Influence of Electric Bicycles on Urban Transportation in China (Concise Edition)

Urban Public Transportation Association of China

Urban and Rural Construction Committee of Hangzhou

Zhejiang University

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Contents

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Chapter 1 Foreign Development Status of Electric Bicycles

1.1 Foreign Development Situation of Electric Bicycles

Driven by the market demand and energy conservation and environmental protection concept, foreign manufacturers began to develop auxiliary drive bike several years ago. On the basis of mature development of new battery pack drive mechanical motor, Japan's Yamaha Company introduced the world's first commercial Electric bicycles cars in 1994. Foreign Electric bicycles are primarily as an easy walking and leisure fitness tool, used in a large parking lot, supermarkets and the tourist area for example. The number of global Electric bicycles rose sharply from the 36000 to 16000000 in six years from 1994 to 1999. In general, the potential market of Electric bicycles is huge and shows a trend of rising.

Japan is the first country developing electrical country, whose production and technology leading the world. Electric bicycles and motorcycle hold the same treatment in Japan. People can drive only after getting the license. But with the popularity of environmental protection consciousness, many Japan's tourist spots on the Electric bicycles and many tourist places launched rental service to promote people to drive less. In order to make the electric hybrid bicycle become a vehicle with high social value, the Japanese government actively participates in the common use system and creating a suitable environment.

According to the statistic from Bike Europe, European electric bicycles market sales in the recent ten years showed a trend of steady growth. The labor-saving device in the Electric bicycles gets the favor of the senior in the aging European countries.

Electric bicycles activity promoted by the EU (E-tour) trying to introducing the new transportation to clean the air. This activity has been launched in most European big cities and tourist areas. For example, in Rotterdam, the government will provide some subsidies to residents commuting with Electric bicycles. In Germany, new Electric bicycles with high technology emerge constantly and the charging station and bike lanes are growing as well. Traveler riding electric bike needs a driver’s license and to obey the traffic rules, which makes the electric bike a convenient and safe means of transportation.

1.2 Transportation Status and Feature of Foreign Electric Bicycles

1.2.1 Using Group

The aged people especially the older women are the largest consumers in Japan. But in recently years, the buyers gradually turn to young man and 30 years old male white-collar workers. To adapt to the change, the manufacturers produce electric bicycles with more beautiful appearance to satisfy young male consumers.

The elderly are the main consumers for Electric bicycles in European countries at present, while many young people are included as potential consumers. For instance, the majority of consumers in Germany Electric bicycles market are the middle aged and elderly between 45-70years old, especially around the age of 60.

1.2.2 Main Purpose

Due to the numerous hills and slopes in Japan, riding an electric-bike will be less laborious. Therefore many residents will choose this vehicle. The Japanese housewives are the main group. The retired Japanese old man often rides it for entertainment. Many tourist areas offer travelers with Electric bicycles rental services to facilitate them with visiting、energy conversation and environmental protection besides.

Facing with the aging problem, more and more old people choose Electric bicycles for daily journey and leisure entertainment. In addition, in the Netherlands, Germany, Switzerland and other countries many sports fans engaged in their favorite sports buy high-grade Electric bicycles. While in Italy and many countries in Europe countries, people prefer Electric bicycles in lower price to meet daily traveling needs.

1.2.3 Vehicle Performance

The important characteristic of Japanese Electric bicycles is lightweight and durable. As its main structural material is high strength alloy steel or aluminum alloy auxiliary material with its general weight of 20-28 kg. The Electric bicycles only allows proportional power control system rather than all-electric mode.

In EU, the Electric bicycles are usually divided into two categories: auxiliary Electric bicycles and electric bike. The so-called Electric bicycles without license is the former one, whose maximum power limit is 250 watts and top speed is 25km/h.

1.2.4 Road Facilities and Condition

Many countries have set up a special channel for Electric bicycles in order to avoid traffic accidents caused by it. In developed countries as Britain and France, there are special channels of 1.5m to 2m in their sidewalks for Electric bicycles. Electric bicycles in Germany ride on the bike trail. Bicycle lanes are set on the pavement in German towns, about 1 meter wide, and slightly lower than the sidewalks. German bicycle lanes extend to all directions with more than 75000 kilometers long.

1.3 Electric bicycles Traffic Regulations and Related Policies in All Countries

According to Japanese *road traffic laws enforcement rules*, the top speed of electric bicycles must be less than 24km/h and not allowed to the highway. Driving all Electric bicycles need to hold a driver's license, while driving electric power bicycle do not.

In European countries, the definition of Electric bicycles is 250 watts, with a sensor and controller and needing a pedal to help boot. Each high-power motor needs an approval according to the corresponding procedure. In Germany, a license is needed to drive Electric bicycles on the bike lane. The related management agency requires every driver to have at least two days of training, and only the eligible one in the exam can obtain a driver's license. Teenagers under 15 are not eligible for a driver's license. All drivers must purchase the specific insurance. The traffic rules in German are strict, while travelers must abide by them.

