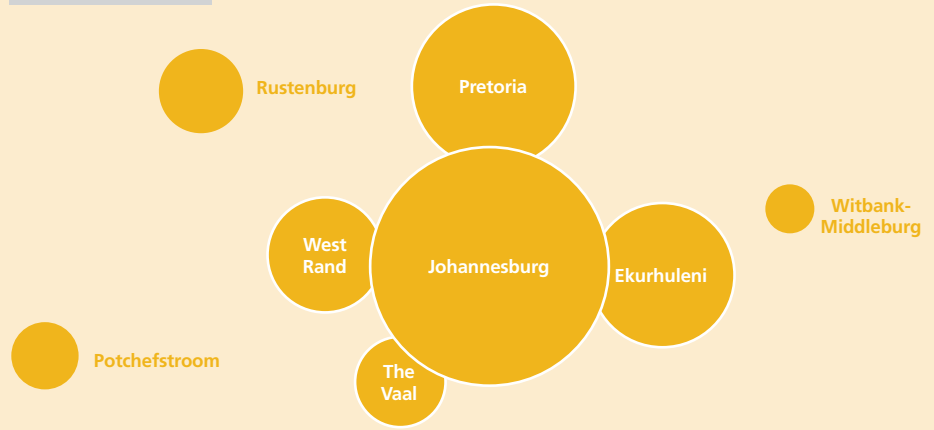
This is a cluster of large and medium-sized cities in the central northern interior of Southern Africa, which forms the economic heartland of the country. Originally based on gold mining, the GCR now has a complex, modern economy, dominated by tertiary sectors contributing over 34% of South Africa's GDP.

POPULATION

» Narrow definition (13.2 million)

» Expanded definition (approx. 16 million)

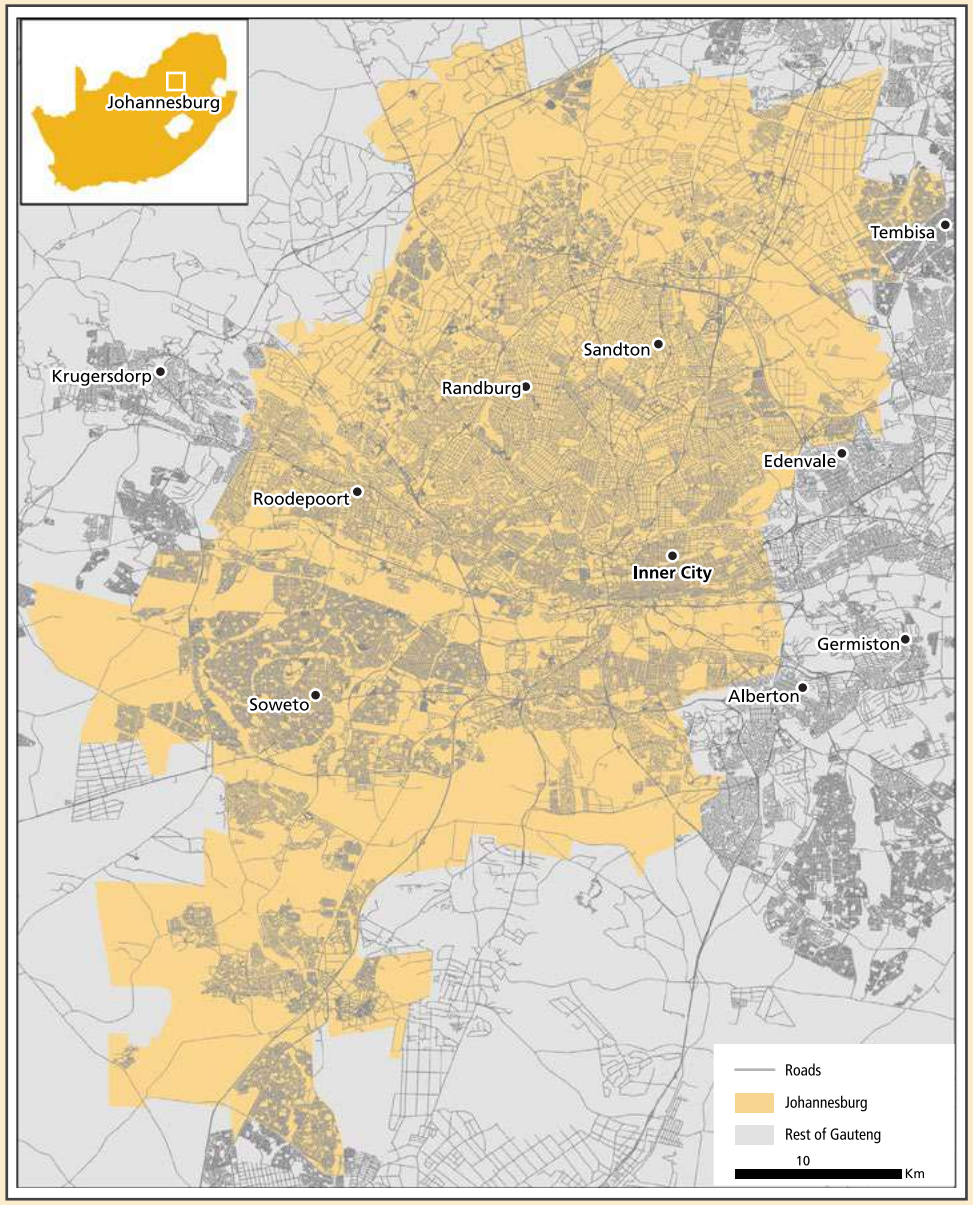
STRUCTURE



GOVERNANCE

Johannesburg, Tshwane (Pretoria) and Ekurhuleni (East Rand) are the three metropolitan municipalities. The Vaal and West Rand have been governed by district and local municipalities, but these are to be consolidated within their own metropolitan municipalities. These areas also fall mainly under the jurisdiction of Gauteng Province (although with part of the Vaal under Free State Province). An expanded definition of the GCR extends the GCR into North West Province and Mpumalanga province, and into various district and local municipalities.

JOHANNESBURG



CONTEXT

LOCATION AND STATUS

Johannesburg is located in the north-central interior of South Africa. It is the most populous and economically important city in the country, and is the provincial capital of Gauteng.

Explanatory note: There are complex matters of boundary definition in defining 'Johannesburg'. The UN Population Division defines the Johannesburg urban agglomeration as including the cluster of cities on the East Rand that fall under the jurisdiction of the Ekurhuleni metropolitan authority, and which are largely contiguous to Johannesburg. However, in South Africa's official statistics Johannesburg is separated from Ekurhuleni. In this compendium we have allocated a separate sheet to Ekurhuleni. In the Factsheet we distinguish between statistics for Johannesburg alone, and those for Johannesburg-Ekurhuleni.

HISTORY

In 1886 the world's richest-ever gold deposits were discovered in the hills of the Witwatersrand, in what was then the Boer-controlled Zuid Afrikaansche Republiek (ZAR); but the British occupied Johannesburg during the South African War (1899-1902). Johannesburg evolved quickly from an informal mining camp to a large urban agglomeration. The gold fields attracted migrants from many parts of the world including Europe, India and China, with migrant labour recruited from across southern and central Africa and housed in tightly-controlled single-sex hostels.

Mining was deep-level, requiring large capital reserves, and so the industry was controlled by an oligopoly of large companies. Tensions between mine owners and white labour culminated in the Rand Rebellion of 1922. Labour was segmented between a protected white 'labour aristocracy' and a large low-wage African workforce. This racial division was reflected in the spatial form of the emerging city. After the apartheid government came to power in 1948, racial divisions were more rigidly enforced than before, with the white population living mainly in the suburbs in the north of the city, and the black African, Indian and coloured (mixed-race) populations living in segregated townships such as Soweto, Alexandra and Lenasia.

By 1950, manufacturing was more important to Johannesburg's economy than mining, although many large global mining companies remain headquartered in the city. In the 1980s there was a sharp decline in manufacturing employment, but with the ending of apartheid in the 1990s, there was rapid growth in the service sector, and especially in finance and business services. The ending of apartheid has seen other significant changes in the city. With the removal of restrictions on the movement of black Africans to cities, there was a surge of in-migration and population growth in the 1990s and early 2000s, but this is now subsiding. Patterns of racial division remain strong, but there are changes in parts of the city, with Johannesburg emerging as the most racially-mixed city in South Africa. The inner city of Johannesburg has changed dramatically, and now provides an entry point for large numbers of foreign migrants. The city has also become more complex, as the private sector has focused its investments mainly in decentralised nodes in the wealthier north of the city.

POPULATION

POPULATION SIZE

Population figures depend in part on how Johannesburg is defined. The larger Johannesburg urban agglomeration including Ekurhuleni (East Rand) and parts of the West Rand, and known as the Central Witwatersrand, has an estimated 2015 population of 9.4 million (UN, 2014). The City of Johannesburg contained within the boundaries of the metropolitan municipality had a

2011 population of 4.43 million (Census, 2011), with an estimated 2015 population of almost five million.

POPULATION RANKING

Using the UN definition Johannesburg may be ranked as 35th globally, 15th in the BRICS and first in South Africa. Using the boundaries of the metropolitan municipality, Johannesburg may be ranked as 73rd globally, 30th in the BRICS and first in South Africa.

POPULATION GROWTH

Johannesburg has grown moderately fast in the recent past, although growth rates are expected to decline into the future with continually declining fertility rates and a flattening urbanisation curve. The UN figures for the period 2010 to 2015 are 3.24% per annum, with the National Census figures for 2001 to 2011 providing a similar figure of 3.18%.

POPULATION DIVERSITY

Johannesburg is a racially and ethnically diverse city. In terms of racial breakdown the population in 2011 was 76.4% black African, 12.3% white, 5.6% coloured (mixed-race) and 4.9% Indian/Asian. The enumerated foreign-born population was 16.4% of the total, with recent migrants mainly from African countries and South and East Asia. The breakdown of home language was: isiZulu 23.4%; English 20.1%; Sesotho 9.6%; Setswana 7.7%; Afrikaans 7.3%; Sepedi 7.3%, isiXhosa 6.8%, Xitsonga 6.6%,

STRUCTURE OF THE URBAN AGGLOMERATION

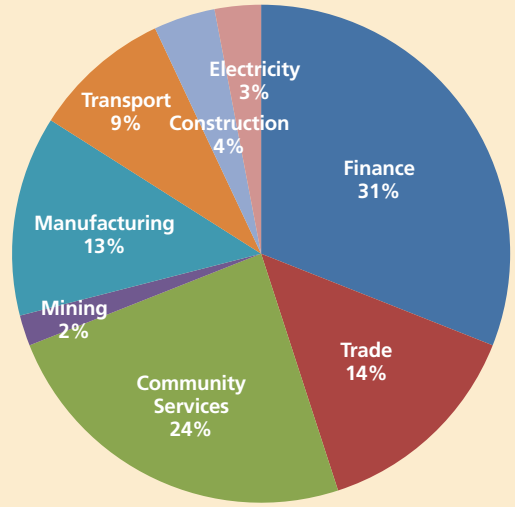
Johannesburg is the central node within a line of urban centres along the linear gold-bearing reefs of the Witwatersrand. In 2011, the historical core of Johannesburg had a population of 957 000. However, Johannesburg is a polycentric city, and there are a number of other historical urban nodes to the north of the city with their own centres of economic activity; including Sandton (222 000), Randburg (337 000), Roodepoort (326 000) and Midrand (87 000). These form the core of what were the historically white local authorities. During the apartheid era a number of large black African townships were created. The largest of these, to the south-west of Johannesburg, is Soweto, with a population of 1 271 000. Other townships include Alexandra (179 000), Ivory Park (184 000), Diepsloot (138 000), and Orange Farm-Stretford (137 000). The Indian township of Lenasia has a population of 89 000. There is also a scattering of informal settlements, new housing estates, and gated communities on the urban edge.

ECONOMY

The Brookings Institution calculated the economy of the Central Witwatersrand for 2014 at USD 138.26 billion, which places the urban agglomeration in the league of cities such as Xi'an, Brasilia, Mumbai and Rio de Janeiro. The urban agglomeration contributed around 22.7% of South Africa's GDP. However, on its own the municipality of Johannesburg had a GDP of around USD 88.66 billion, and contributed about 13.9% of the national economy.

For the urban agglomeration as a whole (the Central Witwatersrand) there is a balance between manufacturing, concentrated in Ekurhuleni, and services, concentrated in Johannesburg. The graphic below indicates Johannesburg only. It shows that the economy is dominated by service sectors, and especially by finance and community services.

