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120 Million E-Bikes, the Effect on Chinese Lifestyle

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Abstract
China has been depicted by the western media as the *Bicycle Kingdom* for over 100 years. Today, one out of every four bicycles in China is electric. 120 million e-bikes are shaping Chinese people's lives in significant ways. In cities, towns and the countryside, e-bikes are widely used for commuting, transportation, family outings and recreation. The livelihood of many small businesses such as courier services and food delivery also rely on e-bikes. Over 2000 e-bike manufacturers are offering consumers choices ranging from less than 300 USD to 600 USD. In 2011, 27 million e-bikes were produced in China with only half million units for export. While almost all e-bikes worldwide, are made in China, or from Chinese components, around half that are sold in the EU leave China as component parts, not complete vehicles, for assembly in EU. These bikes are not included in Chinese export numbers.

With the growing number of e-bikes, the accidents caused by e-bikes are also rising. Regarded as non-motorized vehicles, e-bikes are driven by untrained drivers at the speed of 35km/h on the bicycle lanes, causing more traffic accidents than cars and other vehicles and becoming the number one road killer in some Chinese cities. However, it doesn't mean an e-bike is an unsafe vehicle. Both the government and the industry are working together to improve the e-bike regulations and educate the public. In China, e-bikes have been widely accepted as a practical and affordable means of transportation. The Chinese need e-bikes.

In a country with 22% of the world population, the development of public transportation systems and four wheelers needs to go hand in hand with road construction and resources. While China has replaced the US as the biggest automobile market, e-bikes will still be an indispensable means of transportation. Moreover, with the ever increasing gas prices, motorcycles will be further replaced by e-bikes, especially in the low-end market where luxury style e-bikes can basically replace scooters. With the improvement in battery life and range, e-bikes are able to replace scooters entirely.

Means of Transportation

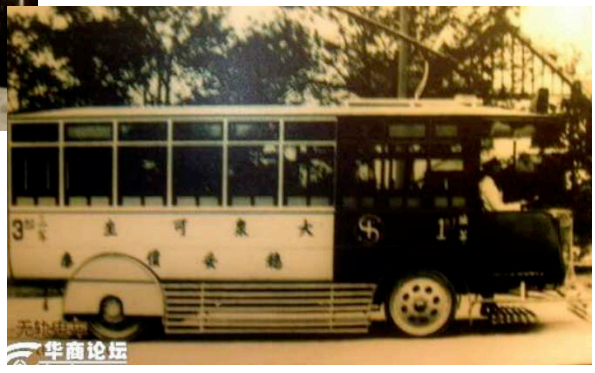
1840-1949: rickshaw, bicycle, Streetcar and bus
After the First Opium War, the common means of transportation was this rickshaw, bicycle, Streetcar and bus. In modern times of China (1840-1949), the advanced transportation was train, ship and plane. After the 1950s, public buses became the hub of urban transportation.

Rickshaw

1950-1980: bicycle, Streetcar and bus

Streetcar

Bus



1980-1998: bicycle, motorcycle, car, bus, e-bike (early stage)

The first car in Shanghai was introduced by an expatriate in 1901. After China's entry into the World Trade Organization (WTO) in 2001, the development of the automobile market further accelerated. In 2010, both sales and production topped 18 million units, with 13.76 million passenger cars delivered, in each case the largest by any nation in history. The number of registered cars, buses, vans, and trucks on the road in China reached 62 million in 2009, and is expected to exceed 200 million by 2020.

1998-now: e-bike, bicycle, motorcycle, car, bus

The E-bike is a “grass-root” industry in China, whose initial development hasn’t received enough attention, resulting in a slow development in their beginning stage. From 2003 to 2007, due to the contribution of “SARS” (Severe Acute Respiratory Syndrome), the e-bike industry gained rapid advances; the e-bike brands, products and dealer networks were increasing rapidly.

Early e-bike in China

1998-now: e-bike, bicycle, motorcycle, car, bus

Currently, the government mandates and global trends have incentivized Chinese automakers to make electric vehicles. Nonetheless, there are some challenges in developing electric car technology. First, the costs of building infrastructure, such as recharge stations. Second, there are concerns over the safety, weight, and recharge speed of lithium-ion batteries. Indeed, a major concern with electric cars is the amount of time it takes to recharge a battery.

A worker recharges an electric taxi at a charging station in Beijing, China

Cost: Ebike VS Automobile

It costs around $0.10 to fully charge a battery. Even with the oldest and least efficient form of battery technology (SLA), it costs less than $0.01 per mile to operate an electric bike. Li-Ion and NiMH cost even less. Compare that to gas-powered vehicles which average about 25 miles per gallon. With gas prices at $2.50 - $3.50 per gallon, it costs about $0.15 per mile for gas alone - or 1500% more than an electric bike. Add

in license costs, registration, maintenance and other fees, and the cost skyrockets. Moreover, the living standards of Chinese consumers generally improved so they can well afford a 2000-3000 RMB e-bike.

E-Bikes in China

In China, half of the 'e-bikes' are called Scooter Style Electric Bikes (SSEB) since they look like scooters, but have pedals. By law, they are designated electric bikes. But they might be more properly called electric motor scooters with pedal assist. There are 3 different styles:

Simple style——e-bikes without footplate, plastic parts, have pedals and look like normal bicycles;

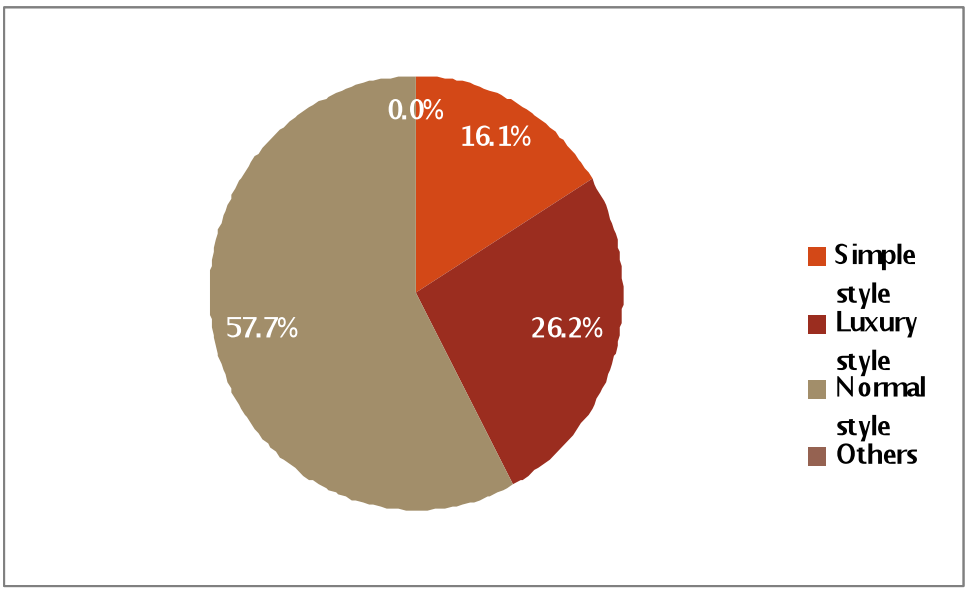
Normal style——e-bikes between simple style and luxury style, with relatively narrower footplate and some plastic parts, have pedals but not of much use;

Luxury style——e-bikes with wide footplate, bigger weight, no pedals or with pedals but of no use, look more like a light motorcycle.

