Electrify Europe: China's E-Mobility is Moving from the Introduction Phase to the Development Period

Sarah Fairhurst

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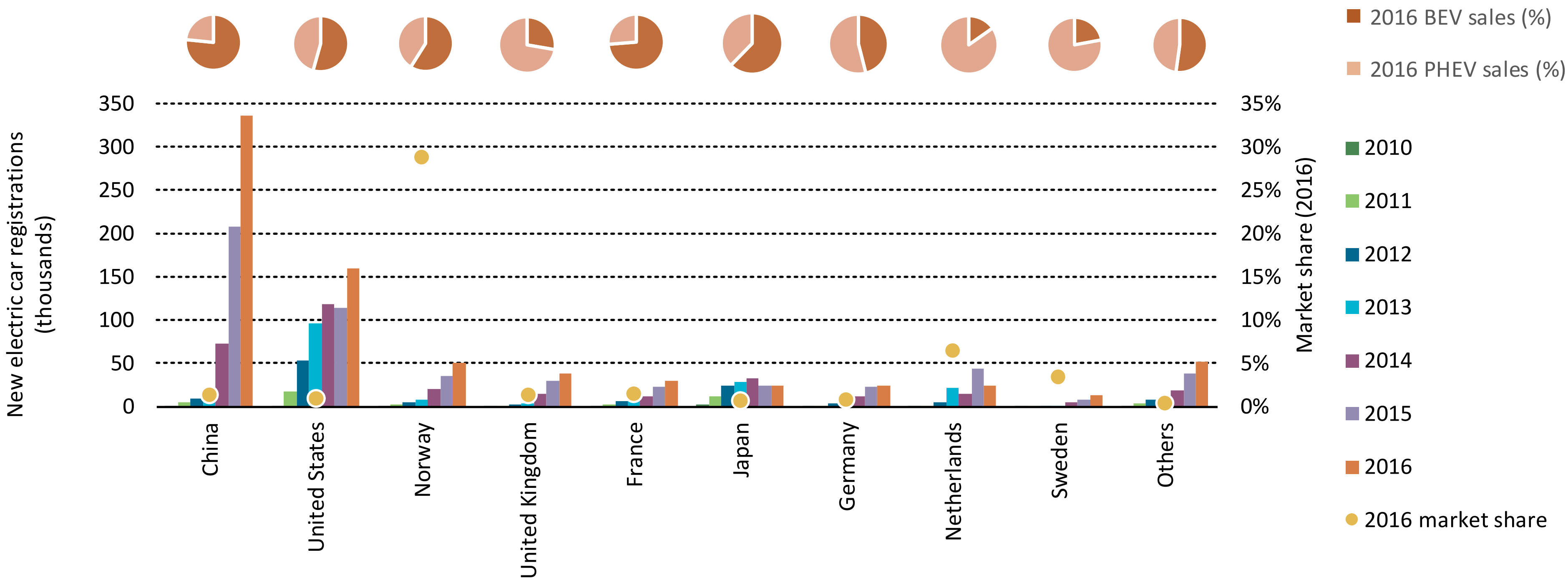
Why China?

- China is leading the world in EV sales – with around half of the sales globally in 2016
- And is growing faster than anyone else



What's driving this, and will it continue as subsidies are wound back?

1 Source: IEA Global EV Outlook 2017

What's happening behind the headlines?

China Wants to Become the Detroit of Electric Cars
Digital Originals - Bloomberg QuickTake
March 6th, 2018, 5:07 AM GMT+0800

Competition to help grow Electric Vehicle market - Chinese BYD
Auto News - Published on Wed, 02 May 2018

Can China's electric cars kill off petrol?

E-mobility in China: Chance or daydream?

China's Didi sets up electric car-sharing platform
3 MIN READ
Reuters Staff

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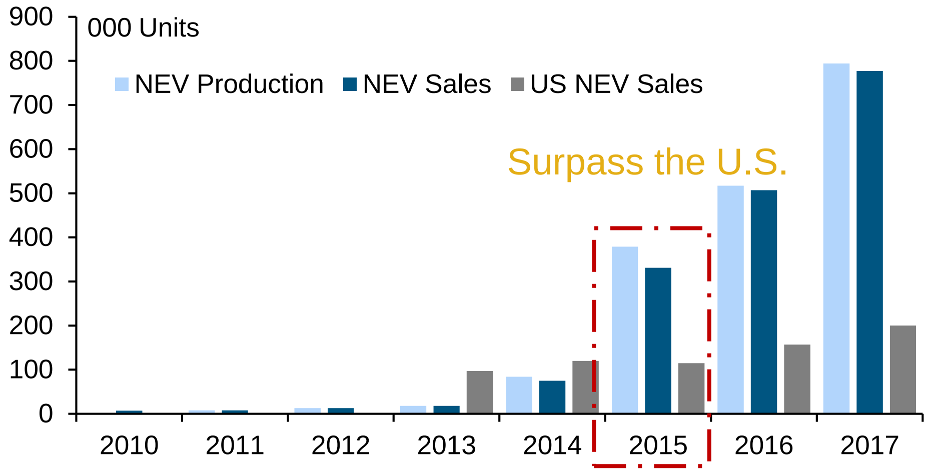
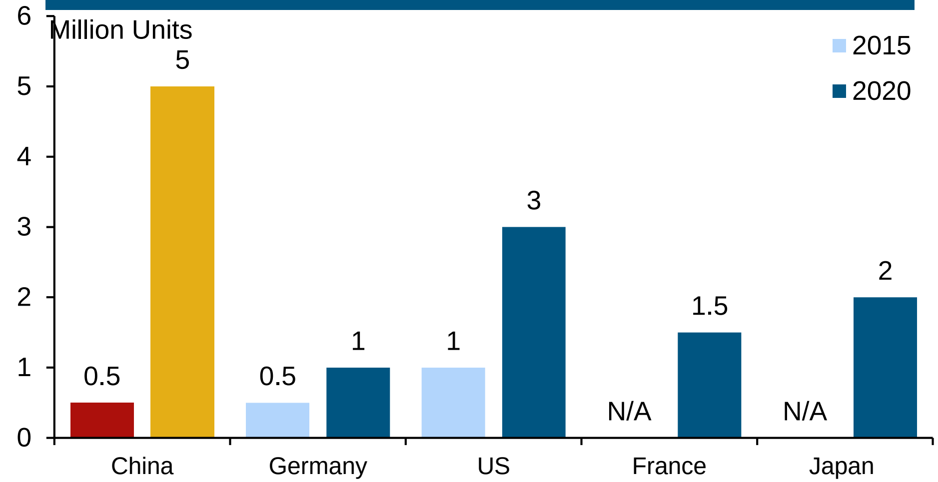
In short – a LOT of growth

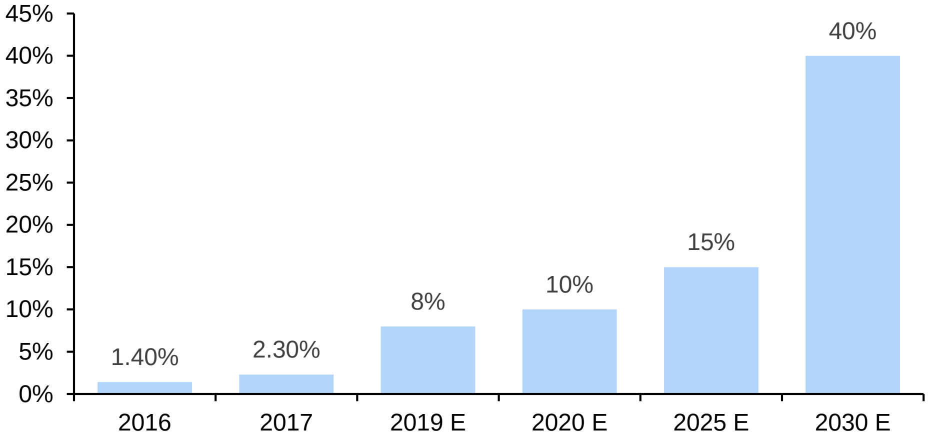
China Surpassed the U.S. in 2015



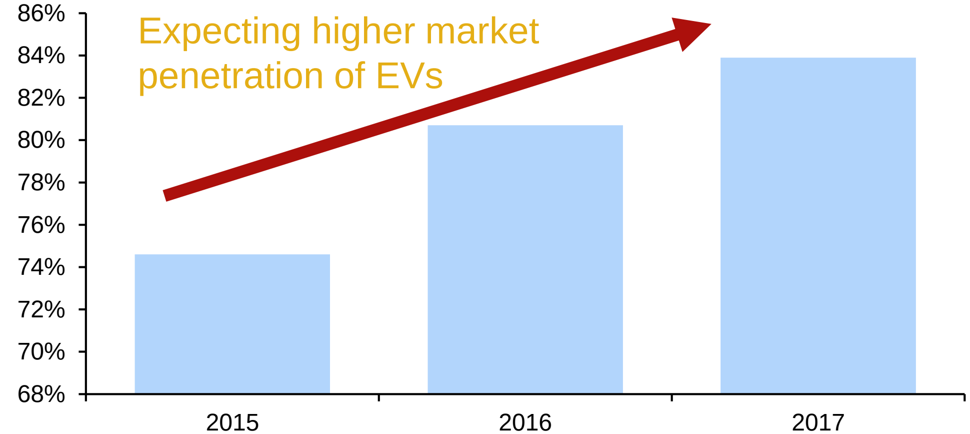
Total Sales Targets



NEV Market Shares in the Chinese Auto Market



Electric Vehicle in the Chinese NEV Market



 Source: TLG Analysis, EV Volumes, National Development and Reform Commission, People's Daily, JRJ, Sohu, Auto China

