Electric Mobility in China – Developments, Opportunities & Challenges

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Tsinghua University

- Established in 1911
- 450 hectares campus area
- 15,000 professors & staffers
- 46,000 students
- 20 schools, 54 departments
- Science, **engineering**, medicine, humanities, law, economics, management, education, art, …








Research areas of my lab

- Vehicle structural failure under impact loading
- Battery failure mechanism and impact protection
- Injury biomechanics
- Crash protection of diverse and vulnerable road users

Electric Mobility in China

1. Rapid economic and societal developments and issues
2. Big strategies and programs for industrialization and innovations
3. Recent developments on electric mobility in China
4. Why these approaches might work in China?

BYD QIN
比亚迪 秦

Rapid economic and societal developments in China

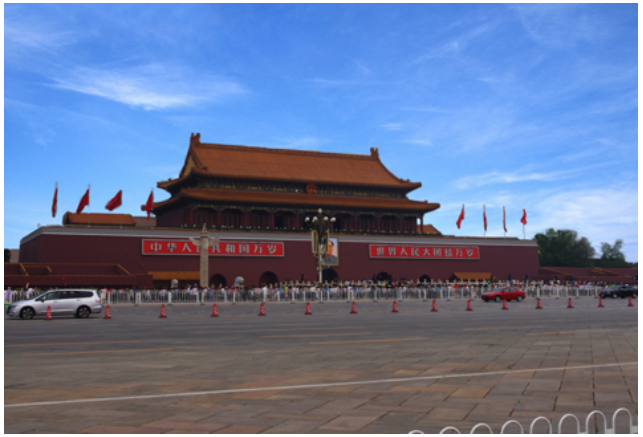
- Rapid economic growth for 30 years
- Now second largest economy
- Largest vehicle market in the world
- Undergoing quick urbanization
- …

Traffic congestions are daily life in many cities

- Beijing and Shanghai each has 25-million population
- Beijing
  - 5 millions registered cars
  - More than 10 millions people take crowded subway each day

The environment is deteriorating
Frequent smog in Beijing

Being improved !



Issues coming with the rapid developments

- Environment is deteriorating
- Gap between rich and poor has been widened
- Corruptions increased and are being cracked down
- Product quality and technologies generally are still low
- Over production capacity of low quality products
- Labor cost keeps increasing at fast pace
- High real estate price in some large cities significantly impacting families and enterprises
- Taxes are high
- Aging society in sight
- …

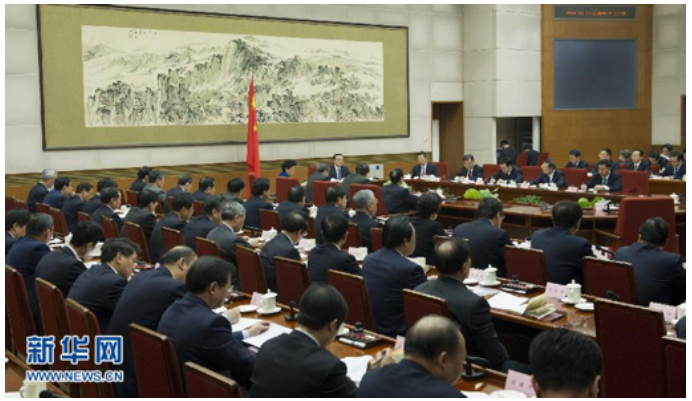
Green GDP is now a key goal of the government

Main performance requirements to government officials

Green GDP

Technology innovation

Societal stability



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“Made in China 2025”

- Program announced in 2015
- Focus on upgrading manufacturing sector to improve innovation ability
- Make manufacturing from large to strong
- Integrate informatization and industrialization

The three-step strategy

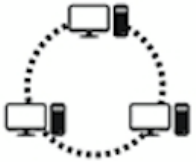
Step 1: Shifting China from a big manufacturing country to a strong one by 2025