simple

normal

luxury



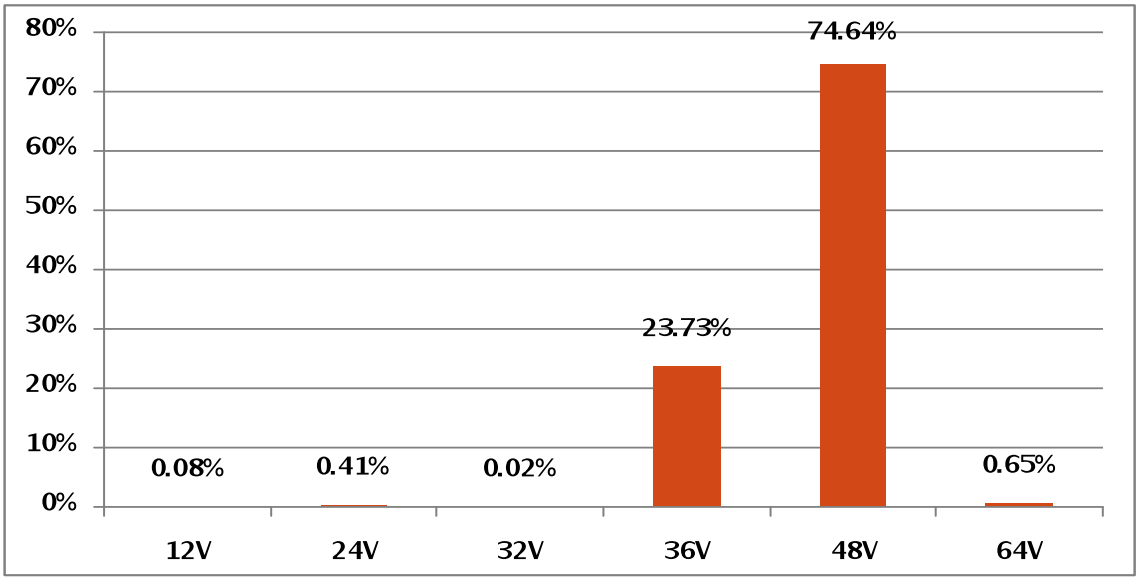
E-bike model proportion

Currently, the average weight of e-bikes (simple-style, normal-style and luxury style) in China is about 55 kg. The weight concentrated around 40-70 kg and speed 20-30 km/h. About 40% of e-bikes weigh over 70 kg. Simple style e-bikes weigh relatively lighter, about 45 kg on average. Normal style e-bikes, as the largest proportion in the market, weigh about 50 kg on average. Luxury style is the most heavy which is around 65 kg on average. Though there are differences in weight, their average speed doesn't differ a lot, about 25 km/h. The luxury e-bikes have the highest average speed which is close to that of light motorcycle in urban area. But in general, speeds of e-bikes mostly fall into the range of 20-30 km/h. Only about 30% of e-bikes have a speed of under 20 km/h.

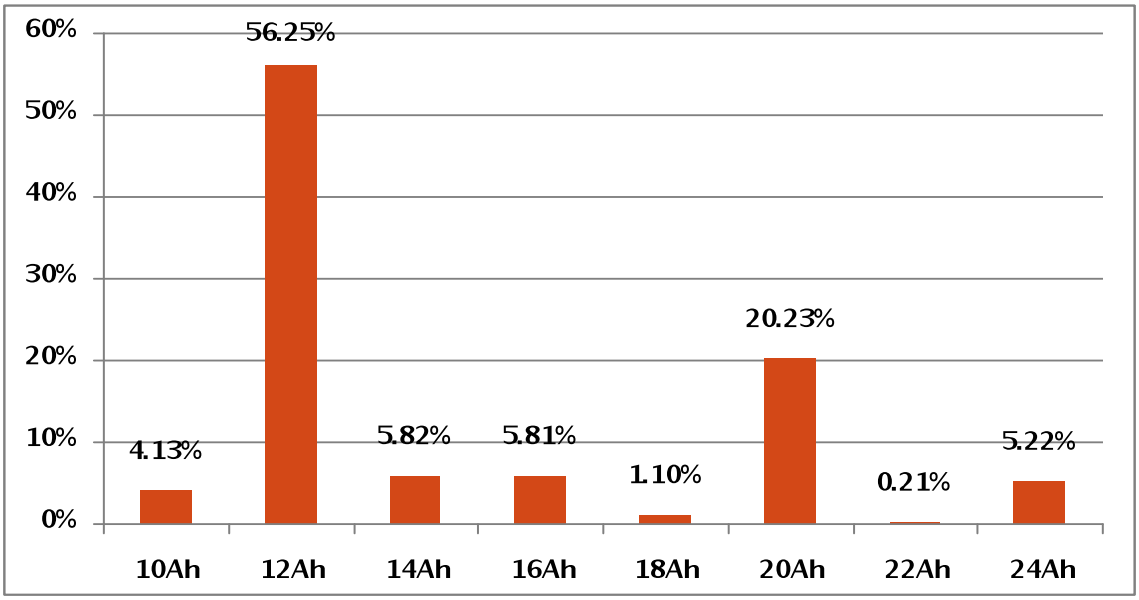
Currently, the price of lead-acid simple style e-bike stays at RMB 1300-2400; that of lithium simple style e-bike stays at around RMB1800-3000; while the luxury style e-bikes (mostly lead acid ones) cost about RMB 2300-3200.

In a questionnaire survey conducted by EBB, 20400 respondents came out with 1069 brands. The chart below shows the top 10 e-bike brands.

