An Asian Transport Outlook (ATO) Storyline

URBAN TRANSPORT IN ASIA

Built Environment, Urban Transport and its Sustainability

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ADB

ADB TRANSPORT

Across Asia, increasing numbers of people are living in cities. As concerns about the dangerous consequences of climate change and urban air pollution are growing, the process of growing urbanisation provides unique opportunities to understand how urban land-use policies targeted at curtailing urban sprawl and increasing density could result in greater sustainability of transport and thereby also promote the decarbonisation of transport. The Asian Development Bank (ADB) launched in November 2020 the "Asian Transport Outlook (ATO)" (https://data.adb.org/dataset/asian-transport-outlook-database) to provide access to transport data and policy information for 51 economies in Asia.

The data used in this storyline is sourced from the ATO - Sharable Urban Database (SUD) (https://data.adb.org/media/9096/download). The SUD consists of data on 460 Urban Centres (cities) across 84 Indicators, under nine categories, sourced from over twenty secondary sources. Using time-series and cross-sectional panel data for the 460 Urban Centres (cities), we illustrate urban transport trends in Asia. It is intended that the storyline presented here will be updated periodically as we find more evidence and data.

Moving towards the implementation of the Sustainable Development Goals (SDGs) and the Paris Agreement, it has become imperative to reconsider how we deal with urban transport planning, and how to utilise the advantage of having urban densities in Asian cities to promote greater sustainability of urban transport, including its possible decarbonisation.

Accross Asia, the cities are evolving to accommodate the increasing urbanisation trends. Are the cities becoming denser than before? How are the transport scenarios comparing across the Asian subregions?

Photo Credits: Vaishanav Chogale, Unsplash; Mumbai, India

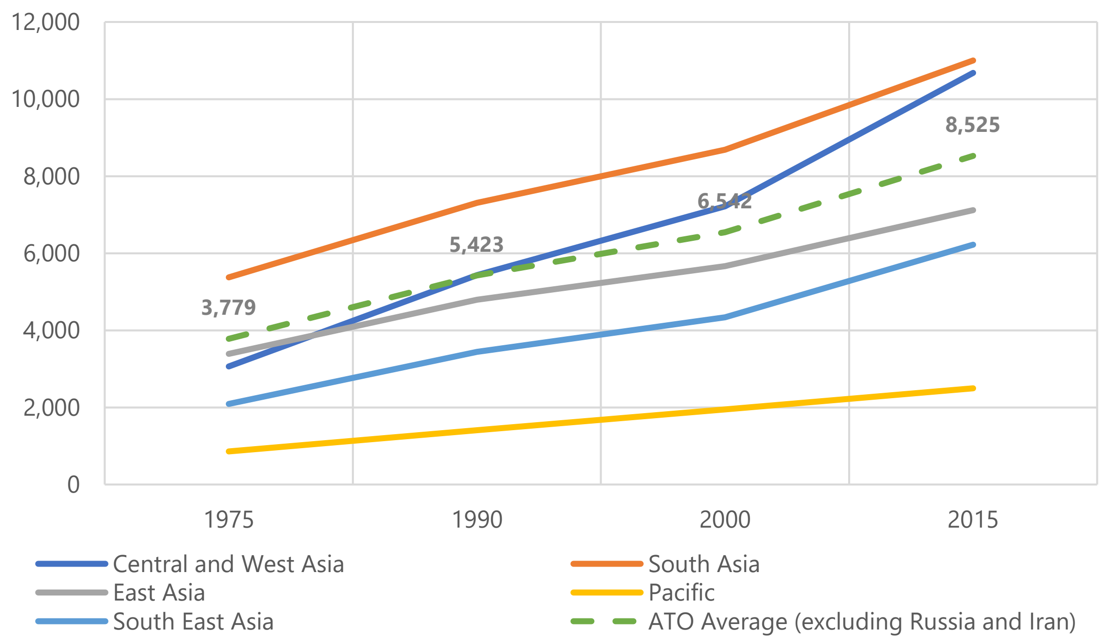
How is urban population density changing in the Asia- Pacific region?

In the age of rapid urbanisation, cities are constantly evolving to accommodate rising urban populations, and so is the planning of transport infrastructure and systems to accommodate the pace of the increase in urban population.

