The E-Mobility Race and China's Determination to Win

Measures by the Chinese government to accelerate e-mobility development

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Beijing, 30.07.2018

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Beijing, 2018

List of Abbreviations

AQSIQ	Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China
ACEA	European Automobile Manufacturers' Association
BEV	Battery Electric Vehicle
BMU	Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit – German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BMWi	Bundesministerium für Wirtschaft und Energie – German Federal Ministry for Economic Affairs and Energy
BYD	Build Your Dreams
CAFC	Corporate Average Fuel Consumption
CATL	Contemporary Amperex Technology
DIN	Deutsches Institut für Normung – German Standardization Institute
ESV	Energy-Saving Vehicle
ETS	Emission Trading Scheme
EVI	Electric Vehicle Initiative
FCEV	Fuel Cell Electric Vehicle
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
HEV	Hybrid Electric Vehicle
HPC	High Power Charging
ICV	Intelligent and Connected Vehicle
IEA	International Energy Agency
JV	Joint Venture
kWh	Kilowatt hour (Energy)
MEE	Ministry of Ecology and Environment of the People's Republic of China (formerly **MEP**: Ministry of Environmental Protection)
MIIT	Ministry of Industry and Information Technology of the People's Republic of China
MOFCOM	Ministry of Commerce of the People's Republic of the People's Republic of China
MOHURD	Ministry of Housing and Urban-Rural Development of the People's Republic of China
MOST	Ministry of Science and Technology of the People's Republic of China
MOT	Ministry of Transport of the People's Republic of China
MoU	Memorandum of Understanding
NDRC	National Development and Reform Commission of the People's Republic of China
NEA	National Energy Administration of the People's Republic of China
NEDC	New European Driving Cycle
NEV	New Energy Vehicle
NTCAS	National Technical Committee of Auto Standardization
OEM	Original Equipment Manufacturer
PHEV	Plug-In Hybrid Electric Vehicle
RTM	Real-Time Monitoring
SGCC	State Grid Corporation of China
SGEVCP	Sino-German EV Charging Project
SPV	Special Purpose Vehicle
WLTP	Worldwide Harmonized Light Vehicles Test Procedure
ZEV	Zero Emission Vehicle

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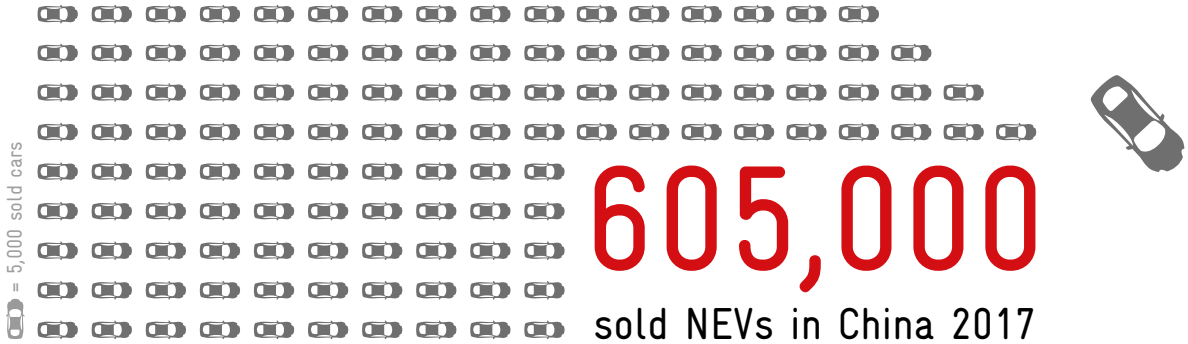
Photo by Anders Jacobsen

01 INTRODUCTION

The E-Mobility Race and China's Determination to Win



Developments in the field of New Energy Vehicles (NEVs) in China have exceeded all expectations. The Middle Kingdom is by far the largest market for NEVs, with 50 % of global passenger cars being sold here[1]. The numbers for NEVs are ever increasing: in the first half of 2018, NEV sales already reached 412,000, up from 195,000 vehicles sold in the first half of the previous year[2]. Overall, China has taken a pioneering role in the e-mobility sector, with numerous Chinese cities on their way to having a fully electrified bus fleet by 2020, if not sooner.

China's quick progress in the electro-mobility field is as much a result of industrial policy considerations as environmental concerns. A comprehensive electro-mobility ecosystem is a foundational aspect of what China regards as a strategic industry in the coming decades, supported by measures implemented at national, regional and local levels. The goal is for NEVs to make up 20 % of all vehicle sales by 2025[3].

"THE MIDDLE KINGDOM IS BY FAR THE LARGEST MARKET FOR NEVS."

China's transition to electro-mobility has led to a general reshuffling within the global automotive market, which of course has significant consequences for international car manufacturers. China is currently both the world's largest automotive production site and its largest sales market, as well as an industry leader in terms of investment and development. Hence, the country has not yet realized its full potential in terms of NEV. In 2015, the density of passenger cars was a mere 121 vehicles per 1,000 people – a figure that is estimated to increase to 200 by 2021. This is still notably less than the passenger car density in Germany, which currently stands at 555 vehicles per 1,000 people (2016). However, the situation in first-tier coastal cities such as Beijing, Shanghai or Shenzhen is markedly different. Passenger car density in Beijing, for instance, has already reached 260 vehicles per 1,000 people (2017). This has led to traffic jams and severe air pollution, which result in policies by municipal governments aimed at reducing the number of conventional vehicles while promoting the development of NEVs.

This report gives a detailed overview of the various measures by which the Chinese government seeks to promote electro-mobility. The current market situation in China is examined, and the industrial policy targets of the central government explained. The body of the report provides a detailed description of the three main incentive measures: financial incentive mechanisms (4.1), non-financial incentive mechanisms (4.2), and requirements for manufacturers (4.3). Finally, the Sino-German cooperation on electro-mobility is discussed, including an examination of charging infrastructure, as well as the outlook for future developments in China.

Photo by GIZ

02 Market Situation in China

Photo by Rob Bye

02 MARKET SITUATION IN CHINA

The E-Mobility Race and China's Determination to Win

NEV market acceleration within China gathered pace in 2017, with battery electric vehicles (BEVs) forming by far the most important product category. Over 50 % of all worldwide BEV sales were in China[4], where NEVs currently represent more than 3 % of all newly licensed cars. This increase in production volume has led to a reciprocal reduction in the costs, in particular for core components such as batteries. While the export share of Chinese original equipment manufacturers (OEMs) remains low, the Chinese market is sufficiently large to support this additional production volume.

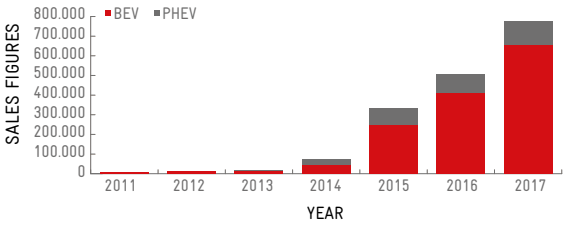


Figure 1: NEV sales (incl. commercial vehicles) in China from 2011 to 2017[5]

Unlike Germany, small car models (e. g., the Zhidou D2 EV or the Chery eQ) are very popular in China. The market leader is the BAIC EC Series model, with almost 80,000 units sold in 2017 alone[6]. It should be noted, however, that sales figures vary considerably between regions due to differences in local subsidies and protectionist measures. This is particularly true for cars and buses, where cities predominantly resort to local OEMs. For instance, electric cars in Beijing are manufactured mainly by BAIC[7] while Shenzhen purchases most of its cars and buses from BYD[8].

