

The Development of Electric Vehicles in China

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I. Strategic Significance

- **China's auto industry development faces global energy and environment challenges**
energy security, low carbon development, pollution and traffic jam in big cities
- **Diversified vehicle energies provide multiple options for coping with energy and environmental challenges**
diversified alternative fuels and technology routes, life cycle assessment
- **Electric vehicle will be the optimal way for China's auto industry to address energy and environmental issues**
Electric vehicle is becoming a major direction
- **Electric vehicle is a strategic measure to improve the international competitiveness of China's auto industry**
Electric vehicle is becoming a commanding height for international competition

II. Development history and current situation in China

China started research on electric vehicle technologies during the 8th Five-year Plan period, and listed electric vehicle R&D into national science and technology programs during the 9th Five-year Plan period to support technology R&D of BEV's complete vehicles, batteries, motors and other key spare parts.

During the 10th Five-year Plan period, China invested RMB 880 million to start the Key Special Electric Vehicle Project of the National 863 Program and establish the three verticals (FCV, HEV and BEV) and three horizontals (multi-energy powertrain control system, drive motor and power battery) R&D layout.

During the 11th Five-year Plan period, China invested RMB 1.16 billion to organize and implement the Key Special Energy Saving and New Energy Vehicle Project of the National 863 Program to carry out research on key technologies of electric vehicles and technologies of large-scale industrialization in an all-around way.

- **HEV, BEV and FCV jointly constitute a foundation for the electrification of the vehicle energy power system.**

HEV is already mature and has initial strength to compete with traditional vehicles. However, China makes slow progress in HEV product technology.

PHEV is still in the product preparation stage though China accelerates PHEV's R&D.

BEV becomes a R&D priority of domestic enterprises and starts mass-production vehicle development from sample vehicle development.

FCV remains one of the strategic options for the electric vehicle in the future. China's FCV product development is in the initial stage and receives inadequate attention from OEMs.

- **Power battery represents a key technology of electric vehicles and becomes an investment priority of major countries and auto makers around the world.**

Power battery technology develops rapidly in recent years. China's single power battery approaches the international advanced level in terms of performance, but still lags behind in engineering capability, packing technology and lifetime of products.

Drive motor technology becomes basically mature. The technical indices of China's drive motors are close to their foreign counterparts, but China still needs to import key spare parts.

Fuel cell technology sees marked progress and gradually lives up to vehicle use requirements in terms of performance.

III. Demonstration and Promotion of Electric Vehicles

Stage 1: the demonstration project on the Nan'ao Island
Intensive operation tests were conducted on 24 electric vehicles of various types

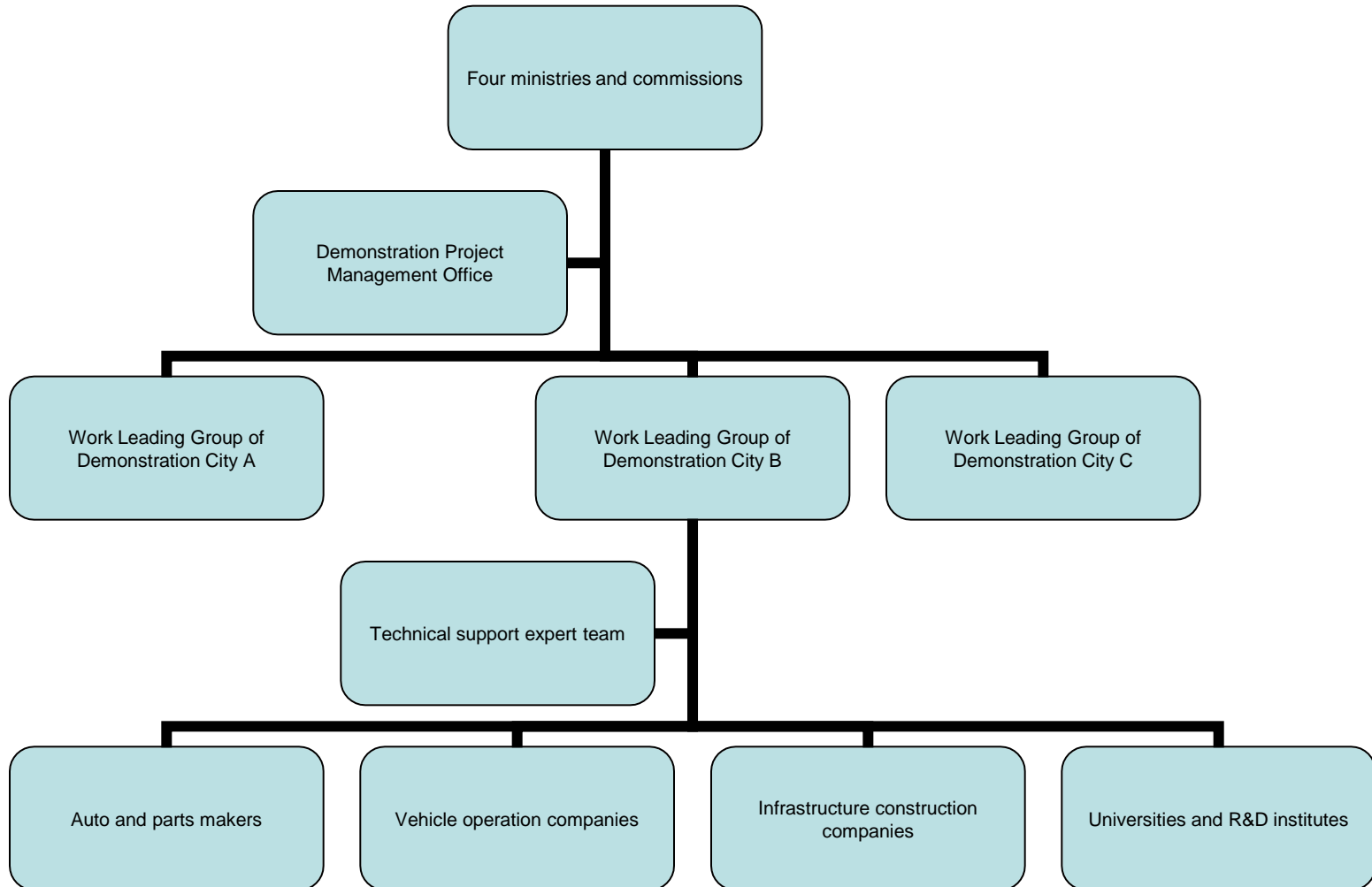
Stage 2: the small-scale demonstration in late 10th Five-year Plan
During 2003-2008, EV commercialization demonstration was carried out in seven cities and in the state grid industry

Stage 3: large-scale intensive demonstration during the Beijing Olympic Games
600 BEVs, HEVs and FCVs, accumulatively traveled over 3.7 million kilometers and transported over 4.4 million passengers.

