Electric vehicles | CHINA

INDUSTRIALS / AUTOS & AUTO PARTS

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NOMURA INTERNATIONAL (HK) LIMITED

NEW THEME

Action

We believe that various electric vehicles (xEV) are the ultimate solution for the sustainability of the global auto industry. We think current EV technology is not sophisticated enough to compete with the internal combustion engine, but can be applied to niche markets. Penetration in niche markets will probably depend on government policy. We are cutting our rating for BYD to NEUTRAL (from Buy) on possible slower sales of EV products in 2011 and a demanding valuation. We think WATG, Tianneng Power, A123, Ningbo Yunsheng and CSR (NEUTRAL) have exposure to the EV theme.

Catalysts

Government policies on EV; auto sales volume.

Anchor themes

We think the niche auto market, including buses, taxis, and LSEVs, provides the first entry point for EV producers.

Stocks in focus

We believe the EV theme will support BYD's share price, although we find it difficult to see upside from here without clearer milestones; CSR could benefit due to its strong R&D ability in EV buses.

Stock	Rating	Price	Price target
BYD (1211 HK)	NEUTRAL↓	42.75	40.00↓
CSR (1766 HK)	NEUTRAL	10.78	11.20

↓ Downgrading from Buy. ↓ Cutting PT.

Closing prices as of 12 January 2011; local currency

So near and yet so far

① Technology ready to take off as a niche product

We believe the current EV technology cannot compete with the conventional internal combustion engine (ICE) on driving experience, but that it is ready to be applied to niche markets, though the speed of penetration depends on government commitment. We forecast EV (including plug-in hybrid) will account for only a 5% market share of annual passenger vehicle sales in 2020. We believe the current EV technology is ready to take off in niche markets.

② Not just a question of technology, but policy

Instead of technology, we believe the speed of EV penetration depends on policy support, encompassing a solution to public transportation, the economics of new infrastructure construction, and total CO2 emission from well to wheel. Consumer attitudes about driving experience could also be a hurdle for EV penetration, while government commitment is likely to be the key to success. In our view, China will be the largest EV market due to its large niche segments of the auto market and strong government execution power. BYD could be the most promising EV maker, in our view, due to its distinct positioning in the battery and auto industry.

③ Assume coverage of BYD with a NEUTRAL rating

We believe the investment story is more complicated than the development of the industry, as growth of EV sales is non-linear, and is highly dependent on government policies. For China in 2020F, we forecast EV to account for 5% of annual private passenger vehicle sales, 20% of the total taxi fleet, and 50% of the total city bus fleet. Successful penetration into niche markets will likely drive the China EV battery market to 69MWh (RMB137bn, ASP=RMB2,000/kwh) in 2020F, larger than the current size of the global lithium-battery market. We believe electrification of automobiles will provide more opportunities for component makers, including battery makers, than for OEMs. We are downgrading BYD to NEUTRAL, due to potential downside risk from short-term earnings growth, slow auto sales, and rich valuations, in our view. We base our HK$40.0 price target on an SOTP methodology. WATG, Tianneng Power, A123, Ningbo Yunsheng and CSR are possible rising stars for the upcoming EV theme.

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Autos and auto parts | CHINA

NOMURA

Passengers in front

Auto sales in China are set to expand by 28% to 17.5mn units in 2010F, following 46% growth in 2009. Sales have been underpinned by favourable government policies, momentum inland, and fundamental demand backed by rising personal wealth. We believe there is plenty of gas left in the tank. Our forecasts call for 15% growth in 2011F to 20mn, driven by inland demand (favouring small cars) and replacement demand (upward shift in product mix). We look for continued momentum in passenger cars, taking sales to 12.8mn (up 16.4%). Prices should stay strong in 2011F, with industry utilisation remaining above 80% amid a modest 15% forecast rise in capacity to 15mn. Leading automakers operate at higher utilisation, giving them significant operating leverage. In sum, we look for small cars to regain market share in 2011F on inland demand and possible policy support, while large sedan and SUV sales are likely to be backed by replacement demand. Commercial vehicles look set for slower growth on a high base and peaking-out of newly started FAI projects. In order, we favour Dongfeng, Geely and Great Wall for 1H11F. We think GAC (NEUTRAL) could come into focus for 2H11F. We cut Weichai to NEUTRAL on limited earnings growth potential. Also, we highlight Nissan, Hyundai, VW (BUYs) and BMW (NEUTRAL) as beneficiaries of continued growth in the China auto market.

① Prefer passenger vehicles over commercial vehicles

② Supply in focus: limited capacity growth

③ Investment conclusion: BUY Dongfeng, Geely and Great Wall

Nomura Anchor Reports examine the key themes and value drivers that underpin our sector views and stock recommendations for the next 6 to 12 months.

Stocks for action

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Summary

Executive summary

Auto: not just a transportation tool

The automobile has long been regarded as one of the most important innovations in history, significantly changing people's lifestyles, quality of life, and productivity. At the same time, the freedom to move, social status, and the fun of driving has fostered an automotive culture, making the automobile a distinct consumer product, rather than a simple transportation tool.

In 1973, the first oil shock hit the world. Since then, an increased number of policy makers, industry experts, and environmental protectionists have become aware of the problems caused by global motorization. In our opinion, the long-term sustainability of motorization faces three major challenges: energy shortages; global warming due to CO_2; and air quality, particularly in cities.

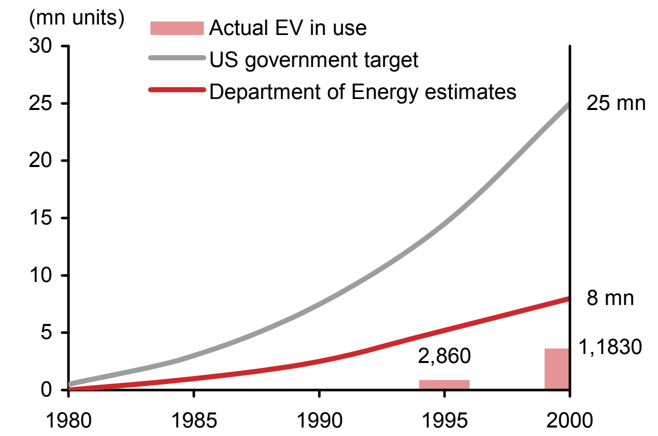
Eco vehicles have consistently been an R&D focus for global auto giants

Over the past three decades, new eco vehicles have consistently been an R&D focus for global auto giants. It is a major topic at global auto shows and is constantly under the media spotlight. Potential solutions to the sustainability of EV include bio-fuel, natural gas, further improvement of ICE via new technology, such as turbo engines and CVT, hybrid electric vehicles (HEV), plug-in hybrid electric vehicles (PHEV), battery electric vehicles (BEV), and fuel-cell electric vehicles (FCEV). Over the past decade, it seems that hybrid vehicles have gradually been taking the lead, and more and more people are starting to believe that EVs could help the environment, and that hybrid vehicles could just be an intermediate stage in the transformation phase.

This is not new. In 1970s, the US Department of Energy forecast that electric car ownership would reach 8mn units in 2000 (the US government set a goal of 25mn units ownership), with a total penetration rate of 3.6%. It is perhaps ironic that EV ownership was only 56,901 units in the US in 2008, with a total penetration rate of 0.028% (source: US Department of Energy). We attribute the slower-than-expected progress of electric vehicle development to:

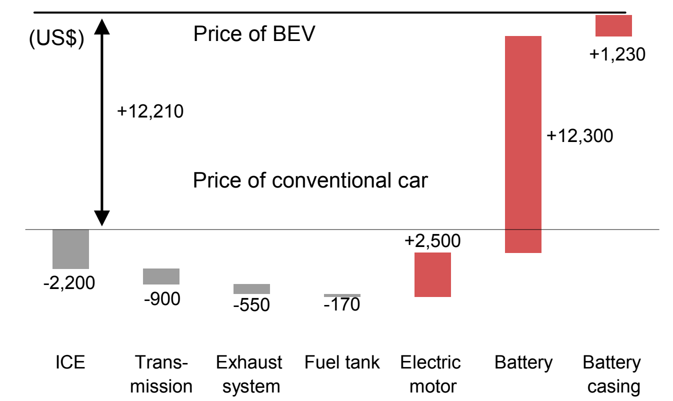
- **Inferior EV technology.** The functionality and practicability of an EV still does not match that of an ICE, including range, top speed, acceleration, and the driver experience, though EVs have enjoyed technological breakthroughs.
- **Consumer mentality.** Consumers like to pay only for something cheaper or better than what they are currently using. Meanwhile, the current eco car is not only more expensive but also offers less functionality (or more inconvenience). We think consumers do not want to pay for something "intangible", such as the prevention of air pollution and global warming.

Exhibit 1. Electric vehicle ownership forecasted by US Department of Energy in 1978



Source: Duke Energy, US Department of Energy, Nomura research

Exhibit 2. Price difference breakdown between ICE car and BEV



Source: Bloomberg, Nomura research

After three decades of "trial and error" with new-energy vehicles, it seems that the BEV solution is now widely accepted as a vehicular system capable of saving the planet from further pollution. We are not as optimistic as many industry experts on BEV development, especially in the next two to three years. We do not foresee a technological breakthrough that will dramatically narrow the price gap between BEV and ICE in the near future, and we do not foresee consumer behaviour changing dramatically to accept inferior functionality for a higher price. Moreover, it would be difficult to build an extensive civil infrastructure network, in this case charging stations, that would support BEV penetration.

However, we believe that the current BEV technology, including the types of battery, is reasonable enough to make BEVs a transportation tool, although it is not sophisticated enough to produce a car that would be fun to drive. Therefore, we believe that with strong government support the current BEV could be widely applied to some niche products, such as taxis, buses, and low-speed electric vehicles, for which driving enjoyment is not really a consideration. We forecast that EVs (including plug-in hybrids) will account for only 5% of annual PV sales in 2020F, and that hybrid vehicles (including plug-in hybrids) would be the mainstream eco-car products in the coming decade, but that the ICE will still take the major share of the market. Meanwhile, we believe, with strong government support, the current EV technology is ready to take off in niche markets, providing significant opportunities for battery and other component makers.

Exhibit 3. xEV market and battery market forecast

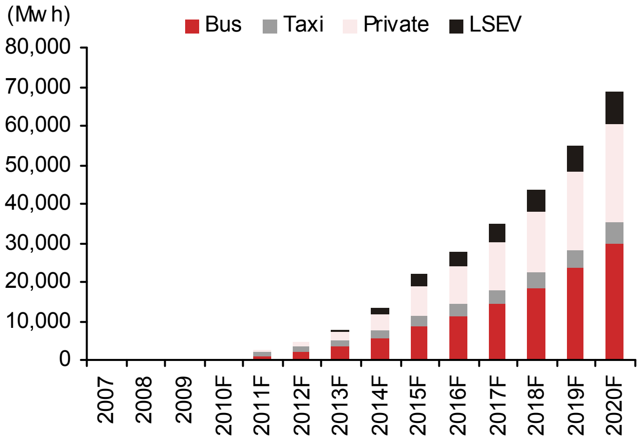
	2012F	2015F	2020F
EV bus ownership (units)	30,000	118,665	397,003
EV taxi ownership (units)	55,626	121,568	281,861
Private EV sedan sales (units)	58,094	385,162	1,255,446
EV bus market share in total public bus fleet (%)	6.0	20.0	50.0
EV taxi market share in total taxi fleet (%)	5.0	10.0	20.0
EV PV sales as % of total annul PV sales	**0.5**	**2.0**	**5.0**
PV sales (mn units)	14	21	27
PV parc (mn units)	86	137	204
LSEV ownership (using Li battery), units		400,000	1,000,000
LSEV total ownership, units		20,000,000	50,000,000
Total EV battery market size (MWh)			
Bus	2,250	8,900	29,775
Taxi	1,113	2,431	5,637
Private EV	1,162	7,703	25,109
LSEV		3,200	8,000
Total (without LSEV)	**4,524**	**19,035**	**60,521**
Total with LSEV	**4,524**	**22,235**	**68,521**
Battery unit price (RMB/kWh)	3,000	2,500	2,000
EV battery market (RMBmn)	**13,573**	**55,586**	**137,043**

Source: Nomura estimates

Battery accounts for more than 100% of the additional cost from conventional ICE car to a BEV in our view. Thus, we believe increasing the penetration rate of EV in China's niche markets could provide ample growth opportunities for battery and other EV-related component makers. Our base-case scenario analysis shows the global battery market will post a CAGR of 8% to RMB255bn in 2020F, doubling the current battery market size, in our view. We think that the EV battery market in China will reach

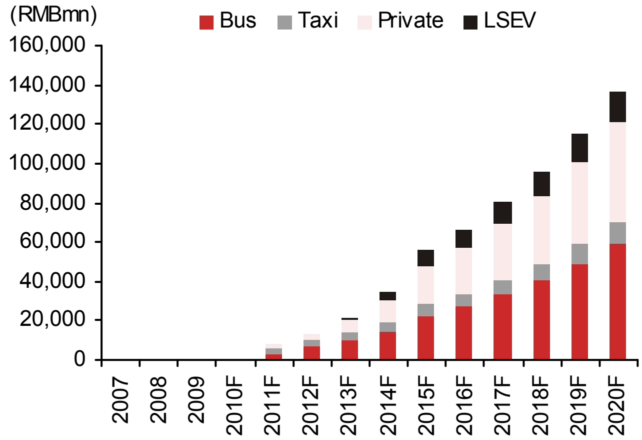
20GWh (RMB51bn, assuming an ASP of 2,500 RMB/kwh) in 2015F, and 64GWh (RMB129bn, assuming an ASP of 2,000 RMB/kwh) in 2020F, which would account for one-third to one-half of the global market due to applications in niche auto markets. We expect the electrification of automobiles to provide more upside opportunity for components makers than for OEMs.

Exhibit 4. China EV battery market (MWh)



Source: CEIC, Nomura estimates

Exhibit 5. China EV battery market (RMBmn)



Source: CEIC, Nomura estimates

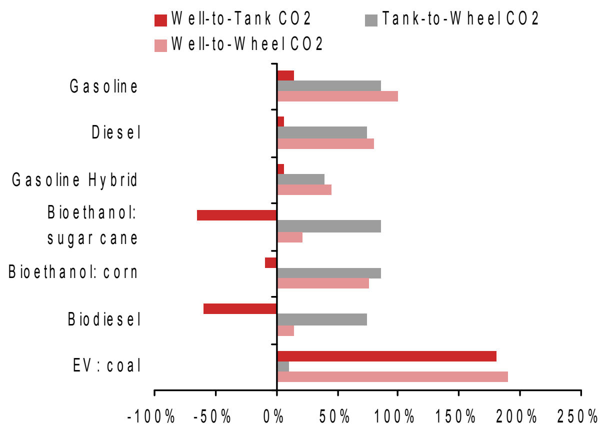
We believe that, due to limited oil reserves, EVs are the ultimate direction for the auto industry even if they fail to provide driver enjoyment. However, the speed of penetration is not just a question of technological breakthroughs but depends on government policies. Ultimately, it is a question of philosophy. To some extent, the electrification of the automobile is a top-down problem, raised and pushed by politicians and environmentalists, while the solution to it has to be bottom-up, in the sense that successful EV adoption has to create real demand among consumers, in our view. This is, we believe, why the evolution of EVs has been very slow.

We believe that the speed of EV penetration is a political question, encompassing a solution to public transportation, the economics of new infrastructure construction, and total CO_2 emissions from oil well to wheel. Consumer attitudes towards the driving experience also could be a hurdle to EV penetration, while government commitment is key to success, in our view. As shown in the Exhibit below right, EVs sometimes emit a higher amount of CO_2 from "well to wheel", if the electricity that they are using is generated by coal. We believe that a combination of technologies is needed to protect the environment, not just a breakthrough in EV technology, but that again, this will depend largely on government policies.

In our view, China will be the largest EV market due to the large size of its niche markets and the power of the government to carry out its policies. BYD is the most promising EV manufacturer, in our view, due to: 1) its distinct positioning in the battery and auto industry; and 2) its access to the largest xEV market. BYD is transforming itself into a new-energy conglomerate, encompassing EVs, storage batteries, and solar power. Continuous R&D investment and strong management execution record support the company's current premium valuation, in our view.

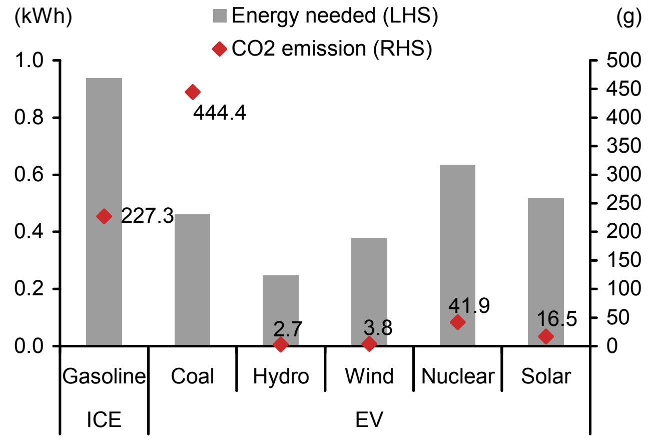
China electric vehicle industry cheatsheet

Exhibit 6. Life cycle carbon emission



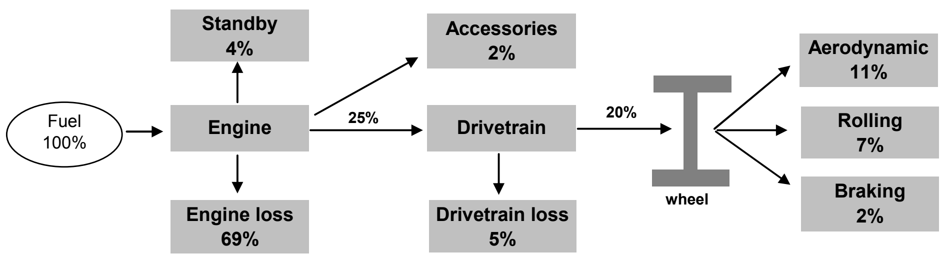
Source: Toyota, Nomura research

Exhibit 7. Energy need and CO2 emission per 1km by different drive-trains



Source: Wikipedia, Nomura research

Exhibit 8. Energy flows for a midsize passenger car during urban driving



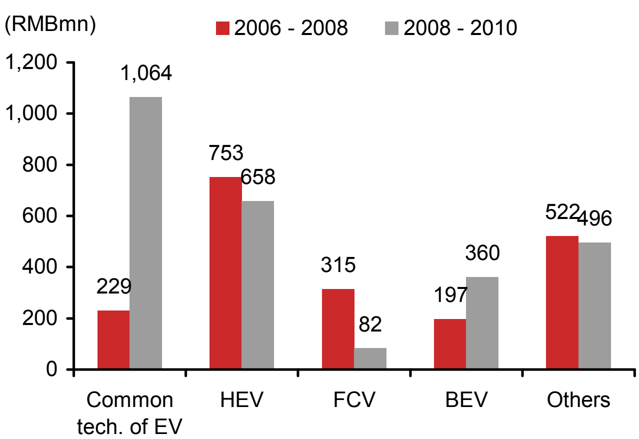
Source: US Department of Energy

Exhibit 9. Energy density comparison

	Gasoline	Diesel	Lead-acid	NiMH	Li-ion
Specific energy (Wh/kg)	13,000	12,900	35	70	140
Energy density (Wh/L)	9,600	10,500	90	140	300

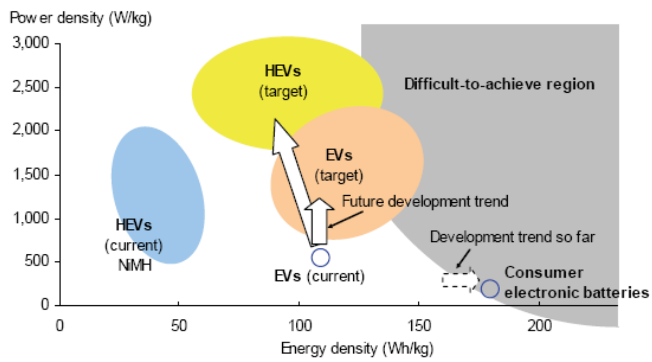
Source: Wikipedia, Nomura research

Exhibit 10. Government subsidies to xEV R&D projects through 863 program



Source: NDRC, Nomura research

Exhibit 11. Performance of EV batteries



Source: Nomura research

Valuation

Valuation: how to value concept stock

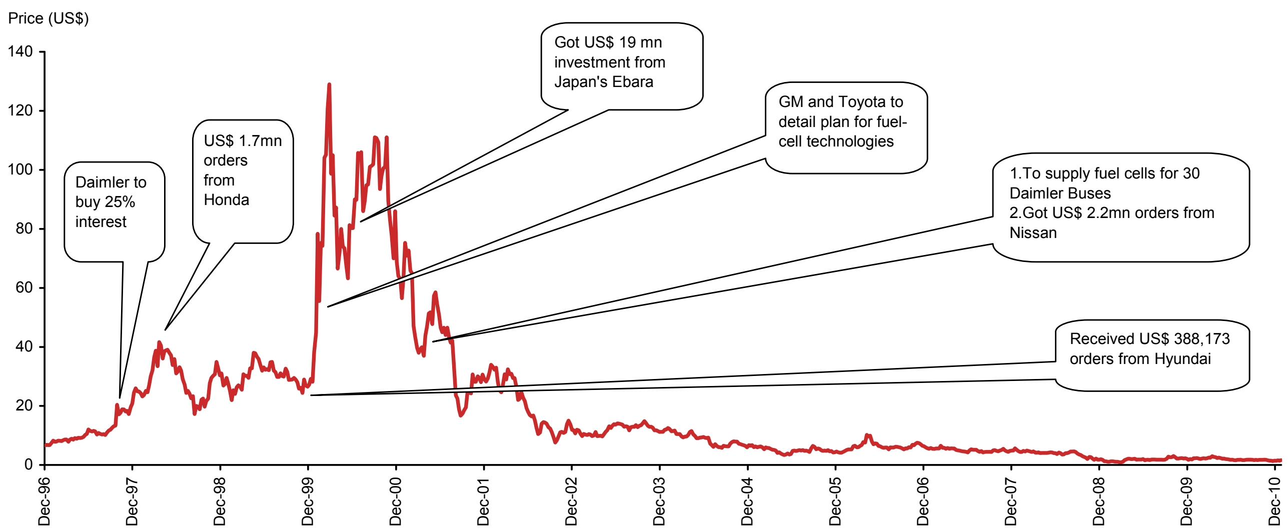
In the late 1990s, fuel-cell electric vehicles were the hottest topic in the auto industry. In 1999 *Time* magazine named the chairman of Ballard Power Systems, then the largest fuel-cell producer, a “Hero for the Planet”. From 1997 to 2000 the share price of Ballard increased 1,900% due to high expectations of fuel-cell car commercialization, but it retreated sharply when investors realized that fuel-cell cars were still a faraway dream. Over the past five years, the stock has traded at US$4 on average, near its pre-rally levels in 1996.

In a similar vein, like those of most Internet stocks, the share price of Amazon rallied in the late 1990s; it rose about 100x from 1997 to 1999, then fell sharply to US$6 when the dotcom bubble burst in 2001. However, compared to Ballard, Amazon managed to become profitable in 2002 after the “online retail” concept debuted in 1997 on the NASDAQ. Since then the share has continued to climb on profit growth and multiple expansion, and it surpassed US$180 in December 2010, an all-time high.

We believe that profitability is the main driver of share-price performance after a concept bubble bursts. In the early stages of trading a concept share, newsflow played an important role in driving the share price, in our view. Many concept stocks rallied when a concept was first introduced to the market, but the rally confused investors with a focus on fundamentals. Thereafter, it appeared that “order book” became a share price driver. For example, the share price of Ballard rallied every time with newsflow of fuel-cell supply contracts with various leading global automakers. Likewise, the share price of Amazon reacted to its “website click rate” and profit growth. This focus on concept soon started to fade and investors returned focus to a company’s cashflow and fundamentals, which finally helped separate the wheat from the chaff.

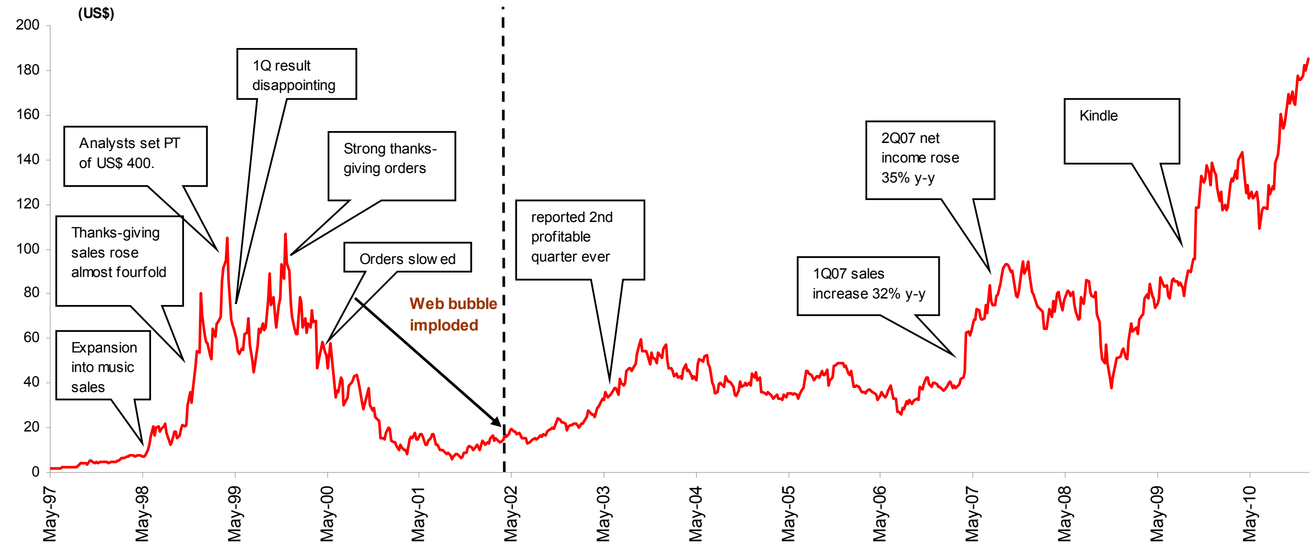
EV is now one of the most popular concepts in the equity market and, in our view, the concept renews itself each time oil prices increase sharply. We see EV becoming the ultimate direction for the auto industry, although we note headwinds facing EVs before they become mainstream automobiles, which we think could take as long as three decades. We believe the penetration of EV is not just a question of technological breakthrough, but a question of philosophy. Government policy over EV involves dynamic factors such as solutions to public transportation, the economics of new infrastructure construction and total CO_2 emissions from well to wheel.

Exhibit 12. Share price of Ballard (1997~2011) and catalysts



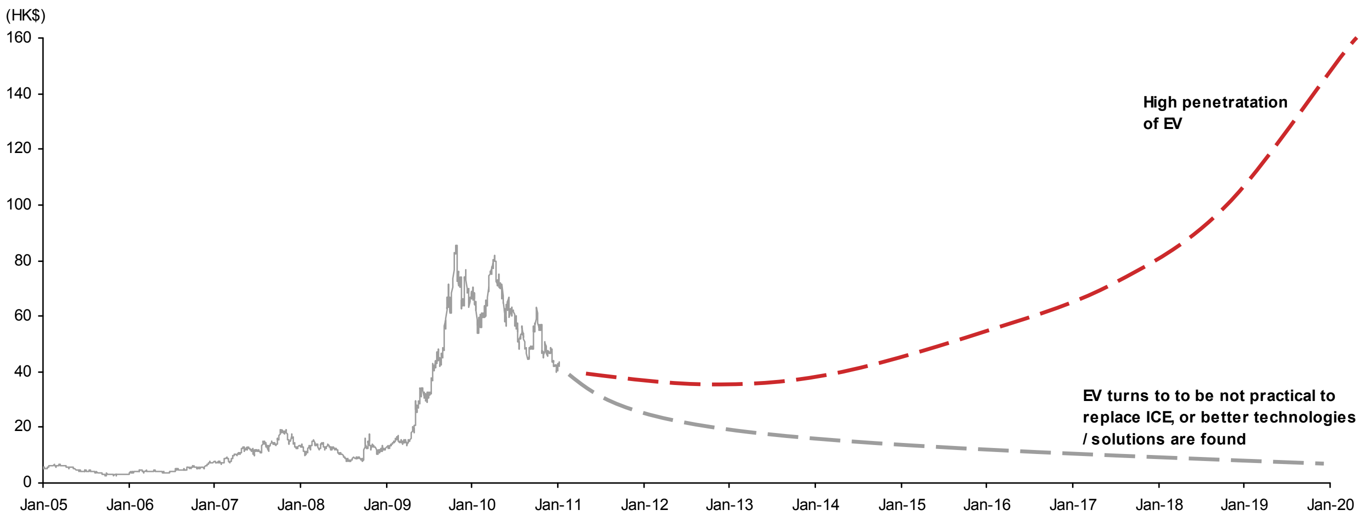
Source: Nomura research

Exhibit 13. Share price of Amazon(1997~2011) and catalysts



Source: Nomura research

Exhibit 14. BYD: to be or not to be



Source: Nomura research

BYD, as a world-leading EV producer, deserves a valuation premium, in our view. We believe the current EV technology is ready to take off in niche markets such as taxis, buses, city vehicles, and rural low-speed vehicles, for which price and safety are more important considerations for a buyer than energy density and driving experience. This matches BYD's lithium iron phosphate (LFP) battery chemistry. With China's electric bus plans underway, we believe the EV used in the battery business of BYD could show significant improvement after 2015F. In our view, if EV proves to be the direction for the auto industry (at least in the niche market) and if BYD continues to lead the EV market, then its share price should rise significantly when EV starts making profits. Otherwise, the share price will decline to where the rally started in 2009, even if Warren Buffet holds the stock forever, in our opinion.

We believe the investment story is more complicated than industry development, as growth of EV sales is non-linear, and is highly dependent on government policies. For 2020F, we forecast that EV will account for 5% of annual private sedan sales, 20% of the total taxi fleet, and 50% of the total city bus fleet. We think that successful penetration into niche markets will likely drive the China EV battery market to 69MWh (RMB137bn, ASP=RMB2,000/kwh) in 2020F, larger than the current size of the global lithium-battery market. We believe that the electrification of automobiles will provide more opportunities for component makers, including battery makers, than for OEMs. We are lowering our rating for BYD to NEUTRAL, due to what we see as potential downside risk for its short-term earnings growth, slow auto sales, and rich valuations. We base our HK$40.0 price target on an SOTP methodology. WATG, Tianneng Power, Ningbo Yunsheng, and CSR are possible rising stars for the upcoming EV theme.