A common perception is that urban land area expands faster than the population residing in cities, resulting in declining urban population densities over time. Earlier research (Angel, Parent, Civco, & Blei, 2010) has concluded that globally, cities worldwide are becoming less dense as they grow bigger. Based on ATO-SUD data for nearly 370 Asian cities, we find that the population density did decrease between 2000 to 2015 for almost 59% (217) of cities. However, overall, we find that between 1975 to 2015, the average urban population density has increased by 126% in Asia (figure 1). Over time, this pace of densification of cities has intensified, especially in more populated cities. Since 2000, the city area, built-up area and population density have increased by 23%, 11% and 30%, respectively.

We also find that the higher the income of cities, the lower the density is. The 2015 density for high income, upper middle income and lower-middle-income cities were 6387, 6574, and 9343 people/ km^{2}, respectively. Since 2000, densification has been more intense in lower-middle-income and upper-middle-income cities, i.e., 8.6% and 7.5%, compared to high-income cities at 2%.

Fig. 1: Weighted Average population density (people/ sqkm)



Source: ATO-SUD Indicators - SEC-UDB-003

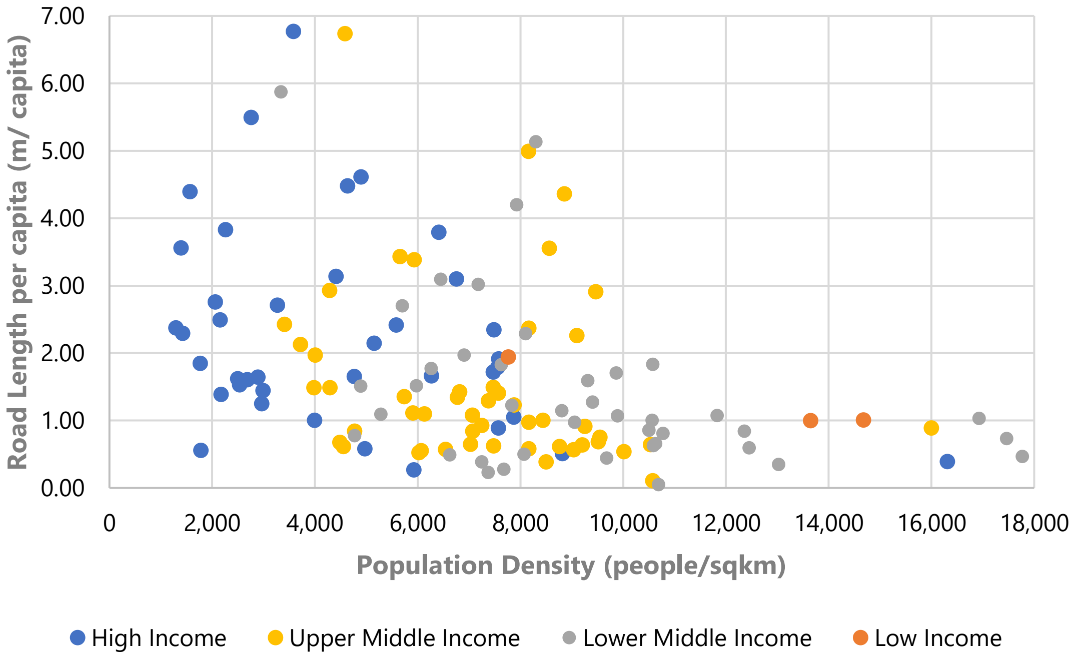
Original Source: GHS (European Commission)

Road Infrastructure and population density – are they linked?

Both logic and empirical evidence indicate that higher population density, i.e. more compact cities with reduced urban sprawl, require lower per-capita road infrastructure to facilitate economic and social development. Moreover, population density is an essential determinant for infrastructure development irrespective of the city income status. We find, overall, as the population density increases across high-income, middle, and low-income cities, the per-capita road infrastructure demand is lower (figure 2).

Average per-capita road infrastructure availability is 2.1km per capita for cities within the population density range of 0-4000 people/ km^2, 1.5km per capita for 4000-8000 people/ km^2 and 0.8km for >8000 people/ km^2 for all Asian cities. Thus, cities with higher population densities can facilitate transport demand with lower road infrastructure per capita. Further, suppose we extend this hypothesis concerning the urbanisation in Asia, i.e. with increasing urbanisation, the national per-capita road infrastructure requirement could be lower in the future as urban areas have a higher density than rural areas (figure 3).

