NEW ENERGY VEHICLE DEVELOPMENT IN CHINA
- A CHINESE E-DRIVE SUPPLIER'S PERSPECTIVE

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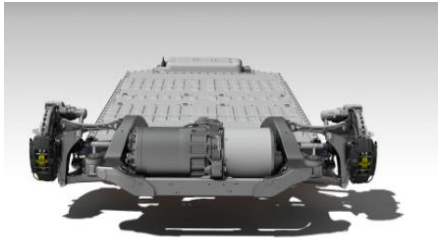
SAE INTERNATIONAL®

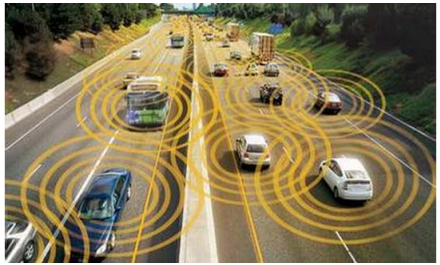
Outlines

Auto Industry Is Experiencing a Revolutionary Change



Electrification

Intelligent



Connectivity

Sharing

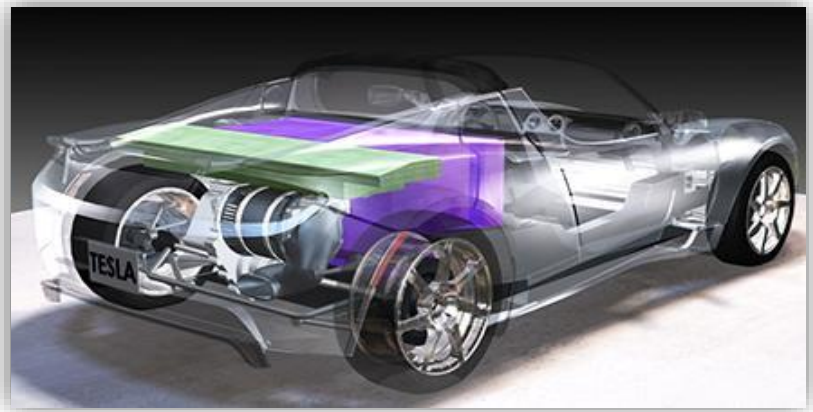
Redefine Auto Industry

Simplified EV Powertrain would facilitate:

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

Broader Opportunity for Vehicle OEMs

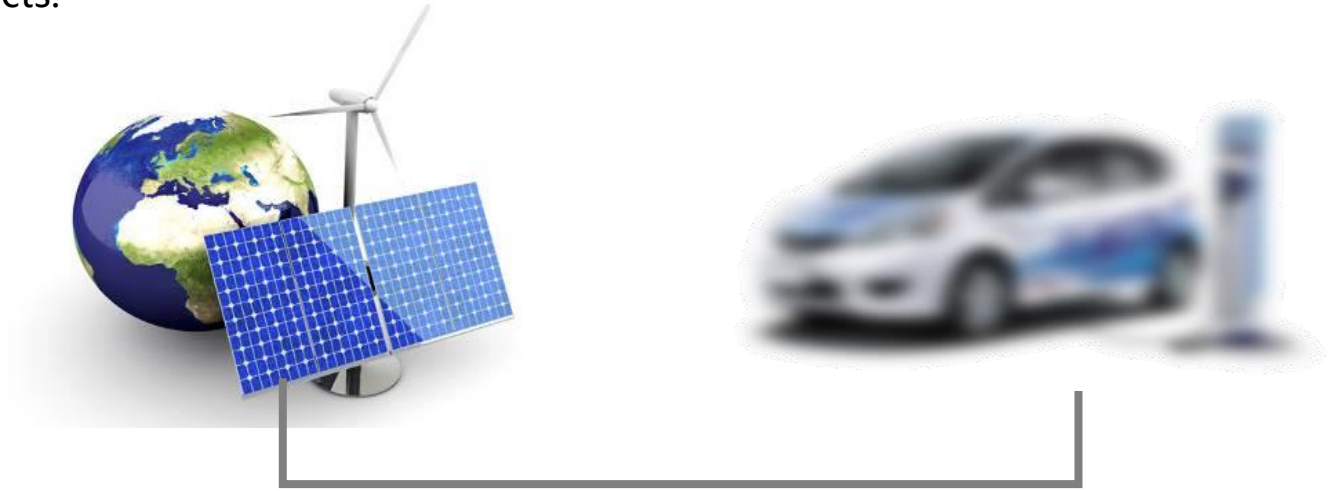
- Personalized products and better consumer experience
- Value-added services during the entire vehicle life



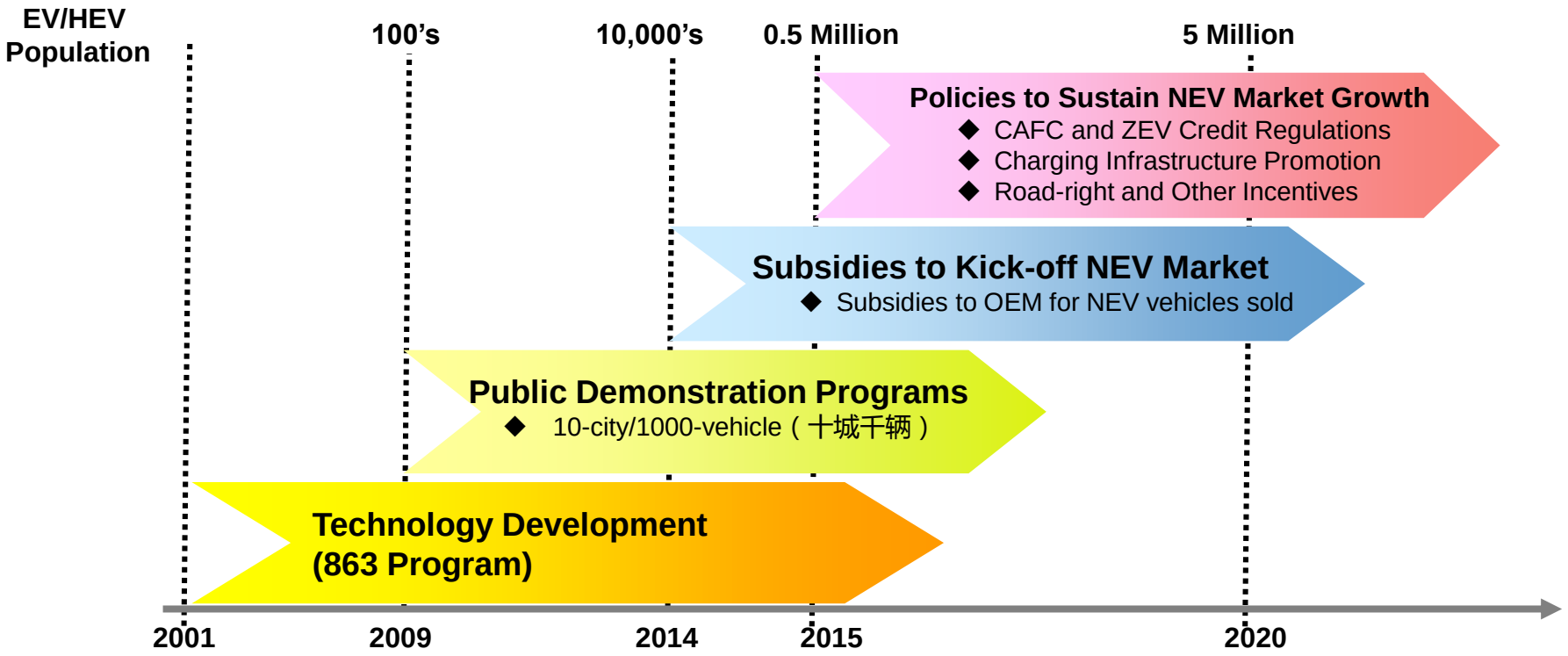
Better Opportunities for Suppliers to Implement Large-scale Automated Production of Standardized Powertrain Components

