Chapter 2

An Overview of Urban Transport Situtation in Asia

Study on energy efficiency improvement in the transport sector through transport improvement and smart community development in the urban area Working Group

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CHAPTER 2
An Overview of Urban Transport Situation in Asia

1. Introduction

Passenger vehicle ownership is soaring in Asia. Passenger vehicles can offer convenient means that can fulfil rising transport needs. Passenger vehicles can offer secure transport means, and for some people its ownership can be a status symbol too. As income of Asian increases, the cost of passenger vehicles decreases at some Asian countries and these two factors primarily assist spurring the growth in the passenger vehicle ownership in Asia. For example, China's accession to World Trade Organization (WTO) in 2001 contributed to decrease the price of imported vehicles, and Thailand's aspiration toward becoming "Detroit of Asia" has promoted to establish domestic vehicle manufacturing industry which can provide opportunities to own vehicles at lower cost. In both countries, the number of passenger vehicles expanded during the time period between 2000 and 2009. China's passenger vehicle stocks quadrupled from 7.9 million units in 2000 to 31.5 million units in 2009. Thailand's passenger vehicle stocks more than doubled from 2.0 million units in 2000 to 4.5 million units in 2009. Asia – as a whole, the number of passenger vehicle stocks increased from 90 million units in 2000 to 140 million units in 2009 constituting about 34% of incremental growth of passenger vehicle stocks in the world during this time period.[1]

What are the drivers for passenger vehicle ownership in the cities of Asia? How does passenger vehicle ownership interact with passengers' urban mass transit usage? What are the barriers and facilitators for shifting people away from passenger vehicle dependence toward less-energy intensive mode of mass transit systems? Understanding these key questions will serve as the basis for the rapidly developing cities in Asia to consider city-specific policy options that can accommodate people's desire for mobility, while the policy options can ensure energy security and sustainable development.

At the *national level*, it is widely accepted that income is a primary driver for car ownership. In fact, a study by Dargay, Gately and Sommer (2006) demonstrates that the relationship between the growth of vehicle ownership and per-capita income is highly correlated, but the level of income needs to be understood as the vehicle ownership follows a

[1] Japan Automobile Manufacture's Association. (2011). *World automobile statistics.* Tokyo.

curb similar to the S-shaped Gompertz function.[2] In other words, at the lowest income level, vehicle ownership increases relatively slowly. Then at middle-income levels (from $3,000 to $10,000), the speed of growth in vehicle ownership becomes twice as fast as that of low income level, and this rate of growth continues until passenger vehicle ownership level reaches saturation at the highest income level.

The broad relationships between income, passenger vehicle ownership and demand for public transport, including mass transit systems, are analyzed by a number of papers. Paullery and et al., (2006) outline these relationships as follows. First, an increase in income will lead to an increase in passenger vehicle ownership, depending on the level of income. Second, an increase in vehicle ownership/availability will lead to a reduction in the demand for public transport modes. Third, the sign and magnitude of demand elasticities for public transport with respect to the income will vary depending upon the income levels. Fourth, income growth is expected to increase average trip length.[3]

Nevertheless, the above discussions over the relationship between income, passenger vehicle ownership and mass transit use need to be carefully interpreted since they may not be the case in Asian cities. Other factors may interplay more important roles. Barter et al., (2003) points out that besides income level, such factors as land use characteristics, transport related policies and infrastructure development can also affect city dwellers decision on passenger vehicle ownership as well as choice of transport mode.[4]

This chapter tries to present the historical trends of the motorization, and resulting growth in the gasoline/diesel consumption of the major urban areas of Asia. The chapter also identifies the critical issues that affect the worsening congestion levels in the major cities of Asia.

