

# NEW ENERGY VEHICLE DEVELOPMENT IN CHINA

## - A CHINESE E-DRIVE SUPPLIER'S PERSPECTIVE

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# Outlines

## **1** Revolution in Auto Industry

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## **2** NEV Development in China

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## **3** Opportunities and Challenges for Chinese eDrive Suppliers

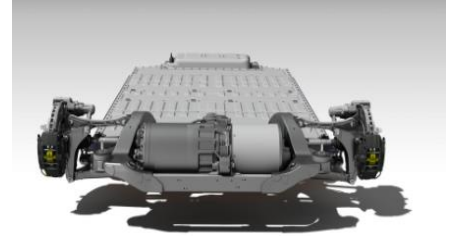
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## **4** Dajun Introduction

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# Auto Industry Is Experiencing a Revolutionary Change

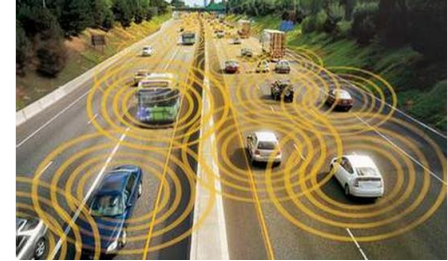
Electrification



Intelligent



Connectivity



Sharing



# Redefine Auto Industry

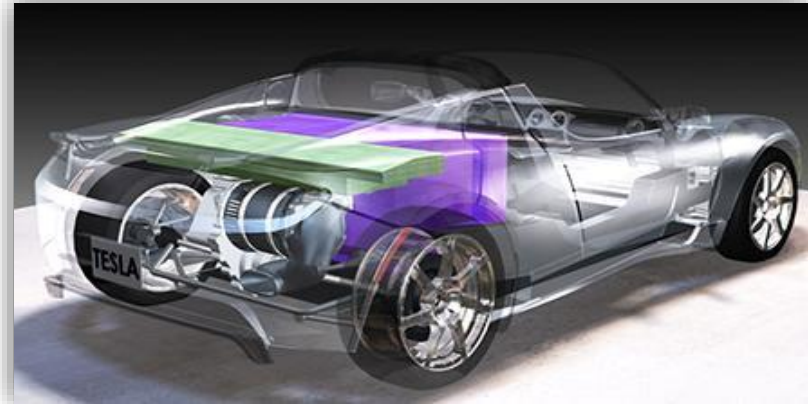
## Simplified EV Powertrain would facilitate:

- Standard and modular power chassis
- Personalized car body, interior and driving experience

## Broader Opportunity for Vehicle OEMs

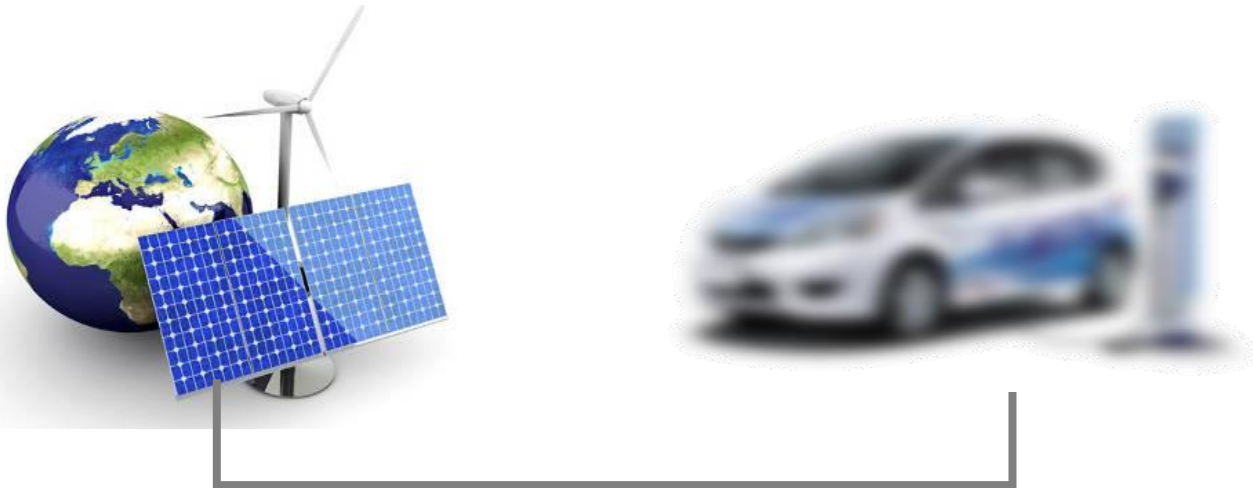
- Personalized products and better consumer experience
- Value-added services during the entire vehicle life

## Better Opportunities for Suppliers to Implement Large-scale Automated Production of Standardized Powertrain Components

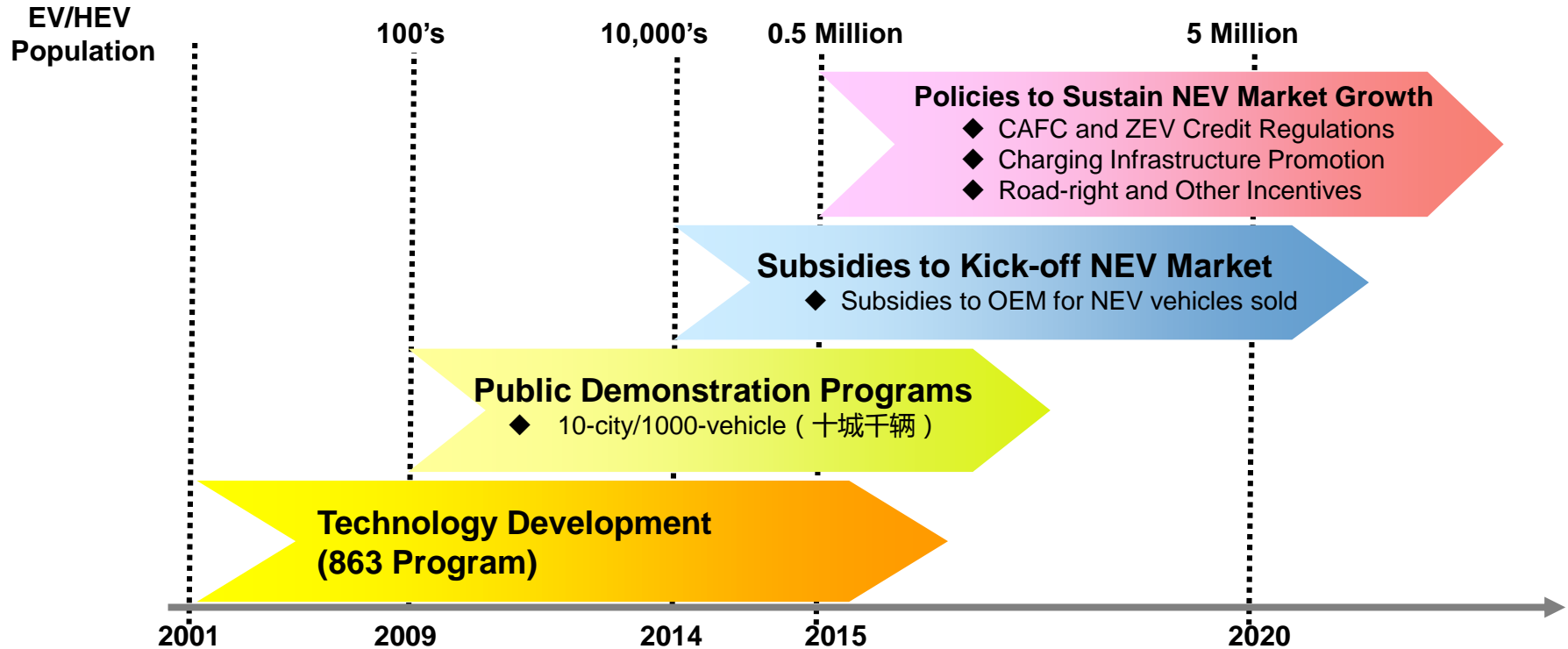


# Redefine “Fueling System”

- With the increasing use of plug-in vehicles, as well as the continuous improvement of battery and fuel cell technologies, electricity is becoming more and more important energy form for transportation;
- The batteries in new energy vehicles can play the role of energy storage components for distributed, intelligent renewable grid systems;
- Charging devices (including vehicle-mounted charging apparatus) will have a vast market prospects.