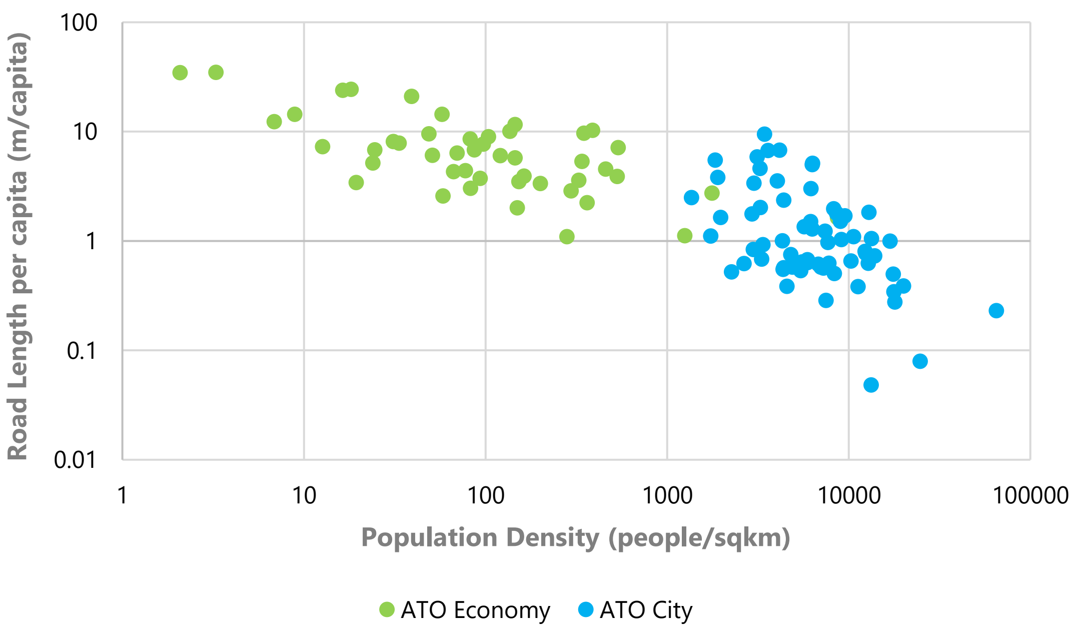
Fig. 2: Road infrastructure per capita



Source: ATO-SUD Indicators - INF-UDB-004, SEC-UDB-003

Original Source: Oke et.al. (2019) (OSM), GHS (European Commission)

Fig. 3: Road infrastructure per capita (ATO economies)