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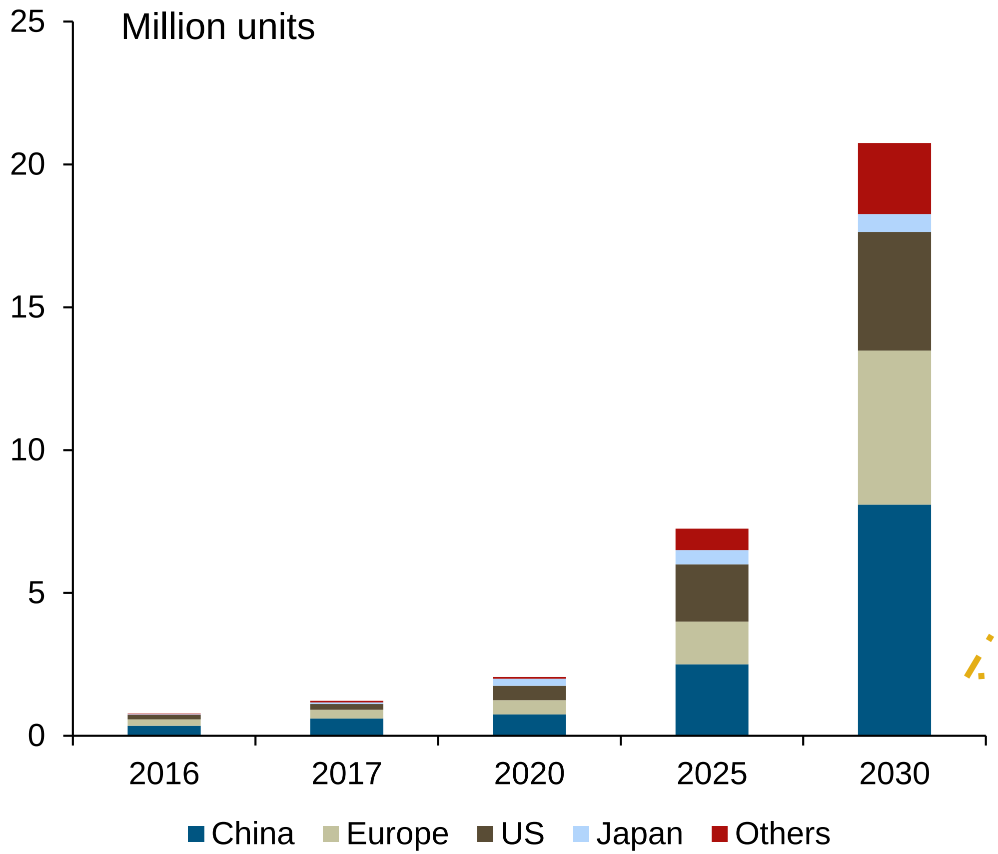
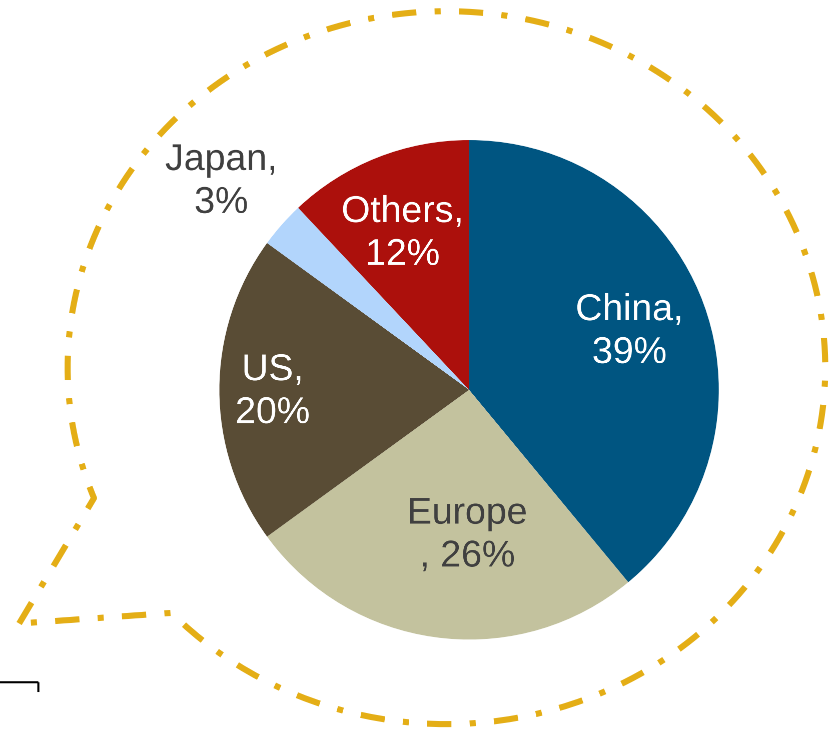
More than 20 million sales by 2030 with China leading the game

Sales from 2016 to 2030



Shares of the Global Market in 2030



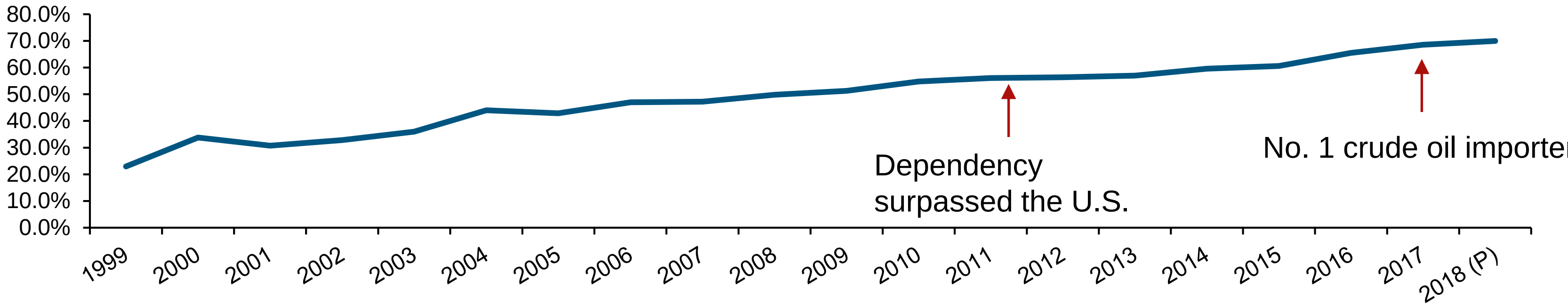
In this presentation we are going to take a deeper dive into the Chinese EV market, from our viewpoint right next door in HK (And yes, it helps to have staff who can read the Chinese policies in their native language!)

 Source: TLG Analysis, BNEF, EVVolumes

But why???

- Drivers of EV in China are not the same as Europe
- Most Chinese consumers show little interest in global environmental issues - they **want a car**
- Chinese Government cares about air **pollution** – Sox, nox and particulates
- But importantly, they also care a about **oil security** and EV policy is one part of the strategy to tackle reliance on imported oil products
  - Vehicles in China consume 1/3 of the crude oil
  - Increasing dependency on foreign oil

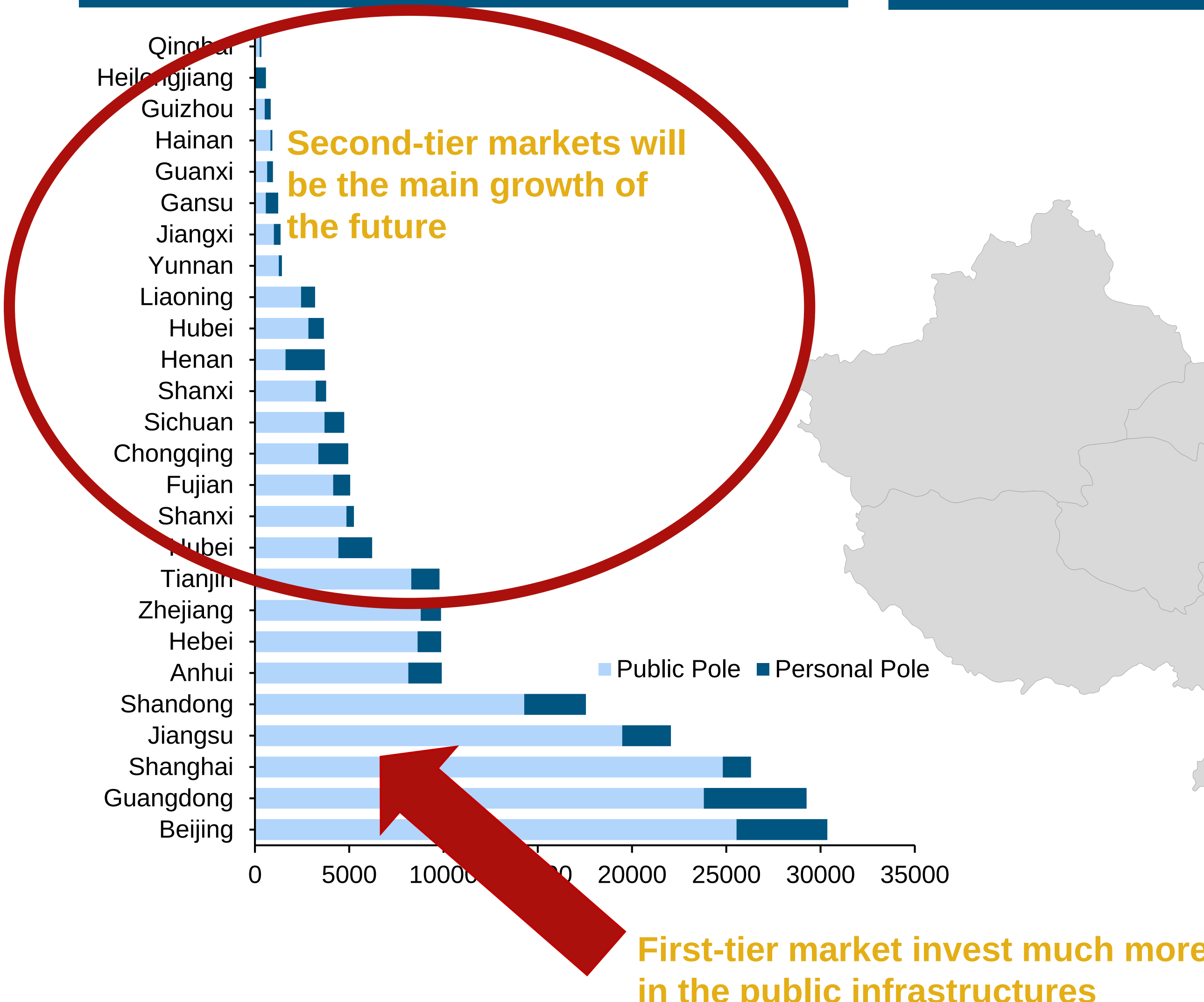
Dependency on foreign oil ratio (increasing)



