



上海交通大学
SHANGHAI JIAO TONG UNIVERSITY



交大密西根学院
UM-SJTU Joint Institute

China's EV Development Strategy and Status of Energy Storage Industry

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Mar. 1st, Tokyo, Japan





Outline



1. Introduction
2. Government-Supported Efforts
3. Market-Oriented Activities
4. Energy Storage Industry
5. Conclusions



Shanghai Jiao Tong University



- 24 Schools/Departments
- 12 Affiliated Hospitals
- 16,802 Undergraduates
- 24,495 Graduates
 - 5,059 Ph.D. students
- 2,979 Faculties
 - 835 Professors
- 3.3km² (Minhang Campus)

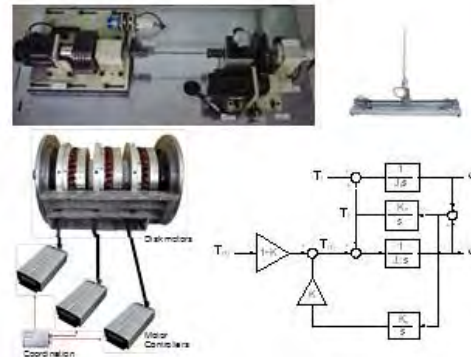




SJTU Minhang Campus



- Background: Motion Control and Mechatronics
- Master(2001), Ph.D.(2004), E. E., the University of Tokyo



1. Motion/Motor Control

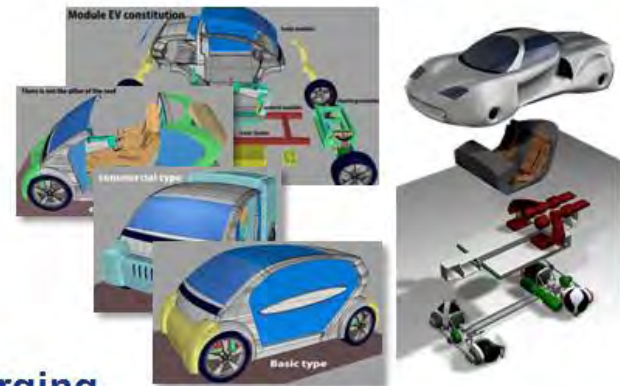


2. Electric Vehicle Dynamics



3. Hybrid Energy System

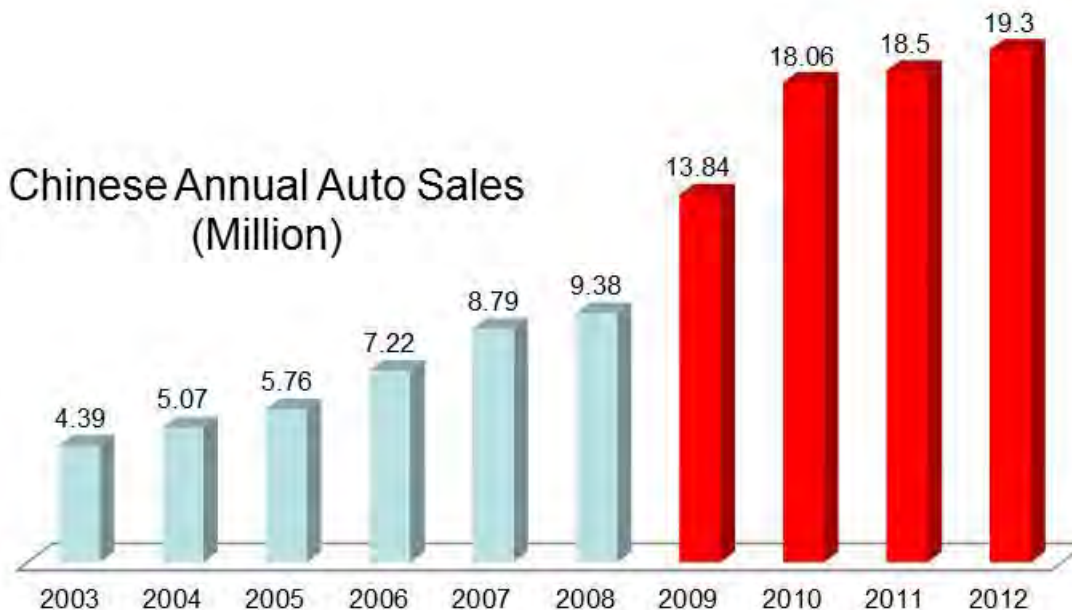
4. 13.56MHz Wireless Charging



5. Test EV Development

Skyrocketing Auto Sales

- Auto sales increased 5 times in the past 10 years.
- The world largest single market from 2009.
- Pollution, overcrowding traffic, parking, rising price of oil...

