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Abstract

In China, bicycle is one of popular transportation tool. Along with the improving of living standard, Light electric vehicle (LEV) will be replaced traditional transportation. In this paper, it mainly introduced development and outer environment in china LEV market, and it will be divided into three parts. Firstly, it was related to introduction of LEV market in China and Luyuan LEV Company. Secondly, it was explained that outer factors, cooperation and objection in the development of Chinese LEV. Final part will be conclusion.

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Light Electric Vehicle (LEV) development of market and outer environment in China

Part One: Introduction of LEV market in China

I Progress of LEV market in China

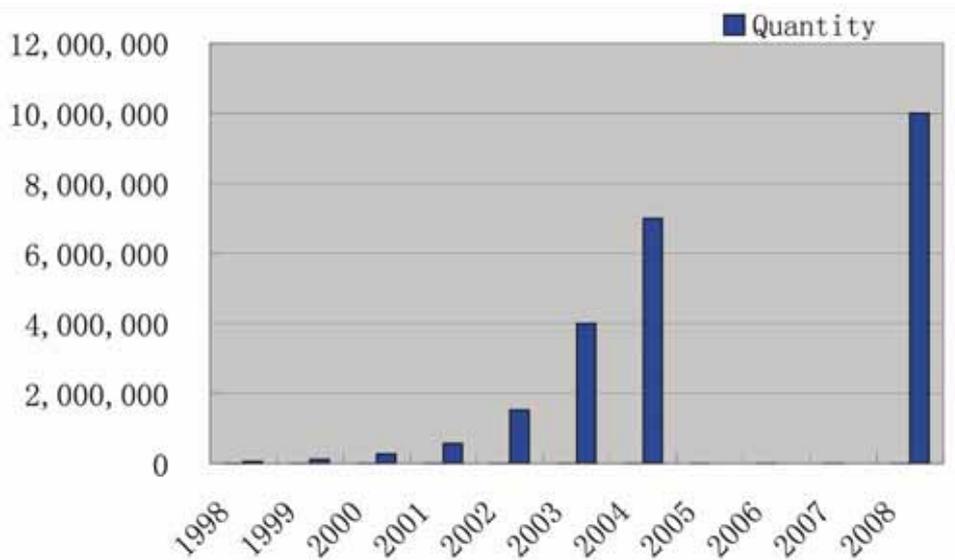


Fig. 1 Total sales of LEV grew up with years

The development of LEV in China could be divided into three stages:

1、 Actively exploring stage (1996-2000):

The exploring stage was characterized by emphasizing technical research on LEV parts, mainly on the so-called four major parts: battery, motor, controller and charger.

A first batch of research companies were founded for promotion of motorized bicycles as a kind of completely new products. They tried to obtain the public common recognition through media voice and language of that the green power of LEV could be good for our earth environment. Thereby consumers (Market) could know and accept electric bicycles gradually.

These companies paid great attention to the public relation with our government at this stage, and strove for the legality of existence for LEV. Through their efforts several important local governments with prosperous economy, such as Shanghai in 1997, Zhejiang province in October 1998 and Jiangshu province at the end of 1999, carried special policies for LEV, permitting LEV to apply license and to be driven on road.

2、Rapidly developing stage(Jan,2000-Dec,2003)

After a few of above mentioned research companies got primary success, large numbers of corporations followed up. LEV development in China came to the second period, a rapidly developing period. The features of this period included: the numbers of LEV corporations grew up very fast; models of LEV products renewed quickly; the total sales increased rapidly; and also the LEV techniques showed a variety of developments (see Fig. 1).

The number of LEV enterprises was difficult to count accurately in this period. It was quite possible that there were more than 10 LEV enterprises in a small city. It was said that in a street that was less than 5 Km in Wuxi city gathered 20-30 LEV companies, which fully reflected the case of “arbitrary investments and liberal economy” in China. The increases of total output were mainly contributed by the increasing of enterprises, though the sales volume of several scaled enterprises also increased. But it was tiny, comparing to the increase of total output. The number of LEV enterprises reached to the peak in 2003, maybe more than 1000. The alterations of enterprises are shown in