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.

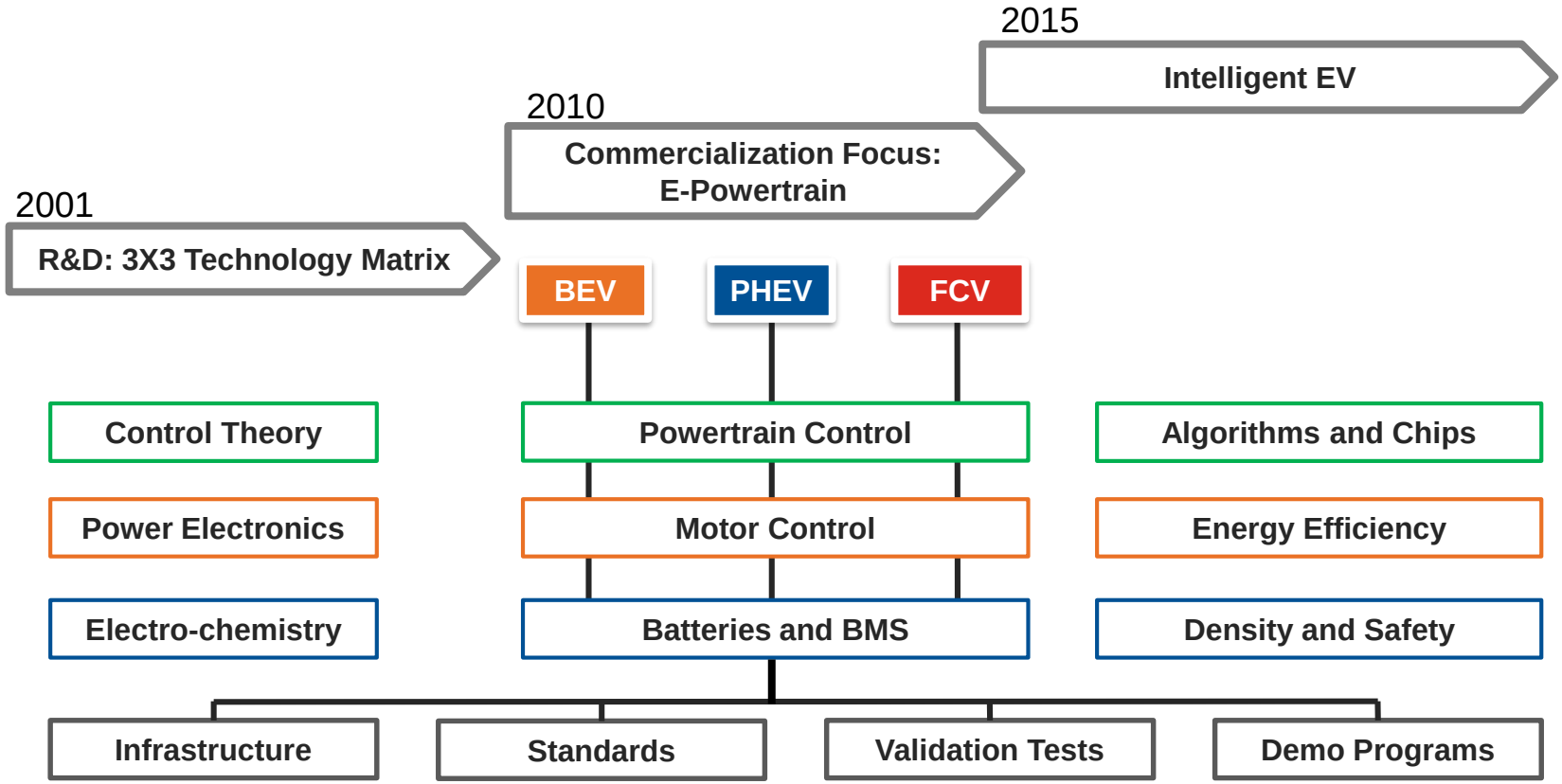


China EV/HEV Development History

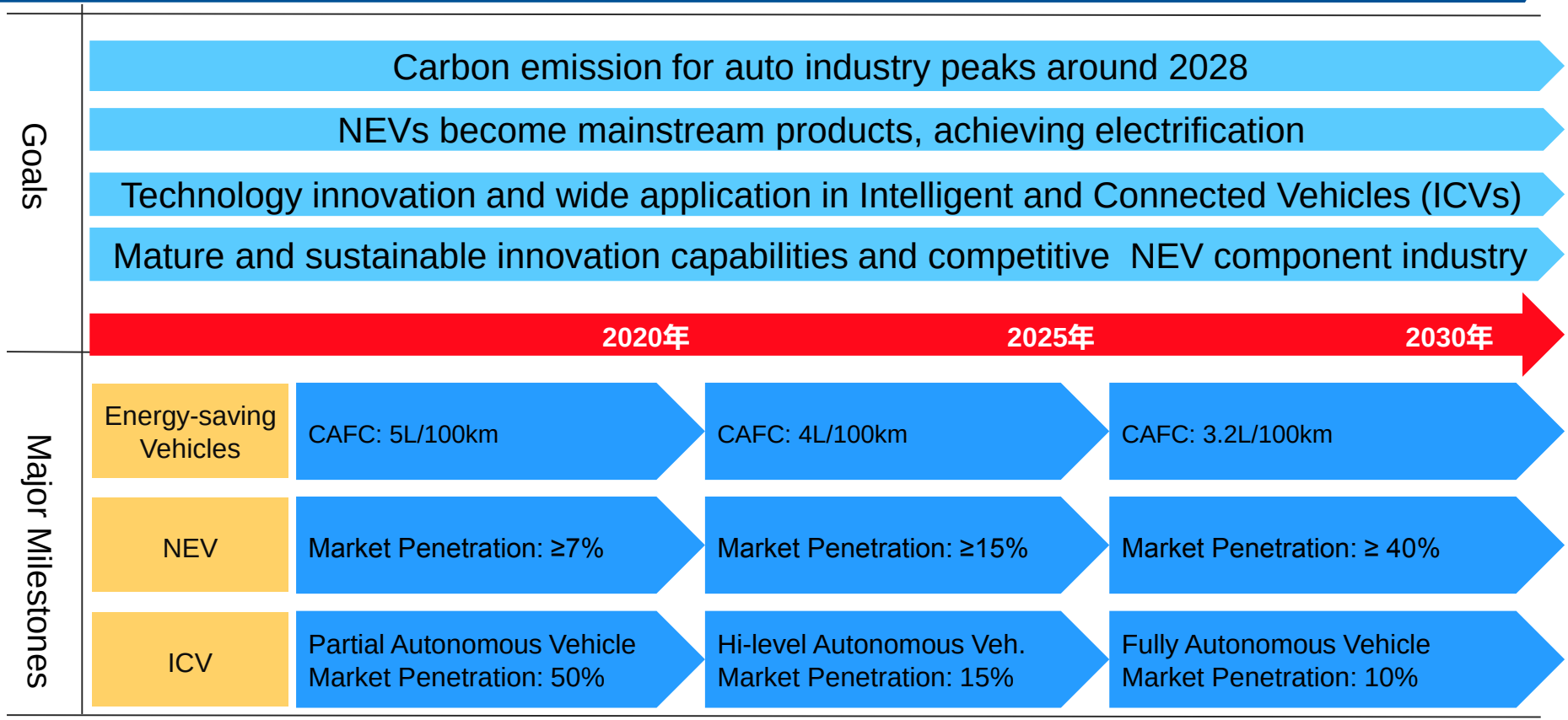


Source: DAJUN Analysis

NEV Technology Development in China



Roadmap by Chinese MIIT



Sources: *Technology Roadmap for Energy-saving and New Energy Vehicles*, by Chinese Ministry of Industry and Information Technology, 2016

Chinese Central Government Subsidies for NEVs (2018/2)

Cars

Veh type	Subsidy by EV Ranges (kRMB/Car)					
EV	150≤R < 200	200≤R < 250	250≤R < 300	300≤R < 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 (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 (¥/kWh)		Multiplier			Upper limit (kRMB/Veh.)		
					6<L≤8 m	8 < L≤10 m	L>10 m
EV Buses (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 (Quick charge)	2100	The charging rate			40	80	130
		3C - 5C	5C - 15C	>15C			
		0.8	1	1.1			
PHEV/ REEV Buses	1500	Fuel-saving rate			22	45	75
		60% - 65%	65% - 70%	>70 %			
		0.8	1	1.1			

China's Subsidies for NEVs – Progressive Changes

		2016	2017	2018
Range	Cars	EV≥100km PHEV≥50km	EV≥100km PHEV≥50km	EV≥150km PHEV≥50km
	Buses	EV≥150km PHEV≥50km	EV≥200km PHEV≥50km	EV≥200km PHEV≥50km
Ekg	EV Buses	0.25 – 0.7	0.24	0.15 – 0.21
Battery Density	Buses		85 – 115 Wh/kg	≥115Wh/kg
	Cars		90 – 120 Wh/kg	105 – 120 Wh/kg: 0.6 120 – 140: 1.0 140 – 160: 1.1 ≥ 160: 1.2
Fuel Savings for PHEV	Cars	≥40%	Non-EV Fuel Consumption ≤70% CAFC	≤65%: 0.5 ≤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	-100%
	150≤R < 200	45	36	15	-58%
	200≤R < 250			24	-33%
	250≤R < 300			34	-23%
	300≤R < 350	55	44	45	2.3%
	350≤R			50	14%
PHEV Cars	50≤R	30	24	22	-8%

Up Limits of Subsidies for EV Buses (kRMB)

