# China New Energy Vehicles Sector

## NEV supply chain study: charging ahead

- Electric vehicles (EVs) on track to replace those with conventional engines given lower production, operating and maintenance costs
- Chinese government efforts to encourage adoption of new energy vehicles (NEVs) likely to shift focus from OEMs to end-users
- Today's NEV pacesetters should turn their head starts into long-term market leadership; we reiterate our Buy (1) calls on BYD and Nexteer

Negative | Neutral | Positive

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Sector

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**What's new:** We have conducted an end-to-end examination of the supply chain for the China New Energy Vehicle (NEV) Sector. Given the speed of industry developments, together with effort to reduce pollution and improve energy efficiency, we consider the segment to be increasingly promising.

**What's the impact: EVs on course to replace vehicles powered by internal combustion engines (ICE).** We see a strong possibility that the cost of production for EVs will be comparable to that for ICE vehicles by 2020, given ongoing declines in battery costs. In our view, the lower cost of driving and maintaining EVs relative to ICE vehicles should propel this market shift, along with environmental-protection considerations. We raise our NEV growth forecasts for 2017-20 to 40-50% YoY, from 20-40% YoY.

**Policy support to shift to end-customers.** NEV development in China has stepped up a gear in recent years, with many domestic OEMs now capable of developing such vehicles, backed by local suppliers. Changes are afoot on the policy front too, as we expect the government to try to stimulate demand rather than supply in 2017 (reduced subsidies to the OEMs and acceleration in the construction of charging facilities). We expect the non-SOEs to concentrate on producing and operating charging poles, while the SOEs dominate large-scale charging station projects.

**Local battery makers rule the road.** In our view, China's local governments are unlikely to make international battery products eligible for subsidies in the near term, giving the domestic players time to close the technology gap.

**ADAS in its early stages in China.** We do not doubt the potential of advanced driver assistance systems (ADAS) in the long term, backed by regulatory change. However, we do not expect the turning point to come until 2018, with partial automation (PA) set to grow in popularity.

**What we recommend:** We believe today's major players will maintain their dominance, as the government will be keen not to have an overcrowded sector. Hence, we reiterate Buy (1) on **BYD (1211 HK, HKD46.70)**, which is setting the pace in NEVs and improving its profitability. Also, we raise our TP for BYD to HKD68 from HKD65. On the components side, we like **Nexteer (1316 HK, HKD9.72, Buy [1])**, which we expect to benefit in the long term from the rise of autonomous driving, a pre-requisite for which is upgraded steering components. The key risk to these Buy (1) calls: lower-than-expected growth in NEV new-car sales.

**How we differ:** Our report examines not only NEV manufacturing but the supply chain, including charging facilities, batteries and battery materials.

### Key stock calls

| | New | Prev. |
|---|---|---|
| **BYD** (1211 HK) | | |
| Rating | **Buy** | Buy |
| Target | **68.00** | 65.00 |
| Upside | ▲ **45.6%** | |
| **Nexteer Automotive Group** (1316 HK) | | |
| Rating | **Buy** | Buy |
| Target | **12.70** | 12.70 |
| Upside | ▲ **30.7%** | |

*Source: Daiwa forecasts*

### Not rated stocks featured in this report

| Company | Ticker | NEV exposure |
|---|---|---|
| Zhengzhou Yutong | 600066 CH | Produces NEV buses |
| Coslight Technology | 1043 HK | Produces motive batteries |
| China Titans Energy | 2188 HK | Produces charging facilities |
| FDG Electric Vehicles | 729 HK | Produces NEVs & motive batteries |
| Minth Group | 425 HK | Produces ADAS components |

*Source: Daiwa*



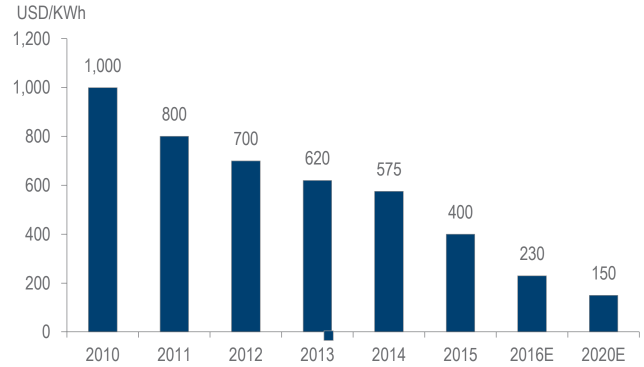
Sector

# Sector stocks: key indicators

| | | Share | Rating | | Target price (local curr.) | | | EPS (local curr.) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | FY1 | | | FY2 | | |
| Company Name | Stock code | Price | New | Prev. | New | Prev. | % chg | New | Prev. | % chg | New | Prev. | % chg |
| BYD | 1211 HK | 46.70 | Buy | Buy | 68.00 | 65.00 | 4.6% | 1.954 | 1.934 | 1.0% | 2.344 | 2.314 | 1.3% |
| Nexteer Automotive Group | 1316 HK | 9.72 | Buy | Buy | 12.70 | 12.70 | 0.0% | 0.117 | 0.117 | 0.0% | 0.132 | 0.132 | 0.0% |

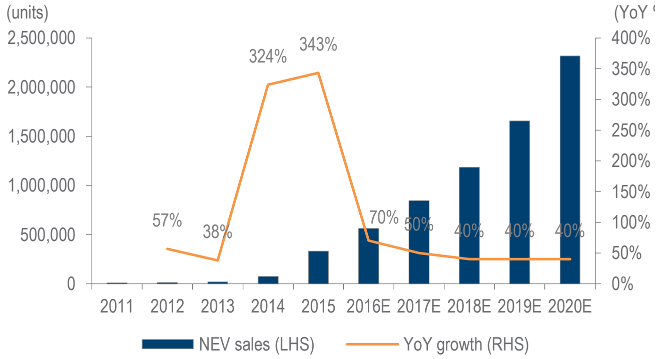
*Source: Bloomberg, Daiwa forecasts*

### Average EV battery pack cost trend (2010-20E)




*Source: Daiwa forecasts*

### China: NEV sales and forecasts




*Source: CEIC, Daiwa forecasts*

### China: Technology Roadmap for Energy Efficiency and New Energy Vehicles

| | 2016–2020 | 2020–2026 | 2026–2030 |
|---|---|---|---|
| Market demand | Production/sales volume of total vehicles to reach 30m units per year | Production/sales volume of total vehicles to reach 35m units per year | Production/sales volume of total vehicles to reach 38m units per year |
| | Average fuel consumption for new PV shall be less than 5L/100km | Average fuel consumption for new PV shall be less than 4L/100km | Average fuel consumption for new PV shall be less than 3.2L/100km |
| | Phase 5 emission standard for PV | Phase 6 emission standard for PV | Phase 7 emission standard for PV |
| | Average cumulative fuel consumption for CV shall be 10% lower | Average cumulative fuel consumption for CV shall be 15% lower | Average cumulative fuel consumption for CV shall be 20% lower |
| | Consumers are more interested in products with informational, intelligent functions | | Low-carbon, informational and intelligent offerings are key to "saving energy, reducing pollution, mitigating traffic jam and ensuring safety" |
| Product application | Sales of vehicles with energy-saving functions account for more than 30% of total sales | Sales of vehicles with energy-saving functions account for more than 40% of total sales | Sales of vehicles with energy-saving functions account for more than 50% of total sales |
| | NEV sales account for more than 7% of total sales | NEV sales account for more than 15% of total sales | NEV sales account for more than 40% of total sales |
| | Long-distance Internet communication devices will be equipped on 50% of vehicles sold | Long/short-distance Internet communication devices will be equipped on 80%/30% of sold vehicles | After accomplishing the transportation communication infrastructure construction, the related laws and regulations shall be set |
| | Vehicles with driver assistance (DA) or partial automation (PA) account for 50% of total sales | Vehicles with PA and DA will maintain their shares; vehicles with high automation (HA) account for 10-20% of total sales | Vehicles with full automation(FA) account for 10% of total sales |
| Industry fundamental | Forming low-carbon consumption and management system | Forming national life-cycle low-carbon management system | Total carbon emissions of vehicles to reach highest level by 2028 |
| | Energy consumption per unit GDP down by 20% | Energy consumption per unit GDP down by 35% | Energy consumption per unit GDP down by 50% |
| | Forming self-innovation system, with enterprises as the main players, led by the market. Combine technology with production; develop across various industries | Form completely self-made automobile industry chain and green, intelligent transportation system | Transportation efficiency to improve by 80%, traffic accidents to fall by 80%, deaths due to traffic accidents to fall by 80%, carbon emissions by vehicles to fall by 20% |
| | Initiate construction of intelligent transportation cities | Whole life cycle of vehicles shall be digital, Internet-connected and intelligent, thereby upgrading the automobile industry | Form intelligent transportation system and realise "low-carbon emission, zero-injuries, zero-traffic jam" |
| | R&D breakthrough in key technologies such as automotive batteries, electric motors and sensors | Form technology centre with the focus on intelligent Internet-connected vehicles | Form complete automobile technology innovation system |

*Source: Society of Automotive Engineers of China, Energy-saving and New Energy Vehicle Technology Roadmap*

# Car manufacturers: support to take a new form

## The government's 2020 target for NEV ownership looks within reach

**The China government is targeting to have 5m NEVs on the roads by 2020**

China's government is targeting to have 5m NEVs on the roads by the end of 2020 (from 0.5m at the end of 2015), comprising 4.3m electric passenger vehicles (PVs), 0.3m electric taxis, 0.2m electric buses and 0.2m electric trucks and other vehicles. Judging from the product pipelines of NEV players, we consider this target to be achievable.

On our forecasts, new-car sales in the NEV segment would expand by 70% YoY in 2016, 50% YoY in 2017, and 40% YoY in 2018-20. According to "The Technology Roadmap for Energy Efficiency and New Energy Vehicles" (referred to in this report as the Roadmap) jointly announced in October 2016 by government authorities and Qinghua University academics, NEV sales in China will reach 2.1m per year by 2020 and 5.25m per year by 2025. We are a little more aggressive in forecasting NEV sales to reach 2.3m per year by 2020, as we anticipate a more robust supply of EVs by OEM players as the technology improves and production costs come down.

**China: Technology Roadmap for Energy Efficiency and New Energy Vehicles**

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| | Forming self-innovation system, with enterprises as the main players, led by the market. Combine technology with production; develop across various industries | Form completely self-made automobile industry chain and green, intelligent transportation system | Transportation efficiency to improve by 80%, traffic accidents to fall by 80%, deaths due to traffic accidents to fall by 80%, carbon emissions by vehicles to fall by 20% |
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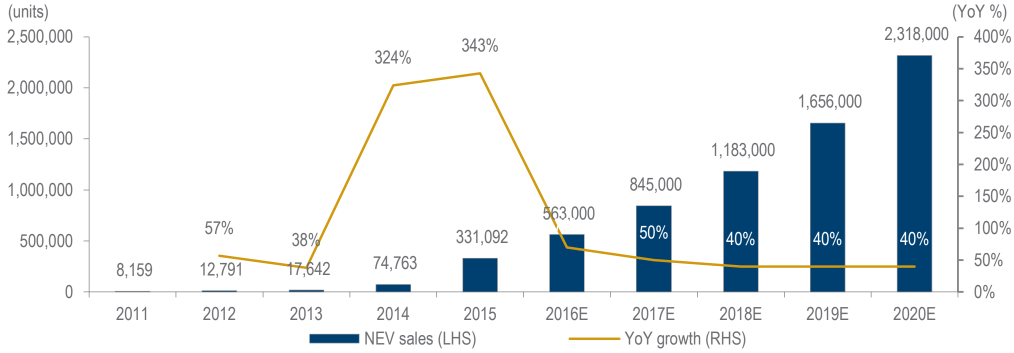
| | R&D breakthrough in key technologies such as automotive batteries, electric motors and sensors | Form technology centre with the focus on intelligent Internet-connected vehicles | Form complete automobile technology innovation system |

*Source: Society of Automotive Engineers of China, Energy-saving and New Energy Vehicle Technology Roadmap*

**China: NEV sales and forecasts**




*Source: CEIC, Daiwa forecasts*

Currently, demand for passenger NEVs in China is driven mainly by companies operating car fleets, whereas demand for NEV electric buses largely stems from local governments that need to replace conventional vehicles in order to comply with forthcoming fuel efficiency standards and other policy measures.

**We expect NEV bus ownership in China to reach 450,000 units by 2020, accounting for around 35% of the total bus fleet**

China's National Development Reform Commission (NDRC) is targeting to have 200,000 NEV public buses on the roads by 2020, which would account for 15% of the total fleet of 1.3m buses in China that we forecast for the same year. In our view, NEV bus ownership could total 450,000 units by 2020, assuming almost flat YoY growth in NEV bus sales over the 2016-20 period (versus 0% in 2016, and 5% YoY in each of 2017 and 2018, but declining to the same level as 2015 in 2019 and 2020). On these forecasts, NEV bus penetration would reach 35% of China's total bus fleet by 2020.

In the PV segment, aside from car-fleet operators that need to meet tighter fuel efficiency standards by 2020, we believe that the licence restrictions in place to limit the number of newly registered vehicles in top-tier cities such as Shanghai are spurring the purchase of NEVs for individual use (NEVs are exempt from the restrictions). As we expect more of China's cities to roll out licence restrictions in the next few years in a bid to ease traffic congestion, we believe NEV sales on the PV side will get a further leg up, particularly plug-in hybrid electric vehicles (PHEVs).

**China: major NEV bus orders (2016)**

| Company | Announcement date | Numbers of vehicles | Customer | Service region | Estimated contract value | Details |
|---|---|---|---|---|---|---|
| BYD | Apr-16 | 3,024 | Shenzhen Eastern Bus | Shenzhen-Guangdong | CNY 1.8bn | n.a |
| BYD | Apr-16 | 3,410 | Shanwei Yueyun Bus | Shanwei-Guangdong | n.a | n.a |
| BYD | Jul-16 | 832 | Shenzhen Western Bus | Shenzhen-Guangdong | CNY 192m | n.a |
| BYD | Jul-16 | 2,719 | Shenzhen Western Bus | Shenzhen-Guangdong | Nearly CNY2.0bn | n.a |
| BYD | Jul-16 | 2,606 | Shenzhen Bus Group | Shenzhen-Guangdong | CNY 1.5bn | n.a |
| BYD | Sep-16 | 600 | Hunan Bus Group | Hunan | n.a | |
| BYD | Nov-16 | 809 (Special Vehicles) | Beijing Environmental Sanitation Department | Beijing | CNY1.2bn | Hualinte Co. (37% controlled by BYD) won the tender |
| Yutong | Jul-16 | n.a | Qinhuangdao Bus Company | Qinhuangdao-Hebei | CNY 150m | |
| Yutong | Jul-16 | 200 | Nanyang Transportation Bureau | Nanyang - Henan | CNY108m | |
| Yutong | Jul-16 | 250 | Shanghai Bus Group | Shanghai | CNY259m | |
| Yutong | Aug-16 | 120 | Suizhou Bus Group | Suizhou-Hubei | n.a | |
| Yutong | Oct-16 | 100 | Xingtai Bus Group | Qingtai-Henan | CNY45m | |
| Ankai | Mar-16 | 378 | Guangzhou Bus Group | Guangzhou | CNY343m | |
| Kinglong | Jul-16 | 967 | Shenzhen Bus Group | Shenzhen-Guangdong | Nearly CNY300m | Shenzhen Chuangyuan (100% controlled by Nanjing Kinglong) won the tender |

*Source: Xinhua net, autohome, various media*

### China: new car licence restrictions in various cities

| Cities | Plate issuance through | Effective year | Quota for conventional vehicles (annual) | Quota set for NEV (annual) | Price per quota for conventional vehicles |
|---|---|---|---|---|---|
| Shanghai | Bidding | 2016 | 100,000 | No limit quota | above CNY 80,000 |
| Beijing | Lotteries | 2016 | 90,000 | 60,000 | |
| Guangzhou | Dual | 2016 | 108,000 | 12,000 | around CNY20,000 |
| Tianjin | Dual | 2016 | 100,000 | 10,000 | around CNY20,000 |
| Hangzhou | Dual | 2016 | 80,000 | No limit quota | above CNY20,000 |
| Shenzhen | Dual | 2016 | 80,000 | 20,000 | above CNY 40,000 |

*Source: local government websites, various media*

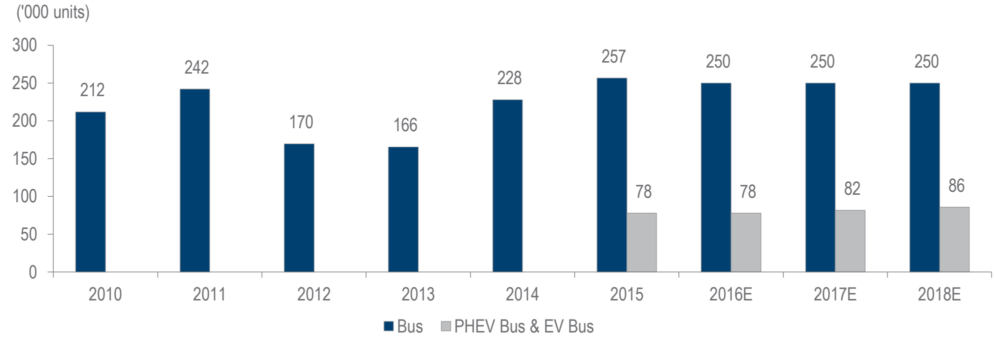
### Major markets: summary of fuel-efficiency targets for PVs

| km/l (mpg) | US | EU | Japan | China | S. Korea |
|---|---|---|---|---|---|
| 2005 | 12.4 (29.0) | 15.8 (37.2) | 16.7 (39.3) | 11.0 (25.9) | 12.3 (28.9) |
| 2010 | 13.9 (33.0) | 18.0 (42.3) | 19.6 (46.1) | 14.4 (33.9) | 14.8 (34.8) |
| 2015 | 15.4 (36.0) | 19.7 (46.3) | 21.0 (49.4) | 15.7 (36.9) | 16.7 (39.3) |
| 2020 | 19.9 (47.0) | 25.8 (60.7) | 23.4 (55.0) | 21.3 (50.1) | 16.7 (39.3) |
| 2025 | 23.9 (56.0) | 30.8 (72.4) ~ 35.0 (82.3) | 23.4 (55.0) | 21.3 (50.1) | 16.7 (39.3) |
| **YoY change in 5 years (%)** | **US** | **EU** | **Japan** | **China** | **S. Korea** |
| 2010 | 12.1% | 13.9% | 17.4% | 30.9% | 20.3% |
| 2015 | 10.8% | 9.4% | 7.1% | 9.0% | 12.8% |
| 2020 | 29.2% | 31.0% | 11.4% | 35.7% | 0.0% |
| 2025 | 20.1% | 19.4%~35.7% | 0.0% | 0.0% | 0.0% |
| **Improvement (%)** | **US** | **EU** | **Japan** | **China** | **S. Korea** |
| 2010-25 | 71.9% | 71.1%~94.4% | 19.4% | 47.9% | 12.8% |
| 2015-25 | 55.2% | 56.3%~77.7% | 11.4% | 35.7% | 0.0% |

*Source: ICCT*
*Note: No official fuel efficiency guidance provided by Korea (from 2015), Japan (from 2020), or China (from 2020)*

**We expect NEV bus sales to stabilise at around 80,000-90,000 units per year in 2016-18**

### China: bus sales and NEV bus (including PHEV bus and EV bus) sales




*Source: Yutong, CEIC, Daiwa estimates*

## China: government policies related to the NEV industry

| Policy | Month of announcement | Details |
|---|---|---|
| Licence & traffic restrictions | 2015.9 /2016.7 | - Lift purchase restrictions and traffic controls for NEVs but retain curbs on conventional ICE vehicles<br><br>- Beijing decides to limit its total number of vehicles to 6.3m in 2020, indicating that the increase in the number of cars would be revised to 10,000 units each year from 2018 to 2020, 33% less than the current level. Licences for purchasing cars would be tighter and NEVs would increase their market share above the current level of 40% |
| Charging stations | 2015.11 /2016.1 /2016.4 | - New residential complexes must be built with chargers or reserved spaces for future installations; at least 10% of public parking facilities should be built with chargers or spaces reserved for future installations; every 2,000 EVs owned should be matched by 1 public charging station; build a nationwide charging network for up to 5m EVs by 2020<br><br>- In Beijing, 18% of parking spaces at all new residential complexes should be built for EVs<br><br>- Provide fiscal grants to local governments where NEV sales reach the threshold from 2016 to 2020<br><br>- The National Energy Bureau plans to invest CNY30bn to build 2,000-plus charging stations, 100,000 public charging piles, and 860,000 private charging piles in 2016 |
| Investigation into fraudulent subsidies of NEV manufacturers | 2016.1 | - The investigation targets NEV manufacturers which received subsidies in 2013 and 2014 and those that applied for subsidies in 2015 |
| Promoting NEV public vehicles sales | 2015.3 /2015.5 | - By 2020, ensure that the number of NEV public city buses reaches 200,000 units, and the number of NEV taxis and urban delivery vehicles reaches 100,000 units<br><br>- Provide annual subsidies for running NEV public city buses during 2015-19 Reduce refined oil subsidy for conventional ICE public buses during 2015-19 |
| Reducing NEV subsidies | 2015.4 /2016.4 /2016.6 | - For 2017-18 and 2019-20, subsidies on purchases of NEVs will be reduced by 20% and 40%, respectively, from the level in 2016 as advised by the NDRC<br><br>- Shanghai decides to cut its local NEV subsidy for both PVs and buses by 25-75% starting from 201X. The new policy also introduces a mechanism to gradually decrease the subsidy for certain models as the OEMs' total local EV sales number passes the minimum threshold.<br><br>- Shenzhen decides to cut its annual local EV bus subsidy for operators starting from 2016 by an amount determined by factors such as operating distance and purchasing price<br><br>- Hangzhou effectively maintains its subsidy for 2016 at the 2015 level, but it now has more detailed eligibility requirements |

*Source: NDRC, CAAM, local government*

**NEV commercial vehicle (CV) sales grew at a higher rate than NEV passenger vehicle (PV) sales in 2015**

## China: NEV sales breakdown

| | 2014 | 2015 | YoY growth |
|---|---|---|---|
| China NEV sales | **74,763** | **331,092** | 343% |
| PV Sales | **54,012** | **207,382** | 284% |
| EV | 36,680 | 146,719 | 300% |
| PHEV | 17,332 | 60,663 | 250% |
| CV Sales | **20,751** | **123,710** | 496% |
| EV | 8,368 | 100,763 | 1,104% |
| PHEV | 12,383 | 22,947 | 85% |

*Source: CAAM*
*Note: CAAM does not count hybrid electric vehicles (HEVs) as NEVs*

## China: comparison of various NEV models

| | EV | PHEV | FCV | HEV |
|---|---|---|---|---|
| Subsidy | Medium | Low | High | None* |
| Cost | Medium | Medium | High | Medium |
| Technology requirements | Medium/Low | Medium | High | Medium |

*Source: government documents, various media, Daiwa estimates*
*Note: EV = electric vehicles; PHEV = plug-in hybrid electric vehicles; FCV = fuel cell vehicles; and HEV = hybrid electric vehicles*
** Currently only Guangzhou city provides a local subsidy of CNY10,000 per unit of HEV*

## Subsidies: more fine-tuning to come

### Reduction in subsidies likely to be offset by lower cost of production

**Subsidies to be cut starting from 2017**

According to China's Ministry of Industry and Information Technology (MIIT), the government plans to cut subsidies given to NEV OEMs by 20% in 2017-18 relative to the 2016 level, and by 40% from 2019. Fuel-cell vehicles will be excluded from the cuts. By 2020, the subsidy scheme is to be cancelled altogether and replaced with a carbon trading scheme, a move that the government believes will encourage healthier development of the industry.

It is a similar story for subsidies at the local government level. For example, Shanghai plans to reduce its local subsidies by 25-75% starting from 2016 according to a mechanism of gradual reductions that depend upon the NEV OEMs achieving certain production scale. Although most cities will likely opt for more straightforward subsidy schemes (ie, no subsidy reductions depending upon production scale), we believe that the general trend will be for subsidies to OEM to decline given recent cases of fraud. In September 2016, the Ministry of Finance announced that, following an investigation of 93 OEMs, 5 companies were found to have cheated when claiming subsidies. We believe the fraud investigation underlines the extent of the government's concern regarding such abuses of the subsidy system.

**China: fraud cases involving EV bus subsidies**

| Company name | Fraud details | Number of buses | Claimed subsidy amount (CNYm) |
|---|---|---|---|
| Suzhou Gemsea | Applying for subsidy through false documents | 1,131 | 262 |
| Kinglong (Suzhou) | Applying for subsidy for unfinished vehicles | 1,683 | 519 |
| Shenzhen WZL Motors | Applying for subsidy for unfinished vehicles | 154 | 56 |
| Qirun Wanda (Guizhou) | Applying for subsidy for unfinished vehicles | 327 | 98 |
| Shaolin Bus (Henan) | Applying for subsidy for unfinished vehicles | 252 | 76 |

*Source: Ministry of Finance*

**We see a shift in the government's focus towards encouraging end-demand**

We believe that the China government considers the existing subsidy to be too high, which in turn has encouraged OEMs to indulge in fraudulent behaviour. In this context, we believe that the direction of travel policy-wise is to: 1) reduce subsidies to the OEMs, 2) change the format of the subsidy scheme to one more akin to carbon credits that OEMs could trade, and 3) focus more on subsidies designed to spur demand at the consumer level, including charging facilities and tax rebates.

We believe this change in approach will benefit the existing major players such as BYD, as their profitability has improved through scale economies such that they are less reliant on subsidies than the small players. On the other hand, the shift in focus should reduce the incentive for OEMs to cheat and, as a result, we think some smaller OEMs may exit the market in the coming 5 years. A fall in the number of participants in the NEV industry would likely translate to less competition, which would benefit the existing players.

**Cost of production of EVs should be comparable to that for ICE vehicles by 2020**

Given the ongoing reduction in battery costs, we believe a tipping point will be reached in 2020 at which the production cost of EVs will be comparable to that of ICE vehicles. According to our research on a Japanese car model (listed below), assuming the cost of a car battery comes down to USD150/KWh, from USD400/KWh in 2015, the cost of production for an EV, with all other component costs unchanged, would decline to JPY1.96m by 2020 (implying a cost declining rate of around of 18% YoY per year), very close to the JPY1.8m figure for ICE vehicles (see SY Chung's report *Electric vehicles and smart cars: reinventing the wheel*, published 23 June 2016).

### Japanese car case study: cost structure comparison for a gasoline vehicle vs. an electric vehicle

| JPY'000 | Gasoline vehicle | | Electric vehicle | |
|---|---|---|---|---|
| | Price | Percentage | Price | Percentage |
| Total cost | 1,800 | | 2,560 | |
| **Special components for EV** | | | **1,442** | **56%** |
| Electric Motor | | | 180 | 7% |
| Power control module | | | 180 | 7% |
| LiB | | | 960 | 38% |
| Others (transmission shaft etc.) | | | 122 | 5% |
| **Common components for both** | **1,800** | | **1,118** | **44%** |
| Engine (including gearbox) | 432 | 24% | 0 | 0% |
| Chassis | 198 | 11% | 198 | 8% |
| Body | 414 | 23% | 320 | 13% |
| Electronic components | 360 | 20% | 360 | 14% |
| Others | 396 | 22% | 240 | 9% |

*Source: Taiwan Economic Research Institute, IEE JAPAN, Daiwa estimates*
*Note: component costs estimated for the period of 2011 except for LiBs, updated by Daiwa based on cost during 2015*

**The subsidy provided by government is set to decline by 20% YoY in 2017 and an additional 20% YoY in 2019**

### China: new energy PV subsidies (2016-20E)

| Year | Subsidies (CNY/vehicle) | Pure electric driving range, R (Km) | | | |
|---|---|---|---|---|---|
| | | 100 ≤ R < 150 | 150 ≤ R < 250 | R ≥ 250 | R ≥ 50 |
| 2016 | Pure EV | 25,000 | 45,000 | 55,000 | / |
| | Plug-in hybrid electric vehicle | / | / | / | 30,000 |
| 2017-2018 | Pure EV | 20,000 | 36,000 | 44,000 | / |
| | Plug-in hybrid electric vehicle | / | / | / | 24,000 |
| 2019-2020 | Pure EV | 15,000 | 27,000 | 33,000 | / |
| | Plug-in hybrid electric vehicle | / | / | / | 18,000 |

*Source: NDRC*

### China: new energy passenger bus subsidies (2016-20E)

| Year | Subsidy (10k CNY/vehicle) | Ekg, Wh/km·kg | Standard bus (10m<vehicle length<12m) * Pure electric driving range, R (Km) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 6 ≤ R <20 | 20≤ R <50 | 50 ≤ R <100 | 100 ≤ R <150 | 150 ≤ R <250 | R ≥ 250 |
| 2016 | Pure EV Bus | Ekg <0.25 | 22 | 26 | 30 | 35 | 42 | 50 |
| | | 0.25≤Ekg<0.35 | 20 | 24 | 28 | 32 | 38 | 46 |
| | | 0.35≤Ekg<0.5 | 18 | 22 | 24 | 28 | 34 | 42 |
| | | 0.5≤Ekg<0.6 | 16 | 18 | 20 | 25 | 30 | 36 |
| | | 0.6≤Ekg<0.7 | 12 | 14 | 16 | 20 | 24 | 30 |
| | Plug-in hybrid EV Bus | | / | / | 20 | 23 | 25 | |
| 2017-2018 | Pure EV Bus | Ekg <0.25 | 18 | 21 | 24 | 28 | 34 | 40 |
| | | 0.25≤Ekg<0.35 | 16 | 19 | 22 | 26 | 30 | 37 |
| | | 0.35≤Ekg<0.5 | 14 | 18 | 19 | 22 | 27 | 34 |
| | | 0.5≤Ekg<0.6 | 13 | 14 | 16 | 20 | 24 | 29 |
| | | 0.6≤Ekg<0.7 | 10 | 11 | 13 | 16 | 19 | 24 |
| | Plug-in hybrid EV Bus | | / | / | 16 | 18 | 20 | |
| 2019-2020 | Pure EV Bus | Ekg <0.25 | 13 | 16 | 18 | 21 | 25 | 30 |
| | | 0.25≤Ekg<0.35 | 12 | 14 | 17 | 19 | 23 | 28 |
| | | 0.35≤Ekg<0.5 | 11 | 13 | 14 | 17 | 20 | 25 |
| | | 0.5≤Ekg<0.6 | 10 | 11 | 12 | 15 | 18 | 22 |
| | | 0.6≤Ekg<0.7 | 7 | 8 | 10 | 12 | 14 | 18 |
| | Plug-in hybrid EV Bus | | / | / | 12 | 14 | 15 | |

*Source: NDRC*
*Note: The unit of Ekg is Wh/km·kg, which is used to quantify the energy consumed for a certain driving distance and weight*
*Note2: * For passenger buses with lengths of less than 6 metres, 6-8 metres, 8-10 metres and 12 metres above, the subsidy will be 0.2x, 0.5x, 0.8x, 1.2x respectively the subsidy of a standard vehicle*

### China: fuel-cell vehicle subsidies (2016-20)

| Vehicle types | Subsidies (CNY/vehicle) |
|---|---|
| Fuel-cell PV | 200,000 |
| Fuel-cell light CV | 300,000 |
| Fuel-cell mid-large CV | 500,000 |

*Source: NDRC*

## Shenzhen: local new energy PV subsidies (2016)

| Subsidy Steps | Subsidies (CNY/vehicle) | Pure electric driving range, R (Km) | | | |
|---|---|---|---|---|---|
| | | R < 150 | 150 ≤ R < 250 | R ≥ 250 | R ≥ 50 |
| Purchase | Pure EV | 35,000 | 50,000 | 60,000 | / |
| | Plug-in hybrid electric vehicle | / | / | / | 35,000 |
| | Pure EV Bus | Same as central subsidies | | | |
| Use | Pure EV | 10,000 | 15,000 | 20,000 | / |
| | Plug-in hybrid electric vehicle | / | / | / | 10,000 |

*Source: Shenzhen Municipal Transportation Commission*

**Various local governments have launched their own subsidy policies**

## Beijing: local new energy PV subsidies (2016)

| Subsidies (CNY/vehicle) | Pure electric driving range, R (Km) | | | |
|---|---|---|---|---|
| | 100 ≤ R < 150 | 150 ≤ R < 250 | R ≥ 250 | R ≥ 50 |
| Pure EV | 25,000 | 45,000 | 55,000 | / |
| Plug-in hybrid electric vehicle | / | / | / | 30,000 |
| Pure EV Bus | Same as central subsidies | | | |

*Source: Beijing Municipal Transportation Commission*
*Note: For now, Beijing only considers pure EVs to be eligible for registration as NEVs, and hence to acquire local subsidies in practice, though its official document mentions subsidies for PHEVs*

## Shanghai: local new energy PV subsidies (2016-17)

| Subsidies (CNY/vehicle) | Pure electric driving range, R (Km) | | |
|---|---|---|---|
| | 100 ≤ R < 150 | R ≥ 150 | R ≥ 250 |
| Pure EV | 10,000 | 30,000 | / |
| Plug-in hybrid electric vehicle | / | / | 10,000 |

*Source: Shanghai Municipal Government*
*Note: PHEV vehicles that meet the following requirements: 1) engine of less than 1.6L, 2) fuel consumption of less than 5.9L/100km under hybrid working conditions, and 3) fuel tank capacity of less than 40L can receive a further CNY14,000 per vehicle*

## Shanghai: local new energy passenger bus subsidies (2016-17)

| Subsidy (10k CNY/vehicle) | Ekg, Wh/km·kg | Standard bus (10m<vehicle length<12m) * Pure electric driving range, R (Km) | | |
|---|---|---|---|---|
| | | 150 ≤ R <250 | R ≥ 250 | R ≥ 50 |
| Pure EV Bus | Ekg <0.25 | 21 | 25 | / |
| | 0.25≤Ekg<0.35 | 19 | 23 | / |
| | 0.35≤Ekg<0.5 | 17 | 21 | / |
| | 0.5≤Ekg<0.6 | 15 | 18 | / |
| | 0.6≤Ekg<0.7 | 12 | 15 | / |
| Plug-in hybrid EV Bus | | / | / | 5 |

*Source: Shanghai Municipal Government*
*Note: The unit of Ekg is Wh/km·kg, which is used to quantify the energy consumed for a certain driving distance and weight*
*Note2: * For passenger buses with lengths of less than 6 metres, 6-8 metres, 8-10 metres and 12 metres above, the subsidy will be 0.2x, 0.5x, 0.8x, 1.2x respectively the subsidy of a standard vehicle*

## Shanghai: new mechanism for cutting subsidy for certain models (2016-17)

| Approved subsidy amount | Passenger Vehicle | Commercial Vehicle | Special Purpose Vehicle |
|---|---|---|---|
| Subsidy Amount × 1 | S≤ 40,000 | S≤ 1,000 | TS≤ 3,000 |
| Subsidy Amount × 0.5 | 40,000<S≤ 60,000 | 1,000<S≤ 2,000 | 3,000<TS≤ 5,000 |
| 0 | S>60,000 | S>2,000 | TS>5,000 |

*Source: Shanghai Municipal Government*
*Note: 'S' represents the total EV sales amount in the corresponding sector in Shanghai since 1 January 2014; 'TS' represents the total EV sales amount in the corresponding sector in Shanghai since 1 January 2016*

## Hangzhou: local new energy PV and passenger bus subsidies (2016)

| | Subsidies (CNY/vehicle) |
|---|---|
| Pure EV | 30,000 |
| Plug-in hybrid electric vehicle | 20,000 |
| Pure EV Bus | Same as central subsidies |

*Source: Hangzhou Municipal Government*

### China: price comparison of selected NEV and comparable ICE models

| Company | Model | Type | Car Length (m) | MSRP (Before subsidy, CNY '000) | Price (After subsidy, CNY '000) | Comparable ICE Model | MSRP range (CNY'000) |
|---|---|---|---|---|---|---|---|
| BYD | Qin | PHEV | 4.7 | 210-220 | 150-185 | BYD F3, Geely Vision | 73-100 |
| | Tang | PHEV | 4.8 (SUV) | 251-280 | 191-245 | GWM Haval H6 | 93-168 |
| SAIC Motor | Roewe e550 | PHEV | 4.7 | 240 | 180-196 | Roewe 550 | 105-150 |
| | Roewe e950 | PHEV | 5.0 | 290-310 | 230-300 | Roewe 950 | 185-295 |
| GAC Motor | GA5 PHEV | PHEV | 4.8 | 200-220 | 140-185 | GAC GA5 | 105-145 |
| BYD | e6 | EV | 4.6 (MPV) | 310-370 | 210-260 | Chery Arrizo M7, BYD M6 | 85-155 |
| | Qin | EV | 4.7 | 260-310 | 150-200 | BYD F3, Geely Vision | 73-100 |
| | e5 | EV | 4.7 | 230-250 | 120-140 | BYD F3, Geely Vision | 73-100 |
| | Denza | EV | 4.6 | 370-400 | 260-290 | Toyota Carolla, Honda Civic | 125-180 |
| BAIC Motor | ES 210 | EV | 4.8 | 350 | 240 | Geely Emgrand GL | 85-120 |
| | EU 260 | EV | 4.6 | 240 | 130 | BYD F3, Geely Vision | 73-100 |
| | EV 200 | EV | 4.1 | 210-247 | 120-157 | Senova D20 | 55-85 |
| | EV 160 | EV | 4.0 | 180-190 | 90-100 | Senova D20 | 55-85 |
| Dongfeng Nissan | Venucia E30 | EV | 4.5 | 243-257 | 158-172 | Nissan Tiida, Honda Fit | 80-115 |
| Geely | Emgrand EV | EV | 4.6 | 230-250 | 120-140 | Geely Emgrand | 75-100 |
| Changan | Eado | EV | 4.6 | 235-250 | 145-160 | Geely Emgrand | 75-100 |
| JAC | iEV6S | EV | 4.2 (SUV) | 220 | 110 | GWM Haval H1 | 60-85 |
| | iEV5 | EV | 4.3 | 180 | 90 | Geely Kingkong | 50-70 |
| | iEV4 | EV | 4.2 | 153-155 | 63-65 | Geely Panda | 40-52 |
| Zotye | Yun 110 | EV | 3.6 | 159-170 | 49-60 | Geely Panda | 40-52 |
| Chery | eQ | EV | 3.6 | 160-165 | 70-75 | Geely Panda | 40-52 |
| SAIC Motor | E50 | EV | 3.6 | 190 | 100 | Geely Panda | 40-52 |
| Zhidou | D2 | EV | 2.8 | 159-189 | 69-99 | Geely Panda | 40-52 |

*Source: Companies, Autohome*
*Note: Subsidies partly subject to various local policies; MSRP = manufacturer's suggested retail price*

### China: NEV strategic plans of major China auto OEMs

| Company | Plans |
|---|---|
| Geely | NEV sales targeted to reach 90% of total sales by 2020, 65% of which will be PHEV and Hybrid EV while the remainder will be pure EV. |
| GWM | According to autohome market news GMW's first EV sedan, C30EV, is targeted to be launched in 2016. The company also aims to launch its first hybrid SUV model in 2017. |
| GAC | Over the next 5 years, GAC will invest CNY2bn to develop NEVs and launch 5 new NEV models, including a sedan and SUV. |
| Changan | Changan has invested CNY1bn to develop NEVs since 2001 and plans to invest CNY18bn more in the coming 10 years. The company aims to bring 34 new NEV products to the market for the coming decade and targets cumulative NEV sales of 100,000 units and 2,000,000 units by 2020 and 2025, respectively. It expects NEVs to account for 10% of its total sales by 2025. |
| SAIC | The company plans to invest CNY20bn to develop EV products and aims to launch 30 NEV products, comprising 13 pure EV models and 17 Hybrid EV models. It is targeting for its NEV sales on a cumulative basis to reach 600,000 units in 2020, of which 200,000 will be under its self-owned brand. |

*Source: cnstock.com*

## New direction: customer-driven subsidies

Most subsidy schemes in developed nations effectively subsidise end-customers, whereas China's focus to date has been on subsidising OEMs. China's subsidies, including tax waivers and low land costs, help to reduce the start-up costs of OEMs. But China's approach has incentivised some unqualified OEMs to cheat the subsidy system. Moreover, under the current system, companies are inclined to design NEVs expressly to meet the eligibility requirements for subsidies and have little incentive to invest further in R&D.

With NEV technology maturing rapidly and the domestic market home to dozens of NEV OEMs, we believe now is the time for China to shift focus and start subsiding end-customers rather than the OEMs. By doing so, it could reduce the incentive for OEMs to file fraudulent subsidy claims as well as raise the start-up costs for OEMs, which would likely reduce the possibility of excess competition in the long term.

**China so far has been pushing subsidies for OEMs to boost the pace of R&D**

Other countries, particularly those in which (NEV) penetration is high, such as Norway (23% market share for NEVs) and the Netherlands (10%), mostly provide tax incentives or exemptions to encourage customers to buy. Since countries such as the US, UK, Japan, Norway and the Netherlands have mature technology and established infrastructure, we think it makes sense for them to focus on incentivising consumers rather than manufacturers.

In China, the government's priority to date has to been to stimulate R&D on NEVs by OEMs, with the goal of bringing the country up the technology curve. This approach has also meant that the domestic car makers have benefited and the international players have not. Now that the NEV technology used by domestic OEMs is more mature, we expect the government to change tack and consider introducing customer-friendly measures such as tax benefits and lower charging costs.

## Comparison: key EV subsidy policies in major countries (2015)

| Countries | Key subsidies - central government | Key subsidies - local government |
|---|---|---|
| US | BEVs and PHEVs are eligible for a federal income tax credit of up to USD7,500, based on the capacity of the battery used to power the vehicle | California: Up to USD2,500 rebate for BEVs, USD1,500 for PHEVs, and USD900 for electric motorcycles and neighbourhood electric vehicles<br>Illinois: Rebate on 80% of the cost premium of buying an EV or converting a car to an EV, up to USD4,000 |
| France | Vehicles emitting less than 20 g/km of CO2 (mainly BEVs) receive a one-time bonus of EUR7,000 (about USD7,800). For vehicles with emissions of between 21 and 50 g/km (mainly PHEVs), the bonus is EUR5,000. (about USD5,600). | n.a |
| UK | BEVs or PHEVs can receive a one-time bonus of 35% of the value of the vehicle, up to a maximum of GBP4,500 (about USD5,500 ), based on CO2 emissions and zero emission range. | n.a |
| Netherlands | Cars emitting zero CO2 at the exhaust pipe are exempt from registration tax. Most PHEVs pay EUR6 per g CO2/km, while diesel-engine vehicles emitting more than 70g CO2/km pay EUR86 per g CO2/km | n.a |
| Norway | EVs are exempt from purchase taxes (about NOK100 000 or USD12 000). BEVs are also exempt from VAT (set to 25% of the vehicle's price before tax). | n.a |
| Japan | Provides a bonus based on two-third of the price difference between the EV and a comparable gasoline car, which is capped at JPY850,000 (about USD8,200). | n.a |
| China | BEVs/PHEVs are eligible for a one-time subsidy based on battery range, which is up to CNY55,000/30,000 (about USD8,200/4,500) | Beijing: BEV/PHEV up to CNY55,000/35,000 (about USD8,200/5,200)<br>Shanghai: BEV/PHEV up to CNY30,000/24,000 (about USD4,500/3,600)<br>Shenzhen: BEV/PHEV up to CNY60,000/30,000 (about USD9,000/4,500) |

*Source: IEA, ICCT, UK government, Pluginamerica*

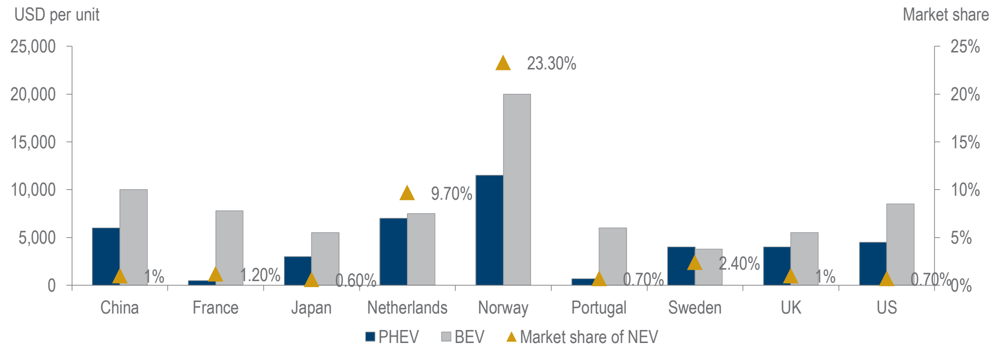
## Comparison: policy mechanisms to encourage adoption of EVs (2015)

| | EV purchase incentives | | | | EV use and circulation incentives | | | | Waivers on access restrictions | | | Tailpiple emissions standards | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Countries | Restrictions at restriction/ sale | Sales tax exemptions (excl. VAT) | VAT exemptions | Tax credits | Circulation tax exemptions | Waivers on fees (e.g. tolls, parking, ferries) | Electricity supply reductions/ exemptions | Tax credits (company cars) | Access to bus lanes | Access to HOV lanes | Access to restricted traffic zones* | Fuel economy standards /regulations including elements | Road vehicles exhaust pipe pollutant emissions standards |
| Canada | | | | | | | | | | | | | |
| China | | | | | | | | | | | | | China 5 |
| Denmark | | | | | | | | | | | | | Euro 6 |
| France | | | | | | | | | | | | | Euro 6 |
| Germany | | | | | | | | | | | | | Euro 6 |
| India | | | | | | | | | | | | | Bharat 3 |
| Italy | | | | | | | | | | | | | Euro 6 |
| Japan | | | | | | | | | | | | | JPN 2009 |
| Netherlands | | | | | | | | | | | | | Euro 6 |
| Norway | | | | | | | | | | | | | Euro 6 |
| Portugal | | | | | | | | | | | | | Euro 6 |
| South Korea | | | | | | | | | | | | | Kor 3 |
| Spain | | | | | | | | | | | | | Euro 6 |
| Sweden | | | | | | | | | | | | | Euro 6 |
| UK | | | | | | | | | | | | | Euro 6 |
| US | | | | | | | | | | | | | Tier 2 |

Legend:
No policy
Targeted policy**
Widespread policy***
Nationwide policy
General fuel economy standard indirectly favouring EV deployment

*Source: IEA*
*Note: * Such as environmental/low emission zones **Policy implemented in certain geographical areas (eg, specific states/regions/municipalities) affecting less than 50% of the country's inhabitants ***Policy implemented in certain geographical areas (eg, specific states/regions/municipalities) affecting more than 50% of the country's inhabitants*
*Note 2: © OECD/IEA, 2016 Global EV Outlook, IEA Publishing. Licence: http://www.iea.org/t&c*

## Comparison: purchase incentives for BEVs and PHEVs (2015)




*Source: IEA*
*Note: estimates for the Netherlands are calculated as the difference between the tax incurred by a BEV and a PHEV emitting 50g CO2/km and the average of the tax paid by a gasoline- or diesel-engine car emitting 130g CO2/km. Incentives in Norway are based on an average electric car cost (before VAT) of USD30,000*
*Note 2: © OECD/IEA, 2016 Global EV Outlook, IEA Publishing. Licence: http://www.iea.org/t&c*

# ADAS: still too early

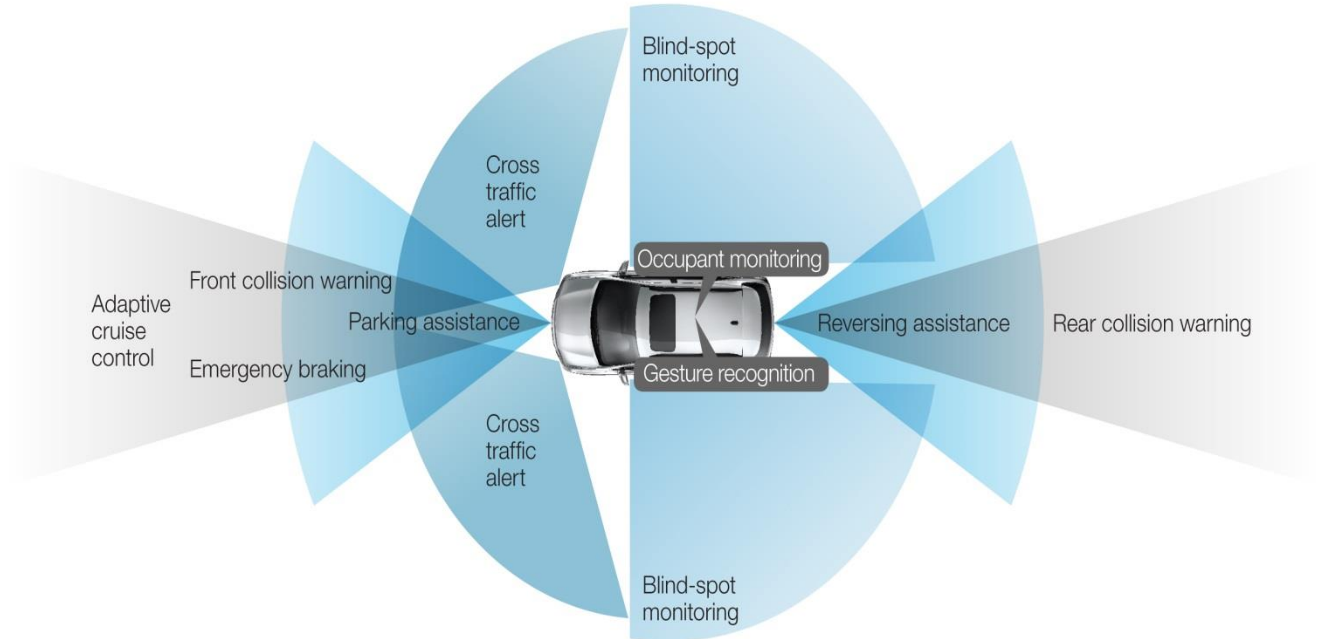
## Another step towards fully autonomous cars

**ADAS are seen as a way to differentiate NEV models**

In order to differentiate themselves, many OEMs have sought to deploy ADAS features in their vehicles recent years. Broadly speaking, ADAS are designed to enhance safety by automating some of a vehicle's functionality. Essentially there are 2 types of ADAS: 1) safety features that are designed to avoid collisions or accidents by sending alerts to the driver about potential problems or by taking over control of the vehicle, and 2) adaptive features that may automate lighting, provide adaptive cruise control, automate braking, incorporate GPS or traffic warnings, connect to smartphones, alert the driver to other cars or dangers, keep the driver in the correct lane, or show what is in a driver's blind spot.

There are many different forms of ADAS available — some are installed as part of a vehicle's fundamental designs, others are available as add-on packages, and still others can be bought as after-market solutions. The underlying technology takes many forms, including vision/camera systems, sensor technology, and car data networks. Next-generation ADAS will increasingly leverage wireless network connectivity using car-to-car and car-to-infrastructure data.

**ADAS-related technology**




*Source: Leddar Tech*

### Six levels of autonomous driving set by SAE International

SAE International, an automotive standardisation organisation, has classified 6 levels of autonomous driving (ranging from driver assistance to fully automated systems) based on the amount of driver intervention required. Autonomous driving will come with varying degrees of system automation and will require human intervention before ultimately giving way to fully autonomous driving.

**Autonomous driving: six levels as set by SAE International**

| Level | | Description | Execution of steering and acceleration | Monitoring of driving environment | Fallback performance of dynamic driving task | System capability (driving modes) |
|---|---|---|---|---|---|---|
| **Human driver monitors driving environment** | | | | | | |
| 0 | No automation | Automated system has no vehicle control, but may issue warnings. | Human driver | Human driver | Human driver | Not available |
| 1 | Driver assistance | Driver must be ready to take control at any time. Automated system may include features such as Adaptive Cruise Control (ACC), Parking Assistance with automated steering, and Lane Keeping Assistance (LKA) Type II in any combination. | Human driver | Human driver | Human driver | Some driving modes |
| 2 | Partial automation | The driver is obliged to detect objects and events and respond if the automated system fails to respond properly. The automated system executes accelerating, braking, and steering. The automated system can deactivate immediately upon takeover by the driver. | System | Human driver | Human driver | Some driving modes |
| **Automated driving system monitors driving environment** | | | | | | |
| 3 | Conditional automation | Within known, limited environments (such as freeways), the driver can safely turn their attention away from driving tasks. | System | System | Human driver | Some driving modes |
| 4 | High automation | The automated system can control the vehicle in all but a few environments such as severe weather. The driver must enable the automated system only when it is safe to do so. When enabled, driver attention is not required. | System | System | System | Some driving modes |
| 5 | Full automation | Other than setting the destination and starting the system, no human intervention is required. The automatic system can drive to any location where it is legal to drive. | System | System | System | All driving modes |

*Source: SAE International, Daiwa*

## Regulations and legislation to play a key role

The technology associated with autonomous driving has made significant progress in recent years, and some observers believe it will be sufficiently mature to support partly autonomous driving by 2025, if not earlier. But the regulatory framework has not kept up with these developments, and we think that without a property framework in place autonomous vehicles are unlikely to win the trust of consumers.

**Who bears the responsibility in the event of an accident: car owner and manufacturer?**

In our view, a framework consisting of legislation and regulations, vehicle testing and ratings, insurance, and a broader ethical and social context are needed for autonomous driving to move forward. A raft of other changes will need to be made, including to traffic regulations and the technical requirements and testing procedures for certifying vehicles. And this new framework will have to codify the answers to questions such as this: will the car owner or manufacturer be responsible if the car is involved in an accident? Progress on such changes not surprisingly varies by market.

### Related regulations and legislation in developed nations

*Europe* – Under the Vienna Convention of Road Traffic, which came into force in 1977, autonomous vehicles were formerly illegal in all 73 party countries with the exception of the US, Japan, China, and Australia. Following an amendment submitted in 2014 by the governments of Germany, Italy, France, Germany, Belgium and Austria, the Convention now allows drivers to take their hands off the steering wheels of autonomous vehicles as long as the vehicle "can be overridden or switched off by the driver".

*United States* – Unlike the majority of countries in Europe, the US has not been hindered by the Vienna Convention and has moved forward with research and testing of autonomous vehicles on public roads. Currently, 4 states — California, Florida, Michigan, and Nevada — have established regulations governing autonomous vehicle testing, and another 12 have regulations under consideration.

### Technical certification

**NCAP are designed to help drivers make informed decisions**

New Car Assessment Programmes (NCAP) are standard tests designed to facilitate evaluations of vehicles and allow drivers to make informed decisions. Euro NCAP has led the way so far in terms of testing and consumer outreach. In 2014, it began evaluating autonomous emergency braking systems, and it saw successful engagement with

European consumers as electronic stability control moved from optional to standard to mandatory status. The US, Japan, South Korea, and Australia are all considering adding new technologies to their new car evaluation programmes.