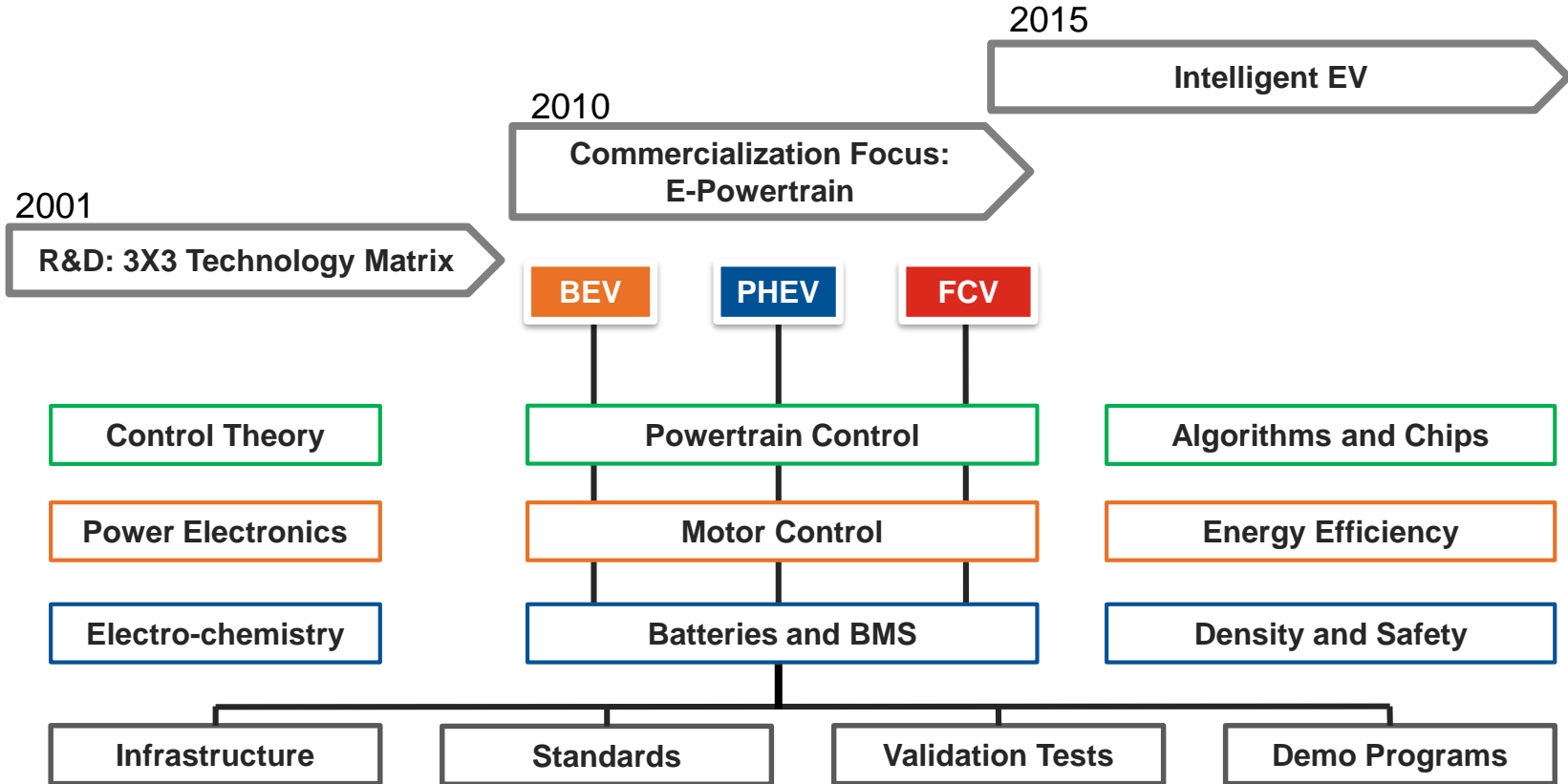


# China EV/HEV Development History

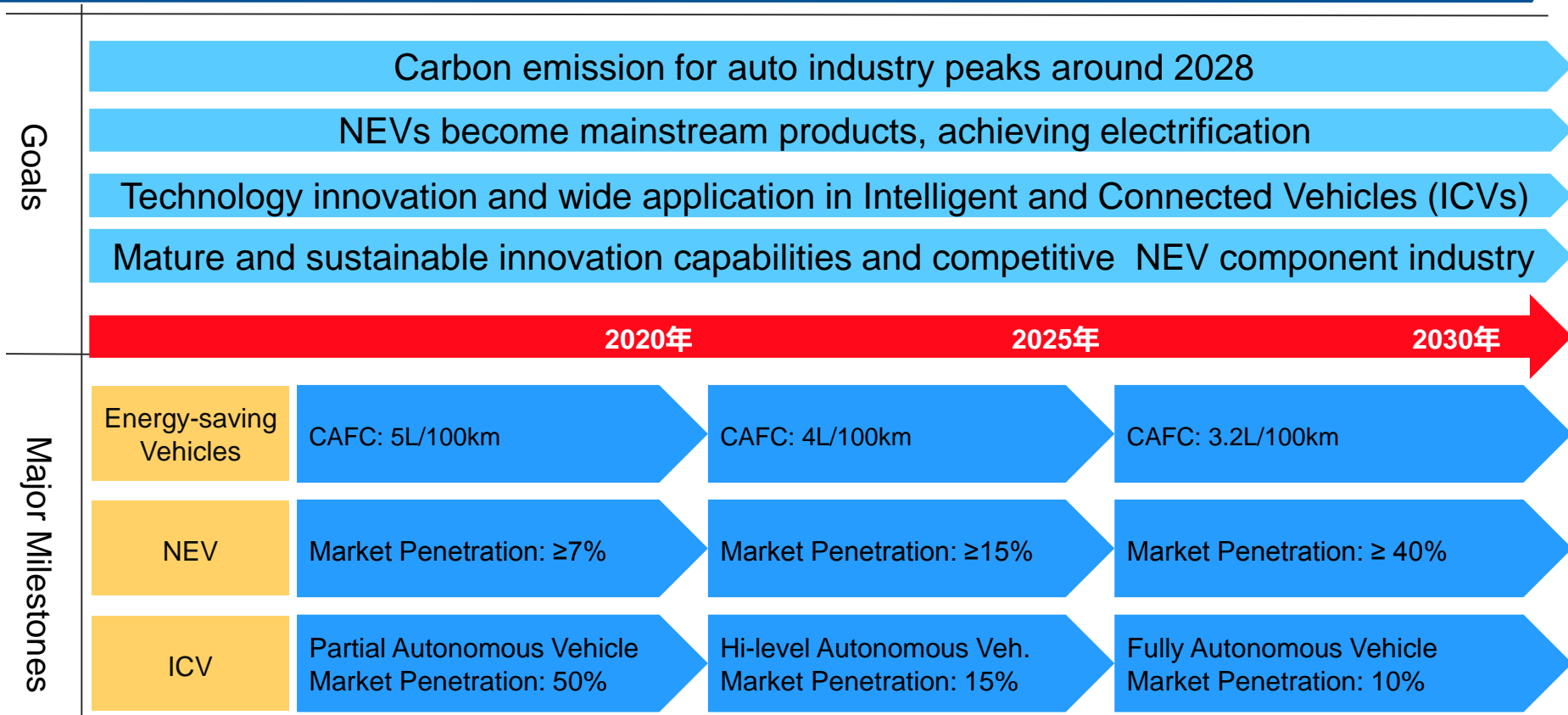


Source: DAJUN Analysis

# NEV Technology Development in China



# Roadmap by Chinese MIIT





# Chinese Central Government Subsidies for NEVs (2018/2)

## Cars

| Veh type  | Subsidy by EV Ranges ( kRMB/Car) |                |                |                |       |      |
|-----------|----------------------------------|----------------|----------------|----------------|-------|------|
| EV        | 150≤R<br>< 200                   | 200≤R<br>< 250 | 250≤R<br>< 300 | 300≤R<br>< 400 | R≥400 | R≥50 |
|           | 15                               | 24             | 34             | 45             | 50    | /    |
| PHEV/REEV | /                                |                |                |                |       | 22   |

## Delivery Trucks and Special Vehicle

| Subsidy by Battery Size ( ¥/kWh ) |             |         | Upper limit<br>( kRMB/Veh. ) |
|-----------------------------------|-------------|---------|------------------------------|
| ≤30 kWh                           | 30 ~ 50 kWh | >50 kWh |                              |
| 850                               | 750         | 650     | 100                          |

## FCVs

| Vehicle type          | Subsidy by FC Power ( ¥/kW ) | Upper limit ( kRMB/Veh. ) |
|-----------------------|------------------------------|---------------------------|
| Cars                  | 6000                         | 200                       |
| Light Duty Commercial | -                            | 300                       |
| Large Commercial      | -                            | 500                       |

## Buses

| Subsidy standards<br>( ¥/kWh ) |      | Multiplier                |              |          | Upper limit ( kRMB/Veh. ) |               |           |
|--------------------------------|------|---------------------------|--------------|----------|---------------------------|---------------|-----------|
|                                |      |                           |              |          | 6<L≤8<br>m                | 8 < L≤10<br>m | L>10<br>m |
| EV Buses<br>(Non quick charge) | 1200 | Battery Density ( Wh/kg ) |              |          | 55                        | 120           | 180       |
|                                |      | 115 - 135                 |              | >135     |                           |               |           |
|                                |      | 1                         |              | 1.1      |                           |               |           |
|                                |      | Ekg ( Wh/km-kg )          |              |          |                           |               |           |
|                                |      | 0.15-0.21                 |              | <0.15    |                           |               |           |
| 1                              |      | 1.1                       |              |          |                           |               |           |
| EV Buses<br>(Quick charge)     | 2100 | The charging rate         |              |          | 40                        | 80            | 130       |
|                                |      | 3C - 5C                   | 5C - 15C     | >15C     |                           |               |           |
|                                |      | 0.8                       | 1            | 1.1      |                           |               |           |
| PHEV/<br>REEV<br>Buses         | 1500 | Fuel-saving rate          |              |          | 22                        | 45            | 75        |
|                                |      | 60% -<br>65%              | 65% -<br>70% | >70<br>% |                           |               |           |