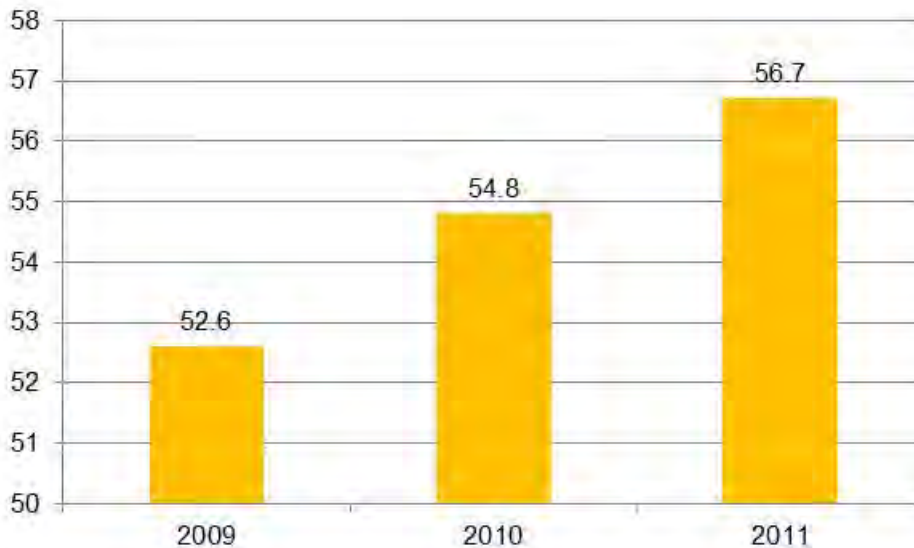




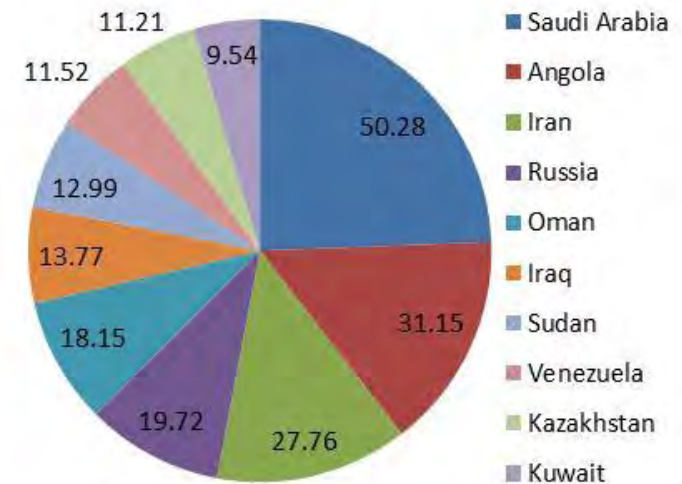
Dependence on Imported Oil



- China is actually more depending on imported oil than the United States.
- In 2011, China imported 254 million ton oil.
- National energy security is a serious concern.



Percentage of consumption of imported oil



Oil imports by country of origin in 2011

- More consumption of electric power would reduce dependence on any one source of imported energy.