Exhibit 15. Valuation comp table

				Historical Performance			Market Cap	EPS CAGR	PE				PB				EV/Sales				EV/EBITDA				ROE				PEG			
Company Name	Ticker	Rating	Price	1W chg	1M chg	1Y chg	(US$ mn)	(09A-12E)	09A	10E	11E	12E	09A	10E	11E	12E	09A	10E	11E	12E	09A	10E	11E	12E	09A	10E	11E	12E	09A	10E	11E	12E
GS Yuasa Corp	6674 JP	Neutral	590	0.5%	6.7%	-10.0%	2,947	29.8%	24.5	27.4	20.5	20.5	2.5	2.3	2.1	2.1	1.1	1.0	0.9	0.9	10.6	9.8	8.4	8.6	8%	8%	10%	10%	0.8	0.9	0.7	0.7
Panasonic Corp	6752 JP	Not rated	1,174	0.6%	-0.6%	-19.1%	34,875	n.a.	134.9	23.9	17.9	17.9	0.9	0.9	0.8	0.8	0.4	0.4	0.4	0.4	4.9	6.1	5.8	6.1	-4%	4%	5%	5%	n.a.	n.a.	n.a.	n.a.
Asahi Kasei Corp	3407 JP	Neutral	545	2.4%	5.3%	14.0%	9,320	39.0%	19.2	12.7	12.2	12.2	1.2	1.1	1.1	1.1	0.5	0.6	0.6	0.6	4.3	4.7	4.8	4.5	4%	9%	9%	9%	0.5	0.3	0.3	0.3
Kureha Corp	4023 JP	not rated	496	2.2%	-0.8%	6.7%	1,111	57.2%	32.2	29.6	19.8	19.8	1.0	0.9	0.9	0.9	0.9	1.0	0.9	0.9	6.2	7.7	6.1	5.9	2%	3%	5%	5%	0.6	0.5	0.3	0.3
Ube Industries Ltd	4208 JP	Neutral	257	6.2%	16.7%	-0.4%	3,134	40.0%	16.3	14.6	13.4	13.4	1.5	1.4	1.3	1.3	0.8	0.8	0.8	0.8	6.3	7.4	7.0	7.0	5%	10%	9%	9%	0.4	0.4	0.3	0.3
Hitachi Chemical Co Ltd	4217 JP	Neutral	1,738	-0.5%	0.3%	-5.3%	4,334	11.0%	12.4	13.3	12.4	12.4	1.3	1.3	1.2	1.2	0.5	0.6	0.6	0.6	3.5	4.0	3.9	4.2	9%	10%	9%	9%	1.1	1.2	1.1	1.1
Furukawa Electric Co Ltd	5801 JP	Neutral	378	2.7%	5.9%	-11.1%	3,216	31.9%	24.9	19.0	14.4	14.4	1.6	1.6	1.4	1.4	0.7	0.7	0.7	0.7	7.4	8.1	7.6	7.0	6%	9%	12%	12%	0.8	0.6	0.5	0.5
Samsung SDI Co Ltd	006400 KS	Neutral	169,500	-5.8%	-4.2%	25.9%	6,951	28.1%	33.5	23.6	19.4	16.0	1.5	1.5	1.4	1.3	1.7	1.4	1.5	1.6	12.4	11.4	10.2	9.7	5%	6%	7%	9%	1.2	0.8	0.7	0.6
LG Chem Ltd	051910 KS	Buy	419,000	-0.5%	12.4%	92.1%	24,744	21.6%	20.5	13.2	12.0	11.7	5.0	3.9	3.1	2.6	1.1	1.4	1.3	1.4	6.4	8.7	7.4	6.9	29%	33%	28%	24%	0.9	0.6	0.6	0.5
A123 Systems Inc	AONE US	not rated	10.77	11.8%	15.7%	-46.3%	1,131	n.a.	n.a.	n.a.	n.a.	n.a.	2.6	2.5	3.0	3.4	6.8	8.5	3.9	1.8	n.a.	n.a.	n.a.	n.a.	n.a.	-29%	-26%	-10%	n.a.	n.a.	n.a.	n.a.
Energy Conversion Devices	ENER US	not rated	4.57	-1.8%	-7.3%	-59.4%	228	n.a.	n.a.	n.a.	n.a.	n.a.	0.8	0.7	0.7	0.7	1.2	1.0	0.8	0.8	n.a.	730.8	14.8	19.8	-88%	-17%	-8%	-8%	n.a.	n.a.	n.a.	n.a.
Global battery and battery material average									**35.4**	**19.7**	**15.8**	**15.4**	**1.8**	**1.6**	**1.5**	**1.5**	**1.4**	**1.6**	**1.1**	**1.0**	**6.9**	**79.9**	**7.6**	**8.0**	**-2%**	**4%**	**6%**	**7%**	**0.8**	**0.7**	**0.6**	**0.5**
Shenzhen Desay	000049 CH	not rated	25.76	-4.2%	-9.1%	125.8%	527	n.a.	77.0	72.0	43.8	25.7	22.4	20.3	13.7	9.1	3.8	3.3	2.5	1.8	n.a.	22.0	12.8	n.a.	-27%	33%	35%	35%	n.a.	n.a.	n.a.	n.a.
Hunan Corun New Energy	600478 CH	not rated	20.16	13.9%	15.5%	16.2%	954	124.3%	220.6	93.0	39.6	25.3	6.0	8.3	7.1	5.8	4.0	5.5	3.8	3.0	n.a.	59.1	25.1	n.a.	3%	9%	19%	25%	1.8	0.7	0.3	0.2
Jiangsu Guotai International	002091 CH	not rated	23.91	-9.7%	-19.3%	21.7%	1,067	29.8%	41.9	34.1	26.4	22.0	8.0	7.1	5.5	4.2	2.6	1.9	1.6	1.4	n.a.	23.7	16.5	n.a.	20%	20%	22%	22%	1.4	1.1	0.9	0.7
CITIC Guoan Information Indust	000839 CH	not rated	11.87	-1.8%	-11.2%	-26.0%	2,803	15.9%	94.4	34.4	26.8	19.3	3.2	n.a.	n.a.	n.a.	14.8	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	11%	n.a.	n.a.	n.a.	5.9	2.2	1.7	1.2
Ningbo Shanshan Co Ltd	600884 CH	not rated	23.28	-6.3%	-4.3%	36.6%	1,432	57.3%	108.3	43.6	30.1	25.5	3.0	2.6	2.5	2.2	3.7	4.1	3.1	2.4	n.a.	33.5	22.6	n.a.	3%	4%	7%	9%	1.9	0.8	0.5	0.4
China BAK Battery Inc	CBAK US	not rated	2.01	3.1%	16.2%	-31.6%	128	n.a.	n.a.	n.a.	40.2	40.2	0.8	n.a.	n.a.	n.a.	1.3	1.1	1.0	1.0	n.a.	12.5	8.4	n.a.	-21%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
China battery and battery material average									**108.5**	**55.4**	**34.5**	**26.3**	**7.2**	**9.6**	**7.2**	**5.3**	**5.0**	**3.2**	**2.4**	**1.9**	**n.a.**	**30.2**	**17.1**	**n.a.**	**-2%**	**16%**	**21%**	**23%**	**2.8**	**1.2**	**0.9**	**0.7**
Tesla Motors Inc	TSLA US	not rated	26.96	0.5%	-11.8%	n.a	2,515	n.a.	n.a.	n.a.	n.a.	n.a.	11.4	9.2	79.3	74.9	18.8	21.8	16.3	3.7	n.a.	n.a.	n.a.	n.a.	n.a.	-114%	-202%	-190%	n.a.	n.a.	n.a.	n.a.
CSR Corp	1766 HK	Neutral	10.78	-1.8%	5.6%	108.3%	16,417	52.6%	63.4	35.5	23.0	17.9	6.1	5.4	4.6	3.9	2.0	1.5	1.1	0.9	37.8	21.5	13.7	10.1	9%	14%	18%	19%	1.6	0.9	0.6	0.4
Wolong Electric Group Co Ltd	600580 CH	not rated	15.97	-4.9%	-14.5%	-1.3%	1,044	23.7%	30.5	26.6	19.6	15.8	2.9	2.7	2.5	2.3	2.5	2.2	1.8	1.4	n.a.	17.5	12.9	n.a.	17%	12%	13%	16%	1.3	1.1	0.8	0.7
Ningbo Yunsheng Group Co Ltd	600366 CH	not rated	23.71	-9.2%	-16.0%	54.1%	1,402	n.a.	19.8	43.6	31.6	21.3	5.4	5.0	4.4	3.7	5.3	4.7	3.8	2.9	n.a.	n.a.	n.a.	n.a.	44%	12%	14%	18%	n.a.	n.a.	n.a.	n.a.
Nidec Corp	6594 JP	Buy	8,720	3.1%	0.1%	-0.1%	15,124	17.9%	18.5	19.6	15.8	15.8	3.5	3.2	2.7	2.7	1.8	2.0	1.7	1.7	8.8	10.0	8.7	8.1	16%	17%	18%	18%	1.0	1.1	0.9	0.9
Rohm Co Ltd	6963 JP	Neutral	5,550	0.4%	3.0%	-12.6%	7,717	66.3%	33.1	38.6	22.5	22.5	0.9	0.9	0.9	0.9	0.9	1.1	1.0	1.0	3.3	4.8	4.2	4.1	1%	2%	4%	4%	0.5	0.6	0.3	0.3
EV & component maker average (except Tesla)									**33.1**	**32.8**	**22.5**	**18.7**	**3.8**	**3.4**	**3.0**	**2.7**	**2.5**	**2.3**	**1.9**	**1.6**	**16.6**	**13.4**	**9.9**	**7.5**	**17%**	**11%**	**13%**	**15%**	**1.1**	**0.9**	**0.7**	**0.6**
Dongfeng Motor	489 HK	BUY	14.30	-2.7%	-5.9%	29.2%	15,688	27.8%	16.7	9.2	8.6	8.0	3.9	2.8	2.2	1.8	0.9	0.7	0.5	0.4	6.7	4.0	3.0	2.3	26%	35%	28%	24%	0.6	0.3	0.3	0.3
Guangzhou Auto	2238 HK	NEUTRAL	10.30	-5.1%	-1.5%	n.a	8,159	25.6%	16.0	10.7	9.2	8.1	2.6	2.9	2.3	1.9	1.0	0.8	0.7	0.5	10.6	7.7	6.5	4.9	17%	32%	28%	26%	0.6	0.4	0.4	0.3
Geely Automobile	175 HK	BUY	3.80	-0.5%	-0.3%	-7.1%	3,607	26.4%	19.3	15.7	11.5	9.6	3.6	3.0	2.4	1.9	1.7	1.3	1.0	0.9	14.8	11.6	7.9	6.0	22%	23%	27%	26%	0.7	0.6	0.4	0.4
Brilliance China	1114 HK	REDUCE	5.55	-9.1%	-18.0%	154.6%	3,532	n.a.	(12.9)	21.2	15.6	12.5	4.7	3.8	3.1	2.5	3.4	2.1	1.8	1.5	31.3	25.8	22.2	18.2	-30%	20%	22%	22%	n.a.	n.a.	n.a.	n.a.
Great Wall Motor	2333 HK	BUY	25.45	15.8%	7.4%	145.0%	3,767	38.5%	23.1	12.0	9.9	8.7	3.1	2.6	2.1	1.8	1.8	1.1	0.9	0.7	17.0	7.0	5.5	4.3	14%	23%	24%	22%	0.6	0.3	0.3	0.2
Weichai Power	2338 HK	NEUTRAL	48.35	3.0%	-11.4%	32.3%	11,804	3.5%	10.0	10.6	10.6	9.1	2.9	3.8	2.9	2.2	2.1	1.2	1.0	0.8	12.9	6.7	6.0	4.6	35%	44%	31%	27%	2.9	3.1	3.1	2.6
Sinotruk	3808 HK	BUY	7.07	-8.7%	-12.9%	-26.6%	2,578	14.5%	13.7	10.4	9.8	9.1	1.0	0.9	0.8	0.8	0.5	0.4	0.3	0.3	7.0	4.5	4.4	3.8	7%	9%	9%	9%	0.9	0.7	0.7	0.6
BYD	1211 HK	Nuetral	42.75	-1.8%	-1.8%	-34.2%	12,448	11.4%	20.6	29.8	23.4	17.9	4.7	4.6	3.8	3.2	2.1	1.9	1.7	1.5	14.5	16.6	13.1	10.5	27%	16%	18%	19%	1.8	2.6	2.0	1.6
H-share auto average									**13.3**	**14.9**	**12.3**	**10.4**	**3.3**	**3.0**	**2.5**	**2.0**	**1.7**	**1.2**	**1.0**	**0.8**	**14.4**	**10.5**	**8.6**	**6.8**	**15%**	**25%**	**23%**	**22%**	**1.2**	**1.1**	**1.0**	**0.9**
Shanghai Auto	600104 CH	BUY	15.48	3.6%	-9.7%	-10.2%	21,790	184.5%	20.0	10.9	8.7	7.9	3.8	3.1	2.6	2.1	1.3	0.9	0.4	0.4	n.a.	77.9	6.7	5.6	2%	16%	24%	25%	0.1	0.1	0.0	0.0
Jinan Truck	000951 CH	Not rated	26.19	-10.7%	-15.5%	-16.7%	1,601	41.5%	13.0	12.1	11.0	8.7	3.0	2.9	2.3	1.8	0.5	0.5	0.5	0.4	n.a.	8.9	7.8	n.a.	16%	22%	21%	20%	0.3	0.3	0.3	0.2
Yutong Bus	600066 CH	Not rated	22.70	2.6%	0.0%	24.8%	1,806	28.4%	15.5	15.0	12.9	10.0	5.6	4.9	4.2	3.6	0.9	1.0	0.8	0.7	n.a.	11.2	9.6	n.a.	29%	32%	33%	32%	0.5	0.5	0.5	0.4
King Long Motor	600686 CH	Not rated	9.68	2.4%	2.4%	-3.4%	658	26.3%	17.4	18.7	16.9	14.3	2.6	2.4	2.0	1.7	0.4	0.3	0.3	0.3	n.a.	n.a.	n.a.	n.a.	10%	14%	15%	14%	0.7	0.7	0.6	0.5
Foton Motor	600166 CH	Not rated	23.34	-3.7%	-10.8%	14.5%	3,689	33.8%	11.3	11.6	10.7	8.5	3.1	3.7	2.8	2.2	0.3	0.4	0.3	0.3	n.a.	7.9	6.8	n.a.	29%	34%	29%	28%	0.3	0.3	0.3	0.3
Chang'an Automobile	000625 CH	Not rated	9.64	-0.7%	-11.2%	-27.1%	3,043	40.2%	11.5	10.1	9.3	7.6	2.2	1.8	1.5	1.3	0.7	0.6	0.6	0.4	n.a.	11.8	9.9	n.a.	13%	20%	18%	19%	0.3	0.3	0.2	0.2
FAW Xiali	000927 CH	Not rated	8.76	-1.6%	-4.6%	-15.3%	2,098	58.0%	34.9	24.5	19.6	20.0	3.8	n.a.	n.a.	n.a.	1.5	1.5	2.5	11.2	n.a.	n.a.	n.a.	n.a.	5%	5%	4%	4%	0.6	0.4	0.3	0.3
Jianghuai Automobile	600418 CH	Not rated	11.15	3.4%	-4.0%	13.3%	2,158	79.4%	15.5	13.1	9.4	n.a.	2.8	2.7	2.2	1.8	0.5	0.5	0.4	0.3	n.a.	8.5	6.0	n.a.	8%	20%	24%	24%	0.2	0.2	0.1	n.a.
Jiangling Motors	000550 CH	Not rated	26.02	0.2%	-7.5%	26.5%	3,107	32.3%	13.2	12.8	10.8	9.5	3.9	3.7	3.0	2.4	1.2	1.0	0.9	0.7	n.a.	6.6	5.6	n.a.	24%	28%	27%	25%	0.4	0.4	0.3	0.3
A-share auto average									**16.9**	**14.3**	**12.2**	**10.8**	**3.4**	**3.2**	**2.6**	**2.1**	**0.8**	**0.8**	**0.7**	**1.6**	**n.a.**	**19.0**	**7.5**	**5.6**	**15%**	**21%**	**22%**	**21%**	**0.4**	**0.4**	**0.3**	**0.3**
Minth	425 HK	Not rated	13.02	12.8%	5.1%	25.7%	1,825	19.5%	14.5	14.7	12.3	10.1	2.4	2.7	2.4	2.1	2.0	2.9	2.3	1.9	7.2	10.2	8.3	6.3	17%	18%	18%	19%	0.7	0.8	0.6	0.5
Xinyi Glass	868 HK	Not rated	6.74	-0.3%	8.9%	90.1%	3,044	41.1%	20.1	17.8	12.8	10.7	4.1	4.0	3.5	3.0	2.4	4.3	3.0	2.4	7.1	14.4	9.6	7.9	16%	22%	28%	28%	0.5	0.4	0.3	0.3
Xingda International	1899 HK	Not rated	8.39	-4.9%	-4.2%	93.9%	1,571	29.5%	11.4	12.3	9.5	7.9	2.6	2.3	1.9	1.6	1.6	2.4	1.9	1.5	4.7	8.4	6.4	5.3	17%	19%	20%	21%	0.4	0.4	0.3	0.3
Fuyao Glass	600660 CH	Not rated	10.45	0.7%	-9.2%	-22.4%	3,150	30.1%	11.4	11.8	10.0	8.4	3.9	3.6	2.9	2.3	3.4	3.1	2.6	2.2	n.a.	9.2	7.8	n.a.	29%	32%	30%	29%	0.4	0.4	0.3	0.3
Dongan Auto Engine	600178 CH	Not rated	11.61	-5.5%	-12.2%	-31.8%	802	35.1%	22.6	16.3	13.2	9.2	2.3	n.a.	n.a.	n.a.	2.8	2.3	2.0	1.5	n.a.	n.a.	n.a.	n.a.	12%	n.a.	n.a.	n.a.	0.6	0.5	0.4	0.3
Weifu High-tech	000581 CH	Not rated	36.79	-9.9%	-7.6%	98.9%	2,908	39.9%	24.8	23.9	20.2	16.9	6.1	5.7	4.9	4.0	2.7	4.0	3.4	2.7	n.a.	23.1	20.5	n.a.	17%	20%	20%	22%	0.6	0.6	0.5	0.4
Qingdao Doublestar	000599 CH	Not rated	5.51	-4.2%	-11.0%	-38.3%	437	n.a.	57.2	n.a.	n.a.	n.a.	2.0	n.a.	n.a.	n.a.	0.9	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	20%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
China Auto Parts Average									**23.2**	**16.1**	**13.0**	**10.5**	**3.3**	**3.7**	**3.1**	**2.6**	**2.3**	**3.2**	**2.5**	**2.0**	**6.3**	**13.1**	**10.5**	**6.5**	**18%**	**22%**	**23%**	**24%**	**0.5**	**0.5**	**0.4**	**0.3**
Dah Chong Hong	1828 HK	Not rated	7.89	1.1%	-13.4%	131.7%	1,877	30.5%	15.7	15.2	11.4	9.2	2.5	2.3	2.0	1.7	0.4	0.6	0.5	0.4	7.4	9.7	7.9	6.2	14%	19%	18%	19%	0.5	0.5	0.4	0.3
Zhongsheng Group	881 HK	Not rated	17.20	1.8%	0.4%	n.a.	4,197	n.a.	n.a.	25.2	n.a.	n.a.	n.a.	5.7	4.9	3.9	n.a.	1.1	0.7	0.5	n.a.	16.0	9.8	8.0	25%	27%	26%	28%	n.a.	n.a.	n.a.	n.a.
China Auto Dealerships Average									**15.7**	**20.2**	**11.4**	**9.2**	**2.5**	**4.0**	**3.5**	**2.8**	**0.4**	**0.8**	**0.6**	**0.4**	**7.4**	**12.8**	**8.9**	**7.1**	**19%**	**23%**	**22%**	**24%**	**0.5**	**0.5**	**0.4**	**0.3**
Ford	F US	Not rated	18.71	4.6%	13.6%	60.2%	70,107	31.7%	9.3	9.0	8.8	9.0	n.a.	(50.3)	10.7	3.6	0.9	1.2	1.2	1.1	10.0	12.9	11.2	5.5	n.a.	-226%	192%	62%	0.3	0.3	0.3	0.3
General Motors	GM US	Not rated	38.62	1.4%	n.a	n.a	57,930	n.a.	n.a.	13.5	9.2	7.7	2.5	2.3	1.8	1.3	n.a.	0.3	0.3	0.3	n.a.	3.1	2.8	3.2	n.a.	31%	35%	31%	n.a.	n.a.	n.a.	n.a.
Johnson Controls	JCI US	Not rated	40.74	0.3%	7.8%	36.5%	27,474	17.8%	20.5	16.2	13.5	13.5	2.7	2.4	2.1	2.1	0.7	0.8	0.8	0.8	10.0	10.2	8.7	8.2	16%	16%	17%	17%	1.1	0.9	0.8	0.8
US Average									**14.9**	**12.9**	**10.5**	**10.1**	**2.6**	**(15.2)**	**4.9**	**2.4**	**0.8**	**0.8**	**0.7**	**0.7**	**10.0**	**8.7**	**7.6**	**5.7**	**16%**	**-60%**	**81%**	**36%**	**0.7**	**0.6**	**0.5**	**0.5**
Hyundai Motor	005380 KS	Buy	193,500	-1.0%	7.0%	88.2%	37,959	26.6%	17.6	9.7	8.4	8.7	1.8	1.7	1.4	1.4	0.6	0.6	0.5	0.9	5.6	7.8	5.1	6.4	14%	21%	19%	18%	0.7	0.4	0.3	0.3
Kia Motors	000270 KS	Buy	58,800	1.9%	15.0%	206.3%	20,783	20.1%	14.7	10.0	8.7	8.5	3.1	2.4	1.9	1.6	0.6	0.8	0.7	1.0	5.7	10.2	7.6	8.1	22%	27%	25%	22%	0.7	0.5	0.4	0.4
Hyundai Mobis	012330 KS	Buy	307,000	1.7%	2.3%	103.0%	26,778	19.8%	17.2	12.9	11.3	10.0	3.7	3.1	2.3	1.9	1.5	1.5	1.1	1.7	9.6	13.0	8.9	10.2	24%	28%	24%	22%	0.9	0.6	0.6	0.5
Hankook Tire	000240 KS	Neutral	32,700	-4.0%	-0.6%	44.5%	4,371	12.2%	13.2	11.4	11.4	9.4	2.3	1.8	1.6	1.5	1.3	0.8	0.7	1.2	7.2	8.0	4.3	6.7	19%	20%	17%	17%	1.1	0.9	0.9	0.8
Korea Average									**15.7**	**11.0**	**9.9**	**9.1**	**2.3**	**2.3**	**1.8**	**1.6**	**0.9**	**0.9**	**0.7**	**1.2**	**7.0**	**14.1**	**6.5**	**7.9**	**-9%**	**30%**	**21%**	**20%**	**0.8**	**0.6**	**0.6**	**0.5**
Daimler	Dai GR	Reduce	54.91	0.3%	-0.3%	50.5%	76,477	n.a.	18.6	12.2	10.6	9.2	1.7	1.6	1.5	1.4	1.1	1.1	1.0	1.0	10.0	9.5	8.7	3.7	-9%	14%	15%	16%	n.a.	n.a.	n.a.	n.a.
BMW	BMW GR	Neutral	59.64	-1.9%	-7.3%	86.0%	49,066	173.5%	17.6	13.2	10.7	9.3	1.8	1.6	1.5	1.3	1.4	1.5	1.4	1.3	6.5	8.6	7.8	2.3	1%	13%	15%	15%	0.1	0.1	0.1	0.1
Porsche	PAH3 GR	Neutral	73.05	12.6%	12.4%	59.9%	17,376	n.a.	2.3	22.5	9.9	9.9	0.9	0.9	0.9	0.9	n.a.	n.a.	n.a.	n.a.	4.3	39.4	27.0	25.7	-3%	0%	6%	6%	n.a.	n.a.	n.a.	n.a.
Volkswagen	VOW3 GR	Buy	130.34	2.6%	-1.8%	103.2%	74,439	81.6%	14.6	12.2	10.6	9.1	1.4	1.3	1.2	1.1	0.7	0.9	0.8	0.8	6.0	7.3	6.7	3.4	3%	11%	11%	12%	0.2	0.1	0.1	0.1
Peugeot	UG FP	Buy	32.18	3.1%	2.6%	22.3%	9,832	n.a.	15.1	8.1	6.5	4.7	0.5	0.6	0.5	0.5	0.5	0.6	0.5	0.5	6.5	6.1	5.9	1.3	-9%	7%	9%	11%	n.a.	n.a.	n.a.	n.a.
Renault	RNO FP	Buy	48.50	3.4%	7.6%	22.6%	18,813	n.a.	32.9	9.9	7.8	5.7	0.7	0.7	0.6	0.6	0.9	1.1	1.0	1.0	8.8	9.8	10.0	3.6	-18%	12%	8%	10%	n.a.	n.a.	n.a.	n.a.
Fiat	F IM	Reduce	7.85	3.9%	21.9%	65.8%	12,573	n.a.	n.a.	45.8	20.5	11.1	0.9	1.2	1.2	1.1	0.6	0.8	0.8	0.7	4.7	8.7	7.8	3.0	-8%	3%	6%	10%	n.a.	n.a.	n.a.	n.a.
Michelin	ML FP	Neutral	53.62	-0.9%	-3.3%	-5.0%	12,310	118.3%	11.2	9.0	8.6	7.4	1.3	1.2	1.2	1.0	0.8	0.7	0.7	0.6	5.0	5.0	4.5	3.6	2%	15%	15%	15%	0.1	0.1	0.1	0.1
Valeo	FR FP	Buy	46.62	7.3%	5.1%	74.9%	4,754	n.a.	15.2	10.6	9.5	8.4	2.4	2.3	1.9	1.6	0.3	0.4	0.4	0.4	n.a.	3.9	3.7	2.8	-12%	23%	21%	20%	n.a.	n.a.	n.a.	n.a.
Europe Average									**16.0**	**15.7**	**10.7**	**8.7**	**1.3**	**1.3**	**1.2**	**1.1**	**0.8**	**0.9**	**0.8**	**0.8**	**6.5**	**10.9**	**9.1**	**5.5**	**-5%**	**12%**	**12%**	**13%**	**0.1**	**0.1**	**0.1**	**0.1**
Toyota	7203 JP	Neutral	3,500	7.3%	8.8%	-12.8%	146,728	61.1%	20.0	24.6	16.8	16.8	1.1	1.1	1.0	1.0	0.9	1.1	1.1	1.1	9.4	14.5	12.3	10.6	2%	5%	7%	7%	0.3	0.4	0.3	0.3
Honda	7267 JP	Neutral	3,310	5.1%	6.1%	2.0%	73,486	32.9%	9.9	10.8	11.3	11.3	1.4	1.3	1.2	1.2	0.9	1.0	0.9	0.9	6.5	9.0	8.2	7.2	6%	12%	11%	11%	0.3	0.3	0.3	0.3
Nissan	7201 JP	Buy	853	5.4%	6.3%	7.3%	46,693	110.5%	14.8	11.8	10.6	10.6	1.3	1.2	1.1	1.1	0.8	0.8	0.8	0.8	5.4	7.7	7.1	6.5	2%	11%	11%	11%	0.1	0.1	0.1	0.1
Suzuki	7269 JP	Neutral	2,092	3.9%	3.9%	-4.9%	14,251	27.1%	24.0	23.3	19.1	19.1	1.2	1.2	1.2	1.2	0.3	0.4	0.4	0.4	3.1	4.2	3.8	3.9	4%	5%	6%	6%	0.9	0.9	0.7	0.7
Isuzu	7202 JP	Not rated	402	5.5%	9.2%	98.5%	8,232	103.3%	10.4	12.2	11.0	11.0	2.2	2.0	1.7	1.7	0.5	0.6	0.5	0.5	6.1	6.8	6.1	5.9	3%	18%	17%	17%	0.1	0.1	0.1	0.1
Toyota Boshoku Corp	3116 JP	Neutral	1,490	2.9%	0.7%	-25.7%	3,400	57.1%	12.1	17.0	12.1	12.1	1.7	1.6	1.4	1.4	0.3	0.3	0.3	0.3	3.6	4.4	3.8	3.7	4%	9%	12%	12%	0.2	0.3	0.2	0.2
TS Tech Co Ltd	7313 JP	Buy	1,700	3.0%	6.4%	-4.8%	1,395	23.3%	10.7	10.6	10.1	10.1	1.2	1.1	1.1	1.1	0.2	0.3	0.3	0.3	2.9	3.7	3.3	2.7	7%	11%	10%	10%	0.5	0.5	0.4	0.4
Koito Manufacturing Co Ltd	7276 JP	Neutral	1,382	3.8%	3.2%	-2.4%	2,673	63.0%	21.2	16.5	9.8	9.8	1.5	1.4	1.3	1.3	0.5	0.5	0.5	0.5	2.9	3.8	3.6	3.6	4%	9%	14%	14%	0.3	0.3	0.2	0.2
Aisin Seiki Co Ltd	7259 JP	Buy	3,060	5.1%	9.5%	17.9%	11,014	73.2%	9.1	12.4	11.3	11.3	1.3	1.2	1.1	1.1	0.4	0.5	0.5	0.5	3.0	3.9	3.7	3.3	3%	10%	10%	10%	0.1	0.2	0.2	0.2
Denso Corp	6902 JP	Buy	3,000	4.9%	6.1%	5.2%	32,193	38.4%	15.0	16.8	14.8	14.8	1.3	1.2	1.1	1.1	0.5	0.7	0.7	0.7	3.5	5.7	5.3	4.9	4%	7%	8%	8%	0.4	0.4	0.4	0.4
Bridgestone	5108 JP	Buy	1,672	1.6%	-2.9%	7.4%	15,808	400.6%	15.1	12.9	12.0	9.7	1.2	1.1	1.0	0.9	0.6	0.6	0.6	0.6	4.5	5.2	4.9	4.6	0%	8%	8%	9%	0.0	0.0	0.0	0.0
Japan Average									**14.8**	**15.4**	**12.6**	**12.4**	**1.4**	**1.3**	**1.2**	**1.2**	**0.5**	**0.6**	**0.6**	**0.6**	**4.6**	**6.3**	**5.7**	**5.2**	**4%**	**10%**	**10%**	**10%**	**0.3**	**0.3**	**0.3**	**0.3**

Note: Valuation metrics for all stocks other than those under Yankun Hou's coverage are derived from Bloomberg consensus. Priced as of 12 January, 2011.

Source: Bloomberg, Nomura research

Wisdom

Words of wisdom

“Some problems are so complex that you have to be highly intelligent and well informed just to be undecided about them.”

Laurence J. Peter, American educator

“I don't want to have to import a hybrid car, I want to build a hybrid (plug-in hybrid) car here.”

Barack Obama, 5 August 2009

"The buzz-phrase now is plug-in hybrid."

"The end of the petrolhead", The Economist, 2008

“Plug-in hybrid gasoline-electric vehicles offered too few environmental benefits to be worth pursing for the Japanese car company. Improved batteries would be better used for electric vehicles”.

Takeo Fukui, Honda Motor Co. Chief Executive, 2009

“Fuel cell will end the 100-year reign of the internal-combustion engine.”

William Ford, CEO of Ford, May 2000

“In order to get significant deployment (of fuel cell), you need four significant technological breakthroughs. If you need four miracles, that's unlikely. Saints only need three miracles.”

Steven Chu, US Secretary of Energy, 2009

“This car (EV) will be a money maker, no doubt about it. We are not amateurs, and we would not have put US$5 billion into this with no possibility of return. But will it make money in three, four or five years? I could give a different answer every month.”

Carlos Ghosn Nissan CEO, 2010

“The world hates change, but it is the only thing that has brought progress.”

Charles Kettering, Head of Research for GM from 1920 to 1947

Background

Simple facts that we believe

Why are eco-car strategies at automakers so diversified and confusing? We believe that the answer is not simple. Automakers, depending on their strengths, try to persuade the media and the public that their way/strategy is the correct one, though some of them might not actually believe that it is.

According to a survey done by Toyota, half of automobiles in the world are never driven for more than 200 miles in a single day during their life cycles. Thus we see a large potential customer base for current EV products.

Even so, why do customers not switch to EVs? An automobile is not just a transportation tool; more importantly, many customers see driving a car as bringing fun, comfort, flexibility, and social status.

Customers are happy to switch to EV from ICE if one of two criteria is met: cheaper or better

We think that consumers have simple requirements and would be happy to switch to EVs from ICEs if they were cheaper or better. However, we believe that existing battery technology is still not able to make EVs perform better than ICEs, and it is difficult to produce an EV more cheaply than an ICE with comparable performance. At the same time, we believe some niche markets are ready for EVs to take off, including the markets for taxis, city buses, and low-speed electric vehicles (LSEV), where the purchasing decisions are different from those made by private buyers buying conventional ICE vehicles.

Unless there are further technological breakthroughs (mainly on cathode material), economies of scale can reduce battery cost by only 20~30% at most, based on our estimates. This implies that EVs cannot become mainstream automobiles without government subsidies, in our view. With new material innovations, battery prices could be halved but it is extremely difficult to use new material without compromising battery capacity.

The success of BEVs does not just require a technological breakthrough, but also policy support. In our opinion, governments have several ways of addressing environment issues, such as developing an efficient public transport system or promoting “car-sharing” systems, and really do not need to depend on EVs.

Under the current power capacity structure in China (74% of electricity is generated from coal and gas, source: CEIC), we see BEVs as being worse than ICEs if “well-to-wheel” CO_2 emissions are calculated. Therefore, a niche EV programme, such as for city buses, might take off, while the full penetration of EVs will require a systematic development of new energy and will depend on the penetration of new energy sources.

If EVs are the ultimate direction for the auto industry, we believe that China could be the first country to experience the deep penetration of EVs, due to its intensive research investment and capability, short development cycles, strong governmental execution power, and large market size (even if only niche markets are included). Over the past two years, the Chinese government shifted its new eco-car strategy to EV development from alternatives. We believe that BYD could be the most competitive EV manufacturer globally, due to its easy integration between battery and automobile, in our view.

Under the bnonet

Eco car – a puzzle for three decades

What is an eco car?

Efforts to improve fuel efficiency have been made in three main areas: electrification of power trains; alternative fuels; and improvements to current power trains. In this report, we provide a brief introduction to each technology, and we will address some of them in detail later.

So far efforts to improve fuel efficiency have been made in three main areas: electrification of power train, alternative fuel, and improvement of the current power train

Electrification

Hybrid electric vehicle (HEV)

An HEV combines a conventional internal combustion engine (ICE) propulsion system with an electric propulsion system. HEVs can be categorised as mild hybrids or strong hybrids, depending on the degree of usage of the electric propulsion system. HEVs can also be categorised as series hybrids, parallel hybrids, or combined (blended) hybrids depending on their engineering structure.

Electric vehicle (EV)

Sometimes designated as battery electric vehicles (BEVa), these vehicles use electric motors for propulsion. As the name suggests, batteries, instead of fuel based on oil, are used as energy sources.

Fuel-cell vehicle (FCV)

FCV is a special type of EV that uses a fuel cell as an energy source and for storage. Fuel cells create electricity to power an electric motor using hydrogen and oxygen from the air.

Alternative fossil fuels

Diesel

The diesel engine has the highest thermal efficiency of any internal combustion engine due to its very high compression ratio. In passenger-vehicle applications, the overall energy efficiency of diesel engines is about 20% greater than that of gasoline versions. Passenger cars with diesel-engines are widely used in Europe.

Compressed natural gas (CNG)

CNG is made by compressing natural gas to less than 1% of the volume it normally occupies. It can be used in cars with traditional gasoline internal combustion engines that receive a fairly easy technical conversion. Due to rising gasoline prices, the technology is increasingly used in the Asia-Pacific region, Latin America, Europe, and America.

Improvements to current ICE drive train

Currently, ICE drive trains transform less than 20% of fuel energy into motive power, due to inefficiencies in engines and transmissions (measured by so-called tank-to-wheel efficiency). For gasoline vehicles it is about 16%; for diesel vehicles it is slightly higher at 20%. With a theoretical thermodynamic limit of 37%, the fuel economy of ICE vehicles has large potential to improve. Various innovations have been made to current engines and transmissions to improve fuel efficiency. The best experimental engine already reaches 28% efficiency.

Engine improvements

Widely used applications include:

- Turbochargers, which increase the density of air entering the engine to create more power.

- Gasoline direct injection (GDI), which injects highly pressurized gasoline into the combustion chambers to achieve more controlled and efficient combustion.
- Variable valve timing (VVT), which enables more accurate control of engine valves to achieve higher combustion efficiency.

Transmission improvement

The most notable case is continuously variable transmission (CVT), which basically can change smoothly through an infinite number of effective gear ratios between maximum and minimum values. The flexibility of a CVT enables the engine to run at its most efficient level for a range of vehicle speeds, thus enhancing efficiency.

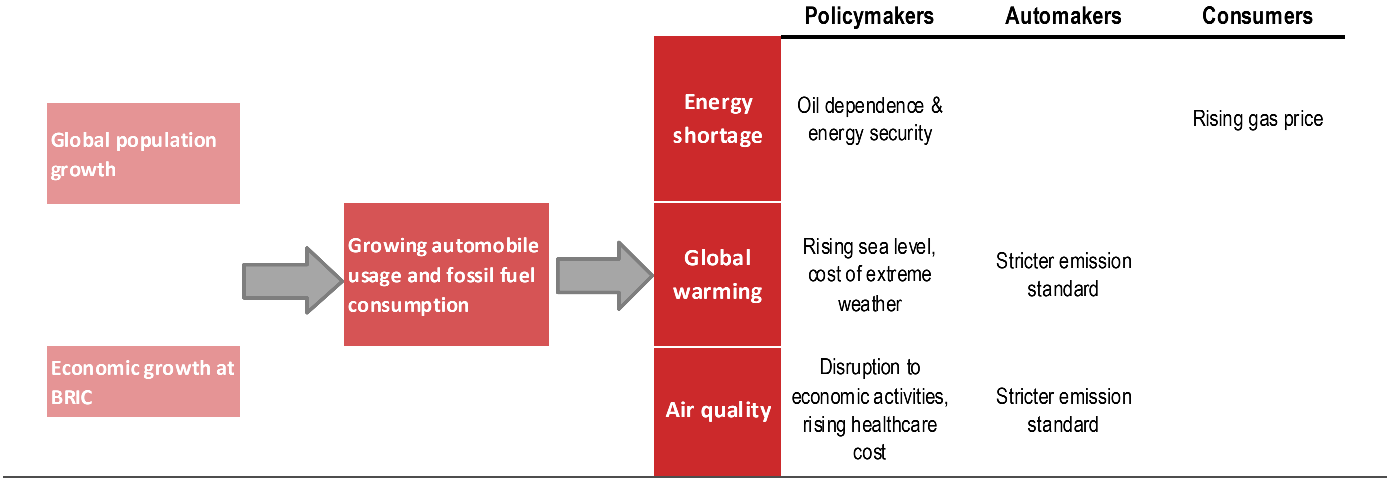
Material improvement

This is another straightforward and effective way to improve efficiency. By using lighter materials in components and car bodies (eg, replacing steel with aluminium), cars can travel farther using the same amount of fuel.

At present, eco cars are still a top-down question

So far, the push for EVs is coming from policymakers, environmentalists, and automakers and thus is a top-down issue, in our view. But for sustainable industry development, a bottom-up solution is needed to ensure public demand.

Exhibit 16. Growing concerns on sustainable drivability



Source: Nomura research

Energy: a strategic concern for policymakers, but not for consumers

Energy: strategic concerns for policy makers, but not for consumers

According to the EIA, current reserves of conventional petroleum worldwide amount to 1,239bn barrels. At the current pace of production, these could be exhausted within 54 years. The poor sustainability of petroleum implies a worrying future for autos. The auto sector consumes up to 45% of global gasoline output, which is derived from crude oil through refinery. As crude-oil sources dry up, autos will be deprived of power.

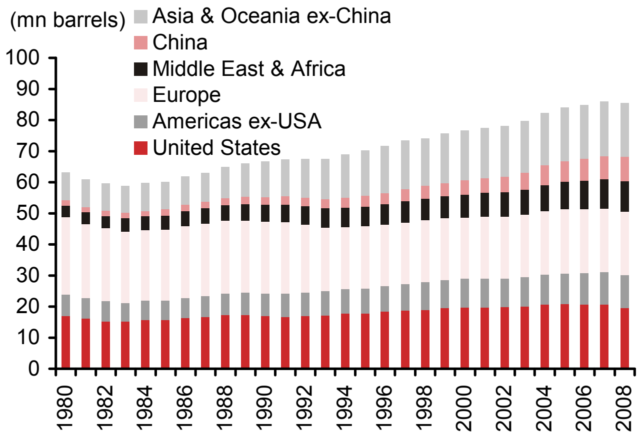
Is 54 years a long period? Different people have different answers. From a policymaker's point of view, the government has a strategic reason to control oil consumption and prompt fuel efficiency in vehicles. However, end users can barely feel the pain. Unless economically sensible, we do not believe consumers will pay for a benefit that is intangible. We think alternative energy vehicles also need to become more attractive in terms of performance before consumers are likely to consider changing their driving behaviour.

In some resource-scarce countries, such as Israel, as well as some highly environmentally friendly countries such as Denmark, the governments have strategically started up EV projects. However, these countries are much smaller, so infrastructure is easier to set up, and residents typically drive short distances. Therefore, we do not expect this approach to be widely adopted in other countries.

Without an immediate shortage of supply for oil and concern about immediate global warming from end users, we believe conventional energy (especially oil) will continue to be the main stream energy source for the next one or two decades for driving. With continuous efforts to reduce CO2 emissions by governments, we believe hybrids could lead in terms of new alternatives, while the penetration rate depends on government subsidies.

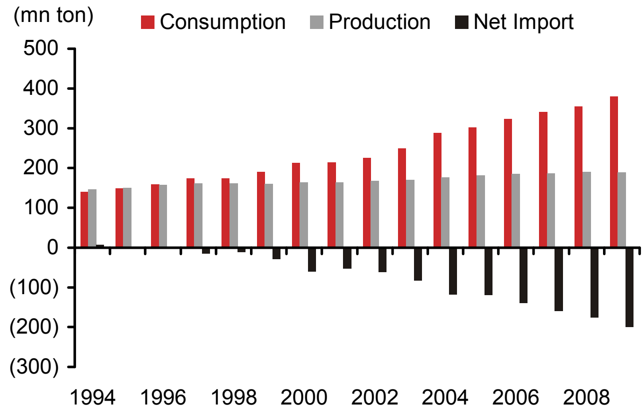
We believe conventional energy will continue to be the main energy source for driving for the next one or two decades

Exhibit 17. Global daily oil consumption, with rising share from China and other Asian countries



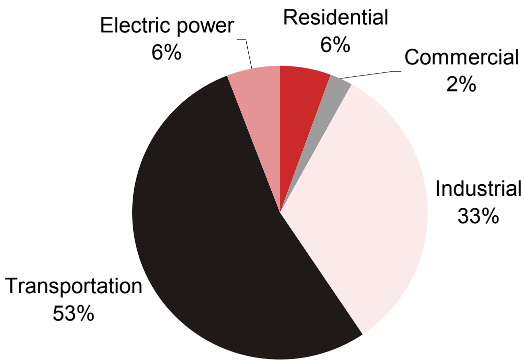
Source: US Department of Energy, Energy Information Administration

Exhibit 18. Crude-oil shortage in China



Source: CEIC

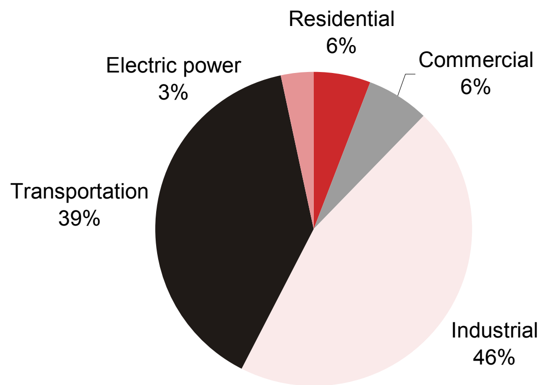
Exhibit 19. Breakdown of oil consumption by industry (global, 2007)



Note: latest available data

Source: EIA, Nomura research

Exhibit 20. Breakdown of oil consumption by industry (China, 2007)



Note: latest available data

Source: EIA Nomura research

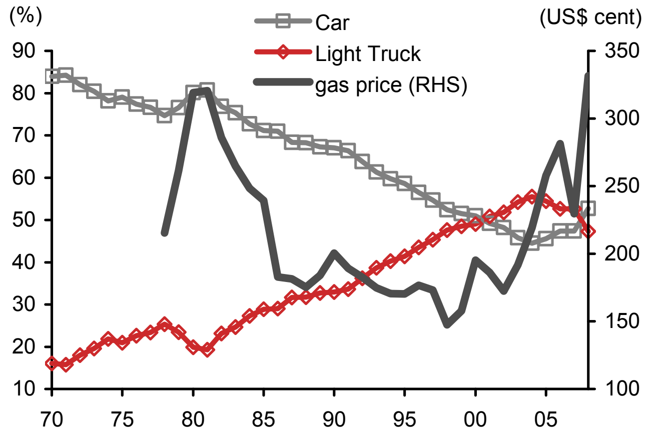
Lessons from the 1970s: consumers do not care

Soaring oil prices can influence a driving behaviour, but only for a short period of time, in our view. Gasoline prices rose by 20% in just a few months in the 1970s. During the period in the US, soaring gas prices and the pain of having to wait in line for gas changed consumers' preferences, switching vehicle demand from traditional gas guzzlers to smaller, more-efficient cars. In Korea, similar trends were observed: the mix of passenger vehicles and trucks changed from 49%: 51% in 1968 to 61%:39% in 1978.

The parallels to the current situation are straightforward: surging oil prices and falling oil reserves. The turning point in the US vehicle sales mix was observed in 2004, amid surging gas prices. In 2008, the percentage of cars surpassed that of light trucks for the first time in eight years. The concern over fuel costs was also reflected in the different levels of depreciation of models with comparable performance but different fuel efficiency.

However, the interest in smaller cars lasted only for a few years, and from the 1970s until 2004 SUVs gained market share. This was a period when the Big Three automakers (General Motors [GM US, not rated]), Ford [F US, not rated] and Chrysler [unlisted]) profited from SUVs, although GM and Chrysler both ended up in bankruptcy. With the global economy coming out of a recession, many may not remember much of the incidence of surging oil prices in 2008, but we believe that consumers, politicians, and automakers have become more concerned and serious about fuel economy and oil dependence now.

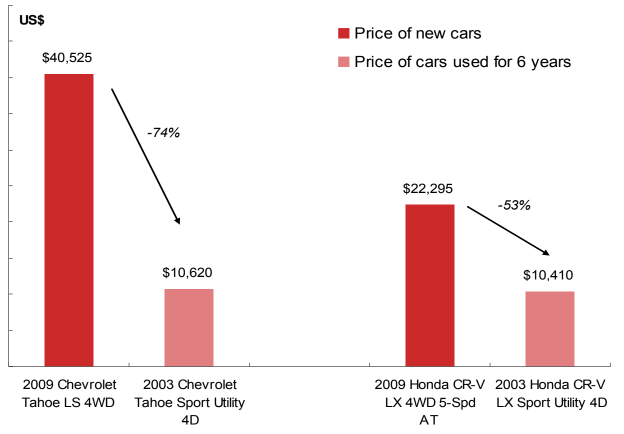
Exhibit 21. Shift of vehicle sales mix in the US



Note: Gas price measured in 2008 constant US$.

Source: US Department of Energy, Nomura research

Exhibit 22. Prices of comparable models with different fuel economy



Source: Yahoo, Nomura research

CO2 emissions: an inconvenient truth for the automakers

Transport has been a significant source of CO2 emissions over the past ten years. Governments around the world are setting stricter rules on automobiles' fuel efficiency and exhaust-gas emissions. As the standards are set for the average efficiency of a whole fleet, a significant increase in the percentage of vehicles far below the emissions standards will offset the excess emissions from the current product mix, and thus save the automakers from lower profitability resulting from a dramatic product mix downgrade. This is one of the key motivations behind automakers' green car strategies, in our view.

Stricter emissions standards are being set globally

According to the European Federation for Transport and Environment, transport CO2 emissions in the EU grew by 35% between 1990 and 2006, while other sectors reduced their emissions by 3% on average during the same period. The share of the transport sector in CO2 emissions grew from 21% in 1990 to 28% in 2006. Emissions from passenger cars and light commercial vehicles were responsible for approximately half of this.

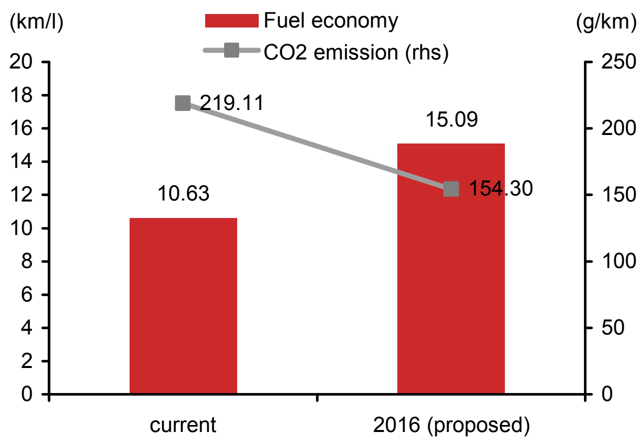
Governments across the globe are gearing up to set stricter emissions standards. In Europe, which has always been the most aggressive in environmental regulations, legislators are proposing a rule that requires the average CO2 emissions of the whole fleet sold be lowered to 130 g/km per vehicle by 2015. In the US, which traditionally lags Europe in emissions regulations, President Obama has proposed to amend federal Corporate Average Fuel Economy (CAFE) standards to raise the fuel efficiency of passenger vehicles (cars and light trucks) sold in the US to 35.5 miles per gallon (mpg) by 2016 (implying a CO2 emissions of roughly 154 g/km per car), from the current level of 25 mpg (implying 219 g/km of CO2 emissions for each car).

According to media reports, the Chinese government will release the third phase of Passenger Vehicle Fuel Economy Standard before 2011. The new standard aims to lower Chinese cars' average fuel consumption to about 7L / 100km by 2015, about 20% down from the current level. The new standard, if implemented, will be roughly in line with the US fuel economy target for 2016 (6.63L / 100km), although still lagging regulations in the EU and Japan.

But little progress has been made on this regard …

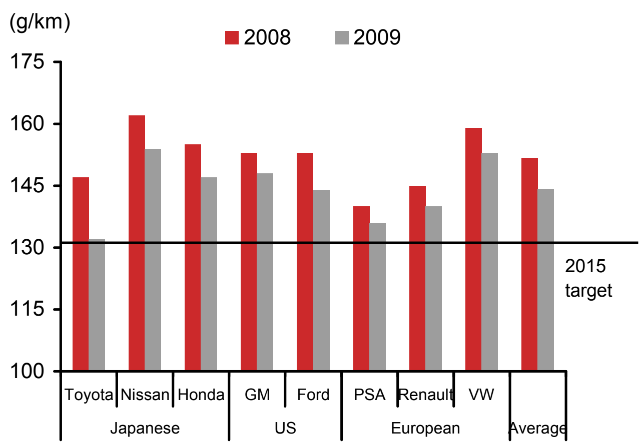
We believe this is one of the most important reasons behind automakers' ambitions in developing xEV. It is difficult to achieve these goals based purely on improvements in traditional gasoline and diesel internal combustion engines (ICE). For example, major automakers made little progress in 2008 and 2009 in Europe, and are far away from meeting the 2015 target, and this implies unaffordable penalties for noncompliance. In China, cars made by domestic automakers also lag behind global peers' on fuel economy. Given the fact that the standard is set for the whole fleet, a significant increase in the percentage of vehicles far below the emissions standards will offset the excess emissions from the current product mix, and thus save the automakers from lower profitability resulting from a dramatic product-mix downgrade.

Exhibit 23. Fuel efficiency & CO2 emissions standards in the US



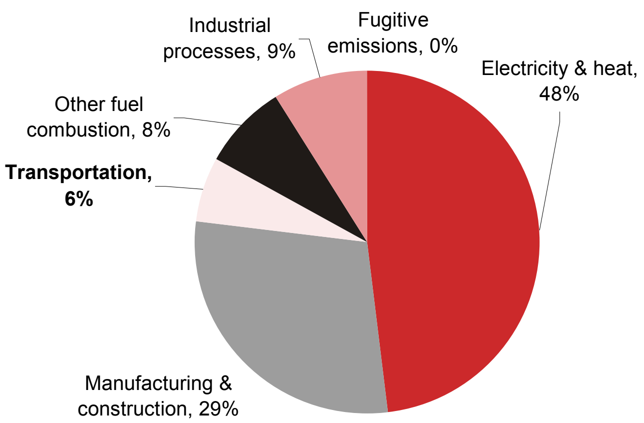
Source: US Department of Transportation, Nomura research

Exhibit 24. CO2 emissions of new cars sold in EU in 2008 & 2009 vs EU target



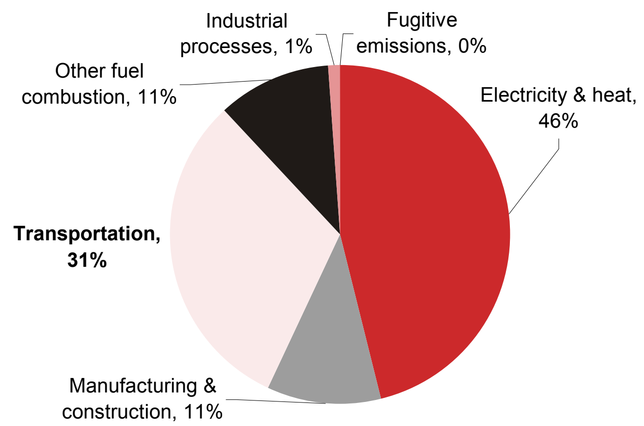
Source: European Federation for Transport and Environment

Exhibit 25. CO2 emissions breakdown by industry, China (2009)



Source: World Resources Institute

Exhibit 26. CO2 emissions breakdown by industry, US (2009)



Source: World Resources Institute

Air quality: a more direct catalyst?

The exhaust gases of automobiles are a major source of air pollutants, especially nitrogen oxides and particulate matter, which cause smog and acid rain. China's Ministry of Environmental Protection reported in November 2010 that in 2009 motor vehicles in China (including automobiles and motorcycles) emitted 40mn tonnes of carbon monoxide, 58mn tonnes of nitrogen oxides, and 0.59mn tonnes of particulate matter into the air. Air quality in one-third of 113 large cities in China failed to meet national standards in 2009. Although regulators around the world are setting up stricter emissions standards, these measures can only slow the increase of pollutants caused by automobile usage, given the robust growth of auto ownership in emerging countries, in our view.

Exhaust gas of automobiles is a major source of air pollutants

For a more effective solution, some local governments globally are directly limiting the usage of automobiles in urban or downtown areas. London limits the usage of vehicles that do not meet EURO IV emissions standards. In China, Beijing and Shanghai ban vehicles below China I emissions standard (equivalent to EURO I) within downtown areas (we think several other Chinese cities are also considering adoption of the policy). During the Shanghai World Expo in 2010, the Shanghai government ran a pilot project in the Expo site that used only electric or hybrid vehicles for transportation. More than 1,000 xEV were deployed in an area which by size was 1.6x Central Park, New York, or 3.5x Central, Hong Kong. We believe the success of this pilot project could prompt the Chinese government to introduce more policies to promote the use of EV in public transportation. We will discuss fleet demand in detail later in this report.

Eco cars in China

Eco-car development in China

Automakers' eco strategies

The strategies vary among automakers, as the following charts show. Although every automaker is talking publicly about EV, they are pursuing different approaches based on their respective strategy and R&D strengths. This also reflects a wide range of possible solutions, as we have just discussed.

Automakers adopt various strategies for EV

We believe HEV or EV is the most feasible approach for China among all the "unrealistic eco approaches", if the government has to pick up one of the most feasible approaches for China. These technologies can all become useful complements to help reduce emissions and reliance on oil, but due to various reasons they cannot solve the problem fundamentally.

More complicated in China, due to their lack of advanced technology, some Chinese automakers' eco-car strategies more or less depend on their joint-venture partners. In our view, this also reflects the weak R&D power of most of these JVs and their global partners' strategic considerations. On the other hand, some local OEMs have made steady progress in this field. Aside from BYD, Chery (not listed) has rolled out an HEV version of the A5 and introduced it to the taxi fleets of Wuhu and Beijing. Chana and FAW, respectively, introduced their Jiexun and Besturn HEVs during the Beijing Olympics. We think all major Chinese bus manufacturers are developing hybrid buses and, according to Fourin, 300 buses have been introduced into bus fleets around the country.

