Research and Development of Electric Vehicle in China and Latest Trends on Diffusion

China Automotive Technology & Research Center (CATARC)
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1. Research and manufacture of EV in China
2012, 15,495 thousand passenger cars were sold in China. Chinese government will attempt to double citizens' revenue before 2020. And this plan will promote the passenger cars market continue increase.
Support Policies from Central Government

- 863 major projects of Electric vehicle R&D and industrialization
- "Carry out energy-saving and new energy vehicle demonstration pilot work notice"
- Interim Measures for the Administration of energy-saving and new energy financial assistance
- "Automobile industry restructuring and revitalization plan"
- "New energy vehicle production companies and product access rules"
- "Notice on the private purchase of new energy vehicles subsidy pilot"
- 10 billion CNY of funds of the State Council to support technical innovation
- "Energy-saving and new energy automotive industry development plan (2010-2120)"
- New energy vehicle demonstration pilot cities to extend

Bulletin number of models of EV(PHV) and HV (2006-2012)

<table>
<thead>
<tr>
<th></th>
<th>2006-2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>Add up</th>
</tr>
</thead>
<tbody>
<tr>
<td>EV (PHV)</td>
<td>27</td>
<td>26</td>
<td>93</td>
<td>121</td>
<td>192</td>
<td>459</td>
</tr>
<tr>
<td>HV</td>
<td>58</td>
<td>48</td>
<td>63</td>
<td>84</td>
<td>163</td>
<td>416</td>
</tr>
</tbody>
</table>
Various types of vehicles

- Fuel cell vehicle power system platform
- Hybrid vehicle power system platform
- Pure electric vehicle power system platform

Key components technology
- Fuel cell engines, power battery, super capacitor
- Drive motor, the motor drive train assembly, engine
- New materials, new components, common technology infrastructure technology

Vehicle development
- Vehicle dynamic system integration technology

Public support platform
- Testing
- Technology standards
- Policies and regulations
- Demonstration operations
- Industry financing
- Intellectual property rights
- Technical Information

Layout: the major projects of the national energy-saving and new energy vehicles
Cycle life about 1500 times, costs 3-4 yuan / watt

Cycle life more than 2000 times, the cost is reduced to 2 / W or less

Cycle life more than 3000 times, cost 1.5 yuan / watt or less

- Strengthen the positive anode material, separator, electrolyte, production processes and equipment R & D
- The power batteries consistency and groups matching technology
- To carry out multi-electron reaction cell, two-phase electrolyte batteries, light metal-air batteries and free radical polymer battery, the new battery technology research.
- To carry out the next generation of new battery materials, the mechanism of basic research. Focus on the study of a new lithium-ion battery.
# The level of motor technology

<table>
<thead>
<tr>
<th>Key technical indicators</th>
<th>Industrial energy-saving motors 180ZWS001</th>
<th>Domestic typical permanent magnet motors 274YZ-XI 02</th>
<th>Typical domestic asynchronous motors TYC-168-260</th>
<th>U.S. typical motor EDM60/90</th>
<th>Toyota 2010 Pruis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak power (kW)</td>
<td>30</td>
<td>92</td>
<td>90</td>
<td>60</td>
<td>94%</td>
</tr>
<tr>
<td>Peak torque (Nm)</td>
<td>200</td>
<td>210</td>
<td>240</td>
<td>239</td>
<td>207</td>
</tr>
<tr>
<td>Maximum speed (r/min)</td>
<td>1500</td>
<td>1150</td>
<td>6000</td>
<td>10000</td>
<td>13500</td>
</tr>
<tr>
<td>Efficiency / efficiency District</td>
<td>92%</td>
<td>94%/70%</td>
<td>91.2%/70%</td>
<td>90%/50%</td>
<td>94%/75%</td>
</tr>
<tr>
<td>Total weight of the motor / controller (kg)</td>
<td>90/18.5</td>
<td>65/28</td>
<td>99/30</td>
<td>65/35</td>
<td>37.7/17.9</td>
</tr>
<tr>
<td>Motor / controller power density (kW/kg)</td>
<td>0.33/1.62</td>
<td>1.42/3.29</td>
<td>0.91/3.00</td>
<td>1.39/2.57</td>
<td>1.59/3.35</td>
</tr>
</tbody>
</table>
Production of hybrid vehicles in China in 2012

- Special Purpose Vehicle: 1
- Bus: 6834
- Passenger cars: 8192
Pure electric vehicle production in China in 2012

- Trucks and special-purpose vehicles: 1881
- Buses: 3956
- Passenger cars: 8751
Plug-in hybrid production in China in 2012

- Buses: 1
- Passenger cars: 262
Electric passenger car production in the top five

2011

2012

- 奇瑞: 3467
- 江淮: 2493
- 比亚迪: 1032
- 北汽: 742
- 江南: 386

江    南
比    亚    迪
众        马
        海
        福
"Pure electric passenger car technology" (GB / T 28382-2012) standard specifies: the maximum speed shall not be less than 80 km / h, mileage must be greater than 80 km.