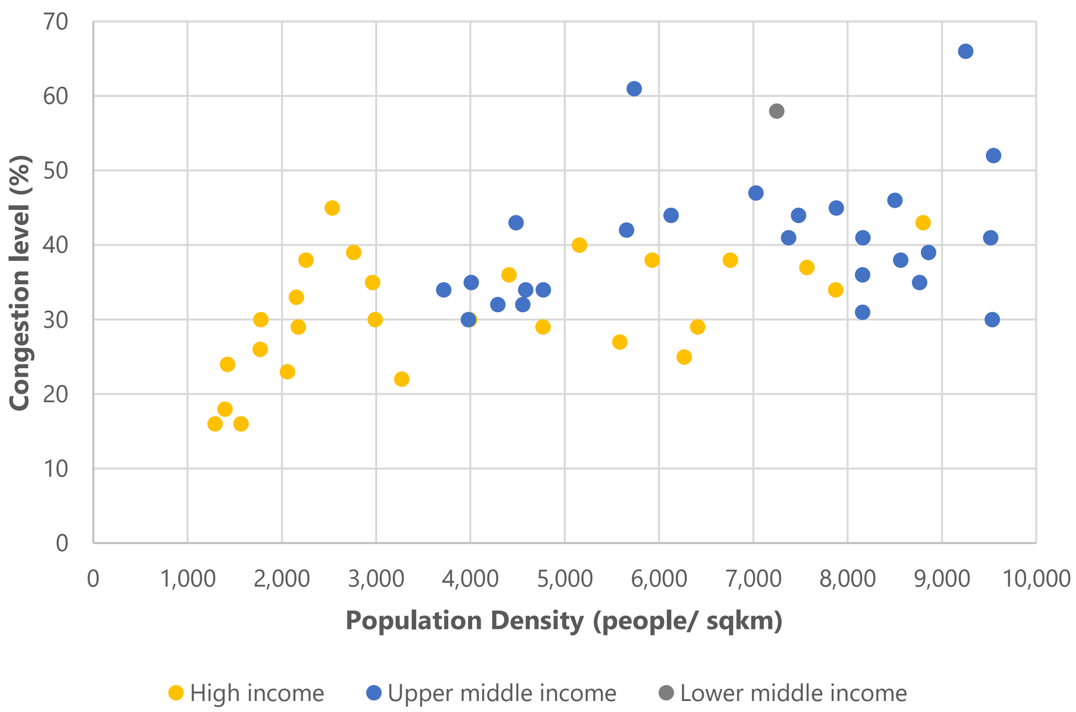


Source: ATO-SUD Indicators - INF-UDB-004, INF-TTI-005, SEC-UDB-003, SEC-DEV-014

Original Source: Oke et.al. (2019) (OSM), Country Official Statistics, GHS (European Commission), UN

However, the availability of limited road infrastructure in dense cities results in higher levels of congestion (figure 4). There are varied reasons for such high congestion, which, apart from limited road infrastructure in some cities, also includes the limited availability of mass transit systems.

Fig. 4: Congestion level (%)



Source: ATO-SUD Indicators - TAS-UDB-009, SEC-UDB-003

Original Source: TomTom, GHS (European Commission)

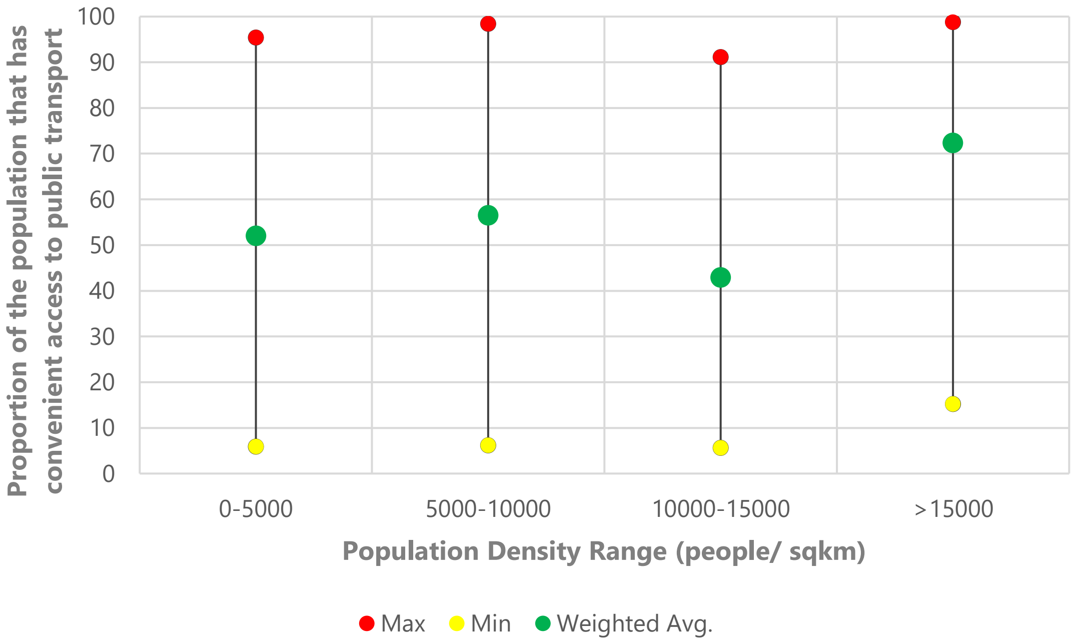
Have "Denser" Asian cities optimised public transit advantage?

