Proceedings of the 2023 International Conference on Functional Materials and Civil Engineering
DOI: 10.54254/2755-2721/26/20230785

# A consideration of reconstruction of Shanghai's green transit

**Yunshi Zhou**

The Northwest School, Seattle, WA 98122, United States

yuzhou@northwestschool.org

**Abstract.** One of the most important things that affect people's lives is transit. Everyone relies on transit to go to different places. Due to a high amount of private car ownership in the city, traffic jams start to occur. Then, demands start to show up on public transit. Lots of people nowadays rely on public transit to go to different places. Therefore, a small modification on a transit line could affect a massive number of residents. To build an accessible and eco-friendly transit has always been a goal for most of the city governments and agencies. In this essay, some factors that affect modern transit and people's intention to ride transit in Shanghai will be discussed. Shanghai's different transit factors, including private cars ownership, public transit coverage, and eco-friendly fleet rate will be compared among two other similar cities globally. Some suggestions on different dimensions of transit will be given to help Shanghai to build a greener and more efficient transit, to reduce the air pollution and traffic congestion.

**Keywords:** Shanghai's transit, transit line, public transit, eco-friendly transit, green transit, city planning.

## 1. Introduction

People's life quality has been massively increased due to improvement of technologies and productivity. People have been enjoying the product led by this – better city, better life, and better healthcare. In the city, transit access has been easier and more accessible; people can easily monitor the timing of the upcoming bus; the frequency of the buses is massively improved.

However, one of the greatest outcomes lead by this is the popularization of private cars. The increase of private cars will definitely cause the city road congestion, and it is also a leading factor that caused carbon emission and greenhouse problem worldwide. Therefore, solving the problem of too much private car ownership can be really urgent for most megacities.

In Shanghai, the high ownership of private cars is also one of the biggest problems in city managing. The "Shanghai 2035" published by Shanghai Government, suggests that Shanghai is intending to have more than 75% of residents to commute by public transit instead of private cars on daily commute by the year of 2035 [1].

Demands shift really fast. Nowadays, people are expecting more efficient and greener transit. In this essay, problems that affect people's intention to ride transit, such as the public transit coverage in different cities, are analyzed to provide a more straightforward visual image to identify the weak spots in different cities. The goal for this essay is to analyze different transit aspects of different cities, and to provide a constructional result and suggestions to have Shanghai's transportation better and greener.

DOI: 10.54254/2755-2721/26/20230785

## 2. Literature review

The best and most effective way to analyze the statistics is to compare it with other cities which have the similar size. From data interpretation, it can be easily and clearly inferred on how Shanghai is making a good progress on, and what dimension Shanghai's transit needs to be improved. From comparing these elements, the problem Shanghai has can be identified and a suitable solution for it can be made from interpreting and adopting better policies from other cities and learning what other cities are doing (like special treatments).

In recent research regarding greener transit, lots of essays also practice a similar method with this essay –compare, analyze, and generate suggestions. For example, the essay Domestic and Foreign Urban Green Transportation Development Strategy and Enlightenment by Chen Wei [2], analyzes different method that different cities use to give suggestions on how to construct a greener city and transit system; the essay Approaches towards Realization of Urban Green Transportation by Chen Huapu [3], demonstrates the meaning of "Green Transportation" and gives some example and suggestions on how to implement in real life; the essay Urban three-dimensional transportation and green travel environment by Tang Yue[4], illustrates some successful domestic and international examples on planning green transportation and provide some feedback on how to make it better.

To evaluate the ability to reduce the carbon emission and encourage more people to ride public transit in Shanghai, I hereby compare two other relatively successful cities, Guangzhou, which is one of the greenest cities in China, and Singapore, which is one of the greenest cities worldwide. The paper will compare the private car ownership (which is one of the highest contributors to the global warming), public transit coverage (which is an important factor on affecting people's will to ride transit), and eco-friendly car fleet rate throughout the city (which is another important factor on transit's effect on global warming). These three elements are the most important points on determine the city's ability to overcome with the traffic challenges.