 Note: Dependency on foreign oil ratio is the percentage of crude oil import out of total consumption
Source: CNPC

But when you think about China… it's a bit like assuming "Europe" is one country: Different regions are moving at very different speeds

Charging Facilities by Province in 2017



Most Sales are Concentrated by the Major Producers

 Source: TLG Analysis, EVCIPA, OFweek

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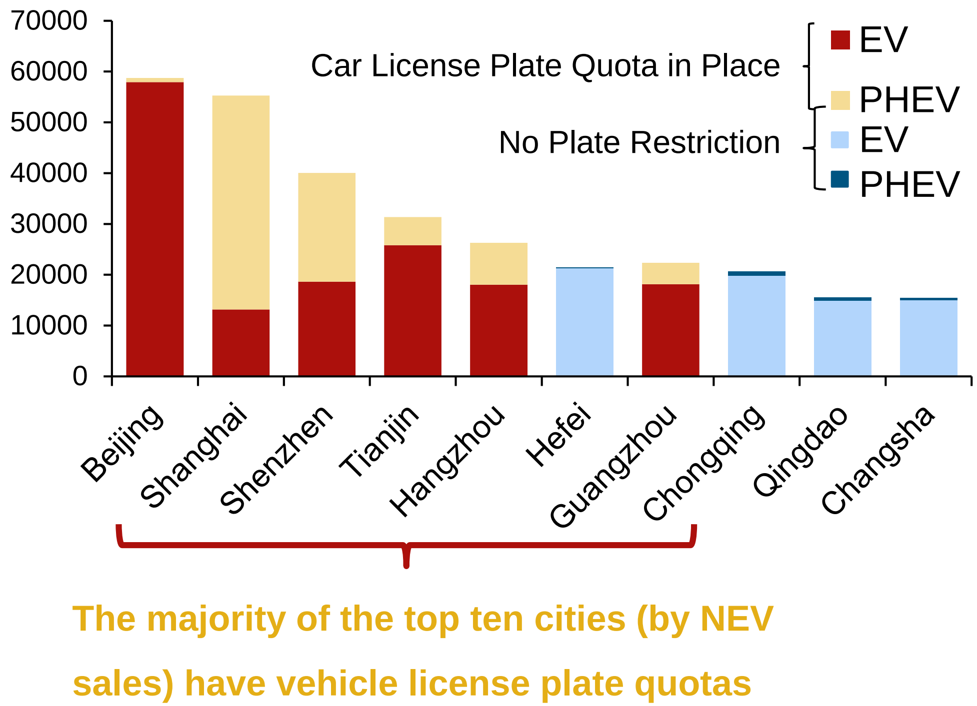
Government support still plays a significant role, and it varies by location

Electric Vehicle (EV) Vs. Plug-in Hybrid Electric Vehicle (PHEV) Market Shares by Sales in Top Ten Cities



- In many cities you must compete for a license plate to get a car
- In Beijing, the available quota for a conventional car is 843 people per plate. For an EV, it's 3.5.
- This drives popularity of Electric Vehicles (EVs):
  - EVs generally receive more subsidies than plug-in hybrid electric vehicles (PHEVs)
  - In Beijing, only EVs receive subsidies
  - In Shanghai, PHEVs are more popular since small PHEVs receive extra subsidies

The industry projects that EVs will continue the dominancy as technologies advance; however, with heavy government support, it's yet too early to tell if the market actually prefers Electric Vehicles (EVs)

Source: OFweek

Chinese NEV buyers have a strong preference for smaller cars

A00

A0

- A00: Wheelbase 2-2.2m
  - Engine Capacity <1.0 L
- A0: Wheelbase 2.3-2.45m
  - Engine Capacity 1-1.6L
- A: Wheelbase 2.45-2.65m
  - Engine Capacity 1.6-2.0L
- B: Wheelbase 2.6-2.75m
  - Engine Capacity 1.8-2.4L
- C: Wheelbase 2.7-2.8m
  - Engine Capacity 2-3.0L
- D: Wheelbase 2.8m+
  - Engine Capacity >3.0L

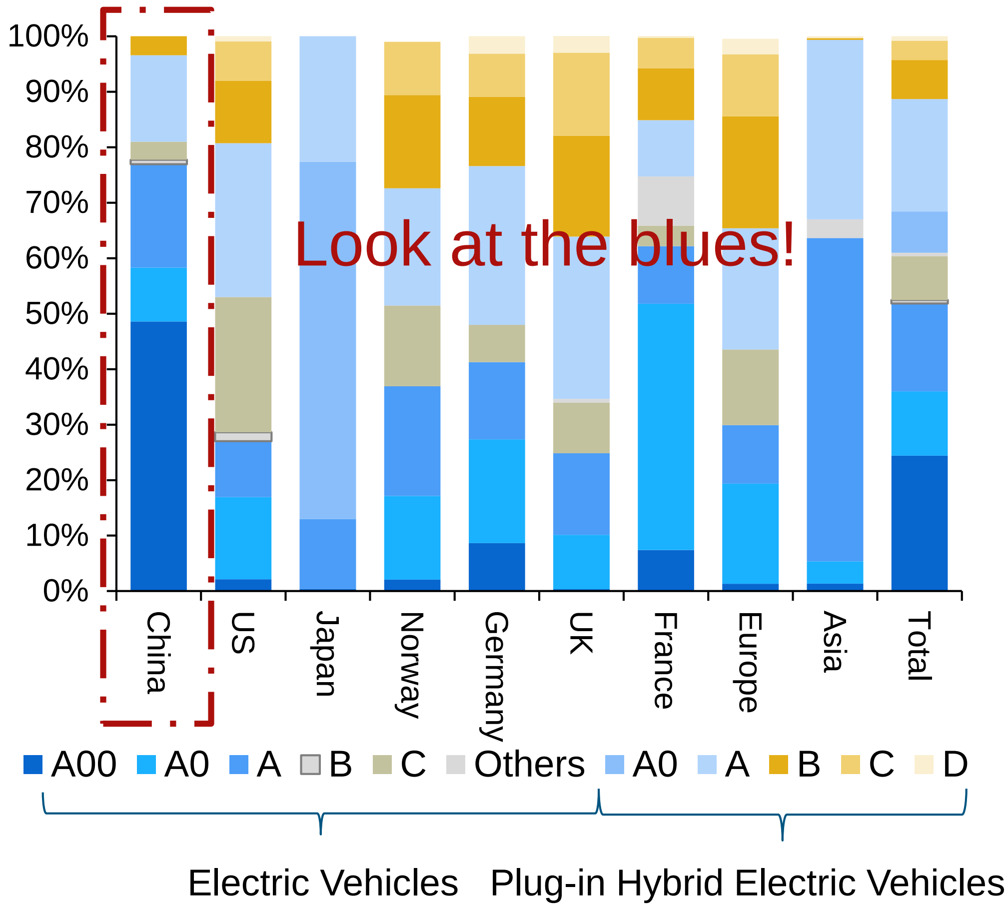
C

D

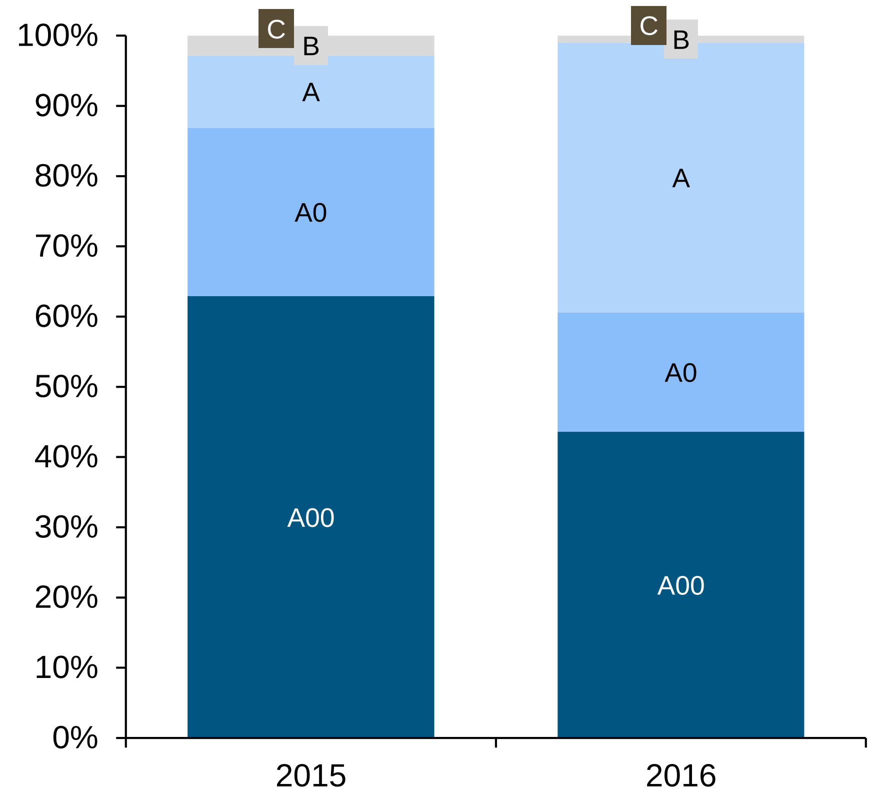
 Image source: Vladimir Kramin/123rf.com, lex Varlakov/123rf.com, rawpixel/123rf.com

And these differences in car preference are unlikely to change because changes in subsidy regimes are also supporting a drive to small cars