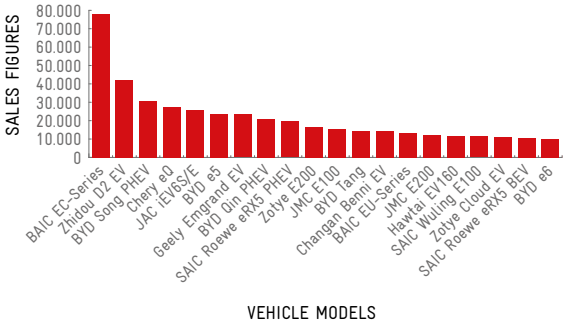


Figure 2: NEV sales in 2017 within China by vehicle model[9]

China is seeking to gain a dominant position in the NEV and intelligent and connected vehicles (ICVs) market, and the political commitment to NEV market acceleration remains strong. In large cities, ecological factors such as emissions play as much of a role in political decision-making as does industrial policy. Despite the quick progress of NEV market growth, dependence on subsidies remains high, with turnovers sensitive to adjustments in state support.

To reduce this dependency and the financial burden on the state, existing purchasing subsidies will be phased out by 2020, by which time market mechanisms should be sufficiently robust to sustain the market acceleration, according to the Chinese government. As part of this goal, stricter electric vehicle subsidy regulations became effective on 12 February 2018. Subsidies were cut completely for electric vehicles with operating distances less than 150 km, while subsidies for electric vehicles with a range of 400 km were increased from 44,000 Yuan (5,600 euros) to 50,000 Yuan (6,300 euros). Electric bus subsidies, meanwhile, were cut by up to 50 %. Local subsidies still exist at provincial and city levels; however, these are limited to 50 % of those provided by the central government.

By cutting state subsidies, the Chinese government hopes to promote market consolidation and increase competition. The aim is that of the currently very large number of NEV manufacturers, only the strongest ten companies delivering the highest quality products will survive. As per the Made in China 2025 national development plan[10], the emergence of a small number of strong brands and national leaders will strengthen the overall market. These measures are also intended to counteract the trend of smaller manufacturers – often with insufficient industrial knowledge and poor observance of safety standards – producing electric vehicles merely to obtain subsidies.

Photo by Hanny Naibaho

03 Industrial Policy Targets

Photo by Ari Spada

03 INDUSTRIAL POLICY TARGETS

The E-Mobility Race and China's Determination to Win

"CHINA IS MAKING SUBSTANTIAL EFFORTS TO REPLACE CONVENTIONAL VEHICLES WITH ELECTRIC VEHICLES"

To achieve these industrial policy targets, China is making substantial efforts to replace conventional vehicles with electric vehicles. Several government departments are in charge of promoting electro-mobility. The overview below shows the most important government departments and their responsibilities.

MIIT

Ministry of Industry and Information Technology

- In charge of permits for automotive companies and their products
- Developing technical regulations and standards
- Developing a national strategy for the automotive industry
- Testing and managing incentive measures

NDRC

National Development and Reform Commission

- Reviewing key projects (research programs or pilot projects) for NEVs within the automotive industry
- Reviewing the development planning of large corporate groups
- Defining important measures and strategies in connection with automotive industry development

MOST

Ministry of Science and Technology

- Coordinating scientific projects for NEV development

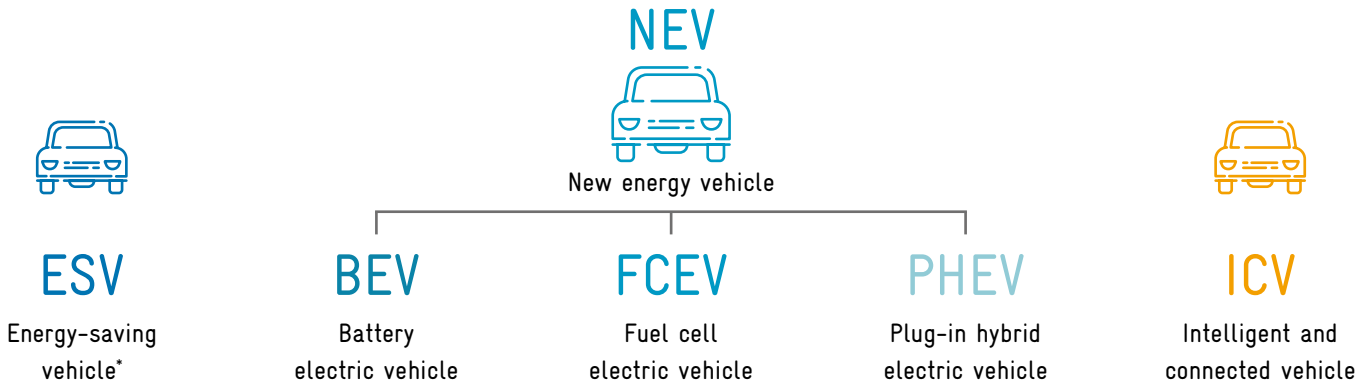
MOT

Ministry of Transport

- Management of car sharing/ car rental platforms
- Management of the so-called "Green Traffic" initiative

In May 2015, the State Council published the Made in China 2025 national development plan, which highlights the importance of electro-mobility industrial development and sets ambitious goals for Chinese car manufacturers.

Four vehicle types are identified: battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV), fuel cell electric vehicles (FCEV), ICV and energy-saving vehicles (ESV).



* Vehicle with consumption < 2.8 l/100 km according to New European Driving Cycle (NEDC)

At least two million Chinese PHEVs and BEVs are planned for production by 2020 – a 70 % sales share in the national NEV market. This figure is scheduled to increase to three million by 2025 – an 80 % sales share (20 % of the overall automobile market). The export market for Chinese PHEVs and BEVs is also scheduled to be in place by 2020, with the export share set to reach 10 % by 2025. An 80 % market share is also planned for the supply of automotive core components by 2020. To hit these targets, China is investing heavily in research and development for core components, standardization and certification, and international cooperation.

While buses do not play a major role in Made in China 2025, they nevertheless remain an important component of the Chinese strategy to improve urban air quality. The city of Shenzhen in Southern China, for instance, has already replaced its entire fleet of more than 16,000 buses with electric models. State incentives are in place throughout the country to encourage the switch to electric buses, resulting in a ratio of 70 % electric buses for all new purchases in 2016. More than 250,000 electric buses are already in operation throughout China, with Chinese manufacturers such as BYD[11] or Yutong[12] taking steps to expand into the developing international market. In late 2016, for instance, the european electric bus market comprised merely 1,300 units[13], most of which were still in the test phases. London currently has the largest electric bus fleet in europe, including 51 electric buses from BYD, with other Chinese-made buses also being sold to numerous european cities.

In 2016, to further promote the development of a strong automotive industry, the MIIT published their Technology Roadmap for Energy-Saving Vehicles and NEVs[14]. This document describes the technological developments planned by the Chinese electro-mobility industry until 2030. The following seven categories are identified: ESV, BEV and PHEV, FCEV, ICV, traction batteries, reduced-weight vehicles, and manufacturing technology. Based on Made in China 2025 and the Technology Roadmap of Made in China 2025[15], the current roadmap is an enhancement of China's existing industrial development strategy. The main objective is to strengthen the Chinese automotive industry through innovation, rendering it more competitive on the global marketplace.