Step 2: China being able to compete with developed manufacturing powers by 2035

Step 3: Transforming China into a leading manufacturing power by 2049

10 key sectors

MADE IN CHINA 中国制造 2025



New information technology
新一代信息技术产业

Numerical control tools and robotics
高档数控机床和机器人

Energy saving and new energy vehicles
节能与新能源汽车

Power equipment
电力装备

Aerospace and aeronautical equipment
航空航天装备

New materials
新材料

Ocean engineering equipment and high-tech ships
海洋工程装备及高技术船舶

Biological medicine and medical devices
生物医药及高性能医疗器械

Modern railway equipment
先进轨道交通装备

Agricultural machinery
农机装备

Technical Roadmap of Energy Saving Vehicle 《节能与新能源汽车技术路线图》

- On 26 October 2016, China issued a 450-page technical roadmap for energy saving vehicles
- Blueprint for development of virtually every aspects of automotive industry toward 2030
- Having high level automotive technologies is a critical channel for energy security of China, relieving environmental protection pressure, and achieving goal of “Made in China 2025”

Presented by Prof. Minggao Ouyang (欧阳明高), Tsinghua University, at 2016 SAE-China Annual Conference

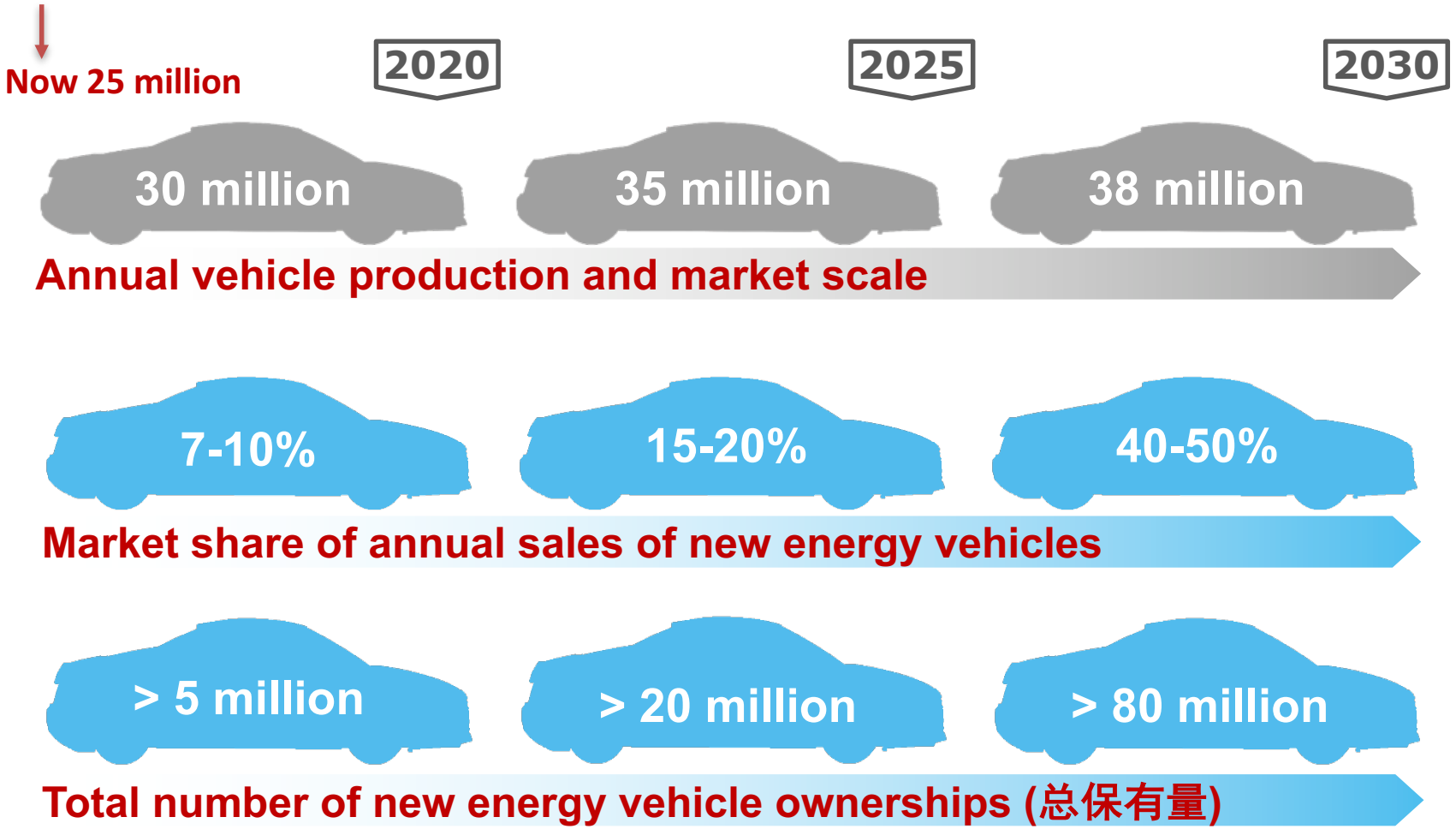
《节能与新能源汽车技术路线图》
内容主旨发布

7 aspects of automotive technologies integrated into 1 road map

1. Energy saving vehicle
2. Pure battery powered & plug-in EV
3. Fuel cell vehicle
4. Smart and connected vehicle
5. Battery for vehicle power
6. Vehicle lightweighting
7. Vehicle manufacturing