Fig. 2

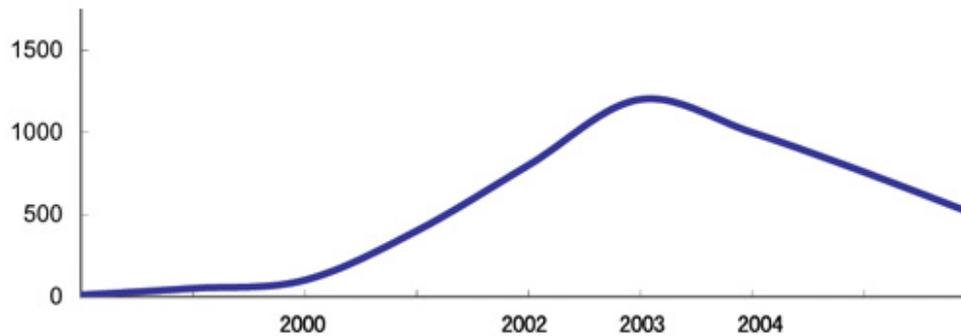


Fig. 2 Alteration of total number of LEV enterprises with years

3、 Steady developing stage (Jan,2004 -)

From the end of 2003, the number of LEV enterprises started showing a negative increase. Some small companies dropped out due to finance difficulty on one hand, and few of new enterprises joined in the competition in 2004 on the other hand. Meanwhile the total output of LEV still increased. A batch of large scaled manufacturers with more than 100,000 units of annual production grew up. Chinese LEV came to a favorable “steady developing state”. We anticipate that this period will last 5-6 years. In this period, the total sales will keep increase; and the number of enterprises will reduce further. A group of enterprises with real strength will become LEV leaders in China. They have strong ability of technical development, perfect testing and production capacity, famous brand rolled up through years, strong sales and service system. They will become the core power of LEV industry gradually.

We are sanguine of LEV’s future from our forecasting. Average income of Chinese people has reached 1000 USD since 2004. It means that the social demand will be upgraded with the increase of average income. LEV is defined as a transportation tool of non-power-driven vehicles in the << Security law for Road transportation >>, which has been put in effect since 1st May 2004. So LEV, as a legal transportation tool,

could be driven on road. A quite large part of people considers that LEV could be the first choice of their transportation tools. Now nothing could stop the further development of LEV in China. The future will be better.

II Progress of Luyuan Company development:

As one of the earliest LEV enterprises in China, Luyuan electric vehicle company was founded in July 1997. But our successful research on LEV could be traced back to July 1996. The development of Luyuan Company could also be divided into three stages.

1. Establishing stage (Mar, 1996-Dec, 1998): research on electric driving system, and refit of normal bicycles into motorized ones.

In July 1996, the first prototype of Luyuan's LEV was made by our technical team with me in a very simple lab. After one year, we finished designing and developing of electric motor, controller and charger. And we established a capacity of production with small batches. In July 1997, Jinhua Luyuan electric vehicle Co., Ltd was founded formally, and started to manufacture and sell the major four parts in batches. At that time our business goal was to provide technical support for bicycle manufacture enterprises in China, to encourage them to manufacture LEV. And we also took advantage of their market channels to sell LEV products. For these purposes we sent "Letter for seeking collaborations" to almost all famous bicycle enterprises and some of them made responses to it. We sold to these bicycle manufacture enterprises about

500 sets of electric driving systems from July to Dec 1997, most of which became the earliest samples of such system obtained by these enterprises.

Meanwhile, in July 1997, Jinhua local government formally agreed to issue “bicycle license” to refitted LEV. This policy provided great opportunity for us to establish a business of refitting bicycle into LEV for Jinhua people. At the beginning, nobody cared to pay money to refit bicycle. What could we do? Our funds were less than RMB 200,000 (about US\$ 20,000) that needed to turnover urgently. We adopted an adventurous plan, promising to return all expenses (1500RMB) to the first 150 users in 2 years. After launching the plan, our employees made positive response first. Their family members and they became the first batch of users. Following the examples set by the 150 first users, some people showed their interests in these new products and about 500 persons became our precious users from July to Dec 1997. The more important thing was our practice in Jinhua city caught some businessmen’s eyes from other places. They started to place orders of “electric drive system” from us and learnt our methods of refitting bicycle into LEV to develop their business. In 1998, the refit business of Luyuan Company achieved success in Hangzhou and Nanjing city. Especially in Hangzhou city, more than 5000 units of refitted LEV were accomplished in a year. The public had paid great attentions to LEV, and started to discuss the legal status of this product. An official policy of “permitting to issue bicycle license to LEV” was stipulated by Zhejiang province government under this background.