|                                |      | 0.8                       | 1            | 1.1      |                           |               |           |

# China's Subsidies for NEVs – Progressive Changes

|                          |             | 2016                  | 2017                                    | 2018   |
|--------------------------|-------------|-----------------------|---|--|
| Range                    | Cars        | EV≥100km<br>PHEV≥50km | EV≥100km<br>PHEV≥50km                   | EV≥150km<br>PHEV≥50km  |
|                          | Buses       | EV≥150km<br>PHEV≥50km | EV≥200km<br>PHEV≥50km                   | EV≥200km<br>PHEV≥50km  |
| Ekg                      | EV<br>Buses | 0.25 – 0.7            | 0.24                                    | 0.15 – 0.21  |
| Battery<br>Density       | Buses       |                       | 85 – 115<br>Wh/kg                       | ≥115Wh/kg  |
|                          | Cars        |                       | 90 – 120<br>Wh/kg                       | 105 – 120 Wh/kg: 0.6<br>120 – 140: 1.0<br>140 – 160: 1.1<br>≥ 160: 1.2 |
| Fuel Savings<br>for PHEV | Cars        | ≥40%                  | Non-EV Fuel<br>Consumption<br>≤70% CAFC | ≤65%: 0.5<br>≤60%: 1.0   |
|                          | Buses       |                       | ≥40%                                    | ≥60%   |

*Ekg: Energy consumption per kilogram payload per kilometer*

## Up Limit of Subsidies for NEV Cars (kRMB)

| Type         | Range       | 2016 | 2017 | 2018 | Change       |
|--------------|-------------|------|------|------|--------------|
| EV Cars      | 100≤R < 150 | 25   | 20   | 0    | <b>-100%</b> |
|              | 150≤R < 200 | 45   | 36   | 15   | <b>-58%</b>  |
|              | 200≤R < 250 |      |      | 24   | <b>-33%</b>  |
|              | 250≤R < 300 |      |      | 34   | <b>-23%</b>  |
|              | 300≤R < 350 | 55   | 44   | 45   | <b>2.3%</b>  |
|              | 350≤R       |      |      | 50   | <b>14%</b>   |
| PHEV<br>Cars | 50≤R        | 30   | 24   | 22   | <b>-8%</b>   |

## Up Limits of Subsidies for EV Buses (kRMB)

| Type     | Length ( m ) | 2016 | 2017 | 2018 | Change      |
|----------|--------------|------|------|------|-------------|
| EV Buses | L < 6        | 100  | 0    | 0    | <b>—</b>    |
|          | 6 ≤ L < 8    | 250  | 90   | 55   | <b>-39%</b> |
|          | 8 ≤ L < 10   | 400  | 200  | 120  | <b>-40%</b> |
|          | 10 ≤ L < 12  | 500  |      |      |             |
|          | 12 ≤ L       | 600  |      | 300  | 180         |

# Chinese Government Incentive Regulations

CAFC

| 年份   | CAFC/<br>T <sub>CAFC2020</sub> | 年下降<br>百分点 | CAFC<br>L/100km | CAFC 年度下降<br>L/100km | 年降幅度  |
|------|--------------------------------|------------|-----------------|----------------------|-------|
| 2013 | 144%                           | 5          | 7.22            | 0.16                 | -2.1% |
| 2014 | 141%                           | 3          | 7.06            | 0.16                 | -2.2% |
| 2015 | 138%                           | 3          | 6.90            | 0.16                 | -2.3% |
| 2016 | 134%                           | 4          | 6.70            | 0.20                 | -2.9% |
| 2017 | 128%                           | 6          | 6.40            | 0.30                 | -4.5% |
| 2018 | 120%                           | 8          | 6.00            | 0.40                 | -6.3% |
| 2019 | 110%                           | 10         | 5.50            | 0.50                 | -8.3% |
| 2020 | 100%                           | 10         | 5.00            | 0.50                 | -9.1% |

ZEV  
Credit

| Year      | W Factor |
|-----------|----------|
| 2016/2017 | 5        |
| 2018/2019 | 3.5      |
| 2020      | 2        |