1.4 Development Prospect of Foreign Electric Bicycles

Japanese electric bicycles develop towards the direction of low price, lightweight and convenient. With the rising calling for reducing automobile exhaust emissions as well as the aging society Japan enters in the future, the popularity of Electric bicycles will continue to increase.

European countries are the most mature ones in studying Electric bicycles. Facing with common issue of aging population in western countries, more and more old people become consumers of Electric bicycles. In addition, the consumer groups of spot fans and the younger generation gradually expanding.

In general, the Japanese Electric bicycles development goes first while European development is the most mature.

Chapter 2 Present Development Situation of Electric Bicycles in China

2.1 A Basic Profile of the Development of Electric Bicycles in China

As one of the extension product of bicycle, electric bicycles is a kind of special-purpose bicycle which can be operated by human power, electricity or electricity-assisted and can drive on bicycle lane, with two wheels and storage battery as auxiliary energy. Currently, Electric bicycles ownership has exceeded fourteen million in China. The Electric bicycles sales have increased 10% annually in recent three years. The penetration rate of Electric bicycles has reached more than 10%, and that in every 100 households has achieved 76%.

The price of common car is around 100-150 thousand Yuan, which is equivalent to six times of average annual income of people who are in urban area. The price of Electric bicycles is about 2000 Yuan which amounts to 1/8 of average annual income. As it is affordable and is convenient for ordinary people, Electric bicycles have been popular widely.

Viewed from the consumption structure, the largest consumption group for Electric bicycles targets middle-aged women around 35-45 years old and the biggest market of it is in small and middle-sized cities. Also, 20 kilometers per hour as the limiting speed can meet the requirement of middle-aged women. In addition, youths in the working class and middle school students are a part of consumption group of Electric bicycles. A survey found that the major consumer group of Electric bicycles is constituted by those who are low-middle degrees, low-middle -income and middle age while the potential consumption group is highly educated, high-income, middle-aged people.

Viewed from the consumption goals, it is used to commute and transport their children by women, drop off and pick up children or take a walk and rest for the old, and stock or deliver for small business owners.

According to the *Electric bicycles – General Technical Requirements* issued by Standardization Administration of China in 1999 is: *the maximum speed of Electric bicycles should not be greater than 20 km/h and the total weight of the vehicle should not exceed 40 kilogram*. But in fact, a lot of electric bicycles are not produced by rule and the selling problem is bad on a national scale. A large number of exceeding-limit Electric bicycles are driving on road, which aroused prominent hidden danger of road transportation safety.

With the popularity of Electric bicycles, the number of traffic accidents caused by Electric bicycles is rising year by year. However, in recent decade, mortality per 10 thousand vehicles is keeping in a relatively stable state. The value of that hovers around 0.3 with a maximum value of 0.311.

Considering its negative effects on urban traffic safety, Electric bicycles has been forbidden to drive on road or to be registered, for example, Guangzhou, Shenzhen, etc. Nonetheless many residents of other cities disapprove the measure of “No Electric bicycles”.

2.2 Current Traffic Regulations and Related Policies of Electric Bicycles in China

In recent 20 years, related standards, traffic regulations and management policies about Electric bicycles have been laid down in China. At the same time, a number of local governments have carried out relative policies and management rules at different times in the light of local development situation.

2.2.1 Laws and Policies at National Level

In 1999, *General Specification of National Standard for Electric bicycles in PRC* (GB17761-1999) designates that, Electric bicycles is kind of special-purpose bicycle which can be operated by human source, electricity or electricity-assisted and can drive on bicycle lane, with two wheels and storage battery as auxiliary energy. *General Specification of National Standard for Electric bicycles* (GB17761-1999) stipulates that the design speed of Electric bicycles should be not more than 20km/h; The mass should be not more than 40 kg; it can be driven by foot and its travelling distance in 30 minutes should be not less than 7km; the continuous range should be not less than 25km after being charged.

Recently, China also launches new *Safety Technical Condition of Vehicle Operation* (GB7258-2012). It points out that Electric bicycles whose speed is between 20km/h and 50km/h, weight is more than 40 kilograms will be recognized as mopeds and they will be regulated as motor vehicles. This rule shows that two-wheel vehicles (namely, Electric bicycles) will not be ruled based on regulations for motor vehicle if they can meet the following requirement: their maximum design speed is not more than 20km/h; they can be forced by human power; their indexes like mass, overall dimensions and motor power can come to the national level.