Alongside market and technology development targets, the roadmap further aims at increasing car traffic goals. Peak CO2 emissions are expected to be passed as early as 2028 – two years sooner than the peak date for all Chinese emissions of 2030 announced by President Xi Jinping in 2016. This is viewed as a decisive contribution to China's climate protection policy.

	2020	2025	2030
Annual vehicle production	30 million	35 million	38 million
Average fuel consumption of new vehicles	5.0 l/100 km*	4.0 l/100 km*	3.2 l/100 km*
Reduction of average fuel consumption in utility vehicles	10 %	15 %	20 %
NEV ratio for new vehicles	7 %	15 %	40 %
Degree of automation	Partially automated systems hold 50 % market share	Highly automated vehicles hold 15 % market share	Completely autonomous vehicles hold 10 % market share
Reduction in energy consumption/BIP	20 %	35 %	50 %

* 1 l/100 km corresponds to 23.2 g CO_2/km

Table 3: Development targets within NEV technology roadmap

Photo by Denys Nevozhai

04 Measures

Photo by Wu Yi

04 MEASURES
The E-Mobility Race and China's Determination to Win

4.1. Financial Incentive Mechanisms

A key incentive promoting NEVs are the generous subsidies offered for vehicles made in China. Depending on vehicle specifications, these can amount to 66,000 RMB (8,500 euros) (see: 9.1 Subsidies for Passenger Cars). Some cities also grant additional local subsidies. Between 2009 and 2015, subsidies totalling some 4.5 billion euros were paid for the purchase of NEVs. Electric vehicles are also exempt from purchase tax (16 %), with a few exceptions for imported vehicles. Imported NEVs, however, do not receive financial support from the state.[16]

Additional incentives also exist for the operation and maintenance of NEVs. The Chinese government is also investing heavily in its charging infrastructure, while incentivising private players to invest in this sector.

To qualify for tax exemption, vehicles must be listed in the so-called "NEV Catalogue"[17]. However, the requirements for inclusion are subject to ongoing adjustments, with incentive measures becoming increasingly targeted. For instance, the minimum required range for BEVs was increased from 80 km to 100 km in January 2018. For FCEVs, meanwhile, there is a newly defined minimum range of 300 km. Stricter requirements are also imposed on individual vehicle components. Currently, the NEV Catalogue differentiates between passenger cars, buses and special purpose vehicles (SPVs)[18]. Similarly, NEV purchase subsidies have become increasingly restricted[19]. Since 12 February 2018, BEVs need to have a proven range of no less than 150 km. In the same vein, the required energy density for batteries was increased from 90 Wh/kg to 105 Wh/kg.

4.5 billion EUR
total subsidies paid between 2009-2015 for NEV purchase

Subsidies for electric buses and SPVs, meanwhile, have decreased by 33-50 % following the commencement of the third phase of the 2009 bus subsidy program, with the maximum subsidy available for new purchases being limited to 198,000 RMB (25,500 euros) (see 9.2 and 9.3). Buses are now listed in three categories: fast-charging battery electric buses; non-quick-charging battery electric buses; and plug-in-hybrid buses. For a bus to qualify for subsidies, it needs to fulfil the following minimum requirements[20]: plug-in-hybrid buses must save at least 60 % in fuel consumption; quick-charging battery electric buses must achieve a minimum charging speed of 3 C*; and non-quick-charging battery electric buses must have a battery with a minimum energy density of 115 Wh/kg.

* 1 C corresponds to charging/discharging at speed 10 Ampere.

Technology	Vehicle length L		
	6 m ≤ L < 8 m	8 m ≤ L < 10 m	L ≥ 10 m
BEV	40,000 RMB 5,400 EUR	60,000 RMB 8,100 EUR	80,000 RMB 10,800 EUR
PHEV	20,000 RMB 2,700 EUR	30,000 RMB 4,000 EUR	40,000 RMB 5,400 EUR
FCEV	60,000 RMB 8,100 EUR		
Super capacitor	20,000 RMB 2,700 EUR		
Hybrid Electric Vehicle (HEV)	20,000 RMB 2,700 EUR		

Table 4: 2015-2019 subsidies for bus operators when implementing various drive technologies by vehicle and year[1]

Subsidies are also in place to support the operation of buses. To qualify, the vehicle must have been registered after 1 January 2015, and the model must be included in the government subsidy catalogue, with a provable annual mileage of no less than 30,000 km. A battery-electric bus of 8-10 m in length, for example, would qualify for subsidies of 60,000 RMB (8,100 euro) (see: Table 4). This new, stricter bus subsidy policy is in response to wide-spread subsidy fraud, which has induced state institutions to further reduce purchase subsidies and, instead, pay incentives for the proven operation of buses. The money saved is channelled into state support for the charging infrastructure and the operation (e. g. recharging) of these vehicles. To create uniform market conditions throughout the country, local subsidies are also scheduled to be phased out and largely eliminated.[21]

4.2. Non-Financial Incentive Mechanisms

China's increasing sales figures for NEVs are also a result of restrictive permit conditions for vehicles with conventional combustion engines. In Beijing, where a license plate lottery takes place once a month, the chances of a successful application for conventional drive cars have decreased from 6 % in February 2011 to 0.2 % in February 2018. The chances of successfully obtaining a NEV license plate, conversely, are 80 %. In Shanghai, authorities conduct a monthly auction where license plates are sold for around 88,000 RMB (12,000 euros). However, future electric-car owners are exempt. Other cities such as Shenzhen implement a hybrid model. Those seeking to purchase vehicles with conventional combustion engines still need to participate in a lottery. But while formerly no more than 20,000 NEVs could be registered each year, there is currently no limit to the number of available NEV license plates[22].

Car usage is restricted whenever air quality dips below the average in a given city. As soon as the air quality in Beijing exceeds a specified pollution limit on three successive days, for instance, driving bans are put in place. However, NEV owners are exempt from these, and free to use their cars at any time.

4.3. Manufacturers requirements

4.3.1 Corporate Average Fuel Consumption

On 28 September 2017, the MIIT published the final version of Method for Parallel Administration on Corporate Average Fuel Consumption (CAFC) and New Energy Vehicle Credit[23]. Besides management of NEV issues, this ordinance includes a CAFC regulation component, summarized below.

Every car manufacturer on Mainland China* is subject to an annual individual CAFC target value, which is calculated according to the companyspecific fleet composition and based upon the weight of these vehicles, where i = weight of vehicle model:

$$CAFC_{Target} = \sum_{i=1}^{N} [Consumption_{Target,i} * \frac{Number_i}{\sum_i^N Number_i}]$$

The average real fleet consumption of a vehicle manufacturer is the ratio between the aggregate real fleet consumption and the number of total vehicles sold**:

$$CAFC_{Real} = \sum_{i=1}^{N} [Consumption_{Real,i} * \frac{Number_i}{\sum_i^N Supercredits_i * Number_i}]$$

Positive CAFC points (credits) are generated if real consumption falls below the target value (1 l/100 km = 1 point), and vice versa (i. e., negative CAFC points (debits) are generated whenever real consumption exceeds the target value). Also, similar to the european CO2 Fleet Limit Value Regulation, so-called "supercredits" play an important role, as they provide multiple credits for NEVs and energy-efficient – or in this case zero emission – vehicles.

Year	BEV	FCEV	PHEV	ESV
2016–2017	5	5	5	3.5
2018–2019	3	3	3	2.5
2020	2	2	2	1.5

Table 5: Supercredits allocation key, 2016–2020

Year	Target Value
2017	128 %
2018	120 %
2019	110 %
2020	100 %

Table 6: Target values for CAFC limits, 2017–2020

Similar to the european CO2 Fleet Target Regulation, the Chinese CAFC regulation incorporates a so-called "phase-in-mechanism" – a successive year-on-year tightening – for individual CAFC limits.