## 3. Comparison and research result

### *3.1. Private cars ownership*

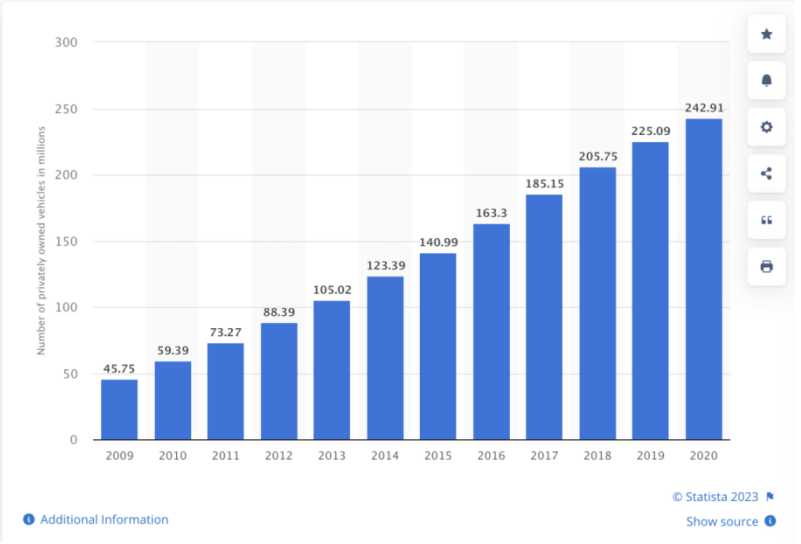


**Figure 1.** The private car ownership trend in China from 2009 to 2020, Statista [5].

To solve the questions regarding to private cars, we must first visualize how the impact has been going lead by private cars. Above is a chart about private car ownership in China, from 2009 to 2020. It can be clearly inferred that the amounts of private cars in 2020 have been more than 5 times than that in

DOI: 10.54254/2755-2721/26/20230785

2009. In 2021, the ownership of private cars has been the top of the world (300 million), exceeding that of the United States.

One of the most serious problems that lead by private cars is the traffic congestion, especially in cities with high population density and poor city planning. Another problem that is led by this is the higher pollution that caused by the emission from cars. In Beijing, the air quality has been reducing since 2004, especially in winter, the city looks dark even in the day. Hard to find a parking place in the community is also another problem that citizens face when purchasing a car. The average price of a park slot (separate from the real estate price) in Shanghai has been more than 350,000 CNY (equal to 48,271 USD).

**Table 1.** The private car ownership in Guangzhou, Shanghai, Singapore [1,6-7].

| Year 2021 | Guangzhou | Shanghai | Singapore |
|---|---|---|---|
| Private car ownerships | 2.67M | 4.8M | 0.91M |
| Car ownership density | 1 for every 14.9 | 1 for every 19.3 | for every 16 |

*3.2. Public transit coverage*

Public Transit Coverage is another factor that will affect citizens to use transit. A bus can replace 10-15 private cars on the road and lead to fewer pollution in the city, which are showing the importance of public transit coverage. Citizens will tend to use public transit if that district has been having a good coverage of transit system. It is generally considered that bus stop within a range of 500 meters is an acceptable standard to evaluate public transit coverage.

The chart below illustrates all statistics that is acquired from each city, including bus lines amount, rail transit distance, public transit ridership, and the rate of using public transit among the population in the city.

**Table 2.** Public transit criteria for Guangzhou, Shanghai, and Singapore [1,6-7].

| Year 2019 | Guangzhou | Shanghai | Singapore |
|---|---|---|---|
| Bus Line Amount | 1244 | 1575 | 772 |
| Rail Transit Distance | 485.7 | 831 | 216.8 |
| Public Transit Daily Ridership | 15.1M | 16.47M | 7.67M |
| Rate of using public transit (ridership /population) | 80.28% | 66.17% | 134.8% |

DOI: 10.54254/2755-2721/26/20230785

### *3.3. Eco-friendly car/transit fleet*

**Figure 2.** A brand new BYD electric car in the Shenzhen factory [8].

A successful green city cannot live without a green transit fleet. Fewer traditional fuel-powered buses and cars can lead to less pollution. It has been a consensus in the world that electric and hybrid energy cars and buses will replace the traditional fuel-powered vehicles. According to "New Energy Automobile Industry Development Plan" published by China State Council, eco-friendly car rate will set to be increased to 30% in 2035, which is 3.4 billion vehicles; selling of eco-friendly cars is set to occupy 50% of the totally sold cars in China.

The chart below indicates the current situation (in 2021) reflecting on the eco-friendly transit fleet and private car rate in Guangzhou, Shanghai, and Singapore.