2. Motorization in Asia: General Trends

To capture different growth trends in passenger vehicle ownership by city, this section provides the 7 major cities in Asia, including Bangkok, Beijing, Jakarta, Seoul, Shanghai,

[2] Dargay, J., Gately, D., and Sommer, M. (2007). Vehicle Ownership and Income Growth, Worldwide: 1960-2030. A paper presented at the USAEE North American Conference. 25 September, 2006. http://www.econ.nyu.edu/dept/courses/gately/DGS_Vehicle%20Ownership_2007.pdf

[3] Paulley, N, Balcombe, R., Mackett, R., Titheridge, H., Preston, J., Wardman, M., Shires, J., and White, P. (2006). The demand for public transport: the effects of fares, quality of service, income and car ownership. *Transport Policy.* 13, (2006) pp.295-306.

[4] Barter, P., Kenworthy, J., and Laube, F. (2003). Lessons from Asia on Sustainable Urban transport, in Low, N.P. and Gleeson, B.J. (eds.) *Making Urban Transport Sustainable* (Basingstoke UK: Palgrave-Macmillan).

Singapore and Tokyo. These cities involve diverse economic development levels, population and population density.

Table 2-1 compares population, urban land area, population density, gross regional product and per capita gross regional product of the analyzed cities. As the comparison show, the analyzed cities involve diverse group in terms of economic development, and population size. Tokyo's per capita gross regional product in 2009 represented the highest at $53,201.5 (purchasing power parity in 2005 price level), which is more than 3.8 times bigger than that of Jakarta at $ 16,738.2 in the same year. Likewise, the analyzed cities involve diverse level of population ranging from Singapore's 5.0 million at the lowest to Shanghai's 19.2 million at the highest in the same year. Somewhat the size of urban land area represents the similar level at around 600-700 km^2, excluding Beijing of which urban land area stands at the highest of 12,187.8 km^2.

Table 2-1: Comparison of Key Statistics for the 7 Analyzed Cities

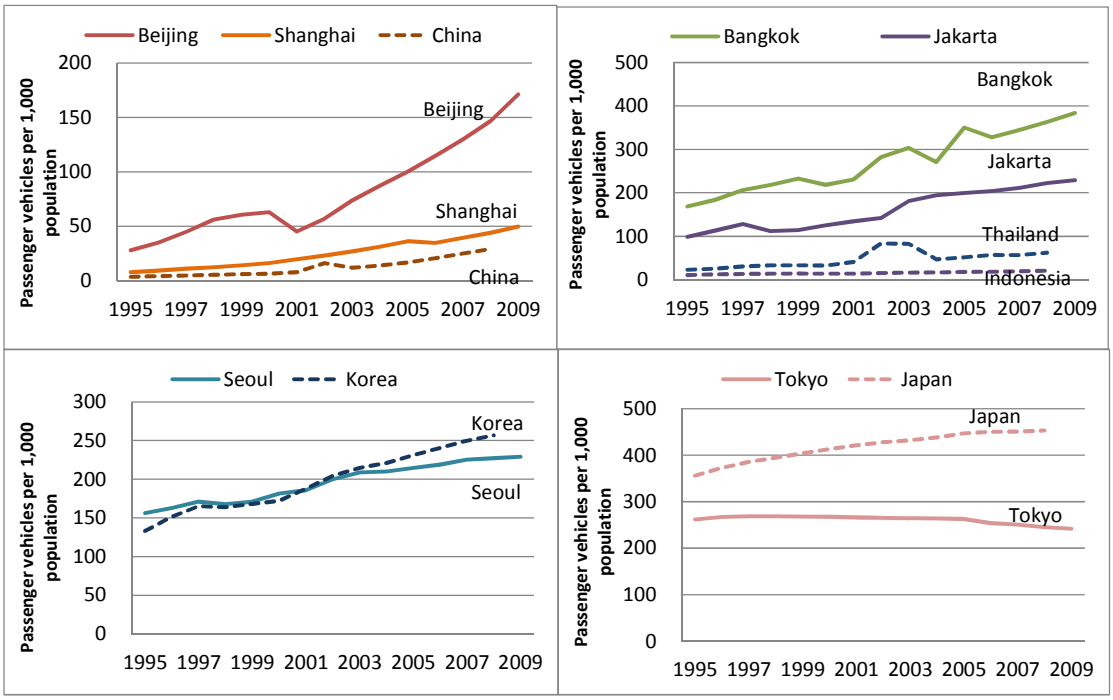
		Bangkok	Beijing	Jakarta	Seoul	Shanghai	Singapore	Tokyo
Population	millions	5.7	17.6	9.2	10.5	19.2	5.0	13.0
Urban Land Area	km^2	700.0	12,187.8	661.5	605.0	660.0	710.0	621.5
Population Density	person/km^2	8,146.6	1,440.0	13,942.6	17,296.0	29,110.9	7,024.8	20,901.4
Growth Regional Product	million US $ 2005 PPP	127,207.9	293,755.9	128,278.7	310,776.0	363,694.9	226,821.9	691,088.1
Per Capita GRP	US $ 2005 PPP	22,307.0	16,738.2	13,908.6	29,699.4	18,929.4	45,477.2	53,201.5