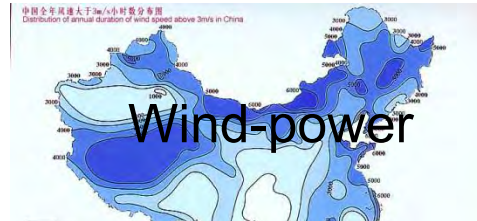
我国主要煤炭分布



Coal

Nuclear-power

15 in operation
26 in construction





Importance of Automotive Industry

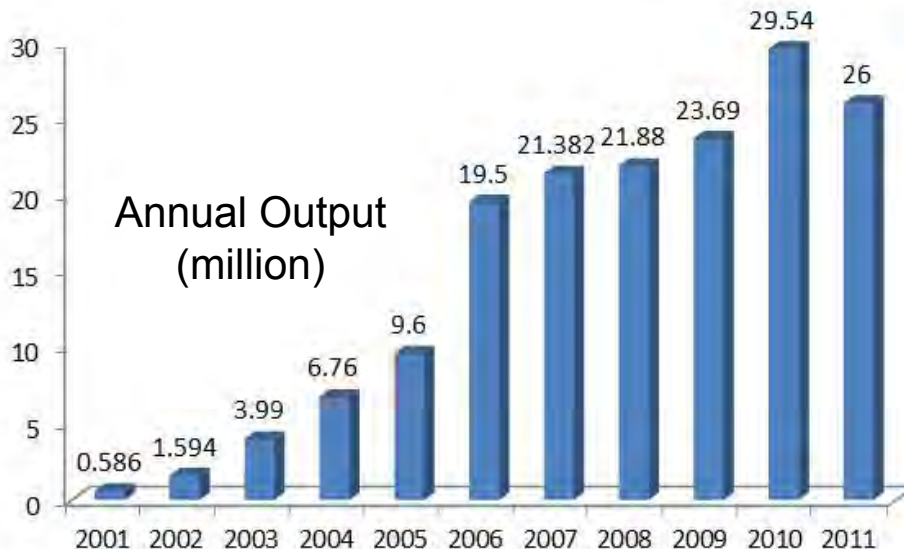


- Automotive industry and its value chain contributed **2%** and **8.3%** of China's GDP in 2010.
- China's predicted GDP per capita is **\$6,094.04** in 2012 by Intentional Monetary Foundation.
(Beijing: \$12,631; Shanghai: \$12,784; Guangzhou: \$14,796.47 in 2011)
- The market share of domestic makers is only around **30%**. (24.31% in July, 2012)
- Strategic importance of Electric Vehicles: 1) Improve national energy security; 2) Enhance the competitiveness of Chinese auto makers.

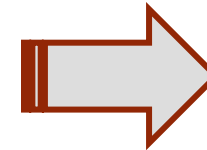
- In 2011, over 26 million e-bikes were produced.
- A horizontal division structure was established.



≈ \$300



- Rising labor and material cost, safety and environmental regulations are bringing the fundamental transition.





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Decision-Making Bodies



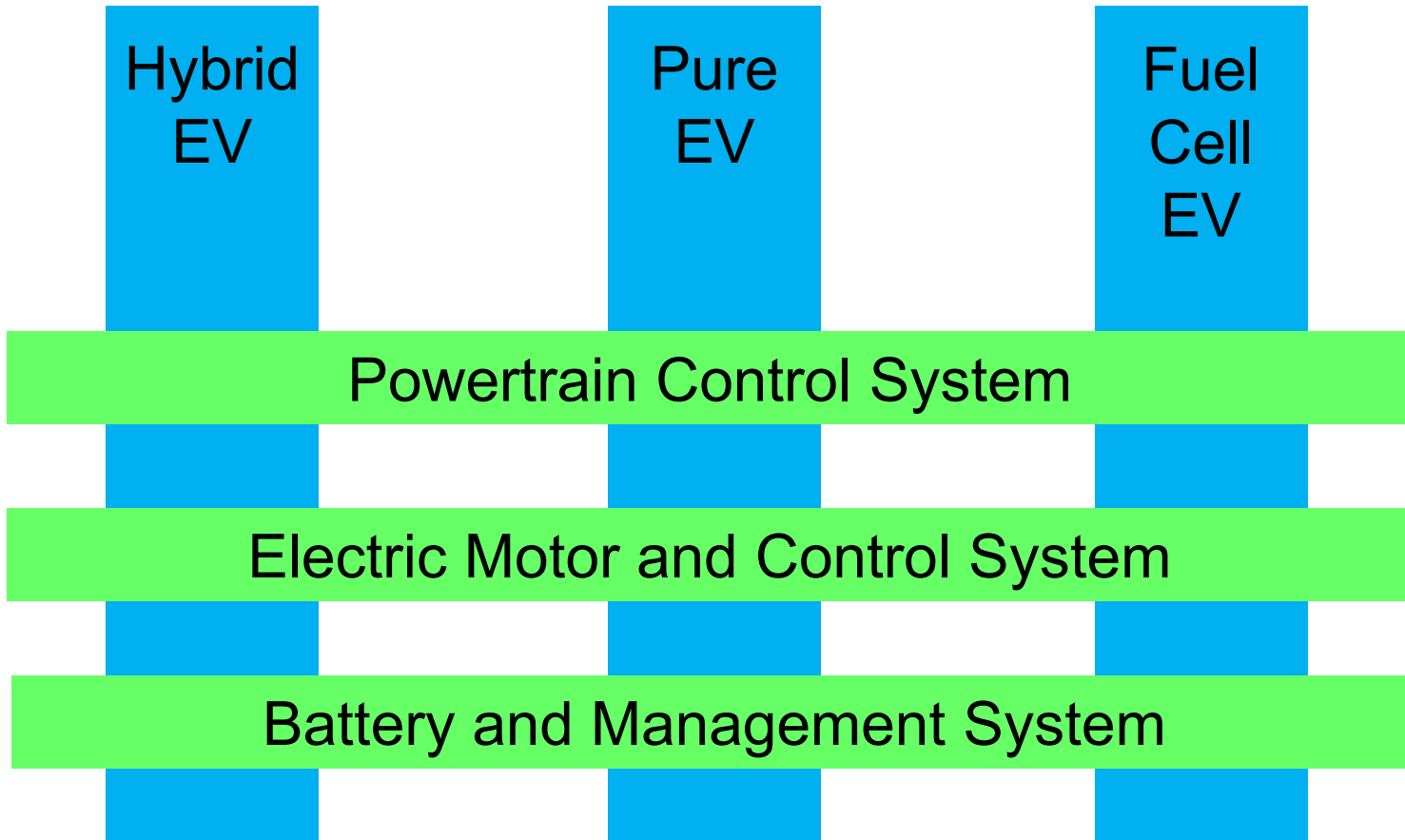
- Ministry of Science and Technology
 - 863 national EV key project, Pilot demo projects
- National Development and Reform Commission
 - Policy on the development of automobile industry
- Ministry of Industry and Information Technology
 - Electric vehicle commercialization
- Ministry of Finance
 - Financial subsidies