**Table 3.** Eco-friendly vehicles in Guangzhou, Shanghai, and Singapore [1,6,9].

| Year 2021 | Guangzhou | Shanghai | Singapore |
|---|---|---|---|
| Eco-friendly Transit Fleet Rate | 83.4% | 79.1% | 10.34% |
| Eco-Friendly Private Car Rate | 9% | 36% | 1% |

## 4. Discussion

### *4.1. Private car ownership*

Shanghai has the least private car ownership density, despite the highest number of private cars. Shanghai is one of the first cities that opened up trading with foreign countries, so it is reasonable that Shanghai people's life has started to increase very early, which leads to a high ownership of cars. However, because of its early development, similar to Hong Kong, Shanghai has the least car ownership density with only 1 for every 19.3, since when the population density increases, the car density decreases. This also points out the fact that when the parking slot's price is too high, people will tend not to purchase a car to afford both the car price and the parking price [10].

Guangzhou does not have much private cars as Shanghai does, with a 2 million gap. However, it's car density is higher, compared to Shanghai. One probable reason for that is Guangzhou's development starts later than Shanghai, but still lots of people intended to purchase cars because of the low price and

DOI: 10.54254/2755-2721/26/20230785

poor public transit in the early times. It furthermore proves the fact that when the population density decreases, the car density will increase [11].

### *4.2. Public transit coverage and ridership*

Shanghai has the longest distance of metro lines and the most public transit ridership among these cities. This means that Shanghai has gained a great development on route planning. Also, the 16 million ridership shows that Shanghai's transit planning is relatively successful. The method of "Subway and shuttle bus to the community" is also another way of maximizing the limited bus and driver resources. For instance, in the Xinjiangwancheng area in Yangpu District, there are six shuttle buses serving more than 20 different small communities and all terminates at the Xinjiangwancheng Subway Station. Most of them are peak-only routes, but these routes are still popular during the hours of operation.

Shanghai has the lowest rate of transit use. Although a 16M ridership is achieved, there is only 66% of the population are intended to use public transit as their daily commute use. This is not only because of the habit of driving to work (since Shanghai people have got their cars pretty early), but also an unreasonable and poor route planning in some places. There are some small communities where have more than 5 routes, while there are some big communities do not have a single route serving them. For instance, Xinjiangwancheng community, as I mentioned before, has 6 shuttle buses that serve it and two main bus lines that could be used to reach further destinations. However, communities like Shuyuan does not have sufficient bus routes that serve it. Since Shuyuan communities are too far from the subway station and due to the rural geographic feature, communities are too far from each other, it is hard for the transit company to distribute the routes and buses to the most efficient way [12].

Shanghai has 346km more rail transit distances than Guangzhou, but it still only got 1 million more ridership overall. That furthermore shows the unreasonable route planning, which leads to less people having confident riding public transit. One reason is that several Guangzhou subway lines have express service, which means that several stops will be skipped to maximize the efficiency of people living far from the city center. However, lots of extremely long subway lines that reach to the suburbs in Shanghai do not have express service, which means the travel time will be very long if a traveler wants to travel inbound by the subway. One reason that Shanghai metro does not promote express service on multiple long lines is that every stop can be considered as a "big stop", meaning that it is hard to set up an express service, since it might make the passenger experience in the "skipped stops"worse [13].

### *4.3. Eco-Friendly car fleet rate*

Guangzhou's bus fleet has a higher eco-friendly rate than in Shanghai. That is very likely caused by the BYD factory that was set up in Guangzhou in 2014. After BYD started to manufacture buses in Guangzhou, Guangzhou's bus fleets started to change to electric buses, including brands other than BYD. Furthermore, Guangzhou will be having a 100% electric bus fleet before 2030.

Shanghai's eco-friendly car rate is the highest among the three cities. Shanghai was the first city starting to promote the free electric car license policy, so people will tend to buy electric cars rather than purchase traditional cars, which high price of licensing fee is applied. Hence, the discount applied to electric car price is also another factor that encourages Shanghai people to purchase electric cars.

Shanghai has achieved using fully eco-friendly bus fleet by the end of 2020 in the area that is enclosed by the Outer-ring Highway, S20. Shanghai is also planning to add 1500 more eco-friendly bus to its fleet, according to the official planning guide released by Department of Transportation of Shanghai. In Jinshan District and Lingang Area, the government also promotes the increased installation of hydrogen-powered buses, which has been introduced to Shanghai in 2020.