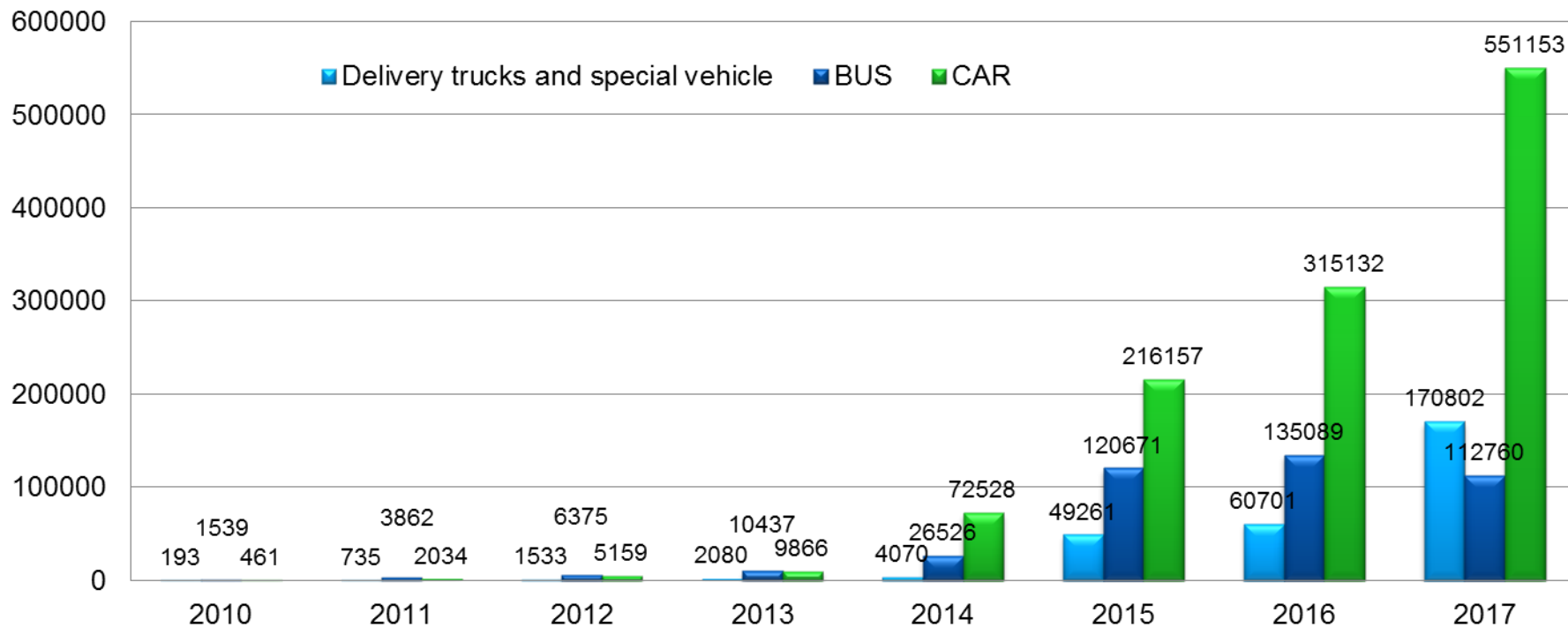


5L/100KM



5.8L/100KM

# China NEV Market Growth 2010-2017



Source : China Association of Automobile Manufacturers

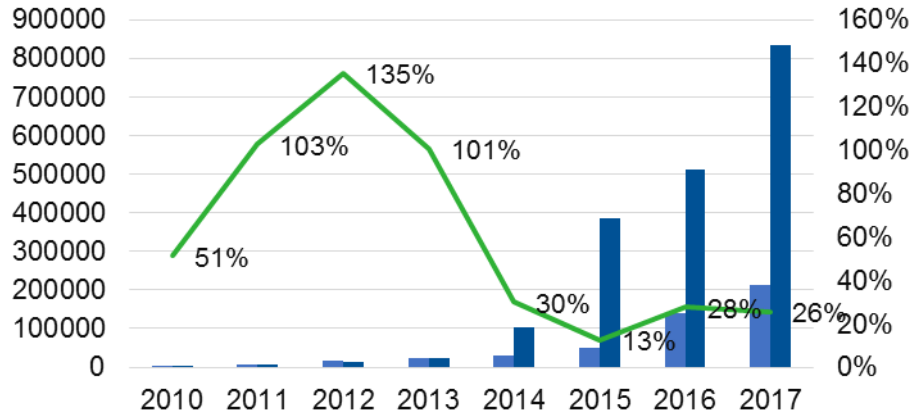
# China Is Leading EV Development in the World

## Huge total market with a large variety of segments

- Car-sharing in large cities vs. personal cars in the countryside;
- Light duty commercial vehicles with various specialties;
- Heavy duty E-trucks; etc.

### Charging Posts and Stations in China

■ Charging pile ■ NEV — Proportion



### Worldwide NEV Sales in 2017

| Ranking | Country | Total sales | Proportion |
|---------|---------|-------------|------------|
| 1       | China   | 463369      | 53.70%     |
| 2       | Japan   | 107740      | 12.49%     |
| 3       | USA     | 104487      | 12.11%     |
| 4       | Norway  | 33439       | 3.88%      |
| 5       | France  | 32305       | 3.74%      |
| 6       | Germany | 27583       | 3.20%      |
| 7       | England | 22141       | 2.57%      |
| 8       | Korea   | 13541       | 1.57%      |
| 9       | Holland | 8771        | 1.02%      |
| 10      | Canada  | 8057        | 0.93%      |

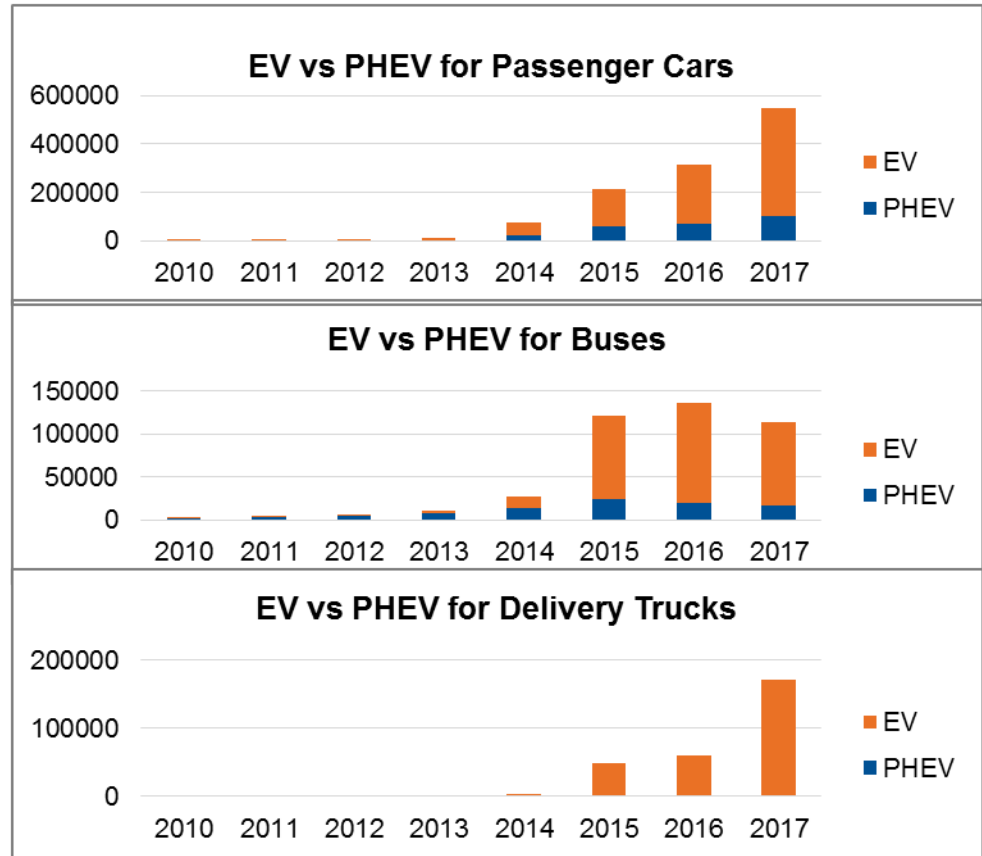
Source: Marklines

Source: Perspective research institute

# E-Powertrain is the Strategic Technology Focus for China

- Increasing emission concerns, especially in cities;
- Flexible energy sources for transportation;
- Simple and easy technology that matches with the current capabilities for Chinese auto industry;
- Natural combination of EV and Autonomous Vehicles;

