Case Study 3: Why the car is key to low carbon mobility in Brazil

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Introduction

The challenge of transitioning to low carbon mobility differs between industrialised countries and emerging economies. Industrialised countries – where mobility is high but its growth has slowed down – must reduce absolute levels of transport emissions, i.e. they have to transition from high carbon to low carbon mobility. Emerging economies – where continued growth of both transport and associated emissions appear inevitable – have to find mobility pathways that allow for growth of transport while curbing the growth of transport emissions. Different strategies are required to achieve this objective in an emerging economy, depending on respective framework conditions. Brazil is a particularly interesting case. As this chapter will illustrate, Brazil is headed toward an auto-dominated mobility system. We argue that Brazil must achieve low carbon automobility in order to achieve low carbon mobility.

With a population of 204 million and a GDP of $3.276 trillion in 2014, Brazil is the 6th largest country and the 8th largest economy worldwide (CIA, 2016), and is one of the most important developing economies. Thus Brazil is not only a major market itself – its economic and political leadership position causes Brazil to be influential beyond its own borders on a regional and global scale. Against this background it is evident, that Brazil, with transport accounting for 42% of total carbon dioxide (CO_2) emissions (CAIT, 2016), presents an important case for climate change mitigation and the decarbonising of transport.

The current model of transport in Brazil

During the last decades, car ownership and usage has increasingly shaped transport in Brazil as both new car registrations and the total car fleet grew substantially. With 2.9 million new car registrations in 2014 (doubling from 2005 figures), Brazil was the fourth largest new cars and light commercial vehicle market in the world (Fenabrave, 2006, Fenabrave, 2015). The used car market is even bigger; in 2014 8.7 million used cars changed hands, 3.1 times the number of new car registrations (Fenabrave, 2015). At 162 cars per 1000 inhabitants, the car ownership rate in Brazil exceeds that of India and China; however, it is still far below those of Germany and the USA, yet the average annual mileage is similar to that of China and India but low compared to Germany and the USA (see Table 1). The car, however, is not the only important private motor vehicle: a surge in motorcycle ownership in the recent years has led to 20 million motorbikes on register in 2015 (Fenabrave, 2015).

Table 1: Car fleet and car usage figures in Brazil and in four other countries. Sources: OICA (2016), progtrans (2010), KBA (2016), BTS (2013), National Bureau of Statistics of China (2012), Ministry of Statistics and Programme Implementation (2013).

	New car registrations [millions] (data from 2014)	Car fleet [millions] (data from 2012)	Car ownership rate [cars/1,000 inhabitants] (data from 2011)	Average annual mileage of the car fleet [km] (data from 2010)
GER	3.0	44	547	12,400
USA	7.7	234	722	19,800
BRA	2.9	33	162	7,000
CHN	19.7	61	45	9,300
IND	2.6	19	15	6,200

As exemplified by its 1.5 million km interurban roads compared to 28,500 km railway infrastructure, Brazil has a predominantly road-based transport system (CIA, 2016). This has also contributed to a bus dominated public transport system with long distance bus lines connecting metropolitan areas across Brazil. In various Brazilian cities, bus rapid transit (BRT) systems enable fast connections within the cities; for example in Rio de Janeiro, where about 9 million passengers use the BRT every month (Colin, 2015).

In Brazilian cities with more than 60,000 inhabitants, walking still forms an important part of everyday mobility accounting for 37% of all trips (across all trip purposes) in 2013. The car (as driver or passenger) is used for 27% of all trips, followed by public road transport (25%). Rail, motorbike and bicycle all have a modal share of about 4% (ANTP, 2014).

To obtain a better understanding of how the transport system in Brazilian cities compares to other cities worldwide, we draw on a cluster analysis of over 40 metropolitan transport systems from around the world (Kuhnimhof & Wulfhorst, 2013, Priester *et al*., 2013). Figure 1 visualises the result of this cluster analysis including two Brazilian cities (Sao Paulo and Campinas). It also includes a brief characterisation of the clusters. The original cluster analysis included 41 cities – among them Sao Paulo – which were categorised on the basis of data from the millennium cities data base (Kenworthy & Laube, 2001), including 59 transport system indicators for the year 1995. Despite the fact that some of these 1995 indicators are likely to be outdated, the clusters still provide a good indication about the general pathway that cities are on (Kuhnimhof & Wulfhorst, 2013). Campinas was fitted into the clusters later on the basis of more current transportation system data dating from around 2010 (WBCSD, 2016).

Figure 1 shows that high income cities typically fall into one of three clusters: 'Transit' cities (mostly high density Asian cities), 'Hybrid' cities (European and most North American and Australian cities) and 'Auto' cities (low density US cities and Riyadh, Saudi Arabia). Cities from emerging economies typically fall into the 'Non-motorised' cluster (some Asian cities), 'Traffic-saturated' cluster (some Asian cities, cities in the Middle East and North Africa) and the 'Paratransit' cluster (cities in Africa and South America). Interestingly, both Sao Paulo (1995) and Campinas (2010) did not fall in line with other cities from emerging economies and clustered as 'Hybrid' cities. Relevant differences between these Brazilian cities and typical 'Hybrid' cities in Europe and North America were relatively low GDP, a low car mode share and a high level of motorcycle ownership.