Exhibit 27. Global automakers' eco-car strategies

EV	HEV	Neutral (improvement to conventional automotive technologies)
Nissan	Toyota	EU automakers (diesel)
GM	Honda	Mazda
Ford	Chang'an	Suzuki
BYD	Chery	Geely
Mitsubishi	Shanghai Auto	Great Wall

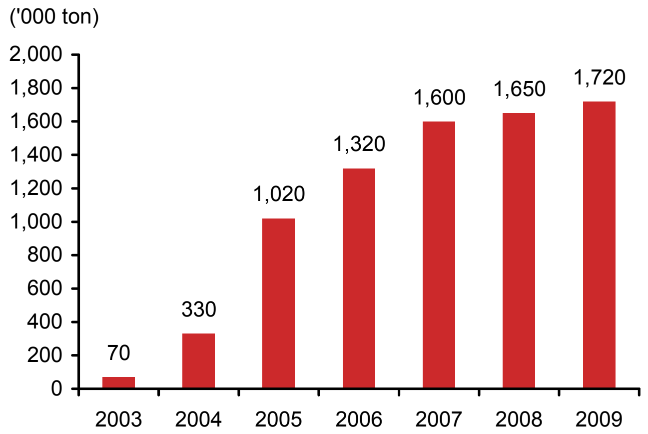
Source: *The War of Eco Car*, Nomura research

Biofuel: food vs fuel

Biofuel is anything but new. When it was exhibited at a World Expo more than 100 years ago, the original diesel engine was designed to run on peanut oil. Biofuel technology aims at producing fuel, primarily ethanol and diesel, from biomasses such as sugarcane, corn, and canola. Biofuel is very efficient in terms of reducing CO2 emissions, because emissions during fuel combustion are offset by the absorbed CO2 in photosynthesis when the feedstock plants grow. It can thus be "carbon neutral" or even "carbon negative" over a lifecycle. The US and several European countries are aggressively pushing biofuel by promoting research and giving farmers financial incentives to sell crops for use as biofuel. It has gained a significant market in some developing countries, such as Brazil, where sugarcane is widely planted. China is perhaps a late-comer to biofuel, with mass production of bioethanol beginning in 2004. However, the industry is growing fast and China has become the third-largest bioethanol producer in the world, after only the US and Brazil. According to the National Development and Reform Commission, ethanol-blended gasoline accounted for 20% of total gasoline consumption in China in 2007.

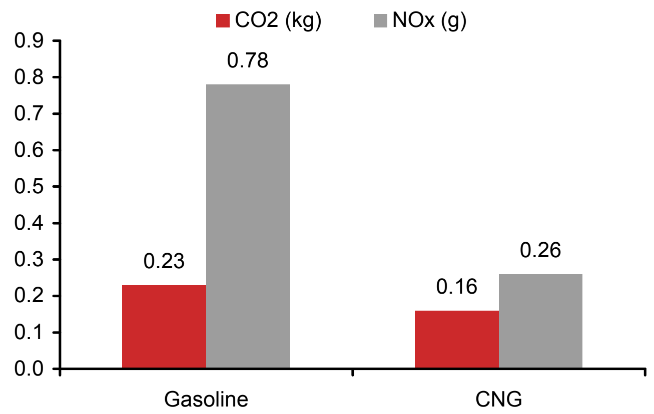
The major argument against biofuel is so-called "food versus fuel". In 2008 the biofuel industry received criticism for pushing global food prices higher, due to its reliance on farm products as feedstock. In China, more than 99% of fuel ethanol in 2007 was converted from grain, mainly corn and wheat. Concerned about food supply, the Chinese government has rolled out policies to curb grain-based biofuel production, such as halting new projects and paring subsidies paid to bioethanol producers. Although the government still encourages the development of non-grain based biofuel technology, the wave of biofuel projects has waned.

Exhibit 28. Slowing growth of fuel ethanol production in China



Source: NDRC, Roland Berger

Exhibit 29. Emissions per 1km, CNG vs gasoline



Source: Nomura research

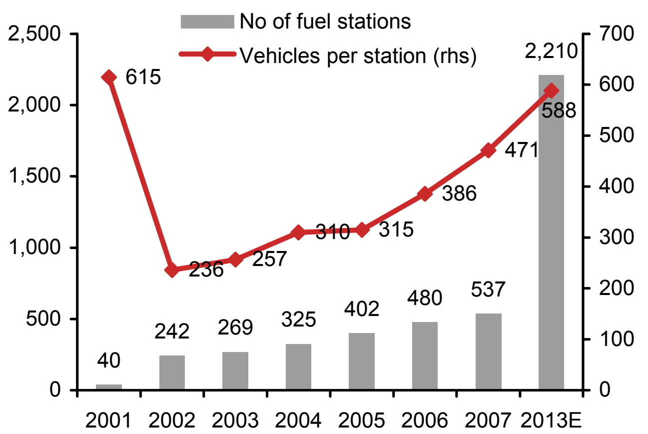
CNG/LNG vehicle: infrastructure bottleneck

Lack of infrastructure bottleneck is the main problem for CNG

Compressed (liquidized) natural gas (CNG/LNG), mainly made up of methane, is a non-toxic, non-corrosive, and safe energy source with extensive applications. It burns more completely than gasoline or diesel, and produces less emission. It also does not require a significant restructuring of power-train engineering. With the support of the Chinese government, CNG vehicles have seen strong growth in sales volume, with a CAGR of 47.5% from 2001 to 2007. The number of pilot cities under the Clean Car Action initiative has been increased to 22 from 12 under the 11th Five Year Plan. Our channel checks with industry experts suggest it will continue to grow and take a larger market share.

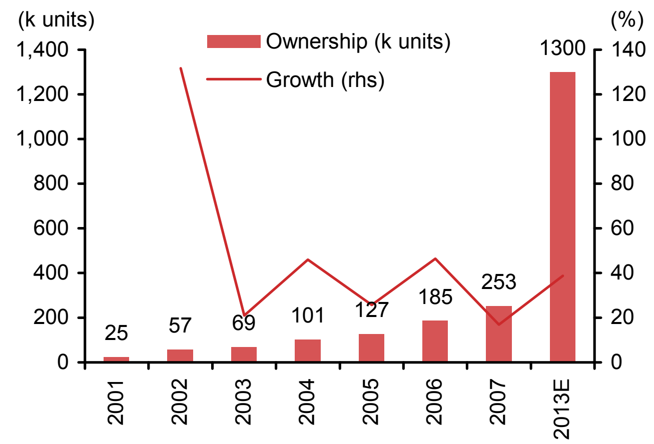
The main problem facing the promotion of CNG vehicles is lack of infrastructure. First, over 60% of China's natural gas reserves are in middle and western regions. Pipelines are needed to transport the gas to coastal regions. The other reserves lie in the offshore gas fields, which are hard to exploit due to technical and geopolitical reasons. Second, slower growth in the number of refuelling stations has been causing shortages in CNG supply, inhibiting the ownership of CNG vehicles. The reasons behind slower station building include low profitability and heavy dependence on imported key equipment.

Exhibit 30. Lack of CNG refuelling stations



Source: Wikipedia, Nomura research

Exhibit 31. CNG vehicle ownership and forecast



Source: Roland Berger, Nomura research

Diesel: practical but problematic

The commercial use of diesel fuel as an alternative to gasoline can be traced back to the oil crisis in the 1970s, when European automakers advocated diesel for its better mileage because of higher energy density. Diesel vehicles have been quite popular in Europe where, according to European Automobile Manufacturers Association, 53% of newly registered cars in Western Europe in 2007 were diesel powered.

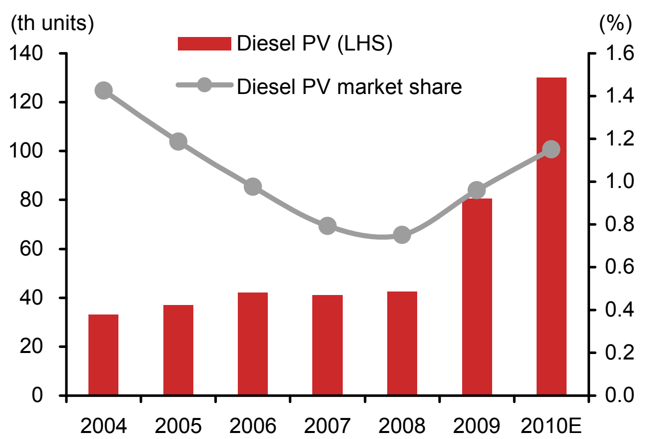
In China, however, diesel passenger vehicles have been continuously losing market share. We believe this trend is likely to extend into the future due to:

- **Bottlenecks in the diesel supply.** The diesel/gasoline output ratio in China has hit an alarmingly high level. Due to technical constraints, it will be difficult to produce more diesel vehicles without additional capacity investment. Meanwhile, the quality of the diesel supplied for PVs in China is far below the global benchmark, and leading local and international refiners have little motivation to invest in diesel refineries.
- **Poor diesel power-train technology in China.** We believe it will take another 10 years for China to catch up with today's global benchmark in terms of diesel power-train technologies. Meanwhile, only a few OEMs are doing R&D on diesel PV technology, as a result of low demand outlook, a short supply of high-quality diesel, and a lack of government funding support.

Diesel-powered PV losing grounds in China

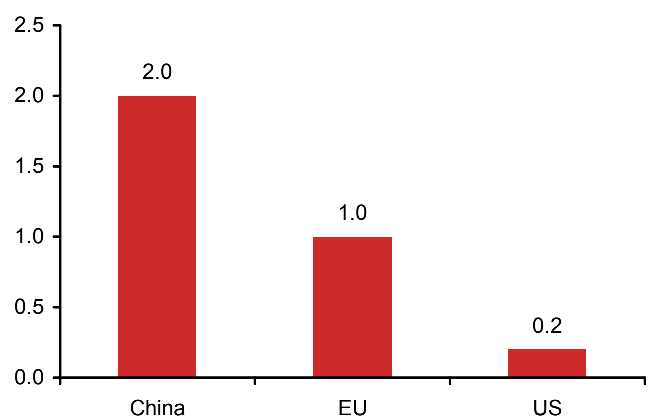
- **Market perception.** Diesel PVs are viewed as low-end vehicles, with high emissions and poor comfort, according to our interview with an industry expert. Meanwhile, due to the smaller driving range of the average Chinese family car, the savings in fuel costs are not big enough to offset the additional cost of the purchase.
- **Government attitude changed from "supportive" to "allowable":** In the "Industry Structure Adjustment Guide" published in 2007 by the Chinese government, diesel vehicle was removed from the promoted category and no "863" projects (government sponsored R&D initiatives) for diesel were planned. As China aims to stand out in the next round of vehicle technology revolution, we believe diesel has been dropped, because its own technology lags far behind the global benchmark.

Exhibit 32. Diesel PV sales volume and market share in China



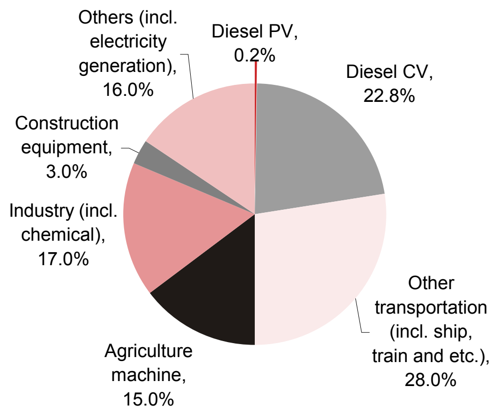
Source: Roland Berger

Exhibit 33. Diesel/gasoline ratio trend in China vs. international levels



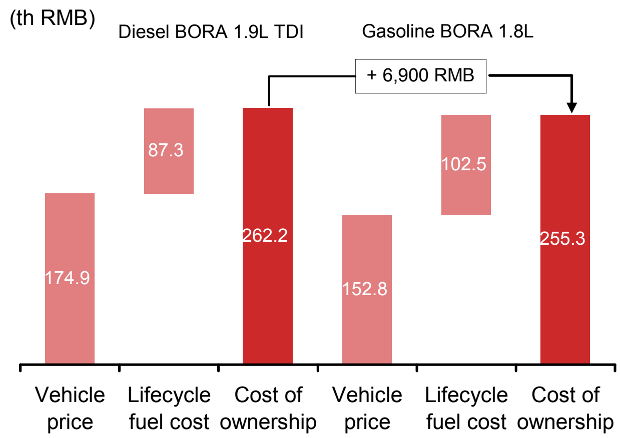
Source: Roland Berger

Exhibit 34. China: diesel usage breakdown (2008)



Source: Roland Berger

Exhibit 35. Overall cost comparison



Source: Roland Berger

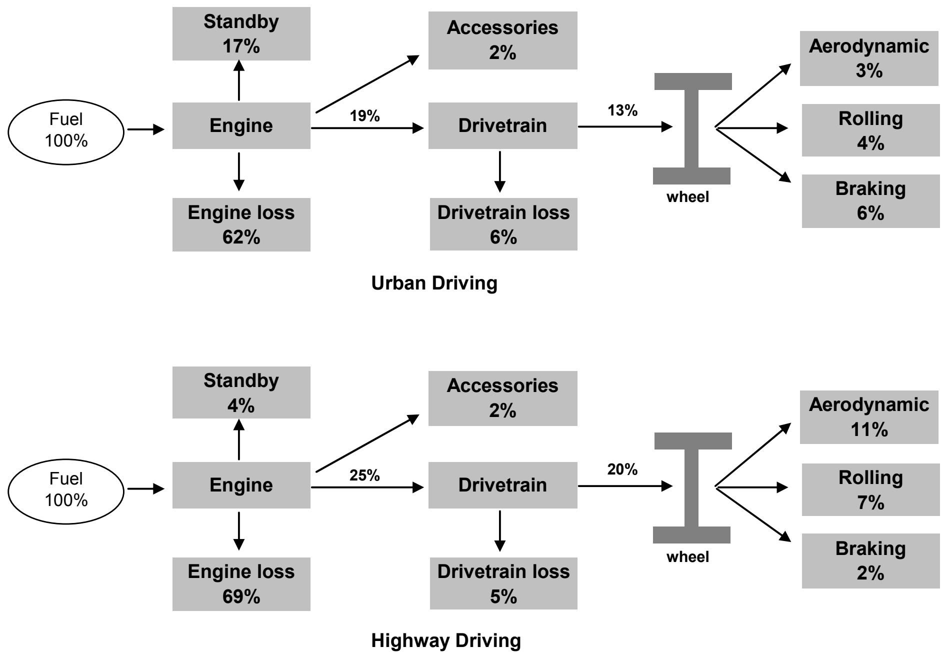
Improvement potential in ICE fuel economy

Fuel efficiency of ICE vehicles still has ample potential to improve

The current ICE drive-train transforms less than 20% of fuel energy to motive power, due to inefficiencies in engines and transmissions (measured by so-called tank-to-wheel efficiency). For gasoline vehicles it is about 18%; for diesel vehicles it is slightly higher at 20%. With a theoretical thermodynamic limit of 37%, the fuel economy of ICE vehicles still has ample potential to improve, in our view. The best experimental engine reaches 28%, which is not so inferior against BEV if low efficiency at the power-generation phase is considered. Several engineering breakthroughs have been made in this area, including:

- Atkinson-cycle engines, which can achieve higher fuel economy at the expense of lower power output, and have been widely used in hybrid drive-trains, including the Toyota Prius.
- Variable Valve Timing (VVT) engines, which improve combustion efficiency of ICE.
- Continuously variable transmission (CVT), which can provide better fuel economy than other transmissions by enabling the engine to run at its most efficient stage for a wider range of vehicle speeds.
- Turbo engine, which creates more power than a normal engine, by using a turbocharger that increases the density of air entering the engine.
- Use of aluminium in engines to replace cast iron or steel, which can improve fuel efficiency by reducing engine weight and internal piston friction losses.
- Better design of vehicle air-conditioning and other accessories. With less than 20% tank-to-wheel efficiency, the other fuel energies are wasted in the exhaust gases and the engine's cooling system. Re-utilization of these energies can enhance the overall efficiency of ICE vehicles.

Exhibit 36. Energy flows for a midsize passenger car



Source: US Department of Energy

Third phase fuel economy standard

New PV fuel economy standard to be enacted

According to media reports, the Chinese government will release the third phases of Passenger Vehicle Fuel Economy Standard before 2011. The new standard targets to lower Chinese cars' average fuel consumption to about 7L / 100km by 2015, about 20% down from current levels. The new standard, if implemented, will be roughly in line with the US fuel economy target for 2016 (6.63L / 100km), although still lagging regulations in the EU and Japan. The standard updates should save a substantial amount of fuel and reduce emissions, even without a wide adoption of EVs.

Public transit system

According to our exchanges with global transportation experts during the World Economic Forum, leverage of the current transportation network (such as car-sharing systems and public transportation) could be more effective to reduce auto demand and auto usage, rather than new energy vehicles including hybrids and EVs. We believe it is more efficient for the Chinese government to promote public transportation, including light trains from downtown to suburban areas, subways, and bus lines. Investing in charging stations before EV thrills, no matter with public money or private money, faces significant risks. Thus, infrastructure and EV could run into a chicken/egg problem, even if EV is to be the future trend of the auto industry.

EVs: the issues

Electric vehicles: promises and compromises

Although electrification has failed a few times in automobile history, automakers have rushed into this territory again with various new product launches targeting mass production in the next two to three years.

EV could be the ultimate solution, in our view

There are currently several approaches regarding the development of xEV, which differ in efficiency, cost and R&D stage. Below we review the technologies and compare them in various perspectives. Well-to-wheel efficiency plays an important role in regulators' policymaking process, which will in turn determine in a large part the future of these approaches. At the same time, automakers will directly make their choices on technology path and influence policymakers' decisions, while consumers will ultimately cast their votes. It is a three-some play in which the government has a key role.

In terms of efficiency, it is largely determined by efficiency in power generation, as xEV drive-trains have a significant advantage over ICE. In China, however, the use of coal as the primary power generation feedstock may make xEV less efficient and produce more carbon emissions.

Lithium battery technology has achieved significant improvement during the past decade, and has emerged as the most preferred battery technology for EV. However, cost, safety and power density still hinder popularization.

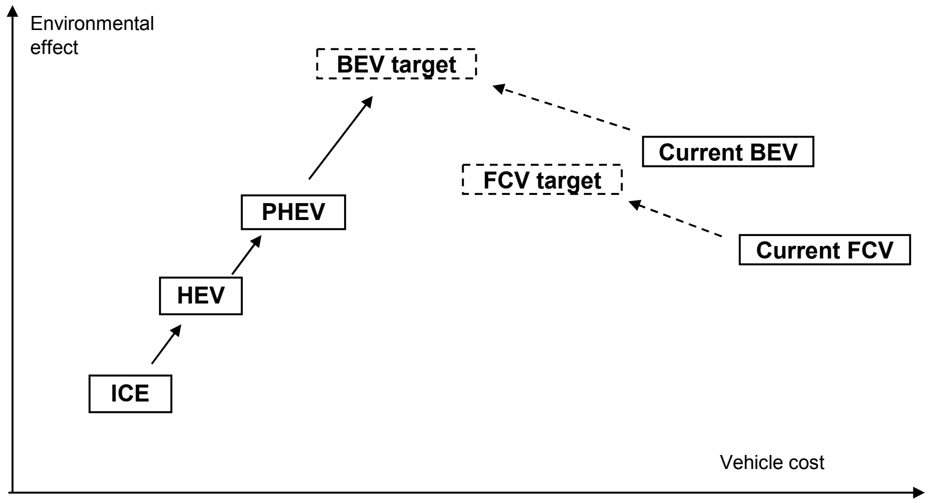
We believe xEV is the most promising approach for our planet. We believe EV could be the ultimate solution; however, the speed of penetration depends on further technological breakthroughs for battery, government support and changing consumer behaviour. We believe hybrid electric vehicles could be the leading new eco car in the next decade, since it has no new infrastructure requirement, there's no need to change consumer behaviour, and as product cost gradually decline.

Exhibit 37. xEV technology overview

Metrics	Well-to-wheel efficiency	Total carbon footprint	Cost (production, infrastructure)	Technology barrier (R&D input) except battery	Battery usage	Price	Performance	Ease of use (infrastructure)	Suitable for	Example
BEV	Well-to-tank: depends on feedstock, low in China Tank-to-wheel: high	Depends on power generation feedstock, high in China	High battery cost High infrastructure cost	Ready	Heavy usage	Largely depends on battery, high	Quick acceleration; Low top speed; limited range	Heavily dependent on charging station or battery swap facility	Public transportation, urban driving	**Nissan Leaf**
Series HEV	Low-speed mode: high High-speed mode: low (< ICE)	Higher than BEV due to use of fossil fuel	Low battery and infrastructure cost	Developing (Transmission is not needed, enabling more diverse design)	Less than BEV	Acceptable cost increase	Comparable to ICE cars; low top speed	Much less dependence on infrastructure	Public transportation, urban driving	**Chevrolet Volt**
Parallel HEV	Low-speed mode: medium High-speed mode: high (> series HEV)	Higher than series HEV due to more use of ICE; limited CO2 reduction	Lower battery and infrastructure cost	Ready	Less than series HEV	Acceptable cost increase	Comparable to ICE cars	Much less dependence on infrastructure	PV (transition product or entry-level)	**Honda Insight**
Blended HEV	Highest among HEV	Series < Blended < Parallel	Battery cost higher than parallel but lower than BEV	Complex structure (power splitter)	Higher than series HEV	Significant increase	Comparable to ICE cars	Much less dependence on infrastructure	Premium PV	**Toyota Prius**
PHEV	Well-to-tank: depends on feedstock, low in China Tank-to-wheel: same with underlying power-train structure	Depends on power generation feedstock, high in China	depends on underlying power-train Medium infrastructure cost (lower than BEV)	Complex	High	Significant increase due to complex structure and larger battery	Comparable to ICE cars	can be charged at home using residential grid; fast recharging requires special facility	PV for urban use	**BYD F3DM**
FCV	Well-to-tank: low Tank-to-wheel: high	Depends on hydrogen path. Low only if electrolysis with renewable energy	High production cost Height infrastructure cost	High fuel-cell tech barrier	Medium	Significant increase	Comparable to ICE cars	Highly depends on infrastructure	Bus for urban public transportation	**Honda FCX**

Source: Nomura research

Exhibit 38. Technology path, current status and target



Source: Nomura research

Battery electric vehicle: running purely on electricity

BEW: runs solely on battery

BEV runs solely on battery, which stores energy and drives the vehicle through a motor. The motor may also serve as generator to recover vehicle kinetic energy and store them into the battery. It has a simple structure and was first used when the automobile was in its infancy, as we have mentioned at the start of this report.

BEV is considered to be the most effective in CO_2 emission reduction and oil substitution, as it uses no petroleum fuel directly. However, several issues remain unsolved and impede mass usage. The issues will be listed below and will be discussed in details later, as they epitomize the socio-politico-economic debates around EV.

- **Life cycle energy efficiency and reduction in CO_2 emissions may not be high.** Well-to-tank efficiency could be as high as 86% if power is generated by wind, but in China's case, where power generation is based on coal, front-end efficiency is low and CO_2 emissions will be significant. This, overall emissions in the usage cycle (carbon footprint) would not be effectively lowered.
- **Limited battery capacity** will limit the range BEV can travel after one charge.
- Use of **large battery pack** makes the car less affordable.

Examples of BEV include the Nissan LEAF, which will likely be launched in 2011.

Exhibit 39. BEV at a glance

metrics	Well-to-wheel efficiency	Total carbon footprint	Cost (production, infrastructure)	Technology barrier (R&D input) except battery	Battery usage	Price	Performance	Ease of use (infrastructure)
BEV	Well-to-tank: depends on feedstock, low in China Tank-to-wheel: high	Depends on power generation feedstock, high in China	High battery cost High infrastructure cost	Ready	Heavy usage	Largely depends on battery, high	Quick acceleration; Low top speed; limited range	Heavily dependent on charging station or battery swap facility
Suitable for								
Public transportation, urban driving: Intra city, fixed line, limited range								

Source: Nomura research

Hybrid electric vehicle (HEV): a compromise

HEV: a combination of EV and ICE

A hybrid electric vehicle uses a conventional ICE and an electric motor as a power source. The combination of the ICE and the motor can take various forms, yielding different fuel economy and performance. Because HEV still uses gasoline, it is less effective in the reduction of CO2 emissions and energy dependence. However, the use of ICE mitigates some of the major issues faced by BEV under current technology, e.g. driving range limit and cost. Therefore, HEV emerges as a compelling compromise option, favoured by many global automakers, most notably Toyota. However, due to its intense use of traditional ICE technology, where Chinese OEMs lag their global peers, the Chinese government does not subsidize HEV's R&D and usage as strongly as for EV, which may become the major risk to its demand in China.

Engineering structure

As the power source of most motor vehicles, ICE can achieve best efficiency only at a limited range of speeds and temperature. As a car needs to operate in a wide variety of speed and settings, this discrepancy between engine and wheel causes a high degree of inefficiency, which is most apparent in cases like starting, braking and idling (such as waiting at a traffic red light). In theory, ICE can transform 37% of the energy in fuel to kinetic power that drives the wheels (already a low figure), while the current average is only 20% in practice.

Hybrid technology aims to improve the efficiency of ICE by attaching a set of battery, electric motor/generator and controlling devices to the power-train. In terms of how the ICE and electric power source are connected, HEV can be categorised as:

Series hybrid

In these cars, ICE drives a generator which in turn powers an electric motor that drives the car. This concept has been used by electromotive locomotives for over 60 years. The **advantages** of series hybrid include:

- **Higher efficiency.** By removing the mechanical link between the engine and the wheels, ICE can be run at a constant and efficient rate, even as the car changes speed, so that higher efficiency is achieved.
- **More design possibilities.** Due to the lack of a mechanical link, series hybrids can also go without mechanical transmissions, thus enabling more design possibilities, for example low floors, which would make it a favoured option for public buses.

The **disadvantages** are:

- **Larger motor adds to engineering difficulty.** As the wheels are directly driven by a motor, the size of the motor needed will be larger than those in parallel hybrids.
- **Lower efficiency for highway travelling.** Because power from ICE must run through both generator and electric motor, engine-to-transmission efficiency is lower than for a conventional mechanical transmission. In long-distance high-speed driving mode, which is widely seen on highways and the power will mainly come from generator rather than the battery, this will cause significant energy waste.

Due to these characteristics, we believe this system is more suitable for transit buses or cars, which run along fixed lines within a limited range. Indeed, almost all hybrid bus models offered by Chinese bus makers use the series structure.

Exhibit 40. Series HEV at a glance

metrics	Well-to-wheel efficiency	Total carbon footprint	Cost (production, infrastructure)	Technology barrier (R&D input) except battery	Battery usage	Price	Performance	Ease of use (infrastructure)
Series HEV	**Low-speed mode**: high **High-speed mode**: low (< ICE)	Higher than BEV due to use of fossil fuel	Low battery and infrastructure cost	Developing (Transmission is not needed, enabling more diverse design)	Less than BEV	Acceptable cost increase	Comparable to ICE cars; low top speed	Much less dependence on infrastructure
Suitable for								
Public transportation, urban driving: Intra city, fixed line, limited range								

Source: Nomura research

Parallel hybrid

With a parallel HEV, both the engine and the electric motor generate the power that drives the wheels. A computer-controlled transmission allows these components to work together. The electric motor assists in the starting up and acceleration process, when the engine's efficiency is at the lowest. That's why they are sometimes called **motor-assist hybrid**. When the car cruises, the motor will act as a generator, converting excessive power from the ICE into electricity and storing it in the battery.

Parallel hybrid: both engine and electric motor generate power

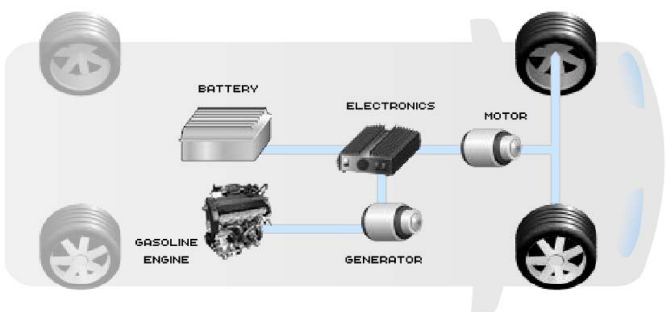
The parallel hybrid has following **advantages**:

- **Better high speed performance.** Because ICE is connected directly to the wheels, and provides the primary driving force, parallel hybrids provide better driving performance.
- **Better highway efficiency.** It eliminates the inefficiency of converting mechanical power to electricity and back, making these hybrids more efficient on the highway than series equivalents. Yet this direct connection also reduces city driving efficiency benefits, as the engine operates inefficiently in stop-and-go driving.
- **Cheaper and technologically less demanding.** Because the electric power set plays only a relatively minor role, the motor and battery is relatively small (also only one motor/generator is needed). This makes parallel hybrid technology relatively cheaper than series HEV and also easier at the R&D level.

Of course the flip side is its limited gains in efficiency and environmental benefit.

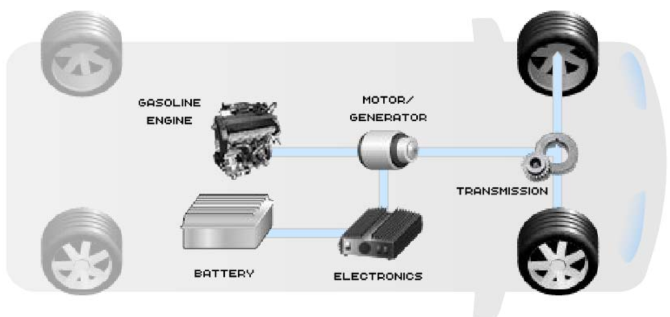
Due to its lower R&D requirement, it has become a favoured choice for automakers that do not have either a commitment to any particular EV technology approach or strong R&D power. Honda's Insight is an example of parallel hybrid.

Exhibit 41. Structure of series hybrid



Source: Hybrid Center

Exhibit 42. Structure of parallel hybrid



Source: Hybrid Center

Exhibit 43. Parallel HEV at a glance

metrics	Well-to-wheel efficiency	Total carbon footprint	Cost (production, infrastructure)	Technology barrier (R&D input) except battery	Battery usage	Price	Performance	Ease of use (infrastructure)
Parallel HEV	**Low-speed mode**: medium **High-speed mode**: high (> series HEV)	Higher than series HEV due to more use of ICE; limited CO2 reduction	Lower battery and infrastructure cost	Ready	Less than series HEV	Acceptable cost increase	Comparable to ICE cars	Much less dependence on infrastructure
Suitable for								
PV (transition product **or entry-level): acceptable cost increase, limited energy and environment saving**								

Source: Nomura research

Blended hybrid: decoupling of power input and power output

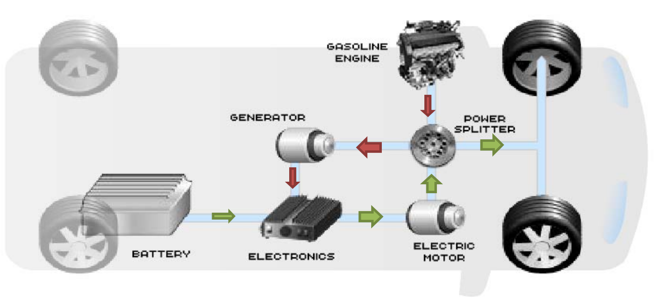
Blended hybrid, or combined hybrid, series/parallel hybrid, combines the series hybrid and parallel hybrid formats. It can be seen as 'the hybrid of hybrids', as a combined hybrid can function in either the series or parallel modes, according to driving conditions.

Blended hybrid: a combination of series hybrid series hybrid and parallel hybrid

The main principle behind this system is the decoupling of the power supplied (input power) from the power demanded by the driver (output). Because it can operate in both series and parallel hybrid modes, it inherits the benefits of both systems. When the car starts up and accelerates, it runs in series mode, in which the electric motor engages and shortens (or even eliminates) the engine's inefficient running period. When the car exceeds certain speed, parallel mode is triggered and the engine drives the wheel, with excessive power from the engine directed through the generator to recharge the battery. The Toyota Prius is the most prominent application of this drive-train design.

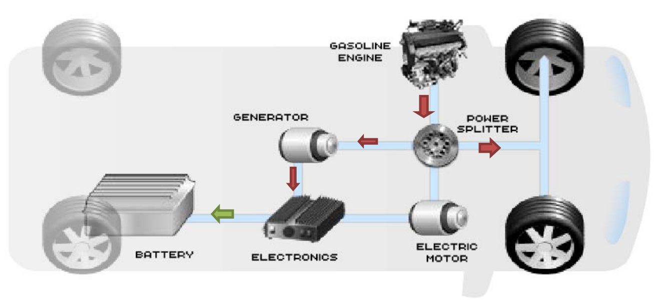
A complicated power-split device is needed in blended HEV that acts as a hub of incoming and outcoming power. Compared with parallel hybrids, a larger battery and a stand-alone generator are needed. Although blended (or combined) HEV delivers the highest fuel economy among HEV powertrains, the **power splitter** and larger battery set also mean **higher R&D inputs and production costs**.

Exhibit 44. Blended hybrid: acceleration mode



Source: Hybrid Center

Exhibit 45. Blended hybrid: cruise mode



Source: Hybrid Center

Exhibit 46. Blended HEV at a glance

metrics	Well-to-wheel efficiency	Total carbon footprint	Cost (production, infrastructure)	Technology barrier (R&D input) except battery	Battery usage	Price	Performance	Ease of use (infrastructure)
Blended HEV	Highest among HEV	Series < Blended < Parallel	Battery cost higher than parallel but lower than BEV	Complex structure (power splitter)	Higher than series HEV	Significant increase	Comparable to ICE cars	Much less dependence on infrastructure
Suitable for								
Premium PV : significant fuel economy improvement, large cost increase, high price								

Source: Nomura research

Plug-in hybrid (PHEV)

Technically PHEV is not a new structure. It just attaches a plug to the battery set that allows it be plugged in to an electrical outlet to be charged. In terms of power-train, it can take the form of either series (e.g. Chevrolet Volt), parallel (e.g. Audi Duo) or blended (e.g. the proposed Toyota Prius plug-in and BYD F3DM), although most current PHEV models follow blended HEV structure for its superior performance and fuel economy.

Plug-in hybrid: could be plugged into an electrical outlet to be charged

As a result of its technological similarity with other HEV configurations, its fuel economy is also comparable to underlying power-train structure, while its well-to-wheel efficiency as well as gross emissions (carbon footprint) largely depends on the front end, i.e. power generation. As we have discussed in previous chapters, emissions during coal-based generation are much higher than other feedstock bases. As a matter of fact, our calculation shows that for a given distance, total CO2 emission of coal-based electricity generation is even higher than (more than double) the volume emitted during the combustion of gasoline in ICE cars. Therefore it would be hard to promote PHEV in large scale in China, considering around 80% of China's electricity is coal-based. On the other hand, if nuclear or other clean energy source takes a larger percentage, such as the case in California, where the power grid is mainly dependent on natural gas, hydroelectric power, and wind power, the PHEV system would be much more efficient in emissions reduction.

Exhibit 47. PHEV at a glance

Metrics	Well-to-wheel efficiency	Total carbon footprint	Cost (production, infrastructure)	Technology barrier (R&D input) except battery	Battery usage	Price	Performance	Ease of use (infrastructure)
PHEV	Well-to-tank: depends on feedstock, low in China Tank-to-wheel: same with underlying power-train structure	Depends on power generation feedstock, high in China	Depends on underlying power-train Medium infrastructure cost (lower than BEV)	Complex	High	Significant increase due to complex structure and larger battery	Comparable to ICE cars	can be charged at home using residential grid; fast recharging requires special facility
Suitable for								
PV for urban use: charge at home								

Source: Nomura research

Fuel-cell vehicle (FCV): still in the labs

An FCV simply put is a BEV whose electricity is generated by fuel cell through the electrochemical reaction between hydrogen and oxygen. In terms of structure it's similar to a series HEV, where the engine and generator is replaced by a fuel cell, and the gas tank is replaced by a hydrogen tank.

The key **advantages** of FCV include

- **Low carbon emissions.** FCV itself does not have any carbon emissions, given the nature of the reaction inside (the only by-product is water).
- **Longer mileage.** Because the liquidized hydrogen storage has higher energy density than batteries of current technology, FCV also offers longer mileage than BEV, and shorter refuelling time.

FCV was once very close to commercial application, at least in public perception. At the turn of the millennium, several fuel-cell companies as well as automakers announced their plan to launch FCV and fuel cells for FCV. As flagged, fuel-cell producer Ballard Power Systems was the frontrunner of this FCV boom. It teamed up with Daimler-Chrysler and Ford, two automakers that are most fervent about FCV and together held a 35% stake in Ballard, to develop FCV. Company founder Geoffrey Ballard was awarded the Order of Canada and named by Time magazine as Hero for the Planet in 1999. The share price of Ballard rose above US$120 in 2000, and rallied every time with news flow about fuel-cell supply contracts with various automakers, as shown in the exhibit below. According to the US Fuel Cell Council, an industry lobby group, there were at least 29 FCV models announced by automakers in 2001 (7 from Daimler-Chrysler alone).

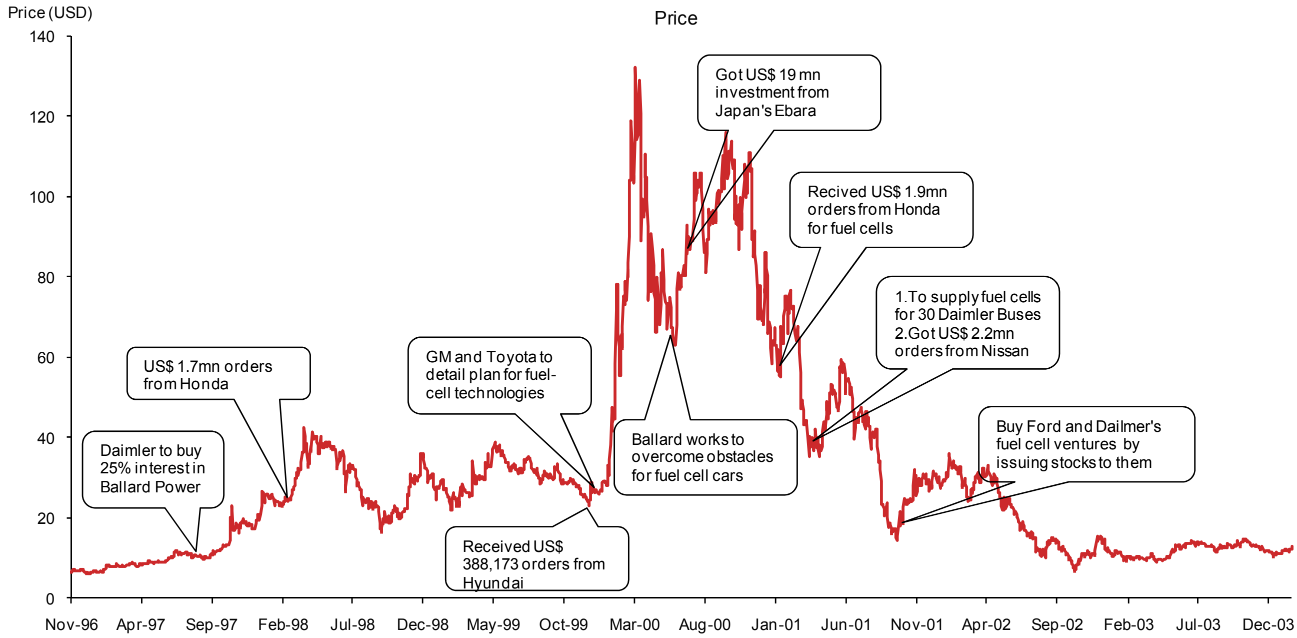
Exhibit 48. Fuel-cell projects announced in 2001

Auto maker	Vehicle type	Year shown	Fuel-cell type	Follow-up model	Launched fuel-cell model in 2007~2009
BMW	Series 7 sedan	In development	hydrogen	no	
DaimlerChrysler	NECAR (van)	1993	gaseous hydrogen	no	√
	MECAR 2 (mini-van)	1995	gaseous hydrogen	no	
	MECAR 3	1997	liquid methanol	no	
	MECAR 4	1999	liquid hydrogen	no	
	Jeep commander 2 (SUV)	2000	methanol	no	
	NECAR 5	2000	methanol	no	
	DMFC (one-person vehicle)	2000	methanol	no	
Energy Partners	Green Car (Sports Car)	1993	hydrogen	no	
Ford	P2000 HFC (sedan)	1999	hydrogen	No. FCV project abandoned	
	P2000 SUV	1999 (concept only)	methanol		
	TH!NK FC5	2000	methanol		
General Motors/Opel	Zafira (mini-van)	1998	methanol	no	√
	Precept	2000	hydrogen	no	
	HydroGen1	2000	hydrogen	HydroGen4 (2007)	
Honda	FCX-V1	1999	hydrogen	FCX Clarity (2007)	√
	FCX-V2	1999	methanol		
	FCX-V3	2000	hydrogen		
H Power	New Jersey Venture	1999	hydrogen	no	
	New Jersey Genesis	2000	hydrogen (from sodium borate or "Borax")	no	
Hyundai	Santa Fe (SUV)	2000	hydrogen	no	
Mazda	Demio	1997	hydrogen (stored in a metal hydride)	no	
Nissan	R'nessa (SUV)	1999	methanol	no	
	Xterra (SUV)	2000	methanol	no	
Renault	FEVER (station wagon)	1997	liquid hydrogen	no	
	Laguna Estate	1998	liquid hydrogen	no	
Toyota	RAV 4 FCEV (SUV)	1996	hydrogen (stored in a metal hydride)	no	
	RAV 4 FCEV (SUV)	1997	methanol	no	
VW/Volvo	Bora HyMotion	1999	hydrogen	no	

Source: US Fuel Cell Council, Wikipedia

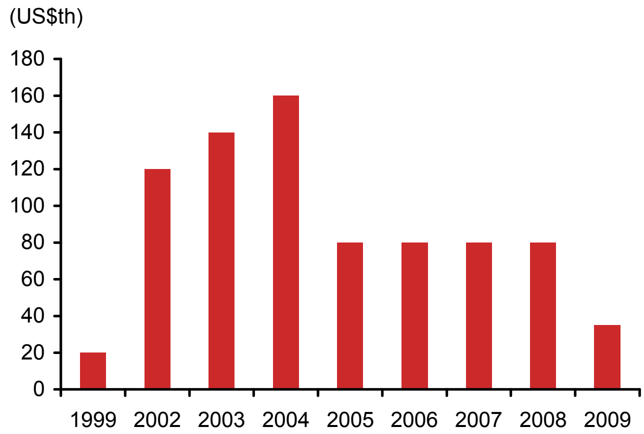
However the tide quickly waned. There are at most five FCV models available in the current market, almost all of them derived from the 29 models mentioned. There's no sales volume statistics but we believe the total number is at most several hundred pa. Ford abandoned the FCV project altogether, stating instead that "The next major step in Ford's plan is to increase over time is the volume of electrified vehicles". The share price of Ballard dropped all the way to US$2, and the company sold its entire vehicle-use fuel-cell business to Daimler in 2007. The money spent on lobbying the US government and legislators on fuel-cell technology kept declining, although total lobbying spending on alternative energy has been rising steadily and began to soar in 2007.

Exhibit 49. Share price of Ballard (1997~2003) and catalysts



Source: Bloomberg, Nomura research

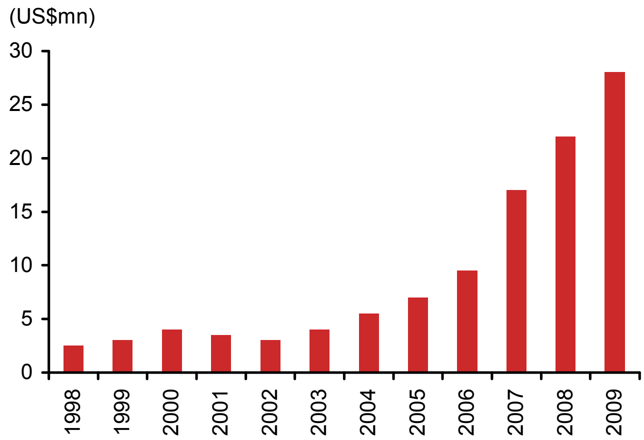
Exhibit 50. Lobbying spending of Ballard



Note: 2000, 2001 data are unavailable.