Milestones (1)



- 2001, 863 high-tech project, MOST (三縱三橫)





Milestones (2)



- 2008, Beijing Olympic Game
 - 595 electric vehicle test fleet (23 Fuel cell, 102 hybrid and 470 pure electric vehicles from 7 Chinese companies, 2 Chinese universities and 1 foreign company)
- 2010, Shanghai Expo
 - Around 1,300 electric vehicle test fleet
 - 1,125 electric vehicles from Shanghai Automotive Industry Corporation (174 Fuel cell, 500 hybrid, 390 battery and 61 supercapacitor electric vehicles)



Milestones (3)



- 2009, Ten-city thousand-EV project (十城千辆)
 - Started jointly by the 4 major decision bodies
 - 10 cities every years, 1,000 EVs/city in 3 years, 10% market share
 - Subsidies
 - › Ministry of Finance: max 50KRMB for HEV, 60KRMB for PEV, 250KRMB for fuel-cell EV passenger cars; 50K-450KRMB for hybrid buses longer than 10m, 500K for pure electric buses and 600K for fuel-cell buses.
 - › Local government: matching funding and facilities
 - Real implementation in 2011: 25 cities, 27,400 EVs (public service 23,000; private 4,400)



Milestone (4)



- 2010, Development planning on energy-saving and new energy vehicle development (2011-2020) 「節能と新能源汽車發展規劃（2011年-2020年）」
 - Long-term target: pure electric vehicle
 - Near-term target: hybrid electric vehicle
 - 5 Million EVs in China until 2020
 - Battery: 200Wh/Kg, 1.6RMB/Wh in 2020
 - 2-3 companies with cumulative production of 500K EVs until 2020



Overview



10th 5-years

11th 5-years

12th 5-years

2001-2005

2006-2010

2011-2015

Focus

Fuel Cell	Fuel Cell	Fuel Cell	Fuel Cell	Fuel Cell
HEV	HEV	HEV	HEV	HEV
BEV	BEV	BEV	BEV/PHEV	BEV/PHEV

Goals

(2005) 5-10% share in 2010 50% share in 2030	(2008) 10% share in 2012	(2009) 500K production 5% share in 2011	(2010-2011) 1 Million EVs in 2015 5 Million EVs in 2020
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Similar with the goals of DOE

Production: 12,784
Model: 361
Company: 75

⇒ 36/model
170/company

Reality

Beijing Olympic
595 EVs

Shanghai EXPO
1,300 EVs



Demonstration

2011



Summary



- The development of EV industry is crucial to improve China's energy security and strengthen its domestic automotive industry.
- Chinese companies have initially grasped the core technologies of motor, inverter and battery for full-size electric vehicles.
- The lack of experiences and the slow EV commercialization are the major problems.
- The next stage may be to switch from government initiatives to market discipline.



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High End versus Low End



BYD



JAC



SAIC



ZOTYE



SHIFENG



Price: 31,800RMB (\$5,129)
 Range: 180Km
 Max speed: 55Km/hr
 Battery: Lead-acid

Roewe E50
 Price: 234,900RMB (\$37,887)
 Subsidy: 106,900RMB (\$17,242)
 Range: 180Km
 Max speed: 130Km/hr
 Battery: 18kWh

83,300 low-speed electric vehicles were sold in Shandong Province in 2012.

- Especially motor, inverter and lead-acid battery are becoming both technological and commercially matured.

Searched on Taobao online shopping site



48V 500W
BLDC Motor
(100RMB, \$56.5)



48V 500W
BLDC Controller
(100RMB, \$16)



48-72V 350-2000W
E-Drive Set
(680-1,500RMB, \$109.68-241.94)



48-84V 2,000W Motor
(1,270RMB, \$204.84)



48-72V 4,500W Controller
(1,500RMB, \$241.94)



E-bike



E-scooter

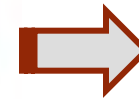
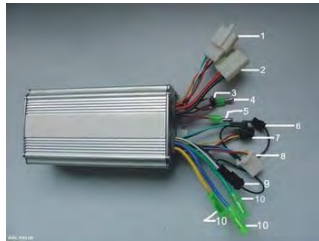


E-motorcycle



E-vehicle?