2. Difficultly developing stage (Jan, 1999-Jan, 2002): Started to manufacture LEV, but met painful problems.

Luyuan started to manufacture LEV in Jan 1999. At that time the model of LEV was simple with quite small volume of sales.



1999 was the eve of rapidly developing of China LEV; but Luyuan nearly disappeared in front of success. With the coming of 1999, Luyuan faced very serious problems. Quality problems arose for most of the products sold in 1998, especially for the batteries. We had guaranteed the life of one year for batteries. But most users were dissatisfied after using the battery for only 6 months. They claimed to change the battery for free. We had to meet user's requirement for the consideration of our business credit and LEV's future. But the major battery supplier didn't carry out his promises. That battery supplier refused to bear any battery losses. Hence we had to suffer great economic losses. The production credit and business self-confidence encountered enormous attack.

Fortunately, Luyuan didn't go down after the failure. We analyzed the mistakes seriously and thought the problem of how to make LEV adapt to Chinese consumers thoroughly. We carried out a series of technical improving projects such as adopting maintainable batteries to replace un-maintainable batteries, developing battery testing

and maintenance technique to extend battery life, enlarging motor high efficiency range and so on. After adjustment for more than one year, Luyuan went out from the failure shadow in 2000, hardly returned to developing orbit.

3. Rapidly developing stage (Feb, 2002-Now): Luyuan grew up

In Feb 2002, Luyuan moved to a new industrial estate of first stage and entered a fast developing period. The company at the new site held perfect production and testing system, manufactured LEV with various models, and expanded sales and service network.



The first term of industrial park



Automatic assembly line in workshop



Testing center: Motor testing facility



various models of LEV

A new part of workshops in the second stage of the industrial park have launched on production in January, 2005. We will achieve the sales and production target of

300,000 units with some brand-new models developed by us.



The total sales status of Luyuan Company with years is as follows, where we can foresee a rapid and steady developing tendency. (See fig3)

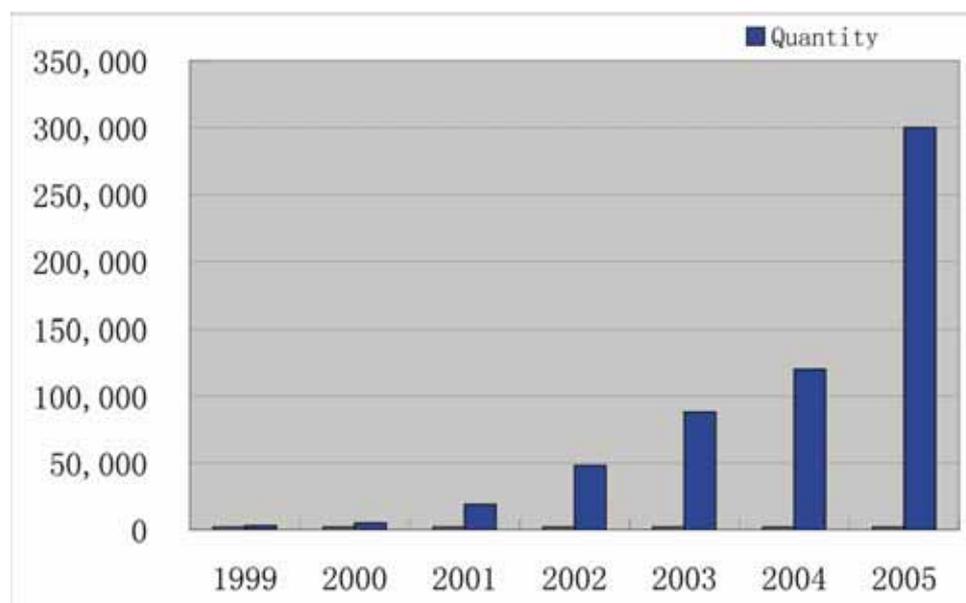


Fig3 total sales status of Luyuan Company

III Several factors promoting the development of LEV in domestic market

1、 Traditional transportation factor

Bicycle had been a necessary transportation tool of every Chinese family since 1960s.