Source: Opensecrets.org, Nomura research

Exhibit 51. Total lobbying spending on alternative energy production & services



Source: Opensecrets.org, Nomura research

The following factors impede the promotion of FCV.

- The most important is **price**. Current fuel cells still need platinum as a catalyst to enable the reaction.
- Overall emissions and efficiency. Although FCV itself produces zero emission, **overall emissions** depends on the hydrogen path and could be high, considering the process in which hydrogen is produced, stored, and transported. According to a research by the European Fuel Cell Forum, fuel-cell vehicles running on compressed hydrogen may only have a power-plant-to-wheel efficiency of 22% if the hydrogen is stored as high-pressure gas, and 17% if it is stored as liquid hydrogen, which is only slightly better than conventional ICE cars, but at a much higher cost.
- Also, the **infrastructure needed for hydrogen production /storage /transportation** must be built from scratch.

Therefore, we believe FCV based on current technology still doesn't make any sense economically or environmentally. According to the New York Times, the US energy secretary announced that FCV will not be practical over the next 10 to 20 years, and the US government would cut off funding for development.

We don't think FCV based on current technology makes any sense both economically and environmentally

The Chinese government dedicated significant resources to the R&D of fuel-cell vehicles. During 2006 to 2008, R&D funding from the central government on FCV was RMB143mn, accounting to 26% of central funding for the R&D of AFV. Mr Gang WAN, minister of Ministry of Industry and Information Technology (MIIT) and an auto expert, used to be in charge of national R&D project in FCV power-train. However, in the new R&D funding schedule for 2008 to 2010, funding to FCV shrank to RMB 41mn, only 10% of total central funding (the percentage of overall funding would be even lower if contributions from local governments are included; see next section). Among Chinese automakers, only SAIC has developed a FCV bus model, which ran at the Expo site of 2010 Shanghai Expo. Although government officials still vocally support the R&D on fuel-cell vehicles, we believe the government has cooled its passion towards FCV and is merely demonstrating its strong resolution towards environmental protection. We are conservative towards the commercial application of FCV, but expect that FCV could be used in buses within some heavily subsidized public transportation system.

Exhibit 52. FCV at a glance

Metrics	Well-to-wheel efficiency	Total carbon footprint	Cost (production, infrastructure)	Technology barrier (R&D input) except battery	Battery usage	Price	Performance	Ease of use (infrastructure)
FCV	Well-to-tank: low Tank-to-wheel: high	Depends on hydrogen path. Low only if electrolysis with renewable energy	High production cost Height infrastructure cost	High fuel-cell tech barrier	Medium	Significant increase	Comparable to ICE cars	Highly depends on infrastructure
Suitable for								
Bus for urban public transportation: high cost, dependence on infrastructure								

Source: Nomura research

Justifications

Right timing, right place and right technology?

Once upon a time in 1900 …

EV has a long history and was especially popular when used as city cars

Despite recent public interest in EV, they are by no means new inventions. The first electric car was made in the 19th century, first in Europe, then in the US. The main reason for the early development was to address the meagre power of the internal combustion engine. It was an electric car that first broke the speed barrier of 100km/h in 1899.

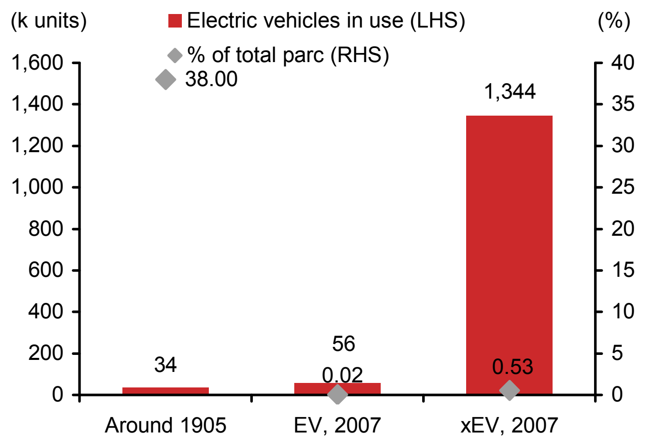
Compared with early ICE cars, EV had a number of advantages, including less vibration, less smell, less noise and no need for gear changes (which was the most difficult part of driving then). **Electric cars were especially popular among well-heeled customers who used them as city cars, where the car's limited range proved to be less of a disadvantage.** Sales of EV in the US peaked in 1912.

EV began to lose its market position thereafter, due to: 1) improved road infrastructure, making the limited range of EV a bigger disadvantage; 2) discovery of large oil reserves in the US, paving the way for the increasing popularity of gasoline-fuelled cars, with their longer range and newly affordable fuel; and 3) a series of inventions that made ICE cars easier to use.

Most importantly, the initiation of mass production of automobiles by Henry Ford significantly brought down the ICE price to about 1/4 of EV's — as low as US$440 in 1915 (equivalent to roughly US$9,200 today). By contrast, in 1912, an electric roadster sold for US$1,750 (roughly US$39,000 today). By the 1920s, the heyday of electric cars had passed, and a decade later, the electric automobile industry in the US had effectively disappeared. There were only some small-scale ventures thereafter.

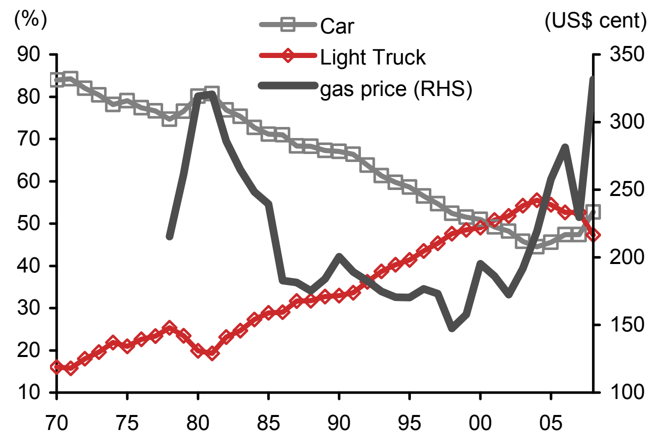
Public interest in EV was revived for a short period after the oil crisis in the 1970s. Consumers began to care about energy cost, also evidenced by the temporary reversal in the truck/car mix in US light vehicle sales. Notable EV prototypes and models in this period included GM EV1 and Impact. However, EV in that period never had a real impact on auto sales due to high prices.

Exhibit 53. US EV in use and share of total auto ownership



Source: DOE, Wikipedia, Nomura research

Exhibit 54. US gas price and PV mix trend



Note: Gas prices in 2008 constant US$.

Source: DOE, Nomura research

Looking at history, we find the factors behind the rise and fall of EV always revolved around:

- Performance, including acceleration, driving range, speed;
- Concerns over energy — including cost and pollution;
- Selling prices of EV vs ICE cars.

We believe the same factors still play a significant role in determining demand for EV currently. Despite the technological breakthroughs made by automakers, we believe current EV models still fail to meet the standard of ICE models in terms of price vs performance. Battery remains the major bottleneck with its limited energy density, although that of the latest Li-ion battery has double the power of NiMH batteries. Meanwhile, the existing power generation capacity structure in China means that the well-to-wheel efficiency and lifecycle CO_2 emissions of xEV could even be higher than for ICE models, due to heavy reliance on coal-based power generation.

Performance: high price unjustified

Unmatched performance and pricing keeps customers from buying EV

We believe it is unrealistic to hope consumers will buy electric/hybrid vehicles only for the sake of environmental protection. In our view, the foremost reason for the slow penetration of hybrid/electric vehicles is that their overall performance is still inferior to traditional ICE cars. The underperformance is due to not only the battery technology but also the motor technology.

Energy density and mileage

Energy density describes how much energy is contained in a given volume or mass of fuel source. As the below chart shows, the energy density of batteries is much lower than that of gasoline, even with Lithium ion battery. For a given distance a vehicle will have to carry more and heavier batteries, even though an electric/hybrid drive-train has higher tank-to-wheel efficiency.

Exhibit 55. Energy density comparison

	Gasoline	Diesel	Lead-acid	NiMH	Li-ion
Specific energy (Wh/kg)	13,000	12,900	35	70	140
Energy density (Wh/L)	9,600	10,500	90	140	300
Weight needed for given distance (kg)	1.0	1.0	99	50	25
Volume needed for given distance **(l)**	1.0	0.9	28	18	9

Note: Tank-to-wheel efficiency assumptions: 20% for ICE, 75% for xEV. Weight and volume of gasoline normalised to 1.

Source: Wikipedia, Nomura research

Speed matters

EV's speed performance is inferior to ICE due to inherent technical reasons

Acceleration and top speed are important factors in choosing a car, whether for practical reasons or for excitement. Electric/hybrid vehicles cannot outperform ICE vehicles in this area due to inherent technical reasons, and their performance is especially inferior in terms of top speed.

The acceleration ability of a car is decided by the **torque** of its engine: the greater the torque, the faster acceleration. Due to different power output patterns, electric cars (driven directly by an electric motor, including BEV and series HEV) can achieve high torque from start-up and accelerate in a short time. Parallel HEVs, however, do not have any advantage over normal ICE vehicles, due to the existence of an ICE, which provides low torque at the initial stage before gradually powering up (see Exhibit below.)

The highest speed a car can reach depends on the **power** of its engine and the car's weight. Due to technical reasons, the power density of an electric motor is inherently limited, so that even a state-of-the-art electric sports car cannot compete with an ordinary sedan in top speed.

Although drivers seldom have the chance to drive at top speed, even on highways, we believe this factor cannot be underestimated, considering the firmly established concepts brought by the long history of auto marketing and motor sports.

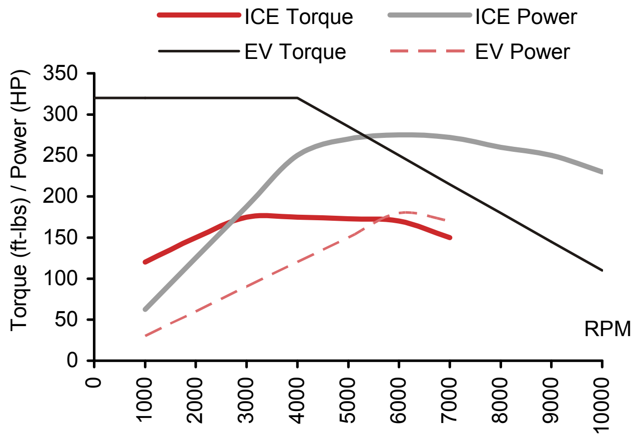
Exhibit 56. Performance comparison, ICE vs electric/hybrid

		Acceleration		Top speed		Price
		Torque (Nm)	0-100 km/h (s)	Power density (power-to-weight ratio, W/kg)	Top speed (km/h)	US$
Ford Focus 2.0L	ICE	185	10	94	220	16,000
Honda Accord 2.0L	ICE	192	9.3	81	215	21,000
Toyota Prius 2010	HEV	210	10	43	160	22,000
Porsche 911 Turbo	ICE	650	3.7	234	312	78,000
Tesla Roadster	BEV	270	3.9	150	200	109,000

Note: Prices are for US market.

Source: Wikipedia, company sites, cars.com, carfolio.com

Exhibit 57. Torque and power output pattern comparison (ICE vs typical EV)



Source: Wikipedia, Nomura research

Socio-economic considerations: macro concerns

Overall efficiency and emissions

In China, front-end efficiency is low and CO2 emissions are significant

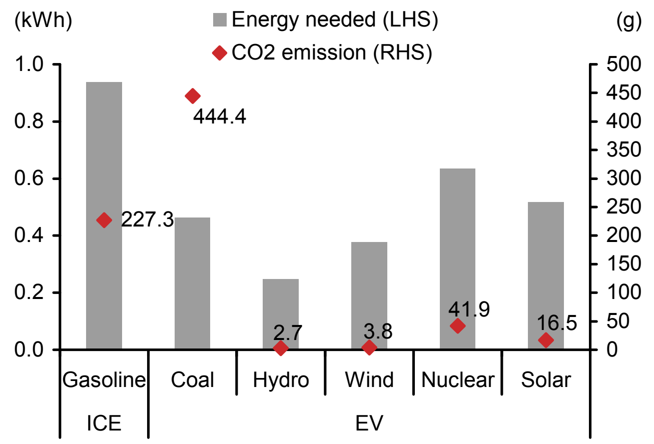
The overall energy efficiency and emission of EV transportation depends not only on drive-train, but also on how the electricity is generated and delivered to batteries in EV (**well-to-tank efficiency**). Well-to-tank efficiency of power generation can reach as high as 80% if power is generated by water, but in China's case, where the majority of power generation is based on coal and gas, front-end efficiency is low and CO2 emissions is significant. Thus, overall emissions in the usage cycle (carbon footprint) would not be effectively lowered. As shown in the chart below, emissions for coal-based generation are much higher than other renewable feedstock. Our calculation shows that for a given distance, total CO2 emissions of coal-based power generation required by BEV are even higher than (nearly double) the volume emitted during the combustion of gasoline in ICE cars (next Exhibit, right). We believe the mass promotion of xEV can only come with the substantial development of renewable energy (or nuclear energy). Renewable energy technologies are not necessarily more efficient than thermal power generation, but given their significantly lower emissions and rich availability of feedstock, we think they better address policymakers' concern over energy dependence and environmental protection.

Exhibit 58. Energy conversion efficiency and carbon footprint by generation technology

Feedstock	Efficiency (%)	CO2 emissions (g/kWh)
Coal	48	960
Solar	43	32
Wind	59	10
Nuclear	35	66
Hydroelectric	90	11

Source: Wikipedia, Nomura research

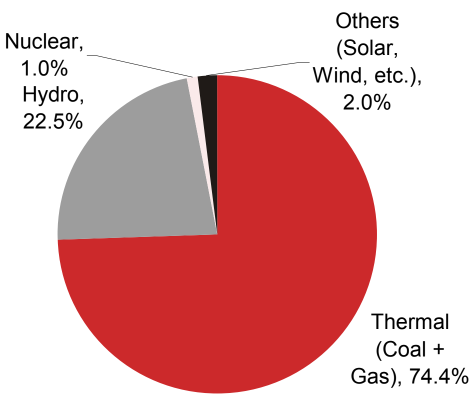
Exhibit 59. Energy need and CO2 emissions per 1km by different drive-trains



Note: the energy required by the wheel for 1km is about 150 Wh.

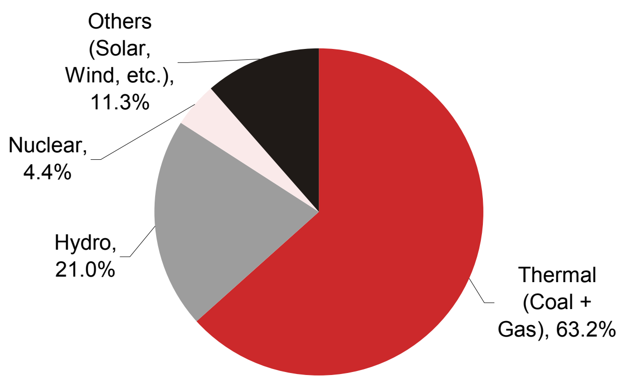
Source: Wikipedia, Nomura research

Exhibit 60. China power capacity breakdown by feedstock, 2009



Source: Nomura research

Exhibit 61. China power capacity breakdown by feedstock, 2020E



Source: Nomura research estimates

Infrastructure

We expect facility-based solution to be more prevalent in China

Charging infrastructure is essential for mass adoption of electric cars, but it can be costly to build. Based on current technology, recharging of EV takes two approaches: 1) a garage-based low-voltage solution that is relatively low cost and requires a full night to recharge; and 2) a facility-based (e.g. gas station) high-voltage solution that is a quick recharging process. We expect the facility-based solution to be more prevalent, given that most Chinese car users do not have a garage (even in the US, the ratio of garages and passenger cars is about 1:4). But associated R&D and upgrade costs could be much higher. A first-of-its-kind charging station ready for commercial use, built by the State Grid of China in Shanghai, cost RMB5.1mn with only 10 charging positions. Industry experts estimate that a charging station will cost RMB4.3mn, according to a report by China Security News.

Exhibit 62. Charging station building plan

Operator	City	Year	Charging stations	Charging poles
China Southern Power Grid	Shenzhen	2009 ~ 2015	250	12,500
State Grid	Nanjing	2010 ~ 2015	30	600
	Chengdu	2010	3	300
	Xi'an	2010	4	200
	Wuhan	2010	16	150
	Nanchang	2010	1	150
	Suzhou	2010	2	100
	Hefei	2010	2 ~ 5	80
	Xiamen	2010	1	76
	Fuzhou	2010	1	70
	Chongqing	2010	1	50
	Wuxi	2010	1	50
	Xuzhou	2010	1	20

Source: NDRC, Nomura research

Policy

Policy: shifting to EV

We believe the Chinese government's future policy on the auto industry will mainly follow two themes: 1) building a strong auto industry in the hope that R&D will spill over to benefit other large-scale manufacturing industries; 2) awareness of energy concerns. EV fits both categories. If successful, it would give China an edge in the next generation of auto technologies (China has no edge in the ICE era currently), while at the same time it will also rein in emissions and the country's dependence on imported energy. Therefore, we expect the central and local governments to continue to support R&D and the use of EVs.

EV fits the Chinese government's main policy themes for the auto industry

Governments are beefing up support

The Chinese government has been consistently encouraging the development of the EV industry, and the pace of policy roll-out has intensified in recent years.

Exhibit 63. Incentive policies issued by the central government related to hybrid/EV industry

	2001 - 2006	2007	2008	2009	2010	2011E
State Council	1.11th Five Year Plan (2006) 2. Mid-Long-term Science & Technology Development Plan (2006, 2006-2020)		Government Working Report	Automobile Industry Adjustment and Revitalization Plan	Decision on Cultivating and Developing Strategic Emerging Industries	12th Five Year Plan
NDRC	Mid-long-term Energy Saving Plan (2004)	1. Catalogue of the State Industry Structural Adjustment 2. Comprehensive Working Plan on Energy Saving and Cutting Pollution 3. China National Plan for Coping with Climate Change 4. 11th Five Year Plan for Energy Development 5. Production Admission and Administration of Alternative Fuel Vehicle		Circular on Subsidising Users of AFVs in 13 Major Cities	Circular on Subsidising Private Purchase of AFVs in 5 Pilot Cities	Automobile Industry Development Policy
Ministry of Industry and Information Technology	2nd Stage PV Fuel Economy Standard (2004)			Circular on Subsidising Users of AFVs in 13 Major Cities	Circular on Subsidising Private Purchase of AFVs in 5 Pilot Cities	3rd Stage PV Fuel Economy Standard Alternative Energy Vehicle Development Plan (2011 - 2021)
Ministry of Science & Technology	863 Alternative Fuel Vehicle Programme (2006, 2006-2008)		863 Alternative Fuel Vehicle Programme (2008-2010)	Circular on Subsidising Users of AFVs in 13 Major Cities	Circular on Subsidising Private Purchase of AFVs in 5 Pilot Cities	
Ministry of Finance			Auto Consumption Tax Adjustment	Circular on Subsidising Users of AFVs in 13 Major Cities	Circular on Subsidising Private Purchase of AFVs in 5 Pilot Cities	
State Administration of Taxation			Auto Consumption Tax Adjustment		Fuel Tax Adjustment	Vehicle Tax Reform

Note: Highlights indicate direct impact, while the other policies have indirect influences.

Source: Nomura research, www.gov.cn/

On the OEM side, generous incentives have been given to manufacturers and R&D institutions for the development of related technology. In the state-funded 863 Programme (State High-Tech Development Plan) alone, around RMB4.7bn of subsidies have been issued for the research of Energy-saving and New Energy Vehicles from 2006 to 2010, compared with RMB617mn for traditional ICE technologies over the same period. In September 2010, xEV was categorized as an important emerging industry by the State Council. According to media reports, the Chinese government targets to achieve 1mn ownership of new energy cars by 2015 in the 12th Five-Year Plan. We expect more R&D subsidies and tax incentives in the coming years.

On the consumer side, the focus has been on improving the affordability of EVs. In January 2009, the Ministry of Finance and Ministry of Science and Technology jointly announced a pilot project promoting the public use of xEV in 13 cities. The programme was expanded to 25 cities in 2010. In June 2010, the government further announced plans to subsidize private purchase of EVs in 5 cities. The details of these two policies will be given below with analysis on their effects.

Aside from the central government, local governments in China have also rolled out policies to support the development of the xEV industry. Examples include:

- Wuhan. So far it has been the most successful Chinese city to run an EV public transportation system, with 20 hybrid buses and 130 electric light buses in 19 transportation lines. The city has teamed up with Nissan to explore the mass adoption of BEVs and infrastructure development;
- Shanghai, which has an aggressive plan of developing an alternative energy vehicle industry. The city ran a successful EV pilot project during the 2010 World Expo;
- Beijing, whose venture began with a pilot project during the Beijing Olympics.

Focus shifting to BEV

Changes in funding destination underscore a shift in the government's focus to BEV

Our research on the funding destinations of Energy-saving and New Energy Vehicles projects of the 863 Programme suggests that the government is shifting its focus from HEV to BEV, while funding for FCV has waned in the past two years.

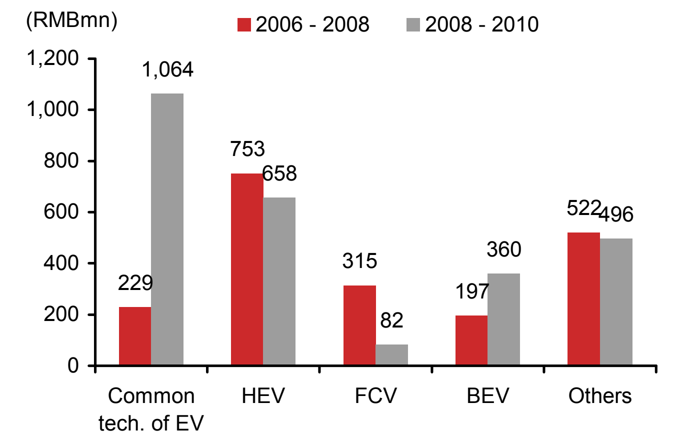
A large amount of subsidies to EVs began in 2006 with the introduction of the 11th Five-Year Plan and National Mid-Long-term Science & Technology Development Plan (2006-2020). From 2006 to 2008, total government funding (including central government and local government) reached RMB753mn, RMB315mn and RMB197mn respectively for HEV, FCV and BEV, while another RMB229mn was spent on generic EV technologies, which are related mainly to battery and motor technologies.

From 2008 to 2010, the government significantly raised R&D funding for BEV, as well as battery and motor technologies. At the same time, funding for FCV was slashed. Funding for HEV has roughly stayed unchanged, although the overall funding for AFV has increased by 32% over the same period.

We believe the shift is due to a change in strategy. In the first stage, the government's strategy is: 1) to catch up with the global technology standard by refining the ICE platform towards HEV drive-trains; and 2) to achieve breakthroughs in fuel-cell technologies. But when policymakers realized how far China's ICE technology lags that of the global standard (with its fuel cells far from reaching commercial application) and given the significant potential of EV, the policy changed to support EV-related technologies, including drive-train, battery and engine.

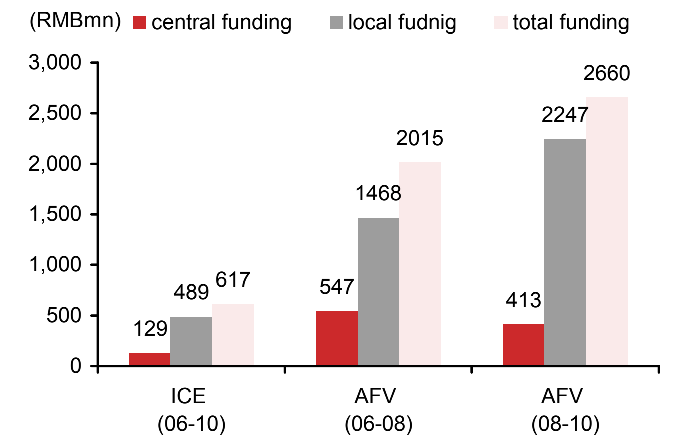
Such a policy stance was reinforced with the inclusion of EV as a strategically important emerging industry. There has also been comment from government officials indicating that HEV (except plug-ins) can only be categorized as an energy-saving vehicle but not a new energy vehicle, so it does not qualify for EV-specific incentives. This shows government wants to encourage EV, not hybrid (HEV); HEV still uses ICE, which Chinese automakers are not as good at. We expect further clarification in the next industry development guideline. In the Admission and Administration Guidelines of New Energy Vehicle Enterprises and Products announced in June 2009, the government categorized Li-ion and NiMH battery as 'developing' technologies, while giving the green light to the application of lead-acid batteries. The decisions did disappoint some industry participants. As the current guideline expires at the end of 2010, we expect the new guideline to be issued soon, whereby the priority of EV technologies would be significantly raised.

Exhibit 64. Government subsidies to xEV R&D projects through the 863 programme



Source: NDRC, Nomura research

Exhibit 65. Government R&D funding for the 863 projects



Source: Toyota, Nomura research

Exhibit 66. Categorization of different technologies

Type	Energy source	Phase
Hybrid PV	**Lithium-ion battery**	**Development**
	Nickel-metal hydride cell	**Mature**
	Lead-acid battery	**Mature**
	Zinc-air battery	Pilot
	Supercapacitor	Development
	Hydro-/aeropower	Development
Hybrid CV	**Lithium-ion battery**	**Development**
	Nickel-metal hydride cell	**Development**
	Lead-acid battery	**Development**
	Zinc-air battery	Pilot
	Supercapacitor	Development
	Hydro-/aeropower	Development
Electric PV	**Lithium-ion battery**	**Development**
	Nickel-metal hydride cell	**Pilot**
	Lead-acid battery	**Mature**
	Zinc-air battery	Pilot
	Supercapacitor	Pilot
Electric CV	**Lithium-ion battery**	**Pilot**
	Nickel-metal hydride cell	**Pilot**
	Lead-acid battery	**Mature**
	Zinc-air battery	Pilot
	Supercapacitor	Pilot
Fuel-cell PV/CV	Fuel cell	Pilot
Hydrogen engine	Hydrogen	Pilot
DME cars	Dimethyl Ether	Pilot

Note: Applicable until December 31, 2010.

Source: Ministry of Industry and Information Technology (MIIT)

Exhibit 67. Definition and regulations to different phases

	Mature	Development	Pilot
Definition	Mature technology	Clear technology approach	Technology still in preliminary R&D
	Established industry standards	Incomplete industry standards	Industry standards absent
	Ready for volume production	Ready for preliminary volume production	Not ready for volume production
Requirements and regulations	Same as normal automobile	Volume production allowed	Small-scale production allowed
		Sold and used in limited area	Test run in limited area
		At least 20% must be monitored	All products must be monitored

Source: MIIT

Niche markets

Niche market: buses, taxis and LSEV

Based on the above analyses, we are cautious on the penetration of hybrid PV in urban areas in the short to medium term, due to: 1) low affordability; 2) inferior performance for personal use; and 3) insufficient subsidies. On the other hand, we believe xEV buses could see sizeable demand, thanks to: 1) the benefit of designated routes and limited range; 2) more advanced R&D in xEV buses than in PV at Chinese automakers; 3) generous government subsidies; and 4) relative price insensitivity of fleet demand. Similar conditions also make taxis a lucrative market, in our opinion. Meanwhile, we expect low-speed EVs powered by lead-acid battery to carve a new niche in China's auto demand spectrum.

Demand from public transportation

Chinese governments have been are pushing for public use of EV

We believe the operating environment of public buses (and taxis to a lesser extent) provides an ideal setting for the adoption of xEV in China's public fleet. With the help of an extensive government subsidy, we believe the HEV bus market could reach 30,000 units in 2012F and 119,000 units in 2015F, accounting for 20% of the country's total bus market. Meanwhile, we are concerned that the tendency to procure locally could hamper industry consolidation and the emergence of a market leader.

We attribute the feasibility of adopting EV in public transportation to:

- **Designated routes of buses**, which is characterised by fixed line, limited range (intra-city) and low speed on congested roads. All these features play to xEV's advantages. We have noted in our previous analysis that BEV, series HEV and FCV are suitable technologies for public transportation vehicles used in urban areas.
- **The purchase decision-making process**. Unlike personal-use consumers, who may be deterred by the upfront cost, public transportation operators tend to consider in detail the lifecycle costs in their decision-making process before making a purchase. Corporate customers also tend to be less price-sensitive, partly because many operators in China are closely associated with local governments.

The Chinese government is pushing for public use of EV, in our view. In February 2009 the Ministry of Science and Technology along with the Ministry of Finance jointly announced the "Ten cities, a thousand electric vehicles" programme, which will run pilot xEV projects in 13 cities from 2009 to 2012 (now expanded to 25 cities). It aims to deploy over 1,000 units of xEV in every participating city by the end of the project. The subsidy scheme is based on fuel economy improvement and electric power output ratio, as shown in the exhibits below.

Exhibit 68. Subsidy for public use of PV & LCV (k RMB)

Vehicle type	Fuel economy improvement (%)	Max. electric power output ratio			
		BSG	10%-20%	20%-30%	30%-100%
Hybrid vehicle	5-10	-	-	-	-
	10-20	4	28	32	-
	20-30	-	32	36	42
	30-40	-	-	42	45
	>40	-	-	-	50
Pure EV	100	-	-	-	60
Fuel-cell vehicle	100	-	-	-	250

Note: 1. The subsidy standard for HEV with max. Electric Power rate over 30% applies to plug-in; 2. BSG: Belt-Starter-Generator system, a start-stop system.

Exhibit 69. Subsidy to public bus over 10m (k RMB)

Energy saving & new energy vehicle type	Fuel economy improvement (%)	Using Lead-acid battery	Hybrid using NiMH/Li-ion batteries or supercapacitor	
			Max. electric power output ratio: 20%-50%	Max. electric power output ratio: >50%
Hybrid vehicle	10-20	50	200	-
	20-30	70	250	300
	30-40	80	300	360
	>40	-	350	420
Pure EV	100	-	-	500

Source: Roland Berger, Nomura research

According to the technical specifications of current xEV models by Chinese automakers (refer to appendix for technical details), we estimate most hybrid buses will get a subsidy of RMB300,000 per unit, about 40% of their selling price, which is a substantial incentive to stimulate demand for hybrid buses for urban transportation.

Based on the procurement plan announced by the cities, we estimate the total number of EV buses will reach more than 30,000 units by 2012, which will account for about 6% of China's total public bus fleet by then. We estimate the central government will spend RMB10bn during the period on purchasing subsidy (remember we have noted that most of China's current hybrid buses will get a subsidy of RMB300,000 per unit), accounting for about 8% of the funds set aside for energy-saving and emission reduction.

We expect number of EV buses in China's public transportation system to reach 119,000 units by 2015

For market growth beyond 2012, we assume China's public bus fleet will post a 6% CAGR in the next 10 years, thanks to massive urbanization and economic growth in inland areas. We further assume EV buses will account for 20% of the total public bus fleet by 2015F, up from 6% in 2012F. Under these assumptions, we expect the number of EV buses in China's public transportation system to reach 119,000 units by 2015. We forecast EV bus PARC will further grow to over 400,000 units by 2020, accounting for 50% of total public buses, thanks to lower costs brought by economies of scale and better performance as R&D advances.

Exhibit 70. EV bus market size forecast

	2001	2006	2008	2012F	2015 F	2020 F
Total bus fleet size	226,640	302,619	366,169	498,169	593,327	794,005
Growth in the last period (CAGR) (%)		6.0	10.0	8.0	6.0	6.0
No. of EV bus	-	-	100	30,000	118,665	397,003
Growth in the last period (CAGR) (%)		-	-	316.2	58.1	27.3
% of fleet size	-	-	0.0	6.0	20.0	50.0

Source: Fourin, Nomura estimates

One of the largest risks to our forecast is the possibility of local protectionism. Many automakers in China are doing research on EV and have rolled out models for production. Almost all of the cities procure locally, although many of the OEMs buy a hybrid system from foreign-parts makers and apply it onto existing models to "develop" an EV bus. We believe this would hamper industry consolidation and an emergence of a market leader, thereby holding back development of the whole industry.

Exhibit 71. Overview of "ten cities, a thousand electric vehicles" programme

City	Target fleet size (year)	Major supplier	Local xEV makers: Name	Local xEV makers: EV type
Beijing	1,000 (2009) 5,000 (2012)	Beiqi Foton	Beiqi Foton	HEV/FCV bus
			Jinghua Bus	HEV/EV bus
			Beifang Neoplan	EV bus
Shanghai	1,000 (2010)	SAIC	Wanxiang Daewoo	EV bus
			Sunwin	EV bus
		SGM	SGM	HEV PV
Chongqing	6,000 (2012)	Chang'an Auto	Chang'an Auto	HEV PV
		Hengtong Auto		
Hangzhou	3,000 (2012)	Wanxiang EV	Wanxiang EV	HEV PV
		Xiamen Kinlong		
Wuhan	1,500 (2011)	Dongfeng	Dongfeng	HEV bus
Shenzhen	2,600 (2012)	BYD	BYD	HEV PV
		Wuzhoulong	Wuzhoulong	HEV bus
Changchun	1,000 (2012)	FAW	FAW Car	HEV PV
			FAW Fengyue	HEV PV
Jinan	1,610 (2012)	Zhongtong Auto	Zhongtong Auto	HEV/EV bus
		Beiqi Foton		
Dalian	1,200 (2010) 2,400 (2012)	FAW	FAW Bus	HEV bus
Hefei	1,400 (2012)	Ankai Auto	Ankai Auto	HEV bus
		Chery		
Nanchang	1,400 (2012)	Anyuan Bus	Anyuan Bus	HEV bus
Kunming	1,000 (2012)	Beiqi Foton		
Changsha	4,570 (2012)	Zhuzhou CSR Times	Zhuzhou CSR Times	HEV bus

Source: MIIT, Nomura research

Growth prospects for the xEV private market

Incentives offered by governments will help the growth potential of xEV

We believe the growth potential of xEV will be helped by incentives offered by central and local governments. In June 2010, the Chinese government announced a programme to subsidize private purchase of BEV and PHEV in five cities. Subsidies are based on the energy the battery can provide (based on battery rather than, which we will discuss later), as shown in the table below. Many local governments also issue their own incentive policies, on top of the national one, to stimulate EV sales and development of local EV-related industries. These also include some cities not featured in the national programme, for example, Beijing and Wuhan.

Exhibit 72. Central government subsidy for private EV purchase

Applicable to	BEV	PHEV
Minimum battery energy requirement	15kWh	10 kWh
Subsidy	RMB3,000@kWh	
Maximum subsidy	RMB60,000	RMB50,000

Source: Ministry of Science and Technology

Exhibit 73. Local government subsidy for private EV purchase and sales targets

City	Maximum subsidy (RMB)	2012 BEV / PHEV ownership target	2012 charging station target	2012 charging pole target
Shanghai	40,000	20,000	50	25,000
Shenzhen	60,000	34,000	89	47,500
Hangzhou	60,000	20,000	42	3,500
Hefei	20,000	16,000	20	21,100
Changchun	40,000	16,000	15	5,000
Beijing	60,000	30,000	100	36,000

Source: Media reports

We calculate the effective subsidies of these policies based on three widely reported xEV models. As shown in the table below, the subsidies effectively lower selling prices, making possible for some buyers of these vehicles to break even (cover the initial price difference with cost savings from usage).

Exhibit 74. Effect of the subsidies

Model	F3DM	Leaf	Volt
OEM	BYD	Nissan	GM
Type	PHEV	BEV	PHEV
Launch date	2008	2010	2010
Battery energy (kWh)	16	24	16
Central level subsidy (RMB)	48,000	60,000	48,000
Fuel efficiency subsidy (RMB)	3,000	3,000	3,000
Local level subsidy (RMB)			
Shenzhen	30,000	60,000	30,000
MSRP (RMB)	169,800	224,400	272,000
After subsidy (RMB)	88,800	101,400	191,000
ICE benchmark	F3	Tiida	Excelle
MSRP	60,000	100,000	100,000

Source: MIIT, Yahoo! Auto, Sina Auto, Nomura Research

Cost-benefit model

Will the additional purchase costs be offset by a savings in usage costs? Or how much subsidy is enough to make buying an xEV economically sensible? We conduct several scenario analyses based on various operating conditions.

We make two basic assumptions based on our research of current vehicle technologies:

- An ICE car consumes 8L of gasoline per 100km;
- A BEV needs 22 kWh of electricity per 100km;

We also assume a utility price of RMB0.52 per 1 kWh, which is regulated by the National Development and Reform Committee. We ignore maintenance costs for both vehicle types, which are generally higher for xEV than for ICE cars.

We find three driving factors:

- **Fuel cost**. Higher fuel cost dramatically shortens the payback period. We assume RMB6.5 per litre of gasoline in our base case, which we believe is conservative and has upside potential;
- **Higher purchase cost of an xEV vs a conventional car**;
- **Annual driving distance**. Longer driving distance shortens the payback period. It is decided by driving patterns, which depends on vehicle usage, infrastructure and EV driving range.

Below we analyse two scenarios: HEV as taxi and HEV for private use.

HEV as taxi: the economics work with subsidies

Scenario analysis suggests that HEV used as taxi makes economic sense with subsidies

In the taxi scenario, we assume a daily driving distance of 300km, which is a reasonable figure for tier-1 and tier-2 cities. Annual driving distance would be 109,500km, which roughly equals the total distance a battery set can support under the current technology. This suggests an **HEV taxi would require a new battery set every year.** This has s two important implications:

- Breakeven period must be shortened to within one year;
- Subsidy must be based on the battery, rather than the car. As the current private purchase incentive policies also subsidize battery leasing, the renewal of a battery could also be subsidized.

Under these assumptions, it would take 0.95 years for F3DM to breakeven in Shenzhen, with the help of central and local subsidies (next Exhibit left). As shown in the next Exhibit left, if the price difference narrows to RMB10,000, and gas prices rise to RMB8 per litre, the breakeven period could shorten to about three months. Although our estimates ignore maintenance cost and the intangible costs of charging infrastructure, this nevertheless shows that adoption of EV taxis is feasible.

Exhibit 75. EV breakeven analysis: taxis

ICE	Fuel used/100km	*6.00*	l
	Unit fuel cost	***6.50***	RMB/l
	Total fuel cost/100km	39.00	RMB
BEV	Elec. used/100km	*22.00*	kWh
	Utility price/kWh	*0.52*	RMB
	Fuel used/100km	0.00	l
	Total usage cost	11.44	RMB
	Cost diff/100km	27.56	RMB
	Price difference	***28,800***	RMB
	Breakeven distance	104,499	km
	Annual driving distance	109,500	km
	Payback period	***0.95***	yr

Source: Nomura Research

Exhibit 76. Sensitivity analysis (RMB, RMB/L)

Gas price	Price difference 5,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000
5.0	0.25	0.30	0.34	0.39	0.44	0.49	0.54	0.59	0.64	0.69
5.5	0.21	0.25	0.30	0.34	0.38	0.42	0.47	0.51	0.55	0.59
6.0	0.19	0.22	0.26	0.30	0.33	0.37	0.41	0.45	0.48	0.52
6.5	0.17	0.20	0.23	0.27	0.30	0.33	0.36	0.40	0.43	0.46
7.0	0.15	0.18	0.21	0.24	0.27	0.30	0.33	0.36	0.39	0.42
7.5	0.14	0.16	0.19	0.22	0.24	0.27	0.30	0.33	0.35	0.38
8.0	0.12	0.15	0.17	0.20	0.22	**0.25**	0.27	0.30	0.32	0.35
8.5	0.12	0.14	0.16	0.18	0.21	0.23	0.25	0.28	0.30	0.32
9.0	0.11	0.13	0.15	0.17	0.19	0.21	0.24	0.26	0.28	0.30
9.5	0.10	0.12	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28

Source: Nomura Research

We expect EV to account for 5% and 10% of total taxi fleet by 2012 and 2015, respectively, and 20% by 2020. China's taxi fleet has been expanding steadily in the past decade, with a 7-year CAGR of 2.2%. We assume it to grow by 3% annually in the next 10 years, thanks to continued urbanization. Under these assumptions, we expect total ownership of EV taxi to reach 120,000 units and 282,000 units by 2015 and 2020. Although not a large absolute number in itself, taxis would contribute significantly to battery demand as they would need to change battery once a year.

Exhibit 77. EV taxi market size

	2000	2007	2012	2015	2020
Total volume (units)	**825,746**	**959,668**	**1,112,518**	**1,215,679**	**1,409,305**
%		2.2	*3.0*	*3.0*	*3.0*
xEV (units)			55,626	121,568	281,861
%			*5.0*	*10.0*	*20.0*

Note: figures in italics are Nomura assumptions

Source: Fourin, Nomura estimates

HEV for private use

Private-use HEV also has an acceptable breakeven period

Personal car owners typically drive far less than taxi drivers. We assume they drive 30km on working days and 50km on weekends. This gives 13,000km per year and it would take them eight years before the cost savings from usage cover the initial price difference between an F3DM and an F3, without even considering the discount factors. Considering that Chinese consumers on average change their car every four years, we believe a breakeven period of two years is acceptable. If the price difference narrows to RMB5,000, and gas prices rise to RMB8 per litre, the breakeven period could fall to about 1.05 years, which, even taking into account the other costs, should enable consumers to recover their initial investment.

Exhibit 78. EV breakeven analysis: taxis

ICE	Fuel used/100km	*6.00*	L
	Unit fuel cost	***6.50***	RMB/l
	Total fuel cost/100km	39.00	RMB
BEV	Elec. used/100km	*22.00*	kWh
	Utility price/kWh	*0.52*	RMB
	Fuel used/100km	0.00	L
	Total usage cost	11.44	RMB
	Cost diff/100km	27.56	RMB
	Price difference	***28,800***	RMB
	Breakeven distance	104,499	Km
	Annual driving distance	13,000	Km
	Payback period	***8.04***	Yr

Source: Nomura Research

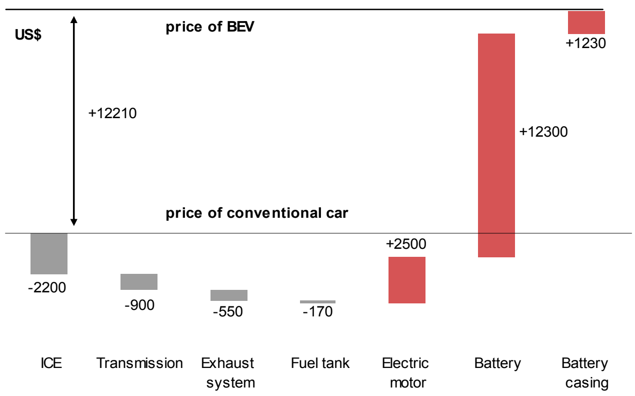
Exhibit 79. Sensitivity analysis (RMB, RMB/L)

Gas price	Price difference 1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000
5.0	0.41	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.14
5.5	0.36	0.71	1.07	1.43	1.78	2.14	2.50	2.85	3.21	3.57
6.0	0.31	0.63	0.94	1.25	1.57	1.88	2.19	2.51	2.82	3.13
6.5	0.28	0.56	0.84	1.12	1.40	1.67	1.95	2.23	2.51	2.79
7.0	0.25	0.50	0.76	1.01	1.26	1.51	1.76	2.01	2.27	2.52
7.5	0.23	0.46	0.69	0.92	1.15	1.38	1.60	1.83	2.06	2.29
8.0	0.21	0.42	0.63	0.84	**1.05**	1.26	1.47	1.68	1.89	2.10
8.5	0.19	0.39	0.58	0.78	0.97	1.17	1.36	1.56	1.75	1.94
9.0	0.18	0.36	0.54	0.72	0.90	1.08	1.27	1.45	1.63	1.81
9.5	0.17	0.34	0.51	0.68	0.84	1.01	1.18	1.35	1.52	1.69

Source: Nomura Research

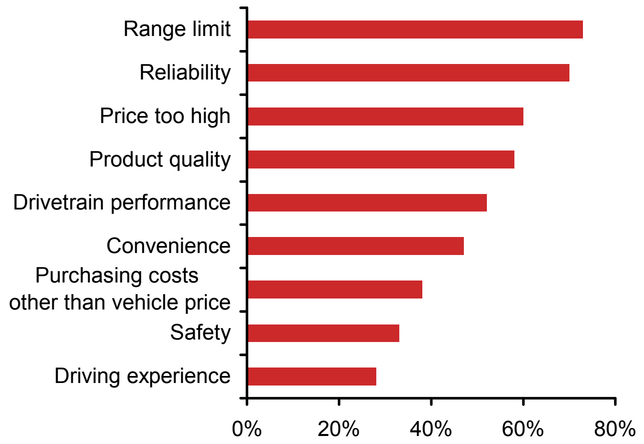
The price difference between xEV and conventional cars is mainly caused by batteries and motors, as shown in the chart below. We believe any OEM or battery maker that can effectively lower the cost of batteries will gain a significant competitive advantage.