The table below shows a comparison between the US, Europe and China variants of the New Car Assessment Programme (NCAP):

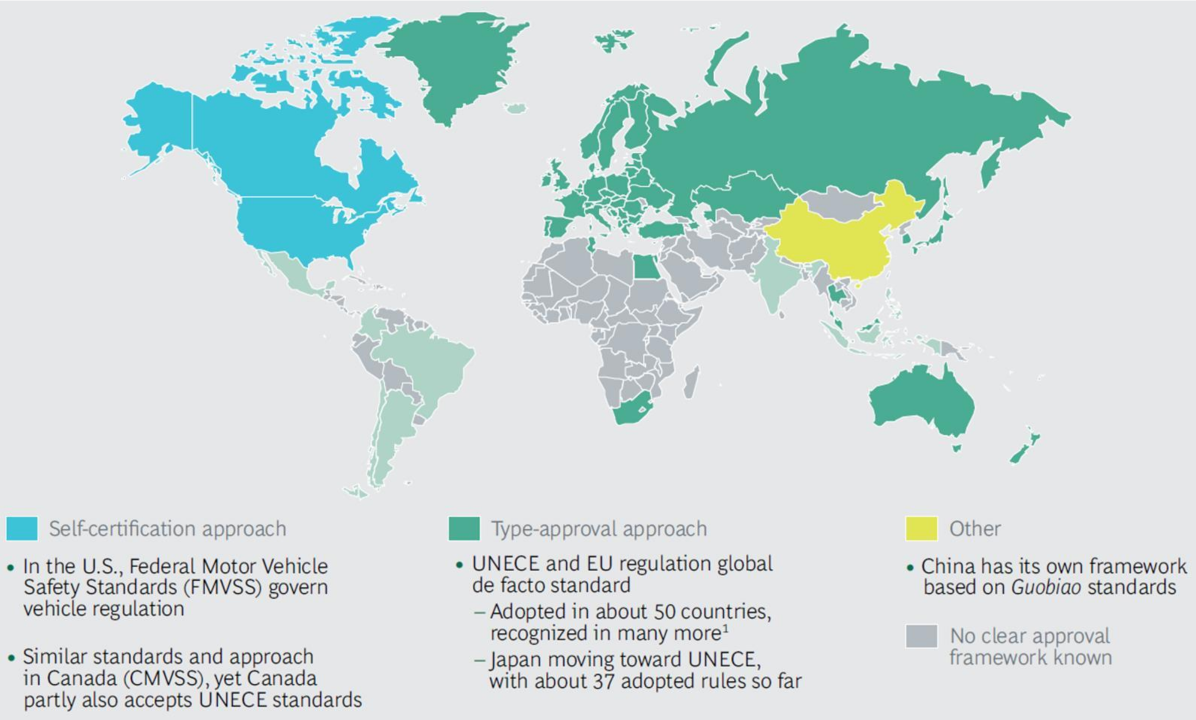
- The US and Canada have taken a self-certification approach: OEMs and suppliers operating in the US self-certify their vehicles and components, affirming that the vehicles and components comply with Federal Motor Vehicle Safety Standards (FMVSS), which are disseminated by the National Highway Traffic Safety Administration (NHTSA).
- The EU has opted for a type-approval approach: manufacturers are required to demonstrate that each vehicle model complies with minimum safety and environmental standards before it is allowed on the market.
- China has its own framework based on its Guobiao national standards.

**Overview: legislation and testing**

| | General | Registration | Testing and safeguards |
|---|---|---|---|
| US | > Individual legislation in each state facilitates fast ratification of legal amendments<br>> Vienna Convention not ratified | > Operation of automated vehicles on public highways is explicitly permitted in a few selected states (e.g. Nevada, Michigan and Virginia) | > Private test sites used by universities and industry (e.g. Michigan M City)<br>> Tests on public highways in selected states |
| Europe | > Most countries have ratified the Vienna Convention<br>> Germany, Sweden, the Netherlands and the UK are calling for swift adjustments, but all EU member states must reach agreement | > Heavy restrictions on registration. In Germany, for example, vehicles can only be registered as test vehicles<br>> Vienna Convention currently prevents the launch of highly automated functions (e.g. ECE R79 ) | > Private and public test fields<br>> Public "Digital Test Field" for infrastructure and connectivity established on the A9 freeway, additional test fields planned in Baden-Württemberg and Lower Saxony |
| China | > Few concrete measures at present, but positive legal conditions for automated driving (Vienna Convention not ratified) | > Several suggestions on how to handle registration of automated vehicles, but no concrete steps yet taken | > Mostly national research projects with corresponding funding for selected Chinese projects |
| Korea | > South Korean government has decided to ease legal restrictions relating to automated driving (e.g. by abolishing speed limits for automated vehicles) | > Concrete adjustments planned to support the launch of automated vehicles | > Concrete plans to set up public test fields |
| Japan | > Legal initiatives for automated vehicles on the political agenda, but slowed significantly of late | > Registration possible above all as test vehicles on public highways | > Private and public test fields<br>> Recent announcement that fully automated vehicles cannot be tested on public highways, limited necessary safeguards |

*Source: fka, Roland Berger*

**Regulatory framework globally**




*Source: UNECE, BCG analysis*

*Note: extracted from BCG's September 2015 report,* Revolution vs. Regulation

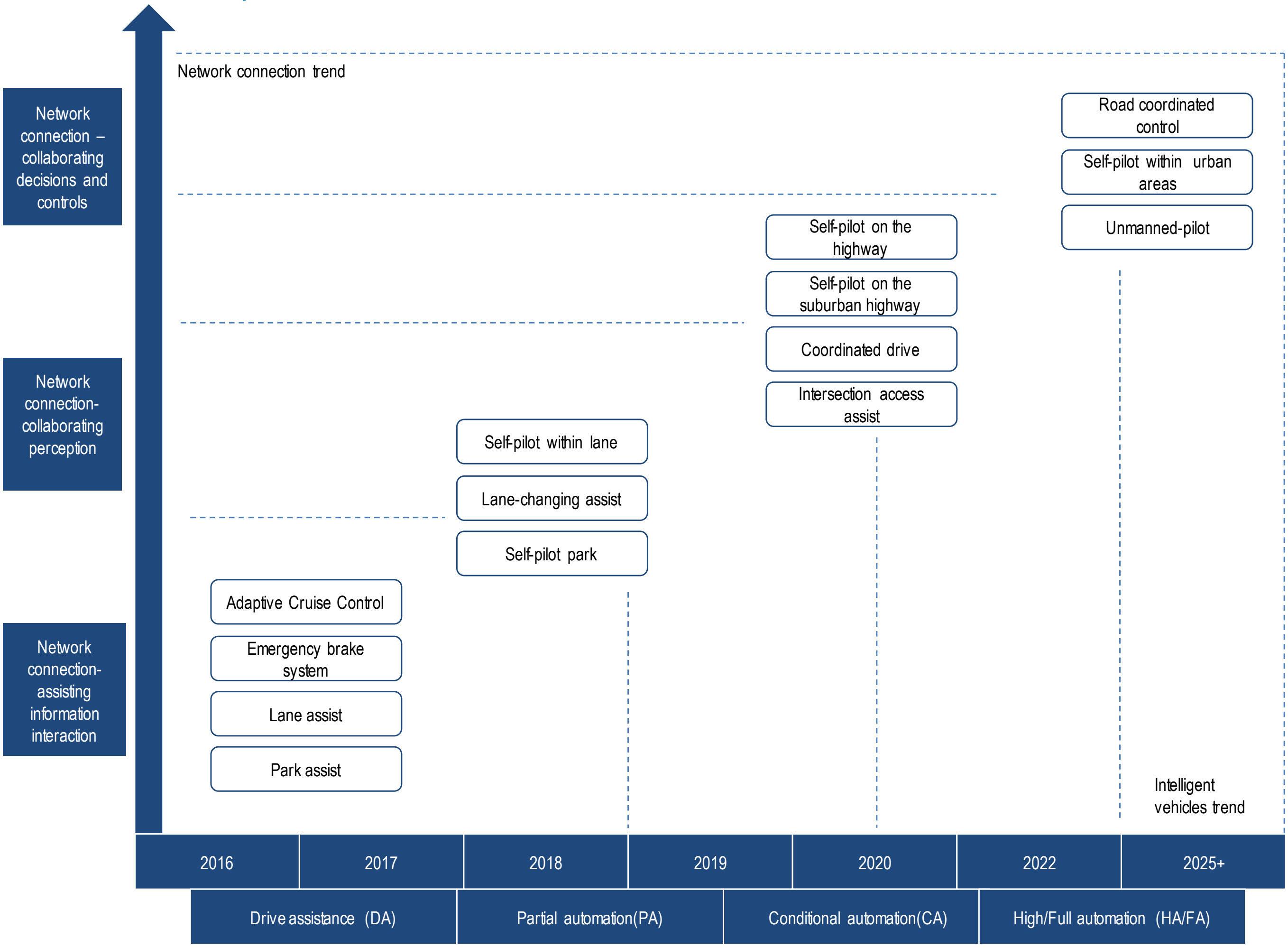
## ADAS in China

### Penetration still low …

**As it stands, most ADAS products are imported**

Being the world's largest auto market, China's auto industry volume growth has been solid YTD (up 14% YoY from Jan-Oct 2016 in terms of total vehicle sales volume), despite the slowdown in the country's economy. Although the penetration of ADAS in China is still low, related technologies are making inroads, particularly in luxury vehicles. According to the Roadmap, 50% of new cars should be equipped with ADAS level 2 partial automation or below by 2020. By 2030, the China Government targets to have 80% of new cars equipped with ADAS level 4 or below, with some models likely to reach level 5.

**China: smart car roadmap**




*Source: Society of Automotive Engineers of China, Energy-saving and New Energy Vehicle Technology Roadmap*

Currently, most ADAS products are imported to China either as systems awaiting installation in cars or already fitted in imported light vehicles. This reliance on imports reflects the fact that ADAS sales in China are not yet big enough to justify localised production. According to our projections, imported systems will continue to account for the majority of ADAS units in the China market for the next 3 years, though some system suppliers are likely to shift their production to China.

## … but rising

**We expect rapid growth in sales of ADAS products in the future**

However, we believe some ADAS products, including adaptive cruise control, blind-spot detection and self-parking systems, are set for robust growth in both shipments and penetration in China from 2016-20, given a rising awareness of driver safety among consumers and vehicle manufacturers. Conversely, we see systems like driver monitoring, high-beam control, night vision, multi-view systems and intelligent speed adaptation to face a slower-growing market from 2016-20 due to high product costs, unique patterns of driver behaviour in China, and limited consumer awareness or acceptance.

Overall, we anticipate further growth in ADAS product demand in China in view of the: 1) rising awareness among China buyers of the benefits of ADAS systems, 2) China has some of the youngest and arguably most tech savvy buyers of premium cars in the world, and 3) the domestic OEMs are increasingly turning towards ADAS solutions as a differentiating factor and market driver. ABI Research, a technology market intelligence company, forecasts growth in China’s ADAS market to gain momentum between 2017 and 2020, during which time it is forecast to expand in terms of market value by about 40% pa.

## Government support through "Made in China 2025"

"Made in China 2025," the banner name for the 10-year plan that China announced in 2015, is aimed at transforming the country and several of its business sectors into an innovation hub. Hence, the government plans to support domestic companies working on connectivity and renewable energy technologies, in the hope that they become industry leaders domestically and globally. The Ministry of Industry and Information Technology also announced the following goals regarding smart cars by 2025: 1) reducing traffic accidents by more than 30%, 2) setting safe autonomous driving speeds of 120km per hour, 3) lowering energy consumption by 10% and emissions by more than 20%.

Meanwhile, several research institutes engaged in R&D into autonomous driving technologies, including the Research Centre for Intelligent and Connected Vehicles at Tsinghua University, are supported fully or partly by the government and industry associations. Backed by such efforts, the government expects Chinese companies to control 80% of the domestic market for vehicle entertainment modules and 100% of the market for satellite navigation systems by 2030. Also, it protects the domestic market from international competition through trade and regulatory barriers (eg, Google Maps is not accessible in the country), and we believe "Made in China 2025" could further raise the barriers to entry facing international players like Google and Apple.

## China Internet companies staking their claim

**Internet companies are teaming up with traditional auto OEMs**

Some of China's Internet and telecoms companies have been partnering with the traditional auto OEMs in developing smart cars. Indeed, 2 of the country's biggest Internet companies, Baidu and Alibaba, are working to develop their own software platforms for use in smart cars.

For example, Baidu has signed up BMW, Mercedes-Benz, Ford, Hyundai, and BYD to use its CarLife connectivity platform, which allows cars' inbuilt infotainment systems to connect with smartphones. Volkswagen, the largest-selling automaker in China, has also agreed to use the software. In addition, Baidu is working on a telematics service for cars, called MyCar, to monitor car- and traffic-related data, which should help the company in its own efforts to develop an autonomous vehicle. Some other partnerships in China include:

- Dongfeng and Changan signed agreements in 2014 with telecom giant Huawei to cooperate on technology for use in autonomous driving.
- Audi has announced plans to work with Tencent to allow location sharing in vehicles.
- PSA will equip some of its cars with a Wi-Fi hotspot in collaboration with Alibaba, and offer an app to remotely check the vehicle's location and fuel levels.
- China Mobile and Deutsche Telekom have signed a deal to create a platform for Internet-connected cars in China.
- The US's Airbiquity, the global leader in connected vehicle technology, and Baidu have announced a partnership to provide connected-car Internet services to the China automotive market.

In conclusion, among the key factors driving growth of the ADAS market globally are government regulations on the installation of ADAS, rising demand for ADAS, inclusion of ADAS in new car assessment programmes, and the increasing adoption of vehicle safety technologies. However, market growth to date has been hindered by factors such as questions over the regulatory landscape, environmental factors, testing and certification hurdles, and the complexity of ADAS features.

In the context of China, we think the combination of rising customer interest, continued government support, and the innovations being led by the Internet giants give the country several advantages in building smart cars. However, going forward, challenges remain for the domestic and international players seeking to win a share of this huge market.

# Charging facilities: a critical step forward

## Addressing the bottleneck with policy support

### Central government taking the lead

**The central government rolled out specific targets for the construction of charging infrastructure in 2015**

To bolster ownership of NEVs in China, the central government started to accelerate the development of EV-charging infrastructure in October 2015, when the State Council published its guidance on NEV development. In the months thereafter, various government departments weighed in with documents of their own providing more specific directions. For example, the “EV charging infrastructure development guide (2015-2020)”, published in November 2015, set a target of installing 4.8m distributed charging poles and 12,000 charging stations to meet the charging demand of 5m NEVs (on the principle of 1 vehicle to 1 charging pole) by 2020. According to the Roadmap, the central government will aim to have in place 36,000 charging stations and 20m charging poles by 2025, rising to 48,000 charging stations and 80m charging poles by 2030, again applying the 1 vehicle to 1 charging pole ratio.

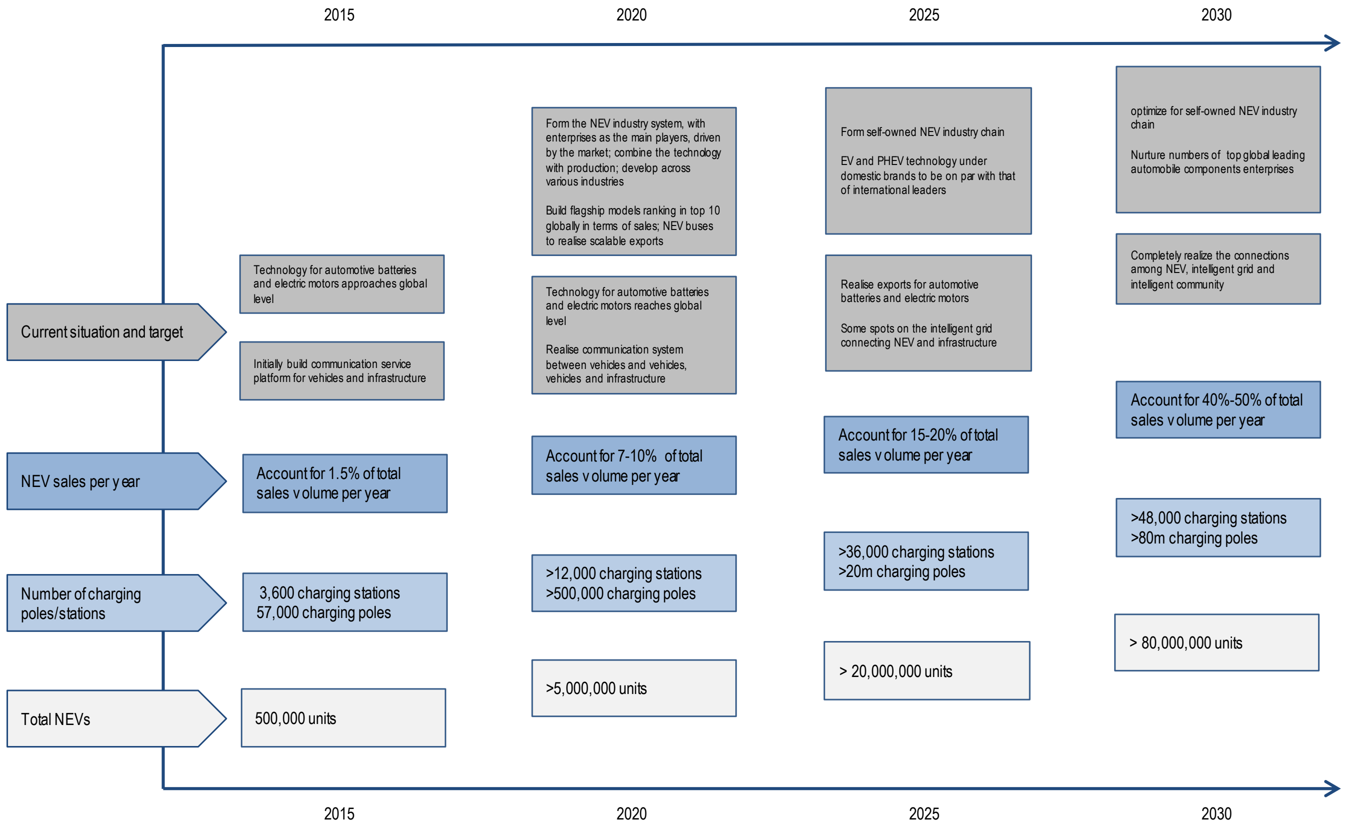
For the period 2016-20, the central government intends to step up the pace of construction of charging facilities in the more developed eastern part of the country, owing to that area’s air pollution problems, followed by the central regions and western regions. In the longer term, the government plans to link its charging stations with the expressway network, building a “4 Vertical, 4 Horizontal” inter-city fast-charging network to facilitate the interprovincial use of NEV vehicles.

**China government: key policies for stimulating the development of EV-charging infrastructure**

| Publish date | Document name | Document name (Chinese) | Publishing entity | Content summary |
|---|---|---|---|---|
| Oct-15 | Guidance for accelerating EV charging infrastructure construction | 关于加快电动汽车充电基础设施建设的指导意见 | State Council | Guidance for promoting the construction of EV-charging infrastructure |
| Nov-15 | EV charging infrastructure development guide (2015-2020) | 电动汽车充电基础设施发展指南（2015-2020 年） | Ministry of Industry and Information Technology; National Development and Reform Commission; National Energy Administration; Ministry of Housing and Urban-Rural Development | New residential complexes must be built with chargers or reserved spaces for future installations<br>At least 10% of public parking facilities should be built with chargers or spaces reserved for future installations<br>Every 2,000 EVs owned should be matched by 1 public charging station<br>To build a nationwide charging network (12,000 charging stations, 4,800,000 charging poles) for up to 5m EVs by 2020 |
| Dec-15 | Notice on strengthening the planning and construction of urban EV charging facilities | 关于加强城市电动汽车充电设施规划建设工作的通知 | Ministry of Housing and Urban-Rural Development | Promoting execution of the plan for EV-charging facility construction |
| Jan-16 | Incentive policies on NEV charging infrastructure during "13th Five-Year Plan" and Notice for promoting usage of NEV | 关于"十三五"新能源汽车充电基础设施奖励政策及加强新能源汽车推广应用的通知 | Ministry of Finance; Ministry of Science and Technology; Ministry of Industry and Information Technology; National Development and Reform Commission; National Energy Administration | Provide fiscal grants to local governments to be used for constructing charging stations and related facilities during 2016-2020 in areas where NEV sales volume reaches the threshold |
| Mar-16 | Energy work guidance for 2016 | 2016 年能源工作指导意见 | National Energy Administration | Plans to invest CNY30bn, build 2,000+charging stations, 100,000 public charging poles and 860,000 private charging poles in 2016 |

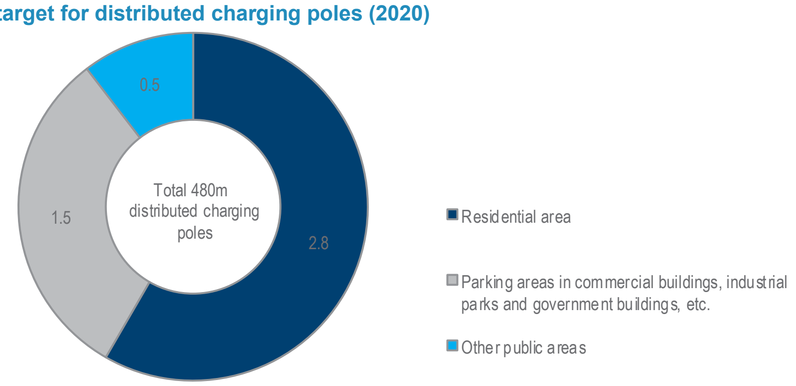
*Source: Various China government documents*

## China: EV development roadmap



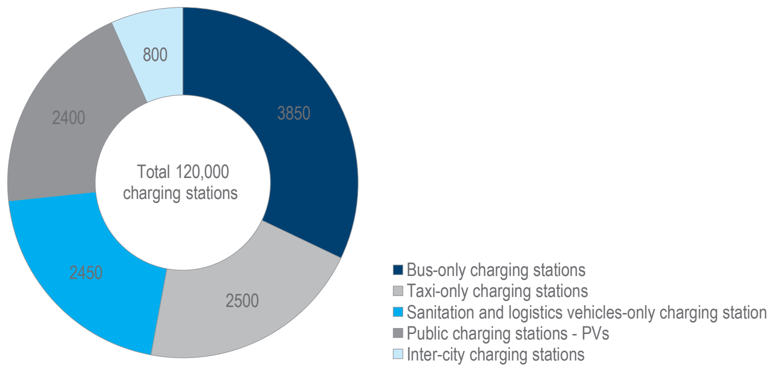

*Source: Society of Automotive Engineers of China, Energy-saving and New Energy Vehicle Technology Roadmap*
*Note: Charging pole inventory given for 2015 (57,000 units) may only take into account public charging poles, in our view*

## China: construction target for distributed charging poles (2020)



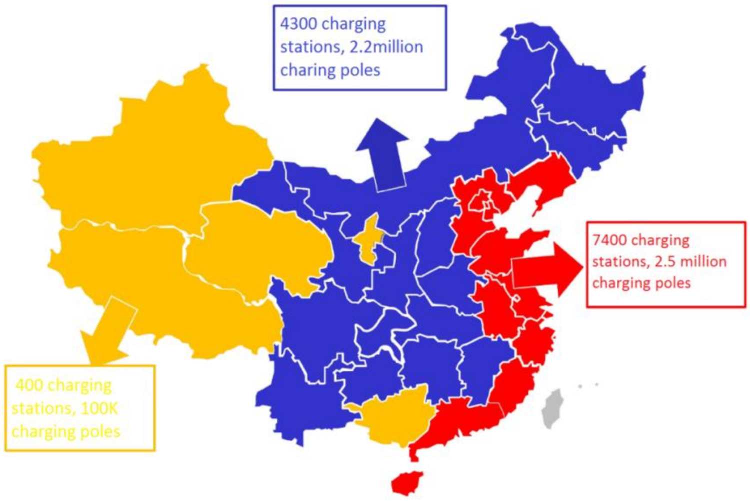

*Source: NDRC, Daiwa*

## China: construction target for charging stations by vehicle usage (2020)




*Source: NDRC, Daiwa*

**China: construction target for charging facilities by region (2020)**




*Source: NDRC, Daiwa*

**China: plan for national inter-city fast-charging network**

*Source: NDRC*

*Note: red lines denote highways built before 2015 and blue lines highways planned to be built from 2016-2020*

**Fiscal grant provided by the central government can be used to construct charging facilities at the provincial level**

On 21 January 2016, the central government announced an incentive scheme for provinces to support the construction and operation of charging facilities. The scheme depends on NEV sales volumes in each province, with the proviso that the funds cannot go towards NEV car manufacturing or purchase subsidies. The incentives should normally account for 15-40% of the capex for a charging facility. Besides, China State Grid will provide a subsidy of around CNY0.1/kWh. Also, around 17 provinces have agreed on a standardised service charge for charging of around CNY0.4-1.6/kWh, which helps to avoid limit competition among charging-station operators, which should have an incentive to build and operate more charging facilities, which in turn should boost customer demand for EVs.

According to our discussions with the listed charging facilities companies, subsidies for charging facilities will likely shift increasingly shift to the end-consumer, mirroring the trend that we expect to play out in subsidies to the NEV OEMs. However, the companies believe that subsidies for the initial construction of charging facilities by local governments might be maintained, in order to encourage construction over the coming 5 years.

**China: incentive standards for local provinces on NEV charging infrastructure (2016-2020)**

| Year | Air pollution control key regions/provinces /cities* Threshold (The number of NEV sales required to reach) - Units | Grant when reaching the threshold - m CNY | Extra grant if exceeding the threshold | Provinces in central region and Fujian Province** Threshold (The number of NEV sales required to reach) - Units | Grant when reaching the threshold - m CNY | Extra grant if exceeding the threshold | Other provinces/cities Threshold (The number of NEV sales required to reach) - Units | Grant when reaching the threshold - m CNY | Extra grant if exceeding the threshold |
|---|---|---|---|---|---|---|---|---|---|
| 2016 | 30,000 | 90 | Extra grant of CNY7.5m for each additional 2,500 units, the upper limit is CNY120m | 18,000 | 54 | Extra grant of CNY4.5m for each additional 1,500 units, the upper limit is CNY120m | 10,000 | 30 | Extra grant of CNY2.4m for each additional 800 units, the upper limit is CNY120m |
| 2017 | 35,000 | 95 | Extra grant of CNY8m for each additional 3,000 units, the upper limit is CNY140m | 22,000 | 59.5 | Extra grant of CNY5.5m for each additional 2,000 units, the upper limit is CNY140m | 12,000 | 32.5 | Extra grant of CNY2.8m for each additional 1,000 units, the upper limit is CNY140m |
| 2018 | 43,000 | 104 | Extra grant of CNY9.5m for each additional 4,000 units, the upper limit is CNY160m | 28,000 | 67 | Extra grant of CNY6m for each additional 2,500 units, the upper limit is CNY160m | 15,000 | 36 | Extra grant of CNY3m for each additional 1,200 units, the upper limit is CNY160m |
| 2019 | 55,000 | 115 | Extra grant of CNY10m for each additional 5,000 units, the upper limit is CNY180m | 38,000 | 80 | Extra grant of CNY7m for each additional 3,500 units, the upper limit is CNY180m | 20,000 | 42 | Extra grant of CNY3.2m for each additional 1,500 units, the upper limit is CNY180m |
| 2020 | 70,000 | 126 | Extra grant of CNY11m for each additional 6,000 units, the upper limit is CNY200m | 50,000 | 90 | Extra grant of CNY8m for each additional 4,500 units, the upper limit is CNY200m | 30,000 | 54 | Extra grant of CNY4.5m for each additional 2,500 units, the upper limit is CNY200m |

*Source: NDRC, Incentive policies on NEV charging infrastructure during "13th Five-Year Plan" and Notice for promoting usage of NEV*
*Note:* The regions include Beijing, Shanghai, Tianjin, Hebei, Shanxi, Jiangsu, Zhejiang, Shandong, Guangdong and Hainan*
*** Provinces in central region include Anhui, Jiangxi*

**Local governments have set their own targets for constructing charging facilities**

## Local governments have followed suit in setting specific targets

In response to the central government's plans, provincial governments and city governments have set their own development targets for constructing charging infrastructure for the 2016-20 period.

Beijing and Shanghai, which are likely to be major EV markets in their own right, are respectively targeting to have 0.43m and 0.21m charging poles by 2020, accounting for 9% and 4.5% of the total number of planned charging poles in China.

Meanwhile, Hebei, Shandong and Zhejiang respectively plan to build 1,970, 920 and 800 charging stations by 2020, which will be used mainly for public EVs (buses, taxis and special vehicles [logistics vehicles, sanitation vehicles, etc.]) and EVs using expressways.

**China: major local governments' targets for EV charging infrastructure**

| | Targeted number of EVs by 2020 | Targeted number of charging poles by 2020 | Targeted number of charging stations by 2020 | Investment target for charging poles (CNYbn) | Investment target for charging stations (CNYbn) |
|---|---|---|---|---|---|
| Beijing | 600,000 | 425,000 | n.a | n.a | n.a |
| Shanghai | 263,200 | 211,200 | 131 | n.a | n.a |
| Guangdong | 200,000 | 189,700 | 343 | n.a | n.a |
| Fujian | 100,000-130,000 | 88,000-111,000 | 387-400 | 0.65-0.9 | 2.9-3.3 |
| Hunan | 178,000 | 200,000 | 415 | 5.1 | 1.1 |
| Shaanxi | 100,000 | 94,400 | 454 | 1.0 | 2.4 |
| Shanxi | 200,000 | 190,000 | 343 | 2.8 | 2.4 |
| Yunnan | 160,000 | 163,000 | 350 | n.a | n.a |
| Anhui | n.a | 180,000 | 500 | n.a | n.a |
| Hebei | n.a | 65,625 | 1,970 | n.a | n.a |
| Shandong | n.a | 350,000 | 920 | n.a | n.a |
| Zhejiang | 230,000 | 210,000 | 800 | 2.3-3 | 2-2.7 |
| Guangxi | n.a | 76,024 | 303 | 0.9 | 1.7 |
| China | 5,000,000 | 4,800,000 | 12,000 | | |

*Source: various local government documents, Daiwa compiles*

While the central government set the proviso that incentives would only be granted to local governments where NEV sales volume had reached a particular threshold, it did not provide details of the subsidy scheme regarding related parties. These details were outlined in documents published by various local governments.

**Local governments have provided detailed subsidy policies designed to boost the construction of charging facilities**

In summary, the local governments will: 1) provide subsidies for building charging stations/ poles based on the corresponding investment capital or number of charging facilities, 2) set the level of the charging service fee which can be collected by the operator, and 3) provide extra subsidies for operators (currently only offered by the Shanghai Government).

**China: subsidy polices of selected local governments**

| | Subsidy for constructing charging poles/stations | Charging service fee set by local government | Extra subsidy for operators |
|---|---|---|---|
| Beijing | Up to 30% of the total investment amount for constructing charging stations/charging poles | Up to 15% of 92 petrol price; for specific companies, CNY0.8/kWh | n.a |
| Shanghai | Up to 30% of the total investment amount for constructing charging stations/charging poles* | Up to CNY1.6/kWh | CNY0.1 and 0.2/kWh for public charging stations (including for special purpose vehicles) and other charging facilities, up to 2,000kWh and 1,000kWh per year respectively** |
| Shenzhen | Up to 30% of the total investment amount for constructing charging stations/charging poles | Up to CNY1.0./kWh | n.a |
| Guangzhou | CNY0.9m-3m per charging station; CNY120,000 per DC charging station; CNY6,000 per AC charging station | CNY0.8/kWh for public vehicles CNY/1.2/kWh for non-public vehicles | n.a |

*Source: various local government documents*
*Note: *For public charging stations (including for special purpose vehicles), up to 30% of the total investment (up to CNY600/kWh and CNY300/kWh for DC and AC charging poles); for city-level platforms, 50% of the investment amount as subsidy in 2016, up to CNY20m; 30% of investment amount for subsidy in 2017-18, up to CNY3m; For enterprise-level, 30% of investment amount as subsidy, up to CNY5m*
*** Only for public charging stations (including for special purpose vehicles)*

## Charging poles to meet varying levels of demand

Charging poles can be categorised in 2 segments depending upon the construction location: 1) public poles, which are built alongside roads or in other public areas, and 2) private poles, which are constructed in parking areas near residential buildings or office buildings.

Alternatively, charging poles can be classified by the power (kW) they produce and, in turn, by the speed at which they can charge an EV:

1) **AC charging poles** pass AC power to the EV, where it is turned into DC power via the EV's onboard charger and fills the EV's battery. Because an EV's onboard charger can absorb only a limited amount of power (normally 3-7kW, though the Tesla Model S can reach 20kW), it typically takes 4-8 hours to fully charge an EV with a 30kWh battery using the AC method. This kind of charging pole is priced at around CNY8,000-10,000 and is commonly installed at an EV owner's home or in parking areas.

2) **DC charging poles,** which look similar to AC charging poles, do not require an onboard charger to convert an AC current to a DC current for charging, though they may need other special designs for an EV (while all EVs can be charged by AC, a few can be charged by DC, depending on whether a DC charging equipment system has been installed in the EV). A typical EV can be fully charged in 0.5-2 hours using DC charging poles (30kW-120kW), which is far more efficient than using AC charging poles. DC charging poles are usually installed in charging stations and have a cost per unit of around CNY100,000-150,000, making them much more expensive than AC poles.

Charging stations, which typically feature 2-6 DC charging poles, are similar to petrol stations and are designed to meet the charging demand of electric public buses, electric taxis, electric special purpose vehicles and EVs using highways. The capex per charging stations is around CNY2-5m, depending on the number of charging poles installed. As well as the money required to purchase the charging poles, other hardware costs (such as transformer, conduit and wire) and instalment costs also account for some of the capex.

**China: estimated cost of EV-charging infrastructure by local governments**

| CNY | AC charging pole | DC charging pole | Charging station |
|---|---|---|---|
| Zhejiang | 8,000 | 100,000 | 2.5m-5m |
| Fujian | 8,000-10,000 | 150,000 | 2m-3m |

*Source: Zhejiang NDRC, Fujian NDRC*

China: EV charging station


Source: State Grid

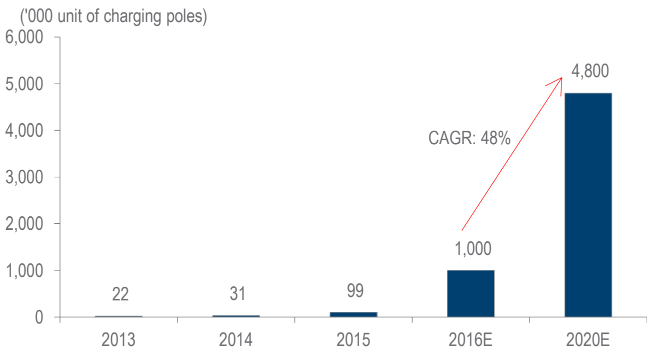
China: EV charging pole

Source: State Grid

## A large market in the making

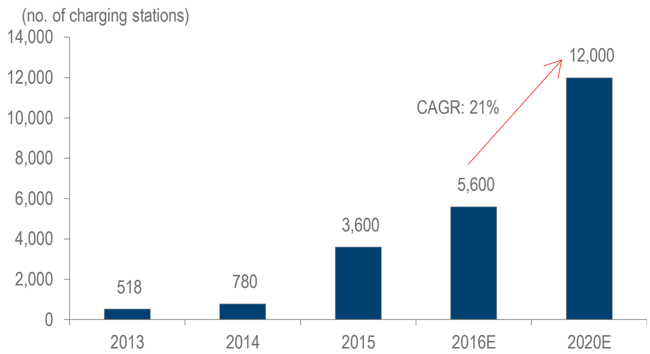
According to *People News*, around 136,000 charging poles (81,800 public charging poles and 55,400 private charging poles) had been installed as at end-1H16, up sharply from 99,000 charging poles (49,000 public charging poles and 50,000 private charging poles) just 6 months earlier. The government is targeting to have 4,800,000 charging poles (500,000 public charging poles and 4,300,000 private charging poles) in place by 2020, which represents a CAGR of 45% during 2016-20.

China: target for charging pole installation and CAGR




Source: Titans, NDRC, CAAM, People News, National Energy Administration

China: target for charging station installation and CAGR




Source: Titans, NDRC, CAAM, People News, National Energy Administration

We believe the target is attainable given the following factors:

**We believe the target for reaching 4.8m charging poles is achievable**

1) the number of NEVs on the roads is targeted to reach 5m by 2020, with a 1:1 ratio of charging poles to NEV vehicles (the ratio was 1:6 at end-2015). This looks reasonable given that the target calls for nearly 90% of charging poles to be privately owned and installed in the car parks of residential or office buildings. In 2015, residential housing in China had a total area of 738m sq m. Assuming an average area per unit of 80 sq m, a 1:1 ratio of parking spaces and housing units, and 10% of newly built parking spaces feature charging poles, the number of charge poles installed annually would be around 0.9m.

2) As the target has been set by the central government, the onus is on local governments to respond, which we believe they are doing. In our view, local governments have sufficient incentives to do so, especially in terms of constructing public charging stations (bus-only/taxi-only/special vehicle-only) through various platforms such as city construction groups or public bus companies.

3) Operating charging facilities is not yet profitable due to the low utilisation rate of charging poles. However, non-SOE operators such as TELD, DZ and Starcharge, backed by capital injections and aggressive strategies, are finding new sources of earnings in box

advertising or EV rentals. They are also developing their own mobile applications to help drivers find charging poles on the map, which we believe will be valuable in their own right once the number of users reaches a critical mass. Hence, we believe that private operators will be an important driver of the market's overall expansion.

**We estimate the market for building charging facilities could reach CNY70bn by 2020**

Assuming the current cost per charging pole of around CNY8,000 declines to around CNY3,000 by 2020, while the facilities expense (excluding the cost of land acquisition) per charging station of approximately CNY3.0m drops to around CNY2.0m by 2020, the total required investment in charging facilities would range from CNY6-11bn pa over 2016-20.

**China: EV charging facilities market estimation**

| Inventory amount - unit | 2014 | 2015 | 2016E | 2017E | 2018E | 2019E | 2020E | 2020 Target |
|---|---|---|---|---|---|---|---|---|
| Charging stations | 780 | 3,600 | 5,600 | 7,600 | 9,400 | 10,930 | 12,000 | 12,000 |
| Charging poles | 31,000 | 99,000 | 1,000,000 | 1,955,060 | 2,910,120 | 3,865,180 | 4,800,000 | 4,800,000 |
| Incremental amount - unit | | | | | | | | |
| Charging stations | | 2,820 | 2,000 | 2,000 | 1,800 | 1,530 | 1,070 | |
| Charging poles | | 68,000 | 901,000 | 955,060 | 955,060 | 955,060 | 934,820 | |
| Incremental amount YoY growth | | | | | | | | |
| Charging stations | | | -29% | 0% | -10% | -15% | -30% | |
| Charging poles | | | 910% | 6% | 0% | 0% | -2% | |

*Source: Titans, NDRC, CAAM, People New, Daiwa estimation*
*Note: charging poles in our model are the ones installed independently from the ones built in charging stations*

## Non-SOE companies emerging among operators

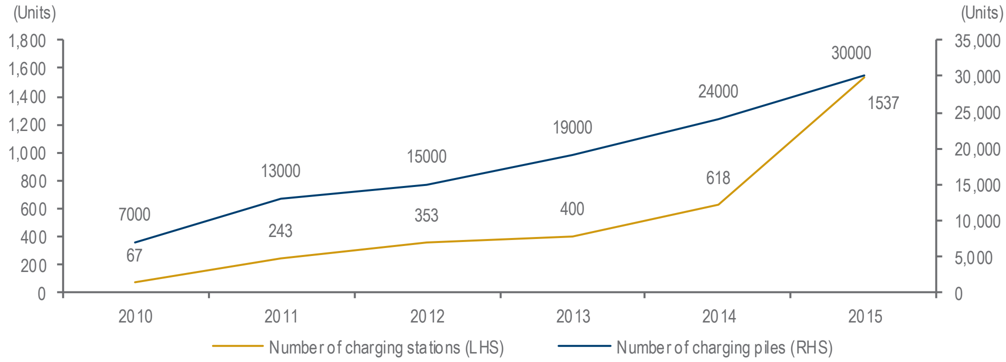
### China State Grid likely to see its role diminish after 2018

**China State Grid is the dominant player in building charging facilities in China**

As only China State Grid and China Southern Power operate the electric transmission network in China, they can easily connect their charging stations/poles to the electric power grid (some charging stations require high-voltage current, in which case the operators need to act in concert with the installers and electric power grid operators). Moreover, as a giant SOE, China State Grid can draw on many resources for renting or purchasing land from governments to build charging facilities.

Relying on the monopoly electric power transmission network in most regions of China (except for the provinces of Guangdong, Guangxi, Yunnan, Guizhou and Hainan, which are under the control of China Southern Power Grid), China State Grid is currently the dominant player in constructing and operating charging stations. As at end-2015, 43% of charging stations were built and operated by China State Grid.

**China State Grid: cumulative number of charging facilities built (2010-15)**




*Source: China State Grid, various media reports*

**China: total number of EV charging poles (end-2015)**

| | Total | China State Grid | China Southern Power Grid | Potevio New Energy |
|---|---|---|---|---|
| Charing stations in China | 3,600 | 1,537 | 19 | 691 |
| Charging poles in China | 99,000 | 29,600 | 3,200 | 9,674 |
| Percentage of total - charging stations | | 43% | 1% | 19% |
| Percentage of total - charging poles | | 30% | 3% | 10% |

*Source: NBD, cnstock, China Southern Power Grid*

**China State Grid has been focusing on the construction of charging stations through its local branches**

China State Grid has rapidly expanded its charging station network in many cities through its local branches, and it has also focused on building inter-city charging stations next to highways. According to the "The service guide of State Grid highway charging network (2016)", published in February 2016, the company has built 186 inter-city charging stations along 8 major expressways by collaborating with local expressway companies and transportation departments. By 2020, China State Grid expects to build an inter-city charging station network spanning 36,000km and linking 202 cities.

**It is likely to remain the major player in the near term but may gradually exit, creating space for more non-SOE operators in the long run**

In 2016, China State Grid is expected to invest some CNY5bn in constructing charging stations and charging poles, according to NBD news. However, the 2 tenders for purchasing charging equipment during the tender period of January-October 2016 were only worth around CNY1.3-1.4bn in total on our estimates. Thus, we think a third tender to be announced before end-2016 will be much larger than the previous 2, in order for China State Grid to meet its investment target for 2016.

Over the next 1-2 years, we believe China State Grid will remain the major player in constructing public charging facilities, given its broad domestic electric transmission network, sufficient capital base for investing, and SOE background. However, for the period after 2018, we expect China State Grid to exit the market gradually as improved operating profits, reduced costs and incremental improvements in the utilisation of charging facilities attract more non-SOE operators.

On the other hand, China Southern Power Grid does not intend to play a dominant role in the 5 southern provinces; instead, investment is likely to rely more on private capital. According to the 13$^{th}$ Five-Year Plan, China Southern Power Grid expects to invest only CNY3bn in constructing charging infrastructure, which is well below the equivalent figure for China State Grid, reflecting the former's much smaller scale.

**13th Five-Year-Plan on investment in charging facilities**

| Company | China Southern Power Grid | China State Grid |
|---|---|---|
| Investment | CNY3bn | n.a |
| Number of centralised charging stations built | 674 | 10,000 |
| Number of decentralised charging poles built | 25,000 | 120,000 |

*Source: China Southern Power Grid, Caixin*

## SOE operators Potevio, Sinopec, China Tower focusing on public transportation

**Potevio's charging stations have grown rapidly in number since 2011, mainly in cities such as Beijing and Shenzhen**

Potevio, an SOE engaged mainly in manufacturing, trading, and researching information, communications and telecoms products, began building and operating EV-charging facilities in 2011 through a new subsidiary, Potevio New Energy. By end-2015, Potevio New Energy had invested CNY4.5bn in the charging facilities business and ranked No.2 behind China State Grid in terms of the number of charging stations under its management (619 units). Most of these facilities are provided for electric bus charging.

**Potevio New Energy: charging facilities operation business in key cities**

| City | Description |
|---|---|
| Beijing | Build 2,000 charging poles in 2015-16; build 10,000 charging poles in 2016-18 |
| Shenzhen | Invest CNY2bn to construct 139 charging poles and thousands of charging poles by now; Poised as the largest operator in Shenzhen |

*Source: Sohu*

Potevio New Energy: Lineng charging station in Shenzhen


Source: Potevio

**China Tower and Sinopec will seek to leverage their distinct advantages to break into this market**

China Tower, a joint venture formed by China's 3 state-owned telecom companies to handle the construction, maintenance and operation of telecom network towers, is also involved in the construction and operation of charging facilities. Since each telecom tower has an electric power storage device, it can also be used to charge EVs. According to a report in *China Stock*, China Tower has started building charging facilities in Beijing, Shanghai, Shenzhen and Jiangsu, and as of February 2016 the venture had 21 charging spots with charging facilities installed.

The acquisition of land is another critical factor in constructing a charging station, especially in mega cities such as Beijing, Shanghai and Shenzhen. Leveraging its ownership of around 30,000 petrol stations in China, Sinopec (386 HK, not rated) started to construct new charging stations and restructure its existing petrol stations. In July 2015, Sinopec entered into a strategic cooperation agreement with BAIC New Energy with the goal of targeting the expanding Beijing market.

**Local governments are keen to invest in charging facilities, especially those used for public transportation**

Aside from the national players mentioned above, local SOEs, including local construction companies, have built charging facilities in new residential and commercial buildings at the behest of local governments keen to encourage local NEV-related businesses and win political points.

Moreover, since roughly half of the new charging stations planned for the period 2016-20 are to be used for electric public buses and electric taxis, local operators such as taxi companies or public bus companies have an incentive to build their own charging stations once they purchase EVs.

In our view, the SOE operators will likely focus more on charging facilities for public transportation such as electric buses and taxis, which should be the near-term growth driver of charging facility construction given the central and local government's policy directives aimed at spurring the EV component of public transportation. In the longer term, however, we expect the private operators to gain more market share.

## Non-SOE operators to emerge in charging pole market

**Private operators are rushing to the market with innovative business models, supported by the capital market**

Prior to May 2014, operators were required to apply for licences to operate charging facilities, which discouraged private capital from entering the market. But following the publication of 2 documents on the opening-up of the charging facilities in May 2014, and with EV sales increasing from 2015 onward, non-SOE companies were encouraged to participate in operating charging facilities.

Hence, private operators such as TELD New Energy, DZ, and Starcharge have expanded their charging pole networks significantly since 2015. As well as operating charging poles, they also offer value-added services such as renting or selling EVs through their customer networks, selling box advertisements and developing mobile applications.

companies have gradually become major players in this market, driven by high expectations in the capital market for the development of NEV-related markets in China. We believe these companies will play an important role in building public charging poles rather than charging stations, which national players and local governments have more incentive to construct.

**Private operators will make one-off payments or revenue-sharing schemes to building owners**

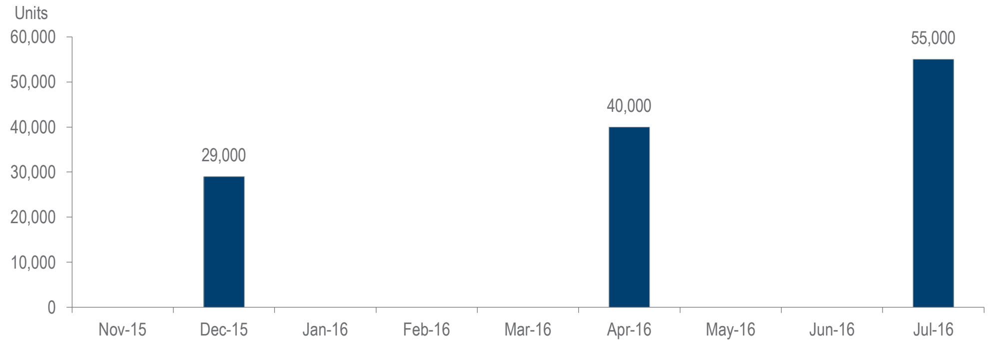
Below we list 5 major private operators in China which have similar business models, collaborating with local partners such as hotels, shopping malls, supermarkets, 4S dealership shops (Sales, Spare parts, Service and Survey) and real-estate developers to install charging poles in parking areas. The operators usually pay all the expense of the installation and provide a one-off payment or revenue sharing scheme to owners of buildings so as to attract more building owners to install charging facilities on their land (owners of buildings can usually share 5-30% of charging service fee in return).

**China: background of private operators**

| Company | Background | Number of charging poles under management | Alliances |
|---|---|---|---|
| TELD | Founded in August 2014 as the subsidiary of Shenzhen-listed TGOOD. As of September 2016, TELD has set up around 51 subsidiaries or JVs in approximately 150 major cities in China | Constructed and operated more than 55,000 charging poles by 2016. | Formed a JV with BAIC New Energy with a view to becoming the key player in Beijing |
| UEEE Network Technology | Founded in 2012 as a start-up company and received funds from several Shenzhen listed companies | Constructed and operated more than 2,655 charging poles by 2016. | n.a |
| DZ | Founded in September 2014 with investments by Titans and LeECO | n.a | n.a |
| Starcharge | Founded in 3Q14 as a subsidiary of Jiangsu Wanbang Group, a local dealer company | Constructed and operated more than 20,000 charging poles by 2016. | n.a |
| Tellus Power (China) | Subsidiary of Tellus Power, a US EV charging infrastructure company | Plans to construct 28,800 charging poles in 2016 with an investment of CNY3.6bn | Signed strategic cooperation with Geely and became the main dealer for the Emgrand EV |

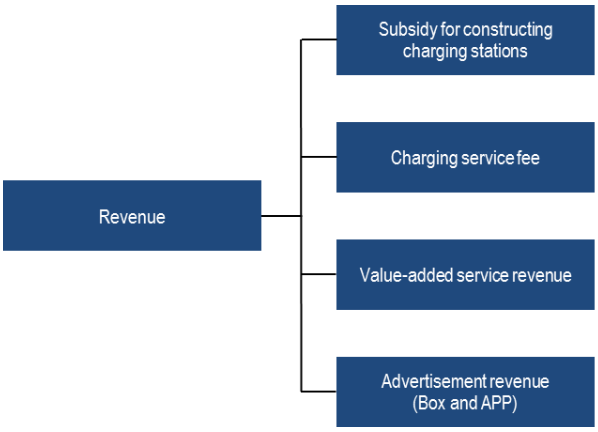
*Source: company website, d1ev*

**TELD: cumulative number of constructed charging poles**




*Source: d1ev*

**Revenue source for charging facilities operators**




*Source: Daiwa*

**TELD's APP for EV users to look for charging poles in Beijing**


*Source: TELD*

## Automobile manufacturers

**Automobile makers have an incentive to construct charging poles: increase demand for EVs**

Automobile manufacturers, such as BAIC Group and SAIC Group, also rely on their local advantages (based in Beijing and Shanghai) to build their own charging platforms, acting in concert with the production and sale of their own EVs.

Not only do these auto makers provide services for installing charging poles for their EV customers in private parking areas, they also build public charging facilities as set by their corporate strategies, aiming to boosting the demand for EVs.

In addition, Tesla expanded its supercharging station network in China since 2014. By July 2016, the new EV star has constructed 100 supercharging stations in China, where 400 120kW DC charging poles (supercharging poles) are installed. However, these are mostly brand specific (eg, Tesla) or city specific (eg, BAIC and SAIC) rather than developing a public charging facility for country-wide or across different brands.

**Automobile manufacturers: charging facilities operation business**

| Automobile manufacturers | Description |
|---|---|
| BAIC | BAIC New Energy, the subsidiary of BAIC Group, had built around 16,000 charging poles in China by March 2016 (mainly in Beijing); It plans to build a further 30,000 charging poles in Beijing in 2016 |
| SAIC | SAIC Anyui, the subsidiary of SAIC Group, focussed on constructing, operating charging facilities, plans to build 4,000 charging poles in 2016, and 660,000 charging poles by 2020 |
| Tesla | By July 2016, Tesla had constructed 100 charging stations (400 supercharging poles and 1,300 charging poles) |

*Source: Various media*

# Equipment manufacturers rushing to the market could see costs go down

## Competition to win orders from China State Grid intensifying

**More charging equipment manufacturers are trying to acquire orders from China State Grid**

The competition among EV charging equipment players to win orders (most are DC charging equipment) from China State Grid is becoming tougher as more and more entrants are rushing to reap the profit from this sub-segment. Looking at the bidder list shown below, we can see that many new non-SOE companies have succeeded in acquiring orders.

With the new China EV charging standards becoming effective in January 2016, we believe China State Grid is currently conducting trials initially to test the functions of the EV charging equipment of various players. As a consequence of these new charging standards, no one charging equipment player will be able to win more than 2 orders for every tender going forward. In the future, we believe China State Grid may pursue a lower price of charging equipment (currently around CNY1.4/W vs. around CNY0.8/W from tenders released by other operators) so as to reduce the cost to the grid of constructing charging facilities. However, China State Grid will still likely try to keep balancing the order allocations shared among its related companies and other companies.

**China State Grid: EV charging equipment orders (2015-1H16)**

| Date tender results released | May-15 | Oct-15 | May-16 | Jun-16 |
|---|---|---|---|---|
| Total investment value (CNYm) | n.a | >1,000 | 800-900 | 400-500 |
| Numbers of orders in total | 17 | 30 | 33 | 20 |
| Hangzhou Zhongheng | 2 | 2 | 2 | |
| Beijing SGEPRI UHV Transmission Technology | 2 | 2 | 2 | 1 |
| Hexin Ruitong – Beijing | 2 | 2 | 2 | |
| Beijing Huashang Sanyou | 2 | 2 | 2 | 1 |
| NariTech | 2 | 2 | 2 | 2 |
| Xuji Group | 3 | 2 | 2 | 1 |
| Shandong Luneng | 2 | 2 | 2 | 2 |
| Wanma-Cable | 1 | 2 | | |
| Fangzhi Tech – Beijing | 1 | 2 | 2 | |
| Shenzhen Guodian Technology Communication | | 2 | | |
| Nengrui Dianli | | 2 | 2 | |
| Hangzhou Dayou Technology | | 2 | 2 | 1 |
| Hangzhou Only Power Supply | | 2 | 2 | |
| CSG | | 1 | | |
| Gaoke China | | 1 | 2 | |
| Titans | | 2 | | 1 |
| ATC-A | | | 2 | |
| Shenzhen CLOU Electronics | | | 2 | |
| Suzhou Heshun Electric | | | 2 | |
| SZ Nari | | | 2 | |
| NariTech – Nanjing | | | 1 | |
| Shandong University Electric Power Technology | | | | 1 |
| Shandong Electric Group New Energy | | | | 1 |
| Tianyu Electric | | | | 1 |
| Golden Phoenix | | | | 1 |
| Fujian Wangneng Technology | | | | 1 |
| Qingdao Luneng Hengyuan | | | | 1 |
| Tianjin Pinggao Electric | | | | 1 |
| Qingdao Hardhitter | | | | 1 |
| CEC Shandong Electric | | | | 1 |
| Ningbo Sanxing Electric | | | | 1 |
| Pinggao Group | | | | 1 |
| Percentage of China State Grid related companies | 76% | 60% | 58% | 55% |

*Source: China State Grid, Various news, Daiwa estimation*
*Note: Highlighted companies are related companies (associates or subsidiaries) of China State Grid*

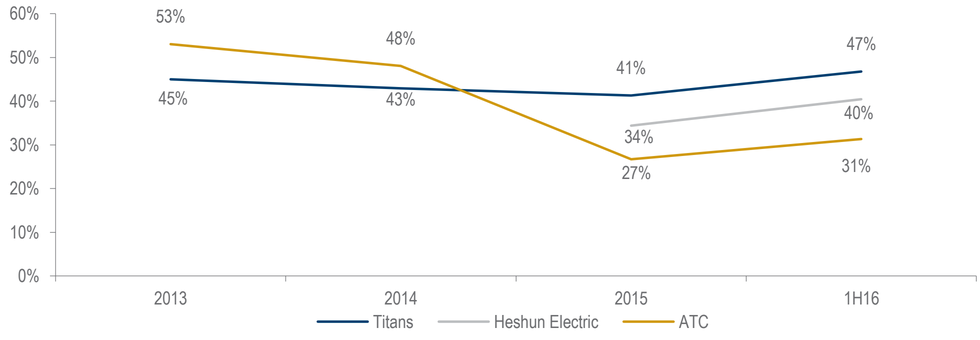
## Potential reduction in cost of charging equipment is achievable

Operators of charging facilities will in the future be able to increase their operating profit margins through 2 main methods: 1) increasing the utilisation rate of their charging facilities, or 2) purchasing facilities at a cheaper price thus requiring less capex. From our analysis, we believe the first method can be achieved in the long run when more EVs are adopted by drivers, while the second method may be the focus in the near term.

**High margins in the charging equipment manufacturing business indicate the potential room for price reductions**

Not only has the competition among charging equipment providers become tougher, as we show in the bidding results for China State Grid tenders, we think the current large operating profit margins earned by equipment makers indicate that there is still room for price reductions. Titans, positioned as one of the leading charging equipment manufacturers in China, registered a gross margin of 47% and operating margin of 26% for its EV charging equipment business in 1H16, while other Chinese players, such as Heshun Electric and ATC, also booked high margins during the same period.

Various players: gross margins of EV charging equipment business




*Source: Companies*

**Private operators with R&D input are eager to provide equipment internally instead of purchasing so as to reduce equipment costs**

Relative to the national players and local governments, private operators tend to try to keep their capex for constructing charging facilities as low as possible in order maximise their operating profits. For example, TELD, a leading private Chinese manufacturer of electrical components, has successfully integrated the industry chain with the support of its parent company (ie, purchases charging facilities from its parent company instead of buying from other players). Currently, TELD is capable of producing its own charging facilities so as to reduce its cost burden.