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

Chinese Government Incentive Regulations

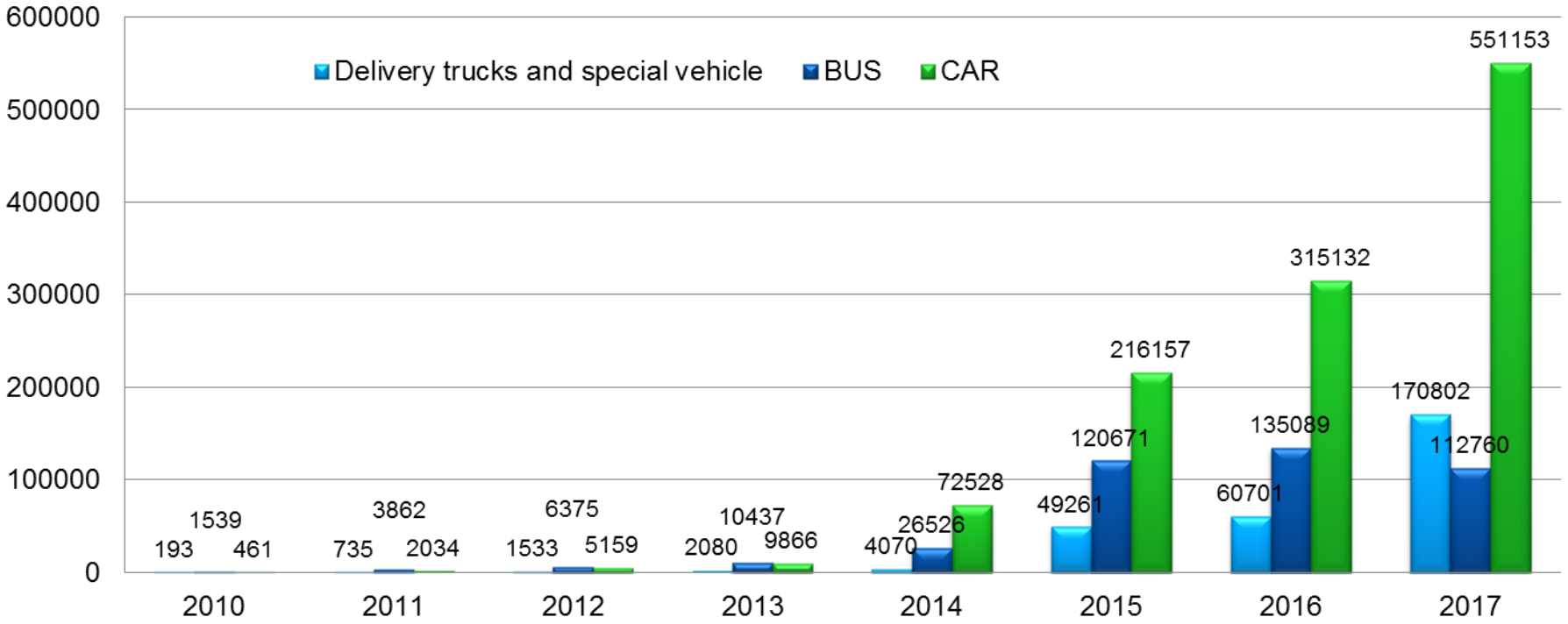
CAFC

年份	CAFC/ $T_{CAFC2020}$	年下降百分点	CAFC L/100km	CAFC 年度下降 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

China NEV Market Growth 2010-2017

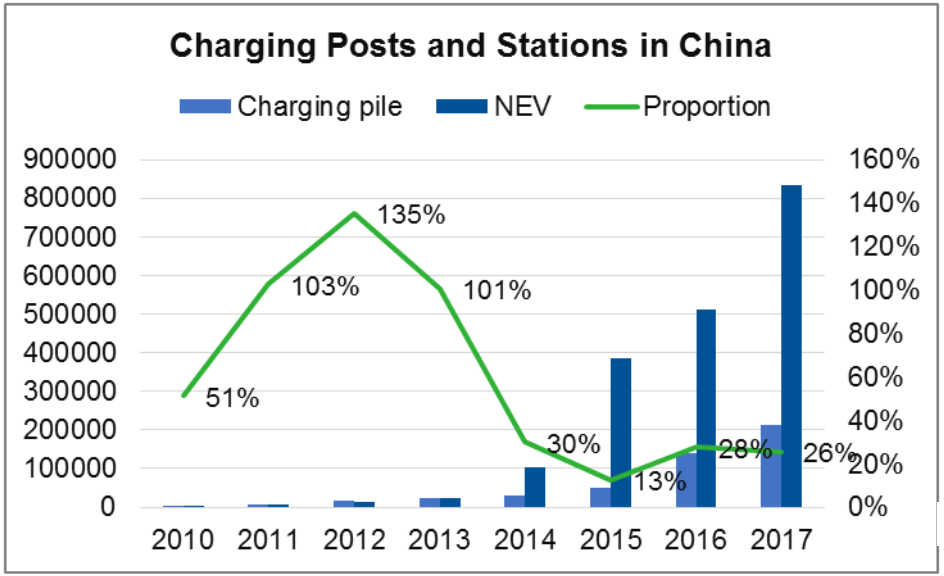


Source：China Association of Automobile Manufacturers

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.



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%

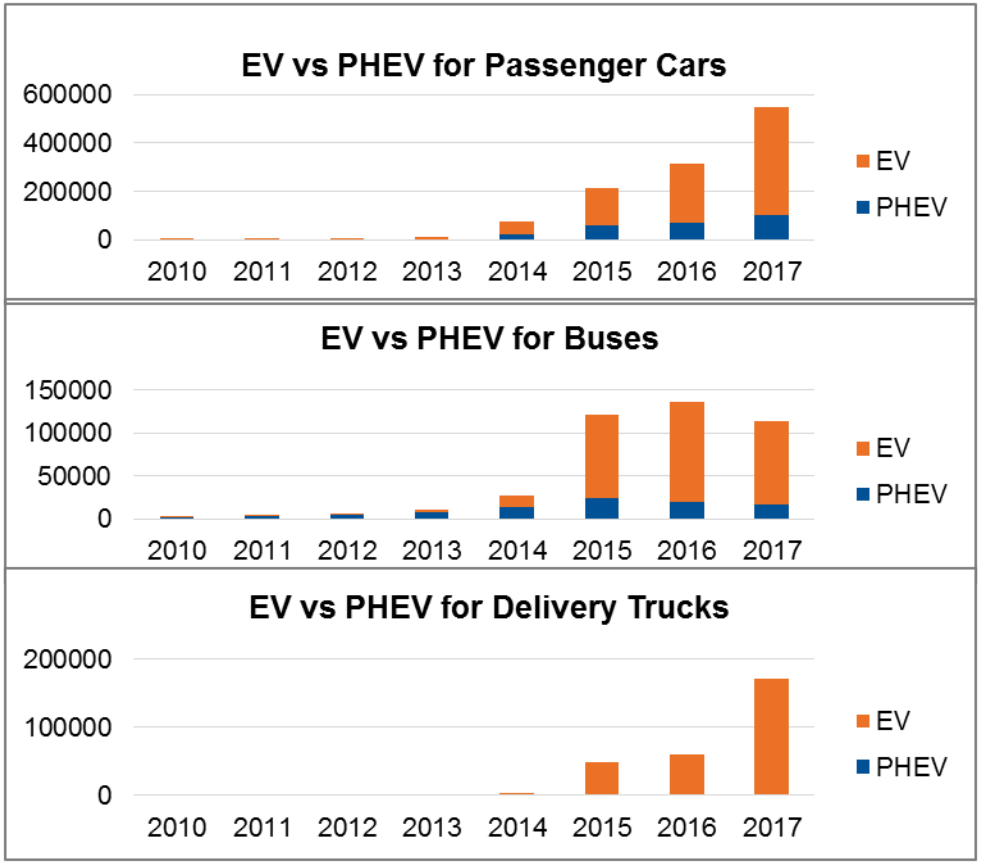
Source: Marklines

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;