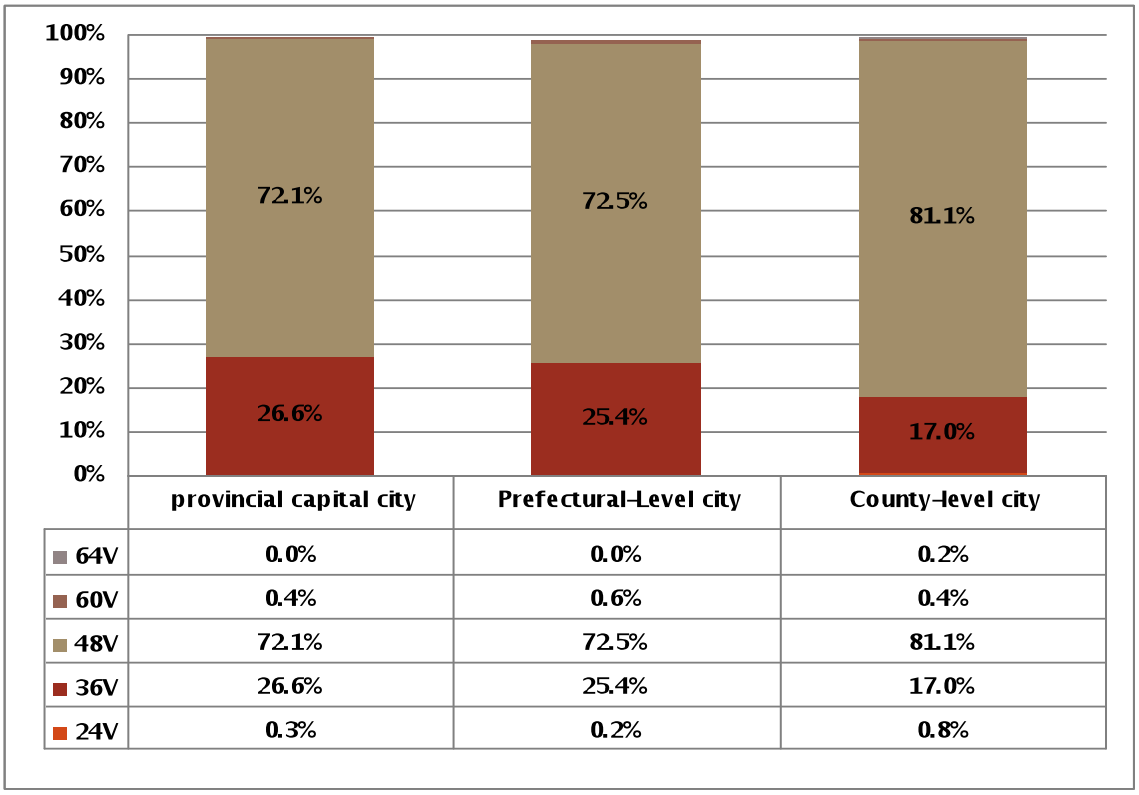
E-bike Normal Volts



Normal Battery Capacity

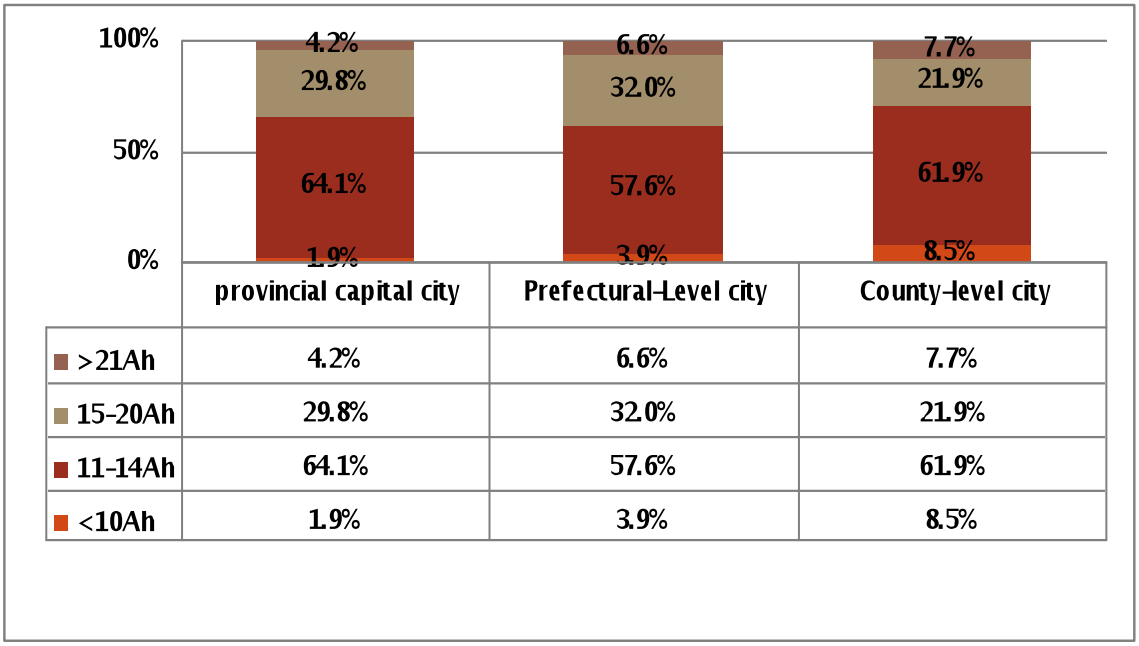


Rated volts in different level of cities (unit：V)



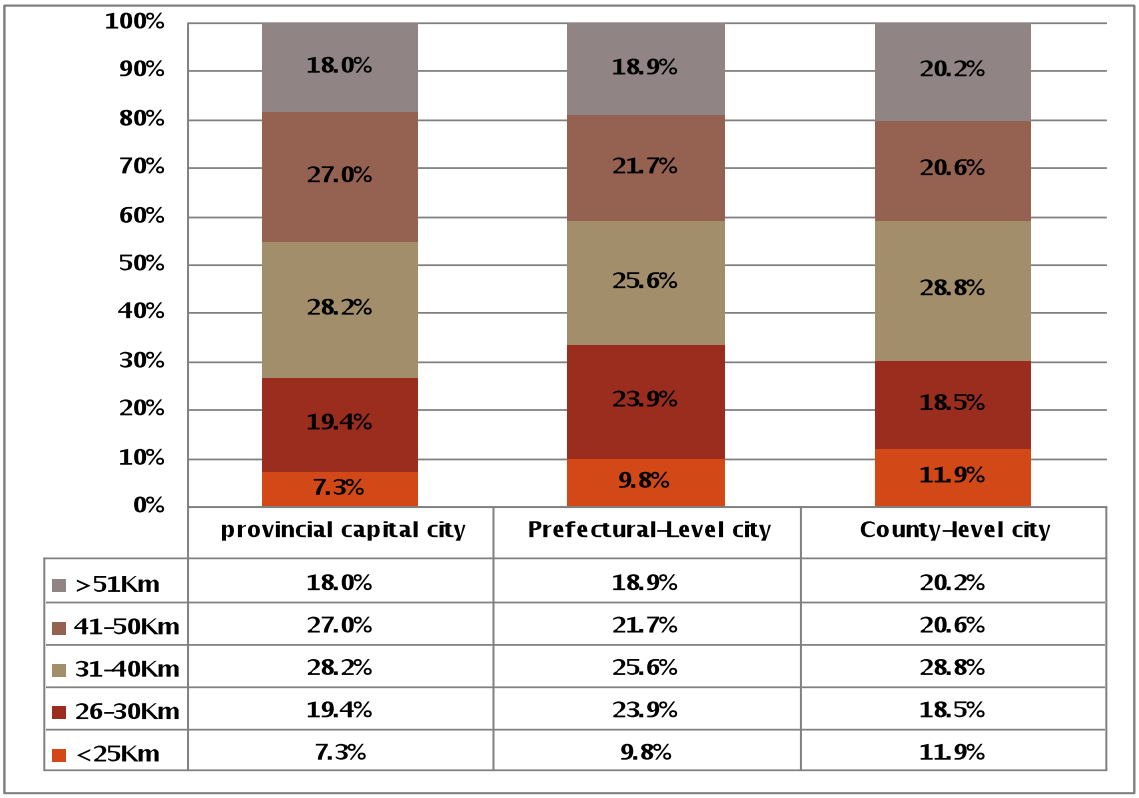
	provincial capital city	Prefectural-Level city	County-level city
64V	0.0%	0.0%	0.2%
60V	0.4%	0.6%	0.4%
48V	72.1%	72.5%	81.1%
36V	26.6%	25.4%	17.0%
24V	0.3%	0.2%	0.8%

Battery capacity in different level of cities (unit：Ah)



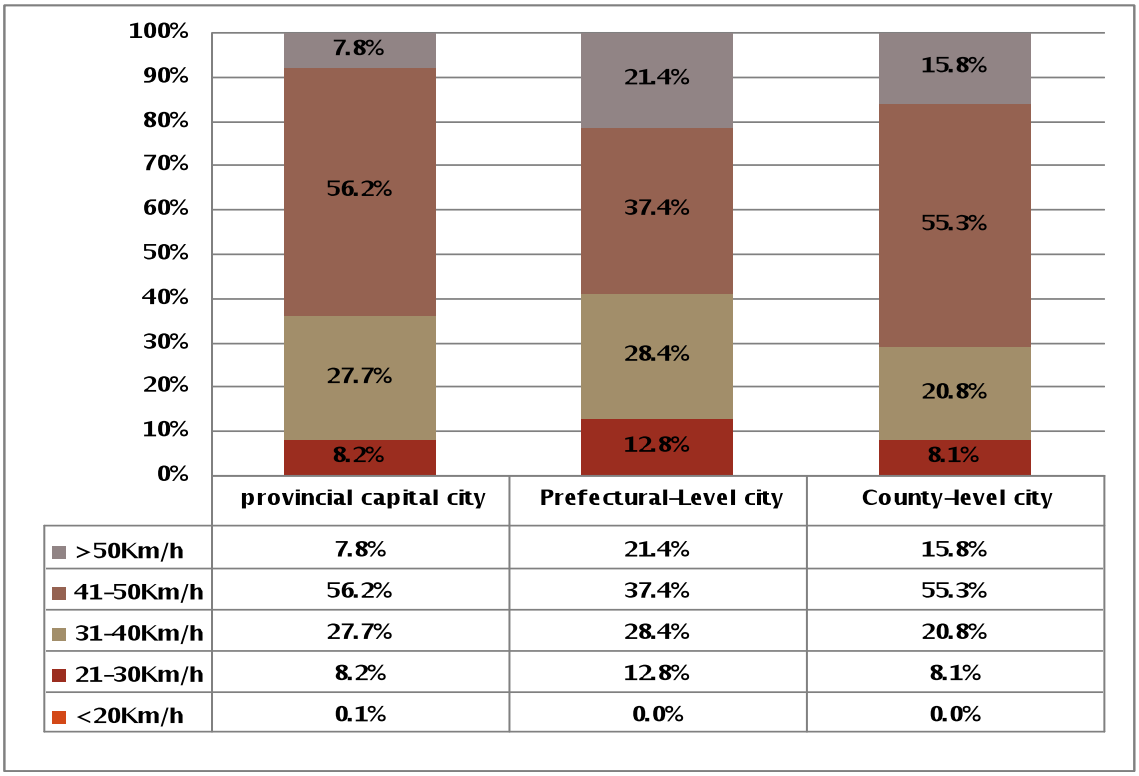
	provincial capital city	Prefectural-Level city	County-level city
>21Ah	4.2%	6.6%	7.7%
15-20Ah	29.8%	32.0%	21.9%
11-14Ah	64.1%	57.6%	61.9%
<10Ah	1.9%	3.9%	8.5%