Source: Author's analysis from the following sources. **Bangkok**: National Statistical Office (2008). *Quarterly bulletin of statistics.* Bangkok. **Beijing**: Beijing Municipal Statistics Bureau (2010) and China Statistics Press (2011). **Jakarta**: BSP Statistics of DKI Jakarta Province (2010). **Seoul**: Seoul Metropolitan Government and National Statistical Office of Korea (2010). **Shanghai**: Shanghai Statistics (2011) and China Statistics Press (2011). **Singapore**: Department of Statistics, Singapore (2010) and Japan Automobile Manufactures Association, Inc. (2011).

Tokyo: Cabinet Office, Government of Japan (2010) and Tokyo Metropolitan Government (2009).

Among the analyzed cities, the vehicle ownership level offers different levels. Figure 2-1 compares passenger vehicle stocks per 1,000 population of the Asian cities with that of country average (Singapore is excluded from this). As the figure shows, differences can be observed between the city's per 1,000 population passenger vehicle stocks and that of country average.[5]

Figure 2-1: Passenger vehicles per 1,000 populations – comparison between cities



Source: Author's analysis from the following sources. **Bangkok**: Alpha Research Co., Ltd. (2010) and National Statistical Office (2008). **Beijing**: Beijing Municipal Statistics Bureau (2010) and China Statistics Press (2011). **Jakarta**: BSP Statistics of DKI Jakarta Province (2010). **Seoul**: Seoul Metropolitan Government and National Statistical Office of Korea (2010). **Shanghai**: Shanghai Statistics (2011) and China Statistics Press (2011). **Singapore**: Department of Statistics, Singapore (2010) and Japan Automobile Manufactures Association, Inc. (2011). **Tokyo**: Cabinet Office, Government of Japan (2010) and Tokyo Metropolitan Government (2009).

[5] For cities, time periods covered in this figure are between 1995 and 2009, while those of countries are between 1995 and 2008 because of data availability.

For example, China's average passenger vehicle stocks per 1,000 population reached 29 in 2008, while that of Beijing was 147 in the same year – five times bigger than the country average level. The Beijing's substantial difference from the country average results from the high income level. In 2008, Beijing's per capita Gross Regional Product (GRP), expressed in purchasing power parity (PPP), at 2005 price) was $15,800, nearly four times bigger than country's per capita GDP at $4,129.[6] By contrast, Shanghai's per capita GRP represented even higher level than that of Beijing at $15,800 in 2008, while its passenger vehicle stocks per 1,000 population was 44 in the same year, accounting for about 50% larger than China's average. The relatively low vehicle ownership level of Shanghai results from the city's policy to implement license plate bidding. Those private car owners would have to bid for license plate as an official requirement, and in 2008 the cost of number plate was nearly $10,000 (in PPP or $6,300 in exchange rate). The additional cost of vehicle ownership results in relatively low vehicle ownership in Shanghai compared with its high income level.