2.2.2 Management Rules and Methods at Local Level

On the basis of policies and rules about electric bicycles in national level, corresponding management rules and methods targeting specific problems have been put into effect by agencies in governments of cities and provinces. For example, *The Provisions on the Administration of Kunming City Electric Car*s claims that the exceeding electric bicycles will be prevented from registering since February 1st, 2012. For the electric bicycles which are newly bought and come to the criterion in national level, the users can register the bicycles at 21 registration office.

2.3 The Existing Problems in the Development of Electric Bicycles in China

Under the current situation of development of electric bicycles national wide in China and that in some cities, some problems cannot be ignored and they should be solved rightly. Some aspects are list on the followings:

1. Incomplete related traffic laws and industrial policy about Electric bicycles lead to difficulty in management of Electric bicycles.
2. It is difficult to position the Electric bicycles in urban traffic structure and its development has a bad effect on the achievement of general goal in traffic strategy.
3. In many cities, electric bicycles accelerate the discrepancy of mixed traffic and it has some kind of effect on efficiency.
4. The illegal acts in traffic violation caused by electric bicycles are very severe.
5. The quality of electric bicycles is bad and after-sales service is not perfect.
6. The batteries of electric bicycles arouse secondary pollution.

Chapter 3 Characteristics of Travelling Demand by Electric Bicycles

3.1 Characteristics of Traffic Structure in Several Typical Cities

Structure of urban traffic is the proportion of traffic undertaken by different means of transportation in integrated transport system. It reflects the features of travelling demand and the staple functions and status of different traffic means. What's more, it directly influences the configuration of limited traffic resources and possibilities of offering superior choices for demanders. Therefore, it is one of the crucial factors in deciding the efficiency of urban traffic system.

Urban traffic structure and choices of travelling means of inhabitants are the same question in different levels. The former is the sum of all microcosmic individual's travelling means, while the latter is the tiny reflection of traffic structure. According to the analysis of the investigation to inhabitant's travelling means in Shanghai, Fuzhou, Ningbo, Zhuji and Shaoxing, we could come to several conclusions.

1. Public transport in Shanghai is relatively more developed, and its passenger capacity is the largest in five cities. But the proportion is still not the appropriate one. At the same time, public transportation accounts for too small proportion in Ningbo, Zhuji and Shaoxing. It is necessary for these cities to improve the efficiency of public transport.
2. Personal vehicles accounts for too much in Zhuji.
3. Shaoxing has a large proportion of bicycles, and Electric bicycles also take up an important position.
4. As for the proportion of travelling by Electric bicycles, it is large in Shaoxing and Ningbo, small in Shanghai Fuzhou and Zhuji, which is similar in these three cities. Apparently, traffic order of Electric bicycles has a great influence on Shaoxing and Ningbo.

In general, these cities' traffic structure is far from perfect. To improve urban traffic efficiency and decrease the traffic cost, these cities need to go on adjusting their traffic structures appropriately.

3.2 Analysis of Demand Characteristics of Electric bicycles

Through investigate the usage of Electric bicycles in Hangzhou and Guilin. Influences of Electric bicycles on the daily travelling ways of two cities' residents are analyzed.

3.2.2 Characteristics of Electric Bicycles Travelers

1. Gender: no matter in Guilin or in Hangzhou, the number of females is larger than that of males about Electric-bike riders.

2. Age: the major flock using Electric bicycles for traffic in Hangzhou and Guilin is people between 20 and 39.
3. Occupation: electronic bicycle users in Hangzhou and Guilin are mainly self-employed people or staff who provide business service,
4. Average monthly income: 1000~2999 Yuan in Guilin and 2000~3999 Yuan in Hangzhou.
5. Understanding of the related traffic rules: in both places, more than 60% of the Electric bicycles users have a good knowledge of related traffic rules.

3.2.3 Travel Characteristics by Electric bicycles

1. Travel distance: no matter in Hangzhou or Guilin, most people tend to choose Electric bicycles if they are going to cover less than 6 kilometers.
2. Travel time: electronic bicyclers in both places mostly spend less than 30 minutes.
3. Trip purpose: in both cities, they ride electric bicycles mainly for work and school.
4. Travel speed: in Hangzhou, the max is less than 25 km/h, and these people account for 60.6%. In Guilin, the speeding phenomenon is more serious, with the max ranging from 20 to 30 km/h, and these people account for 55.6%.

3.2.4 Demand Characteristics of Electric Bicycles

1. In which way electric bicycles travel mode shifted from. In Hangzhou, current Electric-bike riders used bicycle and bus for transportation before they bought Electric bicycles. So is it in Guilin.
2. In which way electric bicycles travel mode will be transferred to. No matter in Hangzhou or Guilin, most people will turn to use bus and bicycle if they are banned from using Electric bicycles. While in Guilin, more people turn to use buses and in Hangzhou, more turn to use bicycles.
3. The rationality of the rules: 68.3% of the Electric bicycles users in Hangzhou think the rules are reasonable, while 57.1% in Guilin. In the meantime, people against the rules think the providing speed is too slow in both Hangzhou and Guilin.
4. Reasons why choosing electric bicycles. No matter in Hangzhou and Guilin, the main reason is that electric bicycles are cheap, convenient and time-saving, which well satisfies their daily needs.
5. Some problems in taking electric bicycles as travel tools. Most people think there are two problems. First, battery lasts for too short. Second, it’s more likely to have accidents when riding electric bicycles.