JOHANNESBURG'S GROSS VALUE ADDED BY SECTOR, 2014



Source: Data derived from IHS Global Insight

In the period 1994 to 2008, Johannesburg experienced relatively rapid rates of economic growth, benefiting from both demographic expansion and the development of the finance and business services sector. The annual growth of the city's GDP averaged around 6% for the period 2000 to 2008. There was a slight contraction in the city economy during the 2009 recession, and a modest recovery to 3% growth by 2013. Since then, however, growth has been trending downwards, and is expected to be around 1% in 2016.

GOVERNANCE

Johannesburg falls within the governance arrangements indicated on the cover sheet for South Africa. The city is under the jurisdiction of the Johannesburg Metropolitan Municipality and the Gauteng Provincial Government. If, however, we use the wider definition of the Johannesburg urban agglomeration to include the cluster of cities along the Central Witwatersrand, it would also fall under the jurisdiction of the Ekurhuleni Metropolitan Municipality and of the West Rand District Municipality. The single-tier metropolitan authority allows for coordination of governance over a large area, but there are complex matters of coordination with the provincial government and with neighbouring municipalities within the framework of South Africa's system of cooperative governance. Some of the contested issues in the recent past, and currently, concern the allocation of powers for making decisions about land use, and for the implementation of housing policy.

DEVELOPMENT CHALLENGES

The GCR has the challenges of a fast-growing urban region within a middle-income country, such as extreme levels of inequality; but it has the additional challenges that are the legacy of apartheid rule.

Unemployment is a major challenge for Johannesburg. The Statistics South Africa Quarterly Labour Force Survey (Q1 2016) indicated an official unemployment rate for Johannesburg of 29.8%. There are also extremely high levels of income inequality in the city. The UN Habitat (2016) records a Gini coefficient for Johannesburg of 0.75, which is the highest for any large city in the world. The Gauteng City-Region Observatory (GCRO) has provided a revised figure of 0.67, which still places Johannesburg at, or near, the top of the world inequality rankings.

The high income inequality and unemployment contribute to a high crime rate. The Mexican Council for Public Security and Criminal Justice ranks Johannesburg as the 47th-most violent city in the world, with a murder rate of 33.3 per 100 000.

Despite an ambitious state-led programme of housing provision, there is a housing shortage. In 2011, around 18% of Johannesburg's households (124 000) lived in shacks, with half in informal settlements and the other half in backyard accommodation in formal areas. Levels of access to formal services (water, electricity, sewerage, refuse collection) are generally high, at over 90%, but remain a problem in informal settlements. The HIV/Aids epidemic is still a challenge for Johannesburg, although progress has been made. The HIV prevalence rate for Johannesburg in 2012 was 11.1%, compared with 12.2% nationally.

Johannesburg has a large environmental footprint as result of its extreme dependency on carbon-based energy. Johannesburg's estimated figure for carbon emissions per head was 6.89 tons in 2007, which makes it a moderately high emitter in international terms, but a very high emitter for the global South. Other challenges include air pollution, with Johannesburg placed by the World Health Organisation among the top 10% of the worst air-polluted cities globally. A further problem is acid mine drainage, as water rises through the shafts of disused mines.

THEMATIC REPORTS

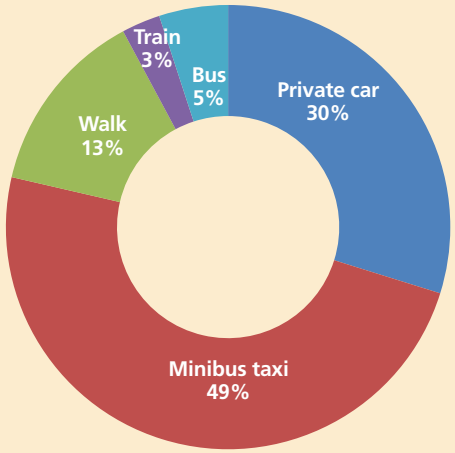
TRANSPORT

Transport is a major challenge for Johannesburg and its wider region. The Gauteng 2055 strategy indicates that "Gauteng recently ranked as the least affordable region in relation to other African cities – with residents typically spending at least 21% of their monthly income on transport". This is compared to around 5% for most BRICS countries. The challenges relate to the legacy of apartheid rule, during which time black Africans were relegated to the urban peripheries; but also to the decline of public transport systems (especially rail and bus services), and a resolutely private-car-oriented middle class. The IBM Commuter Pain Survey rated Johannesburg the fifth-most congested city out of the 20 large cities it surveyed.

MODAL SPLIT

Determining the modal split is not straightforward, as there are different sources of data which contradict each other to some degree. In the reporting below we use the data from the GCRO Quality of Life Survey 2014, for main mode of transport for most frequent trip.

MAIN MODE OF TRANSPORT FOR MOST FREQUENT TRIP

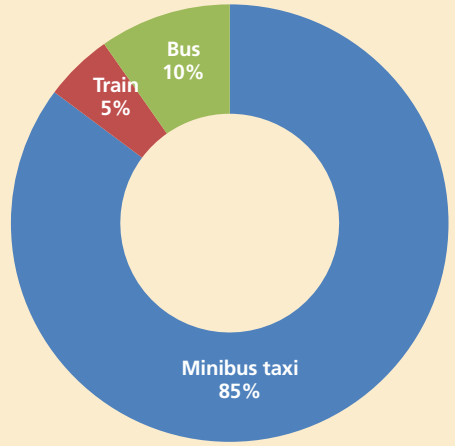


Source: GCRO Quality of Life Survey, 2013

While the use of the private vehicle is less than 30% for 'most frequent trip', it accounts for 42% of 'work trips', and therefore contributes significantly to peak-hour traffic.

If we consider public transport, the dominance of the minibus taxi is reiterated.

MODAL SPLIT WITHIN PUBLIC TRANSPORT (MOST FREQUENT TRIPS)



Source: GCRO Quality of Life Survey, 2013

The equal split between the private motor car and the minibus taxi is significant. These are the dominant modes of transport, but attract a very different ridership, with the middle class overwhelmingly car-oriented and the poorer population hugely dependent on public transport, and especially the minibus taxi. The racial divisions are clear. In Gauteng province, 73% of black Africans use public transport, compared with only 4% of whites.

MINIBUS TAXIS

Minibus taxis are privately owned, but are organised within taxi associations. They are a form of 'paratransit', with features of both formal and informal organisation. There are about 32 taxi associations in Johannesburg, controlling just over 1 000 routes. The minibus industry is a celebrated example of the success of small business, and of black economic empowerment; and with its route and operational flexibility, it is well suited to the complex spatial form of South African cities. However, there are periodic violent conflicts between rival taxi associations, and problems of reckless driving and unroadworthy vehicles.

TRAINS

Johannesburg's Park Station is one of the three hubs of Gauteng's commuter rail network, which is operated by Metrorail, a division of a national parastatal, the Passenger Rail Agency of South Africa (PRASA). This rail network has historically serviced 'black townships', and does not include the historically white suburbs. There has been severe underinvestment in the rail system over a number of decades, and ridership share has declined steadily relative to minibus taxis and private vehicles. The reliability of the service, deteriorating rail stock and passenger safety are major concerns. There is however a major upgrade of the Metrorail network under way, including modernisation of stations, improved signalling, and the purchase of around 3 000 new coaches.

A major development in the lead-up to the 2010 FIFA World Cup hosted by South Africa was the development of the Gautrain, an 80-kilometre, high-quality, fast rail network linking Johannesburg and Tshwane (Pretoria) and the OR Tambo International Airport in Ekurhuleni. It was developed as a public-private partnership between the Gauteng Provincial Government and the Bombela International Consortium.

BUS

The City of Johannesburg owns the Metrobus company, which owns around 500 buses and transports around 90 000 people per day. In addition, the City of Johannesburg contracts private companies to provide city services. The largest of these is PUTCO, which mainly services Soweto and the other townships, and also has around 500 buses. The total city-owned and contracted fleet is 1200. Bus services are subsidised by government to make them viable in the low-density, dispersed spatial structure of the city-region.

After a study tour to Latin America in 2006, the City of Johannesburg decided to implement a Bus Rapid Transit (BRT) system, modelled mainly on the TransMilenio system in Bogotá, Columbia. Johannesburg's BRT, known as the Rea Vaya, is managed by an operating company that has local taxi associations and bus companies as shareholders. It was opened in 2010, despite concerted opposition from some taxi associations, and is being implemented in phases. Global BRT Data indicates a current daily ridership of 42 000, but with more conservative local estimates of around 35 000.

FUTURE PLANS

An Integrated 25-Year Master Plan for Public Transport in Gauteng was released in 2013. The plan proposed to make rail the backbone of Gauteng's transport system, with proposals to significantly expand the Metrorail and Gautrain networks, as well as to establish an integrated transport authority for the city-region (which is planned for launch in 2016) to address the extremely fragmented nature of transport planning and operations in the region. The plan has since evolved to accommodate the plans by the three metropolitan authorities for expanded BRT systems, and also to recognise the importance of minibus taxis. The City of Johannesburg is aiming for a BRT network of around 300km. It is also implementing a programme of Transit Oriented Development (TOD), dubbed the Corridors of Freedom, mainly around the BRT network, which is aimed at spatially stitching together the city fragmented by apartheid.

However, while there is progress with public transport, there has also been heavy investment in the upgrading of Gauteng's extensive freeway system. A major controversy erupted after attempts to force motorists to pay for these upgrades through an e-tolling system.

GREEN ENERGY

South Africa is one of the most coal-dependent countries in the world. In 2010, the base year for South Africa's new energy strategy, 90% of South Africa's electricity was produced from coal, 5% from nuclear, and 5% from hydro-electric energy. Almost all the energy was produced by a single parastatal, Eskom, and was fed into a national grid. The coal dependency is the major contributor to South Africa's position as the 12th-highest carbon emitter per capita in the world (exceeding even China and the United States).

However, the Integrated Resource Plan (IRP), compiled by the Department of Energy, proposed a radical overhaul of the electricity mix, with a reduction in the contribution of coal to less than 50% by 2030, with the gap being addressed by an expansion in electricity produced from gas, nuclear and renewables.

At least 30% of new electricity production must come from renewables if these targets are to be met. This may involve an additional 11 400MW of additional capacity in renewables by 2030 (excluding the requirement for hydro). In 2011, the national Department of Energy launched the Renewable Energy Programme for Independent Power Producers (REIPPP) to procure clean energy from private producers, which was linked to 20-year purchase agreements with Eskom.

Significant progress has been made since 2011, with the OECD identifying South Africa as the fastest-growing renewable-energy market in the G20 group. Renewable energy is expected to expand from 1% of the mix in 2012 to 12% in 2020; a significant leap, resulting in it potentially surpassing its 14% target by 2030.

These programmes are driven primarily at national level, but metropolitan authorities including Johannesburg are also engaging actively in the energy field. The production of electricity by metropolitan authorities is very limited, although Johannesburg does procure from the previously city-owned coal-fired Kelvin Power Station, which produces around 600MW of electricity, or less than 10% of city requirements. A landfill-to-energy programme was launched in 2007 with an installed capacity of 18MW; and more recently, the city issued a green bond to fund its 'green revolution', including biogas-to-energy at the city's wastewater treatment plants.

While petroleum-based fuels remain overwhelmingly dominant, the City of Johannesburg is purchasing 150 new buses for Metrobus that will run on a mixture of compressed natural gas (CNG) and diesel, which would reduce carbon emissions by vehicle by 90%. There are also plans to grow biocrops for fuel production within the municipal boundary.

For the foreseeable future, however, the greatest leverage the city will have in terms of greening energy will be through demand management for greater energy efficiencies. Johannesburg has introduced a range of measures to improve energy efficiency, including building retrofits; efficiency criteria for new buildings; the introduction of smart meters and geyser-control systems; refurbishment of streetlights with solar panels; and the introduction of energy-efficient technologies in government-subsidised low-income housing.