Running distances per charge in different level of cities (unit：hour)



	provincial capital city	Prefectural-Level city	County-level city
>51Km	18.0%	18.9%	20.2%
41-50Km	27.0%	21.7%	20.6%
31-40Km	28.2%	25.6%	28.8%
26-30Km	19.4%	23.9%	18.5%
<25Km	7.3%	9.8%	11.9%

Max speed in different level of cities (unit：km/h)



	provincial capital city	Prefectural-Level city	County-level city
>50Km/h	7.8%	21.4%	15.8%
41-50Km/h	56.2%	37.4%	55.3%
31-40Km/h	27.7%	28.4%	20.8%
21-30Km/h	8.2%	12.8%	8.1%
<20Km/h	0.1%	0.0%	0.0%

Consumer Groups

In the early periods (before 1998), the main customers were concentrated in the eastern big cities of China. Most e-bike sales channels of this period relied on the previous bicycle sales channels and after-sales networks. Many were independent shops.

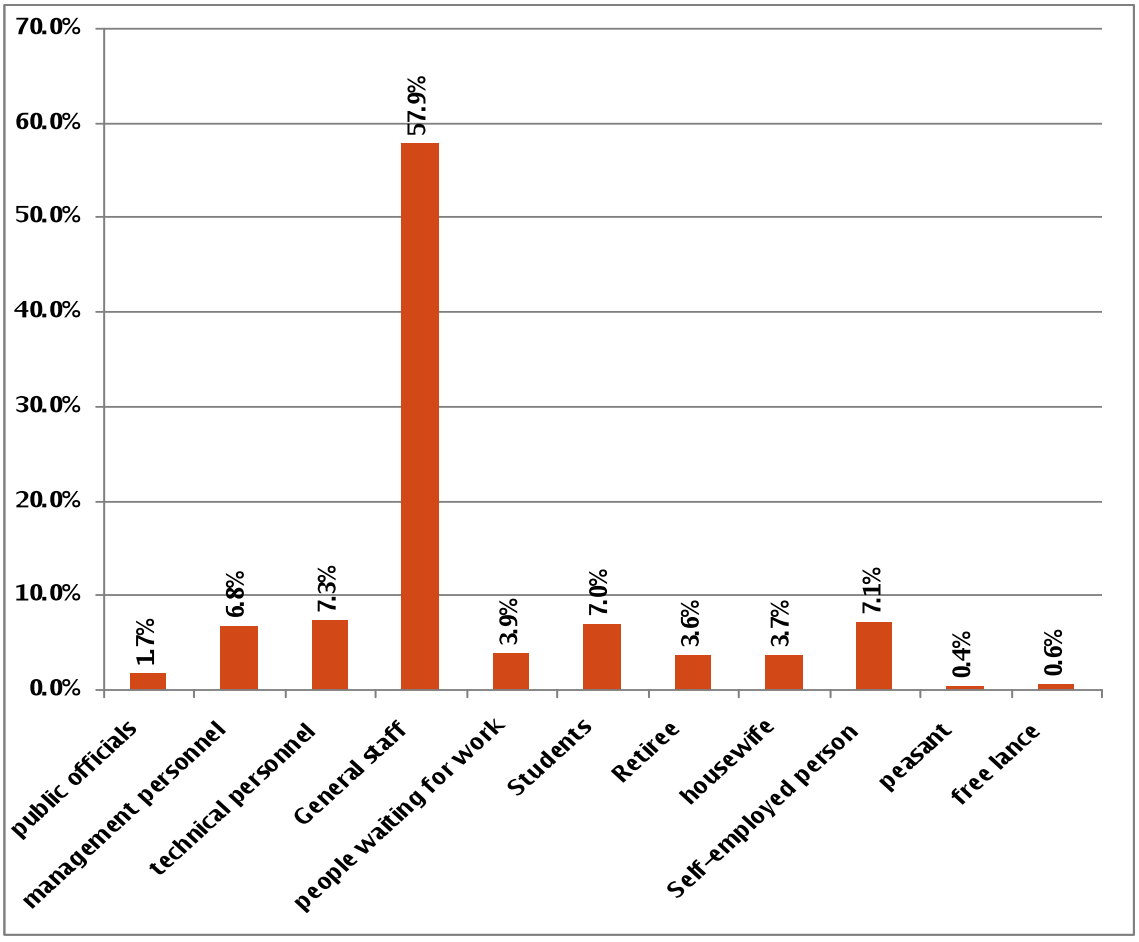
From 1998 to 2005, the consumer market expanded from urban areas to towns and country-sides, from the eastern part to western part of China. In view of age, 20-49 took the majority, accounting for 85.4% of all consumers.

Countryside

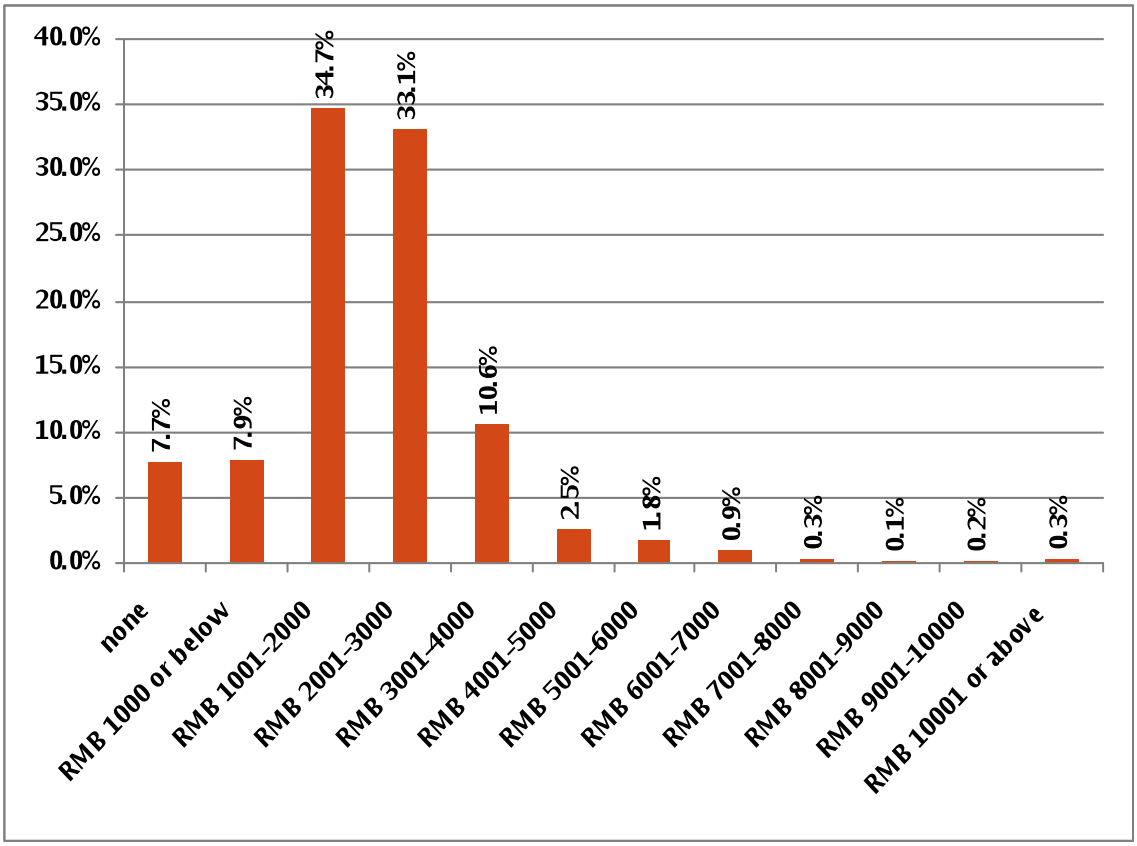
City

The present e-bike consumer group is wider than that of the beginning period.
In the urban area, in addition to the commuters and the older age group, the students, especially the high school students, were increasing steadily; this consumer group emphasized fashion, slimness and unique style. For the urban wage earners, they want the bike to have longer riding range, greater loading ability, nicer ratio of performance and price; and different gender groups have different requirements on the appearance, color and performance of the bikes.