Stage 4: "One Thousand Vehicles in Ten Cities" project
By the end of 2011, 12,000 or so new energy vehicles of 361 models produced by 75 auto makers were put into operation in 25 cities.

3.1 Organizational system construction

An organizational guarantee system for demonstration characterized by central and local governments coordination is established based on pilot projects.



3.2 Vehicle use status

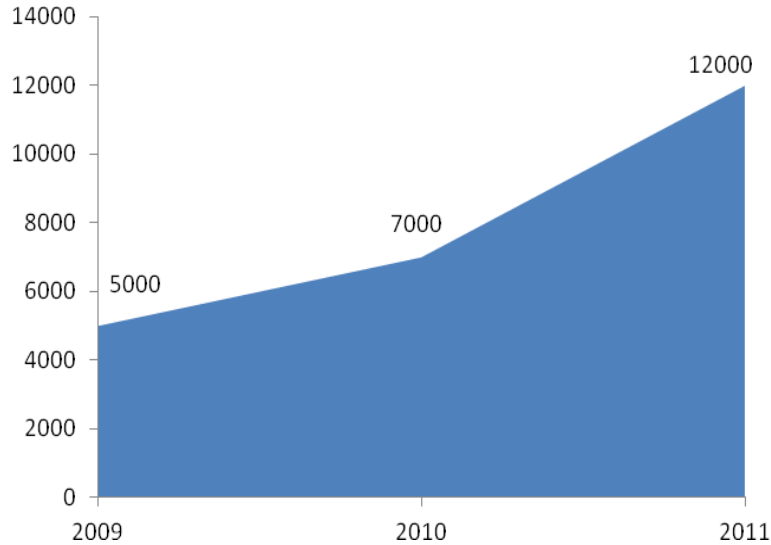


Fig: New energy vehicle accumulated population in demonstration cities during 2009-2011

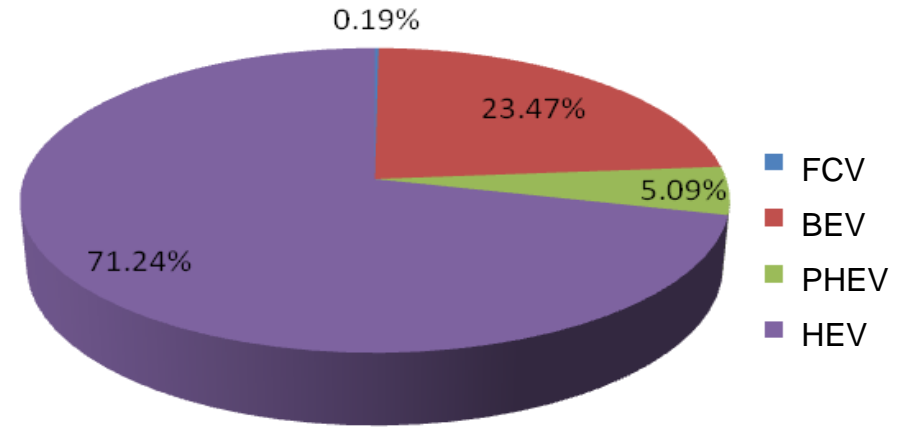


Fig: Proportions of vehicles with different drive systems

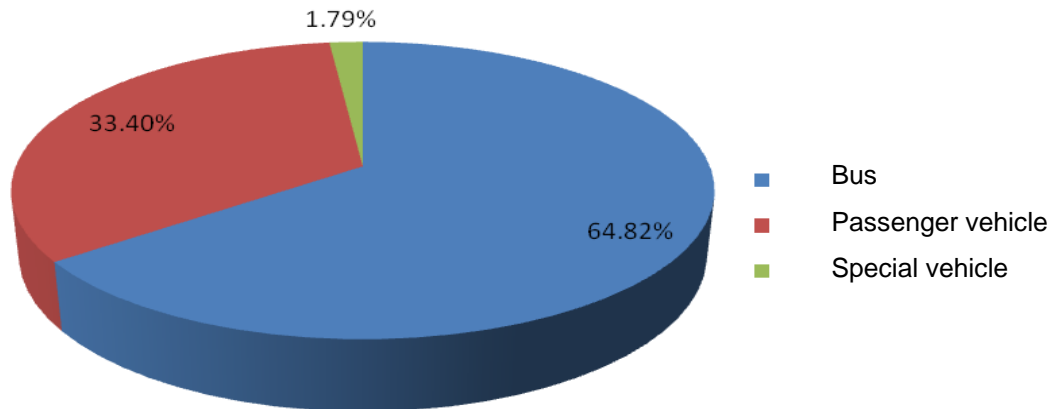
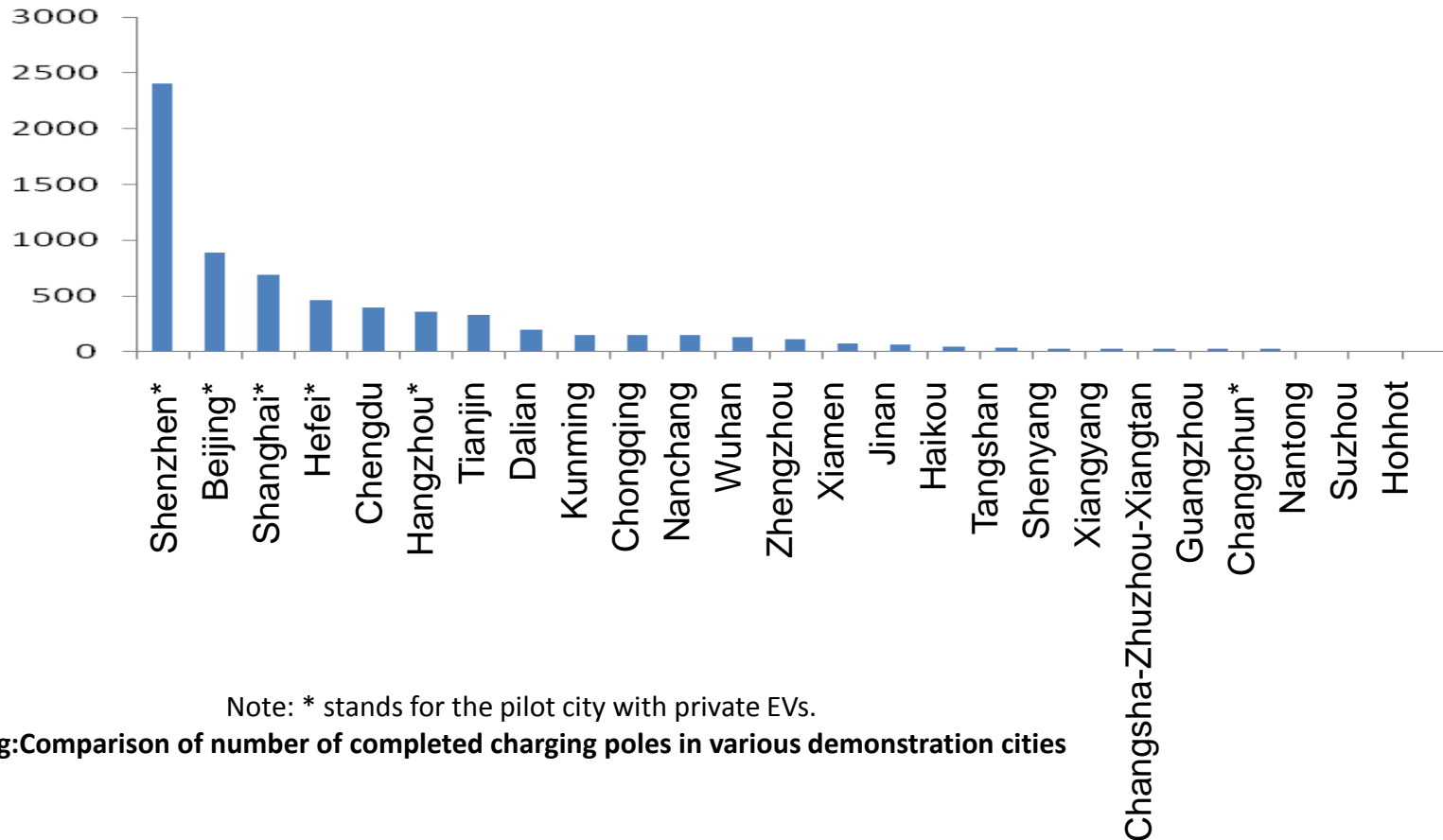