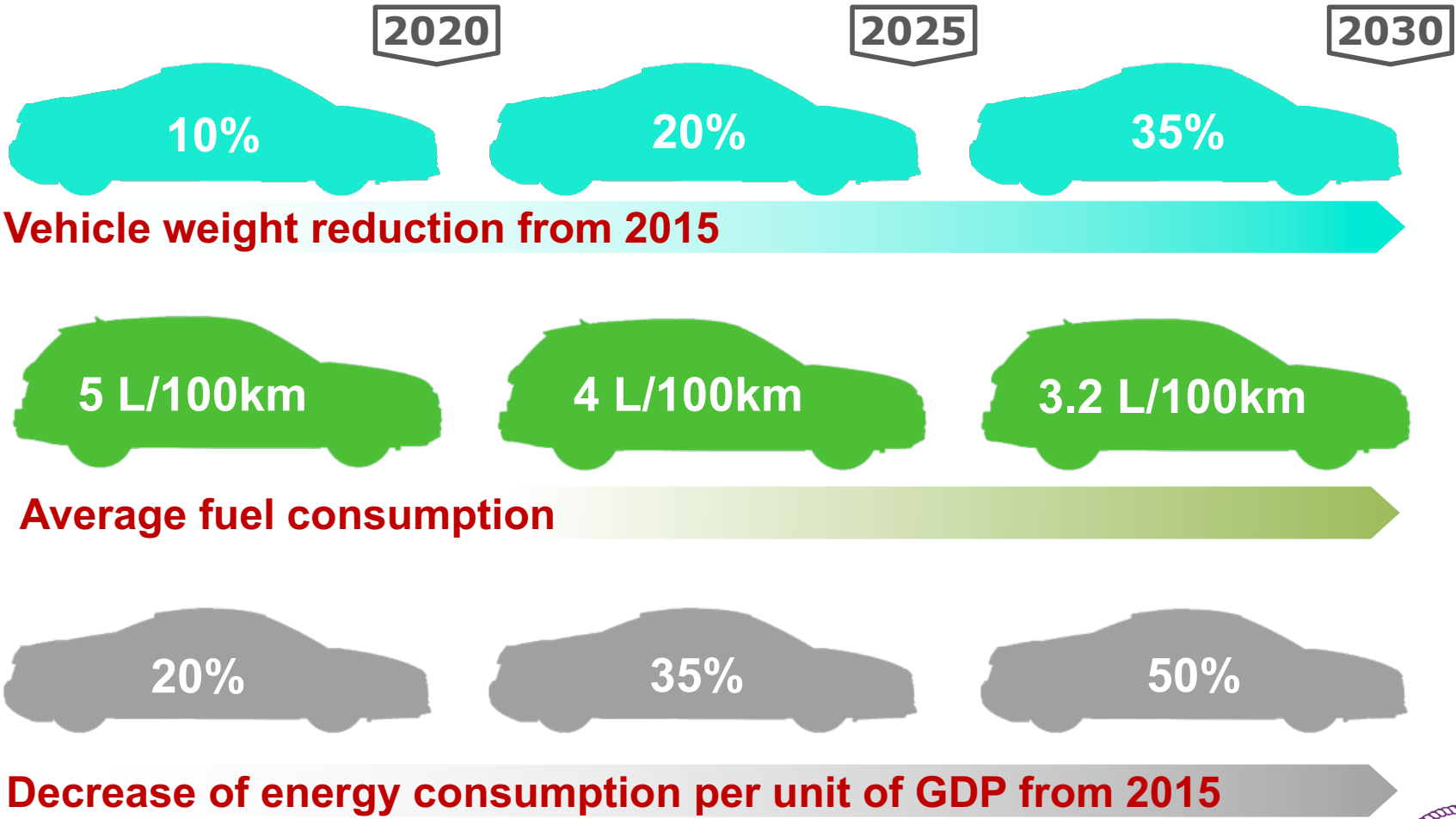
《节能与新能源汽车技术路线图》
内容主旨发布

Market size and new energy vehicles



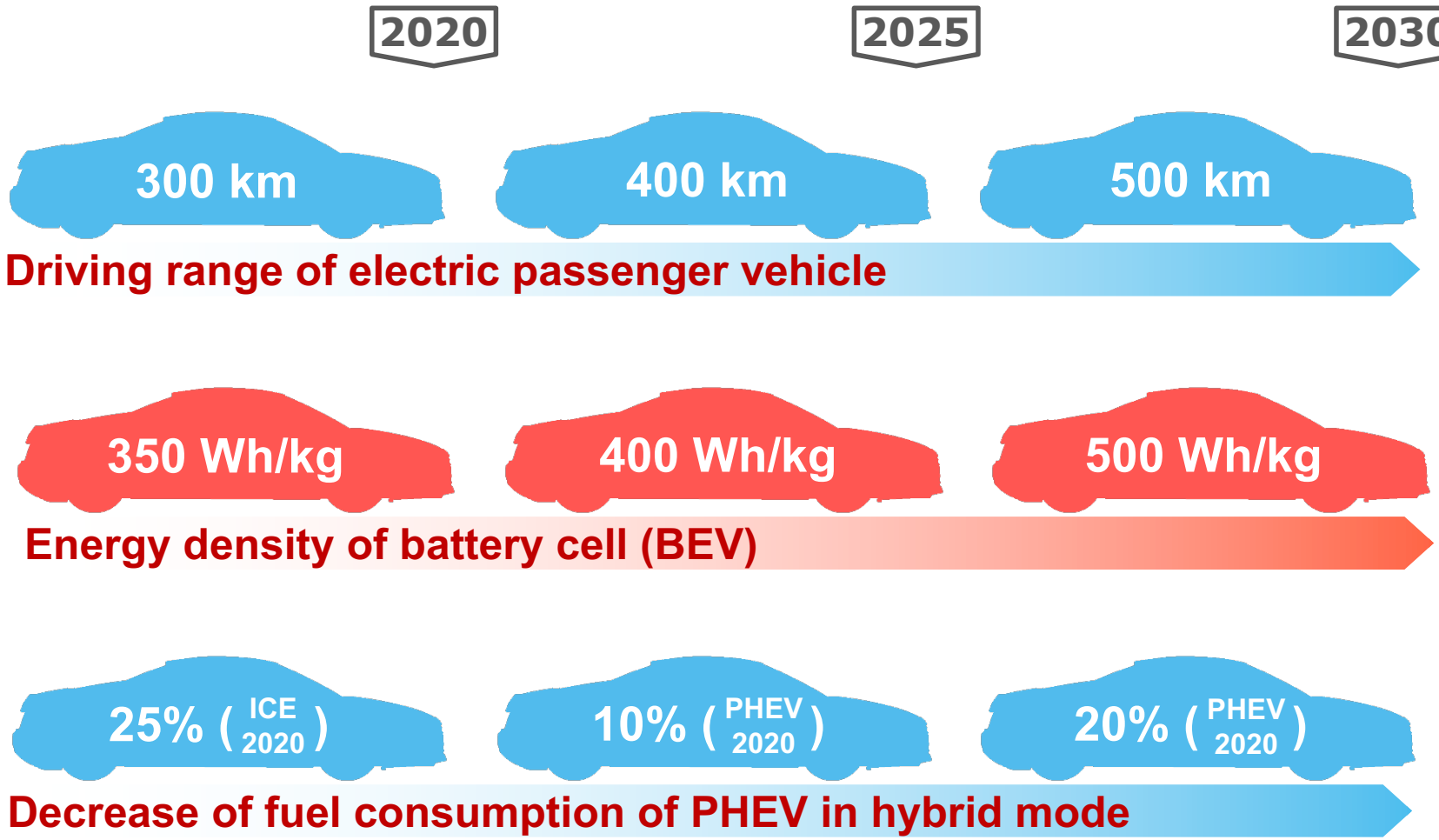
《节能与新能源汽车技术路线图》
内容主旨发布

Highlights of goal – energy saving and lightweighting



《节能与新能源汽车技术路线图》
内容主旨发布

Highlights of goal – BEV and PHEV



《节能与新能源汽车技术路线图》
内容主旨发布

Highlights of goal – EV charging stations

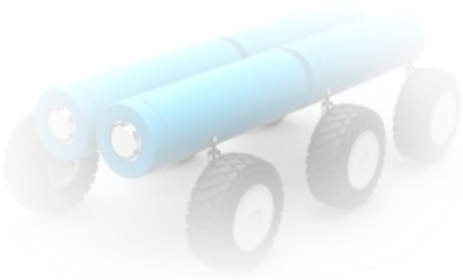
2020	2025	2030
> 12,000	> 36,000	> 48,000
Total number of charging stations		
> 5 million	> 20 million	> 80 million
Total number of charging posts (1 charging post per car)		

National Science and Technology Major Project

- Vehicle related projects
  - New energy vehicles (including battery powered cars)
  - Autonomous driving
  - Vehicle lightweighting
  - Vehicle manufacturing
  - Vehicle power
  - …

Research scope in battery funded by Chinese government

- Battery materials and chemistry for increasing energy density
- Battery safety
- Electric driving system
- Connected vehicle for energy saving
- Wireless charging
- Applications in battery powered vehicles
- Battery recycle and second-use
- Policies for vehicle energy saving and new energy vehicles