INNOVATION-DRIVEN ECONOMY

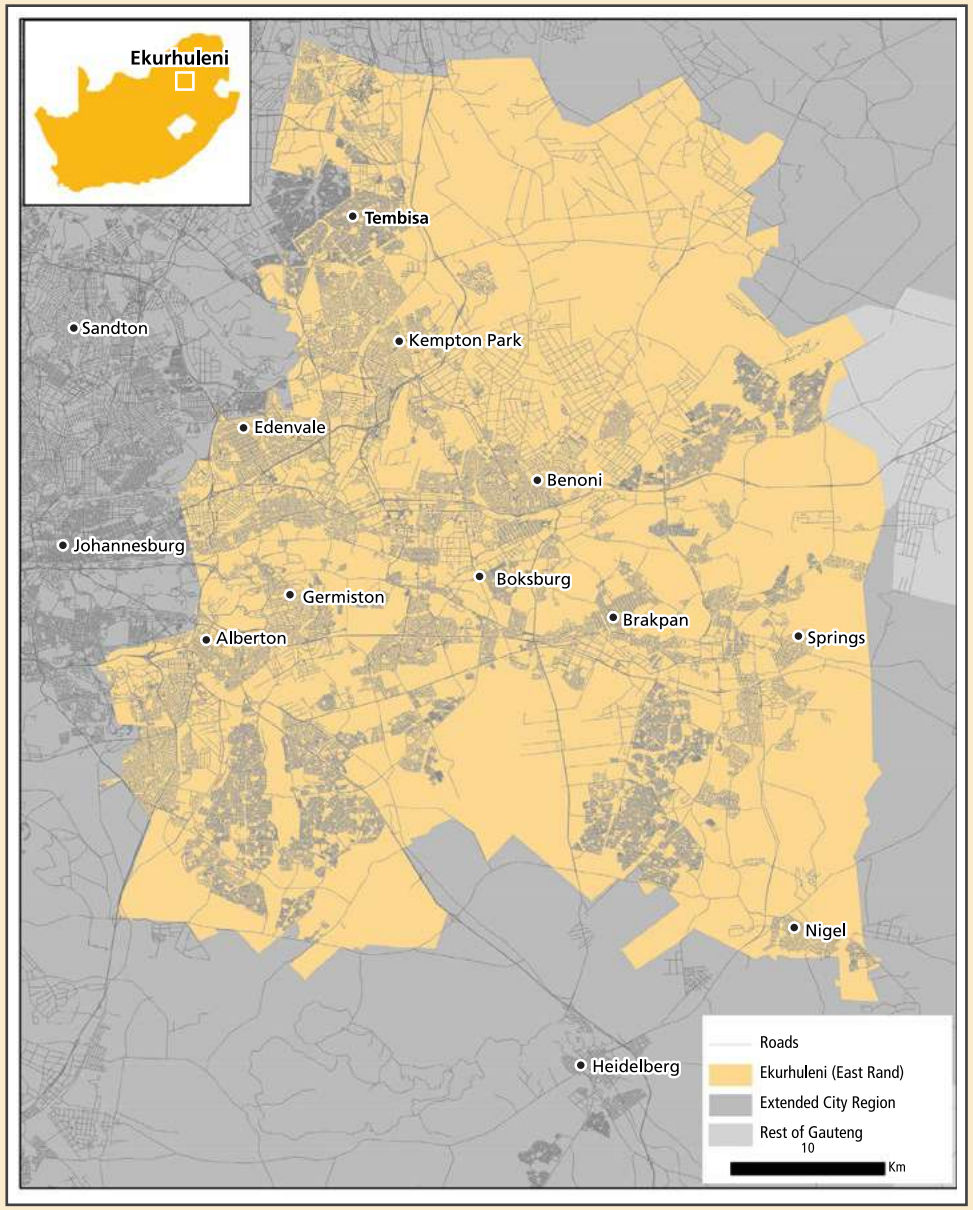
The available data on innovation is from provincial level. It indicates how concentrated innovative capacity is within the Gauteng City-Region, to which Johannesburg is likely to be a leading contributor. Recent data from provincial government reveals that Gauteng has 57% of South Africa's ICT firms. The Quantec research agency indicates that in 2012, Johannesburg accounted for 17.2% of the gross expenditure on R&D in South Africa. This was the largest contribution of any single city, but in per capita terms Johannesburg fell short of Tshwane, Ekurhuleni and Cape Town. Johannesburg does however have the largest single contributor to R&D from an academic institution, namely the University of the Witwatersrand. Together with the University of Johannesburg, and smaller institutions, the city contributed 55% of Gauteng's university-based R&D. City-level data from the OECD report shows that within Gauteng, Johannesburg has the highest concentration of industries in the hi-tech manufacturing class, as well as the largest absolute number of employees in this class.

As indicated in Chapter Two (Part A) we have not used the 2thinknow index for Johannesburg as there are possible data problems relating to the use of different spatial jurisdictions (Central Witwatersrand vs municipal boundaries). Johannesburg may be better placed than the index suggests. However, the city could clearly improve its position globally and in the BRICS. For example, while the OECD indicated that Gauteng (and by extension, Johannesburg) is doing well in national terms in terms of patent applications, in international terms it ranks together with lesser centres of innovation in advanced economies, such as Birmingham, Leeds, Rome and Budapest.

Times Higher Education ranks the University of the Witwatersrand in the band 201-250 globally. The QS University Rankings for 2016 ranked the University of the Witwatersrand 26th in the BRICS.

To improve innovative capabilities there is a provincial strategy to accelerate efforts to contribute to South Africa's National System of Innovation. Among the city's initiatives is the Broadband Network Project, which involves the installation of a 900-kilometre-long fibre broadband network, and is intended to lower the costs of communication.

EKURHULENI (EAST RAND)



CONTEXT

LOCATION AND STATUS

Ekurhuleni is located in the Province of Gauteng, within the Gauteng City Region (GCR). It is immediately to the east of the City of Johannesburg, and includes a cluster of cities and towns historically known as the East Rand. Ekurhuleni has the largest concentration of manufacturing in South Africa.

HISTORY

Like Johannesburg, the settlements that make up Ekurhuleni were founded on gold. They were established mainly during the late 19th and early 20th centuries, around large gold mines. In 1921 the world's largest gold refinery was established in Germiston; and in 1952, the Jan Smuts International Airport (now OR Tambo International) was built at Kempton Park. From around World War II, Ekurhuleni began its transition away from mining to manufacturing. Initially, manufacturing served the mining sector, but it gradually developed as a sector independent of mining. During South Africa's economic boom in the 1960s, Ekurhuleni emerged as the premier hub of manufacturing in the country.

Under apartheid the spatial structure of Ekurhuleni became increasingly complex. Not only were there a number of small cities clustered around different mines, but also racially segregated townships.

In the 1980s, Ekurhuleni was in crisis, as it was a flashpoint of civil conflict and suffered significant loss in manufacturing employment. The local economy has since recovered, and the East Rand has re-established its position as the 'workshop of South Africa'. In 2000 the various separate local authorities on the East Rand were amalgamated to form the Ekurhuleni Metropolitan Municipality. Prior to this there was no clear spatial identity for this urban agglomeration, but this has gradually changed with the institutional consolidation.

POPULATION

POPULATION SIZE

In terms of Census 2011, the Ekurhuleni Metropolitan Municipality had a population of 3.18 million, with an estimated 2015 population of 3.5 million. The UN Population Division included Ekurhuleni within the Johannesburg urban agglomeration.

POPULATION RANKING

Standing on its own, and on the basis of Census 2011, Ekurhuleni would rank around 111th in the world, 45th in the BRICS, and third in South Africa (after Johannesburg and Cape Town).

POPULATION GROWTH

At 2.47% per annum for the period 2001 to 2011, Ekurhuleni has been growing at a moderate pace, slower than neighbouring Johannesburg and Tshwane (Pretoria).

DIVERSITY

Ekurhuleni is racially and ethnically diverse. The racial breakdown in 2011 was 79% black African, 16% white, 3% coloured (mixed race) and 2% Indian/Asian. About 11% of the population was born outside of South Africa. The main home languages spoken are isiZulu (29%), English (12%), Afrikaans (12%), Sepedi (11%), Sesotho (10%) and isiXhosa (8%).

STRUCTURE OF URBAN REGION

Ekurhuleni (East Rand) consists of an agglomeration of nine small cities or towns, and seventeen townships created during the apartheid era. The major physical structuring element is the linear gold-bearing reef that runs east-west. The cities/towns are Boksburg (260 000), Germiston (256 000), Kempton Park (171 000), Benoni (159 000), Alberton (121 000), Springs (121 000) Brakpan (73 000), Edenvale (49 000) and Nigel (38 000). The major townships are Tembisa (463 000), Katlehong (407 000), Vosloorus (163 000), Tsakane (154 000), Etwatwa (152 000), Daveyton (127 000), Thokoza (106 000), KwaThema (103 000) and Duduza (73 000). There are also a large number of scattered informal settlements. The spatial structure is further fragmented by large intervening tracts of derelict mining land.

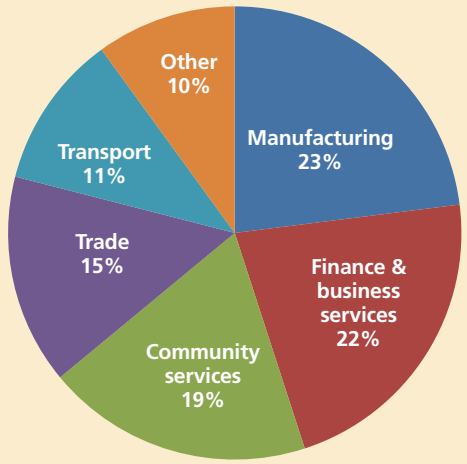
In an attempt to integrate this highly fragmented space, the metropolitan government is seeking to consolidate spatial development along three economic corridors and around an aerotropolis.

ECONOMY

Ekurhuleni accounts for around 8.8% of national GDP. In 2014, the GDP of the city was around USD 53.6 billion.

As shown below, manufacturing is still the largest single sector in the economy in terms of GDP; although it is no longer overly dominant, with tertiary sectors now a significant proportion. However, in comparison with Johannesburg, Ekurhuleni does have a significantly smaller tertiary and a larger manufacturing industry.

CONTRIBUTION TO GVA BY SECTOR, 2014



The economy of Ekurhuleni has been growing moderately faster than the national economy (in 2012, for example, it expanded by 3.3%, compared with 2.5% nationally). The fastest growth locally has been in trade and services, but there has been moderate growth in manufacturing, which has performed far better in Ekurhuleni than nationally. However, conditions are variable, with the Quarterly Labour Force Survey released in May 2016 indicating an 8.9% year-on-year contraction, compared with a 2.2% contraction nationally.

Spatially, the economy of Ekurhuleni is highly dispersed. The highest contribution to Gross Value Added (GVA) comes from Kempton Park (12%), followed by Boksburg (11%), Germiston (9%), Benoni (7%) and Springs (5%). Because of the sheer size of their populations, the townships of Tembisa and KwaThema are also emerging as notable economic nodes.

GOVERNANCE

Ekurhuleni falls within the governance arrangements indicated on the cover sheet for South Africa. The city is under the jurisdiction of the Ekurhuleni Metropolitan Municipality and the Gauteng Provincial Government. As in the case of Johannesburg, there are complex matters of coordination with the provincial government and with neighbouring municipalities within the framework of South Africa's system of cooperative governance.

DEVELOPMENT CHALLENGES

Ekurhuleni is one of the poorer metropolitan areas in South Africa. Although it has a strong manufacturing base, the economy has not been growing fast enough to absorb the increasing population. The official unemployment rate for Ekurhuleni for Q1 2014 was 34.4%, which was the highest of any metropolitan municipality in South Africa, and significantly higher than the national 26.7%.

In Ekurhuleni, 22.6% of households live in shacks, compared with 18% for Johannesburg. The Gini coefficient has been calculated at 0.63, which is less than that of Johannesburg; but Ekurhuleni has less of the upper-end wealth than its neighbouring municipality.

Levels of servicing are lower than for Johannesburg. For example, 57.2% of households have piped water inside the dwelling, and 82.2% have electricity connections, compared with 64.7% and 90.8% respectively for Johannesburg.

In 2012, a national survey indicated an HIV prevalence rate for Ekurhuleni of 14.3%, compared with the national average of 12.2%. It has the second-highest prevalence rate for a metropolitan municipality in South Africa, after eThekwini (Durban).

Ekurhuleni, like Johannesburg, has a large carbon footprint, as it is overwhelmingly dependent on fossil fuels for energy. It also suffers from the legacies of mining including toxic land and acid mine drainage.

THEMATIC REPORTS

TRANSPORT

ECONOMIC INFRASTRUCTURE

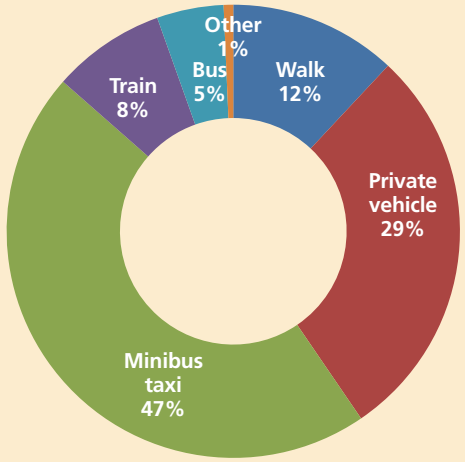
The OR Tambo International Airport, South Africa's premier gateway to the world, is located in Ekurhuleni. With around 28 million passengers annually, this is the busiest airport in Africa, although in 2011 it ranked only 74th in the world, and 14th in the BRICS. Traffic was growing moderately, at 2.9% per annum.