Fig: Proportions of different vehicles

3.3 Infrastructure

By the end of 2011, 6,800 charging poles and 168 charging stations were built in 25 demonstration cities.



Note: * stands for the pilot city with private EVs.

Fig: Comparison of number of completed charging poles in various demonstration cities

3.4 supporting policies and measures

China's supporting policies and measures for EV demonstration and promotion are mainly fiscal subsidy and incentive policies for EV purchase and use.

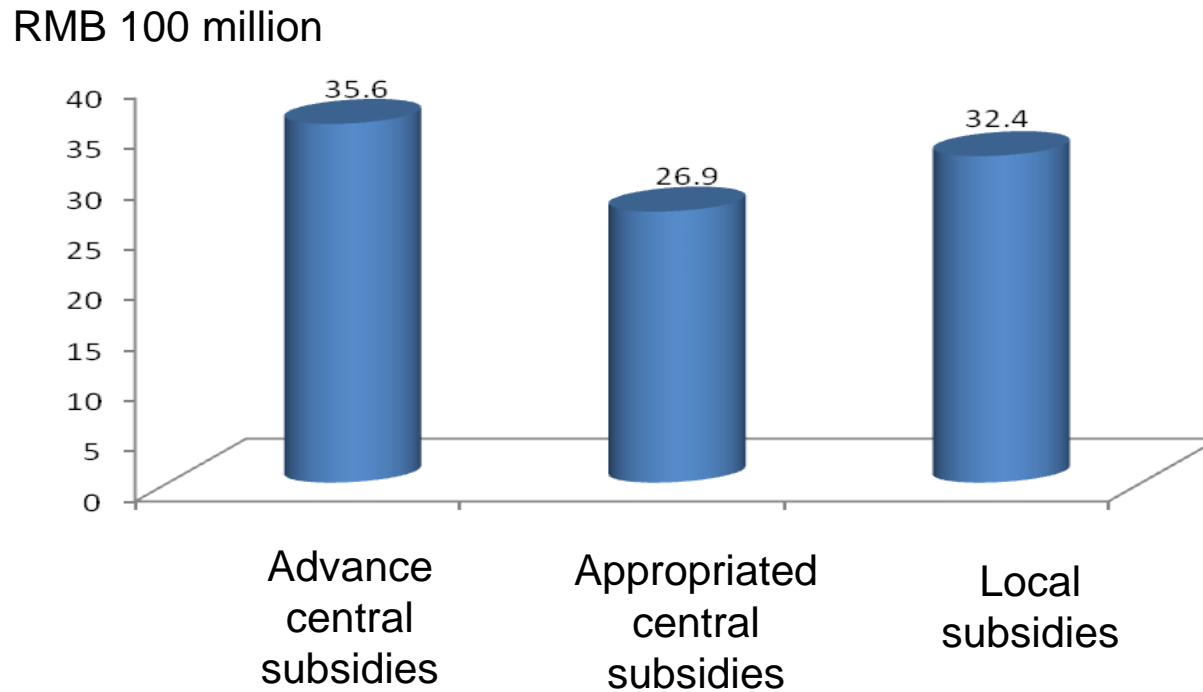


Fig: Comparisons between national and local subsidies

3.5 Data collection and monitoring

Demonstration cities basically establish a special information publishing platform to release relevant information of leading organs, policies, laws and regulations, industry development, demonstration progress as well as technology R&D.

An overwhelming majority of demonstration vehicles are installed with an information terminal to collect data of location, speed and fuel consumption.

An electric vehicle charging monitoring platform is established at all charging stations to monitor and record battery temperature, current and other working parameters during charging.

Dalian and Shenzhen take the lead in operational data collection, recording and analysis nationwide. Dalian and Shenzhen establish an EV remote monitoring and data collection system to collect state data of batteries, motors and complete vehicles, transmit such data to the network via data communication card and realize data storage and analysis by the remote monitoring system.

IV. Current Industrialization of EVs in China

The EVs in China have been shifting from the R&D to industrialization stage in recent years.

The policies such as the "One Thousand Vehicles in Ten Cities" have led to the start of the industrialization of EVs, the initial development of an industry chain with certain production capacity and the gradual formation of industrial organizations.

The HEVs are still the main products for demonstration and promotion in China by the type of EVs.

The industrialization of BEVs and PHVs has speeded up.

Overall, there is a gap between the industrialization of EVs in China and the international advanced level.