Global Market Shares in 2017



Electric Vehicle Market Shares in China



 Source: TLG Analysis, D1EV, CPCA

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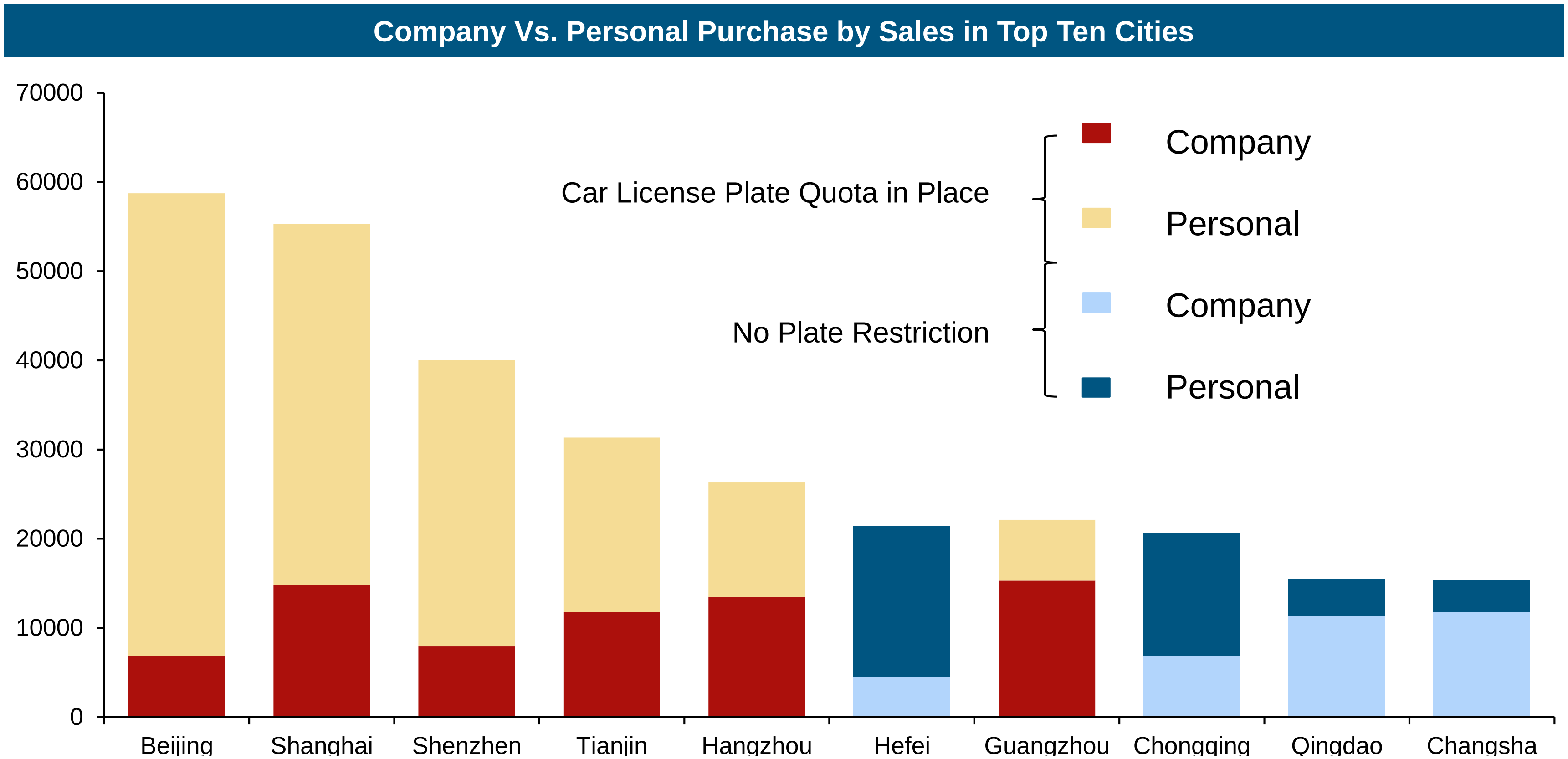
But with reducing subsidies we see more personal purchases that are less policy-driven and more market-reflective



The growth of personal purchases shows the general public is accepting the concept of NEVs

 Source: OFweek

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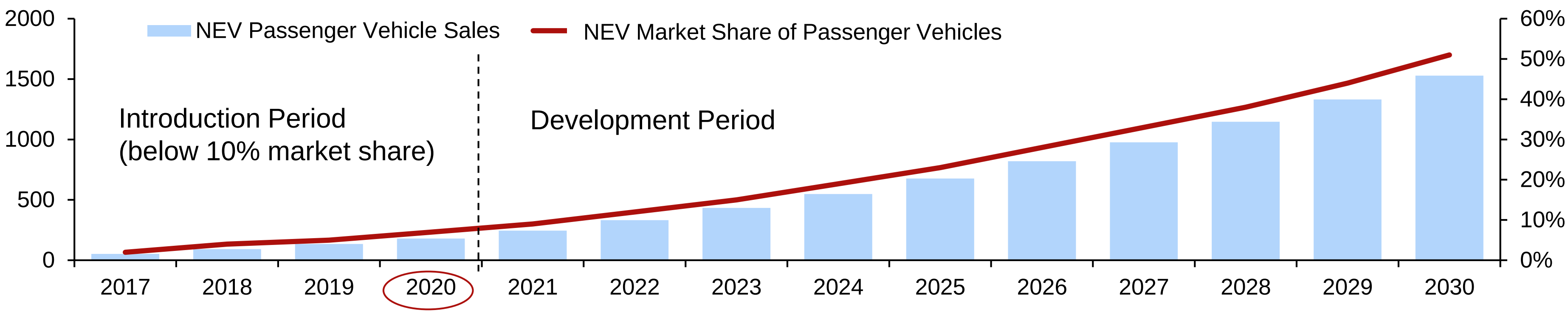
A consensus market projection sees the growth continuing beyond subsidies, but with more innovation and increasingly cost competitive products

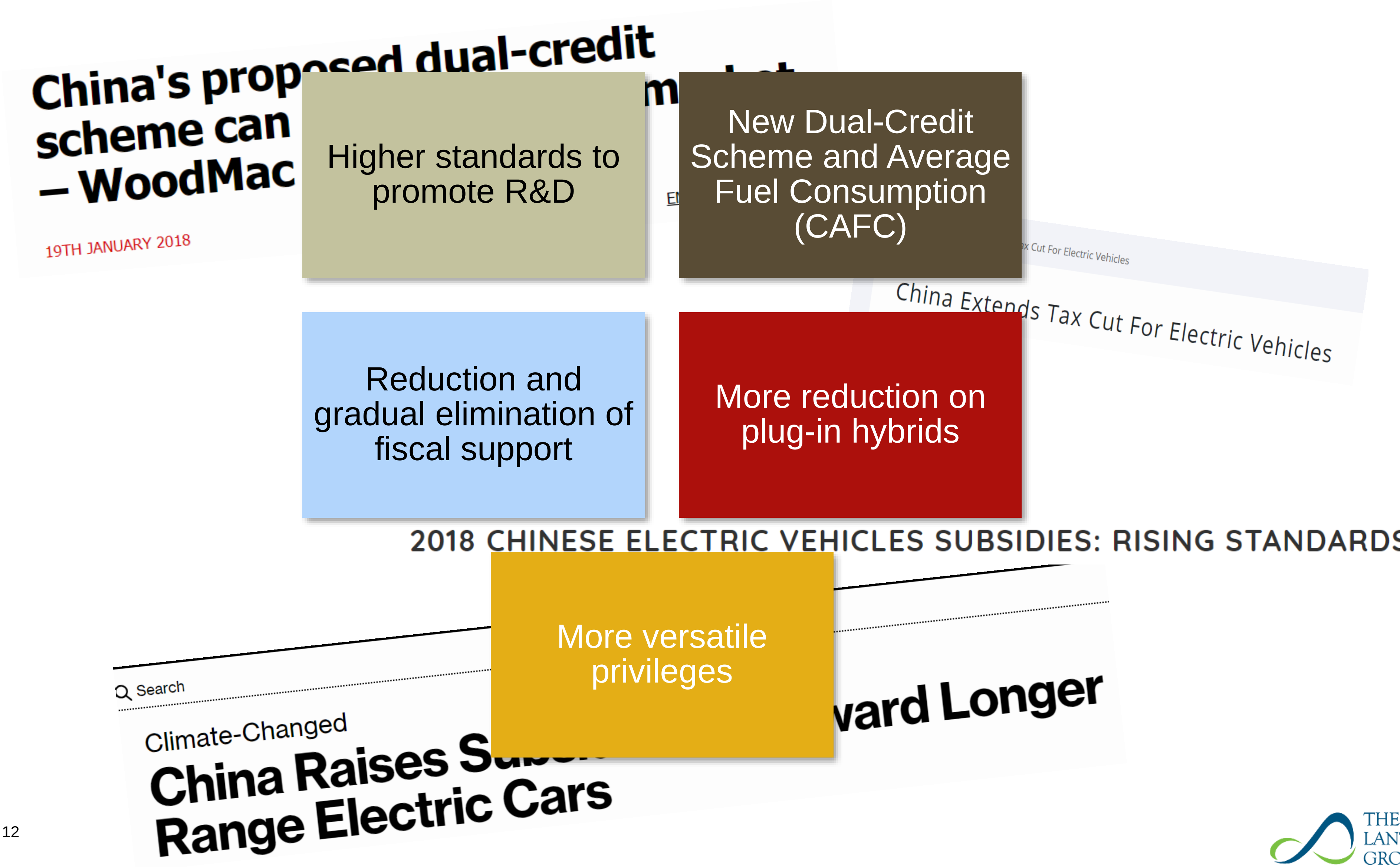
Projection of NEV Passenger Vehicles 2018-2030



2017-2020	2021-2030	2030
• Policy-driven • 2020 passenger vehicle annual sales target :1.8 million – Industry projection: highly feasible	• More innovative products coming only • Decreasing cost--competitive with conventional vehicles by 2021-2022, echoing the full phase out of fiscal subsidies by 2021, e.g. battery cost: – Twelfth five-year annual plan target: 2 RMB/kWh – Thirteenth five-year annual plan target: < 1 RMB/kWh (by 2020) with higher energy density	• Planned NEV market share: 40% • Battery cost: 30% of current cost • Driving range: 500 km+ • Reduced charging time • Other accessories: 5G, self-driving etc.