The low-speed electric vehicles is not officially recognized, but the sales volume is more larger.
Ordinary vehicle standards:
89 mandatory standards,
866 recommended standards

EV standards:
28 mandatory standards, 22 recommended standards
### 荣威 E50 (240,000 CNY)

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated power / maximum power (Kw)</td>
<td>28/52</td>
</tr>
<tr>
<td>nominal / maximum motor speed (rpm)</td>
<td>3000/8000</td>
</tr>
<tr>
<td>Peak torque of the motor (Nm)</td>
<td>155</td>
</tr>
<tr>
<td>0-50 km / h acceleration time (s)</td>
<td>5.3</td>
</tr>
<tr>
<td>0-100 km / h acceleration time (s)</td>
<td>14.6</td>
</tr>
<tr>
<td>Mileage (60km/h) (km)</td>
<td>180</td>
</tr>
<tr>
<td>Maximum speed (km/h)</td>
<td>130</td>
</tr>
<tr>
<td>Slow charge</td>
<td>6h</td>
</tr>
<tr>
<td>Fast charge</td>
<td>30min (10%~80%)</td>
</tr>
</tbody>
</table>

1CNY = 14.3 JPY
### 比亚迪E6 (370,000 CNY)

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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<tbody>
<tr>
<td>Length (mm)</td>
<td>4560</td>
</tr>
<tr>
<td>Width (mm)</td>
<td>1822</td>
</tr>
<tr>
<td>Height (mm)</td>
<td>1630</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>2295</td>
</tr>
<tr>
<td>Maximum power (Kw)</td>
<td>75</td>
</tr>
<tr>
<td>Maximum torque (Nm)</td>
<td>450</td>
</tr>
<tr>
<td>Maximum speed (km/h)</td>
<td>140</td>
</tr>
<tr>
<td>Power consumption (KWh/100Km)</td>
<td>21.5</td>
</tr>
<tr>
<td>Mileage (Km)</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Length (mm)</td>
<td>3550</td>
</tr>
<tr>
<td>Width (mm)</td>
<td>1495</td>
</tr>
<tr>
<td>Height (mm)</td>
<td>1485</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>1050</td>
</tr>
<tr>
<td>Maximum power (Kw)</td>
<td>12</td>
</tr>
<tr>
<td>Maximum torque (Nm)</td>
<td>72</td>
</tr>
<tr>
<td>Maximum speed (km/h)</td>
<td>60</td>
</tr>
<tr>
<td>Mileage (Km)</td>
<td>100</td>
</tr>
</tbody>
</table>

奇瑞QQ3 EV (55,000 CNY)
2. EV demonstration in China
25 cities involved in the EV demonstration plan of our government
Demonstration scale

By the end of 2012, the amount of China's total demonstration and extension energy-saving and new energy vehicles (HV, EV & PHV) is 27,400.

Among those, 23,000 for public services; 4,400 for private use.

To the end of March 2013, that amount will reach 39,700.

At present, there are 174 charge power stations, 8107 charging piles in China.
EV Business Models of China (1)

Whole EV Selling Model

Selling the whole EV at the price of deduction the subsidies, applicable for the small, mini-passenger cars, with some specific consumers.
Whole EV leasing model are applied to passenger car for public car leasing market.
Power company construct and operate the swap station, lease the batteries to taxi company. Power company get the subsidies for private EV buying, and also the subsidies for leasing batteries indirectly from taxi company.
Finance company buy the batteries and lease the batteries to public transportation company, who get subsidies cover the money for leasing battery and buying nude e-bus.
Professional operator borrow the money to buy batteries and nude e-buses, which will be repaid by subsidies. Different from model I, finance company does not own the batteries.
EV Business Models in Demo Cities

- **Battery Leasing Model**
  - Hangzhou (ZOTYE EV)
  - Hefei (JAC EV)

- **Whole EV Selling Model**
  - Hangzhou (ZOTYE 5008EV)

- **Whole EV Leasing Model**
  - Shenzhen (BYD K9 Bus)

- **Financial Leasing Model I**
  - Hefei (Ankai Bus)

- **Financial Leasing Model II**

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At the end of 2011, the total quantity and variety of demonstration electric vehicles was as follows:

- **Total**: 16023
  - Buses (HV, PEV), 6449, 56%
  - Passenger cars (HV), 1766, 15%
  - Passenger cars (EV, including fuel cell cars and plug-in), 2025, 18%
  - Buses (EV, including fuel cell, super capacitor), 990, 9%
  - Special purpose vehicle, 193, 2%

Total: 16023
• The number of vehicles distributed by city (2011)
By the end of 2011, the number of charging spots is about 6800 in China.