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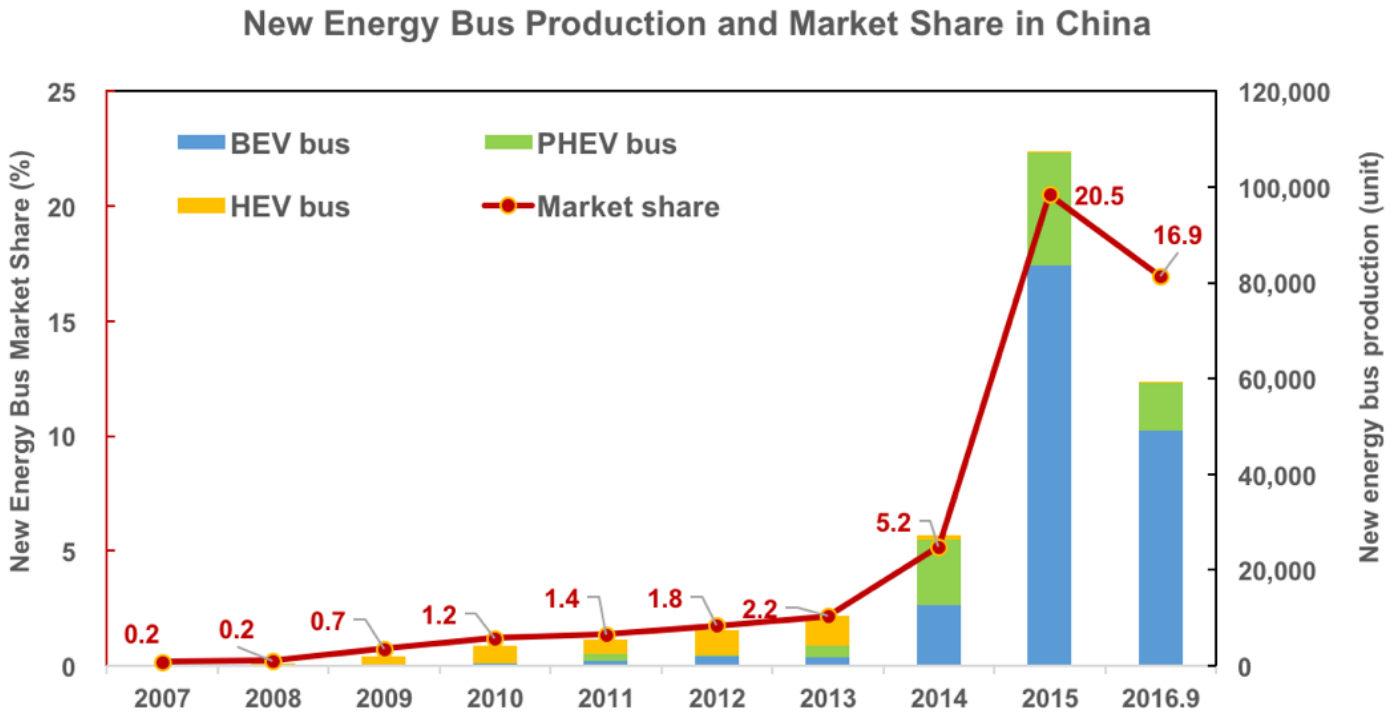