PUBLIC TRANSPORT

Ekurhuleni, like other South African cities, suffers serious challenges in terms of transport. There is the legacy of apartheid and modern planning, which created a fragmented, low-density urban form; but Ekurhuleni is also more affected than any other city by the fragmenting effects of large tracts of mining land. Significantly, the GCRO reports that levels of dissatisfaction with transport in 2013 were higher in Ekurhuleni than in the other metropolitan areas in Gauteng.

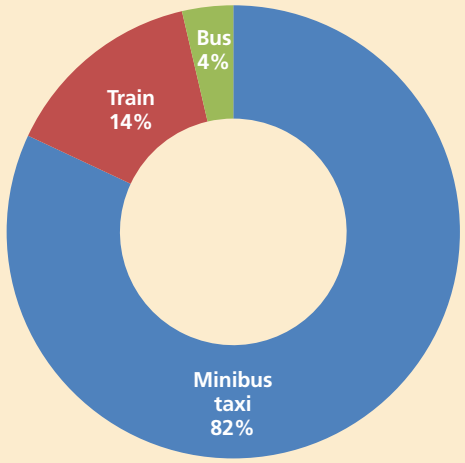
The modal split for most frequent journey is very similar to that of Johannesburg, with a near-equal split between the use of private vehicles and minibus taxis.

MODAL SPLIT FOR MOST FREQUENT JOURNEY



Source: GCRO Quality of Life, 2013

MODAL SPLIT FOR PUBLIC TRANSPORT ONLY (MOST FREQUENT)



GCRO Quality of Life, 2013

If we consider public transport trips, the dominance of the minibus taxi is reiterated. However, there is a slight difference between Ekurhuleni and the other two metropolitan authorities in Gauteng, with Ekurhuleni making more use of trains and less of buses.

MINIBUS TAXIS

Minibus taxis are privately owned, but are organised within taxi associations. They are a form of 'paratransit', with features of both formal and informal organisation. There are around 11 000 minibus-taxi operators in Ekurhuleni. The minibus industry is a celebrated example of the success of small business and of black economic empowerment; and with its route and operational flexibility, it is well-suited to the complex spatial form of South African cities. However, there are periodic violent conflicts between rival taxi associations, and problems of reckless driving and unroadworthy vehicles.

RAIL

Germiston Station in Ekurhuleni is one of the three hubs of Gauteng's commuter rail network, operated by Metrorail. As elsewhere in Gauteng, the network services historically black townships but has declined over an extended period, with strong competition from the minibus taxi industry. There are now ambitious plans to modernise the rail network; which will additionally benefit Ekurhuleni with a potential 33 000 new jobs, as the city is the site of the plant where the rolling stock will be manufactured. Ekurhuleni is also a beneficiary of the Gautrain, which connects the OR Tambo International Airport to Johannesburg and Pretoria.

BUSES

Ekurhuleni's bus services have been highly fragmented due to the legacy of its past as a series of separate cities, with the challenges contributing to the low bus use in the city. Most services are provided through contracts between government and private operators. There have been persistent problems. In 2015, for example, the largest contracted operator, PUTCO, cancelled its operations on a number of township routes in Ekurhuleni, claiming that despite government subsidies, its viability had been undermined by the growth of the minibus taxi industry. The PUTCO service was replaced by Autopax, a subsidiary of state-owned PRASA.

FUTURE DEVELOPMENTS

Ekurhuleni is seeking to modernise its public transport networks with an extensive Bus Rapid Transit (BRT) system known as Harambee, which will commence its first-phase operations in mid-2016. The other major development is the planned modernisation of the Metrorail system.

Problems of integration with transport systems in other municipalities will be addressed through the planned creation of an Integrated Transport Authority for Gauteng. Although Harambee was built using a different technical specification to Johannesburg's Rea Vaya, there is a planned inter-modal facility to link the two systems on the border of the two municipalities.

GREEN ENERGY

The details of South Africa's energy profile and the current national initiatives to transition to renewables are provided in the Johannesburg Factsheet and are not repeated here. Ekurhuleni has the same challenge of overwhelming dependence on Eskom coal-fired power stations for its electricity supply. It has the added challenge of a large, energy-hungry manufacturing sector. However, Ekurhuleni is able to make more use of natural gas than other metropolitan municipalities, as it falls along the SASOL pipeline, which transports natural gas from Mozambique to Gauteng. Approximately 10% of Ekurhuleni's energy needs are supplied by gas.

To date the production of renewable energy within the boundaries of Ekurhuleni remains negligible, although municipal buildings are producing solar energy and there is a site for landfill-to-energy. However, there is potential to develop electricity from industrial waste, and the municipality has initiated a programme to procure green energy from private producers, with a target of 300MW by 2020.

The municipality is also actively involved in promoting energy efficiencies. The programme to improve energy efficiency in building began with municipal buildings, and is being extended to industry and the household sector. The municipality is also rolling out solar home systems in informal settlements.

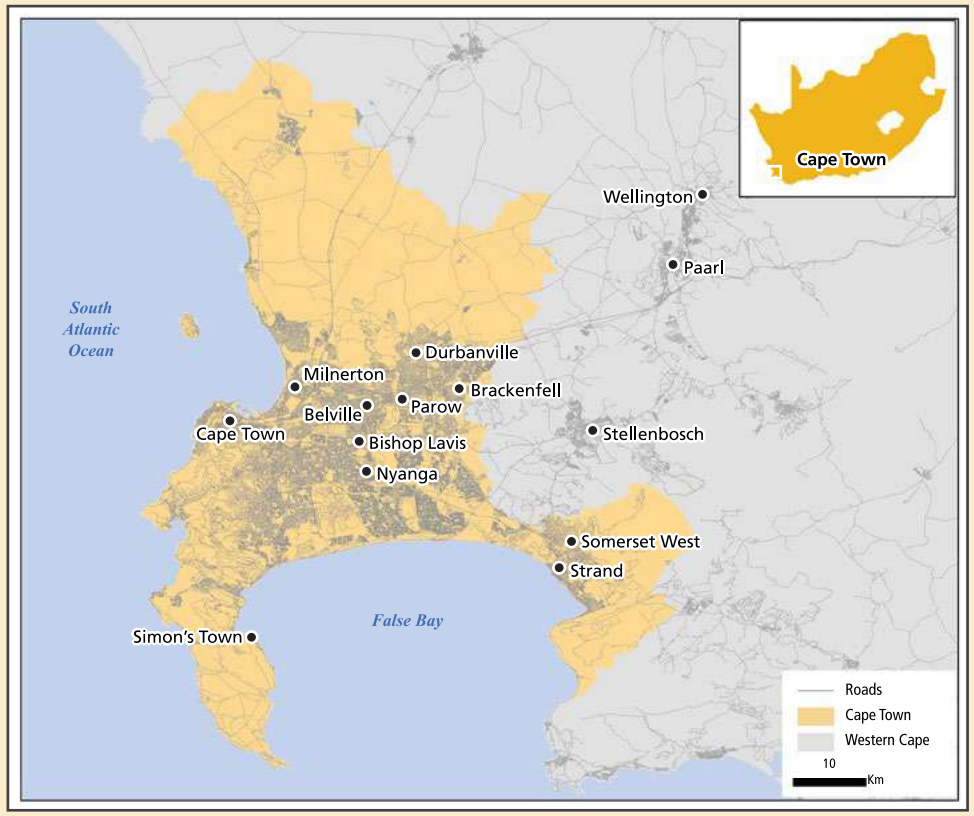
INNOVATION-DRIVEN ECONOMY

In the 1980s and 1990s, Ekurhuleni was South Africa's 'rust belt', but it nevertheless remained the largest hub of manufacturing in South Africa, and experienced partial revival following painful

restructuring processes – partly because of innovative responses within industry. In other respects Ekurhuleni may seem to be outside the mainstream of innovation, lacking – for example – a major institution of higher learning, or a state innovation hub.

However, there may be significant investments in R&D from industry. Quantec indicates that in 2012 Ekurhuleni accounted for 10.9% of the gross expenditure on R&D in South Africa, third after Johannesburg and Cape Town. In per capita terms Ekurhuleni is second in South Africa, after Pretoria (Tshwane). The municipality is working to support innovation in Ekurhuleni. OR Tambo is a critical asset for Ekurhuleni, and the provincial and metropolitan governments are working on creating an Aerotropolis around the airport which will include trade, R&D, logistics and creativity hubs.

CAPE TOWN



CONTEXT

LOCATION AND STATUS

Cape Town has an extraordinary location at the south-western corner of South Africa, and of Africa, at the juncture of the Indian and Atlantic Oceans. The iconic landmark in the city is Table Mountain.

Cape Town is the legislative capital of South Africa (the administrative capital is Pretoria), and is the provincial capital of the Western Cape Province.

HISTORY

Cape Town was established in 1652 by the Vereenigde Oost-Indische Compagnie (VOC) as a refreshment station for ships passing between Holland and the Dutch colonies in present-day Indonesia. The early growth of the town was supported by a slave economy, with slaves drawn from places like Batavia (Java), Ceylon (Sri Lanka) and Madagascar, but also from the indigenous Khoisan population. A large creole population emerged that is now generally referred to as 'coloured'.

In 1806, during the Napoleonic Wars, the British seized control of Cape Town. Slavery was abolished

and the town modernised; but a division was entrenched between the local white elite and the coloured population, and there was also a cultural gap between the English and the Dutch (later Afrikaners). In 1853 the Cape Colony was granted representative status (autonomy with elected government), with Cape Town as the capital.

In the late 19th century, the town grew rapidly, as the gateway to the diamond and gold fields of the interior. In 1910, the Union of South Africa was formed from four colonies, and Cape Town shared capital status with Pretoria. Cape Town developed into a modern port and industrial city in the 20th century. However, its relative position declined, as Durban emerged as South Africa's premier port, Johannesburg emerged as the largest city, and Pretoria dominated government functions. Although Cape Town lost a degree of political and economic power, it was re-identified as a cultural hub ('the Mother City'), and as one of the world's top tourism destinations.

In the second half of the 20th century, Cape Town was socially and spatially reshaped under apartheid rule. Racially mixed areas such as District Six were destroyed, and new, racially segregated housing estates were established to the east of the historic city, on the Cape Flats. Although the government attempted to control the movement of black Africans to Cape Town, making the city a 'coloured labour preference area', large numbers of isiXhosa-speaking African migrants arrived from the Eastern Cape, many settling in informal settlements. A social hierarchy was established, with whites at the top, coloureds in the middle, and black Africans at the bottom, which was also reflected in spatial divisions.

Apartheid was formally ended in 1994, but the sharp inequalities persist, although with some blurring of the divisions. The city has the Janus face of being a global tourism hotspot, but also a place of poverty and violence. After apartheid, however, Cape Town has consolidated its position as South Africa's second city.

POPULATION

POPULATION SIZE

The UN estimates the 2015 population of the actual urban agglomeration to be 3.66 million; which is slightly less than the population of the municipality, which was 3.74 million in 2011, and was estim1ated at around 3.9 million for 2015.

POPULATION RANKING

On the basis of the UN estimates, the Cape Town urban agglomeration ranks 106th in the world, 46th in the BRICS, and second in South Africa (after Johannesburg).

POPULATION GROWTH

The UN estimates the annual growth rate for Cape Town for the period 2010 to 2015 to be 1.8%, with Census 2011 indicating a growth rate of 2.57% for 2001 to 2011. The indications are that growth is slowing, following the relatively fast rates of the 1990s and early 2000s.

DIVERSITY

Cape Town is the only major metropolitan city in South Africa where there is no clear numerical dominance of one race group. In 2011, 42.4% of the population were coloured (mixed race), 39% were black African, 16% were white, and 1% were of Indian/Asian origin. There was a triad of languages of roughly equal proportion – 36% of the population spoke Afrikaans as a home language, followed by 30% speaking isiXhosa and 28% English. Census 2011 indicated that 9.6% of the population were foreign-born.

STRUCTURE OF THE URBAN REGION

The two key influences in terms of spatial structure are the physical geography of the city and the socio-spatial divides (and crossovers) in terms of race, class and language.

The shape of the urban agglomeration is powerfully shaped by the Atlantic and Indian Ocean coastlines, and by the mountainous topography. The Cape Peninsula is a defining geographical feature, with the Table Mountain National Park one of the few major conservation areas in the world completely surrounded by a city.