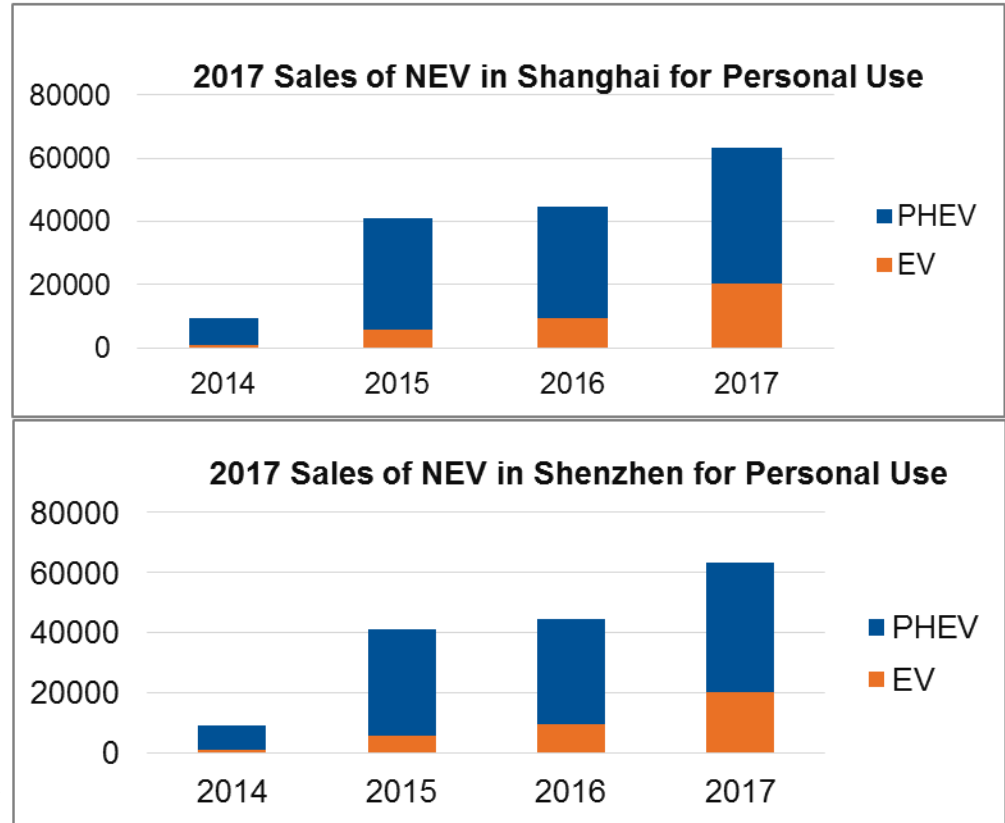
Battery and charging infrastructure are limiting factors



# PHEVs Deserve More Attention

- **Given the choice, PHEVs would be preferred by Chinese consumers today;**
- **PHEV challenges: engine and transmission technologies;**
- **Chinese OEMs plan to develop PHEVs to satisfy both consumer needs and government regulations;**

Source : China Association of Automobile Manufacturers



# Comparison of NEV Powertrains

## EV:

- Simple
- Easy to implement standardized and modular design
- Suitable for autonomous drive
- Suitable for V2G integration
  
- Limited by battery and charging infrastructure

## PHEV:

- Proven technology
- Can meet consumers' needs
  
- Complicated system
- Requires in-depth capability of engine, transmission and integration
- Long PD cycle
- High cost

## REEV:

- No range limit
- Superior emission
- Simple, compatible with China's Industry capability
- Seamless transition to EV and FCV
  
- Fuel economy is slightly inferior to PHEV at high speed cruising

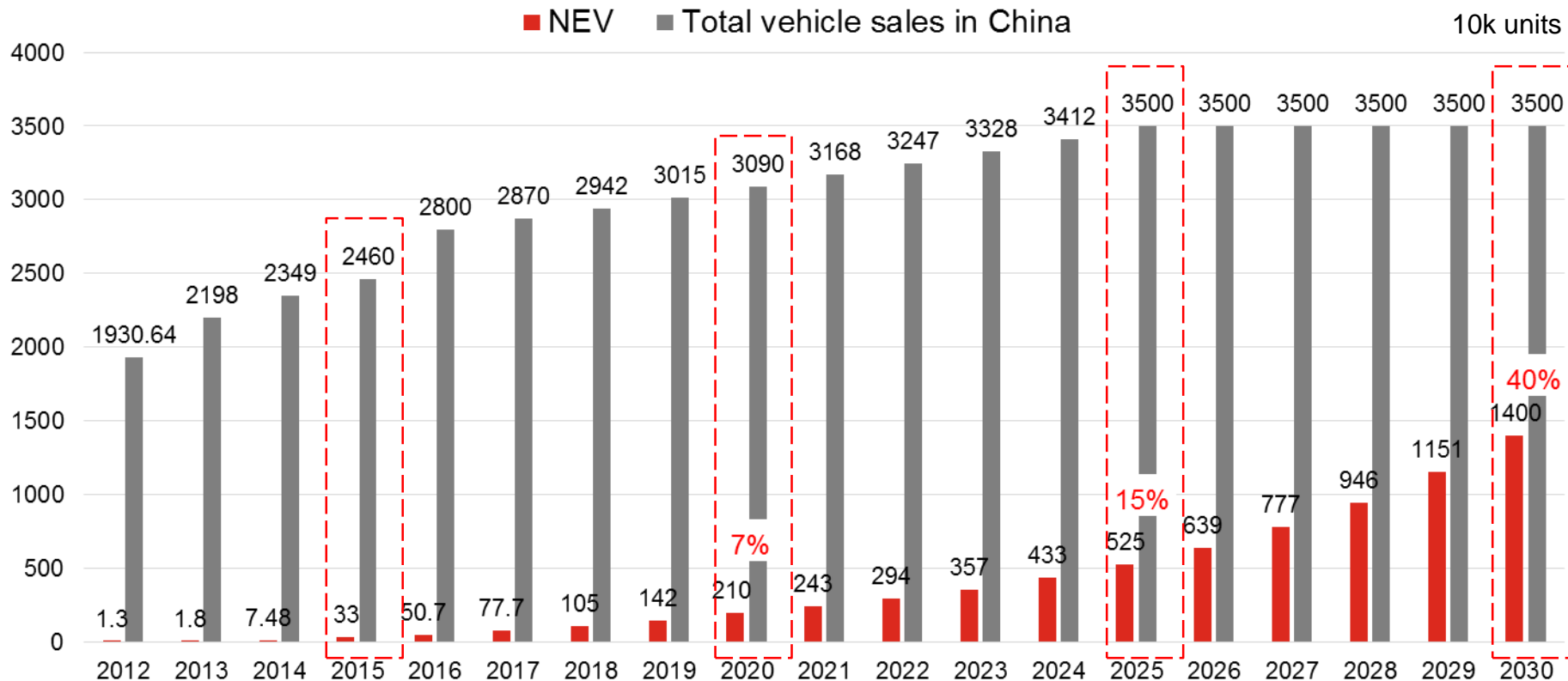
## FCV:

- H2 is expected to be the future energy source
- Current R/D focus
- Rapid progress achieved in reliability and cost
  
- Need relatively long development time due to H2 infrastructure

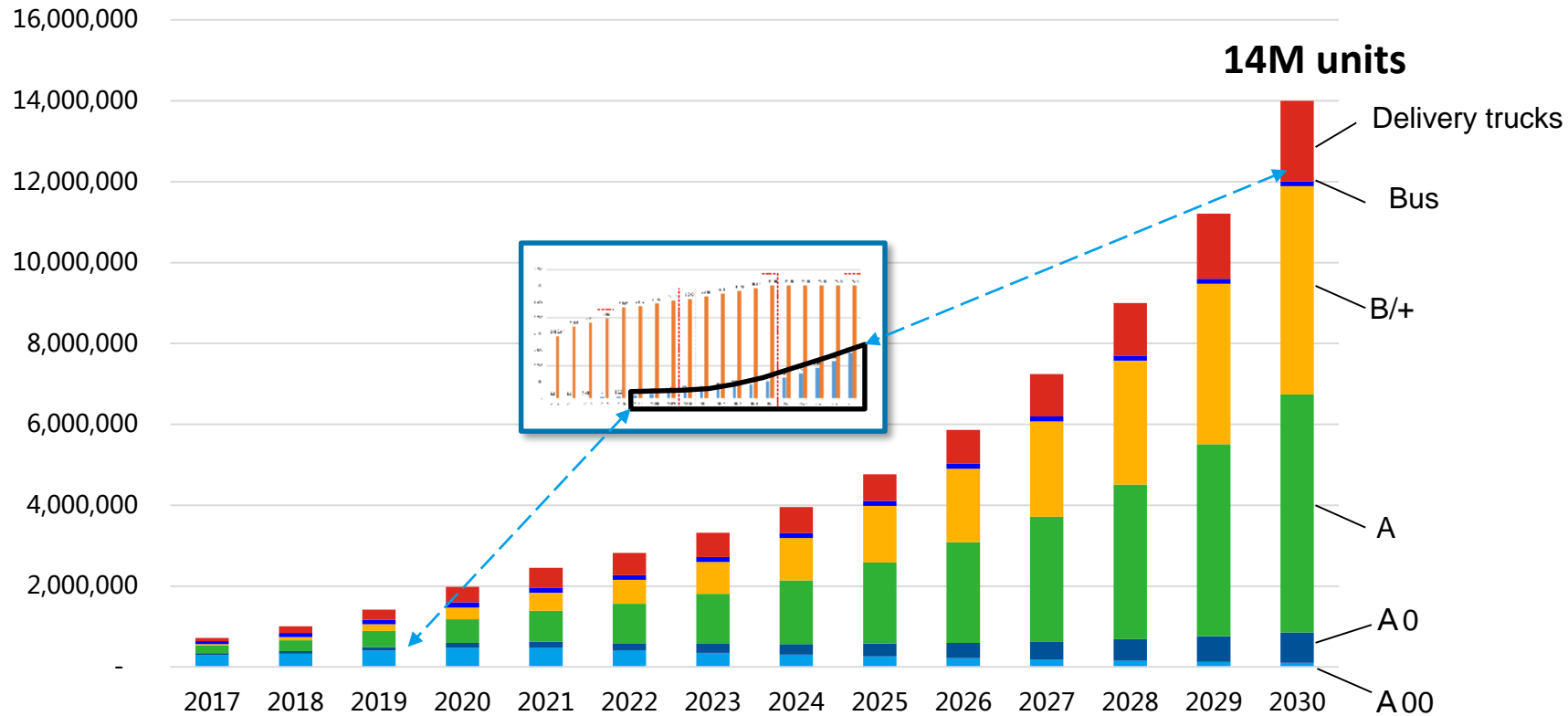
## EV vs. PHEV in China?