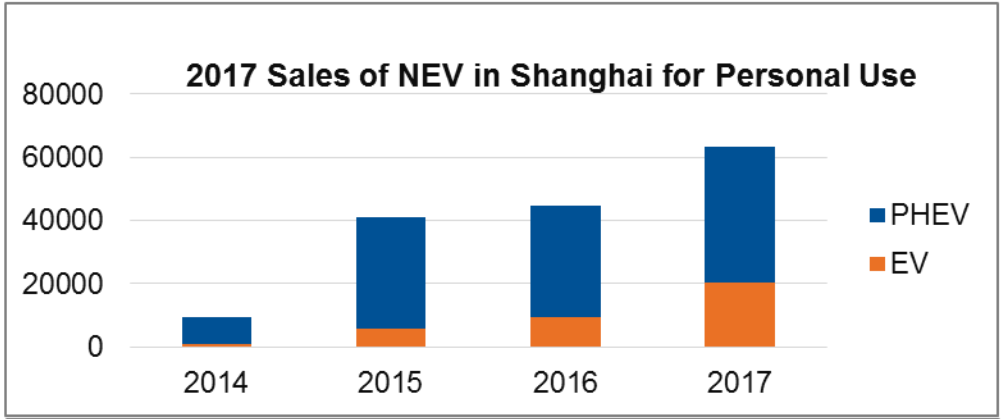
Battery and charging infrastructure are limiting factors

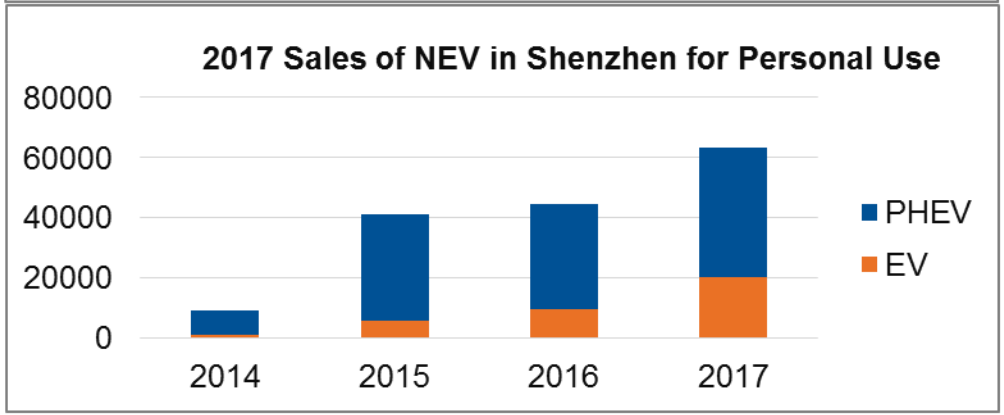


Source ：China Association of Automobile Manufacturers

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

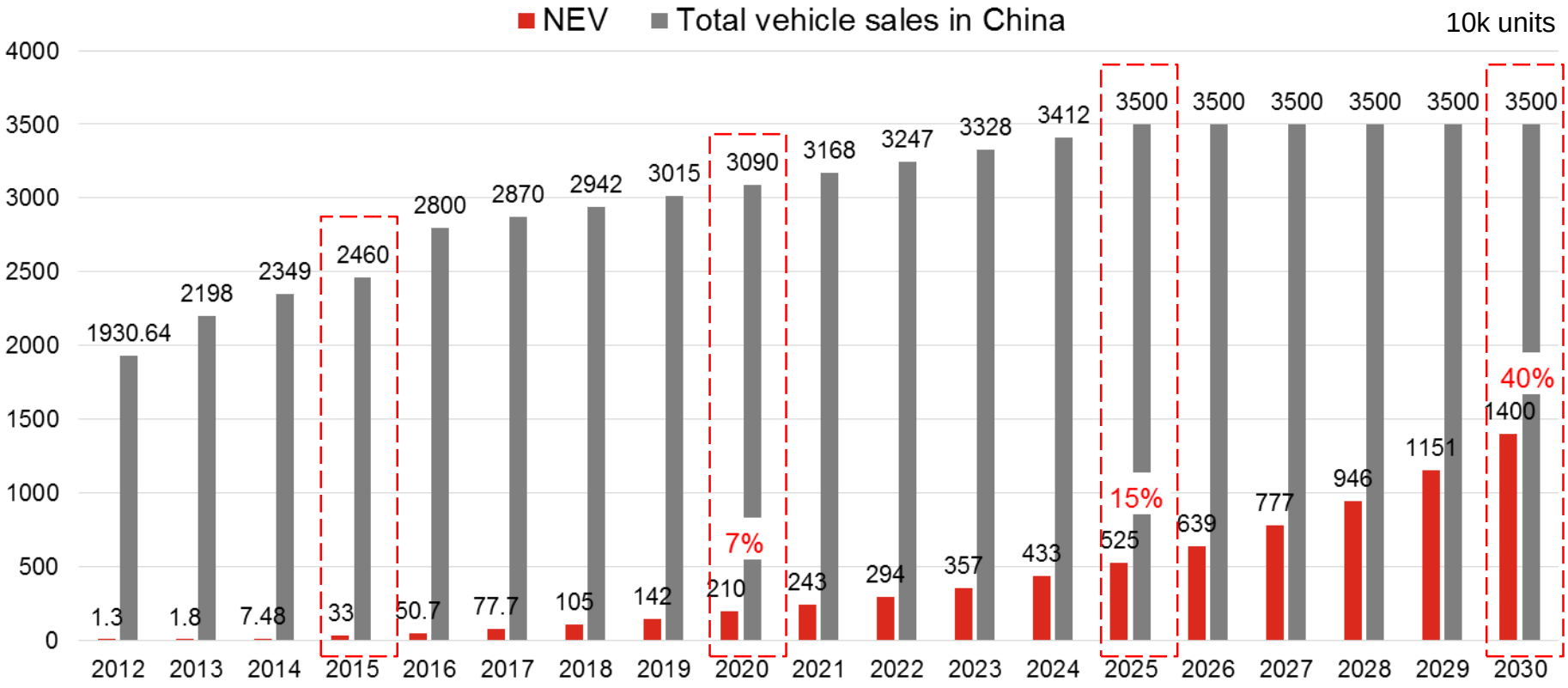
- Fuel economy is slightly inferior to PHEV at high speed cruising

FCV:
- H2 is expected to be the future energy source
- Current R/D focus
- Rapid progress achieved in reliability and cost