Source: TLG Analysis, Ways

The Government is continuing to support the EV industry, but is moving away from direct fiscal incentives



Higher standards to promote R&D

New Dual-Credit Scheme and Average Fuel Consumption (CAFC)

Reduction and gradual elimination of fiscal support

More reduction on plug-in hybrids

More versatile privileges

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For example: Government policies force manufacturers to match conventional car production with EV production

- A New Dual-Credit Scheme and Average Fuel Consumption (CAFC) Regulation has been introduced
- This is a requirement for car manufacturers which governs how many EV's they must produce per production of conventional vehicles
- The calculation of are based on:
  - Electric range
  - Energy efficiency
  - Rated power of fuel cell systems
- Put simply, if you produce vehicles with better range and higher efficiency, you need to producer fewer of them to match the conventional production
- Also allows companies to trade or transfer credits among each other:
  - More concentrated with top manufactures which have the ability to produce high performance NEVs and trade credits

Calculation examples in the back-up slides (Ask me during Q&A!)

 Source: Xinhua, OFweek

Subsidies are being directed to encourage R&D and improve standards; and moving towards pure EV and away from hybrids

One of the examples: changes in the NEV bus sector from 2017 to 2018

Type	Year	State Subsidy (RMB/kWh)	State Subsidy Adjusting Factors			Max Subsidy (000 RMB)		
EV w/o fast charge			System Energy Density (Wh/kg)			6<L≤8m	8<L≤10m	L>10m
	2018	1200	115-135		135+	55	120	180
			1		1.1			
	2017	1800	85-95	95-115	115+	90	200	300
			0.8	1	1.2			
			Fast Charge Multiples					
			3C-5C	5C-15C	15C+			
EV w/t Fast charge	2018	2100	0.8	1	1.1	40	80	130
	2017	3000	0.8	1	1.4	60	120	200
PHEV			Gas Saving Level					
			60-65%	65-70%	70%+	22	45	75
	2018	1500	0.8	1	1.1			
			40-45%	45-60%	60%+	45	90	150
	2017	3000	0.8	1	1.2			

Increase of industry requirements:
- Forcing companies to be more adaptive

Larger reduction on PHEV:
- Strengthening the EV market as the industry always intends to

 Source: TLG Analysis, EV partner

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Another example is driving range – again showing pushing the boundary of standards

- Improvement of subsidy distribution to promote technology improvement
  - E.g. More categories to encourage longer driving range

Driving Range (km)	2017 Subsidy (000 RMB)	2018 Subsidy (000 RMB)	Change
100-150	20	0	-100%
150-200	36	15	-58.3%
200-250		24	-33.3%
250-300	44	34	-22.7%
300-400		45	2.3%
>400		50	13.7%

Higher Threshold

 Source: Xinhua, OFweek

This changing Government support has a greater impact on purchasers of smaller (cheaper) vehicles because these incentives are less relevant for rich buyers

1. Exemption of purchase tax from Dec. 2017

2. Special NEV plate
- **Toll exemptions**
- **Elimination of drivable date restrictions**
- **Parking discounts**
- **Special entrance permits (logistic vehicles)**

Image source: sorax/123rf.com

3. Lower down-payment requirements from 2018

Conventional		NEV		
Self-use	Commercial	Self-use	Commercial	Second hand
20%	30%	15%	25%	30%

 Source: EV partner

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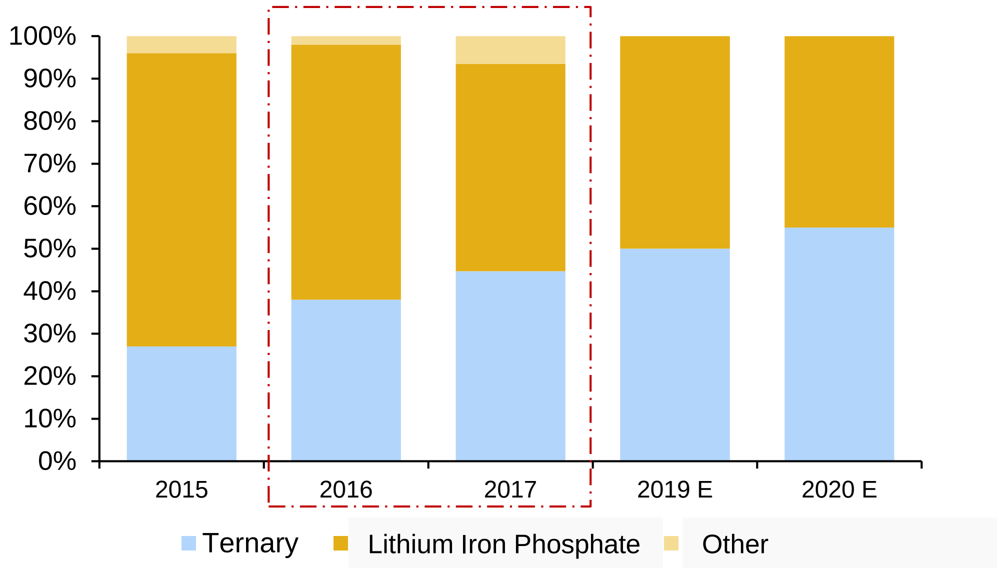
The changes are having impacts across the board

- The changing subsidy regimes are meaning that more private sector buyers are looking at EV’s
- The incentives mean more to less affluent consumers, which influences the type of cars they buy
  - Typically smaller, cheaper passenger cars
- Richer consumers are more interested in performance
  - Which is driving changes in the battery market, as higher performance requires ternary batteries
- And the whole value chain is moving more towards local products
  - Already most of the engines and controllers are local
- However, charging facilities remain a limitation – they are poor quality insufficient in number – but this is also changing
- And as with all things China, fraud is always an issue!

Let’s look at these in more detail

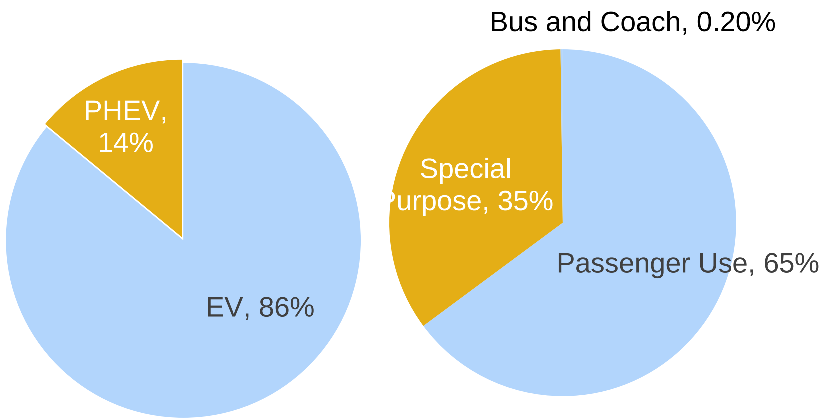
The battle of the batteries – changes in car subsidies are also changing the demand for different types of batteries

Battery Market Shares in China



- Before 2017, ternary not allowed on bus and coach: low stability + poor performance at higher temperature
- Ternary was suspended from the State NEV Recommended List from Jan. to Dec. 2016 by the Ministry of Industry and Information Technology
- Now the technologies have advanced!

Ternary Battery Market Breakdowns



Ternary: Higher energy density = higher performance

Lithium Iron Phosphate: Safer and long cycle time

With growing smaller electric vehicle sales, requirements on energy density and driving distance, ternary battery is expected to dominate the market

Source: TLG Analysis, NBD, OFweek

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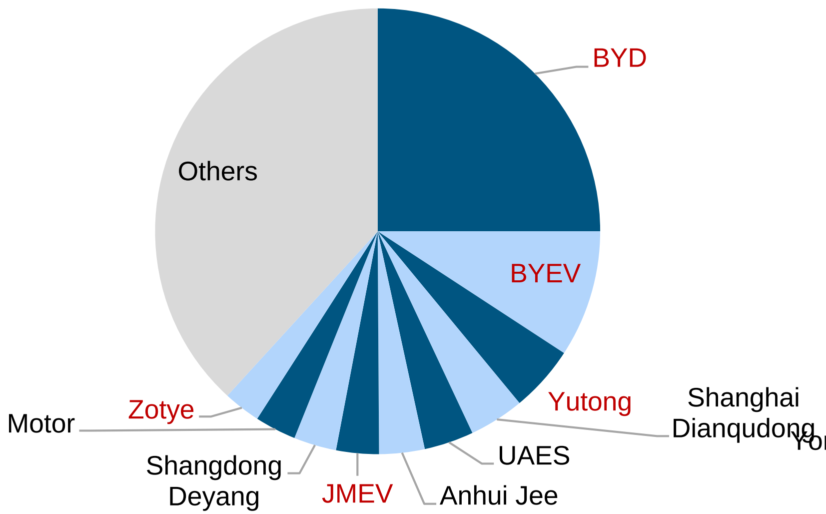
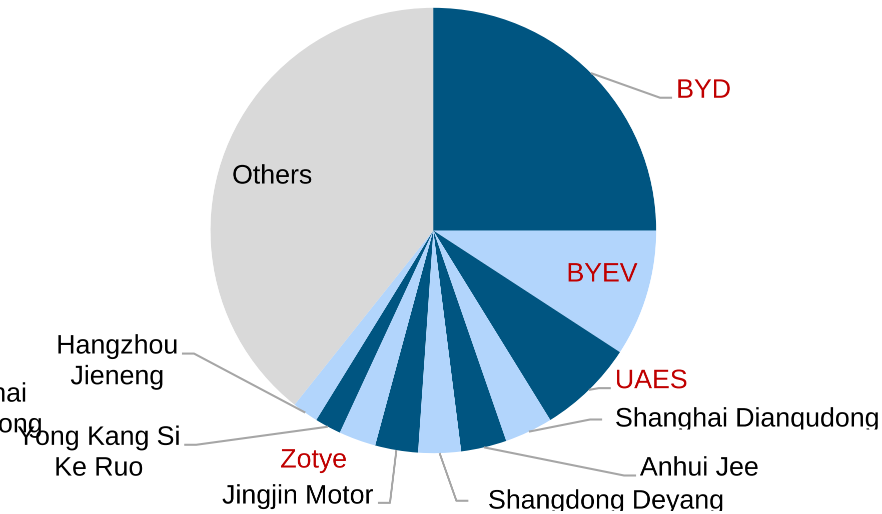
The EV car market is also driving growth in the electric motor and motor's controller market, but most of this is coming solely from Chinese local players