Exhibit 80. Price difference breakdown between ICE car and BEV



Source: McKinsey

Exhibit 81. Chinese consumers' concerns with EV



Source: JD Power, Nomura Research

Aside from the usage costs considerations, we believe there are still at least two factors that will hamper the adoption of EVs.

- **Infrastructure.** Given the range limit of current EV batteries, these vehicles rely more on charging stations than conventional cars' reliance on gas stations, in our view. Even if the plans of local governments materialise, the number of charging stations will still far lag behind the number of gas stations.
- **Local protectionism.** Our previous calculations are all based on the assumption that all subsidies will only be based on technical specifications. However, local incentive plans are prone to protectionism. For example, some city governments have introduced a plan to only subsidize the purchase of hybrid PVs made by automakers located in the area. We fear this tendency to protect local interests, coupled with local governments' financial constraints (in China the central government seems more fiscally resourceful than the local governments, due to distribution of tax revenues), will slow the private adoption of EVs.

Infrastructure and local protection still hampers the adoption of EV

We expect EV to account for 5% of annual PV sales by 2020, including taxi sales. That translates roughly into private purchases of 1.26mn units in 2020.

Low-speed electric vehicle (LSEV): power to the people

In the footsteps of the *Kei* car

Kei car (literally "light automobile" in Japanese) is a unique Japanese car category, which includes cars that are small in size but have significant market share. By current regulations, they must not exceed 3,400/1,480/2,000 mm in size (length/width/height), with an engine smaller than 660ml in displacement and 47 kW in power output. Kei Car owners can enjoy certain benefits in tax and insurance. These standards originated in the period following the Second World War, when most Japanese people could not afford a full-sized car yet had enough money to buy a motorcycle. Kei Car standards were created to promote growth of the car industry, as well as to offer an alternative delivery method for small business and shop owners. Today Kei Cars account for about one-third of auto sales volume in Japan.

We believe China is now at a similar stage in terms of auto industry development:

- There exists significant demand to upgrade transportation vehicles but many cannot yet afford a conventional car;
- The government wants to stimulate the development of auto industry in a strategic way, and is looking for a new segment where it doesn't have a competitive disadvantage;
- China has another concern: its dependence on oil, which is increasingly imported.

We believe LSEV is a potential solution. With the help of China's well-developed e-bike industry chain, we believe LSEV will be able to achieve significant sales volume in cities and townships. We expect LSEV ownership to reach 50mn units by 2020. Although most of them probably will not use Li battery in order to lower cost, we still expect them to create significant market opportunities for the battery makers due to a big ownership base. We expect manufacturers of low speed vehicles and batteries to benefit from this industry trend.

Huge market potential: What is a car?

We believe underlying demand is the fundamental reason for the development of LSEV. Currently China's auto penetration is around 35 units per 1,000 persons, far lower than the US and EU level, which is about 750 and 550 units per 1,000 persons, respectively. With a growing wealth level, more and more people will be able to afford a car. But even at 200 units per 1,000 persons penetration, which is the level in Russia (or 300 as in the case of South Korea), total number of auto vehicle will rise six fold or more, putting huge pressure on energy supply and making auto consumption unsustainable.

Low auto penetration in China implies huge market potential for LSEV

We define a car as just a vehicle that meets a specific need for transportation. It doesn't necessarily need to be able to run at up to 150km per hour or more, and to accelerate from still to 100km per hour within 10 seconds, as in the case of most cars. For consumers in developed markets, an EV inferior to ICE cars in terms of performance may be unacceptable and off the radar. But when Chinese farmers choose their first car, their benchmark is a bicycle or scooter from which they are upgrading. We believe that as a result of mass urbanisation, many Chinese drivers will eventually find themselves at the wheel of a new kind of vehicle, which is affordable, small in size, and running on battery power at around 60 km per hour. We understand it will be hard for people to adapt to this new driving concept, but we see no other better alternative.

We characterise the LSEV discussed above as: 1) priced at around RMB 40,000; 2) running at 70-80km an hour maximum; 3) fit for 2 or 4 people; and 4) equipped with a lead acid or NiMH battery, or low cost lithium ion battery, capable of being charged using home grid and able to travel 100km per charge.

We believe there are at least two major potential customer bases for these vehicles:

- Second car demand in urban areas
  - In city driving conditions, EV speed and range limit are not major disadvantages while its high efficiency during start-up can be fully leveraged.
  - Most Chinese cities have a speed cap of 70km per hour, and road congestion in effect typically limits speed to under 60 km per hour. We have mentioned that ICE vehicles are most inefficient when they start, brake or wait at a red traffic light, which are exactly the cases most encountered in cities. The use of EV can significantly reduce emissions caused in such circumstances. At the same time, according to a CEIBS Business Review study, daily average driving range in Tier-1 to Tier-3 Chinese cities is between 50km and 60km. The range limit caused by battery would not be a big problem in such environment.

– In terms of affordability, we estimate annual usage cost of LSEV will be higher than for motorbike and e-bike, but lower than for entry-level economic cars, as shown in the exhibit below. We believe there is significant demand potential at this income level, just as in the case of entry-level cars a few years ago.

- Upgrading demand in townships

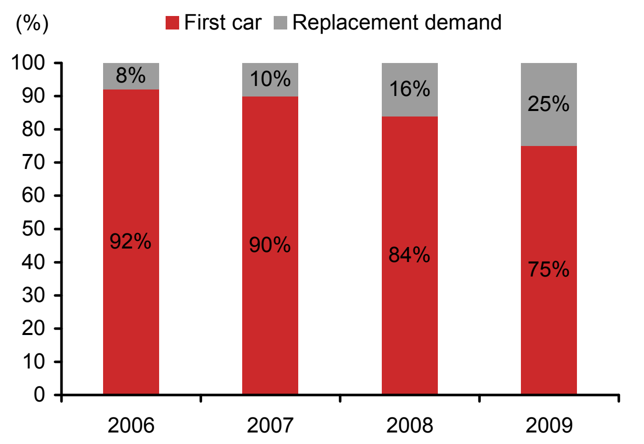
– We expect demand for LSEV to also come from the suburban area and relatively wealthy rural townships in eastern China, where residents will likely upgrade from e-bikes and motorcycles.

Upgrading demand for LSEV will also come from suburban areas and relatively wealthy rural townships

– More than half of China's e-bikes and motorcycles are used in suburbs and townships in eastern China, where people typically have left farming and engage in business or manufacturing activities. We believe the LSEV will become their most cost efficient transportation vehicle for commuting or light-load freight.

– The smaller areas of towns also facilitate charging for these EVs. Aside from charging at home, a quick-charge station at the centre of each town can easily solve the charging problem.

Exhibit 82. Auto demand breakdown trend



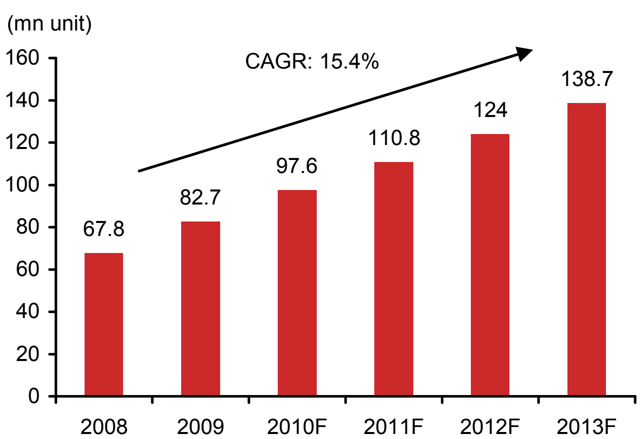
Source: Fourin, Nomura research

Exhibit 83. Comparison of low-end vehicles

	Bike	E-bike	Motorcycle	Low speed vehicle	A00 PV (Chery QQ)	LSEV
Years of usage	5	8	8	8	8	8
Battery life	na	1	na	na	na	1.5
Purchasing cost (RMB)	300	2,000	5,000	20,000	40,000	43,000
Annual usage cost (RMB)	50	500	2,500	3,000	8,000	5,500
Amortized annual cost (RMB)	110	750	3,125	5,500	13,000	10,875

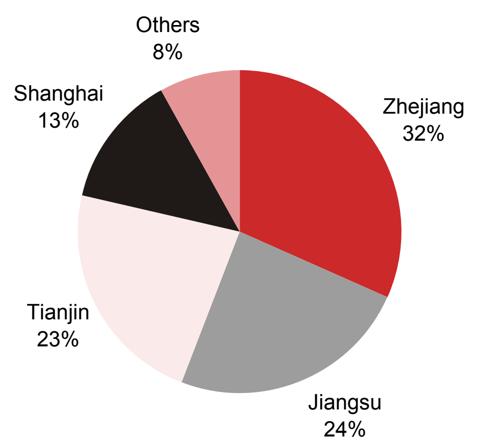
Source: Fourin, Nomura research

Exhibit 84. E-bike population in China



Source: Frost & Sullivan

Exhibit 85. E-bike demand by province, 2008



Source: Frost & Sullivan

Market size

We estimate the market size of LSEV from two perspectives, and come to the conclusion that ownership could reach around 50mn units by 2020.

Under both approaches, we estimate the market size of LSEV to reach 50mn units

Upgrading approach. In 2009 there were about 87mn units of motorcycles in China, and another 68mn units of e-bikes (battery powered scooters), according to CEIC and Frost & Sullivan respectively. We assume 50% of the motorcycles and 90% of the e-bikes are used in urban/suburban area and townships, constructing the potential upgrading base. Among them we assume 50% would buy an LSEV. Under these assumptions we estimate the demand for LSEV could potentially reach 52mn units.

Penetration approach. We assume demand will concentrate in China's coastal provinces and municipalities, from Hebei in the north to Guangdong in the south. Population in these regions amounts to 466mn in 2008, according to China Statistics Yearbook. We further see penetration of LSEV reaching 100 units per 1000 persons. Under these assumptions the market size for LSEV is estimated to be 47mn units.

Exhibit 86. Market size estimates

Upgrading approach				Penetration approach	
	Motorcycle	E-bike	Total		
Total unit (mn)	87.0	68.0	155.0	Total population (mn)	1,321.3
In city and townships	*50%*	*90%*		Population in coastal regions (mn)	466.3
Potential upgrading base (mn)	43.5	61.2	105	Penetration rate (units per 1000 persons)	*100*
% who upgrades			*50%*		
Market size (mn)			**52.4**	Market size (mn)	**46.6**

Source: Nomura estimates

Pride and prejudice: universal government support is needed

We believe the development of LSEV industry will benefit from China's strength in lead-acid battery and e-bike production, but more government support is needed, especially in the area of regulation and industry standards:

More policy supports are called for in areas of regulation and industry standards

Strong government support on lead-acid batteries

Among the currently competing technologies, lead-acid battery technology is thought to be the most mature, in terms of cost efficiency and stability, although it offers inferior power density. The Chinese government now categorizes vehicle-use lead-acid battery technology as 'mature' and grants it full-range use without EV-specific regulations. This could encourage the adoption of lead-acid batteries in LSEV. Industry leaders in lead acid battery production, such as Tianneng Power (819 HK, not rated), should benefit.

Well-established domestic industry value chain

China has the largest e-bike ownership in the world, around 67.8mn units in FY08, according to Frost & Sullivan. Annual demand reached 19.8mn units in 2008, and is forecasted by Frost & Sullivan to grow by a CAGR of 11.7% for the next five years. Starting to take off in 2000 and with an 8-year CAGR of more than 80%, China's has grown into the largest e-bike producer in the world, accounting for more than 90% of annual global production and sales. An extensive industry value chain has been developed in Jiangsu, Zhejiang and Tianjin, covering battery, engine, power-train, electronics. We believe it will provide an ideal springboard to jumpstart the LSEV industry.

Regulations are needed

Government lower speed standard on EV

Currently there's no related law or industry standard regulating the production and usage of LSEV, which we believe will hinder the development of related industries.

The absence of a standard is causing turmoil now. According to media reports, Shandong Shifeng Group, the largest producer of low speed agricultural vehicles in China, rolled out a low speed EV model in 2008. The venture won the support of local government, which allowed the vehicles to run on local roads although by law it doesn't qualify for a licence. The car was popular in the towns and small cities of Shandong, and has sold more than 10,000 units up to recently. However, production and marketing activities had to be halted after several major media (Fourin and other industry magazines) questioned the legitimacy and safety of these cars at the end of 2009. Nevertheless, similar cars (from Shifeng and other manufactures) are still popular among suburban and rural users in those provinces.

Lead-acid battery is now excluded from the subsidy base

In the private purchase subsidy programme announced in June 2010, the government explicitly excluded lead acid battery from the subsidy base. As we have noted previously, the current Li-ion technology cannot make EV cheap enough for this niche market. On the other hand, the lead acid battery industry is well established in terms of both scale and technology, thanks to the development of e-bikes.

We believe the policymakers have also noticed the potential of this market. In the new Automotive Industry R&D and Investment Guideline (2010), issued in May 2010, the government lowered EV standard from the 2009 Guideline: top speed was lowered to 80 km/h from 100 km/h, and driving range per charge was lowered to 100 km from 200 km. These standard changes effectively give LSEV space to grow.

The ambiguous stance towards lead acid battery could be caused by: 1) possible pollution from the production and disposal of batteries, and 2) significant subsidy outflow if the same standard is applied to lead acid battery as to Li ion battery. Nevertheless, we believe clarification of policy could foster healthy growth for the industry.

Li-ion battery

Li-ion battery for EV

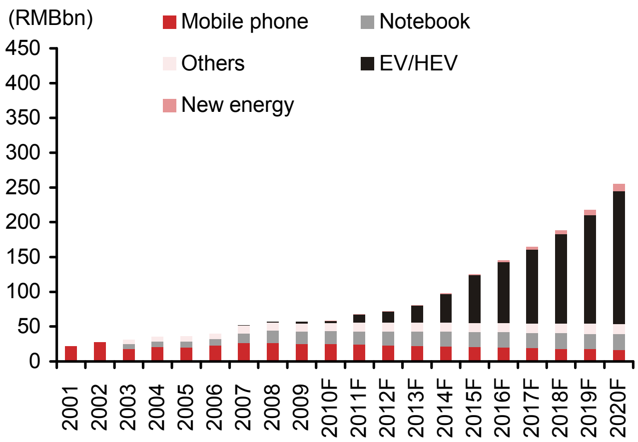
Market overview: big demand from EV

HEV/EV provides huge potential demand for Li-ion based batteries

Electric vehicles have created a huge new market for Li-ion battery makers. Under our base case scenario, the market for primary rechargeable Li-ion battery materials will expand to RMB255bn in 2020F. Under our bullish case scenario analysis, the market will expand to RMB408bn in 2020F.

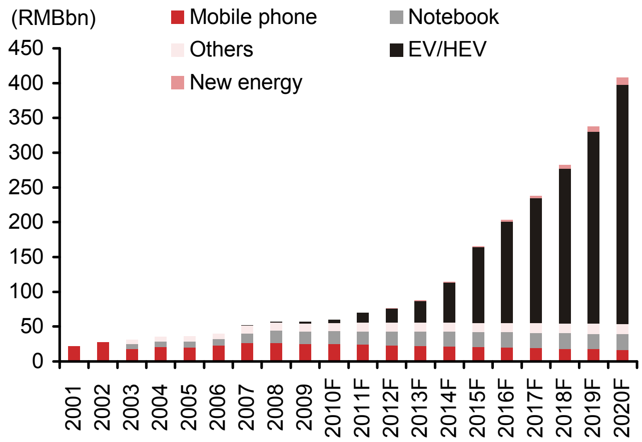
We expect takeoff of EV market demand to be the major growth driver for the battery material makers. In 2009, the main applications for rechargeable Li-ion batteries were: 1) mobile phones, which account for 50% of the market and; 2) notebook computers (30% market). In contrast, EV accounts for only about 1% of the market, as it is still in a trial phase. With the rolling-out of EV especially for public buses using Li-ion based batteries, we expect market growth to takeoff, as shown in two scenarios below for the market.

Exhibit 87. Global battery market: base case



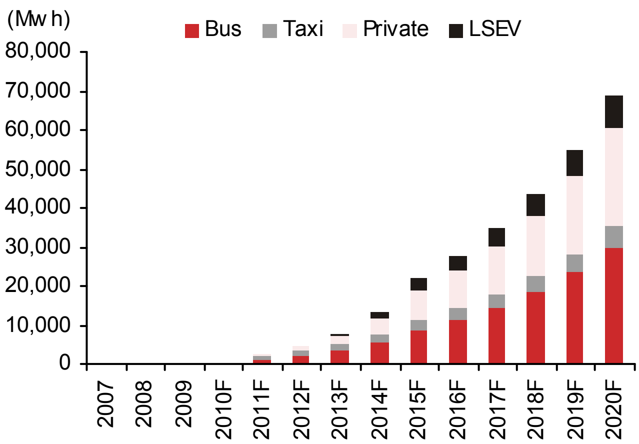
Source: CEIC, Nomura estimates

Exhibit 88. Global battery market: bull case



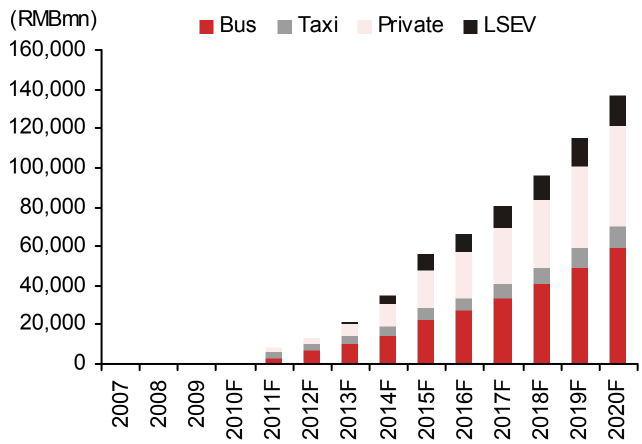
Source: CEIC, Nomura estimates

Exhibit 89. China EV battery: base case (MWh)



Source: CEIC, Nomura estimates

Exhibit 90. China EV battery: base case (RMBmn)



Source: CEIC, Nomura estimates

Under our base case scenario, we assume: 1) gasoline price remains low of RMB 6.5/L and stable; and 2) the penetration of EV remains at current levels even with government policy support. Assuming the gasoline price stays at the current level in the long term, and the price of rechargeable Li-ion batteries fall and EV fuel efficiency improves, we estimate that the vehicle needs to run 105,000km to breakeven on cost with traditional vehicle. Considering that vehicles generally run 50,000-100,000km at present, the penetration of EV will be limited to only a proportion of users. Under such circumstances, we estimate EV will only account for 5% of new vehicle sales in 2020F, and Li-ion battery market will expand to RMB191bn.

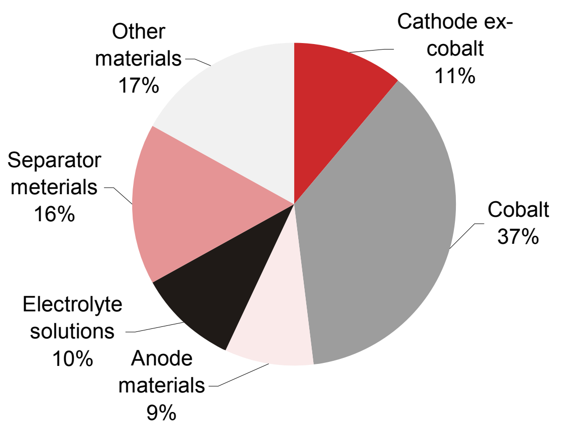
Base-case scenario: EV will only account for 5% of new vehicle sales in 2020F

Under our bullish case scenario, we assume an environment suitable for EV development where: 1) gasoline price trends at a high level of RMB 6.5/L; 2) support from government policies such as environmental tax and/or the carbon tax; 3) customers are motivated to buy EV due to environment awareness; and 4) automakers allocate more resources on EVs to reduce cost and improve performance.

Four key materials for Li-ion batteries

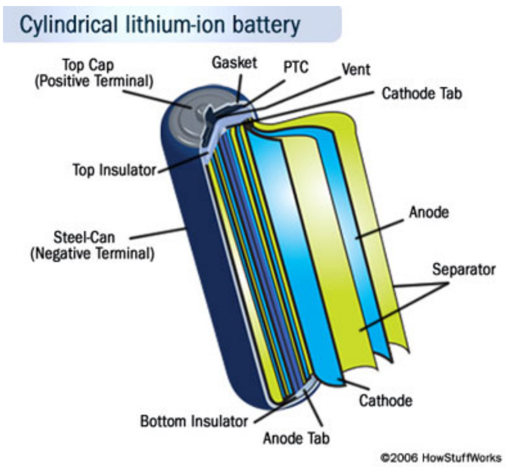
Rechargeable Li-ion batteries are essentially made of four key materials: 1) anode materials (accounting 9% of material costs); 2) cathode materials (48); 3) separator materials (16%); and 4) electrolyte solutions (10%). Cathode materials account for 48% of materials cost, which include the cost of cobalt (chemical symbol: Co), a key input for cathode. Excluding cobalt, the cathode materials make up around 11% of battery makers' material cost.

Exhibit 91. Cost weighting of materials



Source: Wikipedia, Nomura research

Exhibit 92. Structure of Li-ion battery



Source: HowStuffWorks.com, Nomura research

Anode materials

Anode materials store and release lithium ions, and as such are key determinants of capacity density and output characteristics. Graphite (carbon) is the most commonly used raw material, but in theory the capacity limits associated with graphite have more or less been reached. As such, the search is on for alternative materials that afford higher capacity.

Cathode materials

Cathode materials, like anode materials, perform charge and discharge functions, storing and releasing lithium ions. Lithium cobalt oxide ($LiCoO_2$) has long been used as the primary raw material, but there is a big push to find an alternative because the cobalt price fluctuates a lot.

Separator materials

Separators are sandwiched between the cathode and the anode. By selectively allowing lithium ions to travel from one electrode to the other, a separator facilitates electrochemical (battery) reactions while at the same time serving as an insulating layer between electrodes. The material is typically a porous polyethylene membrane, filled with micropores that allow the lithium ions to pass through. Separator materials also fulfil a safety function, as they shut down (close off) the micropores when an internal temperature threshold is exceeded.

Electrolyte solutions

Electrolyte solutions act as an electrically conductive medium transporting lithium ions from one electrode to the other. The correct matching of electrolyte solutions with other materials plays an important role in regulating the battery's performance as a whole. Electrolyte solutions are made by dissolving a lithium compound electrolyte in an organic solvent. The latter tends to be used in place of an aqueous solution because lithium reacts with water.

Other materials

Other than the aforementioned four key materials, rechargeable Li-ion batteries also contain copper foil used as an anode current collector and aluminium foil used for the same purpose in the cathode.

Requirement for EV: more safety and output

Contrary to notebook or mobile phones, safety and output are the most important concerns for EV

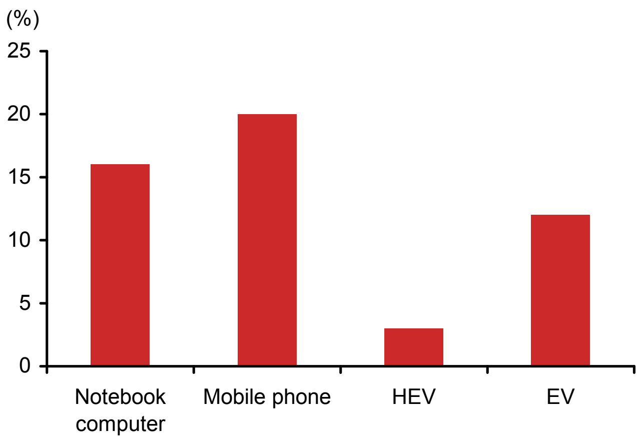
The five key concerns on Li-ion batteries are capacity, output, safety, usable life and cost. During the past 15 years the most important factor is capacity, or energy density, which is the key parameter for reducing notebook computers' and mobile phones' weight and increasing their operational hours. However, for EVs, the most important concerns are output and safety, as both the size and power of the batteries used on cars are significantly bigger than that for computers or phones. To clarify, capacity basically means how much electricity to store in a battery, while output means how fast the electricity can be used from a battery.

Less demanding on the capacity requirement

The first change of requirement for batteries for EVs is that capacity is relatively less important, although size and weight remain important for EV batteries due to fuel efficiency and practicality.

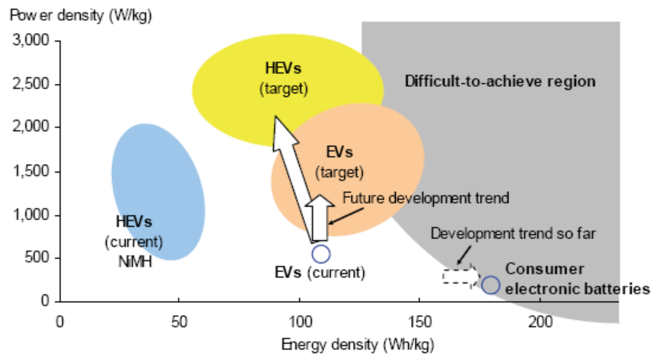
Batteries account for less than 5% of the weight of HEVs and slightly over 10% for EVs, whereas for notebook this number is more than 15% and for mobile phones 20%. Therefore the size and weight requirement for EV batteries is less than that for electronic devices.

Exhibit 93. Battery as % of total weight



Source: Nomura research

Exhibit 94. Performance of EV batteries



Source: Wikipedia, Nomura research

More requirements on output

The second change of requirement is on output, or power density. Rechargeable batteries used in consumer electronics products only need an output of 150-200W/kg, while EV batteries require an output of 500W/kg as minimum requirement and 1,500-3,000W/kg as an ideal level. A trade-off between power density and energy density thus exists.

A reduction in energy density can still lead to higher output, more so in the case of EV batteries than consumer electronics batteries. This trend is particularly true for HEV batteries because the engine is used to get the vehicle moving from standstill (when the load is high) and storage of regenerative energy is important. For EV batteries, development is in the direction of maintaining energy density while increasing power density, because engine-based driving distance is a more important issue.

Safety is an absolute must

Safety is the primary concern for EV

The third change of requirement is safety, which is an absolute requirement for EV batteries. There have been some instances of rechargeable batteries for notebook computers and mobile phones catching fire, but on vehicles this would lead to disasters due to the likelihood of serious accidents and significant recall costs.

Whereas issues related to consumer electronics batteries have been limited to smoke, problems with EV batteries could reduce driving distances and lead to road accidents. The possibility of EV batteries exploding or catching fire is also greater because the batteries contain many more cells than consumer electronics batteries and have more energy output.

Recall costs for EV batteries could be substantial because more vehicles would probably be affected, owing to the trend toward greater use of common parts, and per-vehicle battery costs are high. In the recent past we have witnessed minor defects leading to recall of several hundred thousand vehicles, and in such a scenario costs could spiral out of control. So if we were to consider replacement cost per vehicle to be RMB50,000, a recall of 200,000 vehicles could see total recall costs touching RMB10bn.

Cost: the lower, the better

EV battery costs are likely to be under greater downward pressure than consumer electric battery costs

The fourth change in requirement is cost. While user convenience has been the key factor driving the increasing reach of notebook computers and mobile phones, we believe EVs would be accepted as a substitute for gas-powered vehicles only if consumers are convinced of the economic advantage EVs offer over gas-powered vehicles, or at least a not-so-obvious disadvantage.

Rechargeable batteries account for only 2-3% of the total cost of notebook PCs and mobile phones, but it accounts for 5% of the total cost of HEVs and 20% of the cost of EVs. Thus, EV battery costs are likely to be under greater downward pressure than consumer electronic battery costs.

Nonetheless, some government subsidies are possible to partially offset the battery cost. We therefore think automakers and battery manufacturers are likely to focus more on accelerating product acceptance, by improving HEV/EV battery output and safety even if the costs end up slightly higher, than on cutting material costs.

In search of new materials

As we have noted, in order for EV to take off, the emphasis in Li-ion battery development will have to shift from capacity density to safety and output characteristics. Next, we have drawn up technology roadmaps for the materials that make up secondary batteries in tandem with changes in required specifications.

Anode materials: mature enough

Anode materials currently have little potential for improvement in the near term, as 1) new materials such as synthetic graphite have been adopted whose capacity is near its theoretical limit; and 2) the focus of developing EV battery is more on output rather than capacity as mentioned before. Some new materials such as silicon and lithium have been tested by some manufacturers. However, as many problems such as shipment track record and cost issue remain unsolved, these materials offer little light at least for now.

Cathode materials: key battle field

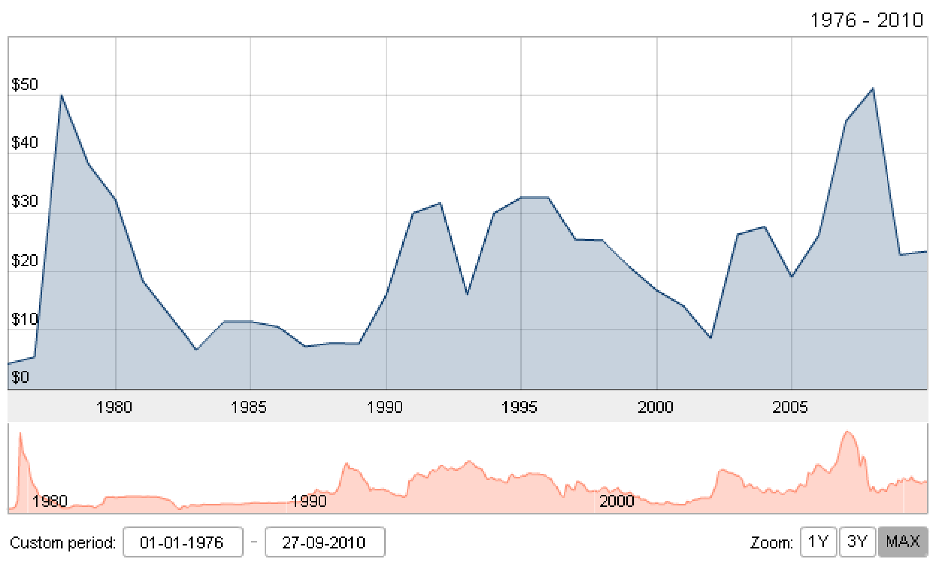
We believe the development of cathode materials is most promising among the four key materials for battery

Among the four key materials for battery, we believe the development of cathode materials is most promising. Currently $LiCoO_2$ has been the most widely used material for cathodes due to capacity density performance. However, since the price of cobalt fluctuates significantly, the main development direction is to substitute cobalt with other materials due to 1) concern of future price fluctuation; 2) the poison properties and environmental issue; and 3) the availability of substitute materials.

Tri-compound nickel-cobalt-manganese (NCM) materials (i.e., new materials that partly replace cobalt with nickel and manganese) have spread rapidly. Manganese and iron phosphate compounds that contain no cobalt at all are under development. These new materials are low cost, safe, and have high capacity densities. Thus, they could quickly become the main type used in EVs.

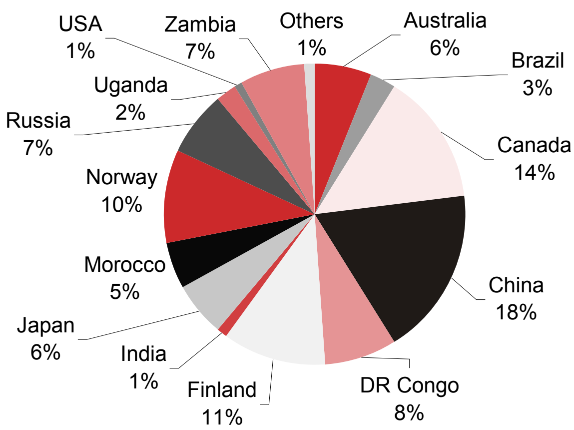
The key reasons for the effort trying to avoid cobalt include its fluctuating price and uncertainty in supply. For instance, around 40% of global cobalt reserve is located in Democratic Republic of Congo. This further emphasizes the attractiveness of non-cobalt materials, especially low cost ones such as LFP.

Exhibit 95. Cobalt price (US$/kg)



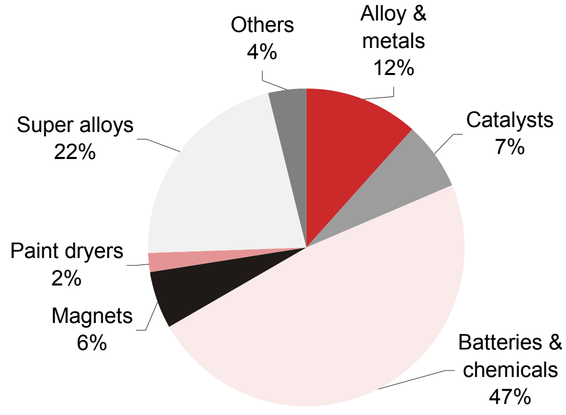
Source: SFP metals

Exhibit 96. Cobalt: global production 2009



Source: SFP metals

Exhibit 97. Cobalt: global consumption 2009



Source: SFP metals

Comparison of cathode chemistries

A typical battery has three high cost components a) the material used to make the cathode, b) the material used to make the electrolyte and c) the separator film. While separators and electrolytes are also important, the largest cost element is the cathode, which is seeing major changes. There are five types of cathodes under development:

Cathode, electrolyte and separator film form the most expensive components of a battery

Exhibit 98. Comparison of electrode materials: pros and cons

Chemistry	Short name	Adopters	Material cost ($/kg)	Material cost ($/kWh)	Safety	Pros	Cons
Lithium cobalt oxide	LCO	Mainstream	30 - 40	57 - 75	Poor	Used in handsets and notebooks	Costly, unsafe
Next generation Li-ion auto batteries							
Nickel cobalt aluminium	NCA	Panasonic Johnson Controls	28 - 30	50 - 55	Poor	Most proven High energy density	Costly (cobalt/nickel) Most unsafe
Nickel cobalt manganese	NCM	Sanyo, Hitachi, Panasonic, LG Chem	22 - 25	30 - 55	Poor	Cheaper vs NCA High energy density	Durability issues (manganese dissolves) Unsafe
Manganese spinel	LMO	Samsung, NEC, LG Chem, GS Yuasa	8 - 10	20 - 25	Fair	Low cost Good safety	Durability issues (manganese dissolves)
Iron phosphate	LFP	BYD, A123 Systems Valence	16 - 20	25 - 35	Excellent	Excellent safety Lowest cost	Low energy density Low temperature performance

Source: US Department of Energy (Argonne Labs), Nomura research

Lithium-cobalt oxide (LCO)

LCO is widely used for small cells like those in handsets or laptops. It has been on the market for 15 years and is expensive. Cobalt is more reactive than nickel or manganese, offering high electrical potential, leading to higher voltage. While it has the highest energy density, it is also the most prone to fire caused by internal shorts. Tesla Motors uses this type of chemistry—6,831 cells—in its Roadster electric car. Its pack uses sensors, cell isolation and liquid cooling, which, in turn, boosts costs. The cost is more than US$30,000 for the battery pack.

Cobalt dioxide is widely used and offers higher voltage than nickel. However, it is expensive and most prone to fire by internal shorts

Nickel-cobalt-manganese (NCM)

NCM uses manganese and nickel to lessen the use of cobalt. Manganese is less expensive than cobalt, but dissolves slightly in electrolytes, leading to a shorter life. Substituting nickel and manganese for some of the cobalt lets manufacturers tune the cell either for higher power (voltage) or for greater energy density, though not both at the same time. NCM is also susceptible to thermal runaway, although less so than cobalt dioxide. Its long-term durability is still unclear and nickel and manganese are both still expensive now. Manufacturers include Hitachi, Panasonic and Sanyo.

NCM uses manganese, which is less expensive than cobalt. But it has a shorter life and is susceptible to thermal runaway

Nickel-cobalt-aluminium (NCA)

NCA is similar to NCM, with lower-cost aluminium replacing the manganese. It has some of the favourable characteristics of LCO at a lower kilowatt /hour cost of US$50-55/kWh vs traditional LCO of US$57-75/kWh. Companies that make NCA cells include Toyota and Johnson Controls–Saft.

Manganese oxide spinel (LMO)

LMO offers higher power at a lower cost than cobalt, because its three-dimensional crystalline structure provides more surface area, permitting better ion flow between electrodes. But the drawback is a much lower energy density. The problem is that while at higher voltage (4V+) it yields excellent storage capacity, at lower voltages its capacity is substantially less owing to the dissolution of manganese. GS Yuasa, LG Chem, NEC and Samsung SDI offer cells with such cathodes.

LMO offers higher power and is less expensive. But it has lower energy density

Iron phosphate (LFP)

LFP might be the most promising new cathode, due to its stability and safety. The compound is inexpensive and because the bonds between the iron, phosphate and oxygen atoms are far stronger than those between cobalt and oxygen atoms, the oxygen is much harder to detach when overcharged. So if it fails, it can do so without overheating. Unfortunately, LFP works at a lower voltage than cobalt, so more of them must be chained together to provide enough power to turn a motor. A123 Systems uses nanostructures in their cathodes, which it says produces better power and longer life. Other manufacturers include China's BYD and US start-ups Gaia and Valence Technology.

Being inexpensive, more stable and safer than other lithium battery technologies, LFP is promising. However, it offers lower voltage and energy density

Exhibit 99. Relative energy densities and characteristics of common cathode materials

Cathode material	Chemical name	Specific capacity, mAh/g	Nominal cell voltage, V	Characteristics
LFP	$LiFePO_4$	140	3.3	Low energy density, but excellent cycle life, safety and high-rate capability
LCO	$LiCoO_2$ (LCO)	160	3.7	Until recently, LCO was the most common cathode material giving the best compromise of capacity, cycle life and safety
NMC	$LiNi_{0.33}Mn_{0.33}Co_{0.33}$	180	3.6	This has replaced LCO as the cathode material of choice in conventional Li-ion cells because of its lower cost and improved safety
NCA	$LiNi_{0.8}Co_{0.15}Al_{0.05}$	185	3.6	Used in next generation highest energy density cells
LMO	$LiMn_2O_4$	130	3.9	Low energy density but low cost, good safety and rate capability; it is mixed with NMC and LiNiO2 in high-rate cells

Source: Company data, Nomura research

Different companies are currently using different approaches for batteries used in autos, as summarized below.

Exhibit 100. Comparison of electrode materials used in auto Li-ion batteries

Company	Cathode	Anode	Packaging	Shape
Toyota	NCA	Graphite	Metal	Prismatic
Panasonic	NMC	Blend	Metal	Prismatic
JCS	NCA	Graphite	Metal	Cylindrical
Hitachi	NMC/LMO	Hard carbon	Metal	Cylindrical
NEC-Lamilin	LMO/NCA	Hard carbon	Pouch	Prismatic
Sanyo	NMC/LMO	Blend	Metal	Cylindrical
GS Yuasa	LMO/NMC	Hard carbon	Metal	Prismatic
A123 Systems	LFPO	Graphite	Metal	Cylindrical
LG Chem	LMO/NMC	Hard carbon	Pouch	Prismatic
Samsung	LMO/NMC	Graphite	Metal	Cylindrical
SK Corp	LMO	Graphite	Pouch	Prismatic
EnerDel	LMO	LTO	Pouch	Prismatic
AltairNano	NMC/LCO	LTO	Pouch	Prismatic
BYD	LFP	Graphite	Metal	Prismatic

Source: Company data, Nomura research

Comparison with different approaches

Japanese: leading in performance

In our view, Japan battery makers — GS Yuasa and Sanyo-Panasonic — are far ahead in terms of battery technology, especially when it comes to raising energy storage capacity (which determines performance). Most Japanese battery makers use a compound of cobalt, nickel and manganese. For example, GS Yuasa uses LMO for Mitsubishi's EVs and NMC for Honda's HEVs. Sanyo uses a tri-compound of nickel, cobalt and aluminium (NCA). This offers the best of all worlds. Cobalt, the main energy storing element, allows for high storage capacity. While using cobalt-based chemistries can lead to problems with overheating, the Japanese firms have developed stringent control circuitry and special coatings to contain this.

Koreans: differentiating with separators and packaging

Another cathode material gaining popularity is Lithium Manganese dioxide (LMO) being used by LG Chem, Samsung SDI, GS Yuasa and NEC. LMO eliminates the use of cobalt (replacing it with manganese) and thus is more stable and lower cost than cobalt oxide. The disadvantage is limited calendar life, given that manganese content tends to degrade at high temperatures. However, this has been surmounted by modifying chemistry, with LG Chem, SDI and GS Yuasa promising a 10-year life now, and targeting a lifespan of 15 years.

Other ways of differentiation are separators and packaging. NEC and LG Chem have used a laminated pouch, which is more forgiving to abuse. In contrast SDI adopts a can approach, which is suited for high volume production. LG Chem also offers a separator that it claims is 5x stronger than the industry norm, so it is more robust in preventing overcharging – which it claims as a competitive advantage.

Exhibit 101. Comparison of various battery offerings

	BYD	LG Chem	SDI (target)	NEC Nissan	Sanyo	GS Yuasa	Hitachi	Toshiba
Cathode	LFP	LMO	LMO	LMO	Tri-compound	LMO (EV) NCM (HEV)	Undisclosed (Manganese series)	Carbon monoxide series
Anode	Carbon	Carbon	Carbon	Carbon		Graphite/Carbon	Carbon	Lithium Titanate
Electrolyte	Lithium Fluorin phosphate	LiPF6 (Gel)						
Volt (V)	3.2	3.9	3.9	3.6	3.6	3.7	3.6	2.4
Capacity (Ah)	40 (HEV), 200 (EV)			3.7 (HEV), 13 (EV)	5.5	6 (HEV), 50 (EV)	5.5	4.2
Energy density (Wh/kg)		150		160 (EV)		110 (EV)	Undisclosed	
	60 (HEV)			70 (HEV)	90 (HEV)	67.1 (HEV)		65
Energy density (Wh/L)	220-240	420				218		
Lifecycle (km)	600,000	240,000	240,000			100,000		
Safety	never explodes	safe	safe	safe		safe		

Source: Nomura research (derived from various teardowns, inputs from companies)

BYD: tailored for intra-city driving

BYD's LFP is the safest technology, but compromises on energy storage

BYD's LFP chemistry allows for a low-cost battery. By replacing the expensive cobalt with easily available iron, this opens up the possibility of producing LFP batteries at a significantly cheaper rate. Moreover, LFP is the most stable of the various chemistries — in fact, it does not explode, even when put in a fire.