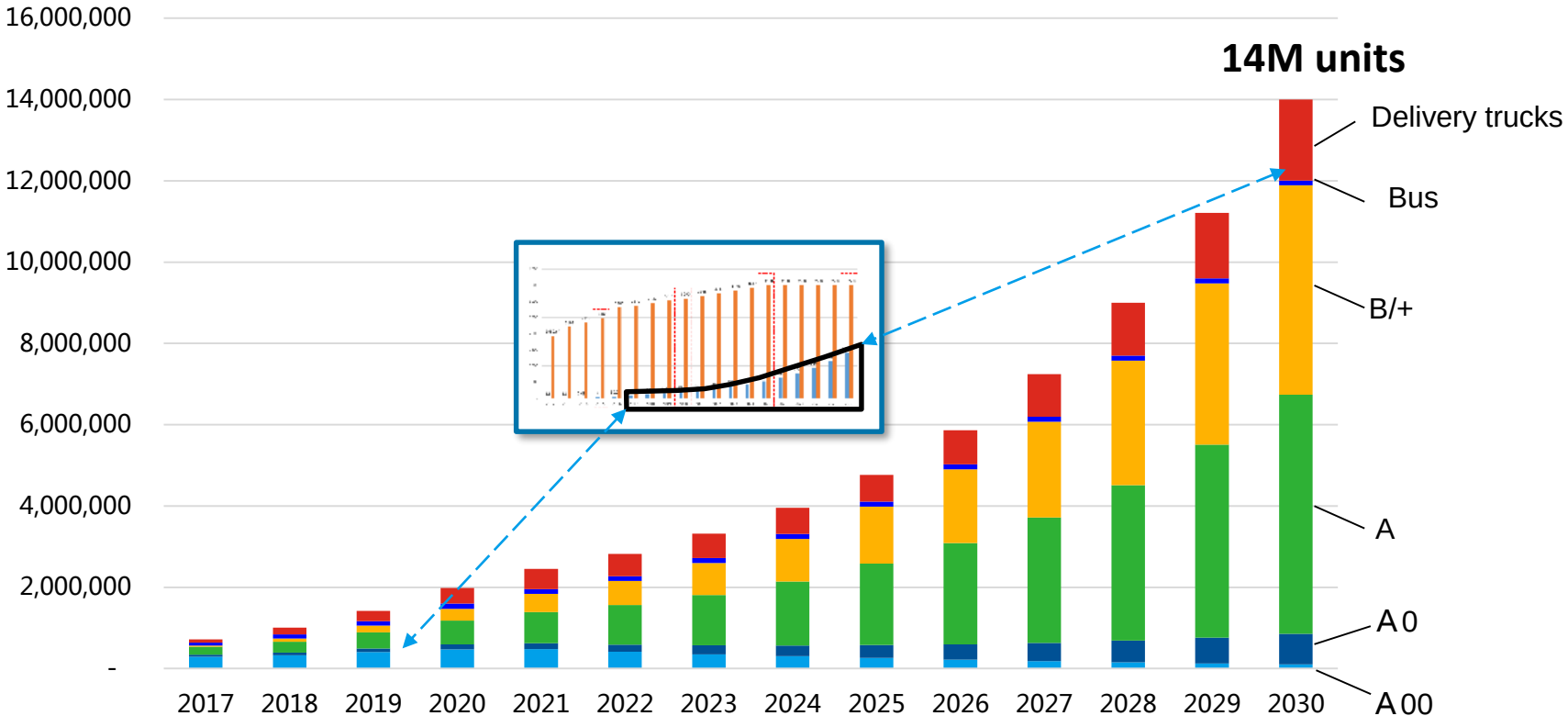
- Need relatively long development time due to H2 infrastructure

EV vs. PHEV in China?