* Beginning at 30,000 vehicles produced annually, divided into importers, joint ventures (JV), and national OEMs.
** Real - Actual

Fleet target regulations are a globally recognized instrument for reducing energy consumption and CO2 emissions in the passenger car sector. In spite of certain technical differences – see, e. g., the non-harmonised definition of driving cycles (NEDC, Worldwide Harmonized Light Vehicles Test Procedure (WLTP), China Cycle) – the international target values are more or less comparable.

In China, German manufacturers consistently meet CAFC target values. This stems in part from current EU specifications being around 20 % stricter than their Chinese equivalents. With the possible termination of the "supercredit" rules for Phase 5*, however, the fear is that German importers will be faced with increased difficulties. This is due to the fact that their fleets, which contain a larger ratio of premium models, cause higher CO2 emissions.

The Chinese government is also considering whether to integrate buses into the existing credit system, which until now was limited to cars. This would both lessen the blow of subsidy cuts and offset any potential slowdown in the market growth of electric buses. Any illegal activities could be easily monitored and sanctioned through a national, standardised system, while saving financial resources.

* As per 2021, with even stricter limits (+20 %) by 2025)

Photo by GIZ

4.3.2 Method for Parallel Administration on Corporate Average Fuel Consumption and New Energy Vehicle Credit

On 28 September 2017, MIIT published the final version of its Method for Parallel Administration on Corporate Average Fuel Consumption and New Energy Vehicle Credit[24]. This regulation covers both vehicles produced in China for domestic sale (but not for export) and imported models.

The document distinguishes two vehicle types:

- Conventional combustion engine vehicles (diesel and gasoline), natural gas vehicles and hybrid vehicles without plug-in drive;
- New energy vehicles: BEVs, PHEVs with and without range extender, and FCEV.

The document defines a company as any legal entity that sells motor vehicles in China. This includes domestic OEMs, companies whose sole operation is vehicle import, as well as any joint venture (JV) between a foreign and a Chinese OEM. All automotive manufacturers with an annual output (including imported cars) of at least 30,000 units within the customs borders of the People's Republic of China are eligible for inclusion under this new points system, the criteria for which are NEV points comprising 10 % of annual sales volume* in 2019 and 12 % by 2020. NEV points generated in 2020 may also be used to offset the gap generated in 2019 (so-called "banking"). Target values for 2021 will be published separately, and the expectation is that these will be even stricter.

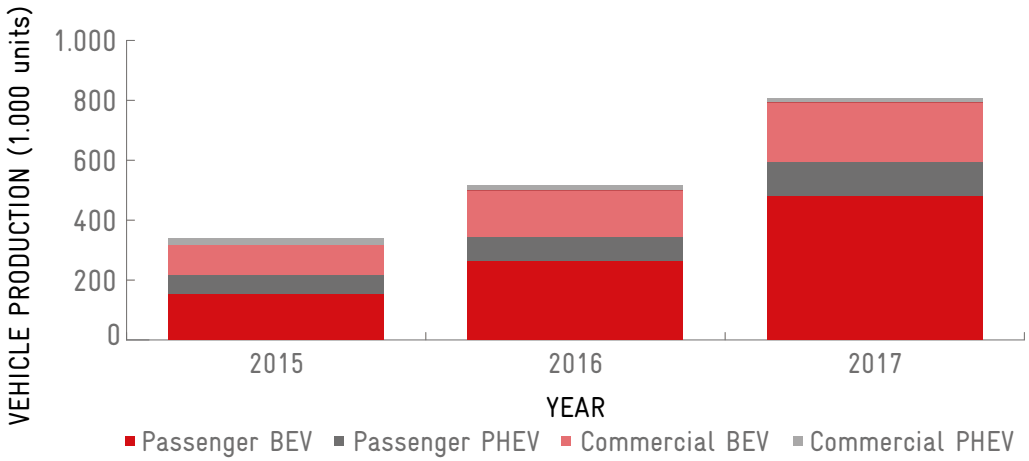


Figure 3: NEV production volumes in China[25]

* Example: a manufacturer with an annual production and import volume of 1 million units must achieve 100,000 NEV points in 2019 (2020: 120,000). Assuming the manufacturer offers BEVs with a standard range of 300 km (i. e. 4 points per unit), the company would need to sell a total of 25,000 BEVs in 2019 (2020: 30,000 units).

The required production volumes, which are stricter than those in the California ZEV Regulation*, pose a challenge to individual international manufacturers as their electro-mobility strategies for the Chinese market will become effective only in the next one or two years. For instance, JVs only generated 0.5 % NEV points in 2017, while Chinese OEMs generated 15.8 % NEV points. These Chinese OEMs – who from the start have focussed heavily on electro-mobility – hence already achieve, on average, the obligatory 10 % NEV ratio as of 2019. JVs, on the other hand, need to significantly improve to avoid having to purchase NEV points.

For BEV and fuel cell models, points are awarded in a linear manner according to vehicle range or rated performance (maximum no. of points = 5):

NEV Points = 0.012 x range [km] + 0.8	BEV
NEV Points = 0.160 x system performance [kW]	FCEV

Vehicles with a plug-in hybrid drive (i. e. minimum battery-electric range of 50 km) receive two NEV points. Other technical, ancillary conditions are in place to sanction retrograde vehicles and award high-quality vehicles as a means to consolidate the market. A selection of these are as follows:

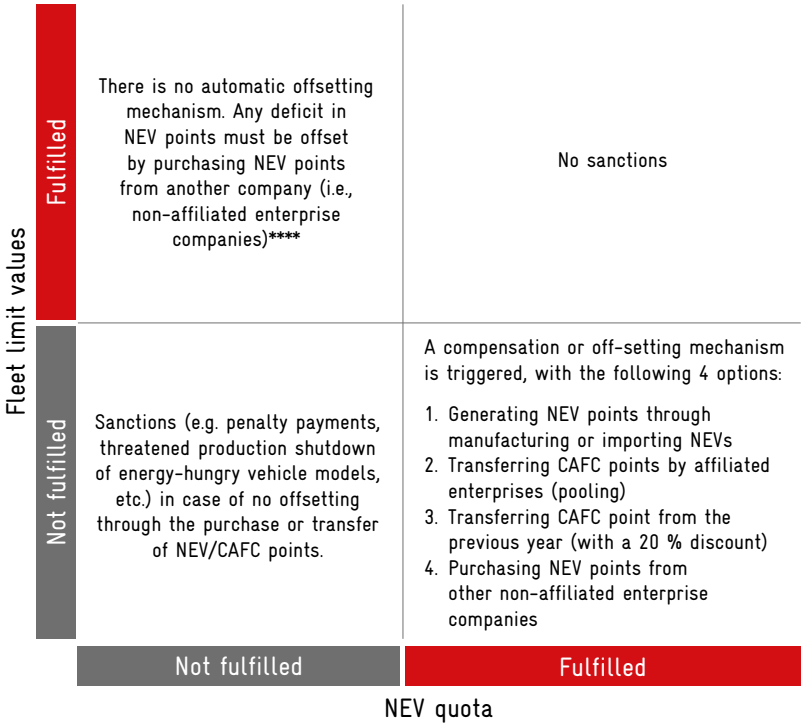
1. The possible number of NEV points received by a BEV will be halved if**
   a. a 100 km minimum range and 100 km/h minimum speed cannot be maintained over a 30 minute period;
   b. energy consumption exceeds the upper limit (24.2 kWh/100 km). Energy-efficient BEVs with energy consumption below the lower limit (12.67 kWh/100 km) are awarded a bonus (as a premium) of 20 %. These limits are identical to the technical approval standards of the national NEV Subsidy Guidelines.***

2. An FCEV generates only half of the possible number of NEV points**** if
   a. its minimum range is below 300 km;
   b. its system performance is less than 10 kW or 30 % of the electric drive performance.