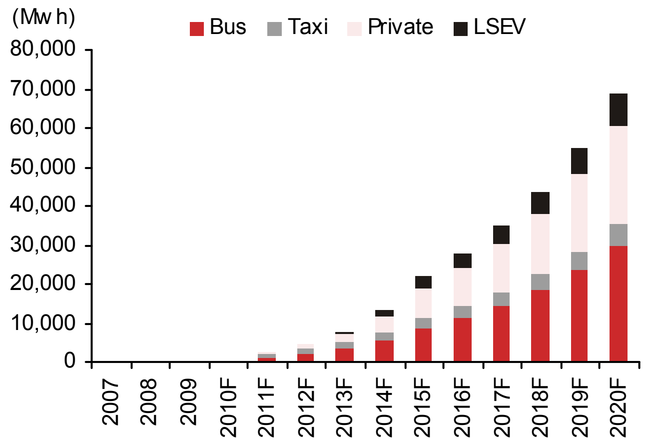
LFP batteries are still in R&D labs; mass production with stable and high quality still faces many challenges

However LFP has disadvantages. First, the energy density of LFP batteries is 40% below that at peers. While BYD acknowledges energy density is a drawback, it claims its battery technology will be enough for intracity driving, where distances are short, with slow speeds owing to traffic. Second, LFP batteries have so far been made only in small prototype volumes, so mass production with stable quality remains to be seen.

BYD's potential market share

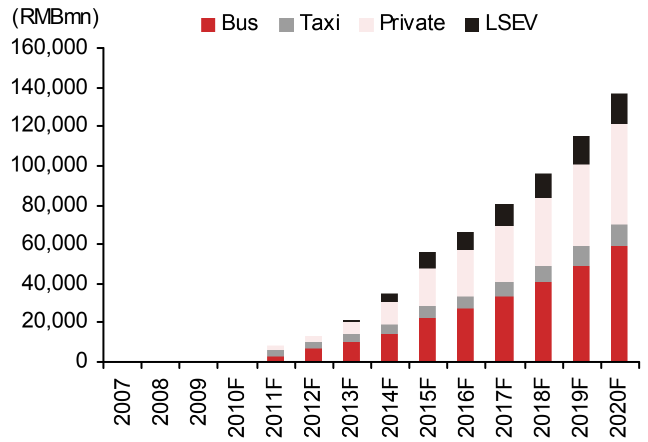
As stated before, we believe current EV technology is ready to take off in niche markets, such as taxi, bus, city dweller, and rural low speed vehicles. On these vehicles, the energy density and accompanied driving experience are relatively less considered factors, while the economic price and safety issue are key considerations. This unique requirement matches BYD's LFP chemistry precisely. With China's electric bus plans under way, we believe the EV used battery business of BYD will show some significant improvement after 2015F.

Exhibit 102. China EV battery market (MWh)



Source: CEIC, Nomura estimates

Exhibit 103. China EV battery market (RMB mn)



Source: CEIC, Nomura estimates

Exhibit 104. China EV battery market size and BYD's market — base case

	2012F	2015F	2020F
EV Bus ownership (units)	30,000	118,665	397,003
EV taxi ownership (units)	55,626	121,568	281,861
Private EV sedan sales (units)	58,094	385,162	1,255,446
EV bus market share in total public bus fleet	6.0%	20.0%	50.0%
EV taxi market share in total taxi fleet	5.0%	10.0%	20.0%
EV PV sales as % of total PV sales	**0.5%**	**2.0%**	**5.0%**
PV sales (mn units)	14	21	27
PV parc (mn units)	86	137	204
LSEV ownership (using Li battery), units		400,000	1,000,000
LSEV total ownership, units		20,000,000	50,000,000
Total EV battery market size (MWh)			
Bus	2,250	8,900	29,775
Taxi	1,113	2,431	5,637
Private EV	1,162	7,703	25,109
LSEV		3,200	8,000
Total (without LSEV)	**4,524**	**19,035**	**60,521**
Total with LSEV	**4,524**	**22,235**	**68,521**
Battery Unit price (RMB/kWh)	3,000	2,500	2,000
EV Battery Market (RMBmn)	**13,573**	**55,586**	**137,043**

Source: Nomura estimates

Other Chinese companies' participation

Currently there are a couple of Chinese companies participating in the production of cathode materials. Products of these companies include LCO, LMO, NMC, LFP, Manganese dioxide (MnO_2) and Lithium carbonate (Li_2CO_3).

Exhibit 105. Chinese participants in Cathode materials

Name	Ticker	Product	Capacity (Ton)
CITIC Guoan	000839 CH	LCO, LMO	2,000
Beijing Easpring	300073 CH	LCO, LMO, NMC	7,100
Ningbo Shanshan	600884 CH	LCO, LMO, LFP, NMC	5,200
China Baoan	000009 CH	NMC, LFP	2,700
Xiangtan Electro	002125 CH	MnO2	55,000
Guizhou Red Star	600367 CH	MnO2	38,000
Kingray	002466 CH	Li2CO3	5,600
Jiangxi Ganfeng	002460 CH	Li2CO3	3,000

Source: Bloomberg, company data

Glossary

863 Programme: State High-Tech Development Plan (863 计划, 国家高技术研究发展计划) is a programme funded and administered by the Chinese government intended to stimulate the development of advanced technologies in a wide range of fields for the purpose of rendering China independent of financial obligations for foreign technologies. For a detailed discussion of funds dedicated to various areas of xEV R&D, please refer to section “Policy: shifting to EV”.

BEV: see Page 28.

Blended hybrid, or combined hybrid, series/parallel hybrid: see page 31.

Carbon footprint: it measures the total set of greenhouse gas (GHG) emissions caused by an organization, event, product or person, often expressed in terms of the amount of CO2 emitted. Please refer to section “The socio-economic considerations: macro concerns” on Page xx for a discussion on the carbon footprints of different power generation technologies used to power EV.

CNG: Compressed Natural Gas. See page 23.

CVT: Continuously variable transmission. See section “Improvements to current ICE drive train” on Page 25. Often confused with CVVT. See **VVT** below.

Energy density: a term used for the amount of energy stored in a single unit of volume. See Exhibit 9 for a comparison of the energy density of different fuels and batteries. See also **specific energy** below.

FCEV: Fuel-cell electric vehicle. See page 32.

HEV: Hybrid electric vehicle. See page 29.

Motor-assist hybrid: Integrated Motor Assist is Honda's hybrid car technology, introduced in 1999 on the Insight. It is a specific implementation of a **parallel hybrid**.

Parallel hybrid: see page 30.

PHEV: Plug-in Hybrid Electric Vehicle. See page 31.

Power: In physics, power is the rate at which work is performed or energy is converted. In automobiles, engine power usually plays key role in deciding the top speed. See **torque**.

Series hybrid: see page 29.

Specific energy: Specific energy is defined as the energy per unit mass. See also **energy density** above.

Tank-to-wheel efficiency: see **well-to-wheel efficiency** below.

Torque: Torque is the tendency of a force to rotate an object about an axis, fulcrum, or pivot. Loosely speaking, torque is a measure of the turning force on an object such as a bolt or a flywheel. In automotive engineering, torque decides the acceleration performance of cars. Power is a function of torque and engine speed. See **power** above.

Turbo: also called turbocharger, is a gas compressor that is used for forced induction of an internal combustion engine. The turbocharger increases the pressure of air entering the engine to create more power. See section “Improvements to current ICE drive train” on Page 25.

VVT: Variable valve timing is a generic term for an automobile piston engine technology. VVT allows the lift, duration or timing (in various combinations) of the intake and/or exhaust valves to be changed while the engine is in operation. See section “Improvements to current ICE drive train” on Page 25. Different companies have their versions of this technology. Famous examples include Toyota's VVT-I, Honda's VTEC, Nissan's VVEL, Ford's VCT, and BMW's Valvetronic.

Well-to-wheel efficiency: Well-to-wheel is the specific life cycle efficiency assessment of fuels used for road transportation. The analysis is often broken down into stages titled "well-to-tank" and "tank-to-wheel". The first stage, which incorporates the feedstock and fuel processing is sometimes called the "upstream" stage, while the latter stage that deals with vehicle operation is sometimes called the "downstream" stage.

Source: Wikipedia, Nomura research.

Appendix

Appendix

Exhibit 106. Current HEV PV models offered in China

		Independent brand					Global JV brand		
	Maker	**BYD**	**FAW Car**	**Chery**		**Chang'an**	**FAW Toyota**	**DF Honda**	**SGM**
Parameter	Type	F3DM	Benteng B70 HEV	A5 ISG	A5 BSG	Jiexun	Prius	Hybrid Civic (imported)	Hybrid LaCrosse
	HEV type	**PHEV (combined)**	**Parallel hybrid**	**Parallel hybrid**	**Parallel hybrid**	**Parallel hybrid**	**Combined hybrid**	**Parallel hybrid**	**Parallel hybrid**
	Length/width/height (mm)	4533/1705/1520	4705/1782/1465	4552/1750/1483	4552/1750/1483	4445/1768/1640	4450/1725/1510	4500/1755/1450	4998/1851/1461
	Wheelbase (mm)	2,600	2,675	2,600	2,600	2,710	2,700	2,700	2,807
	Weight (kg)	1,560	1,840	1,350	1,350	1,501	1,350	1,294	1,630
	Capacity (ppl)	5	5	5	5	5	5	5	5
	Top speed (km/h)	n.a.	180	160	160	160	165	185	180
Battery	Model	n.a.	240QNYD6	n.a.	n.a.	QNYD6/QqNFT6-3	n.a.	n.a.	n.a.
	Type	**LiFePO4**	**NiMH**	**NiMH**	**Lead acid**	**NiMH**	**NiMH**	**NiMH**	**NiMH**
	Voltage (V)	13.2 kWh	288	144	12	144	6.5Ah	n.a.	1.2V, 8.5Ah
	Supplier	BYD	Jonjee Senlai	Johnsons Control	n.a.	Jonjee Senlai/Shenzhou S&T	n.a.	n.a.	COBASYS
Electric motor	Model	n.a.	FM-TM-3002-A	n.a.	n.a.	YZ131001	THSII	Honda IMA	MGU
	Type	2 PMSM	PMSM	PMSM	Claw Pole	PMSM	PMSM	DC brushless motor	PMSM
	Power (kw)	25/50	20	15	2	10	50	82	125
	Supplier	n.a.	Shanghai Dajun	n.a.	n.a.	Yuyao 3rd Auto Appliance Factory	n.a.	Honda (Japan)	Hitachi
Engine	Model	371QA	CA4GA1H	SQR473F (CBR VVT)	SQR481H	JL475Q3	INZ	1.3 i-VTEC	LE5
	Displacement (cc)	998	1,339	1,297.5	1,597	1,497	1,497	1,339	2,384
	Power (kw)	50	67	65	87	72	57	70	125
	Standard	China IV	China IV	China IV	China IV	China IV	China IV	China IV	China IV
	Supplier	BYD	FAW Xiali	Chery	Chery	Chongqing Chang'an	Toyota (Japan)	Honda (Japan)	SGM
Market	Launch date	2008	2009	2008		2009	Jan. 2006	Nov. 2007	Jul. 2008
	Price (k rmb)	150	200~300	80~110		140	270	269.8	269.9
	Qualified subsidy under national plan (k rmb)	42	42	32 ~ 36	4	32 ~ 36	42	42	42
	Comparable ICE model	BYD F3	Benteng B70	Chery A5		Jiangling Lufeng Fengshang	Toyota Corolla	Honda Civic	Buick LaCrosse
	Price (k RMB)	50	150	80		90	150	140	240
	Sales	Around 100 units to government agencies	Start in 2009	Order of 40 units from Beijing government in Dec. 2007	Order of 10 units from Beijing government in Dec. 2007	20 units of MPV sold to 2008 Olympic games, others will start from 2009	Totally sold 2111 units in 06 and 07	Local production may commence from 2010	Sales began from Jul. 2008

Source: Fourin, Nomura research

Exhibit 107. Global EV line-up

	Prius	Insight	Volt	LEAF	Mitsubishi MiEV	Subaru R1e	MINI E	Smart ED	Fisker Karma	Tesla Roadster
OEM	Toyota	Honda	GM	Nissan	Mitsubishi	Subaru	BMW	Daimler	Fisker Motor	Telsa Motor
Category	HEV	HEV	PHEV	BEV	BEV	BEV	BEV	BEV	PHEV	BEV
Battery	Ni-H2	NiMH	Li-ion	Li-ion	Li-ion	Li-ion	Li-ion	Li-ion	Li-ion	Li-ion
Top Speed (km/h)	160	180	160	140	130	100	153	100	200	200
Charging	n.a.	n.a.	n.a.	8 hr @ home; 30 min. to 80% SOC @ charging station	6-7 hr @ home; 30 min. to 80% SOC @ charging station	8 hr @ home; 15 min. to 80% SOC @ charging station	n.a.	n.a.	n.a.	3.5 hr to 100%
Range (km)	n.a.	n.a.	n.a.	160	160	80	175	135	80 (all electric mode)	390
Price ($)	21,750	20,000	40,000	25,000	17,000	17,500	850/month for lease	600/month (currently for lease only on a 4 years / 60,000 km programme, for sale from 2012)	80,000	109,000
Launch	1997	2000	2010	2010	2010	2010	2008	2010	End of 2009	2008
Sales	280,000	200,000					500		800 (pre-order)	700
Specialty	The bestselling HEV model so far with more than 1mn sold	The bestselling model of Japan in April 09	Buyer can enjoy high subsidy from US government	Extensive partnership with governments on infrastructure (in China, with Wuhan and Guangzhou)	Large interior	Partnership with utility company in development	Test a leasing business model	Test a leasing business model		

Source: Fourin, Nomura research

Exhibit 108. Hybrid bus models currently offered by Chinese automakers

Maker			FAW Bus & Coach (Wuxi)		FAW Bus & Coach (Wuxi)	Yutong		Dongfeng		Anhui Ankai	Xiamen King Long		Shanghai Sunwin	
Parameter	Type		CA6124SH8		CA6113SH8	ZK6126HGZ		EQ6100HEV	EQ6122HEV	HFF6110GZ-3	XML5125JHEV 13C	XML5125JHEV 93C		SWB6116HE
	HEV type		Parallel hybrid		Parallel hybrid	Series hybrid		Parallel hybrid	Parallel hybrid	Series hybrid	Parallel hybrid	Parallel hybrid		Parallel hybrid
	Length/width/ height (mm)		11995/2546/3200		11496/2480/3170	11990/2550/ 3300, 2970		11000/2490/3260	11880/2540/ 3200	11220/2500/31 40	11980/2540/31 80	11980/2540/ 3100		11370/2500/3250, 3300
	Wheelbase (mm)		6000		5600	5875		5600		5700	5980	5980		5800
	Weight (kg)		12050		10790	13380, 12665		11000	12300	12000	12300	12000		11800
	Capacity (ppl)		90		64	68		80	80	69	84	89		80
	Top speed (km/h)		80		80	85		69	80	65	80	80		80
Battery	Model		DY336-40		DY336-40	QNFG60	289QNFG40-3	280QNFG40 FG	280QNFG40-3	-	BMOD0165 P048	BMOD0165 P048	YTS-5.5L	QNFG60
	Type		NiMH		NiMH	NiMH	NiMH	NiMH	NiMH	Lead-acid	Super capacitor	Super capacitor	Lead-acid	NiMH
	Voltage (V)		336		336	360	1.2V/40Ah	1.2V/40Ah	1.2V/40Ah, 27	12V/75Ah	16	16	n.a.	n.a.
	Supplier		Chunlan Power Battery		Chunlan Power Battery	Chunlan Power Battery	Shenzhou S&T	Chuanlan Power Battery	Shenzhou S&T	Optima Batteries, Inc	Maxwell	Maxwell	Optima batteries	Chuanlan Power Battery
Electric motor	Model	M10000DA	TYC-168-260-8-C		-	JD147A		KCT C 180-2000	KCT C 180-2000	JD143B	KAM280HL	KAM280HL	Y2-280M2-4T	BS-TM-8002-A
	Type	AC-Asynchronous motors	PMSM		-	PMSM		Switched reluctance motor	Switched reluctance motor	AC-Asynchronous motors	AC-Asynchronous motors	AC-Asynchronous motors	AC variable-frequency motor	PMSM
	Power (kw)	30	30		-	100		40	40	100/150	65	65	66	40
	Supplier	Innova	Beijing Epower		-	Beijing Shidai Huatong		Beijing Zhongfang Ruili	Beijing Zhongfang Ruili	Beijing Shidai Huatong	Jiangmen Motor	Jiangmen Motor	Jiangmen Motor	Shanghai Kinway
Engine	Model		BF6M2012	BF4M1013-19E3	BF4M1013 FC	ISDe160 30		ISBe150	ISBe150 300	SOFIM 8140.43N	ISBe185 32	ISBe185 32	ISDe210 30	SC5DK180 Q3
	Displacement (cc)		6060	4764	4764	4500		3922	3900	2800	5883	5883	6690	5308
	Power (kw)		171	171	140	118		110	110	105	136	136	155	132
	Standard		China III	China III	China III	China III		China III	China III	China III	China III	China III	China III	China III
	Supplier		FAW Dalian Diesel	FAW Dalian Diesel	Deutz	Dongfeng Cummins		Cummins	Dongfeng Cummins	Nanjing Iveco	Cummins	Cummins	Cummins	Shanghai Diesel
	Sales		Sold 12 units to Beijing Bus Group		Haven't started yet	Provided 2 units to Beijing Olympic Games			Sold 15 units as Beijing Olympic buses	Trial operation began in SH		Got orders for 100 units in all		Not start yet

Source: Fourin, Nomura research

Exhibit 109. Hybrid bus models currently offered by Chinese automakers (continued)

Maker				Shenzhen Wuzhoulong	Beijing Jinghua		Beiqi Futian			Anyuan	Zhongtong Bus & Coach		Ningbo Jijiang Automobile
Parameter	Type		FDG6111HEVG	FDG6122HEVG	BK6129HV		BJ6123C7B4D		BJ6113C7M4D	PK6112AGH	LCK6100GHEV	LCK6120HEV	NE6111SHEV1
	HEV type		Parallel hybrid	Parallel hybrid	Parallel hybrid		Parallel hybrid		Parallel hybrid	Parallel hybrid	Series hybrid	Series hybrid	Series hybrid
	Length/width/ height (mm)		11100,11390/2480/3100	11780/2500/3200	11980/3545/ 3200		11980/2540/3050, 3150		11400/2540,3050, 3150	11500/2500/3150/ 3230	11250/2480/ 3170	11990/2500/ 3200	11270/2500/3000, 3150
	Wheelbase (mm)		5300, 5500	5980	5850		3150		5650	5800	6000	5900	5600
	Weight (kg)		12200	1200	12770, 12270		10900/11200		15500	12500	11650	12100	11300, 11560
	Capacity (ppl)		65	89	80		95		76	61	68	90	76
	Top speed (km/h)		85	80	80		80		80	76	65	73	80
Battery	Model		6FM150HD	BMOD0165 P048	DY336-40		IMC6-48		IMC6-48	6DM90	40Ah	NFG60	QNFG60
	Type		Lead-acid	Super capacitor	NiMH		Li-ion		Li-ion	Lead-acid	NiMH	NiMH	NiMH
	Voltage (V)		336	16	336		340		340	300	360	360	336
	Supplier		Shenzhen Taoxiong	Maxwell	Jiangsu Baile		Eaton		Eaton	Beijing Yuanwang	Chuanlan Power Battery	Chuanlan Power Battery	Chuanlan Power Battery
Electric motor	Model		YPQ215M-6	KAM280HL	TYC-168-260-8-C		A-7811		A-7811	KAM 280H1	JD143B	JD147A	YHD130-6
	Type		AC-Asynchronous motors	AC-Asynchronous motors	AC-Synchronous motor		PMSM		PMSM	AC-Asynchronous motors	AC-Asynchronous motors	AC-Asynchronous motors	AC-Asynchronous motors
	Power (kw)		55	65	30		44		44	65	100/150	100/150	65
	Supplier		Dalian Tianyuan	Jiangmen Motor	Beijing Epower		Eaton		Eaton	Xiangfan speical motors factory	Beijing Shidai Huatong	Beijing Shidai Huatong	Sichuan Dongfeng Electric
Engine	Model	YC4G180-30	ISBE180 30	ISBe185 32	BF4M2012-16E3	ISBE185 32	ISBE220 31	ISBE185 32	ISBE220 31	ISBe180 30	SOFIM8140.43N	ISDe610 30	CA4DF3-17E3
	Displacement (cc)	5200	3900	5883	4040	5883	5883	5883	5883	3900	2800	4500	4752
	Power (kw)	132	135	136	124	136	162	136	162	135	107	118	125
	Standard	China III	China III	China III	China III	China III	China III	China III	China III	China III	China III	China III	China III
	Supplier	Guangxi Yuchai	Cummins	Cummins	FAW Dalian Diesel		Cummins		Cummins	Cummins	Nanjing Iveco	Dongfeng Cummins	FAW Wuxi Diesel
	Sales			Sold 9 units totally	Not start yet				Launched in Oct. 2007, and received orders of 30 units in all	Not yet		Sold 20 units to Tianjin Bus Group	Not yet

Source: Fourin, Nomura research

Exhibit 110. Hydraulic electric bus models in China

Maker		Beijing Jinghua Coach
Parameter	Type	BK6113K1
	HEV type	Series hybrid
	Length/width/height (mm)	11235/2480/3230
	Wheelbase (mm)	5600
	Weight (kg)	11630, 10930
	Capacity (ppl)	70
	Top speed (km/h)	80
	Standard	China IV
Hydraulic system	Model	CEVYNB1
	Character	Save 20% power, and 40% lower displacement
	Supplier	Beijing Jiajie Boda
Engine	Model	ISBe22031
	Type	Diesel
	Displacement (cc)	5900
	Power (kw)	162
	Supplier	Cummins
	Sales	Sold 50 units as Olympic buses

Source: Fourin, Nomura research

Exhibit 111. Supercapacitor electric bus models in China

Maker		Beiqi Foton	
Parameter	Type	BJ6123C6N4D	
	HEV type	Series hybrid	
	Length/width/height (mm)	11980/2550/3450	
	Wheelbase (mm)	6000	
	Weight (kg)	14200	
	Capacity (ppl)	49	
	Top speed (km/h)	80	
	Standard	No displacement	
Battery	Model	DY336-80	
	Type	NiMH	NiMH
	Voltage (V)	336	336
	Supplier	General research institute for nonferrous metals	Chunlan Power Battery
Electric motor	Model	JD151	
	Type	Water-cooled AC Asynchronous motors	
	Power (kw)	100	
	Supplier	Zhuzhou Electric Motor	
ECU	Model	VCU2006	
	Supplier	Tsinghua University	
	Sales	Sold 2 units as Olympic buses	

Source: Fourin, Nomura research

Exhibit 112. Strategic alliance of sedan HEV

		Domestic parts maker		Foreign parts maker	
Automakers	Ticker	Name	Content of cooperation/procurement	Name	Content of cooperation/procurement
SAIC	600104 CH			Delphi	Mild hybrid tech.
FAW	unlisted	Thunder Sky Energy	Li-ion battery for HEV bus.		
Dongfeng	489 HK			Detroit Electric	EV power-train
GAIC	unlisted	Yuchai	Joint development of HEV and other AFV		
		Wanxiang EV	Joint development of EV		
BYD	1211 HK	BYD	Li-ion battery	Volkswagen	Joint development of EV & HEV
Chery	unlisted			Ricardo	HEV technology
				Structural Composites Industries LLC	Joint development of AFV
				Quantum LLC	Set up JV (Chery Quantum Auto) to produce EV
Chang'an	000625 CH			Electrovaya	EV battery
Hafei	600038 CH	Tianjin Qingyuan EV	Joint development of EV		
Jianghuai	600418 CH			Light Engineering	Powertrain for electric commercial vehicle
Shifeng	unlisted			Electrovaya	EV battery
Henan Shaolin Bus	unlisted	CSR	Electric motor and power-train for EV		
Foton	600166 CH	Broad-Ocean Motor	Joint development of EV		
Ankai Bus	000868 CH	Shanghai Leibo New Energy	Joint production of EV bus		
Kinglong Bus	600686 CH	Dongfeng EV	Joint development of EV bus (Dongfeng EV is part of Dongfeng Group but not an associate of 489 HK)		

Source: Fourin, Nomura research

Exhibit 113. Global battery alliance

OEM	Battery company: Name	Battery company: Stakeholders	Battery company: Holding structure	Contracts	Type of battery
General Motors [GM US]	Hitachi Vehicle Energy [Unlisted]	• Hitachi [4217JP] Shin-Kobe Electric Machinery [6934JP] Hitachi Maxwell [6810JP]	• Hitachi Vehicle Energy is a joint venture company among Hitachi, Shin-Kobe Electric Machinery, and Hitachi Maxell	• GM - aiming North American market, in 2010	Li-ion
General Motors [GM US]	LG Chem [051910KS]	• LG Chem [051910KS]	•	• GM - Chevy Volt battery production	Li-ion
Ford [F US]	Sanyo [6764JP]	• Sanyo [6764JP]	•	• Ongoing production contract	NiMH
Ford [F US]	Johnson Controls Saft [unlisted]	• Johnson Controls [JCI US] Saft [SAFT FP]	• Johnson Controls launched a JV with Saft to develop and produce batteries for HEVs and EVs, in 2006	• No production contract yet	n.a.
Chrysler [unlisted]	A123 Systems [AONE US]	• A123 Systems [AONE US]	• Recently listed in NASDAQ	• Supply battery and jointly developed battery modules and battery packs for Chrysler's Range-extended Electric Vehicle and pure Electric Vehicle	Li-ion
USABC [Unlisted]	LG Chem [051910KS]	• LG Chem [051910KS]		• Numerous development and research contracts have been awarded by USABC	Li-ion
Toyota [7203JP]	Panasonic EV Energy [Unlisted]	• Toyota [7203JP] Matsushita [6752JP]	• Panasonic EV is an automotive JV between Toyota (60%) and Matsushita (40%)	• Ongoing production with Toyota	NiMH/Li-ion
Honda [7267JP]	Sanyo [6764JP]	• Sanyo [6764JP]	•	• Ongoing production contract	NiMH
Nissan [7201JP]	Automotive Energy Supply [Unlisted]	• Nissan [7201JP] NEC [6701JP]	• NEC owns 49% of Automotive Energy Supply, established in Apr 2007. Nissan owns 51%.	• Nissan - forklifts from 2009, HEVs from 2010	n.a.
Mitsubishi Motors [7211JP]	Lithium Energy Japan [Unlisted]	• GS Yuasa [6674JP] Mitsubishi Corp [8058JP] Mitsubishi Motors [7211JP]	• GS Yuasa owns 51% of Lithium Energy Japan, jointly set up with Mitsubishi in 2007	• MiEV to start production in 2009	Li-ion
Subaru [7270 JP]	NEC Lamilion Energy [Unlisted]	• NEC [6701JP] Fuji Heavy Industries [7270JP]	• Established as a JV between NEC and Fuji Heavy industries in 2002. Now wholly owned by NEC. Subaru is Fuji Heavy Industries' auto brand	• Fuji and TEPCO have been developing the Subaru R1e, with batteries supplied by NEC Lamilion.	Li-ion
Hyundai Motors [005380KS]	LG Chem [051910KS]	• LG Chem [051910KS]		• HMC - Elantra HEV, starting sales July 2009	Li-ion
Tanfield [TAN LN]	Valence [VLNC US]	• Valence [VLNC US]		• Tanfield [TAN LN] - USD 70mn contract to supply batteries for Smith Electric Vehicles	Li-ion
Volkswagen [VOW GR]	Sanyo [6764JP]	• Sanyo [6764JP]		• Volkswagen - next-generation production starting 2015	NiMH/Li-ion
Volkswagen [VOW GR]	BYD [1211HK]	• BYD [1211HK]		• Joint development of EV & HEV	Li-ion
BYD [1211 HK]	BYD [1211HK]	• BYD [1211HK]			Li-ion
Shanghai Auto [600104 CH]	A123 Systems [AONE US]	• A123 Systems [AONE US]		• Supply hybrid technology to the SAIC Motor Corporation Limited (SAIC Motor) for the mild Hybrid Electric Vehicle	Li-ion

Source: Fourin, Nomura research

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From Buy

NEUTRAL

NOMURA

NOMURA INTERNATIONAL (HK) LIMITED

Action

We downgrade BYD to NEUTRAL from Buy due to: 1) likely disappointing 2H10 results, 2) likely weak sales of EV products in FY11F and 3) demanding valuation. We believe expectations of a turnaround in its conventional automobiles business, newsflow on EV and management's commitment to technology and execution power support its valuation premium, compared with conventional auto OEM peers. Our SOTP-based PT of HK$40 applies 13x FY11F P/E to its conventional businesses, and discounts the future value of further battery growth opportunities.

Catalysts

EV bus and taxi sales volumes, auto sales volumes and solar sales volumes.

Anchor themes

We believe EV is the ultimate solution for evolution of the auto industry, while the speed of penetration will depend on government commitment and policy support.

Closing price on 12 Jan	HK$42.75
Price target	**HK$40.00**
	(from HK$62.0)
Upside/downside	-6.4%
Difference from consensus	-9.7%
FY11F net profit (RMBmn)	3,545
Difference from consensus	-24.4%

Source: Nomura

Nomura vs consensus

We're more concerned on the profitability of its auto business.

Second transformation underway

① Autos: "U" shaped or "V" shaped recovery?

We forecast BYD's auto sales volumes in China to grow 19% y-y in FY11F to 616,000 units, on the back of intensive new product launches and stabilising dealerships. With inventory levels having declined to an historical low of one month, we believe the worst is over. Meanwhile, we do not forecast a sharp turnaround in profitability, because the MSRP cut in 2010 has structurally changed the profitability of BYD. We believe BYD will need to reform its marketing strategy further to reduce SG&A expenses.

② Components: steady growth

Amid continuous market-share gains among existing customers and penetration into new customers such as Apple, we believe operating income of the handset components business (including both BYDE and parent components) surged 54% y-y in FY10F to RMB1.2bn and will rise another 16% y-y to RMB1.4bn in FY11F.

③ Commitment on new energy supports high valuation

We believe BYD is the most promising EV manufacturer globally due to 1) its distinctive positioning in both the battery and auto industries; and 2) its access to the largest EV market. BYD is also transforming into a new energy conglomerate, including EVs, storage batteries and solar. Continuous R&D investment and strong management execution track record support the current premium valuation, in our view.

④ Revised price target of HK$40 based on SOTP valuation

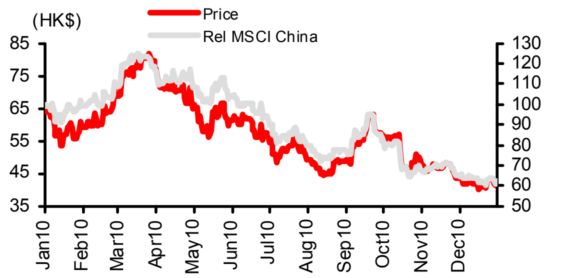
We apply a 14x P/E to our FY11F auto segment earnings estimates, in line with our target multiples for H-share Chinese domestic automakers. Our 10x and 13x target P/Es for its handset and battery businesses correspond respectively to our TMT equipment analyst's target multiples for BYDE and peer valuation for handset battery makers. Our new PT implies 13x forward P/E for its conventional businesses. Given 6% downside, we downgrade BYD to NEUTRAL.

Key financials & valuations

31 Dec (RMBmn)	FY09	FY10F	FY11F	FY12F
Revenue	39,469	45,479	53,560	60,967
Reported net profit	3,794	2,783	3,545	4,625
Normalised net profit	3,794	2,783	3,545	4,625
Normalised EPS (RMB)	1.77	1.22	1.56	2.03
Norm. EPS growth (%)	255.2	(30.9)	27.4	30.5
Norm. P/E (x)	20.6	29.8	23.4	17.9
EV/EBITDA (x)	14.5	16.6	13.1	10.5
Price/book (x)	4.7	4.6	3.8	3.2
Dividend yield (%)	0.9	0.0	0.0	0.0
ROE (%)	27.1	16.0	17.9	19.4
Net debt/equity (%)	8.0	24.5	31.7	33.0
Earnings revisions				
Previous norm. net profit		4,174	4,823	5,596
Change from previous (%)		(33.3)	(26.5)	(17.3)
Previous norm. EPS (RMB)		1.83	2.12	2.46

Source: Company, Nomura estimates

Share price relative to MSCI China



	1m	3m	6m
Absolute (HK$)	(1.9)	(24.9)	(24.2)
Absolute (US$)	(2.0)	(25.0)	(24.2)
Relative to Index	(4.8)	(26.1)	(36.8)
Market cap (US$mn)			12,509
Estimated free float (%)			27.7
52-week range (HK$)			81.8/39.90
3-mth avg daily turnover (US$mn)			33.70
Stock borrowability			Hard
Major shareholders (%)			
Mr. Wang Chuan-fu			28.4
Mr. Lu Xiang-yang			20.0

Source: Company, Nomura estimates

Potential catalysts to change our view

Solar sales volumes could act as an unknown variable and provide upside surprise, we believe. Government policy support for electric city buses could refresh investor interest in BYD, in our view. We think a strong A-share listing of BYD is also a possibility, given the current high valuations of A-share listed new energy-related stocks. A successful listing could stimulate H-share performance.

We apply a 14x P/E to our FY11F auto segment earnings estimates, in line with our target multiples for H-share Chinese domestic automakers. Our 10x and 13x target P/Es for its handset and battery businesses correspond respectively to our TMT equipment analyst's target multiples for BYDE and peer valuation for handset battery makers. Our new PT implies 13x forward P/E for its conventional businesses. Given 3% potential downside, we downgrade BYD to NEUTRAL.

Our previous price target of HK$62 was based on a sum-of-the-parts, valuing core business separately and for the new energy segment, estimating future earnings and discounting back to FY10F (at a discount rate of 15% pa).

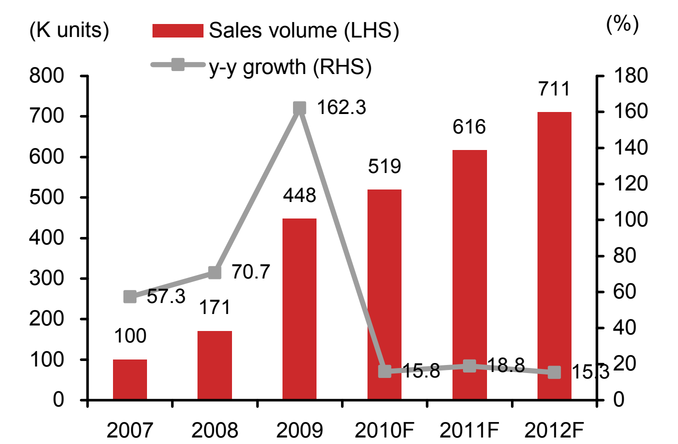
Risks to our investment view: Lukewarm auto sales are a downside risk to our investment stance. On the other hand, should 2011 see stronger-than-expected auto sales, our assumptions may prove too conservative.

Exhibit 114. BYD: SOTP valuation

Segment	FY10E EPS (RMB)	FY11E EPS (RMB)	Target P/E (x)	Valuation (HK$)
Auto	0.66	0.94	14.0	15.8
Handset	0.32	0.39	10.0	4.6
BYDE	*0.27*	*0.31*		
Parent company	*0.06*	*0.08*		
Conventional battery	0.24	0.23	13.0	3.7
Subtotal	**1.22**	**1.56**		**24.0**
EV battery				13.0
Utility storage battery				3.0
Total	**1.23**	**1.56**		**40.0**
Valuation				
Headline P/E			21.4	
Core P/E (excluding discounted future value of EV & utility batteries)			12.9	

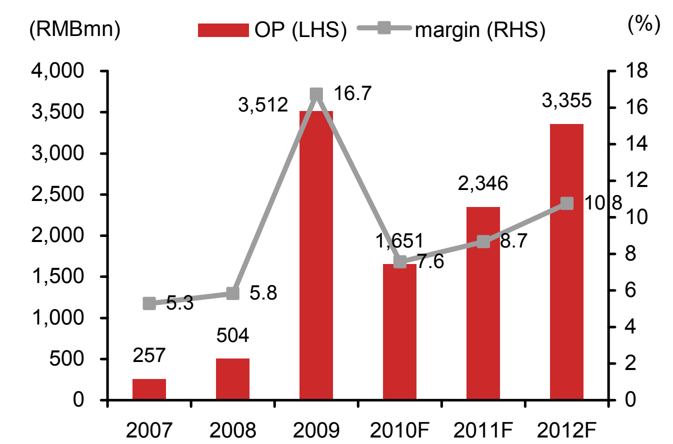
Source: Nomura estimates

Exhibit 115. Auto sales volumes



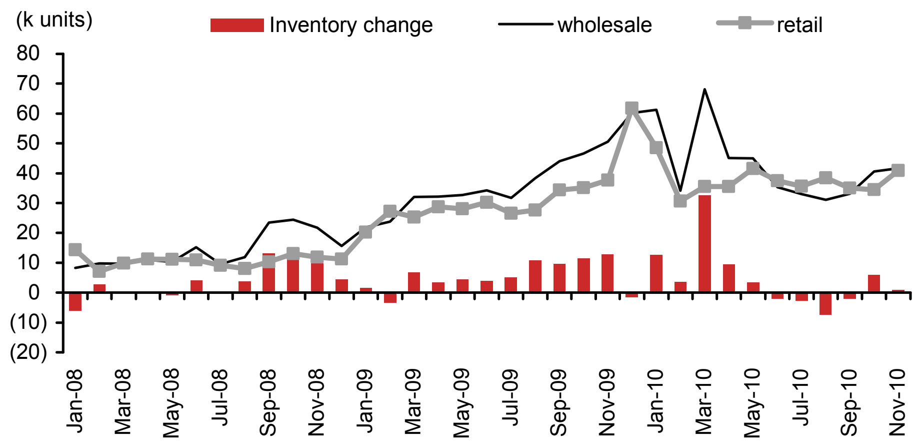
Source: Company data, Nomura estimates

Exhibit 116. Auto operating income



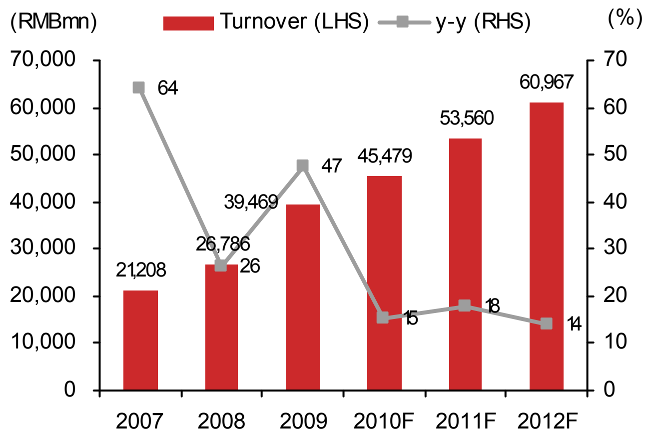
Source: Company data, Nomura estimates

Exhibit 117. BYD monthly auto sales and inventory trend



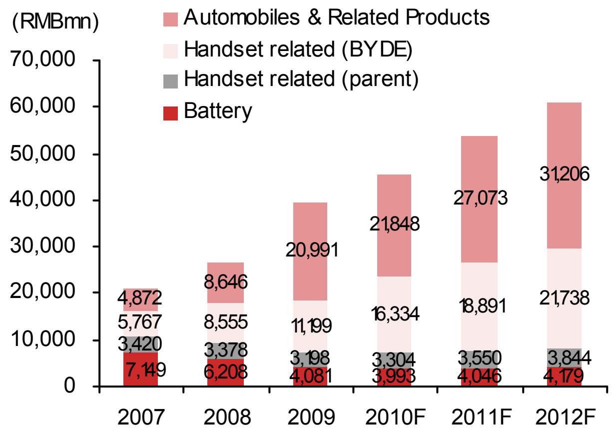
Source: China Auto Market, CEIC, Nomura research

Exhibit 118. BYD: total revenue trend



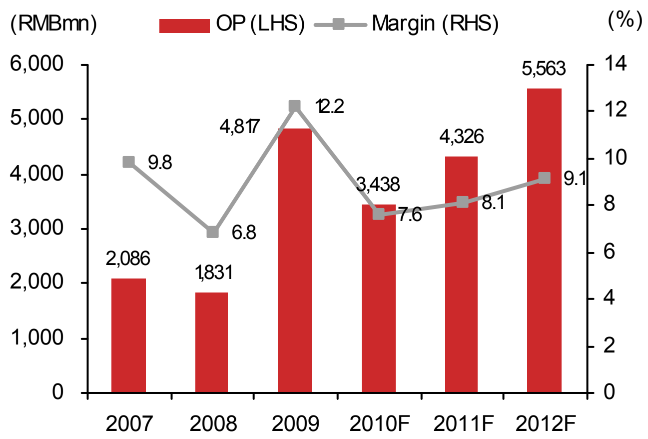
Source: Company data, Nomura estimates

Exhibit 119. BYD: total revenue breakdown



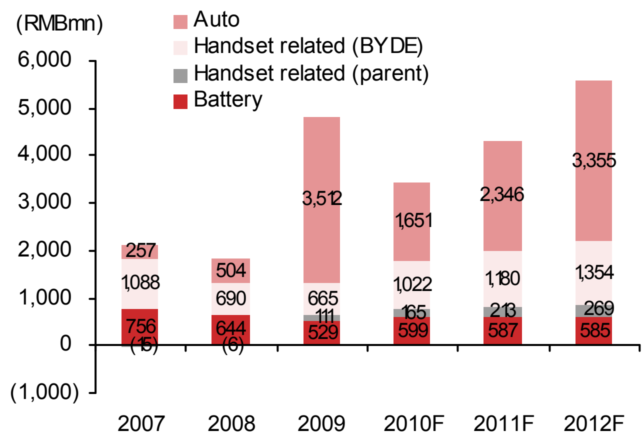
Source: Company data, Nomura estimates

Exhibit 120. BYD: total operating income trend



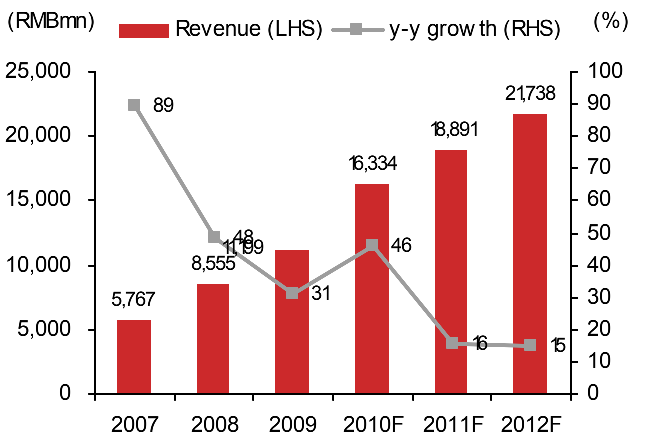
Source: Company data, Nomura estimates

Exhibit 121. BYD: operating income breakdown



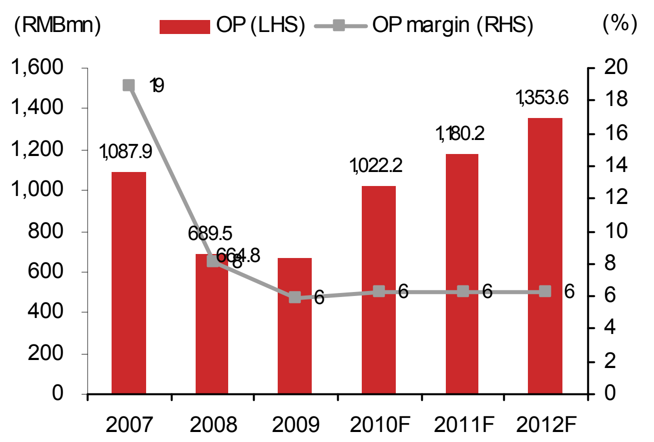
Source: Company data, Nomura estimates

Exhibit 122. BYDE revenue trend



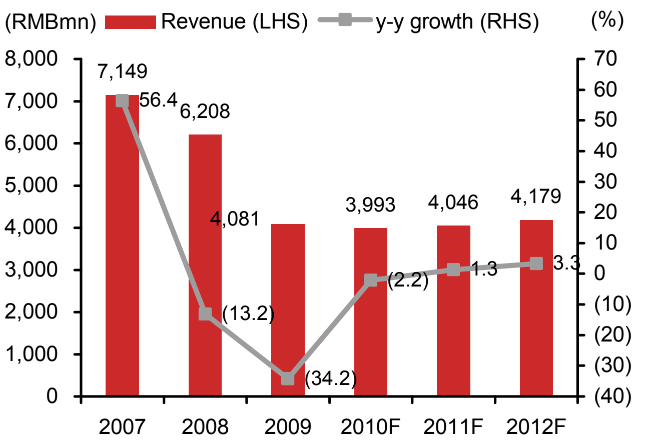
Source: Company data, Nomura estimates

Exhibit 123. BYDE operating income trend



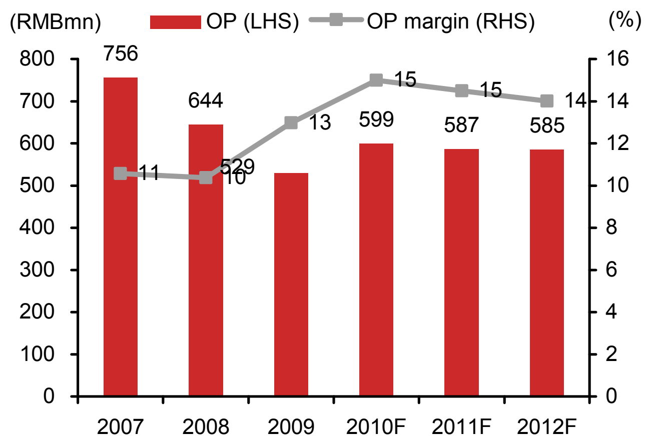
Source: Company data, Nomura estimates

Exhibit 124. BYD: battery business revenue trend



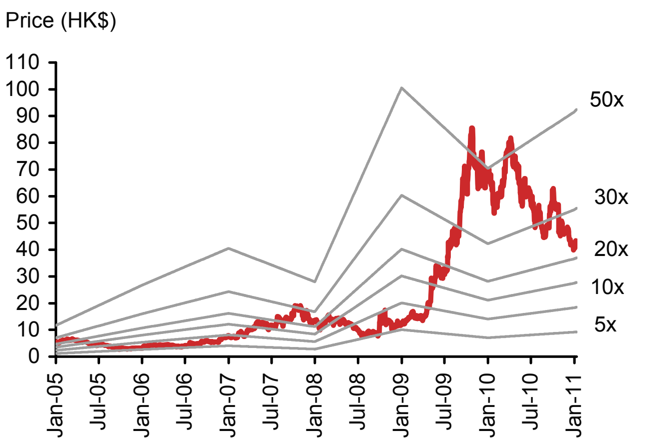
Source: Company data, Nomura estimates

Exhibit 125. BYD: battery operating income trend



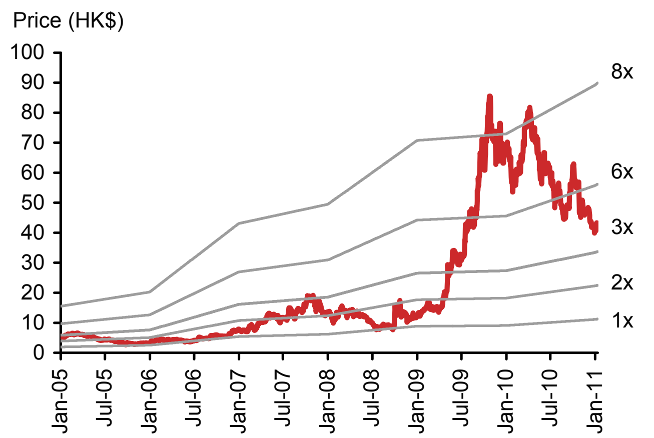
Source: Company data, Nomura estimates

Exhibit 126. P/E band



Source: Bloomberg, Nomura research

Exhibit 127. P/B band



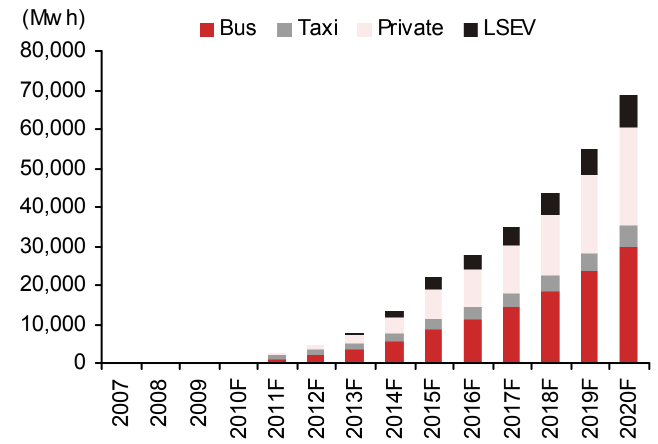
Source: Bloomberg, Nomura research

BYD's potential market share in the EV battery market

Current EV technology is ready to take off in niche markets, such as taxis, buses, city dwellers and rural low speed vehicles, we believe. For such vehicles, the energy density and accompanied driving experience are relatively less considered factors, while economic price and safety issues are key considerations. This distinctive requirement matches BYD's LFP chemistry precisely, in our view.