China Auto Market Forecast: 2017-2030

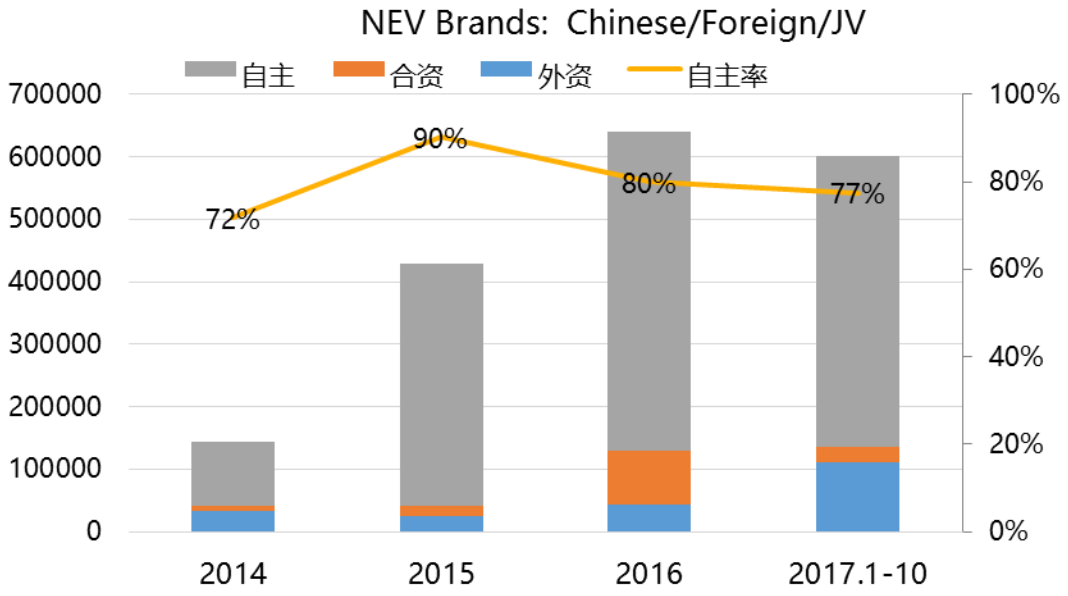


China NEV Market Forecast: 2017-2030



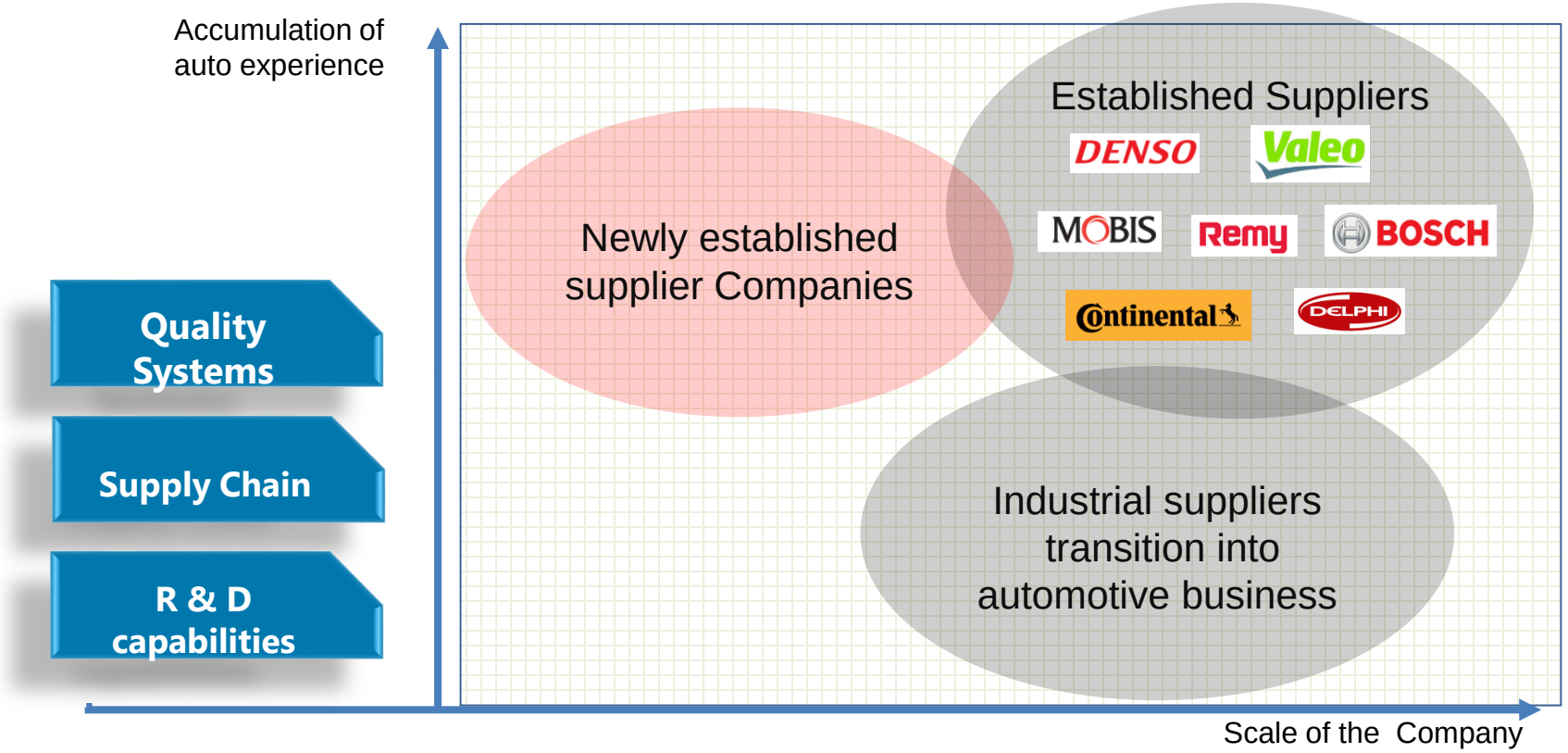
Foreign OEMs Accelerate Penetration into Chinese NEV Market

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

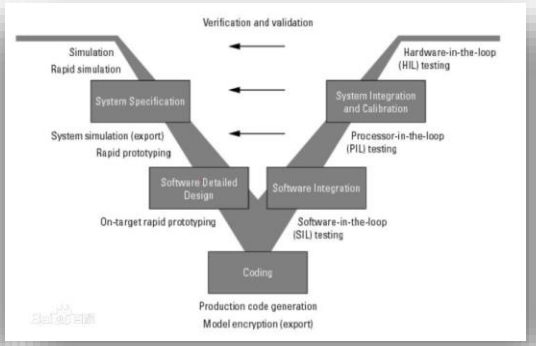
Competition Landscape for Motor & Power Electronics Suppliers

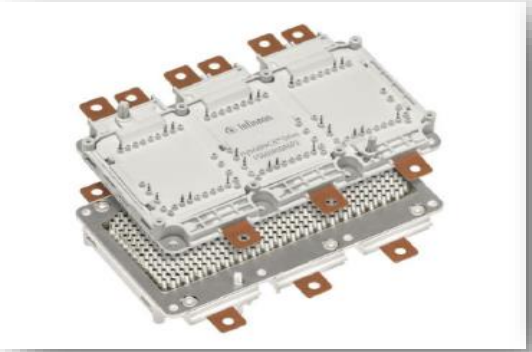


Challenges for Chinese NEV Suppliers

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

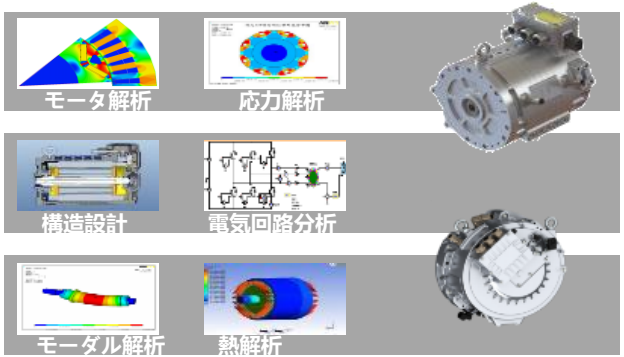