Similar to Beijing, passenger vehicle stocks per 1,000 population for Bangkok and Jakarta represented substantially higher level than that of country's average. Bangkok's this indicator in 2008 was 363, compared with the country's average at 62 – more than five times bigger than the country's average. Also, Jakarta's per 1,000 population passenger vehicle stocks was 222 in 2008, representing more than 10 times bigger than the Indonesia's average at 21 in the same year. Again, the higher income level (in terms of per capita GRP) of cities resulted in higher passenger vehicle stocks per 1,000 population. Bangkok's per capita GRP in 2008 was $22,238, which represents nearly four times bigger than Thailand's per capita GDP in the same year. Jakarta's per capita GRP in 2008 was $12,513, more than five times bigger than that of country's average at $2,191 in the same year.

Income of Seoul and Korea represented similar level respectively at $28,704, and $22,361 in 2008. About a quarter of total population in Korea lives in Seoul metropolitan area, and as a result of this, the income of Seoul offers the similar levels with that of Korea's country average. As a result, per 1,000 population passenger vehicle stocks in Seoul had been at a similar level to that of country's average from 1995 to 2000, but it has been surpassed by country's average from 2001 onwards. In 2008, Seoul's passenger vehicle stocks per 1,000 population was 227, compared with that of country's average at 257. Higher cost of passenger vehicle ownership in Seoul along with the recent improvement in the access to the public transport in Seoul (including buses and subways) explain the changing trends.

[6] Prices shown in this paper were calculated with purchasing power parity basis at 2005 prices.

The case of Tokyo offers different trend from the rapidly developing cities. Tokyo's passenger vehicle stocks per 1,000 population has been representing lower level than that of country average for the entire analyzed period from 1995 to 2008. Per capita GRP of Tokyo in 2008 was nearly double the level of Japan's average at $55,032 (Japan's average was $28,661 in the same year). Apart from Tokyo's good access to public transport systems (including rails and subways), high cost of vehicle ownership (resulting mainly from parking and fuel costs) have resulted in lower passenger vehicle ownership per 1,000 population. By contrast, it is observed that Japan's number of passenger vehicle stocks per 1,000 population has been moderately increasing since 2000 onwards reflecting the increased numbers of small-sized vehicles.

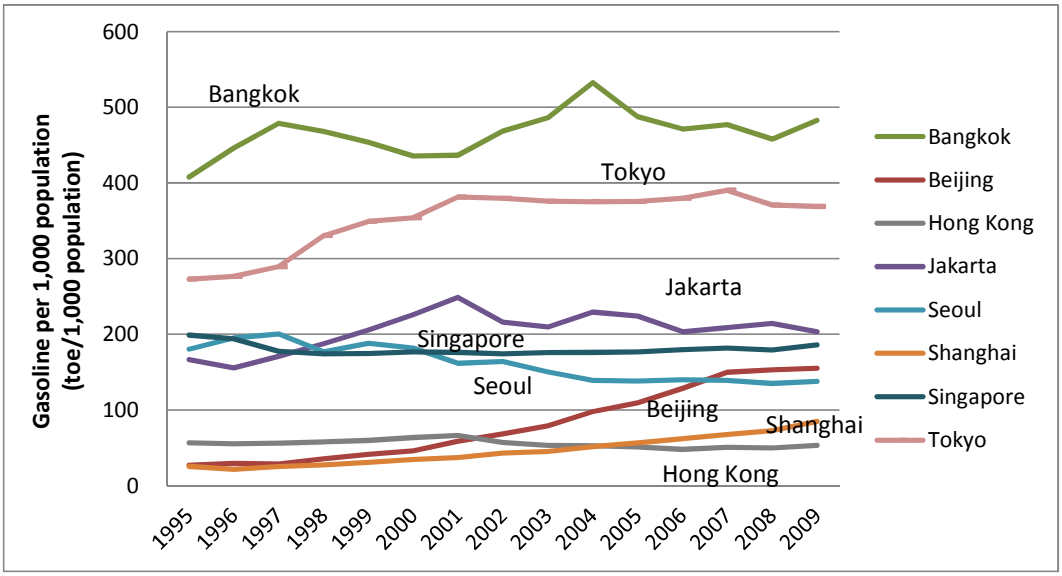
3. General Trends in Gasoline Consumption