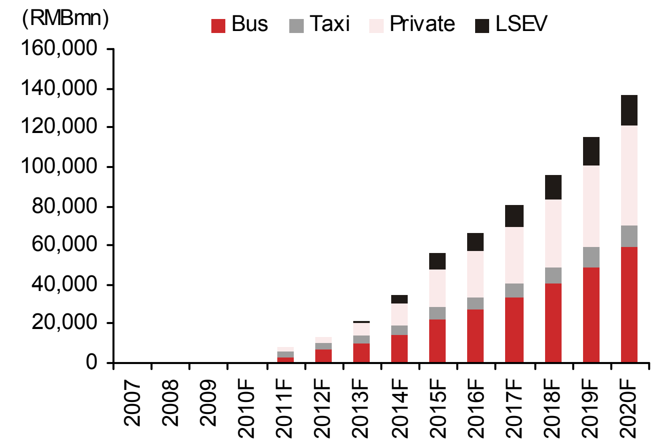
With its electric bus plan for China underway, we believe, BYD's EV-use battery business will show some significant improvement after 2015F.

Exhibit 128. China EV battery market (MWh) base



Source: Nomura estimates

Exhibit 129. China EV battery market (RMB mn) base



Source: Nomura estimates

Exhibit 130. China EV battery market size and BYD's market base case

	2012F	2015F	2020F
EV bus ownership (units)	30,000	118,665	397,003
EV taxi ownership (units)	55,626	121,568	281,861
Private EV sedan sales (units)	58,094	385,162	1,255,446
EV bus market share in total public bus fleet (%)	6.0	20.0	50.0
EV taxi market share in total taxi fleet (%)	5.0	10.0	20.0
EV PV sales as % of total PV sales (%)	**0.5**	**2.0**	**5.0**
PV sales (mn units)	14	21	27
PV parc (mn units)	86	137	204
LSEV ownership (using Li battery), units		400,000	1,000,000
LSEV total ownership, units		20,000,000	50,000,000
Total EV battery market size (MWh)			
Bus	2,250	8,900	29,775
Taxi	1,113	2,431	5,637
Private EV	1,162	7,703	25,109
LSEV		3,200	8,000
Total (without LSEV)	**4,524**	**19,035**	**60,521**
Total with LSEV	**4,524**	**22,235**	**68,521**
Battery unit price (RMB/kWh)	3,000	2,500	2,000
EV battery market (RMBmn)	**13,573**	**55,586**	**137,043**
BYD's market share (%)			25
BYD's revenue from EV battery			34,261
Net margin (%)			10
BYD's earning from EV battery (RMB mn)			3,426
PER (x)			16
Market cap from EV battery (RMB mn)			54,817
Discounted at 9% p.a. to 2011 (RMB mn)			25,239
Number of shares (mn)			2,275
Exchange rate (RMB/HK$)			1.2
Value per share (HK$)			**13.31**

Source: Nomura estimates

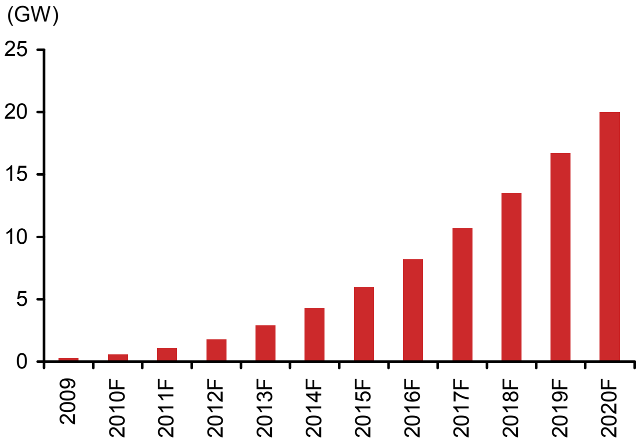
Utility storage battery – an out-of-price call option

BYD also delivers batteries to meet power storage requirements, which is an essential component of solar power construction. However, we believe this market is highly questionable, given that there are several alternative choices available over lithium iron phosphate (LFP) batteries, including super capacitor, lead-acid batteries, sodium sulphate (NaS) batteries, as well as physical methods such as water height approach, compressed air approach or physical momentum approach. The key consideration for utility storage batteries is neither size nor energy density, since these are located in some permanent building structure; rather, 'useful life' and 'cost' are the most important considerations due to significant requirements. Below we summarise the pros and cons of different battery technologies.

- Super capacitor – safe, long useful life, but high costs currently.
- Lead-acid battery – safe, long useful life, low cost, mature technology, but poor environmental friendliness.
- Sodium sulphate – relatively safe, long useful life, relatively low cost, large size, but still has some unsolved recycle issue.
- LFP battery – relatively safe, acceptable useful life, high energy density, but expensive.

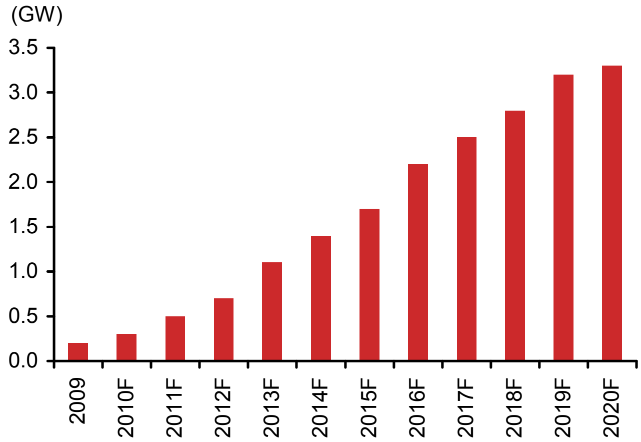
Based on the above comparison, LFP batteries do not appear to us to have any obvious advantage over the other choices available for utility storage purposes. Even if we assume that LFP batteries eventually become a compulsory component of solar power, we believe this would still have only a limited impact on BYD, based on the calculation below.

Exhibit 131. China solar total installation



Source: Nomura estimates

Exhibit 132. China solar annual installation



Source: Nomura estimates

The National Development and Reform Committee (NDRC) has set a solar installation target of 20GW by 2020F. If we assume that this follows an accelerating pattern, the annual installation by 2020F should be between 3GW and 4GW.

Exhibit 133. China utility battery market size and BYD's market base case

	2012F	2015F	2020F
Target for installation of solar energy (GW)	2	6	20
Annual installation (GW)	0.7	1.7	3.3
Cost in RMB/watt	13	13	13
China market for solar energy (RMBbn)	9.1	22.1	42.9
% of investment towards storage battery (%)	15	15	15
China market for storage battery (RMBbn)	1.37	3.32	6.44
BYD's sales at 50% share (RMBbn)	0.68	1.66	3.22
Net margin (%)	20	20	20
Net profit (RMBbn)	0.14	0.33	0.64
PER (x)			20
Market cap (RMBbn)			12.9
Discounted at 9% p.a. to 2011 (RMBbn)			5.9
Number of shares (mn)			2,275
Exchange rate (RMB/HK$)			1.2
Value per share (HK$)			**3.13**

Source: Nomura estimates

We assume that the cost of installation per watt for solar energy is RMB13 or US$2, and we assume 15% of the investment is for storage batteries, of which BYD takes a lion's share at 50%. Assuming a net margin of 20% and 20x P/E for this business in 2020F, this creates a market capitalisation of RMB12.9bn for BYD 's battery business. Discounting it back to 2011F with an annual discount rate of 9%, this leads to only HK$3.13 per share.

To conclude, even if solar power storage is successfully built with LFP batteries and BYD takes 50% market share, this would only lead to HK$3.13 per share, on our estimates. In view of uncertainties such as: 1) the government's determination regarding solar investment; and 2) technological success of LFP as the only choice for utility storage, we believe this contributes a call option value to BYD's share price. Despite this, we still factor in this part in our valuation calculation in view of BYD's determination in the business, and we will review our assumptions based on progress in technology development in this area.

Financial statements

Income statement (RMBmn)					
Year-end 31 Dec	**FY08**	**FY09**	**FY10F**	**FY11F**	**FY12F**
Revenue	26,788	39,469	45,479	53,560	60,967
Cost of goods sold	(21,569)	(30,905)	(37,391)	(43,670)	(49,026)
Gross profit	**5,219**	**8,565**	**8,089**	**9,890**	**11,941**
SG&A	(4,055)	(4,488)	(5,210)	(6,099)	(6,914)
Employee share expense					
Operating profit	**1,164**	**4,077**	**2,879**	**3,791**	**5,028**
EBITDA	**2,495**	**5,807**	**5,263**	**6,842**	**8,745**
Depreciation	(1,211)	(1,594)	(2,249)	(2,915)	(3,582)
Amortisation	(120)	(136)	(136)	(136)	(136)
EBIT	**1,164**	**4,077**	**2,879**	**3,791**	**5,028**
Net interest expense	(401)	(237)	(157)	(157)	(157)
Associates & JCEs					
Other income	601	669	716	692	693
Earnings before tax	**1,364**	**4,509**	**3,438**	**4,326**	**5,563**
Income tax	(88)	(431)	(309)	(389)	(501)
Net profit after tax	**1,276**	**4,078**	**3,128**	**3,937**	**5,063**
Minority interests	(254)	(285)	(346)	(392)	(437)
Other items					
Preferred dividends					
Normalised NPAT	**1,021**	**3,794**	**2,783**	**3,545**	**4,625**
Extraordinary items					
Reported NPAT	**1,021**	**3,794**	**2,783**	**3,545**	**4,625**
Dividends	-	(707)	-	-	-
Transfer to reserves	**1,021**	**3,086**	**2,783**	**3,545**	**4,625**
Valuation and ratio analysis					
FD normalised P/E (x)	73.2	20.6	29.8	23.4	17.9
FD normalised P/E at price target (x)	68.5	19.3	27.9	21.9	16.8
Reported P/E (x)	73.2	20.6	29.8	23.4	17.9
Dividend yield (%)	-	0.9	-	-	-
Price/cashflow (x)	56.5	6.5	11.6	11.6	10.7
Price/book (x)	6.6	4.7	4.6	3.8	3.2
EV/EBITDA (x)	36.2	14.5	16.6	13.1	10.5
EV/EBIT (x)	77.7	20.7	30.3	23.7	18.2
Gross margin (%)	19.5	21.7	17.8	18.5	19.6
EBITDA margin (%)	9.3	14.7	11.6	12.8	14.3
EBIT margin (%)	4.3	10.3	6.3	7.1	8.2
Net margin (%)	3.8	9.6	6.1	6.6	7.6
Effective tax rate (%)	6.5	9.5	9.0	9.0	9.0
Dividend payout (%)	-	18.6	-	-	-
Capex to sales (%)	23.0	18.0	22.0	18.7	16.4
Capex to depreciation (x)	5.1	4.5	4.4	3.4	2.8
ROE (%)	9.3	27.1	16.0	17.9	19.4
ROA (pretax %)	4.2	11.7	6.8	7.4	8.4
Growth (%)					
Revenue	26.3	47.3	15.2	17.8	13.8
EBITDA	(9.1)	132.7	(9.4)	30.0	27.8
EBIT	(36.9)	250.3	(29.4)	31.7	32.6
Normalised EPS	(36.6)	255.2	(30.9)	27.4	30.5
Normalised FDEPS	(36.6)	255.2	(30.9)	27.4	30.5
Per share					
Reported EPS (RMB)	0.50	1.77	1.22	1.56	2.03
Norm EPS (RMB)	0.50	1.77	1.22	1.56	2.03
Fully diluted norm EPS (RMB)	0.50	1.77	1.22	1.56	2.03
Book value per share (RMB)	5.50	7.78	7.93	9.48	11.51
DPS (RMB)	-	0.33	-	-	-

Source: Nomura estimates

Sustainable revenue growth

Cashflow (RMBmn)					
Year-end 31 Dec	**FY08**	**FY09**	**FY10F**	**FY11F**	**FY12F**
EBITDA	2,495	5,807	5,263	6,842	8,745
Change in working capital	(1,229)	6,125	2,837	613	(564)
Other operating cashflow	58	84	(922)	(319)	(430)
Cashflow from operations	**1,324**	**12,016**	**7,178**	**7,137**	**7,751**
Capital expenditure	(6,158)	(7,108)	(10,000)	(10,000)	(10,000)
Free cashflow	**(4,834)**	**4,908**	**(2,822)**	**(2,863)**	**(2,249)**
Reduction in investments	61	(1)	-	-	-
Net acquisitions	(188)	(57)	-	-	-
Reduction in other LT assets	(484)	(1,316)	-	-	-
Addition in other LT liabilities	367	(142)	-	-	-
Adjustments	426	1,449	450	450	450
Cashflow after investing acts	**(4,652)**	**4,841**	**(2,372)**	**(2,413)**	**(1,799)**
Cash dividends	(701)	-	(707)	-	-
Equity issue	701	1,581	-	-	-
Debt issue	1,039	(5,519)	2,280	3,000	3,000
Convertible debt issue	(149)				
Others	(75)	(287)	-	-	-
Cashflow from financial acts	**814**	**(4,226)**	**1,573**	**3,000**	**3,000**
Net cashflow	**(3,838)**	**616**	**(799)**	**587**	**1,201**
Beginning cash	5,540	1,701	2,317	1,518	2,105
Ending cash	1,701	2,317	1,517	2,105	3,306
Ending net debt	7,461	1,337	4,416	6,829	8,627

Source: Nomura estimates

Balance sheet (RMBmn)					
As at 31 Dec	**FY08**	**FY09**	**FY10F**	**FY11F**	**FY12F**
Cash & equivalents	1,701	2,317	1,518	2,105	3,306
Marketable securities	-	1	1	1	1
Accounts receivable	5,566	9,793	8,722	10,272	11,692
Inventories	6,916	4,408	6,146	6,580	6,716
Other current assets	717	678	678	678	678
Total current assets	**14,900**	**17,197**	**17,065**	**19,636**	**22,393**
LT investments	2	2	2	2	2
Fixed assets	14,716	18,907	26,658	33,743	40,161
Goodwill	59	59	59	59	59
Other intangible assets	730	771	635	499	363
Other LT assets	2,485	3,801	3,801	3,801	3,801
Total assets	**32,891**	**40,736**	**48,219**	**57,739**	**66,778**
Short-term debt	4,371	547	1,000	1,000	1,000
Accounts payable	6,849	11,519	14,342	15,554	16,118
Other current liabilities	3,176	6,312	6,992	8,377	8,805
Total current liabilities	**14,395**	**18,377**	**22,334**	**24,931**	**25,923**
Long-term debt	4,792	3,107	4,934	7,934	10,934
Convertible debt					
Other LT liabilities	367	225	225	225	225
Total liabilities	**19,554**	**21,708**	**27,492**	**33,089**	**37,081**
Minority interest	2,052	2,345	2,691	3,082	3,519
Preferred stock					
Common stock	2,050	2,275	2,275	2,275	2,275
Retained earnings	9,235	13,656	15,718	19,249	23,859
Proposed dividends	-	751	43	43	43
Other equity and reserves					
Total shareholders' equity	**11,286**	**16,682**	**18,036**	**21,567**	**26,178**
Total equity & liabilities	**32,891**	**40,736**	**48,219**	**57,739**	**66,778**
Liquidity (x)					
Current ratio	1.04	0.94	0.76	0.79	0.86
Interest cover	2.9	17.2	18.3	24.2	32.0
Leverage					
Net debt/EBITDA (x)	2.99	0.23	0.84	1.00	0.99
Net debt/equity (%)	66.1	8.0	24.5	31.7	33.0
Activity (days)					
Days receivable	75.1	71.0	74.3	64.7	65.9
Days inventory	97.3	66.9	51.5	53.2	49.6
Days payable	106.6	108.5	126.2	124.9	118.2
Cash cycle	65.8	29.4	(0.4)	(7.0)	(2.7)

Source: Nomura estimates

Healthy balance sheet

CSR Corporation 1766 HK

INDUSTRIALS/CAPITAL GOODS | CHINA

NOMURA INTERNATIONAL (HK) LIMITED

Yankun Hou +852 2252 6234 yankun.hou@nomura.com
Paul Gong +852 2252 6177 paul.gong@nomura.com

Maintained

NEUTRAL

Closing price on 12 Jan	HK$10.78
Price target	**HK$11.20**
	(set on 7 Jan 11)
Upside/downside	3.9%
Difference from consensus	20.6%
FY11F net profit (RMBmn)	4,617
Difference from consensus	18.5%

Source: Nomura

Action

Leveraging its core technologies in electrical systems, CSR has expertise in the development and production of both hybrid and pure electric vehicles. Although this business is currently insignificant compared with CSR's train business, we think it could be a potential development direction for CSR in the long term. The order and delivery of several hundred hybrid city buses to Changsha well proved its ability. We remain positive on railway equipment makers, but due to rich valuation at 23x FY11F P/E, we maintain NEUTRAL on CSR with a PT of HK$11.2.

Catalysts

Margin expansion in upcoming results is a potential positive catalyst. Any disappointing news on exports to US could be a negative catalyst.

Anchor themes

We remain long-term positive on rolling stock, given the ongoing exponential growth in high-speed trains, demand arising from metros and export opportunities.

Nomura vs consensus

We believe consensus is in the process of adjusting to reflect the latest developments in railway plans.

More than rail

① Crossover in technology

CSR has one of the most mature technologies in hybrid and pure electrical vehicle development and production, built on its leading expertise in electrical systems, including electrical control systems, asynchronous motors, electricity converters and battery management systems, all of which have been sufficiently studied on train electric systems.

② Electric-vehicle op. insignificant compared with trains

Compared with the huge revenue generated from locomotives, high-speed trains and other railway equipment, the electric-vehicle business currently looks insignificant. We estimate the revenue from EV and related component sales is about 1% of CSR's total revenue. However, this could be the direction for development in the long term; management has expressed optimism on the new industry.

③ Commitment well demonstrated

CSR has so far delivered hundreds of hybrid city buses in Changsha, a significant portion of the electric vehicles used during the Shanghai Expo and of the electric systems to a couple of bus makers. On 5 January 2011, Shuguang Auto (600303 CH) announced that it will cooperate with CSR to produce electric buses. We see this as another step forward. We expect more positive news on EV ahead.

④ Maintain NEUTRAL due to rich valuation

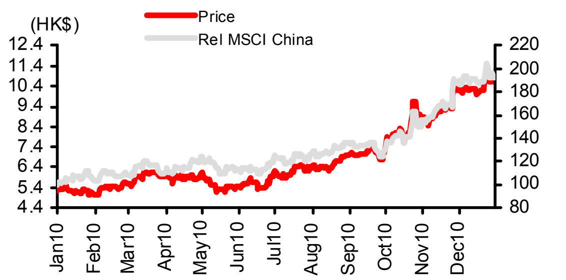
CSR is now trading at 23x FY11F P/E, which we believe is rich compared with 19x for peer CNR. We maintain our NEUTRAL rating on CSR and PT at HK$11.2 (based on 24x our FY11F EPS forecast of RMB0.39). Risks on the upside include margin expansion surprise. Risks on the downside include any disappointing news on exports to the US.

Key financials & valuations

31 Dec (RMBmn)	FY09	FY10F	FY11F	FY12F
Revenue	45,621	63,870	86,481	105,803
Reported net profit	1,678	2,994	4,617	5,958
Normalised net profit	1,678	2,994	4,617	5,958
Normalised EPS (RMB)	0.14	0.25	0.39	0.50
Norm. EPS growth (%)	(9.9)	78.4	54.2	29.0
Norm. P/E (x)	63.4	35.5	23.0	17.9
EV/EBITDA (x)	37.8	21.5	13.7	10.1
Price/book (x)	6.1	5.4	4.6	3.9
Dividend yield (%)	0.4	0.7	1.1	1.4
ROE (%)	10.1	16.2	21.7	23.6
Net debt/equity (%)	net cash	net cash	net cash	net cash
Earnings revisions				
Previous norm. net profit		2,994	4,617	5,958
Change from previous (%)		-	-	-
Previous norm. EPS (RMB)		0.25	0.39	0.50

Source: Company, Nomura estimates

Share price relative to MSCI China



	1m	3m	6m
Absolute (HK$)	5.7	50.6	77.0
Absolute (US$)	5.7	50.3	77.0
Relative to Index	2.9	49.2	64.5
Market cap (US$mn)			16,417
Estimated free float (%)			15.5
52-week range (HK$)			11.34/5.04
3-mth avg daily turnover (US$mn)			13.17
Stock borrowability			Easy
Major shareholders (%)			
Social Security Fund			9.1
JP Morgan			8.1

Source: Company, Nomura estimates

Drilling down

Technology similarities

CSR has one of the most mature technologies in hybrid and pure electrical vehicle development and production, built on its leading expertise in electrical systems, including electrical control systems, asynchronous motors, electricity converters and battery management systems, all of which have been sufficiently studied on train electric systems. CSR is now able to make buses and cars with parallel hybrid, serial hybrid or pure electric systems.

Exhibit 134. CSR: electric control system

Source: Company data

Exhibit 135. CSR: asynchronous motor

Source: Company data

Exhibit 136. CSR: battery management system

Source: Company data

Exhibit 137. CSR: electricity converter

Source: Company data

Exhibit 138. CSR: parallel hybrid bus

Source: eobus.com

Exhibit 139. CSR: pure electric bus

Source: eobus.com

Valuation methodology and risks

We derive our 12-month price target of HK$11.2 by applying a target multiple of 24x to our FY11F EPS forecast of RMB0.39 (forex assumption: RMB1 = HK$1.2). Risks on the upside include margin expansion surprise. Risks on the downside include any disappointing news on exports to the US.

Financial statements

Income statement (RMBmn)					
Year-end 31 Dec	**FY08**	**FY09**	**FY10F**	**FY11F**	**FY12F**
Revenue	35,093	45,621	63,870	86,481	105,803
Cost of goods sold	(29,279)	(38,454)	(53,353)	(71,479)	(87,017)
Gross profit	**5,814**	**7,167**	**10,517**	**15,002**	**18,787**
SG&A	(4,169)	(5,396)	(6,834)	(8,908)	(10,686)
Employee share expense	13	(144)	(150)	(200)	(250)
Operating profit	**1,658**	**1,626**	**3,533**	**5,894**	**7,851**
EBITDA	**2,199**	**2,313**	**4,493**	**7,082**	**9,332**
Depreciation	(668)	(850)	(1,100)	(1,332)	(1,630)
Amortisation	127	163	139	144	148
EBIT	**1,658**	**1,626**	**3,533**	**5,894**	**7,851**
Net interest expense	(431)	(265)	(302)	(349)	(402)
Associates & JCEs	178	344	350	350	350
Other income	525	696	673	663	664
Earnings before tax	**1,930**	**2,401**	**4,253**	**6,558**	**8,463**
Income tax	(245)	(285)	(510)	(787)	(1,016)
Net profit after tax	**1,685**	**2,116**	**3,743**	**5,771**	**7,447**
Minority interests	(301)	(438)	(749)	(1,154)	(1,489)
Other items	-	-	-	-	-
Preferred dividends	-	-	-	-	-
Normalised NPAT	**1,384**	**1,678**	**2,994**	**4,617**	**5,958**
Extraordinary items	-	-	-	-	-
Reported NPAT	**1,384**	**1,678**	**2,994**	**4,617**	**5,958**
Dividends	(379)	(474)	(749)	(1,154)	(1,489)
Transfer to reserves	**1,005**	**1,204**	**2,246**	**3,463**	**4,468**
Valuation and ratio analysis					
FD normalised P/E (x)	57.1	63.4	35.5	23.0	17.9
FD normalised P/E at price target (x)	59.4	65.9	36.9	23.9	18.5
Reported P/E (x)	57.1	63.4	35.5	23.0	17.9
Dividend yield (%)	0.5	0.4	0.7	1.1	1.4
Price/cashflow (x)	57.9	24.2	26.9	13.5	10.9
Price/book (x)	4.9	6.1	5.4	4.6	3.9
EV/EBITDA (x)	41.9	37.8	21.5	13.7	10.1
EV/EBIT (x)	54.3	51.0	26.8	16.3	12.0
Gross margin (%)	16.6	15.7	16.5	17.3	17.8
EBITDA margin (%)	6.3	5.1	7.0	8.2	8.8
EBIT margin (%)	4.7	3.6	5.5	6.8	7.4
Net margin (%)	3.9	3.7	4.7	5.3	5.6
Effective tax rate (%)	12.7	11.9	12.0	12.0	12.0
Dividend payout (%)	27.4	28.2	25.0	25.0	25.0
Capex to sales (%)	11.2	10.2	9.4	4.6	3.8
Capex to depreciation (x)	5.9	5.5	5.5	3.0	2.5
ROE (%)	13.6	10.1	16.2	21.7	23.6
ROA (pretax %)	6.2	5.0	7.8	9.9	10.8
Growth (%)					
Revenue	30.9	30.0	40.0	35.4	22.3
EBITDA	78.1	5.2	94.2	57.6	31.8
EBIT	159.1	(1.9)	117.2	66.8	33.2
Normalised EPS	77.0	(9.9)	78.4	54.2	29.0
Normalised FDEPS	77.0	(9.9)	78.4	54.2	29.0
Per share					
Reported EPS (RMB)	0.16	0.14	0.25	0.39	0.50
Norm EPS (RMB)	0.16	0.14	0.25	0.39	0.50
Fully diluted norm EPS (RMB)	0.16	0.14	0.25	0.39	0.50
Book value per share (RMB)	1.82	1.46	1.65	1.95	2.32
DPS (RMB)	0.04	0.04	0.06	0.10	0.13

Source: Nomura estimates

Revenue driven by strong demand for MU trains

Cashflow (RMBmn)					
Year-end 31 Dec	**FY08**	**FY09**	**FY10F**	**FY11F**	**FY12F**
EBITDA	2,199	2,313	4,493	7,082	9,332
Change in working capital	(1,423)	1,502	(935)	650	556
Other operating cashflow	589	587	396	143	(88)
Cashflow from operations	**1,365**	**4,403**	**3,954**	**7,875**	**9,800**
Capital expenditure	(3,919)	(4,656)	(6,000)	(4,000)	(4,000)
Free cashflow	**(2,554)**	**(253)**	**(2,046)**	**3,875**	**5,800**
Reduction in investments	(49)	76	-	-	-
Net acquisitions					
Reduction in other LT assets	(294)	(775)	(680)	(580)	(630)
Addition in other LT liabilities	16	122	58	72	61
Adjustments	1,197	692	284	252	255
Cashflow after investing acts	**(1,684)**	**(139)**	**(2,385)**	**3,619**	**5,486**
Cash dividends	(379)	(474)	(749)	(1,154)	(1,489)
Equity issue					
Debt issue					
Convertible debt issue		-	-	-	-
Others	5,336	820	502	577	662
Cashflow from financial acts	**4,957**	**347**	**(246)**	**(578)**	**(827)**
Net cashflow	**3,273**	**208**	**(2,631)**	**3,041**	**4,659**
Beginning cash	7,793	11,065	11,273	8,642	11,683
Ending cash	11,065	11,273	8,642	11,683	16,342
Ending net debt	(6,653)	(5,908)	(2,472)	(4,588)	(8,182)

Source: Nomura estimates

Balance sheet (RMBmn)					
As at 31 Dec	**FY08**	**FY09**	**FY10F**	**FY11F**	**FY12F**
Cash & equivalents	11,065	11,273	8,642	11,683	16,342
Marketable securities	100	24	24	24	24
Accounts receivable	6,396	7,637	9,904	13,410	16,407
Inventories	8,389	11,415	13,824	18,718	22,900
Other current assets	5,138	6,337	8,171	10,463	12,422
Total current assets	**31,088**	**36,687**	**40,565**	**54,299**	**68,095**
LT investments	31	31	31	31	31
Fixed assets	10,242	13,509	18,326	20,910	23,196
Goodwill	48	53	53	53	53
Other intangible assets	363	440	496	555	619
Other LT assets	3,744	4,519	5,199	5,779	6,409
Total assets	**45,516**	**55,238**	**64,670**	**81,627**	**98,403**
Short-term debt	3,747	3,193	3,672	4,223	4,857
Accounts payable	11,576	18,838	21,250	28,707	35,079
Other current liabilities	8,329	8,035	11,198	15,084	18,404
Total current liabilities	**23,652**	**30,067**	**36,120**	**48,013**	**58,340**
Long-term debt	665	2,172	2,498	2,872	3,303
Convertible debt	-	-	-	-	-
Other LT liabilities	2,557	2,679	2,737	2,808	2,870
Total liabilities	**26,874**	**34,917**	**41,354**	**53,694**	**64,512**
Minority interest	2,621	2,991	3,740	4,894	6,383
Preferred stock	-	-	-	-	-
Common stock	-	-	-	-	-
Retained earnings	16,021	17,330	19,576	23,039	27,507
Proposed dividends	-	-	-	-	-
Other equity and reserves	-	-	-	-	-
Total shareholders' equity	**16,021**	**17,330**	**19,576**	**23,039**	**27,507**
Total equity & liabilities	**45,516**	**55,238**	**64,670**	**81,627**	**98,403**
Liquidity (x)					
Current ratio	1.31	1.22	1.12	1.13	1.17
Interest cover	3.8	6.1	11.7	16.9	19.5
Leverage					
Net debt/EBITDA (x)	net cash	net cash	net cash	net cash	net cash
Net debt/equity (%)	net cash	net cash	net cash	net cash	net cash
Activity (days)					
Days receivable	56.9	56.1	50.1	49.2	51.6
Days inventory	88.9	94.0	86.3	83.1	87.5
Days payable	121.7	144.3	137.1	127.5	134.1
Cash cycle	24.1	5.8	(0.7)	4.7	5.0

Source: Nomura estimates

Tianneng Power 819 HK

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Key findings

Despite a strong increase in sales revenue, Tianneng Power's electric bike battery business suffered margin deterioration in 1H10 in the face of rising material prices and weak pricing power. Still, with a focus on low- to mid-range segments, the company's EV battery business is starting to yield results, contributing 2.6% of revenue in 1H10. In addition, it is ramping up production capacity in renewable energy and battery recycling. Tianneng Power is trading at 9.8x FY11F and 7.7x FY12F P/E, on Bloomberg consensus numbers.

Business model	SUPERIOR	**SUSTAINABLE**	INFERIOR
Earnings/cashflow growth	**HIGH**	AVERAGE	LOW
Earnings/cashflow quality	**HIGH**	AVERAGE	LOW
Financial strength	STRONG	**ADEQUATE**	WEAK
Corporate governance	TRANSPARENT	**ADEQUATE**	LIMITED
Investment liquidity	HIGH	**ADEQUATE**	LOW
Volatility	LOW	MEDIUM	**HIGH**

NUGGETS

Non-rated ideas from Nomura

Company description

Tianneng Power is the largest motive battery producer in China, with 94.5% of revenue contributed by electric bike batteries in 1H10. It also manufactures storage batteries for electric cars, and wind/solar power generation systems.

Closing price on 12 Jan 2011 HK$3.4

Go biking, go motoring

① Margins squeezed in electric bicycle battery segment

Tianneng Power is the leader in China's electric bike battery market, with approximately 22% of the market in 2009, according to company data. Electric bike batteries contributed 95% of the company's revenue in 1H10. Although this segment performed strongly in 1H10 (+74% y-y), profitability has been damaged by a sharp hike in major material prices — chiefly lead — since end-2009, coupled with the company's weak pricing power in China's highly-competitive electric bike market. Consequently, Tianneng's overall gross margin was dragged down by 10pp to 18.3% in 1H10, with net profit declining slightly.

② Positioned to ride EV wave

Tainneng has ventured into the electric car battery business in recent years, supplying lead-acid batteries to domestic EV OEMs such as Cherry, SAIC, Kandi and Zotye. Given the cost advantage of lead-acid batteries (around 30% of the cost of lithium-ion batteries), we believe the low- to mid-range EV market that Tianneng focuses on could materialise earlier than other categories. In 1H10, sales from EV batteries totalled RMB43.7mn, accounting for 2.6% of Tainneng's revenue. Meanwhile, the company has forged technical cooperation agreements with Cherry and SAIC, and entered a JV with Kandi, to advance development of lead-acid, nickel-hydride and lithium-ion batteries.

③ Ramping up capacity in new business segments

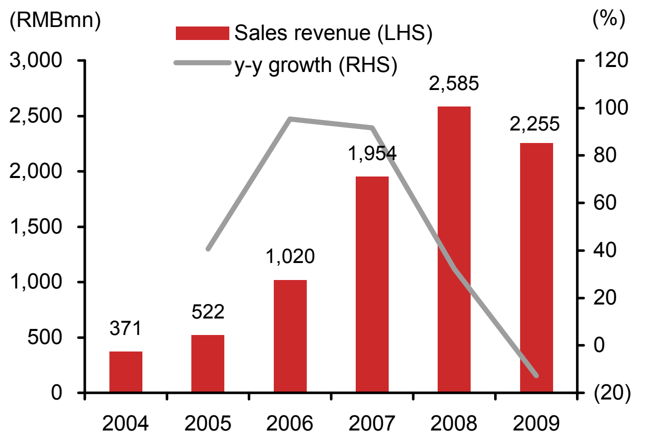
Apart from EVs, the company is actively engaged in the renewable energy and battery recycling businesses. Its renewable energy battery plant in Shuyang County is due to enter full-scale production in 2012F, and its new plant in Changxing County is expected to produce 6mn KVAH motive batteries for renewable energy by 2014F, and recycle 150,000 metric tons of batteries by 2012F. Tianneng Power is trading at 9.8x FY11F and 7.7x FY12F on Bloomberg consensus numbers.

Key financials

30 Jun (US$mn)	FY06	FY07	FY08	FY09
Revenue	1,019	1,954	2,585	2,255
Reported net profit	147.7	202.9	234.2	270.7
Reported EPS	0.22	0.23	0.23	0.27
Rep EPS growth (%)	n.a.	4.5	-	17.3
Rep P/E (x)	15.5	14.8	14.8	12.6
Price/book (x)	4.0	3.2	2.7	2.2
Dividend yield (%)	2.5	1.8	2.1	2.4
ROE (%)	47.0	26.9	20.4	18.5
Net debt/equity (%)	23.8	net cash	net cash	net cash

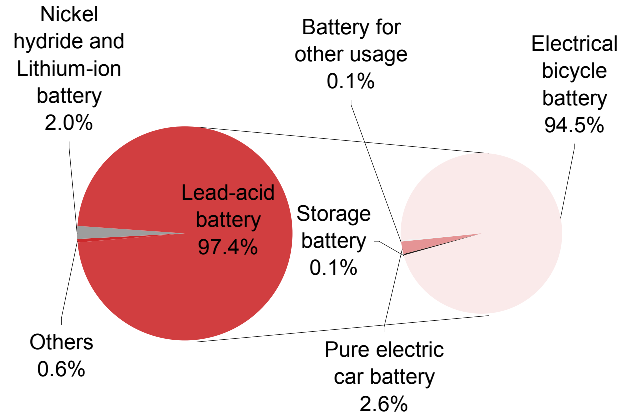
Source: Company data

Exhibit 140. Tianneng Power: revenue growth trend



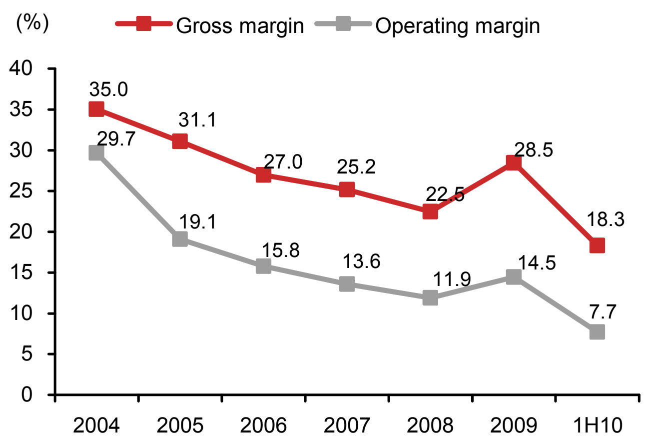
Source: Company data, Nomura research

Exhibit 141. Tianneng Power: segment breakdown of revenue (1H10)



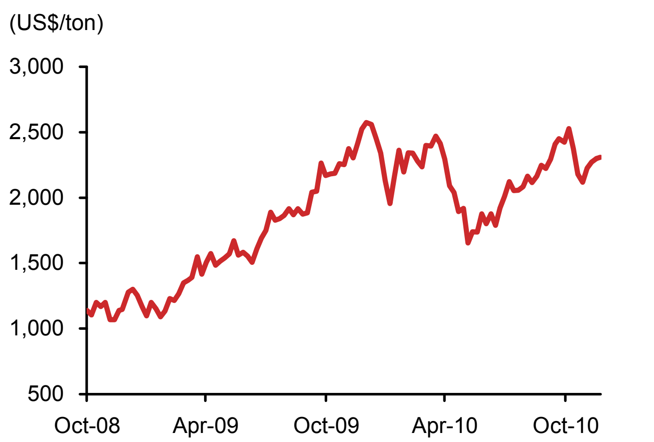
Source: Company data, Nomura research

Exhibit 142. Tianneng Power: gross margin and operating margin



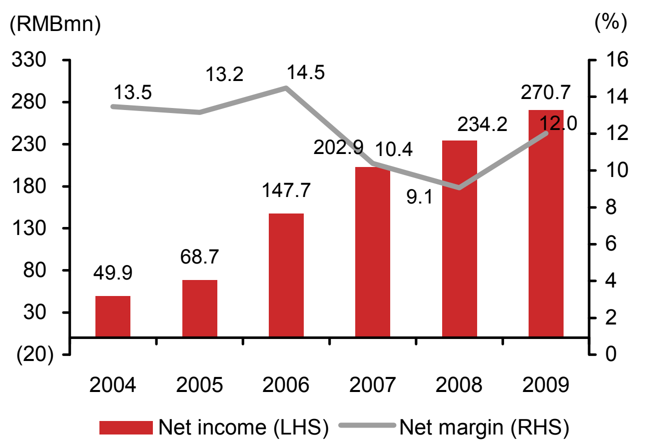
Source: Company data, Nomura research

Exhibit 143. LME 3-month forward lead price



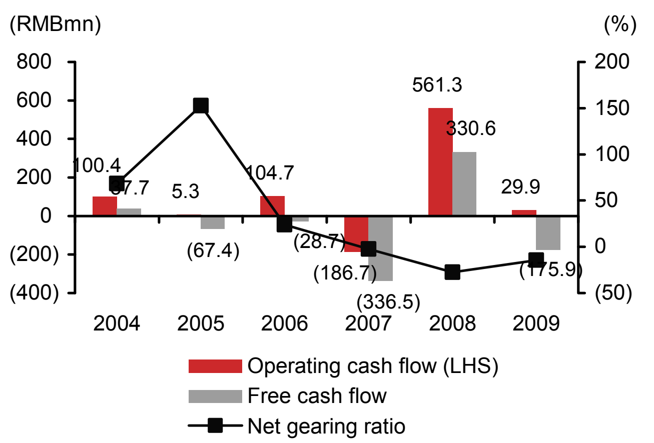
Source: Company data, Nomura research

Exhibit 144. Tianneng Power: net income and net margin



Source: Company data, Nomura research

Exhibit 145. Tianneng Power: balance sheet & cash flow metrics



Source: Company data, Nomura research

Financial statements

Profit and loss (RMB mn)				
Year-end 30 Jun	FY06	FY07	FY08	FY09
Revenue	**1,019**	**1,954**	**2,585**	**2,255**
Cost of goods sold	(744)	(1,462)	(2,004)	(1,613)
Gross profit	**275**	**492**	**581.1**	**641.8**
SG&A	(117)	(193)	(250)	(292.7)
Other income	2.5	20.3	29.6	62.2
Research development costs		(12.1)	(32.5)	(65.3)
Other operating expenses		(28.2)	(21.7)	(13.1)
Operating profit	**160.8**	**279.0**	**306.5**	**332.9**
Net interest expense	(11.2)	(23.5)	(27.5)	(13.3)
Net non-operating losses (gains)	(4.3)	(14.1)	-	-
Earnings before tax	**153.5**	**241.4**	**278.6**	**319.7**
Income tax	(5.9)	(38.5)	(44.4)	(48.9)
Net profit after tax	**147.7**	**202.9**	**234.2**	**270.7**
Minority interests	-	-	-	-
Other items	-	-	-	-
Preferred dividends	-	-	-	-
Normalised NPAT	**147.7**	**202.9**	**234.2**	**270.7**
Extraordinary items	-	-	-	-
Reported NPAT	**147.7**	**202.9**	**234.2**	**270.7**
Dividends	-	(39.9)	(60.4)	(68.7)
Transfer to reserves	**147.7**	**163.0**	**173.8**	**202.0**

Source: Company data

Balance sheet (RMBmn)				
As at 30 Jun	FY06	FY07	FY08	FY09
Cash & equivalents	144.7	401.8	530.4	360.3
Restricted bank deposits	94	40	-	94.8
Inventories	235.2	427.0	338.7	599.1
Trade and other receivables	168.2	343.5	144.8	378.6
Prepaid lease payments	0.4	0.7	0.9	1.8
Other current assets	4.7	0.62	0.53	-
Total current assets	**647.3**	**1,214.0**	**1,014.8**	**1,434.6**
Fixed assets	296.2	408.6	593.5	712.7
Prepaid lease payment	20.9	35.6	37.2	84.4
Deferred tax assets	-	10.2	22.6	26.7
Total assets	**964.5**	**1,668.0**	**1,668.2**	**2,258.4**
Trade and other payables	260.9	214.1	233.5	440.2
Taxation payable	4.7	15.0	6.8	15.7
Short-term bank loans	226.2	336.5	171.6	120.0
Other current liabilities	0.8	-	-	-
Total current liabilities	**492.7**	**565.5**	**411.9**	**575.9**
LT bank loans	25	40	20	-
Total liabilities	**517.7**	**605.5**	**431.9**	**575.9**
Equity attributable to equity holders	446.8	1,062.5	1,236.3	1,682.5
Minority interests	-	-	-	-
Total shareholders' equity	**446.8**	**1,062.5**	**1,236.3**	**1,682.5**
Total equity & liabilities	**964.5**	**1,668.0**	**1,668.2**	**2,258.4**

Source: Company data

A123 AONE US

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Key findings

A123 looks to be gaining traction in the global li-ion battery market, backed by technology enabling higher-power, safer and longer-life battery solutions. Electric vehicles have been its primary growth driver, with steady order flows from commercial vehicle makers and growing traction in the passenger vehicle market. A123 plans to boost manufacturing capacity from 170MWH to 760MWH by end-2011F. It is trading at 5.2x FY11F and 2.4x FY12F P/S (Bloomberg consensus).