3.3 Conclusions of Demand Characteristics Analysis

Through analyzing the features of traffic structure in some typical cities and data of Electric bicycles’ usage in Hangzhou and Guilin, the following conclusions can be drawn.

1. From 2004 to 2009, the proportion of bicycle travelling in Shanghai decrease a lot, and the obvious trend is that it’s replaced by the Electric bicycles. Therefore,

means of travelling by bicycle takes an indispensable part in urban transportation. But on the other hand, the passenger amount in the main city of Shanghai is too large, and the public transport is developed and of high efficiency. So traffic pattern in Shanghai should rely mainly on public transport while bicycle and Electric bicycles as subsidiary means.

2. Electric bicycles travelling take an important part in traffic structure in cities of medium size such as Ningbo and Fuzhou. In Ningbo particularly, its proportion is 24.5%. Therefore, it becomes a big challenge for Ningbo to appropriately guide the improvement of Electric bicycles travelling and improve its traffic specification.
3. In both Hangzhou and Guilin, Electric bicycles users are mainly self-employed people, people who take up business service and salaried people with middle or low income. For all of them, electronic bicycle is an indispensable means of transportation.
4. In small and medium sized cities such as Guilin and Shaoxing, the proportion of Electric bicycles travelling is larger than big cities such as Beijing and Shanghai. It's because public transportation in small and medium cities is incomplete and has a long way to go to catch up with big cities. Thus electric bicycles share a significant part of pressure of short or middle travelling. If its usage is banned, then this proportion of residents will turn to public transport, which causes much more pressure to the faulty public transportation.
5. Rapid growth of the Electric bicycles as well as the faulty management has brought much pressure to many cities. So it is hanging over our head how to make effective regulations and find good approaches according to different cities' characteristics.

In conclusion, according to the survey, as the public transport system in most small and medium-sized city is not developed, unable to meet people's travel needs. And the Electric bicycles can alleviate the physical burden, accelerate travel speed, and effectively improve the motor efficiency. Electric vehicles can better play its advantages of short distance travel, but we should limit its long distance travel in the city. To some extent, electric bicycles can be positioned as a terminal means of transportation, used as to connect the public transportation and home or destination.

Chapter 4 Analysis of Traffic Characteristics of Electric Bicycles

It is necessary to fully grasp the characteristics of the road transport before its transport efficiency and usage factor of road resource are been studied. For electric bicycles, its traffic characteristics include vehicle characteristics, electric bicycles users' characteristics, using characteristics and traffic flow characteristics. Vehicle characteristics and traffic flow characteristics of electric bicycles are elaborated in this chapter.

4.1 Vehicle Characteristics of Electric Bicycles

Vehicle characteristic of electric bicycles is a kind of peculiar nature as a means of transport. Vehicle characteristic of electric bicycles includes two aspects. One is regulations for vehicle characteristics of electric bicycles in the relevant national standards, and the other is the actual vehicle characteristics of electric bicycles which are sold on the market or be used on the road.

4.1.1 Technical Standards of Electric Bicycles

In 2009, the definition of electric-motorcycles was revised by the relevant policy-making administration. Also the standard of *General Technical Conditions of Electric-motorcycles and Electric-mopeds* was proposed. The definition—electric two-wheelers which maximum design speed is larger than 20km/h or overall quality is more than 40kg is identified as electric-mopeds incorporated into the category of motor vehicle management—was stressed. In addition, the new national standard (GB7258-2012) of Safety Requirements for Motor Vehicles Operation was started to enforce on September 1, 2012. In the new standard, electric two-wheelers which maximum design speed is larger than 20km/h and less than 50km/h or overall quality is more than 40kg is identified as electric-scooters incorporated into the category of motor vehicle management. However, the new standard of *General Electric bicycles Conditions* has not been formally introduced, so the electric bicycles mentioned in this project report includes electric-mopeds. It is called as electric-scooters in this project report.

4.1.2 Vehicle Characteristics of Electric Bicycles on the Market

While the electric bicycles technical regulations is proposed in the standard of *General Electric bicycles Conditions* in 1999, the electric bicycles not only has a wide variety of shapes, but also has more and more functions in the actual design and production of electric bicycles. According to the survey, electric bicycles are divided into two kinds in using. One is general electric bicycles. The other is electric-scooters.