- Chinese e-bike industry has evolved to be highly modularized just like the PC industry.
- Most of e-bike makers are working on integration and assembly; while motor, controller and battery are from tier-one suppliers.
- This unique structure explains the significant variety and low-cost of Chinese e-bikes.

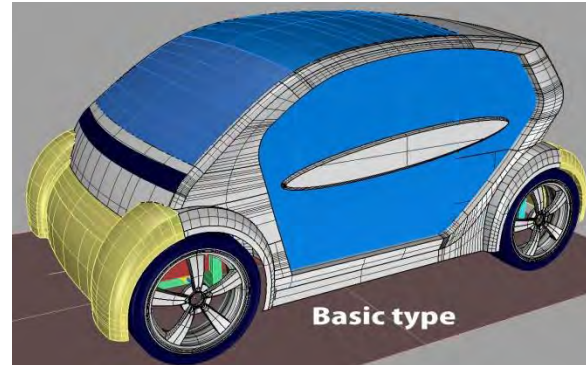
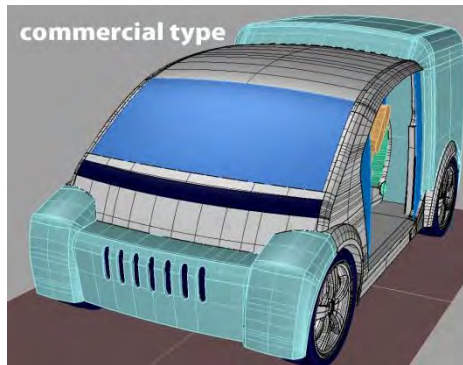
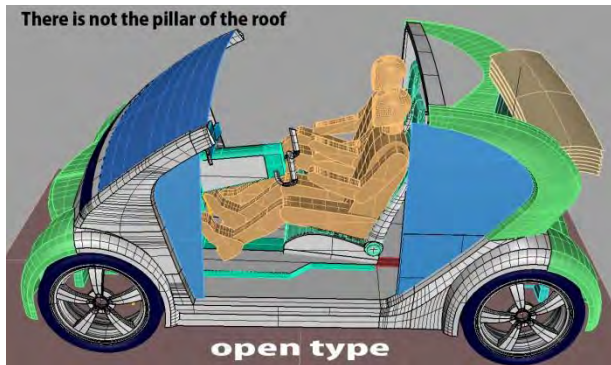
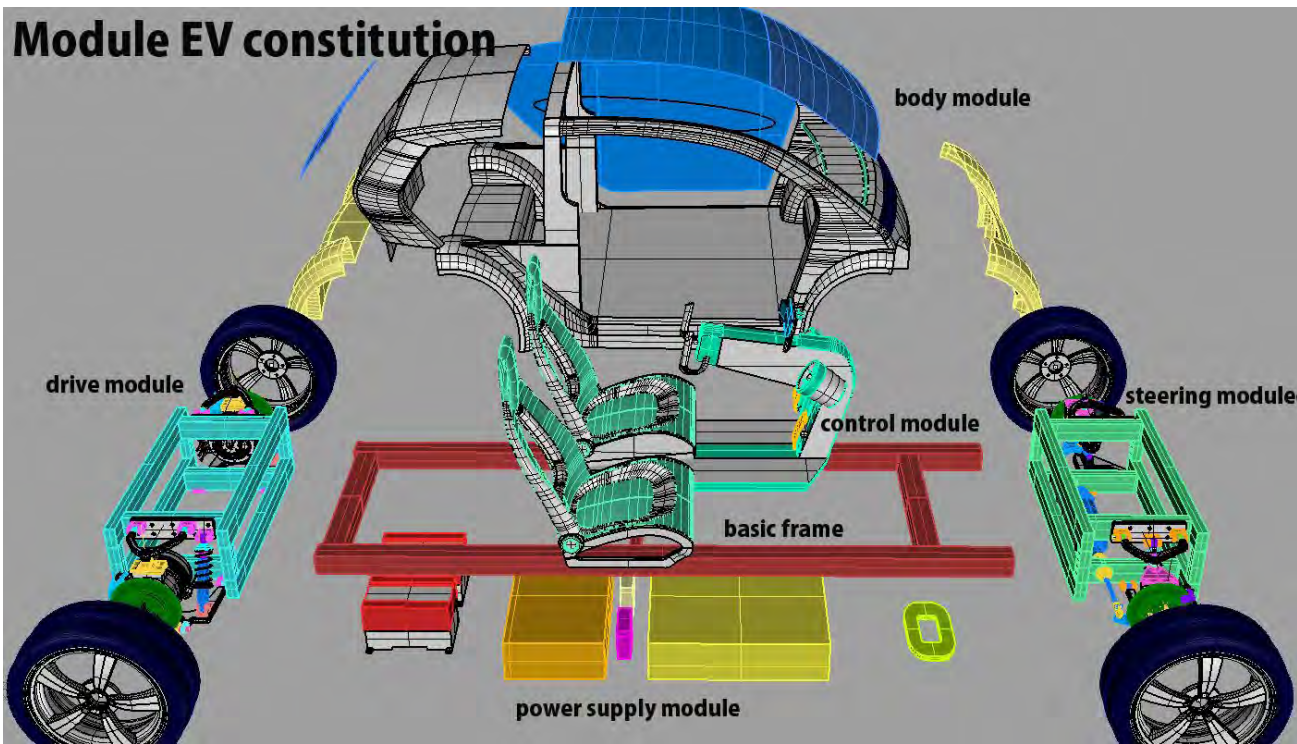