Along with the improving of living standard, bicycles are facing the challenge from other vehicles. Most people hope to save time and energy on transportation. LEV emerged as the final solution. As the replacement of traditional transportation means,

LEV was suited in Chinese income level, because after all, not everyone can afford a car. Moreover, the global oil price is rising. As complying with nation's strategy of energy resources, fuel tax will soon be imposed. Consequently, LEV stands out and wins consumers' favor comparing to the price with fuel vehicle, despite of technical disadvantages. It is coming true that LEV will replace the traditional transportation tool (bicycle)

2、 City factor

China is promoting the country citified, and all kinds of cities are rapidly expanding. In some prosperous areas, some cities are 3-4 times larger than they were 20 years ago. In many middle-size cities, the diameter of traffic extends from 5 Km to 10-20Km. It reaches 30Km in big cities. For various reasons, although developing fast with cities' expanding, the public transit can only bear 20-30% of public transportation. Personal cars increase the congestion of city roads and make the public transit move very slowly. Traffic speed is only about 12Km/h in big cities, such as Beijing and Shanghai. Furthermore, the public transit cannot fulfill "door to door" service. LEV can reach the speed to 15-20km/h, without worrying for traffic jam and parking. With its low cost, no wonder LEV has been won the favor in those medium and low-income classes.

3、 Countryside factor

At first, we defined cities as the main LEV market. Few have predicted the profits in the rural areas. Ironically, the fact rightly proved the countryside is the most potential market for LEV. This fact also pushes the development of LEV to large-scale models. In countryside, LEV is not only a transportation tool but also a small “carriage.” Many people use LEV carrying goods. Especially among those highly income farmers in the east, people tend to choose LEV for the advantages of low-cost, easy recharge (no need for gas station) and easy parking etc. Based on our statistical data, 25% of Luyuan users are from countryside or small towns.

4、 Senior Citizen factor

It is funny that Chinese elders are the earliest active LEV participants. Early in 1997, our original developed LEV needed to conduct some market research. Every morning we took LEV to the park where elders do morning exercise, and they crowded around LEV and showed great interests. We encouraged them to try and they were active, finally most of them became our earliest users who devoted great contributions of China’s LEV industrialization. Why elders prefer LEV? On the one side they have social justices to support electric transportation, they are against environment pollution and over consume of oil; on the other hand, most elders have no experience on driving cars or motorcycles. Bicycles have accompanied all their lives; LEV makes them feel the charming of “electric power” and change their life ultimately. It’s convenient to go shopping and visit family. Some of them even

voluntary take on the works to send kids to school. Their supporting attitude greatly influences the social consensus for the LEV developments in China. Wherever and whenever the local government opposes LEV, there are always some authoritative elders stand up, make their indignant critical voices which effectively knocked back the silly actions of some local governments.

5、 Career woman factor

China's career women are the primary LEV consumption group. In China, there is no obvious "housewife" group but a diligent career women group. They work hard with low pay. They also take on many house chores as well as send child to school. Comparing with the strong Europe women, Chinese women are physically weak. Along with children's growing up, LEV is excepted product. Based on our statistics, more than 60% of Luyuan users are career women.

IV. Chinese LEV market current status and tendency

1. Market Targeting and Market Capacity

Undoubtedly, LEV is one very important vehicle in Mainland China. It has showed a rapid rising trend, and the trend will be even faster in next few years.

There lies a huge market for LEV in China. People from this industry have reckoned that currently Chinese bicycle volume is approximate 500 millions. If 10% of them

were replaced by electric bicycles, that would make 50 millions potential units. This figure should be reached in a short term. (Less than five years). The future demanding increase rate will be at 30% - 40% in a 5-year-period. After that, the development will step into a steady stage. Heavy electric vehicle (HEV: such as car, bus and so on) will be faced the challenge of the market.

2. Market Supporting Point

The key supporting point for LEV is the medium and small urban and prosperous rural areas. In these areas, the development of LEV will not be disturbed by the outer factors and will flourish the market.

3. Market Trend

The trend follows the track of “east then west, south then north.” So far, the consumers, manufacturers, and developers highly concentrate in Zhejiang, Jiangsu, Shanghai, Jiangxi, etc. The market will expand to the west and the north.

4. Product Form

Various products and models of LEV can be found in China to meet the diverse needs of different consumers.

The price is listed at three degrees:

1200-1800: Low-cost series, temporarily lowering the cost, or low cost, low quality product by small manufacturers.

1800-2400: Medium class series, the main stream products, 36V electrical system, luxurious looking, reliability

2400-3000: High-class series, 48V electrical system, or double-battery driven.