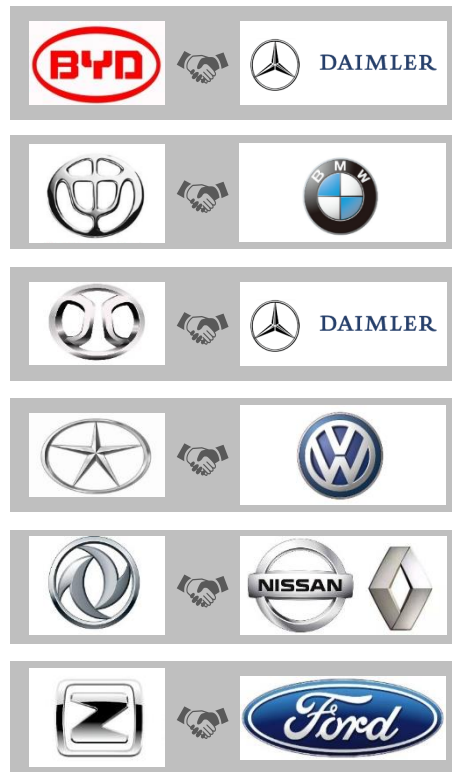
# China Auto Market Forecast: 2017-2030



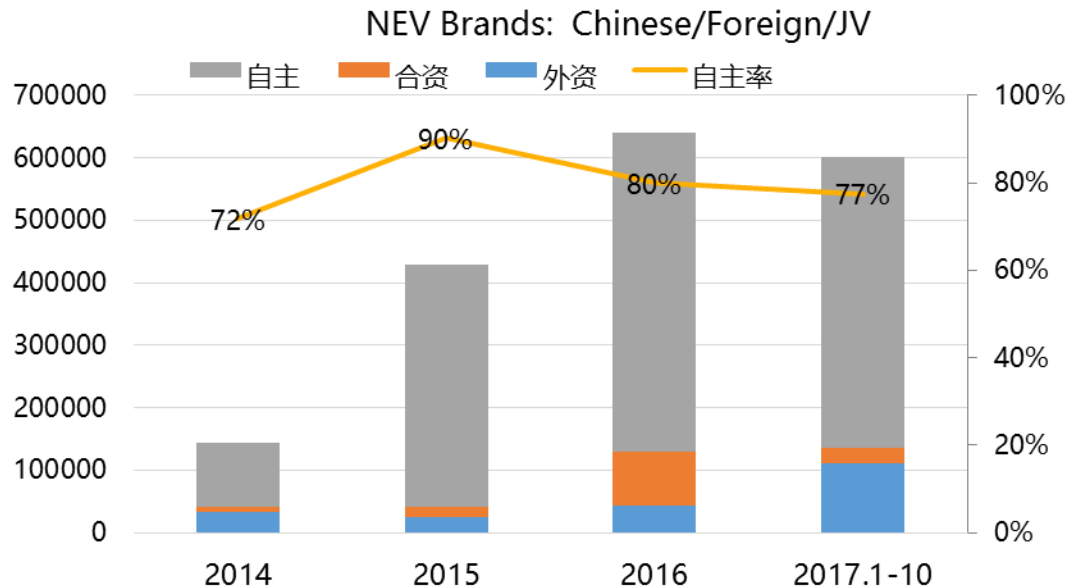
# China NEV Market Forecast: 2017-2030



# Foreign OEMs Accelerate Penetration into Chinese NEV Market

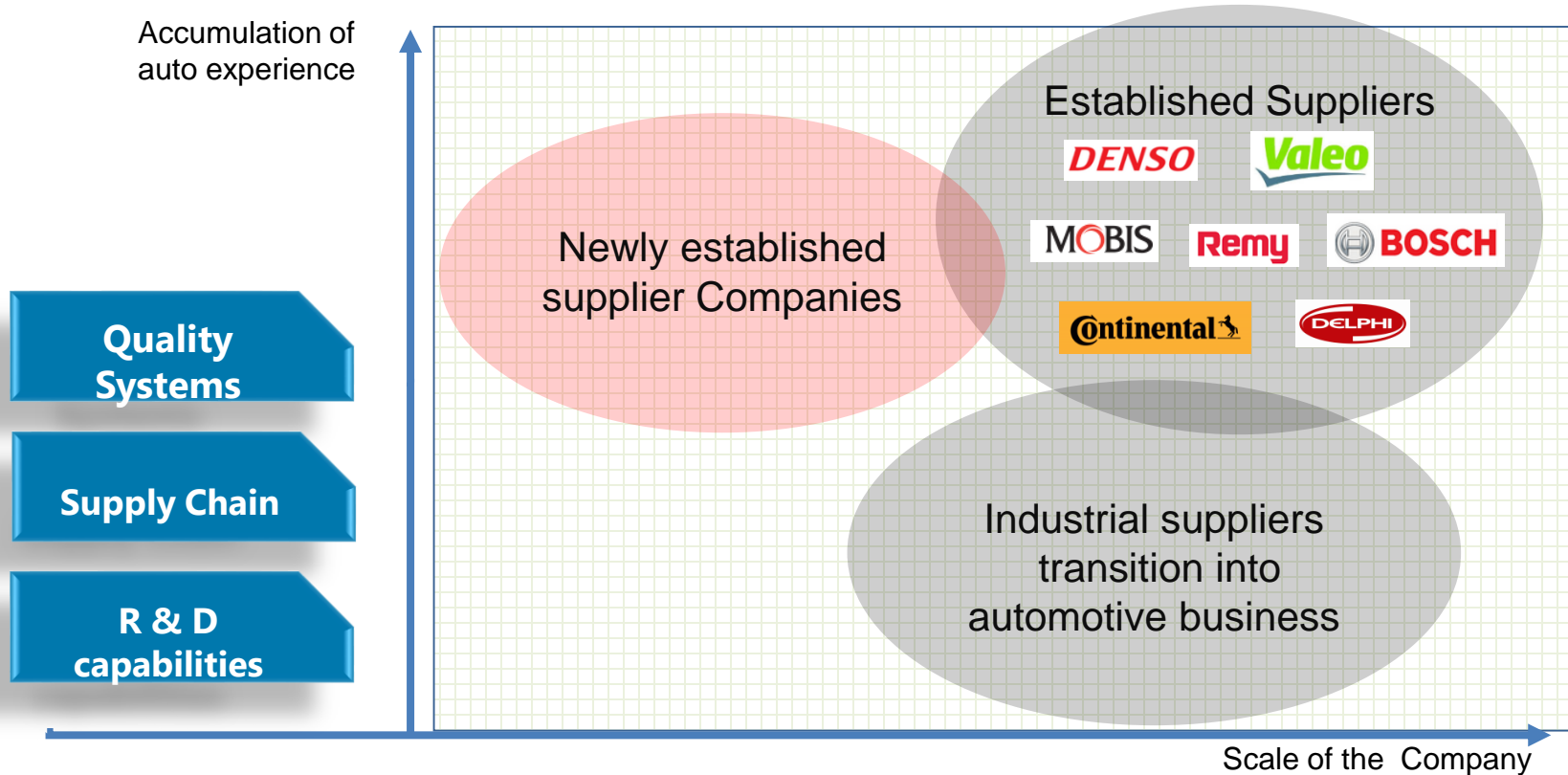


Market penetration of foreign brands is on the rise , the cumulative sales in 2017 accounted for 23% (including HEV)



Source : China Association of Automobile Manufacturers

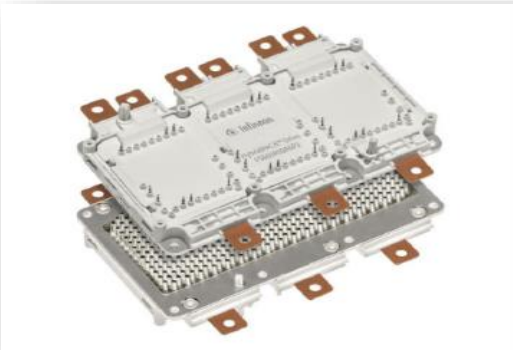
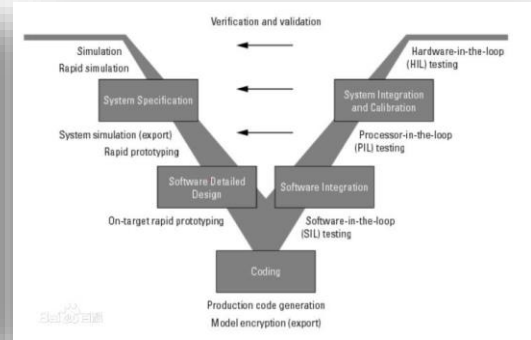
# Competition Landscape for Motor & Power Electronics Suppliers



# Challenges for Chinese NEV Suppliers

## Chinese suppliers lag their foreign competitors in following areas:

- Automotive application experiences
- Product development capabilities
- Core components such as IGBTs and high speed gearbox/transmission
- Intelligent and high quality manufacturing technologies
- Systemic management compatible with automotive industry



# Opportunities for Chinese eDrive Suppliers

- Huge NEV market with large varieties of segments – opportunities to develop products most suitable for Chinese market;
- Close relationship with Chinese OEM and end users;
- Strong government support;
- Readily available capitals;
- Adequate supply chain with low cost capabilities;
- More available rare earth material for PM motors.

# Dajun Company Overview

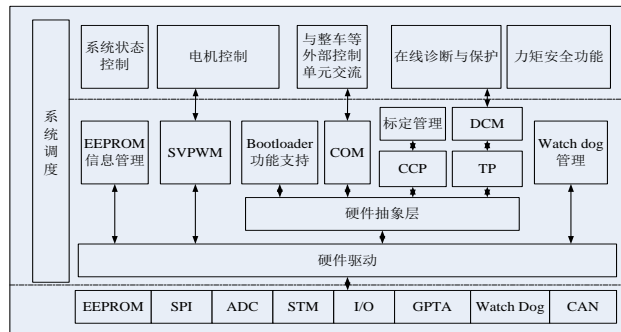
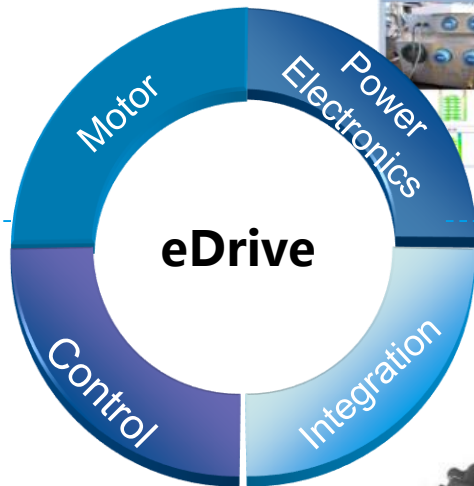
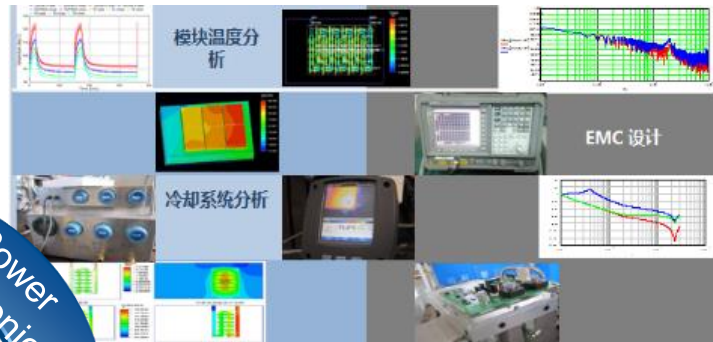
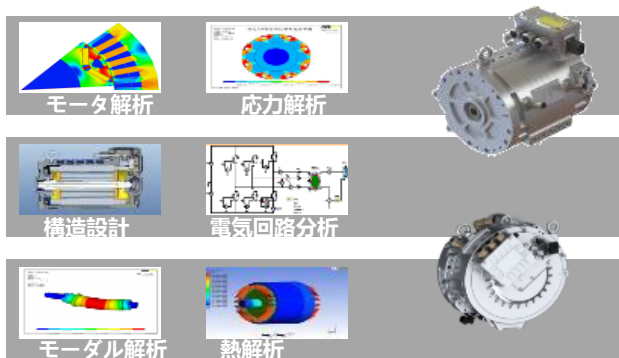
## Mission:

To provide green powertrain for people's mobility.

|                      |                              |
|----------------------|------------------------------|
| <b>Established</b>   | 11. 11. 2005                 |
| <b>Employees</b>     | 600<br>(35% Technical Staff) |
| <b>Main Business</b> | Motor Drives for<br>EV/HEV   |



# Dajun Design Capabilities





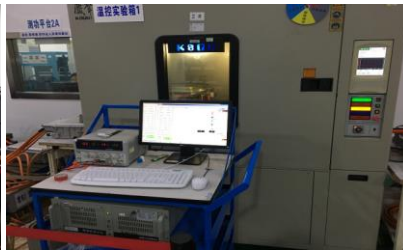
# Test Capabilities



Durability Dyno



Temperature & Power Cycling



Temperature/Humidity Cycling



Vibration/Temp/Power Cycling



Motor Submerge



Controller Submerge



Shock Test



Temperature Shock



Salt Spray

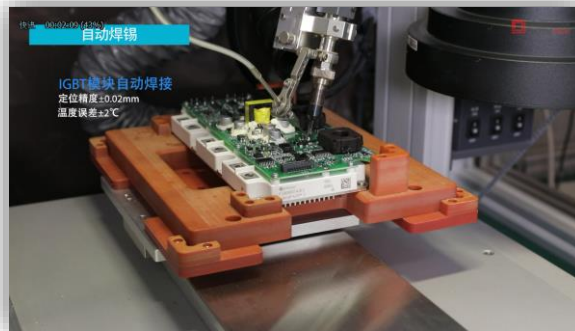
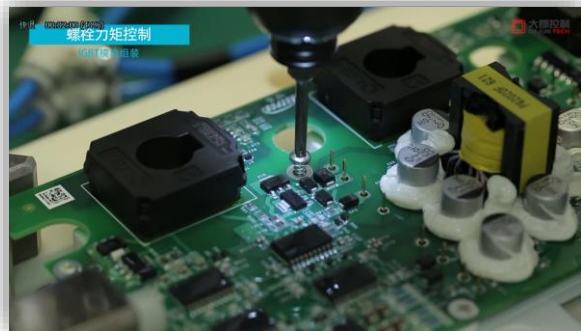


EMC



Noise

# Manufacturing



# Dajun Product Lines – Passenger Car

25KW-150KW

Micro



EV Motor / Inverter



Compact



PHEV Dual Motor



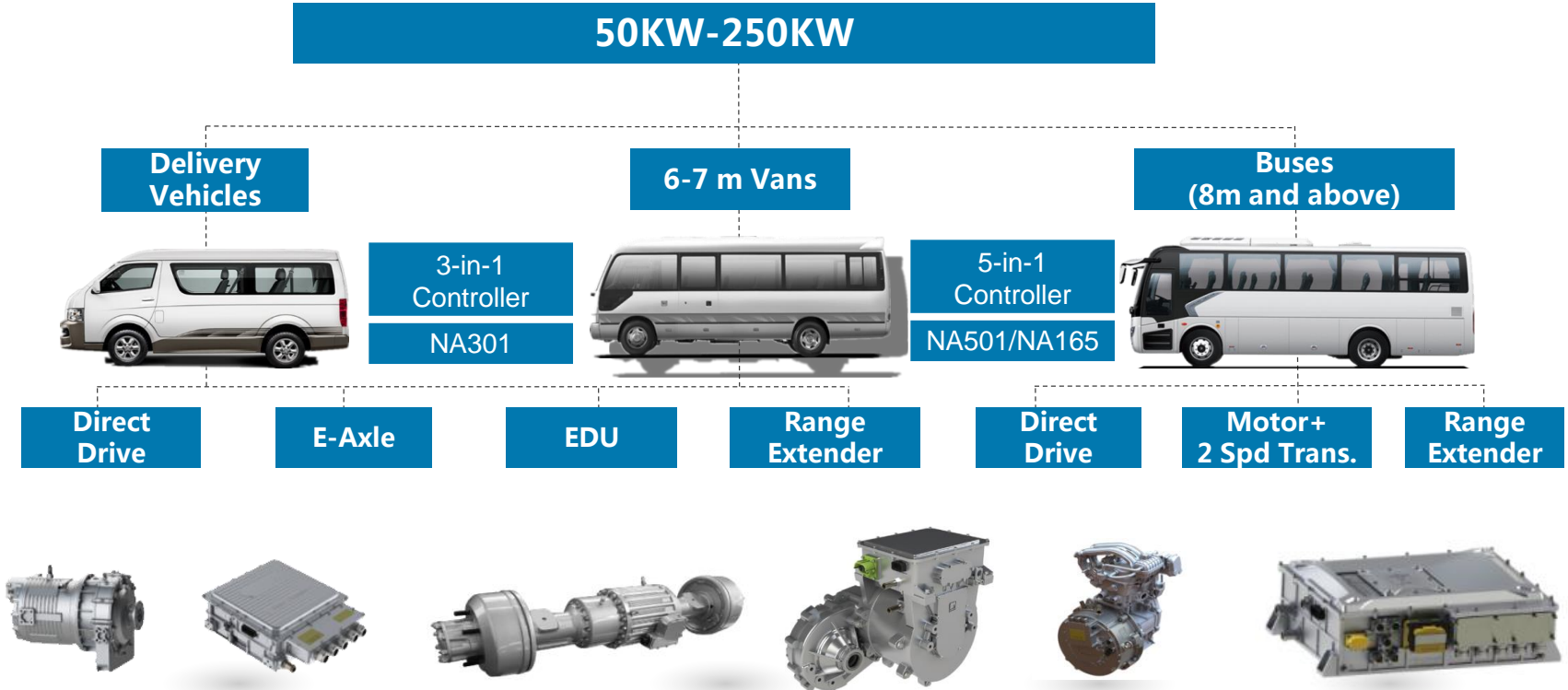
Midsized/MPV



Electric Drive Unit



# Dajun Product Lines – Buses/Commercial Vehicles



# Dajun Customers

Passenger  
cars



Commercial  
Vehicles



# Future is Here



# Thank you for your Attention

Dr. Xingyi Xu

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