To allow inter-city comparisons, gasoline consumption per 1,000 population of eight cities is presented in Figure 2-1. The figure shows wide variations in terms of both levels and trends of per capita gasoline consumption. In terms of the levels, gasoline consumption per 1,000 population ranged from Hong Kong's 50 tons of oil equivalent (toe) at the lowest to Bangkok's 458 toe at the highest in 2008. In terms of trends, Beijing and Shanghai's gasoline consumption per 1,000 population has been on rising trends driven by robust economic development. Meanwhile, that of Seoul has been on a declining trend due to rising fuel prices. Other cities' gasoline consumption per capita represented similar level from 2005 onwards although differences can be observed by city.

In order to further reflect differences in income level among the analyzed cities, gasoline consumption per 1,000 population was normalized by each city's income (Figure 2-2). This indicator can offer proportional size of per capita gasoline consumption relative to the size of income level. As the figure shows, wide variations exist in the historical trends of income normalized per capita gasoline consumption among eight cities. Bangkok and Jakarta represented the highest levels of this indicator although it declined from the respective peak levels in 1998 and 2000, which suggests these cities' high dependence on passenger vehicles for mobility – relative to the size of income. By contrast, Hong Kong's this indicator was the lowest level over the analyzed periods from 1995 to 2008, which suggests least dependence on passenger vehicles for meeting the mobility needs – relative to the income level. The case of Seoul offers an interesting trend that income normalized per capita gasoline consumption

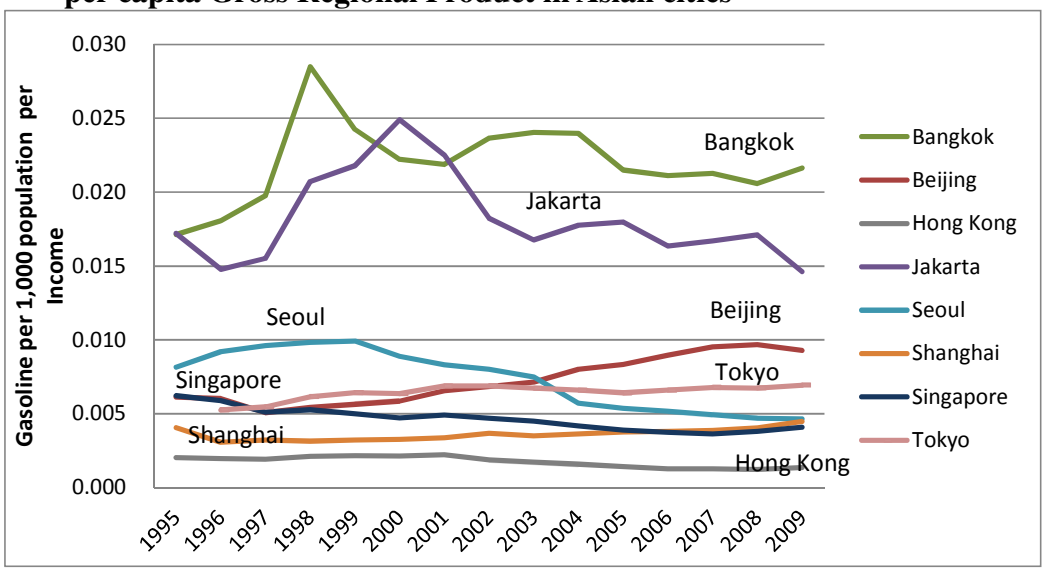
has been continuously declining since 1995, and the trend is accelerating in recent years from 2004. Beijing's this indicator shows an increasing trend since 2001 onwards, which coincides with the timing of China's WTO accession.