Meanwhile, the countrymen pay more attention to the practical function, like if the bike has big goods carrier, strong power, high-capacity battery, etc.

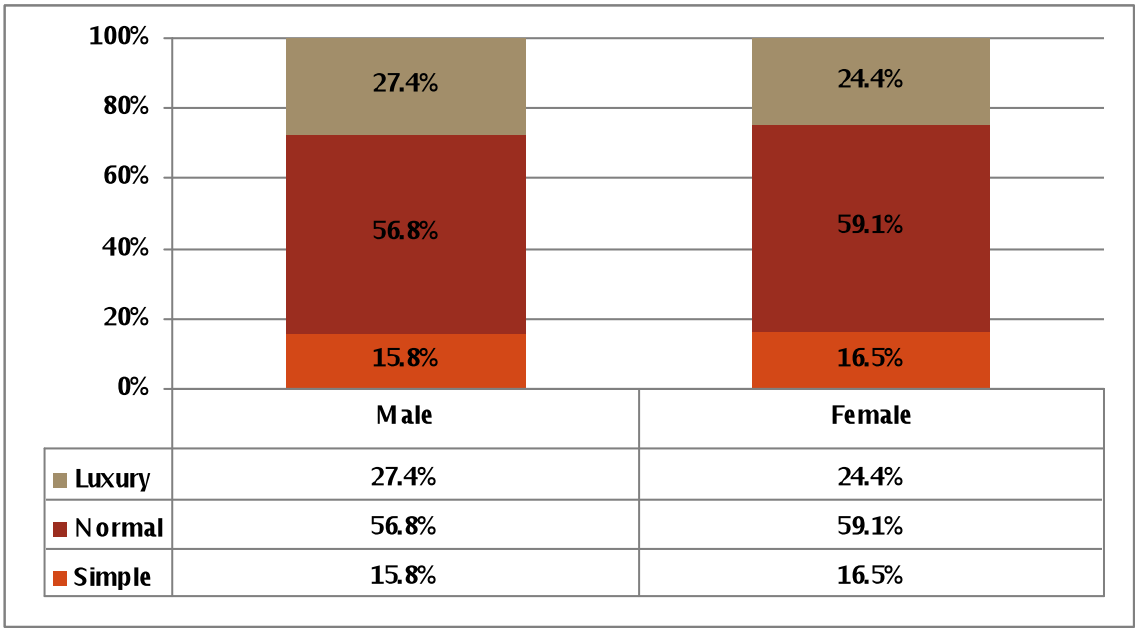


Professions of e-bike users



E-bike users' personal income

Different ages and sexes prefer different models. Below chart shows the selection of e-bikes.

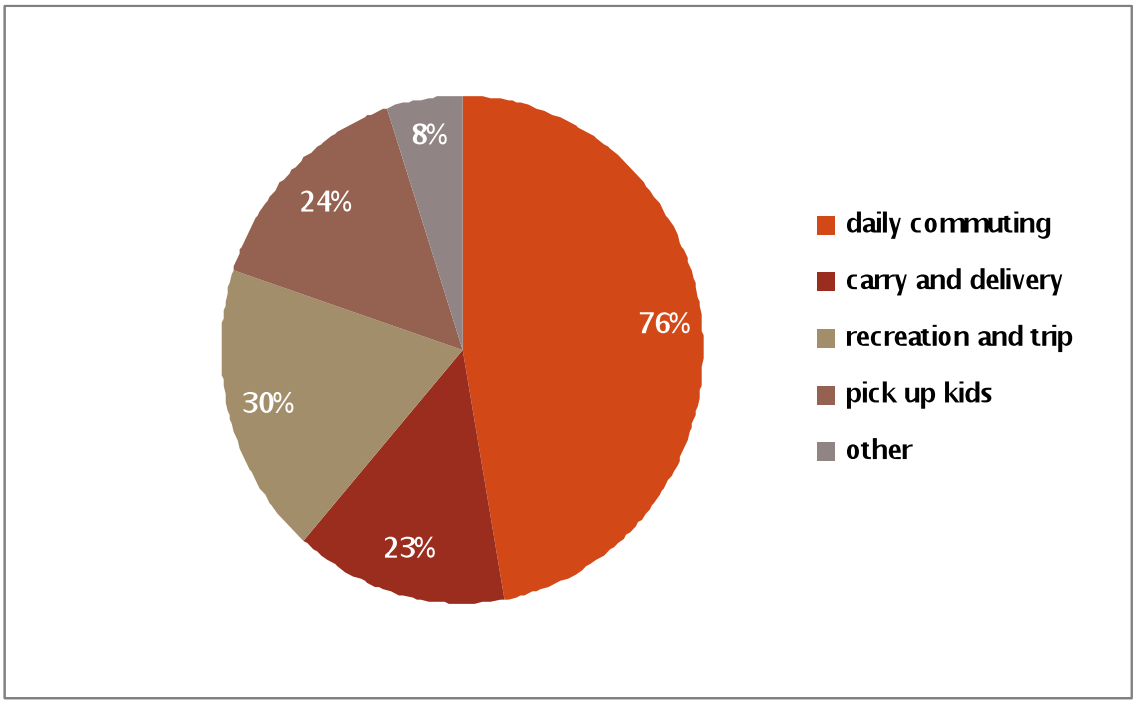


As we can see, the current major consumer groups (over 65%) are urban commuters, general workers and students whose monthly income is between RMB 1000-3000. The trend will remain the same for the years to come.

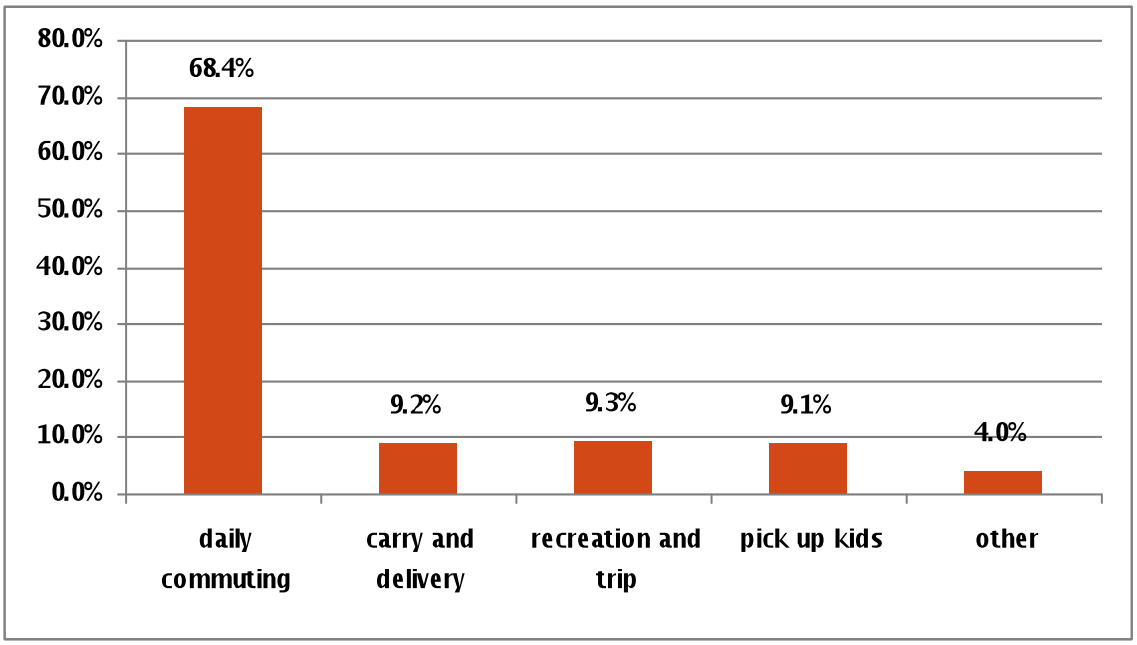
Purpose of Using E-bikes

With the ban on motorcycles in various cities and 2003's SARS epidemic and high car prices, e-bikes have become the Cadillac's of the working class in China.
Even today, the daily commuters are still the major e-bike users, which will remain the same for the years to come.