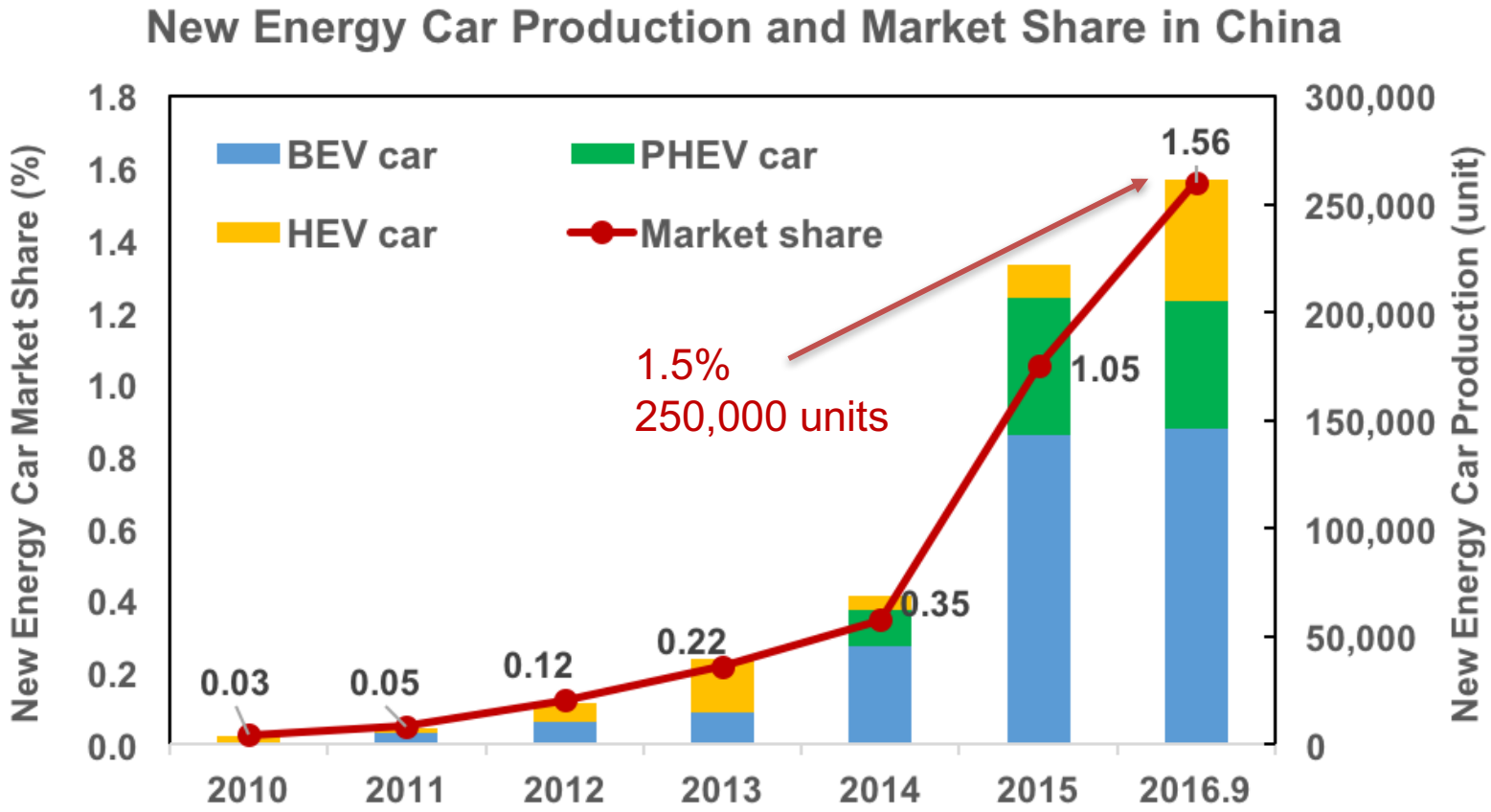
New energy bus production and market share in China