DOI: 10.54254/2755-2721/26/20230785

## 5. Reflections and suggestions

### *5.1. Unequal planning on some large-demand communities*

Riders are the best way to interpret the construction of the public transit system. It is clear that Shanghai still needs to improve its transit planning ability to overcome with large demands especially in these new-developed big communities, where lots of them still do not have a reliable bus/rail supply. Lots of cities in China, including Shanghai, have not achieved a successful public transit planning strategy. Such as the Shuyuan Community mentioned above, it still has problems such as lack of public transit for certain communities, which are still waiting to be solved. New-developed communities like Shuyuan are especially affected by lack of public transit [14].

### *5.2. A network that reflects the current demand should be implemented*

Some bus stops and routes should be adjusted to better accommodate passenger's demand. Bus stops should be moved to where more demands are. When accessing the bus stops become easier, rider's intention to ride buses increases, which can lead to the reducing of carbon emission. Besides that, transit routes, especially night routes, do not reflect the current ridership demands. Night routes do not receive frequent adjustments to meet demands, causing a low ridership and ignoring majoy transit demands during nighttime. Stops and routes should be reviewed and adjusted as soon as possible when demands shift [15].

### *5.3. Duplicated bus routes should be adjusted to more equally distribute the resources*

Duplicated bus routes should be integrated or adjusted so that more people could be served in the district. Occasions that multiple buses on the main road and no bus in the small community often happen in Shanghai. If the bus stop on the main road is too far away from the community people live in, people in the community will lose the confident to use public transit. Suburbs are the most which are affected by the problem. Such as the Zhufeng Highway corridor in Shanghai, which connects Zhujiajiao Town in Qingpu District and Fengjing Town in Jinshan District [16]. There are currently four bus routes sharing the same segment between Liantang Town and Zhujiajiao Town on the same road, which is approximately 13 km. Situations like this should be adjusted, that integration of the routes should be present so that more bus resources could be used to serve those who do not have direct access to transit [17].

### *5.4. More eco-friendly factories should be encouraged*

Introduction of more eco-friendly car manufacturers should be introduced into Shanghai. When the manufacturer started to set up company in Shanghai, the cost of transportation is reduced. Car company do not have to import the cars overseas and pay a high tax fee. Lower the car price is one of the most effective ways to attract citizens buying eco-friendly cars. On the government aspect, introducing more benefits to the eco-friendly car owners can attract more people to purchase eco-friendly cars. For example, lower or eliminate the tax fee for owners, install more charging stations for electric cars, introduce higher standards for eco-friendly cars to let customers have more confident purchasing them [18].

### *5.5. Resource use should be controlled and adjusted*

On eco-friendly transit fleet aspect, carbon emission control system should be set up to reduce or restrict the emission of carbon dioxide. Award system should also be set up to encourage transit companies and governments to increase the speed of replacing traditional vehicles with eco-friendly vehicles. According to "The 14th Five-Year Plan for the Development of a Modern Comprehensive Transport System" by the China State Council, the goal for 2025 is to have no less than 80% of public affair vehicles using eco-friendly resource, including electric-powered and natural gas-powered [19].

DOI: 10.54254/2755-2721/26/20230785

## 6. Conclusion

Although planning a green city is a huge challenge for nearly all big cities, confidence should still be held for every city, that they have the ability to overcome with these challenges and help make a better future for both the city and for all people. Being a leader of promoting green city concept can attract more small cities and countries to fight against carbon emission and start to act on it. This essay illustrates ways to improve public transit in Shanghai by comparing to Guangzhou and Singapore and provides some insights and suggestions regarding on actions and comes with the conclusion that Shanghai has been doing great on limiting private car ownership and introducing diverse powered bus including hydrogen and hybrid buses. However, it still needs a better transit network design to reflect the current ridership and demand, and more duplicated bus routes should be adjusted to distribute the limited resources in a more equal way. Also, more electric vehicle companies should be encouraged and more benefit of purchasing an electric vehicle should be considered so that citizens have more interest on owning an electric car to make the city greener.

There are still some limitations on this essay. For example, direct comparison does not reflect everything. Different cities have different situations, and lots of other factors affect the statistics of the chart. For instance, some people do not want to take transit to work because of the environment of transit, especially after Covid. Lots of people will drive to work because they do not want to stay in a packed metro car and have too close contact with other people.