* The California ZEV (Zero Emission Vehicle) Regulation is the counterpart to the Chinese NEV Regulation.
** Any sale of these NEV points to third parties is also prohibited.
*** For comparison, a BMW i3 weighs circa 1,300 kg and has an average consumption of 12.9 kWh/100 km according to NEDC. It is thus marginally over the lower limit of 12.67 kWh/100 km and, consequently, is awarded neither bonus nor demerit points. A Tesla model S (60 kWh) with an unladen weight of 2,100 kg consuming 22.0 kWh/100 km is thus just below the upper limit of 24.2 kWh/100 km. As such, it also receives neither bonus nor demerit points.
**** Any sale of these NEV points to third parties is also prohibited.

Photo by GIZ

There are now four possible scenarios with respect to the corporate average fuel consumption regulation (CAFC):



Affiliated enterprises are defined as:

a. two or more national companies which, directly or indirectly, hold shares with a total value of 25 % or more in the other company;*

b. two or more national companies, a minimum of 25 % of whose shares are directly or indirectly held by a common third party; **

c. manufacturers of imported vehicles and national companies that mutually hold more than 25 % of each other's shares. ***

In July 2018, the MIIT published their automotive industry results for 2017. Data indicated that the actual fuel consumption was on average 6.05 l/100 km. 99 companies collected 123,814,000 positive credits and 1,689,000 negative credits for fuel consumption. Out of the positive credits, NEVs account for 1,793,200. To compensate these negative credits, in July 2018, MIIT created a credit trading platform[26] allowing CAFC and NEV points to be managed and traded (see: 9.5).

While targets for NEV points will be binding only from 2019 onwards, negative CAFC points are already compensated. Consequently, companies which could currently collect NEV points have the option either to save these points***** or to sell them to companies with negative CAFC points. Prices per NEV point for such transactions range between 1,000 - 8,000 RMB (ca.130-1,030 Euros)[27].

* E. g.: SAIC as a national company has JVs with VW and with GM. These are therefore able to mutually transfer CAFC points.
** E. g.: VW-FAW and VW-SAIC are both held by VW, a third party. Thus, CAFC points may be transferred among both of these JV companies.
*** E. g.: Volkswagen Group China and VW-SAIC are (partially) owned by VW and thus can transfer CAFC points to each other.
**** A similar system applies in California. Sale of ZEV points (corresponding to NEV points) are a major component of Tesla's earnings. Since 2013, Tesla has been able to sell ZEV points for almost 1 billion USD.
***** During the introduction phase, NEV points may be saved up without deductions for the next year; later, they need to be used up or sold in the same year they were generated. This is different from CAFC points, which remain valid for up to three years, subject to an annual 80 % deduction.

4.3.3 Certification to Obtain a NEV Production License

In May 2016, MIIT published its Draft Admission Rules for NEV Producing Entities and Products[28]. The document describes the market access preconditions for companies planning future production of NEVs in China. Given the sharp increase in the numbers of NEV manufacturers, MIIT felt impelled to raise market barriers to ensure product quality and safeguard sustainable development. The stated mid-term target is, simply, to establish less than ten Chinese NEV manufacturers.

In line with this is the Consultation Version of the Regulation on Investment in the Chinese Automotive Industry, released on 04.07.2018 by the National Development and Reform Commission (NDRC). Producers of conventional vehicles are urged to invest in NEV products. Their production volume has to be at least 100,000 BEV per year and product quality has to be guaranteed for a minimum of 5 years.

In line with this is the Consultation Version of the Regulation on Investment in the Chinese Automotive Industry[29], released on 04.07.2018 by the National Development and Reform Commission (NDRC). Producers of conventional vehicles are urged to invest in NEV products. Their production volume has to be at least 100,000 BEV per year and product quality has to be guaranteed for a minimum of 5 years.

To obtain certification, NEV manufacturers must:

- Maintain their own R&D department, which is responsible for:
  - Development and calibration of the entire vehicle control system (hardware and software);
  - Fine-tuning of the on-board energy system, drive systems, and electric equipment.
- Master NEV production in key departments, in particular those relating to the vehicle's control system, on-board energy system, drive system, drive coupling, and associated electric equipment;
- Own and operate a product database containing:
  - Performance data of metal and non-metal materials used in the vehicle models;
  - Design platform-based data for drawings, specifications, technical requirements of the vehicle base model and similar products.

In light of these requirements, it seems likely that the Chinese JV partners view the relationship as a way to gain access to technological know-how for key components such as drive train, control system, and energy storage.

4.3.4 Limitations on Foreign Companies

The Chinese government has initiated various measures to protect local manufacturers against foreign competition, while simultaneously allowing them to maximise the benefits of foreign know-how. Key measures are presented below.

4.3.4.1 Compulsory Joint Ventures

Until recently, foreign company groups seeking to manufacture motor vehicles in China were obliged to establish a JV with a Chinese partner. This policy allowed China to protect certain industries (e. g. automotive, telecommunication or aerospace companies) while gaining additional know-how. In the present context, this meant that all German automobiles manufactured in China (whether NEV or conventional vehicles) must be produced by a German-Chinese JV in which the German partner has a minority interest. Daimler, for example, has established a JV with BYD to produce the Denza model – a successful electric car.

This limitation is expected to be gradually phased out[30]. In June 2018, NDRC and MOFCOM stated that the restriction on foreign capital share ratio will be removed for new energy and special vehicles as early as this year (2018). The same shall apply for commercial vehicles by 2020, and by 2022 for all other passenger vehicles. The two partners per JV restriction will likely also be eliminated by 2022.

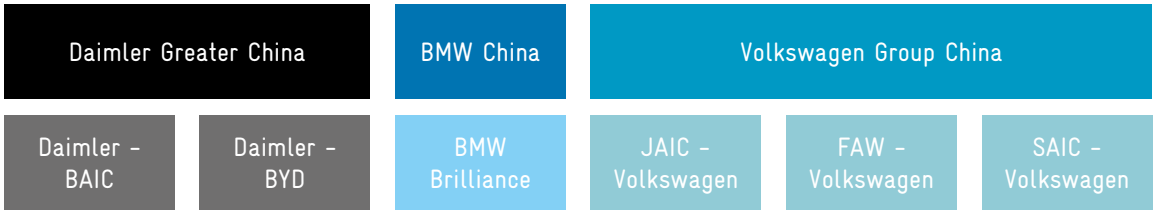


Figure 4: German car manufacturers and their Chinese JVs

4.3.4.2 Market Access

The question of state subsidies aside, several other factors render Chinese market access even more difficult. NEVs produced in China but not containing batteries made by so-called "White List" manufacturers* are also excluded from state subsidies. The aim of the policy is to promote domestic industry. The two largest manufacturers, Contemporary Amperex Technology, Ltd. (CATL)** and Huizhou BYD Battery Co., Ltd***, both of which are among the five largest global producers of lithium batteries, dominate the battery market for electric buses and NEVs in China.