Source: Prof. Hewu Wang (王贺武), Tsinghua University

BYD electric bus in California

New energy car production and market share in China



Source: Prof. Hewu Wang (王贺武), Tsinghua University

Model	BAIC EV	BAIC EU	BYD e5	BYD e6	BYD Qin EV
Picture					
Time to Market	2014	2015	2016	2014	2016
Type	BEV	BEV	BEV	BEV	BEV
Range (km)	160-200	260	305	400	300
Size (mm*mm*mm)	4025*1720*1503	4582*1794*1515	4680*1765*1500	4560*1822*1630	4740*1770*1490
Weight (kg)	1295kg	1295kg	1845kg	2295kg	-
Price (10000RMB)	17.78-24.69	23.00-25.49	22.18-24.48	30.18-35.98	25.38-29.48

Model	Emgrand EV	ZD D1/D2	JAC iEV4	Chery eQ	Zotye Yun 100
Picture					
Time to Market	2015	2015	2015	2014	2014
Type	BEV	BEV	BEV	BEV	BEV
Range (km)	253	180	170	151	155
Size (mm*mm*mm)	4631*1789*1495	2765*1540*1555	4190*1650*1445	3564*1620*1527	3559*1620*1476
Weight (kg)	1570kg	740/775kg	1260kg	1128kg	968-1040kg
Price (10000RMB)	22.88-24.98	15.88-18.88	15.28-17.78	15.99-16.49	15.89-16.99

Model	BYD Qin	BYD Tang	ROEWE 550	Trumpchi GA5 REV	ROEWE E950
Picture					
Time to Market	2013	2015	2013	2014	2016
Type	PHEV	PHEV	PHEV	PHEV	PHEV
Range (km)	70	60	58	50	60
Size (mm*mm*mm)	4740*1770*1490	4815*1855*1720	4648*1827*1479	4800*1819*1484	4995*1857*1500
Weight (kg)	1720kg	2220kg	-	1680	1835
Price (10000RMB)	20.98-21.98	25.13-51.88	24.88-25.98	19.93-21.93	28.88-30.88

EV models launched in recent years

Car sharing services and EV charging stations

江淮 JAC EV
Collaborating with VW

Large number small, low-speed electric cars on streets

Low-speed cars used by elderly

Delivery vehicles for online shopping goods

Safety issue !