A greener and more breathable earth is our shared aspiration. The thought of "green transit" has been on the table for more than 30 years. Although we are now still on the phase of experimenting the greener transit and city, but there have been lots of successful examples that make us believe that we should stay on this track. In the future, how to go beyond the green transit and how should the concept of "green" being used on other aspects of the city should be discussed more on the table.

## References

[1] White Paper on Transportation Development of Shanghai. Shanghai Securities News. (2022, August). https://www.cnstock.com/image/202207/28/20220804203936051.pdf

[2] Wei, C. (2016). Domestic and foreign urban green transportation development strategy and enlightenment. Architecture and Decoration (5), 2.

[3] Huapu, C. (2009, November). Approaches towards Realization of Urban Green Transportation. Urban Transport of China (7), 6.

[4] Yue, T. (2012, April 9). Urban three-dimensional transportation and green travel environment. School of Journalism and Communication, Wuhan University.

[5] Amount of privately owned passenger cars in China from 2009 to 2020. Statista. (2021, September). https://www.statista.com/topics/5676/passenger-vehicles-in-china

[6] Guangzhou Bureau of Planning and Natural Resources. (2022, August 12). 2021 Guangzhou Transport Development Annual Report. The People's Government of Guangzhou Municipality.

[7] Singapore's unique automotive world. China Automotive News. http://www.chezhubidu.com/detail/details/1/872447

[8] 605km Endurance on one Charge's BYD Han EV, the Advantages and Slot Points Are Here (2021, February 4). Sohu News. https://www.sohu.com/a/448679862_115706?_trans_=000019_wzwza

[9] Consumers Prefer Internal Combustion Engines, and Singapore's Road to Electric Vehicle-s Will not Be Easy(2023, March 28). China Economic Net. https://baijiahao.baidu.com/s?id=1761571722963245599&wfr=spider&for=pc

[10] Administration Committee of Lingang New Zone of China Pilot Free Trade Zone. (2021, January). China Pilot Free Trade Zone Lingang New Area Comprehensive Transportation "14th Five-Year" plan. Lingang Government. https://www.lingang.gov.cn/upload/files/2021/2/67db551efb9563a3.pdf

DOI: 10.54254/2755-2721/26/20230785

[11] Shanghai People's Government. (2022, July 8). Shanghai carbon peak implementation pla -n. National Development and Reform Commission. https://www.ndrc.gov.cn/fggz/hjyzy /tdftzh/202208/t20220808_1332758_ext.html

[12] Han, J. (2015, April 13). Characteristics and major problems of urbanization in developed countries. Xinhua Net. http://www.xinhuanet.com/politics/2015-04/13/c_127681461.htm

[13] Zi, H. (2021, October 14). A study on Improving traffic function of integrated nodal city under the new spatial pattern of Shanghai: A case study of five new towns. Shangguan News. https://www.jfdaily.com/sgh/detail?id=560974

[14] Shanghai Municipal Transportation Commission, S. M. T. C. (2021, April). Shanghai Co -mprehensive Transportation development "14th Five-Year" plan. Shanghai Municipal Transportation Commission. https://jtw.sh.gov.cn/uploads/%E4%B8%8A%E6%B5%B7% E5%B8%82%E7%BB%BC%E5%90%88%E4%BA%A4%E9%80%9A%E2%80%9C%E5% 8D%81%E5%9B%9B%E4%BA%94%E2%80%9D%E8%A7%84%E5%88%92.pdf

[15] Circular of The State Council on Printing and Distributing the 14th Five-Year Plan for the Development of the Modern Comprehensive Transport System. China State Council. (2021, December 9). http://www.gov.cn/zhengce/content/2022-01/18/content_5669049.htm

[16] New energy business geography of Guangzhou: the city of smart cars. AutoHome. (2022, September 16). https://www.autohome.com.cn/news/202209/1263103.html

[17] Yang, C., & Qin, Q. (2021, September 29). Current situation and future prospect of Shanghai Urban public Transport. People Net. http://sh.people.com.cn/n2/2021/0929/c134768-34938100.html

[18] Study on public transport fare system in Singapore. ChinaIUT.(2021, March 12). http://old.chinaiut.com/article-1536.html

[19] You, M., Wang, R., & Wang, F. (2019, September 8). Suggestions on further impr- oving Shanghai bus route planning. Shanghai CPPCC. http://61.129.0.41/shzx/tagd/cont ent/ad7cb352-4792-4631-a866-df932cd061b5.html