V. The future trend of LEV technique:

1. Models: fast developing. The consumers consistently pursue newness. The fashion will be inspired the purchasing desire.
2. Control system: the mainstream system will be based on CPU, with capability of different additional functions. Braking Energy Recycling System and Power Assistant Pedal Coordinating System will be two highlights.
3. Motor: highly advancing. The brush motor will smoothly transit to brushless motor; especially those controlled by CPU will rule the market.
4. Charger: the recharge will be designed more intellectual with software. The fast recharging technique is getting more mature.
5. Battery: The lead battery will still play a key role. The capacity will be enlarged. 48V system will substitute 36V system. Meanwhile, lithium-alloyed battery will emerge in 2005.



Part two: Outer factors, Cooperation and Objection in the Development of Chinese LEV

Outer factors indicate those that affect the survival and development of LEV besides producers and consumers. The developing history of LEV in Mainland China accompanied the factors of various “cooperation” and “objection” from the beginning

I. Cooperation

The Clause 19 in Chinese Transportation Regulations, effective from 1989, clearly indicates, “Any bicycle shall not be equipped with mechanical motor whatsoever.” Obviously, this clause baffled the development of LEV in China. At the earlier stage, the companies of LEV had to submit petition to the Chinese government to prove that LEV would be the most demanded and convenient transportation solution to the

low-incomers. Meanwhile, the media played an important role. People, especially prestigious seniors, sincerely and eagerly expressed their wish for the development of LEV. Upon their efforts, many cities' transportation regulation departments adapted a relatively tolerant policy to LEV. This adaptation clearly illustrates the bright side of "cooperation." This cooperation provides LEV a precious "surviving space" in China. As estimated, more than 98% cities flash green light to LEV. Some of them even encourage the development of LEV, such as Zhejiang, Jiangsu, Shanghai, Tianjin, Sichuan, Liaoning, Hebei, Yunnan, etc. The local transportation bureaus have issued "local regulation" to avoid Clause 19 and grant license to LEV. In other cities or provinces, the local transportation bureaus neither grant formal license nor enforce Clause 19, therefore the use of LEV is acquiescent.

In May, 2004, an amended Transportation Regulation was on effect. The 1989's version was abolished. Based on the new law, the provincial government will or won't grant permit to electric bicycles. Until now, no province has banned LEV. We are optimistic to the future of LEV.

Another important support to LEV directly roots from the economic department of the governments. It encourages the development of LEV for the purpose and benefit from energy source, environment protection, EV industry, etc. Among them, Zhejiang Provincial Economic Committee, Jiangsu Provincial Economic Committee, and many more played a key part in the development of LEV.

Most of all, LEV has always been under the ultimate support of the Chinese public, especially the intellectuals. Many famous scientists, economists, socialists and environment protectionists out speak their opinions on this issue. Even the retired officials show their support based on the reason to improve the life of medium or low-income class.

All these can be considered outer factors, which definitely have accelerated and promoted the development of LEV in China.

II. Objection

Though most cities have adapted tolerating policy favoring in LEV, few cities strongly oppose the use of LEV. Two accidents have ignited the dispute against this issue. One is the so-called “Beijing Accident” and another is the “Fuzhou Accident.” I, myself, have actively involved in these two accidents. Now I’d like to give a brief introduction to them.

1. Beijing Accident: July 30th, 2002, Transportation Bureau of Beijing city officially banned the electric bicycles. At the press conference, senior officials stated the reasons for the prohibition. This decision and reasons spread over the whole country. Almost all the important media quoted the words from Beijing officials. These voices seriously threatened the domestic support and survival of LEV. Under the circumstance, I finished the long article on August 6th, entitled “Banned but Not

Cursed of Electric Bicycles”, and published in a professional magazine on August 13th. CBA (China Bicycle Association) also took a step. The leaders of the main LEV manufacturers had an emergency meeting to defend LEV industry. At the end of the meeting, we finalized a letter drafted by me to the leader of Beijing City Government. Meanwhile, everyone agreed to preserve the right seeking the judicial right. The industrial reaction put pressure under Beijing City Government, therefore effectively released the negative consequence. In 2003, there was a severe SARS breakout in Beijing. People living in the city were avoiding the public transportations. Without LEV, many people had to buy private cars. Along the highly increased numbers of cars, the traffic condition deteriorated dramatically at the end of 2003. This had made Beijing city government look back and reconsidered in 2004. Meanwhile, the office of Policy and Research of the City Regulation also appealed to the government, suggesting “borrowing experience from other cities, release the prohibition of LEV.” The LEV market in Beijing has revived. And it will be one of the most important markets in 2005.