Business model	SUPERIOR	**SUSTAINABLE**	INFERIOR
Earnings/cashflow growth	HIGH	**AVERAGE**	LOW
Earnings/cashflow quality	HIGH	**AVERAGE**	LOW
Financial strength	STRONG	**ADEQUATE**	WEAK
Corporate governance	TRANSPARENT	**ADEQUATE**	LIMITED
Investment liquidity	HIGH	**ADEQUATE**	LOW
Volatility	LOW	MEDIUM	**HIGH**

NUGGETS

Non-rated ideas from Nomura

Company description

Founded in 2001, A123 has become a global leader in high-power lithium-ion batteries. Its products are primarily used in three areas: transportation, power grid and electric consumers, which accounted for 50%, 16% and 12% of its revenue in FY09.

Closing price on 12 Jan 2011 US$9.2

Green giant

① Emerging giant in high-power li-lion batteries

Backed by proprietary technology initially developed at MIT, A123 offers li-lion battery products that it claims offer a combination of higher power, better safety, and longer life, and has become a leader in this specific market. The company has a premium and expanding global customer base, including AES Energy Storage, and leading auto makers such as BMW, Mercedes, GM, Magna Steyr and SAIC. It was recently selected to develop battery packs for SAIC's new 2012 EV model, in addition to the Roewe 750 HEV and Roewe 550 PHEV, suggesting strong momentum in China's fast-growing EV market.

② Electric vehicles driving growth

Transportation (EV) was the primary source of A123's sales revenue in FY09 (50%), followed by R&D service (22%), electric grid (16%) and electric consumer (12.2%). Within the transportation segment, electric CVs (HDT and buses) have been the biggest revenue contributor, accounting for around 75% of segment revenue in FY09. With steady order flows in commercial vehicles, and growing traction in passenger vehicles market, management believes the EV business will continue to underpin healthy growth for the company. Meanwhile, its Smart Grid Stabilization System (SGSS) is targeted at capitalising on the booming global renewable energy industry.

③ Investing heavily in production capacity

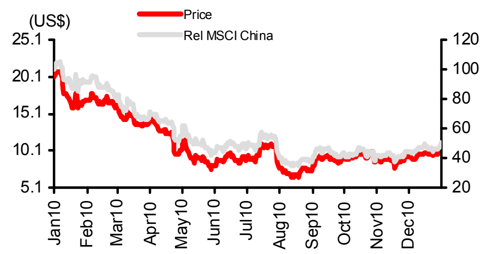
With its primary production facilities based in China and Korea, the company's manufacturing capacity stands at around 170MWH per year, according to company data. To cope with surging demand for li-ion batteries, A123 is investing heavily in capacity expansion and plans to boost annual manufacturing capacity to 760MWH by end-2011F. The stock is trading at 5.2x FY11F and 2.4x FY12F P/S on Bloomberg consensus data.

Key financials

30 Jun (US$mn)	FY06	FY07	FY08	FY09
Revenue	34.4	41.4	68.5	91.1
Reported net profit	(15.78)	(30.97)	(80.47)	(85.78)
Reported EPS	n.a.	n.a.	n.a.	(2.55)
Rep EPS growth (%)	n.a.	n.a.	n.a.	n.a
Rep P/E (x)	n.a.	n.a.	n.a.	n.a
Price/book (x)	n.a.	n.a.	n.a.	1.9
Dividend yield (%)	n.a.	n.a.	n.a.	n.a
ROE (%)	(55)	(44)	(71)	(16)
Net debt/equity (%)	(6.6)	(17.8)	(45.4)	(82.3)

Source: Company data

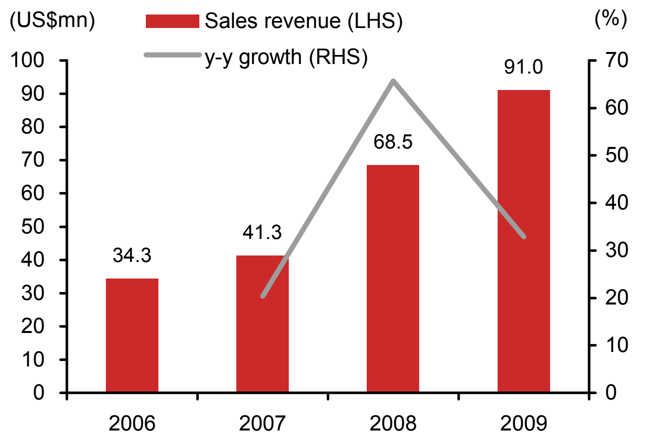
Share price relative to MSCI China



	1m	3m	6m
Absolute (US$)	16.2	17.4	23.5
Absolute (US$)	16.2	17.4	23.5
Relative to Index	13.4	16.2	11.0
Market cap (US$mn)			1,130
Estimated free float (%)			85.6
52-week range (US$)			20.85/6.54
3-mth avg daily turnover (US$mn)			47.80
Major shareholders (%)			
General Electric			7.90%
SPARTA Group			6.60%

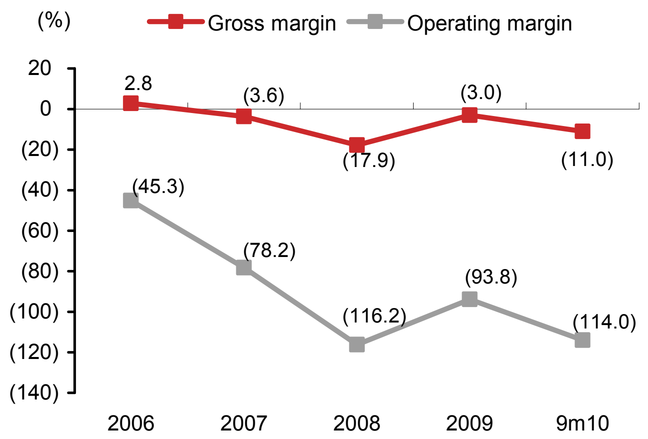
Source: Company, Nomura estimates

Exhibit 146. A123: revenue growth trend



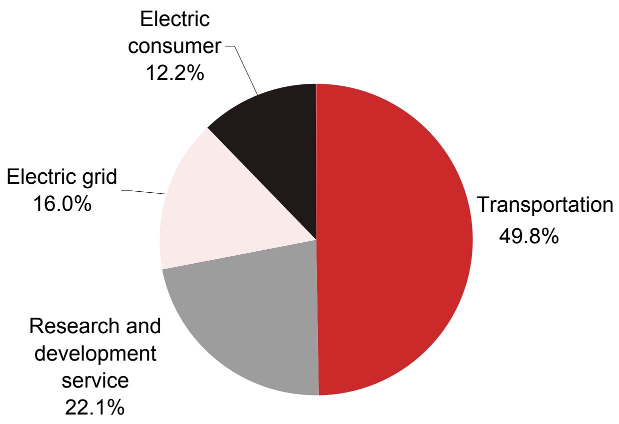
Source: Company data, Nomura research

Exhibit 147. A123: gross margin and operating margin



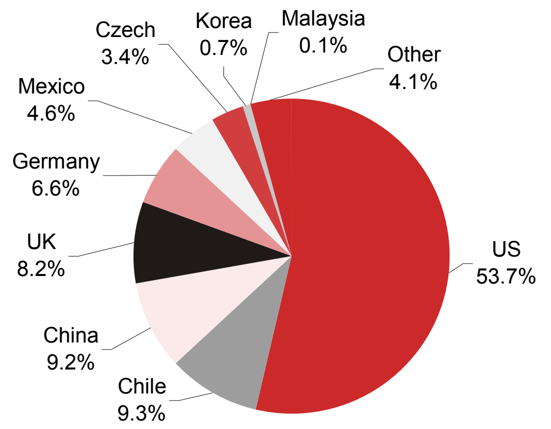
Source: Company data, Nomura research

Exhibit 148. A123: segment distribution of revenue (FY09)



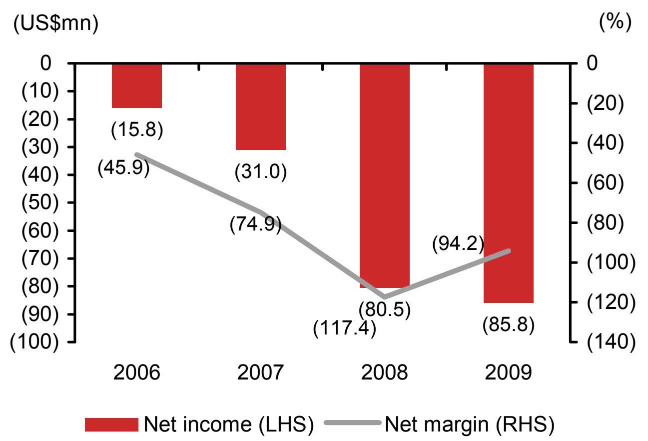
Source: Company data, Nomura research

Exhibit 149. A123: geographic distribution of revenue (FY09)



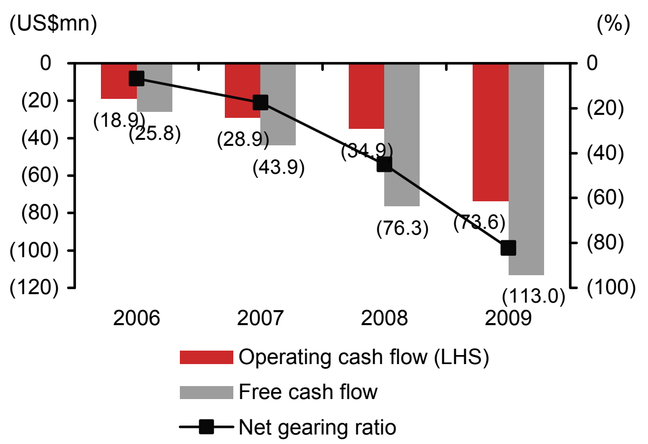
Source: Company data, Nomura research

Exhibit 150. A123: net income and net margin



Source: Company data, Nomura research

Exhibit 151. A123: balance sheet & cash flow metrics



Source: Company data, Nomura research

Financial statements

Profit and loss (US$mn)				
Year-end 30 Jun	**FY06**	**FY07**	**FY08**	**FY09**
Revenue	**34.4**	**41.4**	**68.5**	**91.1**
Cost of goods sold	(33.4)	(42.8)	(80.8)	(93.7)
Gross profit	**0.97**	**(1.47)**	**(12.3)**	**(2.7)**
SG&A	(16.5)	(30.9)	(67.4)	(82.8)
Operating profit	**(15.5)**	**(32.4)**	**(79.6)**	**(85.4)**
Net interest expense	(0.64)	(0.72)	(0.81)	(1.21)
Foreign exchange losses (gains)	-	(0.5)	0.72	(0.68)
Net non-operating losses (gains)	(0.51)	(1.67)	(0.97)	0.35
Earnings before tax	**(15.7)**	**(30.9)**	**(80.2)**	**(86.3)**
Income tax	(0.04)	(0.1)	(0.28)	(0.28)
Net profit after tax	**(15.72)**	**(30.99)**	**(80.43)**	**(86.59)**
Minority interests	-	(0.03)	0.04	(0.81)
Other items	-	-	-	-
Preferred dividends	-	-	-	-
Normalised NPAT	**(15.78)**	**(30.97)**	**(80.47)**	**(85.78)**
Extraordinary items	-	-	-	-
Reported NPAT	**(15.78)**	**(30.97)**	**(80.47)**	**(85.78)**
Dividends	-	-	-	-
Transfer to reserves	**(15.78)**	**(30.97)**	**(80.47)**	**(85.78)**

Source: Company data

Balance sheet (US$mn)				
As at 30 Jun	**FY06**	**FY07**	**FY08**	**FY09**
Cash & equivalents	9.5	23.4	70.5	457.1
Short-term investments	-	-	-	-
Accounts receivables	3.0	9.8	17.7	17.7
Inventories	13.7	21.1	35.7	37.4
Other current assets	1.8	5.5	5.9	10.6
Total current assets	**27.9**	**59.7**	**129.8**	**522.9**
Fixed assets	12.5	29.6	52.7	71.7
LT investments & receivables	0.4	-	-	-
Other LT assets	6.9	15.9	26.4	23.5
Total assets	**47.7**	**105.2**	**208.9**	**618.1**
Accounts payables	4.5	9.1	19.5	16.5
Short-term borrowings	4.4	8.8	13.0	14.9
Other ST liabilities	4.7	11.0	28.0	21.2
Total current liabilities	**13.6**	**28.9**	**60.5**	**52.5**
LT bank loans	3.2	2.1	6.2	7.6
Other LT liabilities	2.1	2.8	28.4	29.6
Total liabilities	**5.2**	**4.9**	**34.6**	**37.3**
Equity attributable to equity holders	28.9	70.3	113.0	528.2
Minority interests	-	1.0	0.9	0.1
Total shareholders' equity	**28.9**	**71.3**	**113.9**	**528.3**
Total equity & liabilities	**47.7**	**105.2**	**208.9**	**618.1**

Source: Company data

Wonder Auto Technology WATG US

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Key findings

Wonder Auto Technology has leading positions in China's automotive electric part, safety product, suspension product and engine component industries, and has a broad client base in the domestic market. A forerunner in the electric vehicle field, the company started supplying electric parts for small electric vehicles in 2009. Industry consolidation presents potential acquisition opportunities for the company. WATG is trading at 6.0x FY11F and 4.9x FY12F P/E, on Bloomberg consensus.

Business model	SUPERIOR	**SUSTAINABLE**	INFERIOR
Earnings/cashflow growth	**HIGH**	AVERAGE	LOW
Earnings/cashflow quality	**HIGH**	AVERAGE	LOW
Financial strength	STRONG	**ADEQUATE**	WEAK
Corporate governance	TRANSPARENT	**ADEQUATE**	LIMITED
Investment liquidity	HIGH	**ADEQUATE**	LOW
Volatility	LOW	MEDIUM	**HIGH**

NUGGETS

Non-rated ideas from Nomura

Company description

Wonder Auto Technology is a leading automotive parts supplier in China, with a product portfolio covering automotive electric parts, safety products, suspension products and engine components.

Closing price on 12 Jan 2010 US$7.8

Wonderful access to EV market

① An automotive electric part leader with broad client base

With a focus on small and medium-sized passenger vehicles, WATG ranked No.2 and No.4 in China's automotive alternator and starter markets, respectively in 2009, and aims to be one of the largest manufacturers of rods and shafts, as well as engine valves and tappets in China. Moreover, post the recent acquisition of Jinheng Auto, WATG also positions itself as the biggest local-brand airbag and pretensioner producer in China. The company has a broad customer base in domestic market, covering six out of China's top ten auto makers.

② Option on electric vehicle theme in China

Backed by distinctive R&D capabilities, WATG is also a forerunner in China's electric vehicle industry. Consistent with its firm-wide strategy, the company mainly provides electric parts for small electric vehicles. Note that it started supplying six models of electric motors worth US$5.5mn to Jinzhou AEV in November 2009, and participated in a pilot electric taxi program in Jinzhou.

③ Acquisitions fuel robust growth

The company holds a decent track record of identifying M&A opportunities and integrating the operation of acquired companies. In recent years, WATG has entered into a string of acquisitions, successfully expanding into rods & shafts, engine valves & tappets, and the automotive safety products business, while further integrating its supply chain. Acquisitions remain part of the company's growth strategy, as the consolidation of China's auto parts industry intensifies.

④ Valuation at 6.0Y11F P/E on Bloomberg consensus

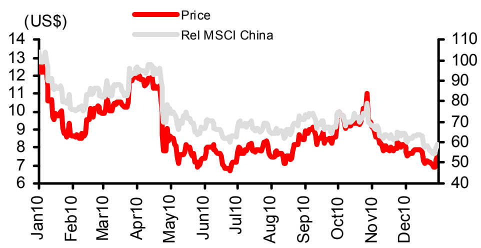
WATG is currently trading at 6.0x FY11F on Bloomberg consensus. Management sees 10% y-y growth in China's auto industry, and expects the company's top line to outgrow the industry average in FY11.

Key financials

30 Dec (US$mn)	FY07	FY08	FY09	FY10
Revenue	72.1	102.1	141.2	211.0
Reported net profit	8.2	(3.8)	18.9	22.9
Reported EPS	0.4	(0.16)	0.7	0.82
Rep EPS growth (%)	n.a.	n.a.	n.a.	17
Rep P/E (x)	19.5	n.a.	11.1	9.5
Price/book (x)	4.8	2.7	2.1	1.4
Dividend yield (%)	n.a.	n.a.	n.a.	n.a
ROE (%)	28.8	(6.4)	20.9	15.5
Net debt/equity (%)	17.6	3.1		37 net cash

Source: Company data

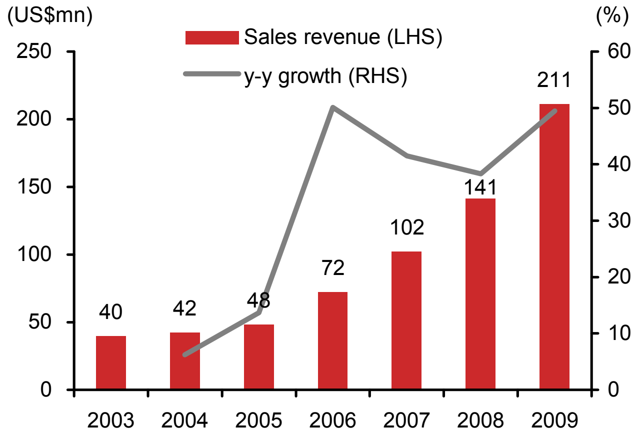
Share price relative to MSCI China



	1m	3m	6m
Absolute (US$)	(7.1)	(19.8)	4.1
Absolute (US$)	(7.1)	(19.8)	4.1
Relative to Index	(10.0)	(21.0)	(8.4)
Market cap (US$mn)			265
Estimated free float (%)			70.8
52-week range (US$)			13.20/7.01
3-mth avg daily turnover (US$mn)			3.12
Major shareholders (%)			
Choice Inspire Limited			28.7
TCW Group			9.0

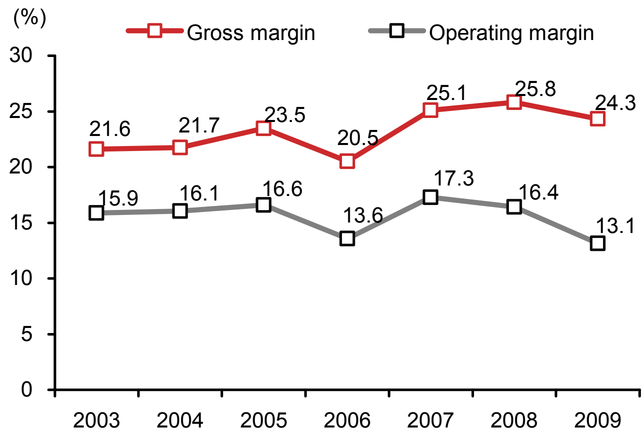
Source: Company, Nomura estimates

Exhibit 152. WATG: revenue growth trend



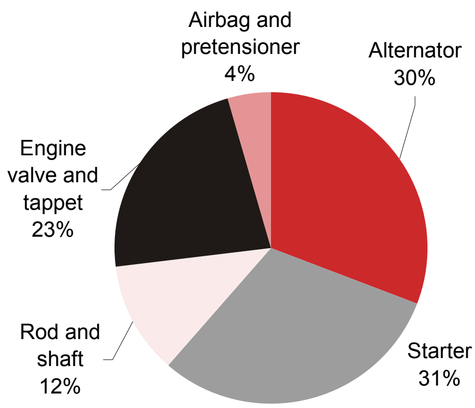
Source: Company data, Nomura research

Exhibit 153. WATG: gross margin and operating margin



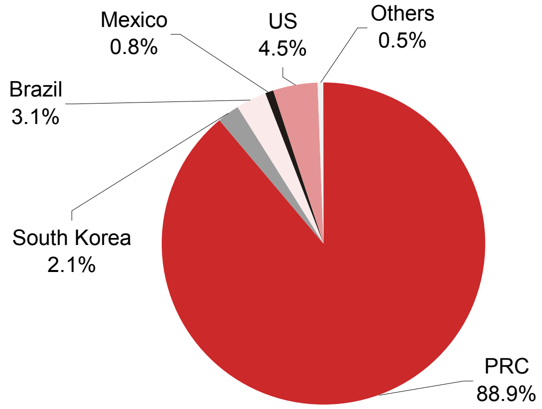
Source: Company data, Nomura research

Exhibit 154. WATG: segment breakdown of revenue (9M10)



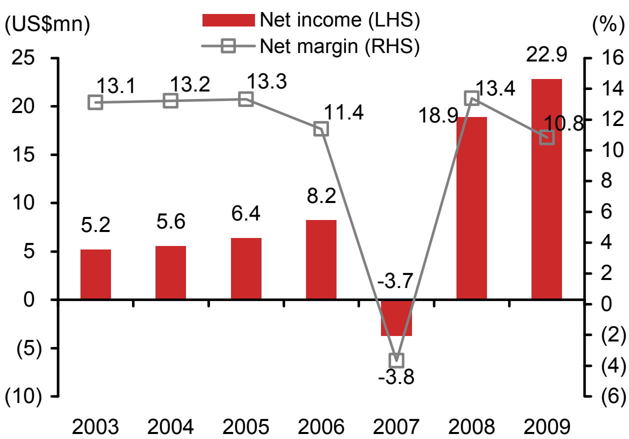
Source: Company data, Nomura research

Exhibit 155. WATG: geographic breakdown of revenue (9M10)



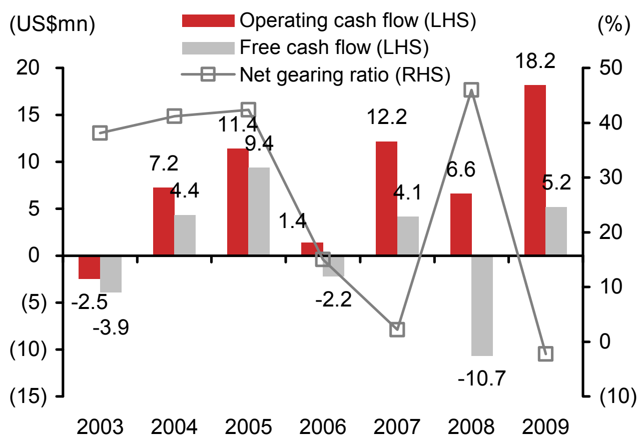
Source: Company data, Nomura research

Exhibit 156. WATG: net income and net margin



Source: Company data, Nomura research

Exhibit 157. WATG: balance sheet & cash flow metrics



Source: Company data, Nomura research

Financial statements

Profit and loss (US$ mn)				
Year-end 30 Jun	**FY06**	**FY07**	**FY08**	**FY09**
Revenue	**72.1**	**102.1**	**141.2**	**211.0**
Cost of goods sold	(57.3)	(76.5)	(104.8)	(159.7)
Gross profit	**14.8**	**25.6**	**36.4**	**51.3**
SG&A	(5)	(8)	(13.3)	(23.6)
Operating profit	**9.8**	**17.6**	**23.2**	**27.7**
Net interest expense	(0.8)	(1.6)	(2.8)	(9.0)
Foreign exchange losses (gains)	-	-	-	-
Net non-operating losses (gains)	(0.6)	17.2	(3.2)	(8.4)
Earnings before tax	**9.6**	**(1.22)**	**23.5**	**27.1**
Income tax	(1.3)	(1.4)	(2.2)	(3.2)
Net profit after tax	**8.3**	**(2.6)**	**21.3**	**23.9**
Minority interests	0.1	1.1	2.5	1.0
Other items	-	-	-	-
Preferred dividends	-	-	-	-
Normalised NPAT	**8.2**	**(3.8)**	**18.9**	**22.9**
Extraordinary items	-	-	-	-
Reported NPAT	**8.2**	**(3.8)**	**18.9**	**22.9**
Dividends	-	-	-	-
Transfer to reserves	**8.2**	**(3.8)**	**18.9**	**22.9**

Source: Company data

Balance sheet (US$mn)				
As at 30 Jun	**FY06**	**FY07**	**FY08**	**FY09**
Cash & equivalents	8.2	26.1	8.2	82.4
Short-term investments	-	-	-	-
Accounts receivables	24.7	38.1	46.6	49.5
Inventories	13.7	12.6	44.0	51.1
Other current assets	9.5	22.4	58.0	53.7
Total current assets	**56.1**	**99.3**	**156.7**	**236.8**
Fixed assets	14.0	22.5	69.1	73.8
LT investments & receivables	-	-	-	-
Other LT assets	7.9	20.6	37.2	51.7
Total assets	**78.0**	**142.4**	**263.0**	**362.3**
Accounts payables	9.6	28.6	52.9	63.5
Short-term borrowings	14.3	10.3	44.0	57.1
Other ST liabilities	13.2	4.2	33.5	18.4
Total current liabilities	**37.2**	**60.7**	**150.0**	**163.8**
LT bank loans	-	17.6	16.1	20.9
Other LT liabilities	-	-	3.6	3.9
Total liabilities	**37.2**	**60.7**	**150.0**	**163.8**
Equity attributable to equity holders	34.6	57.5	140.1	158.0
Minority interests	2.6	3.2	10.9	5.8
Total shareholders' equity	**40.8**	**81.7**	**113.0**	**198.5**
Total equity & liabilities	**78.0**	**142.4**	**263.0**	**362.3**

Source: Company data

Ningbo Yunsheng 600366 CH

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Key findings

Ningbo Yunsheng is an integrated producer of magnetic electric equipment, with 70% of sales from magnetic materials and 15% generated by the electric motor business in FY09. It has mastered key technologies in new-energy car electric drive systems via its 35% subsidiary, Shanghai Edrive, and the newly-acquired China business of Nikko Electric. The company appears on track to recover from a sharp drop since 2008, as export orders have picked up nicely. Ningbo Yunsheng is trading at 32x FY11F and 21.5x FY12F P/E, on Bloomberg consensus.

Business model	SUPERIOR	**SUSTAINABLE**	INFERIOR
Earnings/cashflow growth	**HIGH**	AVERAGE	LOW
Earnings/cashflow quality	**HIGH**	AVERAGE	LOW
Financial strength	STRONG	**ADEQUATE**	WEAK
Corporate governance	TRANSPARENT	**ADEQUATE**	LIMITED
Investment liquidity	HIGH	**ADEQUATE**	LOW
Volatility	LOW	MEDIUM	**HIGH**

NUGGETS

Non-rated ideas from Nomura

Company description

Ningbo Yunsheng primarily engages in the manufacturing of magnetic materials, electric motors and musical instruments. It had 70% revenue from magnetic materials, 15% from electric motors and 8% from music boxes in FY09.

Closing price on 12 Jan 2010 RMB23.7

Playing a new tune

① Integrated supply chain of magnetic electric products

Via extending its business into magnetic materials and automobile/wind power electric motors, Ningbo Yunsheng has transformed itself from a pure musical box manufacturer to an integrated producer of magnetic electric equipment. In FY09, revenue contribution from magnetic materials and electric motors accounted for 70% and 15%, respectively, while just 8% was generated by the music box business. The company now has annual production capacity of 5,550 tons of magnetic materials, 1.5mn units of alternators and 0.5mn units of starters.

② New-energy vehicle business shapes up

The company has been proactively pursuing business opportunities in China's burgeoning new-energy vehicle market. It is the joint founder of Shanghai Edrive (35% owned), which undertakes the government-backed research project for new-energy vehicle electric drive system, and has started supplies for several domestic new-energy car makers, including Cherry and SAIC. In addition, the acquisition of Nikko Electric's China business (2009) also provides it valuable access to the hybrid bus electric parts market. With Shanghai Edrive making a profit contribution from 2010 according to the company, and Nikko Electric's key technology being gradually absorbed, the company sees good growth potential in its alternative-energy vehicles business over the mid-long term.

③ Recovery on track as export orders pick up

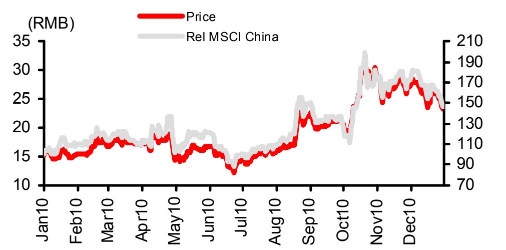
Since a substantial part of its sales are from exports (48% in FY09), Ningbo Yunsheng's top-line dropped sharply amid the global financial crisis in 2008. With the turnaround in overseas markets, export orders for the company's magnetic materials have picked up, triggering a respectable rebound in its sales revenue; up 95% y-y in 9m10. Ningbo Yunsheng is currently trading at 32x FY11F and 21.5x FY12F on Bloomberg consensus estimates.

Key financials

30 Dec (RMBmn)	FY06	FY07	FY08	FY09
Revenue	4,210	4,616	1,882	993
Reported net profit	84.8	104.7	106.4	647.6
Reported EPS	0.23	0.28	0.27	1.64
Rep EPS growth (%)				
Rep P/E (x)	103	85	88	14
Price/book (x)	1.99	4.92	3.38	4.11
Dividend yield (%)	0.1	0.15	0.15	0.20
ROE (%)	12.0	7.8	6.5	43.7
Net debt/equity (%)	48.4	4.1	1.4	net cash

Source: Company data

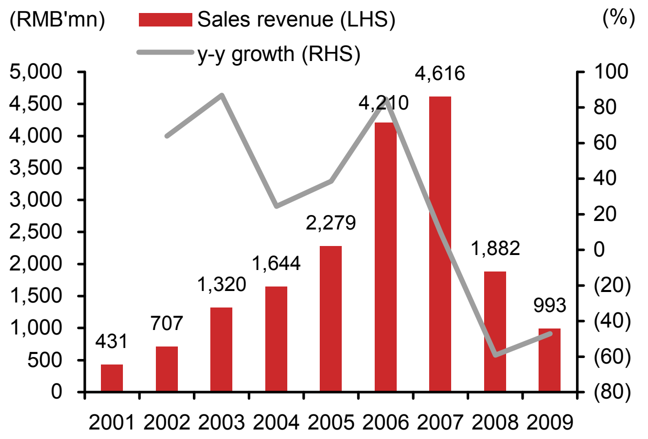
Share price relative to MSCI China



	1m	3m	6m
Absolute (RMB)	(12.6)	13.0	65.2
Absolute (US$)	(11.9)	14.2	69.4
Relative to Index	(15.5)	11.8	54.0
Market cap (US$mn)			1,390
Estimated free float (%)			54.0
52-week range (RMB)			32.65/12.06
3-mth avg daily turnover (US$mn)			16.12
Major shareholders (%)			
Yunsheng Group			39
TCW Group			6.0

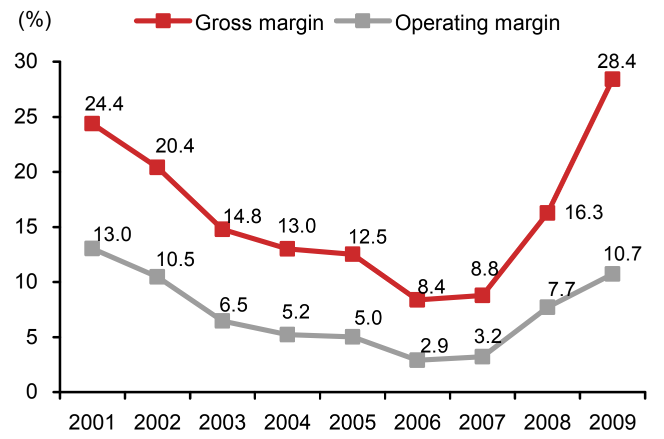
Source: Company, Nomura estimates

Exhibit 158. Yunsheng: revenue growth trend



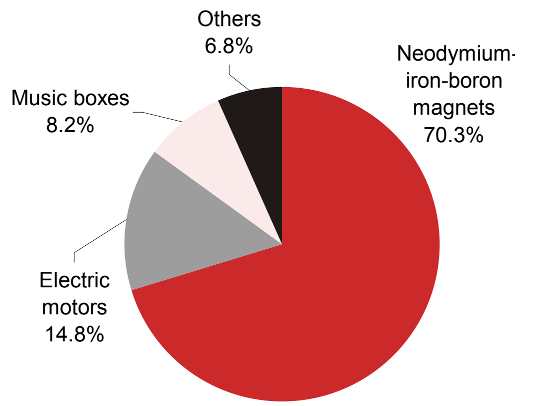
Source: Company data, Nomura research

Exhibit 159. Yunsheng: gross and operating margins



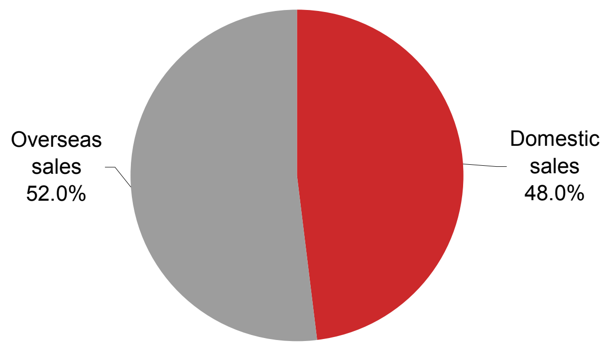
Source: Company data, Nomura research

Exhibit 160. Yunsheng: segment breakdown of revenue (FY09)



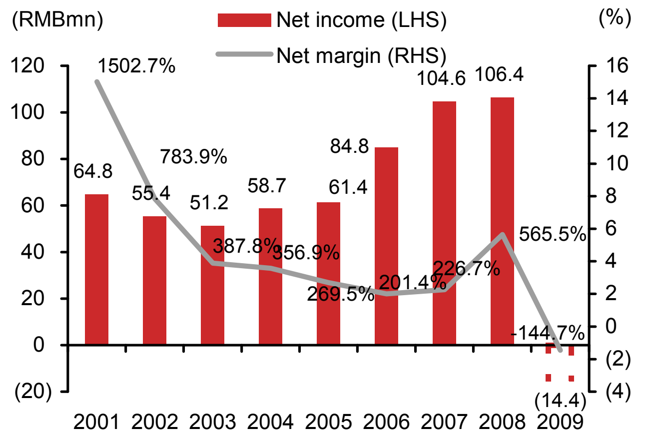
Source: Company data, Nomura research

Exhibit 161. Yunsheng: geographic breakdown of revenue (FY09)



Source: Company data, Nomura research

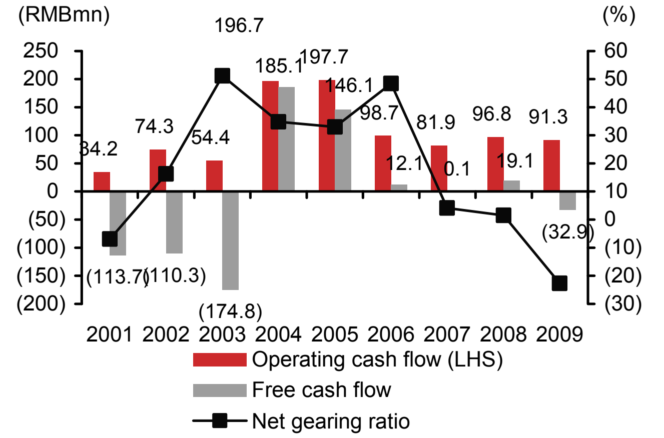
Exhibit 162. Yunsheng: net income and net margin



Note: FY09 net income - excluding the RMB662mn investment income from disposal of shares in Bank of Ningbo

Source: Company data, Nomura research

Exhibit 163. Yunsheng: balance sheet & cash flow metrics



Source: Company data, Nomura research

Financial statements

Profit and loss (RMB mn)				
Year-end 30 Jun	**FY06**	**FY07**	**FY08**	**FY09**
Revenue	**4,210**	**4,616**	**1,882**	**993**
Cost of goods sold	(3,858)	(4,210)	(1,576)	(711)
Gross profit	**352.1**	**405.6**	**305.9**	**282.3**
SG&A	(230.2)	(256.5)	(160.7)	(175.8)
Operating profit	**122.0**	**149.1**	**145.3**	**106.5**
Net interest expense	(15.8)	(23.5)	(27.5)	(13.3)
Foreign exchange losses (gains)	(5.1)	(5.5)	2.3	1.0
Net non-operating losses (gains)	(27.3)	(14.0)	(23.9)	(689)
Earnings before tax	**138.5**	**143.5**	**147.6**	**786.5**
Income tax	(24.6)	(5.1)	(10.5)	(113.2)
Net profit after tax	**113.9**	**138.5**	**137.1**	**673.3**
Minority interests	29.1	33.8	30.6	25.6
Other items	-	-	-	-
Preferred dividends	-	-	-	-
Normalised NPAT	**84.8**	**104.7**	**106.4**	**647.6**
Extraordinary items	-	-	-	-
Reported NPAT	**84.8**	**104.7**	**106.4**	**647.6**
Dividends	(37.2)	(59.4)	(59.4)	(79.2)
Transfer to reserves	**47.6**	**45.3**	**47.0**	**568.4**

Source: Company data

Balance sheet (RMBmn)				
As at 30 Jun	**FY06**	**FY07**	**FY08**	**FY09**
Cash & equivalents	134.3	450.4	182.0	503.8
Short-term investments	1.4	-	1.03	-
Accounts receivables	468.2	339.0	206.3	258.4
Inventories	313.2	439.3	200.5	231.2
Other current assets	305.9	507.5	46.3	243.5
Total current assets	**1,223.0**	**1,736.4**	**636.2**	**1,236.9**
Fixed assets	737.5	757.3	762.7	754.6
LT investments & receivables	62.1	1,335.5	415.1	79.3
Other LT assets	26.6	24.1	75.6	109.8
Total assets	**2,049.2**	**3,853.2**	**1,889.6**	**2,258.4**
Accounts payables	444.7	543.7	74.6	104.5
Short-term borrowings	395.3	435.5	204.0	7.6
Other ST liabilities	232.3	385.2	104.0	223.8
Total current liabilities	**1,072.4**	**1,364.3**	**382.5**	**575.9**
LT bank loans	140.0	100	-	100
Other LT liabilities	11.5	326.7	51.8	0.7
Total liabilities	**1,223.8**	**1,791.0**	**434.3**	**575.9**
Equity attributable to equity holders	738.3	1,846.8	1,338.5	1,682.5
Minority interests	87.1	215.4	116.8	-
Total shareholders' equity	**825.4**	**2,062.2**	**1,455.3**	**1,682.5**
Total equity & liabilities	**2,049.2**	**3,853.2**	**1,889.6**	**2,258.4**

Source: Company data

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Issuer	Ticker	Price (as at last close)	Closing price date	Rating	Disclosures
BYD	1211 HK	42.55 HKD	13 Jan 2011	Buy	4,58
CSR Corporation	1766 HK	10.98 HKD	13 Jan 2011	Neutral	

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Issuer	Previous rating	Date of change
BYD	Reduce	09 Sep 2009
CSR Corporation	Buy	07 Jan 2011

Three-year stock price and rating history

Not Available for BYD
Not Available for CSR Corporation

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Explanation of Nomura's equity research rating system in Japan published prior to 6 January 2009 (and ratings in Europe, Middle East and Africa, US and Latin America published prior to 27 October 2008)

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Explanation of Nomura's equity research rating system for Asian companies under coverage ex Japan published prior to 30 October 2008

STOCKS

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A **'Neutral'** recommendation indicates that upside or downside is less than 10%.
A **'Reduce'** recommendation indicates that downside is between 10% and 20%.
A **'Sell'** recommendation indicates that downside is more than 20%.

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A **'Bullish'** rating means most stocks in the sector have (or the weighted average recommendation of the stocks under coverage is) a positive absolute recommendation.
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