The historical centre of the city is in the shadow of Table Mountain. The expanded urban core, with a population of around 500 000, has spread out around the east and west of the mountain, and includes the affluent southern suburbs such as Wynberg and Kenilworth, and the extravagantly wealthy suburbs on the Atlantic seaboard such as Camps Bay and Clifton, which includes the most expensive real estate in South Africa. The population of this core city is mainly white and English-speaking, but with mixed Afrikaans- and English-speaking coloured populations on the edges of the core.

To the south, along the coastline of the peninsula, are towns such as Simonstown, Fish Hoek, Noordhoek and Hout Bay, with a combined population of around 70 000. These have historically been white, English-speaking, and upper-income, but in recent years large informal settlements with isiXhosa and foreign African migrants have developed here.

A more recent expansion of middle- to high-income development, but also with informal settlement, is directly north of the core city, along the Atlantic coastline. This area now has a population of nearly 200 000 people. On the far northern edge of the city, however, is the satellite town of Atlantis, with a population of 70 000, which was established in the apartheid era for a working-class coloured population.

Towards the north-east, along the road and rail links into the interior, is the historically white Afrikaans working-class segment of the city, including Bellville and Durbanville, but with the racially-mixed Kraaifontein on the city edge. The population of this area is around 370 000.

There are expansive coloured, mainly Afrikaans-speaking, working-class housing estates to the east of the core city, expanding across the so-called Cape Flats, with the large Mitchells Plain township at the far edge. This large complex of coloured townships has a population of around 1.2 million people.

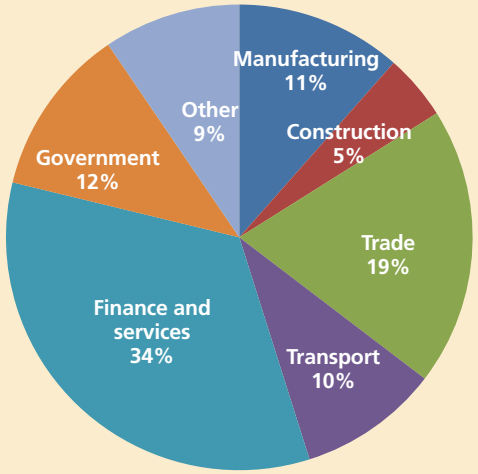
Relatively close to the core city are the older, black African, mainly isiXhosa-speaking townships of Gugulethu, Langa and Nyanga, with a combined population of over 210 000. However, black African townships such as Khayelitsha and Philippi were developed late in the apartheid era beyond the coloured townships on the Cape Flats, and large informal settlements also emerged. There is a population here of more than 700 000 people.

Beyond the Cape Flats to the east is a growing 'satellite city' which includes the higher-income, still largely white areas of Somerset West and Gordon's Bay; the more working-class and mixed white and coloured The Strand; and the black African townships and informal settlements of Nomzamo-Lwandle. The combined population in 2011 was around 130 000.

ECONOMY

Cape Town contributes around 10.9% of South Africa's GDP, second after Johannesburg. The Brookings Institution estimated a 2014 GDP of USD 58.86 billion, placing Cape Town in the league of cities in the BRICS such as Chennai and Curitiba.

% CONTRIBUTIONTO GVA BY SECTOR, 2013



Source: Quantec, 2013

The city has a diversified economy, with the four biggest sectors being finance services, business services, trade and hospitality, and manufacturing. In terms of employment, however, the largest sector is trade and hospitality, followed by finance and business services, and then manufacturing. The sectors have not grown evenly, with the tertiary sectors (finance and business services, transport, and trade and hospitality) growing fastest. Manufacturing employment has been declining, with job losses in labour-intensive industries such as clothing.

For the year ending March 2016, Cape Town experienced a marginal increase of 0.3% in employment. This was low, but better than the national minus-2.2, and better than all other major metropolitan areas.

GLOBAL CONNECTION

A major strength of the economy remains global tourism. Around 44% of visitors are international, 8% from the southern African region, and 48% domestic, with the top international markets being Germany, the UK, the USA and The Netherlands. International tourism has continued to trend upwards, but there has been a modest decline in domestic tourism.

GOVERNANCE

The Cape Town urban agglomerations falls within the governance arrangements indicated on the cover sheet for South Africa. The city is under the jurisdiction of the Cape Town Metropolitan Municipality and the Western Cape Provincial Government.

The city has had a different political profile from other metropolitan cities in South Africa, as it is controlled by the Democratic Alliance (DA), which is in opposition to the ruling African National Congress (ANC) nationally.

DEVELOPMENT CHALLENGES

The City of Cape Town is generally better positioned than other metropolitan areas, and South Africa as a whole, in terms of development indicators. For example, it has an HDI of 0.75, compared with 0.68 for South Africa.

Unemployment remains a key challenge in the city, given the loss of jobs in the manufacturing sector. The official unemployment rate for the first quarter of 2016 was 21.1%, which is high in international terms but less than the national 26.7%. As with other South African cities there are high levels of inequality; but the Gini coefficient of 0.61 (calculated by the City of Cape Town as 0.59) is less than the national 0.64.

The city has been growing relatively fast since the end of apartheid, although slowing recently, and informal housing has expanded. 20.5% of households live in a shack, mostly in freestanding informal settlements, which is high in national terms. The levels of formal servicing in the city are high for South Africa, with electricity connections per household for 2011 at 94%, piped water inside dwellings at 75%, and weekly refuse removal at 94%. However, problems remain within informal settlements.

As indicated in the findings of a 2012 national survey, the City of Cape Town has the lowest rate of HIV infection in a metropolitan city in South Africa, with a reported 5.2% prevalence. However, Cape Town has by far the highest rate of new pulmonary TB infection among the metropolitan cities and nationally. Violent crime is another major challenge for the city, associated in part with ongoing gang warfare and drug abuse on the Cape Flats. The 2015 murder rate for Cape Town of 65.5 per 100 000 placed the city as the ninth-most violent large city in the world, with higher-ranking cities all in Latin America.

The City of Cape Town depends on its natural beauty for tourism, but is facing major challenges. The city lies within the Cape Floristic Kingdom, which is the smallest and most diverse of the earth's six floristic kingdoms. However, this biodiversity is under severe pressure from urban encroachment and pollution.

THEMATIC REPORTS

TRANSPORT

ECONOMIC INFRASTRUCTURE

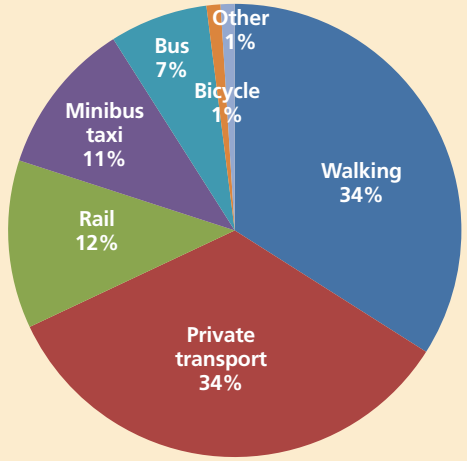
The City of Cape Town has a seaport and an airport. The port is too distant from South Africa's economic heartland to compete for premier status with the Port of Durban. It handles about a quarter of the traffic of the Port of Durban, but it is strategically located along a busy international shipping route. The Cape Town international Airport is the second-largest airport in South Africa, with traffic of around 8.4 million annually (compared to OR Tambo International Airport in Gauteng, with 19 million). It is the third-busiest airport in Africa after OR Tambo and Cairo.

COMMUTER TRANSPORT

Cape Town, like other South African cities, suffers serious challenges in terms of transport. There is the legacy of apartheid and modern planning which created a fragmented, low-density urban form, and which relegated the poorest segments of the population to locations far from jobs.

Cape Town has a transportation profile different to that of other metropolitan cities in South Africa, with relatively more dependence on private vehicles and rail, and less on the minibus taxi. The table below indicates the relatively even split between the minibus taxi and rail, which is different from other cities in South Africa where the minibus taxi is overwhelmingly dominant.

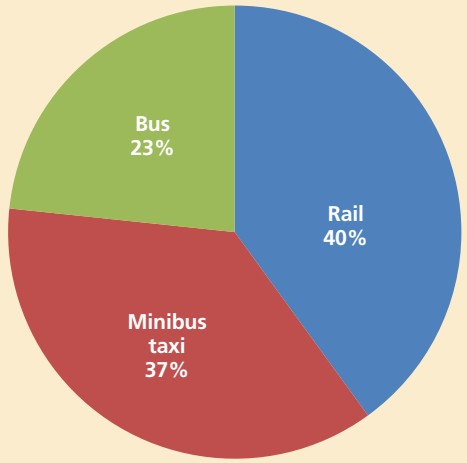
MODAL SPLIT, MOST FREQUENT TRIP



Source: City of Cape Town, 2013

The picture changes when looking at morning peak-hour, when the private vehicle accounts for 53% of all trips, followed by the minibus taxi at 15%, and then rail (13%), bus (11%) and walking (8%).

MODAL SPLIT FOR ALL TRIPS, PUBLIC TRANSPORT ONLY



Source: City of Cape Town, 2013

RAIL

Rail is more important for commuting in Cape Town than for any other metropolitan city in South Africa. The commuter rail service is provided by Metrorail, a division of the state-owned Passenger Rail Service of South Africa (PRASA). There are approximately 622 000 rail trips per day along 610km of rail line and nine commuter routes. Underinvestment over an extended period of time has led to problems, including peak-hour overloading and service unreliability. However, rail is now acknowledged as the backbone of an integrated transport system in Cape Town, and new investments are planned.

MINIBUS TAXIS

The minibus competes with rail in Cape Town for dominance in public transport. Minibus taxis are privately owned but are organised within taxi associations, and are a form of 'paratransit', with features of both formal and informal organisation. There are around 7 600 minibus taxis in operation across the city, organised in over 100 associations, and serving about 560 routes. While the minibus taxi industry is a critically important component of the transport system, it is poorly regulated, and associated with serious problems of road safety. Approximately 46% of taxis are unlicensed.

BUS

Bus accounts for around 250 000 trips a day. There are three main scheduled bus services operating in Cape Town: Golden Arrow, Sibanye, and MyCiTi. The first two are operated under contract from provincial government, and the third is a City of Cape Town operation.

Golden Arrow is by far the largest, carrying 220 000 passengers a day on 1 300 routes across the city. Sibanye serves the Atlantis area and students at the University of Cape Town, along 155 routes. MyCiTi is the Bus Rapid Transit (BRT) service (with feeder routes) introduced by the City of Cape Town in time for the 2010 FIFA World Cup. The system is to be developed in five phases over twenty years, and has a current ridership of around 20 000 per day.

THE FUTURE

Cape Town launched its Integrated Public Transport Network Plan in 2014. The Plan aims to create a seamless network of public transport by 2032, with 80% of households having access to public transport within 500 metres of their dwelling. The main components of the plan are: the further extension of the MyCiTi BRT network, with 10 new trunk routes; the expansion of rail, with two new lines; a major new bus transportation hub at Philippi; a unified scheduling and ticketing system; and active support for non-motorised transport and various forms of demand management, such as car-pooling.

GREEN ENERGY

The details of South Africa's energy profile and the current national initiatives to transition to renewables are provided in the Johannesburg Factsheet and are not repeated here. Cape Town has the same challenge of overwhelming dependence on Eskom coal-fired power stations for its electricity supply. The City, which has an annual demand for electricity of around 2 400MW, is 100% reliant on the national grid for its base load, although it does have three small power stations which it uses for load management – one is hydro pumped storage, and two are diesel-fired gas turbines. Note that the Koeberg Nuclear Power Station, situated 30km north of Cape Town's CBD, delivers around 930MW of electricity; but this is fed into the national grid, accounting for around 5% of South Africa's total supply, rather than directly to the city.

The gradual greening of electricity supply is largely the result of national government's Renewable Energy Programme for Independent Power Producers (REIPPP). There are also local initiatives, although still on a very small scale. South Africa's first wind farm, which preceded the REIPP, was located near the town of Darling, 70km north of Cape Town, in 2008, as a partnership-based initiative involving local companies, the Danish government, and the Development Bank of Southern Africa. The Darling Wind Farm became viable when a long-term purchase agreement was concluded with the City of Cape Town. The electricity produced here is distributed to purchasers of green energy through an instrument called Green Electricity Certificates (GECs). When the City buys electricity from the wind farm, the equivalent quantity of units of Green Electricity Certificates is created, which can then be sold to consumers at a fixed rate. The value of the initiative is mainly as a pilot project, as the wind farm accounts for a mere 0.1% of electricity consumption in Cape Town. However, there is potential for upscaling, including through purchases of electricity from the larger wind farms being developed further north in the Western Cape. The City of Cape Town is also working with provincial government to bring natural gas to the city, which while not a green energy per se,

does have a lower impact on the environment than coal. The City is also exploring options in terms of micro-hydro, waste-to-energy, and solar.