Figure 2-2: Comparisons of gasoline consumption per 1,000 populations in Asian cities



Source: Author's analysis from the following sources. **Bangkok**: Alpha Research Co., Ltd. (2010) and National Statistical Office (2008). **Beijing**: Beijing Municipal Statistics Bureau (2010) and China Statistics Press (2011). **Hong Kong**: International Energy Agency (2011) and World Bank (2010). **Jakarta**: BSP Statistics of DKI Jakarta Province (2010). **Seoul**: Korea National Oil Corporation (2011) and National Statistical Office of Korea (2010). **Shanghai**: Shanghai Statistics (2011) and China Statistics Press (2011). **Singapore**: International Energy Agency (2011) and World Bank (2010). **Tokyo**: Tokyo Metropolitan Government (2009).

Figure 2-3: Comparisons of gasoline consumption per 1,000 populations normalized by per capita Gross Regional Product in Asian cities



Source: Author's analysis from the following sources. **Bangkok**: Alpha Research Co., Ltd. (2010) and National Statistical Office (2008). **Beijing**: Beijing Municipal Statistics Bureau (2010) and

China Statistics Press (2011). **Hong Kong**: International Energy Agency (2011) and World Bank (2010). **Jakarta**: BSP Statistics of DKI Jakarta Province (2010). **Seoul**: Korea National Oil Corporation (2011) and National Statistical Office of Korea (2010). **Shanghai**: Shanghai Statistics (2011) and China Statistics Press (2011). **Singapore**: International Energy Agency (2011) and World Bank (2010). **Tokyo**: Tokyo Metropolitan Government (2009).

4. Common Issues/Challenges Arising from the Motorization in Asia and Options for Overcoming the Issues/Challenges

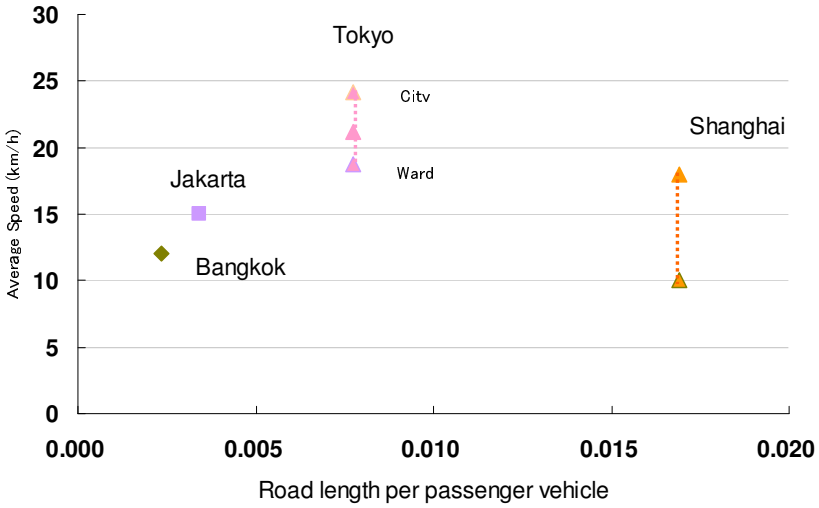
Nevertheless, increases in passenger vehicle stocks pose numerous socio-economic costs. For example, the rising vehicle ownership in turn would mean soaring demand for oil, increasing part of which supply should be secured by imports in Asia. This will pose a great burden on the economy at a time when international crude oil prices record historically high level and the high levels of international crude oil prices are likely to be maintained in future. Asia Pacific Energy Research Centre (APERC) (2009) projects that the major *net oil exporter* in Asia will become *net oil importer* through 2030 as a result of the dwindling oil production and continued increase in oil demand – driven mostly by the increase in the transport sector.[7] For example, Malaysia and Viet Nam are respectively expected to become the net oil importer sometime around 2025 and 2015. Indonesia became the net importer of oil in 2003, and the amount of oil imports will increase in future.