Low-speed EV for last kilometer commute

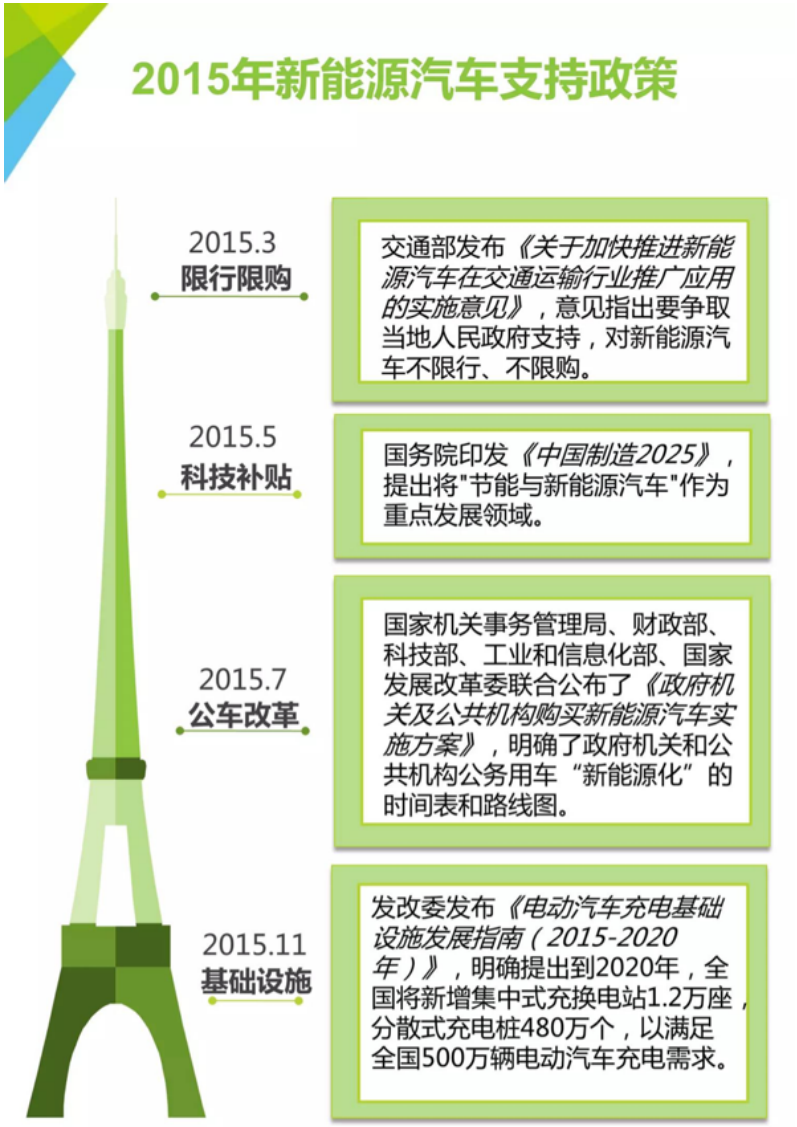
Bicycle sharing/renting

Policies for tackling traffic congestion and air pollution in Beijing

- Allow driving 6 days a week
- Electric vehicles exempted !

- License plates granted by lottery or auction
  - Allow 200,000 new vehicles registered per year on top of 5 millions existing cars
  - No restriction on electric cars !

Government policies for promoting EV



- No restriction for EV license plate registration
- Allow to drive every day
- Subsidy to development & purchase
- Encourage EV for government owned cars
- Push build charging stations
- New vehicle manufacturing permits only granted to manufacturing new energy vehicles

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Why EV market increasing quickly in China?

- Strong will of the government and the goals:
  - Meet CO2 emission reduction target and improve environment & air quality
  - Reduce oil consumption and enhance energy security
  - Build up competitiveness in global auto market
- China's middle class population increasing fast
- More second time buyers and second-car owners
- Customers are buying EV not because they are fans of EV, but because that is their only option
- Customers' concerns: mileage, convenience, safety, …
- Average mileage per trip: Shanghai 12 km, Beijing 14 km

Why these approaches might work in China?

- In China things can change fast by taking approach of

  "government + market + technology"

- When Chinese government wants to do something and it has adequate market and technologies, resource is never a problem and execution & efficiency are amazing

  Example: building high-speed railway network

- Attention to the new energy vehicle quota system announced a few weeks ago !

A way to view China market and developments

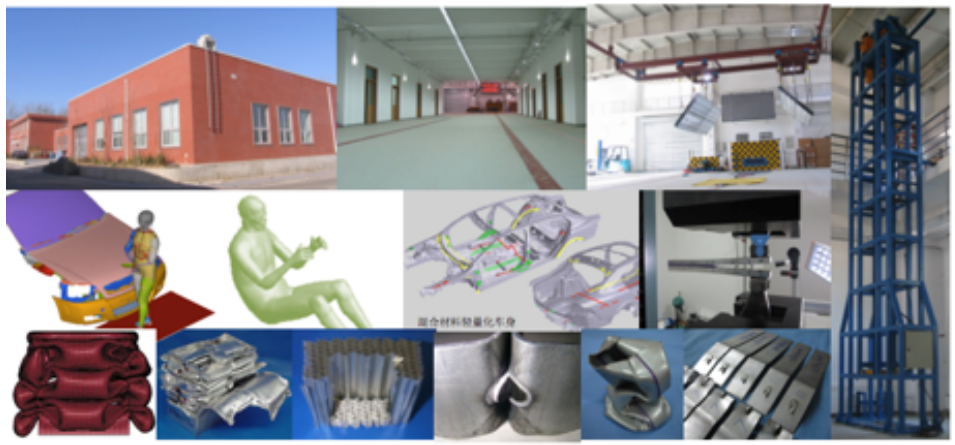
- Looking at average could misleading
- Should look at relevant portions
  - If 10% consumers can afford, → Germany + France
  - If 10% companies can innovate, → significant power

HUAWEI

WeChat

- China became largest market for German car makers when China was far from rich in average sense

谢谢！



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