## The future: wireless charging technology is approaching

### Charging could occur anywhere

**We believe that in the future cars will be charged while moving along the road**

The current charging process is based on a fixed location, like charging poles and stations, which is connected through a physical wire. In the future, we envisage EVs being charged under wireless conditions, similar to the current technology applied to mobile phones. When such technology matures, EVs will actually be able to be charged while being driven. Such a development would solve the problem of having to queue up for charging facilities. At the same time, the battery requirement may be lower and thus the cost of the vehicle would be even lower.

Wireless charging (also known as inductive charging) uses an electromagnetic field to transfer energy between 2 objects through electromagnetic induction. Wireless chargers usually rely on an induction coil and the flowing electric current to create an altering electromagnetic field, which can transfer the power to the second induction coil in the portable device or electric vehicle and convert it back to the current to charge the battery.

Portable devices such as smartphones have gradually adopted wireless charging technology in recent years. In 2015, Samsung released its flagship smartphones the S6 and S6 Edge, which can be charged in a wireless way. In 2015-16, the wireless charging function was adopted by other peers such as Sony, Google Nexus, and Motorola. According Bloomberg and Sohu, it is anticipated that the next-generation smartphones from Apple, Xiaomi and Huawei will utilise this technology.

In terms of the adoption of wireless charging technology in EVs, the timetables of key automobile manufacturers and suppliers reveal that the popularisation of such technology is coming and is likely to boost EV sales in the near term.

### Technology still in its early stages

**Evatran has expanded its business to provide wireless charging facilities for key EVs sold in the US**

Evatran, a leading US company that develops wireless EV charging systems, started selling wireless charging facilities to customers in 2015. Evatran's 3.3kW charging facilities are now adopted in the Chevy Volt, Nissan Leaf and Cadillac ELR EVs in the US, while the company has also taken orders for its 7.2kW system for the Tesla S, which is expected to be launched in late 2016. The pricing of its wireless charging system is in a range of USD1,260-1,940 (without considering the instalment costs), and has 2 parts: one vehicle adapter installed in the vehicle with the help of the dealer shop, and the other built on the parking space.

**Evatran: wireless charging facilities**

*Source: Company*

The new edition of the Mercedes-Benz S-Class S550e PHEV, which is scheduled to be launched in 2017, will feature a wireless charging system as an option. The wireless charging system will be provided by a tier-1 power electronics supplier, which has licensed Qualcomm Halo inventions.

**Wireless charging facilities are more convenient than non-wireless but require higher costs**

Though the power transmission for wireless charging facilities is around 3.6-7.2kW, as we summarize above, which is still much slower than DC charging (around 30-120kW), we believe the charging speed of wireless charging facilities is similar to that for AC charging facilities but can be used much more conveniently as drivers do not need connect the wire to the EV. For now the cost of wireless charging facilities is still on the high side at about 2-3x the price of AC charging facilities. However, we believe this cost will come down in the long run, benefiting from technology improvements and economies of scale.

**Wireless equipment leader ZTE should see more opportunities with the cooperation of local governments**

In the China market, ZTE is the pioneer in the wireless charging equipment market. The company collaborated with Hubei State Grid and Dongfeng Motor to design and construct a wireless charging station for electric public buses in Hubei Xiangyang in September 2014, and plans to expand the business to 50-100 cities within China. By the end of 2015, ZTE had built wireless charging stations in Chengdu, Dali, Zhengzhou, Shenzhen, Zhangjiakou, which are usually used for public buses running a distance of 8-10km.

# Car batteries: the key to success

## Lower battery costs would lead to more competitive selling prices

**EV LiB costs likely to drop further as EV demand leads to scale economies in the industry chain along with technology advances**

We believe the popularity of EVs will increase and see these vehicles dominating the auto market in the long run. The major reason is not only because of rising awareness of environmental protection and concerns about air pollution, but we see the EV being more efficient and cheaper to own than an ICE car in the future. One of the reasons is the upcoming trend of lower battery costs, which account for 30-40% of the production cost of an EV.

Currently, the cost of producing an EV is higher than that for an ICE car due to the high battery cost, which we expect to decline significantly in the run-up to 2020 due to continued technology enhancements which we have seen since 2010. On the other hand, the increasing demand for EV LiBs would also stimulate technology input and expand production capacity, thus leading to better characteristics for EV LiBs and economies of scale. Also, we expect the establishment and expansion of the EV LiB manufacturing supply chain to contribute to falling prices as well.

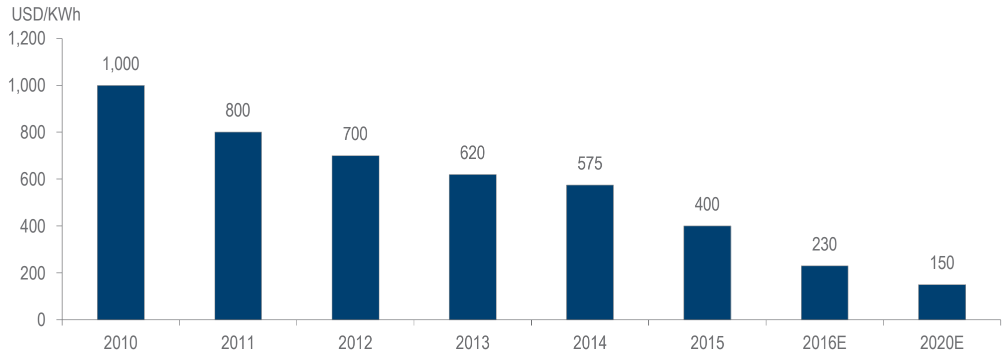
**Battery costs could reach USD100-150/KWh by 2020-21, on our estimates**

According to Tesla's vice-president of Investor Relations, Jeff Evanson, the battery pack cost is already below USD190/KWh, and the base Model 3 is expected to be offered with a battery pack option that is even cheaper than USD60/KWh. Moreover, General Motors (GM) (GM US, USD34.56, Outperform [2]) announced in October 2015 that the cost of its EV LiB, which is sourced from LG Chem, will drop to around USD145/KWh for its Chevrolet Bolt EV model to be unveiled in 2017. The low-cost battery for the Chevrolet Bolt will be produced in LG Chem's plant located in Holland, in the US state of Michigan, which should benefit from high volumes and economies of scale. By 2021, GM expects the cost of this LiB to be lowered to the USD100/KWh mark.

According to Daiwa auto analyst SY Chung (see *Electric vehicles and smart cars: Reinventing the wheel*, dated 23 June 2016), EV LiB pack costs could reach a level of USD150/KWh by 2020. With a much lower battery cost, there would be a good chance of the selling price of an EV dropping to that for an ICE car. For example, when we examined the production cost of the Nissan Leaf's traditional car equivalent, the Nissan Tiida sedan, we note that the production cost of the Leaf is getting close to that for a traditional car, which is likely to increase the incentive for OEMs to focus more on EVs in the future.

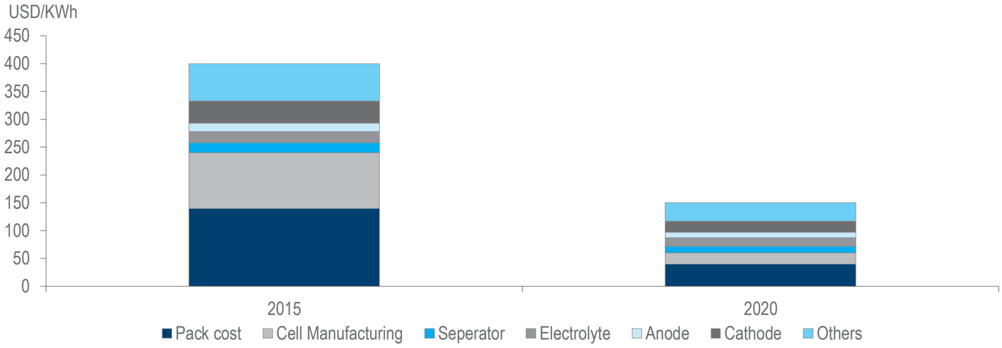
With our expectation of lower battery costs, leading to lower selling prices of NEVs, and an improvement in driving range, we believe there is good chance of China achieving its target of 5m EVs on the roads by 2020.

**Average EV battery pack costs trend (2010-20E)**




*Source: Daiwa forecasts*

**LiB pack cost breakdown**




*Source: Avicenne Energy, Daiwa Estimates*

**Price comparison of selected NEV and comparable ICE models**

| Company | Model | Type | Car Length (m) | MSRP (Before subsidy, CNY '000) | Price (After subsidy, CNY '000) | Comparable ICE Model | MSRP range (CNY'000) |
|---|---|---|---|---|---|---|---|
| BYD | Qin | PHEV | 4.7 | 210-220 | 150-185 | BYD F3, Geely Vision | 73-100 |
| | Tang | PHEV | 4.8 (SUV) | 251-280 | 191-245 | GWM Haval H6 | 93-168 |
| SAIC Motor | Roewe e550 | PHEV | 4.7 | 240 | 180-196 | Roewe 550 | 105-150 |
| | Roewe e950 | PHEV | 5.0 | 290-310 | 230-300 | Roewe 950 | 185-295 |
| GAC Motor | GA5 PHEV | PHEV | 4.8 | 200-220 | 140-185 | GAC GA5 | 105-145 |
| BYD | e6 | EV | 4.6 (MPV) | 310-370 | 210-260 | Chery Arrizo M7, BYD M6 | 85-155 |
| | Qin | EV | 4.7 | 260-310 | 150-200 | BYD F3, Geely Vision | 73-100 |
| | e5 | EV | 4.7 | 230-250 | 120-140 | BYD F3, Geely Vision | 73-100 |
| | Denza | EV | 4.6 | 370-400 | 260-290 | Toyota Corolla, Honda Civic | 125-180 |
| BAIC Motor | ES 210 | EV | 4.8 | 350 | 240 | Geely Emgrand GL | 85-120 |
| | EU 260 | EV | 4.6 | 240 | 130 | BYD F3, Geely Vision | 73-100 |
| | EV 200 | EV | 4.1 | 210-247 | 120-157 | Senova D20 | 55-85 |
| | EV 160 | EV | 4.0 | 180-190 | 90-100 | Senova D20 | 55-85 |
| Dongfeng Nissan | Venucia E30 | EV | 4.5 | 243-257 | 158-172 | Nissan Tiida, Honda Fit | 80-115 |
| Geely | Emgrand EV | EV | 4.6 | 230-250 | 120-140 | Geely Emgrand | 75-100 |
| Changan | Eado | EV | 4.6 | 235-250 | 145-160 | Geely Emgrand | 75-100 |
| JAC | iEV6S | EV | 4.2 (SUV) | 220 | 110 | GWM Haval H1 | 60-85 |
| | iEV5 | EV | 4.3 | 180 | 90 | Geely Kingkong | 50-70 |
| | iEV4 | EV | 4.2 | 153-155 | 63-65 | Geely Panda | 40-52 |
| Zotye | Yun 110 | EV | 3.6 | 159-170 | 49-60 | Geely Panda | 40-52 |
| Chery | eQ | EV | 3.6 | 160-165 | 70-75 | Geely Panda | 40-52 |
| SAIC Motor | E50 | EV | 3.6 | 190 | 100 | Geely Panda | 40-52 |
| Zhidou | D2 | EV | 2.8 | 159-189 | 69-99 | Geely Panda | 40-52 |

*Source: Companies, Autohome*
*Note: Subsidies partly subject to various local policies; MSRP = manufacturer's suggested retail price*

## Longer driving distances make EVs more usable

**Longer driving distance may reduce demand for charging facilities in the long run**

On the consumer side, apart from the constraint from a lack of charging facilities, the much shorter driving range for an EV versus an ICE car is a key concern for potential drivers. However, the driving range has improved significantly in the past 5 years, which we believe has already brought EVs into a more usable level from a customer's perspective.

Currently, BYD's e6 offers a 300km driving range per charge, which is comparable to Tesla's model 3 driving range 345km, according to the respective company websites. According to the China Urban Smart Transportation Report 2015 produced by DiDi, the daily one-way travel distance is 17km (34km per day) in tier-1 cities and 14km (28km per day) in tier-2 cities. Therefore, we believe a 300km driving range would require a driver to charge their EV 1-2 times a week.

If we assume battery technology improves, the driving range would increase, and thus requiring fewer charging facilities in the future. According to the Roadmap (shown below), China's government aims to improve the battery driving range to at least 300km for most EVs sold in China by 2020, and further to 400km or above by 2025 and 500km or above by 2030.

### Comparison of selective models: EV battery capacity and electric distance improvement

| | Launch year | Battery capacity (kWh) | Pure electric distance (km) |
|---|---|---|---|
| Nissan Leaf (Old version) | 2009 | 24 | 175 |
| Nissan Leaf (New version) | 2017E | 60 | 320 |
| BMW i3 (Old version) | 2014 | 22 | 130-160 |
| BMW i3 (New version) | 2016 | 33 | 183 |
| BAIC EV150 (Old model) | 2013 | 26 | 160 |
| BAIC EU260 (New model) | 2016 | 41 | 260 |

*Source: Company website, various media*

### EV battery: technology development roadmap for China

| | 2015 | 2020 | 2025 / 2030 |
|---|---|---|---|
| | Fulfil the EV requirement for driving at pure electric distance of 300km | Fulfil the EV requirement for driving at pure electric distance of 400km | Fulfil the EV requirement for driving at pure electric distance of 500km |
| | Energy/Weight: LiB cell 350Wh/kg, LiB pack 250Wh/kg<br>Energy/Volume: LiB cell 650Wh/L, LiB pack 320Wh/L<br>Charging power/Weight: LiB cell 1,000W/kg, LiB pack 700W/kg<br>Longevity: LiB cell 4,000 charging times/10 year, LiB pack 3,000 charging times/10 year<br>Cost: LiB cell CNY0.6/Wh, LiB pack CNY1.0/Wh | Energy/Weight: LiB cell 400Wh/kg, LiB pack 280Wh/kg<br>Energy/Volume: LiB cell 800Wh/L, LiB pack 500Wh/L<br>Charging power/Weight: LiB cell 1,000W/kg, LiB pack 700W/kg<br>Longevity: LiB cell 4,500 charging times/10 year, LiB pack 3,500 charging times/10 year<br>Cost: LiB cell CNY0.5/Wh, LiB pack CNY0.9/Wh | Energy/Weight: LiB cell 500Wh/kg, LiB pack 350Wh/kg<br>Energy/Volume: LiB cell 1,000Wh/L, LiB pack 700Wh/L<br>Charging power/Weight: LiB cell 1,000W/kg, LiB pack 700W/kg<br>Longevity: LiB cell 5,000 charging times/10 year, LiB pack 4,000 charging times/10 year<br>Cost: LiB cell CNY0.4/Wh, LiB pack CNY0.8/Wh |
| **Improved energy density (Energy/Weight):** | Based on existing materials with high energy, improve the electrode structure and load capacity of active materials | Apply new material system, enhance the running voltage of LiB | Optimise new material system, utilise new battery structure |
| **Improved longevity:** | Develop cathode/anode materials with better longevity;, enhance the purity of electrolytes; develop new additives, optimise electrode design, etc | Apply new materials such as barium salt, improve manufacturing process and environment control | Apply solid electrolyte materials |
| **Improved safety:** | New separator, new electrolyte, electrode safety coating, optimise battery design | New separator, new electrolyte, electrode safety coating, optimize battery design | Combination technology for solid and liquid electrolyte, new material system |
| **Cost control:** | Optimise design, improve manufacturing level | Apply new materials, new manufacturing process and equipment | New material system, new manufacturing process roadmap |

*Source: Society of Automotive Engineers of China, Energy-saving and New Energy Vehicle Technology Roadmap*

**PHEV battery: technology development roadmap for China**

**2020**

Energy/Weight: LiB cell 200Wh/kg, LiB pack 120Wh/kg
Energy/Volume: LiB cell 400Wh/L, LiB pack 240Wh/L
Charging power/Weight: LiB cell 1,500W/kg, LiB pack 900W/kg
Longevity: LiB pack 3,000 charging times/10 year
Cost: LiB cell CNY1.0/Wh, LiB pack CNY1.5/Wh

**2025**

Energy/Weight: LiB cell 250Wh/kg, LiB pack 150Wh/kg
Energy/Volume: LiB cell 500Wh/L, LiB pack 300Wh/L
Charging power/Weight: LiB pack 1500W/kg
Longevity: LiB pack 4,000 charging times/12 year
Cost: LiB cell CNY0.9/Wh, LiB pack CNY1.3/Wh

**2030**

Energy/Weight: LiB cell 300Wh/kg, LiB pack 180Wh/kg
Energy/Volume: LiB cell 600Wh/L, LiB pack 350Wh/L
Charging power/Weight: LiB pack 1500W/kg
Longevity: LiB pack 5,000 charging times/15 year
Cost: LiB cell CNY0.8/Wh, LiB pack CNY1.1/Wh

**Improved energy density (Energy/Weight):**

- Based on existing materials with high energy, improve the electrode structure and load capacity of active materials
- Optimise new material system, utilise new battery structure

**Improved longevity:**

- Develop cathode/anode materials with better longevity; enhance the purity of electrolyte; develop new additives, optimise electrode design, etc
- Apply solid electrolyte materials

**Improved safety:**

- New separator, new electrolyte, electrode safety coating, optimise battery design
- Combination technology for solid and liquid electrolyte, new material system

**Cost control:**

- Optimise design, improve manufacturing level
- New material system, new manufacturing process roadmap

*Source: Society of Automotive Engineers of China, Energy-saving and New Energy Vehicle Technology Roadmap*

# Chinese government nurturing battery technology

## Policies support local battery makers more than foreign makers

In April 2015, the MIIT published its first "Automotive Battery Industry Standards" directory, which contains a list of battery makers and the specifications of the batteries they produce. In this edition, the MIIT introduced new standards for inclusion on the list, including only listing players if they have sufficient production scale and technology level. Automotive battery makers are encouraged to get listed in the directory, which the MIIT uses as a tool to assess subsidies for OEMs; ie, if OEMs do not use batteries whose makers are in the directory, they would be unlikely to receive grants from the central government or local governments.

Up to now, 4 such directories have been published, yet no international companies (including the likes of Samsung SDI and LG Chem) have been featured. We believe the government is more motivated to support domestic LiB suppliers over international players, which it sees as setting up plants in China while not providing any R&D input to local factories. The standards introduced in the April 2015 directory will narrow the scope of LiB makers and eventually wipe out the unqualified small players, hence benefiting leading domestic LiB players in the end.

**Currently, LG Chem and Samsung SDI cannot enter the China market and provide LiBs to local OEMs**

Both LG Chem and Samsung SDI have plans to enter the China market and to that end, set up their plants in Nanjing and Xi'an, respectively, in 2H15. For LiB technology, especially in the NCM and NCA segments, Chinese cell suppliers still lag behind Korean/Japanese peers. As such, LG Chem and Samsung SDI have received orders from many Chinese OEMs such as Yutong, Foton, Shanghai Motor, Changan Motor and JAC recently, providing high quality batteries for their new version EV models.

However, as we comment above, Chinese battery vendors will be more favourable in terms of the subsidy policy. If restrictions on foreign battery vendors listing in the subsidy catalogue remain stringent, those domestic OEMs may source from domestic LiB suppliers instead, in order to receive subsidies from government when selling EVs. Concerning the limited supply of higher-end LiBs from domestic suppliers currently, we think a shortage of higher-end LiBs may exist, thus benefiting domestic suppliers owning more advanced technology.

**Summary of Korea EV LiB suppliers' clients**

| | Foreign clients | Chinese clients | New models of Chinese clients | Current stage of new model due to policy restriction |
|---|---|---|---|---|
| Samsung SDI | BMW, Volkswagen | Jianghuai | iEV6s EV | Postpone the launch time |
| LG Chem | GM, Volkswagen, Ford | SAIC; Changan | RX5 PHEV; one PHEV | Postpone the launch time |

*Source: Sina*

## The whole supply chain is expanding

### Increasing number of participants in battery production

**Various battery cell markers plan to expand their capacity aggressively**

On account of the significant growth in EV sales in 2014 and 2015 and the policy stimulus, Chinese battery cell makers have plans to enlarge their capacity aggressively to acquire more share in this new market. The top players have plans to double or even triple their capacities within 1-2 years as the following table shows, while there are also hundreds of small local players we cannot count, which indicates that we may even have overestimated the utilization rated in 2015 and 2016.

Given our China EV sales growth forecast of 70% YoY for 2016, we forecast battery production capacity to expand faster, by 115% YoY for the same period, as shown below. Currently, Chinese battery suppliers are mostly focusing on lithium iron phosphate (LFP) batteries for meeting the demand for instalment on NEV buses. (Currently, only LFPs are allowed to be installed on NEV buses.) Thus, even though the government is favouring the Chinese battery vendors over foreign players in terms of allocating subsidies, we see the LFP battery segment, especially the low-end segment, facing a potential oversupply and margin contraction issues in the next few years.

On the other hand, foreign players such as LG Chem, Samsung SDI and Panasonic have better technology advantages in NCM/NCA batteries with production sites either already built or in process in various places in China, which can better suit the requirements for NEV PVs. As a result, we note that LG Chem and Samsung SDI received orders from many Chinese OEMs such Shanghai Motor, Changan Motor and JAC in 2015.

Compared to their foreign peers, domestic players still lag behind, especially in terms of unit costs, but are rushing to expand their capacity to acquire cost advantages through economies of scale. We believe the domestic players can narrow the cost gap within a few years aided by the Chinese government remaining stringent on allowing foreign players with their better technology to enter China.

**Summary of major EV LiB vendors' capacity and expansion plans in China**

| Company name | Major clients | Capacity at 2015 end | Capacity expansion plan |
|---|---|---|---|
| BYD | BYD | 9.6GWh | 3GWh by 2016 end and another 3GWh by 2017 end; 10GWh by Aug 2019 in Qinghai |
| CATL | Brilliance BMW, Yutong | 2.4GWh | Reach 7.5GWh by 2016 end |
| Lishen | Yutong, Kinglong, Jianghuai | 2.3GWh | Reach 7GWh by 2017 end |
| Guoxuan high tech | Ankai, Jianghuai, Kinglong | 1.5GWh | Reach 6GWh by 2016 end |
| Tianneng | Kandi, Zoyte, Chery | 1.5GWh | Reach 3GWh by 2016.6; Plan to expand to 5.5GWh |
| Coslight Tech | BAIC, Zhidou | 1GWh | Reach 1.5GWh by 2016 |
| Microvast | Kinglong, Beiqi Futian | 1GWh | n.a |
| CALB | Dongfeng, Kinglong,Zhongtong | 0.9GWh | 1.54GWh under construction in 2016 in Luoyang; 2.5GWh in Jiangsu in plan |
| Wulong Electric | Wulong Electric | 0.8GWh | 1.6GWh in plan |
| Chaowei | n.a | 0.6GWh | Reach 3GWh by 2016 end |
| Boston Power | BAIC, zhidou | >0.35GWh | 3GWh in Jiangsu, 8GWh in Tianjin in plan |

*Source: local government website, Xinhua website, gasgoo, d1ev, gg-lb, china buses, various media*

**EV LiB supply and demand in 2015-2016**

| | 2015 | 2016 | YoY Growth |
|---|---|---|---|
| Capacity of top EV LiB makers (GWh) | 22 | 47 | 115% |
| Demand (GWh) | 16 | 30 | 87% |
| Utilization rate | 73% | 63% | |

*Source: Xinhua website, Daiwa estimates*

## Battery materials also seeing support

**Chinese battery suppliers have advanced to become the main participants in the global LiB materials market**

Chinese suppliers have already become the most important participants in the LiB materials segment thanks to their large amount of domestic LiB cell production volume (used to be mainly for consumer electronics LiB). Among the 4 main segments, Chinese players have more of an advantage in the anode sub-market due to its low technology entry barrier and high reliance on raw materials, graphite, which is abundant in China. In recent years, Chinese players have also moved fast in the electrolyte sector as a result of the relatively low capex requirements and possibility of a fast pick-up in production volume.

For the separator sector and cathode sector, Chinese suppliers still lag behind their foreign counterparts but have increased their competitiveness since 2013 by acquiring more share of the global market. For example, Shenzhen Senior, the leader in China's separator industry, increased its export sales portion from 15% in 2013 to 27% in 2015 and 27% in 1H16, benefiting from its increasing sales to LG Chem. Shenzhen Senior also has a solid Chinese customer base including BTD, Guoxuan high tech and CATL, which previously relied solely on foreign suppliers, proving that the import substitution is effective in the separator segment.

### Market entry barrier for battery materials (3=most, 1=least)

| | Cathode | Anode | Separator | Electrolyte |
|---|---|---|---|---|
| Investment need | 2 | 3 | 2 | 1 |
| Product know-how | 2 | 2 | 3 | 3 |
| Production know-how | 2 | 3 | 3 | 2 |
| Customer relationship | 3 | 2 | 2 | 2 |
| Access to raw materials | 3 | 2 | 1 | 1 |

*Source: Roland Berger*

### Major Chinese companies across the supply chain of LiB industry

| Anode | Global market share in 2013 | Cathode | Global market share in 2014 | Separator | Global market share in 2014 | Electrolyte | Global market share in 2014 |
|---|---|---|---|---|---|---|---|
| Beiterui | 35% | Shanshan | 9% | Senior | 4% | Cap Chem | 15% |
| Shanshan | n.a | Reshine | 9% | Green | 3% | GTHR | 14% |
| Jiangxi Zichen | n.a | B&M | 8% | Jinhui | 2% | Shanshan | 8% |
| SZ Sino | n.a | Easpring | 3% | Fengfan | 1% | Jiniu | 8% |
| Shandou Chengxiang | n.a | Pulead | n.a | CZ mingzhu | n.a | Tinci | 6% |

*Source: Avicenne Energy, Daiwa estimates*

## Listed companies: NEV and ADAS supply chains in China

| Segment | Company | Ticker | Description |
|---|---|---|---|
| EV OEMs | BYD | 1211 HK | BYD Company Limited, through its subsidiaries, manufactures and sells automobiles. The Company also researches, develops, manufactures and sells batteries |
| | BAIC | 1958 HK | BAIC Motor Corporation Limited designs, researches, develops, manufactures and sells a variety of passenger vehicles in China. |
| | Geely | 175 HK | Geely Automobile Holdings Limited, through its subsidiaries, manufactures and sells automobiles and related components. |
| Battery Maker | Tianneng Power International | 819 HK | The company manufactures motive battery products, mainly in electric bikes |
| | Chaowei Power | 951 HK | The company manufactures lead acid batteries, for electric bikes, electric cars and storage batteries of wind and solar equipment |
| | BYD | 1211 HK | BYD Company Limited, through its subsidiaries, manufactures and sells automobiles. The Company also researches, develops, manufactures and sells batteries |
| | FDG Electric Vehicle | 729 HK | FDG Electric Vehicles Limited researches, develops, and produces Ion Lithium Materials and power battery technologies. |
| | Coslight Tech | 1043 HK | The company manufactures and sells sealed lead acid batteries, lithium ion batteries and related accessories |
| | Leoch International Tech | 843 HK | The company is a lead-acid battery manufacturer, developer and exporter. Their products are used in automotive, renewable energy storage systems and other industrial products |
| | Wangxiang | 000559 CH | Wanxiang Qianchao Co., Ltd. manufactures and markets a variety of auto parts. The Company's products include universal joints, car vibration absorbers, transmission systems, bearings, and other related parts. |
| | Shanshan Tech | 600884 CH | Ningbo Shanshan Co., Ltd. manufactures and markets men's suits, casual wear, shirts, uniforms, and other apparel products. The Company also produces lithium ion battery materials. |
| | Guoxuan High-Tech | 002074 CH | Guoxuan High-Tech Co., Ltd manufactures and markets switching equipment products. The company mainly produces high and low voltage switches, switchgears and other related electronic components |
| | Samsung SDI | 006400 KS | Samsung SDI Co., Ltd. specializes in developing Lithium Ion Battery (LIB) technology. |
| | LG Chem | 051910 KS | LG Chem Ltd. is a chemical manufacturer. The Company's products include petrochemicals, plastic resins, and engineering plastics. LG Chem also produces industrial and electronic materials. |
| | SK Innovation | 096770 KS | SK Innovation Co., Ltd. refines, markets, and distributes oil. SK Energy also manufactures petrochemical products, including paraxylene, synthetic resins, styrene monomer, and ethylene. |
| Engine Marker | Broad-Ocean | 002249 CH | Zhongshan Broad Ocean Motor Co Ltd manufactures AC and DC electric motors. |
| | Jiante motor | 002176 CH | Jiangxi Special Electric Motor Co Ltd specializes in the research, development, manufacturing and sales of specialty motors including lifting, mining and high-voltage motors. |
| | Wolong | 600580 CH | Wolong Electric Group Co., Ltd. manufactures and sells a variety of mini electric machinery. |
| | Sec-motor | 603988 CH | SEC Electric Machinery Co Ltd is a professional medium & large scale motors manufacturer and exporter in China mainland. The Company's motors are used in DC motors, and slip ring AC motors |
| Charging station/ pole | Titans Energy | 2188 HK | China Titans Energy Technology Group Company Limited (TITANS) focuses on power electronics. |
| | Shanghai Potevio | 600680 CH | Shanghai Potevio Co., Ltd. manufactures and trades telecommunication equipment and electronic products |
| | ATC | 002227 CH | Shenzhen Auto Electric Power Plant Company, Ltd. researches, develops, manufactures and sells electric automatic power supply equipment and intelligent units. |
| | Beijing Dynamic Power | 600405 CH | Beijing Dynamic Power Co., Ltd. manufactures power supply systems for telecommunication equipment. |
| | Zhongyeda | 002441 CH | Zhongyeda Electric Co., Ltd. is a distributor of industrial electrical products. The Company distributes industrial electrical components, produces and sells systems integration products. |
| | Tgood | 300001 CH | Qingdao TGOOD Electric Co Ltd designs and manufactures electrical transformers and provides related technical services. The Company also provides system solutions for the electrical transformer substations. |
| | Sieyuan | 002028 CH | Sieyuan Electric Company Limited manufactures and markets power supply and converting equipment as well as high voltage electrical apparatus and high voltage monitoring instruments. |
| | Zhejiang Wanma | 002276 CH | Zhejiang Wanma Co., Ltd. produces mainly union insulating electric cable of polyethylene, the insulating electric cable of polyvinyl chloride, and other kinds of electric wires cable. |
| | Zhonhen | 002364 CH | Hangzhou Zhongheng Electric Co Ltd. develops and supplies electrical products. The Company's products include electric power operating power systems, and outdoor communication power supply systems |
| | SZ Clou | 002121 CH | Shenzhen Clou Electronics Co., Ltd. develops, manufactures and markets power automation equipment and public instruments. |
| | Delta Electronic | 2308 TT | Delta Electronics Inc. manufactures power supplies and video display products. |
| Charging cable | Nanyang Cable | 002212 CH | Guangdong Nanyang Cable Group Holding Co., Ltd manufactures power wires and cables, as well as PVC materials for wire and cable making. The company operates under the brand name of NAN cables. |
| ADAS | Nexteer | 1316 HK | Leading global power steering provider and stands to benefit from the rising penetration and development of ADAS |
| | Minth | 425 HK | Leading Chinese auto parts suppliers with ambitions on conducting EV manufacturing business and ADAS related auto parts |

*Source: Daiwa*

# Appendix 1: EV battery development

## Rechargeable battery industry evolution

### Lead-acid batteries

**Benefiting from their cost advantage, lead-acid batteries lead the market scale in the rechargeable battery industry, but have low energy density**

Invented in 1859, lead-acid batteries were recognised as the first rechargeable batteries, and still dominate the rechargeable battery industry in terms of market scale, due to their dependable characteristics and low cost advantage.

Lead-acid batteries are generally classified into 3 main categories: 1) **reserve power batteries:** which provide backup power for a continuous power supply, and are primarily used in telecommunications systems, uninterruptible power supply (UPS) and power storage systems for renewable energy industry; 2) **motive power batteries:** which provide power for motion and are used mostly in vehicles such as forklifts, trucks and electric bicycles, and 3) **SLI batteries:** which are used for starting, lighting and the ignitions (SLI) of vehicles such as motors, tractors, boats or other internal combustion engines.

In the past 15 years (since 2000), lead-acid battery sales volume has risen by around a 4% CAGR, per our estimates, driven mostly by an increase in revenue for the global capital goods sector.

The energy density of a lead-acid battery is only around 40Wh/kg, which is 40-50% that of a nickel-based battery or 20-40% that of a Lithium-ion battery (LIB). Thus, this traditional battery is not suitable for use in portable devices, which require light-weight batteries.

### Nickel-based batteries

In 1899, the first nickel-cadmium (NiCd) battery came out with higher energy density but much more expensive materials. The NiCd was first commercialised in the 1950s and became the preferred choice for 2-way radios, emergency medical equipment, professional video and power tools.

**NiCd and NiMH were commercialised later, leveraging on their higher energy density**

Nickel-based batteries were improved further in 1967, when nickel-metal-hydride (NiMH) was invented, which led to the new batteries achieving a 30-40% improvement in energy density. After that, the NiMH battery was gradually adopted by battery manufacturers such as Panasonic, Energizer, Duracell and Rayovac and became commercialised in the 1990s.

The energy density of an NiMH can reach around 90Wh/kg, which makes it suitable for use in hybrid electric vehicles and consumer electronics. However, as the LiB was also brought out in the 1990s and achieved more success, the NiMH and NiCd batteries have only managed to retain a small share of the market.

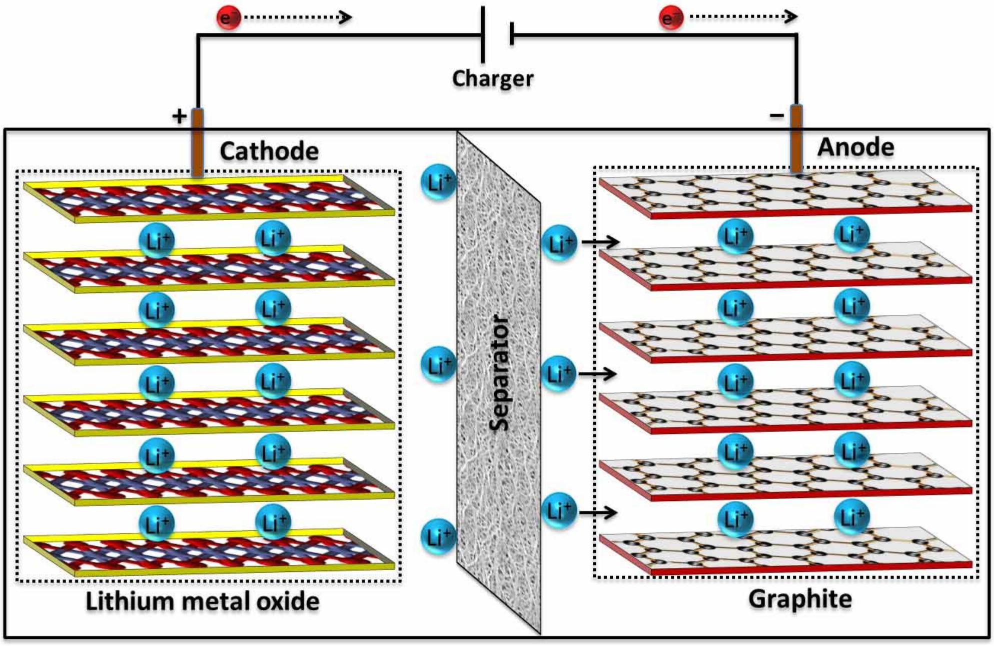
### Lithium-ion batteries (LiB)

Lithium is the lightest of all metals and has the greatest electrochemical potential. The reactive trait of lithium allows for very high energy density as well as power density. However, the inherent instability of lithium metal, especially during charging, has gradually shifted research to a non-metallic solution using lithium ions.

A typical LiB cell uses layers of porous carbon as an anode material, and lithiated metal oxide as a cathode as a material. The electrolyte is a blend of lithium salt in an organic carbonates solution and the separator is made from polyolefin.

When the cell discharges and charges, lithium ions shuttle between the cathode (positive electrode) and anode (negative electrode). For the discharge mechanism, the anode undergoes oxidation, or a loss of electrons, and the cathode sees a reduction, or a gain of electrons. For the charging mechanism, the movement reverses. As the electrons move, the current flows in the opposite direction.

LiB rechargeable battery charge and discharge mechanism




*Source: Purdue University*

Sony commercialised the first LiB in 1991 by using the lithium-cobalt-oxide (LCO) as the cathode. After that, many varieties of LiBs, such as Lithium manganese oxide (LMO), lithium nickel manganese cobalt oxide (NCM), lithium iron phosphate (LFP) and lithium nickel cobalt aluminium oxide (NCA), came out. All varieties had one thing in common – they all used lithiated metal oxide as their cathodes, so as to be called “Lithium-ion”.

LiBs have been widely used in consumer electronics since the 1990s, of which mobile phones, tablets and portable PCs are the 3 major sub-markets. The expansion of the EV market in recent years has led to enormous opportunities for LiBs.

LiBs have several advantages over their peers.

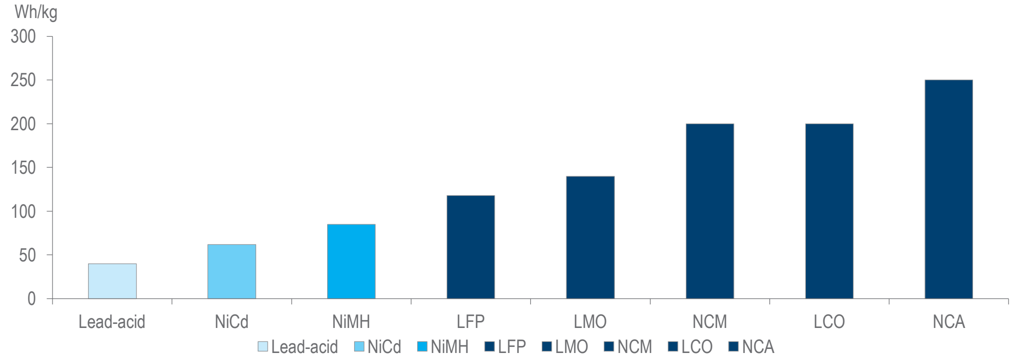
## Energy density

**LiBs have the absolute advantage of a high energy density over other peers**

Energy density is crucial for evaluating batteries since it is the energy amount per unit mass. Energy density can be derived by multiplying voltage and ampere. Therefore, one can increase the energy density by increasing the voltage or ampere.

LiBs have a higher energy density ranging from 120Wh/kg to 250Wh/kg, compared to 90Wh/kg for NiMH batteries and 40Wh/kg for lead-acid batteries. One reason for the superior specific energy of LiBs is their high cell nominal voltage of 3.6V, while the nominal voltage for lead-acid batteries and NiCd/NiMH are 2.0V and 1.25V, respectively.

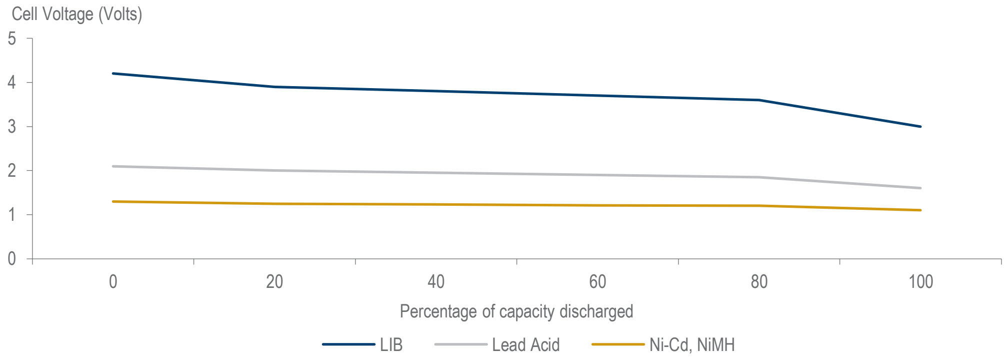
**Typical specific energy density of lead-, nickel- and lithium-based battery cells**




*Source: Battery University*

**LiBs perform better in terms of their longer cycle life over other normal batteries, resulting in a longer usage life**

**Cell nominal voltage comparison**




*Source: Electropaedia*

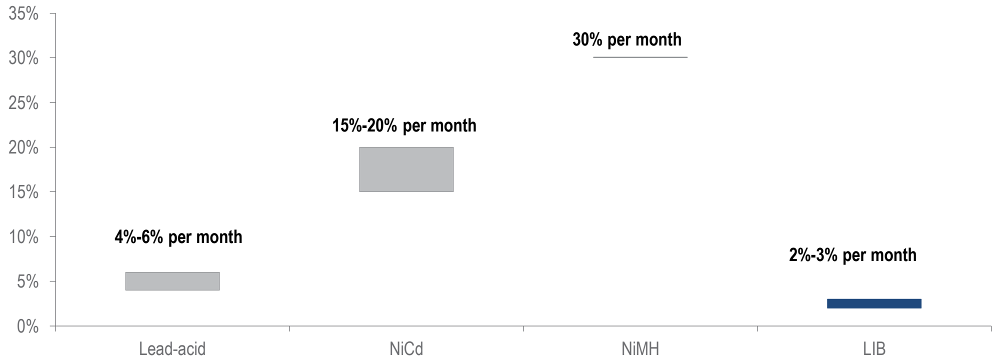
## Self-discharge

The self-discharge is a phenomenon in batteries in which internal chemical reactions reduce the stored charge of the battery. Self-discharge causes batteries to initially have less than a full charge when actually being used.

The self-discharge rate of a LiB is around 2-3% per month. Compared with other kinds of rechargeable batteries, the LiB absorbs the least amount of self-discharge.

**The low self-discharge rate promises the maximum energy volume stored in a LiB for daily use**

Typical self-discharge rates for common rechargeable cells




*Source: Electropaedia*

## Cycle life

A battery's cycle life is defined as the number of complete charge-discharge cycles a battery can perform before its nominal capacity falls below 80% of its initial rated capacity.

The LiB outperforms with its normal cycle life of around 500-2,000x, compared to 300-500x for a NiMH and 200-300 times for a lead-acid battery. Therefore, the LiB does not have to be replaced as frequently as other batteries.

## Fast-charge time

LiBs can be charged to their full capacity from zero within 2-4 hours, which is same as most of its peers. Lead-acid batteries have the longest fast-charge time of 8-16 hours.

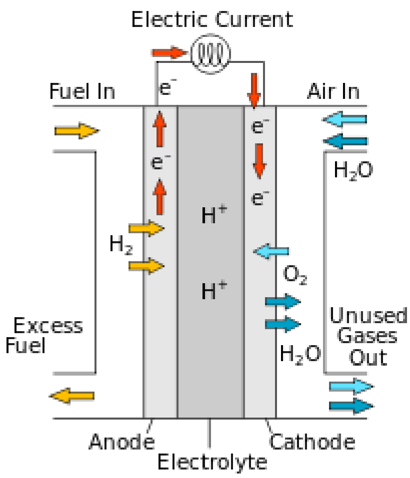
## Fuel cell

**The pure green energy source, fuel cell, has only a small share of rechargeable battery industry currently**

A fuel cell is like a battery in that it generates electricity from an electrochemical reaction. However, it does not need to be recharged or discarded but can run indefinitely as long as it is supplied with a source of hydrogen and a source of oxygen, which are the most common sources for the fuel cell. Other types of fuel cells can also be fuelled with methanol, syngas (a mixture of carbon monoxide and hydrogen) but only account for a very small share of the battery.

In general, hydrogen atoms enter a fuel cell at the anode where a chemical reaction strips them of their electrons. On the other hand, oxygen enters the fuel cell at the cathode and there combines with electrons flowed from the anode.

Hydrogen fuel cell battery charge mechanism




*Source: Wikipedia*

**FCEV has potential in the future due to its long pure electric distance and fast recharging speed**

One strong appeal of the hydrogen fuel cell is that it generates electricity with very little pollution – much of the hydrogen and oxygen used in generating electricity ultimately combines to form a harmless by-product, namely water. Therefore, it is considered a zero-emissions fuel.

The first references to hydrogen fuel cells appeared in 1838 while the first commercial use of fuel cells came more than a century later in NASA space programmes to generate power for satellites and space capsules. Later, it was used mostly for primary and backup power for buildings and vehicles. According to the US Department of Energy, the fuel cell market value was around USD2.2bn and the corresponding shipments were around 180MW in 2014, which were still meagre compared to those of LiBs and lead-acid batteries.

Starting from 2008, when the Honda FCX Clarity FCEV was first introduced for leasing by customers in Japan and California, the fuel cell began emerging as another source of power for a new energy vehicle called a fuel cell electric vehicle (FCEV). We believe the FCEV has strong potential in the future due to its advantages of having: 1) long-distance travel similar to petrol cars, and 2) a few-minutes recharging time. However, we see 2 potential obstacles facing FCEVs.

**FCEVs face 2 main obstacles: a lack of infrastructure and high cost**

First, there are not enough hydrogen-filling stations. Unlike battery electric vehicles (BEV) or plug-in hybrid electric vehicles (PHEV), which can be charged in any place with electrical plugs, FCEVs can only be charged at specific stations. Hence, all current FCEV models (Toyota Mirai, Honda FCX Clarity, Hyundai Tuscon) rely heavily on the business model of leasing to car users instead of selling to car owners, as drivers can only use them in regions covered by installed stations, which reduces the incentive to buy an FCEV.

Japan and Korea are 2 countries that see substantial support for FCEVs from both the government and influential automakers. As our table below shows, though the number of stations in those 2 countries is expected to keep increasing, it will still fall far short of the number of petrol stations, making it difficult for users to drive throughout the whole country in the next 5 years or even longer. The limited number of hydrogen-filling stations is partly a result of high installation costs, which are around USD5m in Japan, according to Reuters. For China, it has an aggressive target of reaching 100 hydrogen-filling stations by 2020, 300 by 2025 and 1,000 by 2030.

**Comparison: number of stations**

| | Japan | Korea |
|---|---|---|
| Hydrogen-filling stations in 2015 | ~80 | ~10 |
| Hydrogen-filling stations in 2020 by plan | 120 | 20 |
| Petrol stations in 2015 | 35,000 | 14,000 |

*Source: IEA, Wikipedia, Reuters, Daiwa estimates*

Second, even though the cost of fuel cells has come down substantially by reducing the required usage of platinum catalysts, the cost of an FCEV is still not competitive vis-a-vis the cost of a normal EV. Toyota Mirai is currently the only FCEV model on sale in the commercial market with an MSRP of USD57,500 in the US, while a regular EV, such as the Nissan Leaf or BMW i3, are priced at USD29,010 and USD42,400, respectively.

According to the IEA, the fuel cell system cost per unit is around USD30,000, around half that of the MSRP on a Toyota Mirai. The IEA estimates the full cell system cost per unit to reach USD3,000-4,000 in 2030-50 during which the FCEV will likely have a better cost structure. For China, the government aims to reduce the cost to less than CNY300,000 by 2020, less than CNY200,000 by 2025 and less than CNY180,000, albeit lagging behind the global standard.

## FCEV: technology development roadmap for China

| | | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| Target | | Apply in specific areas for public services; scale is 5,000 units | Largely apply in private-owned vehicles, public serving vehicles; scale is 50,000 units | Largely commercialise in private-owned cars, large CVs; scale can reach to million level |
| Target | | Capacity of fuel cell system exceeds 1,000 units per enterprise | Capacity of fuel cell system exceeds 10,000 units per enterprise | Capacity of fuel cell system exceeds 100,000 units per enterprise |
| FCV | Requirements for functions | Low end of start-up temperature to reach -30℃; optimise automotive system design; FCA manufacturing cost is equal to EV's | Low end of start-up temperature to reach to -40°C; lower the purchase cost for FCA; FCA manufacturing cost is equal to PHEV's | Equal to ICE vehicles in terms of performance; competitive among all peers |
| FCV | CV | Durability – 0.4mn km<br>Overall cost per unit – <CNY1.5m | Durability – 0.8mn km<br>Overall cost per unit – <CNY1.0m | Durability – 1m km<br>Overall cost per unit – CNY0.6mn |
| FCV | PV | Longevity – 0.2mn km<br>Overall cost per unit – <CNY0.3m | Longevity – 0.25mn km<br>Overall cost per unit – <CNY0.2m | Longevity – 0.3m km<br>Overall cost per unit – <CNY0.18m |
| Key components technology | | High-speed oil-free air compressor, hydrogen circulation system, hydrogen storage bottle and other key components can fulfill the requirements for manufacturing FCV | | System cost below CNY200/kW |
| Hydrogen energy infrastructure | Hydrogen supply | Producing distributed hydrogen by utilising renewable energy; producing hydrogen as by-product for making "coke oven coal" gas; separation and purifying technology can help to produce hydrogen more efficiently | | Producing distributed hydrogen by utilising renewable energy |
| Hydrogen energy infrastructure | Hydrogen transportation | High pressure gaseous hydrogen - storage and transportation | Low - temperature liquid hydrogen - transportation | Atmospheric pressure high density organic liquid hydrogen - storage and transportation |
| Hydrogen energy infrastructure | Hydrogen station | Over 100 hydrogen stations | Over 300 hydrogen stations | Over 1000 hydrogen stations |

*Source: Society of Automotive Engineers of China, Energy-saving and New Energy Vehicle Technology Roadmap*

## Fuel cell: technology development roadmap for China

| 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|
| 2015:<br>Maximum efficiency is 55%<br>Low end of start up temperature-20°C<br>Materials cost is CNY4,000/kW<br>PV:<br>Rated power output: 35kW<br>Lifespan:3,000h<br>Power/volume: 2.0kW/L<br>Power/weight: 1.5kW/kg<br>CV:<br>Rated power output: 35kW<br>Lifespan: 3,000h<br>Power/volume: 1.5kW/L | 2020 Target:<br>Maximum efficiency is 60%<br>Low end of start up temperature-30°C<br>Materials cost is CNY1,000/kW<br>PV:<br>Rated power output: 70kW<br>Lifespan:5,000h<br>Power/volume: 3.0kW/L<br>Power/weight: 2.0kW/kg<br>CV:<br>Rated power output: 70kW<br>Lifespan: 10,000h<br>Power/volume: 2.0kW/L | 2025 Target:<br>Maximum efficiency is 65%<br>Low end of start up temperature-40°C<br>Materials cost is CNY500/kW<br>PV:<br>Rated power output: 90kW<br>Lifespan:6,000h<br>Power/volume: 3.5kW/L<br>Power/weight: 2.5kW/kg<br>CV:<br>Rated power output: 120kW<br>Lifespan: 20,000h<br>Power/volume: 2.5kW/L | 2030 Target:<br>Maximum efficiency is 65%<br>Low end of start up temperature-40°C<br>Materials cost is CNY150/kW<br>PV:<br>Rated power output: 120kW<br>Lifespan:8,000h<br>Power/volume: 4.0kW/L<br>Power/weight: 3.0kW/kg<br>CV:<br>Rated power output: 170kW<br>Lifespan: 30,000h<br>Power/volume: 3.0kW/L |

| | | | |
|---|---|---|---|
| **Improved performances** | Improve membrane electrode structure based on existing materials; optimise structures of metal bipolar plates and graphite bipolar plates | Apply new electrode materials and electric stack structures | Strengthen validation for new materials and new structure |
| **Improved longevity** | Improve the electric stack design; enhance the consistency of key components of stack | Develop high-efficient management technology and apply new materials | Optimise high-efficiency management technology and strengthen application for new materials |
| **Environmental adaptability** | Research on key components and their characteristics under low-temperature conditions | Develop stack's low-temperature start-up technology | Develop automotive system and comprehensive heat management technology |
| **Cost control** | Reduce the required amount of key materials so as to cut overall material cost | Develop composite proton exchange membrane, new catalyst; research on manufacturing technology for massively producing metal bipolar plates and graphite bipolar plates | Apply low-cost key components and materials, reduce the manufacturing cost |

*Source: Society of Automotive Engineers of China, Energy-saving and New Energy Vehicle Technology Roadmap*

## Global rechargeable battery growth by sector

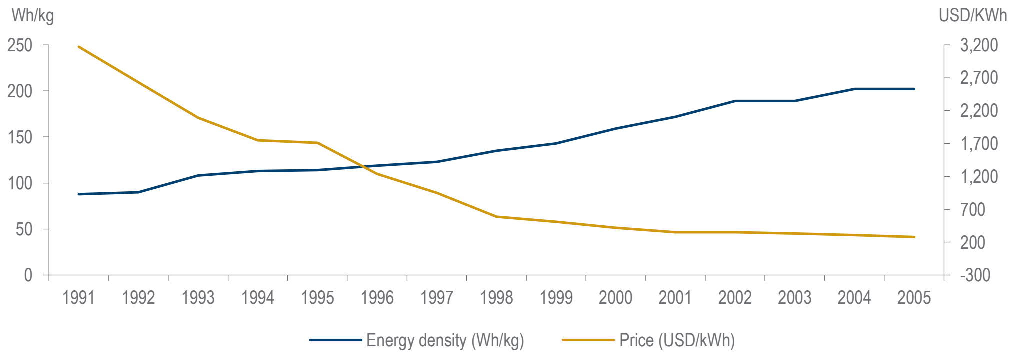
In 2014, the total market size of the global rechargeable battery industry was around USD60bn, by selling total energy volume of around 400GWh. The largest rechargeable battery sector is that for lead-acid batteries, accounting for around 87% of global rechargeable market sales volume and roughly 60% of total market value in 2014.

**LiBs are the second-most popular type of battery after lead acid batteries in global market sales value**

Though lead-acid batteries have many drawbacks compared to NiCd/NiMHs and LiBs due to their low energy density, short battery cycle life and long fast-charging time, they are the cheapest among peers and as such have become popular in various industrial sectors. Generally, the cost per unit energy volume (USD/Wh) of a lead-acid battery is around 25% that of a LiB and 50% that of an NiCd/NiMH, as estimated by Battery University.

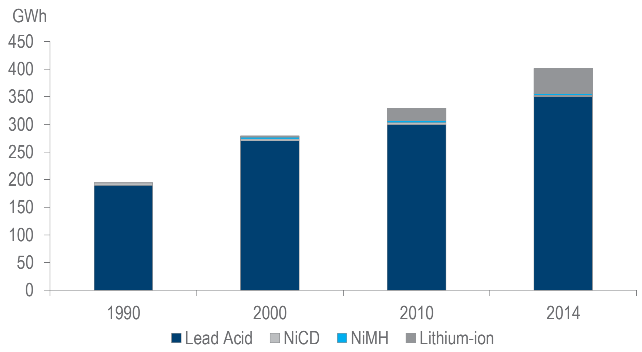
LiBs are the second most popular battery type in the rechargeable market currently. Benefiting from the improved performance and the cost reduction during 1995-05 (as graph below illustrates), LiBs rode on the wave of consumer electronics and achieved a market value CAGR of around 14% from 2000-14, per our estimates. In 2014, LiBs took around 11% of the global rechargeable market sales volume and around 34% of the total market value.