- 9/10 Chinese brands
- 1/10 JV brand
- Because top NEV manufacturers have vertically integrated production lines and local brands are easier to coordinate with

Electric Motor Top Ten Players

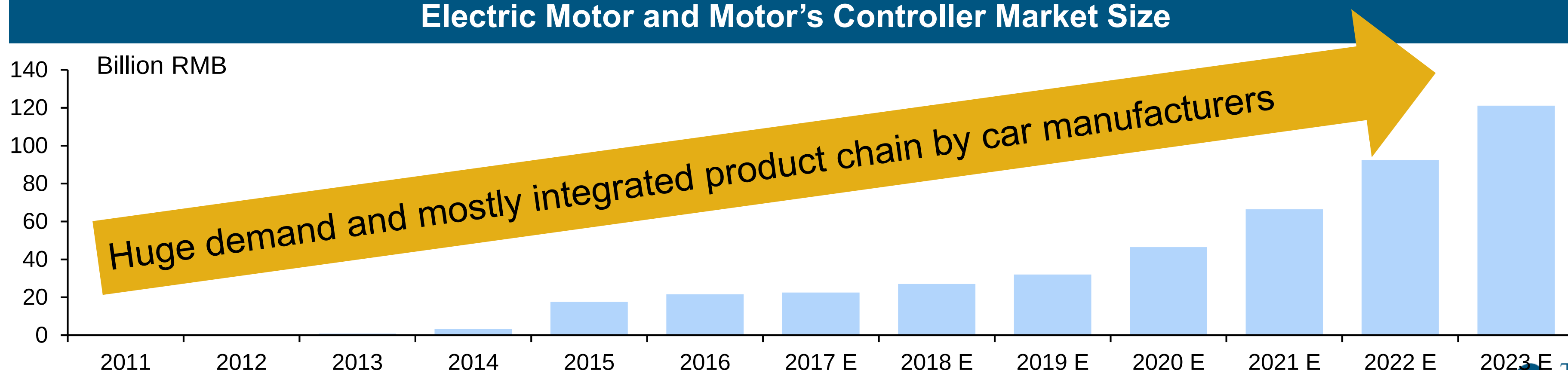


Motor's Controller Top Ten Players



Note: The names of Vehicle manufacturers are colored in **red**

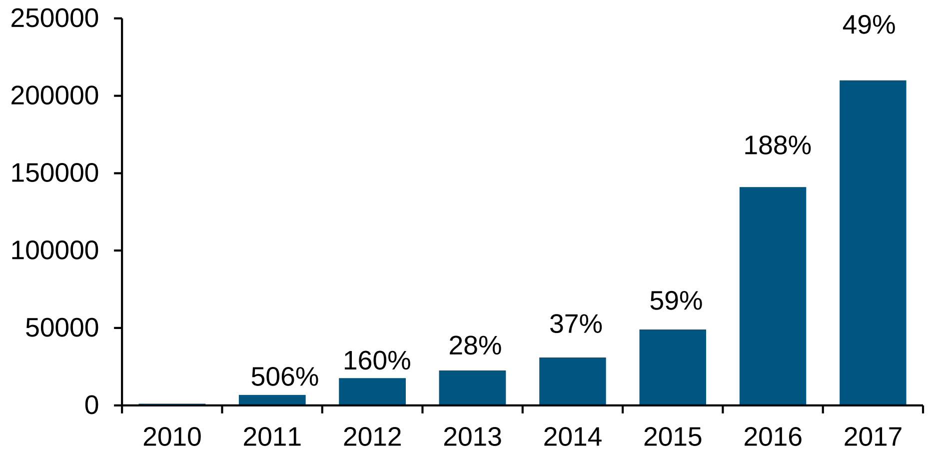
Electric Motor and Motor's Controller Market Size



 Source: TLG Analysis, Qianzhan Research

Charging facilities are below par – but growing and improving

Charging Facility Growth



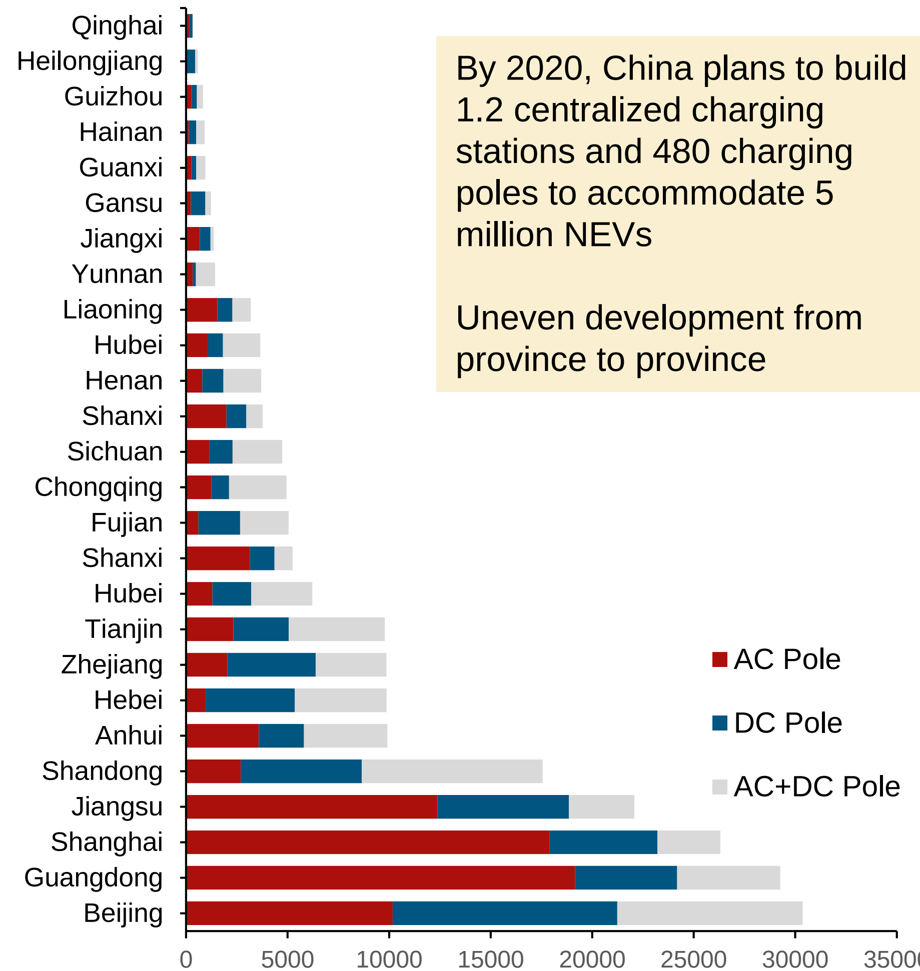
Still large growth potential despite China owns the most charging poles

The car to pole ratio is only 3.8:1 by 2017

Proper planning and maintenance are needed

- The current utilization of public charging poles has not even reached 15% since users prefer private poles
- Most of the charging poles only last up to 3 yrs

Charging Facility by Province in 2017



By 2020, China plans to build 1.2 centralized charging stations and 480 charging poles to accommodate 5 million NEVs

Uneven development from province to province

Source: TLG Analysis. EVCIPA, NBD

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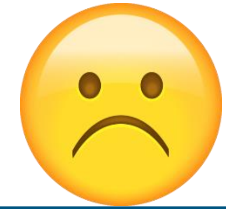
Barriers: fraud is still prevalent …



Main manufacturer frauds

- **Short on quality**
  - Example: Using smaller batteries in production for subsidies that are driving range based
- **Inflated sales**
  - Example: Selling vehicles back to manufactures' rental companies to boost sales for subsidies that are quantity based

Actions taken by the government

- **Phase-down of fiscal incentives**
  - 20% reduction in 2017-2018
  - 50% reduction in 2019-2020
  - Full phase-out by 2020
- **Tightened technical requirements**
- **Robust anti-fraud enforcement**

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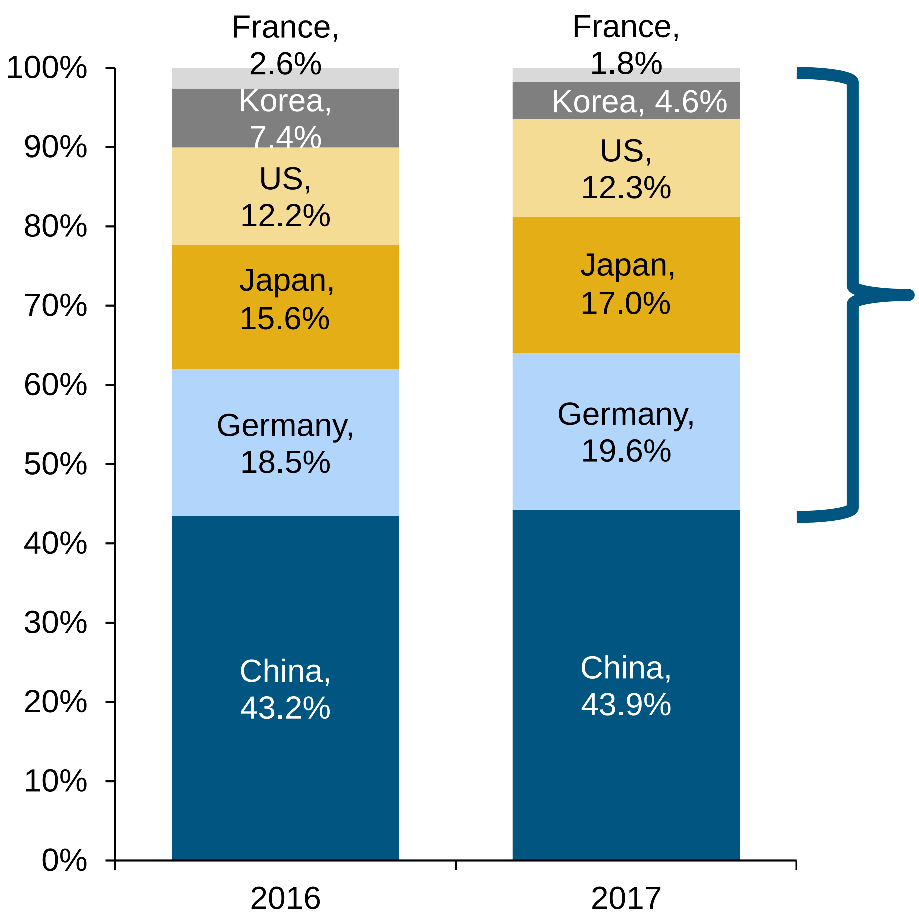
To date, there have been opportunities for manufacturers from a wide range of countries, but this may be changing