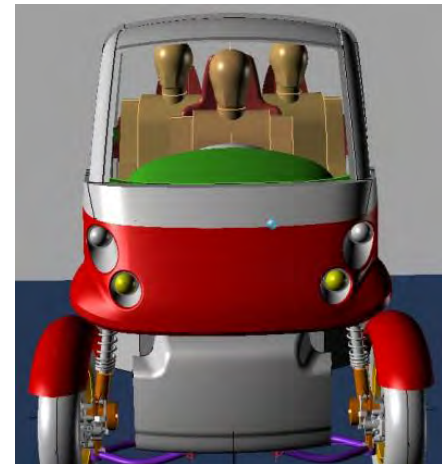
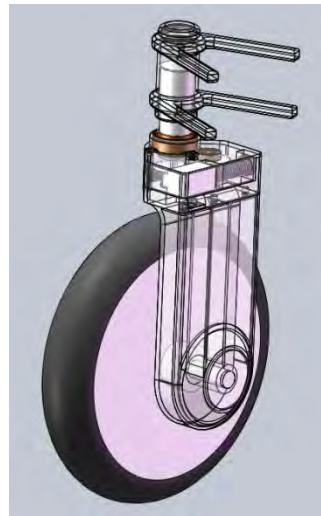
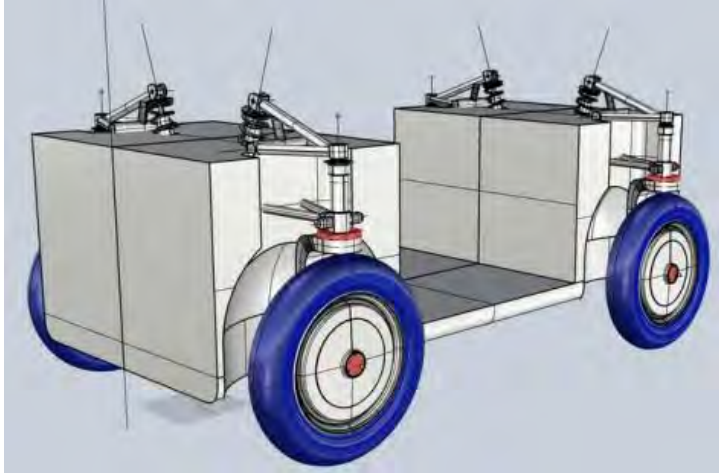
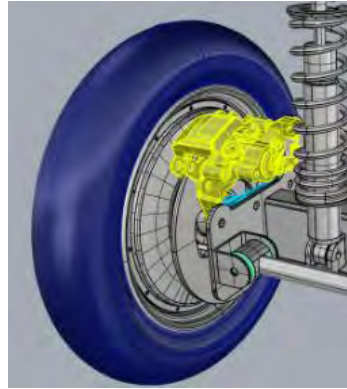
Policies on Low-speed EV



- Central government:
 - Maintain certain entry barrier
 - 2012/7/1: National standard on the technological requirements on pure electric vehicle (GB/T28382-2012)
 - Max speed > 80Km/hr; Range > 80Km, etc.
- Local government:
 - Encourage the local production and export of low-speed EVs
 - Provide formal license; Tolerate low-speed EVs without license and being used a taxi, etc., in remote areas



Our Practices (2)





Summary



- Chinese successful and high commercialized e-bike industry established a good foundation for its transition to produce low-speed electric vehicles with highly competitive cost-performance.
- Its unique structure of horizontal division may indicate an alternative solution for the commercialization of EVs.
- The private sector would be a viable and important player for Chinese future EV industry.