All levels of government are working to unlock potential in the Western Cape for manufacturing in the green-energy sector. The national Department of Energy, for example, has identified Atlantis in Cape Town as a future hub of green technology and manufacturing. Provincial government has established an agency called GreenCape, dedicated to supporting business engaged in the production of green energy.

Like other metropolitan cities in South Africa, Cape Town is actively trying to increase efficiency of energy usage. For example, there is: an active electricity-saving campaign for the residential and commercial sectors; incentives for the uptake of solar water heaters; retrofitting of municipal buildings for energy efficiency; a programme to improve energy efficiency in low-cost housing; and the replacement of street lights and traffic lights with LED lighting.

The liquid fuels used in transport are imported through Saldanha Bay, a port north of Cape Town, and processed in the city at the Caltex Refinery. As with electricity, this segment of energy is nearly entirely carbon-based. However, GreenCape is investigating the possible use of waste-based bioethanol for fleet transport, while the City of Cape Town is procuring electric buses.

INNOVATION-DRIVEN ECONOMY

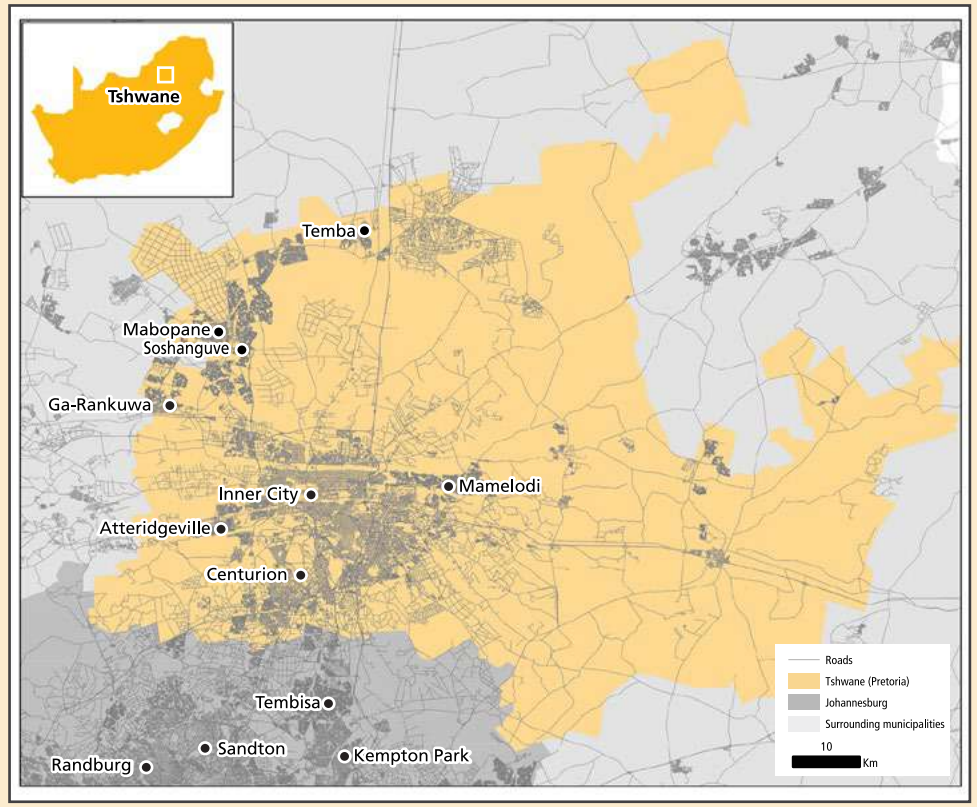
In 2012 Cape Town accounted for 13.8% of R&D expenditure in South Africa, and was second after Johannesburg. In per capita terms, Cape Town was third after Tshwane and Ekurhuleni. Cape Town may however be doing even better in terms of other measures of innovation. Recent survey information reveals an innovative pulse in Cape Town, with a concentration of firm start-ups and entrepreneurial ventures in leading-edge sectors such as ICT.

The reason for this has to do with the presence of leading-edge academic institutions in the region, and the attractive environment, with its appeal to talented young people. Despite being a small city in BRICS terms, (greater) Cape Town ranks sixth in the BRICS in terms of a concentration of high-ranking universities. It has two of the Top 50 universities in the QS 2016 BRICS rankings: the University of Cape Town (14th) and Stellenbosch University (35th).

There are numerous programmes supported by the private sector and government to promote innovation in Cape Town and the Western Cape. Many of these are focused on incubating ICT and other hi-tech firms. One of the initiatives, for example, is Silicon Cape Town. There is a particular focus on the health sector, building on a long-established strength of the region (this was, after all, where the world's first heart transplant was conducted), with a health-technology hub being developed in Pinelands, Cape Town.

Cape Town has received some recognition for these initiatives; for example, it is ranked 125th globally on the 2thinknow index, which is 10th in the BRICS. Cape Town ranks third on 2thinknow's list for innovation in emerging cities (following Abu Dhabi and Dubai).

CITY OF TSHWANE (GREATER PRETORIA)



CONTEXT

LOCATION AND STATUS

Tshwane is located in the Province of Gauteng, within the Gauteng City-Region (GCR). It is immediately to the north of the City of Johannesburg, and includes both the core city of Pretoria and a large complex of 'displaced urbanisation' on the northern edge of the metropolitan region.

Tshwane is South Africa's national administrative capital (sharing status with Cape Town, which is the national legislative capital).

HISTORY

The area has a long history of pre-colonial settlement, serving for example as the temporary headquarters of the Ndebele king Mzilikazi. The formal town of Pretoria was established in 1855 by the Voortrekkers (descendants of the Dutch, also known as Boers). It became the capital of the Zuid Afrikaansche Republiek (or Transvaal). Pretoria was captured by the British in 1900, during the Anglo-Boer War. In 1910 Pretoria became the administrative capital of the Union of South Africa. It remained administrative capital when South Africa became a Republic in 1960, and also when non-racial democracy was established in South Africa with the formal ending of apartheid

in 1994. Pretoria was historically largely dependent on the government sector, but it has diversified economically in the post-apartheid era, growing relatively fast, economically and demographically, in relation to South Africa as a whole and to other metropolitan areas. Apartheid rule led to highly fragmented spatial and institutional arrangements, but the greater metropolitan area is now consolidated under the Tshwane Metropolitan Municipality.

POPULATION

POPULATION SIZE

The UN estimate for 2015 was 2.83 million (which combines the 'Pretoria urban agglomeration' with the 'Soshanguve urban agglomeration'). This is less than the population of the municipality which also includes rural areas and smaller urban centres.

POPULATION RANKING

As an urban agglomeration its ranking is around 154th in the world, 65th in the BRICS, and fifth in South Africa (after Johannesburg, Cape Town, Ekurhuleni and Durban)

POPULATION GROWTH

Tshwane grew moderately fast at 3.1% per annum in the period 2001 to 2011 (Census 2011). But this growth was not evenly distributed across the city. The UN data differentiates between Greater Pretoria, growing at an estimated 4.23% per annum for the period 2010-2015, and the displaced urban agglomeration of Greater Soshanguve, growing at only 1.73%. Population growth is concentrated in the core city.

DIVERSITY

Tshwane is a diverse city in terms of population. The racial breakdown in 2011 was black African (75%); white (20%); coloured (2%); and Indian/Asian (2%). There was a diversity of home languages spoken, including Sepedi (20%), Afrikaans (19%), Setswana (15%), Xitsonga (9%), English (9%), isiZulu(9%) and isiNdebele (6%).

The 2011 census indicated that nearly 11% of Tshwane's population was foreign-born. The cosmopolitan nature of the city is reinforced by the presence of around 130 embassies, the largest concentration globally after Washington D.C.

STRUCTURE OF URBAN REGION

Tshwane's urban structure has been deeply fragmented by apartheid. The core city of Pretoria had around 742 000 people in 2011, and was still majority white. The edge city of Centurion immediately to the south of Pretoria, also majority white, had 237 000. Also on the immediate periphery of Pretoria are the older black African townships of Mamelodi (335 000) and Atteridgeville (64 000).

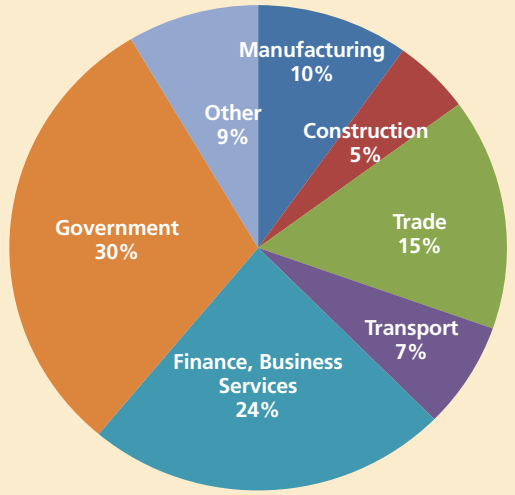
However, a large proportion of the black African population live in displaced urban settlements into which people were moved during the height of apartheid. These settlements were behind the ethnic homeland boundary and remain a persistent feature of the urban landscape in the current period. These are dormitory settlements, and there is daily long-distance commuting into the core city. The largest of these are Soshanguve (403 000), Winterveld (121 000), Mabopane (111 000), Ga-Rankuwa (91 000) and Temba (58 000).

ECONOMY

The Brookings Institution calculated the 2014 GDP of Tshwane as almost USD 50 billon, slightly less than Cape Town, and a little more than Durban. It contributes around 9.3% of the economic output of South Africa.

The largest single sector is government services, though the trade sector and finance and business services sectors are also relatively well developed. The manufacturing sector is relatively small, proportionally speaking, but is has a strong concentration of South Africa's developing motor industry.

% CONTRIBUTION TO GVA, 2013



Source: Quantec, 2016

The economy has been doing well. Between 2010 and 2014, Tshwane had the highest average annual GDP growth of any large urban municipality in South Africa (4%, compared for example with 3% for Cape Town, and 2.6% for the City of Johannesburg). With the concentration of industries such as motor vehicles, Tshwane contributes a significant 22% to national exports. However, Tshwane is not immune to the effects of global and national insecurities. The average annual growth rate in GVA decreased to 1.7% in 2013, this time slightly less than the national 1.9%. The Quarterly Labour Force Survey released in May 2016 indicated a year-on-year contraction in the number of employed workers in Tshwane of 2.4%, compared with a 2.2% contraction nationally. This was slightly worse than Johannesburg, but better than South Africa's other major metropolitan cities.

GOVERNANCE

Greater Pretoria falls within the governance arrangements indicated on the cover sheet for South Africa. The city is under the jurisdiction of the Tshwane Metropolitan Municipality and the Gauteng Provincial Government. As in the case of Johannesburg there are complex matters of coordination with the provincial government, and with neighbouring municipalities within the framework of South Africa's system of cooperative governance.

DEVELOPMENT CHALLENGES

Like other cities in South Africa, Tshwane is unequal and divided. The Gini coefficient for Tshwane is calculated as 0.63, less than Johannesburg but extremely high in international terms.

The Quarterly Labour Force Survey Q1 2014 indicated an unemployment rate of 26% for the City

of Tshwane. This is clearly very high in international terms, but it is lower than those of the other two Gauteng metropolitan municipalities, and is slightly less than the national rate of 26.7%. In 2011, 18% of the households in Tshwane were living in informal accommodation, comparable to Johannesburg, and less than Ekurhuleni.

The city is relatively well-provided for in terms of formal services, with access to electricity by household in 2011 at 88.6%, and weekly refuse removal at 80.7%. The main challenges were in informal settlements, although there was a backlog in terms of piped water inside dwellings, which was at 64.2%.

The 2012 national survey on HIV/Aids indicated a prevalence rate in Tshwane of 11.7%, which is comparable to that of Johannesburg and marginally less than the national rate of 12.2%.

Finally, Tshwane experiences the same challenges as other South African cities in terms of its carbon footprint, given the extremely high dependencies on fossil fuels. However, levels of ambient air pollution are significantly less than in the Johannesburg-Ekurhuleni agglomeration.