**LiB (consumer electronics) price and energy density from 1991-2015**



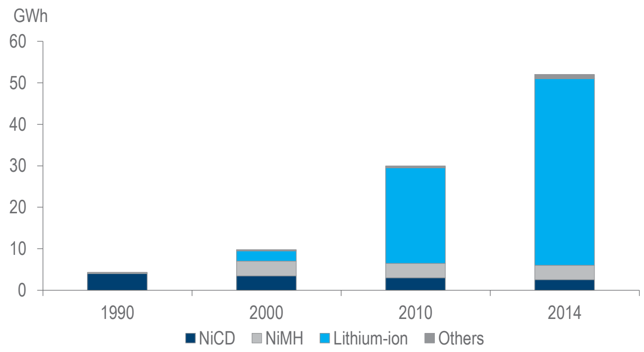

*Source: Battery University*

**Global rechargeable battery sales volume breakdown**



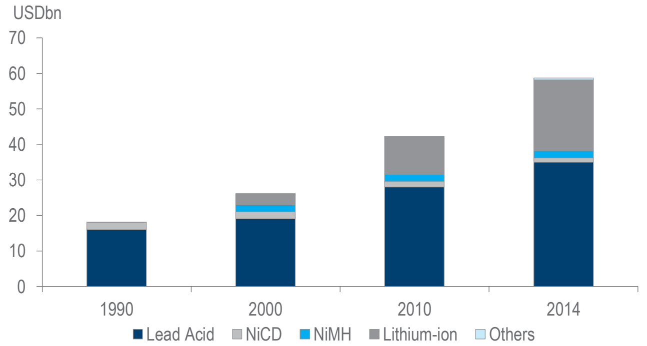

*Source: Avicenne Energy*

**Global rechargeable battery sales volume breakdown (excluding lead-acid)**



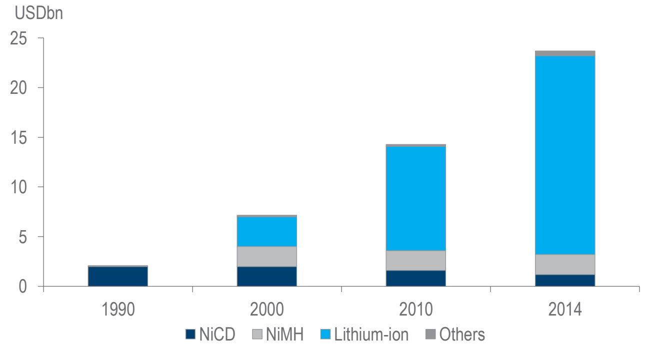

*Source: Avicenne Energy*

**Global rechargeable battery market value breakdown**




*Source: Avicenne Energy*

**Global rechargeable battery market value breakdown (excluding lead-acid)**




*Source: Avicenne Energy*

## LiB shipments set to surge on EV development

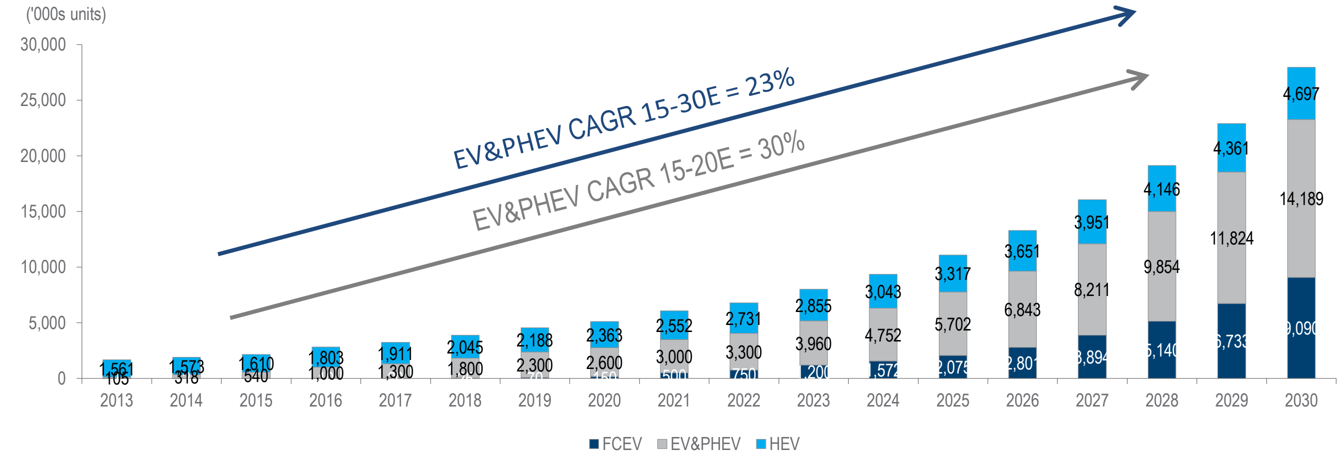
### EV growth the next driver for LiB sales

**Led by China, Europe and the US, EV sales have surged and should show strong momentum for the next few years**

EVs (excluding hybrid electric vehicles) passenger vehicle global shipments first exceeded 100,000 units in 2012, and rose significantly to around 320,000 units in 2014 and 540,000 units in 2015, contributed by sub-markets such as China, Europe (mostly the Netherlands, Norway, the UK, France and Germany) and the US.

According to forecasts from Daiwa's Regional Head of Automobiles and Components, SY Chung, global EV and PHEV shipments should rise at a CAGR of 30% for 2015-20E (for all NEVs including HEVs and FCEVs, the CAGR would be 37%), reaching annual sales of around 2.6m units by 2020.

**Global NEV shipment forecasts**




*Source: Daiwa forecasts*
*Notes: EVs include BEVs and PHEVs while 35-40% of total EVs are PHEVs*

### NEVs to be equipped with larger LiBs in the future

**We see a trend of installing batteries with higher energy volumes as a result of low battery costs and customers travelling long distances**

The energy storage volume per BEV ranges from 20KWh to 90KWh. The Tesla S, the premium BEV model, has the greatest energy storage volume (60-90KWh) among its peers and can achieve the longest pure electric distance at around 300km-500km. On the other hand, the batteries installed in regular EVs have a storage volume of around 20-30KWh which gives roughly 100km-250km pure electric distance.

We expect the cost difference between premium NEVs and regular NEVs to narrow from 2016-20 and expect to see a trend of installing larger batteries in NEVs owing to the need for long electric distance and the benefits of lower battery costs to take hold over the next 5 years. The Nissan Leaf, one of the top-selling EV models in the world, launched its new model this year (the 2016 Nissan Leaf) with a version that is equipped with a 30KWh battery, higher than the previous version (24KWh). Moreover, the new model BMW i3 is due to be launched in 2017 with a higher-energy battery, yielding a 33KWh capacity, significantly improved from its current level of 22KWh.

PHEV models usually require 8-19KWh of energy storage volume, much less than the amount for a BEV, due to a PHEV's shorter required pure electric distance. HEVs, which do not need to be charged, are usually outfitted with 3-5KWh batteries. Given that PHEVs and HEVs require less battery energy and are likely to be the transition models that may be replaced by BEVs when LiB costs come down significantly, we believe EV shipments will be the major driver for LiB sales volume in the long term.

**Global EV and PHEV sales ranking in 2015 and energy storage volume summary**

| Ranking | Model | Automaker | Mode | EV/PHEV | Sales Volume in 2015 | KWh/Unit |
|---|---|---|---|---|---|---|
| 1 | Tesla S | Tesla | Sedan | EV | 50,366 | 60-90 |
| 2 | Nissan Leaf | Nissan | Sedan | EV | 43,870 | 24 |
| 3 | Mitsubishi Outlander | Mitsubishi | SUV | PHEV | 43,259 | 16 |
| 4 | Qin | BYD | Sedan | PHEV | 31,898 | 13 |
| 5 | i3 | BMW | Sedan | EV | 24,083 | 22 |
| 6 | Kandi K11 | Kandi/Geely | Sedan | EV | 20,390 | 20 |
| 7 | Renault Zoe | Renault | Sedan | EV | 18,846 | 22 |
| 8 | Tang | BYD | SUV | PHEV | 18,375 | 19 |
| 9 | Chevrolet Volt | GM | Sedan | PHEV | 17,508 | 17 |
| 10 | Golf GTE | Volkswagen | Sedan | PHEV | 17,282 | 9 |
| 11 | BAIC E-series EV | BAIC | Sedan | EV | 16,488 | 25-30 |
| 12 | Zotye Cloud EV | Zotye | Sedan | EV | 15,467 | 18 |
| 13 | Volkswagen e-Golf | Volkswagen | Sedan | EV | 15,356 | 24 |
| 14 | Audi A3 e-Tron | Volkswagen | Sedan | PHEV | 11,962 | 9 |
| 15 | Roewe 550 | SAIC | Sedan | PHEV | 10,711 | 12 |
| 16 | JAC iEV4/5 | JAC | Sedan | EV | 10,420 | 33 |
| 17 | Ford Fusion Energi | Ford | Sedan | PHEV | 9,894 | 8 |
| 18 | Ford C-Max Energi | Ford | Sedan | PHEV | 9,643 | 8 |
| 19 | Kandi K10 | Kandi/Geely | Sedan | EV | 7,665 | 20 |
| 20 | Kia Soul EV | Kia | Sedan | EV | 7,510 | 27 |

*Source: ev-sales, company website, various media*

Compared with a cell phone LiB's energy volume of 6-15Wh, a tablet LiB's energy volume of 25-45Wh and notebook LiB's energy volume of 50-80Wh, BEVs and PHEVs show their enormous energy volume demand. As shown below, the annual LiB demand for the Tesla S is roughly twice the amount for an iPhone, on our estimates.

**LiB demand comparison between iPhone and Tesla S**

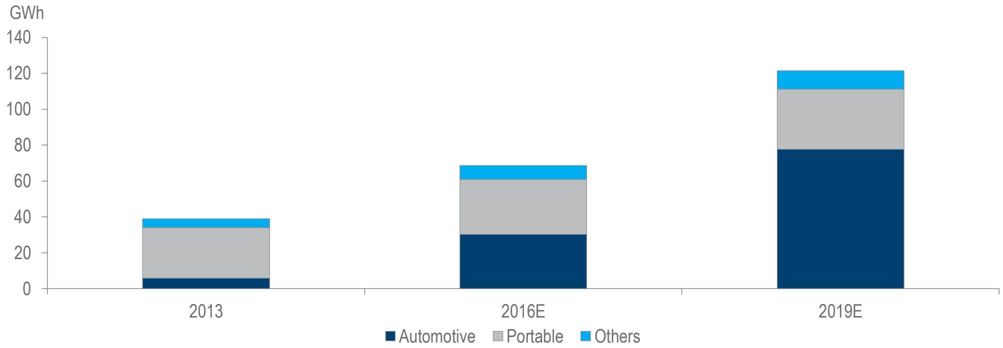
| | Wh/unit | Shipments in 2015 (000's) | Estimation of total demand of LIB in 2015 (KWh) |
|---|---|---|---|
| IPhone | 6.5-11.1 | 231.5 | 1,800 |
| Tesla S | 60,000-90,000 | 0.05 | 3,600 |

*Source: IDC, ev-sa;es, various media*
*Note: IPhone6/6s feature LIB of 6.9/6.5Wh while IPhone 6 plus/6s plus feature LIB of 10.5/11.1Wh*

According to Avicenne Energy, the automotive sector contributed 5GWh of LiB demand in 2013 while portable devices contributed 28GWh. Given the expected surge in EV sales and mild sales growth for consumer electronics, Avicenne Energy forecasts LiB demand from the automotive segment to be more than twice that from portable devices by 2019, achieving a CAGR of 42.7% from 2016-19, higher than the 36.7% CAGR for EV shipments during the same period, due mainly to the higher energy storage volume per unit.

**We expect the EV LiB market to expand rapidly, benefiting from the growing number of EV vehicles and the enlarged energy volume per unit**

**LiB sales volume forecasts**




*Source: Avicenne Energy, Daiwa forecasts*

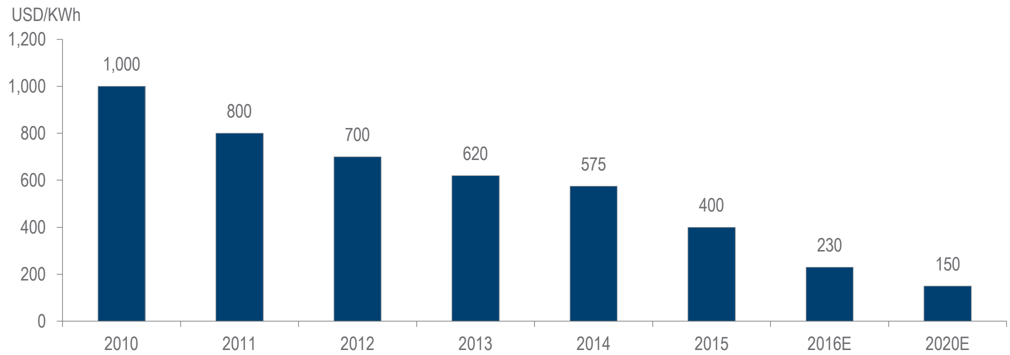
## EV LiB cost reduction will further boost the demand

**We look for the EV LiB cost to decline further as EV demand yields scale economies and as technology advances continue**

The significant reduction in the cost of an EV LiB is one important reason for the acceleration in EV shipment over the past few years. On the other hand, increasing demand for EV LiBs should also stimulate technology input and lead to an expansion in production capacity, thus leading to better characteristics for EV LiBs and economies of scale. Also, the establishment and expansion of the EV LiB manufacturing supply chain will contribute to the falling prices as well. According to Tesla's Jeff Evanson, the battery pack cost is already below USD190/KWh, and the base Model 3 is expected to be offered with a battery pack option that is even cheaper than USD60/KWh.

Moreover, General Motors announced in October 2015, that the cost of its EV LiB, which is sourced from LG Chem, will drop to around USD145/KWh for its Chevrolet Bolt EV model to be unveiled in 2017. The low-cost battery for the Chevrolet Bolt will be produced at LG Chem's plant located in Holland, in the US state of Michigan, and LG Chem stands to benefit from the resulting high volumes and economies of scale. By 2021, GM expects the cost of this LiB to be lowered to the USD100/KWh mark. On our estimates, average EV LiB pack costs could reach a level of USD150/KWh by 2020 (see following chart).

**Average EV battery pack costs trend (2010-20E)**




*Source: Daiwa forecasts*

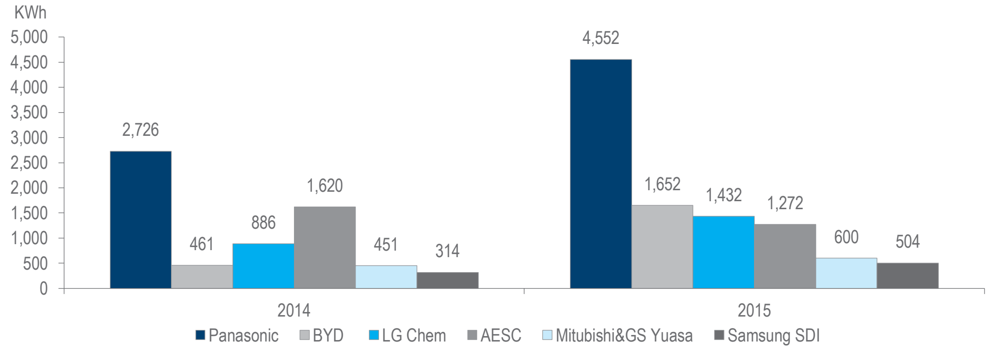
## Major global EV LiB players

### All the top LiB battery cell makers are located in Asia

**Panasonic leads EV LiB sales among its peers, followed by BYD, LG Chem and Samsung SDI**

All the top players in the EV LiB sector are located in Asia, including from Japan, Korea and China. Panasonic leads the sales volume growth among peers, recording around 4.6GWh LiB shipments in 2015, benefiting from robust sales for the Tesla S. Excluding its bus battery sales due to the limited figures available for bus battery sales volume, BYD ranks No.2 as a consequence of its hot-selling models like the BYD Qin, BYD Tang and BYD E6. Korean manufacturers LG Chem and Samsung SDI have also seized the opportunities by providing more LiBs to their international customers such as GM, BMW and Renault. AESC and Mitsubishi & GS Yuasa still rely mostly on battery sales for the reputable models produced by their parent companies.

**Top EV LiB makers: sales ranking (2014-15)**




*Source: evobssession*

*Note: BYD's battery sales volume does not include its EV bus battery operation owing to a lack of reliable figures; Mitsubishi & GS Yuasa is also called Lithium Energy Japan, and is controlled by GS Yuasa (51% stake) and Mitsubishi Corporation (49%); AESC is the battery-producing JV between Nissan (51%) and NEC Corporation (49%)*

**The achieved sales volume of EV LiB players moves in tandem with the sales of the EV models they supply**

The EV LiB sales of these battery markers are highly dependent on the sales performance of the EV models they supply. For those LiB cell companies controlled by auto OEMs such as BYD (BYD Battery), AESC and Mitsubishi & GS Yuasa, the key volume driver is the EV sales of their parent companies. On the other hand, for independent companies such as Panasonic, LG Chem and Samsung, they may face the risk of customer migration but also have more flexibility in terms of acquiring orders by expanding their customer base.

**We expect the top EV LiB makers to focus more on EV markets when expanding their global capacity so as to better connect with local OEMs and governments**

Also, a trend has been emerging whereby auto manufacturers are seeking more control of their battery supply instead of simply sourcing LiB cells or LiB packs from battery makers or pack manufacturers. For example, Tesla's partnering with Panasonic to build their "Gigafactory" in Nevada, US, where they will manufacture their own battery cells, signals that Tesla not only wants to make the packs itself, but also seeks control over the cell manufacturing.

Also, according to Bloomberg News, Volkswagen is considering investing EUR1.7-2bn to set up factories at several sites around the world to supply its main Volkswagen EV line-up, as well as the EV models of its premium brands, such as Audi and Porsche,.

**Top sales EV models and their battery suppliers**

| Battery maker | Top sales EV model | OEM |
|---|---|---|
| Panasonic | Tesla S | Tesla |
| | Golf GTE | Volkswagen |
| | e-Golf | Volkswagen |
| | Audi A3 e-Tron | Volkswagen |
| | Ford Fusion Energi | Ford |
| | Ford C-Max Energi | Ford |
| BYD | BYD Qin | BYD |
| | BYD Tang | BYD |
| | BYD E6 | BYD |
| LG Chem | Renault Zoe | Renault |
| | Chevrolet Volt | GM |
| AESC | Nissan Leaf | Nissan |
| Mitsubishi & GS Yuasa | Mitsubishi Outlander | Mitsubishi |
| Samsung SDI | BMW i3 | BMW |

*Source: Company website, various media*

## Capacity expansion for EV LiB is the big trend

The top EV LiB manufacturers are aggressively expanding into China, Europe and the US, given the surging regional markets and that plenty of big OEMs are located there. In the US, the factory built by Panasonic and Tesla is anticipated to be the largest LiB cell plant in the world. Also, LG Chem is likely to enlarge the scale of its Holland plant, due to its expectation of incremental sales of EV models from GM (Chevrolet Bolt EV) and other potential new clients. AESC is likely to maintain its capacity at its Tennessee facility, and has not made its expansion plan public.

In terms of Europe, both LG Chem and Samsung SDI say they have established new plans so as to better meet the requirements of German brands and win more orders. LG Chem this year started construction of a plant in Poland, while Samsung SDI is planning to build an EV LiB battery plant in Hungary.

The real potential of the EV market and appealing policies in China have attracted battery makers including Panasonic, LG Chem and Samsung to build factories there. All of them have found local partners to form joint ventures, due partly to receiving more support from the local governments. However, foreign battery manufacturers are facing challenges due to the protective environment in China, which currently still excludes foreign battery makers' products from enjoying subsidies.

**Automotive LiB capacity summary of global top players**

| Battery maker | Existing capacity | Capacity expansion plan |
|---|---|---|
| Panasonic | Has 3 factories for producing automotive batteries in Kasai/Sominoe/Kaizuka, Japan | Has partnered with Tesla to build a Gigafactory of 35GWh - LIB cell / 50GWh - LiB pack in 2020 in Nevada, US. Plans to build a plant of around 3-6GWh by 2018 in Dalian, China (production plan is for 200,000 units EV) |
| LG Chem | Has a LiB plant with annual capacity of 50m units located in Ochang, Korea; 0.65GWh in Holland, the US; and roughly 0.7-1.5GWh in Nanjing, China (production plan is for 50,000 units EV per year) | Likely to reach 3GWh at its Holland plant in the future; construction kicked-off in Poland in 2016, capacity is expected to be 1.5GWh; China plant should ramp up to around 6GWh by 2020 |
| Samsung SDI | Has 2 plants in Ulsan, Cheonan, Korea; roughly 0.6-1.2GWh in Xi'an, China (production plan is for 40,000 units EV per year) | Considering building a factory in Europe; potential expansion at the China factory |
| BYD | 8GWh/1.6GWh in Shenzhen/Huizhou, China | Will construct a 6GWh plant in Qinghai, China by end-2017, and add a further 10GWh by August 2019 |
| AESC | Has 3 factories in Zama, Japan/Sunderland, UK/Tennessee, US | Will invest around USD40m in its Sunderland plant; no capacity expansion plan yet |
| Mitsubishi & GS Yuasa | Has 3 plants in Kusatus/Kyoto/Ritto, Japan | No capacity expansion plan yet |

*Source: Company, Koreatimes, Autonews, various media, Daiwa estimation*

# Appendix 2: battery material study

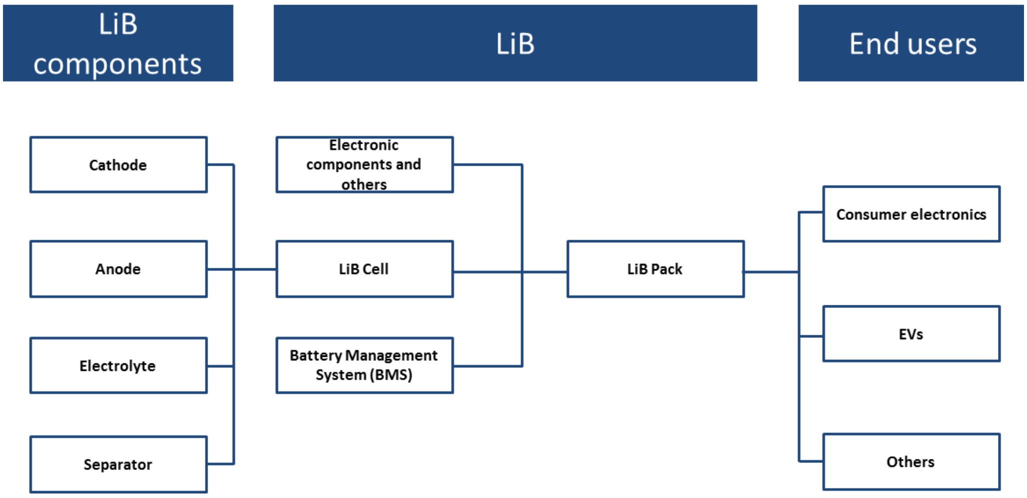
## Understanding the supply chain

### How do the different parts connect together?

**Four basic LiB components: cathode, anode, electrolyte and separator**

There are 4 main components in a LiB cell: a cathode, anode, electrolyte and separator. LiB cell makers source these key materials from suppliers and assemble the cells mechanically or manually. The LiB module is usually formed by connecting multiple cells and encasing those cells in a metal case. Then, a LiB pack is formed by connecting multiple modules together with the battery management system (BMS) and other electronic components. The size and the design of the LiB pack is usually determined by the customers in order to better fit EV models or consumer electronics.

**LiB supply chain**




*Source: Daiwa*

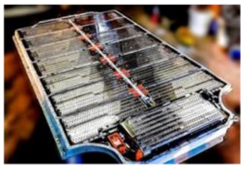
There are various types of LiB cells due to different manufacturing methods.

The cylindrical battery is the most popular, mainly due to its low production costs, stable physical structure and ease of thermal management. Tesla uses this technology with around 7,000 units of Panasonic's "18650" battery (18mm diameter x 65mm length) installed in its vehicle chassis.

Prismatic batteries are also gaining wider recognition and are currently used by the Nissan Leaf. The thin, flat structure allows a greater reduction of space between cells when compared to a cylindrical battery, resulting in higher utilisation of space. However, heat management also becomes more of an issue, thus requiring a higher standard thermal management system.

Pouch batteries, the third type of LiB cell, are more flexible as they are constructed by pouches made from li-polymer. This technology means the battery is light and cost-effective but usually swells over hundreds of cycles, which should be taken into consideration when designing battery cells.

Various types of EV LiB batteries

| EV model / Battery Maker | LiB Cell | LiB Module | LiB Pack |
|---|---|---|---|
| Nissan Leaf/ AESC |  |  |  |
| Tesla S/ Panasonic |   |  |  |

*Source: Company website, various media*

**LiB manufacturers are mainly located in Japan, Korea and China**

LiB cell makers are mainly located in Japan, Korea and China and source most of their materials from various suppliers located in the region. Top LiB cell makers such as Panasonic and LG Chem manufacture LiB cells by combining different materials together. They are also usually required to have in-house BMS technology, to prevent the battery from operating outside a safe operating range, to monitor the state of the battery (temperature, voltage, charging state, coolant flow, current) and other data, so as to deliver the applicable LiB pack for end users to install.

On the other hand, some EV manufacturers such as Tesla tend to source LiB cells directly from cell producers and produce battery packs themselves to reduce costs and gain in-house BMS experience. Many Chinese automobile OEMs such as Beijing Motor, Shanghai Motor and Jianghuai Motor have formed JVs with foreign LiB cell producers and BMS companies to gain knowledge in assembling LiB packs.

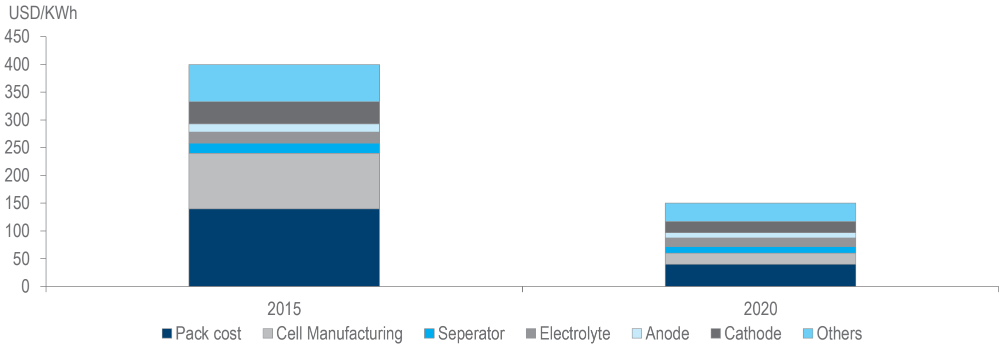
## EV LiB cost structure

**Material costs are likely to account for 30-50% of total LiB pack costs for EV LiBs**

On our estimates, EV LiB pack costs for LiB manufacturers were around USD400/KWh in 2015, down from USD1,000/KWh in 2010. According to Avicenne Energy, for EV LiB pack production in excess of 100,000 units per year (roughly1-3GWh/year), battery producers will bear a pack cost (costs of purchasing electronic materials, BMS and manufacturing) of around 30-40% of the total LiB pack cost, implying an EV LiB cell cost of around USD240-280/KWh. Cell manufacturing costs, including depreciation expenses and labour cost, likely make up around 20-30% of total LiB pack cost. Therefore, according to Avicenne Energy, materials costs make up around 30-50% of total LiB pack costs.

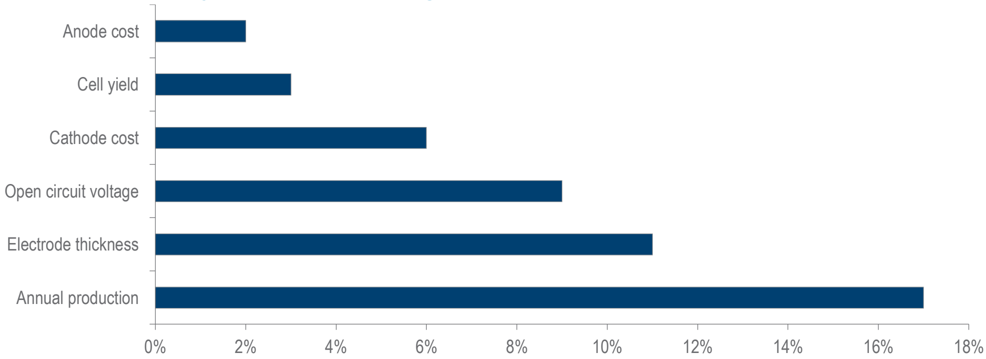
We believe that battery cell pack costs will reach USD150/KWh by 2020 due to several reasons summarised below. Factors such as annual production, anode costs and cathode costs are highly related to overall EV demand, while others are more related to technology advancement, and can be attributed to: 1) optimising the chemistry of different materials, 2) improvement of cell design, and 3) an increase in production efficiency

**LiB pack cost breakdown**




*Source: Avicenne Energy, Daiwa estimates*

**Estimated sensitivity of LiB costs to changes of individual variables**




*Source: Bloomberg New Energy Finance*

## Safety the key selection criteria for LiB technology

There are a number of new advancements in technology which could accelerate LiB improvement. However, a lot of this technology cannot be commercialised yet as it is not safe in its current form. Most safety issues arise due to the instability of LiB materials. Hence, we believe that thermal management systems and BMS are necessary in order to control these issues.

**Overheating can be triggered in many ways and is the most common LiB safety issue**

One of the most common safety problems is overheating. LiBs usually have a cooling system (especially automotive LiBs) to dissipate heat. However, manufacturing flaws or the instability of new materials may lead to a rise in temperature. The higher temperature environment may then set off a reaction in various materials, which could cause further heat. Left unchecked, this could result in a violent emission of gas and flames.

**Safety issues related to LiB**

| Company | Problem | Consequence |
|---|---|---|
| Samsung Electronics | The battery cell made by Samsung SDI had a flaw, which may result in an explosion or fire | Recalled 2.5m units of its new Galaxy Note 7 in 2016 |
| Sony | Laptop battery pack made by Sony may potentially overheat and cause a fire | Recalled approximately 10m laptop batteries in 2006 |
| Tesla | Several Model S fires, probably originating from its battery | Issued a software update so as to reduce amperage if heating is detected in 2014 |

*Source: Bloomberg, Washington Post*

Various materials have different safe operating temperatures. LiBs are equipped with cobalt cathodes which should never rise above 130°C (265°F). Manganese offers superior thermal stability and can sustain temperatures of up to 250°C (482°F) before becoming unstable. However, the latter has the drawback of low energy density. A cell made of pure manganese cathodes only has half the capacity of a cobalt cell. Therefore, we expect many different material mixes to be developed, to achieve the balance between energy density and safety.

# LiB components: cathodes

## Different types of cathodes

**NCM, NCA and LFP are now most popular choices for EV LiB**

Cathodes make up around 40% of LiB cell material cost and are the main element in determining a LiB's characteristics. Currently, we name a LiB based on the cathode material it uses. For example, lithium cobalt oxide (LCO), one of the most common LiBs, has cobalt as its main cathode material. There are five kinds of cathodes and each of them has their strengths and weaknesses.

LCO was commercialised first and is popular for use in consumer electronics LiBs due to its high energy density. However, it has a relatively high price due to the substantial use of cobalt (60% of total material is cobalt) and a low power density. Tesla firstly used LCO in 2008 in its EV LiB for its Roadster model when other technology was less mature.

EV LiB, NCM, NCA and LFP batteries are currently widely used, although LMO is also used by AESC in its Nissan Leaf model. LFP is the safest, but has a relative lower energy density. Conversely, NCM and NCA (which are similar to NCM but use aluminium instead of manganese) have a higher energy density, which means longer distance, but is relatively less stable. Their materials cost is slightly lower than LCO due to a lesser amount of cobalt required (10-20% of total material is cobalt.) Good BMS, thermal management systems and cooling systems are necessary for NCM and NCA.

Different materials are often mixed together to create better batteries. For instance, the BMW i3 is equipped with a LiB cell which uses a LMO and NCM mix in its cathode.

### Various materials used in cathodes

| Cathode materials | Chemical formula | Chinese name | Inception time | Pros | Cons | Energy density (Wh/kg) | Auto models | Specialised battery makers |
|---|---|---|---|---|---|---|---|---|
| Lithium Cobalt Oxide | $LiCoO_2$ / LCO | 鈷酸鋰 | 1991 | Widely used in computer, communication and consumer electronics (3C) products. High energy density and stable discharge voltage | Relatively expensive, short life span and cobalt may cause environmental pollution | 150-200 | Tesla Roadster | Panasonic |
| Lithium Manganese Oxide | $LiMn_2O_4$ / LMO | 錳酸鋰 | 1996 | Low cost, less pollution, better safety and offers a moderate energy capacity | Lower lifer cycle and calendar life, less stable at high temperatures | 150-200 | Nissan Leaf | AESC |
| Lithium Iron Phosphate | $LiFePO_4$ / LFP | 磷酸鐵鋰 | 1996 | One of the safest Li-ion batteries, long life span | Moderate specific energy and lower voltage, higher self-discharge and heavy in weight | 90-120 | BYD E6 | BYD |
| Lithium Nickel Cobalt Aluminum Oxide | $LiNiCoAlO_2$/ NCA | 鎳鈷鋁酸鋰 | 1999 | High energy and power densities, good life span | Higher cost, requires more care | 150-200 | Tesla Model S | Panasonic |
| Lithium Nickel Manganese Cobalt Oxide | $LiNiMnCoO_2$/ NCM | 鎳鈷錳酸鋰 | 2008 | Combined advantages of $LiCoO_2$ and $LiMn_2O_4$ batteries, high capacity and power | More expensive, price also fluctuates with cobalt price; cobalt may cause pollution problems | 200-260 | Kia Soul / BMW i3 | Panasonic, Samsung SDI, LG Chem, SK Innovation |

*Source: Battery University, Daiwa research*
*Note: BMW i3 uses a combined NCM and LMO as its cathode source*

### Comparisons among different cathode materials (3= best, 1= worst)

| | LCO | LMO | LFP | NCA | NCM | Description |
|---|---|---|---|---|---|---|
| Energy density | 3 | 2 | 1 | 3 | 3 | Energy per unit weight |
| Cost | 2 | 2 | 3 | 1 | 2 | Expense per unit energy |
| Life Span | 1 | 1 | 3 | 2 | 2 | Numbers of cycles can be charged |
| Safety | 1 | 2 | 3 | 1 | 2 | Concerns if the battery is misused |
| Performance | 1 | 1 | 2 | 2 | 2 | Performance over extreme temperatures |
| Power density | 1 | 2 | 3 | 2 | 2 | Power per unit weight |

*Source: Battery University, Daiwa research*

## The cathode industry at a glance

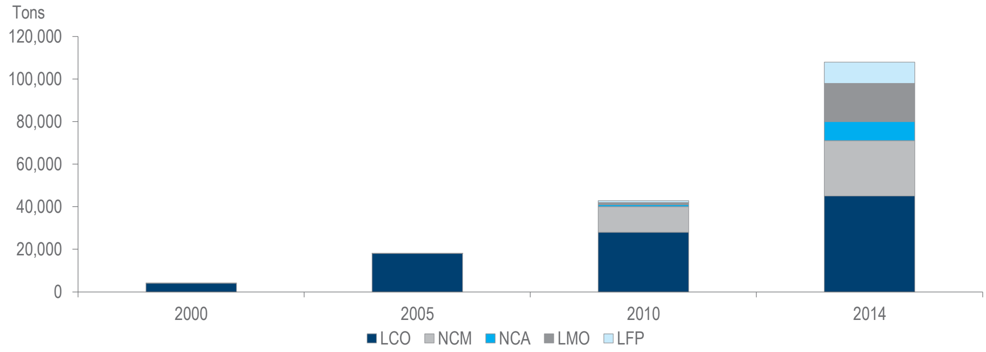
LCOs used to dominate the industry due to rising demand in mobile applications since the 1990s. However, other kinds of cathodes gradually started to gain in popularity and erode LCO market share in the portable device segment during the 2000s. With increased EV sales after 2010, 4 other types of cathodes have entered the market and began to grow substantially.

**LFP sales in the EV LiB market are expected to grow due to growing demand in China**

We expect LFP supply volumes to increase substantially in the coming years as more than two-thirds of Chinese EV LiB suppliers use LFP technology while Chinese EV LiB capacity is expanding aggressively due to policy stimulus. In the long run, we expect NCA and NCM volumes to increase at a constant rate owing to their high energy densities if safety issues can be resolved through advanced BMS technology and temperature control systems. According to a study from Umicore, one of the top cathode suppliers globally, LiBs with NCM/NCA technology will occupy around 74% of total EV LiB market share, increasing from the current 56% by 2020.

**Umicore dominated the LCO and NCM/NCA sub-markets in 2014 and also plans to expand its capacity further in China and Korea**

**Cathode market volume for LiB in 2000-2014**

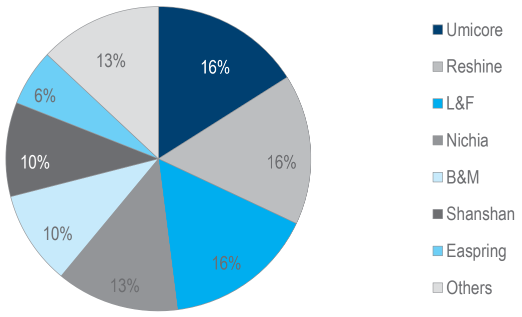



*Source: Avicenne Energy, Daiwa estimates*

In 2014, LCO and NCM/NCA were major sub-segments while we expect LFP to grow significantly from 2015 due to the massive demand from the China EV sector. Among various players, Umicore, a multinational materials technology company headquartered in Belgium, led the market in LCO and NCM/NCA and also planned to invest another EUR160m of capital during 2016-2018 for capacity expansion in Cheonan, Korea and Jiangmen, China.

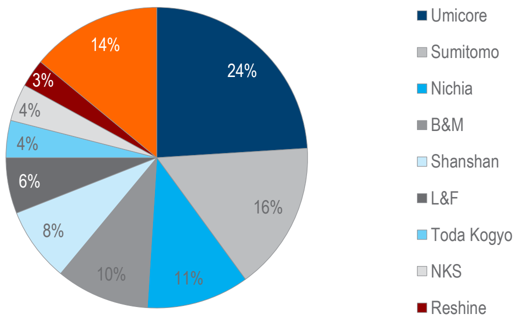
Several Chinese companies such as Reshine, B&M, Shanshan and Easpring are emerging players while many other small Chinese cathode materials makers are also present in the segment. Japanese players such as Nichia, Sumitomo, Toda Kogyo, JGC, Qyanyun and Nippo Denko supply to clients in Japan and Korea. Among the remaining companies, L&F led the Korean market while Johnson Matthey (headquartered in the UK) recently acquired the battery materials segment of A123 and Clariant, gaining market share in the LFP sub-segment.

**2014: LCO shipment breakdown**



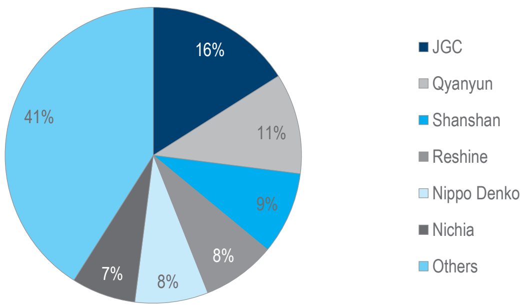

*Source: Avicenne Energy, Daiwa estimates*

**2014: NCM/NCA shipment breakdown**



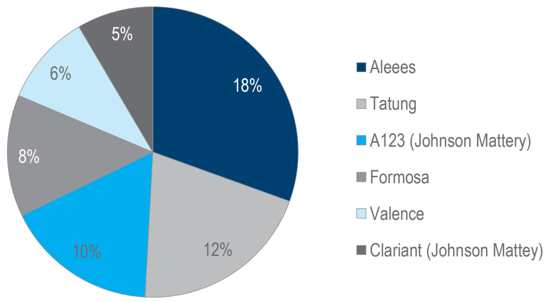

*Source: Avicenne Energy, Daiwa estimates*

**2014: LMO shipment breakdown**




*Source: Avicenne Energy, Daiwa estimates*

**2014: LFP shipment breakdown**




*Source: Avicenne Energy, Daiwa estimates*

## LiB components: anodes

**By adding silicon material to the original anode, energy density can be improved markedly, but this also leads to safety issues**

### Anode development may surprise us in the future

An anode makes up around 10-20% of a LiB cell's total cost, much less than the cost of a cathode. However, we believe that technology advancement in this segment may become crucial to enhancing the performance of LiBs cell in the future.

Originally, anodes were made from coke (derived from coal) when LiBs were first introduced in 1991. Since 1997, most manufacturers have shifted to graphite to obtain a more stable voltage discharge, thus increasing the long-term cycle stability of LiB. Graphite still serves as the main component in anodes today, but there are two potential developments which may change this.

Silicon-based alloys can be effective additives according to academic research and industry practice. It takes six carbon (graphite) atoms to bind to a single lithium ion; while a single silicon atom can bind to four lithium ions, which means that the silicon anode could theoretically store around 24 times the energy of graphite. However, the drawback is that the anode grows and shrinks during charging and discharge, making the cell mechanically unstable. Therefore, only a measured amount of silicon can be added at present.

During a Tesla conference call in July 2015, CEO Elon Musk said that the company had improved its battery by shifting the cell chemistry to partially use silicon in the anode and intended to increase the portion of silicon for higher energy density. Hence, we believe the race among battery markets to include more silicon in anodes has already started.

**Various anode energy capacity comparisons**

| | Capacity (mAh/g) |
|---|---|
| Graphite | 400-1000 |
| Mixture of graphite and silicon | 300-400 |

*Source: BTR Company*

The second promising technology is nano-structured lithium-titanate, a material which offers good load capabilities, a promising life cycle, excellent low-temperature performance and is relatively safe. However, its current energy density means it is still not very attractive while its high cost may prevent it from being widely utilised.

### The anode industry at a glance

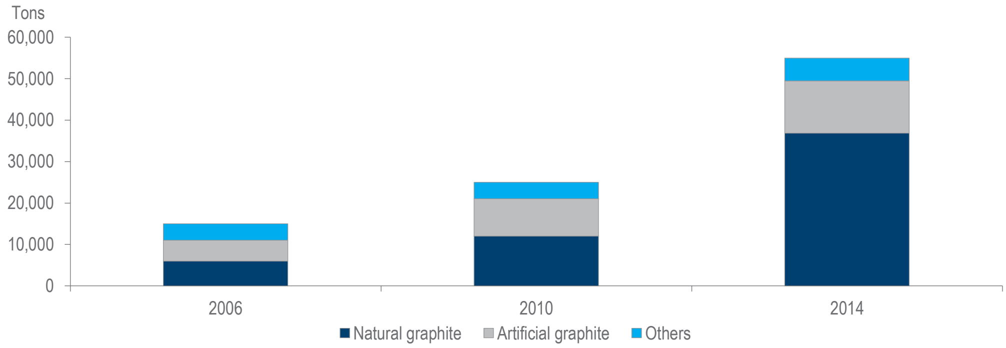
**Leveraging on its large natural graphite reserves, China has the largest market share for anode material supply**

Natural graphite occupied around 70% of anode material market share in 2014 due to its lower price. Artificial graphite is more expensive but has a relatively higher purity. Due to its abundant natural graphite resources, China led the market with approximately 60%-70% of total material supply in 2014, with the remainder mostly coming from Japan, according to our estimates.

Chinese battery maker Beiterui's (BTR) sales have increased significantly during recent years and the company claims it was No.1 in terms of the total anode shipments in 2010. BTR has maintained its market leading position with around 35% of market share in 2012. It has integrated its supply chain and gained cost advantages by building plants to process raw materials. Apart from BTR, other Chinese players include Shanghai Shanshan, Shinzoom and Shenzhen Sinuo.

Historically, Japanese companies were the largest in terms of market share, but they have lagged behind Chinese peers in terms of market scale as demand in China has grown in recent years. Hitachi, JFE Chem, Mitubishi Chem and Nippon Carbon are major Japanese players.

**Anode market volume for LiBs**




*Source: Avicenne Energy, Daiwa estimates*

## LiB components: electrolytes

**Electrolytes provide safety and conductivity**

**Electrolytes have 3 main components: organic solvents, lithium salts and additives**

The electrolyte provides conductivity in a battery by facilitating the movement of ions from anodes to cathodes on discharge and vice versa. LiBs use liquid, gel, or dry polymer electrolytes.

Liquid electrolytes are most common and are made up of 3 parts: organic solvents, lithium salts and additives.

Organic solvents such as ethylene carbonate allow batteries to be used safely as water will react with electrodes and may cause an explosion. Lithium salts such as $LiPF_6$ provide higher conductivity by increasing the number of lithium ions in the electrolyte. Additives are also added to electrolytes to enhance battery performance. One well-known additive is vinylene carbonate (VC). The chemical improves the cycle life of Li-ion batteries, especially at higher temperatures and keeps internal resistance low.

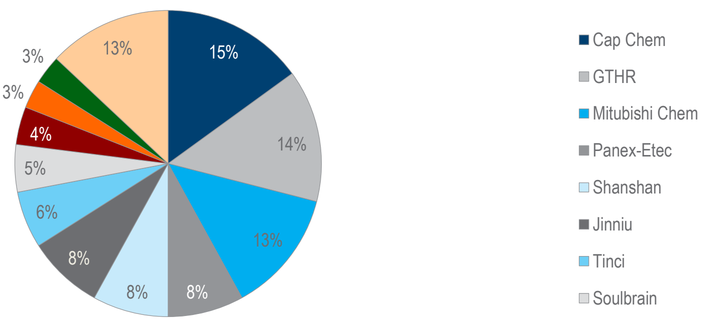
We believe that academic research is lagging behind cell manufacturers/electrolyte suppliers in terms of the choice of additives. Hence we assume each manufacturer has its own secret blend, which is an entry barrier for this market.

**Chinese electrolyte suppliers such as Cap Chem and GTHE rank highly in the global market**

**The electrolyte industry at a glance**
The bulk of electrolyte suppliers originate from Japan, Korea and China. Chinese players ranked highly in 2014, with Cap Chem and GTHE the No.1 and No.2 in terms of shipment volume. Shanshan, Jinniu and Tinci also had significant market share. Cap Chem disclosed in its 2015 annual report that the company has won contracts with foreign customers such as Samsung and Sony, which means that the quality of the Chinese domestic electrolyte market has been recognised by top LiB cell makers.

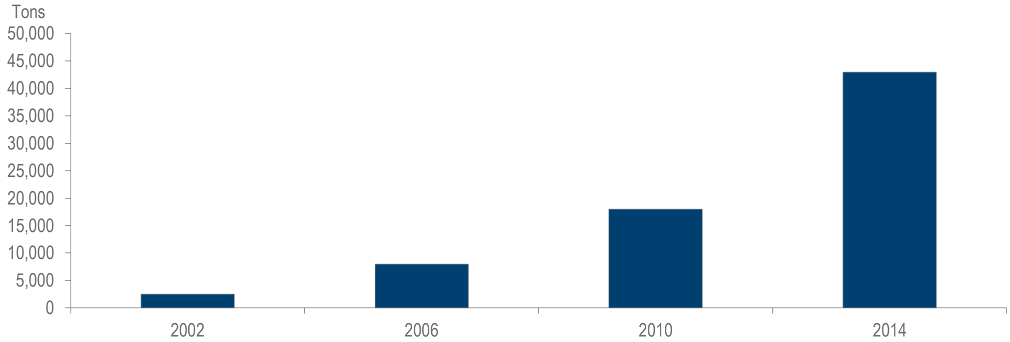
Japanese companies such as Mitubishi Chem, UBE, Mitsui Chem and Tomiyama mostly supply local Japanese cell makers such as Panasonic and Sony. Panex-Etec and Soulbrain are Korean companies which largely rely on domestic demand.

**2014: electrolyte shipment breakdown**




*Source: Avicenne Energy, Daiwa estimates*

**Electrolyte market volume for LiBs**




*Source: Avicenne Energy, Daiwa estimates*

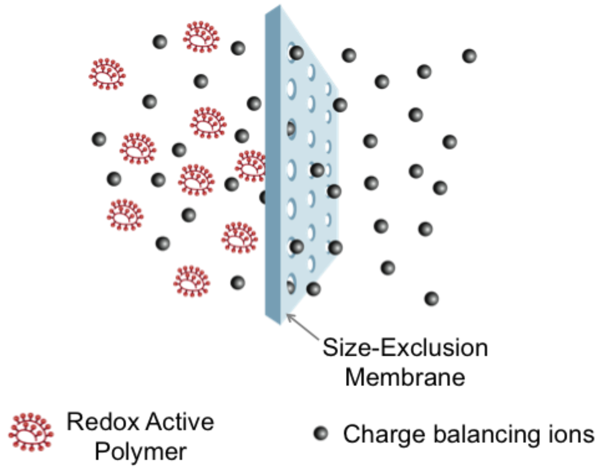
## LiB components: separator

**Safety wall**
The separator serves as the catalyst for promoting the movement of ions, and is also used as a fuse in a LiB. The separator provides a barrier between the anode and the cathode, preventing the exchange of liquid electrolytes, but enables the movement of lithium ions from cathode to anode when charging and vice versa.

A separator is also necessary for battery safety and will shut down by closing its pores to stop the transport of ions during excessive heat (usually above 130 Celsius). Without this protection, heat could rise above the thermal runaway threshold and cause a fire.

**Separators are made as thin as possible in order to save space in the LiB and allow more active materials to be placed in the cell**

**Separator enabling movement of ions**




*Source: UIUC*

Most LiB separators are made from polyolefin, which is made from polyethylene (PE), polypropylene (PP) or laminates of both materials. An enhanced level of safety and increased energy density can be achieved by upgrading the separator.

Starting from 2008, further improvements were made by adding a ceramic-coated material to the PE and PP layers so as to provide an additional safety net. However this also added more cost.

Separators are also getting thinner from 26 µm to 12 µm, according to a study from the Battery University (one micron, also known as µm, is one millionth of a meter.), hence leading to an improvement in LiB's energy density by taking up less space and allowing a larger amount of active materials to be placed in the cell.

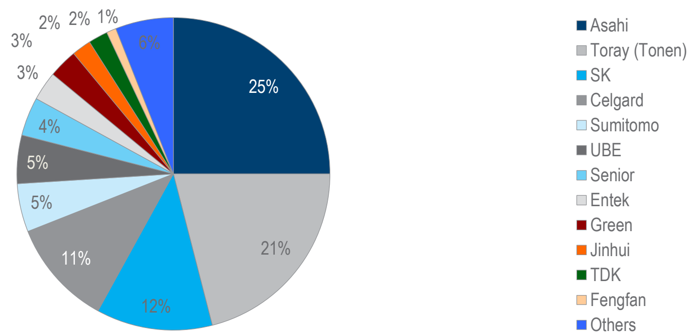
**The separator industry at a glance**

Japanese suppliers dominate the separator market, as shown in the shipment breakdown from 2014. The top player in 2014, Asahi Kasei, strengthened its position further by acquiring Polypore International, the mother company of Celgard in August 2015. Other major Japanese players are Toray (Tonen), Sumitomo, UBE and TDK. SK was ranked No.3 overall and is a key player in the Korean market.

**For Chinese suppliers, the separator sub-market's entry barrier is the highest among the four components**

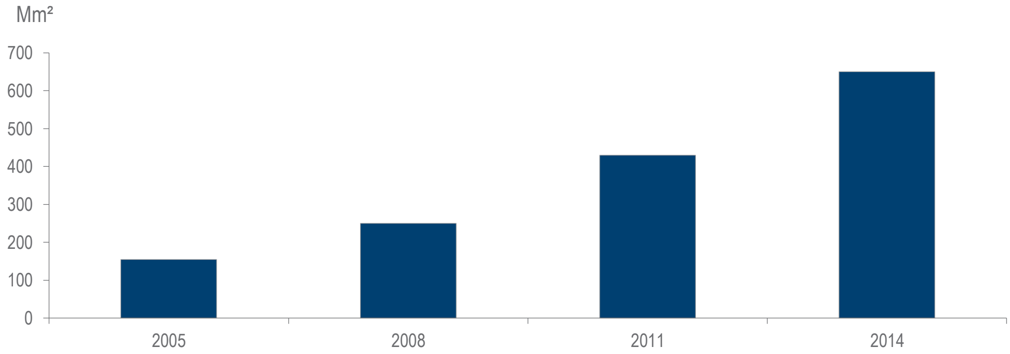
Chinese suppliers are not as competitive in separator sub-market as compared to the anode and electrolyte sub-markets. Senior, Green, Jinhui and Fengfan mainly sell products to domestic cell makers. Among them, Senior was the top-ranked in terms of market share and has successfully acquired orders from LG Chem prior to 2013, marking its expansion to overseas markets.

**Separator shipment breakdown (2014)**




*Source: Avicenne Energy, Daiwa estimates*

**Separator market volume for LiBs**




*Source: Avicenne Energy, Daiwa estimates*

Daiwa Capital Markets

# BYD (1211 HK)

Target price: **HKD68.00** (from HKD65.00)

Share price (30 Nov): **HKD46.70** | Up/downside: **+45.6%**

5 4 3 2 **1**

**Buy**
(unchanged)

## Advancing its competitive edge in 2017

- We expect BYD's strong NEV sales growth to be sustained in 2017
- Cost reductions should offset the subsidy cut starting in 2017
- Reiterate Buy (1); raising TP to HKD68 (from HKD65)

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**What's new:** After recent discussions with management, we remain upbeat on the outlook for BYD in 2017-18. We expect its new energy vehicle (NEV) sales-volume growth to be sustained throughout 2017 and margin pressure from the reduction in subsidies to be offset by cost control.

**What's the impact:** **New NEV models now launching in 1H17.** Based on BYD's revised plan, the Song and Yuan PHEVs are now being launched in 1H17 (previously 2H16), while the Song EV and Yuan EV may be released in 2H17 (previously 1H17). Riding on additional new model sales and more EV bus orders from 10+ key cities including Shenzhen, Guangzhou and Beijing, we expect BYD's NEV passenger vehicle (PV) and EV bus sales volume to rise by 52% YoY and 50% YoY in 2017, in line with management guidance of 50% YoY growth for both segments.

**Margin pressure could be largely offset by cost reductions.** Plans by the government to reduce the subsidy on NEV purchases by 20% starting in 2017 will negatively affect the entire industry and squeeze margins for all players, in our opinion. However, we think BYD will be able to sustain its operating margin in 2017, and even expand it in 2018, by leveraging its internal battery supply, and in turn cutting its NEV production costs by 5-10% per year over 2017-20. We believe such policy tightening by the government will eliminate weak players and benefit BYD in the long run.

**TP raised on improved margin.** We lower our 2016-18 revenue forecasts by 5-8% to account for the delay in launches of the Song and Yuan PHEVs. However, we raise our 2016-18E EPS by 1-18% after revising up our 2016-18 operating-margin forecasts to 8.1-9.3% from 6.8-6.9%, given BYD's 1H16 operating margin increase to 8.9% from 5.6% in 2H15 and 4.7% in 1H15. Also, we include the contribution from the new monorail business starting from 2017. As such, we lift our SOTP-based 12-month TP to HKD68 (from HKD65) based on 2017E average equity value.

**What we recommend:** We reaffirm our Buy (1) call, and expect BYD to remain a key beneficiary of strong NEV growth in China, both as an OEM and a battery maker. We foresee the stock undergoing a strong rerating on improving profitability through economies of scale, lower battery production costs and improving brand acceptance. The shares are trading currently at 1-yr-forward PER of 18x, which we consider undemanding based on our 20-44% YoY EPS growth forecasts for 2017-18. The key risk to our call: lower-than-expected NEV sales.

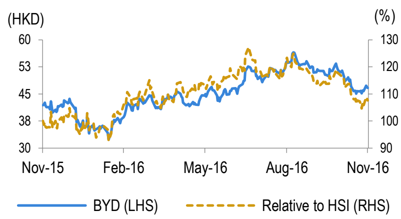
**How we differ:** Our 2016-18 EPS are 6-31% higher than consensus due to our stronger NEV sales forecasts.

### Forecast revisions (%)

| Year to 31 Dec | 16E | 17E | 18E |
|---|---|---|---|
| Revenue change | (7.8) | (5.2) | (5.1) |
| Net profit change | 1.0 | 6.4 | 24.1 |
| Core EPS (FD) change | 1.0 | 1.3 | 18.2 |

*Source: Daiwa forecasts*

### Share price performance




| | |
|---|---|
| 12-month range | 32.35-56.50 |
| Market cap (USDbn) | 16.48 |
| 3m avg daily turnover (USDm) | 30.95 |
| Shares outstanding (m) | 2,737 |
| Major shareholder | Mr. Wang Chuan-fu (23.1%) |

### Financial summary (CNY)

| Year to 31 Dec | 16E | 17E | 18E |
|---|---|---|---|
| Revenue (m) | 108,380 | 130,869 | 155,843 |
| Operating profit (m) | 8,793 | 10,642 | 14,402 |
| Net profit (m) | 5,093 | 6,415 | 9,261 |
| Core EPS (fully-diluted) | 1.954 | 2.344 | 3.383 |
| EPS change (%) | 196.1 | 20.0 | 44.4 |
| Daiwa vs Cons. EPS (%) | 6.4 | 7.8 | 31.1 |
| PER (x) | 21.2 | 17.7 | 12.3 |
| Dividend yield (%) | 0.0 | 0.0 | 0.0 |
| DPS | 0.000 | 0.000 | 0.000 |
| PBR (x) | 2.2 | 1.9 | 1.7 |
| EV/EBITDA (x) | 9.2 | 7.8 | 6.1 |
| ROE (%) | 12.0 | 11.5 | 14.6 |

*Source: FactSet, Daiwa forecasts*



Company

5 4 3 2 1

Buy (unchanged)

# How do we justify our view?

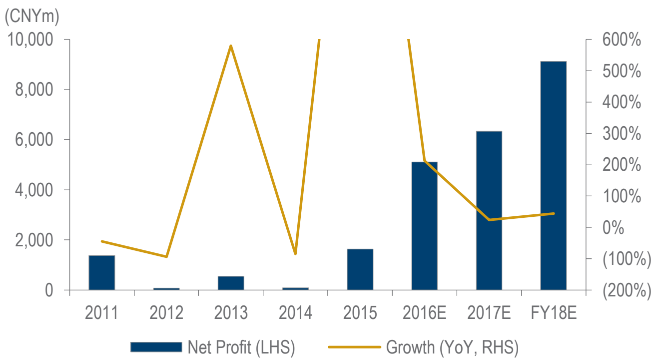
| Growth outlook | Valuation | Earnings revisions |
|---|---|---|
| ✔✔✔✔✔ | ✔✔✔✔ | ✔✔✔✔✔ |

## Growth outlook

We forecast BYD to register strong net profit growth of 212% YoY in 2016, in line with the company's guidance of CNY5.0-5.2bn. For 2017, we forecast growth to slow markedly to 26% YoY, as a consequence of the high base in 2016 and the nearly flat operating margin for its NEV business due mainly to the 20% subsidy cut.