Outline



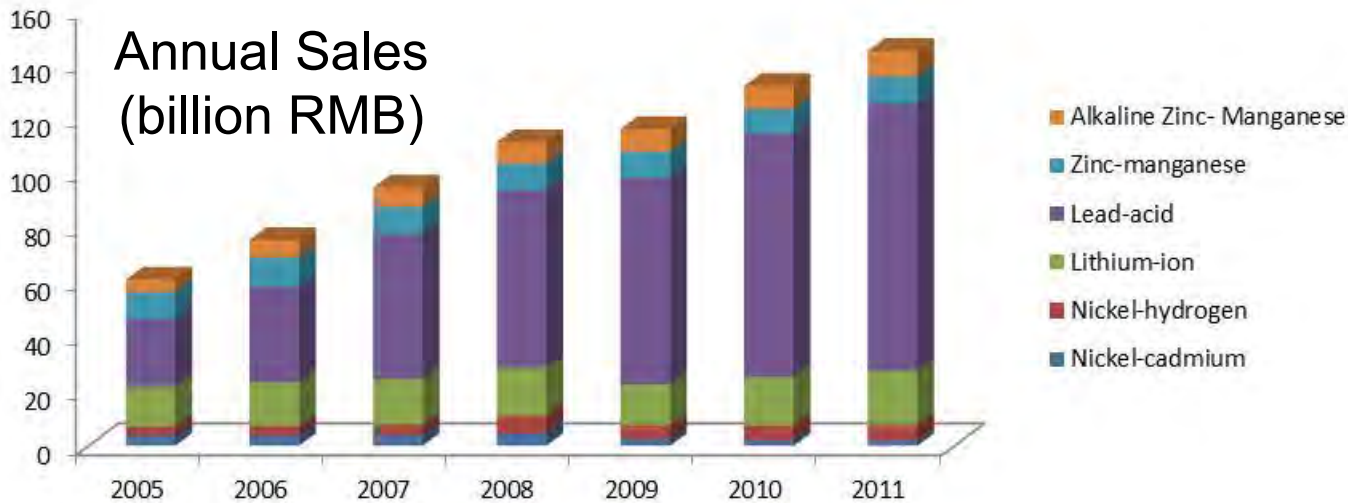
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Overview (Yr. 2011)



- Over 40 billion batteries produced; 146 billion RMB (\$23.5 billion) sales; Export 30.2 billion batteries (73.3%); Domestic market 11 billion batteries (26.7%).
- The average profit margin < 4~5%

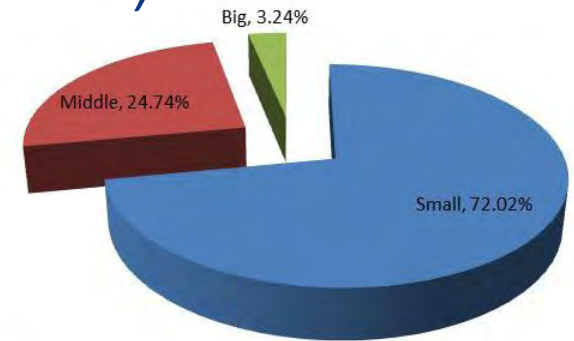
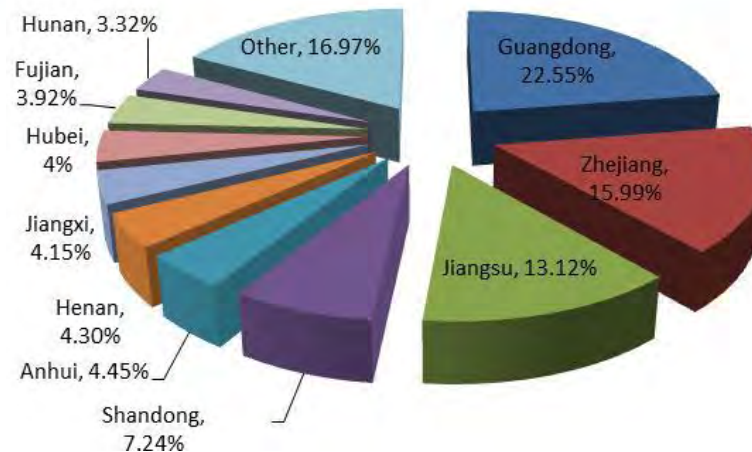
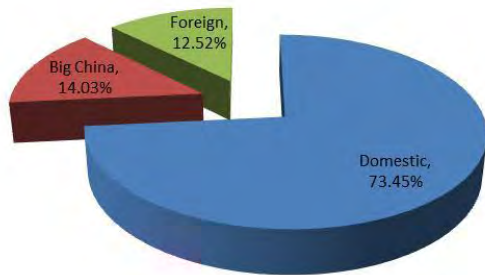