4.2 Analysis of Road Resource Utilization Characteristics of Different Travel Modes

With the rapid development of cities in China, the pressure faced by urban road traffic is enlarged increasingly because urban roads resource supply is far lagging behind the increase in demand. In this case, it is necessary to rationalize the structure of urban transportation. Unit space-time resource consumption of vehicle can be used to evaluate the merits of different means of transportation in road resource utilization directly.

4.2.1 Analysis of Space-Time Resource Consumption Characteristics of Five Travel Modes

Concept of space-time resource consumption was first proposed by French engineer Louis Horse. It is the time occupied by each traffic individual travels (person or vehicle) in a certain space or is the space occupied by each traffic individual travels in a certain time. The unit measurement is m^2•h per car or m^2•h per person, that is, the product of the dynamic area and the travel time occupied by each traffic individual travels.

1. Space-time resource consumption of bicycles

Physical isolation facilities are set in the middle of motor way and non-motor way in traffic survey area. Non-motor vehicle lane width includes 4.6m, 3.5m, 3m and 2.5m. Majority of the lane width is 3.5 meters. So the section width of bike lanes is in accordance with 3.5 meters to calculate. Space-time resource consumption of bicycle is 0.415 m2•h per bike.

2. Space-time resource consumption of electric bicycles

Since bikes and electric bicycles are mixed on non-motor way, the section width of electric bicycles lanes is also chosen 3.5 meters to calculate. Space-time resource consumption of electric bicycles is 0.546 m^2•h per e-bike.

3. Space-time resource consumption of cars

The width of motor vehicle lanes in traffic survey area is 3.5 meters. Space-time resource consumption of car is 2.121 m^2•h per car.

4. Space-time resource consumption of taxis

The width of motor vehicle lanes in traffic survey area is 3.5 meters. Space-time resource consumption of taxi is 2.121 m^2•h per taxi.

5. Space-time resource consumption of buses

The width of motor vehicle lanes in traffic survey area is 3.5 meters. When the average travel speed of bus is not considered, the space-time resource consumption of bus is 12.963 m^2•h per bus in the case that the proportion of stopped bus and skipped bus in bus station is 3:1.

Different transport modes can load different number of passengers. So unit space-time resource consumption of vehicle can be used to evaluate the merits of different means of transportation in road resource utilization more directly. Traffic surveys show that the average number of passengers of single bicycles is 1 people. The average number of passengers of single Electric bicycles is 1.12 people. The average number of passengers of single car is 1.24

people. The average number of passengers of single taxi is 1.06 people (not including the driver). The average number of passengers of single bus is 62.45 people. Therefore, the unit space-time resource consumption corresponding to the five modes of transportation are 0.415 m^2•h per person (bike), 0.488 m^2•h per person (electric bike), 1.710 m2•h per person (car), 2.0 m2•h per person (taxi), 0.208 m2•h per person (bus).

4.2.2 Comparative Analysis of Different Travel Modes

Through above analysis of space-time resource consumption of each transport mode, it shows that the transport mode of bus is the lowest unit space-time resource consumption compared with the other four kinds of transport mode. Bicycles and electric bicycles consume considerable space-time resource, far less than cars' and taxis'.

From above analysis, the transport mode of electric bicycles has comparative advantage. Although electric bicycles in many cities have a certain proportion of travel, its development is still subject to some controversy because of many road accidents related to it. It will be an energy-efficient way to travel if the development of electric bicycles can be systematically planned. In addition, there is suitable travel distance and travel time consumption for electric bicycles. To make electric bicycles play a good role in urban road traffic, not only its advantages, but also its using scope and conditions should be taken into account. It should encourage the usage of electric bicycles in short-distance travel in urban traffic. When long-distance travel is unavoidable in great cities, it should be made the electric bicycles mode shift to public transport modes or combine travel with public transport modes. Meanwhile, transport mode of cars should be limited because of its maximum space-time resource consumption.

Chapter 5 Security Impact Analysis of Electric Bicycles

According to the *Annual Report of road traffic accidents* from 2004 to 2011, statistics show that China's Electric bicycles ownership increased rapidly year by year, growing electric bike also brought a series of problems. The number of deaths from accidents involving Electric bicycles increased from 589 in 2004 to 4790 people in2011, injured increased by 5295 people in 2004 to 23830 in 2011. This is only the conclusions drawn from the data, because the electric bike also has the characteristics of an ordinary bicycle, some are not statistics for casualty data.

In addition, when handling accidents involving electric bicycles, local traffic control departments confuse if Electric bicycles are motor vehicles or not. All these lead to that the conclusion of the Electric bicycles safety cannot be drawn simply from the statistics, we also need to consider the causes of electric bike accidents and then analyze its security.

5.1 Characteristics of Electric Bicycles Accidents

An accident is that when people are in the course of action to achieve its purpose, the sudden, unexpected event which forced a purposeful action to temporarily or permanently terminate. Road accident is the result of a fault or in the event of personal injury or property damage caused by vehicle on the road.