Nevertheless, we believe BYD can retain its competitiveness and achieve margin expansion from 2018 by reducing overall costs through economies of scale, improving its battery technology and reducing raw-material costs, helping it to record net income growth of 44% YoY in 2018.

### BYD: adj. net profit and growth (2011-18E)




*Source: Company, Daiwa forecasts*

## Valuation

We still adopt an SOTP valuation for BYD given its diversified businesses, which is now derived using an EV/EBITDA methodology (previously PER and PBR), as we note that segmental operating profit turned positive in 2015. We apply 2017E EV/EBITDAs (previously 2016-17E average) of 6.0x for its rechargeable battery business, 3.5x for mobile handsets and 4.0x for conventional cars, in line with peers. For the new monorail segment, we apply a 2017E EV/ EBITDA of 6x, in line with our target for CRRC (1766 HK, HKD7.00, Underperform [4]). For the NEV segment, we assign a 20.0x 2017E EV/ EBITDA, based on its high sales growth trend. We have also updated our CNY/HKD exchange rates.

### BYD: SOTP valuation

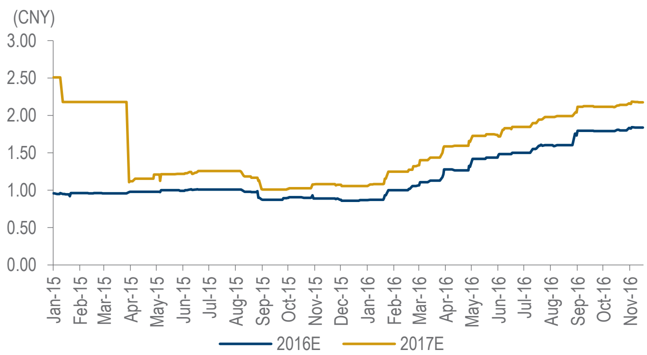
| | Valuation | Multiple (x) | NAV 17E (CNY m) |
|---|---|---|---|
| Rechargeable Battery | EV/EBITDA | 6.0 x | 11,778 |
| Mobile handset | EV/EBITDA | 3.5 x | 13,965 |
| Auto - Conventional | EV/EBITDA | 4.0 x | 6,597 |
| Auto - NEV | EV/EBITDA | 20.0 x | 199,832 |
| Monorail | EV/EBITDA | 6.0 x | 2,520 |
| **Sub-total** | | | **234,693** |
| - Net debt/cash | | | (21,769) |
| - Minority interest | | | (4,661) |
| **Equity value (CNYm)** | | | **208,263** |
| Exchange rate, 1HKD = x CNY | | | 0.89 |
| **Equity value (HKDm)** | | | **234,266** |
| **Conglomerate discount** | | | **20%** |
| **Equity value/share (HKD)** | | | **68.00** |

*Source: Daiwa forecasts*

## Earnings revisions

The Bloomberg-consensus 2016-17 forecasts have been revised up since mid-2016 after BYD reported solid 1H16 and 3Q16 results and provided promising 4Q16 guidance. We expect more upward earnings revisions by the market if BYD can maintain strong NEV model sales growth and sustain its operating margin in 2017 against the backdrop of the subsidy cut starting in 2017. Our 2016-17 EPS forecasts are 6-8% above consensus. For 2018, we are 31% higher, likely because we our more upbeat on BYD's margin expansion and sales growth.

### BYD: consensus 2016-17 EPS forecasts




*Source: Bloomberg*

# Financial summary

## Key assumptions

| Year to 31 Dec | 2011 | 2012 | 2013 | 2014 | 2015 | 2016E | 2017E | 2018E |
|---|---|---|---|---|---|---|---|---|
| BYD NEV volume (units) | n.a. | 3,344 | 3,576 | 20,972 | 67,016 | 132,302 | 201,238 | 282,717 |
| Volume growth - NEV (%) | n.a. | n.a. | 6.9 | 486.5 | 219.5 | 97.4 | 52.1 | 40.5 |
| Battery shipment (%) | 0.8 | 1.2 | 7.4 | (0.8) | 15.5 | 20.0 | 10.0 | 10.0 |
| Handset shipment (%) | (4.8) | (12.3) | 13.4 | 23.9 | 36.5 | 25.0 | 22.0 | 20.0 |

## Profit and loss (CNYm)

| Year to 31 Dec | 2011 | 2012 | 2013 | 2014 | 2015 | 2016E | 2017E | 2018E |
|---|---|---|---|---|---|---|---|---|
| Automobile | 22,136 | 22,551 | 25,291 | 26,270 | 38,934 | 60,320 | 73,064 | 87,235 |
| Mobile handset | 19,557 | 17,155 | 19,459 | 24,116 | 32,928 | 41,160 | 50,215 | 60,258 |
| Other Revenue | 4,620 | 4,675 | 5,018 | 4,980 | 5,750 | 6,900 | 7,590 | 8,349 |
| **Total Revenue** | **46,312** | **44,381** | **49,768** | **55,366** | **77,612** | **108,380** | **130,869** | **155,843** |
| Other income | 846 | 718 | 651 | 950 | 499 | 618 | 569 | 678 |
| COGS | (39,445) | (39,255) | (43,252) | (47,743) | (65,753) | (88,391) | (106,531) | (125,131) |
| SG&A | (5,299) | (4,717) | (5,364) | (6,694) | (8,295) | (11,813) | (14,265) | (16,987) |
| Other op.expenses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Operating profit** | **2,414** | **1,127** | **1,803** | **1,879** | **4,063** | **8,793** | **10,642** | **14,402** |
| Net-interest inc./(exp.) | (687) | (812) | (947) | (1,292) | (1,464) | (1,887) | (2,312) | (2,588) |
| Assoc/forex/extraord./others | 1 | (25) | (24) | 287 | 1,196 | (250) | 50 | 150 |
| **Pre-tax profit** | **1,727** | **291** | **832** | **874** | **3,795** | **6,656** | **8,380** | **11,964** |
| Tax | (132) | (78) | (56) | (134) | (657) | (1,152) | (1,450) | (2,071) |
| Min. int./pref. div./others | (210) | (132) | (223) | (306) | (315) | (412) | (515) | (633) |
| **Net profit (reported)** | **1,385** | **81** | **553** | **434** | **2,823** | **5,093** | **6,415** | **9,261** |
| **Net profit (adjusted)** | **1,385** | **81** | **553** | **87** | **1,634** | **5,093** | **6,415** | **9,261** |
| **EPS (reported)(CNY)** | **0.598** | **0.035** | **0.235** | **0.179** | **1.140** | **1.954** | **2.344** | **3.383** |
| **EPS (adjusted)(CNY)** | **0.598** | **0.035** | **0.235** | **0.036** | **0.660** | **1.954** | **2.344** | **3.383** |
| **EPS (adjusted fully-diluted)(CNY)** | **0.598** | **0.035** | **0.235** | **0.036** | **0.660** | **1.954** | **2.344** | **3.383** |
| **DPS (CNY)** | **0.000** | **0.000** | **0.050** | **0.000** | **0.000** | **0.000** | **0.000** | **0.000** |
| **EBIT** | **2,414** | **1,127** | **1,803** | **1,879** | **4,063** | **8,793** | **10,642** | **14,402** |
| **EBITDA** | **5,091** | **4,383** | **5,336** | **6,092** | **9,376** | **14,836** | **17,710** | **22,575** |

## Cash flow (CNYm)

| Year to 31 Dec | 2011 | 2012 | 2013 | 2014 | 2015 | 2016E | 2017E | 2018E |
|---|---|---|---|---|---|---|---|---|
| Profit before tax | 1,727 | 291 | 832 | 874 | 3,795 | 6,656 | 8,380 | 11,964 |
| Depreciation and amortisation | 2,678 | 3,256 | 3,533 | 4,212 | 5,314 | 6,043 | 7,068 | 8,173 |
| Tax paid | (344) | (299) | (246) | (192) | (399) | (1,152) | (1,450) | (2,071) |
| Change in working capital | 1,179 | 1,132 | (2,913) | (6,106) | (5,977) | (3,161) | (1,949) | (2,514) |
| Other operational CF items | 744 | 1,175 | 1,230 | 1,251 | 1,110 | 2,202 | 2,551 | 2,773 |
| **Cash flow from operations** | **5,985** | **5,555** | **2,436** | **38** | **3,842** | **10,588** | **14,600** | **18,325** |
| Capex | (8,942) | (7,150) | (5,764) | (8,578) | (12,290) | (11,903) | (13,871) | (13,871) |
| Net (acquisitions)/disposals | (280) | 2,573 | 80 | 480 | 1,562 | 0 | 0 | 0 |
| Other investing CF items | 299 | (32) | (168) | 197 | (8) | 0 | 0 | 0 |
| **Cash flow from investing** | **(8,923)** | **(4,610)** | **(5,851)** | **(7,901)** | **(10,736)** | **(11,903)** | **(13,871)** | **(13,871)** |
| Change in debt | 3,733 | (3,085) | 3,232 | 5,314 | 5,774 | 9,200 | 6,200 | 6,200 |
| Net share issues/(repurchases) | 1,368 | 0 | 0 | 3,342 | 3,200 | 15,000 | 0 | 0 |
| Dividends paid | 0 | 0 | 0 | (124) | (37) | 0 | 0 | 0 |
| Other financing CF items | (366) | 1,868 | 1,276 | (1,262) | (187) | (1,952) | (2,601) | (2,923) |
| **Cash flow from financing** | **4,736** | **(1,217)** | **4,508** | **7,271** | **8,750** | **22,248** | **3,599** | **3,277** |
| Forex effect/others | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Change in cash** | **1,798** | **(271)** | **1,093** | **(592)** | **1,856** | **20,934** | **4,329** | **7,731** |
| Free cash flow | (2,958) | (1,595) | (3,328) | (8,540) | (8,448) | (1,314) | 730 | 4,455 |

*Source: FactSet, Daiwa forecasts*

Daiwa Capital Markets

## Financial summary continued …

### Balance sheet (CNYm)

| As at 31 Dec | 2011 | 2012 | 2013 | 2014 | 2015 | 2016E | 2017E | 2018E |
|---|---|---|---|---|---|---|---|---|
| Cash & short-term investment | 3,737 | 3,487 | 4,511 | 3,950 | 6,011 | 26,945 | 31,274 | 39,005 |
| Inventory | 6,596 | 7,345 | 8,221 | 9,978 | 15,751 | 21,173 | 25,519 | 29,974 |
| Accounts receivable | 9,782 | 9,937 | 13,135 | 22,435 | 26,679 | 37,255 | 44,985 | 53,570 |
| Other current assets | 2,665 | 2,555 | 4,099 | 4,471 | 6,079 | 7,379 | 8,330 | 9,385 |
| **Total current assets** | **22,780** | **23,324** | **29,966** | **40,834** | **54,519** | **92,753** | **110,108** | **131,935** |
| Fixed assets | 30,723 | 33,659 | 34,147 | 36,379 | 38,126 | 42,910 | 48,796 | 53,738 |
| Goodwill & intangibles | 6,689 | 7,983 | 9,623 | 10,821 | 11,824 | 12,900 | 13,816 | 14,572 |
| Other non-current assets | 6,689 | 5,042 | 4,279 | 5,974 | 11,016 | 10,766 | 10,816 | 10,966 |
| **Total assets** | **66,881** | **70,008** | **78,015** | **94,009** | **115,486** | **159,329** | **183,536** | **211,211** |
| Short-term debt | 11,342 | 11,288 | 16,172 | 19,173 | 26,413 | 35,413 | 41,413 | 47,413 |
| Accounts payable | 17,236 | 19,933 | 22,293 | 25,851 | 30,656 | 41,210 | 49,668 | 58,340 |
| Other current liabilities | 6,050 | 6,008 | 4,879 | 7,998 | 9,041 | 12,626 | 15,246 | 18,155 |
| **Total current liabilities** | **34,628** | **37,228** | **43,344** | **53,022** | **66,110** | **89,249** | **106,326** | **123,908** |
| Long-term debt | 7,079 | 7,341 | 8,652 | 10,979 | 11,230 | 11,430 | 11,630 | 11,830 |
| Other non-current liabilities | 1,194 | 1,294 | 1,162 | 1,113 | 2,116 | 2,116 | 2,116 | 2,116 |
| **Total liabilities** | **42,901** | **45,863** | **53,158** | **65,114** | **79,457** | **102,795** | **120,073** | **137,854** |
| Share capital | 2,354 | 2,354 | 2,354 | 2,476 | 2,476 | 2,737 | 2,737 | 2,737 |
| Reserves/R.E./others | 18,770 | 18,843 | 19,356 | 22,890 | 29,818 | 49,649 | 56,065 | 65,325 |
| **Shareholders' equity** | **21,125** | **21,197** | **21,710** | **25,366** | **32,294** | **52,387** | **58,802** | **68,063** |
| Minority interests | 2,856 | 2,947 | 3,147 | 3,529 | 3,735 | 4,146 | 4,661 | 5,294 |
| **Total equity & liabilities** | **66,881** | **70,008** | **78,015** | **94,009** | **115,486** | **159,329** | **183,536** | **211,211** |
| EV | 130,549 | 130,723 | 135,959 | 141,899 | 147,060 | 135,987 | 138,323 | 137,275 |
| **Net debt/(cash)** | **14,684** | **15,143** | **20,313** | **26,202** | **31,632** | **19,898** | **21,769** | **20,238** |
| **BVPS (CNY)** | **9.127** | **9.004** | **9.222** | **10.245** | **13.043** | **19.138** | **21.482** | **24.865** |

### Key ratios (%)

| Year to 31 Dec | 2011 | 2012 | 2013 | 2014 | 2015 | 2016E | 2017E | 2018E |
|---|---|---|---|---|---|---|---|---|
| Sales (YoY) | n.a. | (4.2) | 12.1 | 11.2 | 40.2 | 39.6 | 20.8 | 19.1 |
| EBITDA (YoY) | n.a. | (13.9) | 21.7 | 14.2 | 53.9 | 58.2 | 19.4 | 27.5 |
| Operating profit (YoY) | n.a. | (53.3) | 60.0 | 4.2 | 116.2 | 116.4 | 21.0 | 35.3 |
| Net profit (YoY) | n.a. | (94.1) | 579.6 | (84.2) | 1,772.9 | 211.7 | 26.0 | 44.4 |
| Core EPS (fully-diluted) (YoY) | n.a. | (94.2) | 579.6 | (84.7) | 1,734.4 | 196.1 | 20.0 | 44.4 |
| Gross-profit margin | 14.8 | 11.6 | 13.1 | 13.8 | 15.3 | 18.4 | 18.6 | 19.7 |
| EBITDA margin | 11.0 | 9.9 | 10.7 | 11.0 | 12.1 | 13.7 | 13.5 | 14.5 |
| Operating-profit margin | 5.2 | 2.5 | 3.6 | 3.4 | 5.2 | 8.1 | 8.1 | 9.2 |
| Net profit margin | 3.0 | 0.2 | 1.1 | 0.2 | 2.1 | 4.7 | 4.9 | 5.9 |
| ROAE | 13.1 | 0.4 | 2.6 | 0.4 | 5.7 | 12.0 | 11.5 | 14.6 |
| ROAA | 4.1 | 0.1 | 0.7 | 0.1 | 1.6 | 3.7 | 3.7 | 4.7 |
| ROCE | 11.4 | 2.6 | 3.9 | 3.5 | 6.1 | 9.9 | 9.7 | 11.6 |
| ROIC | 5.8 | 2.1 | 4.0 | 3.2 | 5.5 | 10.1 | 10.9 | 13.3 |
| Net debt to equity | 69.5 | 71.4 | 93.6 | 103.3 | 97.9 | 38.0 | 37.0 | 29.7 |
| Effective tax rate | 7.7 | 26.8 | 6.8 | 15.3 | 17.3 | 17.3 | 17.3 | 17.3 |
| Accounts receivable (days) | 38.5 | 81.1 | 84.6 | 117.2 | 115.5 | 107.7 | 114.7 | 115.4 |
| Current ratio (x) | 0.7 | 0.6 | 0.7 | 0.8 | 0.8 | 1.0 | 1.0 | 1.1 |
| Net interest cover (x) | 3.5 | 1.4 | 1.9 | 1.5 | 2.8 | 4.7 | 4.6 | 5.6 |
| Net dividend payout | 0.0 | 0.0 | 21.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Free cash flow yield | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 0.6 | 3.9 |

*Source: FactSet, Daiwa forecasts*

## Company profile

Listed in Hong Kong in 2002, BYD is engaged in the R&D, manufacture and distribution of automobiles, rechargeable batteries and mobile phone components. It owns 65% of BYD Electronics (285 HK, Not rated). BYD focuses on autos (especially NEVs), rechargeable batteries (lithium-ion and nickel batteries used in mobile phones and other portable electronic devices), as well as mobile-phone components and its assembly mobile phones business (casings, keypads, mobile-phone designs, etc.).

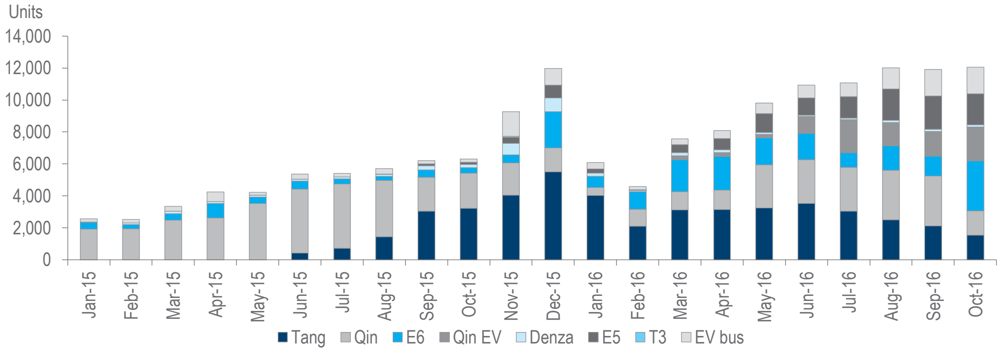
# Surging trend in NEV sales here to stay

## Securing the No.1 position in selling EVs

**Management guidance for 2016 NEV sales is conservative in our opinion, as we expect some front-loaded-sales at the end of 2016**

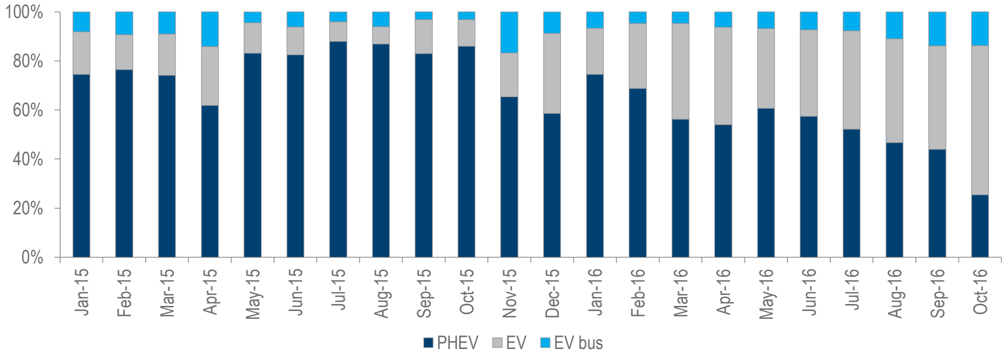
According to China Auto Market (CAM), BYD booked NEV sales of 94,132 units (including 8,425 units EV bus) from January to October 2016 with sales growth of 105% YoY. Based on our recent discussion with management, it targets NEV sales volume of around 131,000 units (including 11,000 unit sales of EV buses) for 2016, which is not aggressive in our opinion, given its monthly sales of around 12,000 units in the past 3 months and the likelihood of front-loaded-sales for the last 2 months of 2016, ahead of the anticipated subsidy cut by the central government starting in 2017.

**BYD: NEV monthly sales breakdown (Jan 2015-October 2016)**



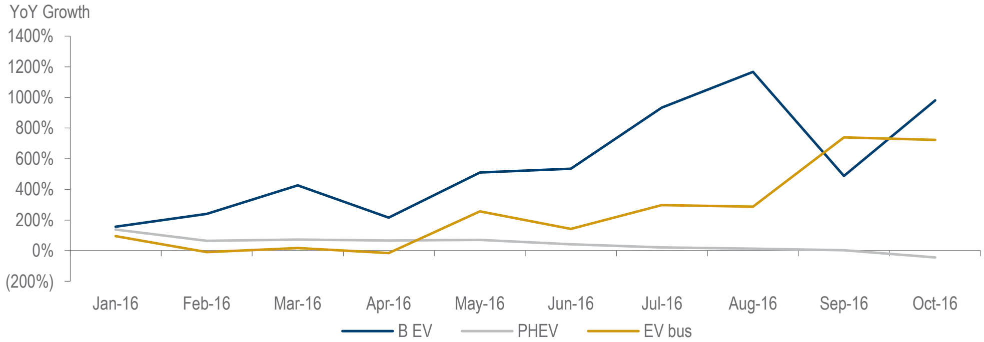

*Source: CAM*
*Notes: Only Tang and Qin are PHEV models (the 2 sections at the bottom of the bars) while E6, E5, Denza, T3 and Qin EV are EV models.*

**BYD: NEV monthly sales breakdown (Jan 2015-Oct 2016)**




*Source: CAM*

**BYD: NEV segment monthly sales YoY growth (Jan-Oct 2016)**

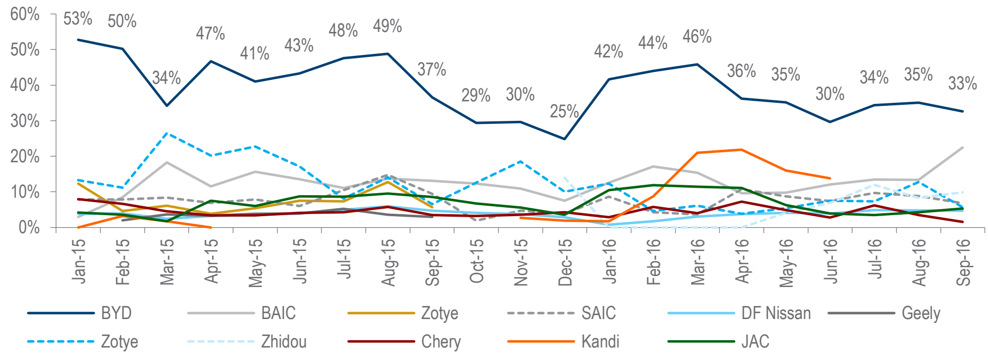



*Source: CAM*

**BYD is ranked No.1 in terms of NEV sales volume in China, with a 30-40% market share YTD**

Our research indicates that BYD has the No.1 position in NEV sales in China with a 30-40% market share in 2016 YTD. We look for BYD to expand its overall market share and register NEV sales growth of 97% YoY in 2016, 52% YoY in 2017 and 40% YoY in 2018.

### China: monthly EV PV market share of various players




*Source: CEIC, CAM, company files, Daiwa estimates*

### BYD: future model pipeline, 2017-18E

| Model | Type | Launch date |
|---|---|---|
| Qin PHEV(Facelift) | Sedan (PHEV) | 2017 |
| Song PHEV | SUV (PHEV) | 1H17 |
| Yuan PHEV | SUV (PHEV) | 1H17 |
| Yuan EV | SUV (EV) | 2H17 |
| Song EV | SUV (EV) | 2H17 |
| Han EV | Sedan (EV) | 2018-19 |
| Ming EV | SUV (EV) | 2018-19 |

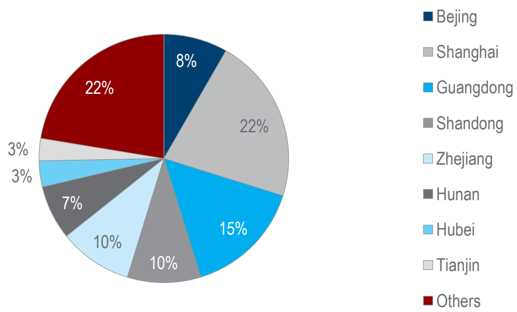
*Source: Company, various media*
*Notes: For the Han and Ming models, the launch schedule is estimated by us according to various media*

**We believe both BYD's PHEV and EV segments can achieve solid sales growth in 2017, even though its PHEV sales did not perform well in Jan-Oct 2016**

We expect BYD's sales volume of pure electric vehicles (EV) to continue to rise thanks to significant growth in industry demand (up 213% YoY for January-September), the ramp-up of its new models such as the Qin EV (launched in March 2016), and the launch of more new models (the Song EV and Yuan EV) in 2017. However, the company may see lower sales growth for its plug-in hybrid electric vehicles (PHEV) in 2016, due mainly to soft demand growth (up 67% YoY in January-September 2016) and the company losing some market share in Shanghai as a result of the subsidy issue (more on this further on).

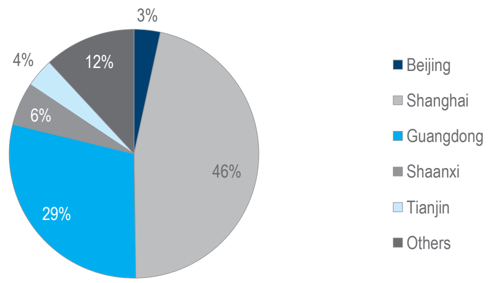
However, looking out to the start of 1H17, we expect BYD's PHEV sales growth to recover and even exceed sales for its EV segment, thanks to the release of new models (the Song PHEV, Yuan PHEV, scheduled to be launched in 1H17), the expected local subsidy cut for peer SAIC Motor (600104 CH, not rated), and BYD's market expansion in other key regions except for Shanghai.

### China NEV market: new registration amount – regional breakdown (2015)




*Source: CAM, Ministry of Public Security, Daiwa estimates*
*Notes: the new registration number was not equal to the sales number but may be regarded as the proxy sales number*

### BYD: new registration amount – regional breakdown (2015)



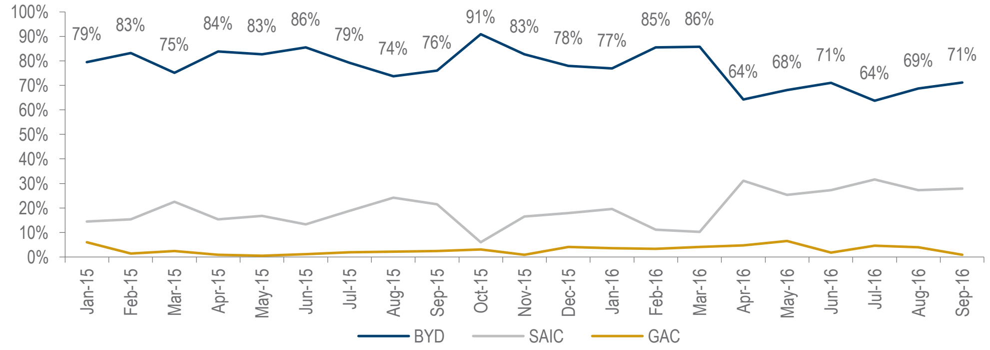

*Source: CAM, Ministry of Public Security, Daiwa estimates*
*Notes: the new registration number was not equal to the sales number but may be regarded as the proxy sales number*

## The dominant player in the China PHEV segment

**BYD dominates the PHEV sub market in China, thanks to its excellent R&D capability and first-mover advantage**

BYD currently dominates the PHEV sub-market in China with a 60-80% domestic market share in 2015-16, as a result of the early launch of its flagship model, the Qin PHEV, at the end of 2013 and high entry barriers for manufacturing PHEVs compared EVs due to the complexity of the hybrid engine design in a PHEV. Currently, we consider BYD and SAIC Motor to be the 2 strongest domestic players in China's PHEV sector.

**China: PHEV PV market share of key players**




*Source: CEIC, CAM, company files, Daiwa estimates*

**The Shanghai Government's new subsidy document is aimed at protecting the city's local companies by granting different levels of local subsidies**

Under the Shanghai Government's new subsidy policy for 2016-17 published in April 2016, BYD's subsidy was cut by half to only CNY5,000 per NEV (vs. CNY24,000 for SAIC Motor's Roewe e550) because: 1) the Tang and Qin PHEV did not meet all 3 requirements for earning the extra subsidy of CNY14,000 per unit, and 2) BYD already has accumulated sales of more than 40,000 units since 2014 in Shanghai, resulting in it only being eligible for half the regular grant of CNY10,000 per vehicle.

According to our market research, to make up for the extra subsidy it was unable to get from the government, BYD decided to provide an extra CNY5,000-15,000 per unit in subsidies for PHEV customers. We think BYD having to provide this extra subsidy will lead to slight margin erosion for the company in 2H16 compared 1H16.

**Shanghai: local new energy PV subsidies in 2016-17**

| Subsidies (CNY/vehicle) | Pure electric driving range, R (Km) | | |
|---|---|---|---|
| | 100 ≤ R < 150 | R ≥ 150 | R ≥ 250 |
| Pure EV | 10,000 | 30,000 | / |
| Plug-in hybrid electric vehicle | / | / | 10,000 |

*Source: Shanghai Municipal Government*
*Note: PHEV vehicles which met all requirements: (1) The engine emission is less than 1.6L (2) The fuel consumption is less than 5.9L/100km under hybrid working condition (3) Fuel tank capacity is less than 40L can have another 14,000 CNY per vehicle*

**Shanghai: new mechanism for cutting subsidies for certain models in 2016**

| Approved subsidy amount | Passenger Vehicle | Commercial Vehicle | Special Purpose Vehicle |
|---|---|---|---|
| Subsidy Amount × 1 | S≤ 40,000 | S≤ 1,000 | TS≤ 3,000 |
| Subsidy Amount × 0.5 | 40,000<S≤ 60,000 | 1,000<S≤ 2,000 | 3,000<TS≤ 5,000 |
| 0 | S>60,000 | S>2,000 | TS>5,000 |

*Source: Shanghai Municipal Government*
*Note: S represents the total EV sales amount in the corresponding sector in Shanghai since 2014.1.1 and TS represents the total EV sales amount in the corresponding sector in Shanghai since 2016.1.1*

While BYD's PHEV sales will likely remain weak in the near term, we expect sales volume to recover starting from 1H17 for 3 main reasons:

**We believe BYD can remain competitive in the China PHEV sub-market and see sales growth recovering, starting from 2017**

1) **New model releases in 2017:** The Song PHEV and Yuan PHEV are scheduled to be launched by 1H17. We estimate they will meet all 3 requirements and be granted the extra subsidy (CNY14,000 per unit) from the Shanghai Government. Moreover, the facelift version of the Qin PHEV is expected to be released next year, which would also contribute to the company's total sales.

2) **SAIC Motor may also reach the sales threshold in 2017:** By October 2016, SAIC had accumulated PHEV sales of around 30,000 units since 2014, with around 95% of sales derived from the Shanghai market, on our estimates. Thus, it is possible that SAIC Motor will reach the 40,000 threshold in the Shanghai market in 1H17, which would trigger a reduction in its subsidy level to CNY12,000 per unit (from CNY24,000), and alleviate the competitive pressure for BYD.

3) **BYD's sales-volume growth in other key regions should be sustained:** BYD is still more competitive than SAIC Motor in other regions outside of Shanghai since the company accounted for more than 90% of PHEV sales in key regions such as Guangdong, Shaanxi and Zhejiang in 2015. As such, we expect BYD to maintain its leading position thanks to its accumulated technology and superior brand recognition.

**Key PHEV model subsidy and selling price comparison in Shanghai**

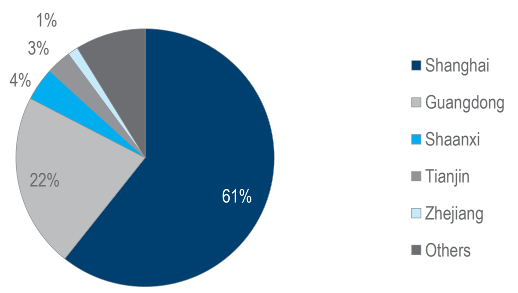
| Unit: CNY | 2015 | | 2016 | | | 2H17-2018 | | |
|---|---|---|---|---|---|---|---|---|
| Model | Qin PHEV | Roewe 550 Plug-in | Qin PHEV | Tang PHEV | Roewe 550e (facelift) | Qin PHEV (Facelift) | Tang PHEV | Roewe 550e |
| MSRP | 219,800 | 248,800 | 219,800 | 279,800 | 239,800 | 219,800 | 279,800 | 239,800 |
| Subsidy - Central government | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 | 24,000 | 24,000 | 24,000 |
| Subsidy - Shanghai government | 30,000 | 30,000 | 5,000 | 5,000 | 24,000 | 5,000 | 5,000 | 12,000 |
| Corporate subsidy | 0 | 0 | 15,000 | 5,000 | 9,000 | n.a | n.a | n.a |
| Cash payment by customer | 159,800 | 188,800 | 169,800 | 239,800 | 176,800 | 190,800 | 250,800 | 203,800 |
| | | | | | | | | |
| Engine emission | 1.5T | 1.5L | 1.5T | 2.0T | 1.5L | n.a | 2.0T | 1.5L |
| Fuel tank capacity | 50L | 31L | 50L | 53L | 31L | n.a | 53L | 31L |

*Source: Autohome, Daiwa*

*Notes: The Roewe 550 Plug-in was renamed the Roewe 550e with the new updated PHEV version, released in April 2016; the Qin PHEV has two versions priced at CNY209,800 and CNY219,800, while the latter is more comparable to the Roewe 550e in terms of configuration.*

As such, we forecast BYD's PHEV sales to reach 62,200 units in 2016, registering 24% YoY growth (vs. 30% YoY growth during January-October 2016) as a result of the high base last year and slight market losses in Shanghai in the next 2 months. We estimate the company's PHEV sales will increase by 66% YoY in 2017 and 29% YoY in 2018, due mainly to a sales recovery kicking in from 1H17.

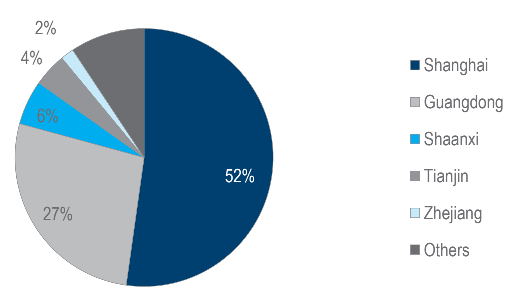
**China: PHEV regional market share of new registration numbers in China (2015)**




*Source: CAM, Ministry of Public Security, Daiwa estimate*

*Notes: the new registration number was not equal to the sales number but may be regarded as the proxy number*

**BYD: PHEV regional market share of new registration numbers in China (2015)**



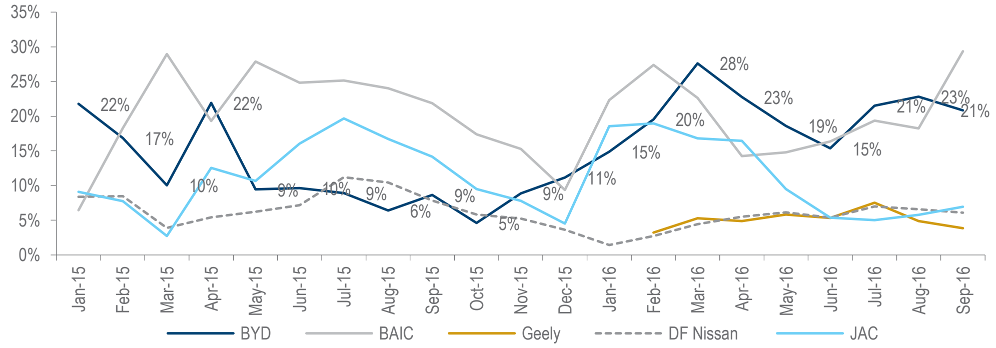

*Source: CAM, Ministry of Public Security, Daiwa estimate*

*Notes: the new registration number was not equal to the sales number but may be regarded as the proxy number*

## Sees advancement in EV sub-market

Thanks to the sales contribution from new EV models such as the E5 (launched in October 2015) and the Qin EV (launched in March 2016), BYD has expanded its EV market share to around 20% so far in 2016 from around 10% in 2015 and registered sales growth of more than 540% YoY in January-October 2016 (vs. industry sales growth of 210% YoY).

**China: EV PV market share of key players**




*Source: CEIC, CAM, company files, Daiwa estimate*

**We think EV industry sales will rise sharply in the next few years**

In the next 1-2 years, we expect EV industry sales to continue to rise strongly, mainly on: 1) tighter rules for obtaining licence plates for conventional vehicles and the increasing quota for registering NEVs, especially for EVs (in big cities like Beijing), and 2) significant growth in the number of newly built charging facilities, which would greatly enhance the convenience of driving an EV.

Thus, we believe Beijing and Guangdong (mainly Shenzhen) will remain the key EV sub-markets for BYD. While Zhejiang, Hunan and Shandong continued to be dominated by small-size EVs like the Kandi K10, Zhidou D1/D2 and Zotye Yun100 in 2015, we see BYD making inroads in these provinces as a result of the anticipated severe restrictions on the granting of licence plates to conventional vehicles in capital cities like Hangzhou.

**China: new car licence restrictions in various cities**

| Cities | Plate issuance through | Effective year | Quota for conventional vehicles (Annual) | Quota set for NEV(Annual) | Auction price per conventional vehicles quota |
|---|---|---|---|---|---|
| Shanghai | Bidding | 2016 | 100,000 | No limit quota | above CNY80,000 |
| Beijing | Lotteries | 2016 | 90,000 | 60,000 | |
| Guangzhou | Dual | 2016 | 108,000 | 12,000 | around CNY20,000 |
| Tianjin | Dual | 2016 | 100,000 | 10,000 | around CNY20,000 |
| Hangzhou | Dual | 2016 | 80,000 | No limit quota | above CNY20,000 |
| Shenzhen | Dual | 2016 | 80,000 | 20,000 | above CNY40,000 |

*Source: local government websites and various media*

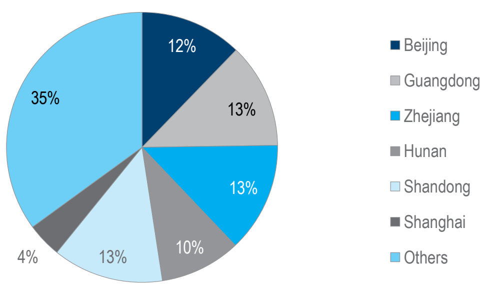
**China: EV charging facilities market estimates**

| Inventory amount - unit | 2014 | 2015 | 2016E | 2017E | 2018E | 2019E | 2020E | 2020 Target |
|---|---|---|---|---|---|---|---|---|
| Charging stations | 780 | 3,600 | 10,086 | 22,409 | 43,359 | 76,879 | 123,806 | 120,000 |
| Charging piles | 31,000 | 99,000 | 262,200 | 621,240 | 1,339,320 | 2,631,864 | 4,829,189 | 4,800,000 |
| Incremental amount - unit | | | | | | | | |
| Charging stations | | 2,820 | 6,486 | 12,323 | 20,950 | 33,520 | 46,928 | |
| Charging piles | | 68,000 | 163,200 | 359,040 | 718,080 | 1,292,544 | 2,197,325 | |
| Incremental amount YoY growth | | | | | | | | |
| Charging stations | | | 130% | 90% | 70% | 60% | 40% | |
| Charging piles | | | 140% | 120% | 100% | 80% | 70% | |

*Source: NBD, NDRC, PRnewswire, People website, Daiwa estimates*
*Note: the charging piles in our model are those installed independently from the ones built in charging stations*

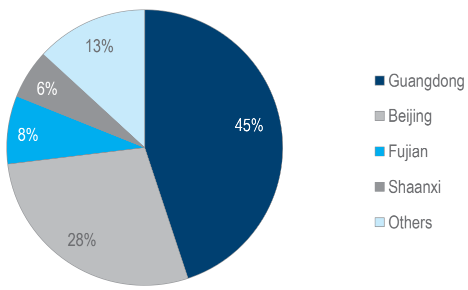
We look for BYD's EV sales to achieve sales growth of around 420% YoY in 2016 (vs. 540% YoY in January-October 2016) and register growth of around 37% YoY in 2017 and 60% YoY in 2018, fuelled by newly launched models and demand.

**China: regional market share of EV new registration numbers (2015)**




*Source: CAM, Ministry of Public Security, Daiwa estimate*
*Notes: the new registration number was not equal to the sales number but may be regarded as the proxy number*

**BYD: regional market share of EV new registration numbers (2015)**




*Source: CAM, Ministry of Public Security, Daiwa estimate*
*Notes: the new registration number was not equal to the sales number but may be regarded as the proxy number*

## Favourable outlook for EV bus sales growth

**We think BYD can reach its 2016 EV bus sales target of c.11,000 units, mainly relying on the Shenzhen market**

According to CAM, BYD booked 8,425 unit sales of EV buses from January to October 2016, reaching around 77% of its sales target of 11,000 units for the full year. We believe BYD can meet its 2016 target with its rich orderbook accumulated in Shenzhen, where it has won around 12,000 unit orders so far in 2016 with 7,000-9,000 units able to be delivered within 2016, according to management.

**BYD: 2016 EV orders**

| Month | Number of vehicles | Customer | Customer region | Estimated contract value | Details | Unit price (CNY) |
|---|---|---|---|---|---|---|
| Feb | 29 | AVTA (Los Angeles) | California , US | USD 72.4m | To be delivered from February 2016 | n.a |
| Mar | 150 | Transjakarta | Jakarta, Indonesia | n.a | Deliveries started in December 2016 and should be completed by end-2017 | n.a |
| Apr | 3,024 | Shenzhen Eastern Bus | Shenzhen, China | CNY 1.8bn | n.a | 595,238 |
| Apr | 3,410 | Shanwei Yueyun Bus | Shanwei, China | n.a | Should be completed by 2019 | n.a |
| May | 200 | Municipality of St. Albert | St. Albert, Canada | USD 160m | Deliveries started in August/September 2016 | n.a |
| June | 27 (trucks) | Fund of San Bernardino County | California, US | USD 9.1m | n.a | n.a |
| July | 2 (trucks) and 2.6MW battery storage systems | Operators of California ports | California, US | USD 26.6m | Should be completed by end-2016 | n.a |
| July | 832 | Shenzhen Western Bus | Shenzhen, China | CNY 192m | n.a | 230,769 |
| July | 2,719 | Shenzhen Western Bus | Shenzhen, China | n.a | n.a | 615,471 |
| July | 2,606 | Shenzhen Bus Group | Shenzhen, China | CNY 1.5bn | n.a | ~ 575,595 |
| Sep | 600 | Hunan Bus | Hunan, China | n.a | 600 units K8 (10.5m length) | |
| Nov | 809 (special vehicles) | Beijing Environmental Sanitation Department | Beijing, China | CNY1.2bn | Hualinte Co. (37% controlled by BYD) won the tender | 1,483,313 |

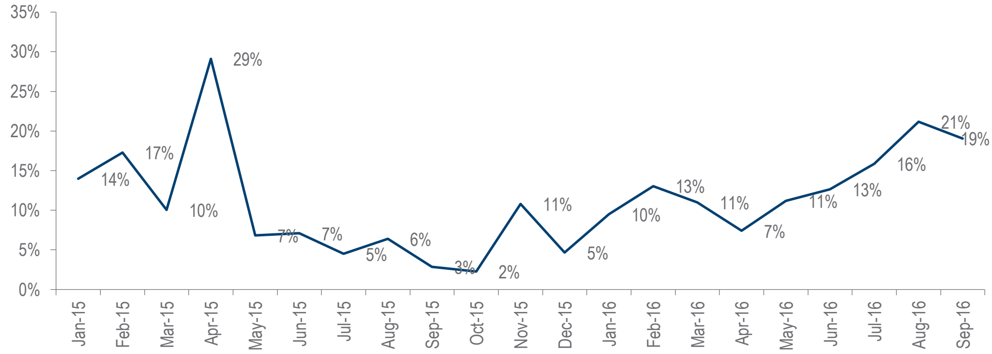
*Source: Company, GGLB, Gasgoo, xcar*
*Note: Unit price is excluded from government subsidies; most buses are priced at around CNY550,000-600,000 with the average length of around 10m*

**BYD should keep receiving orders from Shenzhen bus companies and generate more orders from other cities through previous collaborations with local governments**

We expect BYD's EV bus sales growth to remain robust at 50% YoY in 2017 and 20% YoY in 2018, benefiting from the anticipated successive newly acquired orders in key cities (such as Shenzhen, Xi'an and Changsha), where BYD owns EV manufacturing plants and revenue can be booked on the top line, as well as in other cities (such as Nanjing, Hangzhou, Guangzhou, Beijing and Tianjin), where BYD has collaborated with local partners to form JVs for constructing EV factories and where the net profit is booked as investment income. Relying on its relationships built up with local governments through constructing local plants and providing tax income, BYD should be able to acquire orders more easily with the support of local authorities.

Moreover, we believe its good reputation, excellent technology accumulation and solid balance sheet (local bus companies usually defer cash payments by extending OEMs' cash collection period to 1-3 years after delivery) could enhance its competitiveness in this segment.

BYD: China EV bus market share

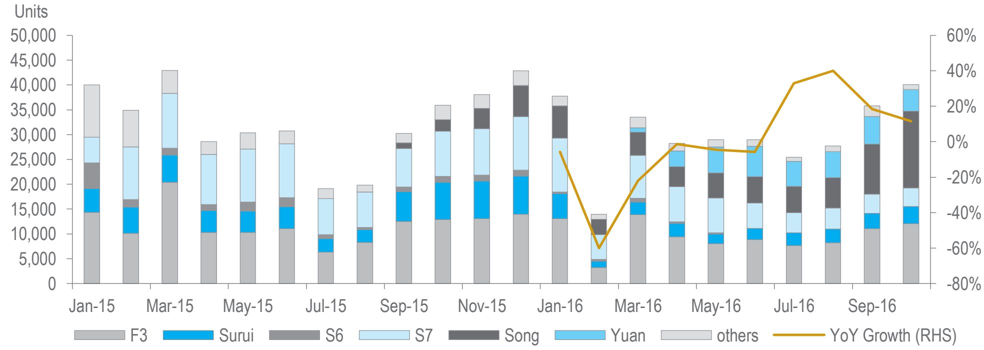



Source: CEIC, CAM, company files, Daiwa estimates

## SUV sales to offset weak conventional vehicle sales

From January-October 2016, around 54% of BYD's total sales were SUVs, thanks to the ramp-up of the Song and Yuan models. In October 2016, the Song SUV reached its monthly sales target of over 15,000 units, one of the best-selling models among domestic SUV peers.

BYD: conventional vehicles sales YoY growth and breakdown by model




Source: CAM

**A sales decline or margin erosion for the conventional segment is not likely to affect its bottom line much**

The outlook for the conventional vehicle market in 2017 is not very positive due to the likelihood of front-loaded-sales in 2016, ahead of the purchase-tax cut for vehicles with 1.6L (or less than 1.6L) engines coming into force in 2017. While we think BYD may be partly affected, any margin erosion or sales decline it may see for its conventional vehicle business would be unlikely to affect its bottom line much, as most of its profit is generated from NEV sales. According to our estimates, for each 1pp drop in the operating margin for BYD's conventional vehicle business, its 2017E net profit would decline by around 3.0%.

BYD: sensitivity analysis – impact on 2017E net profit

| Sensitivity | Impact on 2017E net profit |
|---|---|
| Assuming 1ppt decline in operating margin of conventional vehicle segment | Down 3.0% |
| Assuming 10% decline in conventional sales volume | Down 0.3% |

Source: Daiwa

## Operating margin improvement should be sustained

### Earnings growth should mostly rely on NEV business

Relative to BYD's total sales volume, we expect the company's NEV models to contribute 27% in 2016, 36% in 2017 and 45% in 2018. That is to say, BYD should be able to generate around 92% of its operating profit from the NEV segment from 2016-18 (if we include intersegment losses, which may result from internal battery sales to the NEV segment, we estimate the contribution ratio would be 65-68%), though we estimate the new monorail business segment would take shares of 3% in 2017 and 8% in 2018.

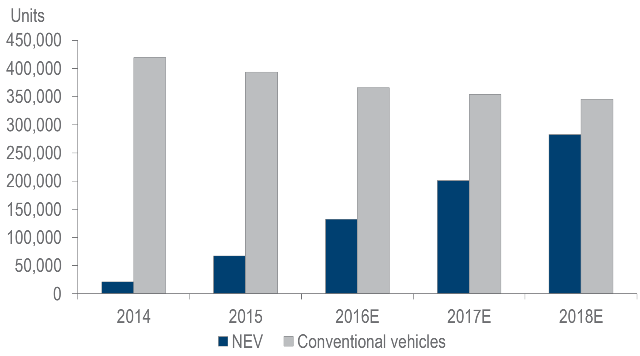
In an attempt to reduce the industry's reliance on subsidies, the government plans to lower subsidies on NEVs starting from next year, with the target of completely eliminating them by 2021. On our estimates, the anticipated 20% cut in the cash subsidy given to NEV buyers starting from 2017 would result in BYD's ASP declining by 5-13% in 2017, depending on the type of model and region. However, we believe BYD and its NEV peers will be able to withstand most of the subsidy loss by: 1) releasing new models at a lower MSRP, 2) granting an extra subsidy to customers, or 3) cutting the selling price directly.

**We believe BYD can sustain its operating margin largely in 2017 mainly thanks to the LiB cost reduction**

Nevertheless, we believe BYD will largely be able to sustain its operating margin for the NEV segment (at 14.8% in 2016E, 14.3% in 2017E and 16.2% in 2018E) by lowering its NEV production costs by 5-10% per year, mainly by cutting its Lithium-ion battery (LiB) costs. In addition, BYD's improved manufacturing process and the lower prices of auto components such as electric motors, electronic control modules thanks to economies of scale could help alleviate margin pressure.

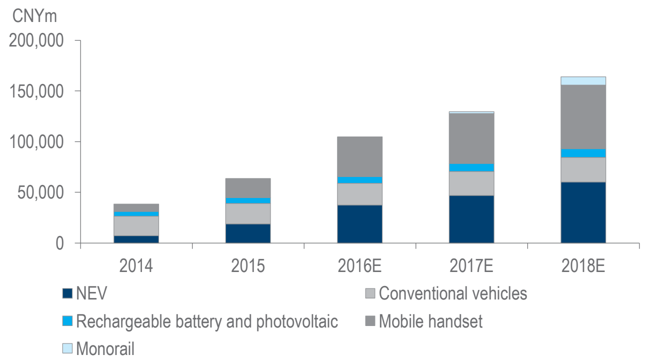
Thus, we forecast the blended operating margin for BYD to rise to 9.3% in 2018 from 8.1% in 2016 and 5.3% in 2015, as a consequence of the improved operating margin for the NEV business segment and product-mix adjustments.

**BYD: automobile sales volume comparison**



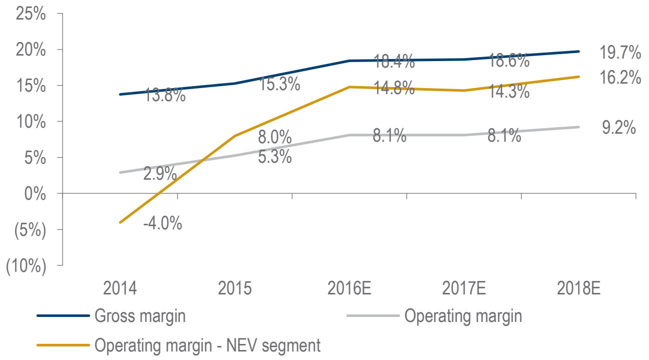

*Source: Company, Daiwa forecasts*

**BYD: revenue breakdown by business segment**




*Source: Company, Daiwa forecasts*

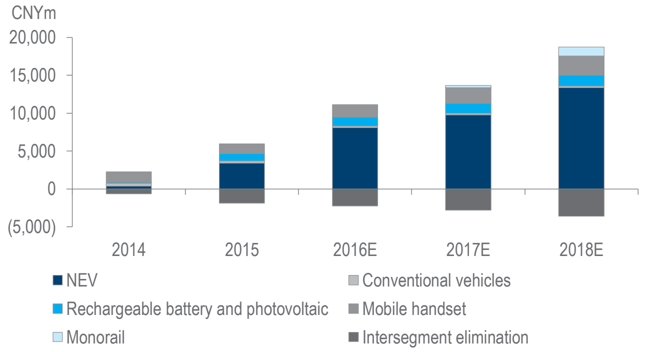
**BYD: gross margin and operating margin trend**




*Source: Company, Daiwa forecasts*

*Notes: We add the intersegment loss, which was related to the internal batteries supply to its NEV segment, to the operating profits earned by NEV segment to get the adjusted operating margin of NEV segment*

**BYD: operating profit breakdown by business segment**




*Source: Company, Daiwa forecasts*

*Notes: Intersegment loss is mainly resulted from the sales to NEV segment from battery segment, in our opinion*

**We believe BYD will benefit from 4 main factors to reach its goal of reducing its LiB costs over the next 5 years**

We believe a declining EV LiB cost trend during 2016-20 would largely offset the profit loss on the subsidy cut and result in NEV sales being boosted in China, especially in tier 3-4 cities, where prices matter and no local subsidies are provided currently.

Based on our estimates, battery costs could decline by 8-15% annually mainly thanks to:

1) **Economies of scale:** BYD plans to expand its capacity of Lithium iron phosphate (LFP) batteries to 13gWh by the end of 2016 and 16gWh by 2017, from 10gWh in 2015. As its energy storage business keeps expanding and the anticipated new

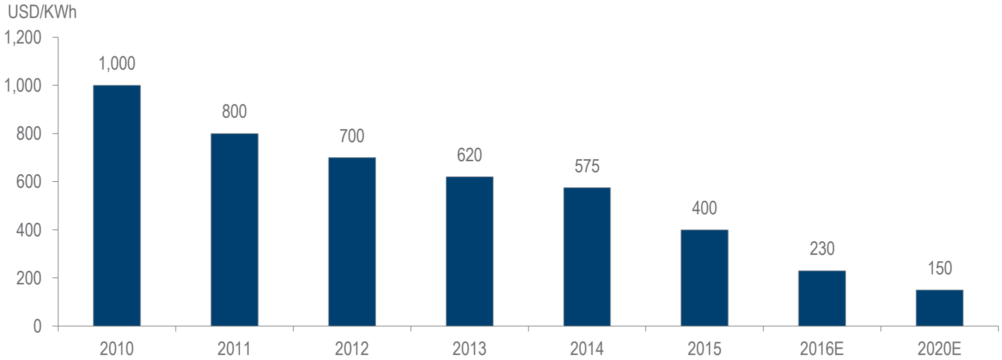
monorail unit would install LFP batteries as well, we expect the company's battery costs to drop during the 2017-20 period thanks mainly to economies of scale. The larger production volume should lead to higher bargaining power when purchasing raw materials and higher operating efficiency.

2) **Advances in R&D:** BYD also targets to produce nickel manganese (NCM)/nickel cobalt aluminium (NCA) batteries, which usually have higher energy density (180Wh/kg) than LFP batteries (110Wh/kg), which can lower the unit price of LiB. BYD is considering equipping its new models, the Song PHEV and Yuan PHEV, with NCM/NCA batteries. Also, the energy density of LFP batteries can be increased in the future due to the improved technology.

3) **The declining price of battery components:** With the whole EV battery industry expanding capacity aggressively, the supply of battery components (cathode, anode, electrolyte and separator) has risen rapidly in 2015-16, which should result in lower unit prices for various battery components and benefit all battery makers as well as EV makers. In addition, more materials can be supplied by domestic players instead of foreign producers, such as separators and cathodes, which can greatly help lower procurement cost since domestic components suppliers still have labour cost advantages over their Korea and Japanese peers.