4.1 Current industrialization of complete EVs

By November 2011, 78 out of the OEMs in the bulletin have new energy vehicle models listed in the bulletin, and a total of 448 energy efficient and new energy vehicles have been included in the new motor vehicle bulletin.

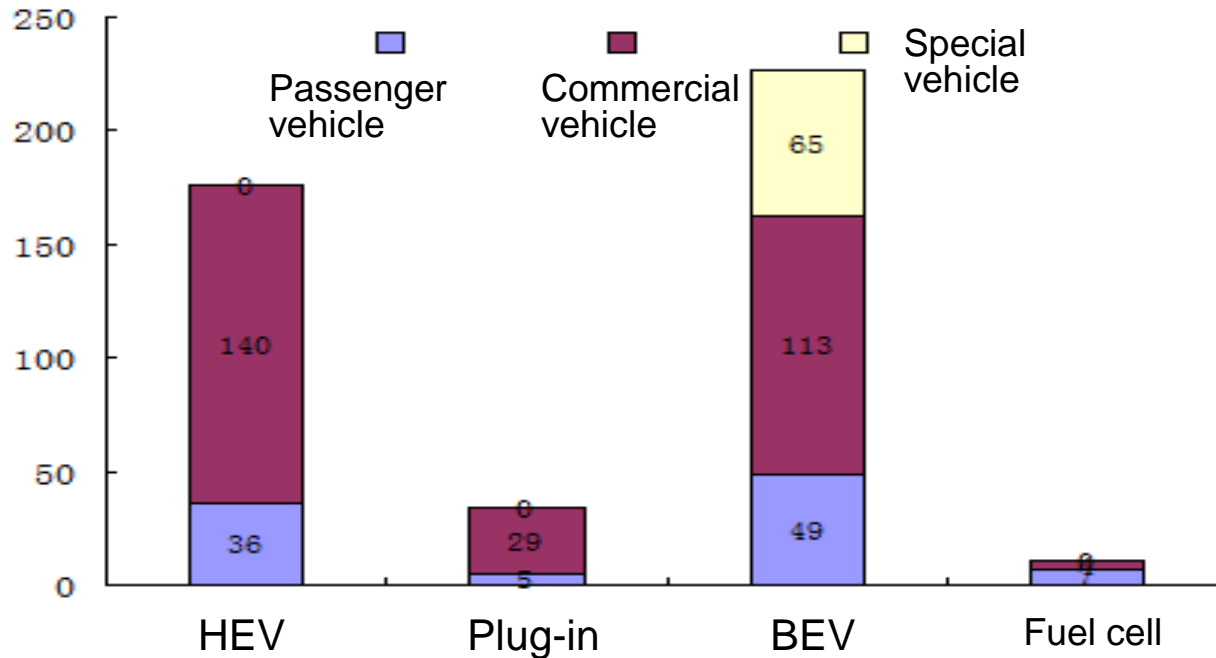


Fig: Layout of EV models listed in the bulletin in China

An accumulative number of 25,678 bulletin models (including joint ventures brand) have been produced.

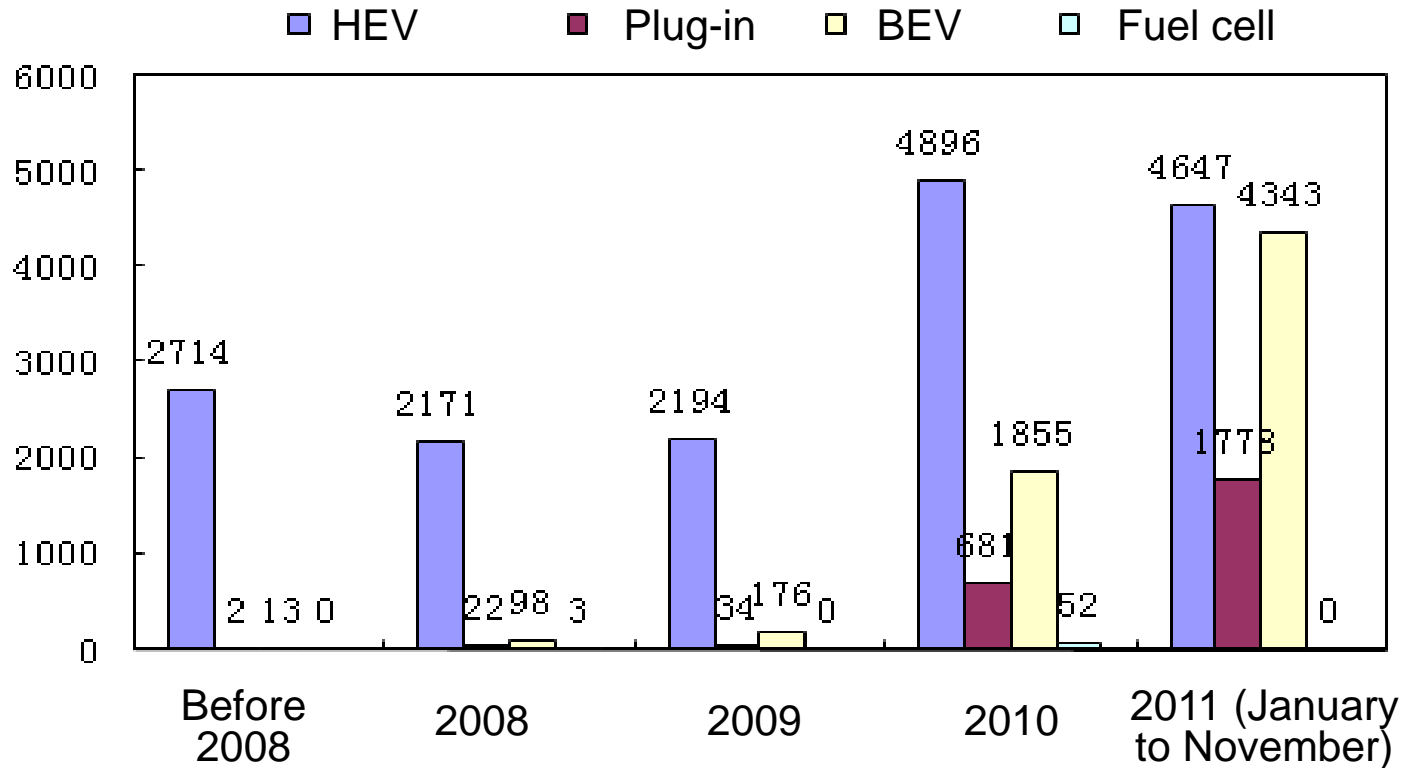


Fig: Output of different types of energy-saving and new energy vehicles in China in the past years