Passenger* NEV Market Shares in the Chinese NEV Market



*Passenger cars (for private use) reflect the market better as sales of other car types are more policy driven

Source: Sohu, Ministry of Finance

- **Foreign brands ➔ higher end consumers**
  - High import tariff and,
  - Market image
    - Foreign brands tend to compete on quality over price
    - Chinese brands target at lower end clients who are attracted by subsidies, elimination or reduction of car plate and various city driving restriction
    - Leaving very little market competition for vehicles priced between 33,000 and 47,000 EUR (mid price range)
- **Opportunity**
  - China will cut import tariff on vehicles (from current 20%, for trucks, and 25%, for passenger cars less than 9 seats, to 15%) and auto parts from July 1st, 2018

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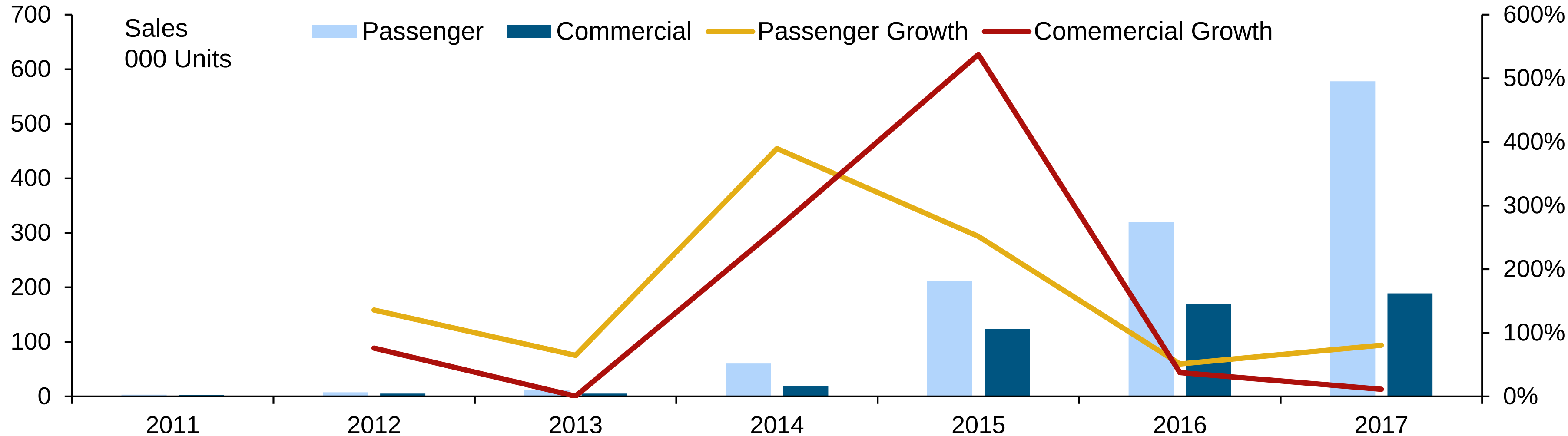
Opportunity: strong growth (but not really for overseas manufacturers except in the high end of the market)

Passenger and commercial NEVs are expected to continue their performances



- Passenger NEVs will remain the dominancy
- In 2017, market shares by sales:
  - Passenger: (annual sales):
    - Electric Vehicles: 11% SUV, 89% regular vehicle
    - Plug- in Hybrid Electric Vehicles: 37% SUV, 63% regular vehicle
  - Commercial (total accumulated sales):
    - 87% cargo vehicle, 13% bus and coach

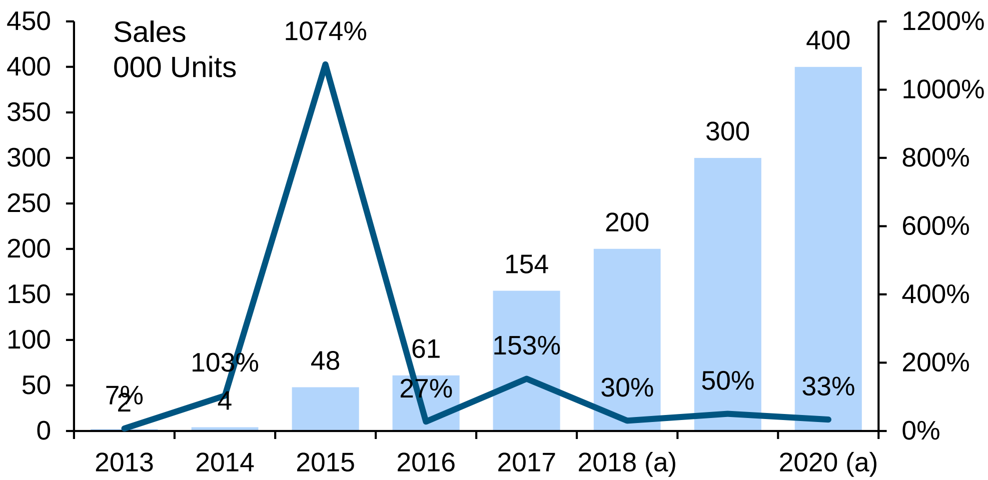
 Source: TLG Analysis, EV Partner, China Power, OFweek

Don’t forget about the dark horse—special purpose NEVs

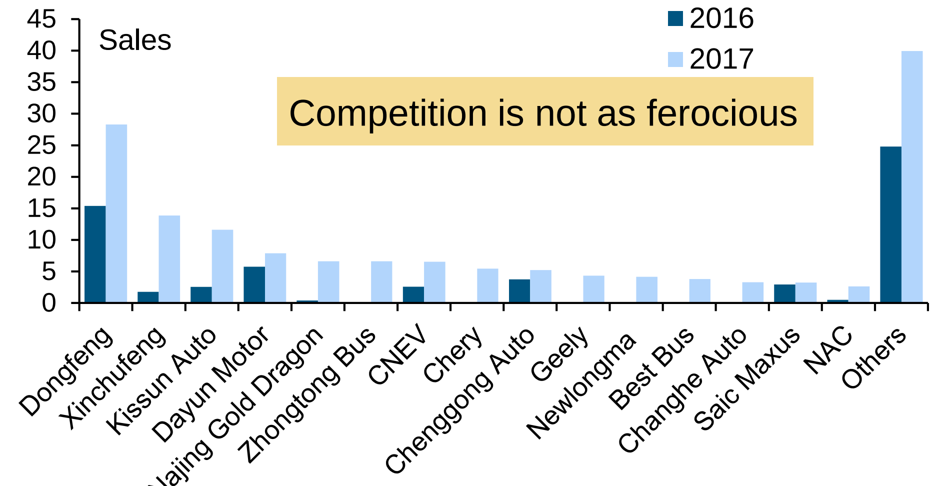
- Passenger cars (private cars)
- Commercial vehicles (buses)
- logistic vehicles (95% of all special purpose Electric Vehicles in 2017)

Fast Growth
especially with the expansion of online shopping delivery service

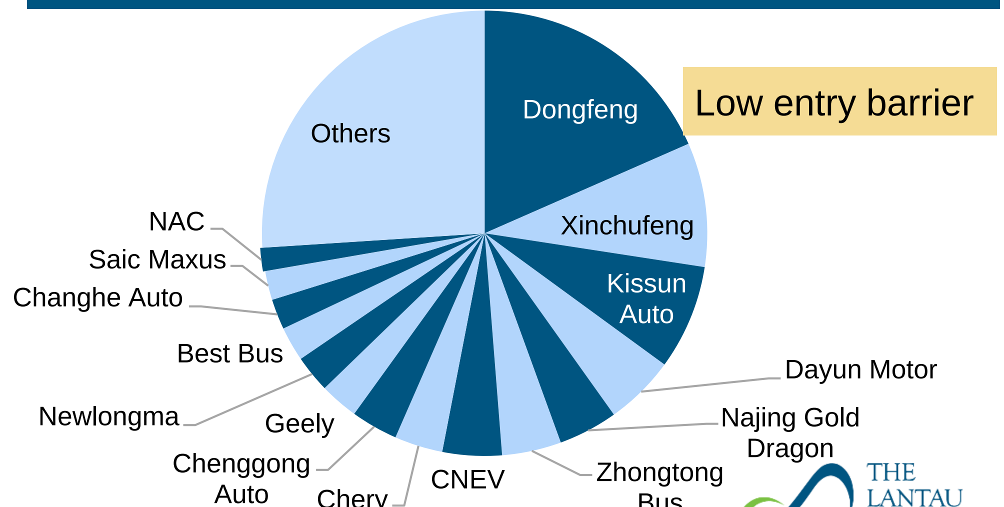
Online shopping: 50%+ sales volume growth in the recent 5 years



Top Producers of Special Purpose Electric Vehicles



Top Producers in 2017



Source: TLG Analysis, Cvworld, OFweek

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EV's are becoming consumer driven – and this is what the consumers want