Conventional logic suggests that a dense city may provide better access to transit when compared to a sprawling city with the same population and transit length. Global research indicates that population density is generally positively associated with transit use (i.e., assuming denser areas have more people to use transit) (Fulton, Reich, & et.al., 2021) (Gomez, Arturo, Alves, & Moody, 2021). Transit availability and access to transit could significantly impact actual transit use. We find that many Asian cities with higher densities have not yet capitalised on the density benefit; access to public transport is not substantially better in cities with higher density (figure 5).

In the case of dense cities, a per unit length of mass transit provides access to higher passenger volumes, compared to sparser (less dense) cities.

Photo credits: Trvaelvui, Bangkok skytrain

Fig. 5: Access to public transportation



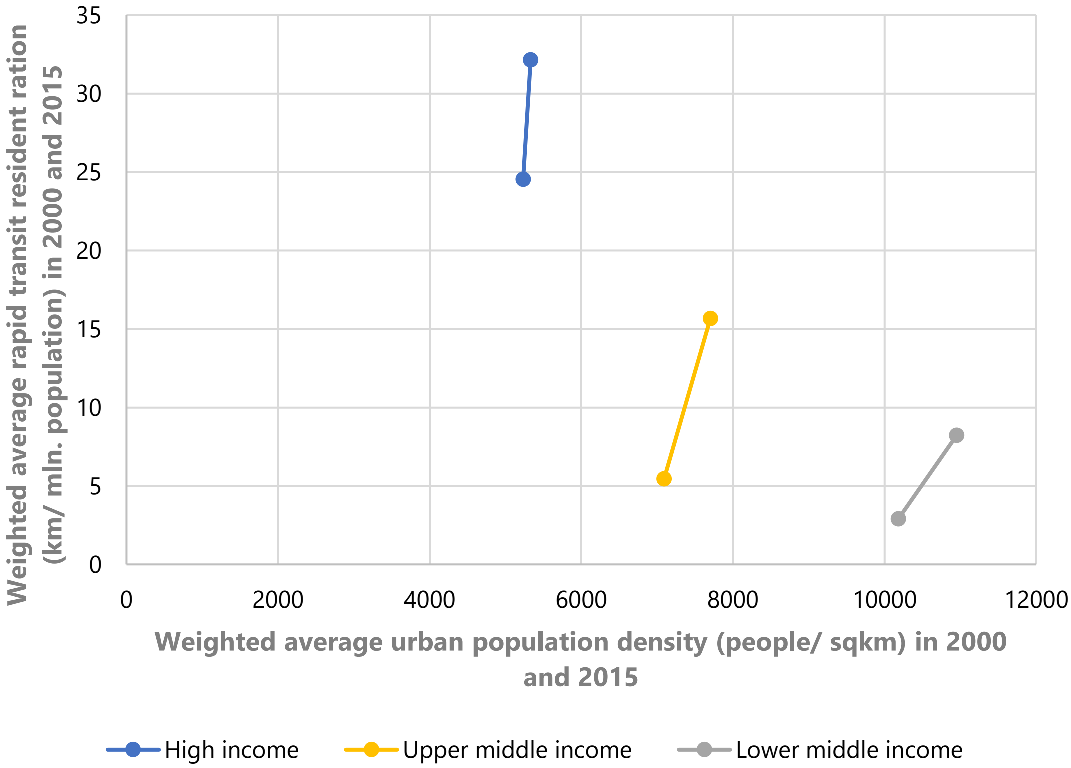
Source: ATO-SUD Indicators - ACC-UDB-001, SEC-UDB-003

Original Source: UN Habitat, GHS (European Commission)

Recent-generation high-quality public transit (BRT, MRT, LRT etc.) investments in Asian cities have significantly enhanced access to high-quality public transit systems across the region.

Using data on 140 Asian urban transit systems, assembled by ITDP, for the period 2000 to 2015, we find that the weighted average rapid transit (BRT, Metro, LRT combined) to the resident ratio (RTR) has increased 31% in the case of high-income economy cities (from an already high base level of 24.6 km of rapid transit/ million population to 32.2 km of rapid transit/ million population). During the same period, the upper middle income and lower middle income experienced even more significant increases in RTR of 181% and 183% (figure 6). The most significant increase in rapid transit was observed in lower middle income and upper-middle-income economies, along with densification resulting in improved transit access.