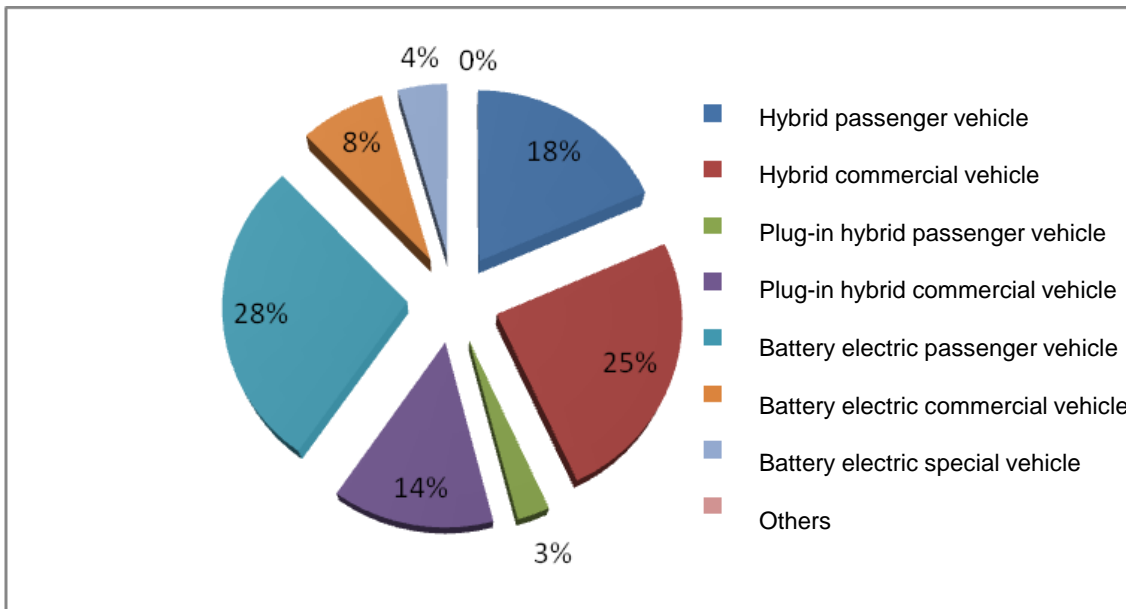


Fig: Output ratio of EVs of different types in China in 2011

Major auto groups in China have developed certain EV production capability. According to an incomplete statistics on 83 enterprises in the bulletin, all of them have an annual production capacity of over 600,000 EVs/year, among which, BYD has a production capacity of 80,000 EVs/year and Chery 50,000 EVs/year, taking a leading position.

Model Name	Key products during the "12th Five-Year Plan" period	Time to put into production	Expected cost
Passenger vehicle	Mainly are BEVs, supplemented by long-range vehicles, plug-in vehicles and HEVs	Put into production during 2012-2013	Low-speed BEV: RMB 30,000-80,000/unit; Battery electric car: RMB 150,000-200,000/unit; Long-range and plug-in vehicles: RMB 200,000-250,000/unit
Commercial vehicle	Mainly are 10-12 meter BEVs and HEVs, supplemented by long-range and plug-in vehicle	Put into production during 2011-2012	BEV: RMB 1.3 million-1.5 million/unit; HEV: RMB 800,000-1 million/unit; Long-range and plug-in vehicle: RMB 1 million-1.3 million/unit
Special vehicle	Mainly are BEVs, including electric garbage trucks and postal vehicles etc.	Put into production during 2011-2012	BEV: RMB 120,000-150,000/unit

4.1.1 industrialization of PEVs

China doesn't have a large number of HEVs compared with the developed countries. The industrialization is still limited to micro, mild and medium hybrid passenger vehicles and that of heavy hybrid passenger vehicles is yet to take place.

China has produced an accumulative number of 9,722 HEVs by the end of 2011, among which FAW Toyota's Prius and Guangzhou Automobile Toyota's Camry accounted for 60%, GM 19%, Brilliance and Chang'an nearly 900 units. SAIC, Dongfeng and Geely have begun to mass produce and launch self-owned hybrid passenger vehicles.

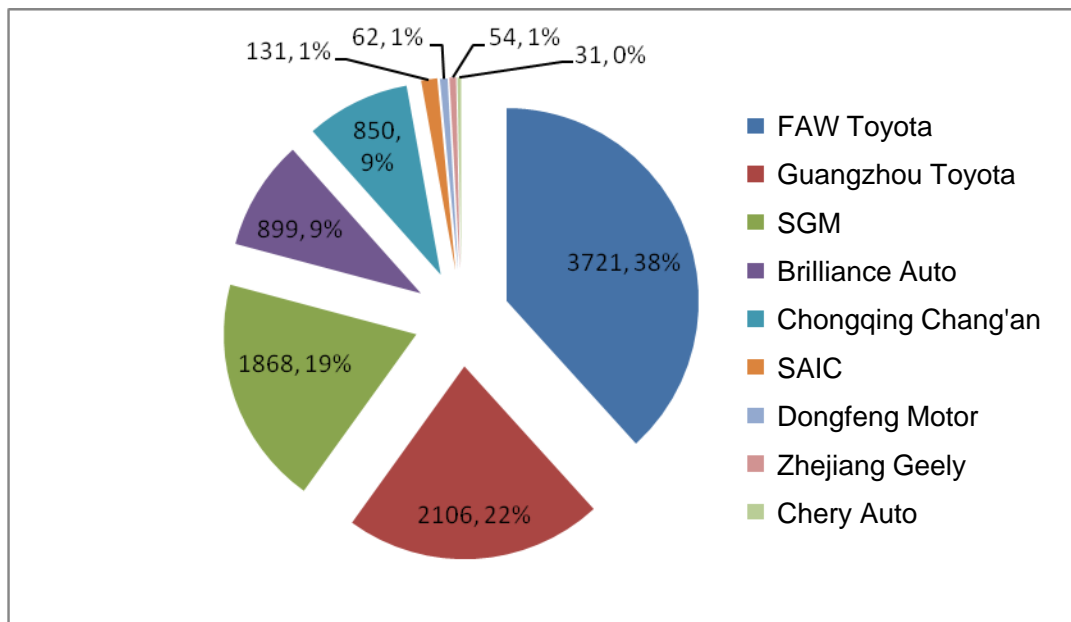


Fig: Top 10 enterprises in terms of the accumulative output of hybrid passenger vehicles (Vehicles)

4.1.1 industrialization of PEVs

Thanks to the "One Thousand Vehicles in Ten Cities" project in 2009, the industrialization of hybrid buses gets off to a quick start in China and the urban buses equipped with independently developed hybrid systems have improved stability and reliability, gaining obvious advantages over foreign countries in terms of cost and the demonstration and promotion of vehicles.