Formation of accidents is related to the physiological and psychological characteristics of traffic participants, traffic safety characteristics of roads, vehicles, and environment.

According to the department of transportation statistics, the main form of electric bike accidents is collisions with the motor vehicle. The collisions with the non-motor vehicle are generally not included in the statistical coverage of the accident because of its less hazardous.

Accidents have the following characteristics:

1) High accident rate. Due to small size, poor driving stability, less secure facilities, two-wheelers bike especially Electric bicycles is a low safety performance transport.

2) High casualty rate (moderate injury and above). Because of the great disparity of quality between both sides of the vehicle collision, and faster speed, Electric bicycles are significantly disadvantaged party, with high rates of personal injury.

5.2 Distribution of Electric Bicycles Accident

1. Temporal Distribution

Statistics show that accidents "peak" period did not occur in traffic travel "peak" period, but in the time from crowded to dissipate of the city traffic (called the peak dissipation period). According to accident statistics for electric bicycles, collision between the electric bicycles and pedestrian, which caused pedestrian injuries or death, occurred mostly in the evening or at night.

Serious accidents occur more easily due to poor visibility at night, lack of riding

people's observation and excessive speed of electric vehicles.

2. Spatial Distribution

In the view of the location where the accident occurred in the road cross section according to the accident files from January 2007 to July,

The number of electric vehicles accidents and deaths that occurred in the motor vehicle lane accounted for 50.30% and 60.71% of the total Electric bicycles accidents respectively, with an increase of 30.49% and 34.92% year on year. The number of bike accidents and deaths that occurred in the machine non-hybrid Electric bicycles track accounted for 27.25% and 25.71% respectively of the total, with an increase of 56.16% and 132.26% year on year.

3. Accident Scenarios

Electric bicycles accidents from accidental morphological point of view mainly are side impact, positive impact, and orthogenetic scrape.

The basic form of Electric bicycles accidents is consistent with the morphology of the ordinary bicycle accident such as a basic two-wheeled transport.

Especially the collision occurs between Electric bicycles in the straight and turn right vehicle, although vehicle failing to give way is primarily responsible for the accident, which is related to the faster electric bike.

5.3 Distribution of the reasons of Electric Bicycles Accidents

According to the *Annual Report of Road Traffic Accidents* statistics data in 2011, in the view of the accident cause, electric moped accidents resulting from failure to reverse driving, illegal lane driving, failing to give way, affect the safety of other acts, violation of traffic lights, speeding and other violations accounted for 20.70%, 17.84%, 17.73%, 12.03%, 11.54%, 6.83% of the total electric scooter accidents, respectively. According to the Chengdu accident file from January 2007 to July, in the view of the accident cause, electric moped accidents resulting from failure to reverse driving, illegal lane driving, failing to give way, affect the safety of other acts, violation of traffic lights, speeding and other violations accounted for 20.41%,16.3696%, 15.00%, 7.90%, 6.65%of the total electric scooter accidents, respectively, with an increase of 83.29%, 3.59%, 17.11%, 31.25% and 35.28% year on year, respectively.

2004 in the area controlled by the1st Branch Office in Chengdu the bike accidents resulting from speeding accounted for 10.21% of the total electric accidents with Grab Road accounted for 12.64%, failing to follow the lane accounted for 11.33%, violation of traffic signal indication accounted for 17.31%.

Chapter 6 Environmental Impact Analysis of Electric Bicycles

In the urban traffic, all kinds of vehicles, including cars, buses, motorcycles, Electric bicycles and others consume energy in different degrees, at the same time, they emission greenhouse gases and all kinds of pollutants more or less. Therefore, how to solve the problem of saving energy and reducing consumption is one of the important links that whether China can response to the global energy crisis reasonably, realizes the urban sustainable development; build a resource-conserving of environment-friendly society. This chapter is mainly analyzed the energy consumption and pollutant emission for the several kinds of means of transportation in the city.

6.1 Analysis of the Situation about Energy Consumption and Pollutant Discharge of Electric Bicycles

In recent years, Electric bicycles have become one of the major transportation for urban residents in our country because of its rapid growth. At the same time, Electric bicycles have been paid more attention to the problems of the energy consumption and environmental pollution. It mainly generates for the use of the energy consumption and pollutant emissions.

1. Energy consumption

According to the calculation, the social average energy intensity of all kinds of Electric bicycles can be expressed as: 1 km per car, electricity 12 w, 32 kcal; Every car travels 100 km, power consumption 1.2 kWh, equivalent to 31.9 kcal/km. Loading coefficient is 1.2, energy intensity of Electric bicycles are as follows: 26.6 kcal/person • km.