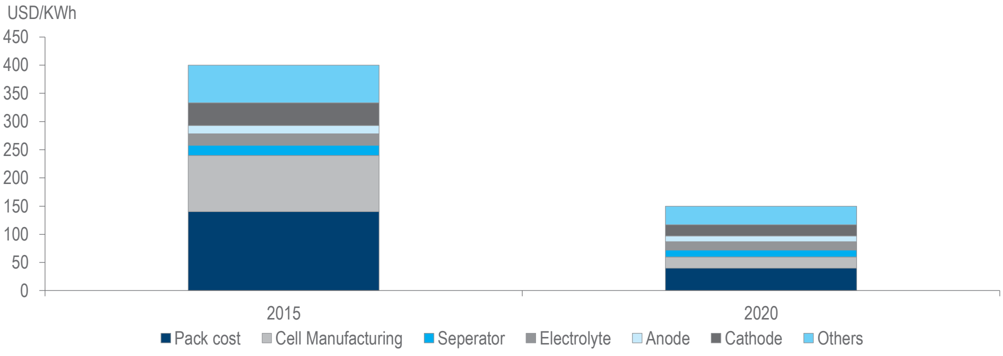
**4) Integration of the industry chain on key raw materials:** As disclosed by BYD, it formed a JV located in Qinghai Province in October 2016 for the purpose of producing Li2CO3, the main raw material for producing cathodes. According to many industry experts, there is likely to be a shortage of Li2CO3 in the next few years, which we expect to result in higher prices. Thus, we believe BYD's integration of this upstream business segment will diminish the cost pressure on manufacturing LiBs.

**Average EV battery pack cost trend (2010-20E)**




*Source: Daiwa forecasts*

**LiB pack cost breakdown**




*Source: Avicenne Energy, Daiwa estimates*

## Other opportunities

### Entering cities to build monorail systems

According to our recent discussion with management, BYD plans to initiate its first phase of monorail projects in Shantou in 2017 and finish construction by 2018. The contract value for the first phase of the project is around CNY10bn for constructing the monorail (including manufacturing 70-80 multiple units) for a length of 50km.

**BYD has started its 4th business line and should finish the first phase of the project, located in Shantou, by 2018**

According to Bloomberg, BYD has secured a loan commitment of CNY60bn from China Development Bank for future expansion of its monorail business, which can enhance the ROE for its new monorail projects and relieve capital constraints for BYD. We believe BYD can leverage its strong relationships with various local governments to speed up its monorail business, which targets to be the solution to the urban gridlock in China's small cities, such as Shantou. We forecast BYD to generate monorail construction revenue of CNY2bn in 2017 and CNY8bn in 2018, and register operating margins of around 15%, which we estimate is nearly in line with CRRC's operating margin for manufacturing locomotives and multiple units.

**BYD: monorail system in BYD Pingshan industry zone**

*Source: BYD official website*

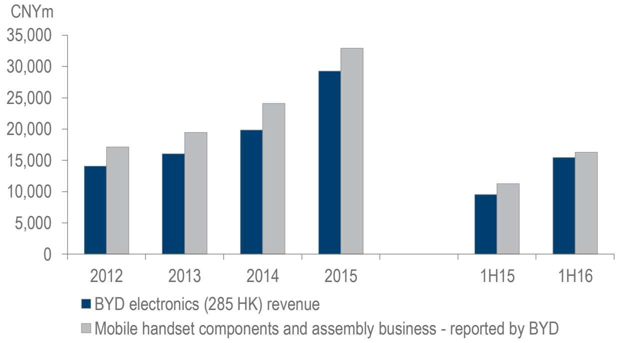
### Handset business to continue to grow

BYD conducts its handset business mainly through subsidiary BYD Electronics (285 HK, not rated), whose revenue accounted for c.95% of BYD's handset business segment revenue in 1H16.

**Handset business segment can succeed in growing operating profit, mainly on the positive outlook for the metal casing business**

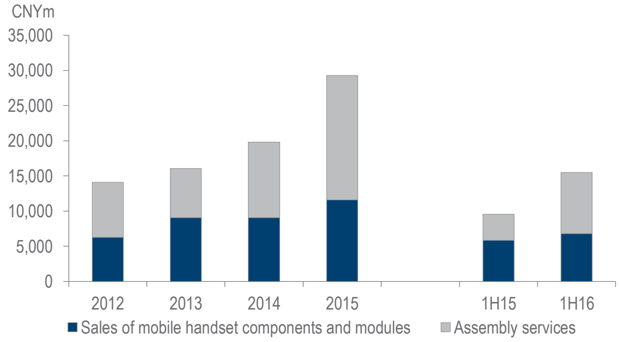
We forecast BYD Electronics' operating profit to expand by 29% YoY in 2016, 25% YoY in 2017 and 23% YoY in 2018, attributable to: 1) stronger metal casing orders from Samsung and Chinese smartphone makers such as Huawei and Vivo due to the higher adoption rate for metal casings by various brands; 2) the increasing contribution from its sales of auto electronics products, including multimedia systems and V2V communication modules; and 3) product mix changes with a higher revenue contribution from metal casings, whose gross margin is higher than BYD Electronics' blended margin.

**BYD Electronics: handset business segment revenue vs. reported revenue**




*Source: Company*

**BYD Electronics: handset business revenue breakdown**




*Source: Company*

## LiB and energy storage businesses to remain on an upward trend

In 1H16, the operating profit of the rechargeable battery and photovoltaic business grew significantly by 202% YoY (compared to 833% YoY in 2015), mainly thanks to the low base in 2015.

**The operating profit for the LiB and energy storage segments is likely to expand thanks to BYD's advantage in LiB technology**

As disclosed by the company, its LiB (including the internal sales to its NEV business segment) and energy storage businesses continued to expand during 2012-15. However, we remain cautious on a sales decline for its nickel battery business and the operating pressure on its solar segment, which mainly focuses on manufacturing solar components (including polysilicon, silicon wafer, solar cell, solar modules) and constructing solar power stations. Given the high base for its operating profit in 2H15 (CNY881m in 2H15 vs. CNY107m in 1H15), we forecast the operating profit for the rechargeable battery and photovoltaic business segment to increase by just 19% YoY in 2016.

BYD plans for its capacity for producing LFP batteries, which are mainly used for EV and energy storage systems, to reach 13GWh by end-2016 and 16GWh by end-2017. Management seems confident that BYD will not face any capacity constraint issues in the near term.

**Summary of major EV LiB vendors' capacity and expansion plans in China**

| Company name | Major clients | Capacity at end-2015 | Capacity expansion plan |
|---|---|---|---|
| BYD | BYD | 9.6GWh | 3GWh by end-2016 and another 3GWh by end-2017; 10GWh by Aug 2019 in Qinghai |
| CATL | Brilliance BMW, Yutong | 2.4GWh | Reach 7.5GWh by end-2016 |
| Lishen | Yutong, Kinglong, Jianghuai | 2.3GWh | Reach 7GWh by end-2017 |
| Guoxuan high tech | Ankai, Jianghuai, Kinglong | 1.5GWh | Reach 6GWh by end-2016 |
| Tianneng | Kandi, Zoyte, Chery | 1.5GWh | Reach 3GWh by 2016.6; Plan to expand to 5.5GWh |
| Coslight Tech | BAIC, Zhidou | 1GWh | Reach 1.5GWh by 2016 |
| Microvast | Kinglong, Beiqi Futian | 1GWh | n.a |
| CALB | Dongfeng, Kinglong,Zhongtong | 0.9GWh | 1.54GWh under construction in 2016 in Luoyang; 2.5GWh in Jiangsu in plan |
| Wulong Electric | Wulong Electric | 0.8GWh | 1.6GWh in plan |
| Chaowei | n.a | 0.6GWh | Reach 3GWh by 2016 end |
| Boston Power | BAIC, zhidou | >0.35GWh | 3GWh in Jiangsu, 8GWh in Tianjin in plan |

*Source: local government website, Xinhua website, gasgoo, d1ev, gg-lb, china buses, various media*

# Valuation and recommendation

## Valuation

**New monorail business and better-than-expected operating margin would help boost net profit from 2016-18**

We are revising up our 2016-18E EPS by 1-18% to account for the net profit contribution from the new monorail business and improved operating margin for the NEV business, though we lower our revenue forecasts by 5-8% as a result of the delay in the launch of the new models (the Song PHEV and Yuan PHEV) until 1H17 instead of 2H16. We raise our 2016-18 operating-margin assumptions to 8.1-9.3% from 6.8-6.9% after taking into account its significant operating margin improvement for the period of 1H16 (8.9% in 1H16 vs. 5.6% in 2H15 and 4.7% in 1H15).

The stock is trading currently at a 1-year forward PER of 18x, which we see as undemanding, considering our strong 2017-18 EPS growth forecasts of 20-44% YoY.

**1-year forward PER of 18x looks undemanding**

We stick with our SOTP valuation methodology for BYD given its diversified businesses, utilising an EV/EBITDA methodology to value each segment (previously PER and PBR).

We apply an EV/EBITDA of 6.0x to our 2017E EBITDA forecasts for its rechargeable batteries and photovoltaic business (previously 1x average 2016-17E PBR), in line with the average for other battery makers.

We still apply an EV/EBITDA of 3.5x for the mobile handset business (previously 8.0x average 2016-17E PER), which is at the high end of its peers' range given its strong sales growth and anticipated margin expansion from an increase in orders for the metal casing business.

For the conventional vehicle business, we apply an EV/EBITDA of 4.0x to our 2017 EBITDA forecast (previously 6.0x average 2016-17E PER), which is at the low end of the various H-share automobile companies under our coverage. And we value the new monorail business at a 2017E EV/EBITDA of 6.0x, in line with our valuation for CRRC.

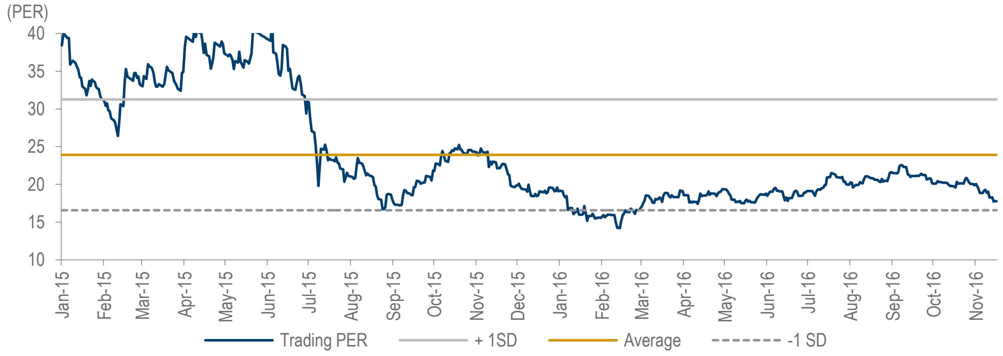
For the NEV segment, we assign an EV/EBITDA of 20.0x (previously 25.0x average 2016-17E PER), to reflect our high EPS growth forecasts of 20-44% YoY and solid EBITDA growth of 22-39% YoY in 2017-18E. We also update our CNY/HKD exchange rate to HKD1:CNY0.89 from HKD1:CNY0.85.

### BYD: SOTP valuation

| | Valuation method | Multiple (x) | NAV 17E (CNY m) |
|---|---|---|---|
| Rechargeable batteries | EV/EBITDA | 6.0 x | 11,778 |
| Mobile handsets | EV/EBITDA | 3.5 x | 13,965 |
| Autos – conventional | EV/EBITDA | 4.0 x | 6,597 |
| Autos – NEVs | EV/EBITDA | 20.0 x | 199,832 |
| Monorail | EV/EBITDA | 6.0 x | 2,520 |
| **Sub-total** | | | **234,693** |
| - Net debt/cash | | | (21,769) |
| - Minority interest | | | (4,661) |
| **Equity value (CNYm)** | | | **208,263** |
| Exchange rate, 1HKD = x CNY | | | 0.89 |
| **Equity value (HKDm)** | | | **234,266** |
| **Conglomerate discount** | | | **20%** |
| **Equity value/share (HKD)** | | | **68.00** |

*Source: Bloomberg, Daiwa estimates*

### BYD: 1-year forward PER band




*Source: Bloomberg, Daiwa estimate*

### Global automotive manufacturers peers: valuation comparison

| Name | | Bloomberg code | Trading currency | Share price 30-Nov-16 | Rating | PER (x) FY16E | PER (x) FY17E | PBR (x) FY16E | PBR (x) FY17E | EV/EBITDA(x) FY16E | EV/EBITDA(x) FY17E | Div yield (%) FY16E | Div yield (%) FY17E | ROE (%) FY16E | ROE (%) FY17E |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **China H-share listed** | | | | | | | | | | | | | | | |
| Geely Automobile Holdings Lt | * | 175 HK | HKD | 8.02 | Outperform | 14.2 | 9.2 | 2.6 | 2.1 | 7.1 | 4.1 | 0.9 | 1.3 | 20.4 | 25.2 |
| BYD Co Ltd-H | * | 1211 HK | HKD | 46.70 | Buy | 21.2 | 17.7 | 2.2 | 1.9 | 9.2 | 7.8 | n.a. | n.a. | 12.0 | 11.5 |
| Brilliance China Automotive | * | 1114 HK | HKD | 10.86 | Hold | 14.0 | 11.2 | 2.1 | 1.8 | n.a. | n.a. | 0.9 | 1.1 | 16.2 | 17.4 |
| Dongfeng Motor Grp Co Ltd-H | * | 489 HK | HKD | 7.89 | Outperform | 5.0 | 4.8 | 0.6 | 0.6 | 6.3 | 4.6 | 3.0 | 3.1 | 13.3 | 12.5 |
| Great Wall Motor Company-H | * | 2333 HK | HKD | 7.30 | Hold | 8.2 | 8.0 | 1.4 | 1.2 | 5.5 | 5.2 | 3.8 | 3.8 | 17.6 | 16.1 |
| Guangzhou Automobile Group-H | * | 2238 HK | HKD | 10.16 | Sell | 10.3 | 9.5 | 1.4 | 1.2 | 13.3 | 10.9 | 3.1 | 3.4 | 13.8 | 13.6 |
| BAIC Motor Corp Ltd-H | * | 1958 HK | HKD | 7.54 | Sell | 12.9 | 11.3 | 1.3 | 1.2 | 5.1 | 3.5 | 2.7 | 3.0 | 10.8 | 11.5 |
| **China A-share listed** | | | | | | | | | | | | | | | |
| Byd Co Ltd -A | | 002594 CH | CNY | 55.33 | NR | 28.8 | 23.9 | 3.0 | 2.8 | 13.9 | 12.0 | 0.0 | 0.0 | 12.2 | 12.5 |
| Guangzhou Automobile Group-A | | 601238 CH | CNY | 25.14 | NR | 21.7 | 18.6 | 3.6 | 3.2 | 20.9 | 16.3 | 0.0 | 0.0 | 17.3 | 18.2 |
| Great Wall Motor Co Ltd-A | | 601633 CH | CNY | 10.84 | NR | 10.5 | 9.7 | 2.2 | 1.9 | 6.5 | 6.0 | 0.0 | 0.0 | 22.2 | 20.6 |
| Saic Motor Corp Ltd-A | | 600104 CH | CNY | 25.25 | NR | 8.8 | 8.1 | 1.5 | 1.3 | 10.3 | 8.8 | 0.1 | 0.1 | 17.1 | 17.3 |
| Chongqing Changan Automobi-B | | 200625 CH | HKD | 11.70 | NR | 4.3 | 4.1 | 1.1 | 1.0 | 29.4 | 20.7 | 0.1 | 0.1 | 28.6 | 25.2 |
| Faw Car Company Limited-A | | 000800 CH | CNY | 11.88 | NR | 349.4 | 516.5 | 2.2 | 2.1 | 21.3 | 19.3 | n.a. | n.a. | 3.8 | 3.6 |
| Anhui Jianghuai Auto Co-A | | 600418 CH | CNY | 12.75 | NR | 17.9 | 14.7 | 1.8 | 1.7 | 15.3 | 12.3 | 0.0 | 0.0 | 10.7 | 12.0 |
| Jiangsu Yueda Investment C-A | | 600805 CH | CNY | 8.97 | NR | 56.1 | 49.8 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| Tianjin Faw Xiali Automobi-A | | 000927 CH | CNY | 5.77 | NR | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| Lifan Industry Group Co Lt-A | | 601777 CH | CNY | 9.60 | NR | 14.3 | 11.2 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| Haima Automobile Group Co-A | | 000572 CH | CNY | 5.36 | NR | 44.7 | 38.3 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| Shenyang Jinbei Automotive-A | | 600609 CH | CNY | 6.64 | NR | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| **US** | | | | | | | | | | | | | | | |
| Tesla Motors Inc | | TSLA US | USD | 189.40 | NR | n.a. | n.a. | 10.2 | 10.3 | 53.5 | 25.3 | n.a. | n.a. | n.a | n.a |
| Ford Motor Co | * | F US | USD | 11.96 | Hold | 6.6 | 7.3 | 1.5 | 1.2 | 2.9 | 3.0 | 0.1 | 0.1 | 25.8 | 19.3 |
| General Motors Co | * | GM US | USD | 34.53 | Hold | 5.7 | 6.1 | 1.2 | 1.0 | 2.5 | 2.5 | 0.0 | 0.0 | 21.3 | 18.1 |
| **Europe** | | | | | | | | | | | | | | | |
| Daimler Ag-Registered Shares | | DAI GR | EUR | 62.68 | NR | 7.6 | 7.4 | 1.2 | 1.1 | 2.6 | 2.4 | 0.1 | 0.1 | 15.7 | 15.4 |
| Bayerische Motoren Werke AG | | BMW GR | EUR | 80.22 | NR | 7.9 | 8.1 | 1.1 | 1.0 | 6.1 | 6.2 | 0.0 | 0.0 | 14.9 | 13.5 |
| Volkswagen AG | | VoW GR | EUR | 128.93 | NR | 7.3 | 6.0 | 0.7 | 0.7 | 1.3 | 1.2 | 0.0 | 0.0 | 10.1 | 10.5 |
| Fiat Chrysler Automobiles NV | | FCA IM | EUR | 7.29 | NR | 4.7 | 4.2 | 0.7 | 0.6 | 1.6 | 1.5 | n.a. | 0.0 | 13.8 | 14.8 |
| Peugeot SA | | UG FP | EUR | 13.92 | NR | 7.0 | 6.6 | 1.0 | 0.9 | 1.4 | 1.4 | 0.0 | 0.0 | 15.0 | 14.4 |
| Renault SA | | RNO FP | EUR | 74.34 | NR | 6.3 | 5.6 | 0.7 | 0.6 | 3.3 | 3.1 | 0.0 | 0.0 | 11.3 | 11.9 |
| **Japan** | | | | | | | | | | | | | | | |
| Honda Motor Co Ltd | ** | 7267 JP | JPY | 3332.00 | Hold | 11.0 | 11.6 | 0.8 | 0.9 | 6.7 | 7.3 | 0.0 | 0.0 | 7.7 | 7.6 |
| Nissan Motor Co Ltd | ** | 7201 JP | JPY | 1056.50 | Hold | 7.9 | 8.0 | 0.9 | 0.9 | 2.7 | 2.8 | 0.0 | 0.0 | 11.2 | 11.2 |
| Toyota Motor Corp | ** | 7203 JP | JPY | 6649.00 | Outperform | 8.9 | 12.1 | 1.1 | 1.2 | 8.6 | 11.9 | 0.0 | 0.0 | 13.4 | 9.7 |
| **Korea** | | | | | | | | | | | | | | | |
| Hyundai Motor Co | * | 005380 KS | KRW | 133000.00 | Buy | 6.3 | 5.5 | 0.4 | 0.4 | 4.6 | 4.0 | 3.5 | 3.9 | 8.7 | 9.2 |
| Kia Motors Corp | * | 000270 KS | KRW | 37400.00 | Outperform | 5.5 | 5.4 | 0.6 | 0.5 | 2.9 | 2.6 | 3.2 | 3.5 | 10.7 | 10.0 |
| **India** | | | | | | | | | | | | | | | |
| Tata Motors Ltd | ** | TTMT IN | INR | 459.30 | NR | 13.1 | 11.3 | 2.0 | 1.7 | 4.7 | 4.4 | 0.0 | 0.0 | 16.4 | 15.2 |
| Mahindra & Mahindra Ltd | ** | MM IN | INR | 1185.10 | NR | 20.7 | 16.3 | 2.6 | 1.9 | 12.8 | 10.6 | 0.0 | 0.0 | 12.4 | 12.0 |
| **Total** | | Weighted average | | | | 10.2 | 10.8 | 1.5 | 1.5 | 7.9 | 7.2 | 0.3 | 0.4 | 13.9 | 12.5 |
| | | High | | | | 349.4 | 516.5 | 10.2 | 10.3 | 53.5 | 25.3 | 3.8 | 3.9 | 28.6 | 25.2 |
| | | Low | | | | 4.3 | 4.1 | 0.4 | 0.4 | 1.3 | 1.2 | 0.0 | 0.0 | 3.8 | 3.6 |
| | | Median | | | | 8.9 | 9.2 | 1.4 | 1.2 | 6.4 | 5.6 | 0.0 | 0.0 | 13.8 | 13.5 |

*Source: Bloomberg, *Daiwa forecasts*
*Note: **Mar year-end*

# Risks to our view

## Unexpected subsidy cuts by local governments

**Any local subsidy cut by more than 20% in key cities would affect BYD's and peers' profitability**

Starting from 2017, China's central government plans to cut the cash subsidy offered to NEV buyers by 20% to eliminate green car subsidies entirely by 2021 so the industry does not grow dependent on them. In addition to the central government subsidy, local governments also levy their own subsidies; and while we would expect local governments to follow the central government in cutting subsidies by 20%, it is by no means certain that this would be the case. As such, if any major cities cut the subsidy by more than 20% and lower their subsidy levels significantly, the margin erosion for BYD's NEV segment would become severe in 2017, and may not lead to a rise in margins in 2018.

## Unfavourable local policies weakening BYD's competitiveness

Under the Shanghai Government's new subsidy document published in 1H16, BYD and most of its peers, except for SAIC Motor, are only eligible to receive a CNY5,000 grant per PHEV model sale (vs. CNY24,000 for SAIC Motor's Roewe e550). If any similar local protective policies are released in the future, BYD may not reach its sales target for 2017.

## Failure to reduce LiB costs

**If BYD does not cut its LiB costs, its NEV products may not be competitive in terms of pricing**

In the near term, successive cost reductions could allow BYD to maintain its operating margin against the backdrop of the 20% subsidy cut starting in 2017. In the long run, BYD could build up its competitive advantage through its internal LiB supply if the cost of its self-made LiBs were the same or slightly higher than the market leader's cost. However, if BYD fails to reduce its LiB costs, either it would lose competitiveness in supplying more expensive NEVs or it would have to purchase LiBs from external suppliers and write off its battery business.

## Delays in infrastructure completion

Though we believe the government is determined to speed up the construction of EV-related infrastructure such as charging facilities, several factors could slow the process, including a lack of interest from private capital and difficulties in land acquisition and conversion. We believe a delay in infrastructure construction would be one of the major risks hindering NEV sales, despite the government potentially lengthening the NEV subsidy scheme in response.

Daiwa Capital Markets

# Nexteer Automotive Group (1316 HK)

Target price: **HKD12.70** (from HKD12.70)

Share price (30 Nov): **HKD9.72** | Up/downside: **+30.6%**

5 4 3 2 **1**

**Buy**
(unchanged)

## Emerging opportunity in autonomous driving

- Benefits from upgrading of steering systems for ADAS development
- Robust order backlog provides good earnings visibility
- Reiterate Buy (1) rating and 12-month target price of HKD12.70

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**What's new:** Nexteer is a leading global power steering provider that we believe stands to benefit from the rising penetration and development of Advanced Driving Assistance Systems (ADAS), which requires the company to upgrade its steering products. The industry's conversion to more fuel-efficient electric power steering from traditional energy-consuming hydraulic power steering, driven by strengthening fuel efficiency standards across the globe is also a boon to Nexteer.

**What's the impact: ADAS products development.** Nexteer is becoming increasingly involved in ADAS development. In August 2016, it hosted a public Senate committee hearing on autonomous driving legislation in Michigan where GM, Ford, Nexteer itself and other industry leaders gave testimony supporting a package of sweeping autonomous vehicle bills in the state. Management believes Nexteer will remain the dominant steering supplier in the US. Any announcement of concrete plans of ADAS-related acquisitions would provide a solid boost to the share price, in our view.

**Strong order backlog to provide earnings visibility.** Nexteer recorded a total of USD26bn worth of orders-to-delivery (over 6x its full-year revenue) and orders-to-launch of USD11.8bn as of end-3Q16 (vs. USD10.8bn in 1H16). We believe the large order backlog gives it solid earnings visibility. With an increasing mix of orders for the China market (which has a shorter lead time of 1.5 years on average versus 2 years for international OEMs), we expect to see faster revenue recognition.

**China remains the key earnings driver.** Nexteer aims to be one of the top-3 steering suppliers in China by 2020, from its current <5% market share and 20% revenue contribution in China. About 90% of its revenue in China is from SUVs, MPVs and minivans – sub-segments whose sales volumes we estimate will significantly outperform the overall China PV market in 2017-18E. A large proportion of Nexteer's products are for small size engines (<1.6L), which augurs well for the company given the potential extension of China's purchase tax incentives into 2017.

**What we recommend:** We reiterate our Buy (1) rating on Nexteer and 12-month TP of HKD12.70. While we roll over our valuation to 2017E EPS (from average 2016-17E), we lower our target PER to 12x (from 13x) to reflect likely softening global auto industry demand. We still like Nexteer for its leading position in the steering business and our earnings CAGR of 13% and ROE of +25% over 2016-18E. Key risk: high customer concentration.

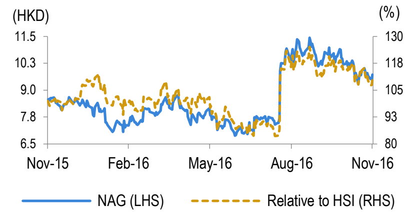
**How we differ:** We are more bullish than the market on Nexteer securing more orders in China by leveraging its parent AVIC's strong network.

### Forecast revisions (%)

| Year to 31 Dec | 16E | 17E | 18E |
|---|---|---|---|
| Revenue change | - | - | - |
| Net profit change | - | - | - |
| Core EPS (FD) change | - | - | - |

*Source: Daiwa forecasts*

### Share price performance




| | |
|---|---|
| 12-month range | 6.88-11.44 |
| Market cap (USDbn) | 3.13 |
| 3m avg daily turnover (USDm) | 6.24 |
| Shares outstanding (m) | 2,500 |
| Major shareholder | Pacific Century Motor (67.0%) |

### Financial summary (USD)

| Year to 31 Dec | 16E | 17E | 18E |
|---|---|---|---|
| Revenue (m) | 3,810 | 4,203 | 4,649 |
| Operating profit (m) | 430 | 482 | 545 |
| Net profit (m) | 292 | 331 | 373 |
| Core EPS (fully-diluted) | 0.117 | 0.132 | 0.149 |
| EPS change (%) | 42.1 | 13.3 | 12.9 |
| Daiwa vs Cons. EPS (%) | 4.9 | 4.2 | 5.1 |
| PER (x) | 10.7 | 9.5 | 8.4 |
| Dividend yield (%) | 1.9 | 2.2 | 2.4 |
| DPS | 0.024 | 0.027 | 0.031 |
| PBR (x) | 2.9 | 2.3 | 1.9 |
| EV/EBITDA (x) | 5.5 | 4.6 | 3.7 |
| ROE (%) | 30.6 | 27.3 | 24.9 |

*Source: FactSet, Daiwa forecasts*

5 4 3 2 1

**Buy**
(unchanged)

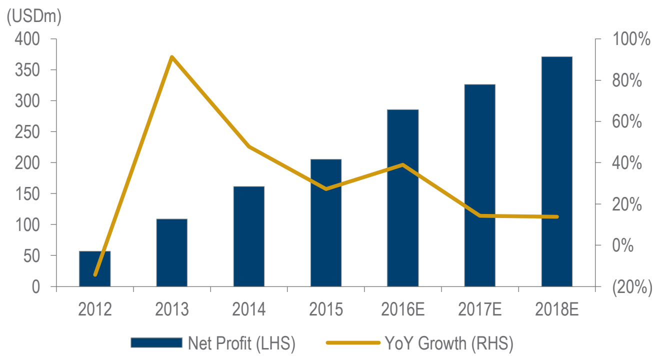
# How do we justify our view?

| Growth outlook | Valuation | Earnings revisions |
| --- | --- | --- |

## Growth outlook

We forecast Nexteer to reported net-profit growth of 42% YoY to USD292m for 2016E, driven by expansion in the China market and conversion of steering systems from hydraulic power steering to electric power steering, especially in emerging countries like China. From a high earnings base in 2016, the company still stands to record solid net profit growth of 13% YoY for 2017E and 2018E, based on our forecasts, supported by market-share gains in China's SUV market and Nexteer's rich order backlog.

**Nexteer: adj. net profit and growth (2012-18E)**

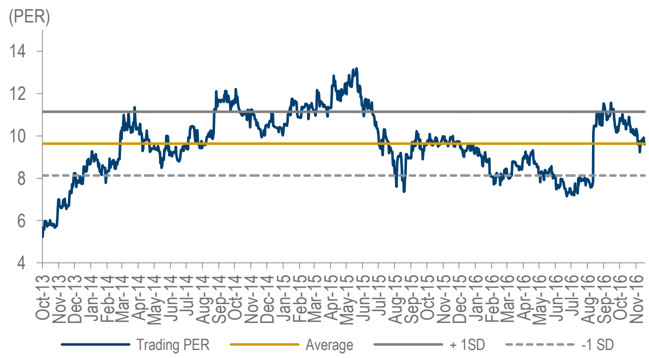



*Source: Company, Daiwa forecasts*

## Valuation

Nexteer is trading currently at a 2017E PER of 10x, based on our forecasts, largely in line with its average trading PER of 10x since listing in October 2013. We set our 12-month target price at HKD12.70, now based on a 2017E PER of 12x (from 13x applied to our average 2016-17E EPS), in line with global auto part peers' average, but at the high end of its steering peers' valuation range. In our view, this is justified by Nexteer's higher-than-peer profit growth and ROE for the next 3 years.

**Nexteer: 1-year forward PER**

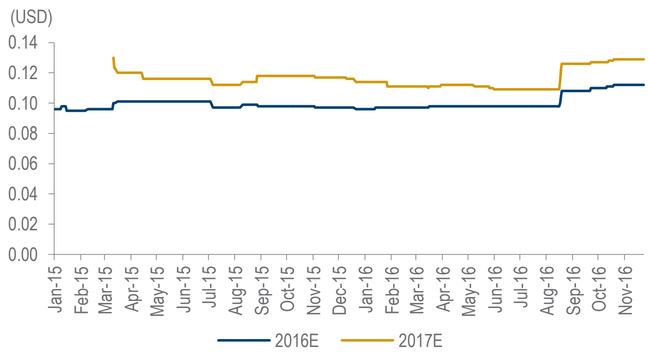



*Source: Bloomberg, Daiwa forecasts*

## Earnings revisions

The street has been revising up Nexteer's earnings forecast after it reported better than expected gross margin improvement as a result of increasing penetration of electric steering products. Our current earnings forecasts are largely in line with the Bloomberg consensus. However, on the operational front, we are more bullish than the market on Nexteer securing more orders in China by leveraging on parent company AVIC's strong SOE background and network.

**Nexteer: consensus 2016-17E EPS revisions**




*Source: Bloomberg*

# Financial summary

## Key assumptions

| Year to 31 Dec | 2011 | 2012 | 2013 | 2014 | 2015 | 2016E | 2017E | 2018E |
|---|---|---|---|---|---|---|---|---|
| Revenue growth (%) - U.S. | 13.3 | 4.5 | 10.4 | 20.3 | 8.6 | 13.0 | 7.0 | 7.0 |
| Revenue growth (%) - China | 14.3 | 8.2 | 43.6 | 78.8 | 56.5 | 20.0 | 20.0 | 20.0 |
| EBITDAR margin (%) - U.S. | 4.6 | 4.7 | 10.9 | 11.4 | 15.2 | 16.0 | 16.0 | 16.0 |
| EBITDAR margin (%) - China | (2.5) | 11.0 | 8.6 | 15.5 | 14.7 | 17.0 | 17.5 | 18.0 |

## Profit and loss (USDm)

| Year to 31 Dec | 2011 | 2012 | 2013 | 2014 | 2015 | 2016E | 2017E | 2018E |
|---|---|---|---|---|---|---|---|---|
| North America | 1,470 | 1,536 | 1,697 | 2,042 | 2,217 | 2,505 | 2,680 | 2,868 |
| China | 168 | 182 | 262 | 468 | 733 | 879 | 1,055 | 1,266 |
| Other Revenue | 609 | 449 | 428 | 468 | 411 | 425 | 468 | 514 |
| **Total Revenue** | **2,248** | **2,168** | **2,387** | **2,978** | **3,361** | **3,810** | **4,203** | **4,649** |
| Other income | 9 | (3) | (2) | (5) | (15) | 0 | 0 | 0 |
| COGS | (1,970) | (1,896) | (2,047) | (2,558) | (2,816) | (3,138) | (3,441) | (3,785) |
| SG&A | (197) | (180) | (163) | (178) | (214) | (242) | (280) | (319) |
| Other op.expenses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Operating profit** | **90** | **89** | **175** | **238** | **316** | **430** | **482** | **545** |
| Net-interest inc./(exp.) | (16) | (22) | (22) | (22) | (31) | (28) | (27) | (31) |
| Assoc/forex/extraord./others | (1) | (5) | (2) | (1) | (1) | (1) | (1) | (2) |
| **Pre-tax profit** | **73** | **62** | **151** | **215** | **283** | **400** | **453** | **512** |
| Tax | (5) | (4) | (40) | (51) | (73) | (104) | (118) | (133) |
| Min. int./pref. div./others | (1) | (2) | (2) | (2) | (5) | (4) | (5) | (6) |
| **Net profit (reported)** | **67** | **57** | **109** | **161** | **205** | **292** | **331** | **373** |
| **Net profit (adjusted)** | **67** | **57** | **109** | **161** | **205** | **292** | **331** | **373** |
| **EPS (reported)(USD)** | **66.686** | **57.096** | **0.058** | **0.065** | **0.082** | **0.117** | **0.132** | **0.149** |
| **EPS (adjusted)(USD)** | **66.686** | **57.096** | **0.058** | **0.065** | **0.082** | **0.117** | **0.132** | **0.149** |
| **EPS (adjusted fully-diluted)(USD)** | **66.686** | **57.096** | **0.058** | **0.065** | **0.082** | **0.117** | **0.132** | **0.149** |
| **DPS (USD)** | **33.600** | **0.000** | **0.009** | **0.013** | **0.017** | **0.024** | **0.027** | **0.031** |
| **EBIT** | **90** | **89** | **175** | **238** | **316** | **430** | **482** | **545** |
| **EBITDA** | **144** | **146** | **248** | **356** | **458** | **584** | **660** | **749** |

## Cash flow (USDm)

| Year to 31 Dec | 2011 | 2012 | 2013 | 2014 | 2015 | 2016E | 2017E | 2018E |
|---|---|---|---|---|---|---|---|---|
| Profit before tax | 73 | 62 | 151 | 215 | 283 | 400 | 453 | 512 |
| Depreciation and amortisation | 54 | 58 | 74 | 119 | 142 | 155 | 178 | 204 |
| Tax paid | (8) | (6) | (7) | (51) | 0 | (104) | (118) | (133) |
| Change in working capital | (39) | (8) | (27) | (109) | 64 | (32) | (26) | (29) |
| Other operational CF items | 17 | 54 | 32 | 78 | (15) | 32 | 32 | 37 |
| **Cash flow from operations** | **98** | **160** | **223** | **251** | **475** | **451** | **520** | **591** |
| Capex | (137) | (276) | (287) | (279) | (270) | (230) | (238) | (245) |
| Net (acquisitions)/disposals | 3 | 4 | 13 | 0 | 0 | 8 | 10 | 11 |
| Other investing CF items | 1 | (0) | (4) | 3 | (6) | 0 | 0 | 0 |
| **Cash flow from investing** | **(133)** | **(273)** | **(277)** | **(276)** | **(276)** | **(222)** | **(228)** | **(234)** |
| Change in debt | 15 | 133 | 47 | (107) | (140) | 0 | 0 | 0 |
| Net share issues/(repurchases) | 0 | 0 | 295 | 0 | 0 | 0 | 0 | 0 |
| Dividends paid | 0 | 0 | 0 | (22) | 0 | (42) | (60) | (68) |
| Other financing CF items | (15) | (34) | (38) | 219 | (22) | (22) | (31) | (36) |
| **Cash flow from financing** | **0** | **99** | **305** | **91** | **(162)** | **(64)** | **(90)** | **(103)** |
| Forex effect/others | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Change in cash** | **(35)** | **(14)** | **250** | **66** | **37** | **165** | **201** | **253** |
| Free cash flow | (39) | (116) | (65) | (28) | 205 | 221 | 282 | 346 |

*Source: FactSet, Daiwa forecasts*

## Financial summary continued …

### Balance sheet (USDm)

| As at 31 Dec | 2011 | 2012 | 2013 | 2014 | 2015 | 2016E | 2017E | 2018E |
|---|---|---|---|---|---|---|---|---|
| Cash & short-term investment | 78 | 64 | 314 | 380 | 417 | 582 | 783 | 1,036 |
| Inventory | 157 | 174 | 185 | 226 | 254 | 283 | 310 | 341 |
| Accounts receivable | 316 | 324 | 364 | 525 | 570 | 646 | 713 | 788 |
| Other current assets | 45 | 65 | 76 | 94 | 95 | 108 | 119 | 132 |
| **Total current assets** | **596** | **628** | **939** | **1,226** | **1,336** | **1,619** | **1,925** | **2,297** |
| Fixed assets | 290 | 434 | 563 | 626 | 685 | 713 | 735 | 748 |
| Goodwill & intangibles | 76 | 180 | 272 | 345 | 408 | 435 | 459 | 472 |
| Other non-current assets | 12 | 17 | 31 | 46 | 27 | 30 | 33 | 36 |
| **Total assets** | **973** | **1,259** | **1,805** | **2,242** | **2,457** | **2,797** | **3,152** | **3,553** |
| Short-term debt | 405 | 99 | 130 | 97 | 81 | 81 | 81 | 81 |
| Accounts payable | 260 | 296 | 336 | 439 | 559 | 623 | 683 | 751 |
| Other current liabilities | 103 | 112 | 125 | 146 | 167 | 189 | 209 | 230 |
| **Total current liabilities** | **767** | **507** | **592** | **682** | **807** | **893** | **973** | **1,063** |
| Long-term debt | 2 | 442 | 458 | 634 | 561 | 561 | 561 | 561 |
| Other non-current liabilities | 82 | 118 | 165 | 218 | 235 | 235 | 235 | 235 |
| **Total liabilities** | **850** | **1,067** | **1,214** | **1,534** | **1,602** | **1,688** | **1,768** | **1,858** |
| Share capital | 111 | 171 | 568 | 684 | 827 | 827 | 827 | 827 |
| Reserves/R.E./others | 0 | 0 | 0 | 0 | 0 | 250 | 520 | 826 |
| **Shareholders' equity** | **111** | **171** | **568** | **684** | **827** | **1,077** | **1,348** | **1,653** |
| Minority interests | 12 | 21 | 23 | 24 | 27 | 31 | 36 | 42 |
| **Total equity & liabilities** | **973** | **1,259** | **1,805** | **2,242** | **2,457** | **2,797** | **3,152** | **3,553** |
| EV | 3,474 | 3,631 | 3,431 | 3,503 | 3,375 | 3,212 | 3,013 | 2,762 |
| **Net debt/(cash)** | **328** | **477** | **274** | **351** | **225** | **60** | **(141)** | **(394)** |
| **BVPS (USD)** | **110.828** | **170.931** | **0.227** | **0.274** | **0.331** | **0.431** | **0.539** | **0.661** |

### Key ratios (%)

| Year to 31 Dec | 2011 | 2012 | 2013 | 2014 | 2015 | 2016E | 2017E | 2018E |
|---|---|---|---|---|---|---|---|---|
| Sales (YoY) | 9.5 | (3.6) | 10.1 | 24.8 | 12.8 | 13.4 | 10.3 | 10.6 |
| EBITDA (YoY) | 154.4 | 1.7 | 69.6 | 43.6 | 28.5 | 27.6 | 13.0 | 13.4 |
| Operating profit (YoY) | 232.5 | (1.7) | 97.2 | 36.1 | 32.8 | 36.2 | 12.2 | 13.0 |
| Net profit (YoY) | 608.2 | (14.4) | 91.2 | 47.8 | 27.3 | 42.0 | 13.3 | 12.9 |
| Core EPS (fully-diluted) (YoY) | 608.2 | (14.4) | (99.9) | 10.5 | 27.1 | 42.1 | 13.3 | 12.9 |
| Gross-profit margin | 12.4 | 12.5 | 14.2 | 14.1 | 16.2 | 17.6 | 18.1 | 18.6 |
| EBITDA margin | 6.4 | 6.8 | 10.4 | 12.0 | 13.6 | 15.3 | 15.7 | 16.1 |
| Operating-profit margin | 4.0 | 4.1 | 7.3 | 8.0 | 9.4 | 11.3 | 11.5 | 11.7 |
| Net profit margin | 3.0 | 2.6 | 4.6 | 5.4 | 6.1 | 7.7 | 7.9 | 8.0 |
| ROAE | 80.7 | 40.5 | 29.6 | 25.8 | 27.2 | 30.6 | 27.3 | 24.9 |
| ROAA | 7.1 | 5.1 | 7.1 | 8.0 | 8.7 | 11.1 | 11.1 | 11.1 |
| ROCE | 18.1 | 14.0 | 18.3 | 18.2 | 21.5 | 26.5 | 25.5 | 25.0 |
| ROIC | 20.8 | 14.9 | 16.7 | 18.8 | 21.9 | 28.3 | 29.6 | 31.7 |
| Net debt to equity | 296.3 | 278.8 | 48.2 | 51.3 | 27.2 | 5.6 | net cash | net cash |
| Effective tax rate | 7.4 | 5.7 | 26.7 | 23.9 | 25.8 | 26.0 | 26.0 | 26.0 |
| Accounts receivable (days) | 50.7 | 53.9 | 52.6 | 54.5 | 59.5 | 58.3 | 59.0 | 58.9 |
| Current ratio (x) | 0.8 | 1.2 | 1.6 | 1.8 | 1.7 | 1.8 | 2.0 | 2.2 |
| Net interest cover (x) | 5.7 | 4.1 | 8.0 | 11.0 | 10.2 | 15.1 | 17.6 | 17.4 |
| Net dividend payout | 50.4 | 0.0 | 15.0 | 20.0 | 20.5 | 20.5 | 20.5 | 20.5 |
| Free cash flow yield | n.a. | n.a. | n.a. | n.a. | 6.5 | 7.0 | 9.0 | 11.0 |

*Source: FactSet, Daiwa forecasts*

## Company profile

Listed on the Hong Kong Stock Exchange in 2013, Nexteer is a leading global steering and driveline manufacturer, solely dedicated to electric and hydraulic steering systems, steering columns and driveline products for original equipment manufacturers. Its customers include General Motors, Fiat, Ford, Toyota, Chrysler and PSA Peugeot Citroen, as well as automakers in India, China and South America.

# Investment thesis

## Opportunity arising from ADAS penetration

**Nexteer needs to upgrade its electric power steering product so that it is compatible with other ADAS components**

### Requires upgrading of steering products for ADAS development

ADAS systems utilise various sensors within the car that enable the vehicle to control itself and adapt to changing situations on the road. An upgraded electric power steering is required as the steering system needs to be linked to the car's artificial intelligence (AI) and ADAS components. Nexteer targets not only to provide the required steering technology, but also to offer integration expertise of different subsystems.

Nexteer is becoming increasingly involved in ADAS technologies development. In August 2016, it hosted a public Senate committee hearing on autonomous driving legislation in Michigan where GM, Ford, Nexteer itself and other industry leaders gave testimony supporting a package of sweeping autonomous vehicle bills in the state. Management believes Nexteer will remain the dominant steering supplier in the US. Any announcement of concrete plans of ADAS-related acquisitions would provide a solid boost to the share price, in our view.

## Rich backlog, high earnings visibility

**Rich order backlog and large exposure to China's SUV market provide high earnings visibility**

### Heavy backlog should drive future earnings growth

We expect the proportion of electric power steering revenue in Nexteer's overall revenue mix to continue to increase, driven by the low penetration rate of these systems in the emerging markets, including China. Typically, there is a 2-2.5 year lead time for a new programme to be launched for international OEMs, and it is likely to last for the vehicle's entire life cycle, averaging about 4-7 years.

Nexteer had a total of USD24bn worth of orders-to-delivery (more than 6x its full-year revenue) and orders-to-launch of USD11.8bn as of end-3Q16 (vs. USD10.8bn in 1H16). As such, its large order backlog gives Nexteer high earnings growth visibility for the next few years, in our view. With the company's increasing mix of orders for the China market (which has a shorter lead time of 1.5 years on average versus 2 years for international OEMs), we expect it to see faster revenue recognition.

### Large exposure to China's SUV market

According to management, about 90% of Nexteer's revenue in China is derived from steering and driveline systems for SUVs, MPVs and minivans – sub-segments that tend to significantly outperform the overall automobile market in China. A large proportion of Nexteer's products are for PVs with small engines (<1.6L), which should also benefit from potential extension of China's purchase tax incentives which are due to expire at end-2016.

## Strengthening fuel efficiency standards to drive electric power steering growth

**Higher fuel efficiency standards and environmental regulations should accelerate the adoption of electric power steering**

### China to strengthen fuel efficiency standards by 35% over next 5 years

China's new fuel consumption standards call for vehicle fuel consumption to be reduced to 5.0L/km (or 21.3km/litre) by 2020, from 6.9L/km (or 15.7km/litre) currently. This is lower than current US standards and close to Japan's. Meanwhile, China has also announced that it plans to cut $CO_2$ emissions by 27% by 2020.

China's fuel-consumption target is calculated by taking the weighted average number of vehicles sold and then determining the corresponding fuel consumption per OEM. Thus, we believe the OEMs are likely to develop more electric vehicles (EVs) in the next few years, as doing so would allow them to reduce their blended fuel consumption figures. We see increasing demand for electric power steering in China, especially for SUV OEMs, as they will need to develop more fuel-efficient models, given that SUVs typically consume a lot of fuel.

Nexteer's advanced technology is complemented by its strong technical expertise in the field of electric power steering, which is widely considered a pioneering and industry-leading technology. In our view, the company is poised to benefit from higher electric power steering adoption in China.

**Summary of fuel-efficiency targets: major markets in terms of car manufacturing or exports**

| km/l (mpg) | US | EU | Japan | China | S. Korea |
|---|---|---|---|---|---|
| 2005 | 12.4 (29.0) | 15.8 (37.2) | 16.7 (39.3) | 11.0 (25.9) | 12.3 (28.9) |
| 2010 | 13.9 (33.0) | 18.0 (42.3) | 19.6 (46.1) | 14.4 (33.9) | 14.8 (34.8) |
| 2015 | 15.4 (36.0) | 19.7 (46.3) | 21.0 (49.4) | 15.7 (36.9) | 16.7 (39.3) |
| 2020 | 19.9 (47.0) | 25.8 (60.7) | 23.4 (55.0) | 21.3 (50.1) | 16.7 (39.3) |
| 2025 | 23.9 (56.0) | 30.8 (72.4) ~ 35.0 (82.3) | 23.4 (55.0) | 21.3 (50.1) | 16.7 (39.3) |
| **5-YOY (%)** | **US** | **EU** | **Japan** | **China** | **S. Korea** |
| 2010 | 12.1% | 13.9% | 17.4% | 30.9% | 20.3% |
| 2015 | 10.8% | 9.4% | 7.1% | 9.0% | 12.8% |
| 2020 | 29.2% | 31.0% | 11.4% | 35.7% | 0.0% |
| 2025 | 20.1% | 19.4%~35.7% | 0.0% | 0.0% | 0.0% |
| **Improvement (%)** | **US** | **EU** | **Japan** | **China** | **S. Korea** |
| 2010-25 | 71.9% | 71.1%~94.4% | 19.4% | 47.9% | 12.8% |
| 2015-25 | 55.2% | 56.3%~77.7% | 11.4% | 35.7% | 0.0% |

*Source: ICCT*
*Note: No official guidance on fuel efficiency has been provided by Korea (beyond 2015), Japan (beyond 2020), or China (beyond 2020)*

## Valuation and recommendation

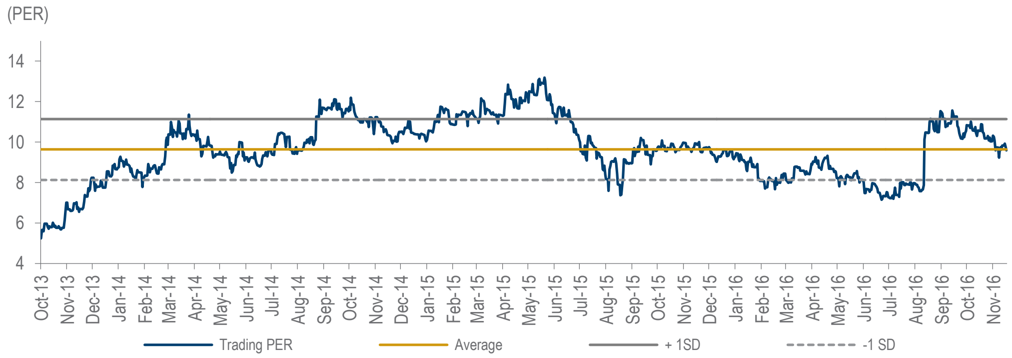
**We believe Nexteer should trade at the high end of its peers' range, backed by its higher ROE and earnings growth, especially in China SUV market**

We reiterate our Buy (1) rating and 12-month target price of HKD12.70, based on a 2017E PER of 12x, representing 30% upside potential from the current share-price level. We believe Nexteer's leading position in the steering business, stronger-than-peer earnings CAGR of 13% and ROE of 25-31% over 2016-18E, as well as increasing exposure to the SUV segment, which should outperform the overall China PV market, justify the stock trading at a valuation premium to its peers. Our target multiple for Nexteer represents the average of the global auto parts players' valuation, but is at a high end of its steering peers' range – a premium we believe is well deserved.

Auto fuel efficiency standards are currently being strengthened across the globe, which is resulting in an acceleration in the shift to electric power steering from hydraulic power steering. Nexteer, as one of the world's leading steering systems manufacturers, should benefit from its substantial electric power steering revenue portion, leading to higher margins and earnings growth for the company.

By 2020, the company targets to have become a top-3 steering supplier in China, the largest auto market in the world. About 90% of Nexteer's revenue in China is derived from SUVs, MPVs and minivans, the sub-segments that since this year have significantly outperformed (in terms of volume) the overall automobile market in China. New vehicle programmes from OEMs also provide good delivery visibility and sold earnings growth.

**Nexteer: PER bands**




*Source: Bloomberg, Daiwa forecasts*

## Auto parts: valuation comparisons

| Name | | Bloomberg code | Trading currency | Share price 30-Nov-16 | Rating | PER (x) | | PBR (x) | | EV/EBITDA(x) | | Div yield (%) | | ROE (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FY16E | FY17E | FY16E | FY17E | FY16E | FY17E | FY16E | FY17E | FY16E | FY17E |
| **China H-share listed** | | | | | | | | | | | | | | | |
| **Nexteer Automotive Group** | * | **1316 HK** | **HKD** | **9.70** | **Buy** | **10.7** | **9.5** | **2.9** | **2.3** | **5.5** | **4.6** | **1.9** | **2.2** | **30.6** | **27.3** |
| Fuyao Glass Industry Group-H | | 3606 HK | HKD | 23.45 | Outperform | 16.8 | 14.7 | 3.0 | 2.7 | 10.3 | 8.9 | 3.6 | 4.1 | 18.3 | 19.3 |
| Minth Group Ltd | | 425 HK | HKD | 25.70 | NR | 15.2 | 12.6 | 2.4 | 2.2 | 10.6 | 8.8 | 2.5 | 3.0 | 17.0 | 18.1 |
| Johnson Electric Holdings | ** | 179 HK | HKD | 22.20 | NR | 12.6 | 11.9 | 1.3 | 1.3 | 8.7 | 7.3 | 2.3 | 2.6 | 10.1 | 11.3 |
| Xinyi Glass Holdings Ltd | | 868 HK | HKD | 5.95 | NR | 7.4 | 6.4 | 1.6 | 1.4 | 7.2 | 6.4 | 6.6 | 7.4 | 21.8 | 22.4 |
| Weichai Power Co Ltd-H | | 2338 HK | HKD | 12.28 | NR | 21.7 | 18.3 | 1.3 | 1.3 | 6.6 | 5.9 | 1.8 | 2.0 | 6.3 | 7.1 |
| **China A-share listed** | | | | | | | | | | | | | | | |
| Huayu Automotive Systems -A | | 600741 CH | CNY | 16.36 | NR | 9.6 | 8.8 | 1.5 | 1.3 | 5.0 | 4.6 | 5.0 | 5.3 | 17.3 | 15.9 |
| Weifu High-Technology Grp-A | | 000581 CH | CNY | 23.91 | NR | 14.4 | 12.9 | 1.9 | 1.7 | 31.2 | 21.7 | 2.1 | 2.4 | 13.9 | 14.1 |
| Songz Automobile Air Con-A | | 002454 CH | CNY | 15.22 | NR | 18.5 | 15.0 | 2.2 | 1.9 | n.a. | n.a. | 0.5 | 1.5 | 10.0 | 12.6 |
| Ningbo Huaxiang Electronic-A | | 002048 CH | CNY | 23.59 | NR | 19.9 | 14.6 | 1.7 | 1.6 | 9.4 | 7.5 | 0.4 | 0.4 | 11.3 | 12.5 |
| **Japan** | | | | | | | | | | | | | | | |
| Jtekt Corp | *, ** | 6473 JP | JPY | 1796.00 | Hold | 12.3 | 15.7 | 1.3 | 1.3 | 5.4 | 6.1 | 2.3 | 2.3 | 10.6 | 8.8 |
| Nsk Ltd | *, ** | 6471 JP | JPY | 1236.00 | Hold | 10.4 | 15.7 | 1.4 | 1.4 | 6.0 | 7.5 | 2.7 | 3.0 | 13.7 | 9.4 |
| Ntn Corp | *, ** | 6472 JP | JPY | 421.00 | Hold | 14.9 | 20.3 | 0.9 | 1.0 | 5.5 | 6.6 | 2.3 | 2.6 | 6.4 | 5.9 |
| Denso Corp | *, ** | 6902 JP | JPY | 4789.00 | Outperform | 15.6 | 18.2 | 1.2 | 1.2 | 6.1 | 6.6 | 2.4 | 2.4 | 7.6 | 6.9 |
| Aisin Seiki Co Ltd | *, ** | 7259 JP | JPY | 4710.00 | Outperform | 14.8 | 13.8 | 1.2 | 1.2 | 5.3 | 5.0 | 2.1 | 2.1 | 8.0 | 8.7 |
| Toyota Industries Corp | *, ** | 6201 JP | JPY | 5150.00 | Hold | 8.7 | 14.1 | 0.7 | 0.8 | 10.6 | 11.0 | 2.3 | 2.2 | 7.7 | 5.8 |
| Asahi Glass Co Ltd | * | 5201 JP | JPY | 733.00 | Hold | 23.6 | 17.7 | 0.9 | 0.8 | 5.9 | 5.5 | 2.4 | 2.4 | 3.4 | 4.9 |
| Central Glass Co Ltd | ** | 4044 JP | JPY | 431.00 | NR | 9.0 | 10.4 | 0.6 | 0.6 | 5.4 | 5.7 | 2.2 | 2.4 | 6.5 | 5.3 |
| Nippon Sheet Glass Co Ltd | *, ** | 5202 JP | JPY | 829.00 | Outperform | n.a. | 14.2 | 0.6 | 1.0 | 6.6 | 6.7 | n.a | n.a | n.a | 5.9 |
| **S.Korea** | | | | | | | | | | | | | | | |
| Hyundai Mobis Co Ltd | * | 012330 KS | KRW | 248000.00 | Hold | 7.4 | 6.9 | 0.8 | 0.8 | 5.2 | 4.9 | 1.6 | 1.8 | 12.1 | 11.6 |
| Mando Corp | * | 204320 KS | KRW | 244500.00 | Buy | 12.9 | 10.9 | 1.6 | 1.4 | 6.9 | 6.3 | 1.9 | 2.1 | 13.2 | 14.3 |
| Hyundai Wia Corp | * | 011210 KS | KRW | 70800.00 | Outperform | 8.7 | 5.6 | 0.6 | 0.5 | 4.6 | 3.8 | 1.6 | 1.9 | 6.5 | 9.5 |
| Hanon Systems | * | 018880 KS | KRW | 10100.00 | Buy | 18.1 | 15.1 | 2.8 | 2.5 | 8.9 | 8.1 | 2.2 | 2.6 | 16.0 | 17.5 |
| Halla Holdings Corp | | 060980 KS | KRW | 61900.00 | NR | 9.1 | 8.0 | 0.7 | 0.6 | 7.6 | 6.5 | 1.9 | 2.0 | 8.0 | 8.3 |
| **US** | | | | | | | | | | | | | | | |
| Dana Holding Corp | | DAN US | USD | 17.23 | NR | 9.7 | 9.1 | 3.2 | 3.1 | 5.1 | 5.0 | 1.4 | 1.4 | 33.3 | 30.9 |
| Johnson Controls Inc | *** | JCI US | USD | 45.25 | NR | 31.9 | 16.5 | 2.9 | 2.1 | 22.2 | 11.9 | 2.3 | 2.3 | 25.1 | 8.0 |
| Delphi Automotive Plc | * | DLPH US | USD | 66.98 | Hold | 10.7 | 9.8 | 6.0 | 4.4 | 7.5 | 7.1 | 1.8 | 1.9 | 62.1 | 50.1 |
| Autoliv Inc | * | ALV US | USD | 101.81 | Hold | 15.2 | 14.4 | 2.4 | 2.3 | 7.8 | 7.3 | 2.3 | 2.4 | 16.1 | 15.5 |
| Visteon Corp | | VC US | USD | 79.04 | NR | 16.5 | 16.1 | 3.9 | 3.1 | 7.2 | 6.6 | n.a | n.a | 18.6 | 21.7 |
| BorgWarner Inc | | BWA US | USD | 35.81 | NR | 10.9 | 10.0 | 2.0 | 1.7 | 6.5 | 6.2 | 1.5 | 1.7 | 18.9 | 18.4 |
| **Others** | | | | | | | | | | | | | | | |
| Motherson Sumi Systems Ltd | ** | MSS IN | INR | 296.00 | NR | 31.9 | 25.8 | 9.7 | 6.5 | 13.4 | 11.4 | 1.1 | 1.2 | 33.1 | 30.5 |
| Tong Yang Industry | * | 1319 TT | TWD | 67.70 | Buy | 16.5 | 13.7 | 2.0 | 1.9 | 8.9 | 8.2 | 2.9 | 3.7 | 12.4 | 14.4 |
| Continental AG | | CON GR | EUR | 165.60 | NR | 11.7 | 10.3 | 2.3 | 2.0 | 6.2 | 5.6 | 2.5 | 2.8 | 20.6 | 19.7 |
| Valeo Sa | | FR FP | EUR | 53.07 | NR | 14.1 | 12.3 | 3.1 | 2.6 | 6.4 | 5.7 | 2.2 | 2.5 | 23.0 | 22.6 |
| Compagnie De Saint Gobain | | SGO FP | EUR | 41.34 | NR | 16.9 | 14.4 | 1.2 | 1.1 | 7.5 | 6.9 | 3.1 | 3.1 | 6.9 | 7.9 |
| Magna International Inc | | MG CN | CAD | 55.47 | NR | 7.7 | 6.9 | 1.3 | 1.2 | 5.0 | 4.7 | 2.5 | 2.8 | 21.8 | 20.7 |
| **Total** | | Weighted average | | | | 15.7 | 15.8 | 13.4 | 2.2 | 1.8 | 9.0 | 7.3 | 2.3 | 2.5 | 18.1 |
| | | High | | | | 31.9 | 25.8 | 9.7 | 6.5 | 31.2 | 21.7 | 6.6 | 7.4 | 62.1 | 50.1 |
| | | Low | | | | 7.4 | 5.6 | 0.6 | 0.5 | 4.6 | 3.8 | 0.4 | 0.4 | 3.4 | 4.9 |
| | | Median | | | | 14.1 | 13.7 | 1.6 | 1.4 | 6.6 | 6.6 | 2.2 | 2.4 | 13.7 | 13.3 |

*Source: Bloomberg, *Daiwa forecasts*

## Risks to our call

**Main risk: high customer concentration**

Nexteer's top-3 customers (including GM, FCA and Ford) accounted for 79% of its revenue in 1H16. Its largest customer, GM, accounted for 44% of Nexteer's global sales, with the next 2 largest customers making up a further 21% and 14%, respectively. The loss of any one of these customers could have a material adverse effect on the company's financial condition.