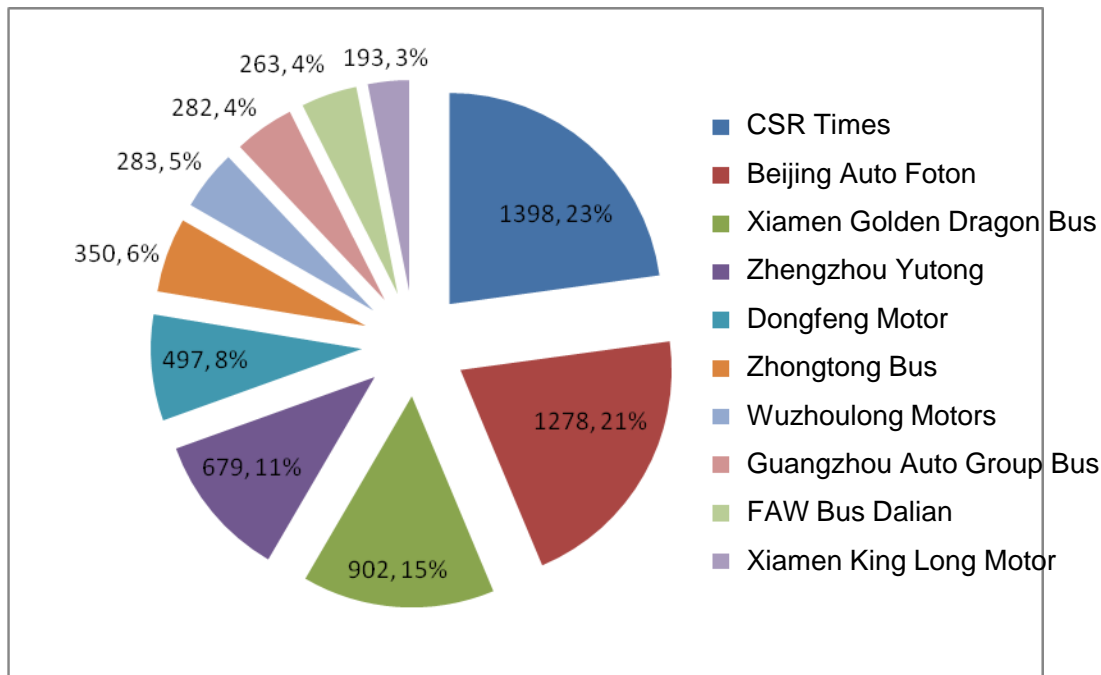


Fig: Top 10 enterprises in terms of the accumulative output of hybrid buses (Vehicles)

4.1.2 industrialization of BEVs and plug-in vehicles

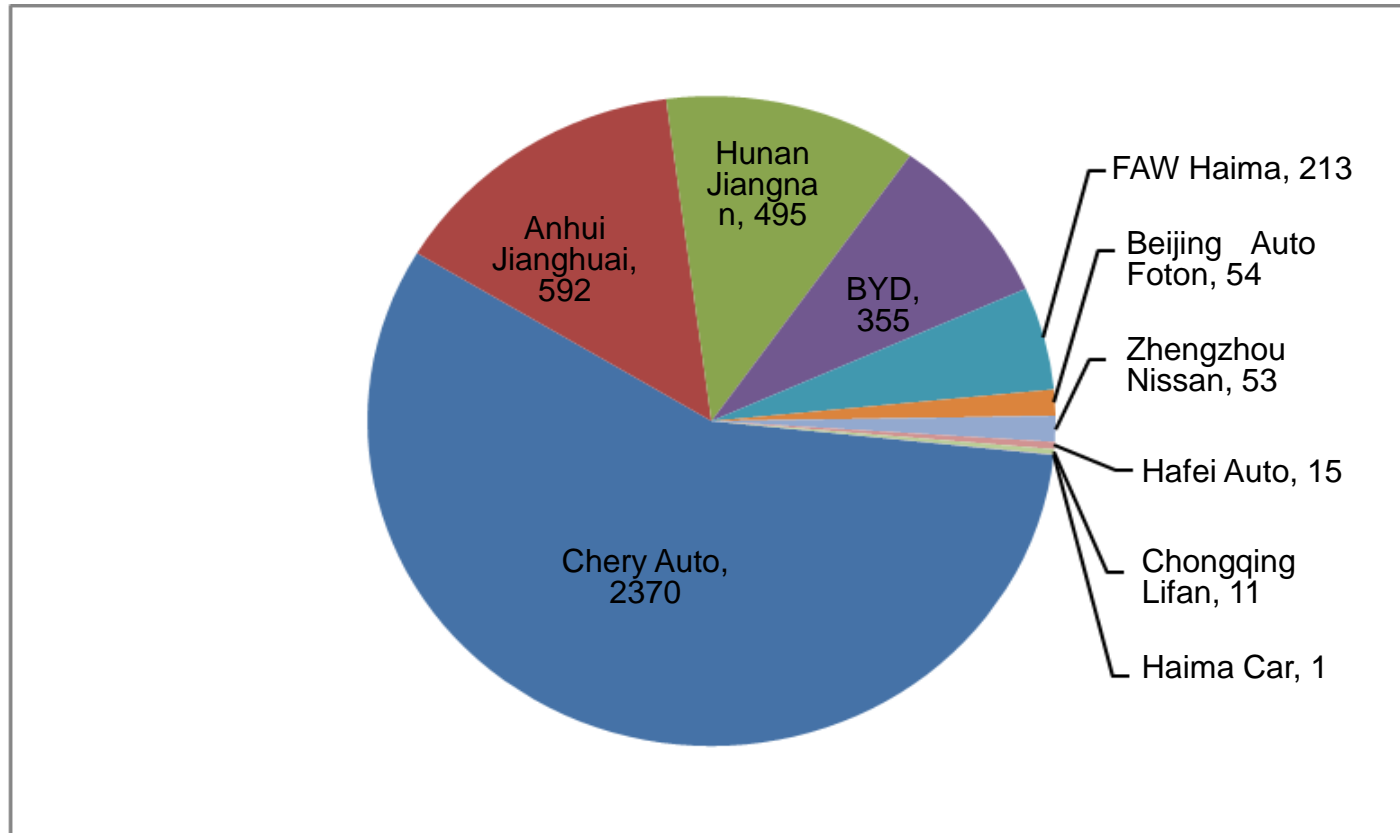


Fig: Top 10 enterprises in terms of the accumulative output of battery electric passenger vehicles (Vehicle) by the end of 2011