2. CO_2 emission

CO2 emissions indicators of Electric bicycles are as follows: Every car travels 1 km, CO2 emissions is 9.6 kg. Loading coefficient is 1.2, CO2 emissions intensity of Electric bicycles are as follows: 8 g /person • km.

3. Lead resource consumption

In our country, the batteries' average weight in each group of Electric bicycles is 17.3 kg (48 v), the proportion of lead is 70%, about 12 kg, the average service life is 1.5 years, and there is 4% of lead resource losing in circulation process, so almost 0.32kg lead resource is consumed by every user every year.

6.2 Contrastive Analysis of Energy Consumption and Pollutant Emissions for All Kinds of Transportation

In order to optimize the structure of all kinds of urban transportation, reduce the energy consumption cost and the negative effect of the urban environment madding by pollution. it is necessary to comparative analysis of the energy consumption and pollutant emissions for all kinds of transportation in the study of it.

1. The Energy Consumption Contrast

It is not easy to calculate as the energy consumption of the bike in use is physical's which vary with each individual. Therefore, only gives energy consumption data of the other four main travel modes here.

Electric bicycles: A basic indicator is per 100 km power consumption less than 1.2 kWh. 1 KWH calculated by 0.36 kg of standard coal, every person each 10 km of the energy consumption index is 0.043 kg of standard coal;

Motorcycle: The 100 km fuel consumption of Motorcycle is generally 2 ~ 3L. If taking 2.5L to calculate, 1 liters of gasoline is equal to 1.088 kilogram of standard coal. The energy consumption is 0.272 kilogram of standard coal person per 10 kilometer, which is 6.3 times as much as electric vehicle;

Car: a car run in the city per 10 km fuel consumption is 1 L with 2 people on average. The energy consumption is 0.544 kilogram of standard coal person per 10 kilometer.

Bus: the ministry of construction thought that" The energy consumption of urban public transportation is about 8.4% of the cars' such as mileage per capita." In this principle, estimates that energy consumption indexes of the bus for person per 10 kilometer are 0.042 L petrol, about 0.046 kg of standard coal.

2. Comparison of Harmful Gas and CO_2 Emissions

Electric bicycles:

(1) Harmful gas: zero.

(2) Greenhouse gases: Electric bicycles 10 km power consumption is 0.12 kWh, comprehensive CO_2 emissions is 0.082 kg.

Motorcycle:

(1) Harmful gas : although its emissions is littler than cars, but some of the old motorcycle which does not pass the environmental protection does exist serious harmful gas emissions, such as CO, ammonia, oxygen compounds, hydrocarbons and inhalable particles.

(2) Greenhouse gases: carbon intensity coefficient of the petrol is 2.3 kg/L. Calculated on the 2.5 L per 100km, so the CO_2 emissions for per 100km are 5.75 kg of, which is 7 times as much as electric vehicles.

Car:

(1) Harmful gas: emissions are serious.

(2) Greenhouse gases: the fuel consumption is 0.5 L person per 10 km, CO_2 emissions

is 0.115 kg.

Bus:

(1) Harmful gas: the emission is serious as taking every bus to calculate, but the emission for per capita is low.

(2) Greenhouse gases: count as 8.4% of the car, CO_2 emissions is 0.097 kg person per 10km

3. Lead Emissions:

Electric bicycles: a study every 1 million electric vehicles, the total mileage of Electric bicycles' batteries (each group's weighs is 17.3 kg) is 10000 kilometers, there are 17300 tons lead-acid battery need to be dealt , lead emissions into the atmosphere is 0.4 tons at the process of it.(calculated at rate of 100%).

Motorcycle: the lead limit of the unleaded gasoline is 0.013 g/L, if the fuel consumption is 2.5L per 100 km. Then the full lead emissions are 3.25 tons with 1million Motorcycles traveling 10000km.

Car: The 100 km fuel consumption of car is 10L with two people. So the full lead emissions are 5.42 tons if there are 1 million people using it driving 10000km.

Bus: count as 8.4% of the car about per capita energy consumption, so the lead emissions are 8.4% of the car's for 1 million people, equal to 0.455 tons.

Chapter 7 Electric Bicycles Development Suggestions

Put forward relevant development proposals for the advantages and problems of electric bicycles in urban traffic development, including: industrial policy recommendations, traffic regulations and management recommendations, transportation facilities set up recommendations, waste battery management recommendations.

7.1 Electric Bicycles Industry Policy Recommendations

1 New industry standard, industry access system should be proposed as soon as possible.
2 Chinese electric bicycles industry should develop into lighter, booster and high-end to be consistent with the development of international regulations, trends and industry.
3 Vigorously develop the power electric bicycles. The types of vehicles should have automatically speed limit in speed limit, continued long trip mileage, riding easily, safe, portable and other functions.
4 It is recommended to urge relevant manufacturers to improve their own level of design and manufacture of electric bicycles and product quality, manufacturing and producing vehicles with independent intellectual property rights.
5 It is recommended to punish the phenomenon of the using commercial hype, false advertising and other means to expand market share severely, in order to prevent redundant.