**Secondary risk: Political risk in the US**

Nexteer plans to expand its Mexican plant capacity to meet part of the US market demand. Its Mexican plant currently serves mainly the Mexican domestic market, accounting for c.20% of the company's revenue. If there is a tariff imposed on its products as a result of political policy change, we believe Nexteer may have to expand its US capacity instead. Nevertheless, there would be a short-term impact on its operation and likely negative sentiment toward the stock if a tariff were imposed, in our view.

**Other risk: Worse-than-expected automobile sales**

The steering business is directly related to automotive sales and production, which are highly cyclical and depend on general economic conditions and consumer spending. Slower-than-expected auto sales in the US (Nexteer's largest market) and China (increasing exposure) would have a negative impact on the company's financial performance.

Hong Kong | Consumer Discretionary | 1 December 2016

# Minth Group (425 HK )

Target price: **n.a.**

Share price (30 Nov): **HKD25.40** | Up/downside: **-**

5 4 3 2 1

**No Rating**

## Diversifying into ADAS and EV manufacturing

- Leading China auto parts supplier looking to diversify
- Management expects the gross margin to continue to improve in 2017
- Has an aggressive revenue target of CNY20bn by 2020, a 20% CAGR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**Background:** Minth is a leading Chinese auto parts supplier, with key products including trim, decorative parts and structural body parts. With production bases in China, the US, Mexico, Thailand and Germany, the company generated 59% of sales in China and 41% from overseas in 1H16. Management guides for 15% YoY revenue growth and a 33-35% gross margin for 2016.

**Highlights: EV manufacturing business.** Minth obtained approval from the Ministry of Industry and Information Technology (MIIT) in November 2016 to begin construction of a pure electric passenger vehicle manufacturing facility through Min'an Electric Cars, a 50-50 joint venture between Minth and the Jiangsu local government. It plans to commence EV production once construction of the plant is completed in the next 2 years.

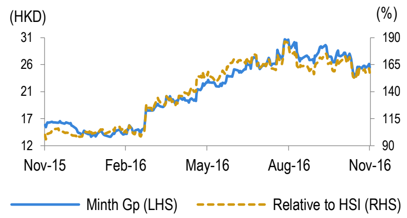
**Advanced Driver Assistance System (ADAS) business.** Following its acquisition of SPTek, a Taiwanese auto camera module manufacturer, in 1Q16, Minth plans to sell camera products to auto OEMs through a 60:40 JV with Fujitsu in China. Minth said it would consider increasing its stake in the JV in the future. The auto camera modules should record annual production capacity of 6m units and an ASP of USD25-40 per unit. After the facility fully ramps up, management guides for a 30% gross margin in the long run, and expects to see a meaningful earnings contribution from the ADAS segment only after 2018. Minth also plans to look for other ADAS parts opportunities.

**Looking for a margin improvement.** The company's gross margin has been under pressure over the past several years. However, it started to stabilise and improve in 2015. Management guides for a 33-35% gross margin for 2016 (vs. 31.7% in 2015), driven by: 1) lower raw-material costs, 2) CNY depreciation along with increasing exports/overseas revenue, 3) economies of scale due to increased sales volume, and 4) a higher mix of aluminium products, which carry a higher margin.

**Aiming for CNY20bn in revenue by 2020.** The company has an aggressive target for its top line to reach CNY20bn by 2020, representing a revenue CAGR of 20% for 2015-20. Along with an overseas sales recovery, partly helped by CNY depreciation, Minth expects its plants in Germany and Mexico to be the key earnings contributors.

**Valuation:** According to the Bloomberg consensus, Minth is trading currently at a 15.2x 2016E PER and 12.6x 2017E PER. The consensus earnings forecasts call for growth of 30% YoY for 2016 and 20% in 2017, or a 2016-18 earnings CAGR of 19%.

**Share price performance**




| | |
|---|---|
| 12-month range | 13.50-30.20 |
| Market cap (USDbn) | 3.70 |
| 3m avg daily turnover (USDm) | 13.37 |

*Source: FactSet, Daiwa forecasts*

# Embracing the EV and ADAS business

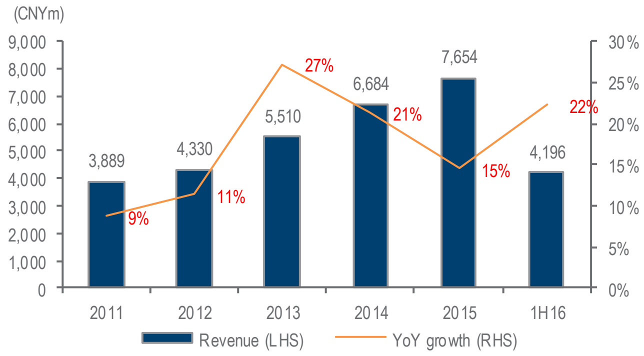
## Actively involved in high-growth business development

**Minth has been actively diversifying its client base geographically and by brand**

### Customer diversification

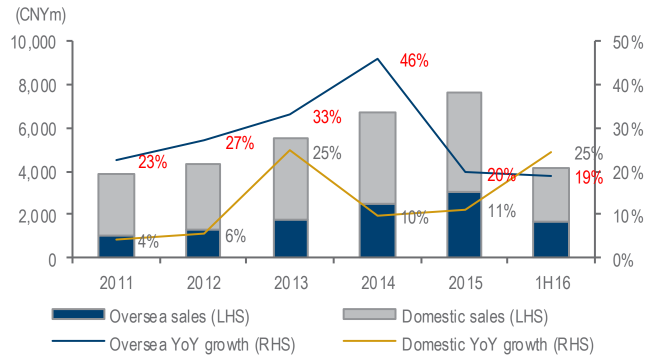
Minth has been actively diversifying its customer base over the past 5 years. General Motors is now the company's largest customer by revenue, followed by Nissan and Honda, as a result of Minth's efforts at customer diversification. Nevertheless, Japanese brands remain its key customers in China, accounting for over 50% of domestic sales in 2015. Great Wall (2333 HK, HKD7.30, Hold [3]), Changan and Guangzhou Auto (2238 HK, HKD10.16, Sell [5]) are its key customers for domestic brands.

**Minth: revenue growth**




*Source: Company*

**Minth: revenue by market**




*Source: Company*

Minth's overseas revenue rose by 25% YoY for 1H16, accounting for 41% of its total revenue, thanks mainly to the business growth of its European and US customers. Management believes the company's rich CNY70bn order backlog in 1H16, representing 8x backlog coverage, provides good visibility for Minth to achieve its aggressive target of CNY20bn in revenue by 2020, representing a CAGR of 20% for 2015-20E.

**Minth: customer base**


*Source: Company*

**EV manufacturing and ADAS components are the new key business segments and should provide long-term growth**

## EV manufacturing business

Minth received approval from MIIT in November 2016 to begin construction of a pure electric passenger vehicle manufacturing facility through Min'an Electric Cars, a 50-50 joint venture between Minth and the Jiangsu local government. It plans to commence EV production once the JV completes construction of the plant in the next 2 years.

According to the company, all of the EV costs relating to R&D in the past were expensed on the P&L, and therefore the JV should not be a drag on the company's bottom line. However, the company will need to negotiate any future capex requirements with the Jiangsu local government when it wants to expand its EV business. As such, with management expecting no cash flow issues, it maintains its dividend payout guidance of 40% for 2016.

## ADAS – camera module manufacturing

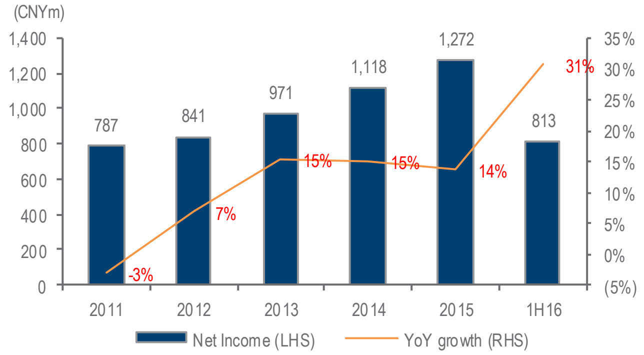
Following its acquisition of SPTek, a Taiwanese auto camera module manufacturer, in 1Q16, Minth plans to sell camera products to auto OEMs through a 60:40 JV with Fujitsu in China. Minth said it would consider increasing its stake in the JV in the future. The auto camera modules should record annual production capacity of 6m units and an ASP of USD25-40 per unit. After the facility fully ramps up, management guides for a 30% gross margin in the long run. Management expects to see a meaningful earnings contribution from the ADAS segment only after 2018. Minth also plans to look for other ADAS parts opportunities.

### Minth: profit and loss (CNYm) and key ratios

| CNY m | 2011 | 2012 | 2013 | 2014 | 2015 | 1H16 |
|---|---|---|---|---|---|---|
| **Revenue** | **3,889** | **4,330** | **5,510** | **6,684** | **7,654** | **4,196** |
| COGS | -2,527 | -2,896 | -3,692 | -4,599 | -5,226 | -2,753 |
| Gross profits | 1,307 | 1,363 | 1,434 | 1,819 | 2,085 | 1,443 |
| Other income | 213 | 291 | 328 | 356 | 299 | 180 |
| Marketing expense | -131 | -130 | -172 | -203 | -231 | -151 |
| Administrative expense | -310 | -347 | -460 | -567 | -586 | -304 |
| Research expense | -209 | -232 | -260 | -299 | -331 | -174 |
| **Operating profits** | **925** | **1,016** | **1,255** | **1,373** | **1,579** | **995** |
| Finance expense | -16 | -27 | -63 | -65 | -70 | -30 |
| Shares of JVs | 19 | 25 | 1 | 6 | 22 | 4 |
| Shares of Associates | 34 | 30 | 32 | 42 | 38 | 17 |
| Profit before tax | 963 | 1,044 | 1,225 | 1,356 | 1,569 | 986 |
| Income tax expense | -136 | -148 | -196 | -203 | -249 | -145 |
| Net profits | 827 | 896 | 1,029 | 1,153 | 1,320 | 841 |
| **Net profits to shareholders** | **787** | **841** | **971** | **1,118** | **1,272** | **813** |
| Minority interest | 40 | 55 | 58 | 35 | 48 | 28 |
| | | | | | | |
| **Margin** | | | | | | |
| **Gross margin** | **33.6%** | **31.5%** | **26.0%** | **27.2%** | **27.2%** | **34.4%** |
| Marketing expense to revenue | -3.4% | -3.0% | -3.1% | -3.0% | -3.0% | -3.6% |
| Administrative expense to revenue | -8.0% | -8.0% | -8.3% | -8.5% | -7.7% | -7.2% |
| R&D expense to revenue | -5.4% | -5.4% | -4.7% | -4.5% | -4.3% | -4.1% |
| Operating margin | 23.8% | 23.5% | 22.8% | 20.5% | 20.6% | 23.7% |
| Net margin | 20.2% | 19.4% | 17.6% | 16.7% | 16.6% | 19.4% |

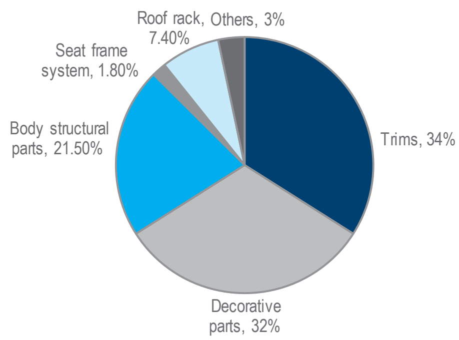
*Source: Company*

### Minth: net income growth



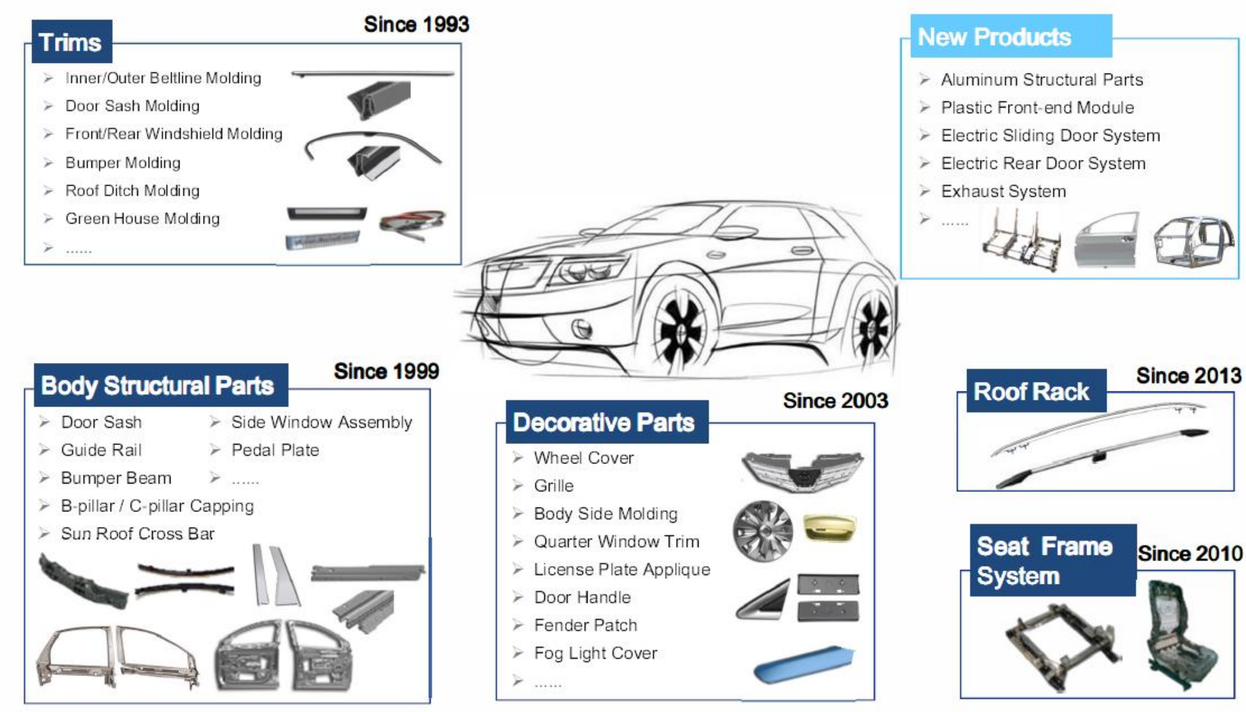

*Source: Company*

### Minth: revenue breakdown by product (1H16)



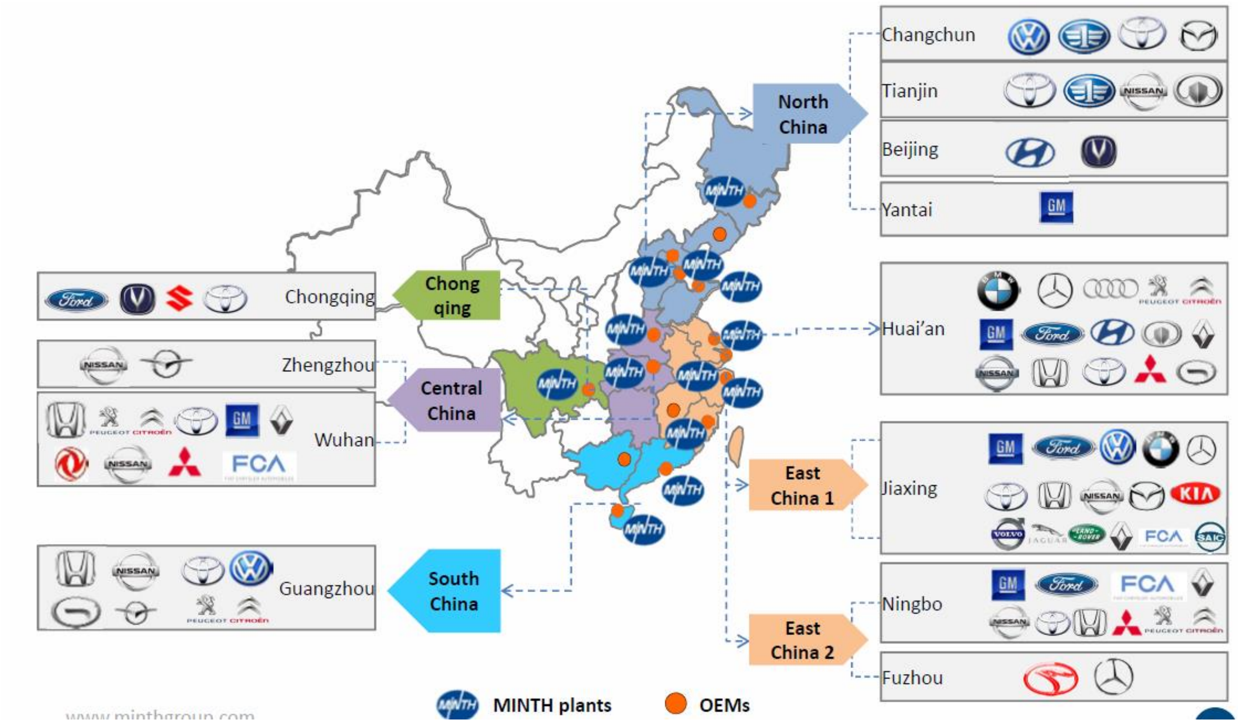

*Source: Company*

### Minth: product line-up



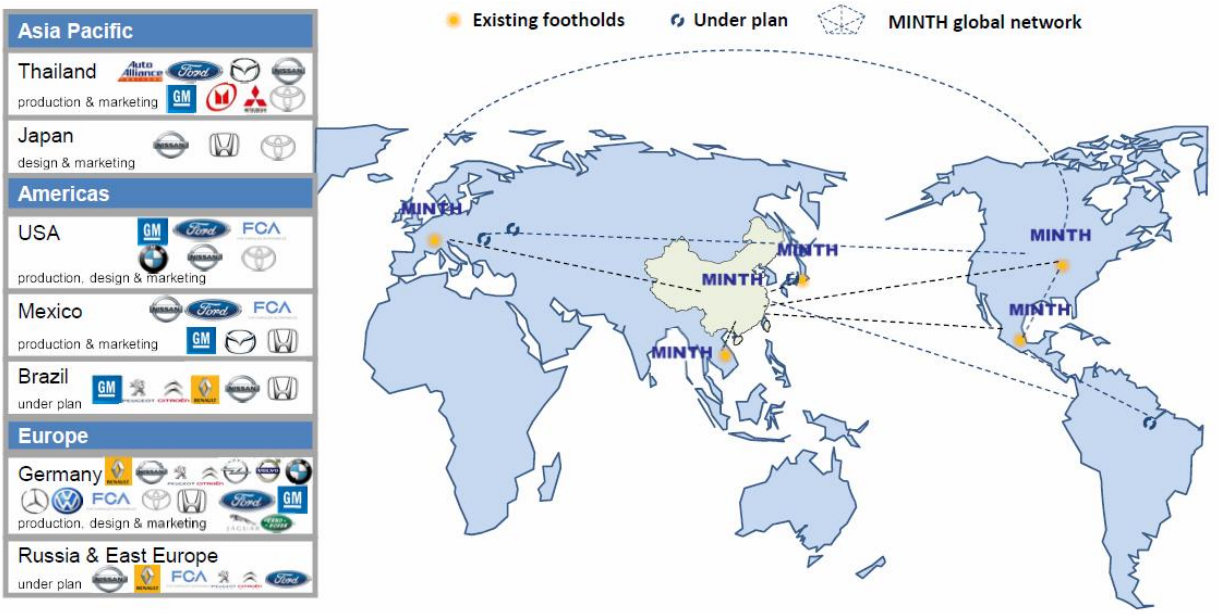

Source: Company

### Minth: domestic Network




Source: Company

### Minth: global footprint




*Source: Company*

# Zhengzhou Yutong Bus (600066 CH)

Target price: **n.a.**

Share price (30 Nov): **CNY21.05** | Up/downside: **-**

5 4 3 2 1

**No Rating**

## China's leading NEV bus manufacturer

- The largest manufacturer of buses in China…
- …and the country's No.1 NEV bus producer by sales volume in 2015
- Improving margins due mainly to rising NEV sales contribution

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**Background:** Zhengzhou Yutong Bus Co. is a bus manufacturer based in Zhengzhou, Henan province. According to the company, it was the largest bus manufacturer by sales volume in China in 2015. Yutong also sells its buses in international markets such as Cuba, Venezuela, Peru and Austria, which collectively accounted for around 10% of its total sales volume in 2015. The company has an annual production capacity of 65,000 units, which covers product segments including expressway transit buses, tourism buses, school buses and public buses.

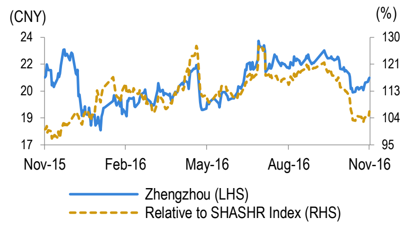
**Highlights:** **Above-peer margins reflect market-leader status and operating skills.** From 2009-15, Yutong expanded its China bus market share from 18% to 26% through a direct sales strategy and by honing its operations. Using its economies of scale, low sourcing costs and client relationships, Yutong recorded a gross margin of 15-25% in 2009-15, around 3-8pp higher than those of domestic peers such as Kinglong (600686 CH, not rated) and Zhongtong (000957 CH, not rated).

**China's top NEV bus producer.** Harnessing its research on NEV buses going back to the 1990s, the company booked total sales of 20,446 units (13,885 EV buses and 6,560 PHEV buses) in 2015, accounting for 31% of its bus sales volume. As the ASP for a NEV bus is approximately twice that of a conventional bus, Yutong derived around 45% of its revenue from NEV buses in 2015. The company has also been seeking entry into new markets by researching and then applying new technology. For example, the company recently launched a third version of its fuel cell vehicle (FCV) bus and signed an MOU with a Beijing client for an order of 100 FCV buses.

**Enhanced margin a consequence of product-mix change.** For 2015, EV and PHEV buses were entitled to China government subsidies averaging around CNY0.37m and CNY0.25m per unit, respectively, giving Yutong's NEV buses higher gross margins than its conventional bus models. In 2015, NEV buses accounted for 31% of Yutong's total sales volume, up sharply from 3% for 2012 and 0% for 2011, while its gross margin reached 25% for 2015 and 9M16, up from 19% for 2012 and 18% for 2011.

**Valuation:** According to Bloomberg consensus data, Yutong is trading at a 11.0x 2017E PER. The market forecasts EPS growth of 13.4% YoY for 2016, 6.6% YoY for 2017 and 10.3% YoY for 2018.

**Share price performance**




| | |
|---|---|
| 12-month range | 17.89-23.28 |
| Market cap (USDbn) | 6.76 |
| 3m avg daily turnover (USDm) | 28.70 |

*Source: FactSet, Daiwa forecasts*



Company

# China's leading NEV bus manufacturer

## Growing revenue base from bus sales

### The country's dominant player in large and medium buses

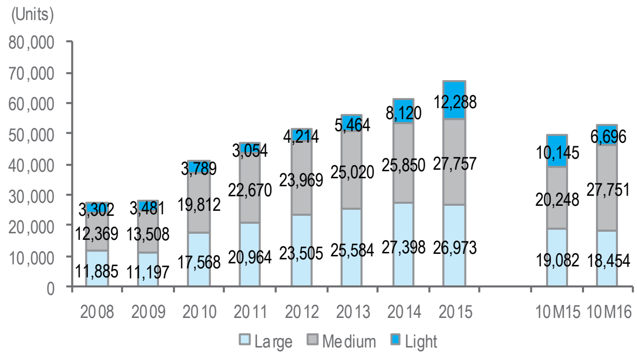
Having existed since 1963 as the Zhengzhou Bus Repair Factory, Yutong was restructured along company lines following China's implementation of shareholding reform measures in 1993 and became the first publicly traded bus company in China upon its listing in Shanghai in 1997.

**Yutong leads its peers on bus sales (2015 data)**

The company's annual sales volume exceeded 10,000 units for the first time in 2002 and by 2015 they reached 67,108 units. Yutong has been exporting its bus products, including complete knock-down (CKD) parts, since 2005. In 2015, it recorded total revenue of CNY31.2bn (up 21% YoY), of which 12% was derived from international markets (by volume, overseas markets accounted for 10% of its bus sales).

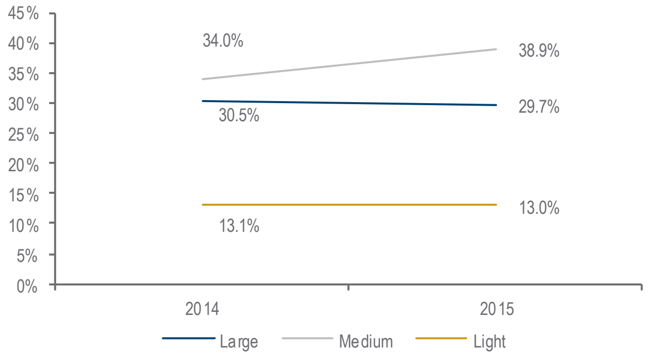
The company mainly produces large buses (length: more than 10m), as well as medium buses (length: between 7m and 10m), and in 2015 it ranked No. 1 in China by sales in both segments. For 10M16, Yutong's sales of large and medium buses totalled 18,454 and 27,751 units, respectively, equivalent to 35% and 52% of its total sales volume.

**Yutong: bus sales volume breakdown**



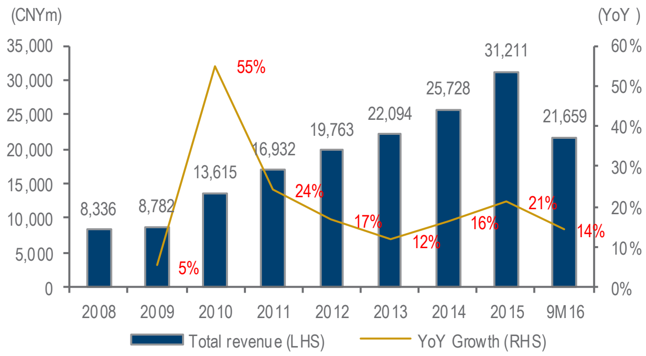
Source: Company

**Yutong: bus sales marker share in China by segment**



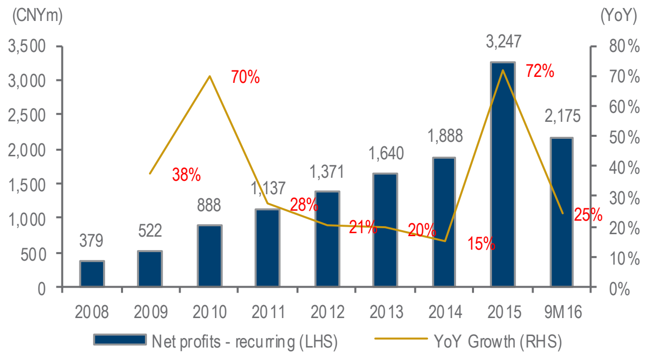
Source: Company
Note: a large bus has a length of more than 10m; a medium bus has a length of between 7m and 10m; and a light bus has a length of between 5m and 7m.

**Yutong: total revenue and YoY revenue growth**



Source: Company

**Yutong: recurring net profit and YoY growth**



Source: Company

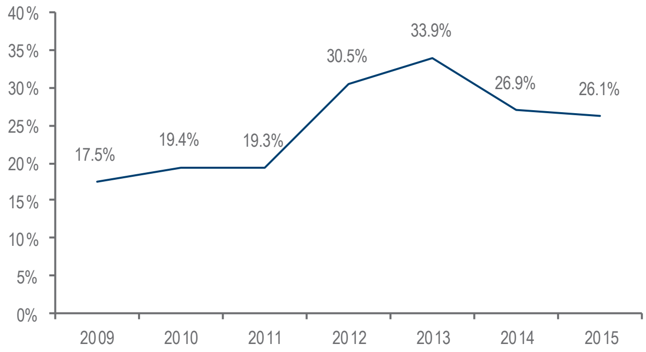
### Enhanced competitiveness reflected in market-share gains

**Yutong increased its market share over the 2009-15 period**

Yutong's bus sales accounted for around 18% of total industry sales in China in 2009, and the proportion has risen steadily to around 26% by 2015. Unlike most of its peers which sell buses through distribution channels, Yutong relied on a direct sales strategy which is now responsible for more than 70% of its sales. According to the company, the direct sales approach is more closely aligned with the order requirements of large customers.

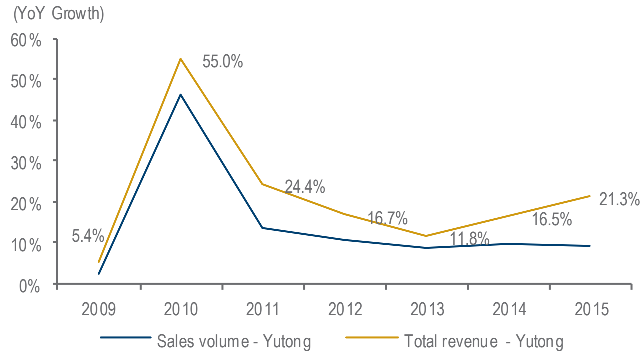
While industry sales saw a 7% CAGR for 2009-15, Yutong's bus sales volume recorded a 16% CAGR in the same period, underlining the extent of its market-share expansion. Backed by upgraded bus products (including NEV bus sales, which began in 2012) and an improved ASP, the company's revenue recorded a 24% CAGR in the same period.

**Yutong: Bus sales market share in China**




*Source: Company, CAAM*

**Yutong: Bus sales and total revenue YoY growth**




*Source: Company*

## The NEV bus leader

### NEV bus sales boosted by government subsidy

**Harnessing its manufacturing expertise and years of research, Yutong was the No.1 player in China in NEV bus sales in 2015**

Yutong began its R&D work on NEV buses back in the early 1990s. Propelled by government subsidy, surging industry demand, together with its strong ties with clients and its competitive products, the company's NEV bus sales had grown to 7,405 units and 20,446 units by 2014 and 2015, respectively.

The company mainly produces 2 types of NEV bus — PHEV and EV models — with the latter type accounting for 60-70% of the company's overall NEV bus sales. Unlike BYD, Yutong does not produce lithium-ion battery (LiB) packs internally but rather purchases them from leading manufacturers such as Contemporary Amperex Technology Co., Limited (CATL) (not listed).

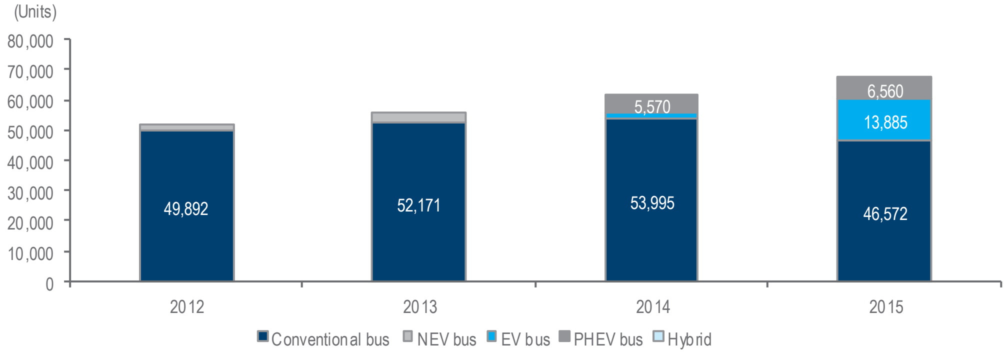
Aside from EV and PHEV buses, Yutong has also sought to enter new markets by honing its technology skills. Indeed, it recently launched a third version of its FCV bus and signed a memorandum with a Beijing client for an order of 100 FCV buses.

**China: NEV bus players ranked by sales (2015)**

| 2015 EV CV sales volume | |
|---|---|
| Total EV bus sales | 77,795 |
| Top 5 EV bus producer sales | 51,477 |
| -Yutong | 20,446 |
| -Kinglong | 18,434 |
| -BYD | 5,400 |
| -Beiqi Futian | 4,008 |
| -Zhuhai Yinlong | 3,189 |

*Source: Company*

**Yutong: sales volume breakdown in 2015**

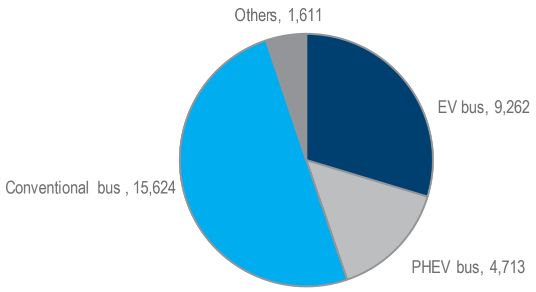



*Source: Company*
*Notes: NEV buses comprise EV, PHEV and hybrid models. There was no breakdown given for NEV buses for the period 2012-13*

**NEV buses accounted for a larger proportion of Yutong's total sales volume in 2015 than in 2014 and 2013**

In 2015, NEV buses accounted for 31% of Yutong's total sales volume, up from 12% for 2014 and 7% for 2013. Reflecting the fact that EV and PHEV buses tend to be eligible for central and local government subsidies, their ASPs are 99-110% higher than those of conventional buses, according to Yutong. Hence, around 45% of the company's total revenue in 2015 came from NEV bus sales.

**Yutong: revenue breakdown by segment (2015, CNYm)**




*Source: Company*

**Yutong NEV: E12 (large bus)**

*Source: Company*
*Note: bus length: 12m*

**Yutong NEV: E8 (medium bus)**

*Source: Company*
*Note: bus length: 8m*

**Yutong NEV: E6 (light bus)**

*Source: Company*
*Note: bus length: 6m*

**Yutong NEV: FCV bus (large bus)**


*Source: National Engineering Technology Research Centre for EV Bus Control and Safety*
*Note: bus length: 12m; it can be fully charged in 10 minutes and has a pure electric distance of 300km*

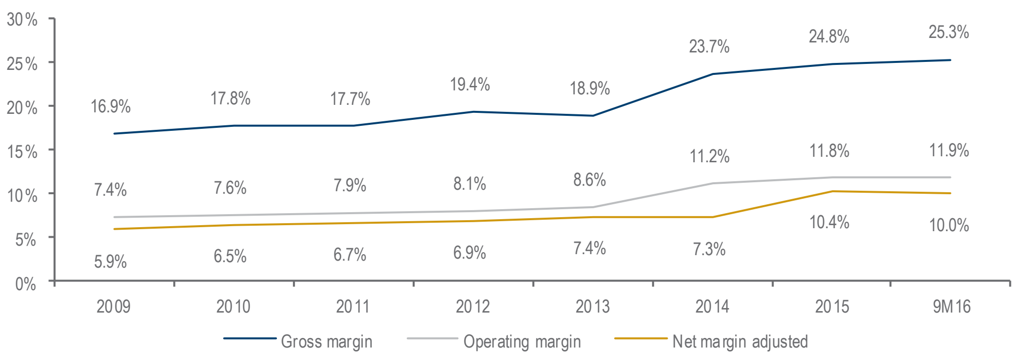
## Increased profitability due mainly to product-mix change

Over the period 2008-12, Yutong's gross margin ranged from 17% to 18%, compared with equivalent figures for its domestic peers of 12-13%. In 2012, Yutong's gross and operating margins started to pick up, due mainly to a change in its product mix as the company started booking higher sales volumes of NEV buses.

**Yutong's margins have widened since 2012, due mainly to the increased sales contribution from NEV buses**

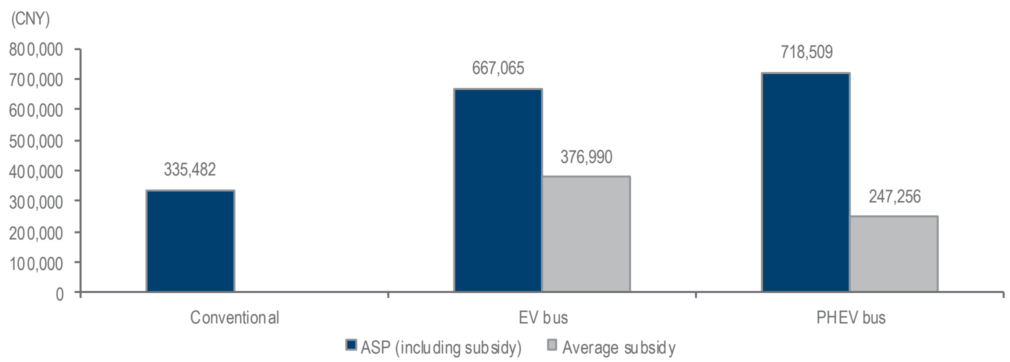
We understand that, in the case of Yutong, each EV bus is entitled to a subsidy of CNY370,000, while each PHEV bus is entitled to a subsidy of some CNY250,000. As a result, the gross margin on NEV buses should be much higher than 17-18%, which likely explains the company's margin expansion in recent years. Indeed, for 9M16, the company recorded a gross margin of 25.3% and an operating margin of 11.9%.

**Yutong: gross margin and operating-margin trend (2009-9M16)**




*Source: Company*

**Yutong: average selling price (ASP) and average subsidy by segment (2015)**




*Source: Company*

## Yutong: profit and loss summary

| (CNY m) | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 9M16 |
|---|---|---|---|---|---|---|---|---|
| Revenue | 8,782 | 13,615 | 16,932 | 19,763 | 22,094 | 25,728 | 31,211 | 21,659 |
| COGS | -7,259 | -11,150 | -13,850 | -15,817 | -17,794 | -19,481 | -23,306 | -16,093 |
| Gross profits | 1,484 | 2,423 | 2,999 | 3,830 | 4,176 | 6,092 | 7,753 | 5,485 |
| Selling expense | -470 | -830 | -928 | -1,150 | -1,241 | -1,518 | -2,034 | -1,502 |
| G&A expense | -358 | -523 | -699 | -881 | -1,071 | -1,452 | -1,813 | -1,179 |
| Impairment | -40 | -45 | -40 | -259 | -11 | -357 | -241 | -212 |
| fair value change | 5 | -5 | 0 | -2 | 8 | 15 | -41 | 18 |
| Investment income | 32 | 17 | 8 | 61 | 31 | 98 | 62 | -34 |
| Operating income | 652 | 1,037 | 1,341 | 1,600 | 1,892 | 2,878 | 3,686 | 2,575 |
| Interest expense | -9 | -23 | -9 | 38 | -8 | 25 | 142 | -77 |
| Non-operating income | 10 | -31 | 22 | 128 | 203 | 149 | 276 | 191 |
| Profit before tax | 654 | 983 | 1,353 | 1,766 | 2,088 | 3,052 | 4,104 | 2,689 |
| Income tax | -86 | -117 | -171 | -215 | -265 | -398 | -517 | -351 |
| Net profits - shareholders | 563 | 869 | 1,181 | 1,550 | 1,823 | 2,613 | 3,535 | 2,276 |
| Net profits - recurring | 522 | 888 | 1,137 | 1,371 | 1,640 | 1,888 | 3,247 | 2,175 |
| Margin | | | | | | | | |
| Gross margin | 16.9% | 17.8% | 17.7% | 19.4% | 18.9% | 23.7% | 24.8% | 25.3% |
| Operating margin | 7.4% | 7.6% | 7.9% | 8.1% | 8.6% | 11.2% | 11.8% | 11.9% |
| Net margin | 6.4% | 6.4% | 7.0% | 7.8% | 8.2% | 10.2% | 11.3% | 10.5% |
| Net margin - recurring | 5.9% | 6.5% | 6.7% | 6.9% | 7.4% | 7.3% | 10.4% | 10.0% |
| YoY Growth | | | | | | | | |
| Total revenue | 5.4% | 55.0% | 24.4% | 16.7% | 11.8% | 16.5% | 21.3% | 14.4% |
| Gross profits | 15.8% | 63.3% | 23.8% | 27.7% | 9.0% | 45.9% | 27.3% | 24.7% |
| Operating income | 0.2% | 59.0% | 29.3% | 19.3% | 18.3% | 52.1% | 28.1% | 33.8% |
| Net profits - shareholder | 6.1% | 54.2% | 36.0% | 31.2% | 17.6% | 43.3% | 35.3% | 22.0% |
| Net profits - recurring | 37.9% | 70.1% | 28.0% | 20.5% | 19.7% | 15.1% | 72.0% | 24.7% |

*Source: Company*

# FDG Electric Vehicles (729 HK)

Target price: **n.a.**

Share price (30 Nov): **HKD0.38** | Up/downside: **-**

5 4 3 2 1

**No Rating**

## Ambitions along the whole EV industry chain

- Sees itself as a competitive entrant in electric vehicle manufacturing
- Claims electric vehicle orders picking up after opening of new factory
- Says it is leveraging on its expertise in LiB and cathode technologies

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**Background:** FDG Electric Vehicles (FDG EV), formerly Sinopoly Battery, is engaged in the production and sale of electric vehicles (EVs) such as mid-sized buses, public buses, commercial vehicles and passenger vehicles, along with providing leasing services for EVs. The company currently generates most of its revenue from the battery business, focusing on the production and sale of LiBs and cathode materials.

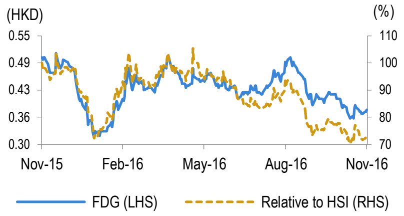
**Highlights:** **The company said EV orders have started to rise after the new capacity at Hangzhou entered operations.** On 30 September 2016, the company announced it had already acquired EV orders of 2,200 units with a contract value of HKD1.7bn as of 30 September, while over 600 units had been delivered with a contract value of HKD366m. By contrast, it booked EV sales of only HKD10m in FY16 (ending 31 March). The main reason for the sales improvement was the official commencement in April 2016 of mass production at the new EV factory located in Hangzhou.

**One of the few to receive permission to produce EV passenger vehicles (PVs).** In May 2016, the company's new Hangzhou facility successfully received a licence from the government to produce EV PVs, making FDG EV 1 of only 5 companies in China to hold this licence currently. The government plans to limit the total number of licences for EV start-ups to 10, excluding the EV subsidiaries of traditional auto makers such as BYD. FDG EV plans to launch its first PV model, "e.Cool", within 4Q16.

**Expects its technology know-how in LiBs and cathode materials to sharpen its competitiveness.** The company supplies LiBs internally to its own EV manufacturers and records revenue by selling them to external clients as well. In FY16, FDG EV recorded sales of HKD593m (including internal sales of HKD307m), up 95% YoY, due mainly to a surge in sales to its internal EV producers. Meanwhile, subsidiary FDG KINETIC fully acquired a cathode materials business from SK Group in September 2015, and attained a 21.9% stake in ALEEES (a Taiwan cathode materials producer) in August 2016, in an attempt to build its competitiveness in NCM and LFP cathode materials, respectively.

**Valuation:** According to the Bloomberg consensus (currently only 1 broker covers this stock), FDG EV is trading currently at a 13x FY19E PER. The consensus forecasts a net profit of HKD737m in FY19E, implying EPS of HKD0.03.

### Share price performance




| | |
|---|---|
| 12-month range | 0.31-0.51 |
| Market cap (USDbn) | 1.09 |
| 3m avg daily turnover (USDm) | 3.81 |

*Source: FactSet, Daiwa forecasts*

# Now covering the full EV spectrum

## An emerging EV manufacturer

### The Hangzhou factory is set to increase production

FDG EV was formerly known as Sinopoly Battery, and built up its automobile manufacturing platform by leveraging on acquisitions. It was renamed FDG EV in 2014.

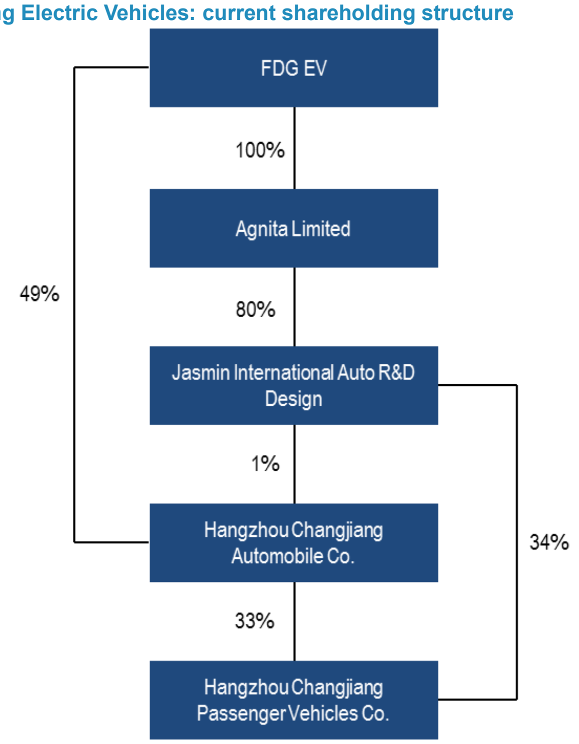
During 2014, the company acquired 100% of Agnita Limited (acquired 58.5% of the shares in March 2014 and the remaining 41.5% in November 2014), which held 80% of the equity in a Chinese EV design company (Jasmin International Auto R&D Design). The EV design company had a number of China-based customers such as Chery, FAW and Shanghai Motor and had also acquired a 55% stake in a Chinese automobile manufacturing company (Hangzhou Changjiang Automobile) located in Hangzhou in July 2013. In May 2014, FDG EV injected additional capital of CNY490m into Hangzhou Changjiang Automobile (meanwhile other shareholders injected around CNY486m), thereby increasing its shares in the company to 49.9% from 44%.

**The Hangzhou subsidiary of FDG EV was granted a licence to produce EV PVs in China**

On 16 May 2016, Hangzhou Changjiang Passenger Vehicle, a subsidiary of FDG EV in which FDG EV has an effective stake of 43.68%, successfully secured a licence to manufacture EV PVs in China. The granting of this licence was a significant milestone for the company, given that currently only 4 other companies in China (Beijing Electric Vehicle, Beijing CH-Auto Technology, Chery New Energy and Minan Auto) have the requisite permission from the Ministry of Industry and Information Technology (MIIT).

According to a Bloomberg news report on 28 August 2016, MIIT is considering restricting the number of EV makers to a maximum of 10 (not including the subsidiaries of traditional OEMs such as SAIC Motor and BYD). We see such potential limiting of the licences as a way for the government to exert stricter control over product quality and believe it would be beneficial for existing EV makers.

**Hangzhou Changjiang Electric Vehicles: current shareholding structure**




*Source: Company, Administration of Industry and Commerce of Zhejiang Province*

The new Hangzhou factory commenced mass production in April 2016 with annual production capacity of 100,000 units (20,000 units of mid-size buses and 80,000 units of PVs); it targets to produce 5,000-10,000 units of mid-size buses during FY17 (ending at 31 March) according the management.

**Sales orders for EVs started to pick up after the Hangzhou factory commenced operations in April 2016**

During FY16 (ending 31 March), FDG EV achieved EV sales of around HKD10m, which it expects to rise sharply as a consequence of the newly established factory in Hangzhou. According to a company announcement made on 30 September 2016, it had received sales orders for around 2,200 EVs with a total contract value of HKD1.7bn, while over 600 units had been delivered with a contract value of HKD366m.

**FDG EV: EV revenue breakdown (2015-2016)**

| HKDm | 2015 | 2016 |
|---|---|---|
| EV revenue | 4 | 12 |
| -Design | 3 | 2 |
| -Sales | 0 | 10 |
| -Rent income | 1 | 1 |

*Source: Company*

The company's first EV passenger vehicle, "e.Cool", was designed as a small SUV model and was planned to be launched in 4Q16 at a selling price of CNY180,000 (excluding subsidies amounting to around CNY90,000 from central and local governments).

**Hangzhou Changjiang Electric Vehicles: e.Cool EV**

*Source: Company*

**Hangzhou Changjiang Electric Vehicles: e.Glory**

*Source: Company*

**Hangzhou Changjiang Electric Vehicles: e.Zone**

*Source: Company*

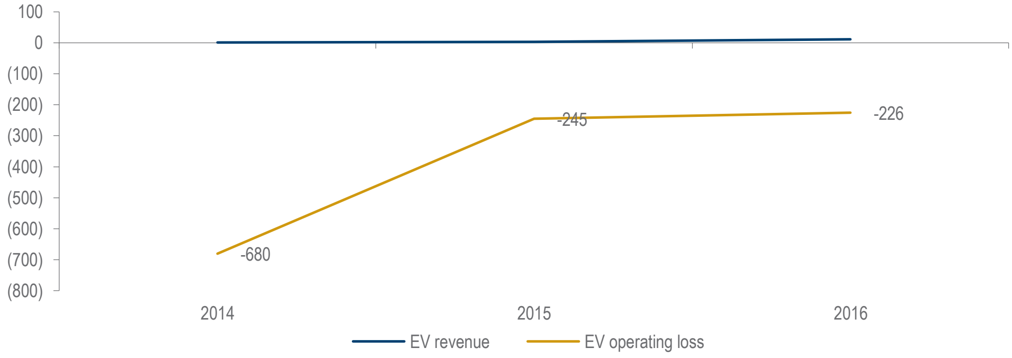
**Hangzhou Changjiang Electric Vehicles: e.Boss**

*Source: Company*

**The company's EV business posted big losses from FY15-16 due mainly to high operating expenses and low EV sales**

However, the EV business booked operating losses of HKD245m and HKD226m in FY15 and FY16, respectively, due to the recognition of the initial cost for producing EVs while not recording much in the way of EV sales over the same periods. In 2014, the company recognised the impairment of goodwill of HKD665m for the acquisition of Agnita Limited.

FDG EV: revenue and operating loss of EV business (2014-16)




*Source: Company*

## 2 additional factories designed to accelerate EV business development

**The Yunnan factory commenced operations in 2015…**

In April 2014, FDG EV acquired Southwest EV, which had a 50% interest in a Chinese automobile manufacturing company (Chinese-foreign joint venture) located in Kunming, Yunnan. The Yunnan factory (known as Yunnan FDG) commenced soft production of EVs in 2015 and has since focused mainly on producing electric buses according to management, with an annual production capacity of 10,000 units. In March 2015, the company signed a cooperation framework agreement with Kunming General Bus Company to replace some public buses in Kunming with EV buses purchased from Yunnan FDG.

**… while the timetable for the Guian plant is unknown**

Under a cooperation agreement signed with the Guian Committee in May 2016, FDG EV plans to establish a pure EV production base located in Guian, Guizhou Province, with an annual design production capacity of 150,000 units. The new plant will help the company expand its business in Guizhou Province and also increase its total production volume in the future.

## Sales network expanding as promoted by new business development projects

On 4 May 2015, a JV known as Orng EV Solutions was formed by the company with Smith Electric Vehicles Corp (Smith) to sell EVs in the US. Smith is a manufacturer of zero-emissions EV medium-duty commercial vehicles with customers such as PepsiCo/Frito-Lay, Federal Express, Staples and Coca-Cola. As at May 2015, FDG EV owned around 6.81% of Smith on a fully diluted basis and has exclusively supplied automotive batteries to Smith since October 2014.

FDG EV's management anticipates the JV will leverage on the EV designs of FDG EV and the technologies and sales network of Smith. As at May 2016, FDG EV had around an 80% stake in the JV.

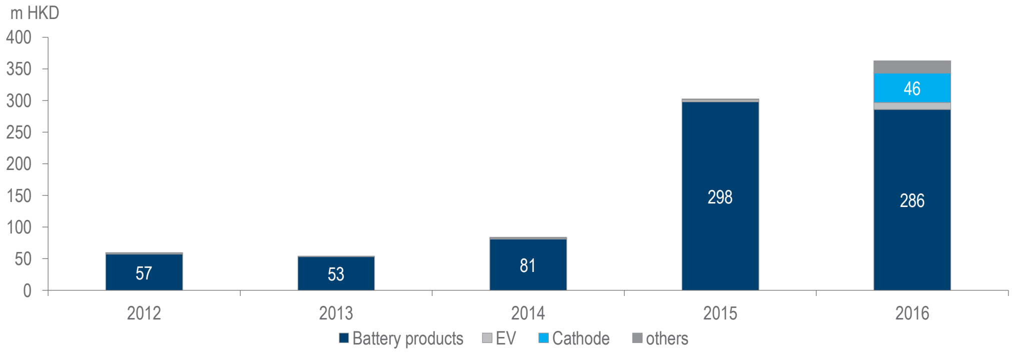
In March 2016, the company signed a strategic partnership deal with Dah Chong Hong (1823 HK, not rated) to provide sales and marketing, after-sales and maintenance services for EV models produced by FDG EV in the key markets of Mainland China and Hong Kong.