Also, road transport is responsible for significant share of the world CO_2 emissions. In 2008, CO_2 emissions from the road sector accounted for 20% of the world CO_2 emissions. In terms of growth trends of Asia, CO_2 emissions from the road sector grew at a faster pace (2.3% per year) than that of total world CO_2 emissions (1.8% per year) during the time period between 1990 and 2008. Asian Development Bank (2009) shows that the transport sector CO_2 emissions in Asia is projected to increase at the fastest annual rate of 2.8%, followed by the power sector at 2.6%, the residential/commercial sectors at 2.4%, and the industry sector at 1.5% between 2005 and 2030.[8]

[7] Asia Pacific Energy Research Centre – APERC. (2009). *APEC energy demand and supply outlook – the 4th edition.* Tokyo.

[8] Asian Development Bank – ADB. (2009). *Energy outlook for Asia and the Pacific.* Manila.

Figure 2-4: Average speed and road length per passenger vehicle



Source: Various sources.

Aside from the above mentioned issues on energy security and CO_2 emissions growth that rapidly developing Asian countries are facing, the major cities of Asia generally suffer chronic congestion problems caused by rapid motorization and relatively low infrastructure development for roads, and insufficient level of public transport infrastructure (for buses, urban rails and subways). The congestion problems in turn deteriorate the passenger vehicles' fuel economy as well as economic efficiency of urban areas. For example, average vehicle's travel speed in the urban core area of Jakarta is about 15 km per hour, and that of Bangkok is about 12 km per hour. The average speed travelled on major road in the city center of Shanghai during peak hours, ranged from 10 to 18 km per hour.[9] Asian Development Bank (ADB) estimates that the costs of congestion account for as much as 2-5% of GDP annually in developing Asia because of lost time and increased transport costs.[10]

[9] Shanghai Metropolitan Multi-Transport Planning Research Center. (2004). *Shanghai metropolitan transport development report.* Shanghai.

[10] Asian Development Bank – ADB. (2011). *Sustainable transport initiative, operational plan.* Asian Development Bank. Manila.

Table 2-2: Road length per passenger vehicle

	1995	2009
Bangkok	0.004	0.002
Beijing	0.034	0.007
Hong Kong	0.005	0.005
Jakarta	0.007	0.003
Seoul	0.004	0.003
Shanghai	0.060	0.017
Singapore	0.009	0.006
Tokyo	0.008	0.008

Source: Author's analysis from the following sources. **Bangkok**: Alpha Research Co., Ltd. (2010) and National Statistical Office (2008). **Beijing**: Beijing Municipal Statistics Bureau (2010) and China Statistics Press (2011). **Jakarta**: BSP Statistics of DKI Jakarta Province (2010). **Seoul**: Seoul Metropolitan Government and National Statistical Office of Korea (2010). **Shanghai**: Shanghai Statistics (2011) and China Statistics Press (2011). **Singapore**: Department of Statistics, Singapore (2010) and Japan Automobile Manufactures Association, Inc. (2011). **Tokyo**: Cabinet Office, Government of Japan (2010) and Tokyo Metropolitan Government (2009).

Not only this, air pollution arising from passenger vehicles' fuel combustion and road congestion problems affect urban dwellers' health conditions in Asia. The region's cities suffer from the highest air pollution levels in the world, and the transport sector is responsible for as much as 80% of cities' air pollutions. According to the analysis by the World Health Organization (2009), the costs of health – including respiratory ailments and other diseases from local air pollution, and resulting premature death – would cost up to 2-4% of GDP in Asia.[11]

[11] World Health Organization (2009). *Global status report on road safety. Time for action.* Geneva.