Nevertheless, Volvo recently managed to negotiate an agreement allowing the group – via a JV – to integrate LG Chem**** battery technology into their NEV vehicles while retaining access to state subsidies[31]. However, this seems an exceptional case that was only made possible thanks to the good contacts maintained by Geely*****. The approach has drawn criticism from other foreign OEMs, who have continued their collaborations with Chinese manufacturers, as the risk of sanctions is deemed too great.

Rank	Name	Volume [GWh]
1	Contemporary Amperex Technology Ltd.	10.57
2	BYD	5.65
3	OptimumNano Energy Co., Ltd	2.41
4	Hefei Guoxuan High-Tech Power Energy Co., Ltd.	2.05
5	Shenzhen BAK Battery Co., Ltd.	1.65
6	Lishen Battery Co., Ltd.	1.07
7	Farasis Technology (Qianzhou) Co., Ltd.	0.98
8	Energy Very Endure Energy Co., Ltd.	0.81
9	Beijing National Battery Technology Co., Ltd.	0.81
10	Jiangsu Zhihang New Energy Co., Ltd.	0.73

Table 7: List of the 10 largest Chinese NEV traction battery manufacturers for 2017 (Power Battery Applications Branch of China Industrial Association of Power Sources)

4.3.4.3 Real-Time-Monitoring Data (RTM)

Local governments instruct all OEMs to forward relevant data on user behaviour, technical information about batteries, drive train and control etc. to municipal data centres. The stated aim is to increase the safety of this new technology. If this transfer of RTM data is refused, the vehicles are not issued with separate NEV license plates. OEMs thus have no option but to comply, providing the Chinese government with an exhaustive data stream that strengthens the competitiveness of the domestic industry even more.

* The White List contains all subsidy-approved batteries for use in NEVs. If batteries are sourced from manufacturers not included in this White List, all claims for NEV subsidies are forfeited.
** Website: http://www.catlbattery.com/en/
*** Website: http://www.byd.com/sites/byd/en/NewEnergy.html
**** Website: http://www.lgchem.com/global/main
***** Geely Automobile took over Volvo Cars in 2010.

4.3.5 Including NEVs in an Emissions Trading Scheme

In August 2016, NDRC issued a draft document entitled Administrative Method for Carbon Quota of New Energy Vehicles[32]. A year later, towards the end of 2017, China initiated a national Emission Trading Scheme (ETS), which is expected to be fully functional by 2020. While its application is currently limited to the energy sector, the scheme still regulates over 3 Gt CO2, making it the largest of its kind in the world. Over the next few years, the scheme will seek to incorporate an additional six high-emission industry sectors, as well as Chinese inland air traffic.

The guideline presented for discussion describes the interaction between NEVs within the framework of the ETS, as well as the role of the NEV carbon quota.

The ETS divides companies into two types:

- Companies producing or importing a specific number of conventional vehicles. These companies are obliged to become part of the scheme.
- Companies in which the production and sale of conventional vehicles has not yet reached a specified volume, but which have a significant NEV production and sales volume. These may opt to become part of the scheme on a voluntary basis.

The ETS sets targets according the level of CO2 emissions generated by the companies. The amounts set out in the NEV Carbon Quota are calculated based on the number of newly produced and imported NEVs, as well as on the product mix. Exported vehicles are not included. The guideline does not define the calculation methods used, although more detailed information is anticipated in the near future*. The NEV Carbon Quota is intended to be traded as a separate product, and interactions with other ETS sectors are not yet provided for. Companies that fail to meet their targets must offset the shortfall via purchases, or else face fines of up to one million RMB (135,000 euros).

This approach provides an alternative to the fleet target regulation and NEV point system proposed by MIIT. However, a common expert opinion is that this pathway is incompatible with both MIIT suggestions, as while vehicle usage and upstream chain emissions are supposed to be included in the calculation, technology parameters such as the electric range of NEVs do not play any direct role.

* As yet unanswered questions include, among others: How to address upstream emissions? How does the usage pattern of a vehicle influence emissions?

Photo by GIZ

4.4. Measure Overview

	Measures	Description
Financial incentive mechanisms	Release from purchase tax	No purchase tax is due on vehicles included in the NEV catalogue.
	Subsidies	Depending on vehicle specifications, every car purchase will include a refund of up to 66,000 RMR (8,500 euros) (see: 9.1 subsidies for passenger cars)
Non-financial incentive mechanisms	Awarding license plates	Chances of obtaining a license plate through the traditional lottery method are minimal. However, chances in the separate NEV license plate lottery are far higher.
	Driving ban days	Conventional gasoline and diesel vehicles are banned from running in Beijing for around one day a week. During days with high air pollution, these restrictions are even more severe. However, these limitations do not apply to NEVs.
Requirements for manufacturers	Corporate average fuel consumption	Fines are issued if weight-based fleet consumption limits are exceeded.
	Method for parallel administration on CAFC and NEV credit	CAFC and NEV points are tradeable. Fines are imposed on manufacturers who end the year with negative points.
	Certification to obtain a NEV manufacturing license	For reasons of quality assurance, subsidies for vehicles produced are coupled with a NEV manufacturing license that must be applied for.

Table 8: Overview of measures for promoting NEVs in China

05 Standards

Photo by Jesse Echevarria

05 STANDARDS

The E-Mobility Race and China's Determination to Win

5.1. Electro-Mobility Standardization Roadmap

"A POSITIVE ASPECT [...] IS THE PARTICIPATIVE DESIGN THAT SEEKS TO MAKE INTERNATIONAL RECOGNITION OF CHINESE STANDARDS POSSIBLE."

China's National Technical Committee of Auto Standardization (NTCAS) has developed a Standardization Roadmap for Electro-Mobility[33]. This document defines the anticipated development of Chinese electro-mobility standards until 2025. Standards and deadlines for NEVs are addressed across a range of areas, including energy storage, NEV drive systems and communication technology. Standardization in respect of charging infrastructure is also discussed, with conventional charging stations and poles as much a feature of the plan as hydrogen refuelling stations. The roadmap also gives timeframes for developing standards in other relevant areas such as battery recycling (section 5.2) and emergency rescue training.

Within the Sino-German cooperation, a comparison was made of the applicable Chinese and German standardization roadmaps. Areas considered included, among others, targets, scope, creation process and prioritisation, as well as the specific content of individual standardization issues. Efforts were made to align the respective standards, especially concerning charging processes. Specifically, this addressed inductive charging, safety of E/E systems, new fast charging systems, and smart grids. It was soon apparent, however, that while there was significant interest in aligning standards in a general sense, the impulse to establish the predominance of one or other country's specific, existing standards remained strong.

A positive aspect of this new approach to standardisation is its participative design that seeks to make international recognition of Chinese standards possible. This is particularly significant in the new market environment of ICVs, with China striving to become a key player in accordance with the strategy set out in Made in China 2025.

While this renewed approach to standardization laws has been generally greeted with enthusiasm, some fears nevertheless remain. A frequent criticism is that the difference between recommended and compulsory standards* remains unclear. It has also been observed that standards frequently overlap, which may lead to market barriers during implementation**. See, for example, compatibility problems between foreign-made plugs and Chinese charging poles.

5.2. Traction Battery Recycling

On 26 January 2018, MIIT, together with six other government departments (MOST, the Ministry of Environmental Protection (MEP), MOT, the Ministry of Commerce (MOFCOM), the Administration of Quality Supervision, Inspection and Quarantine (AQSIQ), and the National Energy Administration (NEA)) issued a temporary regulation on traction battery recycling for NEVs[34]. According to this regulation, NEV manufacturers are obliged – in accordance with the principle of "extended producer responsibility" – to provide battery recycling guarantees as part of vehicle sales. Battery and vehicle manufacturers are thus required to code traction batteries according to national standards to ensure that they can be backtraced (supported by an IT platform created by MIIT and AQSIQ).