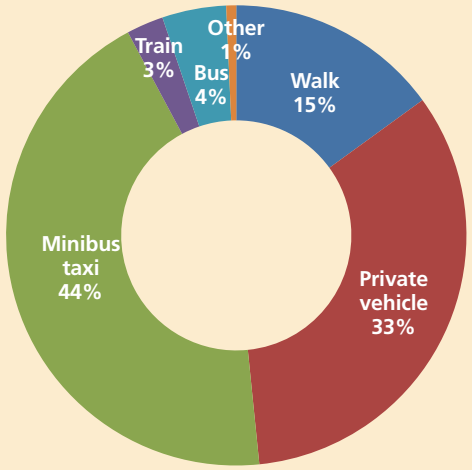
THEMATIC REPORTS

TRANSPORT

Tshwane has the usual challenges of South African cities in terms of fragmented spatial form, low density, and motor-car dependency. However, the Tshwane case is extreme as a result of 'displaced urbanisation'. A significant proportion of Tshwane's population is located behind what were the previous ethnic homeland boundaries, and are forced into long-distance daily or weekly commuting. Although the bus and rail services have been heavily subsidised to deal with longer commuter runs, they have been steadily declining in modal share. The unsubsidised minibus taxi industry run by competing cartels has been the most successful.

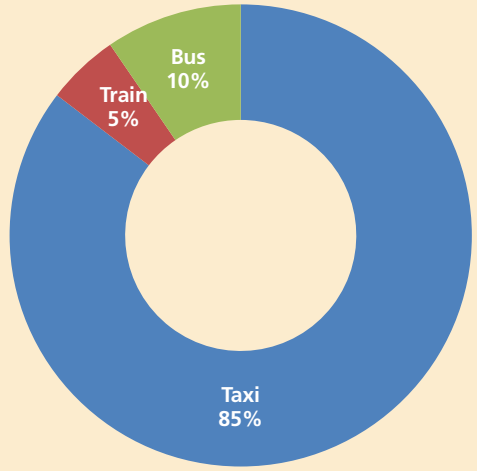
The modal split for most frequent trip is similar to that of Johannesburg, with a large proportion of trips by private cars and minibus taxis. The racial divide is strong, with whites almost exclusively using private vehicles and black Africans mainly walking or using minibus taxis and other public transport. Tshwane, however, has an even higher proportion of private cars than the other metropolitan municipalities.

MODAL SPLIT FOR MOST FREQUENT TRIP



Source: GCRO, Quality of Life Survey, 2013

MODAL SPLIT FOR PUBLIC TRANSPORT ONLY



Source: GCRO Quality of Life Survey, 2013

In terms of public transport only, minibus taxis are enormously dominant, with bus following at a distance, and train a mere 5%.

MINIBUS TAXIS

Minibus taxis are privately owned but are organised within taxi associations, as a form of paratransit. The minibus industry is a celebrated example of the success of small business and of black economic empowerment, and with its route and operational flexibility it is well suited to the complex spatial form of South African cities. There are, however, periodic violent conflicts between rival taxi associations, and problems of reckless driving and unroadworthy vehicles.

BUSES

After minibus taxis, buses are most important. There are five companies, including a municipal bus service, providing subsidised services to commuters. There are now serious attempts to improve the quality of these fragmented services. Tshwane has introduced a Bus Rapid Transit (BRT) system, known as Re Yang, with a planned 80-kilometre service of dedicated lanes. It has been operational since 2014. The eventual target is 127 000 passengers daily.

RAIL

Pretoria is one of the three hubs of Gauteng's commuter rail network, which is operated by Metrorail, a division of a national parastatal, the Passenger Rail Agency of South Africa (PRASA). This rail network has historically serviced 'black townships' and does not include the historically white suburbs. There has been severe underinvestment in the rail system over a number of decades, and ridership share has declined steadily relative to minibus taxis and private vehicles. However, there are now ambitious plans to modernise the rail network.

A major development in the lead-up to the 2010 FIFA World Cup hosted by South Africa was the development of the Gautrain, an 80-kilometre, high-quality, fast rail network, linking Johannesburg and Tshwane (Pretoria) and the OR Tambo International Airport in Ekurhuleni. It was developed as a public-private partnership between the Gauteng Provincial Government and the Bombela International Consortium. However this is not a mass transit network, as it caters mainly to higher-income travellers.

FUTURE DEVELOPMENTS

The City of Tshwane is working towards an integrated public transport network, linking the various

nodes more effectively. It proposes dealing with demand through promoting non-motorised transport, rideshare, flexitime employment, parking controls, an intelligent road traffic system, and a possible road-user tax. In terms of new developments, the BRT expansion is a key focus.

These developments complement the provincial strategy to expand the Gautrain system, which already has a greater (although still very modest) ridership in Tshwane than in other parts of Gauteng. It is anticipated that the launch of a Gauteng integrated transport authority in 2016 will assist with the coordination of transport initiatives between Tshwane and its neighbouring authorities.

In addition, there is a strong focus on road safety. One of the biggest challenges in Tshwane has been the Moloto Corridor, known as the 'Road of Death', which links Tshwane with Mpumalanga and Limpopo provinces. A R34 billion investment involving road and rail upgrades is planned to relieve the severe pressures and safety risks.

GREEN ENERGY

Tshwane, like all other cities, faces the challenge of overwhelming dependence on the national electricity grid powered mainly by Eskom's coal-fired stations, and also on the near-total use of petroleum and diesel in the transport sector.

Tshwane does however have two municipal coal-fired power stations, which provide up to 10% of the city's electricity (around 630MW). The city is trying to improve the operational and environmental efficiency of these power stations by contracting a private operator (although maintaining municipal ownership).

With the rise of Independent Power Producers (IPPs) in South Africa, 'wheeling agreements' which allow private producers and users to use state infrastructure are gradually being introduced. In Tshwane, the BMW plant, for example, is sourcing green energy directly from the firm Bio2Watt, through an agreement that allows the company to use the municipal distribution network for transmission of the electricity.

Tshwane is working to position itself as the Green Energy Capital of South Africa. A City Sustainability Unit was established in January 2013 to guide the city's transition to a green economy, and in November that year the City launched its Strategic Framework for a Transition to a Green Economy with a planned R1.1 billion investment. The green economy investments include a number in relation to green energy, such as: a 20MW solar farm; energy-efficient lighting replacement of mercury and sodium vapour lamps and fixtures with energy-efficient induction; 6MW/h biomass-powered electricity generation; natural gas exploration within the municipality; mini-hydro generation of electricity with an initial pilot at municipal reservoirs; and the refurbishment of the two coal-fired power stations. These are in addition to existing interventions such as green building design, solar water heaters for low-income households, and retrofitting of municipal buildings.

Tshwane municipality has also made a start with the greening of fuel in the transport sector. Around 40 buses in its BRT fleet run on Compressed Natural Gas (CNG), the first in Africa, and there is a commitment to run 83 buses on clean energy by 2020.

While these interventions may still be very limited in relation to the overall dependence on carbon-based sources, it does reveal a strong commitment to the idea of green energy.

INNOVATION-DRIVEN ECONOMY

Tshwane's strong dependence on government services may have stifled innovation historically, but there is a strong basis for innovation in the relationship between government, a newly vibrant private sector, and the large number of research institutions in the city. Tshwane is the site of three large universities, as well as the headquarters of South Africa's leading government research institutes. Together these institutions form a significant knowledge hub. In 2012, Tshwane contributed 11.5% of South Africa's expenditure on R&D, which was third after Johannesburg and Cape Town.

But in per capita terms, Tshwane had the highest expenditure on R&D, reflecting the significance of the state research councils in the city, and the presence of the universities.

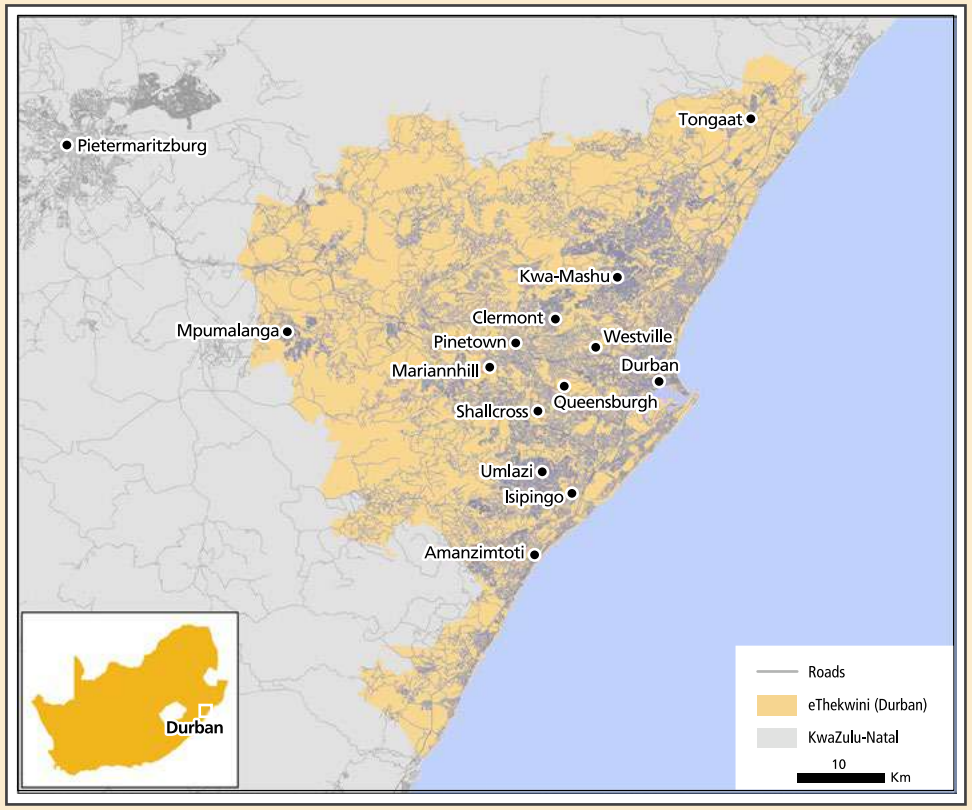
There has been a concerted effort recently to promote local innovation. The Gauteng Provincial Government established the Innovation Hub Management Company SOC Ltd, which established and manages the Innovation Hub and a Science and Technology Park in Pretoria to support provincial competitiveness. The metropolitan government is also actively promoting innovation, having established the Tshwane Innovation Zone, targeted especially at supporting innovation among the youth.

There are specific industries locally that have developed a profile for innovation, or where there are active attempts to support innovation. Most significant is the automobile industry, which has developed an Automotive Incubation Centre at Rosslyn that gives support to small- and medium-sized industry in supplying components to the major manufacturers. Beyond automobiles, state-owned Denel has established a reputation for cutting-edge research and innovation in the aerospace and defence sectors, through Denel Military Research and Development.

The QS University Rankings for 2016 ranked the University of Pretoria 49th in the BRICS. However, R&D led by research institutions does not only happen in the universities, but also in the state research councils, such as the Council for Scientific and Industrial Research (CSIR), Human Sciences Research Council (HSRC), and Agricultural Research Council.

CITY OF ETHEKWINI

(GREATER DURBAN)



CONTEXT

LOCATION AND STATUS

Greater Durban is located on the eastern coastline of South Africa within the Province of KwaZulu-Natal (KZN). It falls largely under the jurisdiction of the eThekwini Metropolitan Municipality. Durban is the largest city in the Province of KwaZulu-Natal, and also has the largest port in South Africa.

HISTORY

Durban began as a colonial trading outpost and small port in 1824, within a region that was then dominated by the newly-consolidated Zulu Kingdom. The settlement survived early conflict between the Zulu kingdom and the British, and between the British and the Boers. Durban was proclaimed as a town in 1835 in the British Colony of Natal, and formally laid out in 1860. In the late 19th century it expanded, largely as a result of the development of sugar cane estates in the hinterland, a coal-mining industry in north-western Natal, and the development of a railway line to the gold fields of the Witwatersrand. In the 20th century Durban developed as the premier destination for domestic tourism in South Africa, and also as Africa's largest port. From around World War II it developed a significant manufacturing sector, focused on chemicals, port-related industry, and clothing and textiles. Colonial and apartheid policies of racial segregation significantly shaped the spatial and institutional form of Durban, with the boundary between Natal and the ethnic homeland of KwaZulu passing through the metropolitan region. With the ending of apartheid, the metropolitan region was consolidated under the eThekwini Metropolitan Municipality.

POPULATION

POPULATION SIZE

Census 2011 indicated a population of 3.44 million for the eThekwini Metropolitan Municipality, with municipal estimates for 2015 of 3.55 million. The UN figures for the urban agglomeration for 2015 are lower, at 2.9 million, but this is because the UN excluded the approximately 500 000 people living in the rural or semi-rural parts of the municipality.

POPULATION RANKING

Using the UN estimated data, Greater Durban would rank about 150th globally, 63rd in the BRICS and fourth in South Africa (after Johannesburg, Cape Town and Ekurhuleni).

POPULATION GROWTH

The population is growing slowly. The UN estimates 1.15% per annum in the period 2010-2015. Census 2011 indicated an annual growth of 1.08% for 2001 to 2011.