Fig. 6: Rapid transit to resident ratio (RTR) - Average for 140 cities



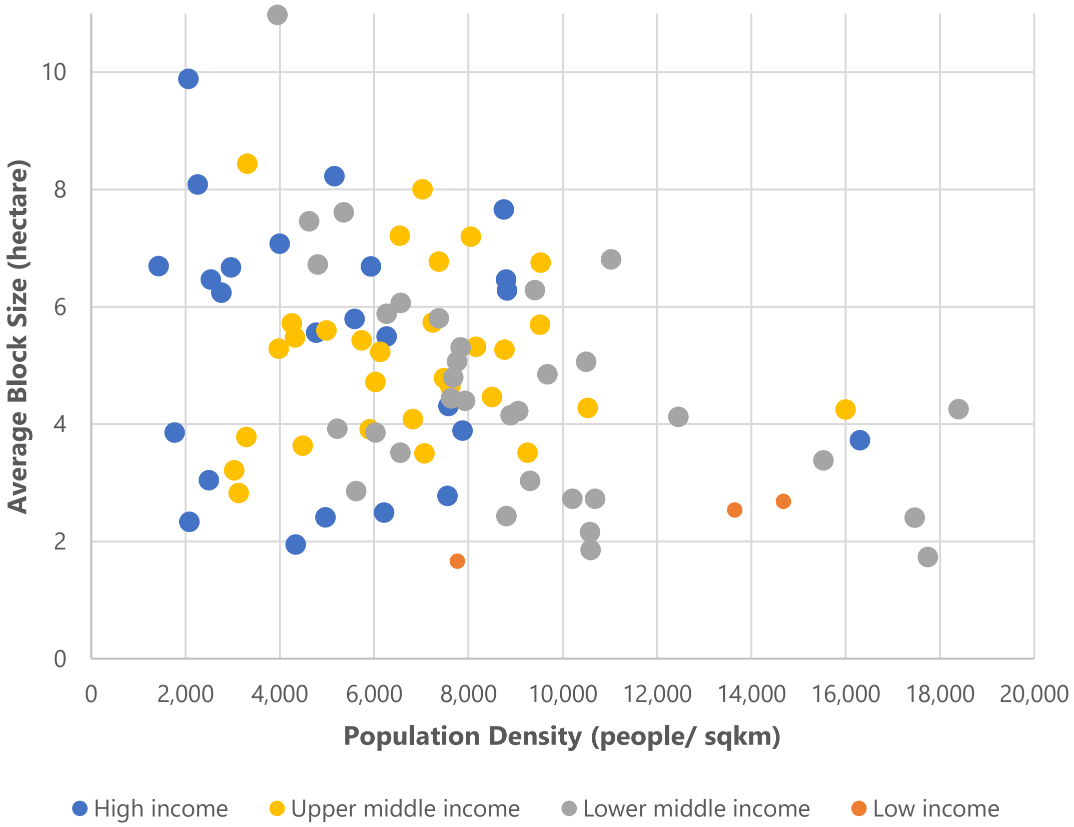
Source: ATO-SUD Indicators - INF-UDB-025, SEC-UDB-003

Original Source: ITDP, GHS (European Commission)

Are “Denser” Asian Cities more optimised for Walking and Cycling?

Our evidence reveals that higher population density is positively associated with smaller block sizes (figure 7). Furthermore, empirical evidence suggests that smaller blocks induce more walking and cycling trips as efficient physical connectivity translates to shorter travel time to reach the same number of destinations.