NEV manufacturers are also obliged to establish an effective, efficient battery recycling system that guarantees the following:

- Accessible technical information on dismantling and reuse of batteries. Reception centres for the collection and sorting of batteries must be established and operated by specialist recycling companies;
- All statutory and technical requirements related to storage and transportation (e. g., firefighting, environmental protection and safety) must be fulfilled;
- The reuse of batteries must be simplified and automated wherever possible.

* Even though compulsory and recommended standards are clearly differentiated within the roadmap itself, the recommended standards are treated either as optional or compulsory.
** Overlapping and contradictions of certain standards increase complexity and costs, rendering market access for foreign companies even more difficult.

In late February 2018, MIIT announced the initiation of pilot projects in the Beijing-Tianjin-Hebei region, Greater Shanghai, Greater Guangzhou, and Central China aimed at reducing pollution from batteries. The emphasis was on the potential reuse of raw materials and the disposal of non-useable waste. In the future, MIIT will cooperate with the competent authorities in developing national standards for dismantling, packaging, reuse, cascading use, materials recycling, safety and environmental protection.

To ensure the Standard Requirements for the Comprehensive Utilization of Decommissioned NEV Power Batteries[35], MIIT announced a White List of five NEV battery recycling enterprises in July 2018. Besides Huayou Cobalt, Ganzhou Highpower Technology and JHD, the list also lists GEM and Brunp, which have close ties to BYD and CATL, China's largest traction battery manufacturers. These enterprises were chosen based on their scale, their rate of automatization, low energy consumption, environmental protection standards, efficient utilization of resources, and clean and high efficient technology.

Number	Province	Enterprise
1	Zhejiang	Huayou Cobalt
2	Jiangxi	Ganzhou Highpower Technology
3	Hubei	GEM
4	Hunan	Brunp
5	Guangdong	JHD

Table 9: First batch of approved NEV battery recycling enterprises.[37]

At the beginning of 2018, Shenzhen was selected as a demonstration city for the practical implementation of this temporary central government regulation. As of 31 December 2017, Shenzhen had 156,726 registered NEVs, and hence a large amount of traction batteries in use. In April 2018, Shenzhen published the Working Plan of Demonstration on NEV Battery Recycling System (2018-2020)[36], in light of which a control system was built to record all data generated during the battery lifecycle. A recycling system was implemented, and citywide recycling stations were built to facilitate the recycling, transportation and storage of traction batteries. The cascading use and reuse of these batteries is monitored by the competent local authorities.

Background of the Chinese-German Task Force (AG) on traction battery recycling

On 28 June 2011, NDRC and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety of the Federal Republic of Germany (BMU) signed a Memorandum of Understanding (MoU) on Cooperation on Traction Battery Recycling. This MoU defined the members, work content, work processes, technical support etc. of the Chinese-German Task Force (AG) on traction battery recycling. Four meetings of this task force have taken place to date, supported by GIZ GmbH in cooperation with CATARC.

The main outcome of these meetings was the results of a feasibility study regarding recommendations for establishing a pilot and demonstration system for recycling electric vehicle traction batteries in China. This study was prepared by CATARC in cooperation with GIZ.

NDRC has since taken up the recommendations, and the significance of the pilot project for developing an environmentally sustainable, resource-saving recycling system.

06 Charging Infrastructure

Photo by GIZ

06 CHARGING INFRASTRUCTURE

The E-Mobility Race and China's Determination to Win

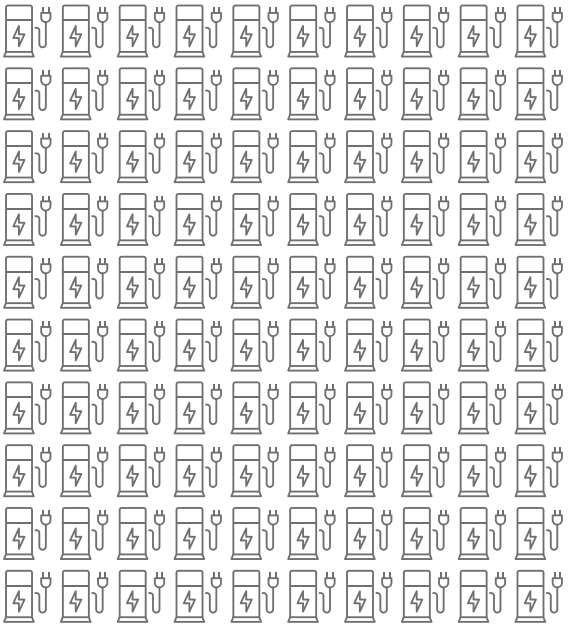
China's NEV charging infrastructure is continually being extended. Nevertheless, it remains the central impediment to establishing the NEV industry on an international footing. The ratio of electric vehicles to charging poles is currently a mere 3.8 to 1 across the country[38], and the anticipated increase in NEVs will only serve to highlight the insufficient charging infrastructure and its hindrance to development. At the beginning of October 2015, a common charging infrastructure development plan for 2015-2020[39] was drawn up in cooperation with NDRC, NEA, MIIT, and the Ministry of Housing and Urban-Rural Development (MOHURD). Part of the 13th Five-Year-Plan (2016-2020) issued in March 2016, this development plan includes specifications for the Guiding Opinions on Accelerating the Electric Vehicle Charging Infrastructure Construction simultaneously published by the Chinese State Council. According to this document, the existing 159,000 charging stations (as of 2015) will be increased to almost 5 million by 2020, of which 4.3 million will be privately operated and 500,000 will be public or semi-public. Charging infrastructure coverage for public spaces, residential areas, company parking sites, highways and other important sites should thus be significantly improved[40]. Shanghai already has more charging columns than all of Germany, and if China is to achieve its stated 2020 target, this rate of growth – currently 50 % – must continue to be exponential.

Overview of charging infrastructure goals in China

Charging Stations 2015

159,000

Charging Station Target 2020



5,000,000

Private: 4,300,000; public/semi-public: 500,000

=50,000 Charging stations

The charging stations installed must have a rated performance of 60 kW. Clearly, China's focus is on volume over performance – a stance in stark contrast to that of Germany, which aims to achieve the first charging station prototypes performing at up to 350 kW by 2025. China and Germany are both searching for a business model that allows for the economically sustainable operation of charging stations, in particular fast-charging stations. In China, BEV users set great store on achieving the shortest possible recharging times. However, their willingness to pay for this is somewhat low, as shown in a survey by the Sino-German EV Charging Project (SGEVCP)*. This is aggravated by the fact that charging station capacity utilisation on a national average is still only 15 %, and thus insufficient to allow for the timely amortisation of infrastructure costs**.

* According to the survey, although most of the customers prefer using high power charging (HPC), 93 % state that they would not pay more than the gasoline cost of conventional vehicles. Moreover, only 4 % of the customers would be willing to pay more than 3-times of the gasoline price in order to have a faster charging experience.

** Amortisation duration is currently 8-10 years – a timeframe that will increase with higher charging performance and decrease as BEVs with ranges over 400 km become more common.