7.2 Electric Bicycles Traffic Position Suggestions

China's urban transportation development patterns are mainly "transit-oriented", "non-motorized transport-oriented" and "non-motorized transport affiliate transit-oriented" and other models. Specific city should make their transport modes adapt to their own specific characteristics of urban traffic.

In recent years, many large traffic density urban public transport systems construct fast, high efficiency; public transportation system is more developed. Traffic passenger has an apparent trends shift into public transport, which caused the less proportion of non-motorized transport trips, for this kind of city we should promote "transit-oriented" development mode. In the core of the largest city with high traffic density, green, environmentally friendly bicycle is encouraged for a short distance travel; develop the connection mode of "bicycle + public transport". In the remote suburban public where transport system is underdeveloped, travel distance is longer, while a larger proportion of people is in low-income, and therefore, it's more reasonable to use the connection mode of "electric bicycles + rail transportation", and transfer station should be built next to electric bicycles parking and other facilities. In a way, it is a complement for the traffic development model of "bicycles + Public transit" of these cities, and is basically a transitional means of transport.

In cities with small traffic density, non-motorized transport is the main part of urban traffic; basically exceed the proportion of 60%. Public transport proportion is low in such cities, only hold about 20% of the proportion of all trips. This kind of city electric bicycles act as a supplementary form of transport bicycles is experiencing a rapid growth. In a long future,

electric bicycles are still an important part of urban non-motorized transport systems. Therefore, it's necessary for these cities develop their electric bicycles reasonable adopt to their own specific problem, implement reasonable and effective traffic management measures, set up completely road traffic facilities.

7.3 Electric Bicycles Traffic Laws and Management Recommendations

Electric bicycles are different from bikes, motorcycles and conventional vehicles, although it has something in common with bicycles and motorcycles, but overall it still has its own characteristics. Therefore, the management should be based on its own characteristics to take effective management approaches.

First define the electric bicycles firmly. According to the research results and experience, two wheels electric bicycles could be divided into ordinary electric bicycles and electric bicycles of "light friction".

Ordinary electric bicycles use storage battery as auxiliary energy, can achieve human riding, electric or electric assist function with two wheels, it retains the bike's features of lightweight, flexible, mobile, and is defined as non-motor vehicles which should be driving in the non-motor vehicle lane. In terms of speed, the new reasonable provisions should be made based on science. Survey results of traffic speed through a number of the city's main roads showed that the average speed of electric bicycles are in 16~19 km/h or so, the maximum speed of more than 28km/h is very little, but portion above the current standard 20 km/h has reached 42% , which cannot be ignored.

Electric bicycles beyond the above Standards must be Classified as the range of "light friction" electric bicycles, and "light friction" electric bicycles' speed limit needs to be further defined, the lower limit is not specified, and should no longer be seamless connected with electric bicycles. In terms of traffic management, electric bicycles of "light motor" should be managed as motor vehicles, the vehicle requires an audit on the card, and relevant drivers should be included into management mechanism, the driver needs to have a short study of traffic regulations and related driving skills before actually driving. In the meantime this type of vehicle should travel in the non-motor vehicle lane.

In terms of traffic regulations, Specific and clear accountability regulations and penalties should be set up for electric bicycles related accidents.

7.4 Electric Bicycles Transportation Facilities Setting Recommendations

1 Electric bicycles should drive in the non-motor vehicle lane with bikes.
2 Non isolation belt should be set up in the city's main roads and secondary roads, the widths of non-motorized vehicles lane would be reasonably range from 2 meters to 3.5 meters.
3 Reasonable left turn and straight vehicles waiting area should be set at the road intersection.

In addition, we can draw on the experience of developed countries, set up specially

route area of the non-motor vehicle at the intersection.

7.5 Electric Bicycles Scrap Battery Management Recommendations

1 The state authorities should introduce policies as soon as possible, ban small scrap lead recycling company. At the same time introduce policies to encourage and support the large battery manufacturer for recycling waste batteries, or build large specialized recycling of waste batteries handle enterprises.

2 In conjunction with local conditions, establish and operate a perfect battery disposal center as soon as possible to ensure the right order of battery waste collection, transportation, deployment, storage and final disposal of the security.

3 To guide classified, establish a smooth recycling system. Wasted lead-acid battery should be recycled and entrusted to qualified units according to relevant laws and regulations. Establish a unified collection points for used batteries, gradually standardize the collection, storage, transfer and use of used batteries.

4 Increase publicity, guide properly， Publicize the knowledge of recycling and use of wasted batteries to make people understand the hazards of waste batteries, and guide a concept of environmental protection, from its start, protect the pollution of used batteries together.