By the end of 2011, the number of charging stations is about 168.
In ShenZhen city, With a measure of exempting five-year license fee, the first pure electric taxi operation company of China was established. 300 pure electric taxis were put into the demonstration, whose daily average mileage was up to 450 km, and of which the longest single mileage reached 220,000 km (till 2012.07).
Till to June 2012, the total amount of NEV in Shenzhen had been up to 3,147, including 2,050 buses (1,771 hybrids, 253 pure EVs, 26 pure electric midibuses), 300 pure electric taxis, 62 fuel cell vehicles, 20 official cars, over 715 private cars. 2,600 charging poles and 62 charging stations (57 for public, 5 for private) had been built up.
According to the characteristics of moderate mileage and fix route, public buses were selected as a breakthrough to expand NEV promotion scale. Up to now, the number of applications of new energy bus has been up to 2,050, accounting for 12.8% of the population of the city bus in Shenzhen.
Multinational auto companies cooperated with CATARC, to carry out test run of EV in China

<table>
<thead>
<tr>
<th></th>
<th>MINI E</th>
<th>Active E</th>
<th>User</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount</td>
<td>50</td>
<td>100</td>
<td>Government, research institutions, and the general public</td>
</tr>
<tr>
<td>TOYOT</td>
<td>PRIUS</td>
<td>IQ-EV</td>
<td>User</td>
</tr>
<tr>
<td>Amount</td>
<td>40</td>
<td>5</td>
<td>Government, research institutions</td>
</tr>
</tbody>
</table>
The demonstration features: government-led, combined with the large-scale events.
3. Chinese EV development plan

✓ 2015, strive to cumulatively produce and sale EV and PHV 500,000;
✓ 2020, EV and PHV production capacity reach 2 million, the cumulative production and sales over 5 million.
4. Measures to promote the application of EV in China
Fiscal and taxation policies

- The central government has appropriated special funds to support technological innovation, demonstration pilot and promote the application;
- Local arrangements for special matching funds to support the construction of infrastructure, set up battery recycling and echelon use system;
- For enterprises, tax system based on average fuel consumption of passenger cars. Tax relief on new energy vehicles;
- Engaged in the research and development of new energy vehicles and key parts production enterprises and institutions shall be exempted from business tax.

Support for technological innovation

Technology Policies

- Create a new energy automotive industry alliance, and concentrate our efforts to overcome technical difficulties;
- To develop and perfect the new energy vehicle technology and regulations;
- Support the development and industrialization of energy-saving and new energy vehicle technology.

Support the demonstration and application

Management policies

- Combined with the adjustment of industrial structure, improve admittance management system for new energy auto companies and products;
- Establishment and improvement of new energy vehicle demonstration operation management system, establish a supervision and evaluation and elimination mechanism, give full play to the leading role of the pilot and demonstration projects;
- Established the management system for recovering the key components and power batteries.

Support infrastructure construction

Other policies

- Promote financial institutions to increase support for the new energy automotive industry development efforts;
- Support for new energy vehicles and key parts companies listed and refinancing;
- Create a convenient EV use environment, eliminating the limitation for licence plate number, purchase indicators restrictions.
<table>
<thead>
<tr>
<th>City</th>
<th>Car ownership</th>
<th>Restriction measures</th>
<th>Promotional measures for EV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beijing</td>
<td>5,200,000</td>
<td>20,000 indicators per month, ballot</td>
<td>Production enterprises per vehicle subsidies 60,000 most (central financial); Private purchase of each vehicle subsidies 60 000 most (local government); Free license fee or without balloting.</td>
</tr>
<tr>
<td>Shanghai</td>
<td>2,600,000</td>
<td>10,000 indicators per month, Bid (75,000)</td>
<td></td>
</tr>
<tr>
<td>Canton</td>
<td>2,500,000</td>
<td>10,000 indicators per month, Ratio of EV/PHV: ballot: bid is 1:5:4</td>
<td></td>
</tr>
</tbody>
</table>
How to achieve the goals of the plan......

Bus

Taxi

Postal

Sanitation

Lease

Official business

Logistics

Private cars
5. Some views about Chinese EV market
Under the pressure on energy and environmental protection, in Chinese cities, electric vehicles will rapidly increase.

In the field of private vehicles, EV should use fast charging model (less than 10 to 15 minutes is perfect. On the other hand, to improve mileage, increasing the battery is necessary, that cause charging time grow).

PHV is a good transition (the financial subsidies less than EV).

In many Chinese residential area, parking spaces are leased to vehicle owner, and charging pile construction will take up some of the land, so parking charging piles is not easy to achieve.

As EV charging stations increased, in order to reduce the impact on the grid, to stabilize the electricity peak-to-valley, more new distributed energy storage (Distributed Energy Storage, DES) device will be needed.
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Thanks for Your attention!

2013-11  Beijing
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