Photo by GIZ

07 Outlook

Photo by Hanson Lu

07 OUTLOOK

The E-Mobility Race and China's Determination to Win

To achieve a position of technological dominance within the electric vehicle market, the Chinese government has provided longstanding, extensive incentives for research and development, with initial financial incentives for purchasing electric vehicles supplemented by more recent long-term strategies. The simultaneous development of the charging infrastructure is an important factor in the attainment of these goals, and development plans are in place to ensure this. Likewise, local measures to combat poor air quality due to increasing levels of motorisation and urbanisation are another factor in the successful market acceleration of electro-mobility in China.

China is very much interested in profiting from foreign know-how and experience, as well as from innovative approaches in the electro-mobility sector. At the same time, the national economy operates under strict levels of protection, making entry to the Chinese market a challenging prospect for foreign companies. In the future, challenges in developing ICVs and data policy issues are likely to increase even further. Financial incentives are being gradually phased out, and policies such as vehicle license issuing systems require urgent reevaluation and development.

International automotive manufacturers thus face huge challenges if they want to remain successful in the Chinese market. Uncertainties and answered questions abound. How will the quota system develop in the future? How will manufacturer data be handled? It is hence essential to maintain a dialogue while developing incentive measures for NEVs and ICVs – a process that should also be in Chinese interests if their national standards are to gain a higher profile on the international stage. To do this, the country needs strong partners. Particularly in the case of ICVs, it is expected that China, as an important manufacturer and the world's largest domestic producer, will be the one to set the pace.

China's focus in the coming years is to achieve the strategic goals set out in Made in China 2025 and to further promote the rollout of ICVs. A decisive factor in this will be the adjustment of existing regulations and standards to continuously changing industry requirements. One foreseeable difficulty lies in the fact that regulatory structures in China – unlike Germany – have not been subject to long-term testing, and are hence less stable and more prone to faults that may prove detrimental to both foreign industry and their own.

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09 ANNEX

The E-Mobility Race and China's Determination to Win

9.1. Subsidies for Passenger Cars

Range [km]	Subsidies 2017 [RMB]	Subsidies 2018 [RMB]
100-150	20,000	0
150-200	36,000	15,000
200-250	36,000	24,000
250-300	44,000	34,000
300-400	44,000	45,000
>=400	44,000	50,000
Subsidy per vecicle = Subsidy * corrective factor for energy density * corrective factor for energy consumption		

Table 10: Subsidies per BEV depending on range (VDA, 14.02.2018)

Range [km]	Subsidies 2017 [RMB]	Subsidies 2018 [RMB]
>=50	23,000	22,000

Table 11: Subsidies per PHEV depending on range (VDA, 14.02.2018)

Energy density [Wh/kg]	Multiplier 2017	Multiplier 2018
< 90	0.0	0.0
90-105	1.0	0.0
105-120	1.0	0.6
120-140	1.1	1.0
140-160	1.1	1.1
>=160	1.1	1.2

Table 12: Multiplier according to battery energy density (VDA, 14.02.2018)

Energy consumption vs. basic requirements 2018	Multiplier 2018
> 1.0	0.0
0.95-1.0	0.5
0.75-0.95	1.0
<= 0.75	1.1
Basic requirements 2018 = 0.9 * Basic requirements 2017	

Table 13: Multiplier according to energy consumption for BEVs and PHEVs (VDA, 14.02.2018)

2017	2018	
In Phase IV the fuel consumption limit is < 70 %.	In Phase IV the fuel consumption limit is < 65 %.	60-65 %: 0.5 * Subsidies
		< 60 %: 1.0 * Subsidies

Table 14: Fuel consumption limit values of PHEVs with electric range 50-80 km (VDA, 14.02.2018)

9.2. E-Bus subsidies

Vehicle type	Subsidy [RMB/kWh]	Corrective factor			Upper limit [10,000 RMB]		
					6 < L < 8m	8 < L < 10m	L < 10m
Non-quick-charging battery-electric bus	1,200	Energy density [Wh/kg]			5.5	12	18
		115-135	Over 135				
		1	1.1				
Quick-charging battery-electric bus	2,100	Quick-charging speed			4	8	13
		3 C-5 C	5 C-15 C	Over 15 C			
		0.8	1	1.1			
Plug-in-hybrid Bus	1,500	Fuel savings			2.2	4.5	7.5
		60%-65%	65%-70%	>70%			
		0.8	1	1.1			
Subsidy per vehicle = min (Subsidy * Energy; upper limit) * corrective factor							

Table 15: Calculation schedule for bus subsidies (ACEA, 14.02.2018)

9.3. Subsidies for SPVs

Subsidy [RMB/kWh]			Upper Limit [10,000 RMB]
≥ 30 kWh	31 – 50 kWh	< 50 kWh	
850	750	650	10

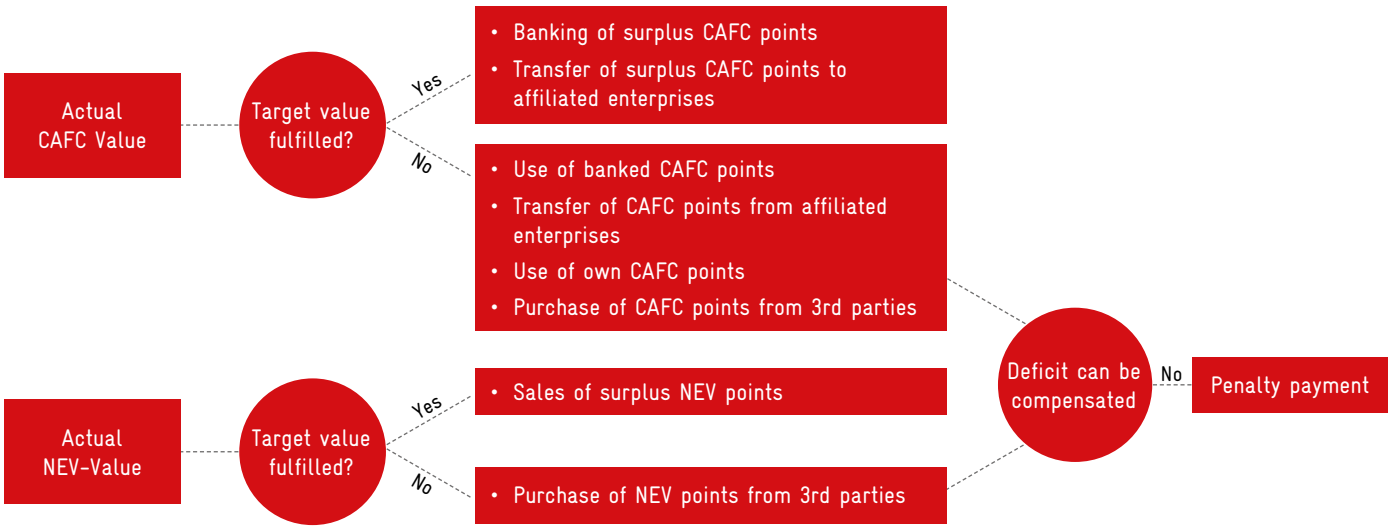
Table 16: Subsidy schedule for SPVs (Source ACEA)

9.4. Charging Station Manufacturers

Company	Website	City
Potevio New Energy Co., Ltd 普天新能源	http://www.ptne.cn/jeecms/	Beijing
NARI Technology Co., Ltd. 国电南瑞科技股份有限公司	http://www.naritech.cn/en/	Nanjing
XJ Group Corporation 许继集团有限公司	http://www.xjgc.com/html/xjen/col2015100651/column_2015100651_1.html	Xuchang
Aotexun 奥特迅	http://www.atc-a.com/	Shenzhen

Table 17: Charging station manufacturers for electric vehicles in China.

9.5. Interrelationship between CAFC and NEV Points



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