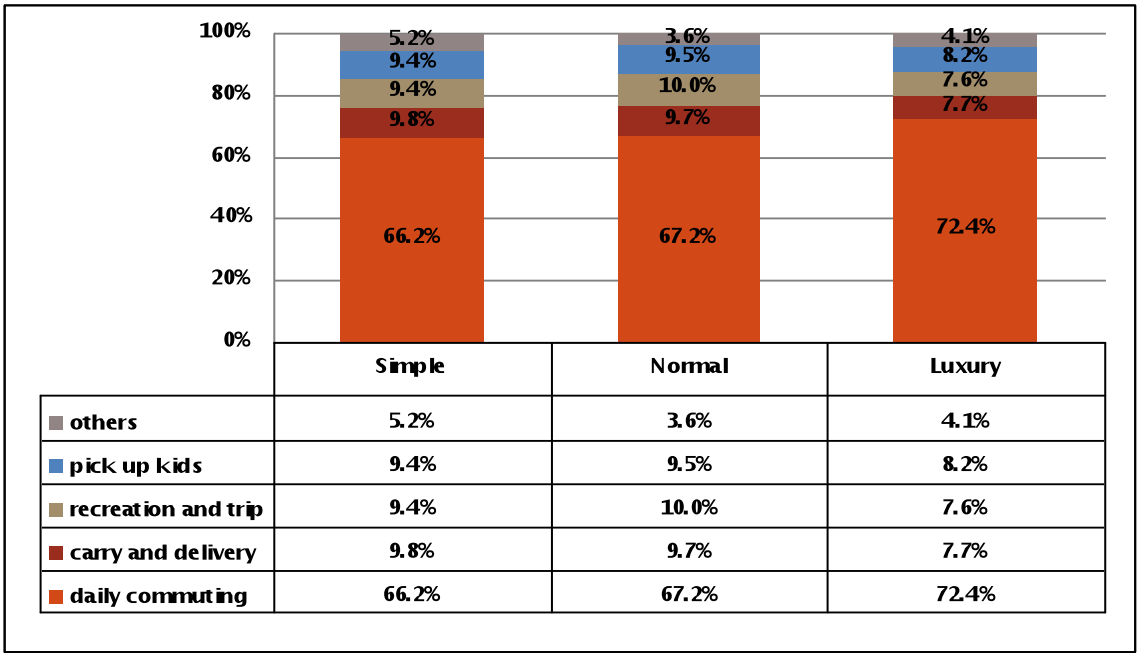
Current E-bike use conditions



Current Main uses of E-bikes

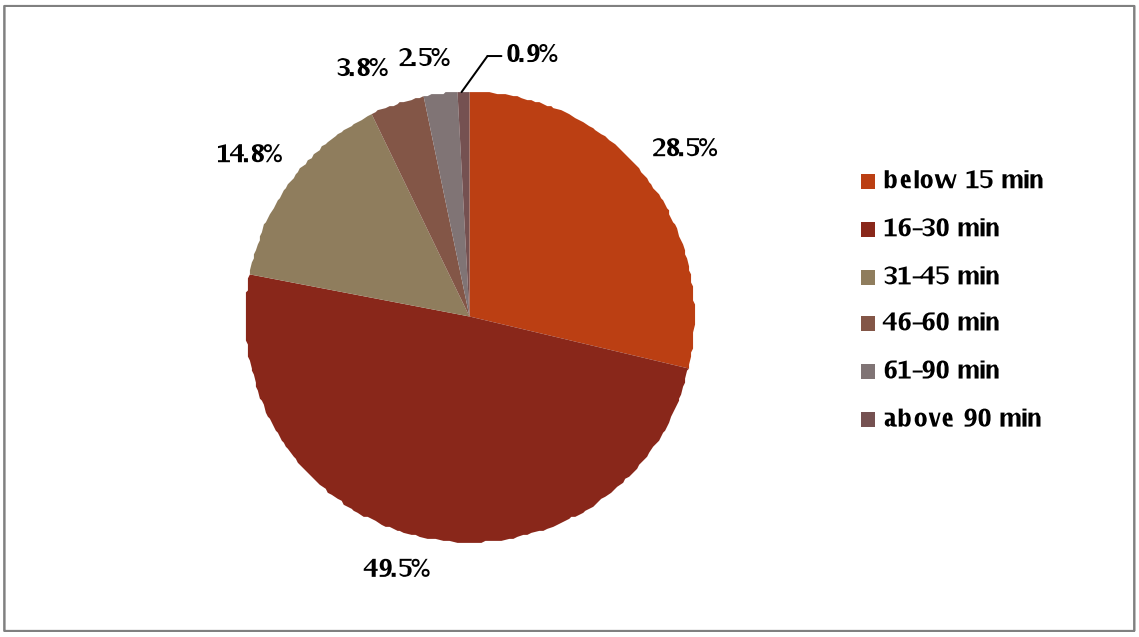


Main uses of different styles of e-bikes

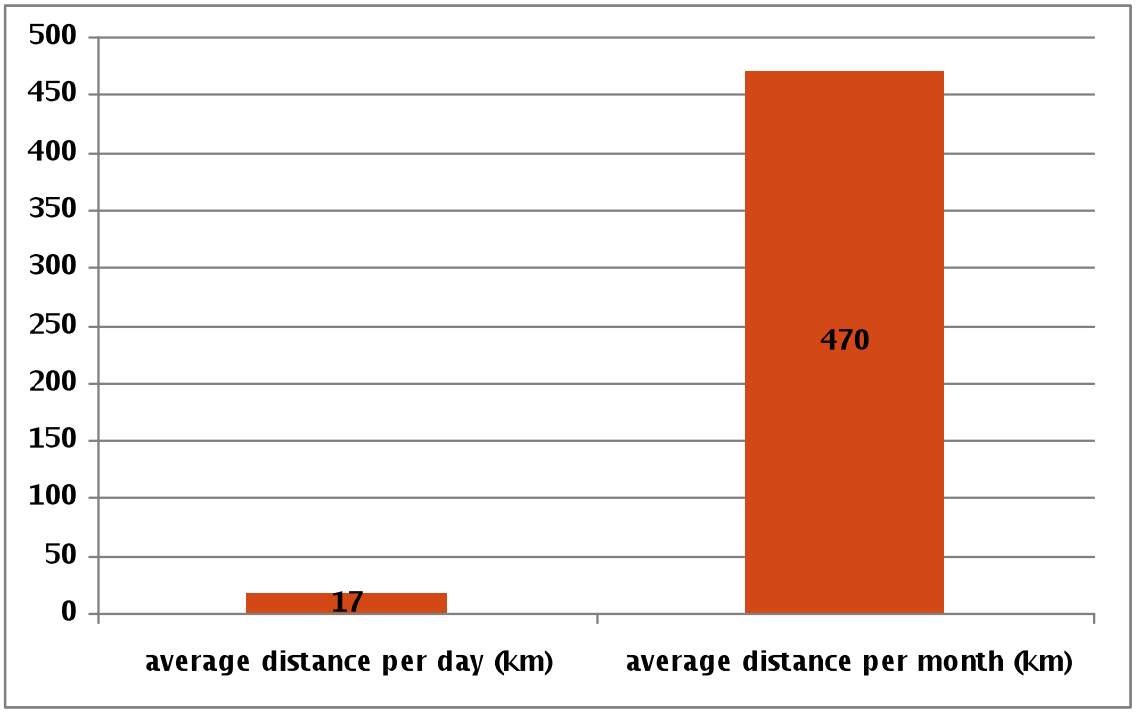


	Simple	Normal	Luxury
others	5.2%	3.6%	4.1%
pick up kids	9.4%	9.5%	8.2%
recreation and trip	9.4%	10.0%	7.6%
carry and delivery	9.8%	9.7%	7.7%
daily commuting	66.2%	67.2%	72.4%