- Huge NEV market with large varieties of segments – opportunities to develop products most suitable for Chinese market;
- Close relationship with Chinese OEM and end users;
- Strong government support;
- Readily available capitals;
- Adequate supply chain with low cost capabilities;
- More available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

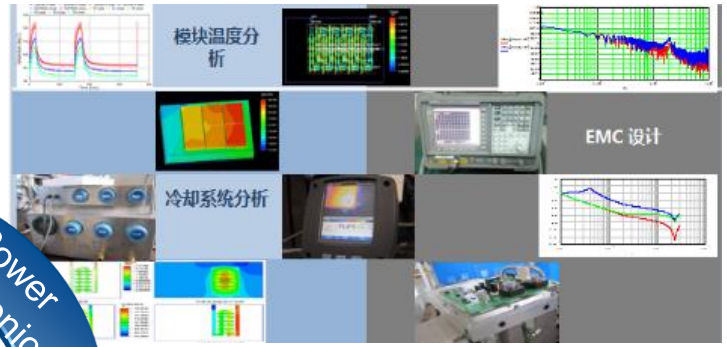
Dajun Company Overview

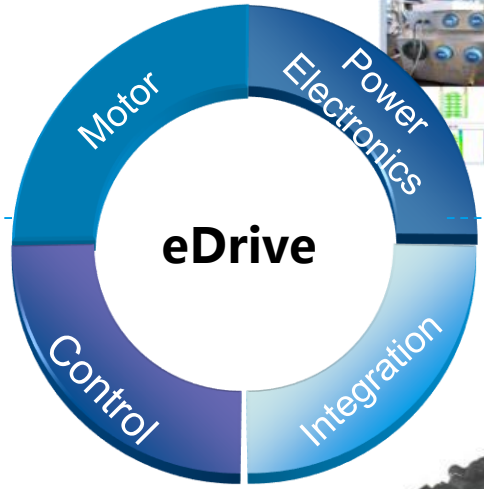
Mission:
To provide green powertrain for people's mobility.