70% consumers need to travel ~40km on weekdays, ~26km on weekends	**Shorter Charging Time**	Advanced Driver Assistance System (ADAS)
70% consumers expect the range to be 350km	53%+ owners and 73% potential buyers: Up to 4hrs regular charging	Parking Assistance
Quietness with high energy density	84% owners and 61% potential buyers: Maximum fast charging time < 1hr	**Market Change**
Economical	**High-Tech Features**	More high-end options other than Tesla
Lower maintenance costs	49% owners: Autonomous driving level 3 (eyes off)	Very little market competition for vehicles priced between 33,000 and 47,000 EUR
Environmental Friendly	32% owners: Autonomous driving level 2 (hands off)	**Sharing Economy**
45% current NEV owners would purchase another NEV	68% potential buyers: Both autonomous driving level 2 and 3	65% of population would use self-driving car-sharing services

Notes: Percentages are based on KPMG China and Auto Foresight's survey of 220 owners (100) and potential owners (120) of NEV in China. 8% of the respondents are 30-35 years old. Survey performed in 2017
Source: TLG analysis, KPMG, OFweek,

In summary

- EV policy is driven by a need for lower air pollution and a diversification away from oil for security of supply reasons
- EV ownership started with state-owned companies (more easily done in a command and control economy) but now individuals are seeing the benefits and the ownership is spreading out to the private sector
- The Government is using policy mechanisms to:
  - Reduce the direct financial burden of the policies (phasing out direct subsidies but using other incentives instead)
  - Improve EV quality and standards
  - To promote pure EV rather than PHEV
  - Force manufacturers to ramp up production
- This is resulting in a move towards more private buyers of EV's:
  - Which is driving small cars (because incentives are more valuable to lower income purchasers)
  - Who want greater performance (impacts on ternary battery)
  - And making the rampant fraud easier to stamp out

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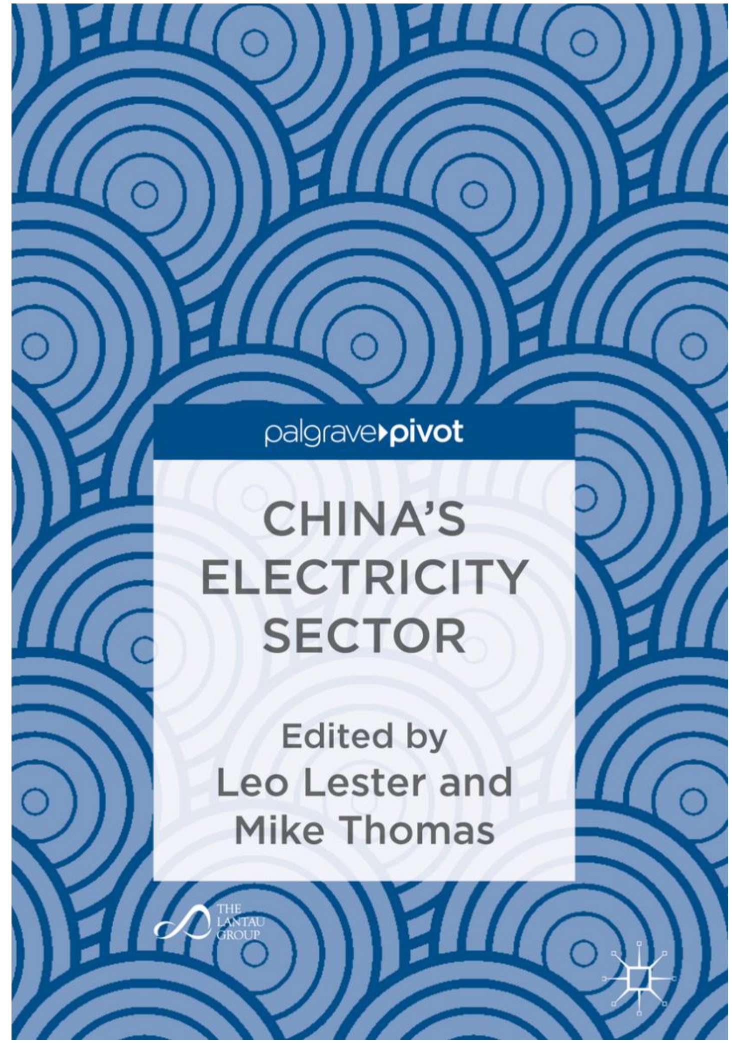

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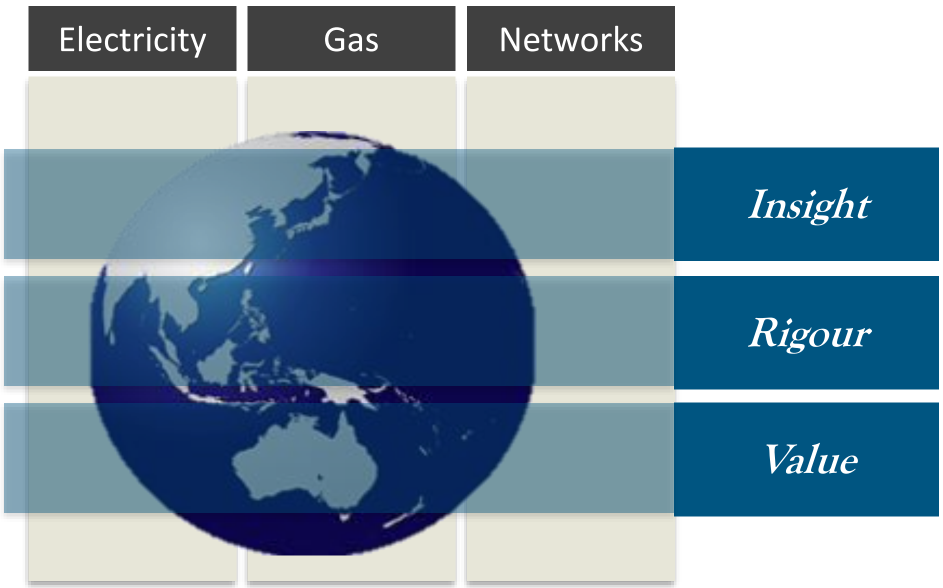

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New Dual-Credit Scheme and Average Fuel Consumption (CAFC) Regulation

	2018	2019	2020
(1) Total Production estimation (000)	25,320	26,590	27,920
(2) NEV Credit Minimum Requirement	8%	10%	12%
(3) Total Targets [(1) × (2)]	2,025.6	2,659.0	3,350.4
(4) CAFC Credit	840	1,470	2,420
(5) Total Dual-Credit Scheme [(3) + (4)]	2,865.6	4,129.0	5,7704
(6) Final NEV Production Required (000) Assuming 3 credits/each	950	1370	1920
(7) Production Share [(6) / (1)]	3.8%	5.2%	6.9%

Source: TLG Analysis and Ministry of Industry and Information Technology

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The Most Popular Vehicles

<table>
<tr><th>Comp.</th><th>Series</th><th>Size</th><th>000 RMB</th><th>Type</th><th>Battery Cap. (kWh)</th><th>Battery Type</th><th>Range (km)</th><th>Charging Time (hrs)</th><th>Maintenance Coverage</th><th>Battery Coverage</th></tr>
<tr><td rowspan="5">BYD</td><td>Qin 100</td><td rowspan="3">Mid SUV</td><td>209.9</td><td>PHEV</td><td>13</td><td>Ternary</td><td>199</td><td>6</td><td rowspan="4">6 yrs. or 150,000km</td><td rowspan="2">6 yrs. or 150,000km</td></tr>
<tr><td>EV 300</td><td>145.9</td><td>EV</td><td>47.5</td><td>Lithium Iron Phosphate</td><td>350</td><td>1.2(F)/7(S)</td></tr>
<tr><td>Tang 100</td><td>219.9</td><td>PHEV</td><td>23</td><td>Ternary</td><td>100</td><td>6.9</td><td>Lifetime</td></tr>
<tr><td>300 e</td><td>Compact</td><td>195.9</td><td>EV</td><td>43</td><td>Lithium Iron Phosphate</td><td>305</td><td>1.2(F)/7(S)</td><td rowspan="9">8 yrs. or 150,000km
8 yrs. or 150,000km</td></tr>
<tr><td>400</td><td>MPV</td><td>309.8</td><td>EV</td><td>82</td><td>Lithium Iron Phosphate</td><td>400</td><td>1.5(F)/8(S)</td><td>4 yrs.</td></tr>
<tr><td rowspan="4">BJEV</td><td>EC200</td><td>Mini</td><td>158.8</td><td>EV</td><td>20.5</td><td>Ternary</td><td>162</td><td>0.6(F)/8(S)</td><td rowspan="4">3 yrs. or 120,000km</td></tr>
<tr><td>EX260</td><td>Small SUV</td><td>192.9</td><td>EV</td><td>38.6</td><td>Ternary</td><td>250</td><td>0.5(F)/6-7(S)</td></tr>
<tr><td>EV160</td><td>Small</td><td>177.8</td><td>EV</td><td>25.6</td><td>Lithium Iron Phosphate</td><td>150</td><td>1(F)/7-8(S)</td></tr>
<tr><td>EU260</td><td>Compact</td><td>205.9</td><td rowspan="5">EV</td><td>41.4</td><td>Ternary</td><td>260</td><td>0.5(F)/7-8(S)</td></tr>
<tr><td>Geely</td><td>EV300</td><td>Compact</td><td>205.8</td><td>41</td><td>Ternary</td><td>300</td><td>0.8(F)/14(S)</td><td>4 yrs. or 150,000km</td></tr>
<tr><td rowspan="2">Zhidou</td><td>D12016</td><td rowspan="3">Mini</td><td>158.8</td><td>18</td><td>Lithium Iron Phosphate</td><td>180</td><td>8-10</td><td>2 yrs. or 40,000km</td></tr>
<tr><td>D22017</td><td>151.8</td><td>18</td><td>Ternary</td><td>180</td><td>6-8</td><td rowspan="2">3 yrs. or 60,000km</td></tr>
<tr><td>Cherry</td><td>eQ2017</td><td>169.9</td><td>23.6</td><td>Ternary</td><td>200</td><td>8-10</td><td>3 yrs.</td></tr>
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