E-bike riding time

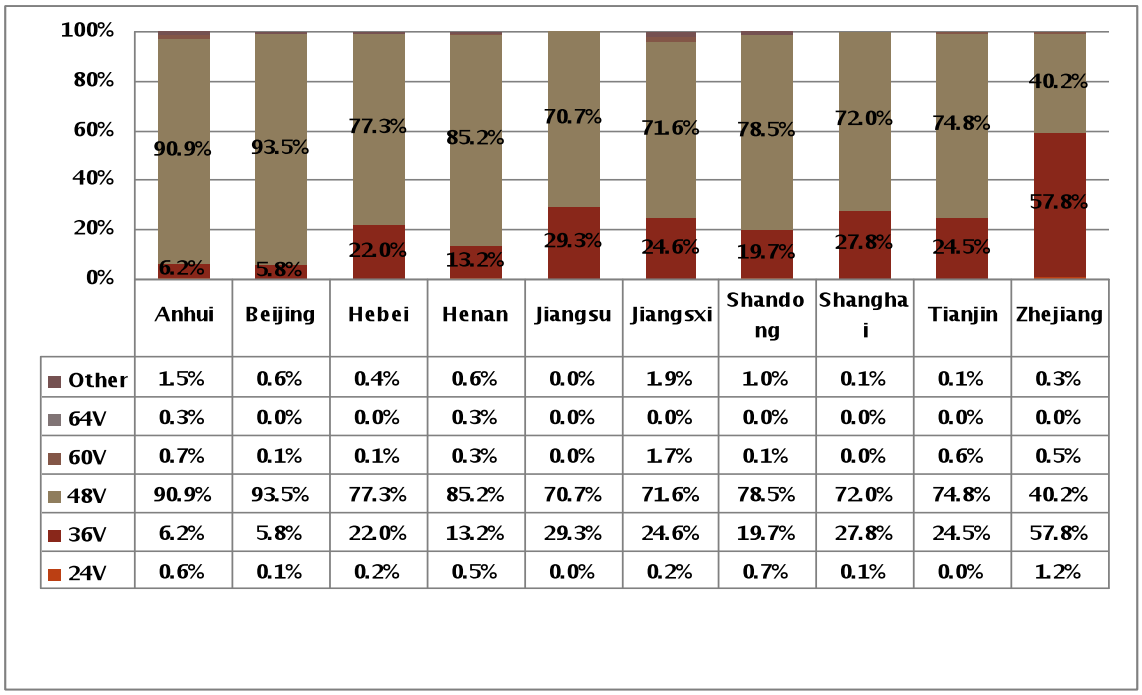


Daily/ Monthly average distance (km)



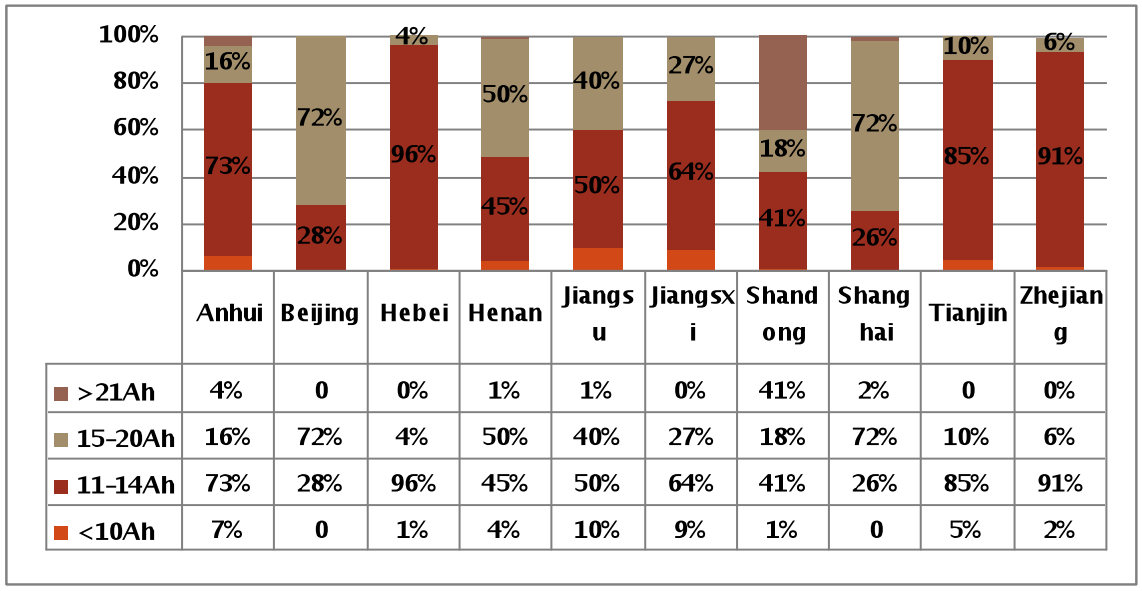
Major Regions of E-bike Use

Different e-bike parameters in different regions of China:



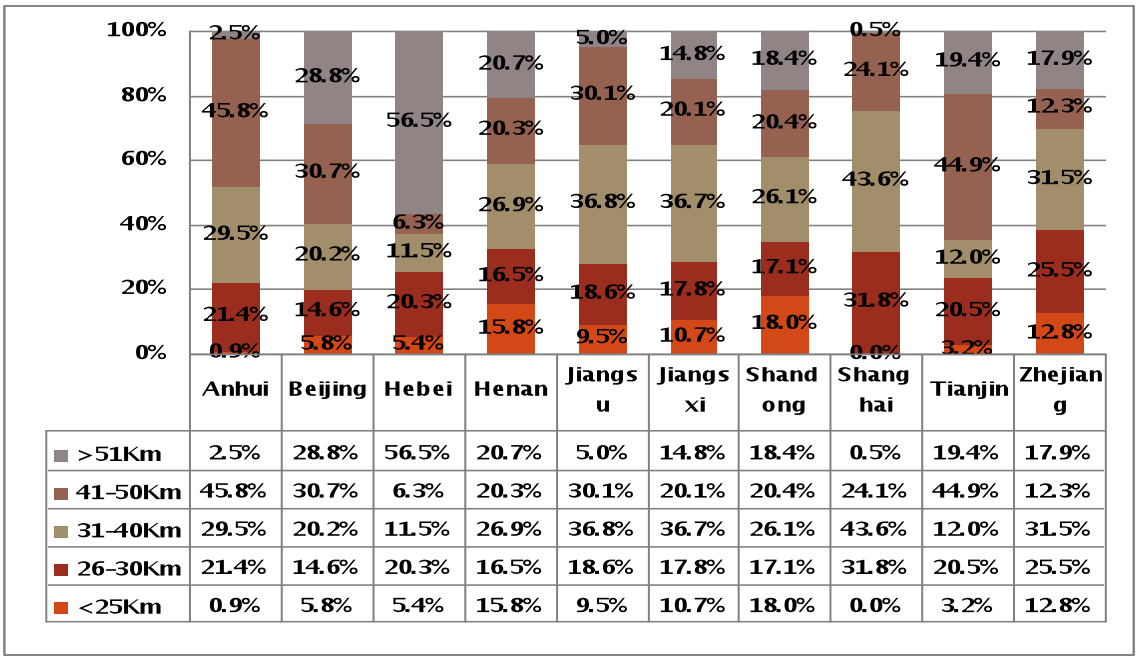
	Anhui	Beijing	Hebei	Henan	Jiangsu	Jiangsxi	Shandong	Shanghai	Tianjin	Zhejiang
Other	1.5%	0.6%	0.4%	0.6%	0.0%	1.9%	1.0%	0.1%	0.1%	0.3%
64V	0.3%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
60V	0.7%	0.1%	0.1%	0.3%	0.0%	1.7%	0.1%	0.0%	0.6%	0.5%
48V	90.9%	93.5%	77.3%	85.2%	70.7%	71.6%	78.5%	72.0%	74.8%	40.2%
36V	6.2%	5.8%	22.0%	13.2%	29.3%	24.6%	19.7%	27.8%	24.5%	57.8%
24V	0.6%	0.1%	0.2%	0.5%	0.0%	0.2%	0.7%	0.1%	0.0%	1.2%