2. Fuzhou Accident: June 1st, 2003, Fuzhou Government announced that it would be illegal to sell electric bicycles. Those who disobey will be punished by regulation. Right after the announcement, the official enforcers closed the stores that had been selling LEV, seized the goods, destroyed the store signboard, and painted off “Electric Bicycles” on the signs. They expressed irrational hatred to LEV. Under the circumstance, Luyuan filed the lawsuit against Fuzhou Industry and Commercial

Bureau. 126 manufacturers supported, and sponsored us RMB 91,000.00. The lawsuit lasted six months. Whoever won the case is not important; I know that LEV is the real winner. During the lawsuit, many domestic newspapers and TV stations followed the whole procedure. Many people stood out and supported LEV. This lawsuit also limited other cities, which might “boycott” electric bicycles. LEV in Fuzhou was wiped off the face of the earth. Consumers have been secretly purchasing electric bicycles all the time. We estimate that the sales of LEV in Fuzhou were over 10,000 in 2004.

3. Other objections and current status

For years, some cities are still against LEV, such as Guangzhou, Haikou, Nanning etc. Nevertheless, consumers and vendors' effort toward rights should end to good deed. Those who are against LEV are the minority standing on insufficient reasons. They will submit eventually. So far, no provincial government has stated to ban LEV entirely. We have reason to believe none would do so in the future.

III. Technical regulations and related arguments

1. Speed regulation

In 1999, China published technical regulations for electric bicycle, national standard code GB17761-1999. In this standard, the top speed of LEV was limited to 20km/h, and it is mandatory. Currently, manufacturers and consumers mainly dispute over this regulation. Most Chinese LEV is adopted PWM to regulate speed. Top speed is

decided by battery voltage and motor rotate speed. There is about 30% gap between maximum battery voltage (fully charged) and minimum battery voltage (nearly exhausted). If maximum speed is 20km/h, actual speed is about only 14km/h when battery is nearly exhausted. This will not satisfy consumers. They would complain about LEV's slowness, which is even worse than ordinary bicycle, thus could ask for refund. Therefore, at present, most manufacturers have to violate the speed regulation in disguised form, install accelerating device. Sale is done by regulation, whereas consumers can make adjustment when they need higher speed. The maximum is about 24-27km/h. Recently many manufacturers propose a revision of the standard, suggest to raise it to 25km/h, which is more reasonable. However, this suggestion will unlikely be adopted.

2. Other mandatory regulations

In GB17761-1999, other than "top speed ", there are two mandatory regulations. One is "braking distance": less than 4 meters in dry state, less than 12 meters in moist state. The other is "frame intensity": great than 90,000 times in vibration test. As to these two requirements, high-level corporations can reach them. Some advanced companies have further raised their testing requirement to ensure better safety.

3. Dispute over amending standard

During the past year, in Chinese LEV industry, the dispute over amending standard is still fruitless. Some people believe that electric bicycle is just a bicycle; LEV should

be entirely "bicyclized". Any design conflicting to "bicyclization" should be prohibited, and declared as "unqualified product" leading to legal penalty. For example, a wheel's diameter cannot be shorter than 20 inches, the width of plastic decoration cannot be wider than 300mm, without battery, bicycle body mass cannot be heavier than 23kg, and etc. There are up to 30 items in disqualification list, among which most are not related to "safety". Some other people disagree, and they think that most Chinese consumers' demand for "luxurious appearance" should be gratified; otherwise LEV will be lost mainly domestic market. Too many "legal prohibitions" will only result in resting more burdens onto the manufacturers. Putting a series of safety-unrelated items into mandatory standard not only has no legal basis, but also could bring chaos from governments' inconsistent execution. This argument drastically goes on. Most manufacturers agree with latter, while a few agree with former. The 1999's standard still is in ruled for now.

Conclusion

In this paper, I introduced different development stage and various outer factors in China LEV market. It is obvious that the time of development in LEV is very short, however LEV is very popular vehicle in China. Its market has been showed a rapid rising trend, and the trend will be even faster in next few years. Along with enhancing of production technique, we believe that the future of LEV will be better. Thank you for everybody.