DIVERSITY

eThekwini differs from other metropolitan cities in South Africa with its large minority population of Indian/Asian origin, and with the predominance of a single language, isiZulu. It also has a relatively low proportion of foreign nationals for a South African city. The racial breakdown in 2011 was: black African (74%); Indian/Asian (17%); white (7%); coloured (mixed-race) (3%). The main home languages spoken were isiZulu (63%) and English (27%). 6.5% of the population was foreign-born.

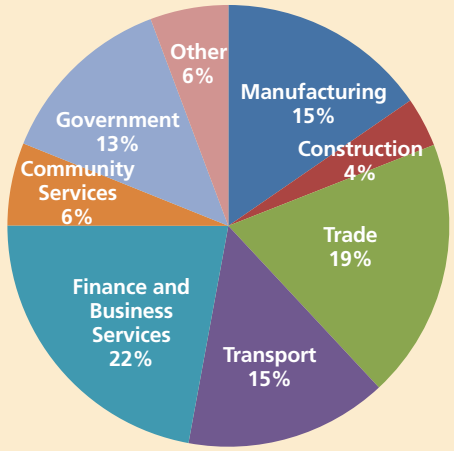
STRUCTURE OF URBAN REGION

The Durban Metropolitan Region is strongly shaped by physical elements, including the Indian Ocean coastline, the Bay of Natal, and the road network, with the N3 (east/west) connecting with the N2 (north/south) to create a 'T' shape. The historical City of Durban is the dominant core of the metropolitan region, with a 2011 population of around 600 000 (with the currently designated Central Region having 1.3 million people). The other major concentrations are on the edge of the core city, in the apartheid-created black African townships of Umlazi (408 000) and KwaMashu (176 000); the Indian townships of Chatsworth (196 000) and Phoenix (176 000); and the mainly informal settlements of Inanda (178 000) and Ntuzuma (125 000). But these are all dormitory settlements with no substantial economic base. The small satellite nodes with economic activity beyond the boundaries of Durban include Pinetown (144 000), Stanger (51 000) Verulam (37 000), and Umhlanga (24 000). A new 'edge city' with large-scale, upmarket private development is emerging to the north of Durban, at Umhlanga Ridge. There is also a semi-urban population within the jurisdiction of the municipality of around 500 000.

ECONOMY

The Brookings Institution estimated the GDP of Durban to be around USD 48.9 billion. This is slightly less than that of Pretoria (Tshwane) and comparable to that of cities in the BRICS such as Bengaluru, Hyderabad and Curitiba. Durban's economy contributes around 8.7% of South Africa's GDP and 52% for the Province of KwaZulu-Natal.

% CONTRIBUTION TO TOTAL GVA, DURBAN, 2013



Historically, Durban's economy was built around transport and logistics, manufacturing, and tourism. Recently, however, tertiary sectors have become more important. Currently the largest sector in terms of GVA is Finance and Business Services, followed by Trade, and then Manufacturing and Transport. The relatively large size of the transport sector in this port city is what distinguishes eThekwini from other metropolitan cities in South Africa.

There is a lack of reliable economic data, but in the period 2006 to 2011, eThekwini outperformed the other metropolitan areas in terms of employment creation, with employment increases of 3.8% per annum. eThekwini's unemployment rate trended down to 16% by the second quarter of 2015, compared with the national average of 25% unemployment, indicating its relative success in creating jobs. There are indicators however that the downturn in the national economy from around 2014 is having a disproportionately negative impact on eThekwini. The Statistics South Africa Labour Force Survey for Q1 2016 revealed a dramatic 12.8% reduction in employment since Q1 2015, with unemployment rising to 18.8%. It is not clear however whether or not this represents a longer-term setback for the local economy.

GOVERNANCE

Greater Durban falls within the governance arrangements indicated on the cover sheet for South Africa. The city is under the jurisdiction of the eThekwini Metropolitan Municipality and the KwaZulu-Natal Provincial Government.

There are minor differences between the governance of eThekwini and that of South Africa's other metropolitan municipalities; with, for example, the executive authority in the eThekwini municipality resting in an Executive Committee, which then appoints a Mayor as chairperson. In other metropolitan municipalities, executive power is vested in a Mayor who appoints an executive committee at his/her discretion.

The other key features of eThekwini include the role of traditional (or tribal) authorities on the edge of the urban agglomeration, and the significance of the Transnet National Ports Authority as a major institutional player.

The relationship between the democratically elected local authorities and the hereditary traditional structures has not been entirely resolved in the post-apartheid period. There has also been a history of fragmented governance, with the ports authority and the metropolitan authority not coordinating adequately; but this is improving.

DEVELOPMENT CHALLENGES

As indicated, economic and employment data reveals an uncertain picture. Significantly, for example, the Census 2011 data suggested an unemployment rate significantly higher than the Labour Force Survey data.

It is clear however that eThekwini is one of the poorer metropolitan municipalities in South Africa. While population growth is relatively low, the housing backlog remains high. In 2011, 18% of the households in the metropolitan municipality were living informally, a figure similar to that of Gauteng's metropolitan municipalities. However, two-thirds of these informally accommodated households were living in freestanding informal settlements, and only one-third in backyard accommodation. This is different from Gauteng, where there is a far higher proportion of the latter.

Durban has been one of the HIV/Aids hotspots of South Africa and globally. Estimates of HIV infection have varied dramatically, but the 2012 national HIV/Aids survey put the prevalence rate for eThekwini municipality for the total population at 14.5%. This is the highest for any metropolitan municipality in South Africa, although lower than other estimates, which go as high as 30%.

Crime rates remain high in Durban, with the Mexican Council for Public Security and Criminal Justice ranking the city as the 41st-most violent in the world, with a 2015 murder rate of 35.9 per 100 000.

Other significant problems faced by the city are the high levels of air pollution in Durban's Southern Industrial Basin where the chemical industry is concentrated, and social tensions including often-violent forms of xenophobia.

THEMATIC REPORTS

TRANSPORT

ECONOMIC INFRASTRUCTURE

As a major port city, transport and logistics have been critical to the development and functioning of Durban. The Port of Durban is the largest and busiest in sub-Saharan Africa, handling about 31.4 million tons of cargo a year and accommodating 4 500 commercial vessels. According to the World Shipping Council, the Port of Durban ranked 50th globally in 2013 as a container port, but it was second in Africa after Port Said in Egypt, and 14th in the BRICS (mainly after Chinese ports). Durban handles around 58% of South Africa's container market, followed by Cape Town at 19%. While the Port of Durban is moderately large in global terms, it has faced challenges in terms of efficiency. There are major plans for port expansion, by creating a large dug-out port on the site of the previous airport.

A major new development has been the construction of the King Shaka International Airport to the north of Durban, which opened in 2010. It is ranked as the ninth-busiest airport in Africa. The airport forms part of the Dube Tradeport, which includes a trade zone with industrial and commercial activities linked to air travel.

The rail and road corridor between Durban and Gauteng is recognised by government as critical to the national economy. There are ambitious plans to rehabilitate this corridor, including the proposed dug-out port, a logistics hub midway between the two urban centres, and massive improvements to rail capacity and efficiency for freight. A high-speed rail link between Durban and Johannesburg has been mooted through a partnership with the China International Railway Group, but finding an adequate funding model has proved difficult.

HOUSEHOLD TRANSPORT

There are significant data challenges in calculating a modal split for eThekwini, especially since national travel data is provided on the provincial scale only, and there is no KZN equivalent to the

GCRO. The municipality estimates that 40% of residents use public transport in Durban, with 60% using private modes. Of the 40% who use public transport, 68% use minibus taxis (which is a form of paratransit, as it is privately run), 25% use buses, and 7% use rail. However, this data is 'broad brush', and does not distinguish between different types of trips.

MINIBUS TAXIS

The minibus is by far the most important mode of collective travel and is organised within 120 taxi associations. It is a flexible mode of transport suited to the spatial form of South Africa's cities, but is also associated with problems of user safety, a poorly-maintained fleet, and conflict between associations over routes, which frequently turn violent.

BUSES

After taxis, buses are most important; and here there is considerable complexity, with around 200 operators serving 1 400 routes, with a mix of government-subsidised contracts and unsubsidised services. These operators often have low profit margins, and inadequate and deteriorating fleets. Durban Transport was historically a municipally-owned operator, accounting for around a third of the bus fleet and half of the routes. It experienced increasing problems resulting in growing unreliability of service, and in 2003, was controversially privatised when it was sold to Remant (Pty) Ltd and the Alton Coach Africa Consortium. However, as part of the preparations for the FIFA 2010 World Cup the municipality established a bus service called People Mover. The system only operates in the Durban CBD and along the beachfront.

RAIL

The commuter rail service is run by an SOE, Metrorail, and has eight routes radiating outwards from central Durban; but the share of rail transport has been declining, and major investment is required for rail to regain an advantage.

FUTURE

Overall, Durban's transport system is inefficient and inadequate for the mobility challenges in the city. But there are plans for improvement. Go! Durban is the name of the Integrated Rapid Public Transport Network (IRPTN) Project, which aims to provide seamless, safe, cost-effective and flexible public transport to at least 85% of the metro's population. The project involves the development of nine transport corridors of various modes (bus, rail, and taxi) by 2027. Phase 1 of the project entails the development of four corridors, and is expected to be complete in 2018. It includes three Bus Rapid Transit (BRT) corridors and one railway corridor. There are also plans for a high-speed monorail between the Durban CBD and King Shaka Airport, with construction expected to begin in 2017.

GREEN ENERGY

eThekwini Municipality is massively dependent on Eskom for its electricity, and faces all the challenges and vulnerabilities of other municipalities in this position. Only 0.4% (45GWh) of annual electricity supply is generated within the boundaries of the municipality, mainly from the Landfill Gas projects at the Bisasar Road and Marianhill landfills. For the foreseeable future Durban will remain dependent on national systems for supply, and the shift towards green energy will follow the pace of change nationally.

The main impact of the municipality will be in demand management. eThekwini municipality has an Energy Office which began operation in 2009, set up with funds from the Danish International Development Agency (DANIDA) and the Environmental Management Programme. The Energy Office is responsible for promoting sustainable energy options in the city; mainly through improving energy efficiency, but also exploring new sources of green energy. This unit has worked to reduce energy consumption in municipal infrastructure (e.g. with street lights and metering systems, retrofitting of buildings for energy efficiency, and solar water heating in township houses). eThekwini launched the Durban Solar City Framework Project in April 2015. The project aims to promote rooftop solar PV panels on homes, factories, and office blocks, with the aim of making sun power a significant contributor to Durban's energy supply. The project proposes to allow residents to export surplus energy generated by their PV panels into the grid, which would reduce their electricity bill. Although production of green energy is still very limited, eThekwini municipality is exploring the potential of flare methane at waste treatment plants, 'water reticulation mini hydros' at reservoir turbine sites, and wind-energy options with a German association.

INNOVATION-DRIVEN ECONOMY

eThekwini was ranked only 385th on the 2thinknow Innovation Cities Global Index, which is also relatively low for a BRICS city. Its ratings are also low in South African terms, with its share of expenditure on R&D only 6.5% in 2012, and its per capita expenditure on R&D the lowest of all South Africa's metropolitan cities.

eThekwini may lag behind the Gauteng metros and Cape Town in terms of innovation indicators such as R&D expenditure and patents submitted, but the metropolitan municipality has taken a recent lead in promoting innovation. Innovate Durban was launched in 2014 'to highlight the importance of innovation in economic processes, as well as channel creativity into improving the City'. It is a partnership between eThekwini Municipality and institutions including the University of KwaZulu-Natal, Durban University of Technology, the International Labour Organisation, IBM, the Technology Innovation Agency, and the Standard Bank of South Africa. Its programmes include an Open Exchange Project to accelerate internal innovation within the municipality through the smart use of technology, and the development of an innovation precinct, a youth innovation challenge, and an innovation needs assessment.

Durban has two major universities – the University of KwaZulu-Natal (UKZN) and the Durban University of Technology. In terms of the 2016 Times Higher Education rankings, UKZN ranks in the band 501-500 globally. The QS University Rankings for 2015 ranked the University of KwaZulu-Natal as 68th in the BRICS.

YOUR NOTES

YOUR NOTES

YOUR NOTES

BRICS Cities: Facts & Analysis is a compendium of research produced through a partnership between the South African Cities Network and the South African Research Chair in Spatial Analysis and City Planning in the School of Architecture and Planning at the University of the Witwatersrand. It presents key general and thematic descriptive and comparative information about urban growth and development in the five BRICS states: Brazil, Russia, India, China and South Africa. The comparative analysis includes a section relating to cities in Africa, while the detailed Factsheets cover thirty-one of the largest BRICS cities. BRICS Cities provides a first-of-its-kind research base to inform ongoing sub-national BRICS research and policy consideration.

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