Battery capacity in Each Provinces and Cities (unit：Ah)



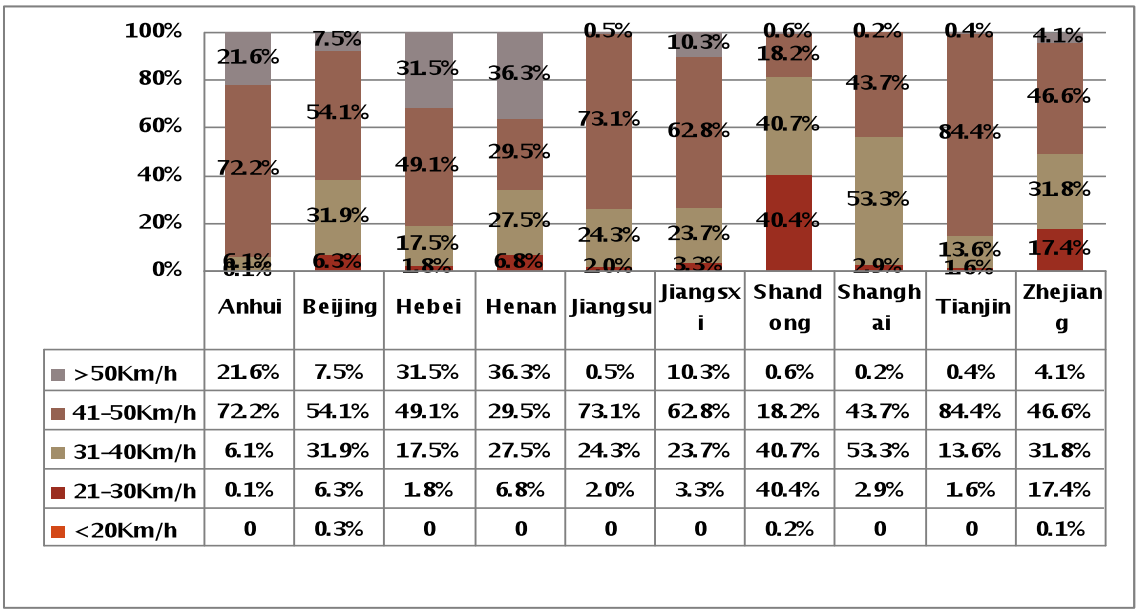
	Anhui	Beijing	Hebei	Henan	Jiangsu	Jiangsxi	Shandong	Shanghai	Tianjin	Zhejiang
>21Ah	4%	0	0%	1%	1%	0%	41%	2%	0	0%
15-20Ah	16%	72%	4%	50%	40%	27%	18%	72%	10%	6%
11-14Ah	73%	28%	96%	45%	50%	64%	41%	26%	85%	91%
<10Ah	7%	0	1%	4%	10%	9%	1%	0	5%	2%

Running distances per charge in Each Provinces and Cities (unit: km)



	Anhui	Beijing	Hebei	Henan	Jiangsu	Jiangsxi	Shandong	Shanghai	Tianjin	Zhejiang
>51Km	2.5%	28.8%	56.5%	20.7%	5.0%	14.8%	18.4%	0.5%	19.4%	17.9%
41-50Km	45.8%	30.7%	6.3%	20.3%	30.1%	20.1%	20.4%	24.1%	44.9%	12.3%
31-40Km	29.5%	20.2%	11.5%	26.9%	36.8%	36.7%	26.1%	43.6%	12.0%	31.5%
26-30Km	21.4%	14.6%	20.3%	16.5%	18.6%	17.8%	17.1%	31.8%	20.5%	25.5%
<25Km	0.9%	5.8%	5.4%	15.8%	9.5%	10.7%	18.0%	0.0%	3.2%	12.8%

Max speed in Each Provinces and Cities (unit: km/h)



	Anhui	Beijing	Hebei	Henan	Jiangsu	Jiangsxi	Shandong	Shanghai	Tianjin	Zhejiang
>50Km/h	21.6%	7.5%	31.5%	36.3%	0.5%	10.3%	0.6%	0.2%	0.4%	4.1%
41-50Km/h	72.2%	54.1%	49.1%	29.5%	73.1%	62.8%	18.2%	43.7%	84.4%	46.6%
31-40Km/h	6.1%	31.9%	17.5%	27.5%	24.3%	23.7%	40.7%	53.3%	13.6%	31.8%
21-30Km/h	0.1%	6.3%	1.8%	6.8%	2.0%	3.3%	40.4%	2.9%	1.6%	17.4%
<20Km/h	0	0.3%	0	0	0	0	0.2%	0	0	0.1%

MOTOR

In the early period (1983-1998), the max output torque of the motor was 14-18N.M; they were almost all gearless motors with brushes which were easily worn with poor climbing ability.

In early 2000s, many e-bike makers started switching to brushless motors. From 2005 till now, the motor develops from the previous gearless motor with brush to the present high-efficiency brushless motor. The second advance was in motor efficiency, which improved ~60% between 1995 and 2000 from 50% to 85%. This improvement resulted in a 60% increase in range. In the mid 1990's motors were disc-type and used Fe-O permanent magnets. In 1997, brush-type motors were introduced with a reduction gear system. Around 2000, Ru-Fe-O magnets were introduced into e-bike motors. In 2006, neodymium magnets have been introduced that are increasing motor efficiency even more.
Designs of motors for pedelecs will continue to improve to increase torque performance and efficiency as well as to reduce size and weight.

Brushless 350 w

250/ 350/ 500/ 800w motor with brush

BATTERY

In the early period (1983-1998), batteries used liquid acid electrolyte instead of the fixed electrolyte used today in most Pb-acid batteries today. Liquid-type required more maintenance. The e-bike batteries then could only run about 30 km.

From 2005 till now, the energy density of e-bike batteries also increased 33% from 1997 to 40Wh/kg while battery life also increased 35%. The appearance of lithium batteries made exclusive contribution to e-bikes, especially the simple-style e-bikes.

The sealed lead-acid battery (VRLA - Value Regulated Lead Acid) is currently the dominant battery used in electric bicycles in China where the emphasis is on low cost. However, electric bicycles made in China for the export-market are mostly equipped with Lithium Ion (Li-ion) and in some case Nickel Metal Hydride (NiMH) batteries that are both lighter weight and operate up to 2,000 recharge cycles. The Nickel-Metal-Hydride (NiMH) battery is also used in China and in around half the

pedelecs sold in the European Union.

The LEV battery pack business is becoming more sophisticated with expectations of higher voltage systems providing a lower cost opportunity.

E-bike PB battery

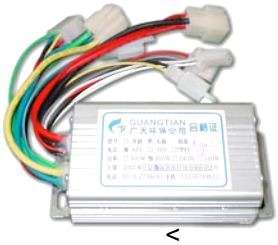
E-bike Li-ion battery

CONTROLLER

In the early period, controllers were much simpler and cheaper. The technology is under-development and the market was filled with many inferior and copied products. The heat dissipation and water proof function were a major defect; there were lots of controllers with different dimensions and functions. This is still true today.

The future trend should be “Intelligent, precise, and stupid-ization”. The single drive controller market will slowly disappear and the high-end and multi-functional controllers will become the main trend. In the future, the key of e-bike challenge will be that of controllers.

Brushless controller



Controller with brush