4.1.2 industrialization of BEVs and plug-in vehicles

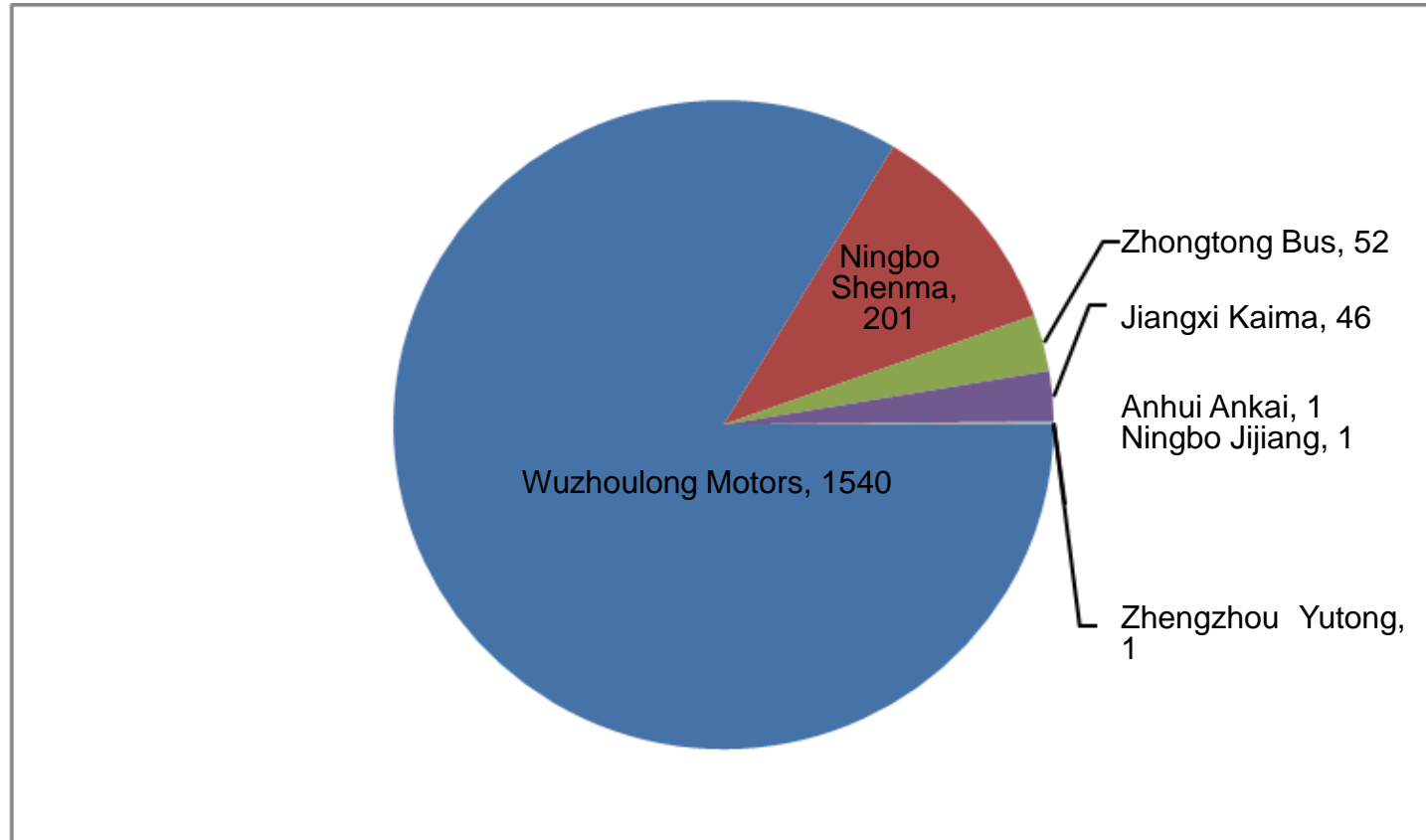


Fig: Accumulative output of plug-in hybrid buses of enterprises (Vehicle)

4.1.3 industrialization of slow-speed EVs

A group of low-speed EV manufacturers have emerged in the third and fourth tier cities in Shandong, Zhejiang. As they can meet some people's travel needs due to low purchase and use costs, their industrialization has been developed and presents fast growth.

According to the statistics of the Shandong Automobile Industry Association, the output of low-speed EVs reached 68,000 in Shandong in 2011. The low-speed EVs have not only met the demands of a specific market, but have been exported on a large scale.

4.2 Key parts and powertrain systems of EVs

4.2.1 industrialization of power batteries

Recently, increasing investment has been made in the industrialization of power batteries, the production capacity expanded, an industry chain preliminarily established and a certain industrial scale formed.

According to the statistics of 83 domestic power battery enterprises, they invested about RMB 8 billion the industrialization of power batteries in 2011 and have an annual production capacity of over 11 billion Wh at present.