Fig. 7: Urban block sizes



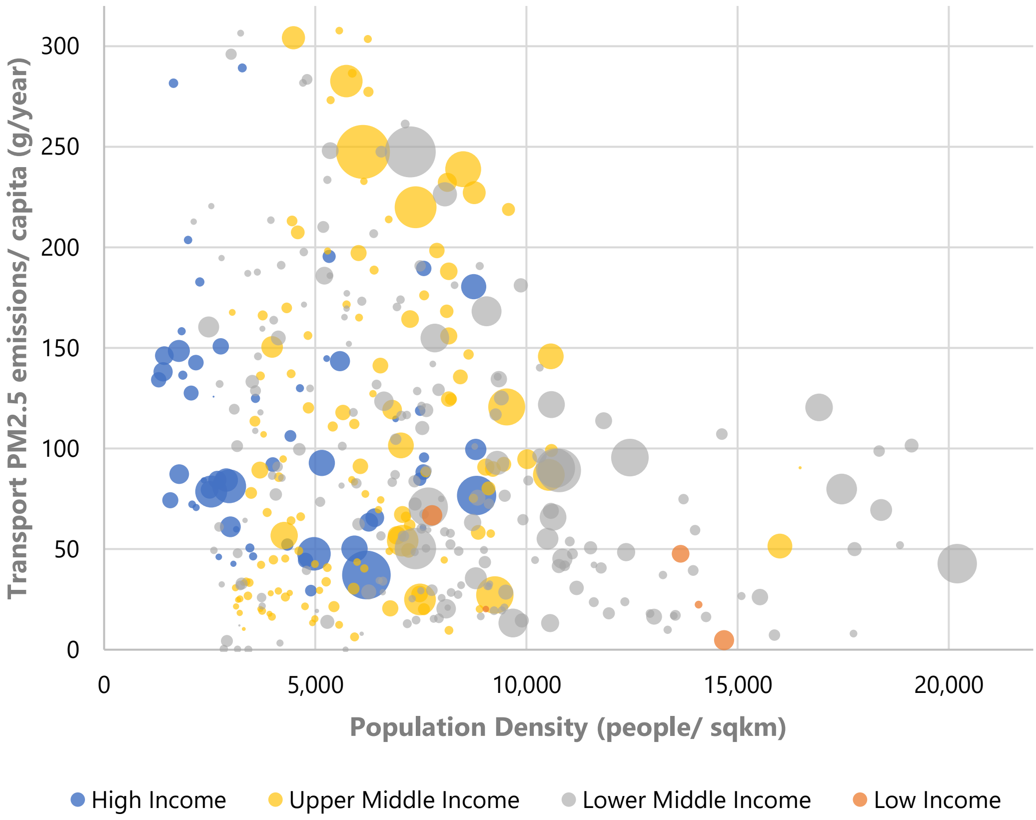
Source: ATO-SUD Indicators - UFS-UDB-006, SEC-UDB-003

Original Source: AUE (Lincoln Institute of Land Policy, UN-Habitat, New York University), GHS (European Commission)

Do compact cities have potential to reduce Transport PM2.5 emissions?

Our empirical analysis for over 400 Asian cities indicates a positive correlation between increased densification and lower per capita transport PM2.5 emissions (figure 8). However, increased density also means that a more significant population is exposed to urban air pollution. Thus, policies and practices promoting denser cities need to be combined with policies to improve fuel quality and emission standards. In addition, a shift towards electrification of transport will also result in lower emissions of air pollutants. Likewise, greater use of transit, walking and cycling, which was found to have more potential in denser cities, can also reduce transport-related air pollution.

Fig. 8: Transport PM2.5 emissions (Bubble size represents Population)



Source: ATO-SUD Indicators - APH-UDB-002, SEC-UDB-003

Original Source: GHS (European Commission)