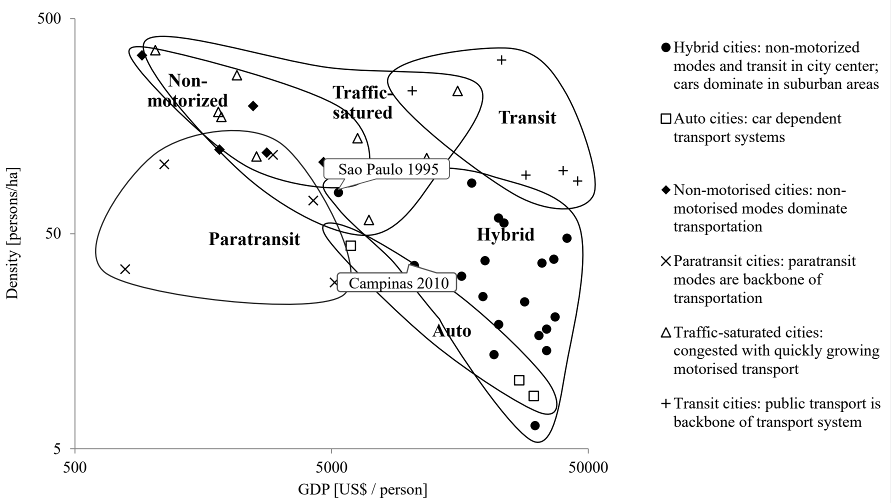

Figure 1: The position of Brazilian cities among global cities clustered based on mobility system characteristics. Source: Figure adapted from Kuhnimhof and Wulfhorst (2013).

Of course, there are important factors that make Brazilian cities unique. However, it is interesting to note that on a global scale Brazilian cities are not so different from European and many North American cities, for instance with regard to density. Moreover, the clusters in Figure 1 can also be interpreted as stages of development of urban mobility systems: as the economy grows, cities move from left to right in the graph. Often population densities decrease with rising incomes (Angel *et al*., 2010). Hence, cities tend to move towards the lower right corner of the graph (with the notable exception of some Asian cities that manage to maintain high densities as incomes grow). If Sao Paulo and Campinas follow this path, they seem to be heading towards a relatively low density, auto-oriented section of the 'Hybrid' cluster. This is a first indication of the direction that Brazil is taking in terms of its future development which we will discuss in more detail in the remainder of the paper.

Factors shaping Brazilian automobility in the next decades

Economic development

Figure 2 shows the historic evolution of car ownership over change in GDP in four selected industrialised countries as well as in the BRIC countries (Brazil, Russia, India and China). For GDP per capita, we used data from Bolt and van Zanden (Bolt & van Zanden, 2013) which are based on conversion using purchasing power parity (PPP) applying a particular conversion developed for international comparisons called Geary-Khamis dollars (GK$). Other than ordinary exchange rates, these purchasing power parities do not only consider income differences across countries but also cost-of-living differences. In other words: a given amount of Geary-Khamis dollars (GK$) buys the consumer an equivalent set of consumer products in different study countries.

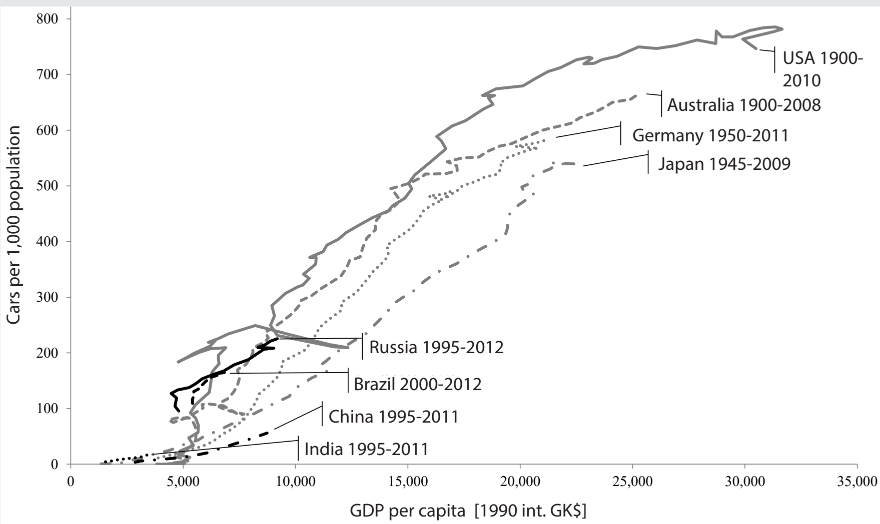

Figure 2: Car ownership over GDP per capita for USA, Australia, Germany, Japan, Russia, Brazil, China, and India. Authors' own representation using data from the Maddison Project (2013), US Census Bureau (2010), BITRE (2012b), BMVBS (2013), KBA (2016), Statistics Japan (2014b), BTS (2012), progtrans (2010), National Bureau of Statistics of China, (2012), Ministry of Statistics and Programme Implementation (2013), and Knott (2000).