Battery Manufactures (Yr. 2011)



- 1,326 battery manufactures in total
 - 974 domestic companies (73.45%)
 - 955 small companies (72.02%)
 - 887 companies in coastal area (66.89%)



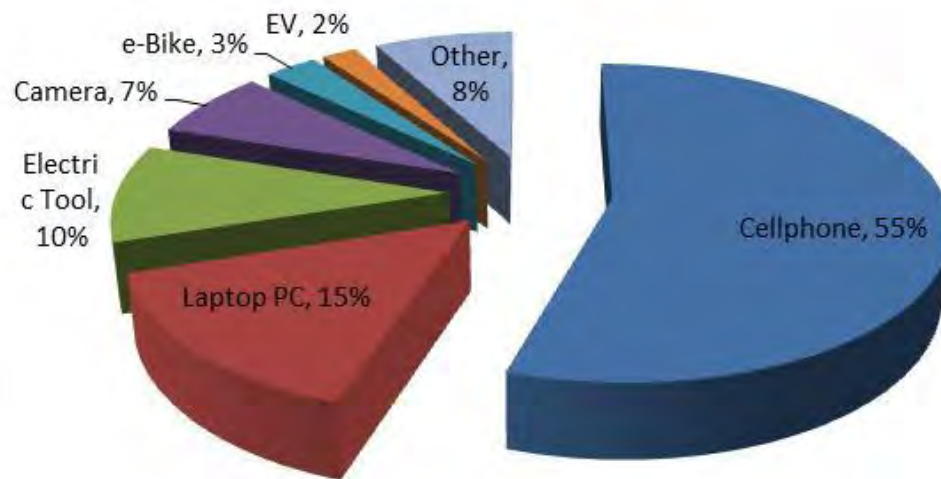


Top 10 Leading Companies (Yr. 2011)



- Japan (30.1%), Korea (33.9%) and China (29.2%) are providing 94% of the world lithium batteries.

Company	2011 Production (Million Batteries)
Samsung-TSDI, Tianjin	261
Sony, Wuxi	235
BYD, Shenzhen&Shanghai	216
ATL, Dongguan	199
Lishen, Tianjin	157
BAK, Shenzhen	155
B&K, Shenzhen	108
Sanyo, Beijing	102
TMB, Zhongshan	99
FST, Jiangxi	75





Materials (Yr. 2011)



- Cathode material (33,000 ton): 57% Lithium Cobalt Dioxide, 15% Lithium manganate, 19% Lithium terpolymer, 7% Lithium iron phosphate, 2% Others.
- Anode material (over 22,300 ton): mostly low-end graphitic negative electrode material
- Electrolytes (over 20,000 ton) : Guotai-Huarong in Zhangjiagang, Jiangsu Province (5,000 ton).
- Battery diaphragm (160 million m²): heavily depends on import materials (65%).



New Opportunities



- E-bike:
 - 97% of 150 million e-bikes are using lead-acid batteries in 2011.
 - 60%-70% lead-acid battery factories were forced to shut down in 2011 due to the pollution regulations.
 - 10% of e-bikes would use Lithium-ion batteries in 2015, i.e., 3 million e-bikes and 2 billion RMB Lithium-ion batteries
- Electric vehicles:
 - Commercialization is still challenging...



- Lead-acid batteries: China is producing 1/3 of the world lead-acid batteries.
 - Pollution problem and thus the build-up of national-wide recycling mechanism are major challenges.
- Supercapacitor (7.9 billion RMB sales in 2013):
 - Early stage commercialization: 20 companies
 - 3 major companies: 1) Kamcap in Jinzhou, Liaoning 2) Spscap in Beijing 3) Aowei in Shanghai





Summary



- Most of Chinese lithium-ion batteries are being produced for cellphones.
- Share in the laptop battery market is low due to the strict requirement on cell consistency.
- The potential for traction purpose is promising; however, the commercialization of EV is slow.
- E-bike would be a huge future market considering the stricter pollution regulations.
- Enlargement of the share in laptop PC, electric tools and mass energy storage is important.



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Conclusions



- Development of EV industry has a strategic importance for Chinese national energy security and the future of domestic automotive industry.
- Due to the technological limitations, the commercialization of high-end/full-size electric vehicles is much more difficult than expected.
- The successful private e-bike industry provides a market-oriented solution for developing low-speed EVs with a superior cost-performance.
- The commercialization and research on common core technologies are important.



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