# The layout of upstream sectors

## LiBs meeting both external and internal demand

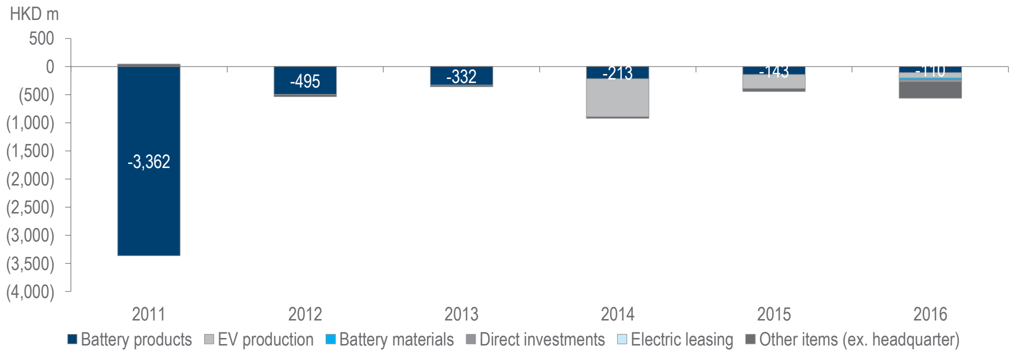
In FY16, 79% (or HKD286m) of FDG EV's total revenue was derived from battery product sales. The company mainly produces LiBs for EVs or power storage in 2 plants located in Jilin and Tianjin, with capacities of 120mAh and 130mAh, respectively (collectively 0.85GWh). The products include 40Ah-500Ah single-cell batteries, battery modules, battery packs and BMS.

**FDG EV: revenue breakdown by segment**




*Source: Company*

**FDG EV: operating profit breakdown by segment**

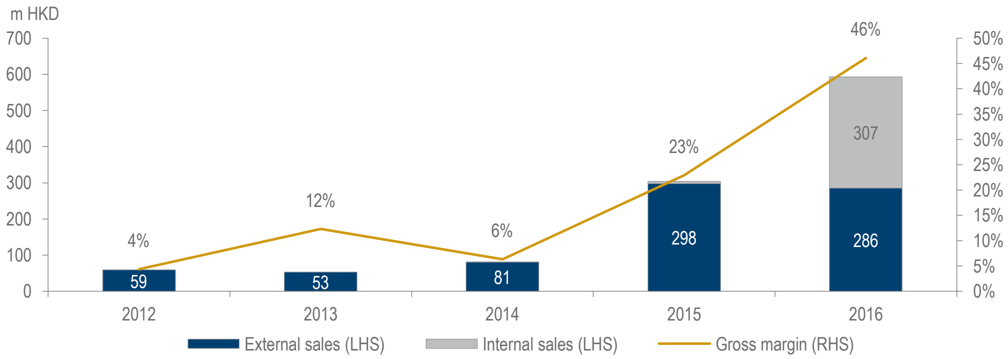



*Source: Company, compiled by Daiwa*

**The gross margin for the LiB business has risen considerably due mainly to economies of scale**

Without considering inter-segment elimination, the company's battery sales reached HKD593m in FY16, up from HKD304m in FY15. Such marked growth was driven mostly by a rise in internal sales, in turn due partly to incremental orders from the Hangzhou EV plant and Kunming EV plant. Thanks to better economies of scale and higher efficiency for producing LiBs, the gross margin surged to 46% in FY16 as reported by the company, up from 23% in FY15. The company recorded segment EBITDA of HKD36m (vs. HKD4m in 2015) and a reduced segment operating loss of around HKD110m (vs. HKD143m in 2015), indicating that the segment operating margin loss narrowed from -48% in 2015 to -39% in 2016.

**FDG EV: battery product sales and gross margin (2012-16)**




*Source: Company*

## Acquisitions of 2 important cathode materials businesses

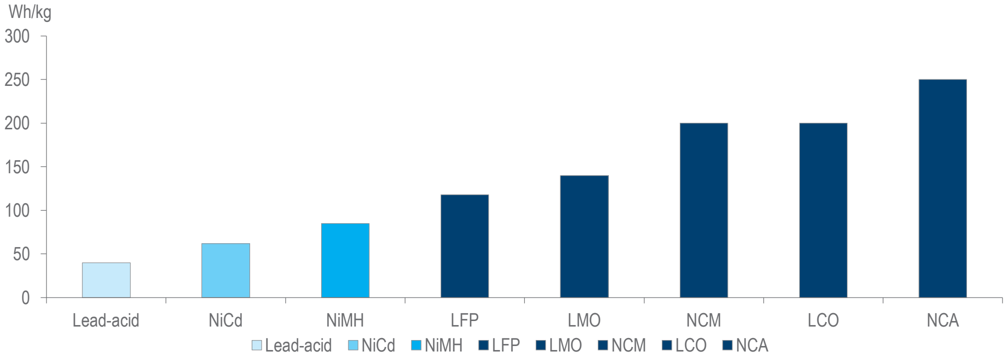
**The cathode business of SK (Chongqing) has helped FDG EV accumulate more technology know-how in the NCM realm**

In September 2015, CIAM Group (now renamed FDG KINETIC), a subsidiary of FDG EV, completed the acquisition of SK (Chongqing), which was a subsidiary of SK Group and principally engaged in the manufacturing of NCM cathode materials. The total consideration was HKD722m and was settled partly by cash of HKD372m and the issuance of 53.8m shares of CIAM Group. As such, SK (Chongqing) – now renamed FDG Kinetic (Chongqing) Lithium-ion Battery Materials – has been indirectly controlled by FDG EV since then.

According to management, the addition of the NCM cathode materials business will enhance the competitiveness of its battery products and help the company explore more potential applications for NCM LiBs in EVs, which usually enjoy a higher energy density than battery categories such as LFP and LMO.

In FY16, FDG EV recognised cathode materials sales of HKD46m and an operating loss of HKD30m through FDG Kinetic (Chongqing) Lithium-ion Battery Materials, which now owns 2 production lines with annual design production capacity of 2,400 tonnes.

**Typical specific energy density of lead-, nickel- and lithium-based batteries**



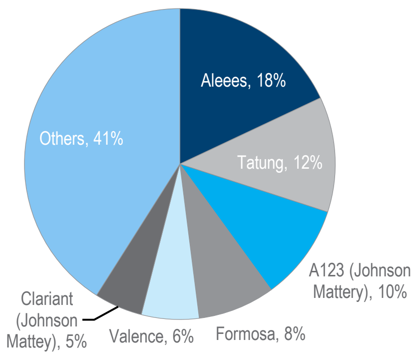

*Source: Battery University*

**The strategic cooperation with ALEEES shows the company's ambitions to enhance the competitiveness on its battery technology**

In April 2016, FDG KINETIC and ALEEES (listed on the Taipei Exchange), which is one of the global leading suppliers of LFP cathode materials with capacity of around 3,000tpa, entered into a long-term strategic cooperation agreement via an equity restructuring. ALEEES, ranked No.1 in terms of global LFP cathode materials shipments, as estimated by Avicenna Energy, had a c18% global market share in 2014, and annual shipments of 2,498 tonnes in 2015, up from 1,997 tonnes in 2014 and 914 tonnes in 2013.

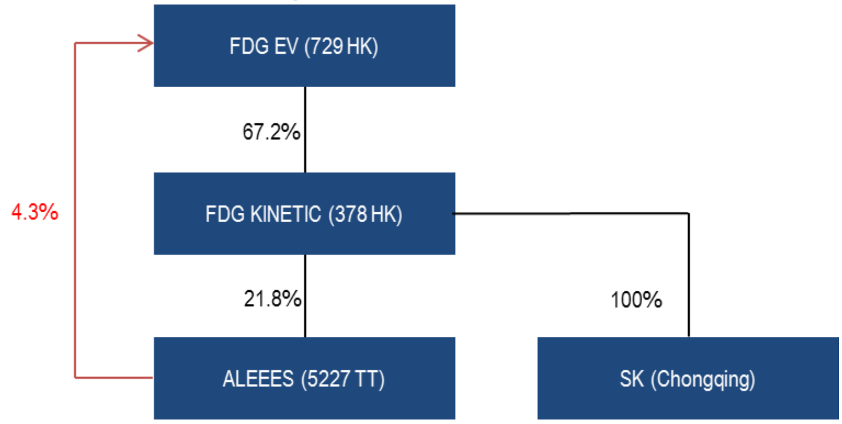
After the completion of the transaction in August 2016, FDG KINETIC holds a 21.85% equity interest in ALEEES, while ALEEES holds a 4.27% equity interest in FDG EV. As disclosed by ALEES's annual reports, it booked net losses of TWD431m and TWD563m in 2015 and 2014, respectively (equivalent to around HKD101m and HKD137m).

**2014: LFP global shipment breakdown**




*Source: Avicenne Energy, Daiwa estimates*

### FDG EV: cathode business structure graph




*Source: Company*

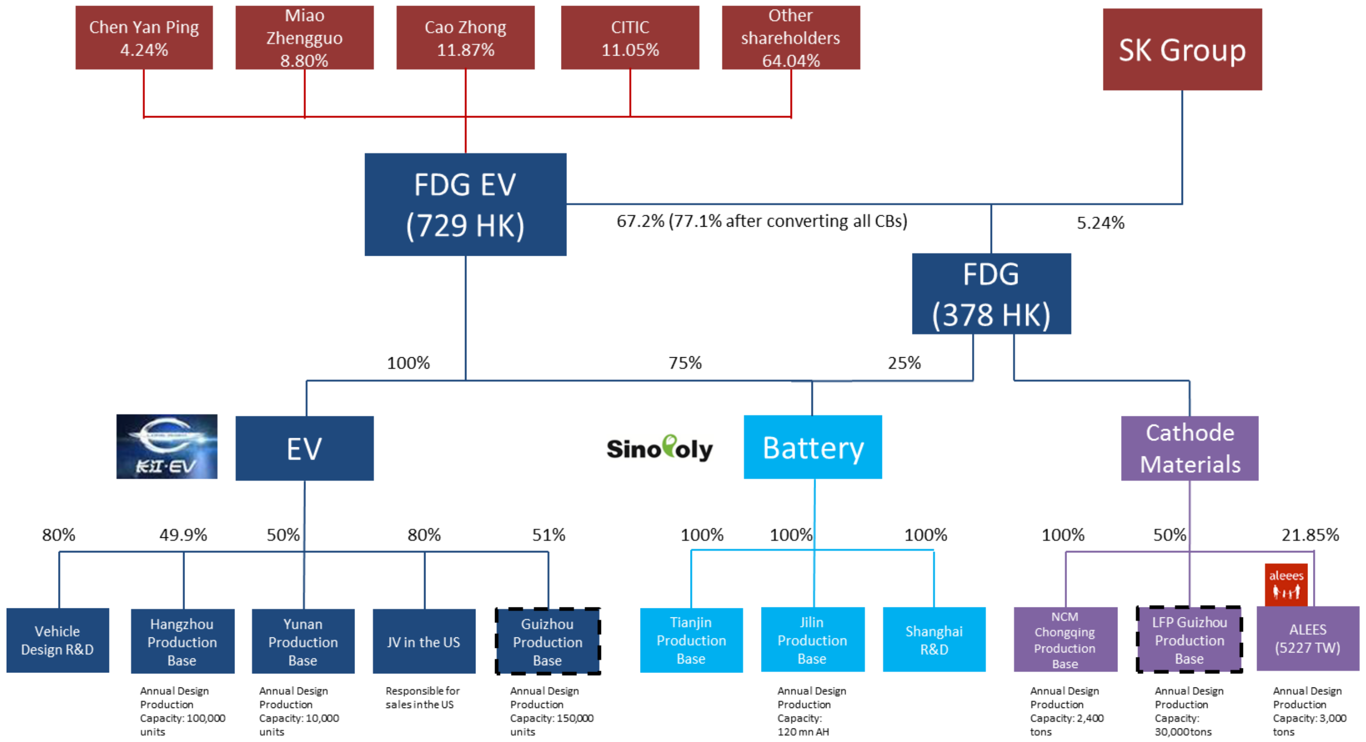
FDG EV's battery business currently sources LFP cathode materials from ALEEES, and the strategic tie-up should further strengthen the links between the 2 parties. Under the tie-up, FDG KINETIC is licensed by ALEEES to undertake the joint production of LFP cathode materials at a facility in Guian with a capacity of 30,000 tonnes pa and must pay a management fee per kilogram of cathode material produced. Moreover, the FDG Group intends to acquire ALEEES's EV equipment and battery-related R&D for a total consideration of HKD100m through assets and equity purchases as well as an R&D service agreement.

### FDG EV: profit and loss summary

| HKDm | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| **Revenue** | **76** | **59** | **54** | **84** | **304** | **363** |
| COGS | -41 | -55 | -47 | -77 | -233 | -219 |
| **Gross profit** | **35** | **5** | **7** | **7** | **71** | **144** |
| Selling and distribution costs | -6 | -14 | -20 | -19 | -28 | -37 |
| General and administrative expenses | -54 | -94 | -82 | -118 | -233 | -350 |
| Research and development expenses | 0 | 0 | -17 | -12 | -17 | -63 |
| Other income and expenses | -28 | -13 | -40 | -10 | -52 | -96 |
| Impairment and amortisation of intangible assets | -3,265 | -414 | -207 | -764 | -182 | -171 |
| Share from associates and JVs | 0 | 0 | 0 | 0 | 0 | 10 |
| **Operating profit** | **-3,319** | **-531** | **-358** | **-917** | **-441** | **-562** |
| Finance costs | -81 | -15 | -18 | -19 | -126 | -305 |
| Profit before tax | -3,400 | -546 | -376 | -937 | -567 | -867 |
| Income tax | 582 | 103 | 52 | 25 | 58 | 1 |
| Net profit | -2,819 | -442 | -324 | -912 | -509 | -866 |
| **Net profit – shareholders** | **-2,806** | **-442** | **-324** | **-906** | **-410** | **-228** |
| | | | | | | |
| **Margin** | | | | | | |
| Gross margin | 46% | 8% | 13% | 8% | 23% | 40% |
| Operating margin | -4380% | -893% | -666% | -1093% | -145% | -155% |
| Net margin | -3703% | -744% | -602% | -1080% | -135% | -63% |
| | | | | | | |
| **Growth YoY** | | | | | | |
| Revenue | | -22% | -9% | 56% | 262% | 20% |
| Gross profit | | -86% | 50% | -4% | 916% | 104% |
| Operating profit | | -84% | -32% | 156% | -52% | 28% |
| Net profit | | -84% | -27% | 179% | -55% | -44% |

*Source: Company*

## FDG EV: group structure




*Source: Company*

*Notes: By 30 September 2016, FDG had issued 22,394,363,108 shares; FDG Kinetic had issued 5,135,646,855 shares; The shareholding structure shown in the diagram above includes the shares held by their respective subsidiaries and associates; including SKC (with 24,479,955 shares, accounting for 0.48%) and SK China Company (with 244,755,815shares, accounting for4.76%); a dash line denotes an uncompleted project*

Daiwa Capital Markets

# Coslight Technology International (1043 HK)

Target price: **n.a.**

Share price (30 Nov): **HKD5.24** | Up/downside: **-**

5 | 4 | 3 | 2 | 1

**No Rating**

## Increasing lithium-ion battery sales

- The company has shifted focus from sealed acid to lithium-ion batteries
- Its customer base includes electronics OEMs and auto OEMs
- Narrowing losses from sealed lead acid battery business line

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**Background:** Coslight Technology started out as a manufacturer of sealed lead acid (SLA) batteries in 1994 and shifted to producing lithium-ion batteries (LiBs) in 2010. With production bases in Zhuhai and Harbin, the company supplies LiBs for use in consumer electronics, power LiBs (LiBs for use in automotive vehicles) and SLA batteries. In 1H16, the company derived 75% and 15% of its revenue from the sale of LiBs and SLA batteries, respectively. Separately, the company is also an online game developer, and the games segment contributed significantly to its total net income in 2014-15.

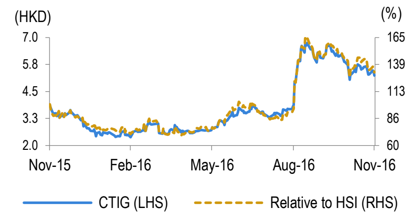
**Highlights: Increasing demand for EV batteries.** In 1H16, Coslight Technology supplied 11,127 electric vehicle (EV) batteries, a rise of 264% YoY. To meet the increasing demand, the company has expanded its power LiB capacity to the factory in Harbin and this should boost the company's capacity by 1GWh by 4Q16-1Q17. The company plans to have 2GWh and 3GWh of EV battery capacity by the beginning of 2017 and 2018, respectively. The capex for each 1GWh additional capacity is around CNY300m-400m, according to management.

**Soft LiB sales growth for electronics segment.** The company sold 40m lithium polymer batteries (mostly to electronics companies) in 1H16, a rise of 3% YoY compared with 34% YoY in the corresponding period last year. According to management, this deceleration was mainly due to the decline in global consumer electronics shipments. The company counts Lenovo, Coolpad, HP, Huawei and ZTE among its major customers. For 2016, management guides for 15-20% YoY revenue growth for this segment, compared to 30% YoY growth in 2015.

**Operating losses from SLA battery segment have started to narrow.** In 1H16, the company booked a 45% YoY increase in total sales and a 68% YoY increase in gross profit, owing to a gross-margin improvement of 2.5pp (to 18.6% in 1H16 from 16.1% in 1H15). The margin expansion reflected reduced losses in the SLA segment, as the company disposed of 1 plant at end-2014 and completed a plant relocation at end-2015. In 2014 and 2015, the company recorded operating losses of CNY140m and CNY180m, respectively; the operating loss for 1H16 was a more modest CNY25m.

**Valuation:** According to the Bloomberg consensus data (currently only 1 broker covers this stock), Coslight Technology is currently trading at 5.9 2017E PER. The consensus forecast calls for YoY EPS growth of 161% for 2016, 37% for 2017 and 35% for 2018.

**Share price performance**




| | |
|---|---|
| 12-month range | 2.38-6.75 |
| Market cap (USDbn) | 0.27 |
| 3m avg daily turnover (USDm) | 1.55 |

*Source: FactSet, Daiwa forecasts*



Company

# Riding on the growth in LiB demand

## Shifting to LiB from SLA batteries

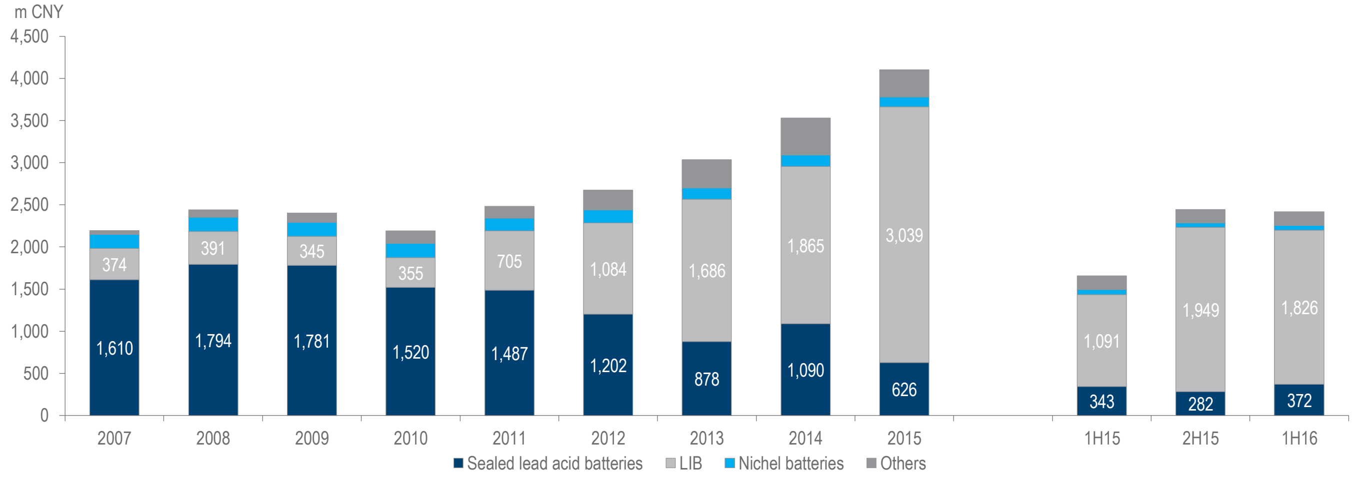
**Coslight derived 74% of its total revenue from LiB sales in 2015**

Coslight Technology was founded as an SLA battery manufacturer in 1994. SLA batteries were primarily used for providing backup power to continuous power supplies used in such places as telecommunications towers, energy storage stations, aircrafts and forklifts.

In 2010, the company shifted its business strategy towards LiBs, given limited growth in SLA battery demand and strong competition from peers. The company began to expand its LiB business and increase its production capacity from 2011.

In 2015, LiB sales accounted for 74% of Coslight Technology's revenue, up from 16% in 2010, following a CAGR of 54% over 2010-15. According to the company, this growth was mostly driven by sales of lithium polymer batteries (mostly used in consumer electronics) and sales of power batteries (used for automotive vehicles). According to the company's annual report, 57% and 26% of its total LiB sales came from its lithium polymer battery business and power batteries business in 2015, respectively.

**Coslight Technology: revenue breakdown**




*Source: Company, Daiwa complied*

### Slowdown in growth of lithium polymer battery business

**Lithium polymer battery sales volume growth has slowed from around 100% YoY in 2011-12 to 15-20% YoY for 2016E as guided by management**

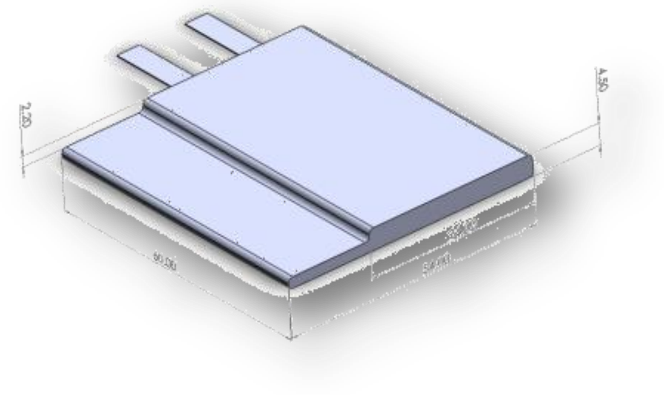
A lithium polymer battery, or more correctly a lithium-ion polymer battery, is a rechargeable battery which uses a polymer electrolyte instead of the more common liquid electrolyte. Therefore, unlike cylindrical and prismatic cells, which require rigid metal cases to hold the liquid electrolyte, lithium polymer batteries come in a soft package or pouch, making them lighter, thinner and more flexible but also less rigid.

Coslight Technology's lithium polymer battery sales volumes increased sharply during 2011-14 (a CAGR of 68% YoY), likely due to client-base expansion as well as a production capacity ramp-up. With a customer base including names such as Huawei, ZTE, Lenovo, Coolpad and HP, Coslight is one of the top-5 lithium polymer cell manufacturers by volume globally.

Sales volumes have stabilised to approximately 40m pieces in 1H16 (vs. 39m in 1H15), as a consequence of the negative growth in global consumer electronics shipments, according to the company. Management's guidance calls for shipment volume growth of 15-20% YoY for full-year 2016, indicating a sales volume of around 60m pieces in 2H16, supported by capacity expansion to 150m pieces per year in 2016 from 120m pieces in 2015.

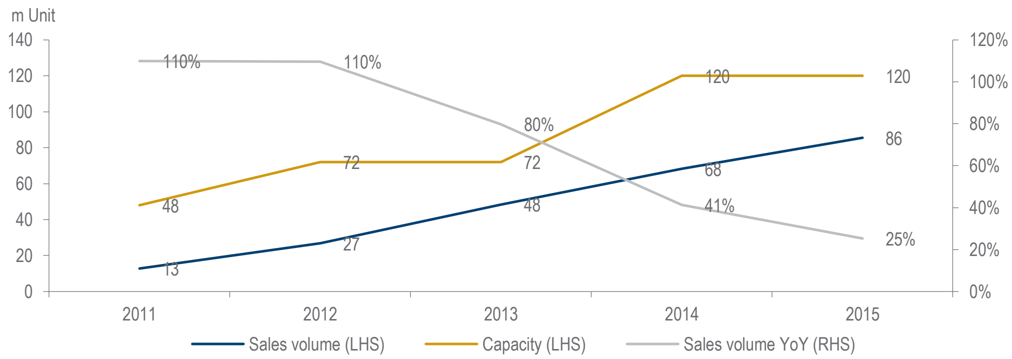
The ASP of lithium polymer batteries has held steady at CNY20-22 per piece during 2011-15, from our calculations based on disclosures by the company.

**Lithium polymer cells**



*Source: Company*

**Coslight Technology: sales volume and YoY growth**




*Source: Company*

## EV battery sales growth a top-line driver

**Coslight is benefiting from rising EV demand in China**

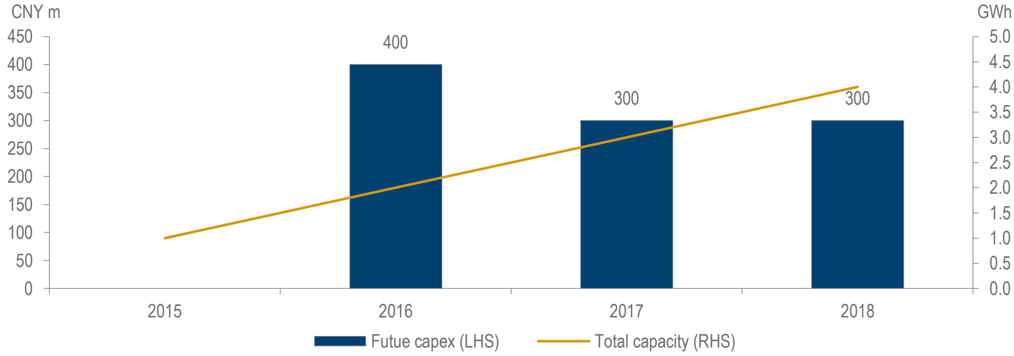
According to management, it is poised to become a major supplier of LiBs to EV companies. The company delivered 11,127 sets of various EV batteries in 1H16, an increase of 264% YoY.

Coslight can produce both LFP and NCA/NCM batteries, supplying vehicles including buses, commercial vehicles, passenger vehicles, and electric bicycles. Its clients in this segment include BAIC, GAC, Xindayang and Jinlong. In 1H15, the company delivered 1,420 battery sets to BAIC Motor (among total EV battery sales of 3,061 sets), making it one of the top battery suppliers to NEV players in China.

At end-2015, the company relocated from its original SLA battery plant in downtown Harbin to the northern part of the Songhua River, Harbin City. It plans to overhaul the original factory to enhance its LFP battery capacity (capex: CNY400m) to cope with a sharp rise in market demand for NEVs in China. The revamped factory is scheduled to commence operations by end-2016 and the company expects to double its power LiB capacity to 2GWh and increase its annual LiB sales to CNY4bn.

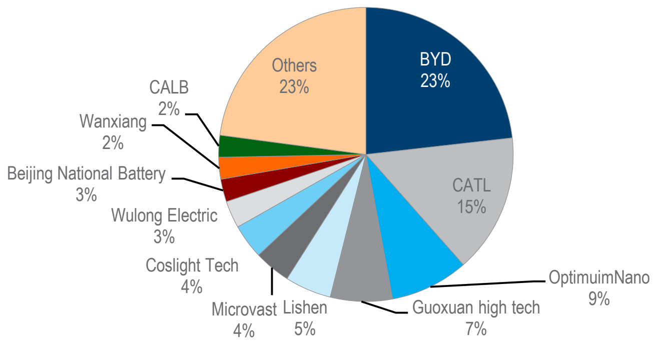
The company has earmarked capex of CNY300m for 2017 and a further CNY300m for 2018 in order to increase its EV battery capacity to 3GWh in 2017 and 4GWh in 2018.

**Coslight: capex and scheduled capacity for EV batteries**




Source: Company

**China EV LiB shipment volume: breakdown by vendor (2015)**




Source: Gaogong Lidian

**Coslight: EV battery during packing procedure**

Source: Company

**Coslight: EV battery after packing**

Source: Company

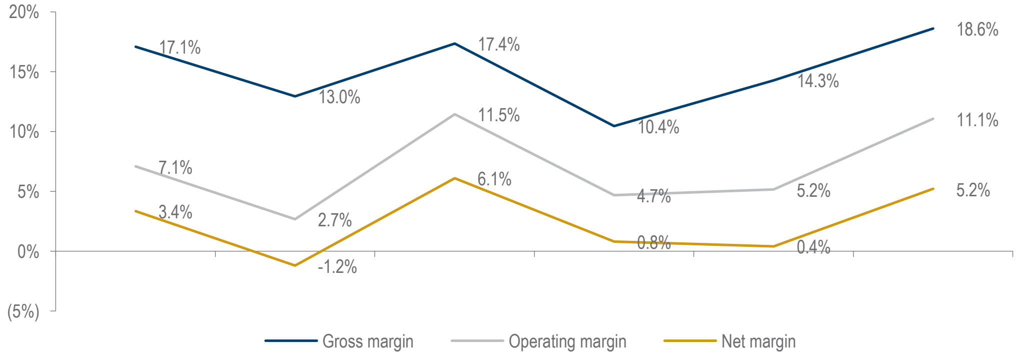
## Increased profitability from product-mix change and reduced losses in SLA battery segment

The company's operating margin widened to 11% in 1H16, from 5% in 2014-15, due mainly to the expanded sales contribution from the LiB segment, which usually carries a higher margin than the SLA battery segment. At the same time, margins have improved in the LiB segment as a result of economies of scale, with production capacity having expanded and raw material costs having declined (see the following charts).

**SLA segment saw reduced operating losses in 1H16**

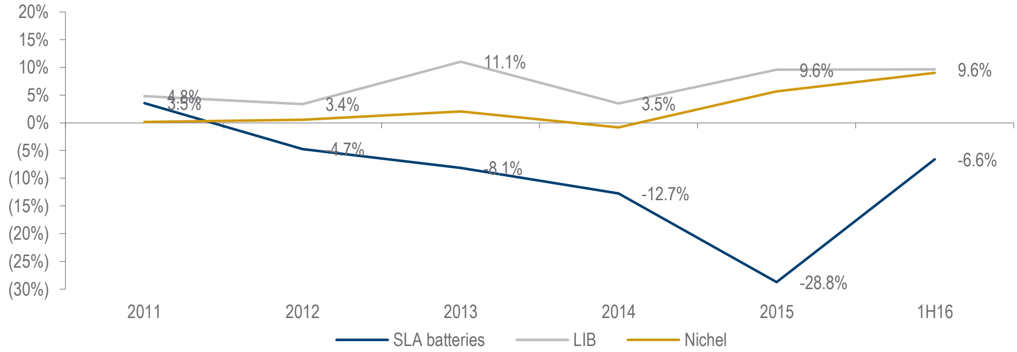
Moreover, the company saw a reduction in losses in the SLA segment in 1H16 due to the disposal of the factory in Shenyang at end-2014 and the completion of the plant relocation exercise at end-2015. In 2015, the company's SLA operation recorded a larger loss as compared with 2014, which management attributed to the relocation and its impact on revenue growth.

**Coslight Technology: profit margin (2011-1H16)**




*Source: Company*

**Coslight Technology: segment operating profit margin**

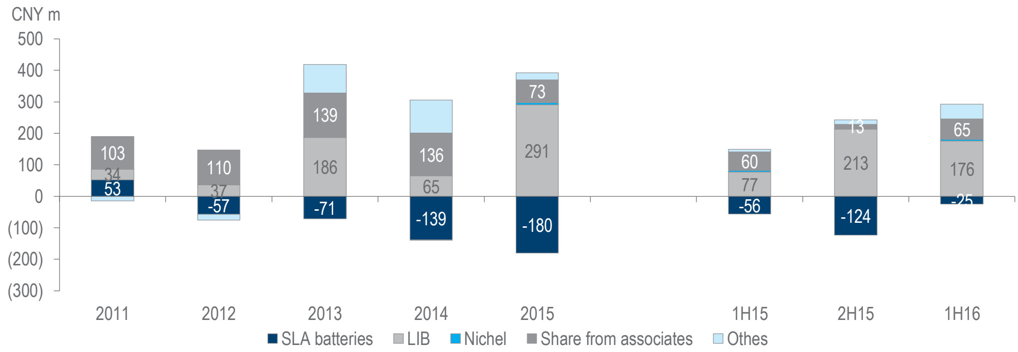



*Source: Company*

**Associated companies develop online games, which contributed significantly to the company's net income in 2014-15**

Apart from its battery businesses, Coslight Technology owns associated companies which have launched online gaming and web-based game products. During 2014-15, profits from these gaming associates accounted for 30-80% of the company's total operating profit given the significant losses of the SLA business.

**Coslight Technology: operating profit contribution from segments**




*Source: Company, Daiwa*

## Coslight Technology: profit and loss summary

| CNY m | 2011 | 2012 | 2013 | 2014 | 2015 | 1H16 |
|---|---|---|---|---|---|---|
| SLA batteries | 1,487 | 1,202 | 878 | 1,090 | 626 | 372 |
| LiB | 705 | 1,084 | 1,686 | 1,865 | 3,039 | 1,826 |
| Nichel batteries | 151 | 155 | 136 | 138 | 116 | 57 |
| Others | 141 | 234 | 334 | 438 | 321 | 164 |
| **Total Revenue** | **2,484** | **2,675** | **3,034** | **3,531** | **4,102** | **2,419** |
| COGS | -2,059 | -2,329 | -2,507 | -3,162 | -3,516 | -1,969 |
| **Gross profit** | **425** | **347** | **527** | **369** | **586** | **450** |
| Administrative expenses | -252 | -295 | -287 | -381 | -437 | -225 |
| Distribution expenses | -162 | -157 | -142 | -122 | -112 | -52 |
| Other income and expenses | 62 | 68 | 110 | 164 | 102 | 30 |
| Share from associates | 103 | 110 | 139 | 136 | 73 | 65 |
| **Operating income** | **176** | **72** | **347** | **166** | **212** | **268** |
| Finance costs | -80 | -97 | -113 | -108 | -127 | -75 |
| Profit before tax | 95 | -25 | 235 | 58 | 85 | 193 |
| Income tax expense | -12 | -7 | -49 | -29 | -68 | -54 |
| **Net profit** | **83** | **-32** | **185** | **28** | **17** | **126** |
| **EPS** | 0.23 | -0.06 | 0.46 | 0.08 | 0.01 | 0.32 |
| | | | | | | |
| **Margin** | | | | | | |
| Gross margin | 17.1% | 13.0% | 17.4% | 10.4% | 14.3% | 18.6% |
| Administrative expenses | -10.1% | -11.0% | -9.4% | -10.8% | -10.7% | -9.3% |
| Distribution expenses | -6.5% | -5.9% | -4.7% | -3.5% | -2.7% | -2.2% |
| Operating margin | 7.1% | 2.7% | 11.5% | 4.7% | 5.2% | 11.1% |
| Net margin | 3.4% | -1.2% | 6.1% | 0.8% | 0.4% | 5.2% |
| | | | | | | |
| **YoY Growth** | | | | | | |
| Total revenue | | 7.7% | 13.4% | 16.4% | 16.2% | 45.9% |
| -SLA batteries | | -19.2% | -26.9% | 24.1% | -42.6% | 8.3% |
| -LiB | | 53.8% | 55.5% | 10.6% | 63.0% | 67.4% |
| -Nichel batteries | | 2.5% | -12.4% | 1.6% | -16.2% | -6.1% |
| Gross profits | | -18.4% | 52.1% | -30.0% | 58.9% | 68.2% |
| Operating income | | -59.1% | 382.8% | -52.3% | 27.8% | 187.8% |
| Net profit | | -138.8% | -673.6% | -84.7% | -40.9% | 525.1% |

*Source: Company*

# China Titans Energy Technology (2188 HK)

Target price: **n.a.**

Share price (30 Nov): **HKD1.31** | Up/downside: **-**

5 4 3 2 1

**No Rating**

## Booming sales of charging equipment

- EV-charging equipment sales on sharp uptrend
- Moved into the black in 1H16 for the first time since 2013
- Endeavouring to start operating EV charging station

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kelvin.lau@hk.daiwacm.com

**Background:** China Titans Energy Technology has been selling electrical DC products since 1995. In 2008, the company harnessed its expertise in the electrical equipment sector and became a provider of EV charging equipment, supplying the 2008 Beijing Olympics and 2010 Shanghai Expo. In 1H16, the company derived 77% of its revenue from EV-charging equipment, up from 63% in 2015 and 34% in 2013, backed by the government's efforts to boost investment in EV-charging stations.

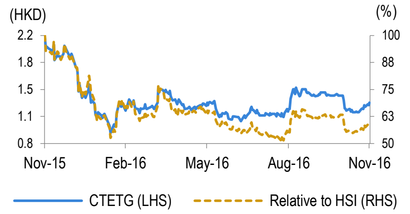
**Highlights: Significant growth in EV-charging equipment sales in 1H16.** Titans booked EV-charging equipment sales of CNY91m in 1H16, up by 119% YoY, which contributed to total revenue growth of 77% YoY for the same period. The company won 2 orders in October 2015 and another order in June 2016 from China State Grid with respective contract values of CNY82m and CNY17m. According to management, the company is more competitive in bidding for local orders, for which it accounted for 10% of total sub-market sales in 2015 compared with its 5-6% market share of national-level orders (orders from China State Grid and China Southern Power Grid).

**Gross-margin enhancement reflects improvement to product mix.** Titan's EV-charging equipment business has realised a gross margin of 40-50% over the past 5 years; the most recent figures of 47% in 1H16 and 41% in 2015 are both higher than the company's gross margin in the electrical equipment business (25% in 1H16 and 29% in 2015). Thanks to an increased sales contribution from EV-charging equipment, Titan's overall gross margin widened to 42% in 1H16, from 37% in 2015 and 34% in 2014, helping the company achieve its first positive net profit of CNY1.2m in 1H16 since 2013 (1H15: net loss of CNY1.9m).

**Keen to become operator of EV-charging stations.** Alongside its move into selling EV-charging equipment, the company also has ambitions of investing in and operating EV charging stations. To this end, it formed a joint venture with Pangda Automobile Trade (601258 CH, not rated), a leading auto dealer in China, in March 2016 to explore opportunities in charging services. The company already owns 1 charging station, in Shaoguan, Guangdong, and is actively proceeding with other projects in Foshan, Shenzhen, Ningde and Beijing.

**Valuation:** The stock is currently trading at a PBR of 2.3x based on its 1H16 BVPS.

### Share price performance




| | |
|---|---|
| 12-month range | 0.93-2.04 |
| Market cap (USDbn) | 0.15 |
| 3m avg daily turnover (USDm) | 0.48 |

*Source: FactSet, Daiwa forecasts*

# Benefiting from EV infrastructure investment

## A leading manufacturer of EV-charging equipment

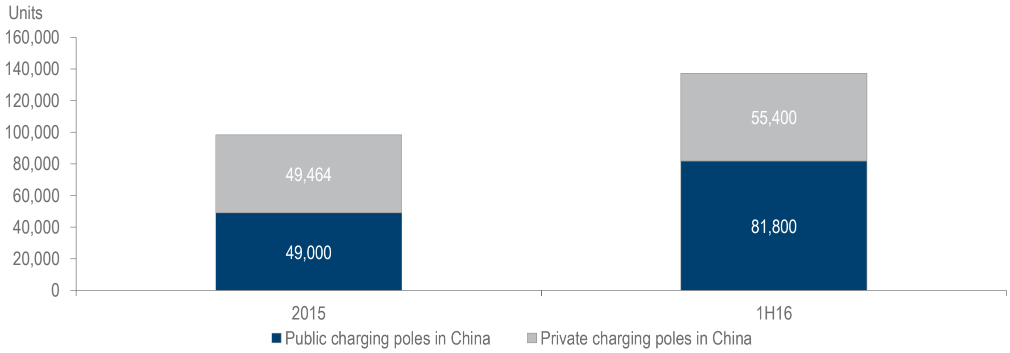
### EV-charging equipment is the company's main sales driver

**The company's total sales rose by 77% YoY in 1H16, on rising demand for EV charging equipment**

Leveraging its electrical DC product technology and its established customer base with power grid companies in particular, Titans began providing customised EV-charging facilities in 2008, and served as an equipment supplier for the 2008 Beijing Olympic Games and 2010 Shanghai Expo. Although sales of its EV-charging equipment fell sharply in 2013, to CNY11m, amid weak industry demand, the company went on to post EV-charging equipment sales of CNY61m for 2014 and CNY123m for 2015.

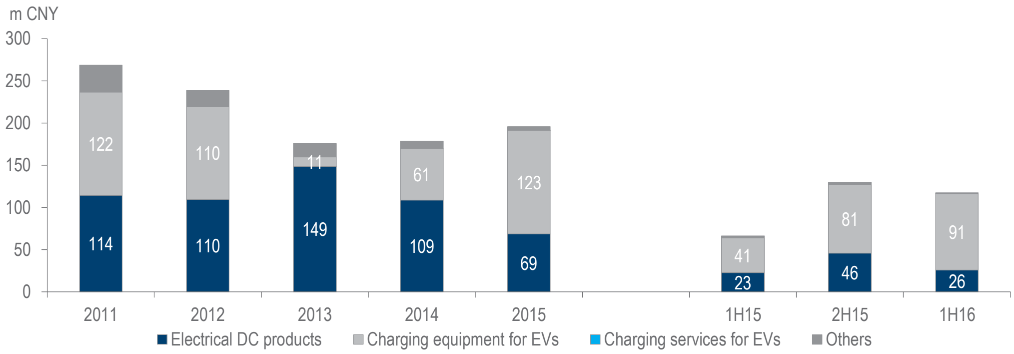
With demand for EV charging stations in China rising due to more favourable government policy in recent years, Titans has relied on its technology expertise and allocated more resources to take advantage of this opportunity. In 1H16, Titans' revenue from EV charging equipment sales was CNY91m, up 119% YoY, and boosting total revenue growth by 77% YoY.

**China: number of EV charging poles as at end-2015 and 1H16**




*Source: NBD News*

**Titans: revenue breakdown**




*Source: Company*

### Bidding for both national-level and local-level orders

Currently, EV-charging equipment demand comes from 2 sources: 1) national-level orders from China State Grid, China Southern Power Grid and other SOEs and, 2) local-level orders from local governments and private EV-charging station operators.

**China State Grid is the country's leading buyer of EV-charging equipment**

The dominant player nationally is China State Grid, which plans to invest CNY5bn in charging equipment in 2016, according to NBD news. Meanwhile, China Southern Power Grid is expected to invest some CNY3bn in the construction of 674 charging stations and 25,000 charging poles over the period 2016-20, according to China Southern Grid's 13th Five-Year Plan. Titans' management estimates that around 50% of total industry orders came from China State Grid in 2015, though it expects this proportion to decline to 30-40% in the next few years.

**13th Five-Year-Plan: investment in charging facilities**

| Company | China Southern Power Grid | China State Grid |
|---|---|---|
| Investment scale | CNY 3bn | n.a |
| Number of centralised charging stations built | 674 | 10,000 |
| Number of decentralised charging poles built | 25,000 | 120,000 |

*Source: China Southern Power Grid, Caixin*

For national-level orders, subsidiaries or associates of China State Grid such as NariTech and Shandong Luneng typically do well in tenders. Indeed, we estimate somewhere between 50% and 80% of such orders are awarded to companies related to China State Grid. Non-affiliated companies such as Titans have been successful in securing local-level orders. According to management, Titans had around a 5-6% market share in bidding on China State Grid orders but roughly a 10% share in bidding on other orders in 2015, where the market is more competitive.

**Titans won 2 orders from China State Grid in 2015 and another order in 2016 YTD**

In 2015, Titans won 2 orders from China State Grid's second EV-charging equipment tender with a contract value of CNY82m, which helped boost its 1H16 sales of EV charging equipment. In 2016, Titans did not win any orders in the first EV-charging equipment tender, but it did win a contract worth around CNY17m according to GG-LB.com in the second tender.

As for capacity, the company intends to open a new plant in Zhuhai in July 2017, which it expects to help it to reach an annual production capacity worth around CNY400m-CNY500m from the current CNY200-300m.

**China State Grid: EV charging equipment orders in 2015-1H16**

| Date of tender results releasing | May-15 | Oct-15 | May-16 | Jun-16 |
|---|---|---|---|---|
| **Total investment value (m CNY)** | **n.a** | **>1,000** | **800-900** | **400-500** |
| **Numbers of orders in total** | **17** | **30** | **33** | **20** |
| Hangzhou Zhongheng | 2 | 2 | 2 | |
| Beijing SGEPRI UHV Transmission Technology | 2 | 2 | 2 | 1 |
| Hexin Ruitong - Beijing | 2 | 2 | 2 | |
| Beijing Huashang Sanyou | 2 | 2 | 2 | 1 |
| NariTech | 2 | 2 | 2 | 2 |
| Xuji Group | 3 | 2 | 2 | 1 |
| Shandong Luneng | 2 | 2 | 2 | 2 |
| Wanma-Cable | 1 | 2 | | |
| Fangzhi Tech - Beijing | 1 | 2 | 2 | |
| Shenzhen Guodian Technology Communication | | 2 | | |
| Nengrui Dianli | | 2 | 2 | |
| Hangzhou Dayou Technology | | 2 | 2 | 1 |
| Hangzhou Only Power Supply | | 2 | 2 | |
| CSG | | 1 | | |
| Gaoke China | | 1 | 2 | |
| Titans | | 2 | | 1 |
| ATC-A | | | 2 | |
| Shenzhen CLOU Electronics | | | 2 | |
| Suzhou Heshun Electric | | | 2 | |
| SZ Nari | | | 2 | |
| NariTech - Nanjing | | | 1 | |
| Shandong University Electric Power Technology | | | | 1 |
| Shandong Electric Group New Energy | | | | 1 |
| Tianyu Electric | | | | 1 |
| Golden Phoenix | | | | 1 |
| Fujian Wangneng Technology | | | | 1 |
| Qingdao Luneng Hengyuan | | | | 1 |
| Tianjin Pinggao Electric | | | | 1 |
| Qingdao Hardhitter | | | | 1 |
| CEC Shandong Electric | | | | 1 |
| Ningbo Sanxing Electric | | | | 1 |
| Pinggao Group | | | | 1 |
| **Percentage of China State Grid related companies** | **76%** | **60%** | **58%** | **55%** |

*Source: China State Grid, Various news, Daiwa estimation*
*Note: Grey companies are related companies (associates or subsidiaries) of China State Grid*

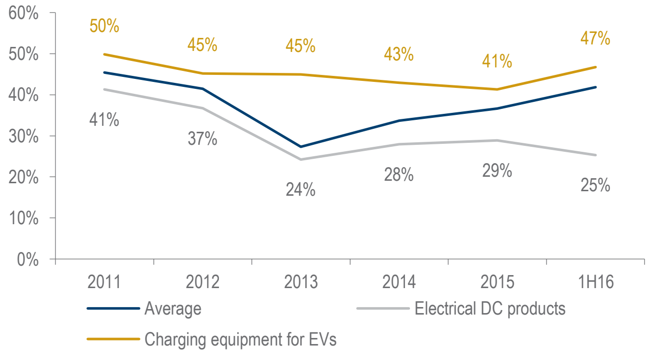
**Titan's overall gross margin picked up to 42% in 1H16, from 37% in 2015 and 34% in 2014**

### Product-mix change has supported margin improvement

Titan's gross margin in the EV-charging equipment segment remained at 40-50% over the period 2011-1H16, which compares well with its 25-29% gross margin on electrical DC products in 1H16 and 2015.

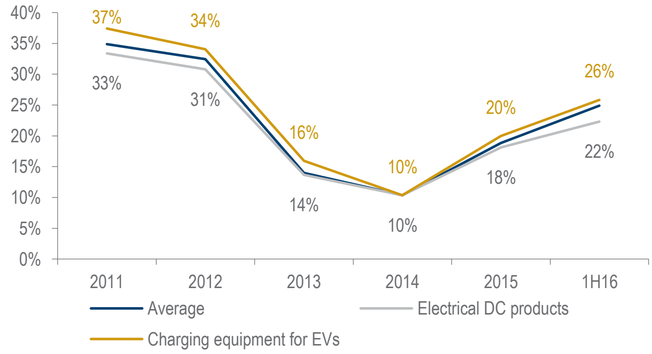
As the company has derived increasing revenue from EV-charging equipment sales since 2014, its gross margin widened to 42% in 1H16, from 37% in 2015 and 34% in 2014. In turn, the company moved into the black in 1H16 for the first time since 2013, supported by the profit contribution of the charging equipment business.

**Titans: gross margin trend in 2011-1H16**



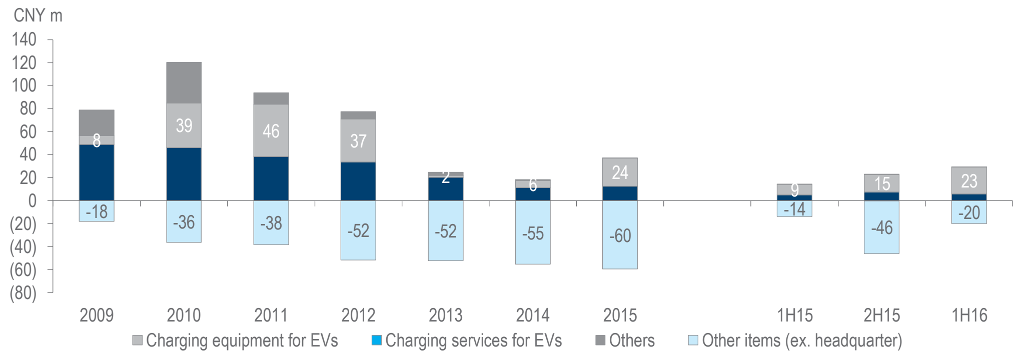

*Source: Company*

**Titans: segment operating margin trend in 2011-1H16**




*Source: Company*

**Titans: operating profit breakdown by segment**




*Source: Company*

## Sales of electrical DC products declining

The company began selling electrical DC products in 1995, and these were its most important business segment until 2010. It mainly supplied 3 product types: 1) high-frequency switch DC power supply systems, 2) high-frequency switch communication power supply systems, and 3) power-dedicated uninterruptible power supplies.

**Titans' EV-charging equipment business can tap the company's existing customer base**

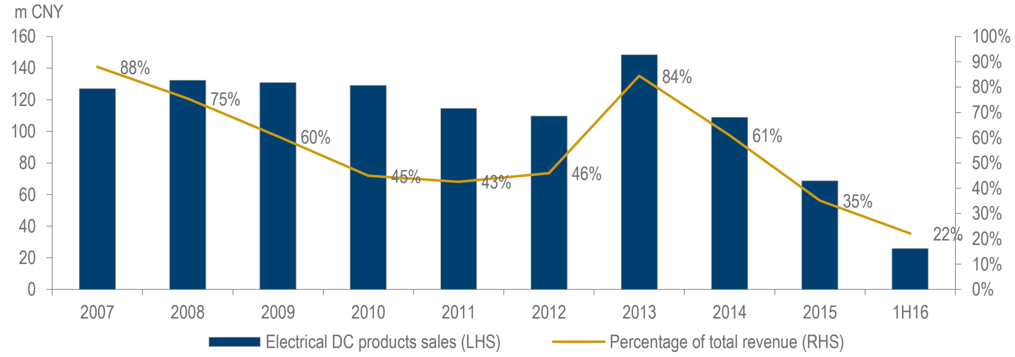
Its major customers in this segment are enterprises investing in power infrastructure, such as power plants and transforming stations. The main end-users are typically national and local power grid companies, power plant operators, companies conducting petrochemical businesses, and transportation, water treatment and metallurgy and coal-mining enterprises.

Some of those same end-users, including gird companies (such as China State Grid) and local enterprises related to the transportation business, also have demand for building EV-charging stations. Hence, Titans can seek to leverage its existing customer relationships to expand its sales of EV-charging equipment.

Since 2014, the company has seen a significant fall in its sales of electrical DC products. Titans attributes the decline to a decreasing number of tenders held by China State Grid. In response, the company has pushed on with its efforts to explore the market for electrical

DV products in railway and nuclear power projects. In 1H16, the company recorded segment sales of CNY26m, up 14% YoY, albeit from a low base.

**Titans: electrical DC sales and share of total revenue**




*Source: Company*

# Setting its sights on operating EV-charging stations

Aside from its sale of EV-charging equipment, Titans has been investing in building and operating EV-charging stations since 2H15, though the related revenue contributes a very small portion of total sales (CNY0.05m in 2H15 and CNY0.19m in 1H16).

**The company plans to expand its EV-charging station business**

According to the company, it has conducted a detailed cost-benefit analysis of EV-charging station projects, taking into consideration such factors as the minimum charging amount per day from customers, to project the charging fee earned to determine the IRR for constructing charging stations, service fees for unit charging, and local government subsidies. The company said it only invests in projects with reasonable IRRs rather than focusing solely on market-share gains.

In March 2016, the company entered an agreement with Pangda Automobile Trade, one of the leading auto dealers in China, to establish a joint venture in Beijing whose main business would be related to charging services. As at the end of March 2016, the company was operating 1 charging station in Shaoguan, Guangdong, and was continuing with direct-investing charging facilities projects in Foshan, Shenzhen, Ningde and Beijing.

**Titans: profit and loss summary**

| CNY m | 2011 | 2012 | 2013 | 2014 | 2015 | 1H16 |
|---|---|---|---|---|---|---|
| **Revenue** | **268.7** | **238.7** | **175.9** | **178.5** | **195.9** | **117.4** |
| COGS | -146.7 | -139.8 | -127.9 | -118.4 | -124.1 | -68.3 |
| **Gross profits** | **122.0** | **98.9** | **48.0** | **60.1** | **71.8** | **49.1** |
| Selling and distribution expenses | -33.4 | -32.3 | -33.9 | -31.5 | -41.0 | -21.8 |
| Administrative expenses | -55.7 | -60.7 | -56.9 | -46.2 | -53.1 | -30.2 |
| Other revenue | 20.9 | 13.8 | 29.5 | 9.4 | 25.2 | 5.5 |
| Share of associates | 1.7 | 6.4 | 7.5 | 4.5 | 1.8 | -0.7 |
| Impairment | 0.0 | 0.0 | -21.7 | -33.1 | -29.9 | 0.2 |
| Others | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 7.0 |
| **Operating profits** | **55.4** | **25.9** | **-27.6** | **-36.8** | **-22.6** | **9.1** |
| Finance costs | -3.8 | -9.4 | -10.6 | -8.3 | -7.7 | -5.1 |
| Profits before tax | 51.7 | 16.5 | -38.1 | -45.2 | -30.3 | 4.0 |
| Income tax | -18.6 | -4.8 | 3.9 | 2.2 | 2.6 | -3.3 |
| Net profits | 33.1 | 11.8 | -34.3 | -43.0 | -27.7 | 0.7 |
| **Net profits attributable to shareholders** | **33.8** | **11.8** | **-34.3** | **-43.0** | **-26.1** | **1.2** |
| | | | | | | |
| **Margin** | | | | | | |
| Gross margin | 45% | 41% | 27% | 34% | 37% | 42% |
| Operating margin | 21% | 11% | -16% | -21% | -12% | 8% |
| Net margin | 13% | 5% | -19% | -24% | -13% | 1% |
| | | | | | | |
| **YoY Growth** | | | | | | |
| Revenue | | -11% | -26% | 1% | 10% | -40% |
| Gross profits | | -19% | -51% | 25% | 19% | -32% |
| Operating profits | | -53% | -206% | 34% | -39% | -140% |
| Net profits | | -65% | -391% | 25% | -39% | -105% |

*Source: Company*

Daiwa
Capital Markets

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"5": the security could underperform the local index by more than 15% over the next 12 months.

**Disclosure of investment ratings**

| Rating | Percentage of total |
|---|---|
| Buy* | 64.0% |
| Hold** | 21.2% |
| Sell*** | 14.8% |

*Source: Daiwa*

*Notes: data is for single-branded Daiwa research in Asia (ex Japan) and correct as of 30 September 2016.*
** comprised of Daiwa's Buy and Outperform ratings.*
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