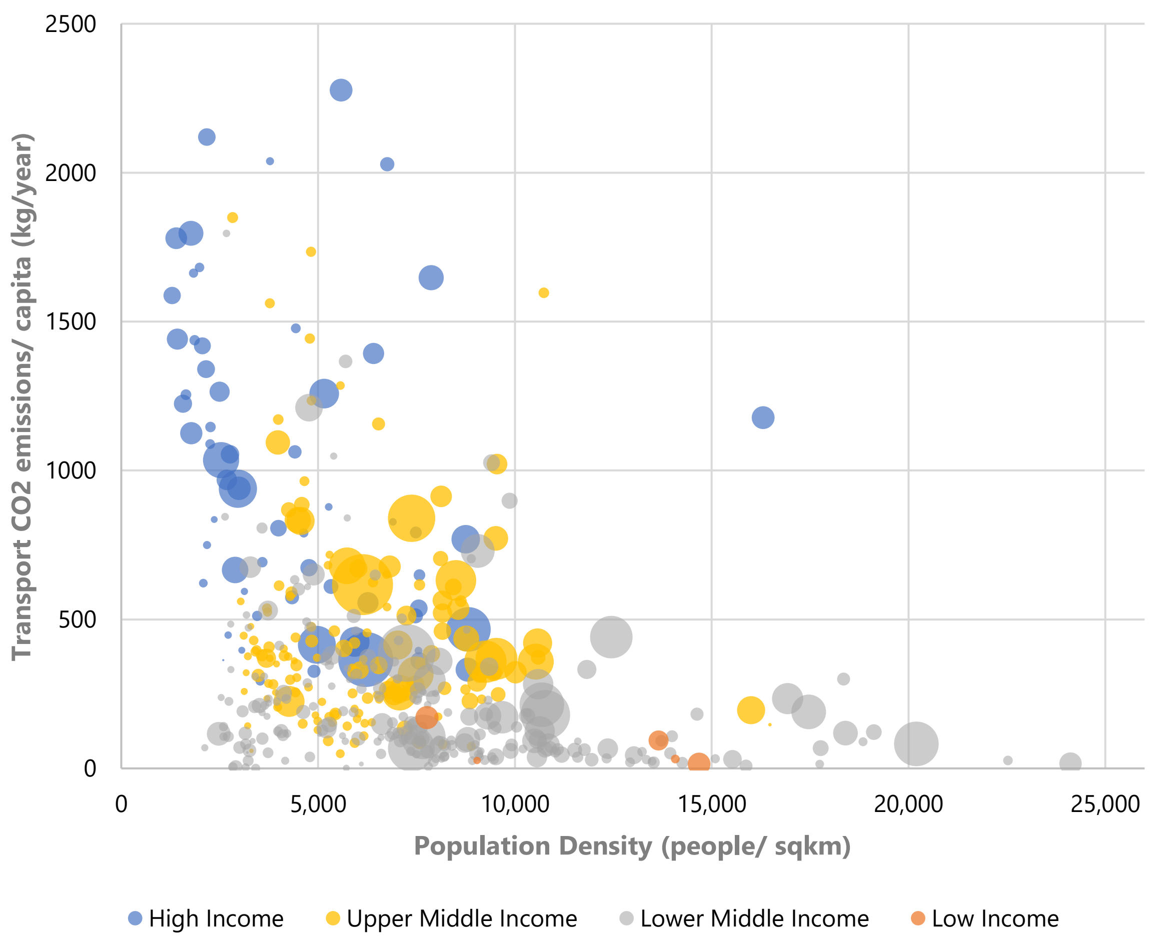
Does Built Environment have a role in reducing Transport CO2 emissions?

Over the last few decades, research has steadily shown that the built environment influences travel demand and transport emissions. One of the most comprehensive attempts was by Kenworthy et al., that collected data from over 100 urban systems from around the world over the period from 1960 to 2000 (Newman & Kenworthy, 1999) (Kenworthy, Laube, & et.al., 1999) (Kenworthy & Laube, 2001). The collected data included economic statistics, population, urban structure, numbers of road vehicles, taxis, road network, parking, public transport networks, individual mobility and choice of transport mode, transport system efficiency and environmental impact (duration and cost of transport, energy consumption, accidents, pollution, etc.). "The millennium cities" database established a link between urban intensity, automobile dependence, transport energy consumption, and CO2 emissions. Furthermore, their evidence indicates that the higher urban population densities, mixed land-use, and urban transport design promote shorter trips, reduce private vehicle dependencies, and impact transport sector GHG emissions. However, since the early 2000s, this hypothesis has not been validated with new data.

Based on the latest ATO-SUD data covering more than 400 cities in Asia, we find the same relationship across Asian cities. Increasing population density (a proxy of the built environment) positively correlates with reduced transport CO_2 emissions (figure 9). This relationship is across diverse cities with varied socio-economic and demographic characteristics.

It is evident, in the case of high-density cities, that, where people and businesses are concentrated into a small space, by inducing smaller grid size, improving access to public transit, cities can leverage urban densities to reduce transport activity, shorten trip lengths and utilise more sustainable modes of transport. On the other hand, low-density cities are usually associated with longer trip lengths and high dependencies on private vehicles, leading to increased transport CO_2 emissions.

Fig. 9: Transport CO2 emission per capita (Bubble size represents Population)



Source 10: ATO-SUD Indicators - CLC-UDB-002, SEC-UDB-003, SEC-UDB-001

Original Source: GHS (European Commission)

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