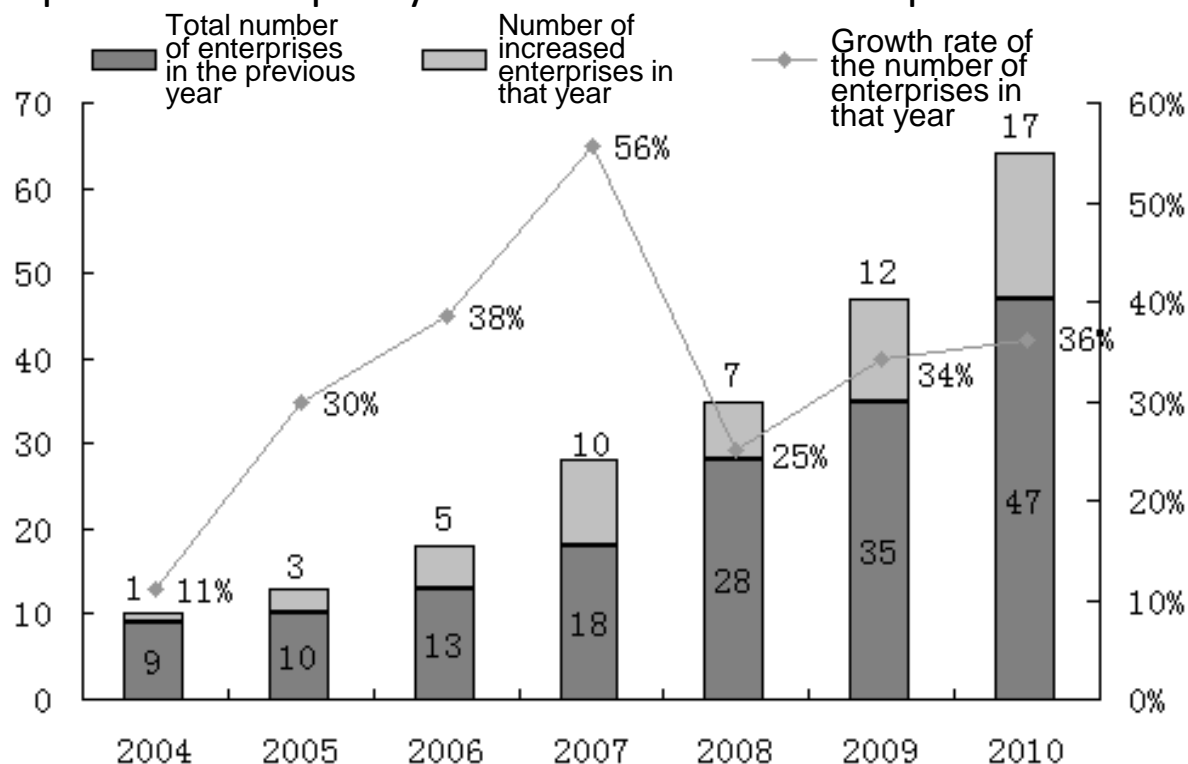


Fig: Number of enterprises in the lithium-ion power battery industry

According to the research of a relevant organization on some power battery enterprises in China, taking only 10 large power battery enterprises for instance, they plan to invest over **RMB 15 billion** in the construction of production lines during the "12th Five-Year Plan" period and by the end of the period, an expected production capacity of nearly **20 billion Wh power batteries** will be developed to match about **1 million EVs** (calculated based on 20 kWh for each battery pack).

Besides, the selling price of a domestic lithium-ion power battery cell is currently RMB 2.5-3.5/Wh, the average selling price of a lithium-ion power battery pack (including the management system) is RMB 4-5/Wh, the selling price of a Ni-MH power battery cell RMB 3-4/Wh and the average selling price of a Ni-MH Ni-MH power battery pack (including the management system) is RMB 4.5-5.5/Wh. The average selling price of a battery pack (including the management system) is RMB 4-5/Wh. **Some enterprises expect the cost reduction of power batteries by RMB 2-3/Wh by the end of the "12th Five-Year Plan" period (year 2015).**

4.2.2 The matching capability for small batch production of drive motors

Domestic drive motors mainly consist of permanent magnet synchronous motors and AC asynchronous motors, supplemented by other motors. According to incomplete statistics of 56 domestic enterprises, the production capacity of electric motors in China reached 1.08 million unit/year in 2010 and the output was 35,600 units. Among them, the sales of permanent magnet synchronous motors accounted for 70.69%.

Electric motor model (Unit/year)	Production capacity	Output in 2010	Sales in 2010	Market share (%)
CSR Times	10,000	10,000	10,000	31.1
Shanghai Electric Drive	30,000	6,000	6,000	18.7
Zhejiang Unite	50,000	3,160	3,145	9.8
Broad-Ocean Motor	30,000	1,500	-	-
Shanghai Zhongke Shenjiang	2,500	1,000	1,000	3.1
Shenzhen Greatland Electrics	15,000	1,000	1,000	3.1
Dalian Motor	2,000	1,000	0	0.0
BYD	5,500	450	397	1.2

Table: Top 10 domestic enterprises in terms of the output of permanent magnet synchronous motors in 2010

4.2.3 The matching capability for industrialization of hybrid systems has been preliminarily developed

- **Several mainstream commercial HEV systems have been developed.**

A group of relatively mature bus hybrid systems have been developed in the commercial vehicle sector.

- **Several independent commercial HEV system suppliers have been preliminarily established.**

CSR Times launched a series hybrid powertrain system (for large passenger vehicles and environment & sanitary engineering vehicles), a bus parallel hybrid powertrain system, a passenger vehicle hybrid powertrain system and a passenger vehicle long-range hybrid powertrain system.

A total of 1,398 hybrid powertrain systems have been applied, only calculating those used on CSR Time's own hybrid buses.

CSR Times have developed an annual production capacity of 10,000 electric drive systems and key parts.

4.3 Industrial organizations

- **The market-oriented joint ventures, cooperation and competition between enterprises are preliminarily carried out**
- **As a main part of industrial organizations, enterprises are still weak and make inadequate investment**
- **The horizontal division of industry remains the general model for current OEMs**
- **The early market formed under policy guidance is at risk of division**

V. Business Model Innovation

The business models currently used in China are divided into four types: complete vehicle sales, complete vehicle rental, battery rental and finance lease.

- **Complete vehicle sales model**

Currently, Hefei and Shenzhen have used the complete vehicle sales model for private users and by November 2011, 585 JAC Tongyue electric cars and 300 BYD electric taxis have been sold.

However, given the current high cost of vehicle power batteries, it's difficult to promote the complete vehicle sales model on a large scale.

- **Complete vehicle rental model**

The vehicle rental providers purchase the electric cars equipped with batteries that can be charged from a charging pole or domestic AC power supply to provide long-term (at least half a year) rental services for individuals.

If the policies and measures about subsidies or tax relief can be introduced to reduce the vehicle dealers' operation costs and enhance their ability to continue the operation, it would play a critical role in the development of this business model.

- **Battery rental model**

The electric taxi companies in Hangzhou have provided a business model under which the power operators rent batteries to taxi companies for use and charge the rental fees based on mileage and as well as offer power supply through battery replacement or electric taxis.

Due to the strong involvement of power operators, the battery rental model and battery replacement mode are always tied together for promotion.

- **Finance lease model**

The EV finance lease model in china currently has two types-the financial institutions dominated type and the professional operators dominated type, and are mainly suitable for electric buses.

The financial institutions dominated type: the financial institutions (asset management companies) purchase the batteries through finance lease and rent them to the bus companies which make payment by installments, thus reducing the payment pressure of the bus companies.

The professional operators dominated type: professional operators get financing from financial institutions, part of which is offered to the bus companies for purchase of standard-equipped vehicles and the other part of which is used by the operators themselves for purchase, repair and maintenance of batteries and construction of charging infrastructure. The capital for finance lease services is paid in installments with the finance lease, operation and maintenance subsidies provided by the government.

VI. Strategy

“Development Plan for the Energy-saving and New Energy Vehicle Industry (2012-2020) ”

Major strategic orientation:

Pure electric drive

Mainly focus on:

accelerating the industrialization of BEV and PHEV
popularizing the use of non-plug-in hybrid vehicles
and energy-saving internal combustion engine vehicles.

Thank you!