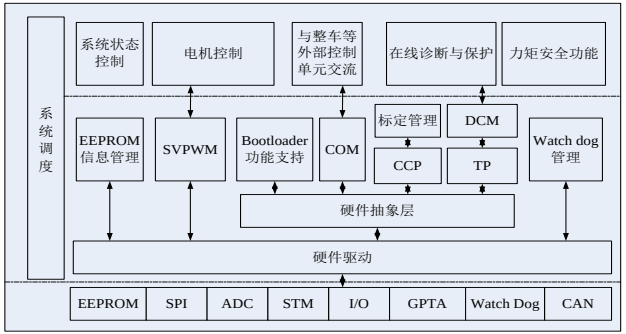
Established	11. 11. 2005
Employees	600 (35% Technical Staff)
Main Business	Motor Drives for EV/HEV

Dajun Design Capabilities

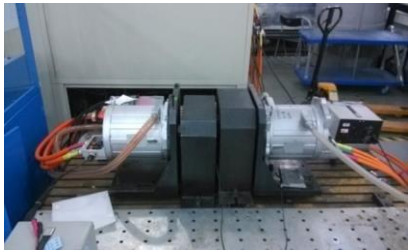






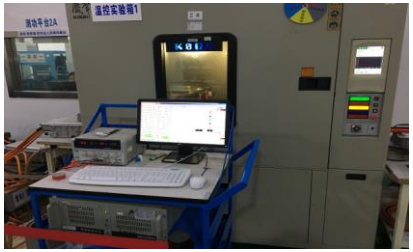


Test Capabilities



Durability Dyno

Temperature & Power Cycling



Temperature/Humidity Cycling

Vibration/Temp/Power Cycling

Motor Submerge

Controller Submerge

Shock Test

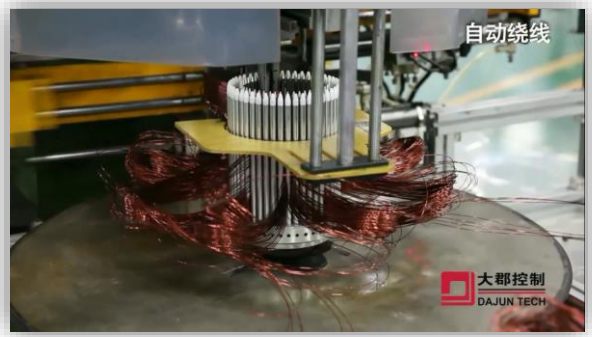
Temperature Shock

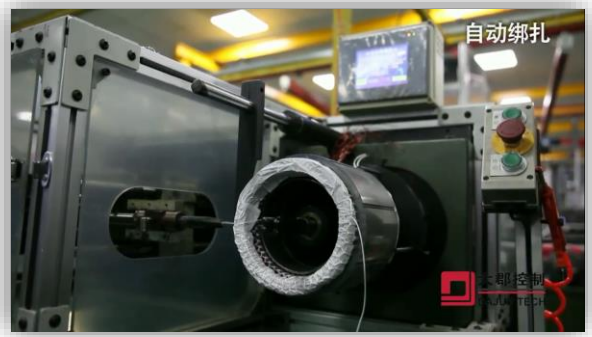
Salt Spray

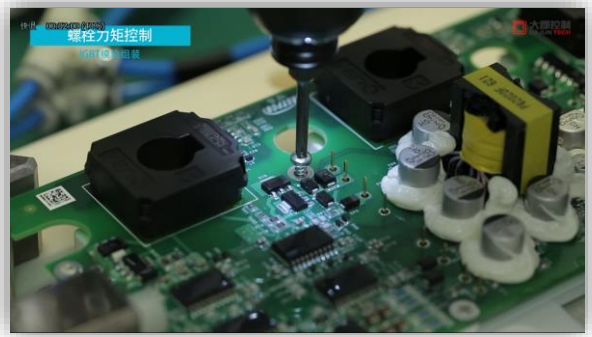
EMC

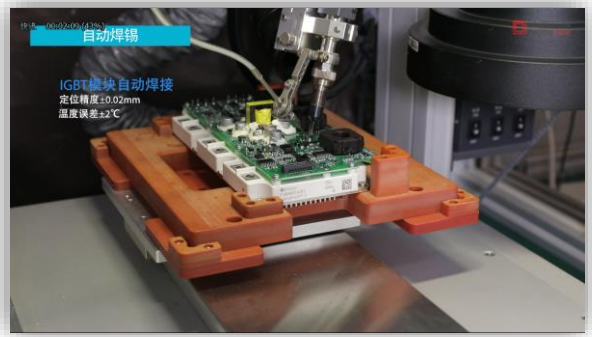
Noise

Manufacturing









Dajun Product Lines – Passenger Car

25KW-150KW

Micro

EV Motor / Inverter

Compact

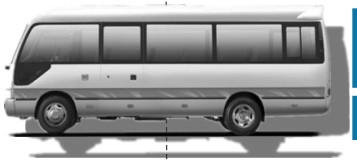
PHEV Dual Motor

Midsize/MPV

Electric Drive Unit

Dajun Product Lines – Buses/Commercial Vehicles

50KW-250KW

Delivery Vehicles	6-7 m Vans	Buses (8m and above)
		
3-in-1 Controller	3-in-1 Controller	5-in-1 Controller
NA301	NA301	NA501/NA165
Direct Drive	E-Axle	EDU	Range Extender	Direct Drive	Motor+ 2 Spd Trans.	Range Extender






Dajun Customers

Passenger cars

北汽集团 BAIC GROUP

广汽集团 GAC GROUP

东风汽车公司 DONGFENG MOTOR CORPORATION

众泰汽车 ZOTYE AUTO

长安汽车

吉利汽车 GEELY AUTO

上汽集团 SAIC MOTOR

Commercial Vehicles

金龙客车 KING LONG

金旅客车 GOLDEN DRAGON

中通客车

FOTON 福田汽车

广通客车 GRANTON BUS

申沃客车 SUNWIN

恒通客车 HENGTONG

Future is Here

Thank you for your Attention

Dr. Xingyi Xu

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